Interior San Francisco Bay Diversity Stratum

This stratum includes populations of steelhead that spawn in tributaries to San Francisco (SF) Bay that exhibit the warmer, drier characteristics of basins that lie well inland of the coast.

The populations that have been selected for recovery scenarios are listed in the table below and their profiles, maps, results, and recovery actions are in the pages following. Essential populations are listed by alphabetical order within the diversity stratum, followed by the Rapid Assessments of the Supporting populations:

- Alameda Creek
- Coyote Creek
- Green Valley/Suisun Creek
- Napa River
- Petaluma River
- Sonoma Creek
- Interior San Francisco Bay Diversity Stratum Rapid Assessment
    - Codornices Creek
    - Pinole Creek
    - San Leandro Creek
    - San Lorenzo Creek
    - San Pablo Creek
    - Wildcat Creek

CCC steelhead Interior San Francisco Bay Diversity Stratum, Populations, Historical Status, Population's Role in Recovery, Current IP-km, and Spawner Density and Abundance Targets for Delisting. IP was not developed for these populations by the SWFSC.

Diversity Stratum	CCC Steelhead Population	Historical Population Status	Population's Role In Recovery	Current Weighted IP-km	Spawner Density	Spawner Abundance
Interior S.F. Bay	Alameda Creek	I	Essential	108.3	27.2	2,900
	Codornices Creek*	D	Supporting	N/A	N/A	N/A
	Coyote Creek	I	Essential	109.3	27.0	3,000
	Green Valley/Suisun Creek	I	Essential	64.3	33.3	2,100
	Napa River	I	Essential	233.2	20	4,700
	Petaluma River	I	Essential	64.9	33.2	2,200
	Pinole Creek*	D	Supporting	N/A	N/A	N/A
	San Leandro Creek	I	Supporting	5.4	6-12	30-63
	San Lorenzo Creek	I	Supporting	18.6	6-12	110-221
	San Pablo Creek	I	Supporting	8.6	6-12	50-101
	Sonoma Creek	I	Essential	128.7	24.3	3,100
	Wildcat Creek*	D	Supporting	N/A	N/A	N/A
Interior San Francisco Bay Diversity Stratum Recovery Target						18,000

CCC steelhead Interior San Francisco Bay Diversity Stratum

Alameda Creek Population

CCC Steelhead Winter-Run

- Role within DPS: Functionally Independent Population
- Diversity Stratum: Interior San Francisco Bay
- Spawner Density Target: 2,900 adults
- Current Intrinsic Potential: 108.3 IP-km

Steelhead Abundance and Distribution

The limited amount of information available regarding the historical accounts of steelhead within the Alameda Creek watershed indicates their presence between the construction of Calaveras Dam and the Alameda Creek Diversion Dam (ACDD), completed in 1925, and the construction of the Bay Area Rapid Transit (BART) Weir in 1972. Photographic accounts document the existence of a historical steelhead run; however, there are not scientific records regarding the size of steelhead spawning populations or the distribution of spawning and rearing areas that once occurred within the watershed.

Although steelhead do not currently have volitional access to suitable habitat areas above the BART Weir, there are well-documented reports of adult steelhead being sighted in the Alameda Creek Flood Control Channel (below the BART Weir). Since 1998, steelhead have been captured and relocated above the BART Weir at various locations throughout Niles Canyon and lower Alameda Creek by local government agencies and citizen action groups. Unfortunately, little spawner success has been documented as a result of this effort and no adult steelhead have been observed at or below the BART Weir during the last five spawning seasons (2009, 2010, 2011, 2012, and 2013). Designs for a fish passage facility are underway in an effort to re-establish volitional passage over the BART Weir.

After volitional passage at the BART Weir is re-established, steelhead will likely utilize many of the same habitats that are presently occupied by resident *O. mykiss*. However, the extent of anadromy will be limited by the three long standing dams (Calaveras Dam, Turner Dam, and Del Valle Dam) within the watershed. In areas below these dams during the summer rearing season, resident *O. mykiss* are currently found in the higher gradient canyon reaches of Alameda Creek and its adjacent tributaries. These areas typically retain cool water pools throughout the summer months due to their large bedrock geology and considerable high value habitat. Although, some high-value habitat exists below the dams, the highest densities of *O. mykiss* exist above Calaveras and San Antonio reservoirs. These reservoir populations are known to be

self-sustaining and have been documented expressing an adfluvial life-history strategy (spending most of their lives in the reservoirs and migrating to tributary streams to spawn).

History of Land Use

The Alameda Creek watershed has experienced a number of land-use practices that have resulted in major changes to watershed processes and related instream morphology. Over the past 150-years, the watershed has experienced major channel modifications for flood control purposes, urbanization, agricultural development, grazing, and the development of domestic water supply. Much of the historic farmland has now been urbanized; however, cattle grazing is still the predominant land use within undeveloped lands throughout the watershed. As noted above, three major dams within the watershed have severely altered the natural hydrology and have significantly reduced the amount of accessible high value steelhead habitat that historically existed within the watershed. In addition to these historic and ongoing land uses, substantial portions of the watershed are designated as regional and state parklands.

Current Resources and Land Management

The majority of the lower and northern portions of Alameda Creek watershed are divided by the urban cities of San Ramon, Dublin, Pleasanton, Livermore, Fremont, Hayward, and Union City. Water resources and operations within the Alameda Creek watershed are controlled by the Alameda County Water District (ACWD), Zone 7 Water Agency (Zone 7), the Department of Water Resources (DWR), and the San Francisco Public Utilities Commission (SFPUC). The SFPUC and DWR operate three major dams in the watershed, two operated by SFPUC and one by DWR. ACWD, SFPUC, and Zone 7 are the three local agencies responsible for water supply operations in the watershed. The SFPUC owns and manages much of the southern watershed historically occupied by steelhead. Zone 7 owns and manages about a third of the channels in the Livermore Valley portion of the watershed. The cities of Dublin, Livermore, and Pleasanton also own and manage portions of the channels for flood protection. The Alameda County Flood Control and Water Conservation District manages the lower Alameda Creek Flood Control Channel and many of the county roads and stream culverts throughout the watershed. East Bay Regional Park District manages the parklands and various water bodies within the watershed for recreational opportunities. Private landowners receive some assistance from the Natural Resource Conservation Service with managing their agricultural and cattle grazing lands. There are also many stakeholders and NGOs, including the Alameda Creek Alliance, involved in restoring steelhead to Alameda Creek that participate in the Alameda Creek Fisheries Restoration Workgroup. The following pertinent documents are available for the Alameda Creek watershed:

- Evaluating Priority Life History Tactics for Reintroduced Alameda Creek Steelhead (NMFS 2012)
- Calaveras Dam Replacement Project Biological Opinion (NMFS 2011)
- Stonybrook Creek Watershed: A Strategic Plan for Eliminating Barriers to Steelhead Migration (MLA 2010)
- Calaveras Dam Replacement Project Fisheries Technical Report (Hagar 2008)
- Alameda Creek Population Recovery Strategies and Instream Flow Assessment for Steelhead Trout (McBain & Trush 2007)
- Alameda Creek Aquatic Resource Monitoring Reports (SFPUC 2005-2009)
- Evaluation of the Potential Historical and Current Occurrence of Steelhead within the Livermore-Amador Valley (Zone 7 2004)
- A Preliminary Assessment of Potential Steelhead Habitat in Sinbad Creek, Alameda County (Kondolf 2004)
- Supplementation Alternatives for Restoration of a Viable Steelhead Run to Alameda Creek (CSCC 2004)
- Aerial Survey if the Upper Alameda Creek Watershed to Assess Potential Rearing Habitat for Steelhead (BSSPPUC 2003)
- Migratory Fish Stream Report for the Livermore, Pleasanton and Dublin-Tri-Valley (Mohr 2002)
- An Assessment of the Potential for Restoring a Viable Steelhead Population in the Alameda Creek watershed (ACFRW 2000)
- Alameda Creek Water Resources Study (SFWD 1995)

Salmonid Viability and Watershed Conditions

The following indicators were rated Poor through the CAP process: LWD frequency, passage flows, physical barriers, floodplain connectivity, turbidity, spawner density, flow conditions (instantaneous condition and baseflow), estuary quality and extent, magnitude of diversions, temperature, spatial structure, smolt abundance, and stream side road density. Recovery strategies will typically focus on ameliorating these habitat indicators, although strategies that address other indicators may also be developed where their implementation is critical to restoring properly functioning habitat conditions within the watershed.

Current Conditions

The following discussion focuses on those conditions that were rated Fair or Poor as a result of our CAP viability analysis. The Alameda Creek CAP Viability Table results are provided below. Recovery strategies will focus on improving these conditions.

Population and Habitat Conditions

Viability: Density, Abundance, and Spatial Structure

The current condition of Alameda Creek has resulted in the loss of a viable steelhead run. Barriers and impaired hydrologic conditions within the watershed have significantly contributed to a functionally extinct steelhead population. Future passage projects will re-establish access to the upper Alameda Creek watershed. However, even if a few adult steelhead return and successfully spawn, the number of offspring produced will be so low that the population will still be at a High risk of extinction. Investigations regarding the suitability of the adfluvial stocks located within Calaveras and San Antonio reservoirs as potential source populations for a future "jump-starting" program are underway.

Hydrology: Baseflow and Passage Flows

Alameda Creek hydrology has been greatly altered by development, flood control, and water supply activities. These hydrology impairments have left very few remaining habitat segments that are considered suitable for all lifestages of steelhead. Hydrology conditions have an overall rating of Poor for all targets but especially for summer rearing juveniles. Flow releases to Arroyo del Valle have been made since 1979, and Zone 7 and ACWD manage flow releases from Del Valle Reservoir to comply with the "live stream" requirement which is a condition of Zone 7 and ACWD's water right permits. Minimal or no flow releases from all fours major dams (including the ACDD) coupled with lost perennial, cool stream habitat above these facilities, have severely limited summer rearing productivity. Impaired hydrologic conditions have greatly limited the migration window duration and the availability of suitable spawning (including incubation) conditions for steelhead.

Passage/Migration: Mouth or Confluence and Physical Barriers

Various passage impediments have been identified and documented by Alameda Creek watershed stakeholders (Gunther 2000; Moir 2002; SFPUC 2010a, 2010b, 2010c). Cumulatively, these barriers have resulted in a 95% reduction in the historical habitat once occupied by steelhead (Spence 2008). Passage impediments within the watershed vary in scale from partial to complete barriers. The most notable complete barrier in the watershed is the BART Weir, located shortly above head-of-tide within the Alameda Creek Flood Control Channel. However, efforts are underway to construct a fish passage facility over the BART Weir by 2015/16. Once steelhead have access to habitat beyond the BART Weir, they still will remain restricted from accessing the high value habitat existing above Turner, Calaveras, and Del Valle dams.

Estuary: Quality and Extent

Numerous modifications have severely altered the hydrodynamics and historical extent of the tidal interaction between Alameda Creek and San Francisco Bay/Estuary. Historically, miles of complex tidal delta habitat existed at the mouth of Alameda Creek (SFEI 2010). During the 1970s, the U.S. Army Corps of Engineers constructed a massive flood channel below the BART Weir that resulted in the complete relocation of the Alameda Creek mouth. The current Alameda Creek mouth is confined by this constructed flood control channel. Additionally, adjacent levees and salt pond developments have significantly reduced miles of tidal sloughs that previously contributed to the historical extent of the Alameda Creek estuary. Estuary rearing is an important stage for juvenile steelhead. The loss of this highly productive habitat has further reduced rearing opportunities for steelhead and lowered steelhead population productivity in the Alameda Creek watershed. The proposed South Bay Salt Pond Restoration Project, once implemented, is anticipated to benefit CCC steelhead and critical habitat. The restoration of 960 acres of tidal habitat at former salt production ponds in the South Bay will expand the quantity of estuarine habitat in the South Bay and enhance the quality of existing habitat.

Habitat Complexity: Large Wood and Shelter

Instream habitat quality throughout major portions of Alameda Creek has been limited by reduced instream habitat complexity. The northern watershed has been extensively altered by urban development and channel modifications. Niles Canyon is currently limited in the amount of preferable habitat features that provide shelter from predation for all steelhead lifestages. The lower watershed flood control channel has been cleared of most habitat complexity features during past maintenance practices, limiting shelter for smolts and adult steelhead as they migrate to and from the SF Bay.

Velocity Refuge: Floodplain Connectivity

Floodplain habitat during the wet season has been severely disconnected from the active stream channel throughout much of the watershed due to channel modification designed to enhance flow conveyance through urbanized areas. Lost floodplain connectivity within the Alameda Creek watershed limits the amount of velocity refuge available to migrating juvenile and adult steelhead during peak storm events. Additionally, the loss of potentially high-value floodplain habitat in the lower and northern watershed has limited juvenile steelhead rearing potential within the watershed during winter and spring months. Moreover, following the loss of floodplain connectivity in the northern watershed, many stream reaches have become greatly incised and are known to be sources of fine sediment.

Habitat Complexity: Percent Primary Pools and Pool/Riffle/Flatwater Ratios

As a consequence of urban development and channel modification, the diversity of geomorphic features within much of the Alameda Creek watershed has been greatly reduced. Poor riffle/run/pool ratios are a further indication of currently degraded habitat conditions and reduced population productivity. Riffles are essential habitat components for feeding and spawning steelhead. Pools can be equally important for foraging, but also may be the only summer rearing habitat available during dry conditions and provide important staging areas for migrating steelhead during the winter. The northern (i.e., lower) watershed areas are the most geographically altered areas, and subsequently contain a limited number of pool and riffle habitat. The loss of these geomorphic features in the northern and lower watershed is most limiting to steelhead production during the winter season.

Sediment: Gravel Quality and Distribution of Spawning Gravels

Coarse sediment in many reaches of the Alameda Creek watershed is of high quality for spawning, egg incubation, and macro-invertebrate production. However, below Calaveras, Turner, and Del Valle dams sediment transport has been eliminated resulting in degraded spawning gravel conditions. Moreover, miles of high-value habitat consisting of quality coarse material are currently inaccessible due to all the major dams in the watershed. Cattle grazing and ranching has also significantly degraded gravel quality in potential spawning reaches throughout many of the un-urbanized areas.

Water Quality: Temperature

Summer rearing habitat is limited throughout many reaches of Alameda Creek. Instream temperatures were likely warm historically, although historical evidence suggests significant groundwater sources existed that likely aided in cooling surface water conditions within lower sections of the watershed during the dry season. For example, it is hypothesized a historic lagoon (Tulare Lake) once existed at the head of the Arroyo De La Laguna which likely provided a significant source of cooler groundwater that drained into Niles Canyon. The lagoon no longer exists, and Niles Canyon water temperatures are currently considered marginal for summer rearing steelhead. Discharge from quarry pits and the South Bay Aqueduct may have also contributed to higher temperatures in Niles Canyon. Additionally, limited releases from all major reservoirs within the watershed have severely impaired flow and water temperatures in some potential rearing areas. Moreover, significant alterations to the riparian corridor have also accelerated thermal warming of streamflow within many sections of the watershed.

Threats

The following discussion focuses on those threats that rate as High or Very High (See Alameda Creek CAP Results). Recovery strategies will likely focus on ameliorating High rating threats; however, some strategies may address Medium and Low threats when the strategy is essential to recovery efforts.

Water Diversion and Impoundments

Calaveras, San Antonio, and Del Valle reservoirs are the major impoundments altering flow throughout the watershed. The Alameda Creek Diversion Dam/Tunnel (ACDD/T) and the ACWD's water diversion facility also heavily influence hydrologic conditions downstream of their locations. However, future threats to hydrology from Calaveras Reservoir and ACDD/T are projected to be significantly reduced as the SFPUC has recently completed consultation with NMFS, which includes a future flow regime prescribed for steelhead. The SFPUC is also currently involved in a Habitat Conservation Plan process with NMFS that will target releases from San Antonio Reservoir. Similarly, ACWD is currently undergoing a pre-consultation process to address passage at the BART Weir and associated bypass flow operations. Impaired flow conditions due to Del Valle Reservoir and other proposed water supply projects will remain a future threat to hydrologic conditions within the northern watershed.

Channel Modification

Channel modifications due to flood control concerns are primarily focused in the urbanized areas of the watershed. The most highly developed residential areas occur within the Livermore Valley and adjacent to the lower Alameda Creek Flood Control Channel. Future flood control maintenance activities incorporating habitat complexity features and potential levee breaches within the tidal areas of Alameda Creek will reduce the threat of channel modification in the future.

Residential and Commercial Development

Residential and commercial development is primarily concentrated in the lower areas of the watershed. The construction of engineered flood control channels allowed for high densities of residential and commercial development to occurs, and has ultimately resulted in the cost of flooding to be extreme (Gunther *et al.* 2000). The high economic value of these urbanized areas will limit the ability to completely restore natural stream geomorphic function, and thus poses a long-term threat to habitat conditions within these areas. Additional concerns regarding current and future residential and commercial development include water quality impacts due to urban run-off and increased water demand.

Roads and Railroads

Urbanized areas of the Alameda Creek watershed contain high densities of impervious surfaces and roads. Impervious areas have significantly contributed to the altered hydrologic conditions within the northern and lower portions of the watershed, where flashier and more intense streamflows follow storm events. In undeveloped areas, road networks near streams alter coarse sediment transport downstream of some stream crossings, and are a source of fine sediment in others. Additionally, roads have contributed significantly to impaired passage conditions throughout the watershed, as many of the observed road crossing in Sinbad and Stonybrook creeks have a bridge-over concrete box culvert design (Gunther 2000, Moir 2002, Love 2010). Addressing fish passage impediments at stream crossings while incorporating geomorphic elements to passage designs will greatly improve habitat condition and availability within tributaries and main stem reaches throughout the watershed.

Livestock Farming and Ranching

Cattle grazing is still the predominant land use on undeveloped land throughout the watershed. Recent cattle management has improved as some grazing is strategically used to manage vegetation and wildlife habitat for terrestrial species. However, cattle grazing near streams of the upper Alameda Creek watershed are a concern for stream health and condition. Cattle accessing some sections of streams have significantly degraded riparian conditions and pose a threat to water quality. Cattle have been observed grazing along Arroyo Hondo and the Calaveras Reservoir shoreline (Entrix 2002). Other evidence of habitat degradation associated with cattle grazing has been observed in the upper Alameda Creek watershed within Sunol Regional Park. Following the return of steelhead to the Alameda Creek watershed, efforts should be made to exclude cattle from entering all potential *O. mykiss* spawning and rearing reaches.

Mining

Gravel mining operations within the Sunol Valley Quarry Reach has significantly altered the physical location, morphology, and hydrology of many reaches of Alameda Creek (URS/HDR 2010). Similar gravel mining operations are occurring around the Livermore Valley area near the Chain-of-Lakes. Both operations are off-stream and pose the greatest threat to instream hydrology. For instance, some degree of water infiltration is natural and expected within the Sunol Valley Quarry Reach; however, the rate of infiltration due to the open gravel pits and subsequent discharge from those pits back into Alameda Creek have raised concerns regarding water quality impacts (temperature, turbidity, etc.). The SFPUC and other stakeholder groups are involved in the development of a Sunol Valley Restoration Plan in an effort to reduce flow loss from the creek and rehabilitate habitat conditions within this reach. Investigations regarding the extent of streamflow impairment within the Livermore Valley may be needed.

Severe Weather Patterns

The Alameda Creek watershed exhibits a mild marine climate with an average rainfall between 10 to 30 inches, with most areas averaging around the mid-teens (Gunther 2000). Like other watersheds along the central and southern California coast, Alameda Creek is subject to periodic droughts (Gunther 2000). Many streams within the watershed are historically intermittent during the summer months with limited summer rearing opportunity. Subsequent alterations to hydrology caused by development, channel modification, and water supply facilities have further reduced the duration and extent of suitable habitat. Summer and fall can be arid and dry with daytime temperatures exceeding 100°F. Given the intense water demands and limited water supply, severe dry years and drought patterns will pose a significant threat to maintaining suitable streamflows throughout the watershed.

Limiting Stresses, Lifestages, and Habitats

All lifestages are severely limited in the Alameda Creek watershed due to passage barriers. Following the re-establishment of passage at the BART Weir, summer rearing and adult abundance are projected to be the most limited lifestages primarily due to impaired hydrologic conditions, habitat connectivity and accessibility (barriers), and spawner abundance.

General Recovery Strategy

Improve Fish Passage

Recovery of a viable steelhead run within the Alameda Creek watershed starts with re-establishing fish passage at the BART Weir. Efforts to accomplish this high profile recovery action are well on the way, as a passage facility is projected to be completed by 2015/16 at this location. Following completion of a fish passage facility at the BART Weir, other passage barriers will need to be addressed. Addressing the multiple barriers within the Stonybrook watershed alone will greatly improve the quality and quantity of higher-value habitat for steelhead. Passage at the three major dams will need to be considered in efforts to reach the biological and ecological goals of recovery planning. Rigorous population dynamic and genetic investigations will need to be conducted, as well as thorough habitat assessment above these dams, to ensure successful fisheries management in the Alameda Creek watershed.

Develop Flow Schedules

Flow schedules for San Antonio and Del Valle reservoirs will need to be evaluated, developed, implemented, and tested. Highly complex water operations need to be thoroughly assessed in terms of their impacts on flow duration, magnitude, and timing in relevance to steelhead life

history requirements. Following successful implementation of the Calaveras/ACDD flow schedule, extensive flow/habitat evaluations will need to be conducted to ensure targeted steelhead lifestages are adequately protected.

Improve Habitat Complexity

Many areas of the northern watershed and lower Alameda Creek flood control channel have been completely denuded of habitat complexity. Flood control maintenance activities will need to incorporate habitat complexity features that aid steelhead migration and provide shelter in priority reaches. Additionally, further habitat assessment below Turner and Del Valle dams will need to occur. Designing and implementing optimal habitat conditions coupled with developed flow schedules below these dams will significantly aid in the recovery of steelhead in the Alameda Creek watershed. Installing cattle exclusion fencing will also help rehabilitate important rearing and spawning reaches in Alameda Creek.

Improve the Quality and Extent of the Estuary

Rehabilitating and reclaiming historic tidal wetland/slough habitat will greatly improve estuarine habitat for rearing steelhead. Levee breaching in strategic locations may increase the amount of high value estuarine habitat for steelhead. Implementation of the SBSP restoration project will restore tidal habitats at former salt ponds adjacent to the mouth of Alameda Creek.

Investigate Potential Population Augmentation for Steelhead

With very few or no anadromous steelhead returning annually to the Alameda Creek watershed, it is imperative that a population enhancement plan be developed and implemented in combination within an appropriate scientific-based framework.

Literature Cited

Alameda Creek Fisheries Restoration Workgroup. 2010. Stonybrook Creek watershed: A strategic plan for eliminating barriers to steelhead migration. Prepared by Michael Love & Associates.

Entrix. 2003. Aerial Survey of the Upper Alameda Creek Watershed to Assess Potential Rearing Habitat for Steelhead. Fall 2002. Final Report. Prepared for the San Francisco Public Utilities Commission. April 3, 2003.

Gunther, A.J., J.M. Hagar, and P. Salop. 2000. *An Assessment of the Potential for Restoration a Viable Steelhead Population in the Alameda Creek Watershed.* Prepared for the Alameda Creek Fisheries Restoration Workgroup. February 7, 2000.

Kondolf, G.M. 2004. A preliminary assessment of potential steelhead habitat in Sinbad Creek, Alameda Creek. Paper submitted for LA222: Hydrology for planners. University of Berkeley.

Moir, R. 2002. Migratory fish stream report for the Livermore, Pleasanton and Dublin-Tri-Valley.

San Francisco Public Utilities Commission. 2009a. Technical Memorandum: Feasibility of Fish Passage at Alameda Creek Diversion Dam. Prepared by URS and HDR, June 2009.

San Francisco Public Utilities Commission. 2009b. San Antonio Creek, Indian Creek, and Arroyo Honda Fish Trapping Data Summary 2005. Natural Resources and Lands Management Division. Fisheries and Wildlife Section, Sunol, CA. June 2009.

San Francisco Public Utilities Commission: Technical Memorandum: Assessment of Fish Upstream Migration at Natural Barriers in the Upper Alameda Creek Sub-Watershed, prepared by URS and HDR, January 2010.

San Francisco Public Utilities Commission: Technical Memorandum: Feasibility of Fish Passage at Calaveras Dam, prepared by URS and HDR, June 2009.

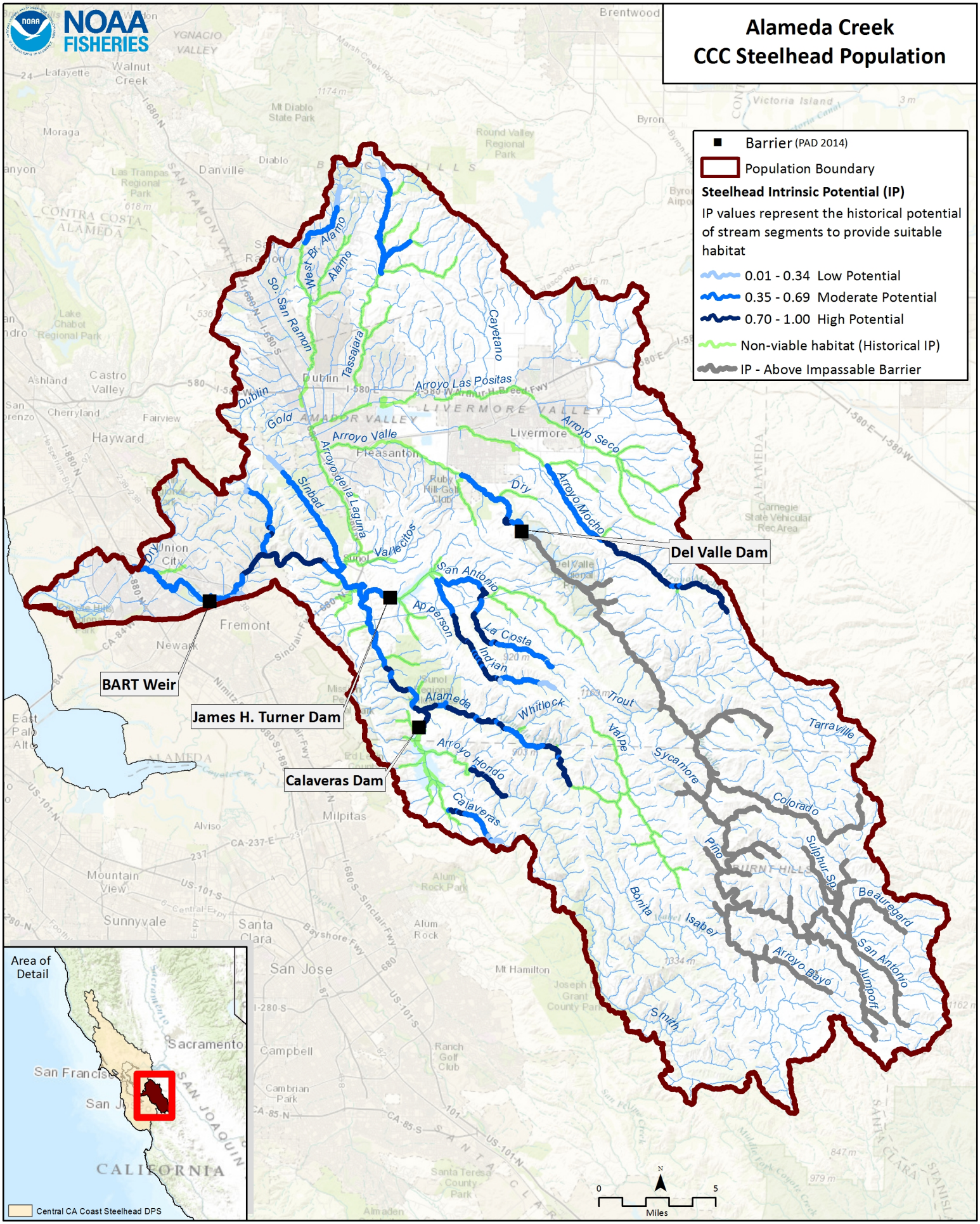
San Francisco Public Utilities Commission: Technical Memorandum: Feasibility of Fish Passage At the Alameda Creek Diversion Dam, prepared by URS and HDR, June 2009.

San Francisco Public Utilities Commission: Technical Memorandum: Assessment of Fish Migration at Riffles in Sunol Valley Quarry Reach of Alameda Creek, prepared by URS and HDR, February 2010.

San Francisco Public Utilities Commission: Technical Memorandum: Assessment of Fish Upstream Migration at Natural Barriers in the Upper Alameda Creek Sub-Watershed, prepared by URS and HDR, January 2010.

San Francisco Public Utilities Commission and EDAW Turnstone Joint Venture: Calaveras Dam Replacement Project Fisheries Technical Report, prepared by Hagar Environmental Science, August 2008.

Spence, B.C., E.P. Bjorkstedt, J.C. Garza, J.J. Smith, D.G. Hankin, D. Fuller, W.E. Jones, R. Macedo, T.H. Williams, and E. Mora. 2008. A framework for assessing the viability of threatened and endangered salmon and steelhead in the north-central California coast recovery domain. United States Department of Commerce, National Oceanic and Atmospheric Administration Technical Memorandum NOAA-TM-NMFS-SWFSC-423.


Alameda Creek
CCC Steelhead Population
Barrier (PAD 2014)
Population Boundary
Steelhead Intrinsic Potential (IP)
IP values represent the historical potential of stream segments to provide suitable habitat
0.01 - 0.34 Low Potential
0.35 - 0.69 Moderate Potential
0.70 - 1.00 High Potential
Non-viable habitat (Historical IP)
IP - Above Impassable Barrier
Del Valle Dam
BART Weir
James H. Turner Dam
Calaveras Dam
Arroyo Las Positas
Arroyo Valle
Arroyo Seco
Arroyo Mocho
Dry
Cayetano
Tassajara
Alamo
West Br. Alamo
So. San Ramon
Dublin
Gold
Arroyo de la Laguna
Sinbad
Vallecitos
San Antonio
Apperson
La Costa
Indian
Alameda
Whitlock
Trout
Valpe
Arroyo Hondo
Calaveras
Sycamore
Tarraville
Colorado
Pino
Sulphur Sp.
Beauregard
Bonita
Isabel
Arroyo Bayo
San Antonio
Jumpoff
Smith
Livermore
Pleasanton
Dublin
Hayward
Fremont
Union City
Newark
Milpitas
San Jose
Sunnyvale
Mountain View
Alviso
Danville
Walnut Creek
Brentwood
Byron
Area of Detail
Sacramento
San Francisco
San Jose
CALIFORNIA
Central CA Coast Steelhead DPS
0
5
Miles
N

	Conservation Target	Category	Key Attribute	Indicator	Poor	Fair	Good	Very Good	Current Indicator Measurement	Current Rating
1	Adults	Condition	Habitat Complexity	Large Wood Frequency (BFW 0-10 meters)	<50% of streams/ IP-Km (>6 Key Pieces/100 meters)	50% to 74% of streams/ IP-Km (>6 Key Pieces/100 meters)	75% to 90% of streams/ IP-Km (>6 Key Pieces/100 meters)	>90% of streams/ IP-Km (>6 Key Pieces/100 meters)	<50% of streams/ IP-km (>6 Key Pieces/100 meters)	Poor
			Habitat Complexity	Large Wood Frequency (BFW 10-100 meters)	<50% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	50% to 74% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	75% to 90% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	>90% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	<50% of streams/ IP-km (>1.3 Key Pieces/100 meters)	Poor
			Habitat Complexity	Pool/Riffle/Flatwater Ratio	<50% of streams/ IP-Km (>40% Pools; >20% Riffles)	50% to 74% of streams/ IP-Km (>40% Pools; >20% Riffles)	75% to 90% of streams/ IP-Km (>40% Pools; >20% Riffles)	>90% of streams/ IP-Km (>40% Pools; >20% Riffles)		Not Specified
			Habitat Complexity	Shelter Rating	<50% of streams/ IP-Km (>80 stream average)	50% to 74% of streams/ IP-Km (>80 stream average)	75% to 90% of streams/ IP-Km (>80 stream average)	>90% of streams/ IP-Km (>80 stream average)	50% to 74% of streams/ IP-km (>80 stream average)	Fair
			Hydrology	Passage Flows	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score >75	Poor
			Passage/Migration	Passage at Mouth or Confluence	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	50% of IP-km to 74% of IP-km	Fair
			Passage/Migration	Physical Barriers	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	SEC 2.42% of current IP-km available	Poor
			Riparian Vegetation	Tree Diameter (North of SF Bay)	≤39% Class 5 & 6 across IP-km	40 - 54% Class 5 & 6 across IP-km	55 - 69% Class 5 & 6 across IP-km	>69% Class 5 & 6 across IP-km		Not Specified
			Riparian Vegetation	Tree Diameter (South of SF Bay)	≤69% Density rating "D" across IP-km	70-79% Density rating "D" across IP-km	≥80% Density rating "D" across IP-km	Not Defined	70-79% Density rating "D" across IP-km	Fair

			Sediment	Quantity & Distribution of Spawning Gravels	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	50% of IP-km to 74% of IP-km	Fair
			Velocity Refuge	Floodplain Connectivity	<50% Response Reach Connectivity	50-80% Response Reach Connectivity	>80% Response Reach Connectivity	Not Defined	<50% Response Reach Connectivity	Poor
			Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No Evidence of Toxins or Contaminants	Sublethal or Chronic	Fair
			Water Quality	Turbidity	<50% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-Km maintains severity score of 3 or lower	75% to 90% of streams/ IP-Km maintains severity score of 3 or lower	>90% of streams/ IP-Km maintains severity score of 3 or lower	<50% of streams/ IP-km maintains severity score of 3 or lower	Poor
		Size	Viability	Density	<1 spawner per IP-km to < low risk spawner density per Spence (2008)	>1 spawner per IP-km to < low risk spawner density per Spence (2008)	low risk spawner density per Spence (2008)		<1 spawner per IP-km to < low risk spawner density per Spence (2008)	Poor
2	Eggs	Condition	Hydrology	Flow Conditions (Instantaneous Condition)	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score >75	Poor
			Hydrology	Redd Scour	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 51-75	Fair
			Sediment	Gravel Quality (Bulk)	>17% (0.85mm) and >30% (6.4mm)	15-17% (0.85mm) and <30% (6.4mm)	12-14% (0.85mm) and <30% (6.4mm)	<12% (0.85mm) and <30% (6.4mm)	15-17% (0.85mm) and <30% (6.4mm)	Fair
			Sediment	Gravel Quality (Embeddedness)	<50% of streams/ IP-Km (>50% stream average scores of 1 & 2)	50% to 74% of streams/ IP-Km (>50% stream average scores of 1 & 2)	75% to 90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	>90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	50% to 74% of streams/ IP-km (>50% stream average scores of 1 & 2)	Fair
3	Summer Rearing Juveniles	Condition	Estuary/Lagoon	Quality & Extent	Impaired/non-functional	Impaired but functioning	Properly Functioning Condition	Unimpaired Condition	Impaired/non-functional	Poor

			Habitat Complexity	Large Wood Frequency (Bankfull Width 0-10 meters)	<50% of streams/ IP-Km (>6 Key Pieces/100 meters)	50% to 74% of streams/ IP-Km (>6 Key Pieces/100 meters)	75% to 90% of streams/ IP-Km (>6 Key Pieces/100 meters)	>90% of streams/ IP-Km (>6 Key Pieces/100 meters)	50% to 74% of streams/ IP-km (>6 Key Pieces/100 meters)	Fair
			Habitat Complexity	Large Wood Frequency (Bankfull Width 10-100 meters)	<50% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	50% to 74% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	75% to 90% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	>90% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	50% to 74% of streams/ IP-km (>1.3 Key Pieces/100 meters)	Fair
			Habitat Complexity	Percent Primary Pools	<50% of streams/ IP-Km (>40% average primary pool frequency)	51% to 74% of streams/ IP-Km (>40% average primary pool frequency)	75% to 89% of streams/ IP-Km (>40% average primary pool frequency)	>90% of streams/ IP-Km (>40% average primary pool frequency)	51% to 74% of streams/ IP-km (>40% average primary pool frequency)	Fair
			Habitat Complexity	Pool/Riffle/Flatwater Ratio	<50% of streams/ IP-Km (>40% Pools; >20% Riffles)	50% to 74% of streams/ IP-Km (>40% Pools; >20% Riffles)	75% to 90% of streams/ IP-Km (>40% Pools; >20% Riffles)	>90% of streams/ IP-Km (>40% Pools; >20% Riffles)	50% to 74% of streams/ IP-km (>40% Pools; >20% Riffles)	Fair
			Habitat Complexity	Shelter Rating	<50% of streams/ IP-Km (>80 stream average)	50% to 74% of streams/ IP-Km (>80 stream average)	75% to 90% of streams/ IP-Km (>80 stream average)	>90% of streams/ IP-Km (>80 stream average)	50% to 74% of streams/ IP-km (>80 stream average)	Fair
			Hydrology	Flow Conditions (Baseflow)	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score >75	Poor
			Hydrology	Flow Conditions (Instantaneous Condition)	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score >75	Poor
			Hydrology	Number, Condition and/or Magnitude of Diversions	>5 Diversions/10 IP km	1.1 - 5 Diversions/10 IP km	0.01 - 1 Diversions/10 IP km	0 Diversions	>5 Diversions/10 IP-km	Poor
			Passage/Migration	Passage at Mouth or Confluence	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	50% of IP-km to 74% of IP-km	Fair
			Passage/Migration	Physical Barriers	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	<50% of IP-km or <16 IP-km accessible*	Poor

			Riparian Vegetation	Canopy Cover	<50% of streams/ IP-Km (>70% average stream canopy; >85% where coho IP overlaps)	50% to 74% of streams/ IP-Km (>70% average stream canopy; >85% where coho IP overlaps)	75% to 90% of streams/ IP-Km (>70% average stream canopy; >85% where coho IP overlaps)	>90% of streams/ IP-Km (>70% average stream canopy; >85% where coho IP overlaps)	50% to 74% of streams/ IP-km (>70% average stream canopy; >85% where coho IP overlaps)	Fair
			Riparian Vegetation	Tree Diameter (North of SF Bay)	≤39% Class 5 & 6 across IP-km	40 - 54% Class 5 & 6 across IP-km	55 - 69% Class 5 & 6 across IP-km	>69% Class 5 & 6 across IP-km		Not Specified
			Riparian Vegetation	Tree Diameter (South of SF Bay)	≤69% Density rating "D" across IP-km	70-79% Density rating "D" across IP-km	≥80% Density rating "D" across IP-km	Not Defined	70-79% Density rating "D" across IP-km	Fair
			Sediment (Food Productivity)	Gravel Quality (Embeddedness)	<50% of streams/ IP-Km (>50% stream average scores of 1 & 2)	50% to 74% of streams/ IP-Km (>50% stream average scores of 1 & 2)	75% to 90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	>90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	50% to 74% of streams/ IP-km (>50% stream average scores of 1 & 2)	Fair
			Water Quality	Temperature (MWMT)	<50% IP km (<20 C MWMT; <16 C MWMT where coho IP overlaps)	50 to 74% IP km (<20 C MWMT; <16 C MWMT where coho IP overlaps)	75 to 89% IP km (<20 C MWMT; <16 C MWMT where coho IP overlaps)	>90% IP km (<20 C MWMT; <16 C MWMT where coho IP overlaps)	<50% IP-km (<20 C MWMT; <16 C MWMT where coho IP overlaps)	Poor
			Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No Evidence of Toxins or Contaminants	Sublethal or Chronic	Fair
			Water Quality	Turbidity	<50% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-Km maintains severity score of 3 or lower	75% to 90% of streams/ IP-Km maintains severity score of 3 or lower	>90% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-km maintains severity score of 3 or lower	Fair
		Size	Viability	Density	<0.2 Fish/m^2	0.2 - 0.6 Fish/m^2	0.7 - 1.5 Fish/m^2	>1.5 Fish/m^2	<0.2 Fish/m^2	Poor
			Viability	Spatial Structure	<50% of Historical Range	50-74% of Historical Range	75-90% of Historical Range	>90% of Historical Range	<50% of Historical Range	Poor

4	Winter Rearing Juveniles	Condition	Habitat Complexity	Large Wood Frequency (Bankfull Width 0-10 meters)	<50% of streams/ IP-Km (>6 Key Pieces/100 meters)	50% to 74% of streams/ IP-Km (>6 Key Pieces/100 meters)	75% to 90% of streams/ IP-Km (>6 Key Pieces/100 meters)	>90% of streams/ IP-Km (>6 Key Pieces/100 meters)	50% to 74% of streams/ IP-km (>6 Key Pieces/100 meters)	Fair
			Habitat Complexity	Large Wood Frequency (Bankfull Width 10-100 meters)	<50% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	50% to 74% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	75% to 90% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	>90% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	50% to 74% of streams/ IP-km (>1.3 Key Pieces/100 meters)	Fair
			Habitat Complexity	Pool/Riffle/Flatwater Ratio	<50% of streams/ IP-Km (>40% Pools; >20% Riffles)	50% to 74% of streams/ IP-Km (>40% Pools; >20% Riffles)	75% to 90% of streams/ IP-Km (>40% Pools; >20% Riffles)	>90% of streams/ IP-Km (>40% Pools; >20% Riffles)	50% to 74% of streams/ IP-km (>40% Pools; >20% Riffles)	Fair
			Habitat Complexity	Shelter Rating	<50% of streams/ IP-Km (>80 stream average)	50% to 74% of streams/ IP-Km (>80 stream average)	75% to 90% of streams/ IP-Km (>80 stream average)	>90% of streams/ IP-Km (>80 stream average)	50% to 74% of streams/ IP-km (>80 stream average)	Fair
			Passage/Migration	Physical Barriers	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	<50% of IP-km or <16 IP-Km accessible*	Poor
			Riparian Vegetation	Tree Diameter (North of SF Bay)	≤39% Class 5 & 6 across IP-km	40 - 54% Class 5 & 6 across IP-km	55 - 69% Class 5 & 6 across IP-km	>69% Class 5 & 6 across IP-km		Not Specified
			Riparian Vegetation	Tree Diameter (South of SF Bay)	≤69% Density rating "D" across IP-km	70-79% Density rating "D" across IP-km	≥80% Density rating "D" across IP-km	Not Defined	70-79% Density rating "D" across IP-km	Fair
			Sediment (Food Productivity)	Gravel Quality (Embeddedness)	<50% of streams/ IP-Km (>50% stream average scores of 1 & 2)	50% to 74% of streams/ IP-Km (>50% stream average scores of 1 & 2)	75% to 90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	>90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	50% to 74% of streams/ IP-km (>50% stream average scores of 1 & 2)	Fair
			Velocity Refuge	Floodplain Connectivity	<50% Response Reach Connectivity	50-80% Response Reach Connectivity	>80% Response Reach Connectivity	Not Defined	<50% Response Reach Connectivity	Poor
			Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No Evidence of Toxins or Contaminants	Sublethal or Chronic	Fair

			Water Quality	Turbidity	<50% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-Km maintains severity score of 3 or lower	75% to 90% of streams/ IP-Km maintains severity score of 3 or lower	>90% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-km maintains severity score of 3 or lower	Fair
5	Smolts	Condition	Estuary/Lagoon	Quality & Extent	Impaired/non-functional	Impaired but functioning	Properly Functioning Condition	Unimpaired Condition	Impaired/non-functional	Poor
			Habitat Complexity	Shelter Rating	<50% of streams/ IP-Km (>80 stream average)	50% to 74% of streams/ IP-Km (>80 stream average)	75% to 90% of streams/ IP-Km (>80 stream average)	>90% of streams/ IP-Km (>80 stream average)	<50% of streams/ IP-km (>80 stream average)	Poor
			Hydrology	Number, Condition and/or Magnitude of Diversions	>5 Diversions/10 IP km	1.1 - 5 Diversions/10 IP km	0.01 - 1 Diversions/10 IP km	0 Diversions	>5 Diversions/10 IP-km	Poor
			Hydrology	Passage Flows	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score >75	Poor
			Passage/Migration	Passage at Mouth or Confluence	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km		Not Specified
			Smoltification	Temperature	<50% IP-Km (>6 and <14 C)	50-74% IP-Km (>6 and <14 C)	75-90% IP-Km (>6 and <14 C)	>90% IP-Km (>6 and <14 C)	50-74% IP-km (>6 and <14 C)	Fair
			Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No Evidence of Toxins or Contaminants	Sublethal or Chronic	Fair
			Water Quality	Turbidity	<50% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-Km maintains severity score of 3 or lower	75% to 90% of streams/ IP-Km maintains severity score of 3 or lower	>90% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-km maintains severity score of 3 or lower	Fair
		Size	Viability	Abundance	Smolt abundance which produces high risk spawner density per Spence (2008)	Smolt abundance which produces moderate risk spawner density per Spence (2008)	Smolt abundance to produce low risk spawner density per Spence (2008)		Smolt abundance which produces high risk spawner density per Spence (2008)	Poor

6	Watershed Processes	Landscape Context	Hydrology	Impervious Surfaces	>10% of Watershed in Impervious Surfaces	7-10% of Watershed in Impervious Surfaces	3-6% of Watershed in Impervious Surfaces	<3% of Watershed in Impervious Surfaces	SEC - 5.65%	Good
			Landscape Patterns	Agriculture	>30% of Watershed in Agriculture	20-30% of Watershed in Agriculture	10-19% of Watershed in Agriculture	<10% of Watershed in Agriculture	SEC - 1.31%	Very Good
			Landscape Patterns	Timber Harvest	>35% of Watershed in Timber Harvest	26-35% of Watershed in Timber Harvest	25-15% of Watershed in Timber Harvest	<15% of Watershed in Timber Harvest	<15% of Watershed in Timber Harvest	Very Good
			Landscape Patterns	Urbanization	>20% of watershed >1 unit/20 acres	12-20% of watershed >1 unit/20 acres	8-11% of watershed >1 unit/20 acres	<8% of watershed >1 unit/20 acres	11% of watershed >1 unit/20 acres: Urbanization clustered around migration cooridor	Fair
			Riparian Vegetation	Species Composition	<25% Intact Historical Species Composition	25-50% Intact Historical Species Composition	51-74% Intact Historical Species Composition	>75% Intact Historical Species Composition	25-50% Intact Historical Species Composition	Fair
			Sediment Transport	Road Density	>3 Miles/Square Mile	2.5 to 3 Miles/Square Mile	1.6 to 2.4 Miles/Square Mile	<1.6 Miles/Square Mile	3.0 Miles/Square Mile	Fair
			Sediment Transport	Streamside Road Density (100 m)	>1 Miles/Square Mile	0.5 to 1 Miles/Square Mile	0.1 to 0.4 Miles/Square Mile	<0.1 Miles/Square Mile	2.8 Miles/Square Mile	Poor

Alameda Creek CAP Threat Results

	Threats Across Targets	Adults	Eggs	Summer Rearing Juveniles	Winter Rearing Juveniles	Smolts	Watershed Processes	Overall Threat Rank
	Project-specific-threats	1	2	3	4	5	6	
1	Agriculture	Low	Low	Medium	Low	High	Medium	Medium
2	Channel Modification	Very High	Medium	High	Very High	Very High	Very High	Very High
3	Disease, Predation and Competition	Low	Low	High	Low	Medium	Low	Medium
4	Hatcheries and Aquaculture	Medium						Low
5	Fire, Fuel Management and Fire Suppression	Medium	Low	Medium	Low	Medium	Low	Medium
6	Fishing and Collecting	Medium	Low	Medium		Medium		Medium
7	Livestock Farming and Ranching	High	High	Very High	Medium	High	High	Very High
8	Logging and Wood Harvesting							
9	Mining	Medium	Low	Medium	Medium	High	High	High
10	Recreational Areas and Activities	Low	Low	Low	Low	Medium	Low	Low
11	Residential and Commercial Development	High	Medium	High	High	Very High	Very High	Very High
12	Roads and Railroads	High	Medium	Medium	High	High	High	High
13	Severe Weather Patterns	High	Medium	High	High	High	High	High
14	Water Diversion and Impoundments	Very High	High	Very High	High	Very High	Very High	Very High
	Threat Status for Targets and Project	Very High	High	Very High	Very High	Very High	Very High	Very High

Alameda Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
AIC-CCCS-1.1	**Objective**	**Estuary**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**										
AIC-CCCS-1.1.1	Recovery Action	Estuary	Rehabilitate natural river mouth dynamics										
AIC-CCCS-1.1.1.1	Action Step	Estuary	Increase the current tidal extent of the Alameda Creek estuary	2	10	Alameda Flood Control, CDFW, Corps	468	468				935	Cost based on treating 19 acres (assume 10% of total estuarine acres) at a rate of $49,200/acre.
AIC-CCCS-1.1.1.2	Action Step	Estuary	Identify strategic locations to breach levees within the tidal portion of Alameda Creek.	2	10	Alameda Flood Control, CDFW, Corps	20	20				40	Cost based on artificial breaching of sandspit at a rate of $19,670/breaching.
AIC-CCCS-1.1.1.3	Action Step	Estuary	Identify and enhance key attributes necessary to establish a functioning estuary ecosystem.	2	10	Alameda Flood Control, CDFW, Corps, USFWS	170	170				339	Cost based on estuary use/residence time model at a rate of $338,679/project.
AIC-CCCS-1.1.1.4	Action Step	Estuary	Develop an estuary rehabilitation and enhancement plan in efforts to reclaim historically tidal influenced areas of Alameda Creek.	2	10	Alameda Flood Control, CDFW, Corps, USFWS						0	Cost accounted for in above action step.
AIC-CCCS-1.1.1.5	Action Step	Estuary	Develop alternative recommendations for creating a new estuary ecosystem.	2	10	AC Alliance, Alameda Flood Control, CDFW, Corps						0	Cost accounted for in above action step.
AIC-CCCS-1.1.1.6	Action Step	Estuary	Implement rehabilitation and enhancement recommendations.	2	10	AC Alliance, ACWD, CDFW, Corps						0	Cost accounted for in above action step.
AIC-CCCS-1.1.2	Recovery Action	Estuary	Increase the quality and extent of estuarine habitat										
AIC-CCCS-1.1.2.1	Action Step	Estuary	Investigate tidal circulation within potential tidal marsh restoration sites.	2	10	AC Alliance, Alameda Flood Control, CDFW, Corps, USFWS						0	Cost accounted for in above action step.
AIC-CCCS-1.1.2.2	Action Step	Estuary	Identify salmonid migration routes within possible tidal marsh restoration sites.	2	10	AC Alliance, Alameda Flood Control, CDFW, Corps, USFWS						0	Cost accounted for in above action step.
AIC-CCCS-1.1.2.3	Action Step	Estuary	Investigate potential prey items for rearing salmonids within current and potential estuary habitat zones.	2	10	AC Alliance, Alameda Flood Control, CDFW, Corps, USFWS						0	Cost accounted for in above action step.
AIC-CCCS-1.1.2.4	Action Step	Estuary	Improve the quality and extent of freshwater lagoon habitat	2	10	AC Alliance, ACWD, Alameda Flood Control, CDFW, Corps, USFWS						0	Dependent upon implementation of other recovery action steps.
AIC-CCCS-1.1.3	Recovery Action	Estuary	Improve estuarine water quality										
AIC-CCCS-1.1.3.1	Action Step	Estuary	Investigate water quality (D.O., temperature, salinity) conditions for rearing steelhead in potential tidal marsh rehabilitation sites.	2	10	AC Alliance, ACWD, CDFW, Corps, USFWS	7.50	7.50				15	Cost based on installing a minimum of 3 continuous water quality monitoring stations at a rate of $5,000/station. Cost does not account for data management or maintenance.
AIC-CCCS-1.1.4	Recovery Action	Estuary	Rehabilitate inner estuarine hydrodynamics										
AIC-CCCS-1.1.4.1	Action Step	Estuary	Improve the inner estuary hydrodynamics that have been altered by levees, dikes, culverts, and tide gates.	2	10	AC Alliance, Alameda Flood Control, CDFW, Corps, USFWS						TBD	

Alameda Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
AIC-CCCS-2.1	**Objective**	**Floodplain Connectivity**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**										
AIC-CCCS-2.1.1	Recovery Action	Floodplain Connectivity	Rehabilitate and enhance floodplain connectivity										
AIC-CCCS-2.1.1.1	Action Step	Floodplain Connectivity	Identify areas where floodplain connectivity can be re-established in low gradient response reaches.	2	10	AC Alliance, ACWD, Alameda Flood Control, Corps, NRCS, RCD, SFPUC, Zone 7	127.50	127.50				255	Cost based on fish/habitat restoration model at a rate of $137,833/project.
AIC-CCCS-2.1.1.2	Action Step	Floodplain Connectivity	Identify the floodplain activation flow - the smallest flood pulse event that initiates substantial beneficial ecological processes when associated with floodplain inundation (Williams et al. 2009).	2	10	AC Alliance, ACWD, Alameda Flood Control, NRCS, RCD, SFPUC, Water Agencies, Zone 7	39.50	39.50				79	Cost based on stream flow/precipitation model at a rate of $78,100/project.
AIC-CCCS-2.1.1.3	Action Step	Floodplain Connectivity	Identify locations where floodplain rehabilitation projects are appropriate.	2	25	AC Alliance, ACWD, Alameda Flood Control, CDFW, RCD, Water Agencies, Zone 7	138					138	Cost based on fish/habitat restoration model at a rate of $137,833/project.
AIC-CCCS-2.1.1.4	Action Step	Floodplain Connectivity	Design and implement floodplain rehabilitation projects that target winter rearing habitat for juvenile steelhead.	2	20	AC Alliance, ACWD, Alameda Flood Control, NRCS, RCD, Water Agencies, Zone 7						0	Cost accounted for in above action step.
AIC-CCCS-2.1.1.5	Action Step	Floodplain Connectivity	Consider incorporating floodplain rehabilitation projects into the Flood Protection and Drainage element of Zone 7's Stream Management Master Plan and include design features to prevent entrapment of steelhead during capture of Arroyo Mocho and Arroyo del Valle flood waters in off-channel detention facilities.	2	10	AC Alliance, ACWD, Alameda Flood Control, Corps, SFPUC, Water Agencies, Zone 7						0	Cost accounted for in above action step.
AIC-CCCS-3.1	**Objective**	**Hydrology**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**										
AIC-CCCS-3.1.1	Recovery Action	Hydrology	Improve flow conditions										
AIC-CCCS-3.1.1.1	Action Step	Hydrology	Evaluate and develop spawning and rearing habitat criteria below all major dam sites (Del Valle, Turner).	2	10	ACWD, DWR, EB Parks, SFPUC, Zone 7						0	Action is considered In-Kind
AIC-CCCS-3.1.1.2	Action Step	Hydrology	Continue to evaluate and, if warranted, develop flow schedules that optimize steelhead spawning and rearing conditions below Del Valle and San Antonio reservoirs.	1	10	SFPUC	39.50	39.50				79	Cost based on stream flow/precipitation model at a rate of $78,100/project.
AIC-CCCS-3.1.1.3	Action Step	Hydrology	Ensure that water imports do not impair seasonal and summer rearing conditions for juvenile steelhead.	2	10	ACWD, DWR, SFPUC, Zone 7						0	Action is considered In-Kind
AIC-CCCS-3.1.1.4	Action Step	Hydrology	Consider mechanisms for water conveyance to Chain-of-Lakes detention ponds that maintain the natural hydrologic conditions in Arroyo Mocho.	2	10	NMFS, RWQCB, USACE, Zone 7	39.50	39.50				79	Cost based on stream flow/precipitation model at a rate of $78,100/project.
AIC-CCCS-3.1.1.5	Action Step	Hydrology	Develop ramping criteria below diversion sites that prevent displacement and stranding of steelhead.	2	10	ACWD, DWR, SFPUC, Zone 7						0	Action is considered In-Kind

Alameda Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
AIC-CCCS-3.1.1.6	Action Step	Hydrology	Develop flow requirements that mimic the natural hydrograph in that suitable conditions for adult and juvenile steelhead migration to and from the South Bay Aquaduct turnout are maintained.	2	TBD	ACWD, DWR, SFPUC, Zone 7						0	Action is considered In-Kind
AIC-CCCS-3.1.2	Recovery Action	Hydrology	Improve passage flows										
AIC-CCCS-3.1.2.1	Action Step	Hydrology	Develop flow requirements that protect emigrating juvenile and adults steelhead (kelts) to SF BAY.	1	10	ACWD, Alameda Flood Control, SFPUC, Zone 7	157.00					79	Cost based on stream flow/precipitation model at a rate of $156,200/project.
AIC-CCCS-3.1.2.2	Action Step	Hydrology	Zone 7 collaboration with NMFS and other regulatory agencies will ensure the Chain-of-Lakes proposed project benefits hydrologic conditions necessary for juvenile and adult steelhead migrations (up and down stream).	1	10	Zone 7						0	Action is considered In-Kind
AIC-CCCS-3.1.3	Recovery Action	Hydrology	Minimize redd scour										
AIC-CCCS-3.1.3.1	Action Step	Hydrology	Develop ramping criteria for spawning and rearing below diversion sites.	2	15	ACWD, DWR, SFPUC, Zone 7						0	Action is considered In-Kind
AIC-CCCS-5.1	**Objective**	**Passage**	**Address the present or threatened destruction, modification or curtailment of the species habitat or range**										
AIC-CCCS-5.1.1	Recovery Action	Passage	Modify or remove physical passage barriers										
AIC-CCCS-5.1.1.1	Action Step	Passage	Determine if there is an appreciable quantity of historic habitat partially or completely blocked.	2	10	ACWD, NMFS, SFPUC, Zone 7	69.00	69.00				138	Cost based on fish/habitat restoration model at a rate of 137,800/project.
AIC-CCCS-5.1.1.2	Action Step	Passage	Evaluate and prescribe volitional and/or non-volitional passage methods for all major dams in the watershed (Del Valle, San Antonio, Calaveras - see actions 2-9).	1	15	ACWD, DWR, SFPUC, Zone 7	75.00	75.00	75.00			225	Cost based on adult escapement and juvenile migration model at a rate of $36,379 and $188,264/project.
AIC-CCCS-5.1.1.3	Action Step	Passage	Determine if fish passage is technologically feasible.	2	10	ACWD, DWR, SFPUC, Zone 7						0	Cost accounted for in above action step.
AIC-CCCS-5.1.1.5	Action Step	Passage	Thoroughly develop potential translocation methods (transportation routes, trapping stations, etc.), including fish trapping scenarios, that will aid in salmonid population planning and recovery.	2	10	AC Alliance, ACWD, Alameda Flood Control, CDFW, EB Parks, NMFS, RCD, SFPUC, Zone 7						0	Cost accounted for in above action step.
AIC-CCCS-5.1.1.6	Action Step	Passage	Thoroughly investigate all out-migrant capture methodologies in efforts to translocate smolts/kelts downstream of impassable dams.	2	10	AC Alliance, ACWD, Alameda Flood Control, CDFW, EB Parks, NMFS, RCD, SFPUC, Zone 7						0	Cost accounted for in above action step.
AIC-CCCS-5.1.1.7	Action Step	Passage	Thoroughly investigate spillway designs or bypass facilities that allow for volitional downstream migration.	2	10	AC Alliance, ACWD, Alameda Flood Control, CDFW, EB Parks, NMFS, RCD, SFPUC, Zone 7						0	Cost accounted for in above action step.
AIC-CCCS-5.1.2	Recovery Action	Passage	Modify or remove physical passage barriers within the Alameda Creek Flood Control Channel										
AIC-CCCS-5.1.2.1	Action Step	Passage	Design and install a fish passage facility at the BART Weir.	1	5	ACWD, Alameda Flood Control	1191.00					1,191	Cost based on providing passage at a rate of $1,190,974/project.

Alameda Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
AIC-CCCS-5.1.2.2	Action Step	Passage	Evaluate and install features at the middle inflatable dam that allow for dam inflation at higher flows (example: Obermeyer gates) that reduce down ramping effects during BART Weir migration/passage windows (<1200 cfs).	2	15	ACWD, Alameda Flood Control	75.00	75.00	75.00			225	Cost based on adult escapement and juvenile migration model at a rate of $36,379 and $188,264/project.
AIC-CCCS-5.1.2.3	Action Step	Passage	Adaptively manage the BART Weir fish passage facility so that fish passage can occur at the highest flows possible and maintenance concerns are addressed.	2	15	ACWD, Alameda Flood Control						0	Action is considered In-Kind
AIC-CCCS-5.1.2.4	Action Step	Passage	Modify or remove all nine passage impediments identified by the Alameda County Flood Control District to the extent that 1ft of depth is achieved at 25 cfs.	1	10	ACWD, Alameda Flood Control	5,360	5,360				10,719	Cost based on providing passage at a rate of $1,190,974/project.
AIC-CCCS-5.1.2.5	Action Step	Passage	Utilize vegetation methods and bio-techniques to establish a low flow channel throughout the flood control channel. Incorporate features that create velocity refuge during high flow events for immigrating adults.	2	10	Alameda Flood Control						0	Action is considered In-Kind
AIC-CCCS-5.1.2.6	Action Step	Passage	Develop and install a fishway at the upper most rubber dam facility (RD1).	1	10	ACWD	392.50	392.50				785	Cost based on installing a fishway at a rate of $784,087/project.
AIC-CCCS-5.1.2.7	Action Step	Passage	Continue the development and implementation of a bypass flow schedule that protects migrating steelhead through the Alameda County Flood Control Channel.	1	5	ACWD, Alameda Flood Control, SFPUC, Zone 7	78					78	Cost based on stream flow/precipitation model at a rate of $78,100/project.
AIC-CCCS-5.1.3	Recovery Action	Passage	Modify or remove physical passage barriers in Niles Canyon										
AIC-CCCS-5.1.3.1	Action Step	Passage	Evaluate, recommend, and implement a fish passage design for the USGS Niles Canyon gaging station.	2	10	AC Alliance, CalTrans, NMFS, SFPUC	39.50	39.50				79	Cost based on stream flow/precipitation model at a rate of $78,100/project.
AIC-CCCS-5.1.3.2	Action Step	Passage	Develop and install a fish passage facility at the BART Weir.	1	5	ACWD, Alameda Flood Control						0	Cost accounted for in above action step.
AIC-CCCS-5.1.3.3	Action Step	Passage	Evaluate the potential of installing a fish capture facility at the Niles gage station weir.	2	10	ACWD, SFPUC						0	Cost accounted for in other action steps.
AIC-CCCS-5.1.4	Recovery Action	Passage	Modify or remove physical passage barriers in the northern watershed										
AIC-CCCS-5.1.4.1	Action Step	Passage	Evaluate, develop, and implement fish passage facilities and/or solutions for passage barriers identified in the: Migratory fish stream report for the Livermore, Pleasanton, and Dublin-Tri-Valley (Moir 2002).	1	10	AC Alliance, ACWD, Alameda County, Cities, NRCS, RCD, Zone 7	2,166	2,166				4,331	Cost based on providing fish passage at a rate of $1,443,585/project for 4 project sites.
AIC-CCCS-5.1.4.2	Action Step	Passage	Promote collaborative research by the various stream channel owners to properly identify passage barriers and associated remedial activities.	3	20	AC Alliance, ACWD, Alameda County, NRCS, Private Landowners, RCD, Zone 7						TBD	
AIC-CCCS-5.1.5	Recovery Action	Passage	Modify or remove physical passage barriers in the southern watershed										
AIC-CCCS-5.1.5.1	Action Step	Passage	Evaluate, develop, and implement fish passage features to enhance passage conditions in the Sunol Valley.	1	10	AC Alliance, SFPUC	112.50	112.50				225	Cost based on adult escapement and juvenile migration monitoring at a rate of $36,379 and $188,264/project.
AIC-CCCS-5.1.5.2	Action Step	Passage	Remove or modify the PG&E gas line crossing in the Sunol Valley.	1	5	PG&E, SFPUC						TBD	Cost based on appropriate method to move or modify gas line.
AIC-CCCS-5.1.6	Recovery Action	Passage	Modify or remove physical passage barriers in Stonybrook Creek										
AIC-CCCS-5.1.6.1	Action Step	Passage	Implement recommendations identified for fish passage in the Stonybrook Creek Watershed: A Strategic Plan for Eliminating Barriers to Steelhead Migration (Michael Love & Associates 2010)	2	10	AC Alliance, Alameda Flood Control, NRCS, RCD	320.00	320.00				640	Cost based on providing passage at a rate of $639,247/project.

Alameda Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
AIC-CCCS-6.1	**Objective**	**Habitat Complexity**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**										
AIC-CCCS-6.1.1	Recovery Action	Habitat Complexity	Improve large wood frequency										
AIC-CCCS-6.1.1.1	Action Step	Habitat Complexity	Improve habitat complexity by increasing wood frequency in spawning and rearing areas of Alameda Creek to the extent that a minimum of six key LWD pieces exists every 100 meters.	2	20	CDFW, SFPUC, Water Agencies, Zone 7	101.25	101.25	101.25	101.25		405	Cost based on treating 33 miles (assume 1 project/mile in 50% high IP) at a rate of $31,200/mile.
AIC-CCCS-6.1.1.2	Action Step	Habitat Complexity	Improve habitat complexity by increasing wood frequency in seasonal habitat and migratory reaches of Alameda Creek to the extent that a minimum of 1.3 key LWD pieces exists every 100 meters.	2	20	AC Alliance, ACWD, Alameda Flood Control, CDFW, Corps, EB Parks, Water Agencies, Zone 7						0	Cost accounted for in above action step.
AIC-CCCS-6.1.1.3	Action Step	Habitat Complexity	Evaluate and prescribe an appropriate number of key LWD pieces below Del Valle Reservoir to enhance steelhead summer rearing conditions.	2	10	ACWD, DWR, EB Parks, LARPD, Zone 7	69.00	69.00				138	Cost based on fish/habitat restoration model at a rate of $137,800/project.
AIC-CCCS-6.1.1.4	Action Step	Habitat Complexity	Evaluate and prescribe the appropriate number of key LWD pieces in the following reaches: Niles Canyon, Arroyo de la Laguna, Arroyo Del Valle, Arroyo Mocho, Sunol Valley, and Upper Alameda Creek above ACDD.	2	20	AC Alliance, ACWD, CDFW, EB Parks, LARPD, NRCS, RCD, SFPUC, State Parks, Water Agencies, Zone 7	69.00	69.00				138	Cost based on fish/habitat restoration model at a rate of $137,800/mile.
AIC-CCCS-6.1.2	Recovery Action	Habitat Complexity	Increase frequency of primary pools										
AIC-CCCS-6.1.2.1	Action Step	Habitat Complexity	Evaluate and prescribe habitat features below the confluence of Upper Alameda and Calaveras creeks that enhances primary pool frequency for summer rearing steelhead.	2	15	AC Alliance, CDFW, SFPUC	135.00	135.00	135.00			405	Cost based on treating 13 miles (assume 1 project/mile in 50% high IP) at a rate of $31,200/mile.
AIC-CCCS-6.1.2.2	Action Step	Habitat Complexity	Evaluate habitat conditions in Arroyo Mocho for summer rearing steelhead and prescribe habitat features that increase primary pool.	2	10	AC Alliance, ACWD, CDFW, EB Parks, NMFS, NRCS, RCD, Zone 7						0	Cost accounted for in other action steps.
AIC-CCCS-6.1.2.3	Action Step	Habitat Complexity	Evaluate and prescribe habitat features within Niles Canyon that will increase primary pool depth and frequency for winter and summer rearing juveniles, and quality staging pools for migrating/staging adults.	2	10	AC Alliance, ACWD, CalTrans, CDFW, SFPUC, Water Agencies, Zone 7						0	Cost accounted for in other action steps.
AIC-CCCS-6.1.2.4	Action Step	Habitat Complexity	Evaluate and prescribe habitat features below San Antonio and Del Valle reservoirs that enhances primary pool frequency for summer rearing steelhead.	2	10	AC Alliance, ACWD, Corps, DWR, Zone 7						0	Cost accounted for in other action steps.
AIC-CCCS-6.1.3	Recovery Action	Habitat Complexity	Improve shelter										
AIC-CCCS-6.1.3.1	Action Step	Habitat Complexity	Identify and evaluate adult staging pool in Niles Canyon, Arroyo de la Laguna, Arroyo Mocho, Sunol Valley, and Upper Alameda Creek and ensure that all have an adequate shelter for migrating adults.	2	5	AC Alliance, ACWD, CDFW, NRCS, Zone 7	13.80					14	Cost based on fish/habitat restoration model at a rate of $137,833/project.

Alameda Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
AIC-CCCS-6.1.3.2	Action Step	Habitat Complexity	Increase shelter and habitat complexity features in the Alameda Creek Flood Control Channel that improve survival of emigrating juvenile and adult steelhead.	2	10	AC Alliance, ACWD, CDFW, RWQCB	536	536				1,071	Cost based on treating 1 mile (assume 1 project/mile) at a rate of $1,070,400/mile.
AIC-CCCS-7.1	**Objective**	**Riparian**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**										
AIC-CCCS-7.1.1	Recovery Action	Riparian	Improve canopy cover										
AIC-CCCS-7.1.1.1	Action Step	Riparian	Ensure that mature trees within the stream riparian corridor are not disturbed or lost due to land management activities (roads, cattle, flood control, etc.).	3	25	Cities, Counties						0	Action is considered In-Kind
AIC-CCCS-7.1.1.2	Action Step	Riparian	Identify average percent canopy cover below major dams and provide recommendations for rehabilitating stream canopy cover.	3	15	ACWD, SFPUC, Zone 7	29.67	29.67	29.67			89	Cost based on riparian restoration model at a rate of $88,551/project.
AIC-CCCS-8.1	**Objective**	**Sediment**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**										
AIC-CCCS-8.1.1	Recovery Action	Sediment	Improve instream gravel quality to reduce embeddedness										
AIC-CCCS-8.1.1.1	Action Step	Sediment	Evaluate, design, and implement gravel quality and quantity strategies to the extent that the maximum amount of spawning and incubation habitat is achieved below all dams.	3	10	ACWD, SFPUC, Zone 7	69.00	69.00				138	Cost based on fish/habitat restoration model at a rate of $137,833/project.
AIC-CCCS-8.1.2	Recovery Action	Sediment	Improve gravel quantity and distribution for macro-invertebrate productivity (food)										
AIC-CCCS-8.1.2.1	Action Step	Sediment	Develop strategies to improve gravel quality conditions within all current and potential summer rearing reaches below all dams with emphasis on macro-invertebrate production.	2	15	ACWD, SFPUC, Zone 7						0	Cost accounted for in above action step.
AIC-CCCS-8.1.2.2	Action Step	Sediment	Develop strategies to improve gravel quality conditions within Niles Canyon with emphasis on maco-invertebrate production.	2	25	ACWD, SFPUC, Zone 7						0	Cost accounted for in above action step.
AIC-CCCS-10.1	**Objective**	**Water Quality**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**										
AIC-CCCS-10.1.1	Recovery Action	Water Quality	Improve stream temperature conditions										
AIC-CCCS-10.1.1.1	Action Step	Water Quality	Investigate the potential to reduce water temperature within Niles Canyon by releasing water from San Antonio reservoir.	2	10	AC Alliance, ACWD, SFPUC						0	Action is considered In-Kind
AIC-CCCS-10.1.1.2	Action Step	Water Quality	Investigate the effects to water temperature from gravel mining pit discharge located within the Sunol Valley.	2	10	ACWD, SFPUC	0.75	0.75				2	Cost based on installing a minimum of 3 water temperature loggers at a rate of $500/logger. Cost does not account for data management or maintenance.
AIC-CCCS-10.1.1.3	Action Step	Water Quality	Investigate the groundwater dynamics within Niles Canyon and its relationship with Sunol Valley and the Laguna.	2	10	AC Alliance, ACWD, SFPUC, Zone 7	39.50	39.50				79	Cost based on stream flow/precipitation model at a rate of $78,100
AIC-CCCS-10.1.1.4	Action Step	Water Quality	Ensure SBA releases do not exceed smolt temperatures thresholds in flow conveyance streams or contribute to increased water temperatures within Niles Canyon.	1	10	ACWD, Zone 7						0	Cost based on implementation of other action steps.
AIC-CCCS-10.1.1.5	Action Step	Water Quality	Ensure that future or current SBA water imports do not marginalize or impair stream temperature for summer rearing juveniles and migration smolt steelhead.	2	20	ACWD, Zone 7						0	Action is considered In-Kind
AIC-CCCS-10.1.1.6	Action Step	Water Quality	Develop and implement strategies that prevent potential warm water discharge from gravel mining operations.	1	10	ACWD						TBD	Cost based on the type of recommendations to implement.

Alameda Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
AIC-CCCS-10.1.1.7	Action Step	Water Quality	Develop and implement strategies that minimize water temperature impacts associated with groundwater within the Niles Canyon reach.	1	15	ACWD, SFPUC, Zone 7						TBD	Cost based on type of strategies to implement.
AIC-CCCS-10.1.2	Recovery Action	Water Quality	Reduce toxicity and pollutants										
AIC-CCCS-10.1.2.1	Action Step	Water Quality	Install continuous water quality monitoring stations within the Niles Canyon and the Alameda County Flood Control Channel.	2	10	ACWD, Alameda Flood Control	7.50	7.50				15	Cost based on installing a minimum of 3 continuous water quality monitoring stations at a rate of $5,000/station.
AIC-CCCS-10.1.2.2	Action Step	Water Quality	Identify and provide solutions for point and non-point sources contributing to poor water quality and pollution.	2	10	AC Alliance, ACWD, Alameda Flood Control, Cities, EB Parks, RCD, RWQCB, SFPUC, Zone 7						0	Cost accounted for in other actions steps.
AIC-CCCS-10.1.2.3	Action Step	Water Quality	Evaluate and provided solutions for past fish kills within the Alameda Creek Flood Control Channel.	2	20	ACWD						TBD	Cost based on cause of fish kill and appropriate recommendation to remedy conditions causing fish kills.
AIC-CCCS-11.1	**Objective**	**Viability**	**Address other natural or manmade factors affecting the species' continued existence**										
AIC-CCCS-11.1.1	Recovery Action	Viability	Increase density, abundance, spatial structure, and diversity based on the biological recovery criteria										
AIC-CCCS-11.1.1.1	Action Step	Viability	Determine the need for a conservation hatchery/supplementation/augmentation program.	1	10	AC Alliance, ACWD, CDFW, NOAA SWFSC, NOAA/NMFS, SFPUC, Zone 7						0	Action is considered In-Kind
AIC-CCCS-11.1.1.10	Action Step	Viability	If determined a viable option, develop guidance that best utilizes and incorporates adfluvial O.mykiss into a population enhancement program.	1	20	NMFS, NOAA SWFSC, NOAA/NMFS, SFPUC						0	Action is considered In-Kind
AIC-CCCS-11.1.1.11	Action Step	Viability	Determine the population dynamic and genetic implications of providing passage over Calaveras and Turner dams.	1	10	CDFW, NOAA SWFSC, NOAA/NMFS, SFPUC						0	Action is considered In-Kind
AIC-CCCS-11.1.1.12	Action Step	Viability	Investigate the potential implications/benefits/ consequences of future interactions between anadromous and resident forms of O. mykiss (life history, genetics, etc.).	1	10	NMFS, NOAA SWFSC, NOAA/NMFS, SFPUC						0	Action is considered In-Kind
AIC-CCCS-11.1.1.13	Action Step	Viability	Investigate and address concerns associated with the fate of reservoir O.mykiss if passage is re-established above Calaveras and Turner dams.	1	10	NMFS, NOAA SWFSC, NOAA/NMFS, SFPUC						0	Action is considered In-Kind
AIC-CCCS-11.1.1.14	Action Step	Viability	Develop a population supplementation/augmentation plan to complement recovery goals of the Alameda Creek watershed.	1	15	CDFW, NOAA SWFSC, NOAA/NMFS, SFPUC						0	Action is considered In-Kind
AIC-CCCS-11.1.1.15	Action Step	Viability	Develop and implement an effective population based monitoring program.	2	15	CDFW, NOAA SWFSC, NOAA/NMFS, SFPUC						0	Costs accounted for under the Coastal Monitoring Plan - see Monitoring Chapter in Volume 1.
AIC-CCCS-11.1.1.2	Action Step	Viability	Identify if the population is at short-term or immediate risk of extinction.	1	10	NOAA SWFSC, NOAA/NMFS						0	Action is considered In-Kind
AIC-CCCS-11.1.1.3	Action Step	Viability	Identify how a conservation hatchery/supplementation/ augmentation program will complement the overall recovery effort.	1	10	NOAA SWFSC, NOAA/NMFS						0	Action is considered In-Kind

Alameda Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
AIC-CCCS-11.1.1.4	Action Step	Viability	Identify the biological or DPS significance of the subject population.	1	10	NOAA SWFSC, NOAA/NMFS						0	Action is considered In-Kind
AIC-CCCS-11.1.1.5	Action Step	Viability	Identify population viability goals and the expectations of a conservation hatchery/supplementation/augmentation program.	1	10	NOAA SWFSC, NOAA/NMFS						0	Action is considered In-Kind
AIC-CCCS-11.1.1.6	Action Step	Viability	Investigate the current status genetic diversity within the O.mykiss population in Alameda Creek.	1	10	NOAA SWFSC, NOAA/NMFS, SFPUC						0	Action is considered In-Kind
AIC-CCCS-11.1.1.7	Action Step	Viability	Investigate the current population dynamics and viability status..	1	10	NOAA SWFSC, NOAA/NMFS, SFPUC						0	Action is considered In-Kind
AIC-CCCS-11.1.1.8	Action Step	Viability	Determine the suitability of the Calaveras and San Antonio reservoir adfluvial stocks as source populations for a supplementation/augmentation program.	1	10	NOAA SWFSC, NOAA/NMFS, SFPUC						0	Action is considered In-Kind
AIC-CCCS-11.1.1.9	Action Step	Viability	Conduct research that addresses biological and genetic concerns associated with population supplementation. See NMFS CDRP BO (2011).	1	20	NMFS, NOAA SWFSC						0	Cost likely part of collaboration between NMFS, CDFW, and others to absorb the costs.
AIC-CCCS-13.1	**Objective**	**Channel Modification**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**										
AIC-CCCS-13.1.1	Recovery Action	Channel Modification	Prevent or minimize impairment to floodplain connectivity (impaired quality and extent)										
AIC-CCCS-13.1.1.1	Action Step	Channel Modification	Minimize, or prevent, channelization in areas that provide winter refuge and seasonal habitat for juvenile steelhead	3	25	AC Alliance, ACWD, Alameda County, Alameda Flood Control, CDFW, Corps						0	Action is considered In-Kind
AIC-CCCS-13.1.1.2	Action Step	Channel Modification	Ensure future channel modification activities prevent or minimize impediments to the creation of, or blocking access to, off channel habitat used by salmonids as refuge and winter rearing habitat during high stream flows.	3	50	AC Alliance, ACWD, Alameda County, Alameda Flood Control, Corps, Zone 7						0	Action is considered In-Kind
AIC-CCCS-13.1.1.3	Action Step	Channel Modification	Ensure that all existing channel designed for flood conveyance incorporate features that enhance steelhead migration under high and low flow conditions.	3	25	AC Alliance, ACWD, Alameda County, Alameda Flood Control, Cities, Corps, Zone 7						0	Action is considered In-Kind
AIC-CCCS-13.1.1.4	Action Step	Channel Modification	Develop Bank Stabilization and Floodplain Guidelines for use by private and public entities.	3	50	AC Alliance, ACWD, Alameda County, Alameda Flood Control, Corps, RCD, Zone 7						0	Action is considered In-Kind
AIC-CCCS-13.1.1.5	Action Step	Channel Modification	Evaluate design alternatives to rip-rap bank repairs and incorporate fish habitat features.	3	100	AC Alliance, ACWD, Alameda County, Alameda Flood Control, Corps, Zone 7						0	Action is considered In-Kind

Alameda Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
AIC-CCCS-13.1.2	Recovery Action	Channel Modification	Prevent or minimize impairment to stream hydrology (impaired water flow)										
AIC-CCCS-13.1.2.1	Action Step	Channel Modification	Develop and implement strategies to reduce flow loss in the Sunol Valley Reach.	3	10							TBD	Cost based on optimum flow level for multiple life stages. Cost for stream flow/precipitation monitoring estimated at $78,100/project.
AIC-CCCS-13.1.2.2	Action Step	Channel Modification	Conduct rehabilitation activities that restore channels, floodplains and meadows to extend the duration spring and summer stream flows.	2	5							0	Cost captured in other recovery actions.
AIC-CCCS-13.1.2.3	Action Step	Channel Modification	Develop and implement strategies that slow urban runoff in the northern watershed during the spawning and migration season (slow it, spread it, sink it).	3	25							TBD	Cost based on amount of impervious soils contributing to increased runoff and methods to treat. Flood retention basins, engineered wetlands, and bypass channels are potential possibilities.
AIC-CCCS-13.1.3	Recovery Action	Channel Modification	Prevent or minimize impairment to passage and migration										
AIC-CCCS-13.1.3.1	Action Step	Channel Modification	Ensure that existing engineered and modified channels incorporate features that enhance steelhead migration under high and low flow conditions.	3	20							0	Action is considered In-Kind
AIC-CCCS-13.1.3.2	Action Step	Channel Modification	Incorporate velocity refuge features in all existing engineered and modified channels.	3	10							0	Cost captured in other recovery actions.
AIC-CCCS-13.1.3.3	Action Step	Channel Modification	Install features that provides shelter for emigrating juvenile salmonids - particularly through the Alameda Creek Flood Control Channel.	2	20							0	Cost accounted for in above action steps under Habitat Complexity.
AIC-CCCS-13.1.3.4	Action Step	Channel Modification	Minimize or prevent future channel modifications in potentially high value seasonal habitat and migration (staging) areas.	3	20							0	Action is considered In-Kind
AIC-CCCS-13.1.4	Recovery Action	Channel Modification	Prevent or minimize impairment to instream habitat complexity										
AIC-CCCS-13.1.4.1	Action Step	Channel Modification	Prevent the removal of habitat forming structures (LWD, boulders, vegetation, etc.) in all natural waterways.	3	30							0	Action is considered In-Kind
AIC-CCCS-14.1	**Objective**	**Disease/ Predation /Competition**	**Address disease or predation**										
AIC-CCCS-14.1.1	Recovery Action	Disease/ Predation /Competition	Prevent or minimize reduced density, abundance, and diversity										
AIC-CCCS-14.1.1.1	Action Step	Disease/ Predation /Competition	Investigate impacts and distribution of black spot disease on O. mykiss throughout the Alameda Creek watershed.	2	10	AC Alliance, ACWD, Alameda Flood Control, SFPUC, Zone 7						0	Action is considered In-Kind. Existing and future fisheries monitoring programs carried out by the SFPUC, CMP, and others will document the presence and distribution of black spot disease.
AIC-CCCS-14.1.1.2	Action Step	Disease/ Predation /Competition	If possible, provide and implement recommendations in efforts to reduce BSD.	2	15	AC Alliance, ACWD, CDFW, SFPUC, Zone 7						0	Action is considered In-Kind
AIC-CCCS-16.1	**Objective**	**Fishing/Collecting**	**Address the overutilization for commercial, recreational, scientific or educational purposes**										
AIC-CCCS-16.1.1	Recovery Action	Fishing/Collecting	Prevent or minimize reduced density, abundance, and diversity										
AIC-CCCS-16.1.1.1	Action Step	Fishing/Collecting	Investigate the potential impacts to steelhead from recreational fishing in the Shadow Cliffs area.	2	15	AC Alliance, CDFW, EB Parks, Zone 7						0	Collaboration between agencies and staff is required. Action is considered In-Kind
AIC-CCCS-16.1.1.2	Action Step	Fishing/Collecting	Work with CDFW to modify existing fishing regulations to protect adfluvial O.mykiss above Calaveras, Del Valle, and Turner dams.	2	10	AC Alliance, CDFW, EB Parks						0	Action is considered In-Kind

Alameda Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
AIC-CCCS-18.1	**Objective**	**Livestock**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**										
AIC-CCCS-18.1.1	Recovery Action	Livestock	Prevent or minimize impairment to water quality (increased turbidity, suspended sediment, and/or toxicity)										
AIC-CCCS-18.1.1.1	Action Step	Livestock	Develop off-stream waters sources for livestock.	2	10	NRCS, RCD, SFPUC						TBD	Cost based on amount of off-stream water sources needed and landowner participation. Estimate for off-stream water source is $5,000/system.
AIC-CCCS-18.1.1.2	Action Step	Livestock	Exclude cattle from entering stream riparian areas.	2	10	NRCS, RCD, SFPUC	15.00	15.00				30	Cost based on treating 3.3 miles (assume 1 project/mile in 5% high IP) at a rate of $4.36/ft.
AIC-CCCS-18.1.1.3	Action Step	Livestock	Establish a monitoring protocol to determine the level of nutrient loading associated with livestock.	2	10	NRCS, RCD, SFPUC						0	Action is considered In-Kind
AIC-CCCS-18.1.1.4	Action Step	Livestock	Exclude cattle from entering streams and tributaries of Alameda Creek to prevent nutrient loading issues.	2	10	NRCS, RCD, SFPUC						0	Cost accounted for in above action steps.
AIC-CCCS-18.1.1.5	Action Step	Livestock	Minimize gully initiation by preventing livestock from over utilizing steeper sloped areas.	2	10	NRCS, RCD, SFPUC						0	Action is considered In-Kind
AIC-CCCS-20.1	**Objective**	**Mining**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**										
AIC-CCCS-20.1.1	Recovery Action	Mining	Prevent or minimize impairment to water quality (increased turbidity, suspended sediment, and/or toxicity)										
AIC-CCCS-20.1.1.1	Action Step	Mining	Evaluate and provide solutions to address water quality concerns associated with gravel mining discharge operations within the Sunol Valley.	2	10	AC Alliance, Alameda County, SFPUC						TBD	Cost based on type of water quality parameters to monitor. Estimate for water quality testing range from $20 - $2,000/sample (Center for Watershed Science and Education, CCRWQCB).
AIC-CCCS-20.1.1.2	Action Step	Mining	Active and future mining should avoid and minimize any changes to downstream water quality, including changes in turbidity, pH, temperature, and rate of sedimentation.	2	10	AC Alliance, SFPUC, Zone 7						0	Action is considered In-Kind
AIC-CCCS-20.1.1.3	Action Step	Mining	Tailings, settling ponds, and other mining infrastructure should ensure sediment, toxins, and other deleterious substances do not enter streams through either direct runoff or subsurface flow.	2	15	ACWD, Alameda Flood Control, County SMARA, NRCS, RCD, RWQCB, SFPUC						0	Action is considered In-Kind
AIC-CCCS-22.1	**Objective**	**Residential/ Commercial Development**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**										
AIC-CCCS-22.1.1	Recovery Action	Residential/ Commercial Development	Prevent or minimize impairment to floodplain connectivity (impaired quality & extent)										
AIC-CCCS-22.1.1.1	Action Step	Residential/ Commercial Development	Design new development to allow streams to meander in historical patterns; protecting riparian zones and their floodplains or channel migration zones averts the need for bank erosion control in most situations.	3	25	Cities, Counties						0	Action is considered In-Kind
AIC-CCCS-22.1.1.2	Action Step	Residential/ Commercial Development	Minimize or avoid new development within riparian zones and the 100 year floodprone zones.	3	25	City, Counties						0	Action is considered In-Kind
AIC-CCCS-22.1.1.3	Action Step	Residential/ Commercial Development	Develop policy and guidelines that address land conversion and attempt to minimize conversion-related impacts within the aquatic environment.	3	25	Cities, Counties						0	Action is considered In-Kind

Alameda Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
AIC-CCCS-22.1.1.4	Action Step	Residential/ Commercial Development	Educate county and city public works departments, flood control districts, and planning departments, etc., on the critical importance of maintaining a mature riparian and healthy riparian zone.	3	20	Cities, Counties						0	Action is considered In-Kind
AIC-CCCS-22.1.1.5	Action Step	Residential/ Commercial Development	Minimize or prevent future development in remaining undeveloped floodplains or off channel habitats.	3	20	Cities, Counties						0	Action is considered In-Kind
AIC-CCCS-22.1.2	Recovery Action	Residential/ Commercial Development	Minimize or prevent impairment to water quality (increased turbidity, suspended sediment, and/or toxicity)										
AIC-CCCS-22.1.2.1	Action Step	Residential/ Commercial Development	Implement education programs and install signs to promote public awareness of salmon and steelhead and their habitats within the Alameda Creek watershed.	3	5	Cities, Counties, County Planning	5.00					5	Cost based on installing a minimum of 5 signs at a rate of $1,000/sign.
AIC-CCCS-22.1.2.2	Action Step	Residential/ Commercial Development	Develop filter or buffer systems that reduce pollutants from entering streams and waterways of Alameda Creek.	3	25	Cities, Counties						TBD	Cost based on amount and type of filter or buffer strip needed. Estimate for filter strip is $9,00 to $24,000 for a 25ft wide filter strip.
AIC-CCCS-23.1	**Objective**	**Roads/Railroads**	**Address the present or threatened destruction, modification, or curtailment of habitat or range**										
AIC-CCCS-23.1.1	Recovery Action	Roads/Railroads	Minimize or prevent impairment to stream hydrology (impaired water flow)										
AIC-CCCS-23.1.1.1	Action Step	Roads/Railroads	Conduct actions that hydrologically disconnect roads.	3	25	Cities, Counties, NRCS						TBD	Cost based on type and amount of actions to disconnect roads identified in road assessment. Estimate for road inventory is $1,148/mile.
AIC-CCCS-23.1.1.2	Action Step	Roads/Railroads	Minimize or prevent the construction of new roads near high valve habitat areas or sensitive habitat areas.	3	25	Cities, Counties, NRCS, RCD						0	Action is considered In-Kind
AIC-CCCS-23.1.2	Recovery Action	Roads/Railroads	Minimize or prevent impairment to passage and migration										
AIC-CCCS-23.1.2.1	Action Step	Roads/Railroads	All bridges associated with new roads and railroads or replacement bridges should be free span or constructed with the minimal amount of impairment to the stream channel.	2	50	Cities, Counties, NRCS, RCD						0	Action is considered In-Kind
AIC-CCCS-23.1.2.2	Action Step	Roads/Railroads	Ensure that all future road/stream crossing provide passage for all steelhead life stages.	3	25	Cities, Counties, NRCS, RCD						0	Action is considered In-Kind
AIC-CCCS-23.1.3	Recovery Action	Roads/Railroads	Prevent or minimize alterations to sediment transport (road condition/density, dams, etc.)										
AIC-CCCS-23.1.3.1	Action Step	Roads/Railroads	Address high and medium priority sediment delivery sites associated with roads and railroads.	3	25	Cities, Counties, NRCS, RCD						TBD	High and medium priority roads should be identified from road assessment. Recommendations to treat will depend on extent and type of sediment being delivered.
AIC-CCCS-23.1.3.2	Action Step	Roads/Railroads	Assess road runoff conditions and where necessary address sediment and runoff sources from road networks and other actions that deliver sediment and runoff to stream channels.	3	25	NRCS, RCD						TBD	Cost based on road inventory of 3,934 mile of road network at a rate of $1,148/mile and erosion assessment of 25% of total watershed acres at a rate of $15.14/acre.
AIC-CCCS-23.1.3.3	Action Step	Roads/Railroads	Develop a Road Sediment Reduction Plan that prioritizes sites and outlines implementation and a timeline of necessary actions. Begin with a road survey focused on inner gorge roads followed by roads in other settings.	3	25	Cities, Counties, NRCS, RCD						0	Cost accounted for in above action step.
AIC-CCCS-24.1	**Objective**	**Severe Weather Patterns**	**Address other natural or manmade factors affecting the species' continued existence**										
AIC-CCCS-24.1.1	Recovery Action	Severe Weather Patterns	Prevent or minimize impairment to stream hydrology (impaired water flow)										

Alameda Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
AIC-CCCS-24.1.1.1	Action Step	Severe Weather Patterns	Develop and implement severe drought measures that protect adult and juvenile migrating steelhead.	2	15	ACWD, SFPUC, Zone 7						0	Action is considered In-Kind
AIC-CCCS-24.1.1.2	Action Step	Severe Weather Patterns	Develop severe drought measures that protect all steelhead spawning and rearing tributaries within the Alameda Creek watershed.	2	15	ACWD, SFPUC, Zone 7						0	Action is considered In-Kind
AIC-CCCS-25.1	**Objective**	**Water Diversion /Impoundment**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**										
AIC-CCCS-25.1.1	Recovery Action	Water Diversion /Impoundment	Prevent or minimize impairment to stream hydrology (impaired water flow)										
AIC-CCCS-25.1.1.1	Action Step	Water Diversion /Impoundment	Develop a watershed wide hydrology model incorporating operational schedules for all dams and diversions.	2	10	ACWD, Alameda Flood Control, SFPUC, Zone 7	39.50	39.50				79	Cost based on stream flow/precipitation model at a rate of $78,100/project. Anticipate this cost is underestimated for the level of results needed for watershed wide hydrology model.
AIC-CCCS-25.1.1.2	Action Step	Water Diversion /Impoundment	Establish and implement a comprehensive stream flow program to improve survival at all life stages by improving the spatial and temporal pattern of surface flows throughout spawning, rearing, and migration areas.	1	10	ACWD, Alameda Flood Control, DWR, SFPUC, Zone 7						0	Action is considered In-Kind
AIC-CCCS-25.1.2	Recovery Action	Water Diversion /Impoundment	Prevent or minimize impairment to instream habitat complexity (altered pool complexity and/or pool: riffle ratio)										
AIC-CCCS-25.1.2.1	Action Step	Water Diversion /Impoundment	Evaluate and develop flow schedules below San Antonio and Del Valle reservoirs that maximize current and potential habitat conditions.	1	10	ACWD, DWR, SFPUC, Zone 7						0	Cost accounted for in above action steps under Hydrology.
AIC-CCCS-25.1.2.2	Action Step	Water Diversion /Impoundment	Design and install instream habitat enhancement projects to optimize habitat attributes for spawning and rearing associated with developed flow schedules.	2	10	AC Alliance, ACWD, Alameda Flood Control, EB Parks, RCD, SFPUC, Zone 7						0	Costs accounted for in other recovey actions.

Coyote Creek Population

CCC Steelhead Winter Run

- Role within DPS: Independent Population
- Diversity Stratum: Interior San Francisco Bay
- Spawner Density Target: 3,000 adults
- Current Intrinsic Potential: 109.3 IP-km

Steelhead Abundance and Distribution

Sporadic surveys conducted between 1898 and the present indicate that steelhead were once abundant in the Coyote Creek system, occurring within the Coyote Creek mainstem as well as 13 tributary streams (Leidy *et al.* 2005). However, anthropogenic development within the watershed has since altered streamflow and degraded instream spawning and rearing habitat, significantly disrupting salmonid migration pathways (Leidy *et al*. 2005). Steelhead presently persist in the Coyote Creek system; however present conditions limit the ability of this system to support a viable steelhead population.

Complete passage barriers at Coyote and Anderson reservoirs block passage to approximately 56 percent of the watershed (collectively), and all but one of the below-dam subbasins (Upper Penitencia Creek) has been eliminated from anadromy by watershed development. Numerous partial (some near-complete) barriers affect migration throughout the portion of the watershed that remains accessible. The absence of regularly performed, standardized steelhead surveys in this watershed precludes precise determination of steelhead abundance. However, available survey information (Li 2001; Porcella 2002; Leicester 2008; Moore *et al.* 2008; Leicester 2009; Moore *et al.* 2009; Smith 2009; Leicester & Smith 2014a, 2014b) indicate that steelhead persist in the system, and that abundance is likely very low throughout the accessible reaches of Coyote Creek mainstem downstream of Anderson Dam and the Upper Penitencia Creek subbasin (containing Upper Penitencia Creek and its tributary Arroyo Aguague).

Surveys summarized in Leidy *et al.* (2005) indicate that *O. mykiss* have persisted in tributary reaches upstream of Anderson and Coyote reservoirs, suggesting the watershed upstream of these reservoirs was important steelhead habitat that supported moderate densities of anadromous steelhead prior to habitat blockage. Anthropogenic habitat alteration within these reaches remains limited, so they could again potentially provide important habitat for an anadromous steelhead population if passage past Anderson and Coyote dams is restored.

History of Land Use

Detailed discussion of the historical land uses within the Coyote Creek watershed is available in Grossinger (2006). In general, light agricultural and ranching development began during the Spanish Mission System of the late 1700s and gradually transitioned to more intensive agricultural and urban development as the primary land uses within the watershed. Extensive groundwater pumping, channelization of discontinuous and tributary channels, gravel mining, road construction, and flood levee construction are among the land uses that affect the watershed and stream functions within the Coyote Creek system. Watershed processes and hydrology are affected by Coyote and Anderson reservoirs, which were constructed in 1936 and 1950, respectively, to provide water for groundwater aquifer recharge, and urban and agricultural uses. Currently, the primary land use types within the Coyote Creek watershed, accounting for approximately 27- and 4-percent of the total watershed area, respectively (NMFS GIS 2009), are urban, and to a lesser extent, agricultural development. The majority of this development is concentrated within the watershed area below Anderson Reservoir where steelhead presently have access, effectively concentrating the associated effects on the steelhead population.

Current Resources and Land Management

The 322 square-mile Coyote Creek watershed (Santa Clara Valley Water District 2010) includes the cities of Morgan Hill, Milpitas, and San Jose. 83 percent of the watershed is privately held, 14 percent is a combination of local and state parks and recreational holdings, and the remaining 3 percent is in Federal holdings (NMFS GIS 2009).

The Santa Clara Valley Water District (SCVWD) operates an extensive network of water conveyance infrastructure (including Coyote and Anderson reservoirs), maintains responsibility for flood control within Coyote Creek and neighboring watersheds, and performs stewardship duties for its watersheds. Additionally, SCVWD is in the process of drafting a Habitat Conservation Plan, the Three Creeks Habitat Conservation Plan (TC-HCP), to address current and future operations throughout its coverage area that limit conditions for steelhead, as well as a host of Federal and state-listed and special-concern species. Schedule for finalizing and implementing the TC-HCP is uncertain at the time of this assessment; however, NMFS and SCVWD are involved in ongoing discussions towards the goal of finalizing and implementing a plan that will improve instream conditions for steelhead.

Resource management within the basin, including survey efforts and instream restoration efforts, is largely carried out by SCVWD. However, the California Department of Fish and Wildlife (CDFW) has been active in performing stream surveys, and a host of public interest groups, including Friends of Coyote Creek, Santa Clara Valley Audubon Society, CLEAN South Bay,

Santa Clara County Creeks Coalition, and the California Nature Conservancy, are active in the watershed. For more information on the organizations active in Coyote Creek see SCBWMI 2001, SCBWMI 2003, and SCBWMI 2011.

Salmonid Viability and Watershed Conditions

The following habitat indicators were rated Poor through the CAP process: physical barriers, riparian tree diameter, spawning gravel quantity and distribution, toxicity, turbidity, pool/riffle/flatwater ratio, gravel quality (bulk), gravel embeddedness, baseflow and instantaneous flow condition (summer), estuary quality and extent, percent primary pools, juvenile density and spatial structure, smolt and adult abundance, urbanization, road density, and streamside road density. Recovery strategies will typically focus on ameliorating these habitat indicators, although strategies that address other indicators may also be developed where their implementation is critical for restoring properly functioning habitat conditions within the watershed.

Current Conditions

The following discussion focuses on those conditions that were rated Fair or Poor as a result of our CAP viability analysis. The Coyote Creek CAP Viability Table results are provided below. Recovery strategies will focus on improving these conditions.

Population and Habitat Conditions

Water Quality: Turbidity or Toxicity

Water Quality: Turbidity and toxicity conditions have an overall rating of Poor due to the high density of urbanization within the watershed below Anderson Dam, where water quality within much of Coyote Creek is degraded and likely limiting steelhead survival within Coyote Creek. Entrix (2000) notes that instream turbidity conditions likely limit adult migration, and limit juvenile survival to the next lifestage at all but the upstream-most reaches below Anderson Dam. The US Environmental Protection Agency's (US EPA) list of assessed waters includes Coyote Creek as a threatened waterbody, signifying that although water quality conditions currently support all uses, they appear to be declining (US EPA 2010A). Data for the most recent year for which an EPA assessment are posted (2004) indicate that Coyote Creek water quality is impaired due to debris, pesticides, and urban runoff, and threatens support of several water quality attainment measures (US EPA 2010B). Threats contributing significantly to this condition include channel modification, water diversion and impoundments, and residential development.

Sediment: Gravel Quality and Distribution of Spawning Gravels

Sediment transport, and thereby instream substrate and its ability to support spawning and invertebrate food resources, are highly affected by development and management of the Coyote Creek system. Sediment conditions have an overall Poor ratting. Generally, overall distribution of high quality substrate in the Coyote Creek system is likely highly affected by Anderson and Coyote reservoirs, which block access to above-reservoir habitat, block downstream transport of sediment, and affect sediment transport within downstream reaches due to hydrograph alterations. Additionally, the lower gradient conditions, urbanization, and flood control projects within the reaches downstream of Anderson Dam, to which steelhead are currently confined, likely result in accumulation of fines that can also impair substrate quality. Downstream of Anderson Dam, spawning gravels are limiting in Coyote Creek mainstem (Entrix 2000), but appear to be available in adequate quantities in the Upper Penitencia Creek subbasin (Entrix 2000, Stillwater Sciences 2006). Additionally, Entrix (2000) notes that food transport was the most limiting factor in 3 of 7 reaches habitat typed (all below Anderson Dam). Threats contributing significantly to this stress include channel modification, water diversion and impoundments, and residential development.

Viability: Density, Abundance, and Spatial Structure

Various reports document recent efforts between 1998 and 2008 to assess the density and abundance of steelhead within the Coyote Creek system. As discussed above, the absence of regularly performed, standardized surveys precludes precise determination of steelhead abundance in this watershed. However, available survey information (Li 2001; Porcella 2002; Leicester 2008; Moore *et al.* 2008; Leicester 2009; Moore *et al.* 2009; Smith 2009; Leicester & Smith 2014a, 2014b) suggests that steelhead abundance is likely very low. Viability conditions have a rating of Poor. Highest steelhead densities occur within Upper Penitencia Creek and the upstream reaches of Coyote Creek mainstem (downstream of Anderson Dam) where habitat is generally better than habitat found within the other reaches. The Upper Penitencia Creek tributary is relatively low in the system, and contains instream habitat that is generally suitable for steelhead (primarily within upper reaches), although a partial barrier at SCVWD's Noble Diversion may limit access to this habitat (see Stillwater Sciences 2006 for more on Upper Penitencia Creek). Similarly, the upstream-most reaches of Coyote Creek mainstem downstream of Anderson Dam contain habitat features that are, in general, suitable for steelhead. Reservoir operations likely limit juvenile lifestages in Coyote Creek, and the presence of several significant barriers may limit anadromy within much of the mainstem reach. Further discussion on migratory barriers is provided below in *Passage/Migration: Mouth or Confluence and Physical Barriers*. Threats contributing significantly to this condition include water diversion and impoundments.

Habitat Complexity: Percent Primary Pools and Pool/Riffle/Flatwater Ratios

There are limited data available regarding the distribution of pool/riffle/flatwater ratios and pool complexity within the Coyote Creek system. Quantitative surveys conducted by Entrix (2000) calculated pool/run/flatwater/riffle ratios for Coyote Creek mainstem downstream of Anderson Dam, and rapid, qualitative, assessments were performed by NMFS during site visits to several reaches on Coyote Creek in 2009 (Howe and Stern 2009). Habitat complexity within the Coyote Creek mainstem downstream of Anderson Dam is limiting, with many reaches dominated by long flat-water sections and runs. This stress was rated as High for summer and winter rearing. Above-reservoir data are limited, but considering the fact that many of these reaches continue to support *O. mykiss* (Leidy et al. 2005), NMFS expects they contain high quality habitat suitable for the support of steelhead.

Data on habitat complexity within the Upper Penitencia Creek subbasin are similarly limited. However, Stillwater Sciences (2006) performed a limiting factors analysis for Upper Penitencia Creek and identified reduced instream habitat (compared to likely historical conditions) as likely limiting steelhead production (specifically the juvenile lifestages). Threats contributing significantly to this condition include channel modification, water diversion and impoundments, and residential development.

Hydrology: Baseflow and Passage Flows

This stress was rated as Very High for summer rearing juveniles. Threats contributing significantly to this condition include water diversion and impoundments.

Before European settlement, much of the reach of Coyote Creek mainstem downstream of Anderson Reservoir was likely an intermittently wetted channel. Steelhead distribution is currently limited to this section. SCVWD manages groundwater levels via instream percolation in summer. Current reservoir operations manage the flows to such an extent that a significant muting of the natural hydrograph occurs downstream of Anderson Dam. Additionally, current reservoir operations result in much higher summer-time flows, and lower winter-time flows within this reach than occurred historically, resulting in higher flows during summer rather than during winter. These flows may provide suitable steelhead habitat within the reach below the Anderson Dam (Spencer et al. 2006), but there is concern that current operations may inadvertently adversely affect newly emerged fry and rearing young-of-the year by creating high water velocities through homogeneous channel conditions. Additionally, reservoir releases may not be ramped up and down (increased/decreased, respectively) in such a way as to prevent stranding of juveniles. Further, these hydrograph alterations likely affect adult passage during winter by muting attractant flows and curtailing passage opportunities at some partial, but significant, migratory barriers (*i.e.*, Singleton Rd Crossing, and Ogier Pond Complex). Further refinement of discharge operations from Anderson Reservoir is warranted.

Although Upper Penitencia Creek is relatively less managed than Coyote Creek, the City of San Jose operates a small reservoir (Cherry Flat) in the upper watershed, and SCVWD owns a diversion facility on the creek (Noble Diversion) and operates off channel storage ponds and discharge facilities along the creek. These facilities modify storm discharges, potentially impacting adult and smolt passage, and juvenile rearing.

Passage/Migration: Mouth or Confluence and Physical Barriers

Numerous impairments to passage and migration exist within the Coyote Creek system, so Passage/Migration conditions have an overall rating of Poor. Anderson and Coyote Reservoirs block access to approximately 56 percent of the watershed, eliminating access to historically important spawning and rearing reaches. CDFW identified 28 man-made barriers on Coyote Creek downstream of Anderson Dam, and 14 man-made barriers on Upper Penitencia Creek (Cleugh and Mcknight 2002). Of these, the ones at the Singleton Road low-flow crossing and the Ogier Pond complex on Coyote Creek, are considered to be the most significant barriers to upstream passage. While these barriers are considered partial barriers, their configurations, coupled with the severely altered hydrology associated with water infrastructure management, result in their functioning as near complete barriers. Additionally, outmigration of smolts within Upper Penitencia Creek may be limited by flow availability in some years (Smith 2009). Threats contributing significantly to this condition include channel modification, residential development, and water diversion and impoundments.

Velocity Refuge: Floodplain Connectivity

The results of Buchan and Randall (2003) pertaining to the "Condition of Flood Prone Area" in Coyote Creek and Upper Penitencia Creek were used to inform the CAP workbook. The floodplain limitations present today in the Coyote Creek system downstream of Anderson Dam are primarily due to urbanization and the associated effects of channel confinement and altered hydrology, all of which have resulted in riparian encroachment, channel degradation, and floodplain/stream channel disconnection. Connectivity between stream channel and floodplain habitat may be improved in some locations within the Coyote Creek system through future restoration efforts, and the installation of flood control projects that remediate out-dated flood control methods and incorporate methods that allow for steam functions. Velocity Refuge Conditions have a rating of Poor since floodplain connectivity has in many cases been irretrievably lost due to urbanization; the overall degraded condition is expected to persist throughout much of the system. Threats contributing significantly to this condition include channel modification, residential development, and water diversion and impoundments.

Sediment Transport: Road Density

The Coyote Creek watershed is more heavily developed than the Upper Penitencia Creek watershed, and sediment transport is likely affected to a greater degree within Coyote Creek than Upper Penitencia Creek (see discussions of sediment transport within *Mining*, and *Sediment: Gravel Quality and Distribution of Spawning Gravels)*. Within the CAP workbook, road density is used to indicate the degree of sediment transport alteration within the watershed. Per watershed characterization, the Coyote Creek system has high road densities concentrated within urbanized area downstream of Anderson Dam (NMFS GIS 2009), indicating alterations to drainage networks, streamflow and sediment transport and storage regimes, and accelerated erosion processes. As a result, sediment transport from road density conditions have a rating of Poor. Altered flow patterns within the Coyote Creek system, together with channel alterations such as the Ogier Pond complex and instream diversion dams and percolation ponds (e.g., Metcalf Percolation Pond, and the remnants of the Ford Road pond complex), may affect the flows necessary to transport sediment and may effectively act as bed-load barriers (see discussions of hydrology alterations within *Mining,* and *Hydrology: Baseflow and Passage Flows*). Collectively, impaired sediment transport within the Coyote Creek system (downstream of Anderson Dam) likely reduces instream gravel quantity and quality, increases fine sediment deposition, elevates turbidity, and limits survival at all lifestages. Upstream of Anderson and Coyote Creek Reservoirs, alterations to sediment transport processes are likely minimal. Threats contributing significantly to this condition include roads and railroads, and water diversion and impoundment.

Landscape Patterns: Agriculture, Timber Harvest & Urbanization

Major landscape disturbance within the Coyote Creek system is associated with urban development; 27 percent of the entire Coyote Creek watershed is developed as urban land uses (NMFS GIS 2009). Urbanization is concentrated in the watershed area downstream of Anderson Dam; 51 percent of the watershed area downstream of Anderson Dam is urbanized (NMFS GIS 2009). Due to blockage by Anderson and Coyote reservoirs, the current spatial extent of urbanization traces the current steelhead distribution within the Coyote Creek watershed, suggesting that steelhead are likely affected to a High degree by altered watershed processes resulting from these landscaped disturbances. Threats contributing significantly to this condition include channel modification, residential development, and water diversion and impoundments.

Habitat Complexity: Large Wood and Shelter

Buchan and Randall (2003) indicate that large wood is somewhat limiting within the Coyote Creek mainstem, whereas large wood may not be limiting on Upper Penitencia Creek. However, although large wood may not be particularly limiting in all reaches, shelter is generally known to be limiting. Habitat Complexity: large wood and shelter conditions have an overall rating of Fair for summer and winter rearing. Efforts are currently being made to increase large wood

frequency and instream shelter within the Coyote Creek system by SCVWD through its ongoing Stream Maintenance Program (Moore 2010). Threats contributing significantly to this condition include channel modification, residential development, and water diversion and impoundments.

Water Quality: Temperature

High water temperatures throughout much of the Coyote Creek watershed downstream of Anderson Dam likely limit juvenile steelhead survival during summer months. These elevated temperatures, coupled with habitat limitations, likely preclude steelhead from rearing within these reaches. Warm water inputs from off-channel pond complexes and in-stream groundwater recharge facilities on both Coyote Creek (Spencer et al 2006) and Upper Penitencia Creek likely exacerbate the effects of poor instream habitat conditions. SCVWD discharges water imported from the Sacramento-San Joaquin Delta to Coyote Creek near the base of Anderson Dam and to Upper Penitencia Creek at the Robert Gross Percolation Ponds for groundwater recharge. In Upper Penitencia Creek, the discharge of imported water from the Robert Gross Percolation Ponds warms stream temperatures by several degrees during the smolt outmigration season (Will and Stern 2012), a potentially significant effect. In addition to temperature limitations within Upper Penitencia Creek and Coyote Creek downstream of Anderson Dam, the presence of the complete passage barriers at Coyote and Anderson reservoirs block access passage to headwater reaches within upper Coyote Creek that, prior to the construction of the dams, likely provided important thermal refugia during summer. The lack of thermal refugia throughout the watershed downstream of Anderson Dam could be modified to some degree by establishing a cold water management zone on Coyote Creek (Santa Clara Valley Water District, United States Fish and Wildlife Service, *et al*. 2003). Above-reservoir habitat and thermal refugia would remain inaccessible unless above-reservoir passage is implemented (see Passage Above Reservoirs).

Threats contributing significantly to this condition include channel modification, residential development, and water diversion and impoundments.

Riparian Vegetation: Composition, Cover & Tree Diameter

The habitat above Anderson and Coyote Creek reservoirs is presumably intact and in good condition. However, the above-reservoir habitats are inaccessible to steelhead, and much of the below-dam habitat has been degraded through urban development (including the Upper Penitencia Creek subbasin) (NMFS GIS 2009), suggesting steelhead are likely confined to an area characterized by generally poor riparian function and diversity. Within the below-reservoir reaches, the reaches within the County Linear Park system are probably in the best condition, as the riparian corridors within these reaches are relatively intact and in good condition. However, even within these reaches species composition has been altered from historic conditions. Alteration of the natural hydrologic regime has likely decreased sycamore and oak recruitment

and increased willow density and the introduction of *Arundo donax* and other exotics (e.g., acacia, eucalyptus, and understory species such as German ivy, vinca, Himalayan blackberry, etc.). Primary concerns associated with these alterations to the riparian species composition within the Coyote Creek system include decreased large wood loading, increased riparian encroachment of the channel, and migratory blockage by *A. donax*. Threats contributing significantly to this condition include channel modification, residential development, and water diversion and impoundments.

Threats

The following discussion focuses on those threats that rate as High or Very High. Recovery strategies will likely focus on ameliorating High rated threats; however, some strategies may address Medium and Low threats when the strategy is essential to recovery efforts. The figures and tables that display data used in this analysis are provided in Coyote Creek CAP Results.

Channel Modification

Much of Coyote Creek, especially within the downstream most reaches has been channelized; as a result, this threat was rated as High for eggs, and Very High for all other targets. Steelhead are presently absent from all tributaries to Coyote Creek downstream of Anderson Dam except for the Upper Penitencia Creek subbasin, but historically likely occurred within three additional tributaries (Lower Penitencia Creek, Lower Silver Creek, and Upper Silver Creek) (Leidy *et al.* 2005). Each of these three tributaries has experienced significant channel modification that has resulted in habitat loss, channel filling, or channel realignment, eliminating their accessibility for migratory steelhead, and resulting in habitat conditions unsuitable for salmonids.

Residential and Commercial Development

The 2000 census estimated the population within the Coyote Creek area at over 614,698 individuals; 23% of the watershed has a housing density higher than 1 unit per 20 acres, and 27% of the watershed area is developed as urban land uses (NMFS GIS 2008). This threat was rated as High or Very High across all targets. Development is concentrated within the watershed area downstream of the reservoir (51% of watershed area downstream of Anderson Reservoir is developed as urban, NMFS GIS 2011). The high level of urban development increases impervious areas and pollutant input levels and alters hydrology impairing instream conditions (passage, instream habitat, hydrology, and floodplain connection) necessary for the support of a steelhead population. Due to blockage by Anderson and Coyote Creek reservoirs, the current spatial extent of this urbanization traces the current steelhead distribution in the Coyote Creek system, suggesting that steelhead are likely affected to a high degree. Effects to instream conditions related to existing residential and commercial developments may continue into the future. Future

development within riparian and near stream areas is expected to be limited, and future restoration efforts may help to ameliorate some development-related effects. However, once established, urban/suburban development is rarely removed, making its impacts irreversible. Therefore, any increase in residential and commercial development would likely exacerbate existing limiting conditions for steelhead.

Roads and Railroads

Like residential and commercial development, roads are associated with high density urbanization within the Coyote Creek watershed. This threat was rated as Medium for eggs, High for adults, winter rearing juveniles, and smolts, and Very High for summer rearing juveniles and watershed processes. More roads may be built to serve added development, and once established, these roads are unlikely to be removed. Additionally, the Coyote Creek system has a relatively high concentration of roads within riparian zones (3.3 miles of roads per square mile of 100 meter riparian buffer) (NMFS GIS 2009). Although new roads would likely be built to current standards (e.g., NMFS fish passage guidelines) and future repairs of existing roadways and crossings may result in improvements to the current condition for steelhead, the ongoing baseline for urban development, including roads, is so Poor that any increase in road density would will be considered a problematic effect.

Water Diversion and Impoundments

The Coyote Creek watershed is highly affected by water development. SCVWD operates a complex system of dams, canals, diversions, pipelines, and associated facilities within the Coyote Creek system to manage water supplies from both imported and local sources (SCVWD TC-HCP Draft April 2009). SCVWD facilities within the Coyote Creek system include two major reservoirs (Coyote and Anderson), several diversion facilities and instream groundwater aquifer recharge facilities, and multiple pipeline discharge points. Water imported from neighboring watersheds as well as the Sacramento River Delta is discharged into the Coyote Creek system. These diversion and discharge facilities and operations affect all lifestages within the Coyote Creek system, altering instream habitat, hydrology, and water temperature, limiting migration period, blocking passage, and perhaps limiting migratory cues dependent upon flows.

Mining

Primary effects from previous gravel mining within the Coyote Creek watershed are associated with the Ogier Ponds complex, the location of former off-channel gravel quarry pits that "captured" Coyote Creek in 1997 when the levee separating the natural channel from the quarry pits was breached by high flows. This threat was rated as High for winter rearing juveniles, and Very High for adults, summer rearing juveniles, smolts and watershed processes. The resulting reorientation of the stream at this location has altered flood plain connectivity and sediment

transport, and created passage problems for migrating steelhead. During site visits in September 2009, NMFS noted the different substrate between reaches upstream and downstream of the Ogier Pond complex (Howe and Stern 2009). Fines dominated the substrate downstream of the Ogier Pond complex, while gravels dominated the substrate in upstream reaches, suggesting historic gravel mining operations adversely affect substrate distribution and quality.

Disease, Predation, and Competition

The Coyote Creek system contains exotic predatory fish species, so this threat was rated High for the smolt lifestage. Predation of juvenile steelhead is a concern within certain portions of the watershed, primarily in those areas dominated by warm water and perennial flow that support predatory exotic species (e.g., largemouth bass). These areas are typically located low in the Coyote Creek watershed. Additionally, discharges from the Robert Gross percolation ponds on Upper Penitencia Creek are of concern, as these ponds support a suite of exotic fish species. SCVWD is making efforts in select reaches to screen these discharges to preclude the introduction of exotic fish into the natural channel. Recent SCVWD screening efforts include a portion of the Robert Gross Pond complex on Upper Penitencia Creek (Nguyen 2010).

Recreational Areas and Activities

Effects of recreational areas and activities are limited, and in general, recreational areas within the Coyote Creek watershed provide protections for the creek and its associated habitats that contribute to the support of steelhead within the system. However, structures within both county and city parks affect passage, e.g., the Singleton Road crossing within the Coyote Creek County Linear Park system (discussed above), and paved bike paths, levees and road and path crossings may affect bank maintenance, and limit opportunities to expand channel width, reconnect the floodplain, and/or remedy barriers to passage. This threat was rated as High for adults, summer and winter rearing juveniles, and smolts.

Limiting Stresses, Life Stages, and Habitats

Threat and stress analysis within the CAP workbook suggests that extensive watershed development for urban, suburban, and commercial land uses are likely limiting factors affecting steelhead abundance within the Coyote Creek watershed. Numerous partial (some near-complete) barriers exist, and extensive channelization has eliminated access and functionality of all but one subbasin (Upper Penitencia Creek). Additionally, a complex system of water storage, conveyance, and instream and off-channel groundwater recharge operations significantly alter the hydrology of Coyote Creek. These effects affect stream functions and habitat, and limit all lifestages of steelhead within the Coyote Creek system. Restoration actions should target these

issues within high potential stream reaches and consider passage above Anderson Dam and Coyote Dam in order to provide access to important above-reservoir reaches.

General Recovery Strategy

Passage Downstream of Reservoirs

Barriers to passage downstream of Anderson Dam should be systematically remediated. Priorities should focus on those that occur low in the system. Those of primary concern include, but are not limited to, Singleton Road Low Flow Crossing and Ogier Ponds on Coyote Creek.

Passage Above Reservoirs

The IP model predicts that above reservoir reaches are important for the support of a robust steelhead population within the Coyote Creek system (Spence *et al.* 2008; Spence *et al.* 2012), and the habitat and function of these above reservoir reaches cannot be effectively replaced through enhancement of downstream reaches due to natural differences in gradient and hydrology between the below- and above-reservoir reaches, and the effects of anthropogenic landscape alteration (e.g., urbanization and floodplain development) within the below-reservoir reaches. Thus, Anderson Dam and Coyote Dam, in that order (downstream-most reservoir first), should be assessed for passage options, and biologically sound passage programs or volitional passage facilities that coordinate with and allow for ongoing reservoir operations should be implemented.

Reservoir Operation to Benefit All Lifestages of Steelhead

Anderson and Coyote Reservoirs should be operated in such a manner as to benefit all lifestages of steelhead within Coyote Creek. Considerations should include, but not be limited to, water temperature, flow velocity, ramping rates (as necessary to prevent scour of eggs, or displacement or stranding of juveniles), sediment transport, channel maintenance, instream habitat, adult and smolt migratory cues, and reflecting a natural, unimpaired hydrograph.

Reduce Imported Water Uses

A detailed study assessing the effects of imported water uses on the steelhead population within Coyote Creek should be conducted. The degree to which this practice affects the steelhead population within Coyote Creek watershed is not well known. Alternative methods in off-channel locations should be pursued to meet the SCVWD's goals for groundwater recharge with imported water.

Side Channel and Floodplain Reconnection

Where not limited by existing development, efforts should be made to reconnect floodplain habitat and increase channel complexity by reconnecting side channel habitat with the active

stream channel. When possible, existing development should be retrofitted to restore access to floodplain and flood bench habitat, and to allow for natural channel functions.

Improve Sediment Transport

Restoration efforts should focus on providing channel maintenance/forming flows throughout Coyote Creek downstream of Anderson Dam to mobilize bedload material, provide suitable gravel material from upstream sources, and remove/remediate structures and areas of the stream that impair sediment transport processes (e.g., the Ogier Pond complex, Coyote Percolation Pond complex).

Increase Instream Habitat and Cover and Increase Instream Channel Complexity

Instream habitat and cover should be improved within the Coyote Creek system downstream of Anderson Dam. Methods may include increasing sinuosity, creating side channels and gravel bars, and placing large woody debris, rock weirs, and boulders within affected reaches. All structures should be designed to function within an established range of flows to optimize habitat conditions for all steelhead lifestages.

Increase Instream Shelter Ratings and Pool Volume

Shelter ratings are Low within much of Coyote Creek downstream of Anderson Dam due largely to an absence of LWD and reservoir operations quality. Where applicable, restoration efforts should incorporate instream wood/boulder structures into degraded reaches to improve habitat complexity and shelter availability.

Improve Water Quality

Efforts should be made to improve water quality throughout the urbanized reaches of Coyote Creek system. In particular, efforts should focus on limiting or treating urban runoff, as necessary, to decrease turbidity, address pH fluctuations, limit toxicity concerns, and reduce concentrations of pathogens, pesticides, and metals.

Improve Riparian Composition

Much of the Coyote Creek watershed downstream of Anderson Dam would benefit from improved riparian composition and structure, which would decrease riparian encroachment of the channel, improve LWD recruitment, and increase instream shelter for juvenile fish. General practices to improve riparian condition include removing exotic vegetation and implementing channel maintenance flows necessary to support a riparian corridor that is diverse in species and age structure.

Literature Cited

Buchan, L. A. J. and P. J. Randall (2003). Assessment of Stream Ecosystem Functions for the Coyote Creek Watershed.

Cleugh, E. and C. Mcknight (2002). Steelhead Migration Barrier Survey of San Francisco Bay Area Creeks (Contra Costa, Alameda, Santa Clara, and San Mateo Counties), California Department of Fish and Game.

Entrix (2000). Stream habitat inventory summary report for the fisheries and aquatic habitat collaborative effort (FAHCE): draft, Entrix.

Grossinger, R. M., R. Askevold, et al. (2006). Coyote Creek Watershed Historical Ecology Study: Historical Conditions and Landscape Change in the Eastern Santa Clara Valley, California, San Francisco Estuary Institute.

Howe, D. and G. Stern (2009). Reconnaissance Assessment of Coyote Creek Instream Flow Conditions from "Old Golf Course Road Crossing" to Gauge Station SF 82 located downstream of Anderson Dam, National Marine Fisheries Service**:** 27.

Leicester, M. (2008). Upper Penitencia Creek 2008 Fish Sampling Results, California Department of Fish and Game.

Leicester, M. (2009). Upper Penitencia Creek Fish Sampling, California Department of Fish and Game.

Leicester, M. and Smith, J. (2014a). Fish Population Sampling in Fall 2014 on Coyote Creek. California Department of Fish and Wildlife: 21.

Leicester, M. and Smith, J. (2014b). Upper Penitencia Creek Fish Resources in 2014. California Department of Fish and Wildlife: 17.

Leidy, R. A., G. S. Becker, B.N. Harvey (2005). Historical distribution and current status of steelhead/rainbow trout (Oncorhynchus mykiss) in streams of the San Francisco Estuary, California. Oakland, CA, Center for Ecosystem Management and Restoration**:** 275.

Li, S. (2001). Draft electrofishing surveys on Guadalupe Creek, Stevens, Coyote and Penetentia Creeks: catch results. Loomis, CA, Aquatic Systems Research.

Moore, M. (2010). Personal Communication. Biologist. Santa Clara Valley Water District.

Moore, M., L. Porcella, D. Salsbery, V. Stephens. (2009). Mid-Coyote Creek Flood Protection Project: Baseline Fisheries Monitoring Report Year 2. Santa Clara Valley Water District (SCVWD): 54.

Moore, M., L. Porcella, D. Salsbery, K. Sibley. (2008). Mid-Coyote Creek Flood Protection Project: Baseline Fisheries Monitoring Report Year 1 (2007), Santa Clara Valley Water District (SCVWD): 49.

Nguyen, N. (2010). Personal Communication. Santa Clara Valley Water District

Porcella, L. (2002). Memo - Fish Trapping, Summary 1998-2001 upmigrant trapping and 1998-2000 outmigrant trapping, Guadalupe River and Coyote Creek, Santa Clara Valley Water District (SCVWD): 26.

Santa Clara Valley Water District (2010). web page http://www.valleywater.org/Services/CoyoteFastFacts.aspx. Retrieved October 16, 2010, 2010.

Santa Clara Valley Water District, United States Fish and Wildlife Service, et al. 2003. Settlement Agreement Regarding Water Rights of the Santa Clara Valley Water District on Coyote, Guadalupe, and Stevens Creeks.

SCBWMI (Santa Clara Basin Watershed Management Initiative). 2001. Volume One, Watershed Characteristics Report. 147 p. Retrieved February 4, 2011 from http://www.scbwmi.org/PDFs/watershed-characteristic-d8.pdf

SCBWMI (Santa Clara Basin Watershed Management Initiative). 2003. Watershed Characteristics Report Unabridged 2003 Revision. Retrieved February 4, 2011 from http://cf.valleywater.org/_wmi/Related_report/Wcr2003r.cfm

SCBWMI (Santa Clara Basin Watershed Management Initiative). 2011. "Table 5-1 Resource Guide" from Volume One, Watershed Characteristics Report Unabridged 2003 Revision.

Retrieved February 4, 2011 from http://cf.valleywater.org/_wmi/_PDFs/Wcr/WCR2003R/Tables/5-4_74table5-1.pdf.

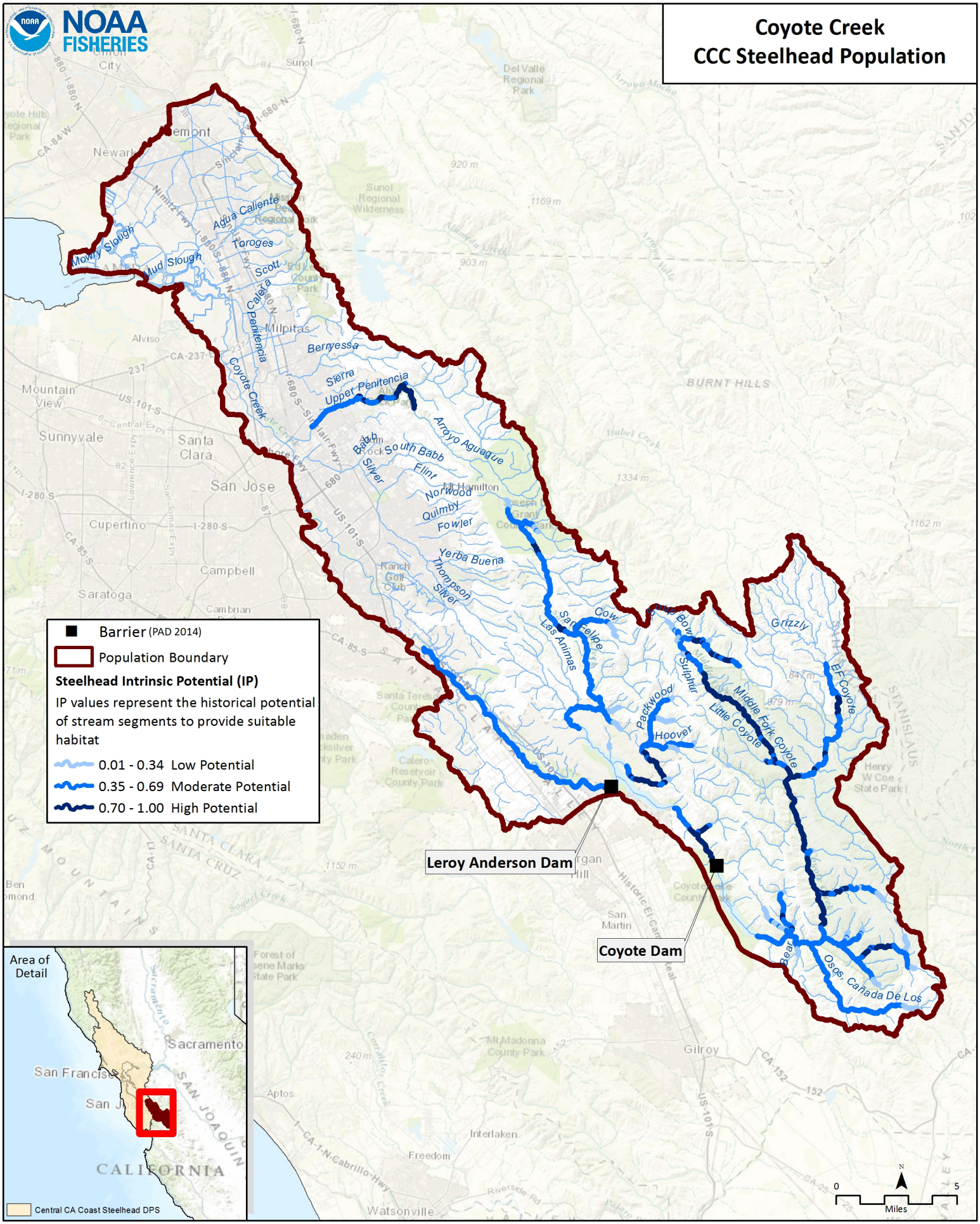
Smith, J. (2009). Upper Penitencia Creek Steelhead, San Jose State University: 4.

Spencer, W. D., S. J. Barry, et al. (2006). Report of Independent Science Advisors for Santa Clara Valley Habitat Conservation Plan/ Natural Community Conservation Plan (HCP/NCCP).

Stillwater Sciences (2006). Upper Penitencia Creek Limiting Factors Analysis Final Technical Report.

United States Environmental Protection Agency (US EPA) (2010 A). "Assessment Data for California, Coyote Watershed (8 Digit USGS Cataloging Unit), Year 2004." Retrieved October 15, 2010, 2010.

United States Environmental Protection Agency (US EPA) (2010 B). "305(b) Lists/Assessment Unit Information Year 2004." Retrieved October 15, 2010, 2010, from http://iaspub.epa.gov/tmdl_waters10/enviro_all.wcontrol?p_au_id=CAR2053002119990218112824_00&p_cycle=2004.


Coyote Creek
CCC Steelhead Population
Barrier (PAD 2014)
Population Boundary
Steelhead Intrinsic Potential (IP)
IP values represent the historical potential of stream segments to provide suitable habitat
0.01 - 0.34 Low Potential
0.35 - 0.69 Moderate Potential
0.70 - 1.00 High Potential
Leroy Anderson Dam
Coyote Dam
Area of Detail
Sacramento
San Francisco
CALIFORNIA
Central CA Coast Steelhead DPS
Agua Caliente
Toroges
Scott
Mowry Slough
Mud Slough
Penitencia
Coyote Creek
Bernyessa
Sierra
Upper Penitencia
Arroyo Aguague
Babb
South Babb
Silver
Flint
Norwood
Quimby
Fowler
Yerba Buena
Thompson
Silver
Las Animas
San Felipe
Cow
Bowman
Grizzly
Sulphur
Packwood
Hoover
Little Coyote
Middle Fork Coyote
E.F. Coyote
Bear
Osos, Cañada De Los
Milpitas
Alviso
Mountain View
Sunnyvale
Santa Clara
San Jose
Cupertino
Campbell
Saratoga
Gilroy
Aptos
Interlaken
Freedom
Watsonville
Miles

#	Conservation Target	Category	Key Attribute	Indicator	Poor	Fair	Good	Very Good	Current Indicator Measurement	Current Rating
1	Adults	Condition	Habitat Complexity	Large Wood Frequency (BFW 0-10 meters)	<50% of streams/ IP-Km (>6 Key Pieces/100 meters)	50% to 74% of streams/ IP-Km (>6 Key Pieces/100 meters)	75% to 90% of streams/ IP-Km (>6 Key Pieces/100 meters)	>90% of streams/ IP-Km (>6 Key Pieces/100 meters)	50% to 74% of streams/ IP-km (>6 Key Pieces/100 meters)	Fair
			Habitat Complexity	Large Wood Frequency (BFW 10-100 meters)	<50% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	50% to 74% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	75% to 90% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	>90% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	<50% of streams/ IP-km (>1.3 Key Pieces/100 meters)	Poor
			Habitat Complexity	Pool/Riffle/Flatwater Ratio	<50% of streams/ IP-Km (>40% Pools; >20% Riffles)	50% to 74% of streams/ IP-Km (>40% Pools; >20% Riffles)	75% to 90% of streams/ IP-Km (>40% Pools; >20% Riffles)	>90% of streams/ IP-Km (>40% Pools; >20% Riffles)	<50% of streams/ IP-km (>40% Pools; >20% Riffles)	Poor
			Habitat Complexity	Shelter Rating	<50% of streams/ IP-Km (>80 stream average)	50% to 74% of streams/ IP-Km (>80 stream average)	75% to 90% of streams/ IP-Km (>80 stream average)	>90% of streams/ IP-Km (>80 stream average)	50% to 74% of streams/ IP-km (>80 stream average)	Fair
			Hydrology	Passage Flows	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 100	Fair
			Passage/Migration	Passage at Mouth or Confluence	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	75% of IP-km to 90% of IP-km	Good
			Passage/Migration	Physical Barriers	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	<50% of IP-km or <16 IP-km accessible*	Poor
			Riparian Vegetation	Tree Diameter (North of SF Bay)	≤39% Class 5 & 6 across IP-km	40 - 54% Class 5 & 6 across IP-km	55 - 69% Class 5 & 6 across IP-km	>69% Class 5 & 6 across IP-km		
			Riparian Vegetation	Tree Diameter (South of SF Bay)	≤69% Density rating "D" across IP-km	70-79% Density rating "D" across IP-km	≥80% Density rating "D" across IP-km	Not Defined	19% Density rating "D" across IP-km	Poor

			Sediment	Quantity & Distribution of Spawning Gravels	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	<50% of IP-km or <16 IP-km accessible*	Poor
			Velocity Refuge	Floodplain Connectivity	<50% Response Reach Connectivity	50-80% Response Reach Connectivity	>80% Response Reach Connectivity	Not Defined	50-80% Response Reach Connectivity	Fair
			Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No Evidence of Toxins or Contaminants	Acute	Poor
			Water Quality	Turbidity	<50% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-Km maintains severity score of 3 or lower	75% to 90% of streams/ IP-Km maintains severity score of 3 or lower	>90% of streams/ IP-Km maintains severity score of 3 or lower	<50% of streams/ IP-km maintains severity score of 3 or lower	Poor
		Size	Viability	Density	<1 spawner per IP-km to < low risk spawner density per Spence (2008)	>1 spawner per IP-km to < low risk spawner density per Spence (2008)	low risk spawner density per Spence (2008)		>1 spawner per IP-km to < low risk spawner density per Spence (2008)	Fair
2	Eggs	Condition	Hydrology	Flow Conditions (Instantaneous Condition)	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 35-50	Good
			Hydrology	Redd Scour	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 51-75	Fair
			Sediment	Gravel Quality (Bulk)	>17% (0.85mm) and >30% (6.4mm)	15-17% (0.85mm) and <30% (6.4mm)	12-14% (0.85mm) and <30% (6.4mm)	<12% (0.85mm) and <30% (6.4mm)		
			Sediment	Gravel Quality (Embeddedness)	<50% of streams/ IP-Km (>50% stream average scores of 1 & 2)	50% to 74% of streams/ IP-Km (>50% stream average scores of 1 & 2)	75% to 90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	>90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	<50% of streams/ IP-km (>50% stream average scores of 1 & 2)	Poor
3	Summer Rearing Juveniles	Condition	Estuary/Lagoon	Quality & Extent	Impaired/non-functional	Impaired but functioning	Properly Functioning Condition	Unimpaired Condition	Impaired/non-functional	Poor

			Habitat Complexity	Large Wood Frequency (Bankfull Width 0-10 meters)	<50% of streams/ IP-Km (>6 Key Pieces/100 meters)	50% to 74% of streams/ IP-Km (>6 Key Pieces/100 meters)	75% to 90% of streams/ IP-Km (>6 Key Pieces/100 meters)	>90% of streams/ IP-Km (>6 Key Pieces/100 meters)	50% to 74% of streams/ IP-km (>6 Key Pieces/100 meters)	Fair
			Habitat Complexity	Large Wood Frequency (Bankfull Width 10-100 meters)	<50% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	50% to 74% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	75% to 90% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	>90% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	<50% of streams/ IP-km (>1.3 Key Pieces/100 meters)	Poor
			Habitat Complexity	Percent Primary Pools	<50% of streams/ IP-Km (>40% average primary pool frequency)	51% to 74% of streams/ IP-Km (>40% average primary pool frequency)	75% to 89% of streams/ IP-Km (>40% average primary pool frequency)	>90% of streams/ IP-Km (>40% average primary pool frequency)	<50% of streams/ IP-km (>40% average primary pool frequency)	Poor
			Habitat Complexity	Pool/Riffle/Flatwater Ratio	<50% of streams/ IP-Km (>40% Pools; >20% Riffles)	50% to 74% of streams/ IP-Km (>40% Pools; >20% Riffles)	75% to 90% of streams/ IP-Km (>40% Pools; >20% Riffles)	>90% of streams/ IP-Km (>40% Pools; >20% Riffles)	<50% of streams/ IP-km (>40% Pools; >20% Riffles)	Poor
			Habitat Complexity	Shelter Rating	<50% of streams/ IP-Km (>80 stream average)	50% to 74% of streams/ IP-Km (>80 stream average)	75% to 90% of streams/ IP-Km (>80 stream average)	>90% of streams/ IP-Km (>80 stream average)	50% to 74% of streams/ IP-km (>80 stream average)	Fair
			Hydrology	Flow Conditions (Baseflow)	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score >75	Poor
			Hydrology	Flow Conditions (Instantaneous Condition)	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score >75	Poor
			Hydrology	Number, Condition and/or Magnitude of Diversions	>5 Diversions/10 IP km	1.1 - 5 Diversions/10 IP km	0.01 - 1 Diversions/10 IP km	0 Diversions	0.01 - 1 Diversions/10 IP-km	Poor
			Passage/Migration	Passage at Mouth or Confluence	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	75% of IP-km to 90% of IP-km	Good
			Passage/Migration	Physical Barriers	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	<50% of IP-km or <16 IP-km accessible*	Poor

			Riparian Vegetation	Canopy Cover	<50% of streams/ IP-Km (>70% average stream canopy; >85% where coho IP overlaps)	50% to 74% of streams/ IP-Km (>70% average stream canopy; >85% where coho IP overlaps)	75% to 90% of streams/ IP-Km (>70% average stream canopy; >85% where coho IP overlaps)	>90% of streams/ IP-Km (>70% average stream canopy; >85% where coho IP overlaps)	50% to 74% of streams/ IP-km (>70% average stream canopy; >85% where coho IP overlaps)	Fair
			Riparian Vegetation	Tree Diameter (North of SF Bay)	≤39% Class 5 & 6 across IP-km	40 - 54% Class 5 & 6 across IP-km	55 - 69% Class 5 & 6 across IP-km	>69% Class 5 & 6 across IP-km		
			Riparian Vegetation	Tree Diameter (South of SF Bay)	≤69% Density rating "D" across IP-km	70-79% Density rating "D" across IP-km	≥80% Density rating "D" across IP-km	Not Defined	19% Density rating "D" across IP-km	Poor
			Sediment (Food Productivity)	Gravel Quality (Embeddedness)	<50% of streams/ IP-Km (>50% stream average scores of 1 & 2)	50% to 74% of streams/ IP-Km (>50% stream average scores of 1 & 2)	75% to 90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	>90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	<50% of streams/ IP-km (>50% stream average scores of 1 & 2)	Poor
			Water Quality	Temperature (MWMT)	<50% IP km (<20 C MWMT; <16 C MWMT where coho IP overlaps)	50 to 74% IP km (<20 C MWMT; <16 C MWMT where coho IP overlaps)	75 to 89% IP km (<20 C MWMT; <16 C MWMT where coho IP overlaps)	>90% IP km (<20 C MWMT; <16 C MWMT where coho IP overlaps)	50 to 74% IP-km (<20 C MWMT; <16 C MWMT where coho IP overlaps)	Fair
			Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No Evidence of Toxins or Contaminants	Acute	Poor
			Water Quality	Turbidity	<50% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-Km maintains severity score of 3 or lower	75% to 90% of streams/ IP-Km maintains severity score of 3 or lower	>90% of streams/ IP-Km maintains severity score of 3 or lower	<50% of streams/ IP-km maintains severity score of 3 or lower	Poor
		Size	Viability	Density	<0.2 Fish/m^2	0.2 - 0.6 Fish/m^2	0.7 - 1.5 Fish/m^2	>1.5 Fish/m^2	<0.2 Fish/m^2	Poor
			Viability	Spatial Structure	<50% of Historical Range	50-74% of Historical Range	75-90% of Historical Range	>90% of Historical Range	<50% of Historical Range	Poor
4	Winter Rearing Juveniles	Condition	Habitat Complexity	Large Wood Frequency (Bankfull Width 0-10 meters)	<50% of streams/ IP-Km (>6 Key Pieces/100 meters)	50% to 74% of streams/ IP-Km (>6 Key Pieces/100 meters)	75% to 90% of streams/ IP-Km (>6 Key Pieces/100 meters)	>90% of streams/ IP-Km (>6 Key Pieces/100 meters)	50% to 74% of streams/ IP-km (>6 Key Pieces/100 meters)	Fair

			Habitat Complexity	Large Wood Frequency (Bankfull Width 10-100 meters)	<50% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	50% to 74% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	75% to 90% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	>90% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	<50% of streams/ IP-km (>1.3 Key Pieces/100 meters)	Poor
			Habitat Complexity	Pool/Riffle/Flatwater Ratio	<50% of streams/ IP-Km (>40% Pools; >20% Riffles)	50% to 74% of streams/ IP-Km (>40% Pools; >20% Riffles)	75% to 90% of streams/ IP-Km (>40% Pools; >20% Riffles)	>90% of streams/ IP-Km (>40% Pools; >20% Riffles)		
			Habitat Complexity	Shelter Rating	<50% of streams/ IP-Km (>80 stream average)	50% to 74% of streams/ IP-Km (>80 stream average)	75% to 90% of streams/ IP-Km (>80 stream average)	>90% of streams/ IP-Km (>80 stream average)	50% to 74% of streams/ IP-km (>80 stream average)	Fair
			Passage/Migration	Physical Barriers	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km		
			Riparian Vegetation	Tree Diameter (North of SF Bay)	≤39% Class 5 & 6 across IP-km	40 - 54% Class 5 & 6 across IP-km	55 - 69% Class 5 & 6 across IP-km	>69% Class 5 & 6 across IP-km		
			Riparian Vegetation	Tree Diameter (South of SF Bay)	≤69% Density rating "D" across IP-km	70-79% Density rating "D" across IP-km	≥80% Density rating "D" across IP-km	Not Defined	19% Density rating "D" across IP-km	Poor
			Sediment (Food Productivity)	Gravel Quality (Embeddedness)	<50% of streams/ IP-Km (>50% stream average scores of 1 & 2)	50% to 74% of streams/ IP-Km (>50% stream average scores of 1 & 2)	75% to 90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	>90% of streams/ IP-Km (>50% stream average scores of 1 & 2)		
			Velocity Refuge	Floodplain Connectivity	<50% Response Reach Connectivity	50-80% Response Reach Connectivity	>80% Response Reach Connectivity	Not Defined	<50% Response Reach Connectivity	Poor
			Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No Evidence of Toxins or Contaminants	Acute	Poor
			Water Quality	Turbidity	<50% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-Km maintains severity score of 3 or lower	75% to 90% of streams/ IP-Km maintains severity score of 3 or lower	>90% of streams/ IP-Km maintains severity score of 3 or lower	<50% of streams/ IP-km maintains severity score of 3 or lower	Poor

5	Smolts	Condition	Estuary/Lagoon	Quality & Extent	Impaired/non-functional	Impaired but functioning	Properly Functioning Condition	Unimpaired Condition	Impaired/non-functional	Poor
			Habitat Complexity	Shelter Rating	<50% of streams/ IP-Km (>80 stream average)	50% to 74% of streams/ IP-Km (>80 stream average)	75% to 90% of streams/ IP-Km (>80 stream average)	>90% of streams/ IP-Km (>80 stream average)	50% to 74% of streams/ IP-km (>80 stream average)	Fair
			Hydrology	Number, Condition and/or Magnitude of Diversions	>5 Diversions/10 IP km	1.1 - 5 Diversions/10 IP km	0.01 - 1 Diversions/10 IP km	0 Diversions	>5 Diversions/10 IP km	Poor
			Hydrology	Passage Flows	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 100	Fair
			Passage/Migration	Passage at Mouth or Confluence	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	75% of IP-km to 90% of IP-km	Good
			Smoltification	Temperature	<50% IP-Km (>6 and <14 C)	50-74% IP-Km (>6 and <14 C)	75-90% IP-Km (>6 and <14 C)	>90% IP-Km (>6 and <14 C)	50-74% IP-km (>6 and <14 C)	Fair
			Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No Evidence of Toxins or Contaminants	Acute	Poor
			Water Quality	Turbidity	<50% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-Km maintains severity score of 3 or lower	75% to 90% of streams/ IP-Km maintains severity score of 3 or lower	>90% of streams/ IP-Km maintains severity score of 3 or lower	<50% of streams/ IP-km maintains severity score of 3 or lower	Poor
		Size	Viability	Abundance	Smolt abundance which produces high risk spawner density per Spence (2008)	Smolt abundance which produces moderate risk spawner density per Spence (2008)	Smolt abundance to produce low risk spawner density per Spence (2008)		Smolt abundance which produces high risk spawner density per Spence (2008)	Poor
6	Watershed Processes	Landscape Context	Hydrology	Impervious Surfaces	>10% of Watershed in Impervious Surfaces	7-10% of Watershed in Impervious Surfaces	3-6% of Watershed in Impervious Surfaces	<3% of Watershed in Impervious Surfaces	>10% of Watershed in Impervious Surfaces	Poor

			Landscape Patterns	Agriculture	>30% of Watershed in Agriculture	20-30% of Watershed in Agriculture	10-19% of Watershed in Agriculture	<10% of Watershed in Agriculture	4% of Watershed in Agriculture	Very Good
			Landscape Patterns	Timber Harvest	>35% of Watershed in Timber Harvest	26-35% of Watershed in Timber Harvest	25-15% of Watershed in Timber Harvest	<15% of Watershed in Timber Harvest	0% of Watershed in Timber Harvest	Very Good
			Landscape Patterns	Urbanization	>20% of watershed >1 unit/20 acres	12-20% of watershed >1 unit/20 acres	8-11% of watershed >1 unit/20 acres	<8% of watershed >1 unit/20 acres	27% of watershed >1 unit/20 acres	Poor
			Riparian Vegetation	Species Composition	<25% Intact Historical Species Composition	25-50% Intact Historical Species Composition	51-74% Intact Historical Species Composition	>75% Intact Historical Species Composition	25-50% Intact Historical Species Composition	Fair
			Sediment Transport	Road Density	>3 Miles/Square Mile	2.5 to 3 Miles/Square Mile	1.6 to 2.4 Miles/Square Mile	<1.6 Miles/Square Mile	4.5 Miles/Square Mile	Poor
			Sediment Transport	Streamside Road Density (100 m)	>1 Miles/Square Mile	0.5 to 1 Miles/Square Mile	0.1 to 0.4 Miles/Square Mile	<0.1 Miles/Square Mile	3.3 Miles/Square Mile	Poor

Coyote Creek CAP Threat Results

	Threats Across Targets	Adults	Eggs	Summer Rearing Juveniles	Winter Rearing Juveniles	Smolts	Watershed Processes	Overall Threat Rank
	Project-specific-threats	1	2	3	4	5	6	
1	Agriculture	Low		Low	Low	Low		Low
2	Channel Modification	Very High	High	Very High	Very High	Very High	Very High	Very High
3	Disease, Predation and Competition	Medium	Low	Medium	Low	High	Low	Medium
4	Hatcheries and Aquaculture	Medium		Medium		Medium		Medium
5	Fire, Fuel Management and Fire Suppression			Low				Low
6	Fishing and Collecting	Medium		Medium		Medium		Medium
7	Livestock Farming and Ranching	Low		Low	Low	Low		Low
8	Logging and Wood Harvesting							
9	Mining	Very High	Medium	Very High	High	Very High	Very High	Very High
10	Recreational Areas and Activities	High		High	High	High	Medium	High
11	Residential and Commercial Development	Very High	High	Very High	Very High	High	Very High	Very High
12	Roads and Railroads	High	Medium	Very High	High	High	Very High	Very High
13	Severe Weather Patterns	Medium	Low	Medium	Low	Medium	Medium	Medium
14	Water Diversion and Impoundments	Very High	Medium	Very High	High	Very High	Very High	Very High
	Threat Status for Targets and Project	Very High	High	Very High	Very High	Very High	Very High	Very High

Coyote Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
CoC-CCCS-1.1	**Objective**	**Estuary**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**										
CoC-CCCS-1.1.1	Recovery Action	Estuary	Increase and enhance habitat complexity features										
CoC-CCCS-1.1.1.1	Action Step	Estuary	Assess tidally influenced habitat and develop plan to restore tidal channels.	2	10	CDFW, USFWS	169.50	169.50				339	Cost based on estuary use/residence model at a rate of $338,679/project.
CoC-CCCS-1.1.1.2	Action Step	Estuary	Develop Estuary Protection and Enhancement Guidelines to maintain estuary function and provide information for estuary restoration.	2	20	CDFW, USFWS						0	Action is considered In-Kind
CoC-CCCS-2.1	**Objective**	**Floodplain Connectivity**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**										
CoC-CCCS-2.1.1	Recovery Action	Floodplain Connectivity	Rehabilitate and enhance floodplain connectivity										
CoC-CCCS-2.1.1.1	Action Step	Floodplain Connectivity	Assess floodplain conditions within Coyote Creek (see Buchan and Randall 2003). Develop and implement plans to maintain and create floodplain areas. Reconnect disconnected floodplain habitat where feasible.	2	10	City of San Jose, County of Santa Clara, Santa Clara Valley Water District	128.00	128.00				256	Cost based on wetland restoration model at a rate of $255,968/project.
CoC-CCCS-2.1.1.2	Action Step	Floodplain Connectivity	Develop and implement plans to provide seasonally appropriate flows from Anderson Dam necessary to activate the floodplain.	1	5	Santa Clara Valley Water District						TBD	
CoC-CCCS-2.1.1.3	Action Step	Floodplain Connectivity	During winter and spring, implement periodic large pulse "maintenance" flows at the full capacity of the Anderson Dam outlet works to provide stream channel maintenance flows. When possible, time these flows so that they coincide with natural rainfall events.	1	5	Santa Clara Valley Water District						TBD	
CoC-CCCS-3.1	**Objective**	**Hydrology**	**Address the inadequacy of existing regulatory mechanisms**										
CoC-CCCS-3.1.1	Recovery Action	Hydrology	Improve flow conditions										
CoC-CCCS-3.1.1.1	Action Step	Hydrology	Establish and implement a comprehensive stream flow program to improve survival at all life stages by improving the spatial and temporal pattern of surface flows throughout spawning, rearing, and migration areas (see Objectives, Actions, and Action Steps within: Threat- Water Diversion/Impoundment, Restoration- Floodplain Connectivity, Restoration-Habitat Complexity, Threat- Channel Modification, and Threat- Residential/Commercial Development).	1	5	Santa Clara Valley Water District	79.00					79	Cost based on stream flow/precipitation model $78,100/project.
CoC-CCCS-5.1	**Objective**	**Passage**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**										
CoC-CCCS-5.1.1	Recovery Action	Passage	Modify or remove physical passage barriers										
CoC-CCCS-5.1.1.1	Action Step	Passage	Improve and maintain exiting fish passage structures below reservoir facilities (i.e., fish ladders); identify and remedy problem culverts, crossings, grade control structures, diversions, etc. in the Coyote Creek watershed. Focus on Singleton road and Ogier Ponds.	1	5	City of San Jose, County of Santa Clara, Santa Clara Valley Water District	1,149					1,149	Cost of replacing culvert at Singleton Road at a rate of $1,148,899 for a large waterway. Cost for Ogier Ponds will be determined on a site-specific basis.

Coyote Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
CoC-CCCS-5.1.1.2	Action Step	Passage	Evaluate the feasibility and benefit of providing passage (both adult immigration and adult/smolt emigration) to the stream reaches located upstream of Anderson and Coyote dams. Consider passage specifics at each dam separately; include a suite of options in this assessment, including volitional (fish ladder) and non-volitional ("trap and haul") passage facilities.	1	5	Santa Clara Valley Water District	113.00					113	Cost for producing and assessment and evaluation of alternatives for fish passage.
CoC-CCCS-5.1.1.3	Action Step	Passage	If found feasible and beneficial, acquire funding necessary to ensure the long-term operations, and future improvement of this passage program.	1	5	Santa Clara Valley Water District						TBD	
CoC-CCCS-5.1.1.4	Action Step	Passage	Implement feasible, biologically sound passage program(s) that are coupled with the reservoir flow plans and operations necessary to facilitate long-term implementation.	1	10	Santa Clara Valley Water District						TBD	
CoC-CCCS-6.1	**Objective**	**Habitat Complexity**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**										
CoC-CCCS-6.1.1	Recovery Action	Habitat Complexity	Improve frequency of primary pools and shelters										
CoC-CCCS-6.1.1.1	Action Step	Habitat Complexity	Identify locations where pool frequency and habitat complexity are limiting, and develop and implement site specific plans to improve these conditions. Consider flow rates and discharges when designing habitat enhancement features.	2	10	City of San Jose, County of Santa Clara, Santa Clara Valley Water District	225.00	225.00				450	Cost based on treating 14 miles (assume 1 project/mile in 50% high IP) at a rate of $31,200/mile. Cost may increase with use of engineered structures such as log jams, boulder clusters, etc.
CoC-CCCS-6.1.2	Recovery Action	Habitat Complexity	Increase large wood frequency										
CoC-CCCS-6.1.2.1	Action Step	Habitat Complexity	Identify locations where channel modification has resulted in decreased shelter, LWD frequency, and habitat complexity, and develop and implement site specific plans to improve these conditions. Consider flow rates and discharges when designing LWD and shelter enhancement features.	2	10	City of San Jose, County of Santa Clara, Santa Clara Valley Water District	69.00	69.00				138	Cost based on fish/habitat restoration model at a rate of $137,833/project.
CoC-CCCS-6.1.2.2	Action Step	Habitat Complexity	Focus initial efforts to restore instream habitat within the "Cold Water Management Zone" downstream of Anderson Dam	2	10	City of San Jose, County of Santa Clara, Santa Clara Valley Water District						0	Cost accounted for in above action step.
CoC-CCCS-6.1.2.3	Action Step	Habitat Complexity	Perform pre- and post-project monitoring to assess steelhead use within improved reaches.	2	10	City of San Jose, County of Santa Clara, Santa Clara Valley Water District	69.00	69.00				138	Cost for fish/habitat restoration monitoring at a rate of $137,833/project. These costs could be higher if greater level of monitoring is required in the future.
CoC-CCCS-7.1	**Objective**	**Riparian**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**										
CoC-CCCS-7.1.1	Recovery Action	Riparian	Improve canopy cover										
CoC-CCCS-7.1.1.1	Action Step	Riparian	Identify reaches dominated by exotic vegetation, and develop and implement site specific plans to restore these reaches with native vegetation.	3	10	City of San Jose, County of Santa Clara	58.50	58.50				117	Cost based on treating 1.4 miles (assume 1 project/mile in 5% high IP with 80 acres/mile) at a rate of $1036/acre.

Coyote Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
CoC-CCCS-7.1.1.2	Action Step	Riparian	Continue, and expand upon current efforts, including those of Santa Clara Valley Water District's Stream Maintenance Program, to remove exotic vegetation (including Arundo donax), and restore these reaches.	3	10	City of San Jose, County of Santa Clara, Santa Clara Valley Water District						0	Cost accounted for in above action step.
CoC-CCCS-7.1.1.3	Action Step	Riparian	Identify reaches suffering from riparian encroachment, and develop and implement site specific plans to restore and maintain these reaches. Consider thinning of dense native riparian vegetation as necessary to better allow healthy species- and age- composition.	3	5	City of San Jose, County of Santa Clara, Santa Clara Valley Water District	592					592	Cost based on treating 4.2 miles (assume 1 project/mile in 15% high IP with 80 acres/mile) at a rate of $1,761/acre.
CoC-CCCS-7.1.1.4	Action Step	Riparian	Develop and implement flow schedules from reservoirs necessary to maintain healthy riparian conditions (see Objective, Actions, and Action Steps within: Restoration- Hydrology).	2	5	Santa Clara Valley Water District						0	Cost accounted for in other action steps.
CoC-CCCS-8.1	**Objective**	**Sediment**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**										
CoC-CCCS-8.1.1	Recovery Action	Sediment	Improve instream gravel quality										
CoC-CCCS-8.1.1.1	Action Step	Sediment	Identify sources of fine sediment, and develop and implement a plan to address these sources; include the effects of the Ogier Ponds complex, on-channel percolation ponds (including Metcalf Pond, and the remnants of the Ford Road Pond complex), water system operations (hydrograph alterations), and urban development in this assessment.	2	5	City of San Jose, County of Santa Clara, Santa Clara Valley Water District	395.00					395	Cost based on erosion assessment of 10% of total watershed acres at a rate of $15.14/acre
CoC-CCCS-8.1.1.2	Action Step	Sediment	Provide flows and instream conditions necessary to provide mobilization and maintenance of gravels.	1	5	Santa Clara Valley Water District						0	Cost accounted for in above action step. See Floodplain Connectivity
CoC-CCCS-8.1.1.3	Action Step	Sediment	Perform reach restoration to facilitate gravel "maintenance". Include methods such as instream restoration (e.g. Ogier Ponds complex, and the remnants of the Ford Road Pond complex), isolation of current on-stream percolation ponds (Metcalf Pond), and a gravel placement program. Include flow schedules necessary for mobilization and "maintenance" of gravel quantity and quality suitable for steelhead.	1	5	City of San Jose, County of Santa Clara, Santa Clara Valley Water District	4,218					4,218	Estimate is for one mile of large scale reach restoration (NMFS 2008, pg 27) - cost will vary depending on extent of restoration efforts, and methodologies employed.
CoC-CCCS-10.1	**Objective**	**Water Quality**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**										
CoC-CCCS-10.1.1	Recovery Action	Water Quality	Improve stream temperature conditions										
CoC-CCCS-10.1.1.1	Action Step	Water Quality	Evaluate the effects of on-channel ponds, and groundwater recharge facilities, on stream temperature. Develop and implement a plan to address any effects. Include methods to address warming of stream water within restoration plans for these reaches.	2	5	City of San Jose, County of Santa Clara, Santa Clara Valley Water District	1.50					2	Cost based on installing a minimum of 3 stream temperature gauges at a rate of $500/gauge.
CoC-CCCS-10.1.1.2	Action Step	Water Quality	During the smoltification and smolt out-migration period, do not discharge water into the channel that will deleteriously warm the receiving waters beyond the background instream water temperature.	2	5	City of San Jose, County of Santa Clara, Santa Clara Valley Water District						TBD	

Coyote Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
CoC-CCCS-10.1.1.3	Action Step	Water Quality	Maintain suitable temperatures downstream of Anderson Dam.	2	5	Santa Clara Valley Water District						TBD	
CoC-CCCS-10.1.2	Recovery Action	Water Quality	Improve stream water quality conditions										
CoC-CCCS-10.1.2.1	Action Step	Water Quality	Evaluate point and non-point sources contributing to poor water quality, including sources contributing debris, pesticides, and sediment (turbidity); develop and implement a plan to address these sources.	2	5	City of San Jose, County of Santa Clara	15.00					15	Cost for a minimum of 3 continuous water quality gauges at a rate of $5,000/gauge. This action should be coordinated with other water quality monitoring actions.
CoC-CCCS-10.1.2.2	Action Step	Water Quality	Encourage the use of native vegetation in new landscaping to reduce the need for watering and application of herbicides, pesticides, and fertilizers.	3	5	City of San Jose, County of Santa Clara, Santa Clara Valley Water District						0	Action is considered In-Kind
CoC-CCCS-11.1	**Objective**	**Viability**	**Address other natural or manmade factors affecting the species' continued existence**										
CoC-CCCS-11.1.1	Recovery Action	Viability	Increase density, abundance, spatial structure, and diversity based on the biological recovery criteria										
CoC-CCCS-11.1.1.1	Action Step	Viability	Implement standardized assessment protocols (i.e., CDFW habitat assessment protocols) to ensure ESU-wide consistency.	2	5	City of San Jose, County of Santa Clara, Santa Clara Valley Water District						0	Action is considered In-Kind
CoC-CCCS-11.1.1.2	Action Step	Viability	Perform standardized adult spawning (redd) surveys.	2	10	Santa Clara Valley Water District						0	Costs accounted for under the Coastal Monitoroing Plan - see Monitoring Chapter
CoC-CCCS-11.1.1.3	Action Step	Viability	Perform standardized smolt outmigration surveys.	2		Santa Clara Valley Water District						0	Costs accounted for under the Coastal Monitoroing Plan - see Monitoring Chapter
CoC-CCCS-11.1.1.4	Action Step	Viability	Perform standardized juvenile rearing surveys.	2		Santa Clara Valley Water District						0	Costs accounted for under the Coastal Monitoroing Plan - see Monitoring Chapter
CoC-CCCS-11.1.1.5	Action Step	Viability	Monitor population status for response to recovery actions, habitat improvements, and recovery action implementation - adjust population and life stage monitoring efforts to reflect new habitat improvements and accessible habitat expansions; use this information to adapt recovery strategies.	2	5	City of San Jose, County of Santa Clara, Santa Clara Valley Water District						0	Costs accounted for under the Coastal Monitoroing Plan - see Monitoring Chapter
CoC-CCCS-11.2	**Objective**	**Viability**	**Address the inadequacy of existing regulatory mechanisms**										
CoC-CCCS-11.2.1	Recovery Action	Viability	Increase density, abundance, spatial structure, and diversity based on the biological recovery criteria										
CoC-CCCS-11.2.1.1	Action Step	Viability	Support (fund) the hiring and retention of dedicated environmental law enforcement personnel (i.e., CDFW wardens; park rangers, federal service enforcement agents, etc.).	3	30	CDFW, CDFW Law Enforcement, City of San Jose, County of Santa Clara, NMFS OLE, Santa Clara Valley Water District	9.34	9.34	9.34	9.34	9.34	56	Cost estimate for Fish and Wildlife Warden from Bureau of Labor Statistics 2009.

Coyote Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
CoC-CCCS-13.1	**Objective**	**Channel Modification**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**										
CoC-CCCS-13.1.1	Recovery Action	Channel Modification	Prevent or minimize impairment to floodplain connectivity (impaired quality & extent)										
CoC-CCCS-13.1.1.1	Action Step	Channel Modification	Design channel modifying projects to fully minimize and mitigate effects and, where possible, implement and remedy existing poor conditions.	2	10	CDFW, City of Milpitas, Santa Clara Valley Water District	2,033	2,033				4,066	Cost based on treating 3.8 miles (assume 25% of total flood channel) at a rate of $1,070,400/mile.
CoC-CCCS-13.1.1.2	Action Step	Channel Modification	Where feasible, implement alternatives to bank hardening; utilize bioengineering.	2	10	City of Milpitas, City of San Jose, County of Santa Clara, Santa Clara Valley Water District						0	Action is considered In-Kind
CoC-CCCS-13.1.1.3	Action Step	Channel Modification	All proposed levees should be designed to account for minimal maintenance associated with an intact and functioning riparian zone.	2	10	City of Milpitas, City of San Jose, County of Santa Clara, Santa Clara Valley Water District						0	Action is considered In-Kind
CoC-CCCS-13.1.1.4	Action Step	Channel Modification	When levees are utilized, design to allow maintenance of an intact and functioning riparian zone where feasible.	2	10	City of Milpitas, City of San Jose, County of Santa Clara, Santa Clara Valley Water District						0	Action is considered In-Kind
CoC-CCCS-13.1.1.5	Action Step	Channel Modification	Where riprap and other bank hardening is necessary, integrate other habitat-forming features – including large woody debris and riparian plantings and other methodologies to minimize habitat alteration effects.	2	10	City of Milpitas, City of San Jose, County of Santa Clara, Santa Clara Valley Water District						0	Action is considered In-Kind
CoC-CCCS-13.1.1.6	Action Step	Channel Modification	Thoroughly investigate the ultimate cause of channel instability prior to engaging in site specific channel modifications and maintenance. Identify and target remediation of watershed process disruption as an overall priority.	2	10	City of Milpitas, City of San Jose, County of Santa Clara, Santa Clara Valley Water District						0	Action is considered In-Kind
CoC-CCCS-13.1.1.7	Action Step	Channel Modification	Promote streamside conservation measures, including conservation easements, setbacks, and riparian buffers (CDFG 2004).	2	10	City of Milpitas, City of San Jose, County of Santa Clara, Santa Clara Valley Water District						TBD	Cost based on amount of conservation measures needed and landowner participation.
CoC-CCCS-13.1.1.9	Action Step	Channel Modification	Evaluate existing and future stream crossings to identify threats to natural hydrologic processes. Replace or retrofit crossings to achieve more natural conditions, and improved passage and stream function.	2	10	City of Milpitas, City of San Jose, County of Santa Clara, Santa Clara Valley Water District	3,412	3,412				6,824	Cost based on treating 11 road crossing (1 impassable, 10 partially impassable) at a rate of $1,07,400/total barrier and $$639,247/partial barrier.

Coyote Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
CoC-CCCS-13.1.1.10	Action Step	Channel Modification	Counties and municipalities should adopt a policy of "managed retreat" (removal of problematic infrastructure and replacement with native vegetation or flood tolerant land uses) for areas highly susceptible to, or previously damaged from, flooding.	2	10	City of Milpitas, City of San Jose, County of Santa Clara						0	Action is considered In-Kind
CoC-CCCS-14.1	**Objective**	**Disease/ Predation /Competition**	**Address disease or predation**										
CoC-CCCS-14.1.1	Recovery Action	Disease/ Predation /Competition	Prevent or minimize reduced density, abundance, and diversity										
CoC-CCCS-14.1.1.1	Action Step	Disease/ Predation /Competition	Identify locations within the watershed that support exotic piscivorous fish species, and develop and implement a plan to decrease the effects of predation by these species. Consider provision of instream habitat and cover that provides refuge for salmonids, and/or the elimination of instream conditions that support and favor exotic species.	2	10	CDFW, City of San Jose, County of Santa Clara, Santa Clara Valley Water District						TBD	Cost based on amount of exotic piscivorous fish species to be removed. Cost for pikeminnow eradication estimated at $9.38/fish.
CoC-CCCS-14.2	**Objective**	**Disease/ Predation /Competition**	**Address the inadequacy of existing regulatory mechanisms**										
CoC-CCCS-14.2.1	Recovery Action	Disease/ Predation /Competition	Prevent or minimize reduced density, abundance, and diversity										
CoC-CCCS-14.2.1.1	Action Step	Disease/ Predation /Competition	Continue programs to screen off channel percolation ponds to prevent the introduction of exotic, predatory, warm water fishes into the channel from these sources. Develop and implement these programs where not in place.	2	50	City of San Jose, County of Santa Clara, Santa Clara Valley Water District						TBD	Cost based on amount of fish screens needed. Cost for fish screens estimated to range between $16,040 to $64,158/screen
CoC-CCCS-20.1	**Objective**	**Mining**	**Address the present or threatened destruction, modification, or curtailment of habitat or range**										
CoC-CCCS-20.1.1	Recovery Action	Mining	Prevent or minimize impairment to watershed processes										
CoC-CCCS-20.1.1.1	Action Step	Mining	Evaluate limiting factors affecting steelhead within the Ogier Ponds complex, including: adult, smolt, and juvenile passage; juvenile rearing; stream functions (sediment transport, hydrology, etc.); stream temperatures; and support of exotic piscivorous fish species.	1	5	County of Santa Clara, Santa Clara Valley Water District	138.00					138	Cost based on fish/habitat restoration monitoring at a rate of $137,833/project. Cost is likely conservative and could be higher depending on additional parameters to be evaluated.
CoC-CCCS-20.1.1.2	Action Step	Mining	Develop and implement a plan to remediate the Ogier Ponds reach; coordinate with NMFS during plan development (see: Restoration- Floodplain Connectivity, Restoration- Passage, Restoration- Habitat Complexity, Restoration- Sediment, Restoration- Temperature).	1	5	City of San Jose, County of Santa Clara						TBD	Cost based on amount and method of ponds to be restored/enhanced.
CoC-CCCS-21.1	**Objective**	**Recreation**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**										
CoC-CCCS-21.1.1	Recovery Action	Recreation	Prevent or minimize impairment to floodplain connectivity (impaired quality and extent)										
CoC-CCCS-21.1.1.1	Action Step	Recreation	Evaluate the effects of recreational facilities such as bike/pedestrian trails, and road crossings that may constrain opportunities to expand channel width and/or reconnect floodplain.	3	5	City of San Jose, County of Santa Clara, Santa Clara Valley Water District						TBD	Cost based on miles of recreational facilities. Cost expected to be less than road inventory methods estimated at $1,148/mile.

Coyote Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
CoC-CCCS-21.1.1.2	Action Step	Recreation	Develop and implement a plan that remediates existing recreational facilities to allow for stream functions, and locates new facilities in such a way they do not constrain channel width or floodplain connection (see Restoration- Floodplain Connectivity).	1	5	City of San Jose, County of Santa Clara, Santa Clara Valley Water District						TBD	Cost accounted for.
CoC-CCCS-21.1.2	Recovery Action	Recreation	Prevent or minimize adverse alterations to riparian species composition and structure										
CoC-CCCS-21.1.2.1	Action Step	Recreation	Encourage acquisition and protection of riparian corridors and stream areas, and incorporate these areas into existing or new protected areas.	2	10	City of San Jose, County of Santa Clara, Private Landowners, State Parks						0	Action is considered In-Kind. Costs associated with encouraging are considered In-kind.
CoC-CCCS-22.1	**Objective**	**Residential /Commercial Development**	**Address the present or threatened destruction, modification, or curtailment of habitat or range**										
CoC-CCCS-22.1.1	Recovery Action	Residential /Commercial Development	Prevent or minimize impairment to watershed processes										
CoC-CCCS-22.1.1.1	Action Step	Residential /Commercial Development	Improve conditions for steelhead by reducing the density of existing residential and commercial development where feasible, and remediating existing development contributing to poor stream conditions.	1	10	City of San Jose, County of Santa Clara, Santa Clara Valley Water District						TBD	Cost based on opportunities to reduce residential and commercial development.
CoC-CCCS-22.1.1.2	Action Step	Residential /Commercial Development	Upgrade existing stormwater systems into a spatially distributed discharge network (rather than a few point discharges).	2	10	City of San Jose, County of Santa Clara						TBD	Cost based on amount of stormwater system needing upgrading.
CoC-CCCS-22.1.1.3	Action Step	Residential /Commercial Development	Restore areas where existing infrastructure exists within streams, historical floodplains or off channel habitats in any steelhead watersheds. Proactively work with landowners.	2	10	City of San Jose, County of Santa Clara, Santa Clara Valley Water District						TBD	Cost likely accounted for in FLOODPLAIN CONNECTIVITY and HABITAT COMPLEXITY.
CoC-CCCS-22.1.1.4	Action Step	Residential /Commercial Development	Maintain intact and properly functioning riparian buffers to filter and prevent fine sediment input from entering streams.	2	10	City of San Jose, County of Santa Clara, Santa Clara Valley Water District						0	Action is considered In-Kind
CoC-CCCS-22.1.1.5	Action Step	Residential /Commercial Development	Improve steelhead survival by minimizing the input of sediment or toxic compounds originating from commercial or residential development.	2	10	City of San Jose, County of Santa Clara	7.50	7.50				15	Cost based to install a minimum of 3 continuous water quality monitoring gauges at a rate of $5,000/station. Cost does not account for data management or maintenance.
CoC-CCCS-22.1.1.6	Action Step	Residential /Commercial Development	Disperse discharge from new or upgraded commercial and residential areas into a spatially distributed network rather than a few point discharges.	2	10	City of San Jose, County of Santa Clara, Santa Clara Valley Water District						0	Action is considered In-Kind
CoC-CCCS-22.2	**Objective**	**Residential /Commercial Development**	**Address the inadequacy of existing regulatory mechanisms**										
CoC-CCCS-22.2.1	Recovery Action	Residential /Commercial Development	Prevent or minimize impairment to watershed processes										

Coyote Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
CoC-CCCS-22.2.1.1	Action Step	Residential /Commercial Development	New development should minimize storm-water runoff, changes in duration, or magnitude of peak flow.	2	10	City of San Jose, County of Santa Clara, Santa Clara Valley Water District						0	Action is considered In-Kind
CoC-CCCS-22.2.1.2	Action Step	Residential /Commercial Development	Design new development to allow streams to meander in historical patterns; protecting riparian zones and their floodplains or channel migration zones avoids the need for bank erosion control in most situations.	2	10	City of San Jose, County of Santa Clara						0	Action is considered In-Kind
CoC-CCCS-22.2.1.3	Action Step	Residential /Commercial Development	Design new developments to avoid unstable slopes, wetlands, areas of high habitat value, and similarly constrained sites that occur adjacent to a steelhead watercourse.	2	10	City of San Jose, County of Santa Clara, Santa Clara Valley Water District						0	Action is considered In-Kind
CoC-CCCS-22.2.1.4	Action Step	Residential /Commercial Development	Minimize or avoid new development within riparian zones and the 100 year floodprone zones.	2	10	City of San Jose, County of Santa Clara, Santa Clara Valley Water District						0	Action is considered In-Kind
CoC-CCCS-22.2.1.5	Action Step	Residential /Commercial Development	Institutionalize programs to purchase land/conservation easements to encourage the re-establishment and/or enhancement of natural riparian communities. Restore uplands for watershed processes; restore stream channel and floodplain for steelhead use.	2	10	City of San Jose, County of Santa Clara, Santa Clara Valley Water District						0	Action is considered In-Kind
CoC-CCCS-22.2.1.6	Action Step	Residential /Commercial Development	Minimize or prevent future development in floodplains or off channel habitats.	2	10	City of San Jose, County of Santa Clara, Santa Clara Valley Water District						0	Action is considered In-Kind
CoC-CCCS-22.2.1.7	Action Step	Residential /Commercial Development	Encourage infill and high density developments over dispersal of low density rural residential development.	2	10	City of San Jose, County of Santa Clara, Santa Clara Valley Water District						0	Action is considered In-Kind
CoC-CCCS-23.1	**Objective**	**Roads/Railroads**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**										
CoC-CCCS-23.1.1	Recovery Action	Roads/Railroads	Prevent or minimize impairment to instream substrate/food productivity (gravel quality and quantity)										
CoC-CCCS-23.1.1.1	Action Step	Roads/Railroads	Evaluate existing roadways within 200 meters of the riparian corridor, and develop plans to decrease the ongoing impacts associated with these roads.	2	5	City of San Jose, County of Santa Clara, Santa Clara Valley Water District	630					630	Cost based on amount of road network in riparian corridor. Cost estimated for 548 miles of road at a rate of $1,148/mile.
CoC-CCCS-23.1.1.2	Action Step	Roads/Railroads	Design new roads that minimize or prevent encroachment into riparian areas and that are hydrologically disconnected from the stream network.	2	10	City of San Jose, County of Santa Clara, Santa Clara Valley Water District						0	Action is considered In-Kind

Coyote Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
CoC-CCCS-23.1.1.3	Action Step	Roads/Railroads	Address sediment and runoff sources from road networks and other actions that deliver sediment and runoff to stream channels.	2	10	City of San Jose, County of Santa Clara, Santa Clara Valley Water District						TBD	Cost based on amount of road network contributing sediment to stream channels.
CoC-CCCS-23.1.2	Recovery Action	Roads/Railroads	Prevent or minimize impairment to passage and migration										
CoC-CCCS-23.1.2.1	Action Step	Roads/Railroads	Bridges associated with new roads or replacement bridges (including railroad bridges) should be free span or constructed with the minimum number of bents feasible in order to minimize drift accumulation and facilitate fish passage.	2	10	CalTrans, City of San Jose, County of Santa Clara, Santa Clara Valley Water District						0	Action is considered In-Kind
CoC-CCCS-23.1.2.2	Action Step	Roads/Railroads	Develop and implement a plan to remedy the road crossings within the Ogier Ponds complex.	1	5	County of Santa Clara						TBD	Cost based on feasible passage alternatives for Ogier Ponds complex. Cost for adult escapement estimated at $43,654 and juvenile migration estimated at $225,916/project.
CoC-CCCS-23.1.2.3	Action Step	Roads/Railroads	Develop and implement a plan to remedy the Singleton Road crossing.	1	5	City of San Jose, County of Santa Clara, Santa Clara Valley Water District						0	Cost accounted for in other action step. See Passage.
CoC-CCCS-25.1	**Objective**	**Water Diversion/ Impoundment**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**										
CoC-CCCS-25.1.1	Recovery Action	Water Diversion/ Impoundment	Prevent or minimize impairment to stream hydrology (impaired water flow)										
CoC-CCCS-25.1.1.1	Action Step	Water Diversion/ Impoundment	During winter and spring implement moderate winter baseflows to provide adequate water depths necessary for upstream and downstream migration between Anderson Dam and the San Francisco Bay (see Appendix E of the May 2003 Fisheries and Aquatic Habitat Collaborative Effort Draft Settlement Agreement).	1	5	Santa Clara Valley Water District						0	Action is considered In-Kind
CoC-CCCS-25.1.1.2	Action Step	Water Diversion/ Impoundment	During winter and spring implement periodic migrant attractant flows necessary to attract adult fish upstream, and encourage outmigration of smolts (see Appendix E of the May 2003 Fisheries and Aquatic Habitat Collaborative Effort Draft Settlement Agreement).	1	5	Santa Clara Valley Water District						0	Action is considered In-Kind
CoC-CCCS-25.1.1.3	Action Step	Water Diversion/ Impoundment	During winter and spring, implement periodic large pulse "maintenance" flows at the full capacity of the Anderson Dam outlet works to provide stream channel maintenance flows. When possible, time these flows so that they are coincident with natural rainfall events.	1	5	Santa Clara Valley Water District						0	Action is considered In-Kind
CoC-CCCS-25.1.1.4	Action Step	Water Diversion/ Impoundment	During summer and fall, maintain cool water temperatures (18 degrees C or less) throughout as much of the "cold water management zone" (between Anderson Dam and "Old Golf course Drive") as possible.	1	5	Santa Clara Valley Water District						0	Action is considered In-Kind
CoC-CCCS-25.1.1.5	Action Step	Water Diversion/ Impoundment	During summer and fall, manage release rates so that depths and velocities favoring fry and juvenile steelhead are provided.	1	5	Santa Clara Valley Water District						0	Action is considered In-Kind

Coyote Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
CoC-CCCS-25.1.1.6	Action Step	Water Diversion/ Impoundment	Implement ramp of all reservoir releases (flood maintenance releases, fisheries passage releases, summer baseflow, and other planned releases) from Anderson Dam as necessary to minimize deleterious effects of flow increases/decreases.	1	5	Santa Clara Valley Water District						0	Action is considered In-Kind
CoC-CCCS-25.1.1.7	Action Step	Water Diversion/ Impoundment	During summer and fall, operate facilities to ensure flow increases and decreases in Coyote Creek downstream of the Coyote Canal intake do not exceed a rate of change greater than 15 percent within a 24 hour period.	1	5	Santa Clara Valley Water District						0	Action is considered In-Kind
CoC-CCCS-25.1.1.8	Action Step	Water Diversion/ Impoundment	Design all habitat enhancements to function within the anticipated range of flows designed for steelhead enhancement.	1	5	CDFW, City of San Jose, Santa Clara Valley Water District						0	Action is considered In-Kind
CoC-CCCS-25.1.1.9	Action Step	Water Diversion/ Impoundment	Install instream habitat enhancement features designed to increase the quantity and quality of fry and juvenile steelhead habitat by creating habitats with depth, velocity, and cover components that favor these life stages.	1	5	Santa Clara Valley Water District	450.00					450	Cost based to treat 14 miles (assume 1 project/mile in 50% high IP) at a rate of $31,200/mile. Cost likely to be higher for greater level of engineering and oversight.
CoC-CCCS-25.2	**Objective**	**Water Diversion/ Impoundment**	**Address the inadequacy of existing regulatory mechanisms**										
CoC-CCCS-25.2.1	Recovery Action	Water Diversion/ Impoundment	Prevent or minimize impairment to stream hydrology (impaired water flow)										
CoC-CCCS-25.2.1.1	Action Step	Water Diversion/ Impoundment	Allow all "fisheries flows" (baseflows, and passage, attractant, and channel maintenance flows) to bypass diversion facilities.	1	5	Santa Clara Valley Water District						0	Action is considered In-Kind
CoC-CCCS-25.2.1.2	Action Step	Water Diversion/ Impoundment	Maintain and operate fish ladders on laddered diversion facilities and bypass flows necessary for passage over critical riffles.	1	5	City of San Jose, County of Santa Clara, Santa Clara Valley Water District						0	Cost accounted for in other action steps.
CoC-CCCS-25.2.1.3	Action Step	Water Diversion/ Impoundment	Assess operations at the City of San Jose's Cherry Flat Reservoir for potential effects to steelhead; develop and implement a plan formalizing operations benefiting steelhead.	1	5	City of San Jose	102.00					102	Cost based on adult escapement monitoring at a rate of $43,564/project and production, run timing, and size monitoring at a rate of $57,434/project.
CoC-CCCS-25.2.1.4	Action Step	Water Diversion/ Impoundment	Manage streamfllow and temperature to improve habitat conditions, and mimic seasonal variability.	1	5	Santa Clara Valley Water District						TBD	Cost likely accounted as part of other action steps. Data monitoring component should be coordinated.

Green Valley/Suisun Creek Population

CCC Steelhead Winter-Run

- Role within DPS: Potentially Independent Population
- Diversity Stratum: Interior San Francisco Bay
- Spawner Density Target: 2,100 adults
- Current Intrinsic Potential: 64.3 IP-km

Steelhead Abundance and Distribution

Suisun Creek and Green Valley Creek are adjacent watersheds draining into San Francisco Bay via Cordelia Slough in Solano County, California. Suisun Creek, the larger of the two watersheds, drains an area of approximately 52 square miles and generally flows year-round within the mainstem and larger tributary reaches.

Anecdotal reports suggest Suisun Creek supported a healthy steelhead run prior to construction of Gordon Valley Dam (which impounds Lake Curry) in 1926. Steelhead abundance declined steadily in the decades following dam construction; CDFW estimated in 1969 that the Suisun Creek steelhead population was likely smaller than 50 adult fish (Leidy *et al*. 2005). Small numbers of juvenile steelhead have been sampled within the watershed during recent years (Hanson 2002; Leidy *et al*. 2005).

Free-flowing Wooden Valley Creek, the largest tributary to Suisun Creek, generally contains the highest quality steelhead habitat within the watershed. As a result, steelhead production appears to be higher in Wooden Valley Creek than Suisun Creek, a premise supported by the frequent and numerous steelhead observations within Wooden Valley Creek during recent surveys (Leidy *et al.* 2002). Steelhead abundance within Green Valley Creek is also likely significantly depressed as compared to historical conditions, although juvenile fish continue to occupy accessible areas of the watershed containing suitable habitat. CDFW sampled four sites on Green Valley Creek during 1975, estimating juvenile steelhead density at 68 fish per 30 meters of stream length (Leidy *et al*. 2002).

Steelhead are likely distributed throughout most low gradient reaches of both watersheds. Gordon Valley Dam on the Suisun Creek mainstem and Lake Frey Dam on Wild Horse Valley Creek preclude upstream and downstream steelhead passage at those locations.

History of Land Use

Few historic records exist documenting the early history of settlement within Green Valley and Suisun creeks. The watershed is now largely rural in nature, dominated by wild land and agricultural uses, and likely differs little from how the watershed appeared a century ago. One large change was the construction of Gordon Valley Dam on the upper mainstem Suisun Creek, which was completed in 1940 to supply drinking water for the City of Vallejo.

Current Resources and Land Management

Much of the Suisun Creek and Green Valley Creek watersheds has remained in a rural state, and is currently utilized mainly for agricultural production and cattle grazing. Urban development is relatively low – the watersheds have no incorporated cities, and only 11 percent of the combined area has a housing density greater than 1 unit/20 acres (NMFS GIS data). The vast majority of land is privately owned.

Salmonid Viability and Watershed Conditions

The following habitat indicators were rated Poor through the CAP process: habitat complexity, riparian vegetation, hydrology, estuary/lagoon, velocity refuge, water quality, viability, and sediment. Recovery strategies will typically focus on ameliorating these habitat attributes, although strategies that address other attributes may also be developed where their implementation is critical to restoring properly functioning habitat conditions within the watershed.

Current Conditions

The following discussion focuses on those conditions that were rated Fair or Poor as a result of our CAP viability analysis. The Suisun Creek Viability Table results are provided below. Recovery strategies will focus on improving these conditions.

Population and Habitat Conditions

Viability: Density, Abundance, and Spatial Structure

Viability conditions have a rating of Poor for adults, smolts, and summer rearing juveniles in part due to Water Diversions and Impoundments. The current size and spatial distribution of both the Suisun Creek and Green Valley Creek steelhead populations are likely not viable. As noted above, only a small number of adult steelhead have been observed within either watershed during past steelhead surveys (e.g., Hanson 2002), and aside from Wooden Valley Creek, juvenile steelhead abundance is low within most accessible stream reaches. Spatial diversity is also likely lacking within the Suisun/Green Valley steelhead population, considering the lack of strong

representation of multiple distinct steelhead age-classes (i.e., fry, parr, smolt, adult) within spatially diverse areas of the watershed (e.g., headwater streams, low gradient slough habitat in lower watershed, etc.). Multiple age-classes of juvenile steelhead were observed within Wooden Valley Creek during a 2002 survey (Marcus 2004). The threat of Water Diversions and Impoundments contributes significantly to this condition.

Habitat Complexity: Large Wood and Shelter

Habitat Complexity: large wood and shelter conditions have a rating of Poor for adults, summer rearing juveniles, winter rearing juveniles, and smolts. Marcus (2003) noted that most stream reaches within Suisun Creek lack LWD in available pool habitat, and suggests restoring LWD levels as a high restoration priority. Existing cover within Wooden Valley Creek is similarly deficient (NCRCD 2002). During a separate habitat assessment, Hanson (2002) found that 34 percent of sampled habitat units had cover elements present, which is higher than general guidelines that suggest suitable steelhead conditions exist when more than 14 percent of habitat units exhibit adequate cover. However, the high number of log jams caused by beaver activity may have biased the results of the cover investigation. Adequate cover and shelter components within the stream channel is a critical component influencing juvenile steelhead growth and survival. Threats contributing significantly to this condition include Agriculture, and Disease, Predation and Competition.

Sediment: Gravel Quality and Distribution of Spawning Gravels

Sediment conditions have a Poor rating for adults, eggs, summer rearing juveniles, and winter rearing juveniles. High instream sediment levels likely limit the production and distribution of steelhead within Green Valley and Suisun creeks. High fine sediment levels were noted during habitat surveys by Marcus (2003), indicating the need for erosion control measures within both Suisun Creek and Wooden Valley Creek. Land management activities associated with agriculture/cattle grazing and road development are likely a large contributor of fine sediment into both Green Valley and Suisun Creek watersheds. High levels of fine sediment can simplify instream habitat and lower benthic invertebrate abundance, a preferred prey item of juvenile steelhead. Available spawning gravel is limited within most reaches of the Suisun Creek watershed, possibly affecting adult steelhead spawning success (Marcus 2004). The threat of Water Diversions and Impoundments contributes significantly to this condition.

Hydrology: Baseflow and Passage Flows

Hydrology conditions have a rating of Poor for adults, summer rearing juveniles, and smolts. A constant 2-3 cfs is released from Gordon Valley Dam into Suisun Creek, a volume of flow that may be inadequate during summer months to attenuate high water temperatures (Marcus 2004). However, the topic of increasing dam releases during summer months to increase juvenile

steelhead survival is complex, since an increase in habitat conditions favored by warm water fish species may transpire within sections of lower Suisun Creek (Jackson and Marcus 2007). Streamflows during winter months are likely high enough to support the upstream migration of adult steelhead (Hanson 2002). The threat of Water Diversions and Impoundments contributes significantly to this condition.

Habitat Complexity: Percent Primary Pools and Pool/Riffle/Flatwater Ratios

Habitat Complexity: percent primary pools and pool/riffle/flatwater ratios conditions have a rating of Poor for adults, summer rearing juveniles, and winter rearing juveniles. The pool/riffle ratio within Suisun Creek is presently not indicative of high quality juvenile steelhead habitat, with an overabundance of pools while lacking riffle and run habitat. The high pool frequency within Suisun Creek is largely a function of the numerous small beaver dams. Pool/riffle ratios within Wooden Valley Creek were more consistent with ratios associated with high quality habitat. Pool complexity is likely poor within both Suisun and Green Valley Creek. Improving cover elements in pool habitat is a high priority restoration action in Suisun Creek (Marcus 2004). The threat of Agriculture contributes significantly to this condition.

Riparian Vegetation: Composition, Cover & Tree Diameter

Riparian Vegetation conditions have a rating of Poor for summer rearing juveniles and watershed processes. Suisun Creek suffers from numerous invasive plant species that are impairing riparian function and structure. Giant Reed (*Arundo donax*), blue periwinkle (*Vinca major*), Harding grass (*Phalaris aquatica*) and Himalayan blackberry (*Rubus discolor*) have covered over native understory and streambank areas throughout most sections of mainstem Suisun Creek (Marcus 2004). Invasive, non-native plants can impair the regeneration of native riparian species, reducing native riparian density and diversity once existing trees and shrubs naturally die. Dysfunctional riparian habitat can limit juvenile salmonid survival by limiting LWD recruitment into the stream environment and lowering canopy cover, a critical component in moderating summer water temperatures. Threats contributing significantly to this condition include Agriculture, and Disease, Predation, and Competition.

Velocity Refuge: Floodplain Connectivity

Velocity Refuge conditions have a rating of Poor for adults and winter rearing juveniles. In most locations along Suisun Creek, the riparian corridor is relatively narrow due to encroachment by agricultural and rural development (Marcus 2004). Furthermore, channel incision and bank sloughing within the middle sections of Suisun Creek are effectively isolating available floodplain habitat from the active stream channel. Poor floodplain connectivity can limit the survival of winter-rearing juvenile steelhead, which often seek refuge from high instream flows within newly

inundated floodplain habitat. The threat of Disease, Predation and competition contributes significantly to this condition.

Water Quality: Temperature

Water Quality, temperature conditions have a rating of Poor for summer rearing juveniles. High summer water temperatures are likely limiting juvenile steelhead survival within portions of Suisun and Green Valley creeks. Water temperature monitoring in Suisun Creek found cooler water temperatures were common within the mile or two directly below Gordon Valley Dam, but temperatures were commonly too warm to support productive steelhead rearing in areas further downstream (Marcus 2004). Water temperatures were coolest within Wooden Valley Creek and tributary White Creek. Threats contributing significantly to this condition include Agriculture; Disease, Predation, and Competition; and Livestock Farming and Ranching.

Threats

The following discussion focuses on those threats that rate as High or Very High (See Green Valley/Suisun Creek CAP Results). Recovery strategies will likely focus on ameliorating High rated threats; however, some strategies may address Medium and Low threats when the strategy is essential to recovery efforts.

Water Diversion and Impoundments

This threat was rated Very High overall. Reservoirs in both Suisun Creek and Green Valley Creek watersheds limit steelhead habitat availability, while also altering downstream natural flow patterns and sediment transport mechanisms. On Suisun Creek, Lake Curry provides little flood storage capacity during winter months, and thus has a minimal impact on winter flood flow intensity and duration. However, the reservoir does alter downstream flow patterns during summer and early fall, when a constant 2-3 cfs of water is released from the dam. Lakes Frey and Madigan within the Green Valley watershed likely have similar impacts on downstream flow and sediment conveyance.

Agriculture

The majority of the Suisun and Green Valley Creek watersheds are privately owned agricultural land used primarily for livestock grazing, vineyards, orchards, and row crops (Marcus 2004). The high volume of fine sediment found within the stream channels of both watersheds are largely a byproduct of agricultural land-practices and private/county road development. Engaging landowners in improving agriculture and road building practices is a high priority recovery strategy for Suisun Creek (Marcus 2004).

Disease, Predation and Competition

Non-native bass and sunfish, as well as other native species such as California Roach, likely compete with steelhead for habitat and food resources throughout much of the Suisun Creek watershed. Furthermore, invasive plant species are impacting riparian function and composition throughout much of mainstem Suisun Creek.

Livestock Farming and Ranching

Portions of Suisun Creek and Green Valley Creek are used for livestock grazing, which can increase erosion and impair riparian habitat quality when proper management techniques are not used.

Other Threats

No fish hatcheries operate within the Suisun or Green Valley creek watersheds, so hatchery-related effects are unlikely within the steelhead population. Little logging or mining occur within the area. Recreational activity is generally uncommon within the Suisun and Green Valley watersheds due to the high level of private land ownership, although Green Valley Creek flows through a large public golf course within its middle reaches.

Limiting Stresses, Lifestages, and Habitats

Threat and stress analysis within the CAP workbook suggests most steelhead lifestages are limited within the Suisun and Green Valley creek watersheds. However, restoration actions that increase adult and summer juvenile survival are perhaps most important, since bolstering these two lifestages appear to be the most critical to re-establishing steelhead within these watersheds.

General Recovery Strategy

In general, recovery strategies will focus on improving conditions and ameliorating stresses and threats discussed above, although strategies that address other indicators may also be developed where their implementation is critical to restoring properly functioning habitat conditions within the watershed.

Restore Riparian Corridors

The poor condition of riparian habitat within both watersheds is likely impairing steelhead production by increasing stream water temperatures and facilitating sediment delivery into the aquatic environment. Removing non-native invasive species followed by re-vegetating with native riparian trees, such as willow, white alder and oak, should be a high priority restoration action.

Address Upslope and Streamside Sediment Sources

Elevated fine sediment concentrations are a problem within many tributaries of Green Valley and Suisun creeks. High embeddedness ratings and poor benthic macroinvertebrate production likely limit steelhead spawning and rearing success. Potential sediment sources should be investigated through a comprehensive watershed-wide assessment, and high priority sources should be remedied.

Increase Instream Shelter Ratings and Pool Volume

Shelter and cover ratings were generally Poor within both watersheds. Restoration actions should target actions that improve habitat complexity, and by extension cover and shelter values, within pool and flatwater reaches by improving LWD abundance within the active channel.

Modify Reservoir Releases to Improve Water Quality

The current release of 2-3 cfs from Lake Curry may be impairing water quality and other fluvial processes within downstream sections of Suisun Creek. Reservoir operations at facilities within the Green Valley Creek watershed are likely causing similar impacts. Potentially altering reservoir operations to improve downstream habitat conditions and improve migration conditions should be investigated, and implemented where appropriate.

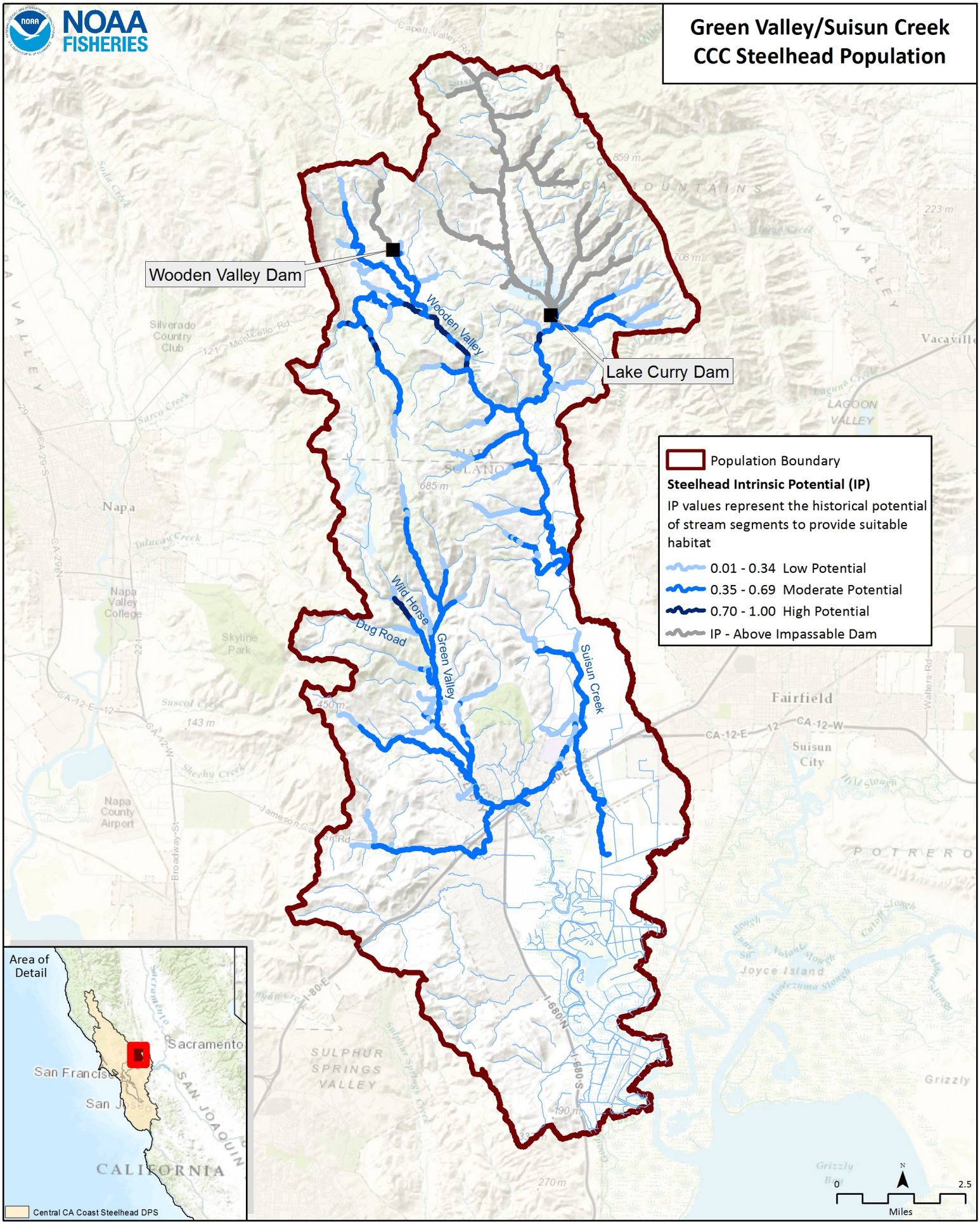
Literature Cited

Laurel Marcus and Associates. 2003. Final Suisun Creek Watershed Assessment and Enhancement Plan. Prepared for the California Sportfishing Protection Alliance, Woodland CA. February 2004. 168 pp.

Hanson Environmental. 2002. Final Suisun Creek Fishery Habitat Reconnaissance Surveys. April 2002.

Napa County Resource Conservation District. 2002. Habitat Inventory Report: Wooden Valley Creek and White Creek. November 2002. 34 pp.

Leidy, R. A., G. S. Becker, and B. N. Harvey. 2005. Historical Distribution and current status of steelhead/rainbow trout (*Oncorhynchus mykiss*) in streams of the San Francisco Estuary, California. Center for Ecosystem Management and Restoration, Oakland, CA.


NOAA FISHERIES
Green Valley/Suisun Creek
CCC Steelhead Population
Wooden Valley Dam
Lake Curry Dam
Wooden Valley
Wild Horse
Dug Road
Green Valley
Suisun Creek
Population Boundary
Steelhead Intrinsic Potential (IP)
IP values represent the historical potential of stream segments to provide suitable habitat
0.01 - 0.34 Low Potential
0.35 - 0.69 Moderate Potential
0.70 - 1.00 High Potential
IP - Above Impassable Dam
Napa
Fairfield
Suisun City
Vacaville
Silverado Country Club
Napa Valley College
Skyline Park
Napa County Airport
Joyce Island
SULPHUR SPRINGS VALLEY
Area of Detail
Sacramento
San Francisco
San Jose
CALIFORNIA
Central CA Coast Steelhead DPS
0
2.5
Miles

#	Conservation Target	Category	Key Attribute	Indicator	Poor	Fair	Good	Very Good	Current Indicator Measurement	Current Rating
1	Adults	Condition	Habitat Complexity	Large Wood Frequency (BFW 0-10 meters)	<50% of streams/ IP-Km (>6 Key Pieces/100 meters)	50% to 74% of streams/ IP-Km (>6 Key Pieces/100 meters)	75% to 90% of streams/ IP-Km (>6 Key Pieces/100 meters)	>90% of streams/ IP-Km (>6 Key Pieces/100 meters)	<50% of streams/ IP-km (>6 Key Pieces/100 meters)	Poor
			Habitat Complexity	Large Wood Frequency (BFW 10-100 meters)	<50% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	50% to 74% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	75% to 90% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	>90% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	<50% of streams/ IP-km (>1.3 Key Pieces/100 meters)	Poor
			Habitat Complexity	Pool/Riffle/Flatwater Ratio	<50% of streams/ IP-Km (>30% Pools; >20% Riffles)	50% to 74% of streams/ IP-Km (>30% Pools; >20% Riffles)	75% to 90% of streams/ IP-Km (>30% Pools; >20% Riffles)	>90% of streams/ IP-Km (>30% Pools; >20% Riffles)	<50% of streams/ IP-km (>30% Pools; >20% Riffles)	Poor
			Habitat Complexity	Shelter Rating	<50% of streams/ IP-Km (>80 stream average)	50% to 74% of streams/ IP-Km (>80 stream average)	75% to 90% of streams/ IP-Km (>80 stream average)	>90% of streams/ IP-Km (>80 stream average)	<50% of streams/ IP-km (>80 stream average)	Poor
			Hydrology	Passage Flows	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 51-75	Fair
			Passage/Migration	Passage at Mouth or Confluence	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	75% of IP-km to 90% of IP-km	Good
			Passage/Migration	Physical Barriers	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	75% of IP-km to 90% of IP-km	Good
			Riparian Vegetation	Tree Diameter (North of SF Bay)	≤39% Class 5 & 6 across IP-km	40 - 54% Class 5 & 6 across IP-km	55 - 69% Class 5 & 6 across IP-km	>69% Class 5 & 6 across IP-km	?39% Class 5 & 6 across IP-km	Poor
			Riparian Vegetation	Tree Diameter (South of SF Bay)	≤69% Density rating "D" across IP-km	70-79% Density rating "D" across IP-km	≥80% Density rating "D" across IP-km	Not Defined		

			Sediment	Quantity & Distribution of Spawning Gravels	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	<50% of IP-km or <16 IP-Km accessible*	Poor
			Velocity Refuge	Floodplain Connectivity	<50% Response Reach Connectivity	50-80% Response Reach Connectivity	>80% Response Reach Connectivity	Not Defined	<50% Response Reach Connectivity	Poor
			Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No Evidence of Toxins or Contaminants	Sublethal or Chronic	Fair
			Water Quality	Turbidity	<50% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-Km maintains severity score of 3 or lower	75% to 90% of streams/ IP-Km maintains severity score of 3 or lower	>90% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-km maintains severity score of 3 or lower	Fair
		Size	Viability	Density	<1 spawner per IP-km to < low risk spawner density per Spence (2008)	>1 spawner per IP-km to < low risk spawner density per Spence (2008)	low risk spawner density per Spence (2008)		<1 spawner per IP-km to < low risk spawner density per Spence (2008)	Poor
2	Eggs	Condition	Hydrology	Flow Conditions (Instantaneous Condition)	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 58	Fair
			Hydrology	Redd Scour	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 58	Fair
			Sediment	Gravel Quality (Bulk)	>17% (0.85mm) and >30% (6.4mm)	15-17% (0.85mm) and <30% (6.4mm)	12-14% (0.85mm) and <30% (6.4mm)	<12% (0.85mm) and <30% (6.4mm)	>17% (0.85mm) and >30% (6.4mm)	Poor
			Sediment	Gravel Quality (Embeddedness)	<50% of streams/ IP-Km (>50% stream average scores of 1 & 2)	50% to 74% of streams/ IP-Km (>50% stream average scores of 1 & 2)	75% to 90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	>90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	<50% of streams/ IP-km (>50% stream average scores of 1 & 2)	Poor
3	Summer Rearing Juveniles	Condition	Estuary/Lagoon	Quality & Extent	Impaired/non-functional	Impaired but functioning	Properly Functioning Condition	Unimpaired Condition	Impaired/non-functional	Poor

			Habitat Complexity	Large Wood Frequency (Bankfull Width 0-10 meters)	<50% of streams/ IP-Km (>6 Key Pieces/100 meters)	50% to 74% of streams/ IP-Km (>6 Key Pieces/100 meters)	75% to 90% of streams/ IP-Km (>6 Key Pieces/100 meters)	>90% of streams/ IP-Km (>6 Key Pieces/100 meters)	<50% of streams/ IP-km (>6 Key Pieces/100 meters)	Poor
			Habitat Complexity	Large Wood Frequency (Bankfull Width 10-100 meters)	<50% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	50% to 74% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	75% to 90% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	>90% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	<50% of streams/ IP-km (>1.3 Key Pieces/100 meters)	Poor
			Habitat Complexity	Percent Primary Pools	<50% of streams/ IP-Km (>49% of pools are primary pools)	50% to 74% of streams/ IP-Km (>49% of pools are primary pools)	75% to 89% of streams/ IP-Km (>49% of pools are primary pools)	>90% of streams/ IP-Km (>49% of pools are primary pools)	75% to 89% of streams/ IP-km (>49% of pools are primary pools)	Good
			Habitat Complexity	Pool/Riffle/Flatwater Ratio	<50% of streams/ IP-Km (>30% Pools; >20% Riffles)	50% to 74% of streams/ IP-Km (>30% Pools; >20% Riffles)	75% to 90% of streams/ IP-Km (>30% Pools; >20% Riffles)	>90% of streams/ IP-Km (>30% Pools; >20% Riffles)	<50% of streams/ IP-km (>30% Pools; >20% Riffles)	Poor
			Habitat Complexity	Shelter Rating	<50% of streams/ IP-Km (>80 stream average)	50% to 74% of streams/ IP-Km (>80 stream average)	75% to 90% of streams/ IP-Km (>80 stream average)	>90% of streams/ IP-Km (>80 stream average)	<50% of streams/ IP-km (>80 stream average)	Poor
			Hydrology	Flow Conditions (Baseflow)	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 75	Poor
			Hydrology	Flow Conditions (Instantaneous Condition)	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 58	Fair
			Hydrology	Number, Condition and/or Magnitude of Diversions	>5 Diversions/10 IP km	1.1 - 5 Diversions/10 IP km	0.01 - 1 Diversions/10 IP km	0 Diversions	1.67 Diversions/10 IP-km	Fair
			Passage/Migration	Passage at Mouth or Confluence	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	75% of IP-km to 90% of IP-km	Good
			Passage/Migration	Physical Barriers	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	75% of IP-km to 90% of IP-km	Good

			Riparian Vegetation	Canopy Cover	<50% of streams/ IP-Km (>70% average stream canopy; >85% where coho IP overlaps)	50% to 74% of streams/ IP-Km (>70% average stream canopy; >85% where coho IP overlaps)	75% to 90% of streams/ IP-Km (>70% average stream canopy; >85% where coho IP overlaps)	>90% of streams/ IP-Km (>70% average stream canopy; >85% where coho IP overlaps)	<50% of streams/ IP-km (>70% average stream canopy; >85% where coho IP overlaps)	Poor
			Riparian Vegetation	Tree Diameter (North of SF Bay)	≤39% Class 5 & 6 across IP-km	40 - 54% Class 5 & 6 across IP-km	55 - 69% Class 5 & 6 across IP-km	>69% Class 5 & 6 across IP-km	?39% Class 5 & 6 across IP-km	Poor
			Riparian Vegetation	Tree Diameter (South of SF Bay)	≤69% Density rating "D" across IP-km	70-79% Density rating "D" across IP-km	≥80% Density rating "D" across IP-km	Not Defined		
			Sediment (Food Productivity)	Gravel Quality (Embeddedness)	<50% of streams/ IP-Km (>50% stream average scores of 1 & 2)	50% to 74% of streams/ IP-Km (>50% stream average scores of 1 & 2)	75% to 90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	>90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	<50% of streams/ IP-km (>50% stream average scores of 1 & 2)	Poor
			Water Quality	Temperature (MWMT)	<50% IP km (<20 C MWMT; <16 C MWMT where coho IP overlaps)	50 to 74% IP km (<20 C MWMT; <16 C MWMT where coho IP overlaps)	75 to 89% IP km (<20 C MWMT; <16 C MWMT where coho IP overlaps)	>90% IP km (<20 C MWMT; <16 C MWMT where coho IP overlaps)	<50% IP-km (<20 C MWMT; <16 C MWMT where coho IP overlaps)	Poor
			Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No Evidence of Toxins or Contaminants	Sublethal or Chronic	Fair
			Water Quality	Turbidity	<50% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-Km maintains severity score of 3 or lower	75% to 90% of streams/ IP-Km maintains severity score of 3 or lower	>90% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-km maintains severity score of 3 or lower	Fair
		Size	Viability	Density	<0.2 Fish/m^2	0.2 - 0.6 Fish/m^2	0.7 - 1.5 Fish/m^2	>1.5 Fish/m^2	<0.2 Fish/m^2	Poor
			Viability	Spatial Structure	<50% of Historical Range	50-74% of Historical Range	75-90% of Historical Range	>90% of Historical Range	75-90% of Historical Range	Good

4	Winter Rearing Juveniles	Condition	Habitat Complexity	Large Wood Frequency (Bankfull Width 0-10 meters)	<50% of streams/ IP-Km (>6 Key Pieces/100 meters)	50% to 74% of streams/ IP-Km (>6 Key Pieces/100 meters)	75% to 90% of streams/ IP-Km (>6 Key Pieces/100 meters)	>90% of streams/ IP-Km (>6 Key Pieces/100 meters)	<50% of streams/ IP-km (>6 Key Pieces/100 meters)	Poor
			Habitat Complexity	Large Wood Frequency (Bankfull Width 10-100 meters)	<50% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	50% to 74% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	75% to 90% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	>90% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	<50% of streams/ IP-km (>1.3 Key Pieces/100 meters)	Poor
			Habitat Complexity	Pool/Riffle/Flatwater Ratio	<50% of streams/ IP-Km (>30% Pools; >20% Riffles)	50% to 74% of streams/ IP-Km (>30% Pools; >20% Riffles)	75% to 90% of streams/ IP-Km (>30% Pools; >20% Riffles)	>90% of streams/ IP-Km (>30% Pools; >20% Riffles)	<50% of streams/ IP-km (>30% Pools; >20% Riffles)	Poor
			Habitat Complexity	Shelter Rating	<50% of streams/ IP-Km (>80 stream average)	50% to 74% of streams/ IP-Km (>80 stream average)	75% to 90% of streams/ IP-Km (>80 stream average)	>90% of streams/ IP-Km (>80 stream average)		
			Passage/Migration	Physical Barriers	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	75% of IP-km to 90% of IP-km	Good
			Riparian Vegetation	Tree Diameter (North of SF Bay)	≤39% Class 5 & 6 across IP-km	40 - 54% Class 5 & 6 across IP-km	55 - 69% Class 5 & 6 across IP-km	>69% Class 5 & 6 across IP-km	?39% Class 5 & 6 across IP-km	Poor
			Riparian Vegetation	Tree Diameter (South of SF Bay)	≤69% Density rating "D" across IP-km	70-79% Density rating "D" across IP-km	≥80% Density rating "D" across IP-km	Not Defined		
			Sediment (Food Productivity)	Gravel Quality (Embeddedness)	<50% of streams/ IP-Km (>50% stream average scores of 1 & 2)	50% to 74% of streams/ IP-Km (>50% stream average scores of 1 & 2)	75% to 90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	>90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	<50% of streams/ IP-km (>50% stream average scores of 1 & 2)	Poor
			Velocity Refuge	Floodplain Connectivity	<50% Response Reach Connectivity	50-80% Response Reach Connectivity	>80% Response Reach Connectivity	Not Defined	<50% Response Reach Connectivity	Poor
			Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No Evidence of Toxins or Contaminants	Sublethal or Chronic	Fair

			Water Quality	Turbidity	<50% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-Km maintains severity score of 3 or lower	75% to 90% of streams/ IP-Km maintains severity score of 3 or lower	>90% of streams/ IP-Km maintains severity score of 3 or lower		
5	Smolts	Condition	Estuary/Lagoon	Quality & Extent	Impaired/non-functional	Impaired but functioning	Properly Functioning Condition	Unimpaired Condition	Impaired but functioning	Fair
			Habitat Complexity	Shelter Rating	<50% of streams/ IP-Km (>80 stream average)	50% to 74% of streams/ IP-Km (>80 stream average)	75% to 90% of streams/ IP-Km (>80 stream average)	>90% of streams/ IP-Km (>80 stream average)	<50% of streams/ IP-km (>80 stream average)	Poor
			Hydrology	Number, Condition and/or Magnitude of Diversions	>5 Diversions/10 IP km	1.1 - 5 Diversions/10 IP km	0.01 - 1 Diversions/10 IP km	0 Diversions	1.67 Diversions/10 IP-km	Fair
			Hydrology	Passage Flows	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 51-75	Fair
			Passage/Migration	Passage at Mouth or Confluence	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	75% of IP-km to 90% of IP-km	Good
			Smoltification	Temperature	<50% IP-Km (>6 and <14 C)	50-74% IP-Km (>6 and <14 C)	75-90% IP-Km (>6 and <14 C)	>90% IP-Km (>6 and <14 C)	50-74% IP-km (>6 and <14 C)	Fair
			Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No Evidence of Toxins or Contaminants	Sublethal or Chronic	Fair
			Water Quality	Turbidity	<50% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-Km maintains severity score of 3 or lower	75% to 90% of streams/ IP-Km maintains severity score of 3 or lower	>90% of streams/ IP-Km maintains severity score of 3 or lower	<50% of streams/ IP-km maintains severity score of 3 or lower	Poor
		Size	Viability	Abundance	Smolt abundance which produces high risk spawner density per Spence (2008)	Smolt abundance which produces moderate risk spawner density per Spence (2008)	Smolt abundance to produce low risk spawner density per Spence (2008)		Smolt abundance which produces high risk spawner density per Spence (2008)	Poor

6	Watershed Processes	Landscape Context	Hydrology	Impervious Surfaces	>10% of Watershed in Impervious Surfaces	7-10% of Watershed in Impervious Surfaces	3-6% of Watershed in Impervious Surfaces	<3% of Watershed in Impervious Surfaces	2.63% of Watershed in Impervious Surfaces	Very Good
			Landscape Patterns	Agriculture	>30% of Watershed in Agriculture	20-30% of Watershed in Agriculture	10-19% of Watershed in Agriculture	<10% of Watershed in Agriculture	9.57 of Watershed in Agriculture	Good
			Landscape Patterns	Timber Harvest	>35% of Watershed in Timber Harvest	26-35% of Watershed in Timber Harvest	25-15% of Watershed in Timber Harvest	<15% of Watershed in Timber Harvest	<15% of Watershed in Timber Harvest	Very Good
			Landscape Patterns	Urbanization	>20% of watershed >1 unit/20 acres	12-20% of watershed >1 unit/20 acres	8-11% of watershed >1 unit/20 acres	<8% of watershed >1 unit/20 acres	11% of watershed >1 unit/20 acres	Good
			Riparian Vegetation	Species Composition	<25% Intact Historical Species Composition	25-50% Intact Historical Species Composition	51-74% Intact Historical Species Composition	>75% Intact Historical Species Composition	25-50% Intact Historical Species Composition	Fair
			Sediment Transport	Road Density	>3 Miles/Square Mile	2.5 to 3 Miles/Square Mile	1.6 to 2.4 Miles/Square Mile	<1.6 Miles/Square Mile	1.9 Miles/Square Mile	Good
			Sediment Transport	Streamside Road Density (100 m)	>1 Miles/Square Mile	0.5 to 1 Miles/Square Mile	0.1 to 0.4 Miles/Square Mile	<0.1 Miles/Square Mile	2.1 Miles/Square Mile	Poor

Green Valley/Suisun Creek CAP Threat Results

	Threats Across Targets	Adults	Eggs	Summer Rearing Juveniles	Winter Rearing Juveniles	Smolts	Watershed Processes	Overall Threat Rank
	Project-specific-threats	1	2	3	4	5	6	
1	Agriculture	High	Medium	Very High	High	Medium	High	Very High
2	Channel Modification	Medium	Medium	Medium	Medium	Medium	Medium	Medium
3	Disease, Predation and Competition	High		Very High	High	Medium	High	Very High
4	Hatcheries and Aquaculture	Low		Low	Low	Medium		Low
5	Fire, Fuel Management and Fire Suppression	Low	Low	Medium	Low	Low	Low	Low
6	Fishing and Collecting	Low		Low		Medium		Low
7	Livestock Farming and Ranching	Medium	Medium	High	Medium	Medium	Medium	High
8	Logging and Wood Harvesting	Low	Low	Medium	Low	Low	Low	Low
9	Mining	Low	Low	Medium	Low	Low	Low	Low
10	Recreational Areas and Activities	Low	Low	Medium	Low	Low	Low	Low
11	Residential and Commercial Development	Medium	Low	Medium	Medium	Medium	Medium	Medium
12	Roads and Railroads	Medium	Medium	Medium	Medium	Low	Medium	Medium
13	Severe Weather Patterns	Medium	Low	Medium	Low	Low	Low	Medium
14	Water Diversion and Impoundments	High	High	Very High	Medium	High	High	Very High
	Threat Status for Targets and Project	High	Medium	Very High	High	High	High	Very High

Green Valley/Suisun Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
GVSC-CCCS-1.1	**Objective**	**Estuary**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**										
GVSC-CCCS-1.1.1	Recovery Action	Estuary	Increase quality and extent of estuarine habitat										
GVSC-CCCS-1.1.1.1	Action Step	Estuary	Develop and implement Estuary Protection and Enhancement Guidelines to maintain estuary function and provide information for estuary restoration.	2	50	CDFW, NMFS, Private Consultants, Public						TBD	Cost is TBD.
GVSC-CCCS-2.1	**Objective**	**Floodplain Connectivity**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**										
GVSC-CCCS-2.1.1	Recovery Action	Floodplain Connectivity	Rehabilitate and enhance floodplain connectivity										
GVSC-CCCS-2.1.1.1	Action Step	Floodplain Connectivity	Maintain and improve instream conditions for steelhead by maintaining access to floodplain habitat where channel connection remains, and improve conditions by reconnecting disconnected floodplain habitat where feasible.	2	10	Napa County, NRCS, Solano County	179.00	179.00				357	Cost based on treating 0.2 miles (assume 1 project/mile in 25% high IP with 40 acres per mile treated) at a rate of $44,640/acre.
GVSC-CCCS-2.1.1.2	Action Step	Floodplain Connectivity	Encourage willing landowners to restore historical floodplains or off-channel habitats through conservation easements, etc.	2	25	CDFW, NMFS, NRCS, Private Landowners, RCD						0	Action is considered In-Kind
GVSC-CCCS-2.1.1.3	Action Step	Floodplain Connectivity	Minimize or avoid future development in floodplains or off channel habitats.	2	100	Farm Bureau, Napa County, NRCS, Private Landowners, RCD, Solano County						0	Cost expected to be small. Action is considered In-Kind
GVSC-CCCS-2.1.1.4	Action Step	Floodplain Connectivity	Investigate areas where floodplain connectivity can be re-established in modified channel areas.	2	5	CDFW, NMFS, Private Consultants, Private Landowners, USACE	100.00					100	Estimated cost of investigation.
GVSC-CCCS-2.1.1.5	Action Step	Floodplain Connectivity	Promote restoration projects designed to create or restore alcove, backchannel, ephemeral tributary, or seasonal pond habitats.	2	25	CDFW, NMFS, NOAA RC, NRCS, RCD						0	Costs accounted for in above recovery action step.
GVSC-CCCS-2.1.1.6	Action Step	Floodplain Connectivity	Set-back existing levees in strategic areas to increase flood-flow detention and promote flood-tolerant land uses.	2	5	CDFW, Farm Bureau, Napa County, NMFS, NRCS, Private Landowners, RCD, Solano County, Solano County Water Agency						0	Costs accounted for in above recovery action step.
GVSC-CCCS-2.1.1.7	Action Step	Floodplain Connectivity	Incorporate structure (LWD, boulders) in floodplain project designs to increase velocity refuge for salmonids.	2	100	CDFW, NMFS, NOAA RC, NRCS, Private Consultants, Private Landowners, RCD						0	Costs accounted for in above recovery action step.

Green Valley/Suisun Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
GVSC-CCCS-2.1.1.8	Action Step	Floodplain Connectivity	Improve over-winter survival by increasing the frequency and functionality of floodplain habitats by delineating reaches possessing both potential winter rearing habitat and floodplain areas.	2	5	CDFW, NMFS, NRCS, Private Landowners, RCD						0	Cost accounted for in above recovery action step.
GVSC-CCCS-3.1	**Objective**	**Hydrology**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**										
GVSC-CCCS-3.1.1	Recovery Action	Hydrology	Improve flow conditions										
GVSC-CCCS-3.1.1.1	Action Step	Hydrology	Improve connectivity of surface flows with groundwater, reduce aggradation, and lower the overall sediment load at the watershed scale.	2	100	CDFW, NOAA RC, Private Landowners, Solano County, Solano County Water Agency						TBD	Costs depend on extent of treatments.
GVSC-CCCS-3.1.1.2	Action Step	Hydrology	Work with water managers on regulated streams to assure adequate and proper consideration is given to fish needs. Develop agreements that will minimize water-use conflicts and impacts on fish and wildlife resources during drought conditions.	2	10	Napa County, NRCS, Solano County, Solano County Water Agency						0	Action is considered In-Kind
GVSC-CCCS-3.2	**Objective**	**Hydrology**	**Address the inadequacy of existing regulatory mechanisms**										
GVSC-CCCS-3.2.1	Recovery Action	Hydrology	Improve flow conditions										
GVSC-CCCS-3.2.1.1	Action Step	Hydrology	Encourage improved compliance with existing water resource regulations via monitoring and enforcement.	3	5	Napa County, Solano County, Solano County Water Agency, State Water Resources Control Board						0	Action is considered In-Kind
GVSC-CCCS-3.2.1.2	Action Step	Hydrology	Support SWRCB in regulating the use of streamside wells and groundwater.	2	60	CDFW, NMFS, NMFS OLE, Solano County Water Agency, SWRCB						0	Action is considered In-Kind
GVSC-CCCS-3.2.1.3	Action Step	Hydrology	Work with SWRCB and landowners to improve flow regimes for adult migration to spawning habitats and smolt outmigration.	2	10	CDFW, Napa County, NMFS, Private Landowners, Solano County, Solano County Water Agency, SWRCB						0	Action is considered In-Kind
GVSC-CCCS-3.2.1.4	Action Step	Hydrology	Work with SWRCB and landowners to improve over summer survival of juveniles by re-establishing summer baseflows (from July 1 to October 1) in rearing reaches that are currently impacted by water use. Wooden Valley Creek is a high priority watershed for this action.	2	10	CDFW, Napa County, NMFS, Private Landowners, Public, Solano County, Solano County Water Agency, SWRCB						0	Action is considered In-Kind

Green Valley/Suisun Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
GVSC-CCCS-3.2.1.5	Action Step	Hydrology	Manage reservoirs (e.g. Lake Curry) and dam releases to maintain suitable rearing temperatures and migratory flows in downstream habitats (e.g., pulse flow programs for adult upstream migration and smolt outmigration).	1	100	CDFW, City of Vallejo, Napa County, NMFS, Solano County, Solano County Water Agency, SWRCB, USACE						TBD	Changes in flow management may incur costs to diverters and water delivery systems, but costs are unknown.
GVSC-CCCS-3.2.1.6	Action Step	Hydrology	Establish a comprehensive stream flow evaluation program to determine instream flow needs for steelhead.	2	20	CDFW, Napa County, NMFS, Private Landowners, RCD, Solano County, Solano County Water Agency, SWRCB						0	Action is considered In-Kind
GVSC-CCCS-3.2.1.7	Action Step	Hydrology	Identify and eliminate depletion of summer base flows from unauthorized water uses.	1	5	CDFW, NMFS, Private Landowners, SWRCB						0	Action is considered In-Kind
GVSC-CCCS-5.1	**Objective**	**Passage**	**Address the present or threatened destruction, modification or curtailment of the species habitat or range**										
GVSC-CCCS-5.1.1	Recovery Action	Passage	Assess and restore passage at barriers.										
GVSC-CCCS-5.1.1.1	Action Step	Passage	Assess and restore passage at barriers in Green Valley Creek.	2	5	CDFW, NMFS, Solano County, Solano County Water Agency						TBD	LSA did an assessment as part of a Salmonid Habitat Assessment Report for Solano County in 2008. Passage treatment would depend on the site characteristics and feasibility studies.
GVSC-CCCS-6.1	**Objective**	**Habitat Complexity**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**										
GVSC-CCCS-6.1.1	Recovery Action	Habitat Complexity	Improve frequency of primary pools, LWD, and shelters										
GVSC-CCCS-6.1.1.1	Action Step	Habitat Complexity	Maintain current LWD, boulders, and other structure-providing features to maintain current stream complexity, pool frequency, and depth (CDFG 2004).	2	100	CDFW, NMFS, NRCS, Private Landowners, Public, RCD, Solano County, Solano County Water Agency						0	Maintenance responsibilities and costs are usually incorporated into the restoration project agreement, and are not likely to have a separate cost.
GVSC-CCCS-6.1.1.2	Action Step	Habitat Complexity	Conduct a full habitat assessment to include substrate/pool riffle mapping.	2	10	CDFW, City of Vallejo, RCD, Solano County						TBD	Cost will be driven by extent and type of sampling conducted.
GVSC-CCCS-6.1.1.3	Action Step	Habitat Complexity	Improve instream conditions for steelhead by increasing LWD frequency and shelter within high priority areas, such as reaches 2-5 of Wooden Valley Creek.	2	20	CDFW, NMFS, NRCS, Private Landowners, RCD	8.00	8.00	8.00	8.00		32	Cost based on treating 0.2 miles at a rate of $31,200/mile.
GVSC-CCCS-6.1.1.4	Action Step	Habitat Complexity	Increase habitat complexity and improve pool frequency and depth within high priority areas, such as CDFW reaches 1,2,3, and 6 within Wooden Valley Creek.	2	20	CDFW, NMFS, NOAA RC, NRCS, Private Landowners, RCD						0	Cost accounted for in above action step.
GVSC-CCCS-6.1.1.5	Action Step	Habitat Complexity	Encourage landowners to implement woody debris restoration projects as part of their ongoing operations in stream reaches where large woody debris is lacking.	2	100	CDFW, NMFS, NOAA RC, NRCS, Private Landowners, RCD						0	Cost of incorporating LWD into ongoing operations is expected to be low.

Green Valley/Suisun Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
GVSC-CCCS-7.1	**Objective**	**Riparian**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**										
GVSC-CCCS-7.1.1	Recovery Action	Riparian	Improve riparian condition										
GVSC-CCCS-7.1.1.1	Action Step	Riparian	Manage riparian areas for their site potential composition and structure.	2	100	CDFW, NMFS, NRCS, Private Landowners, RCD						TBD	Cost of future management unknown at this time.
GVSC-CCCS-7.1.1.2	Action Step	Riparian	Restore and protect riparian vegetation to improve migration and summer/overwintering habitat for steelhead.	3	10	Napa County, NRCS, Solano County	166.00	166.00	166.00			498	Cost based on treating 1 mile (assume 20 acres/mile treated) at a rate of $24,862/acre.
GVSC-CCCS-7.1.1.3	Action Step	Riparian	Promote streamside conservation measures, including conservation easements, setbacks, and riparian buffers (CDFG 2004).	2	100	CDFW, NMFS, NOAA RC, NRCS, Private Landowners, RCD						0	Action is considered In-Kind
GVSC-CCCS-7.1.1.4	Action Step	Riparian	Work with landowners to evaluate any existing conservation easements that exist within the Suisun/Green Valley watersheds. Changes in these easements to better protect riparian habitat should be investigated.	2	5	CDFW, NMFS, NOAA RC, NRCS, Private Landowners, RCD						0	Action is considered In-Kind
GVSC-CCCS-7.1.1.5	Action Step	Riparian	Develop a Large Wood Recruitment Plan that assesses instream wood needs, and sites potentially responsive to wood recruitment or placement, and develop a riparian strategy to ensure long term natural recruitment of wood via large tree retention.	2	5	Napa County, Solano County	138.00					138	cost based on fish/habitat restoration model at a rate of $137,833/project.
GVSC-CCCS-7.1.1.7	Action Step	Riparian	Assess riparian canopy and impacts of exotic vegetation (e.g., Arundo, blue periwinkle, etc.), prioritize and develop riparian habitat reclamation and enhancement programs.	1	20	CDFW, NMFS, NOAA RC, NRCS, Private Consultants, Private Landowners, RCD	3.00					3	Cost to treat 0.3 miles (assume 1 project/mile in 5% high IP with 10 acres/mile treated) at a rate of $1,036/acre.
GVSC-CCCS-8.1	**Objective**	**Sediment**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**										
GVSC-CCCS-8.1.1	Recovery Action	Sediment	Improve instream gravel quality										
GVSC-CCCS-8.1.1.1	Action Step	Sediment	Complete a comprehensive sediment source inventory and assessment for the Suisun Creek and Green Valley Creek watersheds.	2	2	CDFW, NMFS, NRCS, Private Consultants, Private Landowners, RCD, Solano County, Solano County Water Agency, USEPA	50.00					50	Estimated cost of preparing the plan.
GVSC-CCCS-8.1.1.2	Action Step	Sediment	Provide incentives to restore high priority sites as determined by watershed analysis, CDFW or CalFire.	2	20	CalFire, CDFW, NMFS, NRCS, RCD						TBD	The cost of incentives is difficult to determine at this time.
GVSC-CCCS-8.1.1.3	Action Step	Sediment	Implement adequate monitoring to assess and track changes in bed profile and instream sediment levels in the watershed.	3	10	Napa County, RCD, Solano County, Solano County Water Agency	69.00	69.00				138	Cost for fish/habitat restoration monitoring at a rate of $137,833/project. This action step should be coordinated with similar action steps to reduce cost and redundancy.

Green Valley/Suisun Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
GVSC-CCCS-8.1.1.4	Action Step	Sediment	Use the v-star protocol over a broad area of each sub-basin on a regular basis to evaluate pool siltation.	2	10	CDFW, NMFS, NRCS, Private Consultants, Private Landowners, RCD						TBD	V-Star is a rather inexpensive monitoring technique, and cost is not expected to be substantial.
GVSC-CCCS-10.1	**Objective**	**Water Quality**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**										
GVSC-CCCS-10.1.1	Recovery Action	Water Quality	Improve stream temperature conditions										
GVSC-CCCS-10.1.1.1	Action Step	Water Quality	Investigate potential impacts to water temperatures associated with riparian vegetation clearing and/or alterations. Provide recommendations for re-establishing a native riparian corridor that rehabilitates water temperature conditions.	2	5	CDFW, Farm Bureau, NMFS, NRCS, Private Consultants, Private Landowners, RCD	100.00					100	Cost estimate for investigation.
GVSC-CCCS-10.1.1.2	Action Step	Water Quality	Conduct basic water quality studies (pH, dissolved oxygen, and conductivity). Consider additional assessments (e.g. sediment, pesticides, heavy metals, etc.)	3	10	CDFW, City of Vallejo, NMFS, RCD						TBD	
GVSC-CCCS-10.1.1.3	Action Step	Water Quality	Develop a riparian corridor plan that promotes increases in canopy cover.	2	5	CDFW, NMFS, NRCS, Private Consultants, Private Landowners, RCD						0	Cost accounted for in other recovery action steps - see Riparian.
GVSC-CCCS-10.1.1.4	Action Step	Water Quality	Identify factors limiting summer rearing water temperature conditions and develop water temperature reduction recommendations if appropriate.	1	20	CDFW, City of Vallejo, Napa County, NMFS, Private Consultants, Private Landowners, Solano County						TBD	Cost based on analysis of summer rearing water temperature. Cost to reduce water temperature likely accounted for in other action steps.
GVSC-CCCS-10.1.1.5	Action Step	Water Quality	Install water and air temperature data loggers to obtain annual or seasonal temperature data, capture diurnal variation in temperature, and obtain temperature data on a reach scale.	2	10	CDFW, City of Vallejo, RCD, Solano County	1.5					1.5	Cost based on installing a minimum of 3 continuous water/air temperature gauges at a rate of $500/station. Cost does not account for data management or maintenance.
GVSC-CCCS-11.1	**Objective**	**Viability**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**										
GVSC-CCCS-11.1.1	Recovery Action	Viability	Increase density, abundance, spatial structure, and diversity based on the biological recovery criteria										
GVSC-CCCS-11.1.1.1	Action Step	Viability	Develop standardized watershed assessments within sub-watersheds to define limiting factors specific to those areas. Encourage all major landowners to develop similar assessment methods.	3	20	CDFW, NMFS, NRCS, Private Consultants, Private Landowners, RCD						0	Action is considered In-Kind
GVSC-CCCS-11.1.1.2	Action Step	Viability	Evaluate feasibility of installing a lifecycle station in an appropriate location within the watershed. Implement action if found feasible.	1	10	CDFW, NMFS						0	Costs for monitoring population status and trends are accounted for in the Monitoring Chapter.
GVSC-CCCS-11.1.1.3	Action Step	Viability	Monitor population status for response to recovery actions.	3	5	Napa County, NRCS, Solano County						0	Costs for monitoring population status and trends are accounted for in the Monitoring Chapter.

Green Valley/Suisun Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
GVSC-CCCS-11.1.1.4	Action Step	Viability	Utilize CDFW approved implementation, effectiveness, and validation monitoring protocols when assessing efficacy of restoration efforts.	1	100	CDFW, NOAA RC, NRCS, Private Consultants, Private Landowners, RCD						TBD	This will depend on the scope and frequency of restoration projects implemented. Monitoring costs may be considered In-Kind and a requirement of the restoration/permitting process.
GVSC-CCCS-11.1.1.5	Action Step	Viability	Investigate reintroducing steelhead into newly accessible habitat following projects that address passage barriers.	1	50	CDFW, NMFS, NOAA SWFSC						0	Action is considered In-Kind
GVSC-CCCS-11.2	**Objective**	**Viability**	**Address the inadequacy of existing regulatory mechanisms**										
GVSC-CCCS-11.2.1	Recovery Action	Viability	Increase density, abundance, spatial structure, and diversity based on the biological recovery criteria										
GVSC-CCCS-11.2.1.1	Action Step	Viability	Protect adult steelhead from illegal take (e.g., poaching).	3	100	CDFW Law Enforcement, NMFS OLE						0	Action is considered In-Kind
GVSC-CCCS-12.1	**Objective**	**Agriculture**	**Address the present of threatened destruction, modification, or curtailment of the species habitat or range**										
GVSC-CCCS-12.1.1	Recovery Action	Agriculture	Prevent or minimize impairment to stream hydrology (impaired water flow)										
GVSC-CCCS-12.1.1.1	Action Step	Agriculture	Incentive programs and incentive-based approaches should be explored for landowners who conduct operations in a manner compatible with steelhead recovery requirements.	3	25	NRCS, Solano County						TBD	Cost based on amount of landowner participation and appropriate incentives for management operations. Incentive programs currently exist and should be explored and expanded.
GVSC-CCCS-12.1.2	Recovery Action	Agriculture	Prevent or minimize impairment to instream substrate/food productivity (gravel quality and quantity)										
GVSC-CCCS-12.1.2.1	Action Step	Agriculture	Minimize future sediment and runoff sources from agricultural land by modifying actions that deliver sediment and runoff to stream channels.	2	100	NRCS, Solano County						0	Action is considered In-Kind
GVSC-CCCS-12.1.2.2	Action Step	Agriculture	Maintain intact and properly functioning riparian buffers to filter and prevent fine sediment input from entering streams.	2	100	CDFW, Napa County, NMFS, NRCS, Private Landowners, RCD, Solano County						0	Action is considered In-Kind
GVSC-CCCS-12.1.3	Recovery Action	Agriculture	Prevent or minimize impairment to habitat complexity (reduced large wood and/or shelter)										
GVSC-CCCS-12.1.3.1	Action Step	Agriculture	Limit salmonid habitat degradation resulting from conversion of forestland/open space to agriculture.	3	100							0	Action is considered In-Kind
GVSC-CCCS-12.1.3.2	Action Step	Agriculture	Work within the agricultural community to educate landowners and enhance practices that provide for functional watershed processes.	3	25	CDFW, Farm Bureau, Napa County, NMFS, NRCS, Private Landowners, RCD, Solano County						0	Action is considered In-Kind
GVSC-CCCS-12.1.3.3	Action Step	Agriculture	Increase setbacks of existing agricultural activities from the top of bank to 100'	2	100	CDFW, Farm Bureau, Napa County, NMFS, NRCS, Private Landowners, RCD, Solano County						TBD	Cost is difficult to estimate at this time, and will be dependent on the linear distance of setbacks and the cost to landowners of lost production from area inside the setback.

Green Valley/Suisun Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
GVSC-CCCS-12.1.4	Recovery Action	Agriculture	Prevent or minimize impairment to water quality (increased turbidity, suspended sediment, and/or toxicity)										
GVSC-CCCS-12.1.4.1	Action Step	Agriculture	Reduce discharge of chemical effluent and fertilizer related to agricultural practices.	3	25	CDFW, Napa County, NMFS, Private Consultants, Private Landowners, RCD, RWQCB, Solano County						0	Action is considered In-Kind
GVSC-CCCS-12.2	**Objective**	**Agriculture**	**Address the inadequacy of existing regulatory mechanisms**										
GVSC-CCCS-12.2.1	Recovery Action	Agriculture	Prevent or minimize impairment to habitat complexity (reduced large wood and/or shelter)										
GVSC-CCCS-12.2.1.1	Action Step	Agriculture	Minimize impacts to instream flows and aquatic habitat arising from agricultural water diversions or pumping.	2	10	State Water Resources Control Board, Napa County, NRCS, Solano County						0	Action is considered In-Kind
GVSC-CCCS-12.2.1.2	Action Step	Agriculture	Solano and Napa counties should restrict and or minimize conversion of open space, rangeland, or TPZ to vineyards or other agricultural uses that impact salmonids until a grading ordinance and land conversion ordinance are in place.	2	10	CDFW, Napa County, NMFS, Solano County						0	Action is considered In-Kind
GVSC-CCCS-12.2.1.3	Action Step	Agriculture	Develop legislation that will fund county planning for environmentally sound agricultural growth and water supply	2	10	CDFW, Napa County, NMFS, RCD, Solano County						0	Action is considered In-Kind
GVSC-CCCS-12.2.1.4	Action Step	Agriculture	Complete Farm Conservation Plans (through the SRCD, NRCS, Fish Friendly Farming program or other cooperative conservation programs) to reduce sediment sources and improve riparian habitat within the watershed.	2	10	CDFW, Farm Bureau, Napa County, NMFS, NRCS, Private Landowners, RCD, Solano County						TBD	Cost is TBD, since the total number and scope of the future plans is unknown at this time.
GVSC-CCCS-18.1	**Objective**	**Livestock**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**										
GVSC-CCCS-18.1.1	Recovery Action	Livestock	Prevent or minimize impairment to water quality (increased turbidity, suspended sediment, and/or toxicity)										
GVSC-CCCS-18.1.1.1	Action Step	Livestock	Where necessary, establish predetermined stream crossings when herding cattle between pastures.	2	100	Farm Bureau, NRCS, Private Landowners, RCD						TBD	Cost based on the number of stream crossing to establish.
GVSC-CCCS-18.1.1.2	Action Step	Livestock	Develop off-stream waters sources for livestock.	2	25	Farm Bureau, NRCS, Private Landowners, RCD						TBD	Cost based on amount of off-stream water sources needed. Cost estimated at $5,000/site.

Green Valley/Suisun Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
GVSC-CCCS-18.1.1.3	Action Step	Livestock	Implement water quality standards as outlined in the University of California guidelines for water quality protection (Ristow 2006).	3	10	CDFW, Farm Bureau, Napa County, NMFS, NRCS, Private Landowners, RCD, RWQCB, Solano County						0	Action is considered In-Kind
GVSC-CCCS-18.1.1.4	Action Step	Livestock	Implement the recommendations of the California Rangeland Water Quality Management Program.	2	100	Farm Bureau, NRCS, Private Landowners, RCD						0	Action is considered In-Kind
GVSC-CCCS-18.1.1.5	Action Step	Livestock	Address water quality and nutrient loading issues by encouraging sustainable land management practices, controlling sediment sources, protecting riparian zones and employing BMPs that encourage permeability and infiltration (CDFG 2004).	3	10	Napa County, NRCS, Solano County						0	Action is considered In-Kind
GVSC-CCCS-18.1.2	Recovery Action	Livestock	Prevent or minimize adverse alterations to riparian species composition and structure										
GVSC-CCCS-18.1.2.1	Action Step	Livestock	Support grazing practices that minimize impacts to riparian and instream habitat: livestock exclusion, rotational grazing, etc.	2	100	Farm Bureau, NRCS, Private Landowners, RCD						0	Action is considered In-Kind
GVSC-CCCS-18.1.2.2	Action Step	Livestock	Exclude cattle from entering and trampling riparian and instream habitat. High priority reaches to address include survey reaches 2-5 of Wooden Valley Creek (see NCRCD survey).	2	100	Farm Bureau, NRCS, Private Landowners, RCD	2.30	2.30	2.30	2.30	2.30	46	Cost based on riparian exclusion fencing at a rate of $4.36/ft.
GVSC-CCCS-18.1.2.3	Action Step	Livestock	Establish conservative residual dry matter (RDM) target per acre that ensures area is not overgrazed with 1000 lbs RDM (residual dry matter)/acre left at end of grazing season. Remove cattle from pasture before soils dry out.	2	10	Farm Bureau, NRCS, RCD						0	Action is considered In-Kind
GVSC-CCCS-18.1.2.4	Action Step	Livestock	Establish a monitoring protocol to determine if RDM levels exceed targets.	3	10	Farm Bureau, NRCS, RCD						0	Action is considered In-Kind
GVSC-CCCS-25.1	**Objective**	**Water Diversion/ Impoundment**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**										
GVSC-CCCS-25.1.1	Recovery Action	Water Diversion/ Impoundment	Improve flow conditions										
GVSC-CCCS-25.1.1.1	Action Step	Water Diversion/ Impoundment	Through outreach and education, reduce or minimize diversions and water use in tributary reaches in order to maintain surface flows, or restore flows where needed.	2	5	Napa County, Solano County						0	Action is considered In-Kind
GVSC-CCCS-25.1.1.2	Action Step	Water Diversion/ Impoundment	Improve coordination between agencies and others to address season of diversion, off-stream reservoirs, bypass flows protective of steelhead and their habitats, and avoidance of adverse impacts caused by water diversion.	1	5	CDFW, NMFS, Private Landowners, SWRCB						0	Action is considered In-Kind
GVSC-CCCS-25.1.1.3	Action Step	Water Diversion/ Impoundment	Provide incentives to water rights holders within Suisun Creek and Green Valley Creek tributaries willing to convert some or all of their water right to instream use via petition change of use and California Water Code §1707.	2	10	CDFW, Napa County, NMFS, Solano County, Solano County Water Agency						TBD	Potential incentives unknown at this time. Currently, incentive programs exist and should be explored and expanded upon.

Green Valley/Suisun Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
GVSC-CCCS-25.1.1.4	Action Step	Water Diversion/ Impoundment	Promote water conservation best practices such as drip irrigation for vineyards.	2	5	CDFW, Farm Bureau, NMFS, NOAA RC, NRCS, Private Landowners, Public, RCD, Solano County Water Agency						0	Promotion largely done through federal, state and local partnerships with interested NGO's.
GVSC-CCCS-25.1.1.5	Action Step	Water Diversion/ Impoundment	Promote the use of reclaimed water for agricultural or other uses.	2	5	CDFW, Farm Bureau, NMFS, NOAA RC, NRCS, Private Landowners, Public, RCD						0	Promotion likely done largely by agency and NGO partnerships.
GVSC-CCCS-25.2	**Objective**	**Water Diversion/ Impoundment**	**Address the inadequacy of existing regulatory mechanisms**										
GVSC-CCCS-25.2.1	Recovery Action	Water Diversion/ Impoundment	Improve flow conditions										
GVSC-CCCS-25.2.1.1	Action Step	Water Diversion/ Impoundment	Avoid and/or minimize the adverse effects of water diversion on salmonid habitat by establishing a more natural hydrograph, by-passing adequate downstream flows, regulating season of diversion, and promoting and implementing off-stream storage solutions.	1	25	State Water Resources Control Board, CDFW, Napa County, NMFS, Solano County						0	Action is considered In-Kind
GVSC-CCCS-25.2.1.2	Action Step	Water Diversion/ Impoundment	Encourage the SWRCB to adjudicate watersheds within Suisun Creek and Green Valley Creek watersheds to resolve over-allocation of water resources, and provide adequate funding to water masters to enforce allocations.	2	10	CDFW, NMFS, SWRCB						0	No cost expected to encourage the SWRCB. Encouragement would largely arise through already employed CDFW and NMFS staff.
GVSC-CCCS-25.2.1.3	Action Step	Water Diversion/ Impoundment	Encourage the SWRCB to conduct interagency consultation with the California Department of Fish and Wildlife and seek technical assistance from NMFS on the issuance of water rights permits.	1	100	CDFW, NMFS, SWRCB						0	Action is considered In-Kind
GVSC-CCCS-25.2.1.4	Action Step	Water Diversion/ Impoundment	Upgrade the existing water rights information system so that water allocations can be readily quantified by watershed.	2	5	CDFW, NMFS, SWRCB						0	This action is largely part of Water Control Board operations and information database.
GVSC-CCCS-25.2.1.5	Action Step	Water Diversion/ Impoundment	Support the Development and implementation of groundwater use regulations.	1	10	CDFW, NMFS, SWRCB						0	Action is considered In-Kind
GVSC-CCCS-25.2.1.6	Action Step	Water Diversion/ Impoundment	Improve compliance with existing water resource regulations via monitoring and enforcement.	1	100	CDFW, CDFW Law Enforcement, NMFS, NMFS OLE						0	Cost expected to be largely absorbed through already employed agency enforcement personnel.

Napa River Population

CCC Steelhead Winter-Run

- Role within DPS: Functionally Independent Population
- Diversity Stratum: Interior San Francisco Bay
- Spawner Density Target: 4,700 adults
- Current Intrinsic Potential: 233.2 IP-km

Steelhead Abundance and Distribution

Leidy *et al*. (2005) concluded that the Napa River historically supported the largest steelhead run of all San Francisco Bay tributaries (excluding the Sacramento – San Joaquin basin). In 1969, Fiends of the Napa River (FONR) sponsored possibly the most thorough fish survey conducted within any tributary to San Francisco Bay. The 1969 fish survey identified Dry, Redwood, Sulphur, and Soda creeks as important contributors to the Napa River steelhead fishery with a standing crop of juvenile steelhead estimated at 87,300 to 144, 600, resulting in a range of 580 to 1,930 returning adults steelhead (Anderson 1969f, as cited by Leidy *et al*. 2005 and Becker *et al*. 2007). Other historical estimates of steelhead escapement to the Napa River range from 6,000 to 8,000 individuals (Anderson 1972; USFWS and CDFG 1968, as cited by Leidy *et al*. 2005). More recent surveys carried out by the Friends of the Napa River, Ecotrust, and the Napa County Resource Conservation District (RCD) indicate that *O. mykiss* are currently present in many tributaries within the Napa River watershed; however, juvenile densities are substantially lower from reported historical levels (Ecotrust and FONR 2001, as cited by Leidy *et al*. 2005; NRCD 2009). There are no current estimates of the annual number of adult steelhead that return to the Napa River watershed.

History of Land Use

In the mid-1800s, the primary land uses in the Napa River watershed were agriculture, timber production, grazing, and field crops (Stillwater 2002). Prior to the 1960s, the Napa River Valley was used primarily for a combination of orchards, field crops, and vineyards, with localized urban development in the cities of Napa, Yountville, St. Helena, and Calistoga. Vineyards were first developed in the 1860s, but rapidly increased in areal extent from approximately 15 mi^2 in 1970 to 49 mi^2 in 1996 (Napa County RCD 1997, as cited by Stillwater 2002). Intense timber harvest occurred in portions of the watershed until around the 1950s. Groundwater pumping has occurred since 1910, but has increased in recent years as farmers increasingly rely on overhead sprinklers to protect vineyards from frost damage (Stillwater 2002). Other water use activities include construction of major dams in the watershed (Conn, Bell, Rector, Milliken, York, and Kimball), all built between 1924 and 1959 (Stillwater 2002). Direct in-channel alternations to river

geomorphology include river bottom dredging in the mainstem Napa River from the mouth to approximately 15 river miles upstream. Widespread removal of large woody debris, channel clearing, and levee building occurred in the 1960s and again in the 1990s for flood control purposes.

Current Resources and Land Management

The Napa River currently has a relatively low proportion of protected open space compared to the high proportion of open space within the watershed (Becker *et al*. 2007). The majority of unprotected open space that encompasses a significant portion of the Napa River watershed is due to extensive vineyard land use and management (Becker *et al*. 2007). Approximately 30 mi^2 of the basin are currently used and managed for urban uses, including water supply, resorts (spas and golf courses), rural residential housing and rangeland (Stillwater 2002). The Napa River watershed is on the Regional Water Quality Control Board's Impaired Water Bodies List under Section 303(d) of the Clean Water Act.

Major stakeholders in the watershed include Napa County Flood Control and Water Conservation District, Friends of the Napa River, Napa County Restoration and Conservation District, the Rutherford Reach DUST Society, Regional Water Quality Control Board, California Land Stewardship Institute, and other agricultural interests. The following documents are available for the Napa River watershed:

- Napa River Fish Barrier Plan (NCRCD 2011)
- Napa River Steelhead and Salmon Smolt Annual Monitoring Program (NCRCD 2005 – present)
- The Napa River Fisheries Study: The Rutherford Dust Society Restoration Reach (NCRCD 2005)
- Napa River Basin Limiting Factors Analysis (SFBWQCB & CSCC 2002)
- Napa River Sediment TMDL Baseline Study (SFEI 2002)

Salmonid Viability and Watershed Conditions

The following indicators were rated Poor through the CAP process for steelhead: floodplain connectivity, flow conditions (summer baseflow), LWD frequency, pool shelter, primary pools, water temperature, canopy cover, passage/migration, gravel quality, and estuary quality and extent, riparian (species composition and diameter), streamside road density, and turbidity. Recovery strategies will focus on improving these poor conditions as well as those needed to ensure population viability and functioning watershed processes.

Current Conditions

The following discussion focuses on those conditions that were rated Fair or Poor as a result of our CAP viability analysis. The Napa River CAP Viability Table results are provided below. Recovery strategies will focus on improving these conditions.

Population and Habitat Conditions

Passage/Migration: Mouth or Confluence and Physical Barriers

The Napa River watershed is impacted by many in-channel structures, such as bridge aprons, flow diversions, culverts, road crossings, and dams that are complete or partial barriers to juvenile and adult steelhead migration (Stillwater 2002). Historically, about 300 stream miles (480 km) were likely accessible and suitable for steelhead spawning and rearing in most years (USFWS 1968, as cited by Stillwater 2002). Following the construction of Conn, Bell, and Rector dams, the amount of Napa River habitat lost to these dams alone was estimated at 17 percent. Other large dams (York, Milliken, and Kimball) and many smaller dams have resulted in significant loss of high quality habitat within the Napa River basin. Important high-quality habitat has also been lost in Carneros Creek, Mill Creek, Ritchey Creek, Napa River mainstem, Campbell Creek, Pickle Creek, Huichica Creek, Selby Creek, Milliken Creek, and others due to passage impairments (Koehler 2011, pers. comm.). The total amount of lost or available suitable steelhead habitat is unavailable; however, 69 in-channel structures known to block or impede steelhead migration were identified by Stillwater (2002). Moreover, USGS maps indicate over 220 lakes, ponds, and reservoirs within or near many tributaries channels and over 400 road crossing sites that may also disrupt habitat connectivity (Stillwater 2002) suggesting that the number of passage impediments might be far greater than the 69 in-channel structures identified by Stillwater (2002).

Hydrology: Baseflow and Passage Flows

Extensive water diversions, large and small dams, groundwater pumping, channel alterations, and agriculture water use have together greatly impaired Napa River hydrology. Extensive water diversions, groundwater pumping, and increased agriculture (vineyards) water use during the dry season have reduced the extent of suitable summer rearing habitat and quality riffle habitat essential for macro-invertebrate production throughout much of the Napa River watershed. Additionally, reduced surface and ground water interaction has most likely increased water temperatures in many summer rearing tributaries. Large and small dams have also significantly impaired hydrologic conditions for seasonal and summer rearing and juvenile and adult steelhead migration (flow-related barriers) during critical periods of the year.

Sediment: Gravel Quality and Distribution of Spawning Gravels, and Water Quality: Turbidity or Toxicity

The Napa Valley is heavily developed for both agricultural and residential land uses that have led to widespread hill slope erosion. Stream bank erosion has been identified as a clear concern for many stakeholders in the watershed (Napa River Watershed Task Force, as cited by Stillwater 2002). Previous studies indicate that land use activities have increased fine sediment transport into stream channels in the Napa River watershed (WET, Inc 1990; USDA-SCS 1994, as cited by Stillwater 2002). However, Stillwater Sciences (2002) suggested that there is not a chronic source of sediment causing deleterious turbidity levels within sampled stream of the Napa River watershed. Although prolonged chronic levels were not documented during the 2-year study conducted by Stillwater Sciences (2002), the effect of minimally increased turbidity levels due to upslope and bank erosion sources can significantly impair feeding opportunities for winter rearing juvenile steelhead and subsequently reduce their fitness and survival.

Stillwater Science (2002) concluded that fine sediment loading is most likely a widespread problem within the Napa River watershed. Excessive fine sediment delivery from upslope and bank erosion sources has also decreased spawning gravel permeability and impaired successful egg incubation (SFEI Watershed Program 2002). Some localized patches of quality coarse streambed material exist within the mainstem Napa River and selected tributaries; however, the extent and recruitment of coarse material into historically productive rearing and spawning reaches has been reduced. The mainstem Napa River, the Bear Canyon Creek subwatershed, and Milliken Creek have been identified as having inadequate gravel quality and high embeddedness levels.

Habitat Complexity: Large Wood and Shelter

Tributary channels have fewer pools and reduced shelter due to reduced LWD frequency (Stillwater 2002). The loss of channel forming LWD features that historically created habitat complexity and desirable pool/riffle/flatwater ratios has reduced the carrying capacity of rearing juvenile steelhead and spawning gravel abundance in many tributaries. A significant reduction in LWD has also occurred in the mainstem Napa River due to past flood control activities. The reduced LWD volume coupled with channelization has substantially degraded mainstem habitat quality. Moreover, the loss of sloughs, side channels, floodplain, riffle habitat, and hydraulic diversity has increased the frequency of long, straight, deep pool/flatwater habitat favoring exotic predators, and severely limits fall, spring, and winter rearing potential for juvenile steelhead in the mainstem Napa River. In addition, low LWD volume has limited the ability of the mainstem river to trap and sort coarse material desirable for main steelhead spawning and macro-invertebrate production. The following creeks have been identified as having poor shelter, primary pool, and/or pool/riffle/flatwater ratios, and would benefit from restoration work that incorporates LWD: Bear Canyon, Bell, Browns, Canon, Carneros, Conn, Dry, Heath, Milliken,

Montgomery, Napa, Pickle, Redwood, Sulpher, Soda, Wing, York, Ritchie, Salvador, Tulucay, and Hopper creeks.

Riparian Vegetation: Composition, Cover & Tree Diameter and Water Quality: Temperature

Warm water temperatures and low food supply appear to severely limit growth of summer rearing juvenile steelhead in the Napa River watershed (Stillwater 2002). Riparian clearing, resulting in narrow riparian widths and poor species diversity, has mostly likely increased summer water temperatures when compared to pre-development conditions. Instream water temperatures have also likely increased due to reduced gravel permeability and impaired ground-to-surface water interaction. Ground-to-surface water interaction has also been disrupted by the loss of channel forming features that encourage scouring of deep pools and groundwater pumping that significantly lowers the groundwater table. Historically, west side tributaries with mature forest would have provided LWD to stream channels that would have scoured deep pools that remained hydrologically connected to cooler groundwater seeps. Altered species diversity within existing riparian corridors has also occurred throughout the mainstem Napa River, where floodplain clearing and levee building have reduced riparian width and introduced non-native plant species with reduced shading potential.

Velocity Refuge: Floodplain Connectivity

Increased channel connectivity and channelization due to agriculture, urbanization, and flood control activities have increased the magnitude and intensity of flow following winter storm events within the Napa River basin. These conditions, coupled with reduced habitat complexity (e.g., loss of off-channel habitat, shelter, channel forming features, etc.), have accelerated water velocities during winter storm events that can impair adult upstream migration and significantly reduce the value of winter juvenile rearing habitat within the mainstem.

Estuary: Quality and Extent

The Napa River estuary has been dramatically altered by dredging, diking, and the introduction of exotic species (Stillwater 2002), all of which have greatly reduced the quality and extent of estuarine habitat for smolt and summer rearing juveniles. More information is needed to determine the current quality and temporal availability of the Napa River estuary and the rehabilitation work needed to improve its health and condition.

Threats

The following discussion focuses on those threats that were rated as High or Very High (See Napa River CAP Results). Recovery strategies will likely focus on ameliorating High rated threats;

however, some strategies may address Medium and Low threats when the strategy is essential to recovery efforts.

Water Diversions and Impoundments

Several large dams were built between 1924 and 1959 on major eastside tributaries (Conn, Rector, Milliken, York, and Bell dams) and Kimball Dam on the northern headwaters of the Napa River (Stillwater 2002). York Dam is currently inoperable and has been proposed for removal for years by the U.S. Army Corps of Engineers. York Dam currently does not store water, but the physical dam still prevents quality coarse material from recruiting to downstream reaches and precludes steelhead access into quality habitat in upper York Creek. Currently, there is no planned date for removing York Dam. Conn, Rector, Milliken, Kimball, and Bell dams are all in operation for water supply purposes. Impacts associated with each of these dams include: storing quality coarse material (e.g., spawning gravel) and preventing recruitment to downstream reaches, completely blocking steelhead access to high value habitat, and significantly impairing downstream flows. None of these dams have developed flow schedules that adequately address steelhead life history requirements. Therefore, each of these dams individually and collectively threatens the future recovery of steelhead in the Napa River watershed. Additionally, many smaller dams, stream diversion facilities, and groundwater pumps will also continue to threaten streamflow and the quality of steelhead habitat conditions.

Agriculture

The conversion of grazing and open space lands to vineyard production has been the most significant change to the Napa River landscape in recent years (SFEI 2002). This change has increased the pressure on water resources, threatening the ability of the Napa River watershed to support a viable steelhead run in the future. Poor vineyard management has caused severe stream bank erosion along the mainstem river corridor, and has also been a source of excessive fine sediment input to tributary networks. Lost floodplain connectivity, diminished habitat complexity, altered seasonal flow patterns, and increased water temperature can all be attributed to vineyard development within the Napa River Valley. Recent efforts by the Rutherford Reach DUST Society, with assistance from the Napa River Flood Control District and the Napa County RCD, have made significant gains to habitat rehabilitation along the mainstem Napa River; however, more rehabilitation work will be required, and water use efficiency measures during the summer months will need to be implemented, to significantly improve conditions for steelhead to the extent that a viable steelhead run can be restored in the Napa River watershed.

Channel Modification

Channel modification remains one of the most significant threats to habitat complexity within the Napa River watershed. Past LWD removal, levee building, and channel straightening activities

for flood control and agriculture have significantly degraded steelhead habitat condition within many Napa River tributaries and mainstem. Constraining the Napa River mainstem through past channel modification activities has increased in-channel bank erosion and fine sediment input, accelerated channel incision rates, and limited coarse sediment depositional areas. Channel modification techniques that have disconnected stream channels from floodplain habitat also alter natural hydrologic patterns since stream connectivity efficiently drains the landscape during the wet months and reduces the duration of potential groundwater recharge. The Napa River Flood and Conservation District, the Napa County RCD, and the Rutherford Reach DUST Society are in the process of implementing the 4.5 mile Rutherford Reach Restoration Project and have already successfully improved floodplain connectivity and habitat complexity, and designed bank protection features that enhance winter steelhead habitat during the wet season. Once completed, the Rutherford Reach Restoration Project should be an excellent example of a successful large scale rehabilitation project carried out within a highly modified, incised, and channelized stretches of stream. Similar rehabilitation efforts are underway as the California Land Stewardship Institute has recently completed the Oakville to Oak Knoll Napa River Restoration Concept Plan 2011, and the Army Corps of Engineers is in the process of installing habitat enhancement features within Napa Creek as part of the Napa River Flood Protection Project. Implementing these efforts will reduce both the current and future threat of channel modification to Napa River steelhead and their habitat.

Limiting Stresses, Lifestages, and Habitats

Summer and winter juvenile steelhead lifestages are the most limited in the Napa River watershed. The summer juvenile lifestage is limited the most by reduced habitat complexity, poor gravel quality/food production, elevated summer water temperatures, and low summer stream flows. The winter rearing juvenile lifestage is most limited by reduced habitat connectivity (impaired passage), reduced habitat complexity, altered hydrologic stream patterns, and poor floodplain connectivity. Steelhead production in the Napa River watershed is also severely limited by fish passage barriers that limit access to areas of high quality habitat.

General Recovery Strategy

In general, recovery strategies will focus on improving conditions and ameliorating stresses and threats discussed above, although strategies that address other indicators may also be developed where their implementation is critical to restoring properly functioning habitat conditions within the watershed.

Improve Fish Passage

All partial and complete barriers to adult and steelhead migration should be identified and assessed. Passage assessments should prioritize streams based upon their existing habitat value, potential increase in habitat availability, and their potential to aid steelhead recovery in the Napa River watershed.

Improve Habitat Complexity and Gravel Quality

Mainstem habitat enhancement projects incorporating LWD, boulders, and other habitat complexity and channel forming features will greatly improve juvenile steelhead winter survival and adult steelhead upstream migration. Tributary habitat enhancement projects should give the highest priority to those streams with high productivity potential (i.e., suitable water temperatures and quality spawning gravel).

Improve Canopy Cover and Reduce Stream Water Temperature

Many tributaries of the Napa River watershed would benefit from riparian restoration projects that improve stream shading, reduce stream temperatures, and encourage natural LWD recruitment. Priority tributaries should be carefully selected to ensure that restoration efforts have a high probability of success in reducing water temperatures for summer rearing juvenile steelhead.

Protect Seasonal and Summer Hydrologic Conditions

Implementing flow releases out of reservoirs that meet steelhead life history requirements would greatly improve steelhead productivity within the Napa River watershed. Summer streamflow guidelines should be developed and groundwater pumping monitored to ensure the protection of streamflows in productive summer rearing tributaries.

Literature Cited

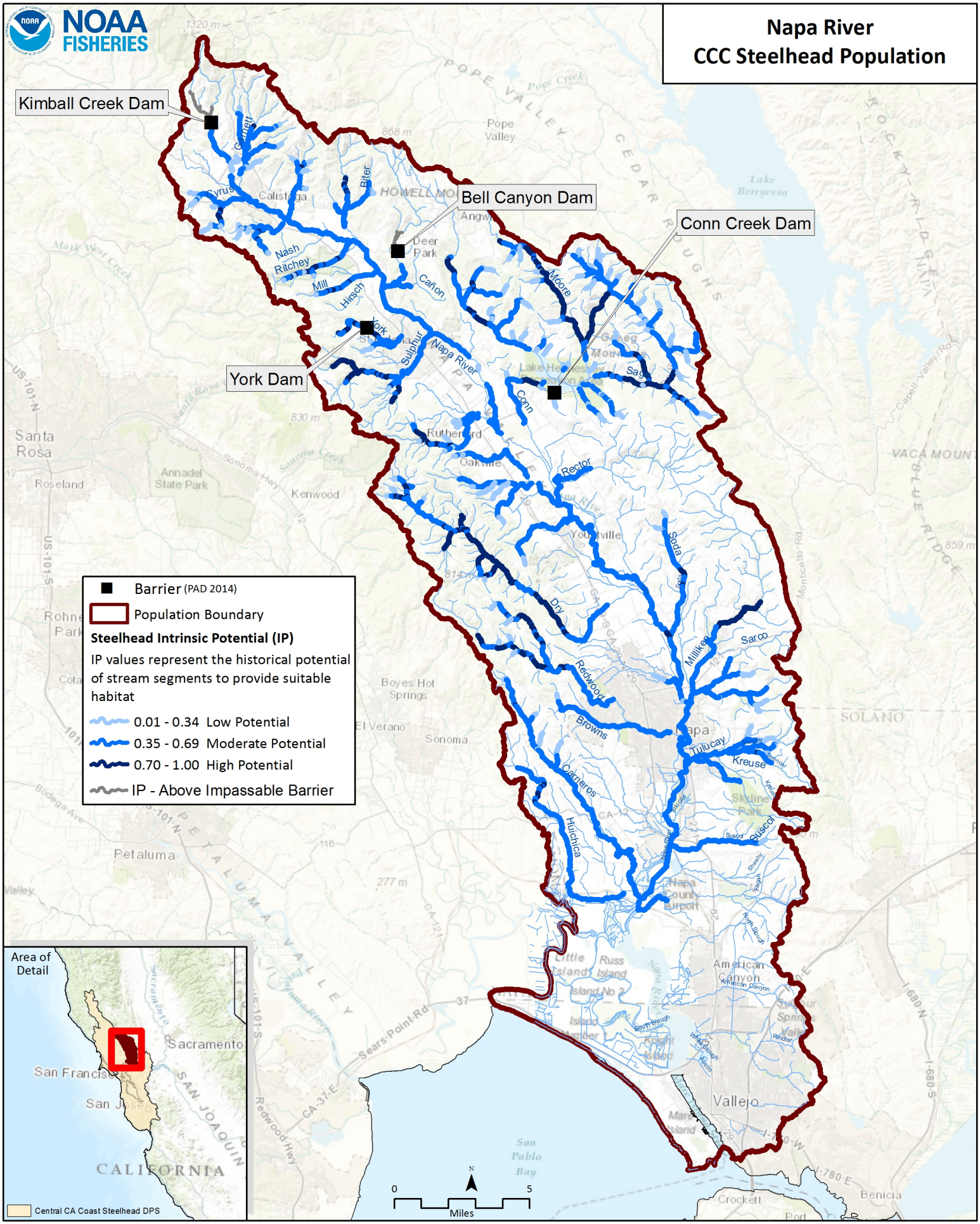
Becker. G.S., I.J. Reining, D.A. Asbury, A. Gunther. 2007. San Francisco Estuary Watershed Evaluation: Identifying Promising Locations for Steelhead Restoration in Tributaries of the San Francisco Estuary. Center for Ecosystem Management and Restoration, Oakland, CA.

Pearce, S., O'Connor, M., Grossinger, R., and McKee, L., 2002. Napa River TMDL Baseline Study: Geomorphic Processes and Habitat Form and Function in Soda Creek. A Technical Report of the Regional Watershed Program, SFEI Contribution 63. San Francisco Estuary Institute, Oakland, CA.

Leidy, R.A., G.S. Becker, B.N. Harvey. 2005. Historical distribution and current status of steelhead/rainbow trout *(Oncorhynchus mykiss)* in streams of the San Francisco Estuary, California. Center for Ecosystem Management and Restoration, Oakland, CA.

Stillwater Sciences. 2002. Napa River Basin Limiting Factors Analysis.

Jonathan Koehler, pers. comm. Napa RCD 2011.


Napa River
CCC Steelhead Population
Kimball Creek Dam
Bell Canyon Dam
Conn Creek Dam
York Dam
Barrier (PAD 2014)
Population Boundary
Steelhead Intrinsic Potential (IP)
IP values represent the historical potential of stream segments to provide suitable habitat
0.01 - 0.34 Low Potential
0.35 - 0.69 Moderate Potential
0.70 - 1.00 High Potential
IP - Above Impassable Barrier
Area of Detail
Sacramento
San Francisco
San Jose
CALIFORNIA
Central CA Coast Steelhead DPS
Miles
Napa
Vallejo
Santa Rosa
Petaluma
Sonoma
Napa River
Conn
Rutherford
Oakville
Yountville
Rector
Soda
Dry
Redwood
Browns
Carneros
Huichica
Milliken
Sarco
Tulucay
Kreuse
Ruscol
Moore
Sulphur
Nash
Ritchey
Mill
Hirsch
Cyrus
Bitter
Canon
Sage
Pope Valley
Calistoga
Deer Park
Lake Berryessa
Lake Hennessey
Napa County Airport
American Canyon
Skyline Park
Little Island
Russ Island
Mare Island
San Pablo Bay
Crockett
Benicia
Boyes Hot Springs
El Verano
Roseland
Annadel State Park
Kenwood
Rohnert Park
Cotati
Bodega Ave
Sears Point Rd
Redwood Hwy
Petaluma Valley
Monticello Rd
Capell Valley Rd
Napa Valley
Vaca Mountains
Rocky Ridge
Howell Mountain
Pope Valley
Cedar Rough
Mark West Creek
Sonoma Creek
Sonoma Hwy
Napa Creek
Pope Creek
Solano
Napa County
Sonoma County
US-101-N
US-101-S
CA-12
CA-121
CA-37-E
I-680-N
I-680-S
I-780-E
I-780-W
1320 m
868 m
830 m
814 m
277 m
859 m

#	Conservation Target	Category	Key Attribute	Indicator	Poor	Fair	Good	Very Good	Current Indicator Measurement	Current Rating
1	Adults	Condition	Habitat Complexity	Large Wood Frequency (BFW 0-10 meters)	<50% of streams/ IP-Km (>6 Key Pieces/100 meters)	50% to 74% of streams/ IP-Km (>6 Key Pieces/100 meters)	75% to 90% of streams/ IP-Km (>6 Key Pieces/100 meters)	>90% of streams/ IP-Km (>6 Key Pieces/100 meters)	50% to 74% of streams/ IP-km (>6 Key Pieces/100 meters)	Fair
			Habitat Complexity	Large Wood Frequency (BFW 10-100 meters)	<50% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	50% to 74% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	75% to 90% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	>90% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	<50% of streams/ IP-km (>1.3 Key Pieces/100 meters)	Poor
			Habitat Complexity	Pool/Riffle/Flatwater Ratio	<50% of streams/ IP-Km (>40% Pools; >20% Riffles)	50% to 74% of streams/ IP-Km (>40% Pools; >20% Riffles)	75% to 90% of streams/ IP-Km (>40% Pools; >20% Riffles)	>90% of streams/ IP-Km (>40% Pools; >20% Riffles)	46% streams/ 52% IP-km (>40% Pools; >20% Riffles)	Fair
			Habitat Complexity	Shelter Rating	<50% of streams/ IP-Km (>80 stream average)	50% to 74% of streams/ IP-Km (>80 stream average)	75% to 90% of streams/ IP-Km (>80 stream average)	>90% of streams/ IP-Km (>80 stream average)	4% streams/ 0 % IP-km (>80 stream average)	Poor
			Hydrology	Passage Flows	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 51-75	Fair
			Passage/Migration	Passage at Mouth or Confluence	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	50% of IP-km to 74% of IP-km	Fair
			Passage/Migration	Physical Barriers	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	98.44% of IP-km	Very Good
			Riparian Vegetation	Tree Diameter (North of SF Bay)	≤39% Class 5 & 6 across IP-km	40 - 54% Class 5 & 6 across IP-km	55 - 69% Class 5 & 6 across IP-km	>69% Class 5 & 6 across IP-km	?39% Class 5 & 6 across IP-km	Poor
			Riparian Vegetation	Tree Diameter (South of SF Bay)	≤69% Density rating "D" across IP-km	70-79% Density rating "D" across IP-km	≥80% Density rating "D" across IP-km	Not Defined		

			Sediment	Quantity & Distribution of Spawning Gravels	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	50% of IP-km to 74% of IP-km	Fair
			Velocity Refuge	Floodplain Connectivity	<50% Response Reach Connectivity	50-80% Response Reach Connectivity	>80% Response Reach Connectivity	Not Defined	<50% Response Reach Connectivity	Poor
			Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No Evidence of Toxins or Contaminants	Sublethal or Chronic	Fair
			Water Quality	Turbidity	<50% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-Km maintains severity score of 3 or lower	75% to 90% of streams/ IP-Km maintains severity score of 3 or lower	>90% of streams/ IP-Km maintains severity score of 3 or lower	<50% of streams/ IP-km maintains severity score of 3 or lower	Poor
		Size	Viability	Density	<1 spawner per IP-km to < low risk spawner density per Spence (2008)	>1 spawner per IP-km to < low risk spawner density per Spence (2008)	low risk spawner density per Spence (2008)		>1 spawner per IP-km to < low risk spawner density per Spence (2008)	Fair
2	Eggs	Condition	Hydrology	Flow Conditions (Instantaneous Condition)	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 51-75	Fair
			Hydrology	Redd Scour	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 51-75	Fair
			Sediment	Gravel Quality (Bulk)	>17% (0.85mm) and >30% (6.4mm)	15-17% (0.85mm) and <30% (6.4mm)	12-14% (0.85mm) and <30% (6.4mm)	<12% (0.85mm) and <30% (6.4mm)	15-17% (0.85mm) and <30% (6.4mm)	Fair
			Sediment	Gravel Quality (Embeddedness)	<50% of streams/ IP-Km (>50% stream average scores of 1 & 2)	50% to 74% of streams/ IP-Km (>50% stream average scores of 1 & 2)	75% to 90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	>90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	71% streams/ 63% IP-km (>50% stream average scores of 1 & 2)	Fair
3	Summer Rearing Juveniles	Condition	Estuary/Lagoon	Quality & Extent	Impaired/non-functional	Impaired but functioning	Properly Functioning Condition	Unimpaired Condition	Impaired/non-functional	Poor

			Habitat Complexity	Large Wood Frequency (Bankfull Width 0-10 meters)	<50% of streams/ IP-Km (>6 Key Pieces/100 meters)	50% to 74% of streams/ IP-Km (>6 Key Pieces/100 meters)	75% to 90% of streams/ IP-Km (>6 Key Pieces/100 meters)	>90% of streams/ IP-Km (>6 Key Pieces/100 meters)	50% to 74% of streams/ IP-km (>6 Key Pieces/100 meters)	Fair
			Habitat Complexity	Large Wood Frequency (Bankfull Width 10-100 meters)	<50% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	50% to 74% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	75% to 90% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	>90% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	50% to 74% of streams/ IP-km (>1.3 Key Pieces/100 meters)	Fair
			Habitat Complexity	Percent Primary Pools	<50% of streams/ IP-Km (>40% average primary pool frequency)	50% to 74% of streams/ IP-Km (>40% average primary pool frequency)	75% to 89% of streams/ IP-Km (>40% average primary pool frequency)	>90% of streams/ IP-Km (>40% average primary pool frequency)	8% streams/ 1% IP-km (>40% average primary pool frequency)	Poor
			Habitat Complexity	Pool/Riffle/Flatwater Ratio	<50% of streams/ IP-Km (>40% Pools; >20% Riffles)	50% to 74% of streams/ IP-Km (>40% Pools; >20% Riffles)	75% to 90% of streams/ IP-Km (>40% Pools; >20% Riffles)	>90% of streams/ IP-Km (>40% Pools; >20% Riffles)	46% streams/ 52% IP-km (>40% Pools; >20% Riffles)	Fair
			Habitat Complexity	Shelter Rating	<50% of streams/ IP-Km (>80 stream average)	50% to 74% of streams/ IP-Km (>80 stream average)	75% to 90% of streams/ IP-Km (>80 stream average)	>90% of streams/ IP-Km (>80 stream average)	4% streams/ 0 % IP-km (>80 stream average)	Poor
			Hydrology	Flow Conditions (Baseflow)	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score >75	Poor
			Hydrology	Flow Conditions (Instantaneous Condition)	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 51-75	Fair
			Hydrology	Number, Condition and/or Magnitude of Diversions	>5 Diversions/10 IP km	1.1 - 5 Diversions/10 IP km	0.01 - 1 Diversions/10 IP km	0 Diversions	3.73 Diversions/10 IP-km	Fair
			Passage/Migration	Passage at Mouth or Confluence	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	50% of IP-km to 74% of IP-km	Fair
			Passage/Migration	Physical Barriers	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	98.44% of IP-km	Very Good

			Riparian Vegetation	Canopy Cover	<50% of streams/ IP-Km (>70% average stream canopy; >85% where coho IP overlaps)	50% to 74% of streams/ IP-Km (>70% average stream canopy; >85% where coho IP overlaps)	75% to 90% of streams/ IP-Km (>70% average stream canopy; >85% where coho IP overlaps)	>90% of streams/ IP-Km (>70% average stream canopy; >85% where coho IP overlaps)	77% streams 47% IP-km (>70% average stream canopy; >85% where coho IP overlaps)	Good
			Riparian Vegetation	Tree Diameter (North of SF Bay)	≤39% Class 5 & 6 across IP-km	40 - 54% Class 5 & 6 across IP-km	55 - 69% Class 5 & 6 across IP-km	>69% Class 5 & 6 across IP-km	?39% Class 5 & 6 across IP-km	Poor
			Riparian Vegetation	Tree Diameter (South of SF Bay)	≤69% Density rating "D" across IP-km	70-79% Density rating "D" across IP-km	≥80% Density rating "D" across IP-km	Not Defined		
			Sediment (Food Productivity)	Gravel Quality (Embeddedness)	<50% of streams/ IP-Km (>50% stream average scores of 1 & 2)	50% to 74% of streams/ IP-Km (>50% stream average scores of 1 & 2)	75% to 90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	>90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	71% streams/ 63% IP-km (>50% stream average scores of 1 & 2)	Fair
			Water Quality	Temperature (MWMT)	<50% IP km (<20 C MWMT; <16 C MWMT where coho IP overlaps)	50 to 74% IP km (<20 C MWMT; <16 C MWMT where coho IP overlaps)	75 to 89% IP km (<20 C MWMT; <16 C MWMT where coho IP overlaps)	>90% IP km (<20 C MWMT; <16 C MWMT where coho IP overlaps)	<50% IP-km (<20 C MWMT; <16 C MWMT where coho IP overlaps)	Poor
			Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No Evidence of Toxins or Contaminants	Sublethal or Chronic	Fair
			Water Quality	Turbidity	<50% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-Km maintains severity score of 3 or lower	75% to 90% of streams/ IP-Km maintains severity score of 3 or lower	>90% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-km maintains severity score of 3 or lower	Fair
		Size	Viability	Density	<0.2 Fish/m^2	0.2 - 0.6 Fish/m^2	0.7 - 1.5 Fish/m^2	>1.5 Fish/m^2	0.2 - 0.6 Fish/m^2	Fair
			Viability	Spatial Structure	<50% of Historical Range	50-74% of Historical Range	75-90% of Historical Range	>90% of Historical Range	50-74% of Historical Range	Fair

4	Winter Rearing Juveniles	Condition	Habitat Complexity	Large Wood Frequency (Bankfull Width 0-10 meters)	<50% of streams/ IP-Km (>6 Key Pieces/100 meters)	50% to 74% of streams/ IP-Km (>6 Key Pieces/100 meters)	75% to 90% of streams/ IP-Km (>6 Key Pieces/100 meters)	>90% of streams/ IP-Km (>6 Key Pieces/100 meters)	50% to 74% of streams/ IP-km (>6 Key Pieces/100 meters)	Fair
			Habitat Complexity	Large Wood Frequency (Bankfull Width 10-100 meters)	<50% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	50% to 74% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	75% to 90% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	>90% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	<50% of streams/ IP-km (>1.3 Key Pieces/100 meters)	Poor
			Habitat Complexity	Pool/Riffle/Flatwater Ratio	<50% of streams/ IP-Km (>40% Pools; >20% Riffles)	50% to 74% of streams/ IP-Km (>40% Pools; >20% Riffles)	75% to 90% of streams/ IP-Km (>40% Pools; >20% Riffles)	>90% of streams/ IP-Km (>40% Pools; >20% Riffles)	46% streams/ 52% IP-km (>40% Pools; >20% Riffles)	Fair
			Habitat Complexity	Shelter Rating	<50% of streams/ IP-Km (>80 stream average)	50% to 74% of streams/ IP-Km (>80 stream average)	75% to 90% of streams/ IP-Km (>80 stream average)	>90% of streams/ IP-Km (>80 stream average)		
			Passage/Migration	Physical Barriers	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	98.44% of IP-km	Very Good
			Riparian Vegetation	Tree Diameter (North of SF Bay)	≤39% Class 5 & 6 across IP-km	40 - 54% Class 5 & 6 across IP-km	55 - 69% Class 5 & 6 across IP-km	>69% Class 5 & 6 across IP-km	?39% Class 5 & 6 across IP-km	Poor
			Riparian Vegetation	Tree Diameter (South of SF Bay)	≤69% Density rating "D" across IP-km	70-79% Density rating "D" across IP-km	≥80% Density rating "D" across IP-km	Not Defined		
			Sediment (Food Productivity)	Gravel Quality (Embeddedness)	<50% of streams/ IP-Km (>50% stream average scores of 1 & 2)	50% to 74% of streams/ IP-Km (>50% stream average scores of 1 & 2)	75% to 90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	>90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	71% streams/ 63% IP-km (>50% stream average scores of 1 & 2)	Fair
			Velocity Refuge	Floodplain Connectivity	<50% Response Reach Connectivity	50-80% Response Reach Connectivity	>80% Response Reach Connectivity	Not Defined	<50% Response Reach Connectivity	Poor
			Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No Evidence of Toxins or Contaminants	Sublethal or Chronic	Fair

			Water Quality	Turbidity	<50% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-Km maintains severity score of 3 or lower	75% to 90% of streams/ IP-Km maintains severity score of 3 or lower	>90% of streams/ IP-Km maintains severity score of 3 or lower		
5	Smolts	Condition	Estuary/Lagoon	Quality & Extent	Impaired/non-functional	Impaired but functioning	Properly Functioning Condition	Unimpaired Condition	Impaired but functioning	Fair
			Habitat Complexity	Shelter Rating	<50% of streams/ IP-Km (>80 stream average)	50% to 74% of streams/ IP-Km (>80 stream average)	75% to 90% of streams/ IP-Km (>80 stream average)	>90% of streams/ IP-Km (>80 stream average)	4% streams/ 0 % IP-km (>80 stream average)	Poor
			Hydrology	Number, Condition and/or Magnitude of Diversions	>5 Diversions/10 IP km	1.1 - 5 Diversions/10 IP km	0.01 - 1 Diversions/10 IP km	0 Diversions	3.73 Diversions/10 IP-km	Fair
			Hydrology	Passage Flows	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 51-75	Fair
			Passage/Migration	Passage at Mouth or Confluence	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	50% of IP-km to 74% of IP-km	Fair
			Smoltification	Temperature	<50% IP-Km (>6 and <14 C)	50-74% IP-Km (>6 and <14 C)	75-90% IP-Km (>6 and <14 C)	>90% IP-Km (>6 and <14 C)	50-74% IP-km (>6 and <14 C)	Fair
			Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No Evidence of Toxins or Contaminants	Sublethal or Chronic	Fair
			Water Quality	Turbidity	<50% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-Km maintains severity score of 3 or lower	75% to 90% of streams/ IP-Km maintains severity score of 3 or lower	>90% of streams/ IP-Km maintains severity score of 3 or lower	<50% of streams/ IP-km maintains severity score of 3 or lower	Poor
		Size	Viability	Abundance	Smolt abundance which produces high risk spawner density per Spence (2008)	Smolt abundance which produces moderate risk spawner density per Spence (2008)	Smolt abundance to produce low risk spawner density per Spence (2008)		Smolt abundance which produces moderate risk spawner density per Spence (2008)	Fair

6	Watershed Processes	Landscape Context	Hydrology	Impervious Surfaces	>10% of Watershed in Impervious Surfaces	7-10% of Watershed in Impervious Surfaces	3-6% of Watershed in Impervious Surfaces	<3% of Watershed in Impervious Surfaces	6.038% of Watershed in Impervious Surfaces	Good
			Landscape Patterns	Agriculture	>30% of Watershed in Agriculture	20-30% of Watershed in Agriculture	10-19% of Watershed in Agriculture	<10% of Watershed in Agriculture	19.08% of Watershed in Agriculture	Good
			Landscape Patterns	Timber Harvest	>35% of Watershed in Timber Harvest	26-35% of Watershed in Timber Harvest	25-15% of Watershed in Timber Harvest	<15% of Watershed in Timber Harvest	0.4% of Watershed in Timber Harvest	Very Good
			Landscape Patterns	Urbanization	>20% of watershed >1 unit/20 acres	12-20% of watershed >1 unit/20 acres	8-11% of watershed >1 unit/20 acres	<8% of watershed >1 unit/20 acres	22% of watershed >1 unit/20 acres	Poor
			Riparian Vegetation	Species Composition	<25% Intact Historical Species Composition	25-50% Intact Historical Species Composition	51-74% Intact Historical Species Composition	>75% Intact Historical Species Composition	<25% Intact Historical Species Composition	Poor
			Sediment Transport	Road Density	>3 Miles/Square Mile	2.5 to 3 Miles/Square Mile	1.6 to 2.4 Miles/Square Mile	<1.6 Miles/Square Mile	3.2 Miles/Square Mile	Poor
			Sediment Transport	Streamside Road Density (100 m)	>1 Miles/Square Mile	0.5 to 1 Miles/Square Mile	0.1 to 0.4 Miles/Square Mile	<0.1 Miles/Square Mile	2.5 Miles/Square Mile	Poor

Napa River CAP Threat Results

	Threats Across Targets	Adults	Eggs	Summer Rearing Juveniles	Winter Rearing Juveniles	Smolts	Watershed Processes	Overall Threat Rank
	Project-specific-threats	1	2	3	4	5	6	
1	Agriculture	High	High	Very High	Very High	High	Very High	Very High
2	Channel Modification	High	High	Very High	Very High	High	Very High	Very High
3	Disease, Predation and Competition	Medium		Medium	Medium	Medium	Medium	Medium
4	Hatcheries and Aquaculture							
5	Fire, Fuel Management and Fire Suppression	Medium	Low	Medium	Medium	Medium	Medium	Medium
6	Fishing and Collecting	Medium		Low		Medium		Medium
7	Livestock Farming and Ranching	Medium	Low	Medium	Medium	Medium	Medium	Medium
8	Logging and Wood Harvesting	Low	Low	Medium	Medium	Medium	Medium	Medium
9	Mining	Low	Low	Medium				Low
10	Recreational Areas and Activities	Low	Low	Low	Medium	Low	Medium	Medium
11	Residential and Commercial Development	Medium	Low	Medium	High	High	High	High
12	Roads and Railroads	High	Medium	Medium	High	High	High	High
13	Severe Weather Patterns	Medium	Medium	High	High	High	Medium	High
14	Water Diversion and Impoundments	High	High	Very High	High	High	Very High	Very High
	Threat Status for Targets and Project	High	High	Very High	Very High	Very High	Very High	Very High

Napa River, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
NpR-CCCS-1.1	**Objective**	**Estuary**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**										
NpR-CCCS-1.1.1	Recovery Action	Estuary	Increase quality and extent of estuarine habitat										
NpR-CCCS-1.1.1.1	Action Step	Estuary	Develop an estuary rehabilitation and enhancement plan in efforts to reclaim historically tidal influenced areas of Napa River.	2	10	Napa CFCWCD, Napa County, Napa County RCD	169.50	169.50				339	Cost based on estuary use/residence time model at a rate of $338,679/project.
NpR-CCCS-1.1.1.2	Action Step	Estuary	Evaluate water quality conditions (salinity, dissolved oxygen, temperature) in potential steelhead estuary rearing areas.	2	10	Napa CFCWCD, Napa County, Napa County RCD	7.50	7.50				15	Cost base on installing a minimum of 3 continuous water quality stations at a rate of $5,000/station. Cost does not account for data management or maintenance.
NpR-CCCS-1.1.1.3	Action Step	Estuary	Identify and provide recommendations for potential rehabilitation sites that have been altered by dredging and diking.	2	10	Napa CFCWCD, Napa County, Napa County RCD						0	Cost accounted for in above action step.
NpR-CCCS-1.1.1.4	Action Step	Estuary	Identify locations to install habitat complexity features to enhance steelhead estuary rearing conditions.	2	10	Napa CFCWCD, Napa County, Napa County RCD	2,337	2,337				4,674	Cost based on treating 95 acres (assume 2.5% of total estuarine acres) at a rate of $49,200/acre.
NpR-CCCS-2.1	**Objective**	**Floodplain Connectivity**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**										
NpR-CCCS-2.1.1	Recovery Action	Floodplain Connectivity	Rehabilitate and enhance floodplain connectivity										
NpR-CCCS-2.1.1.1	Action Step	Floodplain Connectivity	Increase off-channel and velocity refuge in the main stem Napa River.	1	10	Napa CFCWCD, Napa County, Napa County RCD	296.50	296.50				593	Cost based on treating 19 miles (assume 1 project/mile in 50% high IP) at a rate of $31,200/mile. Cost can be significantly higher if greater oversight and engineering is needed such as installing ELJ estimated at $124,800/ELJ.
NpR-CCCS-2.1.1.2	Action Step	Floodplain Connectivity	Design and implement floodplain rehabilitation projects within the main stem Napa River.	2	10	Napa CFCWCD, Napa County, Napa County RCD	157.50	157.50				315	Cost based on riparian and wetland restoration model at a rate of $88,551 and $255,968/project, respectively.
NpR-CCCS-2.1.1.3	Action Step	Floodplain Connectivity	Complete the implementation of the Rutherford Reach Restoration Project (NMFS BO 2009).	1	10	Napa CFCWCD, Napa County, Napa County RCD						0	Action is considered In-Kind
NpR-CCCS-2.1.1.4	Action Step	Floodplain Connectivity	Complete implementation of the Napa River Flood Reduction Project; specifically the Napa Creek improvement plan. Reviewed and approved by NMFS, CDFW, RWQCB (2010).	2	10	Napa CFCWCD, Napa County, Napa County RCD						0	Action is considered In-Kind
NpR-CCCS-2.1.1.5	Action Step	Floodplain Connectivity	Incorporate and design floodplain connectivity features during the development of the Oakville to Oak Knoll Napa Habitat Enhancement and Sediment Reduction Project.	2	10	Napa CFCWCD, Napa County, Napa County RCD	1,116	1,116				2,232	Cost based 5 projects with 10 acres/project at a rate of $44,640/acre.
NpR-CCCS-2.1.1.6	Action Step	Floodplain Connectivity	Incorporate obstructions (LWD, boulders) in floodplain project designs to increase velocity refuge for salmonids.	2	10	Napa CFCWCD, Napa County, Napa County RCD						0	Cost accounted for in above action step.

Napa River, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
NpR-CCCS-2.1.1.7	Action Step	Floodplain Connectivity	Rehabilitate conditions to re-create, and restore alcove, backwater, or seasonal off-channel habitats in low gradient floodplain reaches of the main stem Napa River.	2	10	Napa CFCWCD, Napa County, Napa County RCD						0	Cost accounted for in above action steps.
NpR-CCCS-3.1	**Objective**	**Hydrology**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**										
NpR-CCCS-3.1.1	Recovery Action	Hydrology	Improve flow conditions (baseflow condition)										
NpR-CCCS-3.1.1.1	Action Step	Hydrology	Minimize groundwater pumping in or around alluvial fan reaches.	1	15	Napa County, Napa County RCD, Napa Valley Flood Control District, Private Landowners						0	This action step relies on participation of water users reducing groundwater pumping or locating groundwater wells away from alluvial fan reaches.
NpR-CCCS-3.1.1.2	Action Step	Hydrology	Monitor groundwater levels in alluvial fan reaches.	2	25	CDFW, Napa County, Napa County RCD, Napa Valley Flood Control District	15.80	15.80	15.80	15.80	15.80	79	Cost based on stream flow/precipitation model at a rate of $78,100/project.
NpR-CCCS-3.1.1.3	Action Step	Hydrology	Minimize or prevent frost protection pumping/irrigation in spawning and rearing tributaries of the Napa River.	1	25	CDFW, CWQCB, Napa County, Napa County RCD, Napa Valley Flood Control District, SWRCB						0	Action is considered In-Kind
NpR-CCCS-3.1.1.4	Action Step	Hydrology	Monitor hydrology conditions in all spawning and rearing tributaries of the Napa River.	2	15	CDFW, Napa County RCD, Napa Valley Flood Control District, NOAA/NMFS, Private Landowners	26.33	26.33	26.33			79	Cost based on stream flow/precipitation model at a rate of $78,100/project. This action step should be done in conjunction with similar action steps to reduce cost and redundancy.
NpR-CCCS-3.1.1.5	Action Step	Hydrology	Discontinue surface and groundwater extraction adjacent to high value habitat sub-basins and tributaries (Redwood Creek, Dry Creek, Ritchie Creek , Sulphur Creek, and York Creek).	1	25	Napa County, Napa County RCD, Napa Valley Flood Control District, NOAA/NMFS, Private Landowners, RWQCB						TBD	Cost based on modifying or removing water diversions in high value habitat. Estimate for off-channel storage is $5,000/station.
NpR-CCCS-3.1.1.6	Action Step	Hydrology	Minimize or discontinue surface or groundwater extraction in Salvador Creek, Browns Valley, Napa Creek, Tulucay Creek, and Hooper Creek.	2	25	CWQCB, Napa County RCD, Napa Valley Flood Control District, Private Landowners, SWRCB						TBD	Cost based on modifying or removing water diversions in high value habitat. Estimate for off-channel storage is $5,000/station.
NpR-CCCS-3.1.1.7	Action Step	Hydrology	Develop habitat/spawning/flow criteria that maximize habitat conditions in Milliken Creek below Milliken Reservoir.	2	10	CDFW, Napa (City) Water District, Napa Valley Flood Control District	39.50	39.50				79	Cost based on stream flow/precipitation model at a rate of $78,100/project.

Napa River, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
NpR-CCCS-3.1.1.8	Action Step	Hydrology	Develop habitat/spawning/flow criteria that maximize habitat conditions in Conn Creek below Lake Hennessey.	1	10	CDFW, Napa (City) Water District, Napa Valley Flood Control District, NOAA/NMFS	39.50	39.50				79	Cost based on stream flow/precipitation model at a rate of $78,100/project.
NpR-CCCS-3.1.1.9	Action Step	Hydrology	Develop habitat/spawning/flow criteria that maximize habitat conditions in Bell Creek below Bell Canyon Reservoir.	2	10	CDFW, Napa (City) Water District, Napa County, Napa County RCD, NOAA/NMFS	39.50	39.50				79	Cost based on stream flow/precipitation model at a rate of $78,100/project.
NpR-CCCS-3.1.1.10	Action Step	Hydrology	Develop habitat/spawning/flow criteria that maximize habitat conditions in Rector Creek below Rector Creek Reservoir.	3	10	CDFW, CWQCB, Napa (City) Water District, Napa County, Napa County RCD, NOAA/NMFS	39.50	39.50				79	Cost based on stream flow/precipitation model at a rate of $78,100/project.
NpR-CCCS-3.1.1.11	Action Step	Hydrology	Determine impacts to summer rearing associated with Kimball Reservoir. Prescribe and implement bypass flows to enhance rearing habitat.	2	10	CDFW, Napa (City) Water District, Napa County, Napa County RCD, Napa Valley Flood Control District, NOAA/NMFS						TBD	
NpR-CCCS-5.1	**Objective**	**Passage**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**										
NpR-CCCS-5.1.1	Recovery Action	Passage	Modify or remove physical passage barriers										
NpR-CCCS-5.1.1.1	Action Step	Passage	Determine if there is an appreciable quantity of historic habitat partially or completely blocked.	2	10	CDFW, City of Napa, Napa (City) Water District, Napa County, Napa County RCD, NOAA/NMFS						0	Action is considered In-Kind
NpR-CCCS-5.1.1.2	Action Step	Passage	Determine if the blocked habitat is potentially viable.	2	10	CDFW, City of Napa, Napa (City) Water District, Napa County, Napa County RCD, NOAA/NMFS						0	Action is considered In-Kind
NpR-CCCS-5.1.1.3	Action Step	Passage	Determine if fish passage is technologically feasible.	2	10	CDFW, City of Napa, Napa (City) Water District, Napa County, Napa County RCD, NOAA/NMFS	270					270	Cost based on adult escapement and juvenile migration model at a rate of $270,000.
NpR-CCCS-5.1.1.4	Action Step	Passage	If determined feasible, design and install appropriate fishway for Conn Dam.	1	15	CDFW, City of Napa, Napa (City) Water District, Napa County, Napa County RCD, NOAA/NMFS						TBD	Costs dependent on whether action is considered feasible.

Napa River, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
NpR-CCCS-5.1.1.5	Action Step	Passage	Remove York Dam.	1	10	CDFW, City of St. Helena, Corps, NOAA/NMFS, RWQCB	1,000					1,000	Dam removal projects typically are cost effective approaches to providing passage. Cost for dam removal estimate is $1,000,000.
NpR-CCCS-5.1.1.6	Action Step	Passage	Evaluate, design, and implement appropriate fish passage at Dry Creek Road on Campbell Creek.	2	20	CDFW, Napa County RCD, NOAA/NMFS	67.50	67.50	67.50	67.50		270	Cost based on adult escapement and juvenile migration model at a rate of $43,654 and $225,916/project, respectively.
NpR-CCCS-5.1.1.7	Action Step	Passage	Evaluate, design, and implement appropriate fish passage at Highway 12/121 on Huichica Creek.	2	20	CDFW, Napa County RCD, NOAA/NMFS	67.50	67.50	67.50	67.50		270	Cost based on adult escapement and juvenile migration model at a rate of $43,654 and $225,916/project, respectively.
NpR-CCCS-5.1.1.8	Action Step	Passage	Evaluate, design, and implement appropriate fish passage at Silverado Resort Reservoir on Milliken Creek.	2	20	CDFW, Napa County RCD, NOAA/NMFS	67.50	67.50	67.50	67.50		270	Cost based on adult escapement and juvenile migration model at a rate of $43,654 and $225,916/project, respectively.
NpR-CCCS-5.1.1.9	Action Step	Passage	Evaluate, design, and implement appropriate fish passage at Concrete ford crossing on Pickle Creek.	2	20	CDFW, Napa County RCD, NOAA/NMFS	67.50	67.50	67.50	67.50		270	Cost based on adult escapement and juvenile migration model at a rate of $43,654 and $225,916/project, respectively.
NpR-CCCS-5.1.1.10	Action Step	Passage	Evaluate, design, and implement appropriate fish passage at Silverado Trail culvert on Selby Creek.	2	20	CDFW, Napa County RCD, NOAA/NMFS	67.50	67.50	67.50	67.50		270	Cost based on adult escapement and juvenile migration model at a rate of $43,654 and $225,916/project, respectively.
NpR-CCCS-5.1.1.11	Action Step	Passage	Evaluate, design, and implement appropriate fish passage at Highway 29 on Ritchey Creek.	2	20	, CDFW, Napa County RCD, NOAA/NMFS	67.50	67.50	67.50	67.50		270	Cost based on adult escapement and juvenile migration model at a rate of $43,654 and $225,916/project, respectively.
NpR-CCCS-5.1.1.12	Action Step	Passage	Evaluate, design, and implement appropriate fish passage at Bothe State Park entrance on Ritchey Creek.	2	20	CDFW, Napa County RCD, NOAA/NMFS	67.50	67.50	67.50	67.50		270	Cost based on adult escapement and juvenile migration model at a rate of $43,654 and $225,916/project, respectively.
NpR-CCCS-5.1.1.13	Action Step	Passage	Evaluate, design, and implement appropriate fish passage at Calistoga Community Center on the Napa River.	2	20	CDFW, Napa County RCD, NOAA/NMFS	67.50	67.50	67.50	67.50		270	Cost based on adult escapement and juvenile migration model at a rate of $43,654 and $225,916/project, respectively.
NpR-CCCS-5.1.1.14	Action Step	Passage	Evaluate, design, and implement appropriate fish passage at Winery Driveway on Carneros Creek.	2	20	CDFW, Napa County RCD, NOAA/NMFS	67.50	67.50	67.50	67.50		270	Cost based on adult escapement and juvenile migration model at a rate of $43,654 and $225,916/project, respectively.
NpR-CCCS-5.1.1.15	Action Step	Passage	Evaluate, design, and implement appropriate fish passage at Highway 29 on Mill Creek.	3	20	CDFW, Napa County RCD, NOAA/NMFS	67.50	67.50	67.50	67.50		270	Cost based on adult escapement and juvenile migration model at a rate of $43,654 and $225,916/project, respectively.
NpR-CCCS-5.1.1.16	Action Step	Passage	Evaluate, design, and implement appropriate fish passage at the Old flashboard dam on Wing Canyon Creek.	3	20	CDFW, Napa County RCD, NOAA/NMFS	67.50	67.50	67.50	67.50		270	Cost based on adult escapement and juvenile migration model at a rate of $43,654 and $225,916/project, respectively.
NpR-CCCS-5.1.1.17	Action Step	Passage	Evaluate, design, and implement appropriate fish passage at the Concrete wall weir on Murphy Creek.	3	20	CDFW, Napa County RCD, NOAA/NMFS	67.50	67.50	67.50	67.50		270	Cost based on adult escapement and juvenile migration model at a rate of $43,654 and $225,916/project, respectively.
NpR-CCCS-5.1.1.18	Action Step	Passage	Evaluate, design, and implement appropriate fish passage at Concretes walls dam on Murphy Creek.	3	20	CDFW Law Enforcement, Napa County RCD, NOAA/NMFS	67.50	67.50	67.50	67.50		270	Cost based on adult escapement and juvenile migration model at a rate of $43,654 and $225,916/project, respectively.
NpR-CCCS-5.1.1.19	Action Step	Passage	Evaluate, design, and implement appropriate fish passage at Highway 29 on Suscol Creek.	3	20	CDFW, Napa County RCD, NOAA/NMFS	67.50	67.50	67.50	67.50		270	Cost based on adult escapement and juvenile migration model at a rate of $43,654 and $225,916/project, respectively.
NpR-CCCS-5.1.1.20	Action Step	Passage	Evaluate, design, and implement appropriate fish passage at State Lane on Rector Creek.	3	20	CDFW, Napa County RCD, NOAA/NMFS	67.50	67.50	67.50	67.50		270	Cost based on adult escapement and juvenile migration model at a rate of $43,654 and $225,916/project, respectively.
NpR-CCCS-5.1.1.21	Action Step	Passage	Evaluate, design, and implement appropriate fish passage at the Old concrete dam on Suscol Creek.	3	20	CDFW, Napa County RCD, NOAA/NMFS	67.50	67.50	67.50	67.50		270	Cost based on adult escapement and juvenile migration model at a rate of $43,654 and $225,916/project, respectively.
NpR-CCCS-5.1.1.22	Action Step	Passage	Evaluate, design, and implement appropriate fish passage at Green Valley Road on Spencer Creek.	3	20	CDFW, Napa County RCD, NOAA/NMFS	67.50	67.50	67.50	67.50		270	Cost based on adult escapement and juvenile migration model at a rate of $43,654 and $225,916/project, respectively.
NpR-CCCS-5.1.1.23	Action Step	Passage	Evaluate, design, and implement appropriate fish passage at Vichy Ave culvert on the Sarco Creek.	3	20	CDFW, Napa County RCD, NOAA/NMFS	67.50	67.50	67.50	67.50		270	Cost based on adult escapement and juvenile migration model at a rate of $43,654 and $225,916/project, respectively.

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K) FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	Comment
NpR-CCCS-5.1.1.24	Action Step	Passage	Evaluate, design, and implement appropriate fish passage at Old dam on Huichica Creek.	3	20	CDFW, Napa County RCD, NOAA/NMFS	67.50	67.50	67.50	67.50		270	Cost based on adult escapement and juvenile migration model at a rate of $43,654 and $225,916/project, respectively.
NpR-CCCS-5.1.1.25	Action Step	Passage	Evaluate, design, and implement appropriate fish passage at Robinson Lane on Browns Valley Creek.	3	20	CDFW, Napa County RCD, NOAA/NMFS	67.50	67.50	67.50	67.50		270	Cost based on adult escapement and juvenile migration model at a rate of $43,654 and $225,916/project, respectively.
NpR-CCCS-6.1	**Objective**	**Habitat Complexity**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**										
NpR-CCCS-6.1.1	Recovery Action	Habitat Complexity	Increase large wood frequency										
NpR-CCCS-6.1.1.1	Action Step	Habitat Complexity	Evaluate, prescribe, and implement an appropriate number of key LWD pieces to enhance summer rearing conditions in potential steelhead spawning and rearing areas throughout the tributaries of the Napa River watershed.	2	15	Napa CFCWCD, Napa County, Napa County RCD	46.00	46.00	46.00			138	Cost based on fish/habitat restoration model at a rate of $137,833/project.
NpR-CCCS-6.1.1.2	Action Step	Habitat Complexity	Identify and optimize the appropriate number of key LWD pieces in the following highest priority sub-basins: Redwood Creek, Dry Creek, Ritchie Creek, Sulphur Creek, and York Creek.	2	15	Napa CFCWCD, Napa County, Napa County RCD	62.67	62.67	62.67			188	Cost based on treating 6 miles (assume 1 project/mile in 50% high IP) at a rate of $31,200/mile.
NpR-CCCS-6.1.1.3	Action Step	Habitat Complexity	Evaluate, prescribe, and rehabilitate LWD frequency in Salvador, Browns Valley, Napa, Tulucay, Carneros, Huichica, and Hopper creeks.	2	15	Napa CFCWCD, Napa County, Napa County RCD	5.33	5.33	5.33			16	Cost based on treating 0.5 miles (assume 1 project/mile in 50% high IP) at a rate of $31,200/mile.
NpR-CCCS-6.1.1.4	Action Step	Habitat Complexity	Evaluate, prescribe, and implement, an appropriate number of key LWD pieces below Lake Hennessey, Milliken, Bell Creek Canyon, and Rector Creek reservoirs in efforts to maximize habitat conditions below these barriers.	1	10	Napa (City) Water District, Napa CFCWCD, Napa County, Napa County RCD	8.00	8.00				16	Cost based on treating 0.5 miles (assume 1 project/mile in 50% high IP) at a rate of $31,200/mile.
NpR-CCCS-6.1.1.5	Action Step	Habitat Complexity	Involve a qualified fisheries biologist while designing habitat enhancement features during the development of the Oakville to Oak Knoll Habitat Enhancement and Sediment Reduction Project.	2	10	Napa County, Napa County RCD, NCRWQB						0	Action is considered In-Kind
NpR-CCCS-6.1.1.6	Action Step	Habitat Complexity	Continue the Rutherford Reach Restoration Project habitat enhance strategies.	2	2	Napa CFCWCD, Napa County, Napa County RCD						0	Action is considered In-Kind
NpR-CCCS-6.1.1.7	Action Step	Habitat Complexity	Strategically place LWD in locations that optimize seasonal habitat features for winter (including spring/fall) rearing juvenile steelhead.	2	15	Napa CFCWCD, Napa County, Napa County RCD						0	Cost accounted for in above action steps.
NpR-CCCS-6.1.2	Recovery Action	Habitat Complexity	Increase frequency of primary pools										
NpR-CCCS-6.1.2.1	Action Step	Habitat Complexity	Evaluate, develop, and implement strategies to increase primary pool frequency in high priority reaches within the following tributaries: Bale Slough, Bear Canyon (& tribs), Bell, Brown, Carneros, Conn, Dry, Milliken, Montgomery, Napa, Pickle, Redwood, Sulpher, Wing Canyon, and York creeks.	2	15	Napa CFCWCD, Napa County, Napa County RCD	46.00	46.00	46.00			138	Cost based on fish/habitat restoration model at a rate of $137,833/project.
NpR-CCCS-6.1.3	Recovery Action	Habitat Complexity	Improve pool/riffle/flatwater ratios (hydraulic diversity)										

Napa River, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
NpR-CCCS-6.1.3.1	Action Step	Habitat Complexity	Identify locations and install structures within the main stem Napa River to increase hydraulic diversity, aggregation of coarse sediment, and improve the frequency of riffle habitat.	2	15	Napa CFCWCD, Napa County, Napa County RCD						TBD	
NpR-CCCS-6.1.3.2	Action Step	Habitat Complexity	Develop and implement strategies that promote hydraulic diversity and increase riffle habitat within the Oakville to Oak Knoll Habitat Enhancement and Sediment Reduction Project.	2	10	Napa CFCWCD, Napa County, Napa County RCD						TBD	
NpR-CCCS-6.1.3.3	Action Step	Habitat Complexity	Continue with the same design strategies targeting riffles habitat and hydraulic diversity within the Rutherford Reach.	2	2	Napa CFCWCD, Napa County, Napa County RCD						TBD	
NpR-CCCS-6.1.4	Recovery Action	Habitat Complexity	Improve shelter										
NpR-CCCS-6.1.4.1	Action Step	Habitat Complexity	Identify, evaluate, and improve shelters in adult salmonid staging pool within the main stem Napa River and the following tributaries: Bear Canyon (& tribs), Browns, Canon, Conn, Health, Montgomery, Sulphur, Napa, and York creeks.	2	10	Napa CFCWCD, Napa County, Napa County RCD						TBD	
NpR-CCCS-7.1	**Objective**	**Riparian**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**										
NpR-CCCS-7.1.1	Recovery Action	Riparian	Improve tree diameter										
NpR-CCCS-7.1.1.1	Action Step	Riparian	Evaluate, design, and implement strategies to rehabilitate native riparian communities and encourage large long standing trees.	2	15	CDFW, FONapaR, Napa CFCWCD, Napa County, Napa County RCD, RWQCB	115.00	115.00	115.00			345	Cost based on riparian and wetland restoration model at a rate of $88,551 and $255,969/project, respectively. Estimate for riparian restoration is $$24,682/acre in 25% high IP and 80 acres/mile.
NpR-CCCS-7.1.1.2	Action Step	Riparian	Identify and rehabilitate reaches dominated by exotic vegetation, and develop and implement site specific plans to restore these reaches.	2	15	CDFW, FONapaR, Napa CFCWCD, Napa County, Napa County RCD, RWQCB	52.67	52.67	52.67			158	Cost based on treating 1.9 miles (assume 1 project/mile in 5% high IP with 80 acres/mile) at a rate of $1,036/acre.
NpR-CCCS-7.1.1.3	Action Step	Riparian	Manage for riparian buffer zones to the extent that ambient air temperatures contribute to a reduction in stream water temperatures that are suitable for summer rearing steelhead.	2	15	FONapaR, Napa CFCWCD, Napa County, Napa County RCD, RWQCB						0	Action is considered In-Kind
NpR-CCCS-8.1	**Objective**	**Sediment**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**										
NpR-CCCS-8.1.1	Recovery Action	Sediment	Improve instream gravel quality to reduce embeddedness										

Napa River, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
NpR-CCCS-8.1.1.1	Action Step	Sediment	Evaluate, design, and implement gravel quality and quantity strategies to the extent that the maximum amount of spawning and incubation habitat is achieved below all dams.	2	20	FONapaR, Napa CFCWCD, Napa County, Napa County RCD, RR DUST, RWQCB	34.50	34.50	34.50	34.50		138	Cost based on fish/habitat restoration model at a rate of $137,833/project.
NpR-CCCS-8.1.1.2	Action Step	Sediment	Evaluate, design, and implement gravel quality and quantity strategies to improve and rehabilitate spawning conditions in Salvador, Browns Valley, Napa, Tulucay, Hooper, and Bear Canyon creeks.	2	20	Napa (City) Water District, Napa CFCWCD, Napa County, Napa County RCD, RWQCB, SWRCB	34.50	34.50	34.50	34.50		138	Cost based on fish/habitat restoration model at a rate of $137,833/project.
NpR-CCCS-8.1.1.3	Action Step	Sediment	Evaluate, design, and implement gravel quality and quantity strategies to the extent that the maximum amount of spawning habitat is achieved in the following sub-basins: Redwood Creek, Dry Creek, Ritchie Creek, Sulphur Creek, Carneros, Huichica, and York Creek.	2	20	CDFW, Napa CFCWCD, Napa County, Napa County RCD, RWQCB	34.50	34.50	34.50	34.50		138	Cost based on fish/habitat restoration model at a rate of $137,833/project.
NpR-CCCS-8.1.2	Recovery Action	Sediment	Improve gravel quantity and distribution for macro-invertebrate productivity (food)										
NpR-CCCS-8.1.2.1	Action Step	Sediment	Identify fine sediment point sources within the main stem Napa River.	2	20	Napa CFCWCD, Napa County, Napa County RCD, RR DUST, RWQCB, USEPA	254.25	254.25	254.25	254.25		1,017	Cost based on sediment assessment for 67,158 acres (assume 25% total watershed acres) at a rate of $15.14/acre.
NpR-CCCS-8.1.2.2	Action Step	Sediment	Develop, design, and install habitat enhancement features that encourage trapping of coarse sediment within main stem Napa River.	2	20	CDFW, Napa CFCWCD, Napa County, Napa County RCD, RR DUST, RWQCB						0	Cost accounted for in other action steps: Habitat Complexity.
NpR-CCCS-8.1.2.3	Action Step	Sediment	Develop strategies to improve gravel quality conditions within all current and potential summer rearing reaches below all dams with emphasis on macro-invertebrate production.	2	20	FONapaR, Napa CFCWCD, Napa County, Napa County RCD, NOAA/NMFS, RR DUST, RWQCB						TBD	Cost accounted for.
NpR-CCCS-8.1.2.4	Action Step	Sediment	Design and install habitat features that increase riffle habitat and hydraulic diversity while providing bank stabilization within the main stem Napa River.	2	20	CDFW, Napa CFCWCD, Napa County, Napa County RCD, RR DUST, RWQCB						0	Cost accounted for in other action steps: Habitat Complexity.
NpR-CCCS-10.1	**Objective**	**Water Quality**	**Address the present or threatened destruction, modification or curtailment of the species habitat or range**										
NpR-CCCS-10.1.1	Recovery Action	Water Quality	Improve stream temperature conditions										

Napa River, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
NpR-CCCS-10.1.1.1	Action Step	Water Quality	Identify factors limiting summer rearing water temperature conditions and develop water temperature reduction recommendations (if needed) for Salvador, Browns Valley, Napa (including Redwood), Tulucay, Hopper, Carneros, Huichica, and Milliken creeks.	2	15	CDFW, Napa County RCD, NOAA/NMFS						TBD	Cost based on results from water temperature monitoring.
NpR-CCCS-10.1.1.2	Action Step	Water Quality	Investigate potential impacts to water temperatures associated with riparian vegetation clearing and/or alterations. Provide recommendations for re-establishing a native riparian corridor that rehabilitates water temperature conditions.	2	5	FONapaR, Napa CFCWCD, Napa County, Napa County RCD	1.50					2	Cost based on installing a minimum of 3 stream temperature gauges at a rate of $500/gauge.
NpR-CCCS-10.1.1.3	Action Step	Water Quality	Investigate stream temperature impacts (or potential benefits) associated with all summer water impoundments including, but not limited to: Kimball Reservoir, Lake Hennessey, Milliken Reservoir, Bell Creek Canyon Reservoir, and Rector Creek Reservoir.	2	15	CDFW, NOAA/NMFS, SWRCB, Water Agencies						0	Action is considered In-Kind
NpR-CCCS-10.1.2	Recovery Action	Water Quality	Reduce turbidity and suspended sediment										
NpR-CCCS-10.1.2.1	Action Step	Water Quality	Evaluate, design, and implement, bank stabilization projects that rehabilitate and enhance aquatic habitat (See Rutherford Reach Restoration Project).	2	20	Napa CFCWCD, Napa County, Napa County RCD, RWQCB, USEPA						TBD	Cost based on number and type of bank stabilization projects. Estimate for bank stabilization ranges from $284 to $398/ft (NMFS 2008).
NpR-CCCS-12.1	**Objective**	**Agriculture**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**										
NpR-CCCS-12.1.1	Recovery Action	Agriculture	Prevent or minimize impairment to water quality (increased turbidity, suspended sediment, and/or toxicity)										
NpR-CCCS-12.1.1.1	Action Step	Agriculture	Involve NMFS, CDFW, RWQCB, in the design and implementation of the Oakville to Oak Knoll Habitat Enhancement and Sediment Reduction Project.	2	10	CDFW, Napa CFCWCD, Napa County, Napa County RCD, RWQCB						0	Action is considered In-Kind
NpR-CCCS-12.1.1.2	Action Step	Agriculture	Continue working with NMFS, CDFW, RWQCB, on the design and implementation of the Rutherford Reach Restoration Project.	2	10	CDFW, Napa CFCWCD, Napa County, Napa County RCD, RWQCB, US EPA						0	Action is considered In-Kind
NpR-CCCS-12.1.1.3	Action Step	Agriculture	Encourage and assist the NRCS and RCDs to increase the number of landowners participating in sediment reduction planning and implementation.	2	10	CDFW, Napa CFCWCD, Napa County, Napa County RCD, RCD, RWQCB						0	Action is considered In-Kind
NpR-CCCS-12.1.1.4	Action Step	Agriculture	Continue implementing Best Management Practices such as those in the Fish Friendly Farming program (California Land Stewardship Institute), or other cooperative conservation programs.	2	10	Napa County RCD, NOAA/NMFS, Private Landowners						0	Action is considered In-Kind
NpR-CCCS-12.1.1.5	Action Step	Agriculture	Maintain adequate stream corridor buffers to filter and prevent fine sediment input from entering streams of the Napa River.	2	10	Napa CFCWCD, Napa County, Napa County RCD						0	Action is considered In-Kind

Napa River, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
NpR-CCCS-12.1.2	Recovery Action	Agriculture	Prevent or minimize impairment to water quality (instream water temperature)										
NpR-CCCS-12.1.2.1	Action Step	Agriculture	Re-establish native plant communities in riparian zones to increase stream canopy to a minimum of 80%	2	20	Napa CFCWCD, Napa County, Napa County RCD						0	Costs accounted for in above recovery actions.
NpR-CCCS-12.1.2.2	Action Step	Agriculture	Minimize impacts to stream flow to decrease water temperatures.	2	20	Napa County RCD, Private Landowners						0	Cost based on implementation of other action steps.
NpR-CCCS-12.1.3	Recovery Action	Agriculture	Prevent or minimize impairment to stream hydrology (impaired water flow)										
NpR-CCCS-12.1.3.1	Action Step	Agriculture	Promote off-channel storage to reduce impacts of water diversion during the spring and summer (e.g. diversion during winter high flow).	2	15	Napa CFCWCD, Napa County, Napa County RCD, NRCS						TBD	Cost based on amount and type of off-channel storage needed to reduce impacts during spring and summer flows. Estimate for off-channel storage is $5,000/station.
NpR-CCCS-12.1.3.2	Action Step	Agriculture	Develop legislation that will fund county planning for environmentally sound agricultural growth and water supply	2	15							0	Action is considered In-Kind
NpR-CCCS-12.1.4	Recovery Action	Agriculture	Prevent or minimize adverse alterations to riparian species composition and structure										
NpR-CCCS-12.1.4.1	Action Step	Agriculture	Implement programs to purchase land/conservation easements to encourage the re-establishment and/or enhancement of natural riparian communities.	2	15	Napa CFCWCD, Napa County, Napa County RCD						TBD	Cost based on fair market value, number and type of conservation easement or land acquisition, and participation from landowner.
NpR-CCCS-12.1.4.2	Action Step	Agriculture	Ensure that mature trees within the steam riparian corridor are not disturbed or lost due to agricultural activities.	2	15	Napa CFCWCD, Napa County, Napa County RCD						0	Action is considered In-Kind
NpR-CCCS-12.1.5	Recovery Action	Agriculture	Prevent or minimize impairment to habitat complexity (reduced large wood and/or shelter)										
NpR-CCCS-12.1.5.1	Action Step	Agriculture	Promote the re-vegetation of the native riparian plant community within inset floodplains and riparian corridors to provide future recruitment of large wood and other shelter components.	2	15	Napa CFCWCD, Napa County, Napa County RCD						0	Cost accounted for in above action step.
NpR-CCCS-12.1.6	Recovery Action	Agriculture	Prevent or minimize impairment to instream substrate/food productivity (gravel quality and quantity)										
NpR-CCCS-12.1.6.1	Action Step	Agriculture	Establish appropriately sized and properly functioning riparian buffers adjacent to watercourses that have a potential to deliver sediment to spawning and rearing habitat.	2	20	Napa CFCWCD, Napa County, Napa County RCD						0	Action is considered In-Kind
NpR-CCCS-12.1.6.2	Action Step	Agriculture	Work with landowners to assess the effectiveness of erosion control measures throughout the winter period.	2	15	Napa CFCWCD, Napa County, Napa County RCD						0	Action is considered In-Kind
NpR-CCCS-12.2	**Objective**	**Agriculture**	**Address the inadequacy of existing regulatory mechanisms**										
NpR-CCCS-12.2.1	Recovery Action	Agriculture	Prevent or minimize impairment to water quality (increased turbidity, suspended sediment, and/or toxicity)										

Napa River, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
NpR-CCCS-12.2.1.1	Action Step	Agriculture	Develop riparian setbacks/buffers that protect existing native riparian species composition and structure.	2	25	Napa CFCWCD, Napa County, Napa County RCD						0	Action is considered In-Kind
NpR-CCCS-13.1	**Objective**	**Channel Modification**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**										
NpR-CCCS-13.1.1	Recovery Action	Channel Modification	Prevent or minimize impairment to passage and migration										
NpR-CCCS-13.1.1.1	Action Step	Channel Modification	Ensure that all future channel designs for flood conveyance incorporate features that enhance steelhead migration under high and low flow conditions.	3	20	Corps, Napa CFCWCD, Napa County, Napa County RCD						0	Action is considered In-Kind
NpR-CCCS-13.1.2	Recovery Action	Channel Modification	Prevent or minimize impairment to stream hydrology (impaired water flow)										
NpR-CCCS-13.1.2.1	Action Step	Channel Modification	Develop and implement strategies that slow urban and agriculture runoff during the spawning and migration season (slow it, spread it, sink it).	2	25	City, County						TBD	Cost based on implementing several strategies such as catchment basins, filter strips, and reducing impervious surfaces.
NpR-CCCS-13.1.3	Recovery Action	Channel Modification	Prevent or minimize impairment to instream substrate/food productivity (gravel quality and quantity)										
NpR-CCCS-13.1.3.1	Action Step	Channel Modification	Prevent site specific stabilization projects which will lead to additional stream bank instability up-stream or down-stream causing more fine sediment inputs - promote sediment reduction projects at a geomorphic reach scale.	2	20	Napa CFCWCD, Napa County, Napa County RCD						0	Action is considered In-Kind
NpR-CCCS-13.1.4	Recovery Action	Channel Modification	Prevent or minimize impairment to habitat complexity (reduced large wood and/or shelter)										
NpR-CCCS-13.1.4.1	Action Step	Channel Modification	Ensure all future bank stabilization projects minimize rip-rap, thoroughly evaluate all alternatives to rip-rap, and at minimum incorporate fish habitat complexity features.	3	25	Napa CFCWCD, Napa County, Napa County RCD						0	Action is considered In-Kind
NpR-CCCS-13.1.4.2	Action Step	Channel Modification	Develop and implement mitigation policy that requires In-Kind replacement of removed large woody debris to a minimum of a 3:1 ratio.	2	25	Napa CFCWCD, Napa County, Napa County RCD						0	Action is considered In-Kind
NpR-CCCS-13.1.5	Recovery Action	Channel Modification	Prevent or minimize impairment to instream habitat complexity (altered pool complexity and/or pool:riffle ratios)										
NpR-CCCS-13.1.5.1	Action Step	Channel Modification	Ensure future retention and recruitment of large woody and root wads to rehabilitate existing stream complexity, pool frequency, and depth.	2	25	Napa CFCWCD, Napa County, Napa County RCD						0	Action is considered In-Kind
NpR-CCCS-13.1.5.2	Action Step	Channel Modification	Prevent any future removal of habitat forming structures (LWD, boulders, vegetation, etc.) in natural waterways.	2	25	Napa CFCWCD, Napa County, Napa County RCD						0	Action is considered In-Kind
NpR-CCCS-13.1.6	Recovery Action	Channel Modification	Prevent or minimize impairment to floodplain connectivity (impaired quality & extent)										

Napa River, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
NpR-CCCS-13.1.6.1	Action Step	Channel Modification	Design future channel modification activities to prevent or minimize impediments to the creation, or blocking access to, off channel habitat used by salmonids as refuge and winter rearing habitat during high stream flows.	2	25	Napa CFCWCD, Napa County, Napa County RCD						0	Action is considered In-Kind
NpR-CCCS-13.1.6.2	Action Step	Channel Modification	Ensure that all future levees or similar flood control projects incorporate setbacks that allow the river to respond to natural geomorphic processes and remain in equilibrium. Minimally, setbacks should accommodate a 100 year event.	2	25	Napa CFCWCD, Napa County, Napa County RCD						0	Action is considered In-Kind
NpR-CCCS-22.1	**Objective**	**Residential/ Commercial Development**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**										
NpR-CCCS-22.1.1	Recovery Action	Residential/ Commercial Development	Prevent or minimize impairment to water quality (increased turbidity, suspended sediment, and/or toxicity)										
NpR-CCCS-22.1.1.1	Action Step	Residential/ Commercial Development	Prevent or minimize the future use of commercial and industrial products (e.g. pesticides) with high potential for contamination of local waterways.	3	25	City, County						0	Action is considered In-Kind
NpR-CCCS-22.1.1.2	Action Step	Residential/ Commercial Development	Develop filter or buffer systems that reduce pollutants from entering streams and waterways of the Napa River.	3	25	City, County						TBD	Cost based on number and type of filter or buffer system needed to reduce pollutant discharge to streams and waterways. Estimate for filter strip ranges from $9,000 to $24,000/system.
NpR-CCCS-22.2	**Objective**	**Residential/ Commercial Development**	**Address the inadequacy of existing regulatory mechanisms**										
NpR-CCCS-22.2.1	Recovery Action	Residential/ Commercial Development	Prevent or minimize impairment to floodplain connectivity (impaired quality & extent)										
NpR-CCCS-22.2.1.1	Action Step	Residential/ Commercial Development	Prevent or greatly restrict new development within 100-year floodprone zones.	3	50	City, Counties, Napa CFCWCD						0	Action is considered In-Kind
NpR-CCCS-22.2.1.2	Action Step	Residential/ Commercial Development	Encourage infill and high density developments over dispersal of low density rural residential in undeveloped areas.	2	25	City, County						0	Action is considered In-Kind
NpR-CCCS-23.1	**Objective**	**Roads/Railroads**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**										
NpR-CCCS-23.1.1	Recovery Action	Roads/Railroads	Prevent or minimize alterations to sediment transport (road condition/density, dams, etc.)										
NpR-CCCS-23.1.1.1	Action Step	Roads/Railroads	Identify and address high and medium priority sediment delivery sites associated with roads and railroads.	2	15	CalTrans, City, County, Napa CFCWCD, Napa County, Napa County RCD	511	511	511			1,532	Cost based on road inventory of 1334 miles of road network at a rate of $1,148/mile.
NpR-CCCS-23.1.1.2	Action Step	Roads/Railroads	For all rural (unpaved) and seasonal dirt roads apply best management practices for road construction maintenance management and decommissioning (e.g. Hagans & Weaver 1994 Sommarstrom 2002 Oregon Department of Transportation 1999).	2	15	City, County, Napa CFCWCD, Napa County, Napa County RCD, RR DUST, RWQCB						0	Action is considered In-Kind

Napa River, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
NpR-CCCS-23.1.1.3	Action Step	Roads/Railroads	Educate Napa County road engineers and maintenance staff regarding watershed processes and the adverse effects of improper road construction and maintenance on salmonids and their habitats (i.e. sizing of culverts, gabions, etc.)..	2	20	Napa County, Napa County RCD, NMFS						0	Action is considered In-Kind
NpR-CCCS-23.1.2	Recovery Action	Roads/Railroads	Prevent or minimize impairment to passage and migration										
NpR-CCCS-23.1.2.1	Action Step	Roads/Railroads	Evaluate existing and future stream crossings that impair natural geomorphic processes. Replace or retrofit crossings to achieve more natural conditions that meet sediment transport goals.	2	15	City Planning, County, Napa CFCWCD, Napa County, Napa County RCD, RR DUST, RWQCB						0	Cost accounted for in above action step: Passage.
NpR-CCCS-23.1.2.2	Action Step	Roads/Railroads	Evaluate, design, and implement projects that address private road stream crossings that impair adult and juvenile steelhead migration	2	15	City Planning, County, Napa CFCWCD, Napa County, Napa County RCD, RR DUST, RWQCB	180.00	180.00	180.00			540	Cost based on adult escapement and juvenile migration model for 2 impassable crossing at a rate of $43,654 and $225,916/project, respectively.
NpR-CCCS-23.1.2.3	Action Step	Roads/Railroads	Ensure all future and replacement road/stream crossing provide passage for all steelhead life stages.	2	15	CalTrans, CDFW, City, County, Napa CFCWCD, Napa County, Napa County RCD, RWQCB						0	Action is considered In-Kind
NpR-CCCS-24.1	**Objective**	**Severe Weather Patterns**	**Address other natural or manmade factors affecting the species' continued existence**										
NpR-CCCS-24.1.1	Recovery Action	Severe Weather Patterns	Prevent or minimize impairment to stream hydrology (impaired water flow)										
NpR-CCCS-24.1.1.1	Action Step	Severe Weather Patterns	Develop severe drought measures that protect all steelhead spawning and rearing tributaries within the Napa River watershed.	1	25	CDFW, City, County, SWRCB, Water Agencies						0	Action is considered In-Kind
NpR-CCCS-24.2	**Objective**	**Severe Weather Patterns**	**Address the inadequacy of existing regulatory mechanisms**										
NpR-CCCS-24.2.1	Recovery Action	Severe Weather Patterns	Prevent or minimize impairment to stream hydrology (impaired water flow)										
NpR-CCCS-24.2.1.1	Action Step	Severe Weather Patterns	Develop and implement critical flow levels for stream reaches impacted by water diversions.	2	25	City, County, Napa (City) Water District, Napa CFCWCD, SWRCB, Water Agencies	15.80	15.80	15.80	15.80	15.80	79	Cost based on stream flow/precipitation model at a rate of $78,100/project.

Napa River, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
NpR-CCCS-24.2.1.2	Action Step	Severe Weather Patterns	Work with water managers on regulated streams to assure adequate and proper consideration is given to fish needs. Develop agreements that will minimize water-use conflicts and impacts on fish and wildlife resources during drought conditions.	2	25	CDFW, City, County, FONapaR, Napa (City) Water District, Napa CFCWCD, Napa County, Napa County RCD, NOAA/NMFS, SWRCB						0	Action is considered In-Kind
NpR-CCCS-25.1	**Objective**	**Water Diversion/ Impoundment**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**										
NpR-CCCS-25.1.1	Recovery Action	Water Diversion/ Impoundment	Prevent or minimize impairment to passage and migration										
NpR-CCCS-25.1.1.1	Action Step	Water Diversion/ Impoundment	Develop and implement minimum bypass flows that protect all migrating salmonids.	1	15	CDFW, FONapaR, Napa CFCWCD, Napa County, Napa County RCD, NOAA/NMFS, Private Consultants, Private Landowners, Water Agencies						TBD	Cost for stream flow model accounted for in other action steps.
NpR-CCCS-25.1.1.2	Action Step	Water Diversion/ Impoundment	Adequately screen water diversions to prevent entrainment of all steelhead life stages.	2	15	CDFW, Napa CFCWCD, Napa County, Napa County RCD, NOAA/NMFS, RWQCB, SWRCB						TBD	Cost based on number and type of fish screens needed. Estimate for fish screens is $64,158/screen.
NpR-CCCS-25.1.2	Recovery Action	Water Diversion/ Impoundment	Prevent or minimize impairment to instream habitat complexity (altered pool complexity and/or pool:riffle ratio)										
NpR-CCCS-25.1.2.1	Action Step	Water Diversion/ Impoundment	Review existing and future diversions to minimize effects to channel forming and maintenance flows.	2	25	CDFW, City, County, NOAA/NMFS, RWQCB, Water Agencies						0	Action is considered In-Kind
NpR-CCCS-25.1.2.2	Action Step	Water Diversion/ Impoundment	Develop and implement flow/habitat criteria that optimize pool/riffle /run habitat below all water diversions and impoundments.	2	10	CDFW, Napa County RCD, NOAA/NMFS, Water Agencies						0	Cost accounted for in other action steps: Hydrology
NpR-CCCS-25.1.3	Recovery Action	Water Diversion/ Impoundment	Prevent or minimize impairment to hydrology (gravel scouring events)										
NpR-CCCS-25.1.3.1	Action Step	Water Diversion/ Impoundment	Develop ramping criteria for all dams and water release points within the Napa River watershed. .	2	25	NOAA/NMFS, Water Agencies						0	Action is considered In-Kind
NpR-CCCS-25.1.4	Recovery Action	Water Diversion/ Impoundment	Prevent or minimize impairment to stream hydrology (impaired water flow)										

Napa River, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
NpR-CCCS-25.1.4.1	Action Step	Water Diversion/ Impoundment	Develop and implement water diversion guidelines that minimize adverse effects to salmonid habitat by establishing a more natural hydrograph, by-passing adequate downstream flows, regulating season of diversion, and promoting and implementing off-stream storage solutions.	2	20	CDFW, Napa CFCWCD, Napa County, Napa County RCD, NOAA/NMFS, SWRCB						0	Action is considered In-Kind
NpR-CCCS-25.1.4.2	Action Step	Water Diversion/ Impoundment	Develop and implement alternative off-channel storage to reduce impacts of water diversions during the spring and summer.	2	20	CDFW, Napa CFCWCD, Napa County, Napa County RCD, NOAA/NMFS, RR DUST, RWQCB, SWRCB						TBD	Cost based on the amount and type of off-channel storage facilities needed. Estimate for off-channel storage is $5,000/station.
NpR-CCCS-25.1.4.3	Action Step	Water Diversion/ Impoundment	Continue to prohibit new or increased summer diversions.	2	25	SWRCB						0	Action is considered In-Kind
NpR-CCCS-25.1.4.4	Action Step	Water Diversion/ Impoundment	Assess, map, and install stream gages on all water diversions (CDFG 2004).	2	15	CDFW, Napa (City) Water District, Napa CFCWCD, Napa County, Napa County RCD, NOAA/NMFS, SWRCB						TBD	Cost based on the number of water diversions. Estimate for stream flow gauges is $1,000/station.

Petaluma River Population

CCC Steelhead Winter-Run

- Role within DPS: Potentially Independent Population
- Diversity Stratum: Interior San Francisco Bay
- Spawner Abundance Target: 2,200 adults
- Current Intrinsic Potential: 64.9 IP-km

Steelhead Abundance and Distribution

Limited information exists regarding the historic abundance of steelhead in the Petaluma basin, though the low elevations, gradient, valley confinement and the presence of a large marsh with connection to the San Francisco Bay suggests the population must have been plentiful. More modern day information available indicate that few tributaries in the watershed currently support steelhead. In a 1962 report, steelhead were described as only "lightly using" the Petaluma River (Skinner 1962). A 1968 CDFG visual survey of Adobe Creek reported juvenile steelhead at an estimated density of 150 individuals per 30-meters (Leidy *et al*. 2005). The Casa Grande High School/United Anglers Fish Hatchery was established in 1993. Since this time, the United Anglers of Casa Grande High School (UACGHS) have primarily reared rainbow trout and Chinook salmon in the hatchery. Reared juvenile rainbow trout were released into reservoirs outside of the basin and Chinook juveniles were released into San Francisco Bay (UACG Inc. 2012). In 1994 and 1995 juvenile steelhead were collected from Adobe Creek as part of a tagging study conducted with the Bodega Bay Marine Lab. Four hundred of these fish were released back into Adobe Creek (UACG Inc. 2012).

Other accounts indicate that steelhead have been found in Lichau, Adobe, and San Antonio creeks; and possibly in Lynch, Willow Brook, and Thompson creeks (SSCRCD 1999). Of these listed tributaries, Adobe and Lynch Creeks have had the highest number of recent steelhead observations (P. Comm. Dan Hubacher, UACGH). In spawner surveys conducted from 1987 to 2012 in Adobe Creek by UACGHS, the highest number of adult spawners observed during that span was 60 individuals (UACG Inc. 2012). In 2007 CDFG conducted thorough habitat surveys of major tributaries and confirmed presence of juvenile steelhead in most anadromous reaches.

History of Land Use

The following historical accounts were based on information found in the Sonoma Resource Conservation District's (formerly the Southern Sonoma Resource Conservation District) Draft Watershed Enhancement Plan (2013):

Prior to European settlement in the 1800s, Miwok people lived within the Petaluma River basin for more than 2500 years. Historically, the river was narrow, shallow and difficult to navigate, but through channel dredging, widening, and straightening efforts beginning in the 1850s, it became a vital way of transporting goods from the towns of the North Bay to San Francisco. Farming and chicken ranching boomed within the basin and the town of Petaluma became one of the wealthiest towns in California. The Corps widened the creek in 1880 to fifty feet wide and deepened it to three feet at high tide. By 1915 the area was shipping out an estimated ten million eggs a year, most of them via the Petaluma River. After the chicken industry declined, dairies began to flourish, but the dairy industry also subsequently declined, and by 1997 there were only 15 dairies in the Petaluma watershed, located mostly in the San Antonio Creek and Adobe Creek regions.

Current Resources and Land Management

The Petaluma River watershed is located in southern Sonoma County and northeastern Marin County, California, and drains an area of approximately 146 square miles to San Pablo Bay, part of San Francisco Bay. The lower 12 miles of the river flow through the large and relatively undisturbed Petaluma Marsh, which is the largest remaining salt marsh in San Pablo Bay, covering 5,000 acres and is surrounded by approximately 7,000 acres of reclaimed wetlands (Southern Sonoma Resource Conservation District [SSRCD] 2013). Upstream, the river flows through the urbanized center of Petaluma. Residential and commercial development is sprawled across the foothills, and a small but busy recreational and commercial port brackets the floodplain. The northern watershed harbors the small residential town of Penngrove. The relatively low elevation but hilly nature of upland areas below Sonoma Mountain, supports a significant amount of agricultural and livestock ranching activities (SSRCD 1999).

The climate is relatively mild with annual average temperature ranging from approximately 70° F to 45° F, and annual rainfall averaging from 20 to 50 inches, depending upon location. Although previously considered too cool for grape growing, vineyard development has increased in the watershed, particularly in the Lakeville area, southeast of the city of Petaluma, and vineyards are now competing with the dairy industry throughout the watershed. The watershed has one large urban center, the City of Petaluma, and a smaller commercial and residential development area in the City of Penngrove. There are also open space lands, such as state and local parks as well as almost 5,000 acres in several marsh preserves managed by the CDFW, Marin County, State Coastal Conservancy, U.S. Fish and Wildlife Service and the Sonoma Land Trust (SSRCD 1999).

Salmonid Viability and Watershed Conditions

The following indicators were rated Poor through the CAP process for steelhead: Habitat complexity (all indicators), floodplain connectivity, impaired water flow (redd scour and baseflows) and quality (turbidity and toxicity), riparian vegetation, gravel quality, road density, urbanization, and viability (abundance and density). Recovery strategies will focus on improving these poor conditions as well as those needed to ensure population viability and functioning watershed processes.

Current Conditions

The following discussion focuses on those conditions that were rated Fair or Poor as a result of our CAP viability analysis. The Petaluma River CAP Viability Table results are provided below. Recovery strategies will focus on improving these conditions.

Population and Habitat Conditions

Riparian Vegetation: Composition, Cover & Tree Diameter

Only 50% (5 of 10) of major streams met optimal criteria (>70% canopy averaged for the stream). Specifically Adobe, Washington and Ellis Creek subbasins and their tributaries rated Fair (50-69% canopy), though the native structure of the riparian zone has been highly altered throughout the watershed. Only 7% of the riparian zone is made up of small trees in the class of Hardwood Forest and Hardwood Woodland species; large trees for bank stabilization and the future recruitment of LWD are essentially lacking in this watershed. The surrounding forest, which was historically present, was cleared for livestock and dairy operations. Today, the primary land uses by watershed area are: Herbaceous (45%), Urban (18%), Agricultural (16%) though the lower has a small percentage of Wetland (6%) classification. Threats contributing significantly to this condition include: Agriculture, Channel Modification, Livestock Farming and Ranching, Residential and Commercial Development, Roads and Railroads, Severe Weather Patterns.

Sediment Transport: Road Density

Sediment Transport from road density conditions have a rating of Poor. Altered sediment transport limits spawning gravel recruitment and impacts spawning gravel quality. Juvenile rearing habitat suffers from channel incision and lack of floodplain refugia in all tributaries to the Petaluma River. With continued pressure to convert agricultural and livestock ranches to residential development, road densities are likely to increase throughout the watershed; thus, altered sediment transport will continue to impair juvenile and adult habitat conditions in the future. Threats contributing significantly to this condition include Residential and Commercial Development, and Roads and Railroads.

Estuary: Quality and Extent

The Petaluma River estuary, or "Petaluma Marsh," has been highly altered from its natural state due to widening, straightening and dredging for navigational purposes, and on the north side for agricultural operations. High sediment loading from upstream erosive channel conditions due to grazing, roads, and agricultural development have silted in the existing channel. Historically, dairy waste and treated sewage releases have impaired water quality. Despite these changes, the Petaluma Marsh is now the largest remaining intact natural salt marsh in the San Francisco Bay. Conditions for rearing of smolts are limited by high water temperatures in tidal reaches of the upper mainstem Petaluma River during the summer. Conditions for rearing smolts in the lower estuary are unknown at this time. Threats contributing significantly to this condition include Agriculture, and Channel Modification.

Velocity Refuge: Floodplain Connectivity

While lower Petaluma River retains wetland habitats out to the Bay on the south side, the channel has been straightened, and the historic sloughs which provided complex winter rearing habitat are diked, or flanked by levees, with significant agricultural development on the north side. Mid-watershed, urban development and agricultural lands encroach upon the historic floodplain. Road building, culverts, and grazing activities have led to severe channel incision in the mainstem and eastern tributaries. Western tributaries, mainly San Antonio Creek, retain some natural channel conditions, yet much of the riparian vegetation has been cleared for grazing and channel incision is severe. The lack of large woody debris and the shelter it provides, or access to floodplain refugia reduces overwinter survival of juveniles throughout the watershed. Channel modification and incision has separated the active stream channel from its natural floodplain except at extreme flood flows when salmonids can be flushed out to agricultural and grazing lands, where they may become trapped on the declining limb of the hydrograph. Existing infrastructure, such as urban development and roads, limits opportunities for floodplain enhancement on the eastern side of the watershed. Threats contributing significantly to this condition include: Agriculture, Channel Modification, Residential and Commercial Development, and Roads and Railroads.

Hydrology: Redd Scour

Channel incision in most eastern tributaries of the Petaluma River contributes to the retention of spawning gravels and shelter as they are mobilized during high flow events, and consequently there is high potential for redd scour. The San Antonio Creek subwatershed, on the western side of the Petaluma River, maintains a more natural channel configuration, and therefore it is less susceptible to this stress. Threats contributing significantly to this condition include Agriculture, Channel Modification, and Roads and Railroads.

Hydrology: Baseflow and Passage Flows

Though no major dams exist within the basin, numerous small residential, agricultural and ranching diversions exist which can potentially contribute to reduced summer baseflows. Unlike neighboring watersheds, where viticulture is a major part of the landscape, streamflow in the Petaluma watershed does not experience the significant, instantaneous, flow reductions related to viticulture frost protection, or other agricultural activities. A USGS gage (ID #: 11459150) is located in the Petaluma River just downstream of the mouth of Lynch Creek, which monitors streamflow. Aside from this monitoring station, there is no monitoring of streamflow in the watershed. Threats contributing significantly to this condition include Water Diversions and Impoundments, and Severe Weather Patterns.

Passage/Migration: Mouth or Confluence and Physical Barriers

Passage has not been thoroughly systematically assessed in the Petaluma basin, and numerous adult migration barriers exist in the form of culverts, bridges and small dams and farm ponds. Significant barriers are present at the confluence of Lynch Creek and the Petaluma River and in the lower mile of Adobe Creek (several partial barriers exist that span the creek) that may impede passage of adults into these streams during a majority of streamflows. Threats contributing significantly to this condition include Channel Modification, and Roads and Railroads.

Habitat Complexity: Percent Primary Pools and Pool/Riffle/Flatwater Ratios

No streams met optimal habitat complexity criteria for pools and riffles, or shelter complexity for any lifestage, within the watershed. Summer juvenile production is highly affected by the lack of these habitat elements. Riffle habitats for spawning and deep pool habitats are specifically lacking and are of particular concern in most of Petaluma River and its tributaries. Threats contributing significantly to this condition include Agriculture, Channel Modification, and Residential and Commercial Development.

Sediment: Gravel Quality and Distribution of Spawning Gravels

No streams within the watershed met optimal criteria (>50% scores 1 and 2) for embeddedness. Most streams rated Fair, and Ellis and Washington Creeks rated Poor. Gravel embeddedness affects the survivability of incubating eggs through decreased oxygenation, and the release of metabolic wastes from the redd, and can also inhibit emergence of alevins from the redd. Threats contributing significantly to this condition include Livestock Farming and Ranching, and Roads and Railroads.

Landscape Patterns: Agriculture, Timber Harvest, and Urbanization

High disturbance to watershed processes exists due to high urban development (27%). Approximately six percent of land cover in the watershed is impervious surfaces. Agricultural

development, which was rated as Fair, contributes to 16% of the land cover in the watershed. However, the present landscape, which primarily exists of low forest and high herbaceous cover with high runoff rates, is a product of historical land clearing for agriculture and dairy pastures. The potential for habitat restoration in this rural watershed is higher than for many populations within the Diversity Stratum due to its relatively low degree of urban development and lack of large water impoundments. Threats contributing significantly to this condition include Agriculture, and Residential and Commercial Development.

Viability: Density, Abundance, and Spatial Structure

The numerous habitat impacts and dysfunctional watershed processes contributes to low recruitment, and spawner density, though spatial diversity was rated as good with steelhead still occupying any accessible tributary. The UACGH hatchery program could play a role in supplementing the low population numbers which could stem the decline of steelhead in the watershed. The Petaluma watershed can play a significant role in increasing adult abundance in the Interior Bay Diversity Stratum because of its relatively high potential for habitat restoration and the presence of a functional fish hatchery in the watershed. Threats contributing significantly to this condition include Severe Weather Patterns, and Water Diversion and Impoundments.

Water Quality: Turbidity, Toxicity and Temperature

The lack of riparian habitat and the high occurrence of bank erosion contribute to high siltation and low oxygen levels in the water, which affect incubating eggs. Turbidity is also considered to be a problem for winter rearing juveniles because it inhibits their ability to forage for food and avoid predators. High water temperatures exist throughout the watershed due to the lack of riparian corridor, or thin riparian corridor (and the resulting shade produced from an intact riparian corridor) in many tributaries. In 1982, the State Water Resources Control Board (SWRCB) reported that dissolved oxygen and nutrient problems persist in the watershed (SSRCD 2013). Threats contributing significantly to this condition include Livestock Farming and Ranching, Roads and Railroads

Threats

The following discussion focuses on those threats that were rated as High or Very High (See Petaluma River CAP Results). Recovery strategies will likely focus on ameliorating High rated threats; however, some strategies may address Medium and Low threats when the strategy is essential to recovery efforts.

Agriculture

Ongoing agricultural practices have eliminated or reduced riparian width and thereby the recruitment of LWD and shade, with viticulture being a recent addition in the Lakeville portion of the watershed. Though GIS spatial analysis showed vegetation in the watershed is composed

of 16% agricultural production, an additional 45% of the watershed is currently shrubland; a habitat type which could be readily converted to agricultural production (including vineyards) as this component already contains rangeland and dairy lands. Increased water diversions to support viticulture activity could further impact summer baseflows, causing disconnected aquatic habitat and elevated instream temperatures. Also, future agriculture operations could potentially encroach into adjacent riparian areas, increasing sediment delivery, and impact shading and wood recruitment if proper Best Management Practices are not utilized.

Channel Modification

Channel modification has been the largest impact to salmonid resources in the Petaluma River and its tributaries through the removal of floodplain and riparian resources. Juvenile steelhead access to refugia during high velocity streamflows in the winter is limited because less than 50% of stream channels are connected to their floodplain. Channel modification has also led to channel incision, over-steepened banks, high erosional forces and gravel embededness, and ultimately, loss of riparian trees and width.

Dredging of the lower main river continues by the Corps on a 10 year cycle and in the upper river channel on a 4 year cycle. Based on the Corps' experience over the past 50 years, an average of 60,000 cubic yards of material is deposited in the river each year (SCWA 1986). Sedimentation in un-leveed tidal areas has been aggravated by the construction of levees and landfills in tidal areas. This is because the confinement of the natural waterway by levees has accelerated sediment buildup in areas outside of levees. Sedimentation in these reaches reduces flood-carrying capacity and soon the levees begin to lose their effectiveness (SSCRCD 1999).

Encroachment on the floodplain, and the effects of road building, culverts and grazing have led to severe channel incision in upper reaches of mainstem Petaluma River and many tributary reaches. Bank protection structures such as concrete rubble, rock riprap, grouted gabion baskets and sacked concrete have been placed at locations throughout the watershed by local jurisdictions, water agencies, and residential property owners to protect roads and houses. These types of structures reduce the biological and physical integrity of stream habitats by restricting riparian vegetation growth and lateral channel migration. Bank hardening and grade control structures can also pose as barriers to fish passage.

Livestock Farming and Ranching

Conversion of forestlands to grasslands and livestock grazing has significantly impacted riparian corridors. Cattle and other livestock browsing has decreased understory riparian species which provide habitat for terrestrial invertebrates that are food for rearing juvenile salmonids. GIS analysis of the riparian forest indicated 0% of the forest riparian canopy is made up of large tree

classes, while only 7% of the riparian is made up of small trees in the class of Hardwood Forest and Hardwood Woodland species. Grazing and loafing of livestock within riparian corridors also erodes stream banks which causes high gravel embeddedness that impacts spawning success and egg incubation.

Residential and Commercial Development

Road and water use impacts related to existing residential and commercial developments are discussed below. The potential future conversion of ranchettes and large agricultural parcels to residential and commercial parcels could increase water demand in the watershed. Currently, these large agricultural parcels buffer the watershed from excessive water use to some extent. Summer juvenile habitat is absent in locations where domestic water demand exceeds flow capacity.

Roads and Railroads

Both watershed road density and streamside road density is high in the Petaluma River watershed. In urbanized areas, roads mainly impact the stream by adding to the amount of impermeable surfaces in the watershed, creating passage barriers, and, where they encroach upon floodplains, restricting lateral channel migration. A notable example of this is the reach of Adobe Creek between the Old Adobe Road crossing and the Ely Road crossing, where there are several poorly designed road crossings and the road encroaches upon the floodplain. In rural areas, there are many existing private ranch roads that occur in close proximity to streams and are not properly maintained to reduce erosion. Unlike many of the neighboring watersheds in Marin and Sonoma County, there is no watershed-wide road assessment or transportation plan for the Petaluma River watershed. With few road decommissioning and upgrading projects in the subbasin and the likelihood of more road building, this threat is likely to continue in the future.

Water Diversion and Impoundments

The primary sources of reported water diversions in the watershed are related to summer residential and agricultural diversions. The number of these types of diversions is low. However, there are also many unreported diversions (illegal and riparian rights) throughout the watershed that contribute to the overall water demand in the basin. As vineyard development continues water use for vineyard frost protection will likely increase due to the cool conditions of the basin. Water diversion in the tributaries have the potential to strand and kill steelhead fry and juveniles in isolated pools and dewater redds below in late spring and early summer. Streamflow in the mainstem has been compromised by channelization which has confined winter flows and resulted in high sediment yield, lower riparian cover, and high temperatures.

Limiting Stresses, Lifestages, and Habitats

Threat and stress analysis within the CAP workbook suggests juvenile lifestage is most limited. Quality winter rearing habitat, as well as summer rearing habitat, is lacking for steelhead. Impaired quality and extent of habitat connectivity, as well as impaired water flow, are the stresses most limiting recovery of steelhead in the Petaluma River watershed.

General Recovery Strategy

In general, recovery strategies will focus on improving conditions and ameliorating stresses and threats discussed above, although strategies that address other indicators may also be developed where their implementation is critical to restoring properly functioning habitat conditions within the watershed. Priority Recovery Actions: To improve the Poor and inadequate ratings of key habitat attribute indicators in the Petaluma River watershed. Priority recovery actions in this watershed include: improving riparian and canopy, reducing the input of sand and silt, improving streamflows in tributaries, removing passage barriers, addressing water pollution problems, and increasing population numbers through supplementation efforts following significant habitat restoration to address the above issues. San Antonio, Ellis, Adobe, Lynch, Lichau, and Willow Brook creeks are high priority areas for implementing the following recovery actions.

Improve Canopy Cover and Riparian Recruitment

Improving riparian composition and structure would increase stream shading and improve LWD recruitment and result in increases in instream shelter for juvenile steelhead. Practices to improve riparian condition include native riparian planting, development and enforcement of riparian buffers, livestock exclusion fencing, and aligning stream maintenance objectives with riparian conservation objectives.

Address Upslope Sediment Sources

Existing problem roads and active erosion sites should be evaluated, prioritized, and addressed as part of a comprehensive sediment reduction and transportation plan for the entire Petaluma River basin. Future road construction should utilize BMPs to prevent alteration of hydrologic processes, sediment transport, and fish passage, and avoid or minimize construction of roads within riparian zones.

Increase Instream Habitat Complexity

Shelter ratings should be improved within poor quality reaches of all tributaries. In stable reaches, adding LWD or boulder structures will improve the habitat complexity of existing pool habitats where shelter components are currently comprised of small wood and aquatic vegetation. In unstable channel reaches, restoration efforts should implement wood/boulder

structures into degraded reaches where shelter components are currently comprised of undercut banks to increase pool frequency and volume. Expanding opportunities for adult spawning and resting habitats, such as staging pools for resting, and trapping of spawning gravels for spawning, is specifically recommended throughout the mainstem and higher order tributary stream reaches.

Protect Riparian Corridors and Refugia Areas

Existing riparian corridors should be protected, and where opportunity exists, riparian buffers should be widened and/or floodplain areas lowered to benefit wintertime rearing. Rural residential expansion should be discouraged, especially in lowland agricultural zones, and except where the County General Plan elements are protective enough to offset impacts. Conservation easements to protect riparian resources have been useful and should be implemented further to re-establish riparian corridors. Restoration of riparian corridors through the purchase of easements from willing landowners, removal of levees, and expansion of stream corridors, through both natural meandering processes and re-vegetation with native species appropriate to the area, would aid sediment transport, channel processes and perhaps reduce the need for dredging.

Improving distribution of livestock to reduce prolonged concentrated utilization of grassland and riparian areas and to provide periods of rest for improved grassland is recommended. Confining livestock out of riparian corridors is a high priority for the basin. Projects to limit access by livestock in any riparian areas where livestock currently have access should be implemented, either independently or as part of cooperative restoration projects. Existing and future agricultural practices should follow accepted BMPs such as those of the Fish Friendly Farming program to protect and enhance salmonid resources and water quality. A programmatic approach to funding and regulatory hurdles could be explored with NRCS or the local RCD.

Increase Abundance and Prevent Extirpation

Consider and evaluate the role of a conservation hatchery or hatchery stocking within the Petaluma River basin, as part of a program for the larger Interior San Francisco Bay diversity stratum. Such a program would preserve the remaining genetic and phenotypic characteristics that promote life history variability through a captive broodstock, supplementation, or rescue rearing program, and reduce the short-term or immediate risk of extinction. Evaluate the feasibility of using the existing hatchery facility at the Casa Grande High School for such a program.

Protect Natural Seasonal and Summer Hydrologic Conditions

Protecting and enhancing summer baseflows will increase the extent of summer rearing habitat in most Petaluma River tributaries. Maximizing opportunities for aquifer recharge encourages efficient water use, and establishing guidelines that ensure adequate summer baseflows should be developed and implemented. In order to successfully implement strategies that will protect and enhance summer baseflows, future investigation evaluating groundwater/surface water interaction needs to occur. Streamflow monitoring should also be conducted in the basin.

Improve Fish Passage

Assessing and removing barriers will greatly improve the current access to quality habitat for steelhead in the Petaluma River watershed. Improving or removing fish passage barriers on priority streams (such as Lynch and Adobe Creeks for example), to gain access to upstream higher value habitat, may be the most effective recovery strategy available when compared to rehabilitating degraded habitat conditions through the lowland urban corridor. A comprehensive barrier assessment should be conducted for the basin which would prioritize and evaluate the quality and quantity of habitat made available from each barrier treatment.

Improve the Quality and Extent of the Estuary

A limiting factors assessment should be conducted in the estuary to determine the current and future potential habitat conditions for rearing juvenile and smolt salmonids. Levee breaching and restoring tidal flow in strategic locations may increase the quantity of available estuarine habitat, while rehabilitating and reclaiming historic tidal wetland/slough habitat could greatly improve the quality of estuarine habitat for rearing steelhead.

Literature Cited

Leidy, R.A., G.S. Becker, and B.N. Harvey. 2005. Historical Distribution and Current Status of Steelhead/Rainbow Trout (*Oncorhynchus mykiss*) in Streams of the San Francisco Estuary, California. Center for Ecosystem Management and Restoration, Oakland, California. [Available at: http://www.cemar.org/estuarystreamsreport/pdfonly.html]

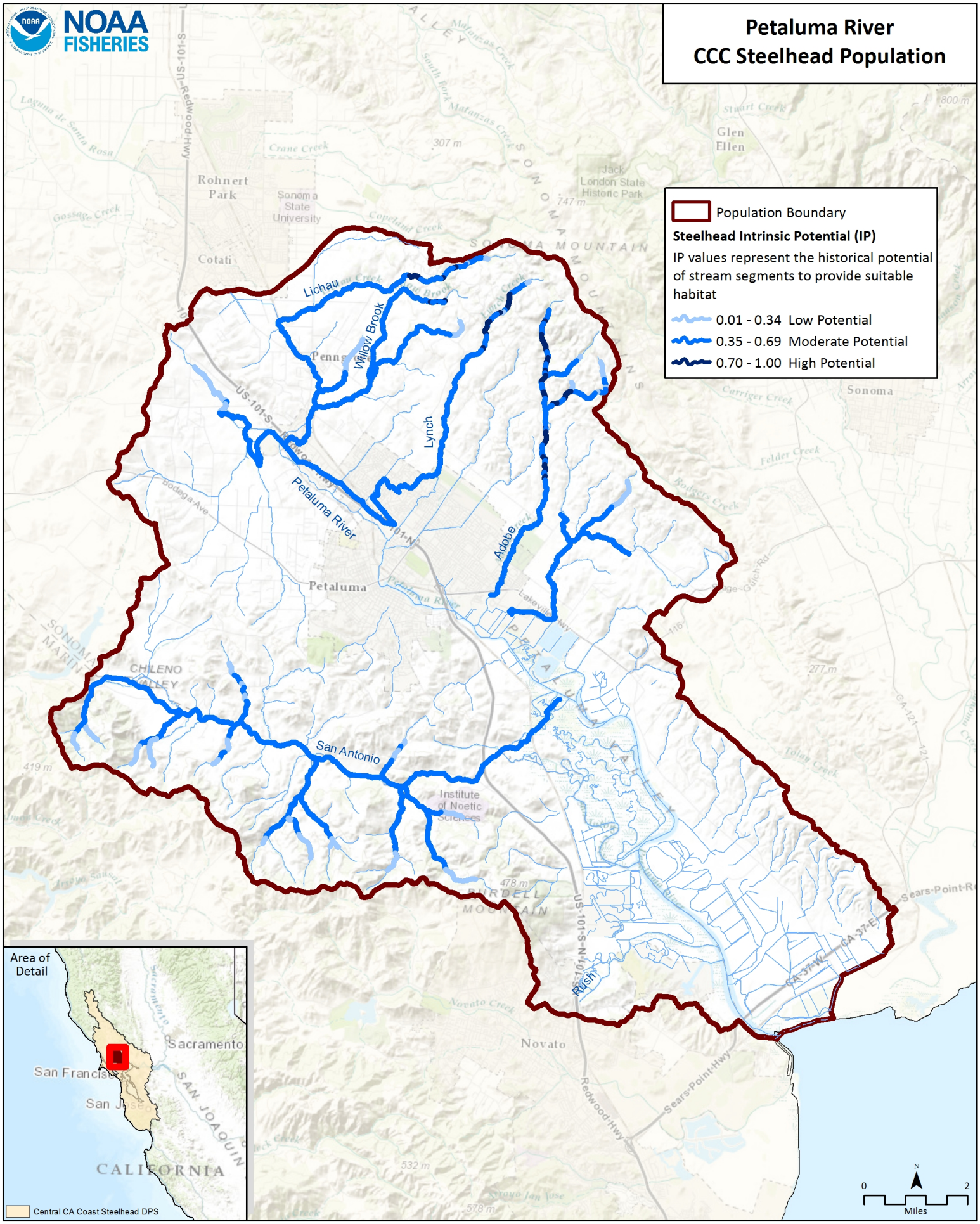
Skinner, J. E. 1962. Fish and Wildlife Resources of the San Francisco Bay Area. California Department of Fish and Game, Water Projects Branch, Sacramento California. [Available at: http://downloads.ice.ucdavis.edu/sfestuary/skinner/archive1000.PDF]

SCWA (Sonoma County Water Agency) 1986. Petaluma River Watershed Master Drainage Plan. Report #47. Prepared for the City of Petaluma. [I added the report number.

SSRCD (Southern Sonoma Resource Conservation District) 1999. Petaluma Watershed Enhancement Plan: An Owner's Manual for the Residents and Landowners of the Petaluma Watershed. July 1999. Available at: http://www.sscrcd.org/pdf/PWEP%20(June%201999)%20Section%201-2.pdf.

SSRCD (Southern Sonoma Resource Conservation District) 2013. DRAFT Petaluma Watershed Enhancement Plan. April 2013.

UACG Inc. 2012. Adobe Creek Restoration Project 5 Year Plan 2012-2016. Petaluma, CA.


Petaluma River
CCC Steelhead Population
Population Boundary
Steelhead Intrinsic Potential (IP)
IP values represent the historical potential of stream segments to provide suitable habitat
0.01 - 0.34 Low Potential
0.35 - 0.69 Moderate Potential
0.70 - 1.00 High Potential
Lichau
Willow Brook
Lynch
Petaluma River
Adobe
San Antonio
Rush
Area of Detail
Central CA Coast Steelhead DPS
Miles

#	Conservation Target	Category	Key Attribute	Indicator	Poor	Fair	Good	Very Good	Current Indicator Measurement	Current Rating
1	Adults	Condition	Habitat Complexity	Large Wood Frequency (BFW 0-10 meters)	<50% of streams/ IP-Km (>6 Key Pieces/100 meters)	50% to 74% of streams/ IP-Km (>6 Key Pieces/100 meters)	75% to 90% of streams/ IP-Km (>6 Key Pieces/100 meters)	>90% of streams/ IP-Km (>6 Key Pieces/100 meters)	<50% of streams/ IP-km (>6 Key Pieces/100 meters)	Poor
			Habitat Complexity	Large Wood Frequency (BFW 10-100 meters)	<50% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	50% to 74% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	75% to 90% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	>90% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	<50% of streams/ IP-km (>1.3 Key Pieces/100 meters)	Poor
			Habitat Complexity	Pool/Riffle/Flatwater Ratio	<50% of streams/ IP-Km (>30% Pools; >20% Riffles)	50% to 74% of streams/ IP-Km (>30% Pools; >20% Riffles)	75% to 90% of streams/ IP-Km (>30% Pools; >20% Riffles)	>90% of streams/ IP-Km (>30% Pools; >20% Riffles)	0% of streams/ IP-km (>30% Pools; >20% Riffles)	Poor
			Habitat Complexity	Shelter Rating	<50% of streams/ IP-Km (>80 stream average)	50% to 74% of streams/ IP-Km (>80 stream average)	75% to 90% of streams/ IP-Km (>80 stream average)	>90% of streams/ IP-Km (>80 stream average)	0% of streams/ IP-km (>80 stream average)	Poor
			Hydrology	Passage Flows	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 51-75	Fair
			Passage/Migration	Passage at Mouth or Confluence	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	50% of IP-Km to 74% of IP-km	Fair
			Passage/Migration	Physical Barriers	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	50% of IP-Km to 74% of IP-km	Fair
			Riparian Vegetation	Tree Diameter (North of SF Bay)	≤39% Class 5 & 6 across IP-km	40 - 54% Class 5 & 6 across IP-km	55 - 69% Class 5 & 6 across IP-km	>69% Class 5 & 6 across IP-km	0% Class 5 & 6 across IP-km	Poor
			Riparian Vegetation	Tree Diameter (South of SF Bay)	≤69% Density rating "D" across IP-km	70-79% Density rating "D" across IP-km	≥80% Density rating "D" across IP-km	Not Defined		

			Sediment	Quantity & Distribution of Spawning Gravels	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	50% of IP-km to 74% of IP-km	Fair
			Velocity Refuge	Floodplain Connectivity	<50% Response Reach Connectivity	50-80% Response Reach Connectivity	>80% Response Reach Connectivity	Not Defined	50-80% Response Reach Connectivity	Fair
			Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No Evidence of Toxins or Contaminants	Sublethal or Chronic	Fair
			Water Quality	Turbidity	<50% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-Km maintains severity score of 3 or lower	75% to 90% of streams/ IP-Km maintains severity score of 3 or lower	>90% of streams/ IP-Km maintains severity score of 3 or lower	75% to 90% of streams/ IP-km maintains severity score of 3 or lower	Good
		Size	Viability	Density	<1 spawner per IP-km to < low risk spawner density per Spence (2008)	>1 spawner per IP-km to < low risk spawner density per Spence (2008)	low risk spawner density per Spence (2008)		<1 spawner per IP-km to < low risk spawner density per Spence (2008)	Poor
2	Eggs	Condition	Hydrology	Flow Conditions (Instantaneous Condition)	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 35-50	Good
			Hydrology	Redd Scour	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score >75	Poor
			Sediment	Gravel Quality (Bulk)	>17% (0.85mm) and >30% (6.4mm)	15-17% (0.85mm) and <30% (6.4mm)	12-14% (0.85mm) and <30% (6.4mm)	<12% (0.85mm) and <30% (6.4mm)	15-17% (0.85mm) and <30% (6.4mm)	Fair
			Sediment	Gravel Quality (Embeddedness)	<50% of streams/ IP-Km (>50% stream average scores of 1 & 2)	50% to 74% of streams/ IP-Km (>50% stream average scores of 1 & 2)	75% to 90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	>90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	44% streams/ 48 % IP-km (>50% stream average scores of 1 & 2)	Poor
3	Summer Rearing Juveniles	Condition	Estuary/Lagoon	Quality & Extent	Impaired/non-functional	Impaired but functioning	Properly Functioning Condition	Unimpaired Condition	Impaired/non-functional	Poor

			Habitat Complexity	Large Wood Frequency (Bankfull Width 0-10 meters)	<50% of streams/ IP-Km (>6 Key Pieces/100 meters)	50% to 74% of streams/ IP-Km (>6 Key Pieces/100 meters)	75% to 90% of streams/ IP-Km (>6 Key Pieces/100 meters)	>90% of streams/ IP-Km (>6 Key Pieces/100 meters)	<50% of streams/ IP-km (>6 Key Pieces/100 meters)	Poor
			Habitat Complexity	Large Wood Frequency (Bankfull Width 10-100 meters)	<50% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	50% to 74% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	75% to 90% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	>90% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	<50% of streams/ IP-km (>1.3 Key Pieces/100 meters)	Poor
			Habitat Complexity	Percent Primary Pools	<50% of streams/ IP-Km (>49% of pools are primary pools)	50% to 74% of streams/ IP-Km (>49% of pools are primary pools)	75% to 89% of streams/ IP-Km (>49% of pools are primary pools)	>90% of streams/ IP-Km (>49% of pools are primary pools)	11% streams/ 4% IP-km (>49% of pools are primary pools)	Poor
			Habitat Complexity	Pool/Riffle/Flatwater Ratio	<50% of streams/ IP-Km (>30% Pools; >20% Riffles)	50% to 74% of streams/ IP-Km (>30% Pools; >20% Riffles)	75% to 90% of streams/ IP-Km (>30% Pools; >20% Riffles)	>90% of streams/ IP-Km (>30% Pools; >20% Riffles)	0% of streams/ IP-km (>30% Pools; >20% Riffles)	Poor
			Habitat Complexity	Shelter Rating	<50% of streams/ IP-Km (>80 stream average)	50% to 74% of streams/ IP-Km (>80 stream average)	75% to 90% of streams/ IP-Km (>80 stream average)	>90% of streams/ IP-Km (>80 stream average)	0% of streams/ IP-km (>80 stream average)	Poor
			Hydrology	Flow Conditions (Baseflow)	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score >75	Poor
			Hydrology	Flow Conditions (Instantaneous Condition)	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 35-50	Good
			Hydrology	Number, Condition and/or Magnitude of Diversions	>5 Diversions/10 IP km	1.1 - 5 Diversions/10 IP km	0.01 - 1 Diversions/10 IP km	0 Diversions	0.94 Diversions/10 IP-km	Good
			Passage/Migration	Passage at Mouth or Confluence	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	<50% of IP-Km or <16 IP-Km accessible*	Poor
			Passage/Migration	Physical Barriers	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	75% of IP-Km to 90% of IP-km	Good

			Riparian Vegetation	Canopy Cover	<50% of streams/ IP-Km (>70% average stream canopy; >85% where coho IP overlaps)	50% to 74% of streams/ IP-Km (>70% average stream canopy; >85% where coho IP overlaps)	75% to 90% of streams/ IP-Km (>70% average stream canopy; >85% where coho IP overlaps)	>90% of streams/ IP-Km (>70% average stream canopy; >85% where coho IP overlaps)	50% streams/ 63% IP-km (>70% average stream canopy; >85% where coho IP overlaps)	Fair
			Riparian Vegetation	Tree Diameter (North of SF Bay)	≤39% Class 5 & 6 across IP-km	40 - 54% Class 5 & 6 across IP-km	55 - 69% Class 5 & 6 across IP-km	>69% Class 5 & 6 across IP-km	0% Class 5 & 6 across IP-km	Poor
			Riparian Vegetation	Tree Diameter (South of SF Bay)	≤69% Density rating "D" across IP-km	70-79% Density rating "D" across IP-km	≥80% Density rating "D" across IP-km	Not Defined		
			Sediment (Food Productivity)	Gravel Quality (Embeddedness)	<50% of streams/ IP-Km (>50% stream average scores of 1 & 2)	50% to 74% of streams/ IP-Km (>50% stream average scores of 1 & 2)	75% to 90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	>90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	44% streams/ 48 % IP-km (>50% stream average scores of 1 & 2)	Poor
			Water Quality	Temperature (MWMT)	<50% IP km (<20 C MWMT; <16 C MWMT where coho IP overlaps)	50 to 74% IP km (<20 C MWMT; <16 C MWMT where coho IP overlaps)	75 to 89% IP km (<20 C MWMT; <16 C MWMT where coho IP overlaps)	>90% IP km (<20 C MWMT; <16 C MWMT where coho IP overlaps)	50-74% IP-km (<20 C MWMT; <16 C MWMT where coho IP overlaps)	Fair
			Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No Evidence of Toxins or Contaminants	Sublethal or Chronic	Fair
			Water Quality	Turbidity	<50% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-Km maintains severity score of 3 or lower	75% to 90% of streams/ IP-Km maintains severity score of 3 or lower	>90% of streams/ IP-Km maintains severity score of 3 or lower	75% to 90% of streams/ IP-km maintains severity score of 3 or lower	Good
		Size	Viability	Density	<0.2 Fish/m^2	0.2 - 0.6 Fish/m^2	0.7 - 1.5 Fish/m^2	>1.5 Fish/m^2	<0.2 Fish/m^2	Poor
			Viability	Spatial Structure	<50% of Historical Range	50-74% of Historical Range	75-90% of Historical Range	>90% of Historical Range	75-90% of Historical Range	Good

4	Winter Rearing Juveniles	Condition	Habitat Complexity	Large Wood Frequency (Bankfull Width 0-10 meters)	<50% of streams/ IP-Km (>6 Key Pieces/100 meters)	50% to 74% of streams/ IP-Km (>6 Key Pieces/100 meters)	75% to 90% of streams/ IP-Km (>6 Key Pieces/100 meters)	>90% of streams/ IP-Km (>6 Key Pieces/100 meters)	<50% of streams/ IP-km (>6 Key Pieces/100 meters)	Poor
			Habitat Complexity	Large Wood Frequency (Bankfull Width 10-100 meters)	<50% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	50% to 74% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	75% to 90% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	>90% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	<50% of streams/ IP-km (>1.3 Key Pieces/100 meters)	Poor
			Habitat Complexity	Pool/Riffle/Flatwater Ratio	<50% of streams/ IP-Km (>30% Pools; >20% Riffles)	50% to 74% of streams/ IP-Km (>30% Pools; >20% Riffles)	75% to 90% of streams/ IP-Km (>30% Pools; >20% Riffles)	>90% of streams/ IP-Km (>30% Pools; >20% Riffles)	0% of streams/ IP-km (>30% Pools; >20% Riffles)	Poor
			Habitat Complexity	Shelter Rating	<50% of streams/ IP-Km (>80 stream average)	50% to 74% of streams/ IP-Km (>80 stream average)	75% to 90% of streams/ IP-Km (>80 stream average)	>90% of streams/ IP-Km (>80 stream average)		
			Passage/Migration	Physical Barriers	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	75% of IP-Km to 90% of IP-km	Good
			Riparian Vegetation	Tree Diameter (North of SF Bay)	≤39% Class 5 & 6 across IP-km	40 - 54% Class 5 & 6 across IP-km	55 - 69% Class 5 & 6 across IP-km	>69% Class 5 & 6 across IP-km	0% Class 5 & 6 across IP-km	Poor
			Riparian Vegetation	Tree Diameter (South of SF Bay)	≤69% Density rating "D" across IP-km	70-79% Density rating "D" across IP-km	≥80% Density rating "D" across IP-km	Not Defined		
			Sediment (Food Productivity)	Gravel Quality (Embeddedness)	<50% of streams/ IP-Km (>50% stream average scores of 1 & 2)	50% to 74% of streams/ IP-Km (>50% stream average scores of 1 & 2)	75% to 90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	>90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	44% streams/ 48 % IP-km (>50% stream average scores of 1 & 2)	Poor
			Velocity Refuge	Floodplain Connectivity	<50% Response Reach Connectivity	50-80% Response Reach Connectivity	>80% Response Reach Connectivity	Not Defined	<50% Response Reach Connectivity	Poor
			Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No Evidence of Toxins or Contaminants	Sublethal or Chronic	Fair

			Water Quality	Turbidity	<50% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-Km maintains severity score of 3 or lower	75% to 90% of streams/ IP-Km maintains severity score of 3 or lower	>90% of streams/ IP-Km maintains severity score of 3 or lower		
5	Smolts	Condition	Estuary/Lagoon	Quality & Extent	Impaired/non-functional	Impaired but functioning	Properly Functioning Condition	Unimpaired Condition	Impaired but functioning	Fair
			Habitat Complexity	Shelter Rating	<50% of streams/ IP-Km (>80 stream average)	50% to 74% of streams/ IP-Km (>80 stream average)	75% to 90% of streams/ IP-Km (>80 stream average)	>90% of streams/ IP-Km (>80 stream average)	0% of streams/ IP-km (>80 stream average)	Poor
			Hydrology	Number, Condition and/or Magnitude of Diversions	>5 Diversions/10 IP km	1.1 - 5 Diversions/10 IP km	0.01 - 1 Diversions/10 IP km	0 Diversions	0.94 Diversions/10 IP-km	Good
			Hydrology	Passage Flows	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 35-50	Good
			Passage/Migration	Passage at Mouth or Confluence	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	50% of IP-Km to 74% of IP-km	Fair
			Smoltification	Temperature	<50% IP-Km (>6 and <14 C)	50-74% IP-Km (>6 and <14 C)	75-90% IP-Km (>6 and <14 C)	>90% IP-Km (>6 and <14 C)	50-74% IP-km (>6 and <14 C)	Fair
			Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No Evidence of Toxins or Contaminants	Sublethal or Chronic	Fair
			Water Quality	Turbidity	<50% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-Km maintains severity score of 3 or lower	75% to 90% of streams/ IP-Km maintains severity score of 3 or lower	>90% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-km maintains severity score of 3 or lower	Fair
		Size	Viability	Abundance	Smolt abundance which produces high risk spawner density per Spence (2008)	Smolt abundance which produces moderate risk spawner density per Spence (2008)	Smolt abundance to produce low risk spawner density per Spence (2008)		Smolt abundance which produces high risk spawner density per Spence (2008)	Poor

6	Watershed Processes	Landscape Context	Hydrology	Impervious Surfaces	>10% of Watershed in Impervious Surfaces	7-10% of Watershed in Impervious Surfaces	3-6% of Watershed in Impervious Surfaces	<3% of Watershed in Impervious Surfaces	6.034% of Watershed in Impervious Surfaces	Fair
			Landscape Patterns	Agriculture	>30% of Watershed in Agriculture	20-30% of Watershed in Agriculture	10-19% of Watershed in Agriculture	<10% of Watershed in Agriculture	16% of Watershed in Agriculture	Good
			Landscape Patterns	Timber Harvest	>35% of Watershed in Timber Harvest	26-35% of Watershed in Timber Harvest	25-15% of Watershed in Timber Harvest	<15% of Watershed in Timber Harvest	<15% of Watershed in Timber Harvest	Very Good
			Landscape Patterns	Urbanization	>20% of watershed >1 unit/20 acres	12-20% of watershed >1 unit/20 acres	8-11% of watershed >1 unit/20 acres	<8% of watershed >1 unit/20 acres	27% of watershed >1 unit/20 acres	Poor
			Riparian Vegetation	Species Composition	<25% Intact Historical Species Composition	25-50% Intact Historical Species Composition	51-74% Intact Historical Species Composition	>75% Intact Historical Species Composition	25-50% Intact Historical Species Composition	Fair
			Sediment Transport	Road Density	>3 Miles/Square Mile	2.5 to 3 Miles/Square Mile	1.6 to 2.4 Miles/Square Mile	<1.6 Miles/Square Mile	3.5 Miles/Square Mile	Poor
			Sediment Transport	Streamside Road Density (100 m)	>1 Miles/Square Mile	0.5 to 1 Miles/Square Mile	0.1 to 0.4 Miles/Square Mile	<0.1 Miles/Square Mile	2.8 Miles/Square Mile	Poor

	Threats Across Targets	Adults	Eggs	Summer Rearing Juveniles	Winter Rearing Juveniles	Smolts	Watershed Processes	Overall Threat Rank
	Project-specific-threats	1	2	3	4	5	6	
1	Agriculture	Medium	Medium	Medium	Medium	Medium	Medium	Medium
2	Channel Modification	High	High	High	High	Medium	Medium	High
3	Disease, Predation and Competition	Low		Medium	Low	Low	Low	Low
4	Hatcheries and Aquaculture	Low		Low		Low		Low
5	Fire, Fuel Management and Fire Suppression	Low	Low	Low		Low	Low	Low
6	Fishing and Collecting	Low		Low		Low		Low
7	Livestock Farming and Ranching	Medium	High	High	Medium	Low	Medium	High
8	Logging and Wood Harvesting	Low	Low	Low	Low	Low	Low	Low
9	Mining	Low		Low		Medium	Low	Low
10	Recreational Areas and Activities						Low	Low
11	Residential and Commercial Development	Medium	Medium	High	Medium	Low	High	High
12	Roads and Railroads	High	High	Medium	Medium	Medium	Medium	High
13	Severe Weather Patterns	Medium	Low	Medium	Low	Medium	Medium	Medium
14	Water Diversion and Impoundments	Medium	Low	High	Low	Medium	Low	Medium
	Threat Status for Targets and Project	High	High	High	Medium	Medium	High	High

Petaluma River, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
PR-CCCS-1.1	**Objective**	**Estuary**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**										
PR-CCCS-1.1.1	Recovery Action	Estuary	Increase the quality and extent of estuarine habitat										
PR-CCCS-1.1.1.1	Action Step	Estuary	Develop Estuary Enhancement Projects to improve rearing habitat for juveniles and smolts (eg. habitat features such as LWD, vegetative cover, deeper habitat, etc.)	2	5	Friends of the Petaluma River, SFEI						TBD	Costs will vary depending on methods implemented.
PR-CCCS-1.1.1.10	Action Step	Estuary	Identify and provide recommendations for potential rehabilitation sites that have been altered by dredging and diking.	3	25	CDFW, Friends of the Petaluma River, NMFS, Private Consultants						0	Existing programs and outreach are considered In-Kind.
PR-CCCS-1.1.1.11	Action Step	Estuary	Identify locations to install habitat complexity features to enhance steelhead estuary rearing conditions.	2	10	CDFW, Friends of the Petaluma River, NMFS, Sonoma RCD						0	Cost accounted for in above action step.
PR-CCCS-1.1.1.2	Action Step	Estuary	Support a salmonid limiting factors assessment in San Pablo Bay (CDFG 2004) and the Petaluma River Marsh.	1	5	Friends of the Petaluma River, SFEI						0	Action is considered In-Kind
PR-CCCS-1.1.1.3	Action Step	Estuary	Per a completed limiting factors assessment, and utilizing adaptive management guidelines, develop restoration projects in areas which have high value physical and chemical properties for rearing salmonids	1	15	NMFS						TBD	Cost based on amount of estuarine habitat restoration projects. Cost accounted for in other action steps.
PR-CCCS-1.1.1.4	Action Step	Estuary	Restore estuarine wetlands and sloughs, and improve prey abundance by increasing shoreline perimeter and planting native emergent and riparian species to improve foraging and cover.	2	10	CDFW, Private Landowners	447	447				893	Cost based on treating 20 acres at a rate of $44,640/acre.
PR-CCCS-1.1.1.5	Action Step	Estuary	Improve estuarine water quality by identifying and remediating upstream pollution sources which contribute to poor water quality conditions in the estuary	2	20	City of Petaluma, RCD, Sonoma County, Sonoma County Water Agency, Sonoma RCD	3.75	3.75	3.75	3.75		15	Cost based on installing a minimum of 3 continuous water quality monitoring stations at a rate of $5,000/station. Cost does not account for data management or maintenance.
PR-CCCS-1.1.1.6	Action Step	Estuary	Minimize future encroachment of landuse (agricultural, residential and commercial) into floodplain areas of the estuary	3	5	CDFW, City of Petaluma, RWQCB, Sonoma County, USACE						0	Action is considered In-Kind
PR-CCCS-1.1.1.7	Action Step	Estuary	Evaluate the effect of nearby landuse practices and development structures which may impair or reduce the historical tidal prism and other estuarine functions and implement improvements	3	10	City of Petaluma, SFEI, Sonoma County						TBD	Costs associated with removal of structures will depend on the number and type of structures identified and cannot be accurately determined at this time.
PR-CCCS-1.1.1.8	Action Step	Estuary	Evaluate alterations to river mouth dynamics and implement changes to restore natural function	2	10	CDFW, NMFS, USACE	169.50	169.50				339	Cost based on estuary use/residence time model at a rate of $338,679/project.
PR-CCCS-1.1.1.9	Action Step	Estuary	Evaluate water quality conditions (salinity, dissolved oxygen, temperature) in potential steelhead estuary rearing areas.	3	10	Friends of the Petaluma River, Private Consultants, UACG						TBD	Cost accounted for in above action step.
PR-CCCS-2.1	**Objective**	**Floodplain Connectivity**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**										

Petaluma River, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
PR-CCCS-2.1.1	Recovery Action	Floodplain Connectivity	Rehabilitate and enhance floodplain connectivity										
PR-CCCS-2.1.1.1	Action Step	Floodplain Connectivity	Encourage willing landowners to restore historical floodplains or offchannel habitats through conservation easements, etc.	3	25	City of Petaluma, Sonoma County, Sonoma RCD						0	Existing programs and outreach are considered In-Kind.
PR-CCCS-2.1.1.2	Action Step	Floodplain Connectivity	Set-back existing levees in strategic areas to increase flood-flow detention and promote flood-tolerant land uses.	2	40	City of Petaluma, Private Landowners, Sonoma County, Sonoma RCD						TBD	Cost based on amount of existing levees to set-back. Cost for set-back estimated at $41.93/linear ft.
PR-CCCS-2.1.1.3	Action Step	Floodplain Connectivity	Support landowners in developing projects to improve channel conditions and restore natural channel geomorphology, including side channels and dense contiguous riparian vegetation (CDFG 2004). Improve conditions to re-create, and restore alcove, backwater, or perennial pond habitats where channel modification has resulted in decreased shelter, LWD frequency, and habitat complexity, develop and implement site specific plans to improve these conditions to re-create, and restore alcove, backwater, or perennial pond habitats.	3	40	City of Petaluma, Private Landowners, Sonoma County, Sonoma RCD						TBD	Cost cannot be determined due to unknown number of projects at various scales.
PR-CCCS-2.1.1.4	Action Step	Floodplain Connectivity	Identify areas where floodplain connectivity can be re-established in low gradient response reaches	2	10	City of Petaluma, NMFS, Private Landowners, Sonoma County, Sonoma RCD						TBD	Cost accounted for in other action steps.
PR-CCCS-3.1	**Objective**	**Hydrology**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**										
PR-CCCS-3.1.1	Recovery Action	Hydrology	Improve flow conditions										
PR-CCCS-3.1.1.2	Action Step	Hydrology	Identify flow requirements that support adult steelhead immigration from and juvenile emigration to San Pablo Bay	3	5	CDFW, NMFS, Sonoma RCD						0	Cost accounted for in above action step.
PR-CCCS-3.1.1.3	Action Step	Hydrology	Reduce redd scour to improve egg incubation/emergence survival.	2	10	City of Petaluma, Private Landowners, Sonoma County, Sonoma RCD						TBD	Costs will vary depending on methods implemented.
PR-CCCS-3.1.1.4	Action Step	Hydrology	Reduce dewatering and stranding conditions.	2	5	City of Petaluma, Private Landowners, Sonoma County, Sonoma RCD						TBD	Costs will vary depending on methods implemented.
PR-CCCS-5.1	**Objective**	**Passage**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**										
PR-CCCS-5.1.1	Recovery Action	Passage	Modify or remove physical barriers to passage										

Petaluma River, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
PR-CCCS-5.1.1.1	Action Step	Passage	Conduct a systematic culvert assessment on county roads within the watershed, and prioritize culverts for replacement, upgrade and retrofit.	2	5	City of Petaluma, Sonoma County, Sonoma RCD, UACG	500					500	Cost based on replacing 5 stream crossings at a rate of approximately $100,000/site assessment.
PR-CCCS-5.1.1.10	Action Step	Passage	Evaluate and modify fish passage impediments on Adobe, Lynch and Washington Creeks at the confluence with the Petaluma River	1	5	City of Petaluma, Sonoma County, Sonoma County Water Agency, UACG						TBD	Costs accounted for in above action step.
PR-CCCS-5.1.1.2	Action Step	Passage	Evaluate private crossings identified in the CDFW Habitat Inventories, conduct culvert assessments, and prioritize culverts for replacement, upgrade and retrofit.	2	5	City of Petaluma, Private Landowners, Sonoma County, Sonoma RCD						TBD	Cost accounted for in above action step.
PR-CCCS-5.1.1.3	Action Step	Passage	Replace, retrofit and upgrade culverts according to completed surveys identified above.	1	5	City of Petaluma, Private Landowners, Sonoma County, Sonoma RCD						TBD	Cost accounted for in above action step.
PR-CCCS-5.1.1.4	Action Step	Passage	Modify or remove man made physical passage barriers to the extent that all current and potential high value habitat is accessible to spawning adults and rearing juvenile steelhead.	1	5	City of Petaluma, Private Landowners, Sonoma County, Sonoma RCD	2,166					2,166	Cost based on providing passage at 5 dams at a rate of $433,178/project.
PR-CCCS-5.1.1.5	Action Step	Passage	Evaluate, develop, and implement fish passage features to enhance passage conditions in Adobe Creek at the Adobe Road Crossing and the boulder structure spanning the creek in the lower reach of Adobe Creek. Recommend and determine maintenance requirements and responsibility.	1	5	City of Petaluma, Sonoma County, Sonoma County Water Agency, UACG						TBD	Cost accounted for in above action steps.
PR-CCCS-5.1.1.6	Action Step	Passage	Relocate or modify the gas/water line crossing on Adobe Creek at Sartori Road.	1	5	City of Petaluma, Sonoma County, Sonoma County Water Agency, UACG						TBD	Costs will vary depending on methods implemented.
PR-CCCS-5.1.1.7	Action Step	Passage	Conduct ground surveys to determine if there is an appreciable quantity/quality of historic habitat partially or completely blocked in the headwaters of Adobe, Lichau and Washington Creeks.	2	5	CDFW, City of Petaluma, NMFS, Private Consultants, UACG	138.00					138	Cost based on fish/habitat restoration model at a rate of $137,833/project.
PR-CCCS-5.1.1.8	Action Step	Passage	Design and install appropriate fishways.	1	5	CDFW, NMFS, Private Consultants, Sonoma County Water Agency, Sonoma RCD						TBD	Costs will vary depending on methods implemented.

Petaluma River, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
PR-CCCS-5.1.1.9	Action Step	Passage	Modify or remove all passage impediments identified to the extent that 1ft of depth is achieved at 25 cfs.	2	10	City of Petaluma, Sonoma County, Sonoma County Water Agency						TBD	Cost accounted for in above action step.
PR-CCCS-6.1	**Objective**	**Habitat Complexity**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**										
PR-CCCS-6.1.1	Recovery Action	Habitat Complexity	Increase large wood frequency										
PR-CCCS-6.1.1.1	Action Step	Habitat Complexity	Increase large wood frequency in 75% of streams within the watershed to improve conditions for adults, and winter/summer rearing juveniles.	2	10	CDFW, City of Petaluma, Private Landowners, Sonoma County, Sonoma RCD	22.00	22.00				44	Cost based on treating 1.4 miles (assume 1 project/mile in 50% high IP) at a rate of $31,200/mile. This action step should be coordinated with other action steps to reduce cost and redundancy.
PR-CCCS-6.1.1.2	Action Step	Habitat Complexity	Increase LWD frequency to optimal conditions (>6 key LWD pieces/100 meters) in select reaches of Lynch, Willow Brook, Lichau, Washington, Adobe, and Ellis Creeks	1	10	CDFW, City of Petaluma, NOAA RC, Private Consultants, Private Landowners, Sonoma County, Sonoma RCD						TBD	Cost accounted for in above action step.
PR-CCCS-6.1.1.3	Action Step	Habitat Complexity	Increase LWD frequency to optimal conditions (>2 key LWD pieces/100 meters) in middle and upper reaches of San Antonio Creek and Petaluma River	1	10	CDFW, City of Petaluma, Marin RCD, NOAA RC, Private Landowners, Sonoma County, Sonoma RCD						TBD	Cost accounted for in above action step.
PR-CCCS-6.1.2	Recovery Action	Habitat Complexity	Increase frequency of primary pools										
PR-CCCS-6.1.2.1	Action Step	Habitat Complexity	Increase primary pool frequency in 75% of streams within the watershed to improve conditions for adults, and summer/winter juveniles.	3	20	CDFW, City of Petaluma, NOAA RC, Private Landowners, Sonoma County, Sonoma RCD						TBD	Cost accounted for in above action step.
PR-CCCS-6.1.2.2	Action Step	Habitat Complexity	Increase primary pool frequency to achieve optimal conditions (>40% of pools meet primary pool criteria (>2.5 feet deep in 1st and 2nd order streams; >3 feet in third order or larger streams)) in select reaches of Lynch, Willow Brook, Lichau, Washington, Adobe, and Ellis Creeks and middle and upper reaches of San Antonio and Petaluma River	2	10	CDFW, City of Petaluma, Marin RCD, NOAA RC, Private Consultants, Private Landowners, Sonoma County, Sonoma RCD						TBD	Cost accounted for in other action steps.
PR-CCCS-6.1.3	Recovery Action	Habitat Complexity	Improve pool/riffle/flatwater ratios (hydraulic diversity)										

Petaluma River, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
PR-CCCS-6.1.3.1	Action Step	Habitat Complexity	Increase the frequencies of riffles in 75% of the streams within the watershed.	2	10	CDFW, City of Petaluma, NOAA RC, Private Consultants, Private Landowners, Sonoma County, Sonoma RCD						TBD	Cost accounted for in other action steps.
PR-CCCS-6.1.3.2	Action Step	Habitat Complexity	Increase riffle frequency to 20% by converting flatwater habitats (glides, runs, etc.) utilizing boulders and log structures in select reaches of Lynch, Willow Brook, Lichau, Washington, Adobe, and Ellis Creeks and middle and upper reaches of San Antonio and Petaluma River	2	5	CDFW, City of Petaluma, Marin RCD, NOAA RC, Private Consultants, Private Landowners, Solano County, Sonoma RCD						TBD	Cost accounted for in other action steps.
PR-CCCS-6.1.4	Recovery Action	Habitat Complexity	Improve shelter rating										
PR-CCCS-6.1.4.1	Action Step	Habitat Complexity	Increase shelter ratings to optimal conditions (>80 pool shelter value) in all reaches of Lynch, Willow Brook, Lichau, Washington, Adobe, and Ellis Creeks and middle and upper reaches of San Antonio and Petaluma River	2	10	CDFW, City of Petaluma, Marin RCD, NOAA RC, Private Consultants, Private Landowners, Sonoma County, Sonoma RCD						TBD	Cost accounted for in other action steps.
PR-CCCS-7.1	**Objective**	**Riparian**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**										
PR-CCCS-7.1.1	Recovery Action	Riparian	Improve canopy cover and species composition										
PR-CCCS-7.1.1.1	Action Step	Riparian	Increase tree diameter within 55% of watershed to achieve optimal riparian forest conditions (55 - 69% Class 5 & 6 tree)	3	20	CDFW, City of Petaluma, Private Consultants, Private Landowners, Sonoma County, Sonoma County Water Agency, Sonoma RCD						TBD	Costs will vary depending on methods implemented and extent of rehabilitation.
PR-CCCS-7.1.1.2	Action Step	Riparian	Plant native riparian species and native conifers/hardwoods throughout riparian zones within Lynch, Willow Brook, Lichau, Washington, Adobe, and Ellis Creeks and middle and upper reaches of San Antonio and Petaluma River portions of the watershed to increase overall tree diameter	1	10	CDFW, City of Petaluma, NOAA RC, Private Consultants, Private Landowners, Sonoma County, Sonoma County Water Agency	199.00	199.00				398	Cost based on treating 0.2 miles (assume 1 project/mile in 5% high IP with 80 acres/mile) at a rate of $24,862/acre.

Petaluma River, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
PR-CCCS-7.2	**Objective**	**Riparian**	**Address the inadequacy of existing regulatory mechanisms**										
PR-CCCS-7.2.1	Recovery Action	Riparian	Improve canopy cover and species composition										
PR-CCCS-7.2.1.1	Action Step	Riparian	Increase the width of riparian corridors to 150' to allow multi-age stands of native trees and shrubs, and eventual recruitment of LWD	3	25	City of Petaluma, Sonoma County						TBD	Cost accounted for in other action steps.
PR-CCCS-7.2.1.2	Action Step	Riparian	Promote streamside conservation measures, including conservation easements, setbacks, and riparian buffers throughout the watershed (CDFG 2004).	3	25	CDFW, City of Petaluma, Friends of the Petaluma River, Land Trusts, Marin RCD, Sonoma County, Sonoma RCD						TBD	Costs for conservation easements vary.
PR-CCCS-8.1	**Objective**	**Sediment**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**										
PR-CCCS-8.1.1	Recovery Action	Sediment	Improve instream gravel quality										
PR-CCCS-8.1.1.1	Action Step	Sediment	Reduce embbeddness levels to the extent that 75% to 90% of streams within the watershed meet optimal criteria (>50% stream average scores of 1 & 2)	2	10	CDFW, City of Petaluma, Private Landowners, Sonoma County, Sonoma RCD						TBD	Cost associated with implementation of other actions steps.
PR-CCCS-8.1.1.2	Action Step	Sediment	Conduct instream and upslope sediment source surveys in Lynch, Willow Brook, Lichau, Washington, and Ellis Creeks and middle and upper reaches of San Antonio and Petaluma River) to identify existing sources of high sediment yield using accepted protocols and implement recommendations	2	10	Marin County, Marin RCD, Private Consultants, Private Landowners, Sonoma County, Sonoma RCD	176.50	176.50				353	Cost based on erosion assessment for 25% of total watershed acres at a rate of $15.14/acre.
PR-CCCS-8.1.1.3	Action Step	Sediment	Implement recommendations of completed sediment source surveys in the watershed (See ROADS for specific actions)	2	5	CDFW, City of Petaluma, Marin County, Marin RCD, Private Landowners, Sonoma County, Sonoma RCD						TBD	Costs accounted for in actions related to roads.
PR-CCCS-8.1.1.4	Action Step	Sediment	Increase the quantity and distribution of spawning gravels in 50% of streams within the watershed	2	10	CDFW, City of Petaluma, Marin RCD, Sonoma County, Sonoma RCD						TBD	Costs will vary depending on methods implemented and extent of rehabilitation.
PR-CCCS-8.1.1.5	Action Step	Sediment	Develop habitat enhancement projects to establish additional riffle habitat and import spawning gravel from mining operations in the basin to select reaches of Lynch, Willow Brook, Lichau, Washington, Adobe, and Ellis Creeks and middle and upper reaches of San Antonio and Petaluma River	1	5	CDFW, NMFS, NOAA RC, Private Consultants, Private Landowners, Sonoma RCD, Trout Unlimited						TBD	Cost accounted for in other action steps.

Petaluma River, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
PR-CCCS-10.1	**Objective**	**Water Quality**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**										
PR-CCCS-10.1.1	Recovery Action	Water Quality	Improve stream temperature conditions										
PR-CCCS-10.1.1.1	Action Step	Water Quality	Monitor temperature to improve rearing conditions for juvenile and smolts to determine baseline conditions and judge the efficacy of restoration actions. High priority streams to monitor and evaluate temperature include tributary and mainstem reaches within Lynch, Willow Brook, Lichau, Washington, Adobe, and Ellis Creeks and middle and upper reaches of San Antonio and Petaluma River	3	5	Private Consultants, Sonoma County Water Agency, UACG	1.50					2	Cost based on installing a minimum of 3 temperature loggers at a rate of $500/logger. Cost does not account for data management or maintenance.
PR-CCCS-10.1.1.2	Action Step	Water Quality	Improve stream water quality conditions	3	10	CDFW, City of Petaluma, Marin County, Marin RCD, Private Landowners, Sonoma County, Sonoma County Water Agency, Sonoma RCD						TBD	Cost accounted for through implementation of other action steps.
PR-CCCS-10.1.1.3	Action Step	Water Quality	Plant native vegetation to promote streamside shade: increase the canopy by planting native species where shade canopy is not at acceptable levels in select reaches of High priority streams include tributary and mainstem reaches within San Antonio, Washington, Adobe, Lynch, Lichau, Willow Brook, and Ellis Creeks and middle and upper reaches of Petaluma River.	1	20	CDFW, Marin RCD, NMFS, NOAA RC, NRCS, Private Landowners, Sonoma RCD						TBD	Cost accounted for.
PR-CCCS-10.1.2	Recovery Action	Water Quality	Improve stream water quality conditions										
PR-CCCS-10.1.2.1	Action Step	Water Quality	Identify and provide solutions for point and non-point sources contributing to toxicity and turbidity.	3	5	NMFS, Private Landowners, RWQCB, Sonoma RCD						0	Action is considered In-Kind
PR-CCCS-10.1.2.2	Action Step	Water Quality	Install continuous water quality monitoring stations in High priority streams include tributary and mainstem reaches within Lynch, Willow Brook, Lichau, Washington, Adobe, and Ellis Creeks and middle and upper reaches of San Antonio and Petaluma River	2	5	NMFS, Private Landowners, RWQCB						15	Cost based on installing a minimum of 3 continuous water quality stations at a rate of $5,000/station.
PR-CCCS-10.1.2.3	Action Step	Water Quality	Work with livestock and ranch owners to implement BMP's to control sediment and nitrates	3	20	NRCS, Private Landowners, RCD						0	Action is considered In-Kind
PR-CCCS-11.1	**Objective**	**Viability**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**										
PR-CCCS-11.1.1	Recovery Action	Viability	Increase density, abundance, spatial structure, and diversity based on the biological recovery criteria										
PR-CCCS-11.1.1.1	Action Step	Viability	Support United Anglers Casa Grande Hatchery with monitoring of target life stages in the watershed.	1	10	CDFW, NMFS, Sonoma County Water Agency, Trout Unlimited, UC Extension	115.50	115.50				231	Cost based on life history/population size monitoring at a rate of $231,076/project.

Petaluma River, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
PR-CCCS-11.1.1.2	Action Step	Viability	Evaluate utilizing the United Anglers Casa Grande Hatchery to supplement the existing steelhead population.	1	5	CDFW, NMFS, UACG						TBD	Restock steelhead according to the lifestage that is most applicable to each tributary. Determine need and locations for smolt imprinting/release stations throughout the watershed together with partners and the community. Costs will vary depending on methods implemented.
PR-CCCS-11.1.1.3	Action Step	Viability	Conduct habitat and sediment characteristics monitoring.	2	60	CDFW, Marin RCD, MMWD, NMFS, Private Consultants, Sonoma County Water Agency						0	To better understand changes in sedimentation, monitoring in the basin should include: longitudinal profiles, cross-sections, V*, LWD volume and distribution, and embeddedness. Costs accounted for in other action steps
PR-CCCS-11.1.1.4	Action Step	Viability	Conduct habitat surveys to monitor change in key habitat variables	1	10	CDFW, NMFS, UACG							Cost accounted for in the Monitoring Chapter. Systematic habitat assessments will be part of the Coast Monitoring Plan.
PR-CCCS-11.1.1.5	Action Step	Viability	Assess habitat conditions in tributaries of Adobe, Lichau and Willow Brook Creeks. Re-assess habitat conditions in upper Adobe, upper Lynch, Ellis and San Antonio Creek and their tributaries. Conduct outreach utilizing existing and broad partnerships to expand landowner access prior to survey.	2	5	CDFW, NMFS, UACG						TBD	Habitat surveys are estimated at $1500/mile. Costs may be reduced if UACG conduct some of the assessments.
PR-CCCS-12.1	**Objective**	**Agriculture**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**										
PR-CCCS-12.1.1	Recovery Action	Agriculture	Prevent or minimize impairment to habitat complexity (reduced large wood and/or shelter)										
PR-CCCS-12.1.1.1	Action Step	Agriculture	Avoid the removal of large wood and other shelter components from the stream system	2	100	NRCS, Private Landowners, RCD, Sonoma RCD							This recommendation should be considered standard practice. Existing programs and outreach are considered in-kind.
PR-CCCS-12.1.1.2	Action Step	Agriculture	Promote the re-vegetation of the native riparian plant community within inset floodplains and riparian corridors to provide future recruitment of large wood and other shelter components	2	20	Marin RCD, NRCS, Private Landowners, Sonoma RCD							Cost accounted for in other actions. See Riparian.
PR-CCCS-12.1.1.3	Action Step	Agriculture	Preserve snags, leave downed wood on the banks or in the stream, and encourage multi-age stands within existing corridors	3	25	Private Landowners, Sonoma County Water Agency						0	Existing programs and outreach are considered In-Kind.
PR-CCCS-12.1.1.4	Action Step	Agriculture	Encourage landowners to implement restoration projects as part of their ongoing practices in priority stream reaches and where habitat is in poor or fair condition.	3	20	Marin RCD, Private Landowners, Sonoma County Water Agency, Sonoma RCD						0	Existing programs and outreach are considered In-Kind.
PR-CCCS-12.1.1.5	Action Step	Agriculture	Implement programs to purchase land/conservation easements to encourage the re-establishment and/or enhancement of natural riparian communities.	3	25	Marin RCD, Sonoma County, Sonoma RCD						TBD	Costs for conservation easements vary.
PR-CCCS-12.1.1.6	Action Step	Agriculture	Implement Best Management Practices such as those in the Fish Friendly Farming program (California Land Stewardship Institute), or other cooperative conservation programs.	2	10	CDFW, Farm Bureau, Marin RCD, NMFS, Private Landowners, RCD, Sonoma RCD						0	Existing programs and outreach are considered In-Kind.
PR-CCCS-12.1.2	Recovery Action	Agriculture	Prevent or minimize impairment to instream substrate/food productivity (gravel quality and quantity)										

Petaluma River, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
PR-CCCS-12.1.2.1	Action Step	Agriculture	Encourage the NRCS, RCDs, and other appropriate organizations to increase the number of landowners participating in sediment reduction planning and implementation.	3	10	CDFW, Marin RCD, NMFS, NRCS, Private Landowners, Sonoma RCD						0	Existing programs and outreach are considered In-Kind.
PR-CCCS-12.1.2.2	Action Step	Agriculture	Complete Farm Conservation Plans (through the SRCD, NRCS, Fish Friendly Farming program or other cooperative conservation programs) to address sediment source reduction, riparian habitat, forest health, and restoration.	2	10	CDFW, Farm Bureau, Marin RCD, NMFS, NRCS, Private Landowners, Sonoma RCD						TBD	Cost based on the number of participants. Cost of completing Farm Conservation Plan estimated at approximately $100,000 per plan.
PR-CCCS-12.1.2.3	Action Step	Agriculture	Assess the effectiveness of erosion control measures throughout the winter period.	3	20	CDFW, Marin RCD, NMFS, NRCS, Private Landowners, Sonoma RCD						TBD	The cost is TBD since the number, location and scope of future erosion control measures is unknown at this time. however, the cost will likely be low if CDFW effectiveness monitoring protocols are used.
PR-CCCS-12.1.2.4	Action Step	Agriculture	Address sediment and runoff sources from road networks and other actions that deliver sediment and runoff to stream channels (see Roads for specific actions/areas)	3	5	CDFW, Marin RCD, Private Consultants, Private Landowners, Sonoma RCD	576					576	Cost based on road inventory of 501 miles of road at a rate of $1,148/mile.
PR-CCCS-12.2	**Objective**	**Agriculture**	**Address the inadequacy of existing regulatory mechanisms**										
PR-CCCS-12.2.1	Recovery Action	Agriculture	Prevent or minimize impairment to stream hydrology (impaired water flow)										
PR-CCCS-12.2.1.1	Action Step	Agriculture	Promote off-channel storage to reduce impacts of water diversion during the spring and summer (e.g. diversion during winter high flow).	2	20	Marin RCD, NMFS, NRCS, Private Consultants, Private Landowners, Sonoma RCD, UC Extension						TBD	Cost based on amount of off-channel storage needed and willingness of landowners. Cost estimate for off-channel storage $5,000/site.
PR-CCCS-12.2.1.2	Action Step	Agriculture	Encourage use of BMP's for irrigation (cover crop, drip) and frost protection (wind machines, cold air drains, heaters, or micro-sprayers) which eliminate or minimize water use	3	20	Marin RCD, NRCS, Private Consultants, Private Landowners, Sonoma RCD						0	Existing programs and outreach are considered In-Kind.
PR-CCCS-12.2.1.3	Action Step	Agriculture	Pursue opportunities to acquire or lease water, or acquire water rights from willing sellers, for steelhead recovery purposes. Develop incentives for water right holders to dedicate instream flows for the protection of steelhead (Water Code § 1707).	2	10	CDFW, Marin RCD, MCRRFCD, MMWD, RWQCB, Sonoma RCD						0	Costs are expected to be minimal as some of these efforts will be part of existing programs, however some technical assistance may be necessary from a variety of agencies.
PR-CCCS-12.2.2	Recovery Action	Agriculture	Prevent or minimize impairment to water quality (impaired stream temperature)										
PR-CCCS-12.2.2.1	Action Step	Agriculture	Develop riparian setbacks/buffers where they do not currently occur, and enforce requirements of local regulations where they do	3	5	City Planning, NMFS, RWQCB						0	Existing programs and outreach are considered In-Kind.
PR-CCCS-12.2.2.2	Action Step	Agriculture	Solicit cooperation from NRCS, RCDs, Farm Bureau, and others to devise incentive programs and incentive-based approaches to encourage increased involvement and support existing landowners who conduct operations in a manner compatible with CCC steelhead recovery priorities.	3	10	CDFW, Farm Bureau, Marin RCD, NMFS, NRCS, Private Landowners, Sonoma RCD						0	Soliciting cooperation not expected to cost much outside of already existing federal and state and local salaries. Existing programs and outreach are considered In-Kind.

Petaluma River, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
PR-CCCS-12.2.2.3	Action Step	Agriculture	Streamline permit processing where landowners are conducting actions aligned with recovery priorities.	3	5	CDFW, Marin RCD, NMFS, NRCS, Sonoma RCD, SWRCB, USACE						0	Streamlining permit processing is not expected to cost much, and may save money through future efficiencies.
PR-CCCS-12.2.2.4	Action Step	Agriculture	Increase setbacks of existing agricultural activities from the top of bank to 100'	3	25	City Planning, Marin County, Marin RCD, NRCS, Sonoma County, Sonoma RCD						TBD	Cost is difficult to estimate at this time, and will be dependent on the linear distance of setbacks and the cost to landowners of lost production from area inside the setback.
PR-CCCS-12.2.3	Recovery Action	Agriculture	Prevent or minimize impairment to riparian species composition and structure										
PR-CCCS-12.2.3.1	Action Step	Agriculture	Utilize native plants when landscaping and discourage the use of exotic invasives	2	20	Marin RCD, Private Landowners, Sonoma RCD, UC Extension						0	Existing programs and outreach are considered In-Kind.
PR-CCCS-12.2.3.2	Action Step	Agriculture	Coordinate with the agencies that authorize forest land conversions to discourage conversions to agriculture.	3	20	Board of Forestry, CDFW, Marin County, NMFS, Sonoma County						0	Action is considered In-Kind
PR-CCCS-13.1	**Objective**	**Channel Modification**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**										
PR-CCCS-13.1.1	Recovery Action	Channel Modification	Prevent or minimize impairment to passage and migration										
PR-CCCS-13.1.1.1	Action Step	Channel Modification	Ensure that all future channel designs for flood conveyance incorporate features that enhance steelhead migration under high and low flow conditions.	2	50	CDFW, Marin County, NMFS, Sonoma County, USACE						0	Existing programs and outreach are considered In-Kind.
PR-CCCS-13.1.2	Recovery Action	Channel Modification	Prevent or minimize impairment to stream hydrology (impaired water flow)										
PR-CCCS-13.1.2.1	Action Step	Channel Modification	Conduct rehabilitation activities that enhance modified and engineered channels, floodplains and marshes to extend the duration of spring and summer streamflow.	2	10	Marin County, NMFS, Sonoma County						TBD	Cost accounted for in above action step.
PR-CCCS-13.1.3	Recovery Action	Channel Modification	Prevent or minimize impairment to floodplain connectivity (impaired quality & extent)										
PR-CCCS-13.1.3.1	Action Step	Channel Modification	Ensure future channel modification activities prevent or minimize impediments to the creation, or blocking access to, off channel habitat used by salmonids as refuge and winter rearing habitat during high stream flows.	3	20	Marin County, NMFS, Sonoma County, USACE						0	Existing programs and outreach are considered In-Kind.
PR-CCCS-13.1.3.2	Action Step	Channel Modification	Ensure that all future levees or similar flood control projects incorporate setbacks that allow the river to respond to natural geomorphic processes and remain in equilibrium. Minimally, setbacks should accommodate a 100 year event.	3	25	Marin County, NMFS, Sonoma County, USACE						0	Existing programs and outreach are considered In-Kind.
PR-CCCS-13.1.3.3	Action Step	Channel Modification	Rehabilitate conditions to re-create, and restore alcove, backwater, or seasonal off-channel habitats in low gradient floodplain reaches of the main stem Petaluma River.	2	10	Marin County, Sonoma County, USACE	312	312				625	Cost based on treating 0.7 miles (assume 1 project/mile, 20 acres/mile in 25% high IP) at a rate of $44,640/acre.
PR-CCCS-13.1.4	Recovery Action	Channel Modification	Prevent or minimize impairment to habitat complexity (reduced large wood and/or shelter)										

Petaluma River, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
PR-CCCS-13.1.4.1	Action Step	Channel Modification	Identify locations where channel modification has resulted in decreased shelter, LWD frequency, and habitat complexity, and develop and implement site specific plans to improve these conditions. Consider flow rates and discharges when designing LWD and shelter enhancement features.	2	10	CDFW, Marin County, Marin RCD, NMFS, Sonoma County, Sonoma RCD							Cost accounted for in other actions.
PR-CCCS-13.1.4.2	Action Step	Channel Modification	Conduct rehabilitation activities that restore channels, floodplains and meadows to extend the duration of the summer flow and provide refuge from high winter flows.(see FLOODPLAIN for specific actions).	2	10	CDFW, Marin County, NOAA RC, NRCS, Private Landowners, Sonoma County, USACE						TBD	Cost accounted for in other action steps.
PR-CCCS-13.2	**Objective**	**Channel Modification**	**Address the inadequacy of existing regulatory mechanisms**										
PR-CCCS-13.2.1	Recovery Action	Channel Modification	Prevent or minimize impairment to floodplain connectivity (impaired quality & extent)										
PR-CCCS-13.2.1.1	Action Step	Channel Modification	All proposed flood control projects should include habitat protection, and/or alternatives that minimize impacts to salmon habitat.	2	20	CDFW, Marin County, NMFS, Sonoma County, USACE						0	Existing programs and outreach are considered In-Kind.
PR-CCCS-13.2.1.2	Action Step	Channel Modification	Channel modifying projects should be designed to ensure potential effects to CCC steelhead habitat are fully minimized or mitigated, and where possible, existing poor conditions should be remediated.	2	10	CDFW, NMFS, USACE						0	Existing programs and outreach are considered In-Kind.
PR-CCCS-13.2.1.3	Action Step	Channel Modification	Using existing laws and permitting processes, ensure all future and, where feasible, existing channels designed for flood conveyance incorporate features that enhance steelhead migration under high and low flow conditions.	2	20	NMFS, USACE						0	Existing programs and outreach are considered In-Kind.
PR-CCCS-13.2.1.4	Action Step	Channel Modification	Evaluate design alternatives to riprap bank repairs. Where riprap is necessary, evaluate integration of other habitat-forming features – including large woody debris to ensure improved habitat at the restoration site.	1	20	CDFW, NMFS, USACE						0	Existing programs and outreach are considered In-Kind.
PR-CCCS-13.2.1.5	Action Step	Channel Modification	Promote bio-engineering solutions as appropriate (e.g. carefully evaluate feasibility where critical infrastructure is located) for bank hardening projects.	2	20	CDFW, Marin RCD, NMFS, Sonoma RCD, USACE						0	Operations conducted normally or with minor modifications are considered In-Kind.
PR-CCCS-13.2.1.6	Action Step	Channel Modification	Encourage cities and counties to modify their regulatory and planning processes to discourage and minimize new construction of permanent infrastructure that will adversely affect watershed processes, particularly within the 100-year flood prone zones in all historical CCC steelhead watersheds.	2	20	City Planning, Marin County, Sonoma County, USACE						0	Existing programs and outreach are considered In-Kind.
PR-CCCS-13.2.1.7	Action Step	Channel Modification	Local agencies should develop large woody debris retention programs and move away from the practice of removing instream large woody debris under high flow "emergencies".	2	20	City Planning, Marin County, Sonoma County, Sonoma County Water Agency						0	Operations conducted normally or with minor modifications are considered In-Kind.
PR-CCCS-17.1	**Objective**	**Hatcheries**	**Address other natural or manmade factors affecting the species continued existence**										
PR-CCCS-17.1.1	Recovery Action	Hatcheries	Prevent or minimize reduced density, abundance, and diversity										

Petaluma River, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
PR-CCCS-17.1.1.1	Action Step	Hatcheries	Evaluate the role of a conservation hatchery or rescue rearing program within the Petaluma Basin, as part of a program for the larger interior SF Bay diversity stratum.	2	1	CDFW, NMFS						0	Existing programs and outreach are considered In-Kind.
PR-CCCS-17.1.1.2	Action Step	Hatcheries	Develop a Technical working group which provides input, recommendations to evaluate the Casa Grande High School fish hatchery in the context of recovery of the Petaluma River basin and it's role within the larger Interior SF Bay Diversity Strata.	2	3	CDFW, NMFS, UACG						0	Existing programs and outreach are considered In-Kind.
PR-CCCS-17.1.1.6	Action Step	Hatcheries	Implement stocking and hatchery recommendations of the Technical working group, together with United Anglers, and CGHS, with oversight provided by CDFW and NMFS	2	4	CDFW, NMFS, UACG						TBD	Cost based on amount of stocking to occur. Estimates for steelhead smolt production have not been established. However, estimates for coho smolts is $0.05/released smolt (NMFS, 2008 pg 66).
PR-CCCS-18.1	**Objective**	**Livestock**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**										
PR-CCCS-18.1.1	Recovery Action	Livestock	Prevent or minimize impairment to water quality (increased turbidity, suspended sediment, and/or toxicity)										
PR-CCCS-18.1.1.1	Action Step	Livestock	Establish conservative residual dry matter (RDM) target per acre that ensures area is not overgrazed with 1000 lbs RDM (residual dry matter)/acre left at end of grazing season. Remove cattle from pasture before soils dry out.	3	25	Marin RCD, NRCS, Sonoma RCD						0	Action is considered In-Kind
PR-CCCS-18.1.1.2	Action Step	Livestock	To minimize gully initiation, grazing should be kept at relatively low intensities on steeper slopes	2	60	Marin RCD, NRCS, Sonoma RCD						0	Action is considered In-Kind
PR-CCCS-18.1.1.3	Action Step	Livestock	Aid landowners willing to fence off riparian areas with development of offstream alternative water sources	3	30	Marin RCD, NRCS, Sonoma RCD						TBD	Cost based on amount of riparian areas needing exclusion fencing and offstream water source. Estimate for riparian exclusion fencing is $4.36/linear ft.
PR-CCCS-18.1.2	Recovery Action	Livestock	Prevent or minimize adverse alterations to riparian species composition and structure										
PR-CCCS-18.1.2.1	Action Step	Livestock	Support grazing practices that minimize impacts to riparian and instream habitat: livestock exclusion, rotational grazing, etc.	2	60	Marin RCD, Sonoma RCD						0	Existing programs and outreach are considered In-Kind.
PR-CCCS-18.1.2.2	Action Step	Livestock	Provide funding assistance to landowners willing to fence riparian and other sensitive areas (areas prone to erosion) to exclude cattle and sheep. Calf/cow operations should take first priority for riparian fencing programs over steer operations.	1	60	Marin RCD, NRCS, Sonoma RCD						TBD	Costs will vary depending on methods implemented and extent of rehabilitation.
PR-CCCS-18.1.2.3	Action Step	Livestock	Encourage develop and fund riparian restoration projects to regain riparian corridors damaged from livestock and other causes.	2	30	Marin RCD, NOAA RC, NRCS, Sonoma RCD	66.33	66.33	66.33	66.33	66.33	398	Cost based on treating 0.2 miles (assume 1 project/mile in 5% high IP with 80 acres/mile) at a rate of 24,862/acre.
PR-CCCS-18.1.2.4	Action Step	Livestock	Manage rotational grazing to assist with the reduction of noxious weeds, improve soil conditions, and encourage groundwater recharge.	3	60	Marin RCD, NRCS, Sonoma RCD						0	Action is considered In-Kind
PR-CCCS-18.1.2.5	Action Step	Livestock	Where necessary, establish predetermined stream crossings when herding cattle between pastures.	3	60	Marin RCD, NRCS, Sonoma RCD						TBD	Cost should be accounted for as part of riparian exclusion fencing.
PR-CCCS-22.1	**Objective**	**Residential/ Commercial Development**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**										
PR-CCCS-22.1.1	Recovery Action	Residential/ Commercial Development	Prevent or minimize impairment to floodplain connectivity (impaired quality and extent)										

Petaluma River, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
PR-CCCS-22.1.1.1	Action Step	Residential/ Commercial Development	Utilize native plants when landscaping and discourage the use of exotic invasives	3	60	Private Landowners, UC Extension						0	Existing programs and outreach are considered In-Kind.
PR-CCCS-22.1.1.2	Action Step	Residential/ Commercial Development	Explore the use of conservation easements to provide incentives for private landowners to preserve riparian corridors	2	10	Land Trusts, Private Consultants, Private Landowners, RCD						TBD	Costs for conservation easements vary.
PR-CCCS-22.1.2	Recovery Action	Residential/ Commercial Development	Prevent or minimize adverse alterations to riparian species composition and structure										
PR-CCCS-22.1.2.1	Action Step	Residential/ Commercial Development	Utilize native plants when landscaping and discourage the use of exotic invasives	3	60	Private Landowners, UC Extension						0	Existing programs and outreach are considered In-Kind.
PR-CCCS-22.1.3	Recovery Action	Residential/ Commercial Development	Prevent or minimize alterations to sediment transport (road condition/density, dams, etc.)										
PR-CCCS-22.1.3.1	Action Step	Residential/ Commercial Development	Disperse discharge from new or upgraded commercial and residential areas into a spatially distributed network rather than a few point discharges.	3	100	City Planning, County Planning, RWQCB						0	Action is considered In-Kind
PR-CCCS-22.2	**Objective**	**Residential/ Commercial Development**	**Address the inadequacy of existing regulatory mechanisms**										
PR-CCCS-22.2.1	Recovery Action	Residential/ Commercial Development	Prevent or minimize impairment to water quality (increased turbidity, suspended sediment, and/or toxicity)										
PR-CCCS-22.2.1.1	Action Step	Residential/ Commercial Development	Implement performance standards in Stormwater Management Plans.	3	25	County Planning, RWQCB						0	Action is considered In-Kind
PR-CCCS-22.2.1.2	Action Step	Residential/ Commercial Development	Assess efficacy and necessity of ongoing stream maintenance practices and evaluate, avoid, minimize and/or mitigate their impacts to rearing and migrating steelhead.	3	25	County Planning, MMWD						0	Action is considered In-Kind
PR-CCCS-22.2.1.3	Action Step	Residential/ Commercial Development	Enforce requirements of local regulations and riparian/setbacks	1	10	City Planning, County Planning						0	Existing programs and outreach are considered In-Kind.
PR-CCCS-22.2.1.4	Action Step	Residential/ Commercial Development	Municipalities and counties should investigate funding of larger detention devices in key watersheds with ongoing channel degradation or in sub-watersheds where impervious surface area > 10 percent.	3	25	County Planning, RWQCB, Water Agencies						0	Action is considered In-Kind
PR-CCCS-22.2.1.5	Action Step	Residential/ Commercial Development	Encourage the use and provide incentives for rooftop water storage and other conservation devices	2	25	County Planning, Private Consultants, Private Landowners, RWQCB, Water Agencies						TBD	Costs will vary depending on methods implemented.
PR-CCCS-22.2.1.6	Action Step	Residential/ Commercial Development	Develop legislation that will fund county planning for environmentally sound growth water supply development and work in coordination with California Dept. of Housing, Association of Bay Area Governments and other government associations (CDFG 2004).	2	25	City Planning, County Planning						0	Action is considered In-Kind
PR-CCCS-22.2.1.7	Action Step	Residential/ Commercial Development	New developments should include measures to minimize or prevent net increases in storm-water runoff, changes in flow durations, and magnitude of peak flow.	3	100	County Planning, RWQCB, SWRCB						0	Existing programs and outreach are considered In-Kind.

Petaluma River, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
PR-CCCS-22.2.2	Recovery Action	Residential/ Commercial Development	Prevent or minimize adverse alterations to riparian species composition and structure										
PR-CCCS-22.2.2.1	Action Step	Residential/ Commercial Development	Develop riparian setbacks/buffers where they do not currently occur, and enforce requirements of local regulations where they do	2	10	City Planning, County Planning						0	Action is considered In-Kind
PR-CCCS-22.2.2.2	Action Step	Residential/ Commercial Development	Develop policy and guidelines that address land conversion and attempt to minimize conversion-related impacts within the aquatic environment.	3	25	City Planning, County Planning, RWQCB, SWRCB						0	Action is considered In-Kind
PR-CCCS-22.2.2.3	Action Step	Residential/ Commercial Development	Identify areas at high risk of conversion, and develop incentives and alternatives for landowners that discourage conversion.	3	25	County Planning, Private Landowners						0	Action is considered In-Kind
PR-CCCS-22.2.3	Recovery Action	Residential/ Commercial Development	Prevent or minimize impairment to floodplain connectivity (impaired quantity and extent)										
PR-CCCS-22.2.3.1	Action Step	Residential/ Commercial Development	Encourage willing landowners to restore floodplains and riparian zones as a means to reduce impacts of existing developments within these habitats.	3	15	CDFW, RCD, RWQCB						0	Action is considered In-Kind
PR-CCCS-22.2.3.2	Action Step	Residential/ Commercial Development	Modify Federal, State, local processes, and County General Plans, to minimize new construction in undeveloped areas within the 100-year flood prone zone	3	60	California Department of Mines and Geology, CalTrans, City Planning, County Planning, NMFS, Private Landowners, Public						0	Effective and consistent implementation of these policies are anticipated to have little cost. Modification of policies may be controversial and costs may be high.
PR-CCCS-22.2.3.3	Action Step	Residential/ Commercial Development	Encourage infill and high density developments over dispersal of low density rural residential in undeveloped areas.	3	60	City Planning, County Planning						0	Action is considered In-Kind
PR-CCCS-22.2.3.4	Action Step	Residential/ Commercial Development	Work with counties to develop and implement ordinances to restrict subdivisions by requiring a minimum acreage limit for parcelization in concert with limits on water supply and groundwater recharge areas.	3	15	County Planning, RCD						0	Action is considered In-Kind
PR-CCCS-22.2.3.5	Action Step	Residential/ Commercial Development	Design new developments to minimize impacts to unstable slopes, wetlands, areas of high habitat value, and similarly constrained sites that occur adjacent to watercourses	3	60	County Planning, Private Landowners, USACE						0	Stringent review by permitting agencies is expected to reduce costs associated with poorly planned and poorly located developments.
PR-CCCS-23.1	**Objective**	**Roads/Railroads**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**										
PR-CCCS-23.1.1	Recovery Action	Roads/Railroads	Prevent or minimize impairment to instream substrate/food productivity (gravel quality and quantity)										
PR-CCCS-23.1.1.1	Action Step	Roads/Railroads	Assess roads in priority streams including tributary and mainstem reaches within Lynch, Willow Brook, Lichau, Washington, Adobe, and Ellis Creeks and middle and upper reaches of San Antonio and Petaluma River to identify high priority and high sediment yield sources.	2	10	Private Consultants, Private Landowners, Public Works, RCD	295.00	295.00				590	Cost based on conducting road inventory for 514 miles of road at a rate of $1,148/mile.

Petaluma River, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
PR-CCCS-23.1.1.2	Action Step	Roads/Railroads	Implement results of existing sediment source surveys.	2	25	Private Consultants, Private Landowners, Public Works, RCD						TBD	Costs will vary depending on methods implemented.
PR-CCCS-23.1.1.3	Action Step	Roads/Railroads	Establish adequate spoils storage sites throughout the watershed so material from landslides and road maintenance can be stored safely away from watercourses. Coordinate these efforts with all landowners in the watershed.	3	25	Private Landowners, Public Works						TBD	Cos based on road assessment identifying adequate spoils storage sites.
PR-CCCS-23.1.1.4	Action Step	Roads/Railroads	Upgrade and decommission sites and road networks where appropriate. These actions include outsloping roads, ditch relief culverts, and installing rolling dips.	3	25	Private Landowners, Public Works	2,326	2,326	2,326	2,326	2,326	11,628	Cost based on decommissioning 51 miles of road at a rate of $14,400/mile and upgrading 17 miles of road at a rate of $25,200/mile.
PR-CCCS-23.1.1.5	Action Step	Roads/Railroads	Utilize best management practices for road construction, maintenance, management and decommissioning (e.g. Fishnet 4c County Roads Manual; Hagans & Weaver, 1994; Sommarstrom, 2002; Oregon Department of Transportation, 1999).	3	25	FishNet 4C, Private Landowners, Public Works						0	Operations conducted normally or with minor modifications are considered In-Kind.
PR-CCCS-23.1.1.6	Action Step	Roads/Railroads	Utilize BMP's to reduce the lengths of ditches, increase the size of ditch relief culverts, or replace with rolling dips.	3	25	Private Consultants, Private Landowners, Public Works, RCD						0	Operations conducted normally or with minor modifications are considered In-Kind.
PR-CCCS-23.1.2	Recovery Action	Roads/Railroads	Prevent or minimize impairment to passage and migration										
PR-CCCS-23.1.2.1	Action Step	Roads/Railroads	All new crossings and upgrades to existing crossings (bridges, culverts, fills, and other crossings) should accommodate 100-year flood flows and associated bedload and debris.	3	25	CalTrans, CDFW, Public Works						0	Action is considered In-Kind
PR-CCCS-23.1.2.2	Action Step	Roads/Railroads	Bridges associated with new roads or replacement bridges (including railroad bridges) should be free span or constructed with the minimum number of bents feasible in order to minimize drift accumulation and facilitate fish passage.	3	60	CalTrans, CDFW, City Planning, Private Landowners, Public Works, RCD						TBD	Incorporating free span bridges into replacement and new construction plans is unlikely to increase costs. Construction of the bridges will likely be much higher.
PR-CCCS-23.1.2.3	Action Step	Roads/Railroads	Assess barriers on public and private roads in tributary and mainstem reaches within Lynch, Willow Brook, Lichau, Washington, Adobe, and Ellis Creeks and middle and upper reaches of San Antonio and Petaluma River	1	5	CDFW, Private Consultants, Private Landowners, RCD, Trout Unlimited						TBD	Cost likely accounted for as part of road assessment.
PR-CCCS-23.2	**Objective**	**Roads/Railroads**	**Address the inadequacy of existing regulatory mechanisms**										
PR-CCCS-23.2.1	Recovery Action	Roads/Railroads	Prevent or minimize impairment to instream substrate/food productivity (gravel quality and quantity)										
PR-CCCS-23.2.1.1	Action Step	Roads/Railroads	Expand the NRCS/RCD coordinated permit program to a statewide programmatic ESA consultation that allows funding and technical expertise to small land owners and rural residential property owners.	3	5	CDFW, RCD, NMFS						0	Cost to expand an existing program are expected to be minimal.
PR-CCCS-23.2.1.2	Action Step	Roads/Railroads	Utilize the Fishnet4c manual in training and operations	1	10	City Planning, County Planning, FishNet 4C, Public Works						0	Existing programs and outreach are considered In-Kind.

Petaluma River, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
PR-CCCS-25.1	**Objective**	**Water Diversion /Impoundment**	**Address the present or threatened destruction, modification, or curtailment of the species habitat or range**										
PR-CCCS-25.1.1	Recovery Action	Water Diversion /Impoundment	Prevent or minimize impairment to stream hydrology (impaired water flow)										
PR-CCCS-25.1.1.1	Action Step	Water Diversion /Impoundment	Allow all "fisheries flows" (baseflows, and passage, attractant, and channel maintenance flows) to bypass diversion facilities.	3	10	SWRCB						0	Operations conducted normally or with minor modifications are considered In-Kind.
PR-CCCS-25.1.1.2	Action Step	Water Diversion /Impoundment	Adequately screen water diversions to prevent juvenile salmonid mortalities.	2	25	CDFW, NMFS						TBD	Costs will vary depending on methods implemented, and number of diversion screened. Estimate for fish screen is $64,158/screen.
PR-CCCS-25.1.1.3	Action Step	Water Diversion /Impoundment	Promote water conservation best practices such as drip irrigation for vineyards.	3	20	CDFW, Farm Bureau, NRCS, Water Agencies						0	Promoting water conservation best practices is not expected to result in additional costs.
PR-CCCS-25.1.1.4	Action Step	Water Diversion /Impoundment	Promote the use of reclaimed water for agricultural or other uses.	3	60	CDFW, RCD, Water Agencies						0	Costs associated with promoting use of reclaimed water is expected to be minimal.
PR-CCCS-25.1.1.5	Action Step	Water Diversion /Impoundment	Promote off-channel storage to reduce impacts of water diversion (e.g., storage tanks for rural residential users).	3	20	CDFW, Private Landowners, RCD, RWQCB, Sonoma County, Sonoma County Water Agency						0	Costs are minimal to promote. Costs for implementation will depend on the number of participants.
PR-CCCS-25.1.1.6	Action Step	Water Diversion /Impoundment	Promote conjunctive use of water with water projects whenever possible	3	60	CDFW, County Planning, RCD, RWQCB, Water Agencies						0	Costs associated with promoting conjunctive use of water is expected to be minimal.
PR-CCCS-25.2	**Objective**	**Water Diversion /Impoundment**	**Address the inadequacy of existing regulatory mechanisms**										
PR-CCCS-25.2.1	Recovery Action	Water Diversion /Impoundment	Prevent or minimize impairment to stream hydrology (impaired water flow)										
PR-CCCS-25.2.1.1	Action Step	Water Diversion /Impoundment	Improve coordination between agencies and others to address season of diversion, off-stream reservoirs, bypass flows protective of steelhead and their habitats, and avoidance of adverse impacts caused by water diversion (CDFG 2004).	3	60	CDFW, RCD, Water Agencies						0	Action is considered In-Kind
PR-CCCS-25.2.1.2	Action Step	Water Diversion /Impoundment	Promote passive diversion devices designed to allow diversion of water only when minimum streamflow requirements are met or exceeded (CDFG 2004).	3	30	NMFS, RCD, RWQCB, Water Agencies						0	Costs to promote this action are expected to be minimal.
PR-CCCS-25.2.1.3	Action Step	Water Diversion /Impoundment	Identify and work with the SWRCB to eliminate depletion of summer base flows from unauthorized water uses. Coordinated efforts by Federal and State, and County law enforcement agencies to remove illegal diversions from streams.	2	5	CDFW Law Enforcement, NMFS OLE, SWRCB						0	Existing programs and outreach are considered In-Kind.
PR-CCCS-25.2.1.4	Action Step	Water Diversion /Impoundment	Improve compliance with existing water resource regulations via monitoring and enforcement.	3	15	NMFS, RWQCB						0	Additional regulatory authorities may be needed to fully implement this action, and associated costs cannot be determined. However technical assistance may be provided, and associated costs are expected to be minimal.

Petaluma River, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
PR-CCCS-25.2.1.6	Action Step	Water Diversion /Impoundment	Design and install instream habitat enhancement projects to optimize habitat attributes for spawning and rearing associated with developed flow schedules.	3	15	CDFW, NMFS, SWRCB, Water Agencies						TBD	Action is considered In-Kind

Sonoma Creek Population

CCC Steelhead Winter-Run

- Role within DPS: Functionally Independent Population
- Diversity Stratum: Interior San Francisco Bay
- Spawner Abundance Target: 3,100 adults
- Current Intrinsic Potential: 128.7 IP-km

Steelhead Abundance and Distribution

Past investigations suggest the Sonoma Creek watershed once supported the second largest steelhead run among San Francisco Bay streams (Napa River was the largest; Becker et al. 2007). The construction of the Lemni Fish Propagating Company (fish hatchery) in 1878 provides evidence of historic steelhead runs and related industries within the Sonoma Creek watershed. Sonoma Creek steelhead eggs produced at the fish hatchery were used to bolster sport fishing as far away as New Zealand in the 1880s (SSCRCD, 1997). In 1946, a visual stream survey of Sonoma Creek was conducted by California Department of Fish and Game/Wildlife (CDFG/CDFW) from the mouth to the natural falls in Sugarloaf Ridge State Park near the headwaters. Sea-run steelhead and resident *O. mykiss* were observed in the system, and natural propagation was noted by the common presence of juvenile steelhead (65 - 100 mm TL, Shapovalov and Bruer 1946, as cited by Leidy *et al*. 2005). A survey conducted by CDFG in 1957 reported that the creek is utilized by steelhead as a spawning nursery and contains very good spawning areas throughout the Adobe Canyon and within mainstem tributaries downstream to Boyes Hot Springs (Elwell 1957, as cited by Leidy *et al*. 2005). No abundance estimates were reported in either of these previous surveys.

CDFG surveys conducted in July 1966 indicate that mainstem Sonoma Creek contained about 15 miles of cold water stream accessible to steelhead trout upstream of Glen Ellen and downstream of the natural falls located in Sugarloaf State Park (Rockwood 1966, as cited by Leidy et al. 2005). Juvenile *O. mykiss* densities within this reach were estimated to be 15 - 60 per 30-meters, and the size of the annual adult steelhead run was estimated to be around 500 individuals, with great variation in year-to-year abundance (Rockwood 1966, as cited by Leidy *et al*. 2005). In 1977, CDFG published a natural resource assessment of the Napa Marsh where the estimated annual adult steelhead run was 1,200 individuals (Michaels 1977, as cited by Leidy *et al*. 2005). Surveys conducted in 1993 by Leidy reported multiple age classes of anadromous and resident *O. mykiss* within the mainstem Sonoma Creek. Sugarloaf Ridge State Park and the Sonoma State Hospital sites were found to contain excellent rearing habitat and steelhead in good condition (Leidy *et al*. 2005). In October 2002, electrofishing surveys were performed by the

Sonoma Ecology Center in various reaches of Sonoma Creek. Data reported from this effort indicated multiple *O. mykiss* age classes were again represented in many reaches of the Sonoma Creek watershed (SEC 2002, as cited by Leidy et al. 2005). In recent years, adult steelhead have been observed spawning immediately below the natural falls in Sugarloaf Ridge State Park (Fuller 2007, 2009, personal observation).

O. mykiss populations have consistently been found in surveyed reaches of the Sonoma Creek mainstem and its tributaries over the past ten years, and the presence of multiple year classes indicates natural reproduction (Leidy et al. 2005). Sonoma Creek tributaries known to currently offer suitable steelhead habitat include Agua Caliente, Mill, Stuart, Asbury, Redwood, Calabazas, Graham, Bear, Hooker, and Smart creeks (Leidy *et al.* 2005).

History of Land Use

Historically, a mosaic of oak woodland, redwood forest, grassland, chaparral, and riparian vegetation covered much of the upper Sonoma Creek watershed. The valley floor had expanses of savannah, oak woodland, grassland, and large areas of fresh and tidal marsh (SEC 2006). Early settlers grazed cattle, farmed the land, logged redwoods, drained wetlands, diverted tributaries, mined instream sand and gravel, constructed small dams, and dredged the mainstem of Sonoma Creek. Construction of a railroad system, and the resultant increased human population in the late 19th century, likely intensified some types of land use. Logging and woodcutting reached a peak around the 1900s (SEC 2006). Many of these historical water and land-use activities, referred to as "drain and reclaim" practices, ultimately changed the geography and hydrology of the watershed. These past practices continue to leave an imprint of "legacy impacts" on the watershed today (SEC & SS, 2006).

The watershed is currently home to an array of land uses that include: vineyards, livestock facilities, grazing, croplands, state and regional parks, urban and industrial development, and rural residential development (SCWEP, 1997). Logging in the Sonoma Mountain area no longer occurs, and much of the existing vegetation has recovered and matured although clearing of native vegetation in some upland areas continues. Even in its current state, more than half of the watershed still supports natural vegetation (SEC 2006). The watershed supports nearly one million tourists who visit the numerous wineries, hot springs, and state parks each year (SSCRCD, 1997).

Current Resources and Land Management

The Sonoma Creek watershed is managed for urban residential, recreational, and agricultural uses. County, regional, and state park land is interspersed with vineyards, wineries, and rural

residential neighborhoods. State landholdings include Sugarloaf Ridge State Park, Jack London State Park, Annadel State Park, and the Sonoma Developmental Center. Open space areas dominate much of the Sonoma Creek watershed, with the historic town of Glen Ellen and Jack London State Park centrally located. However, much of this open space within the watershed is largely due to agricultural (vineyard) land use (Becker *et al*. 2007). The upper watershed is home to Sugarloaf Ridge State Park and is predominately rural residential and open space (SSCRCD 1997). Most urban and industrial development is concentrated around the City of Sonoma. Many of the historical grazing lands are being converted to vineyards as the demand for wine grapes increases (SSCRCD 1997).

Sonoma Creek watershed is on the Regional Water Quality Control Board's Impaired Water Bodies List under Section 303(d) of the Clean Water Act, primarily due to sedimentation and nutrient loading. The accelerated increase in vineyard land development and the anticipated expansion of more vineyards in the future triggered action by the Southern Sonoma County Resource Conservation District to prevent further watershed degradation. The following pertinent documents are available for the Sonoma Creek watershed:

- An Introduction to the Historical Ecology of the Sonoma Creek Watershed (SFEI 2008)
- Sonoma Creek Watershed Limiting Factors Analysis (SEC 2006)
- Sonoma Creek Watershed Sediment Source Analysis (SEC 2006)
- Fish Passage Barrier Assessment in the Sonoma Creek Watershed (Katopothis *et al.* 2005)
- Volunteer Monitoring of Suspended Sediment Concentration and Turbidity and Watershed Monitoring of Road Remediation in Annadel State Park (SEC 2002)
- Spawning Gravel Suitability Assessment: Sonoma Creek Watershed (SEC 2001)
- Sonoma Creek Watershed Assessment: 1998 Water Temperature Monitoring (SVWS 2000)
- Sonoma Creek Watershed Enhancement Plan (SSCRCD 1997)

Salmonid Viability and Watershed Conditions

The following indicators were rated "Poor" through the CAP process for steelhead: LWD frequency, pool shelter, primary pools, impaired hydrology (summer baseflow), water temperature, canopy cover, passage/migration, gravel quality, and estuary quality and extent. Recovery strategies will focus on improving these Poor conditions as well as those needed to ensure population viability and functioning watershed processes.

Current Conditions

The following discussion focuses on those conditions that rated Fair or Poor as a result of our CAP viability analysis. The Sonoma Creek CAP Viability Table results are provided below. Recovery strategies will focus on improving these conditions.

Population and Habitat Conditions

Hydrology: Baseflow & Passage Flows

Historical conditions of Sonoma Creek have been described as having abundant water, low channel connectivity, and extensive wetland complexes that sustained summer baseflows. Over the past two centuries, the hydrologic linkage between tributaries, wetlands, groundwater, and the mainstem Sonoma Creek has been severely altered or lost (SFEI 2008). Freshwater wetland loss is estimated to be greater than 95-percent in the watershed. These alterations have greatly decreased surface flow and groundwater levels, increased channel connectivity, and decreased water quality (SFEI 2008). Juvenile steelhead stranding due to fluctuating spring and summer flows is the greatest source of morality directly observed during stream surveys (SEC 2006). Historically, groundwater seeps adjacent to streams likely contributed to better summer baseflows that supported rearing steelhead. Habitat and low flow surveys measured the extent of dry reaches on ten streams during the summers of 1996, 2001, 2002, and 2003 (SEC 2006). On average, surveyed streams lost 40-percent of potential summer rearing due to dewatering. Hooker, Agua Caliente, and Carriger creeks were the driest, and therefore, they had the greatest potential rearing habitat lost due to dewatering.

Passage/Migration: Mouth or Confluence & Physical Barriers

The Sonoma Ecology Center completed a watershed fish passage assessment between June 2003 and December 2004 (Katopothis *et al.* 2005). The assessment ranked sites determined to be complete barriers and estimated habitat area lost due to these barriers. Twenty-two complete barriers concentrated in 12 tributaries were identified within the Sonoma Creek watershed. Each of these barriers limits the ability of rearing juveniles and resident *O. mykiss* to occupy alternative seasonal rearing habitats or refuge areas and has significantly reduced the overall amount of available spawning and rearing habitat within the Sonoma Creek watershed. The estimated amount of habitat lost within each of these tributaries is as follows: 100-percent of Yulupa, Snag, Kohler, Stuart, Mill, and Dowdall creeks; greater than 50-percent of historical steelhead habitat is estimated lost in Paythian, West Agua Caliente, and Calabazas creeks; and lost habitat ranged from 11 to 41 percent within Arroyo Seco, Nathanson, and Rogers/Fowler creeks. Overall, the estimated total loss of stream habitat within the Sonoma Creek watershed due to these barriers is 25-percent (Katopothis *et al.* 2005). The Sonoma Ecology Center has been

working with CEMAR on conceptual designs and implementation on some of these barriers (Becker et al. 2007).

Habitat Complexity: Large Wood & Shelter

Instream habitat complexity within the Sonoma Creek watershed has been severely impaired as compared to historical conditions. Channel incision and reduced channel forming structures (i.e., LWD, boulders, etc.) have limited the watersheds ability to trap coarse sediment, scour pools, provide shelter, and create hydraulic diversity (i.e., the desirable pool/riffle/flatwater sequences found in productive steelhead bearing streams). Field surveys of Sonoma Creek have reported very low LWD density, with less than one piece of wood per mile of stream channel (SEC 2006). Preliminary monitoring of experimental LWD placement projects within Sonoma Creek and tributaries suggest LWD is highly effective at trapping quality spawning gravel, increasing shelter, and improving overall habitat quality; however, many tributaries are in need of LWD habitat enhancement (SEC 2006). The following streams have been identified as having Poor shelter and/or pool/riffle/flat water ratios: Agua Caliente, Arroyo Seco, Bear Creek, Bedrock Creek, Carriger Creek, Fowler Creek, Graham Creek, Hooker Creek, Mill Creek, and Stuart Creek.

Sediment: Gravel Quality & Distribution of Spawning Gravels

Impaired gravel permeability due to excessive fine sediment likely causes significant steelhead egg and emerging fry mortality in spawning tributaries of the Sonoma Creek watershed (SEC 2006). Excess fine sediment has also reduced available spawning habitat within the mainstem, as 30% of the bed material is comprised of fine sediment – a level associated with impaired spawning gravel (Kondolf 2000, as cited by SEC 2006). Another impact associated with excess fine sediment and reduced gravel quality is reduced macro-invertebrate production or prey availability for rearing winter and summer juvenile steelhead. Potential fine sediment sources within the Sonoma Creek watershed include landslides, stream bank and bed erosion, roads, and land clearing and grading activities (SEC 2006). Vineyard development, grazing, and residential development may also contribute sediment to streams draining the Sonoma Valley (SEC 2001). The following streams have been rated as having High embeddedness and impaired gravel quality/quantity within the Sonoma Creek watershed: Arroyo Seco, Asbury Creek, Fowler Creek, Stuart Creek, and mainstem Sonoma Creek.

Riparian Vegetation: Composition, Cover & Tree Diameter and Water Quality: Temperature

The Sonoma Ecology Center completed a two-year water temperature study in 1998. Temperature monitoring equipment was placed within mainstem Sonoma Creek above Madrone Road, and eight were deployed in five steelhead bearing tributaries (Asbury, Carriger, Graham, Calabazas, and Stuart creeks; McKnight and Katzel 2000). Water temperatures were

found to be suitable (< 20 °C) from June through October in 1996 and 1997. However, water temperatures were noted to be less than suitable, and improving riparian shading and stream flow that could aid in reducing water temperatures was encouraged (McKnight and Katzel 2000). As part of the Sonoma Ecology Center's Sonoma Creek Watershed Limiting Factors Analysis (2006), a five-year stream temperature monitoring program was conducted for the May through October period. This study documented canopy cover in some streams where water temperatures were monitored. The highest riparian density was recorded in Asbury Creek, which was one of the coolest streams monitored (SEC 2006). In contrast, some reaches of Calabazas, Graham, and Carriger creeks exceeded chronic stress criterion (> 20 degrees C) for short durations during summer (SEC 2006). Calabazas, Graham, and Carriger all were rated as having Fair to Poor canopy cover during CDFG stream surveys (2004). Other tributaries that were rated as having Poor canopy cover include: Agua Caliente, Arroyo Seco, Bedrock, Fowler, Hooker, Mill, Nathanson, lower Sonoma, and Stuart creeks. Elevated temperatures in lower elevation stream reaches, likely due to limited canopy cover in localized areas, reduce the extent of available summer rearing habitat, potentially impair growth rates and create stressful conditions for juvenile steelhead (SEC 2006).

Velocity Refuge: Floodplain Connectivity

Increased channel connectivity and associated channelization due to agriculture, urbanization, and flood control activities have increased the magnitude, intensity, and water velocities of stream flow following winter storm events within the Sonoma Creek watershed. These conditions, coupled with the loss of floodplain connectivity within the mainstem and some tributary reaches, have significantly reduced the quality and extent of juvenile steelhead winter rearing habitat. Additionally, a reduction in the quality and extent of floodplain connectivity of the Sonoma Creek watershed may impair adult steelhead upstream migrations due to limited velocity refuge during winter stream flows.

Estuary: Quality and Extent

The Sonoma Creek estuary has been dramatically altered by dredging and diking and the introduction of exotic species. These activities have greatly reduced the quality and extent of the estuary for smolt and summer rearing juveniles. More information is needed to determine the current quality and availability of the Sonoma Creek estuary and the rehabilitation work needed to improve its health and condition.

Threats

The following discussion focuses on those threats that were rated as High or Very High. Recovery strategies will likely focus on ameliorating High rated threats; however, some

strategies may address Medium and Low threats when the strategy is essential to recovery efforts. The figures and tables that display data used in this analysis are provided in Sonoma Creek CAP Results.

Roads and Railroads

Many of the barriers within the Sonoma Creek watershed typically occur where roads cross stream or tributary channels. As originally designed, culverts and other road crossings may not have caused the formation of barriers; however, subsequent erosion and scour around these crossings may disrupt juvenile and adult migration and habitat connectivity (SEC 2006). Additionally, failing culverts and roads will likely contribute or are currently contributing fine sediment into streams and waterways. Upgrading and improving existing culverts and road crossing will be an important element in recovering a viable steelhead population to the Sonoma Creek watershed.

Water Diversions and Impoundments

Sonoma Valley water users are aware that the water table has been declining in elevation over past decades and that low summer baseflows may be a signal of depleted groundwater resources (Nelson pres. comm. 2003, as cited by SEC 2006). Outside of groundwater pumping, 132 registered water right diversions and 14 dams have been identified in the basin. The number of water diversions observed during past CDFW summer habitat surveys was lower than the number of registered water diverters in streams surveyed (SSCRCD 1997). Therefore, accurate data regarding the magnitude and timing of diversions, the number of active users, the rates of groundwater recharge, and aquifer response to current water demands within the basin are limited. More investigations are needed to quantify the relationship between surface flows, water diversions, and shallow groundwater aquifers. Evaluating scenarios that could increase summer baseflows (e.g., flood water retention, timing of diversions, magnitude, locations, etc.) could greatly reduce the current and future threat of habitat loss due to dewatering.

Agriculture

Within the Sonoma Creek watershed, the first grapes were planted in 1824 at the Sonoma Mission (SSCRCD 1997). Vineyard development has been particularly extensive in recent decades, however. As of 1994, there were approximately 13,300 acres (21 mi^2) of vineyards in the 170-square mile watershed (pers. comm., Chris Finlay, Growers & Vintners Alliance, as cited by SEC, 2001). Current vineyard acreage in the Sonoma Valley is unknown, but there has been an average annual increase of 1,500 acres in vineyard acreage (86-percent of which is converted from other agricultural activities) in Sonoma County over the past decade (SEC 2001). The increase of vineyards within the Sonoma Creek watershed will continue to be a threat to

spring and summer baseflows and will continue to degrade habitat if protective measures are not implemented (i.e., riparian buffers, regulated water withdraws, etc.).

Channel Modification

Channel modification began as early as 1823 within the Sonoma Creek watershed (SFEI 2008). With the additions of urbanized and agriculture areas, straightening and engineering of stream networks increased throughout the watershed. Stream channels were modified primarily for flood control purposes and to expand usable land on private properties. However, with channel modification came the loss of habitat complexity (e.g., loss of floodplain and off-channel habitat, etc.), increased erosion and sedimentation, increased urban and agriculture run-off, increased stream connectivity, and potential increased fish passage impediments during low and high flow periods. These associated channel modification impacts have severely altered natural hydrologic patterns and geomorphic processes. Habitat rehabilitation strategies should include efforts to increase channel roughness, sinuosity, floodplain and off-channel habitat, and habitat complexity features.

Fishing and Collecting

Current sport fishing regulations allow angling in Sonoma Creek and tributaries above the Adobe Canyon Road Bridge from the last Saturday in April through November 15, with a bag limit of (5) trout per day. Recent observations (NMFS 2007) have confirmed historical documentation of adult anadromous steelhead successfully spawning above Adobe Canyon Road Bridge. Therefore, all *O. mykiss* below the natural waterfall in Sugarloaf Ridge State Park, including those above Adobe Canyon Road Bridge, should be considered anadromous steelhead and measures should be taken to protect them during the summer rearing season. Allowing the continued harvest of *O. mykiss* within this reach could severely impact future returns of adult steelhead to the Sonoma Creek watershed.

Limiting Conditions, Lifestages, and Habitats

Egg incubation is mostly limited by impaired gravel quality and quantity in most spawning reaches throughout the watershed. The summer rearing juvenile lifestage is limited by unsuitable summer rearing habitat conditions. Overall, impaired passage and migration, poor canopy cover, reduced habitat complexity, and increased water temperatures coupled with reduced surface flow, are the stresses most limiting recovery of steelhead within the Sonoma Creek watershed.

General Recovery Strategy

In general, recovery strategies will focus on improving conditions and ameliorating stresses and threats discussed above, although strategies that address other indicators may also be developed where their implementation is critical to restoring properly functioning habitat conditions within the watershed.

Improve Fish Passage

Improving or removing fish passage barriers on priority streams may be the most effective recovery strategy available when compared to rehabilitating degraded habitat. Removing identified barriers will greatly improve the current extent of quality habitat for steelhead in the Sonoma Creek watershed.

Improve Canopy Cover and Reduce Stream Water Temperature

Rehabilitating riparian cover will help reduce stream temperature, increase shelter, and encourage LWD recruitment. A healthy riparian zone will also increase bank stability and help reduce fine sediment inputs to streams and waterways of Sonoma Creek.

Improve Habitat Complexity

Installing complex instream habitat features composed of boulders and LWD will help enhance channel roughness, pool depth, pool/riffle/flat water ratios, and shelter for all steelhead lifestages. Strategically placed structures will also contribute to substrate sorting and trap desirable spawning gravels. Priority locations should include those areas that contain perennial summer flow and low stream temperatures where habitat enhancement can optimize habitat conditions.

Protect Natural Seasonal and Summer Hydrologic Conditions

Protecting and enhancing summer baseflows will increase the extent of summer rearing habitat in most Sonoma Creek tributaries. Maximizing opportunities for aquifer recharge encourages efficient water use, and guidelines that ensure adequate summer baseflows should be developed and implemented. In order to successfully implement strategies that will protect and enhance summer baseflows, future investigation evaluating groundwater/surface water interaction needs to occur.

Literature Cited

Becker G.S., I.J. Reining, D.A. Asbury, and A. Gunther. 2007. San Francisco estuary watershed evaluation: Identifying promising locations for steelhead restoration in tributaries of the San Francisco Estuary. Prepared for the California State Coastal Conservancy. Prepared by the Center for Ecosystem Management and Restoration.

Katopothis, C. L. Micheli, M. Orme, C. Rossi, R. Branciforte. 2005. Fish Passage Barrier assessment in Sonoma Creek watershed – Final Report.

Leidy, R.A., G.S. Becker, B.N. Harvey. 2005. Historical distribution and current status of steelhead/rainbow trout *(Oncorhynchus mykiss)* in streams of the San Francisco Estuary, California. Center for Ecosystem Management and Restoration, Oakland, CA.

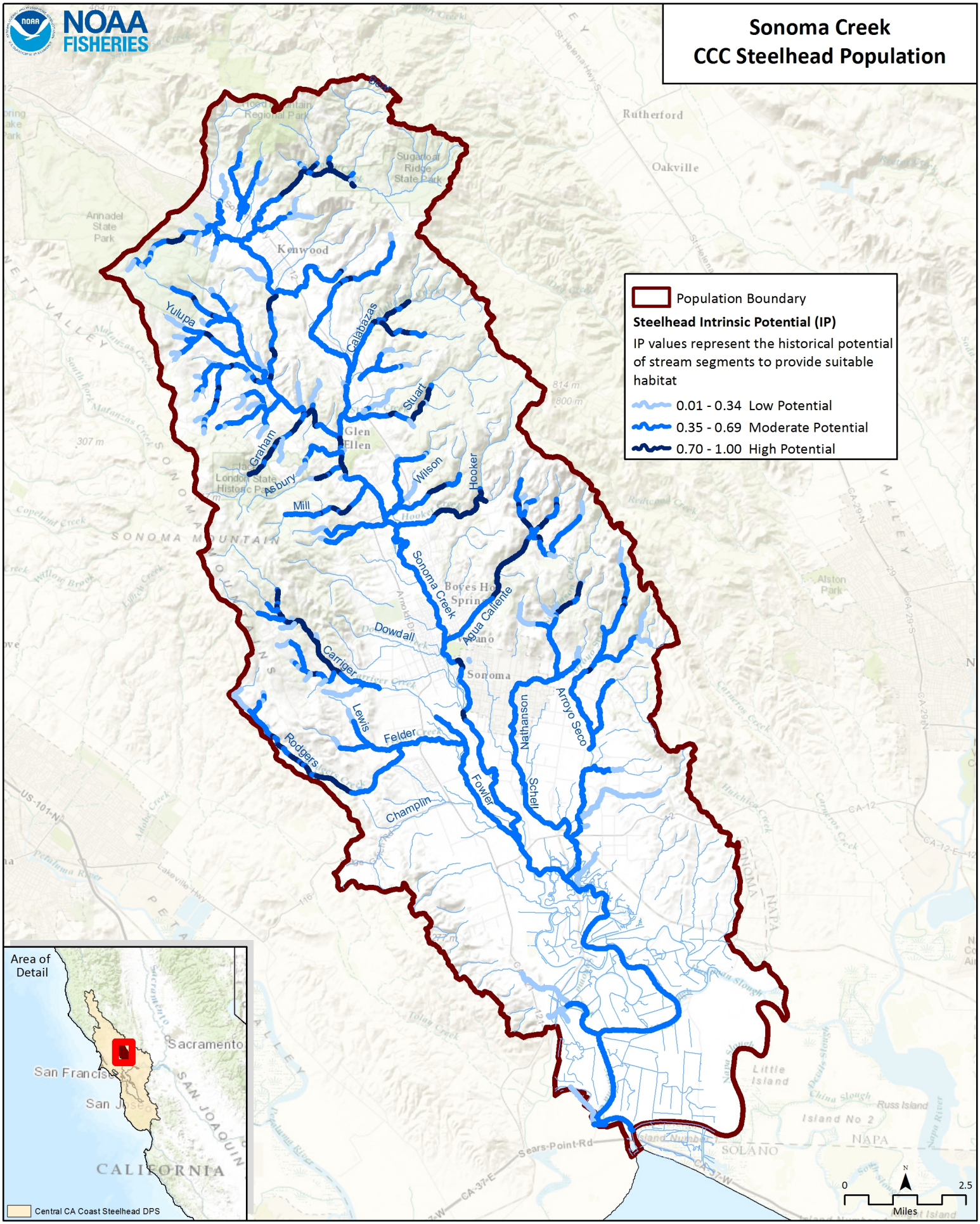
SEC, (Sonoma Ecology Center). 2006. Sonoma Creek Sediment Source Analysis.

SEC, (Sonoma Ecology Center). 2006 Sonoma Creek Watershed Limiting Factors Analysis.

SEC, (Sonoma Ecology Center). 2001. Spawning Gravel Suitability Assessment Sonoma Creek Watershed.

SFEI 2008. An introduction to the historical ecology of the Sonoma Creek watershed: A tool for developing an action plan for the Critical Coastal Areas program. http://www.coastal.ca.gov/nps/cca-nps.html.

SSCRCD 1997. Sonoma Creek Watershed Enhancement Plan.


Sonoma Creek
CCC Steelhead Population
Population Boundary
Steelhead Intrinsic Potential (IP)
IP values represent the historical potential of stream segments to provide suitable habitat
0.01 - 0.34 Low Potential
0.35 - 0.69 Moderate Potential
0.70 - 1.00 High Potential
Yulupa
Calabazas
Stuart
Graham
Asbury
Mill
Wilson
Hooker
Sonoma Creek
Agua Caliente
Dowdall
Carriger
Lewis
Felder
Rodgers
Champlin
Fowler
Nathanson
Schell
Arroyo Seco
Area of Detail
Sacramento
San Francisco
San Jose
CALIFORNIA
Central CA Coast Steelhead DPS
0
2.5
Miles

#	Conservation Target	Category	Key Attribute	Indicator	Poor	Fair	Good	Very Good	Current Indicator Measurement	Current Rating
1	Adults	Condition	Habitat Complexity	Large Wood Frequency (BFW 0-10 meters)	<50% of streams/ IP-Km (>6 Key Pieces/100 meters)	50% to 74% of streams/ IP-Km (>6 Key Pieces/100 meters)	75% to 90% of streams/ IP-Km (>6 Key Pieces/100 meters)	>90% of streams/ IP-Km (>6 Key Pieces/100 meters)	<50% of streams/ IP-km (>6 Key Pieces/100 meters)	Poor
			Habitat Complexity	Large Wood Frequency (BFW 10-100 meters)	<50% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	50% to 74% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	75% to 90% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	>90% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	<50% of streams/ IP-km (>1.3 Key Pieces/100 meters)	Poor
			Habitat Complexity	Pool/Riffle/Flatwater Ratio	<50% of streams/ IP-Km (>40% Pools; >20% Riffles)	50% to 74% of streams/ IP-Km (>40% Pools; >20% Riffles)	75% to 90% of streams/ IP-Km (>40% Pools; >20% Riffles)	>90% of streams/ IP-Km (>40% Pools; >20% Riffles)	50% streams/ 70% IP-km (>40% Pools; >20% Riffles)	Fair
			Habitat Complexity	Shelter Rating	<50% of streams/ IP-Km (>80 stream average)	50% to 74% of streams/ IP-Km (>80 stream average)	75% to 90% of streams/ IP-Km (>80 stream average)	>90% of streams/ IP-Km (>80 stream average)	7% streams/ 2% IP-km (>80 stream average)	Poor
			Hydrology	Passage Flows	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 51-75	Fair
			Passage/Migration	Passage at Mouth or Confluence	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	<50% of IP-km or <16 IP-Km accessible*	Poor
			Passage/Migration	Physical Barriers	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	78.5% of IP-km	Good
			Riparian Vegetation	Tree Diameter (North of SF Bay)	≤39% Class 5 & 6 across IP-km	40 - 54% Class 5 & 6 across IP-km	55 - 69% Class 5 & 6 across IP-km	>69% Class 5 & 6 across IP-km	?39% Class 5 & 6 across IP-km	Poor
			Riparian Vegetation	Tree Diameter (South of SF Bay)	≤69% Density rating "D" across IP-km	70-79% Density rating "D" across IP-km	≥80% Density rating "D" across IP-km	Not Defined		

			Sediment	Quantity & Distribution of Spawning Gravels	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	9 IP-km accessible	Poor
			Velocity Refuge	Floodplain Connectivity	<50% Response Reach Connectivity	50-80% Response Reach Connectivity	>80% Response Reach Connectivity	Not Defined	50-80% Response Reach Connectivity	Fair
			Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No Evidence of Toxins or Contaminants	Sublethal or Chronic	Fair
			Water Quality	Turbidity	<50% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-Km maintains severity score of 3 or lower	75% to 90% of streams/ IP-Km maintains severity score of 3 or lower	>90% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-km maintains severity score of 3 or lower	Fair
		Size	Viability	Density	<1 spawner per IP-km to < low risk spawner density per Spence (2008)	>1 spawner per IP-km to < low risk spawner density per Spence (2008)	low risk spawner density per Spence (2008)		>1 spawner per IP-km to < low risk spawner density per Spence (2008)	Fair
2	Eggs	Condition	Hydrology	Flow Conditions (Instantaneous Condition)	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 51-75	Fair
			Hydrology	Redd Scour	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 51-75	Fair
			Sediment	Gravel Quality (Bulk)	>17% (0.85mm) and >30% (6.4mm)	15-17% (0.85mm) and <30% (6.4mm)	12-14% (0.85mm) and <30% (6.4mm)	<12% (0.85mm) and <30% (6.4mm)	>17% (0.85mm) and >30% (6.4mm)	Poor
			Sediment	Gravel Quality (Embeddedness)	<50% of streams/ IP-Km (>50% stream average scores of 1 & 2)	50% to 74% of streams/ IP-Km (>50% stream average scores of 1 & 2)	75% to 90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	>90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	71% streams/ 86% IP-km (>50% stream average scores of 1 & 2)	Good
3	Summer Rearing Juveniles	Condition	Estuary/Lagoon	Quality & Extent	Impaired/non-functional	Impaired but functioning	Properly Functioning Condition	Unimpaired Condition	Impaired but functioning	Poor

			Habitat Complexity	Large Wood Frequency (Bankfull Width 0-10 meters)	<50% of streams/ IP-Km (>6 Key Pieces/100 meters)	50% to 74% of streams/ IP-Km (>6 Key Pieces/100 meters)	75% to 90% of streams/ IP-Km (>6 Key Pieces/100 meters)	>90% of streams/ IP-Km (>6 Key Pieces/100 meters)	<50% of streams/ IP-km (>6 Key Pieces/100 meters)	Poor
			Habitat Complexity	Large Wood Frequency (Bankfull Width 10-100 meters)	<50% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	50% to 74% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	75% to 90% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	>90% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	<50% of streams/ IP-km (>1.3 Key Pieces/100 meters)	Poor
			Habitat Complexity	Percent Primary Pools	<50% of streams/ IP-Km (>40% average primary pool frequency)	50% to 74% of streams/ IP-Km (>40% average primary pool frequency)	75% to 89% of streams/ IP-Km (>40% average primary pool frequency)	>90% of streams/ IP-Km (>40% average primary pool frequency)	21% streams/ 43% IP-km (>40% average primary pool frequency)	Poor
			Habitat Complexity	Pool/Riffle/Flatwater Ratio	<50% of streams/ IP-Km (>40% Pools; >20% Riffles)	50% to 74% of streams/ IP-Km (>40% Pools; >20% Riffles)	75% to 90% of streams/ IP-Km (>40% Pools; >20% Riffles)	>90% of streams/ IP-Km (>40% Pools; >20% Riffles)	50% streams/ 70% IP-km (>40% Pools; >20% Riffles)	Fair
			Habitat Complexity	Shelter Rating	<50% of streams/ IP-Km (>80 stream average)	50% to 74% of streams/ IP-Km (>80 stream average)	75% to 90% of streams/ IP-Km (>80 stream average)	>90% of streams/ IP-Km (>80 stream average)	7% streams/ 2% IP-km (>80 stream average)	Poor
			Hydrology	Flow Conditions (Baseflow)	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 51-75	Fair
			Hydrology	Flow Conditions (Instantaneous Condition)	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 51-75	Fair
			Hydrology	Number, Condition and/or Magnitude of Diversions	>5 Diversions/10 IP km	1.1 - 5 Diversions/10 IP km	0.01 - 1 Diversions/10 IP km	0 Diversions	1.66 Diversions/10 IP-km	Fair
			Passage/Migration	Passage at Mouth or Confluence	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	<50% of IP-km or <16 IP-Km accessible*	Poor
			Passage/Migration	Physical Barriers	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	78.5% of IP-km	Good

			Riparian Vegetation	Canopy Cover	<50% of streams/ IP-Km (>70% average stream canopy; >85% where coho IP overlaps)	50% to 74% of streams/ IP-Km (>70% average stream canopy; >85% where coho IP overlaps)	75% to 90% of streams/ IP-Km (>70% average stream canopy; >85% where coho IP overlaps)	>90% of streams/ IP-Km (>70% average stream canopy; >85% where coho IP overlaps)	<50% of streams/ IP-km (>70% average stream canopy; >85% where coho IP overlaps)	Poor
			Riparian Vegetation	Tree Diameter (North of SF Bay)	≤39% Class 5 & 6 across IP-km	40 - 54% Class 5 & 6 across IP-km	55 - 69% Class 5 & 6 across IP-km	>69% Class 5 & 6 across IP-km	?39% Class 5 & 6 across IP-km	Poor
			Riparian Vegetation	Tree Diameter (South of SF Bay)	≤69% Density rating "D" across IP-km	70-79% Density rating "D" across IP-km	≥80% Density rating "D" across IP-km	Not Defined		
			Sediment (Food Productivity)	Gravel Quality (Embeddedness)	<50% of streams/ IP-Km (>50% stream average scores of 1 & 2)	50% to 74% of streams/ IP-Km (>50% stream average scores of 1 & 2)	75% to 90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	>90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	71% streams/ 86% IP-km (>50% stream average scores of 1 & 2)	Good
			Water Quality	Temperature (MWMT)	<50% IP km (<20 C MWMT; <16 C MWMT where coho IP overlaps)	50 to 74% IP km (<20 C MWMT; <16 C MWMT where coho IP overlaps)	75 to 89% IP km (<20 C MWMT; <16 C MWMT where coho IP overlaps)	>90% IP km (<20 C MWMT; <16 C MWMT where coho IP overlaps)	50 to 74% IP-km (<20 C MWMT; <16 C MWMT where coho IP overlaps)	Fair
			Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No Evidence of Toxins or Contaminants	Sublethal or Chronic	Fair
			Water Quality	Turbidity	<50% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-Km maintains severity score of 3 or lower	75% to 90% of streams/ IP-Km maintains severity score of 3 or lower	>90% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-km maintains severity score of 3 or lower	Fair
		Size	Viability	Density	<0.2 Fish/m^2	0.2 - 0.6 Fish/m^2	0.7 - 1.5 Fish/m^2	>1.5 Fish/m^2	0.2 - 0.6 Fish/m^2	Fair
			Viability	Spatial Structure	<50% of Historical Range	50-74% of Historical Range	75-90% of Historical Range	>90% of Historical Range	50-74% of Historical Range	Fair

4	Winter Rearing Juveniles	Condition	Habitat Complexity	Large Wood Frequency (Bankfull Width 0-10 meters)	<50% of streams/ IP-Km (>6 Key Pieces/100 meters)	50% to 74% of streams/ IP-Km (>6 Key Pieces/100 meters)	75% to 90% of streams/ IP-Km (>6 Key Pieces/100 meters)	>90% of streams/ IP-Km (>6 Key Pieces/100 meters)	<50% of streams/ IP-km (>6 Key Pieces/100 meters)	Poor
			Habitat Complexity	Large Wood Frequency (Bankfull Width 10-100 meters)	<50% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	50% to 74% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	75% to 90% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	>90% of streams/ IP-Km (>1.3 Key Pieces/100 meters)	<50% of streams/ IP-km (>1.3 Key Pieces/100 meters)	Poor
			Habitat Complexity	Pool/Riffle/Flatwater Ratio	<50% of streams/ IP-Km (>40% Pools; >20% Riffles)	50% to 74% of streams/ IP-Km (>40% Pools; >20% Riffles)	75% to 90% of streams/ IP-Km (>40% Pools; >20% Riffles)	>90% of streams/ IP-Km (>40% Pools; >20% Riffles)	50% streams/ 70% IP-km (>40% Pools; >20% Riffles)	Fair
			Habitat Complexity	Shelter Rating	<50% of streams/ IP-Km (>80 stream average)	50% to 74% of streams/ IP-Km (>80 stream average)	75% to 90% of streams/ IP-Km (>80 stream average)	>90% of streams/ IP-Km (>80 stream average)		
			Passage/Migration	Physical Barriers	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	78.5% of IP-km	Good
			Riparian Vegetation	Tree Diameter (North of SF Bay)	≤39% Class 5 & 6 across IP-km	40 - 54% Class 5 & 6 across IP-km	55 - 69% Class 5 & 6 across IP-km	>69% Class 5 & 6 across IP-km	?39% Class 5 & 6 across IP-km	Poor
			Riparian Vegetation	Tree Diameter (South of SF Bay)	≤69% Density rating "D" across IP-km	70-79% Density rating "D" across IP-km	≥80% Density rating "D" across IP-km	Not Defined		
			Sediment (Food Productivity)	Gravel Quality (Embeddedness)	<50% of streams/ IP-Km (>50% stream average scores of 1 & 2)	50% to 74% of streams/ IP-Km (>50% stream average scores of 1 & 2)	75% to 90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	>90% of streams/ IP-Km (>50% stream average scores of 1 & 2)	71% streams/ 86% IP-km (>50% stream average scores of 1 & 2)	Good
			Velocity Refuge	Floodplain Connectivity	<50% Response Reach Connectivity	50-80% Response Reach Connectivity	>80% Response Reach Connectivity	Not Defined	50-80% Response Reach Connectivity	Fair
			Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No Evidence of Toxins or Contaminants	Sublethal or Chronic	Fair

			Water Quality	Turbidity	<50% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-Km maintains severity score of 3 or lower	75% to 90% of streams/ IP-Km maintains severity score of 3 or lower	>90% of streams/ IP-Km maintains severity score of 3 or lower		
5	Smolts	Condition	Estuary/Lagoon	Quality & Extent	Impaired/non-functional	Impaired but functioning	Properly Functioning Condition	Unimpaired Condition	Impaired/non-functional	Fair
			Habitat Complexity	Shelter Rating	<50% of streams/ IP-Km (>80 stream average)	50% to 74% of streams/ IP-Km (>80 stream average)	75% to 90% of streams/ IP-Km (>80 stream average)	>90% of streams/ IP-Km (>80 stream average)	7% streams/ 2% IP-km (>80 stream average)	Poor
			Hydrology	Number, Condition and/or Magnitude of Diversions	>5 Diversions/10 IP km	1.1 - 5 Diversions/10 IP km	0.01 - 1 Diversions/10 IP km	0 Diversions	1.66 Diversions/10 IP-km	Fair
			Hydrology	Passage Flows	NMFS Flow Protocol: Risk Factor Score >75	NMFS Flow Protocol: Risk Factor Score 51-75	NMFS Flow Protocol: Risk Factor Score 35-50	NMFS Flow Protocol: Risk Factor Score <35	NMFS Flow Protocol: Risk Factor Score 51-75	Fair
			Passage/Migration	Passage at Mouth or Confluence	<50% of IP-Km or <16 IP-Km accessible*	50% of IP-Km to 74% of IP-km	75% of IP-Km to 90% of IP-km	>90% of IP-km	<50% of IP-km or <16 IP-Km accessible*	Poor
			Smoltification	Temperature	<50% IP-Km (>6 and <14 C)	50-74% IP-Km (>6 and <14 C)	75-90% IP-Km (>6 and <14 C)	>90% IP-Km (>6 and <14 C)	75-90% IP-km (>6 and <14 C)	Good
			Water Quality	Toxicity	Acute	Sublethal or Chronic	No Acute or Chronic	No Evidence of Toxins or Contaminants	Sublethal or Chronic	Fair
			Water Quality	Turbidity	<50% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-Km maintains severity score of 3 or lower	75% to 90% of streams/ IP-Km maintains severity score of 3 or lower	>90% of streams/ IP-Km maintains severity score of 3 or lower	50% to 74% of streams/ IP-km maintains severity score of 3 or lower	Fair
		Size	Viability	Abundance	Smolt abundance which produces high risk spawner density per Spence (2008)	Smolt abundance which produces moderate risk spawner density per Spence (2008)	Smolt abundance to produce low risk spawner density per Spence (2008)		Smolt abundance which produces moderate risk spawner density per Spence (2008)	Fair

6	Watershed Processes	Landscape Context	Hydrology	Impervious Surfaces	>10% of Watershed in Impervious Surfaces	7-10% of Watershed in Impervious Surfaces	3-6% of Watershed in Impervious Surfaces	<3% of Watershed in Impervious Surfaces	3.67 of Watershed in Impervious Surfaces	Good
			Landscape Patterns	Agriculture	>30% of Watershed in Agriculture	20-30% of Watershed in Agriculture	10-19% of Watershed in Agriculture	<10% of Watershed in Agriculture	16.45% of Watershed in Agriculture	Good
			Landscape Patterns	Timber Harvest	>35% of Watershed in Timber Harvest	26-35% of Watershed in Timber Harvest	25-15% of Watershed in Timber Harvest	<15% of Watershed in Timber Harvest	25-15% of Watershed in Timber Harvest	Good
			Landscape Patterns	Urbanization	>20% of watershed >1 unit/20 acres	12-20% of watershed >1 unit/20 acres	8-11% of watershed >1 unit/20 acres	<8% of watershed >1 unit/20 acres	27% of watershed >1 unit/20 acres	Poor
			Riparian Vegetation	Species Composition	<25% Intact Historical Species Composition	25-50% Intact Historical Species Composition	51-74% Intact Historical Species Composition	>75% Intact Historical Species Composition	25-50% Intact Historical Species Composition	Fair
			Sediment Transport	Road Density	>3 Miles/Square Mile	2.5 to 3 Miles/Square Mile	1.6 to 2.4 Miles/Square Mile	<1.6 Miles/Square Mile	3.4 Miles/Square Mile	Poor
			Sediment Transport	Streamside Road Density (100 m)	>1 Miles/Square Mile	0.5 to 1 Miles/Square Mile	0.1 to 0.4 Miles/Square Mile	<0.1 Miles/Square Mile	3.4 Miles/Square Mile	Poor

Sonoma Creek CAP Threat Results

	Threats Across Targets	Adults	Eggs	Summer Rearing Juveniles	Winter Rearing Juveniles	Smolts	Watershed Processes	Overall Threat Rank
	Project-specific-threats	1	2	3	4	5	6	
1	Agriculture	Medium	Medium	High	High	Medium	Very High	High
2	Channel Modification	Medium	Medium	High	High	Medium	Very High	High
3	Disease, Predation and Competition	Low		Medium	Medium	Low	Medium	Medium
4	Hatcheries and Aquaculture							
5	Fire, Fuel Management and Fire Suppression	Low	Low	Medium	Low	Low	Low	Low
6	Fishing and Collecting	Low		High	Low	Low		Medium
7	Livestock Farming and Ranching	Medium	Low	Medium	Low	Low	Low	Medium
8	Logging and Wood Harvesting	Low	Low	Medium	Low	Low	Low	Low
9	Mining	Low	Low	Medium	Low	Low	Low	Low
10	Recreational Areas and Activities	Low	Low	Medium	Low	Low	Low	Low
11	Residential and Commercial Development	Medium	Low	Medium	Medium	Low	High	Medium
12	Roads and Railroads	High	Low	Medium	Medium	Medium	High	High
13	Severe Weather Patterns	Medium	Low	High	Medium	Medium	Medium	Medium
14	Water Diversion and Impoundments	High	Medium	Very High	Medium	Medium	Very High	Very High
	Threat Status for Targets and Project	High	Medium	Very High	High	Medium	Very High	Very High

Sonoma Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
SoC-CCCS-1.1	Objective	Estuary	Address the present or threatened destruction, modification, or curtailment of the species habitat or range										
SoC-CCCS-1.1.1	Recovery Action	Estuary	Increase quality and extent of estuarine habitat										
SoC-CCCS-1.1.1.1	Action Step	Estuary	Develop an estuary rehabilitation and enhancement plan in efforts to reclaim historically tidal influenced areas of Sonoma Creek.	1	25	Private Landowners, RCD	250.00					250	Cost estimate for the development of an estuary rehabilitation and enhancement plan.
SoC-CCCS-1.1.1.2	Action Step	Estuary	Evaluate all floodgates located within the tidal portion of Sonoma Creek and determine the feasibility of re-claiming historic tidal slough habitat.	1	25	Private Landowners, RCD						0	Cost accounted for in above action step.
SoC-CCCS-1.1.1.3	Action Step	Estuary	Evaluate water quality conditions (salinity, dissolved oxygen, temperature) in potential steelhead estuary rearing areas.	1	5	Private Landowners, RCD	15.00					15	Cost based on installing a minimum of 3 continuous water quality stations at a rate of $5,000/station. Cost does not account for data management or maintenance.
SoC-CCCS-1.1.1.4	Action Step	Estuary	Identify and provide recommendations for potential rehabilitation sites that have been altered by dredging and diking.	1	25	Private Landowners, RCD						0	Cost accounted for in above action steps.
SoC-CCCS-1.1.1.5	Action Step	Estuary	Identify locations to install habitat complexity features to enhance steelhead estuary rearing conditions.	1	25	Private Landowners, RCD						0	Cost accounted for in above action steps.
SoC-CCCS-1.1.1.6	Action Step	Estuary	Implement estuary rehabilitation and enhancement strategies.	1	25	Private Landowners, RCD	777	777	777	777	777	3,887	Cost based on treating 79 acres (assume 10% total estuarine acres) at a rate of $49,200/acre.
SoC-CCCS-2.1	Objective	Floodplain Connectivity	Address the present or threatened destruction, modification, or curtailment of the species habitat or range										
SoC-CCCS-2.1.1	Recovery Action	Floodplain Connectivity	Rehabilitate and enhance floodplain connectivity										
SoC-CCCS-2.1.1.1	Action Step	Floodplain Connectivity	Identify the floodplain activation flow - the smallest flood pulse event that initiates substantial beneficial ecological processes when associated with floodplain inundation (Williams et al. 2009).	2	10	City, County, RCD, Sonoma Ecology Center	39.50	39.50				79	Cost based on stream flow/precipitation model at a rate of $78,100/project.
SoC-CCCS-2.1.1.2	Action Step	Floodplain Connectivity	Evaluate undeveloped and developed floodplain areas in efforts to identify rehabilitation and habitat enhancement sites with emphasis on increasing floodplain habitat.	2	15	City, County, RCD, Sonoma Ecology Center	115.00	115.00	115.00			345	Cost based on riparian and wetland restoration model at a rate of $88,551 and $255,968/project, respectively.
SoC-CCCS-2.1.1.3	Action Step	Floodplain Connectivity	Design and implement floodplain rehabilitation projects that target velocity refuge for migrating salmonids.	2	25	City, County, RCD, Sonoma Ecology Center						0	Cost accounted for in above action step.
SoC-CCCS-2.1.1.4	Action Step	Floodplain Connectivity	Design and implement floodplain rehabilitation projects that target winter rearing habitat for juvenile steelhead.	2	25	City, County, RCD, Sonoma Ecology Center						0	Cost accounted for in above action step.
SoC-CCCS-3.1	Objective	Hydrology	Address the present or threatened destruction, modification, or curtailment of the species habitat or range										
SoC-CCCS-3.1.1	Recovery Action	Hydrology	Improve passage flows										
SoC-CCCS-3.1.1.1	Action Step	Hydrology	Reduce impacts of impaired hydrology (reduced pulse-flows, magnitude, duration, and timing of freshets) that preclude adult and smolt passage.	2	20	CDFW, NMFS, RWQCB, USACE						0	Action is considered In-Kind
SoC-CCCS-3.1.1.2	Action Step	Hydrology	Establish a comprehensive stream flow evaluation program to determine instream flow needs for steelhead.	1	15	CDFW, NOAA NMFS, Sonoma Ecology Center	26.33	26.33	26.33			79	Cost based on stream flow/precipitation model at a rate of $78,100/project.

Sonoma Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
SoC-CCCS-3.1.1.3	Action Step	Hydrology	Assess and map water diversions (CDFG 2004).	1	15	CDFW, NOAA NMFS, RWQCB, SWRCB						0	Action is considered In-Kind
SoC-CCCS-3.1.1.4	Action Step	Hydrology	Implement passive diversion devices designed to allow diversion of water only when minimum streamflow requirements are met or exceeded (CDFG 2004).	1	15	CDFW, NOAA NMFS, SWRCB						TBD	Cost based on type and amount of passive diversion devices. Additional cost to screen passive diversion devices would also need to be calculated.
SoC-CCCS-3.1.2	Recovery Action	Hydrology	Improve flow conditions										
SoC-CCCS-3.1.2.1	Action Step	Hydrology	Maximize opportunities for aquifer recharge (SCWLFA 2006).	1	15	RCD, Sonoma Ecology Center						0	Action is considered In-Kind
SoC-CCCS-3.1.2.2	Action Step	Hydrology	Develop and implement strategies for efficient water use (SCWLFA 2006).	2	20	CDFW, Sonoma Ecology Center						0	Action is considered In-Kind
SoC-CCCS-3.1.2.3	Action Step	Hydrology	Develop and implement a water use plan ensuring base-flow sustainability (SCWLFA 2006).	1	15	CDFW, Sonoma Ecology Center, SWRCB						0	Action is considered In-Kind
SoC-CCCS-3.1.2.4	Action Step	Hydrology	Require streamflow gaging devices to evaluate impairment to current streamflow conditions.	1	15	CDFW, SWRCB						TBD	
SoC-CCCS-3.1.2.5	Action Step	Hydrology	Monitoring hydrology conditions in all spawning and rearing tributaries of the Sonoma River.	2	15	CDFW, Sonoma Ecology Center, SWRCB	26.33	26.33	26.33			79	Cost based on stream flow/precipitation model at a rate of $78,100/project. This action step may be coordinated with similar action steps to reduce cost or redundancy.
SoC-CCCS-3.1.2.6	Action Step	Hydrology	Minimize or prevent frost protection pumping/irrigation in spawning and rearing tributaries of the Sonoma Creek watershed.	1	25	RCD, Sonoma Ecology Center, SWRCB						TBD	This action step is largely apart of management and resource alternatives. Action is considered In-Kind
SoC-CCCS-5.1	Objective	Passage	Address the present or threatened destruction, modification, or curtailment of the species habitat or range										
SoC-CCCS-5.1.1	Recovery Action	Passage	Modify or remove passage barriers										
SoC-CCCS-5.1.1.1	Action Step	Passage	Evaluate, design, and implement appropriate fish passage at Warm Springs Road on Yulupa Creek (Site ID YULU-193; Katopothis 2005)	1	15	RCD, Sonoma Ecology Center	90.00	90.00	90.00			270	Cost based on adult escapement and juvenile migration at a rate of $43,654 and $225,916/project, respectively.
SoC-CCCS-5.1.1.2	Action Step	Passage	Evaluate, design, and implement appropriate fish passage at Grove Street on Carriger Creek (Site ID CARR-194; Katopothis 2005)	1	15	RCD, Sonoma Ecology Center	90.00	90.00	90.00			270	Cost based on adult escapement and juvenile migration at a rate of $43,654 and $225,916/project, respectively.
SoC-CCCS-5.1.1.3	Action Step	Passage	Evaluate, design, and implement appropriate fish passage at Dunbar Road on Calabazas Creek (Site ID CALA-196; Katopothis 2005)	1	15	RCD, Sonoma Ecology Center, Sonoma Land Trust	90.00	90.00	90.00			270	Cost based on adult escapement and juvenile migration at a rate of $43,654 and $225,916/project, respectively.
SoC-CCCS-5.1.1.4	Action Step	Passage	Evaluate, design, and implement appropriate fish passage at Grove Street #1 on Carriger Creek (Site ID CARR-19; Katopothis 2005)	1	15	RCD, Sonoma Ecology Center, Sonoma Land Trust	90.00	90.00	90.00			270	Cost based on adult escapement and juvenile migration at a rate of $43,654 and $225,916/project, respectively.
SoC-CCCS-5.1.1.5	Action Step	Passage	Evaluate, design, and implement appropriate fish passage at Arnold Drive Private on Stuart Creek (Site ID STUA-191; Katopothis 2005)	1	5	Sonoma Land Trust	270.00					270	Cost based on adult escapement and juvenile migration at a rate of $43,654 and $225,916/project, respectively.
SoC-CCCS-5.1.1.6	Action Step	Passage	Evaluate, design, and implement appropriate fish passage at Glen Oaks Dam on Stuart Creek (Site ID STUA-192; Katopothis 2005)	1	5	Sonoma Land Trust	270.00					270	Cost based on adult escapement and juvenile migration at a rate of $43,654 and $225,916/project, respectively.

Sonoma Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
SoC-CCCS-5.1.1.7	Action Step	Passage	Evaluate, design, and implement appropriate fish passage at Redwood Road on Mill Creek (Site ID MILL-187; Katopothis 2005)	1	15	Sonoma Ecology Center, Sonoma Land Trust, Sonoma RCD	90.00	90.00	90.00			270	Cost based on adult escapement and juvenile migration at a rate of $43,654 and $225,916/project, respectively.
SoC-CCCS-5.1.1.8	Action Step	Passage	Evaluate, design, and implement appropriate fish passage at Trinity Quarry Road on Trinity Creek (Site ID TRIN-129; Katopothis 2005)	1	15	Sonoma Ecology Center, Sonoma Land Trust, Sonoma RCD	90.00	90.00	90.00			270	Cost based on adult escapement and juvenile migration at a rate of $43,654 and $225,916/project, respectively.
SoC-CCCS-5.1.1.9	Action Step	Passage	Evaluate, design, and implement appropriate fish passage at Kinney Brook on Fisher Creek (Site ID FISH-50; Katopothis 2005)	1	15	Sonoma Ecology Center, Sonoma Land Trust, Sonoma RCD	90.00	90.00	90.00			270	Cost based on adult escapement and juvenile migration at a rate of $43,654 and $225,916/project, respectively.
SoC-CCCS-5.1.1.10	Action Step	Passage	Evaluate, design, and implement appropriate fish passage at Pythian Road on Pythian Creek (Site ID PYTH-95; Katopothis 2005)	1	15	Sonoma Ecology Center, Sonoma Land Trust, Sonoma RCD	90.00	90.00	90.00			270	Cost based on adult escapement and juvenile migration at a rate of $43,654 and $225,916/project, respectively.
SoC-CCCS-5.1.1.11	Action Step	Passage	Evaluate, design, and implement appropriate fish passage at Riverside Road on Dowdell Creek (Site ID DOWD-30; Katopothis 2005)	1	15	Sonoma Ecology Center, Sonoma Land Trust, Sonoma RCD	90.00	90.00	90.00			270	Cost based on adult escapement and juvenile migration at a rate of $43,654 and $225,916/project, respectively.
SoC-CCCS-5.1.1.12	Action Step	Passage	Evaluate, design, and implement appropriate fish passage at Warm Springs Road on Snag Creek (Site ID Snag-108; Katopothis 2005)	1	15	Sonoma Ecology Center, Sonoma Land Trust, Sonoma RCD	90.00	90.00	90.00			270	Cost based on adult escapement and juvenile migration at a rate of $43,654 and $225,916/project, respectively.
SoC-CCCS-5.1.1.13	Action Step	Passage	Evaluate, design, and implement appropriate fish passage at Enterprise Road (Site ID SNAG-108; Katopothis 2005)	1	15	Sonoma Ecology Center, Sonoma Land Trust, Sonoma RCD	90.00	90.00	90.00			270	Cost based on adult escapement and juvenile migration at a rate of $43,654 and $225,916/project, respectively.
SoC-CCCS-5.1.1.14	Action Step	Passage	Evaluate, design, and implement appropriate fish passage at Dunbar Road on SF Trinity Creek (Site ID TRIN-131; Katopothis 2005)	1	15	Sonoma Ecology Center, Sonoma Land Trust, Sonoma RCD	90.00	90.00	90.00			270	Cost based on adult escapement and juvenile migration at a rate of $43,654 and $225,916/project, respectively.
SoC-CCCS-5.1.1.15	Action Step	Passage	Evaluate, design, and implement appropriate fish passage at Denmark Road on Harasthy (Site HARA-64; Katopothis 2005)	1	15	Sonoma Ecology Center, Sonoma Land Trust, Sonoma RCD	90.00	90.00	90.00			270	Cost based on adult escapement and juvenile migration at a rate of $43,654 and $225,916/project, respectively.
SoC-CCCS-5.1.1.16	Action Step	Passage	Evaluate, design, and implement appropriate fish passage at Norrbom Road Private (Site ID AGUA-200; Katopothis 2005)	1	15	Sonoma Ecology Center, Sonoma Land Trust, Sonoma RCD	90.00	90.00	90.00			270	Cost based on adult escapement and juvenile migration at a rate of $43,654 and $225,916/project, respectively.

Sonoma Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
SoC-CCCS-5.1.1.17	Action Step	Passage	Evaluate, design, and implement appropriate fish passage at Trinity Road #1 (Site ID TRIN-134; Katopothis 2005)	1	15	Sonoma Ecology Center, Sonoma Land Trust, Sonoma RCD	90.00	90.00	90.00			270	Cost based on adult escapement and juvenile migration at a rate of $43,654 and $225,916/project, respectively.
SoC-CCCS-5.1.1.18	Action Step	Passage	Evaluate, design, and implement appropriate fish passage at Agua Caliente Road on SF Agua Caliente Creek (Site ID AGUA-203; Katopothis 2005)	1	15	Sonoma Ecology Center, Sonoma Land Trust, Sonoma RCD	90.00	90.00	90.00			270	Cost based on adult escapement and juvenile migration at a rate of $43,654 and $225,916/project, respectively.
SoC-CCCS-5.1.1.19	Action Step	Passage	Evaluate, design, and implement appropriate fish passage at Arnold Drive on Kohler Creek (Site ID KOHL-199; Katopothis 2005)	1	15	Sonoma Ecology Center, Sonoma Land Trust, Sonoma RCD	90.00	90.00	90.00			270	Cost based on adult escapement and juvenile migration at a rate of $43,654 and $225,916/project, respectively.
SoC-CCCS-5.1.1.20	Action Step	Passage	Evaluate, design, and implement appropriate fish passage at MacArthur Road on Fryer Creek (Site ID FRYE-54; Katopothis 2005)	1	15	RCD, Sonoma Ecology Center	90.00	90.00	90.00			270	Cost based on adult escapement and juvenile migration at a rate of $43,654 and $225,916/project, respectively.
SoC-CCCS-5.1.1.21	Action Step	Passage	Evaluate, design, and implement appropriate fish passage at unnamed barrier on Sonoma Creek (PAD_ID 712554; Passage ID 14592).	2	15	Sonoma Ecology Center, Sonoma RCD	90.00	90.00	90.00			270	Cost based on adult escapement and juvenile migration at a rate of $43,654 and $225,916/project, respectively.
SoC-CCCS-5.1.1.22	Action Step	Passage	Evaluate, design, and implement appropriate fish passage at unnamed barrier on Graham Creek (PAD_ID 712544; Passage ID 14585).	2	15	Sonoma Ecology Center, Sonoma RCD	90.00	90.00	90.00			270	Cost based on adult escapement and juvenile migration at a rate of $43,654 and $225,916/project, respectively.
SoC-CCCS-5.1.1.23	Action Step	Passage	Evaluate, design, and implement appropriate fish passage at unnamed barrier on Graham Creek (PAD_ID 712545; Passage ID 14586).	2	15	Sonoma Ecology Center, Sonoma RCD	90.00	90.00	90.00			270	Cost based on adult escapement and juvenile migration at a rate of $43,654 and $225,916/project, respectively.
SoC-CCCS-5.1.1.24	Action Step	Passage	Evaluate, design, and implement appropriate fish passage at unnamed barrier on Graham Creek (PAD_ID 712546; Passage ID 14587).	2	15	Sonoma Ecology Center, Sonoma RCD	90.00	90.00	90.00			270	Cost based on adult escapement and juvenile migration at a rate of $43,654 and $225,916/project, respectively.
SoC-CCCS-5.1.1.25	Action Step	Passage	Evaluate, design, and implement appropriate fish passage at unnamed on Graham Creek (PAD_ID 712547; Passage ID 14588).	2	15	Sonoma Ecology Center, Sonoma RCD	90.00	90.00	90.00			270	Cost based on adult escapement and juvenile migration at a rate of $43,654 and $225,916/project, respectively.
SoC-CCCS-5.1.2	Recovery Action	Passage	Rehabilitate and enhance passage into tributaries (aggradation/degradation)										
SoC-CCCS-5.1.2.1	Action Step	Passage	Identify, develop, and implement strategies to address aggradated or degradation passage barriers at tributary mouths. Consider the following: annual variability in passage, seasonality of passage conditions, severity of condition, geographic scope of the problem.	2	15	Sonoma Ecology Center, Sonoma RCD	46.00	46.00	46.00			138	Cost based on fish/habitat restoration model at a rate of $137,833/project.
SoC-CCCS-5.1.2.2	Action Step	Passage	Re-engineer stream crossings where stream channel incision has produced a barrier (SCWLFA 2006).	2	15	Sonoma Ecology Center, Sonoma RCD	90.00	90.00	90.00			270	Cost based on adult escapement and juvenile migration at a rate of $43,654 and $225,916/project, respectively.
SoC-CCCS-5.1.2.3	Action Step	Passage	Treat culverts where smooth concrete surfaces generate flows too swift to pass fish (SCWLFA 2006).	2	15	Sonoma County, Sonoma Ecology Center						TBD	Cost based on number and type of recommendations to employ to improve passage in concrete culverts. Estimate for a new fish ladder in a large waterway is $1,443,585/ladder.
SoC-CCCS-6.1	Objective	Habitat Complexity	Address the present or threatened destruction, modification, or curtailment of the species habitat or range										

Sonoma Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
SoC-CCCS-6.1.1	Recovery Action	Habitat Complexity	Increase large wood frequency										
SoC-CCCS-6.1.1.1	Action Step	Habitat Complexity	Develop strategies to optimize hydraulic conditions and habitat complexity when implementing/installing LWD structures.	2	5	Sonoma Ecology Center, Sonoma RCD	138.00					138	Cost based on fish/habitat restoration model at a rate of $137,833/project.
SoC-CCCS-6.1.1.2	Action Step	Habitat Complexity	Develop and install seasonal habitat rearing features that achieve optimal performance during spring/fall baseflow conditions in main stem Sonoma Creek.	2	10	Sonoma Ecology Center, Sonoma RCD	140.50	140.50				281	Cost based on treating 9 miles (assume 1 project/mile in 50% high IP) at a rate of $31,200/mile. Cost may be significantly greater if a higher level of oversight and engineering is required such as implementing ELJ which are estimated at $124,800/ELJ.
SoC-CCCS-6.1.2	Recovery Action	Habitat Complexity	Increase frequency of primary pools										
SoC-CCCS-6.1.2.1	Action Step	Habitat Complexity	Evaluate, develop, and implement strategies to increase primary pool frequency in high priority reaches within the following tributaries: Agua Caliente, Arroyo Seco, Carriger, Hooker, Mill, and Stuart creeks.	2	25	Sonoma Ecology Center, Sonoma RCD	56.20	56.20	56.20	56.20	56.20	281	Cost based on treating 9 miles (assume 1 project/mile in 50% high IP) at a rate of $31,200/mile. Cost may be significantly greater if a higher level of oversight and engineering is required such as implementing ELJ which are estimated at $124,800/ELJ. This action step should be coordinated with similar action steps to reduce cost and redundancy.
SoC-CCCS-6.1.2.2	Action Step	Habitat Complexity	Enhance pool depth: increase depth, cover, and complexity using CDFW protocols (SCWLFA 2006).	2	25	Sonoma Ecology Center, Sonoma RCD						0	Cost accounted for in above action step.
SoC-CCCS-6.1.3	Recovery Action	Habitat Complexity	Improve shelter										
SoC-CCCS-6.1.3.1	Action Step	Habitat Complexity	Evaluate, identify, and improve shelters in pools within the main stem Sonoma Creek and the following tributaries: Aqua Caliente, Arroyo Seco, Bear, Bedrock, Carriger, Fowler, Graham, Hooker, Mill, upper Sonoma, and Stuart creeks.	2	25	Sonoma Ecology Center, Sonoma RCD						0	Cost accounted for in above action steps.
SoC-CCCS-6.1.4	Recovery Action	Habitat Complexity	Improve pool/riffle/flatwater ratios (hydraulic diversity)										
SoC-CCCS-6.1.4.1	Action Step	Habitat Complexity	Evaluate, identify, and develop strategies that will encourage riffle habitat formation in the main stem Sonoma Creek and the following tributaries: Agua Caliente, Arroyo Seco, Bedrock, Fowler, Hooker, and Mill creeks.	2	25	Sonoma Ecology Center, Sonoma RCD						TBD	
SoC-CCCS-7.1	Objective	Riparian	Address the present or threatened destruction, modification, or curtailment of the species habitat or range										
SoC-CCCS-7.1.1	Recovery Action	Riparian	Improve canopy cover										

Sonoma Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
SoC-CCCS-7.1.1.1	Action Step	Riparian	Identify and implement riparian enhancement projects where current canopy density and diversity are inadequate and site conditions are appropriate to: initiate tree planting and other vegetation management to encourage the development of a denser more extensive riparian canopy in the following streams of the Sonoma Creek watershed: Agua Caliente, Arroyo Seco, Bedrock, Calabazas, Carriger, Fowler, Mill, Rogers, upper Sonoma, and Stuart creeks.	2	15	Sonoma Ecology Center, Sonoma Land Trust, Sonoma RCD	382	382	382			1,144	Cost based on treating 4.6 miles (assume 1 project/mile in 25% high IP with 10 acres/mile) at a rate of $24,862/acre.
SoC-CCCS-7.1.1.2	Action Step	Riparian	Assess riparian canopy and impacts of exotic vegetation (e.g., Arundo donax, etc.), prioritize and develop riparian habitat reclamation and enhancement programs (CDFG 2004).	2	10	Sonoma County Water Agency, Sonoma Ecology Center, Sonoma RCD	44.50	44.50				89	Cost based on riparian restoration model at a rate of $88,551/project.
SoC-CCCS-7.1.1.3	Action Step	Riparian	Ensure that mature trees within the steam riparian corridor are not disturbed or lost due to land management activities (roads, cattle, flood control, etc.).	2	25	Sonoma County Water Agency, Sonoma Ecology Center, Sonoma Land Trust, Sonoma RCD						0	Action is considered In-Kind
SoC-CCCS-7.1.1.4	Action Step	Riparian	Evaluate, design, and implement strategies to rehabilitate native riparian communities and encourage large long standing trees.	2	25	Sonoma Ecology Center, Sonoma Land Trust, Sonoma RCD						0	Cost accounted for in above action steps.
SoC-CCCS-7.1.1.5	Action Step	Riparian	Promote streamside conservation measures, including conservation easements, setbacks, and riparian buffers.	2	25	City, County, Sonoma County, Sonoma County Water Agency, Sonoma Ecology Center, Sonoma Land Trust, Sonoma RCD						0	Action is considered In-Kind
SoC-CCCS-8.1	Objective	Sediment	Address the present or threatened destruction, modification, or curtailment of the species habitat or range										
SoC-CCCS-8.1.1	Recovery Action	Sediment	Improve gravel quantity and distribution for macro-invertebrate production (food)										
SoC-CCCS-8.1.1.1	Action Step	Sediment	Increase the percentage of gravel quality embeddedness to values of 1s and 2s (See NMFS Conservation Action Planning Attribute Table Report) in all current and potential juvenile salmonid summer and seasonal (fall/winter/spring) rearing areas.	2	25	RWQCB, Sonoma County Water Agency, Sonoma Ecology Center, Sonoma RCD						TBD	

Sonoma Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
SoC-CCCS-8.1.1.2	Action Step	Sediment	Increase stream bed and bank stability using biotechnical materials (vegetation, plant fiber, and native wood and rock), where appropriate (SCWLFA 2006).	2	25	RWQCB, Sonoma County Water Agency, Sonoma Ecology Center, Sonoma RCD						0	Action is considered In-Kind
SoC-CCCS-8.1.1.3	Action Step	Sediment	Re-mediate upland sources (prevent eroded soils form entering the stream system) (SCWLFA 2006).	2	25	RWQCB, Sonoma County, Sonoma County Water Agency, Sonoma Ecology Center						TBD	Cost based on remediating eroding soils such as gullies in upslope sources. Estimate for gully/landslide stabilization is $3,681/acre.
SoC-CCCS-10.1	Objective	Water Quality	Address the present or threatened destruction, modification, or curtailment of the species habitat or range										
SoC-CCCS-10.1.1	Recovery Action	Water Quality	Improve instream temperature conditions										
SoC-CCCS-10.1.1.1	Action Step	Water Quality	Rehabilitate or restore riparian corridor conditions within all current and potential high value habitat summer rearing areas.	2	20	Sonoma Ecology Center, Sonoma RCD						0	Cost accounted for in other action steps: Riparian
SoC-CCCS-10.1.1.2	Action Step	Water Quality	Develop strategies to reduce groundwater pumping impacts on summer instream water temperatures and baseflows.	1	20	Sonoma Ecology Center, Sonoma RCD						TBD	Cost based on appropriate strategies such as storage facilities to reduce groundwater impacts. Estimate for storage facilities ranges from $100 to $25,000/facility.
SoC-CCCS-10.1.1.3	Action Step	Water Quality	Implement comprehensive evaluation and monitoring program to determine areas where poor riparian habitat is contributing to increased water temperatures limiting juvenile steelhead survival and summer rearing habitat potential.	2	10	Sonoma Ecology Center, Sonoma RCD	0.75	0.75				2	Cost based on installing a minimum of 3 water temperature gauges at a rate of $500/gauge. Cost does not account for data management or maintenance.
SoC-CCCS-12.1	Objective	Agriculture	Address the present or threatened destruction, modification, or curtailment of the species habitat or range										
SoC-CCCS-12.1.1	Recovery Action	Agriculture	Prevent or minimize impairment to habitat complexity (reduced large wood and/or shelter)										
SoC-CCCS-12.1.1.1	Action Step	Agriculture	Avoid the removal of large wood and other shelter components from the stream system	2	25	City, County, Private Landowners, RCD						0	Action is considered In-Kind
SoC-CCCS-12.1.2	Recovery Action	Agriculture	Prevent or minimize impairment to water quality (impaired stream temperature)										
SoC-CCCS-12.1.2.1	Action Step	Agriculture	Work with landowners to minimize the amount of water used for agriculture to protect stream flow and temperatures.	2	20	NOAA NMFS, RCD, SWRCB, Private Landowners						0	Action is considered In-Kind

Sonoma Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
SoC-CCCS-12.1.2.2	Action Step	Agriculture	Work with landowners to ensure that mature trees within the stream riparian corridor are not disturbed or lost due to agricultural activities.	3	25	Sonoma County, Sonoma County Water Agency, Sonoma Ecology Center, Sonoma Land Trust, Sonoma RCD, Private Landowners						0	Action is considered In-Kind
SoC-CCCS-12.1.3	Recovery Action	Agriculture	Prevent or minimize impairment to water quality (increased turbidity, suspended sediment, and/or toxicity)										
SoC-CCCS-12.1.3.1	Action Step	Agriculture	Work with landowners to maintain adequate stream corridor buffers to filter and prevent fine sediment input from entering streams of the Sonoma Creek.	3	25	NRCS, RCD, Sonoma Ecology Center, Private Landowners						0	Action is considered In-Kind
SoC-CCCS-12.1.3.2	Action Step	Agriculture	Work with landowners to reduce discharge of chemical effluent and fertilizer related to agricultural practices.	2	25	NRCS, RCD, Private Landowners						0	Action is considered In-Kind
SoC-CCCS-12.1.4	Recovery Action	Agriculture	Prevent or minimize impairment to stream hydrology (impaired water flow)										
SoC-CCCS-12.1.4.1	Action Step	Agriculture	If water is being used as part of frost protection measures, flow metering should accompany water management to ensure flows are maintained for other beneficial uses	2	25	Sonoma County Water Agency, Sonoma Ecology Center, Sonoma RCD, SWRCB, Private Landowners						TBD	Cost based on the number of water diversions used for frost protection. Estimate for water metering devices is $1,000/logger.
SoC-CCCS-12.1.5	Recovery Action	Agriculture	Prevent or minimize adverse alterations to riparian species composition and structure										
SoC-CCCS-12.1.5.1	Action Step	Agriculture	Promote the re-vegetation of the native riparian plant community within inset floodplains and riparian corridors to provide future recruitment of large wood and other shelter components	2	25	Private Landowners, RCD						0	Costs accounted for in other recovery actions - see Riparian.
SoC-CCCS-12.1.5.2	Action Step	Agriculture	Develop and implement riparian setbacks/buffers that protect existing native riparian species composition and structure.	2	25	Sonoma County Water Agency, Sonoma Ecology Center, Sonoma Land Trust, Sonoma RCD, Private Landowners						0	Action is considered In-Kind
SoC-CCCS-12.1.5.3	Action Step	Agriculture	Ensure that mature trees within the steam riparian corridor are not disturbed or lost due to agricultural activities.	2	25	Sonoma County Water Agency, Sonoma Ecology Center, Sonoma Land Trust, Sonoma RCD, Private Landowners						0	Action is considered In-Kind

Sonoma Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
SoC-CCCS-12.1.6	Recovery Action	Agriculture	Prevent or minimize impairment to instream substrate/food productivity (impaired gravel quality and quantity)										
SoC-CCCS-12.1.6.1	Action Step	Agriculture	Complete Farm Conservation Plans (through the SRCD, NRCS, Fish Friendly Farming program or other cooperative conservation programs) to address sediment source reduction, riparian habitat, forest health, and restoration.	3	15	Sonoma Ecology Center, Sonoma RCD, Private Landowners						TBD	
SoC-CCCS-12.1.6.2	Action Step	Agriculture	Encourage the NRCS, RCDs, and other appropriate organizations to increase the number of landowners participating in sediment reduction planning and implementation.	3	25	NRCS, RCD, Private Landowners						0	Action is considered In-Kind
SoC-CCCS-13.1	Objective	Channel Modification	Address the present or threatened destruction, modification, or curtailment of the species habitat or range										
SoC-CCCS-13.1.1	Recovery Action	Channel Modification	Prevent or minimize impairment to floodplain connectivity (impaired quality & extent)										
SoC-CCCS-13.1.1.1	Action Step	Channel Modification	Design channel modification activities to prevent or minimize future impediments to the creation, or blocking access to, off channel habitat used by salmonids as refuge and winter rearing habitat during high stream flows.	2	25	City, County, RCD, Sonoma Ecology Center						0	Action is considered In-Kind
SoC-CCCS-13.1.1.2	Action Step	Channel Modification	Construction of new flood control projects or additions to existing projects that would facilitate new development (as opposed to protecting existing infrastructure) are discouraged and should be minimized to the greatest extent.	2	25	City, County, RCD						0	Action is considered In-Kind
SoC-CCCS-13.1.2	Recovery Action	Channel Modification	Prevent or minimize impairment to habitat complexity (reduced large wood and/or shelter)										
SoC-CCCS-13.1.2.1	Action Step	Channel Modification	Prevent any future removal of habitat forming structures (LWD, boulders, vegetation, etc.) in natural waterways.	2	25	City, County, RCD						0	Action is considered In-Kind
SoC-CCCS-13.1.2.2	Action Step	Channel Modification	Minimize or avoid new channelization of natural stream channels	2	25	City, County, RCD						0	Action is considered In-Kind
SoC-CCCS-13.1.2.3	Action Step	Channel Modification	All proposed flood control projects should include habitat protection, and/or alternatives that minimize impacts to salmon habitat.	2	25	City, County, RCD						0	Action is considered In-Kind
SoC-CCCS-13.1.2.4	Action Step	Channel Modification	Add channel roughness (logs, boulders) in strategic locations to encourage spawning tailout formations and gravel sorting.	2	10	Sonoma County Water Agency, Sonoma Ecology Center, Sonoma Land Trust, Sonoma RCD	140.50	140.50				281	Cost based on treating 9 miles (assume 1 project/mile in 50% high IP) at a rate of $31,200/mile.
SoC-CCCS-13.1.2.5	Action Step	Channel Modification	Incorporate velocity refuge habitat features in all future and existing engineered and modified channels.	2	25	City, County, RCD						0	Action is considered In-Kind
SoC-CCCS-13.1.3	Recovery Action	Channel Modification	Prevent or minimize impairment to stream hydrology (impaired water flow)										
SoC-CCCS-13.1.3.1	Action Step	Channel Modification	Conduct rehabilitation activities that restore channels, floodplains and meadows to extend the duration of the summer flow and provide refuge from high winter flows.	2	25	City, County, RCD	411	411	411	411	411	2,054	Cost based on treating 4.6 miles (assume 1 project/mile in 25% high IP with 10 acres/mile) at a rate of $44,640/acre.

Sonoma Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
SoC-CCCS-16.1	Objective	Fishing/Collecting	Address the overutilization for commercial, recreational, scientific or educational purposes										
SoC-CCCS-16.1.1	Recovery Action	Fishing/Collecting	Prevent or minimize reduced density, abundance, and diversity										
SoC-CCCS-16.1.1.1	Action Step	Fishing/Collecting	Modify current bag limit (5) in Sonoma Creek and tributaries (181 A) above the Adobe Canyon Road Bridge to catch-n-release zero-limit retention from the last Saturday in April through November 15.	1	5	CDFW, NOAA NMFS						0	Action is considered In-Kind
SoC-CCCS-22.1	Objective	Residential /Commercial Development	Address the present or threatened destruction, modification, or curtailment of the species habitat or range										
SoC-CCCS-22.1.1	Recovery Action	Residential /Commercial Development	Prevent or minimize impairment to water quality (increase turbidity, suspended sediment, and/or toxicity)										
SoC-CCCS-22.1.1.1	Action Step	Residential /Commercial Development	Minimize or prevent the future use of commercial and industrial products (e.g. pesticides) with high potential for contamination of local waterways.	3	25	City, County						0	Action is considered In-Kind
SoC-CCCS-22.1.1.2	Action Step	Residential /Commercial Development	Upgrade existing stormwater systems into a spatially distributed discharge network (rather than a few point discharges).	3	25	City, County						TBD	
SoC-CCCS-22.1.2	Recovery Action	Residential /Commercial Development	Prevent or minimize impairment to floodplain connectivity (impaired quality and extent)										
SoC-CCCS-22.1.2.1	Action Step	Residential /Commercial Development	Minimize or restrict new development within 100-year floodprone zones.	2	100	City, County						0	Action is considered In-Kind
SoC-CCCS-22.1.2.2	Action Step	Residential /Commercial Development	Rehabilitate areas where existing and dilapidated infrastructure impairs the quality of floodplain and winter rearing for habitat for steelhead within the upper Sonoma Creek watershed.	2	25	City, Corps, County, Sonoma Ecology Center, Sonoma RCD	107.20	107.20	107.20	107.20	107.20	536	Cost based on treating 0.5 miles (assume 1 project/mile in 25% of flood channel) at a rate of
SoC-CCCS-22.1.3	Recovery Action	Residential /Commercial Development	Prevent or minimize impairment to stream hydrology (impaired water flow)										
SoC-CCCS-22.1.3.1	Action Step	Residential /Commercial Development	Encourage and identify opportunities for on-site rain retention facilities.	3	25	Sonoma Ecology Center, Sonoma Land Trust, Sonoma RCD						0	Action is considered In-Kind
SoC-CCCS-22.1.4	Recovery Action	Residential /Commercial Development	Prevent or minimize impairment to hydrology (gravel scouring events)										
SoC-CCCS-22.1.4.1	Action Step	Residential /Commercial Development	Minimize impervious surfaces in new and development projects (SCWLFA 2006).	3	25	City, County						0	Action is considered In-Kind
SoC-CCCS-23.1	Objective	Roads/Railroads	Address the present or threatened destruction, modification, or curtailment of the species habitat or range										
SoC-CCCS-23.1.1	Recovery Action	Roads/Railroads	Prevent or minimize impairment to passage and migration										

Sonoma Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
SoC-CCCS-23.1.1.1	Action Step	Roads/Railroads	Ensure all future new, repair, and replacement road/stream crossing provide unimpaired passage for all steelhead life stages.	2	25	City, County, Sonoma Ecology Center, Sonoma Land Trust, Sonoma RCD						0	Action is considered In-Kind
SoC-CCCS-23.1.1.2	Action Step	Roads/Railroads	Conduct collaborative evaluations of priorities for treatment of road-related CCC steelhead passage barriers, such as the Fish Passage Forum.	2	25	City, County, Sonoma Ecology Center, Sonoma RCD						0	Action is considered In-Kind
SoC-CCCS-23.1.1.3	Action Step	Roads/Railroads	Use NMFS Guidelines for Salmonid Passage at Stream Crossings (NMFS 2001a) and appropriate barrier databases when developing new or retrofitting existing road crossings.	2	25	City, County, Sonoma Ecology Center, Sonoma RCD						0	Action is considered In-Kind
SoC-CCCS-23.1.2	Recovery Action	Roads/Railroads	Prevent or minimize alterations to sediment transport (road condition/density, dams etc.)										
SoC-CCCS-23.1.2.1	Action Step	Roads/Railroads	Bridges associated with new roads or replacement bridges (including railroad bridges) should be free span or constructed with the minimum number of bents feasible in order to minimize drift accumulation and facilitate fish passage.	2	25	Sonoma County, Sonoma Ecology Center, Sonoma RCD						0	Action is considered In-Kind
SoC-CCCS-23.1.2.2	Action Step	Roads/Railroads	Address sediment and runoff sources from road networks and other actions that deliver sediment and runoff to stream channels.	2	10	City, County, Sonoma Ecology Center, Sonoma Land Trust, Sonoma RCD	283.00	283.00				566	Cost based on road inventory of 493 miles of road network at a rate of $1,148/mile.
SoC-CCCS-23.1.3	Recovery Action	Roads/Railroads	Prevent or minimize impairment to stream hydrology (impaired water flow)										
SoC-CCCS-23.1.3.1	Action Step	Roads/Railroads	Conduct actions that hydrologically disconnect roads.	2	25	City, County, RWQCB, Sonoma Ecology Center, Sonoma RCD						TBD	Cost based on type and scope of recommendations identified in road assessment.
SoC-CCCS-24.1	Objective	Severe Weather Patterns	Address other natural or manmade factors affecting the species continued existence										
SoC-CCCS-24.1.1	Recovery Action	Severe Weather Patterns	Prevent or minimize impairment to stream hydrology (impaired water flow)										
SoC-CCCS-24.1.1.1	Action Step	Severe Weather Patterns	Identify and work with water users and appropriate regulatory agencies to minimize depletion of summer base flows during drought years from authorized and unauthorized water uses.	1	25	Sonoma Ecology Center, Sonoma RCD, SWRCB						TBD	This action step will rely on development of a hydrologic model, followed by coordination and cooperation with other stakeholders. Action is considered In-Kind
SoC-CCCS-25.1	Objective	Water Diversion /Impoundment	Address the present or threatened destruction, modification, or curtailment of the species habitat or range										
SoC-CCCS-25.1.1	Recovery Action	Water Diversion /Impoundment	Prevent or minimize impairment to stream hydrology (impaired water flow)										

Sonoma Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
SoC-CCCS-25.1.1.1	Action Step	Water Diversion /Impoundment	Develop and implement alternative off-channel storage to reduce impacts of water diversions during the spring and summer.	1	15	Sonoma County Water Agency, Sonoma Ecology Center, Sonoma Land Trust, Sonoma RCD						TBD	Cost based on number and type of off-channel storage needed to reduce impacts. Estimate for off-channel storage ranges from $100 to $25,000/station.
SoC-CCCS-25.1.1.2	Action Step	Water Diversion /Impoundment	Assess, map, and install stream gages on all water diversions (CDFG 2004).	1	15	CDFW, Sonoma Ecology Center, Sonoma RCD						TBD	Cost based on the number of water diversions without stream gages. Estimate for stream gages is $500/gage.
SoC-CCCS-25.1.1.3	Action Step	Water Diversion /Impoundment	Prevent and/or minimize the adverse effects of water diversion on salmonid habitat by establishing a more natural hydrograph, by-passing adequate downstream flows, regulating season of diversion, and promoting and implementing off-stream storage solutions (CDFG 2004).	1	15	CDFW, Sonoma Ecology Center, Sonoma RCD, SWRCB						TBD	
SoC-CCCS-25.2	Objective	Water Diversion /Impoundment	Address the inadequacy of existing regulatory mechanisms										
SoC-CCCS-25.2.1	Recovery Action	Water Diversion /Impoundment	Prevent or minimize impairment to stream hydrology (impaired water flow)										
SoC-CCCS-25.2.1.1	Action Step	Water Diversion /Impoundment	Support the Development and implementation of groundwater use regulations.	1	25	Sonoma Ecology Center, Sonoma RCD						0	Action is considered In-Kind

CCC Steelhead DPS Rapid Assessment Profile: Interior San Francisco Bay Diversity Stratum Populations

Pinole Creek

- Role within DPS: Dependent Population
- Spawner Density Target: N/A
- Current Intrinsic Potential: N/A

San Pablo Creek

- Role within DPS: Potentially Independent Population
- Spawner Density Target: 50-101 adults
- Current Intrinsic Potential: 8.6 IP-km

San Leandro Creek

- Role within DPS: Functionally Independent Population
- Spawner Density Target: 30-63 adults
- Current Intrinsic Potential: 5.4 IP-km

San Lorenzo Creek

- Role within DPS: Functionally Independent Population
- Spawner Density Target: 110-221 adults
- Current Intrinsic Potential: 18.6 IP-km

Wildcat Creek

- Role within DPS: Dependent Population
- Spawner Density Target: N/A
- Current Intrinsic Potential: N/A

Codornices Creek

- Role within DPS: Dependent Population
- Spawner Density Target: N/A
- Current Intrinsic Potential: N/A

Steelhead Abundance and Distribution

In Pinole, San Pablo, San Leandro, San Lorenzo, Wildcat, and Codornices creeks steelhead are present in low numbers. Historic abundance data are generally lacking (Spence *et al.* 2008 and 2012), and systematic population density studies have not been performed; however, available

information indicates that the current distribution and abundance of steelhead in these watersheds are much reduced from historic conditions (Leidy *et al.* 2005, Spence *et al.* 2008 and 2012). Within the Interior San Francisco Bay stratum, substantial amounts of historic habitat is blocked by dams, remaining accessible habitat is of poor quality, and it is highly unlikely that the stratum supports viable steelhead populations (Spence *et al.* 2008). Of the six creeks considered here, three (San Pablo, San Leandro, and San Lorenzo creeks) were evaluated by NMFS' Technical Recovery Team for the North-Central California Coast Recovery Domain (TRT), and classified as being at high risk of extinction (Spence *et al.* 2008). Pinole, Wildcat, and Codornices creeks were not evaluated by the TRT, but are also characterized by low steelhead abundance and limited distribution (Leidy *et al.* 2005). Although land uses do vary between watersheds, considering general similarities within the six streams (NMFS 2009, 2010, 2011, 2013a, 2013b, 2013c), and the overall similarities with regard to habitat impairments, the populations in Pinole, Wildcat, and Codornices creeks are also likely at high risk of extinction.

Habitats in Pinole Creek are believed to be some of the best for *O. mykiss* in Contra Costa County. Pinole has maintained a self-sustaining *O. mykiss* population over the past decades. The creek has no major water diversions, and the upper two-thirds of the watershed are either protected or sparsely developed (Mulchaey 2010). Archives of DFG surveys document steelhead in the early 1970s in Pinole Creek. Steelhead juveniles, adults and redds have been observed by a number of investigators including CDFG, Robert Leidy and staff from East Bay Municipal Utility District (EBMUD) between 1976 through 2011. In March 2011, EBMUD staff documented anadromous fish redds in the middle of the watershed, 5 miles upstream of San Pablo Bay (Mulchaey pers comm 2011). The resident form of steelhead, known as rainbow trout, have also been documented (Mulchaey 2009; Leidy et al. 2005). Genetic work has confirmed that Pinole rainbow trout are descendants of the Central California Coast steelhead DPS (Nielsen and Fountain 1999).

History of Land Uses

Prior to the late 1840s, landscape modifications within the San Francisco Bay region were small and localized, but accelerated thereafter, resulting in the highly modified conditions seen today (Goals Project 1999). Land use activities associated with urban, industrial, and agricultural development (i.e., diking, draining, and filling of wetlands and tidally-influenced areas; construction of salt ponds, roads, bridges, and airports; marina, commercial, industrial, and residential developments) have altered aquatic habitat quality in the San Francisco Bay Region and contributed to population declines for species (including listed salmonids) that rely upon baylands for feeding or breeding (Goals Project 1999). Within the Interior San Francisco Bay stratum, this history of land development has resulted in most streams being characterized by

highly modified watershed conditions reflective of urban and industrial development, and water-allocation operations (*e.g.*, reservoirs, diversions and associated infrastructure).

Current Resources and Land Management

Numerous private, and local, state, and Federal government entities are responsible for land and resource management within the watersheds of the Interior San Francisco Bay Stratum. Regulated activities include, but are not limited to: resource extraction, infrastructure maintenance, development, restoration and resource management, shipping, commercial and recreational fishing, and recreation.

Pinole Creek is one of the few watersheds in the San Francisco Bay area that has maintained a rural character. The major land uses are public land (39%), agricultural land (31%), single family residences (16%) and open space (11%). Urbanization is limited to the lower third of the watershed within the cities of Pinole, Hercules and El Sobrante and consists primarily of single family residential and commercial uses (Contra Costa County Watershed Atlas 2003). The middle of the watershed consists of undeveloped protected lands owned by the East Bay Municipal Utility District and the upper watershed is comprised of small ranches, agriculture and the Briones Regional Park (Contra Costa County Watershed Atlas 2003).

Conditions

Current impaired conditions result directly or indirectly from human activities, and are expected to continue until restored and/or the threat acting on the condition is abated. The following discussion focuses on those conditions that rated as a Poor or Fair for their effects to Steelhead life history stages (See Interior San Francisco Bay Rapid Assessment Condition Results). Within Pinole, San Pablo, Wildcat, Codornices, San Leandro, and San Lorenzo creeks, all assessed conditions were rated as Poor or Fair. Most watersheds lack specific data except for Pinole Creek. In general, urban development and associated infrastructure, passage impediments, and flow alterations have severely impaired stream habitat throughout the stratum. Recovery strategies will focus on improving these conditions as well as those needed to ensure population viability and functioning watershed processes.

Riparian Vegetation: Composition, Cover & Tree Diameter

This condition was rated as having a major effect on summer rearing juveniles. Tree canopy cover throughout these watersheds is low[1], and road density within the riparian area is typically high[2], indicating poor riparian conditions. Poor riparian conditions are common throughout much of the accessible reaches of these streams. For all but Pinole Creek, which retains relatively accessible upper watershed habitat unencumbered by urban development, steelhead distribution within these streams is typically limited to highly urbanized reaches (NMFS 2009, 2010, 2011, 2013a, 2013b, 2013c) where riparian effects are most prevalent. These conditions likely result in elevated summer water temperature, high streambed embeddeness levels, prevalent stream bank erosion, and limited LWD recruitment for rearing salmonids. Threats contributing to this condition include residential and commercial development, channel modification, and disease/predation/competition.

Estuary: Quality & Extent

This condition was rated as having a major effect on adult, winter rearing and summer rearing juveniles, and smolt lifestages. Bond (2008) documented a large survival advantage for estuarine reared steelhead compared to riverine reared steelhead and that estuary reared juveniles are greater contributors to the subsequent spawning populations. Smolts depend on a functional estuary to complete the physiological process of transition from freshwater to sea water. The tidally influenced reaches of San Francisco Bay tributaries are highly altered and lack historic complexity (Goals Project 1999). Tidal reaches of Pinole, San Pablo, Wildcat, Codornices, San Leandro, and San Lorenzo creeks have been channelized, remain highly urbanized (NMFS 2009, 2010, 2011, 2013a, 2013b, 2013c), and typically lack estuarine complexity beneficial to juveniles and smolts. Threats contributing to this condition include channel modification, residential and commercial development, and roads and railroads.

Velocity Refuge: Floodplain Connectivity

This condition was rated Poor for adult and winter rearing juvenile lifestages. Due to the highly urbanized conditions found in the lower reaches of these watersheds (NMFS 2009, 2010, 2011, 2013a, 2013b, 2013c), engineered channel modifications and floodplain disconnection is prevalent throughout these streams. Threats contributing to this condition include residential and commercial development, channel modification, roads, and water diversion and impoundments.

Hydrology: Redd Scour

---

[1] Combined Conifer Forest, Hardwood Forest, and Hardwood Woodland cover by area ranges between 0- and 23-percent (NMFS 2009, 2010, 2011, 2013a, 2013b, 2013c).

[2] Miles of roads per square mile of riparian buffer (buffer is 100 meters on either side of the stream centerline) ranges between 4.4 and 8.8 (NMFS 2009, 2010, 2011, 2013a, 2013b, 2013c).

This condition was rated as Fair for the egg lifestage. Gravel scouring events have the potential to destroy or degrade spawning and rearing habitat. However, it is not known if adverse scouring events are a significant cause of egg mortality throughout the lower stretches of the creeks assessed, especially those downstream of reservoirs that capture upper watershed flows. For example, *O. mykiss* spawning downstream of Chabot Dam are not usually subjected to flashy storm water runoff events due to flow regulation by Chabot Dam (Mulchaey 2011). Threats contributing to this condition include channel modification, residential and commercial development, and roads and railroads.

Hydrology: Baseflow & Passage Flows

This condition was rated as Fair for adult, summer rearing juvenile, and smolt lifestages. Flow alteration associated with groundwater wells, reservoir discharges and altered hydrology within urbanized watershed areas impairs instream hydrology; limiting the maintenance of instream habitat and substrate, and potentially resulting in flows and temperatures insufficient to support steelhead. Current reservoir operations within San Pablo, Wildcat, San Leandro, and San Lorenzo creeks may impair stream flow; altering discharge timing and volumes. These hydrograph alterations likely affect adult passage by muting attractant flows and curtailing passage opportunities at some partial, but significant, migratory barriers, and reducing the quality and quantity of juvenile rearing habitat. For example, flows supporting steelhead spawning downstream of Chabot Dam depend largely on the timing of flow releases from the dam and the timing and amount of rainfall (Leidy *et al.* 2005). In dry years and during summer, low flows likely limit steelhead survival and reproduction in the accessible reaches of the watershed downstream of Interstate 580. Threats contributing significantly to this condition are channel modification, severe weather patterns, and water diversions and impoundments.

Passage/Migration: Mouth or Confluence & Physical Barriers

This condition was rated as Poor for adults, winter rearing and summer rearing juveniles, and smolts. Significant complete and partial passage barriers exist on each of the streams assessed. In San Pablo, Wildcat, San Leandro, and San Lorenzo creeks, access to upper watershed reaches is precluded by reservoirs (Cleugh and Mcknight 2002; NMFS 2009, 2010, 2013b, 2013c, 2013d, 2013e, 2013f), and according to Spence *et al.* (2008) remaining accessible habitat downstream of reservoirs is typically poor. Additionally, within all streams considered here, including those without large reservoirs (e.g., Pinole and Codornices creeks), passage within accessible reaches is typically impaired by partial passage barriers (Cleugh and Mcknight 2002; NMFS 2009, 2010, 2011, 2013a, 2013b, 2013c). These barriers impede or preclude access to important upper watershed spawning and rearing habitat, and according to Spence *et al.* (2008), are a factor contributing to the likely lack of viability of populations in the stratum. The threats contributing

significantly to this condition include residential and commercial development, channel modification, roads, and water diversion and impoundments.

Habitat Complexity: Percent Primary Pools & Pool/Riffle/Flatwater Ratios

This condition was rated as Poor for adults, and winter rearing and summer rearing juveniles. Instream habitat features and channel complexity necessary to support all lifestages are typically impaired. As indicated by the poor pool frequency and pool/riffle ratios, the highly modified channel conditions in these watersheds constrain habitat complexity necessary for the support of steelhead. Threats contributing to this condition include residential and commercial development, channel modification, roads, and water diversion and impoundments.

Habitat Complexity: Large Wood & Shelter

This condition was rated as Poor for adult, winter rearing and summer rearing juveniles, and smolt lifestages. The highly modified channel conditions in these watersheds constrain habitat complexity, including large woody debris and other complex features necessary for the support of steelhead.

Two separate habitat assessments evaluated shelter complexity within Pinole Creek in 2009. Hagar Environmental Science (2009) found the lower stretch mapped (2.6 miles) to have a fair mean shelter complexity rating (mean shelter complexity of 54%) and Mulchaey (2009) found shelter complexity within the upper reach mapped (4.2 miles) to be good (mean shelter complexity of 80%). Primary shelter components include: root masses, undercut banks, boulders and terrestrial vegetation (Hagar 2009 and Mulchaey 2009). The amount of key wood pieces within the channel were not evaluated within either of the aforementioned reports; however based on the percent of habitats found to have large wood or rootwads as the primary shelter components, the habitat rates as Poor for large woody debris. Threats contributing to this condition include residential and commercial development, channel modification, roads, and water diversion and impoundments.

Sediment: Gravel Quality & Distribution of Spawning Gravels

This condition was rated as Poor for adults, eggs, and winter rearing and summer rearing juvenile lifestages. Sediment transport, and thereby instream substrate invertebrate food resources and spawning habitat, is affected by development and management of the streams in this stratum. Dams intercept nearly all of the sediment from the upper watersheds in the San Pablo, Wildcat, San Leandro, and San Lorenzo watersheds; reducing coarse sediments, and resulting in erosion, incision, and other changes to the streambed and banks. Urbanization and flood control projects in the lower watersheds of all six streams likely result in accumulation of fines that can also impair

substrate quality. Also, according to Pearce *et al.,* (2005), upstream sediment sources in Pinole Creek may also contribute to poor substrate conditions downstream. In Pinole, Hagar Environmental Science (2009) found spawning gravel embeddnedness to be less than 15% for most of the habitat surveyed and Mulchaey (2009) found the average embeddedness of spawning areas to be 28%. Sediment loading within the creek has reduced the amount of spawning areas available for steelhead but quality spawning habitat is still present within the creek (Mulchaey 2000). Threats contributing significantly to this condition include channel modification, residential and commercial development, roads and railroads, and water diversions and impoundments.

Viability: Density, Abundance & Spatial Structure

In Pinole, San Pablo, San Leandro, San Lorenzo, Wildcat, and Codornices creeks, as in watersheds elsewhere in the Interior San Francisco Bay Stratum, steelhead are present in low numbers. Available information (Leidy *et al.* 2005; Spence *et al.* 2008, 2012) indicates that the current distribution and abundance of steelhead in these watersheds is much reduced from historic conditions. Additionally, it is unlikely these populations are viable or, in their current impaired condition, contribute to the support of the stratum; specifically per Spence *et al.*:

> The presence of dams that block access to substantial amounts of historical habitat (particularly in the east and southeast portions of San Francisco Bay), coupled with ancillary data, suggest that it is highly unlikely that the Interior San Francisco Bay (stratum) has any viable populations, or that redundancy criteria would be met (2008, p. xiv).

Threats contributing significantly to this condition include water diversions and impoundments, and disease, predation and competition.

Water Quality: Temperature

This condition was rated as Fair for its effect on summer rearing juveniles. In the lower reaches of these watersheds, temperatures are more likely to be sub optimal, particularly for summer rearing lifestages. As noted above for Hydrology: Impaired Water Flow, impaired flows limit steelhead survival and reproduction in the accessible reaches of the watershed. In Pinole, summer water temperatures have not been found to be a limiting factor for any steelhead lifestage. Summer temperatures average between 14°C and 17°C and temperatures vary rarely exceed 20°C (Mulchaey 2009). Threats contributing significantly to this condition include channel modification, residential and commercial development, roads and railroads, and water diversions and impoundments.

Water Quality: Turbidity or Toxicity

This condition was rated as Fair for adults, summer rearing juveniles, winter rearing juveniles, and smolts. Likely due to the high density of urbanization within these watersheds, water quality within much of the accessible reaches is degraded and likely limiting for steelhead. The 2010[3] United States Environmental Protection Agency (EPA) water quality assessment status data for Pinole, San Pablo, Wildcat, Codornices, San Leandro, and San Lorenzo creeks, indicate that water quality in each of these six streams is impaired for one or more designated uses (EPA 2013a, 2013b, 2013c, 2013d, 2013e, 2013f). According to EPA (2013a, 2013b, 2013c, 2013d, 2013e, 2013f) causes of impairment include water temperature, trash, and diazinon, and probable sources contributing to these impairments include channelization, habitat modification, illegal dumping, loss of riparian habitat, and urban stormwater runoff. Septic systems are also believed to be degrading water quality. Within the Pinole Creek watershed, the Pavon Creeks have been identified as a significant source of the sediment load (Pearce *et al.,* 2005). Threats contributing to this condition include residential and commercial development and roads and railroads.

Threats

The following discussion focuses on those threats that rate High (See Interior San Francisco Bay Rapid Assessment Threats Results). Recovery strategies will focus on ameliorating primary threats; however, some strategies may address other threat categories when the strategy is essential to recovery efforts.

Channel Modification

This threat was rated as High. Engineered stream flood control channels occur in accessible reaches of these watersheds, and are most prevalent within the lower, more heavily urbanized sections. Engineered channels typically lack habitat features found within natural stream channels, and often impede upstream steelhead migration by creating either physical or hydraulic barriers. Channel modification within these streams, combined with other channel and landscape altering practices, has destroyed estuarine habitat, disconnected streams from their floodplains, and constrained natural fluvial and geomorphic processes necessary to create and maintain habitats that support viable steelhead populations.

Disease, Predation and Competition

This threat rated as Medium or Low for most conditions, but High for passage/migration and for reduced abundance. NMFS considered the potential effects of non-native piciviorous fish,

[3] 2010 is the most recent year for which U.S. EPA water quality assessment status reports are available for any of these streams.

particularly in the estuarine reaches, and invasive plants such as *Arundo donax* or Himalayan blackberry, and their impact on riparian structure and function.

Fire, Fuel Management and Fire Suppression

There is a risk of catastrophic fire in a number of these watersheds and this threat was rated a Medium threat. Upper portions of several watersheds are managed by organizations such as East Bay Regional Park District, East Bay Municipal Utility District, reducing risk of fire and ensuring a rapid response in the event of a fire.

Recreational Areas and Activities

This threat was rated as Medium overall. Some recreational equestrian uses occur in the upper portions of several watersheds and likely contribute turbidity and nutrients to the stream. There is a high level of public use in a number of areas below dams where the public has access to the creek channel which may negatively impact spawning habitat. This threat is not known to be a significant contributor to any of the conditions within this watershed.

Residential and Commercial Development

Significant high density development is primarily located in the currently accessible reaches of these watersheds, and this treat was rated as High. All streams considered here have over 28% of the watershed in urban development (NMFS 2009, 2010, 2011, 2013a, 2013b, 2013c). However, passage impediments largely restrict steelhead distribution to urbanized reaches[4], exacerbating the effects of urban development on these populations. Development has generally constrained floodplains and reduced riparian cover, and bank stabilization and flood-control measures have resulted in channelization of stream courses. Major modifications to the historic hydrology and channel forms including increases in impervious surfaces and urban runoff have occurred in these reaches. Homeless encampments are also having a deleterious effect on these watersheds. Trash, pollutants, and impacts such as loss of riparian vegetation, bank erosion and direct take of steelhead have been observed. Unique among the streams assessed here is Pinole Creek which, although it is characterized by typical habitat impairments, is the only watershed considered here that maintains a relatively limited urban footprint and retains accessible reaches within relatively open space (NMFS 2011). Future development within riparian and near stream areas is expected

[4] Considering available information (NMFS 2009, 2010, 2011, 2013a, 2013b, 2013c), of the six streams considered here, only Pinole Creek retains relatively accessible habitat upstream of urbanized reaches. As for all other streams, distribution is either limited to entirely urbanized reaches (e.g., Codornices Creek), or habitat upstream of urbanized reaches and downstream of complete passage barriers (i.e., downstream of reservoirs) is of limited length (e.g., San Pablo, Wildcat, San Leandro, and San Lorenzo creeks).

to be limited; however, the existing urban footprint is unlikely to diminish, and within undeveloped reaches, such as in Pinole Creek, future development may be a threat expected to exacerbate existing limiting conditions.

Roads and Railroads

Road density in these watersheds overall is relatively low; however, road density within the riparian area is typically high[5], indicating the likelihood for roadways to impair stream, riparian, and floodplain habitats. Additionally, for all but Pinole Creek, which retains relatively accessible upper watershed habitat unencumbered by urban development, steelhead distribution within these streams is typically limited to highly urbanized reaches (NMFS 2009, 2010, 2011, 2013a, 2013b, 2013c) where roadway effects are most prevalent. Additionally, roadways outside of the urbanized reaches may also contribute to poor instream and floodplain conditions. For example, according to Pearce *et. al.,* (2005), within Pinole Creek, although roads are relatively well maintained and not considered a significant source of sediment, roadside ditches and culverts do contribute to streambed incision. With few road decommissioning projects, this threat is likely to continue in the future.

Severe Weather Patterns

This threat was rated as a Fair to Good threat. Drought could seriously degrade water flow and temperatures available to steelhead in the lower reaches. Extreme flood events could result in major input of sediment from upslope locations. Additionally, with global climate change expected to result in increased frequency of severe storms (Aumann, Ruzmaikin and Teixeira 2008) and increase flooding in the San Francisco Bay area (Knowles 2009, 2010; Cloern, Knowles, Brown, Cayan, Dettinger, *et al.* 2011), there is the potential that existing stormwater conveyance infrastructure will be inadequate to convey storm flows. Implications are that future flood events will affect streams in the San Francisco Bay area, affecting infrastructure, human health and safety, and environmental resources (including steelhead habitat).

Water Diversion and Impoundments

This threat was rated as High overall. Complex systems of dams, pipelines, canals, diversions, and associated infrastructure are used to capture and transfer water throughout the region. These water allocation systems have altered natural stream flows throughout much of the stratum, and impair downstream flows. For example, in the San Leandro Creek watershed, flows released downstream of Chabot Dam are consistently low, and are not synchronized to promote steelhead

[5] Miles of roads per square mile of riparian buffer (buffer is 100 meters on either side of the stream centerline) ranges between 4.4 and 8.8 (NMFS 2009, 2010, 2011, 2013a, 2013b, 2013c).

life history (Mulchaey 2011), resulting in reduced flow, reduced duration of flow, and poor water quality conditions particularly in summer and during dry years.

Limiting Conditions, Lifestages, and Habitats

Threat and condition analysis suggests that extensive watershed development for urban, suburban, and commercial land uses are likely limiting factors affecting steelhead abundance within Pinole, San Pablo, Wildcat, Codornices, San Leandro, and San Lorenzo creeks. Passage to upper watershed spawning and rearing reaches is blocked by reservoirs, and numerous partial and complete passage barriers exist within reaches downstream of reservoirs. Additionally, a complex system of water storage and conveyance operations significantly alters stream flows within accessible reaches. Combined, the effects of development (e.g., urban, suburban, and associated infrastructure) and water allocation facilities and operations, impair stream functions and habitat, and limit all lifestages of steelhead within the six streams assessed. Restoration actions should target these issues within high potential stream reaches, should restore passage within reaches downstream of reservoirs, and should consider passage above reservoirs in order to provide access to important upper watershed reaches.

Data on the current size and spatial distribution of the Pinole Creek steelhead population are limited. Few adult steelhead have been observed within the watershed during the past several decades but focused surveys for adult steelhead have not been conducted. *O. mykiss* are regularly sampled in the upper portion of Pinole Creek; however, it is unclear to what extent these fish contribute to the anadromous population. The culvert passage barrier under Highway I-80 has critically limited the range of flow conditions where anadromy can occur, effectively restricting steelhead from much of the higher quality habitat upstream.

General Recovery Strategy

Passage Downstream of Reservoirs

Barriers to passage downstream of reservoirs should be systematically remediated. Priorities should focus on those that occur low in the system.

Reservoir Reoperation to Benefit all Lifestages of Steelhead

Large reservoirs within these creeks should be operated in such a manner as to benefit all lifestages of steelhead (i.e., migration, spawning, egg incubation, and juvenile rearing). Release flows are often conducted to manage water supply but these flows are not synchronized to promote steelhead life history. Considerations should include, but not be limited to, water temperature, flow velocity, ramping rates (as necessary to prevent scour of eggs, or displacement

or stranding of juveniles), sediment transport, channel maintenance, instream habitat, adult and smolt migratory cues, and reflecting a natural, unimpaired hydrograph.

Passage at Reservoirs

Dams on lakes and reservoirs within San Pablo, Wildcat, San Leandro, and San Lorenzo creeks[6] act as complete passage barriers that block access to significant portions of habitat in the upper watershed reaches (NMFS 2013d, 2013e, 2013f). These upper watershed reaches were historically important for the support of steelhead populations in these watersheds, and the habitat and function of these above reservoir reaches cannot be effectively replaced through enhancement of downstream reaches. Thus, to address the effects of upstream passage blockage at reservoirs, studies to evaluate the potential biological benefits and technical feasibility of steelhead passage programs should be performed at the reservoirs in this stratum, and if deemed technically feasible and biologically beneficial, passage programs to restore anadromy to the upper watersheds should be implemented.

Increase Habitat Complexity

Habitat complexity should be improved throughout the impaired reaches in each of these watersheds. All structures should be designed to function within an established range of flows to optimize habitat conditions for all steelhead lifestages.

Side Channel and Floodplain Reconnection

Where not limited by existing development, efforts should be made to reconnect floodplain habitat and increase channel complexity by reconnecting side channel habitat with the active stream channel. When possible, existing development should be retrofitted to restore access to floodplain and flood bench habitat, and to allow for natural channel functions.

Increase Estuary Habitat

Efforts to increase estuarine habitat should be maintained, where present, and should be expanded and implemented where needed elsewhere throughout the stratum. Projects should include efforts to improve tidal and subtidal habitat complexity, and should consider the needs of rearing and emigrating salmonids.

Improve Riparian Composition

---

[6] San Pablo Reservoir on San Pablo Creek; Jewel Lake and Lake Anza on Wildcat Creek; Chabot and Upper San Leandro reservoirs on San Leandro Creek; and Don Castro and Cull reservoirs on San Lorenzo Creek act as complete barriers to passage (NMFS 2013d, 2013e, 2013f)

Many of the reaches downstream of reservoirs or within the urbanized areas would benefit from improved riparian composition and structure, which would improve LWD recruitment, and increase instream shelter for juvenile fish. General practices to improve riparian condition include exotic vegetation removal, riparian planting and maintenance, and implementing channel maintenance flows necessary to support a riparian corridor that is diverse in species and age structure.

Improve Sediment Transport and Address Upslope and Instream Sources of Excess Sediment
Restoration efforts in all six streams should consider improving substrate conditions throughout channelized reaches. On streams with large reservoirs (e.g., San Pablo, Wildcat, San Leandro, and San Lorenzo), restoration efforts should focus on providing channel maintenance/forming flows downstream of reservoirs as necessary to mobilize bedload material, and provide suitable gravel material from upstream sources.

Active landslides, gullies, problem roads and bed incision should be prioritized and addressed as part of a comprehensive sediment reduction plan for the entire Pinole basin.

Improve Water Quantity and Quality
Many of these watersheds experience low summer flow; however, appreciable reductions in water quantity has resulted from diversions and likely groundwater pumping. The extent and nature of ground water pumping should be investigated. If pumping is adversely affecting aquatic habitat, Federal, state and local government representatives should work with landowners to implement creative solutions that minimize these effects. Establishing a permanent streamflow gauge for those without a gauge will aid in the assessment of flow conditions.

Efforts should be made to improve water quality throughout the urbanized reaches in all six streams. In particular, efforts should focus on limiting or treating urban runoff to decrease turbidity, address pH fluctuations, limit toxicity concerns, and reduce concentrations of pathogens, pesticides, and metals.

Literature Cited

Aumann, H. H., Ruzmaikin, A., and Teixeira, J. (2008). Frequency of severe storms and global warming. *Geophysical Research Letters*, 35, L19805, doi:10.1029/2008GL034562. Retrieved February 15, 2013 from the Wiley Online Library Web site: http://onlinelibrary.wiley.com/doi/10.1029/2008GL034562/full

Bond, M., S. Hayes, C. Hanson, and B. MacFarlane. 2008. Marine Survival of steelhead (*Oncorhynchus mykiss*) enhanced by a seasonally closed estuary. Can. J. Aquat. Sci. 65: 2242-2252.

Cleugh, E., & Mcknight, C. (2002). Steelhead migration barrier survey of San Francisco Bay Area Creeks (Contra Costa, Alameda, Santa Clara, and San Mateo Counties): California Department of Fish and Game.

Cloern, J. E., Knowles, N., Brown, L. R., Cayan, D., Dettinger, M. D., Morgan, T. L., et al. (2011). Projected evolution of California's San Francisco Bay-delta-river system in a century of climate change. *PLoS ONE, 2011*(E24465).

Goals Project. (1999). Baylands Ecosystem Habitat Goals. A report of habitat recommendations prepared by the San Francisco Bay Area Wetlands Ecosystem Goals Project. U.S. Environmental Protection Agency, San Francisco, Calif./S.F. Bay Regional Water Quality Control Board, Oakland, CA. (pp. 320).

Knowles, N. (2009). Potential inundation due to rising sea levels in the San Francisco Bay Region. California Climate Change Center. Sacramento, California.

Knowles, N. (2010). Potential Inundation Due to Rising Sea Levels in the San Francisco Bay Region. *San Francisco Estuary and Watershed Science*, 8:1. Available at http://escholarship.org/uc/search?entity=jmie_sfews;volume=8;issue=1. Data from website: http://cascade.wr.usgs.gov.

Leidy, R. A., G. S. Becker, B.N. Harvey. (2005). Historical distribution and current status of steelhead/rainbow trout (*Onchorynchus mykiss*) in streams of the San Francisco Estuary, California. Center for Ecosystem Management and Restoration, Oakland, CA. 275 pgs.

Mulchaey, B.W. 2011. Personal Communication with Bert Mulchaey, Fisheries and Wildlife Biologist II, East Bay Municipal Utility District. December 9, 2011

National Marine Fisheries Service (NMFS). (2009). Watershed characterization, San Lorenzo Creek watershed. NMFS Southwest Region, Habitat Conservation Division. October 2009.

National Marine Fisheries Service (NMFS). (2010). Watershed characterization, San Leandro Creek watershed. NMFS Southwest Region, Habitat Conservation Division. January 2010.

National Marine Fisheries Service (NMFS). (2011). Watershed characterization, Pinole Creek watershed. NMFS Southwest Region, Habitat Conservation Division. January 2011.

National Marine Fisheries Service (NMFS). (2013a). Watershed characterization, Codornices Creek watershed. NMFS Southwest Region, Habitat conservation Division. May 2013.

National Marine Fisheries Service (NMFS). (2013b). Watershed characterization, San Pablo Creek watershed. NMFS Southwest Region, Habitat Conservation Division. May 2013.

National Marine Fisheries Service (NMFS). (2013c). Watershed characterization, Wildcat Creek watershed. NMFS Southwest Region, Habitat Conservation Division. May 2013.

National Marine Fisheries Service (NMFS). (2013d). Pinole, San Pablo, Wildcat and Codornices creeks steelhead populations (map). NMFS Southwest Region, Habitat Conservation Division. 2013.

National Marine Fisheries Service (NMFS). (2013e). San Leandro Creek steelhead population (map). NMFS Southwest Region, Habitat Conservation Division. May 2013.

National Marine Fisheries Service (NMFS). (2013f). San Lorenzo Creek steelhead population (map). NMFS Southwest Region, Habitat Conservation Division. May 2013.

Pearce, S., McKee, L., and Shonkoff, S. (2005). Pinole Creek Watershed Sediment Source Assessment. A technical report of the Regional Watershed Program, San Francisco Estuary Institute (SFEI), Oakland, California. SFEI Contribution no. 316, 102 pp.

Spence, B.C., Bjorkstedt, E.P., Garza, J.C., Smith, J.J., Hankin, D.G., Fuller, D., Jones, W.E., Macedo, R., Williams, T.H., and Mora, E. (2008). A framework for assessing the viability of threatened and endangered salmon and steelhead in the north-central California coast recovery domain. U.S. Department of Commerce, National Oceanic and Atmospheric

Administration (NOAA), National Marine Fisheries Service, Southwest Fisheries Science Center. NOAA-TM-NMFS-SWFSC-423. April 2008.

Spence, B.C., Bjorkstedt, E.P., Paddock, S., and Nanus, L. (2012). Updates to biological viability criteria for threatened steelhead populations in the north-central California coast recovery domain. National Marine Fisheries Service, Southwest Fisheries Science Center, Fisheries Ecology Division. March 23, 2012.

United States Environmental Protection Agency (EPA). (2013a). 2010 Waterbody Report for Codornices Creek. Accessed on August 9, 2013, from: http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_au_id=CAR20330011 20080624162950&p_cycle=2010&p_state=CA&p_report_type=

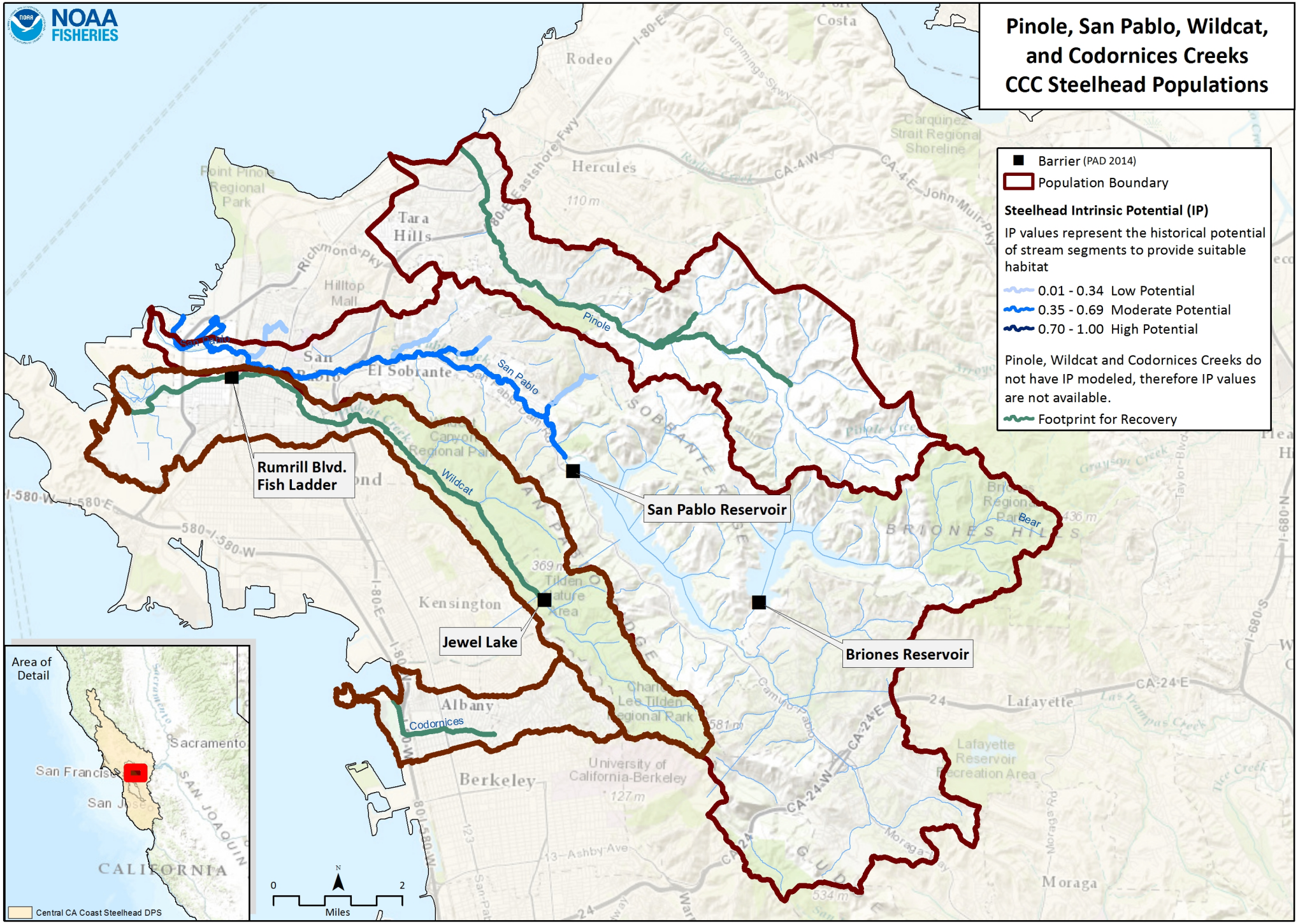
United States Environmental Protection Agency (EPA). (2013b). 2010 Waterbody Report for Pinole Creek. Accessed on August 9, 2013, from: http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_au_id=CAR20660020 19990218104959&p_cycle=2010&p_state=CA&p_report_type=

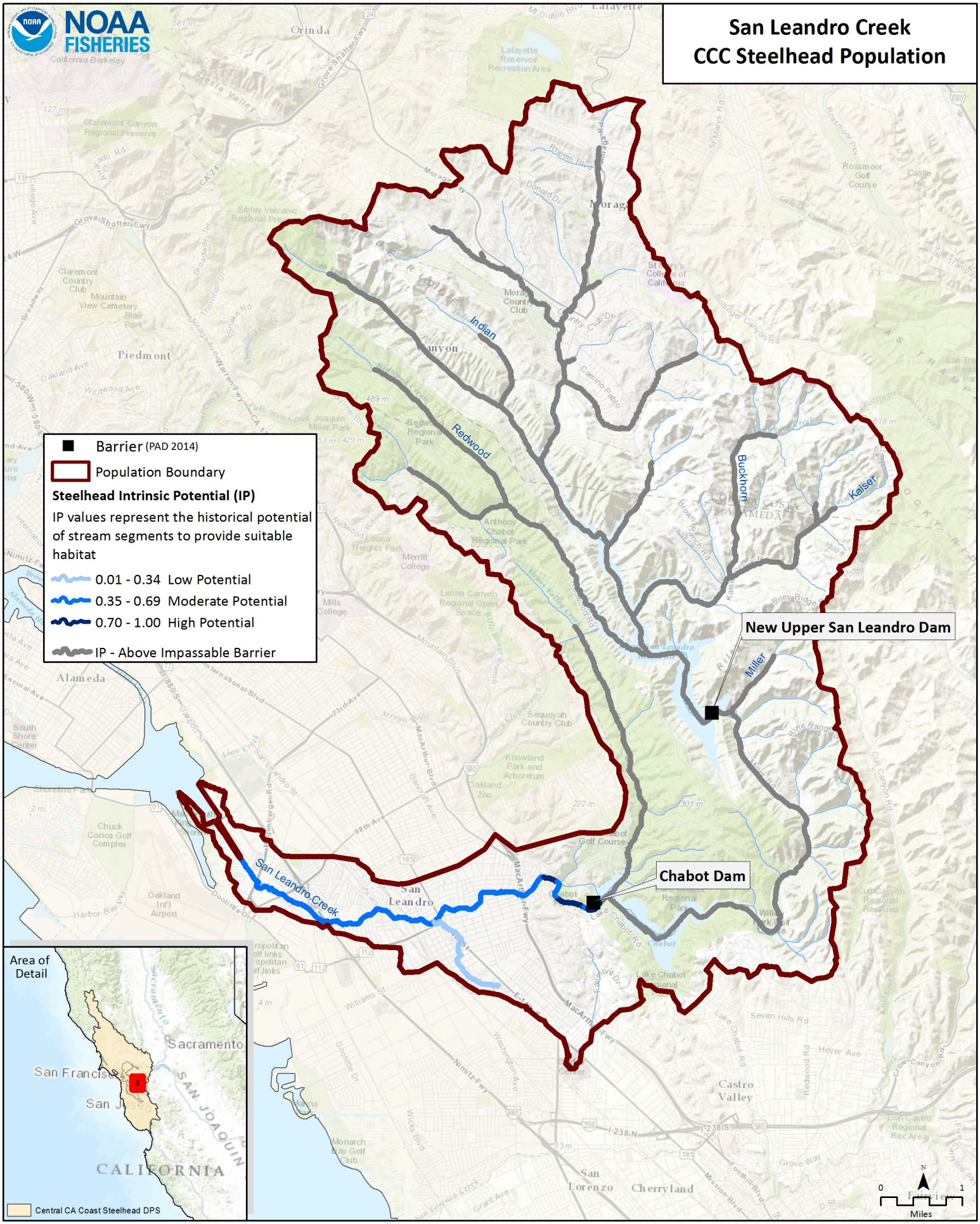
United States Environmental Protection Agency (EPA). (2013c). 2010 Waterbody Report for San Leandro Creek, Lower. Accessed on August 9, 2013, from: http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_au_id=CAR20420012 19990218140451&p_cycle=2010&p_state=CA&p_report_type=

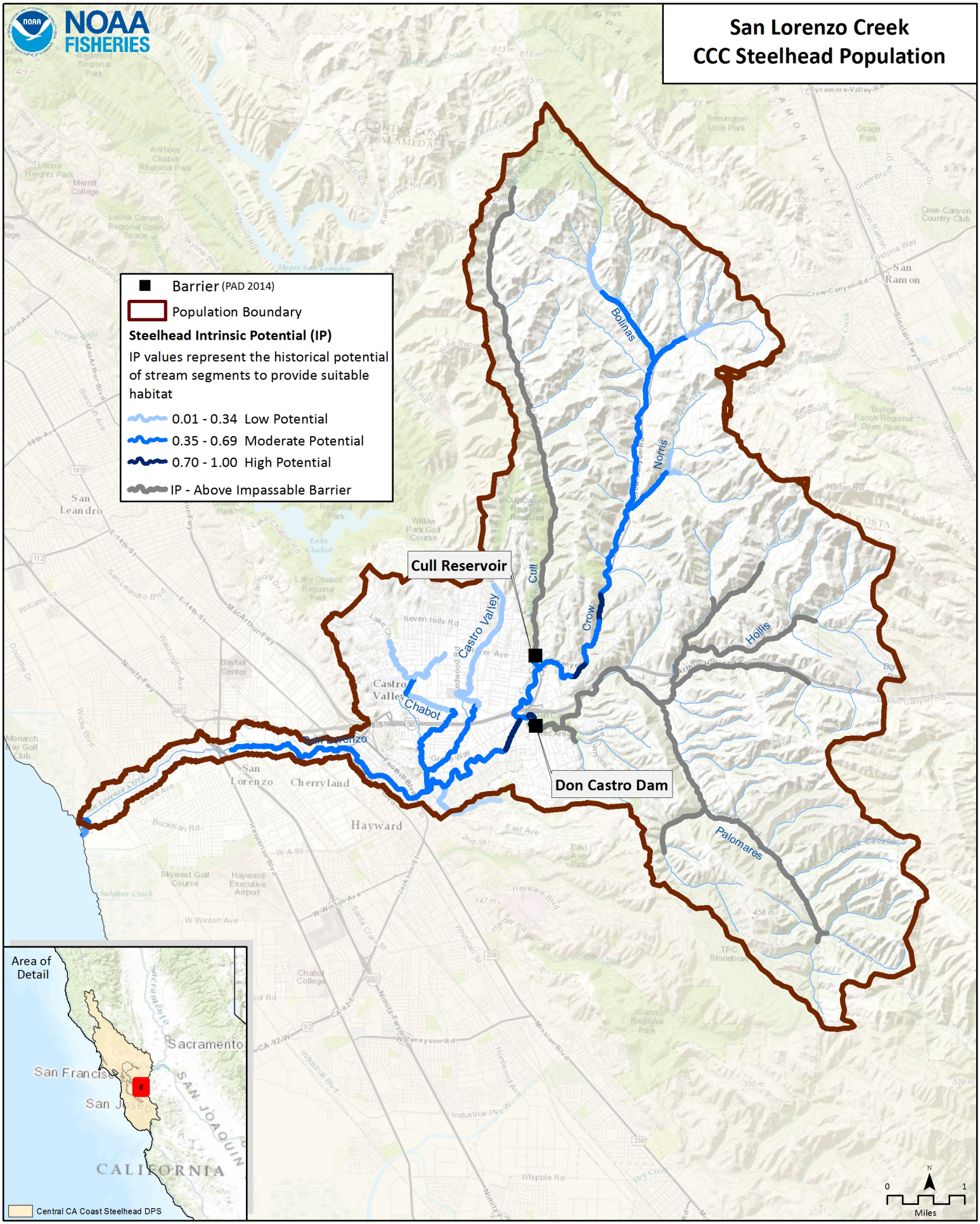
United States Environmental Protection Agency (EPA). (2013d). 2010 Waterbody Report for San Lorenzo Creek. Accessed on August 9, 2013, from: http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_au_id=CAR20420023 19990218140753&p_cycle=2010&p_state=CA&p_report_type=

United States Environmental Protection Agency (EPA). (2013e). 2010 Waterbody Report for San Pablo Creek. Accessed on August 9, 2013, from: http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_au_id=CAR20660014 19990219094913&p_cycle=2010&p_state=CA&p_report_type=

United States Environmental Protection Agency (EPA). (2013f). 2010 Waterbody Report for Wildcat Creek. Accessed on August 9, 2013, from: http://iaspub.epa.gov/tmdl_waters10/attains_waterbody.control?p_au_id=CAR20660013 19990218111129&p_cycle=2010&p_state=CA&p_report_type=


NOAA FISHERIES
Pinole, San Pablo, Wildcat, and Codornices Creeks CCC Steelhead Populations
Barrier (PAD 2014)
Population Boundary
Steelhead Intrinsic Potential (IP)
IP values represent the historical potential of stream segments to provide suitable habitat
0.01 - 0.34 Low Potential
0.35 - 0.69 Moderate Potential
0.70 - 1.00 High Potential
Pinole, Wildcat and Codornices Creeks do not have IP modeled, therefore IP values are not available.
Footprint for Recovery
Rumrill Blvd. Fish Ladder
San Pablo Reservoir
Jewel Lake
Briones Reservoir
Pinole
San Pablo
Wildcat
Codornices
Bear
Area of Detail
Sacramento
San Francisco
San Jose
CALIFORNIA
Central CA Coast Steelhead DPS
0
2
Miles
N


San Leandro Creek
CCC Steelhead Population
Barrier (PAD 2014)
Population Boundary
Steelhead Intrinsic Potential (IP)
IP values represent the historical potential of stream segments to provide suitable habitat
0.01 - 0.34 Low Potential
0.35 - 0.69 Moderate Potential
0.70 - 1.00 High Potential
IP - Above Impassable Barrier
New Upper San Leandro Dam
Chabot Dam
San Leandro Creek
Indian
Redwood
Buckhorn
Kaiser
Miller
Area of Detail
Sacramento
San Francisco
San Jose
CALIFORNIA
Central CA Coast Steelhead DPS
Miles


NOAA FISHERIES
San Lorenzo Creek
CCC Steelhead Population
Barrier (PAD 2014)
Population Boundary
Steelhead Intrinsic Potential (IP)
IP values represent the historical potential of stream segments to provide suitable habitat
0.01 - 0.34 Low Potential
0.35 - 0.69 Moderate Potential
0.70 - 1.00 High Potential
IP - Above Impassable Barrier
Cull Reservoir
Don Castro Dam
Bolinas
Norris
Cull
Crow
Hollis
Palomares
Castro Valley
Chabot
San Lorenzo
Hayward
Cherryland
San Leandro
San Ramon
Area of Detail
Sacramento
San Francisco
San Jose
CALIFORNIA
SAN JOAQUIN
Central CA Coast Steelhead DPS
0
1
Miles

CCC Steelhead DPS: Interior San Francisco Bay (Pinole/San Leandro/San Lorenzo/San Pablo/Wildcat/Codornices)						
Habitat & Population Condition Scores By Life Stage: VG = Very Good G = Good F = Fair P = Poor		Steelhead Life History Stages				
		Adults	Eggs	Summer-Rearing Juveniles	Winter-Rearing Juveniles	Smolts
Stresses: Key Attribute: Indicators	Riparian Vegetation: Composition, Cover & Tree Diameter			P		
	Estuary: Quality & Extent	P		P	P	P
	Velocity Refuge: Floodplain Connectivity	P			P	
	Hydrology: Redd Scour		F			
	Hydrology: Baseflow & Passage Flows	F	G	F		F
	Passage/Migration: Mouth or Confluence & Physical Barriers	P		P	P	P
	Habitat Complexity: Percent Primary Pools & Pool/Riffle/Flatwater Ratios	P		P	P	
	Habitat Complexity: Large Wood & Shelter	P		P	P	P
	Sediment: Gravel Quality & Distribution of Spawning Gravels	P	P	P	P	
	Viability: Density, Abundance & Spatial Structure	P		P		P
	Water Quality: Temperature			F		G
	Water Quality: Turbidity & Toxicity	F		F	F	F

CCC Steelhead DPS: Interior San Francisco Bay (Pinole/San Leandro/San Lorenzo/San Pablo/Wildcat/Codornices)													
Threat Scores L: Low M: Medium H: High		Stresses											
		Altered Riparian Species: Composition & Structure	Estuary: Impaired Quality & Extent	Floodplain Connectivity: Impaired Quality & Extent	Hydrology: Gravel Scouring Events	Hydrology: Impaired Water Flow	Impaired Passage & Migration	Instream Habitat Complexity: Altered Pool Complexity and/or Pool/Riffle Ratio	Instream Habitat Complexity: Reduced Large Wood and/or Shelter	Instream Substrate/Food Productivity: Impaired Gravel Quality & Quantity	Reduced Density, Abundance & Diversity	Water Quality: Impaired Instream Temperatures	Water Quality: Increased Turbidity or Toxicity
Threats - Sources of Stress	Agriculture	M	L	M	L		L	M	M	M		L	L
	Channel Modification	H	H	H	H	H	H	H	H	H		H	M
	Disease, Predation, and Competition	M	M	L			H	M	M		H	L	L
	Fire, Fuel Management, and Fire Suppression	H	L	H	L		L	L	L	H		M	M
	Livestock Farming and Ranching	M	L	M	L		L	M	M	M		L	L
	Logging and Wood Harvesting	L	L	L	L		L	L	L	L		L	L
	Mining	L	L	L	L		L	L	L	L		L	L
	Recreational Areas and Activities	H	H	H	L		L	L	L	L		L	L
	Residential and Commercial Development	H	H	H	H		H	H	H	H		H	H
	Roads and Railroads	H	H	L	H		H	H	H	H		H	H
	Severe Weather Patterns	M	H	M	M	M	M	M	M	M		M	L
	Water Diversions and Impoundments	H	H	H	M	H	H	H	H	H	H	H	L
	Fishing and Collecting										M		
	Hatcheries and Aquaculture										L	L	L

Pinole Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
PinC-CCCS-1.1	Objective	Estuary	Address the present or threatened destruction, modification, or curtailment of the species habitat or range										
PinC-CCCS-1.1.1	Recovery Action	Estuary	Rehabilitate inner estuarine hydrodynamics										
PinC-CCCS-1.1.1.1	Action Step	Estuary	Develop an estuary rehabilitation and enhancement plan in efforts to reclaim historically tidal influenced areas.	2	10	City of Pinole, Contra Costa County	169.50	169.50				339	Cost based on estuary use/residence time monitoring at a rate of $338,679/project.
PinC-CCCS-1.1.1.2	Action Step	Estuary	Restore connection between Chelsea wetlands and Pinole Creek (Phase 2 of Pinole Demonstration Project).	2	50	City of Pinole, Contra Coasta RCD, Contra Costa County, East Bay Municipal Utilities District (EBMUD), Friends of Pinole Creek						5,000	
PinC-CCCS-2.1	Objective	Floodplain Connectivity	Address the present or threatened destruction, modification, or curtailment of the species habitat or range										
PinC-CCCS-2.1.1	Recovery Action	Floodplain Connectivity	Rehabilitate and enhance floodplain connectivity										
PinC-CCCS-2.1.1.1	Action Step	Floodplain Connectivity	Design and implement floodplain rehabilitation projects that target velocity refuge for migrating salmonids.	2	10	City of Pinole, Contra Costa County	1,786	1,786				3,572	Cost based on treating 1 mile (assume 80 acres/mile) at a rate of $44,640/acre.
PinC-CCCS-3.1	Objective	Hydrology	Address the present or threatened destruction, modification, or curtailment of the species habitat or range										
PinC-CCCS-3.1.1	Recovery Action	Hydrology	Improve flow conditions (baseflow conditions)										
PinC-CCCS-3.1.1.1	Action Step	Hydrology	Assess flow conditions to determine if water use is negatively impacting flows necessary to support summer rearing steelhead.	2	10	City of Pinole, Contra Costa County, East Bay Municipal Utilities District (EBMUD)	39.50	39.50				79	Cost based on hydrologic model at a rate of 78,100/project.
PinC-CCCS-5.1	Objective	Passage	Address the present or threatened destruction, modification, or curtailment of the species habitat or range										
PinC-CCCS-5.1.1	Recovery Action	Passage	Modify or remove physical passage barriers										
PinC-CCCS-5.1.1.1	Action Step	Passage	Utilize vegetation methods and bio-techniques to establish a low flow channel throughout the flood control channel. Incorporate features that create velocity refuge during high flow events for immigrating adults.	2	5	City of Pinole, Contra Costa County, East Bay Municipal Utilities District (EBMUD)						0	Cost accounted for in CHANNEL MODIFICATION.
PinC-CCCS-5.1.1.2	Action Step	Passage	Modifications of large woody debris structures for passage should consider wood retention for restoration work in other locations along Pinole Creek.	2	5	City of Pinole, Contra Costa County, East Bay Municipal Utilities District (EBMUD)						0	Action is considered In-Kind

Pinole Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
PinC-CCCS-5.1.1.3	Action Step	Passage	Modify or remove passage impediments. Address barriers identified in the Upper Pinole Creek Salmonid Migration Barrier Assessment (EBMUD 2010).	1	5	City of Pinole, Contra Costa County, East Bay Municipal Utilities District (EBMUD)	448.00					448	Cost based on treating 1 partial barrier at a rate of $447,473/project.
PinC-CCCS-6.1	Objective	Habitat Complexity	Address the present or threatened destruction, modification, or curtailment of the species habitat or range										
PinC-CCCS-6.1.1	Recovery Action	Habitat Complexity	Increase large wood frequency										
PinC-CCCS-6.1.1.1	Action Step	Habitat Complexity	Evaluate and prescribe an appropriate number of key LWD pieces to enhance summer rearing conditions in potential steelhead spawning and rearing areas throughout the watershed.	2	10	City of Pinole, Contra Costa County	69.00	69.00				138	Cost based on fish/habitat restoration monitoring at a rate of $137,833/project.
PinC-CCCS-6.1.2	Recovery Action	Habitat Complexity	Increase frequency of primary pools										
PinC-CCCS-6.1.2.1	Action Step	Habitat Complexity	Evaluate and prescribe habitat features that will increase primary pool depth and frequency for winter and summer rearing juveniles, and quality staging pools for migrating/staging adults.	2	10	City of Pinole, Contra Costa County						0	Cost accounted for in above action step.
PinC-CCCS-6.1.3	Recovery Action	Habitat Complexity	Improve shelter										
PinC-CCCS-6.1.3.1	Action Step	Habitat Complexity	Increase shelter and habitat complexity features that improve survival of emigrating juvenile and adult steelhead; include efforts in areas such as flood control channels that lack habitat complexity.	2	10	City of Pinole, Contra Costa County	16.00	16.00				32	Cost based on treating 1 mile (assume 1 project/mile) at a rate of $31,200/mile.
PinC-CCCS-7.1	Objective	Riparian	Address the present or threatened destruction, modification, or curtailment of the species habitat or range										
PinC-CCCS-7.1.1	Recovery Action	Riparian	Improve canopy cover										
PinC-CCCS-7.1.1.1	Action Step	Riparian	Identify areas in the lower reaches (approximately downstream-most 1.5-2 miles of Pinole Creek) where canopy cover is not meeting the minimum canopy criteria, and prescribe and implement measures to improve riparian habitat.	2	10	City of Pinole, Contra Costa County, East Bay Municipal Utilities District (EBMUD)						0	Cost accounted for in CHANNEL MODIFICATION.
PinC-CCCS-7.1.1.2	Action Step	Riparian	Ensure that mature trees within the steam riparian corridor are not disturbed or lost due to land management activities (roads, cattle, flood control, etc.).	2	10	City of Pinole, Contra Costa County, East Bay Municipal Utilities District (EBMUD)						0	Action is considered In-Kind
PinC-CCCS-7.1.2	Recovery Action	Riparian	Improve riparian condition										
PinC-CCCS-7.1.2.1	Action Step	Riparian	Support additional phases of Pinole demonstration project.	2	50	City of Pinole, Contra Coasta RCD, Contra Costa County						0	Cost accounted for in ESTUARY actions.
PinC-CCCS-7.2	Objective	Riparian	Address disease and predation										
PinC-CCCS-7.2.1	Recovery Action	Riparian	Improve canopy cover										

Pinole Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
PinC-CCCS-7.2.1.1	Action Step	Riparian	Control invasive species (blackberry, ivy, etc.).	2	20	City of Pinole, Contra Coasta RCD, Contra Costa County, Friends of Pinole Creek						TBD	
PinC-CCCS-8.1	Objective	Sediment	Address the present or threatened destruction, modification, or curtailment of the species habitat or range										
PinC-CCCS-8.1.1	Recovery Action	Sediment	Improve instream gravel quality to reduce embeddedness										
PinC-CCCS-8.1.1.1	Action Step	Sediment	Evaluate, design, and implement gravel quality and quantity strategies to the extent that the maximum amount of spawning and incubation habitat is achieved.	2	10	City of Pinole, Contra Costa County, East Bay Municipal Utilities District (EBMUD)						TBD	
PinC-CCCS-8.1.1.2	Action Step	Sediment	Add channel roughness (logs, boulders) in strategic locations to encourage spawning tailout formations and gravel sorting.	2	10	City of Pinole, Contra Costa County, East Bay Municipal Utilities District (EBMUD)	16.00	16.00				32	Cost based on treating 1 mile (assume 1 project/mile) at a rate of $31,200/mile
PinC-CCCS-8.1.1.3	Action Step	Sediment	Identify and address upstream sources of fine sediment input. Assess the Pavon Creeks system for potential deleterious sediment sources.	2	10	City of Pinole, Contra Costa County, East Bay Municipal Utilities District (EBMUD)	8.00	8.00				16	Cost based on erosion assessment for 10% of total watershed acres at a rate of $$15.14/acre.
PinC-CCCS-10.1	Objective	Water Quality	Address the present or threatened destruction, modification, or curtailment of the species habitat or range										
PinC-CCCS-10.1.1	Recovery Action	Water Quality	Improve instream temperature conditions										
PinC-CCCS-10.1.1.1	Action Step	Water Quality	Identify if water temperatures are limiting steelhead viability in Pinole Creek, and if found to be limiting, develop and implement measures to reduce water temperatures where needed.	2	10	City of Pinole, Contra Costa County	0.75	0.75				2	Cost based on installing a minimum of 3 temperature gauges at a rate of $500/gauge.
PinC-CCCS-10.1.2	Recovery Action	Water Quality	Reduce toxicity and pollutants										
PinC-CCCS-10.1.2.1	Action Step	Water Quality	Identify nutrient loading sources causing poor water quality conditions for salmonids.	2	10	City of Pinole, Contra Costa County	7.50	7.50				15	Cost based on installing 3 continuous monitoring gauges at a rate of $5,000/gauge.
PinC-CCCS-10.1.2.2	Action Step	Water Quality	Identify and provide solutions for point and non-point sources contributing to poor water quality and pollution.	2	10	City of Pinole, Contra Costa County						0	Action is considered In-Kind
PinC-CCCS-10.1.2.3	Action Step	Water Quality	Develop and implement strategies reducing toxins in waterways of Pinole Creek.	1	10	City of Pinole, Contra Costa County						0	Action is considered In-Kind
PinC-CCCS-10.1.2.4	Action Step	Water Quality	Abate illegal trash dumping.	3	50	City of Pinole, Contra Coasta RCD, Contra Costa County, East Bay Municipal Utilities District (EBMUD), Friends of Pinole Creek						0	Action is considered In-Kind

Pinole Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
PinC-CCCS-11.1	Objective	Viability	Address the present or threatened destruction, modification, or curtailment of the species habitat or range										
PinC-CCCS-11.1.1	Recovery Action	Viability	Increase density, abundance, spatial structure and diversity										
PinC-CCCS-11.1.1.1	Action Step	Viability	Continue ongoing adult and juvenile sampling efforts in the watershed. Work from Coastal Monitoring Protocols to establish consistent reporting methods to ensure DPS-wide consistency.	2	50	City of Pinole, Contra Coasta RCD, Contra Costa County, East Bay Municipal Utilities District (EBMUD), Friends of Pinole Creek						TBD	
PinC-CCCS-12.1	Objective	Agriculture	Address the present or threatened destruction, modification, or curtailment of the species habitat or range										
PinC-CCCS-12.1.1	Recovery Action	Agriculture	Prevent or minimize impairment to floodplain connectivity (impaired quality and extent)										
PinC-CCCS-12.1.1.1	Action Step	Agriculture	Conserve open space in contiguous landscapes, protect floodplain areas and riparian corridors, and develop conservation easements.	2	100	Contra Costa County						TBD	
PinC-CCCS-12.1.2	Recovery Action	Agriculture	Prevent or minimize impairment to instream substrate/food productivity (impaired gravel quality and quantity)										
PinC-CCCS-12.1.2.1	Action Step	Agriculture	Address sources from agricultural activities that deliver sediment and runoff to stream channels.	2	10	Contra Costa County, RWQCB						0	Action is considered In-Kind
PinC-CCCS-13.1	Objective	Channel Modification	Address the present or threatened destruction, modification, or curtailment of the species habitat or range										
PinC-CCCS-13.1.1	Recovery Action	Channel Modification	Prevent or minimize impairment to floodplain connectivity (impaired quality & extent)										
PinC-CCCS-13.1.1.1	Action Step	Channel Modification	Minimize channelization in areas that provide winter refuge and seasonal habitat for juvenile steelhead.	2	10	City of Pinole, Contra Costa County						0	Action is considered In-Kind
PinC-CCCS-13.1.1.2	Action Step	Channel Modification	Ensure that all existing channel designed for flood conveyance incorporate features that enhance steelhead migration under high and low flow conditions.	2	10	City of Pinole, Contra Costa County						0	Action is considered In-Kind
PinC-CCCS-13.1.1.3	Action Step	Channel Modification	Develop Bank Stabilization and Floodplain Guidelines for use by private and public entities.	2	10	City of Pinole, Contra Costa County						0	Action is considered In-Kind
PinC-CCCS-13.1.1.4	Action Step	Channel Modification	Evaluate design alternatives to rip-rap bank repairs and incorporate fish habitat features.	2	10	City of Pinole, Contra Costa County						0	Action is considered In-Kind
PinC-CCCS-13.1.1.5	Action Step	Channel Modification	Conserve open space in contiguous landscapes, protect floodplain areas and riparian corridors, and develop conservation easements.	2	10	City of Pinole, Contra Costa County						TBD	
PinC-CCCS-13.1.2	Recovery Action	Channel Modification	Prevent or minimize impairment to water quality (increased turbidity, suspended sediment, and/or toxicity										
PinC-CCCS-13.1.2.1	Action Step	Channel Modification	Conduct rehabilitation activities that reconnect channels to floodplains.	2	10	City of Pinole, Contra Costa County						0	Costs accounted for in above actions.

Pinole Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
PinC-CCCS-13.1.2.2	Action Step	Channel Modification	Develop and implement strategies that slow urban runoff during the spawning and migration season (slow it, spread it, sink it).	2	10	City of Pinole, Contra Costa County						TBD	Cost based on amount of urban runoff entering streams during spawning and migration season. Methods to remedy may include flood basins, bypass channels, and storm drain retrofits.
PinC-CCCS-13.1.3	Recovery Action	Channel Modification	Prevent or minimize impairment to passage and migration										
PinC-CCCS-13.1.3.1	Action Step	Channel Modification	Ensure that existing engineered and modified channels incorporate features that enhance steelhead migration under high and low flow conditions.	2	10	City of Pinole, Contra Costa County						0	Cost accounted for in above action step.
PinC-CCCS-13.1.3.2	Action Step	Channel Modification	Incorporate velocity refuge features in all existing engineered and modified channels.	2	10	City of Pinole, Contra Costa County						0	Cost accounted for in above action step.
PinC-CCCS-13.1.3.3	Action Step	Channel Modification	Install features that provides shelter for emigrating juvenile salmonids - focus efforts on areas, such as flood control channels, where shelter is most limited.	2	10	City of Pinole, Contra Costa County						0	Cost accounted for in above action step.
PinC-CCCS-13.1.3.4	Action Step	Channel Modification	Prevent or minimize any future channel modification in potentially high value seasonal habitat and migration (staging) areas.	2	10	City of Pinole, Contra Costa County						0	Action is considered In-Kind
PinC-CCCS-13.1.4	Recovery Action	Channel Modification	Prevent or minimize impairment to habitat complexity (reduced large wood and/or shelter)										
PinC-CCCS-13.1.4.1	Action Step	Channel Modification	Identify locations where channel modification has resulted in decreased shelter, LWD frequency, and habitat complexity, and develop and implement site specific plans to provided shelter and velocity refuge for migrating and rearing steelhead.	2	10	City of Pinole, Contra Costa County						0	Costs accounted for in above actions.
PinC-CCCS-13.1.4.2	Action Step	Channel Modification	Encourage retention and recruitment of large woody debris to rehabilitate existing stream complexity, pool frequency, and depth.	2	10	City of Pinole, Contra Costa County						0	Action is considered In-Kind
PinC-CCCS-13.1.4.3	Action Step	Channel Modification	Prevent the removal of habitat forming structures (LWD, boulders, vegetation, etc.) in all natural waterways.	2	10	City of Pinole, Contra Costa County						0	Action is considered In-Kind
PinC-CCCS-13.1.5	Recovery Action	Channel Modification	Prevent or minimize impairment to estuary (impaired quality and extent)										
PinC-CCCS-13.1.5.1	Action Step	Channel Modification	Develop Estuary Enhancement Projects to improve rearing habitat for juveniles and smolts.	2	10	Contra Costa County	25.00	25.00				50	Cost based on treating 1 acre (assume 10% of total estuarine acres) at a rate of $49,200/acre.
PinC-CCCS-13.1.5.2	Action Step	Channel Modification	Remove structures impairing or reducing the historical tidal prism, where feasible, and benefits to salmonids and/or the estuarine environment are predicted.	2	10	City of Pinole, Contra Costa County						TBD	Cost based on amount of structures to be removed. Cost may be significantly more than implementing stream complexity projects estimated at $31,200/mile.
PinC-CCCS-14.1	Objective	Disease/ Predation /Competition	Address disease or predation										
PinC-CCCS-14.1.1	Recovery Action	Disease/ Predation /Competition	Prevent or minimize reduced density, abundance, and diversity										
PinC-CCCS-14.1.1.1	Action Step	Disease/ Predation /Competition	Identify locations within the watershed that support exotic piscivorous fish species, and develop and implement a plan to decrease the effects of predation by these species. Consider provision of instream habitat and cover that provides refuge for salmonids, and/or the elimination of instream conditions that support and favor exotic species.	2	10	City of Pinole, Contra Costa County						TBD	Cost based on amount of exotic piscivorous fish species to be removed. Cost for pikeminnow eradication estimated at $9.38/fish.

Pinole Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
PinC-CCCS-18.1	Objective	Livestock	Address the present or threatened destruction, modification or curtailment of the species habitat or range										
PinC-CCCS-18.1.1	Recovery Action	Livestock	Prevent or minimize impairment to water quality (increased turbidity, suspended sediment, and/or toxicity)										
PinC-CCCS-18.1.1.1	Action Step	Livestock	Develop off-stream waters sources for livestock.	2	10	Contra Costa County						TBD	Cost based on amount of off-stream waters sources needed. Cost estimated at $5,000/site.
PinC-CCCS-18.1.1.2	Action Step	Livestock	Minimize gully initiation by preventing livestock from over utilizing steeper sloped areas.	2	10	Contra Costa County						0	Action is considered In-Kind
PinC-CCCS-18.1.1.3	Action Step	Livestock	Reduce sediment runoff from confined animal facilities to prevent runoff of animal waste and instream nutrient loading.	2	10	Contra Costa County						0	Action is considered In-Kind
PinC-CCCS-18.1.1.4	Action Step	Livestock	Exclude livestock from riparian areas.	2	10	Contra Costa County	2.90	2.90				6	Cost based on treating 0.25 miles at a rate of $4.36/ft.
PinC-CCCS-21.1	Objective	Recreation	Address inadequacies of regulatory mechanisms										
PinC-CCCS-21.1.1	Recovery Action	Recreation	Prevent or minimize increased landscape disturbance										
PinC-CCCS-21.1.1.1	Action Step	Recreation	Develop, implement, and fund site specific BMPs for equestrian operations.	2	20	Contra Coasta RCD, Contra Costa County, East Bay Municipal Utilities District (EBMUD), Friends of Pinole Creek, NMFS						TBD	
PinC-CCCS-22.1	Objective	Residential/ Commercial Development	Address the present or threatened destruction, modification, or curtailment of the species habitat or range										
PinC-CCCS-22.1.1	Recovery Action	Residential/ Commercial Development	Prevent or minimize impairment to floodplain connectivity (impaired quality & extent)										
PinC-CCCS-22.1.1.1	Action Step	Residential/ Commercial Development	Design new development to allow streams to meander in historical patterns; protecting riparian zones and their floodplains or channel migration zones averts the need for bank erosion control in most situations.	2	10	City of Pinole						0	Action is considered In-Kind
PinC-CCCS-22.1.1.2	Action Step	Residential/ Commercial Development	Minimize or avoid new development within riparian zones and the 100 year floodprone zones.	2	10	City of Pinole						0	Action is considered In-Kind
PinC-CCCS-22.1.1.3	Action Step	Residential/ Commercial Development	Minimize, or greatly restrict future development in floodplains or off channel habitats.	2	10	City of Pinole						0	Action is considered In-Kind
PinC-CCCS-22.1.2	Recovery Action	Residential/ Commercial Development	Prevent or minimize impairment to water quality (increased turbidity, suspended sediment, and/or toxicity)										
PinC-CCCS-22.1.2.1	Action Step	Residential/ Commercial Development	Develop filter or buffer systems that reduce pollutants from entering streams and waterways of Pinole Creek.	2	10	City of Pinole						TBD	Cost based on amount and size of filter or buffer system needed to reduce pollutants. Cost range from $8,000/Mgal to $2,201,426/Mgal.
PinC-CCCS-22.1.2.2	Action Step	Residential/ Commercial Development	Implement education programs and install signs to promote public awareness of salmon and steelhead and their habitats within the Pinole Creek watershed.	3	10	City of Pinole	2.50	2.50				5	Cost based on installing a minimum of 5 signs at a cost of $1,000/sign.

Pinole Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
PinC-CCCS-23.1	Objective	Roads/Railroads	Address the present or threatened destruction, modification, or curtailment of the species habitat or range										
PinC-CCCS-23.1.1	Recovery Action	Roads/Railroads	Prevent adverse alterations to sediment transport (road condition/density, dams, etc.)										
PinC-CCCS-23.1.1.1	Action Step	Roads/Railroads	Address high and medium priority sediment delivery sites associated with roads and railroads.	2	10	City of Pinole, Contra Costa County	50.00	50.00				100	Cost based on road inventory of 87 miles of road at a rate of $1,148/mile. Medium and high priority sediment sites should be identified from road inventory.
PinC-CCCS-23.1.1.2	Action Step	Roads/Railroads	Address sediment and runoff sources from road networks and other actions that deliver sediment and runoff to stream channels.	2	10	City of Pinole, Contra Costa County						TBD	
PinC-CCCS-23.1.2	Recovery Action	Roads/Railroads	Prevent or minimize impairment to stream hydrology (impaired water flow)										
PinC-CCCS-23.1.2.1	Action Step	Roads/Railroads	Conduct actions that hydrologically disconnect roads.	2	10	City of Pinole, Contra Costa County						0	Action is considered In-Kind
PinC-CCCS-23.1.2.2	Action Step	Roads/Railroads	Minimize or restrict the construction of new roads near high valve habitat areas or sensitive habitat areas.	2	10	City of Pinole, Contra Costa County						0	Action is considered In-Kind
PinC-CCCS-23.1.3	Recovery Action	Roads/Railroads	Prevent or minimize impairment to passage and migration										
PinC-CCCS-23.1.3.1	Action Step	Roads/Railroads	Ensure that all future road/stream crossing provide passage for all steelhead life stages.	1	10	City of Pinole, Contra Costa County						0	Action is considered In-Kind
PinC-CCCS-23.1.3.2	Action Step	Roads/Railroads	Identify and remedy all road/stream crossings that impair or prevent steelhead migration.	1	10	City of Pinole, Contra Costa County	640					640	Cost base on improving passage at 1 partial barrier (not counting Highway 80) at a rate of $639,247/project.
PinC-CCCS-23.1.3.3	Action Step	Roads/Railroads	Replace UPRR bridge at mouth.	2	20	Contra Costa County, Friends of Pinole Creek, NMFS, UPRR						TBD	
PinC-CCCS-25.1	Objective	Water Diversion /Impoundment	Address the present or threatened destruction, modification, or curtailment of the species habitat or range										
PinC-CCCS-25.1.1	Recovery Action	Water Diversion /Impoundment	Prevent or minimize impairment to stream hydrology (impaired water flow)										
PinC-CCCS-25.1.1.1	Action Step	Water Diversion /Impoundment	Assess water diversions and prescribe and implement actions to improve life stage survival in areas where found to be limiting.	2	10	Contra Costa County, East Bay Municipal Utilities District (EBMUD)	39.50	39.50				79	Cost based on hydrologic model at a rate of $78,100/project. Cost could be coordinated with above action step.

San Pablo Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
SPab-CCCS-1.1	Objective	Estuary	Address the present or threatened destruction, modification, or curtailment of the species habitat or range										
SPab-CCCS-1.1.1	Recovery Action	Estuary	Prevent or minimize impairment to the estuary (impaired quality and extent)										
SPab-CCCS-1.1.1.1	Action Step	Estuary	Develop an estuary rehabilitation and enhancement plan in efforts to reclaim historically tidal influenced areas.	2	10	City of San Pablo, Contra Costa County						0	Cost accounted for in CHANNEL MODIFICATION.
SPab-CCCS-1.1.1.2	Action Step	Estuary	Identify potential habitat features that will increase current and future estuary habitat values for rearing steelhead.	2	10	City of San Pablo, Contra Costa County	344.50	344.50				689	Cost based on treating 14 acres (assume 25% total estuarine acres) at a rate of $49,200/acres.
SPab-CCCS-1.1.1.3	Action Step	Estuary	Investigate water quality (D.O., temperature, salinity) conditions for rearing steelhead in potential tidal marsh rehabilitation sites.	2	5	City of San Pablo, Contra Costa County	15.00					15	Cost based on installing a minimum of 3 continuous water quality stations at a rate of $5,000/station. Cost does not account for data management or maintenance.
SPab-CCCS-2.1	Objective	Floodplain Connectivity	Address the present or threatened destruction, modification, or curtailment of the species habitat or range										
SPab-CCCS-2.1.1	Recovery Action	Floodplain Connectivity	Rehabilitate and enhance floodplain connectivity										
SPab-CCCS-2.1.1.1	Action Step	Floodplain Connectivity	Design and implement floodplain rehabilitation projects that target velocity refuge for migrating salmonids.	2	10	City of San Pablo, Contra Costa County	446.50	446.50				893	Cost based on treating 0.25 miles (assume 1 project/mile in 25% high IP with 80 acres/mile) at a rate of $44,640/acre.
SPab-CCCS-3.1	Objective	Hydrology	Address the present or threatened destruction, modification, or curtailment of the species habitat or range										
SPab-CCCS-3.1.1	Recovery Action	Hydrology	Improve flow conditions (baseflow conditions)										
SPab-CCCS-3.1.1.1	Action Step	Hydrology	Assess flow conditions to determine if water use is negatively impacting flows necessary to support summer rearing steelhead.	2	10	City of San Pablo, Contra Costa County, East Bay Municipal Utilities District (EBMUD)	39.50	39.50				79	Cost based on stream flow/precipitation model at a rate of $78,100/project.
SPab-CCCS-5.1	Objective	Passage	Address the present or threatened destruction, modification, or curtailment of the species habitat or range										
SPab-CCCS-5.1.1	Recovery Action	Passage	Modify or remove physical passage barriers										
SPab-CCCS-5.1.1.1	Action Step	Passage	Evaluate feasibility of passage methodologies for San Pablo and Briones reservoirs.	1	5	East Bay Municipal Utilities District (EBMUD)	250					250	Cost is an estimate for the assessment and feasibility studies for fish passage at San Pablo and Briones reservoirs.
SPab-CCCS-5.1.1.2	Action Step	Passage	Develop and implement a reservoir bypass flow schedules that protect migrating steelhead through flood control channels.	1	5	East Bay Municipal Utilities District (EBMUD)						TBD	
SPab-CCCS-5.1.1.3	Action Step	Passage	Improve passage conditions at known barriers downstream of San Pablo Reservoir.	1	5	City of San Pablo, East Bay Municipal Utilities District (EBMUD)	1,191					1,191	Cost based on providing passage at one known total barrier at a rate of $1,190,974/project.
SPab-CCCS-6.1	Objective	Habitat Complexity	Address the present or threatened destruction, modification, or curtailment of the species habitat or range										
SPab-CCCS-6.1.1	Recovery Action	Habitat Complexity	Increase large wood frequency										

San Pablo Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
SPab-CCCS-6.1.1.1	Action Step	Habitat Complexity	Evaluate and prescribe an appropriate number of key LWD pieces to enhance summer rearing conditions in potential steelhead spawning and rearing areas throughout the watershed.	2	10	City of San Pablo, Contra Costa County	8.00	8.00				16	Cost based on treating 0.5 miles (assume 1 project/mile in 50% high IP) at a rate of $31,200/mile. Cost likely to be higher if greater level of oversight and engineering are used, such as implementation of ELJ.
SPab-CCCS-6.1.2	Recovery Action	Habitat Complexity	Increase frequency of primary pools										
SPab-CCCS-6.1.2.1	Action Step	Habitat Complexity	Evaluate and prescribe habitat features that will increase primary pool depth and frequency for winter and summer rearing juveniles, and quality staging pools for migrating/staging adults.	2	10	City of San Pablo, Contra Costa County	8.00	8.00				16	Cost based on treating 0.5 miles (assume 1 project/mile in 50% high IP) at a rate of $31,200/mile. Cost likely to be higher if greater level of oversight and engineering are used, such as implementation of ELJ.
SPab-CCCS-6.1.3	Recovery Action	Habitat Complexity	Improve shelter										
SPab-CCCS-6.1.3.1	Action Step	Habitat Complexity	Increase shelter and habitat complexity features that improve survival of emigrating juvenile and adult steelhead; include efforts in areas such as flood control channels that lack habitat complexity.	2	10	City of San Pablo, Contra Costa County	8.00	8.00				16	Cost based on treating 0.5 miles (assume 1 project/mile in 50% high IP) at a rate of $31,200/mile. Cost likely to be higher if greater level of oversight and engineering are used, such as implementation of ELJ.
SPab-CCCS-7.1	Objective	Riparian	Address the present or threatened destruction, modification, or curtailment of the species habitat or range										
SPab-CCCS-7.1.1	Recovery Action	Riparian	Improve canopy cover										
SPab-CCCS-7.1.1.1	Action Step	Riparian	Identify areas in the lower reaches where canopy cover is not meeting the minimum canopy criteria, and prescribe and implement measures to improve riparian habitat.	2	10	City of San Pablo, Contra Costa County, East Bay Municipal Utilities District (EBMUD)	44.50	44.50				89	Cost based on riparian restoration assessment at a rate of $88,551/project.
SPab-CCCS-7.1.1.2	Action Step	Riparian	Ensure that mature trees within the steam riparian corridor are not disturbed or lost due to land management activities (roads, cattle, flood control, etc.).	2	10	City of San Pablo, Contra Costa County, East Bay Municipal Utilities District (EBMUD)						0	Action is considered In-Kind
SPab-CCCS-8.1	Objective	Sediment	Address the present or threatened destruction, modification, or curtailment of the species habitat or range										
SPab-CCCS-8.1.1	Recovery Action	Sediment	Improve instream gravel quality to reduce embeddedness										
SPab-CCCS-8.1.1.1	Action Step	Sediment	Evaluate, design, and implement gravel quality and quantity strategies to the extent that the maximum amount of spawning and incubation habitat is achieved.	2	10	City of San Pablo, Contra Costa County, East Bay Municipal Utilities District (EBMUD)	69.00	69.00				138	Cost based on fish/habitat restoration model at a of $137,833/project.
SPab-CCCS-8.1.1.2	Action Step	Sediment	Add channel roughness (logs, boulders) in strategic locations to encourage spawning tailout formations and gravel sorting.	2	10	City of San Pablo, Contra Costa County, East Bay Municipal Utilities District (EBMUD)	8.00	8.00				16	Cost based on treating 0.5 miles (assume 1 project/mile in 50% high IP) at a rate of $31,200/mile.

San Pablo Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
SPab-CCCS-10.1	Objective	Water Quality	Address the present or threatened destruction, modification, or curtailment of the species habitat or range										
SPab-CCCS-10.1.1	Recovery Action	Water Quality	Improve instream temperature conditions										
SPab-CCCS-10.1.1.1	Action Step	Water Quality	Identify if water temperatures are limiting steelhead viability in San Pablo Creek and, if found to be limiting, develop and implement measures to reduce water temperatures where needed.	2	10	City of San Pablo, Contra Costa County, East Bay Municipal Utilities District (EBMUD)	0.75	0.75				2	Cost based on installing a minimum of 3 water temperature gauges at a rate of $500/gauge.
SPab-CCCS-10.1.2	Recovery Action	Water Quality	Reduce toxicity and pollutants										
SPab-CCCS-10.1.2.1	Action Step	Water Quality	Identify and provide solutions for point and non-point sources contributing to poor water quality and pollution.	2	10	City of San Pablo, Contra Costa County, East Bay Municipal Utilities District (EBMUD)	7.50	7.50				15	Cost based on installing a minimum of 3 continuous water quality monitoring stations at a rate of $5,000/station.
SPab-CCCS-13.1	Objective	Channel Modification	Address the present or threatened destruction, modification, or curtailment of the species habitat or range										
SPab-CCCS-13.1.1	Recovery Action	Channel Modification	Prevent or minimize impairment to floodplain connectivity (impaired quality & extent)										
SPab-CCCS-13.1.1.1	Action Step	Channel Modification	Minimize or avoid channelization in areas that provide winter refuge and seasonal habitat for juvenile steelhead	2	10	City of San Pablo, Contra Costa County						0	Action is considered In-Kind
SPab-CCCS-13.1.1.2	Action Step	Channel Modification	Ensure that all existing channel designed for flood conveyance incorporate features that enhance steelhead migration under high and low flow conditions.	2	10	City of San Pablo, Contra Costa County						0	Action is considered In-Kind
SPab-CCCS-13.1.1.3	Action Step	Channel Modification	Develop Bank Stabilization and Floodplain Guidelines for use by private and public entities.	2	10	City of San Pablo, Contra Costa County						0	Action is considered In-Kind
SPab-CCCS-13.1.1.4	Action Step	Channel Modification	Evaluate design alternatives to rip-rap bank repairs and incorporate fish habitat features.	2	10	City of San Pablo, Contra Costa County						0	Action is considered In-Kind
SPab-CCCS-13.1.2	Recovery Action	Channel Modification	Prevent or minimize impairment to water quality (increased turbidity, suspended sediment, and/or toxicity										
SPab-CCCS-13.1.2.1	Action Step	Channel Modification	Conduct rehabilitation activities that reconnect channels to floodplains.	2	10	City of San Pablo, Contra Costa County						0	Costs acounted for in other recovery action steps: Floodplain Connectivity
SPab-CCCS-13.1.2.2	Action Step	Channel Modification	Develop and implement strategies that slow urban runoff during the spawning and migration season (slow it, spread it, sink it).	2	10	City of San Pablo, Contra Costa County						TBD	Cost based on number and type of strategies implemented such as off-channel storage, filter strips, and reducing impervious surfaces.
SPab-CCCS-13.1.3	Recovery Action	Channel Modification	Prevent or minimize impairment to passage and migration										
SPab-CCCS-13.1.3.1	Action Step	Channel Modification	Ensure that existing engineered and modified channels incorporate features that enhance steelhead migration under high and low flow conditions.	2	10	City of San Pablo, Contra Costa County						0	Action is considered In-Kind
SPab-CCCS-13.1.3.2	Action Step	Channel Modification	Incorporate velocity refuge features in all existing engineered and modified channels.	2	10	City of San Pablo, Contra Costa County						0	Costs acounted for in other recovery actions.

San Pablo Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
SPab-CCCS-13.1.3.3	Action Step	Channel Modification	Install features that provides shelter for emigrating juvenile salmonids - focus efforts on areas, such as flood control channels, where shelter is most limited.	2	10	City of San Pablo, Contra Costa County						0	Costs acounted for in other recovery actions.
SPab-CCCS-13.1.3.4	Action Step	Channel Modification	Minimize or prevent any future channel modification in potentially high value seasonal habitat and migration (staging) areas.	2	10	City of San Pablo, Contra Costa County						0	Action is considered In-Kind
SPab-CCCS-13.1.4	Recovery Action	Channel Modification	Prevent or minimize impairment to habitat complexity (reduced large wood and/or shelter)										
SPab-CCCS-13.1.4.1	Action Step	Channel Modification	Identify locations where channel modification has resulted in decreased shelter, LWD frequency, and habitat complexity, and develop and implement site specific plans to provided shelter and velocity refuge for migrating and rearing steelhead.	2	10	City of San Pablo, Contra Costa County	69.00	69.00				138	Cost based on fish/habitat restoration model at a rate of $137,800/project.
SPab-CCCS-13.1.4.2	Action Step	Channel Modification	Encourage retention and recruitment of large woody debris to rehabilitate existing stream complexity, pool frequency, and depth.	2	10	City of San Pablo, Contra Costa County						0	Action is considered In-Kind
SPab-CCCS-13.1.4.3	Action Step	Channel Modification	Prevent the removal of habitat forming structures (LWD, boulders, vegetation, etc.) in all natural waterways.	2	10	City of San Pablo, Contra Costa County						0	Action is considered In-Kind
SPab-CCCS-13.1.5	Recovery Action	Channel Modification	Prevent or minimize impairment to estuary (impaired quality and extent)										
SPab-CCCS-13.1.5.1	Action Step	Channel Modification	Develop Estuary Enhancement Projects to improve rearing habitat for juveniles and smolts.	2	10	City of San Pablo, Contra Costa County	170.00	170.00				340	Cost based on estuary use/residence time model at a rate of $339,399/project.
SPab-CCCS-13.1.5.2	Action Step	Channel Modification	Where feasible, remove structures impairing or reducing the historical tidal prism, and benefits to salmonids and/or the estuarine environment are predicted.	2	10	City of San Pablo, Contra Costa County						TBD	Cost based on type and amount of structures impairing or reducing historical tidal prism. Assume the cost comparable to implementing stream complexity action steps.
SPab-CCCS-22.1	Objective	Residential /Commercial Development	Address the present or threatened destruction, modification, or curtailment of the species habitat or range										
SPab-CCCS-22.1.1	Recovery Action	Residential /Commercial Development	Prevent or minimize impairment to floodplain connectivity (impaired quality & extent)										
SPab-CCCS-22.1.1.1	Action Step	Residential /Commercial Development	Design new development to allow streams to meander in historical patterns; protecting riparian zones and their floodplains or channel migration zones averts the need for bank erosion control in most situations.	2	10	City of San Pablo, Contra Costa County						0	Action is considered In-Kind
SPab-CCCS-22.1.1.2	Action Step	Residential /Commercial Development	Minimize or avoid new development within riparian zones and the 100 year floodprone zones.	2	10	City of San Pablo, Contra Costa County						0	Action is considered In-Kind
SPab-CCCS-22.1.1.3	Action Step	Residential /Commercial Development	Minimize or restrict future development in floodplains or off channel habitats.	2	10	City of San Pablo, Contra Costa County, East Bay Municipal Utilities District (EBMUD)						0	Action is considered In-Kind
SPab-CCCS-22.1.2	Recovery Action	Residential /Commercial Development	Prevent or minimize impairment to water quality (increased turbidity, suspended sediment, and/or toxicity)										

San Pablo Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
SPab-CCCS-22.1.2.1	Action Step	Residential /Commercial Development	Develop filter or buffer systems that reduce pollutants from entering streams and waterways of San Pablo Creek.	2	10	City of San Pablo, Contra Costa County, East Bay Municipal Utilities District (EBMUD)						TBD	Cost based on the amount and type of filter or buffer system needed to reduce pollutants being discharged into waterways. Estimate for filter strip is from $9,000 to $24,000/system.
SPab-CCCS-22.1.2.2	Action Step	Residential /Commercial Development	Implement education programs and install signs to promote public awareness of salmon and steelhead and their habitats within the watershed.	3	10	City of San Pablo, Contra Costa County	5.00	5.00				10	Cost based on installing a minimum of 10 signs at a rate of $1,000/sign.
SPab-CCCS-23.1	Objective	Roads/Railroads	Address the present or threatened destruction, modification, or curtailment of the species habitat or range										
SPab-CCCS-23.1.1	Recovery Action	Roads/Railroads	Prevent or minimize alterations to sediment transport (road condition/density, dams, etc.)										
SPab-CCCS-23.1.1.1	Action Step	Roads/Railroads	Address high and medium priority sediment delivery sites associated with roads and railroads.	2	10	City of San Pablo, Contra Costa County	137.00	137.00				274	Cost based conducting a road inventory of 238 miles of road network at a rate of $1,148/mile.
SPab-CCCS-23.1.1.2	Action Step	Roads/Railroads	Address sediment and runoff sources from road networks and other actions that deliver sediment and runoff to stream channels.	2	10	City of San Pablo, Contra Costa County						TBD	Cost based on types of recommendations identified in road assessment.
SPab-CCCS-23.1.2	Recovery Action	Roads/Railroads	Prevent or minimize impairment to stream hydrology (impaired water flow)										
SPab-CCCS-23.1.2.1	Action Step	Roads/Railroads	Conduct actions that hydrologically disconnect roads.	2	10	City of San Pablo, Contra Costa County						TBD	Cost based on recommendations identified in road assessment.
SPab-CCCS-23.1.2.2	Action Step	Roads/Railroads	Minimize or prevent the construction of new roads near high valve habitat areas or sensitive habitat areas.	2	10	City of San Pablo, Contra Costa County						0	Action is considered In-Kind
SPab-CCCS-23.1.3	Recovery Action	Roads/Railroads	Prevent or minimize impairment to passage and migration										
SPab-CCCS-23.1.3.1	Action Step	Roads/Railroads	Ensure that all future road/stream crossing provide passage for all steelhead life stages.	1	10	City of San Pablo, Contra Costa County						0	Action is considered In-Kind
SPab-CCCS-23.1.3.2	Action Step	Roads/Railroads	Identify and remedy all road/stream crossings that impair or prevent steelhead migration.	1	10	City of San Pablo, Contra Costa County						0	Cost accounted for in above actions - see Passage.
SPab-CCCS-25.1	Objective	Water Diversion/ Impoundment	Address the present or threatened destruction, modification, or curtailment of the species habitat or range										
SPab-CCCS-25.1.1	Recovery Action	Water Diversion/ Impoundment	Prevent or minimize impairment to passage and migration										
SPab-CCCS-25.1.1.1	Action Step	Water Diversion/ Impoundment	Design all habitat enhancements to function within the anticipated range of flows.	2	5	East Bay Municipal Utilities District (EBMUD)						0	Action is considered In-Kind
SPab-CCCS-25.1.1.2	Action Step	Water Diversion/ Impoundment	Install instream habitat enhancement features designed to increase the quantity and quality of fry and juvenile steelhead habitat by creating habitats with depth, velocity, and cover components that favor these life stages.	2	5	East Bay Municipal Utilities District (EBMUD)						0	Cost accounted for in other action steps CHANNEL MODIFICATION.
SPab-CCCS-25.1.2	Recovery Action	Water Diversion/ Impoundment	Prevent or minimize impairment to stream hydrology (impaired water flow)										
SPab-CCCS-25.1.2.1	Action Step	Water Diversion/ Impoundment	During winter and spring implement moderate winter baseflows downstream of all reservoirs to provide adequate water depths necessary for upstream and downstream migration.	1	20	East Bay Municipal Utilities District (EBMUD)						TBD	

San Pablo Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
SPab-CCCS-25.1.2.2	Action Step	Water Diversion/ Impoundment	During winter and spring implement periodic migrant attractant flows necessary to attract adult fish upstream, and encourage outmigration of smolts.	1	5	East Bay Municipal Utilities District (EBMUD)						TBD	
SPab-CCCS-25.1.2.3	Action Step	Water Diversion/ Impoundment	To provide stream channel maintenance flows, during winter and spring, implement periodic large pulse "maintenance" flows from reservoirs. When possible, time these flows so that they coincide with natural rainfall events.	1	5	East Bay Municipal Utilities District (EBMUD)						TBD	
SPab-CCCS-25.1.2.4	Action Step	Water Diversion/ Impoundment	During summer and fall, manage release rates so that depths and velocities favoring fry and juvenile steelhead are provided.	1	5	East Bay Municipal Utilities District (EBMUD)						TBD	
SPab-CCCS-25.1.2.5	Action Step	Water Diversion/ Impoundment	Ramp all reservoir releases (flood maintenance releases, fisheries passage releases, summer baseflow, and other planned releases) as necessary to minimize deleterious effects of flow increases/decreases.	1	5	East Bay Municipal Utilities District (EBMUD)						0	Action is considered In-Kind
SPab-CCCS-25.1.2.6	Action Step	Water Diversion/ Impoundment	Establish and implement a comprehensive stream flow program to improve survival at all life stages by improving the spatial and temporal pattern of surface flows throughout spawning, rearing, and migration areas.	1	5	East Bay Municipal Utilities District (EBMUD)						TBD	
SPab-CCCS-25.1.2.7	Action Step	Water Diversion/ Impoundment	Develop flow schedules below San Pablo Reservoir that maximize current and potential habitat conditions.	1	5	East Bay Municipal Utilities District (EBMUD)	79.00					79	Cost based on stream flow/precipitation model at a rate of $78,100/project.

San Leandro Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
SanLC-CCCS-1.1	Objective	Estuary	Address the present or threatened destruction, modification, or curtailment of the species habitat or range										
SanLC-CCCS-1.1.1	Recovery Action	Estuary	Prevent or minimize impairment to the estuary (impaired quality and extent)										
SanLC-CCCS-1.1.1.1	Action Step	Estuary	Develop an estuary rehabilitation and enhancement plan in efforts to reclaim historically tidal influenced areas.	2	10	Alameda County, City of San Leandro, Contra Costa County	169.50	169.50				339	Cost based on estuary use/residence time model at a rate of $338,679/project.
SanLC-CCCS-1.1.1.2	Action Step	Estuary	Identify potential habitat features that will increase current and future estuary habitat values for rearing steelhead.	2	10	Alameda County, City of San Leandro, Contra Costa County	123.00	123.00				246	Cost based on treating 5 acres of estuarine habitat at a rate of $49,200/acre.
SanLC-CCCS-1.1.1.3	Action Step	Estuary	Investigate water quality (D.O., temperature, salinity) conditions for rearing steelhead in potential tidal marsh rehabilitation sites.	2	10	Alameda County, City of San Leandro, Contra Costa County	7.50	7.50				15	Cost based on installing a minimum of 3 continuous water quality monitoring stations at a rate of $5,000/station. Cost does not account for data management or maintenance.
SanLC-CCCS-1.1.1.5	Action Step	Estuary	Investigate potential prey items for rearing salmonids within current and potential estuary habitat zones.	2	10	Alameda County, City of San Leandro, Contra Costa County						0	Cost accounted for in above action step.
SanLC-CCCS-1.1.1.6	Action Step	Estuary	Increase the inner estuary hydrodynamics that have been altered by levees, dikes, culverts, and tide gates.	2	10	Alameda County, City of San Leandro, Contra Costa County						0	Cost accounted for in above action step.
SanLC-CCCS-2.1	Objective	Floodplain Connectivity	Address the present or threatened destruction, modification, or curtailment of the species habitat or range										
SanLC-CCCS-2.1.1	Recovery Action	Floodplain Connectivity	Rehabilitate and enhance floodplain connectivity										
SanLC-CCCS-2.1.1.1	Action Step	Floodplain Connectivity	Design and implement floodplain rehabilitation projects that target velocity refuge for migrating salmonids.	2	10	Alameda County, City of San Leandro, Contra Costa County	357.50	357.50				715	Cost based on treating 0.2 miles (assume 1 project/mile in 25% high IP) at a rate of $44,640/acre.
SanLC-CCCS-3.1	Objective	Hydrology	Address the present or threatened destruction, modification, or curtailment of the species habitat or range										
SanLC-CCCS-3.1.1	Recovery Action	Hydrology	Improve flow conditions										
SanLC-CCCS-3.1.1.1	Action Step	Hydrology	Reduce impacts of impaired hydrology (reduced pulse-flows, magnitude, duration, and timing of freshets) that preclude adult and smolt passage.	1	5	East Bay Municipal Utilities District (EBMUD)						TBD	
SanLC-CCCS-3.1.1.2	Action Step	Hydrology	Identify and implement flow requirements that support adult and juvenile steelhead migration downstream of Lake Chabot Reservoir.	1	5	East Bay Municipal Utilities District (EBMUD)						TBD	
SanLC-CCCS-3.1.1.3	Action Step	Hydrology	Identify flow requirements that protect emigrating juvenile and adults steelhead (kelts).	1	5	East Bay Municipal Utilities District (EBMUD)						0	Action is considered In-Kind

San Leandro Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
SanLC-CCCS-3.1.1.4	Action Step	Hydrology	Implement spawning and rearing habitat curves downstream of Lake Chabot Reservoir .	1	5	East Bay Municipal Utilities District (EBMUD)	72.00					72	Cost based on production, run timing, and size monitoring at a rate of $71,196/project.
SanLC-CCCS-3.1.1.5	Action Step	Hydrology	Implement flow schedules that optimize steelhead spawning and rearing conditions downstream of Lake Chabot Reservoir.	1	5	East Bay Municipal Utilities District (EBMUD)						TBD	
SanLC-CCCS-5.1	Objective	Passage	Address the present or threatened destruction, modification, or curtailment of the species habitat or range										
SanLC-CCCS-5.1.1	Recovery Action	Passage	Modify or remove physical passage barriers										
SanLC-CCCS-5.1.1.1	Action Step	Passage	Evaluate the feasiblility of fish passage methodologies for Upper San Leandro and Lake Chabot reservoirs.	1	5	City of San Leandro, East Bay Municipal Utilities District (EBMUD)	125.00					125	Cost estimate for conducting feasibility study for fish passage at Lake Chabot.
SanLC-CCCS-5.1.1.2	Action Step	Passage	Develop and implement a reservoir bypass flow schedules that protect migrating steelhead through flood control channels.	1	5	City of San Leandro, East Bay Municipal Utilities District (EBMUD)						TBD	
SanLC-CCCS-5.1.1.3	Action Step	Passage	Improve passage conditions at known barriers downstream of Lake Chabot.	1	5	City of San Leandro, East Bay Municipal Utilities District (EBMUD)	7,146					7,146	Cost based on providing passage at 6 barriers (assume total of 7 including Lake Chabot) at a rate of $1,190,974/barrier.
SanLC-CCCS-5.1.1.4	Action Step	Passage	Assess and potentially modify passage at I-880 and I-580 crossings.	2	50	CalTrans, East Bay Municipal Utilities District (EBMUD)						TBD	
SanLC-CCCS-6.1	Objective	Habitat Complexity	Address the present or threatened destruction, modification, or curtailment of the species habitat or range										
SanLC-CCCS-6.1.1	Recovery Action	Habitat Complexity	Increase large wood frequency										
SanLC-CCCS-6.1.1.1	Action Step	Habitat Complexity	Evaluate and prescribe an appropriate number of key LWD pieces to enhance summer rearing conditions in potential steelhead spawning and rearing areas throughout the watershed.	2	10	Alameda County, City of San Leandro, Contra Costa County	6.50	6.50				13	Cost based on treating 0.4 miles (assume 1 project/mile in 50% high IP) at a rate of $31,200/mile. Cost could be higher with greater engineering and oversight.
SanLC-CCCS-6.1.2	Recovery Action	Habitat Complexity	Increase frequency of primary pools										
SanLC-CCCS-6.1.2.1	Action Step	Habitat Complexity	Evaluate and prescribe habitat features that will increase primary pool depth and frequency for winter and summer rearing juveniles, and quality staging pools for migrating/staging adults.	2	10	Alameda County, City of San Leandro, Contra Costa County	6.50	6.50				13	Cost based on treating 0.4 miles (assume 1 project/mile in 50% high IP) at a rate of $31,200/mile. Cost could be higher with greater engineering and oversight. this action step should be coordinated with other action step to reduce cost and redundancy.
SanLC-CCCS-6.1.3	Recovery Action	Habitat Complexity	Improve shelter										
SanLC-CCCS-6.1.3.1	Action Step	Habitat Complexity	Increase shelter and habitat complexity features that improve survival of emigrating juvenile and adult steelhead; include efforts in areas such as flood control channels that lack habitat complexity.	2	10	Alameda County, City of San Leandro, Contra Costa County	6.50	6.50				13	Cost based on treating 0.4 miles (assume 1 project/mile in 50% high IP) at a rate of $31,200/mile. Cost could be higher with greater engineering and oversight. this action step should be coordinated with other action step to reduce cost and redundancy.

San Leandro Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
SanLC-CCCS-7.1	Objective	Riparian	Address the present or threatened destruction, modification, or curtailment of the species habitat or range										
SanLC-CCCS-7.1.1	Recovery Action	Riparian	Improve canopy cover										
SanLC-CCCS-7.1.1.1	Action Step	Riparian	Identify areas in the lower reaches where canopy cover is not meeting the minimum canopy criteria, and prescribe and implement measures to improve riparian habitat.	2	10	Alameda County, City of San Leandro, Contra Costa County, East Bay Municipal Utilities District (EBMUD)	124.00					124	Cost based on treating 0.5 miles (assume 1 project/mile with 10 acres/mile) at a rate $24,862/acre.
SanLC-CCCS-7.1.1.2	Action Step	Riparian	Ensure that mature trees within the steam riparian corridor are not disturbed or lost due to land management activities (roads, cattle, flood control, etc.).	2	10	Alameda County, City of San Leandro, Contra Costa County, East Bay Municipal Utilities District (EBMUD)						0	Action is considered In-Kind
SanLC-CCCS-8.1	Objective	Sediment	Address the present or threatened destruction, modification, or curtailment of the species habitat or range										
SanLC-CCCS-8.1.1	Recovery Action	Sediment	Improve instream gravel quality to reduce embeddedness										
SanLC-CCCS-8.1.1.1	Action Step	Sediment	Evaluate, design, and implement gravel quality and quantity strategies to the extent that the maximum amount of spawning and incubation habitat is achieved.	2	10	Alameda County, City of San Leandro, Contra Costa County, East Bay Municipal Utilities District (EBMUD)	69.00	69.00				138	Cost based on fish/habitat restoration model at a rate of $137,833/project. Cost for amount and quality of gravel needed is estimated at $39.52/cu.yd.
SanLC-CCCS-8.1.1.2	Action Step	Sediment	Add channel roughness (logs, boulders) in strategic locations to encourage spawning tailout formations and gravel sorting.	2	10	Alameda County, City of San Leandro, Contra Costa County, East Bay Municipal Utilities District (EBMUD)						0	Cost accounted for in HABITAT COMPLEXITY.
SanLC-CCCS-10.1	Objective	Water Quality	Address the present or threatened destruction, modification, or curtailment of the species habitat or range										
SanLC-CCCS-10.1.1	Recovery Action	Water Quality	Improve instream temperature conditions										
SanLC-CCCS-10.1.1.1	Action Step	Water Quality	Identify if water temperatures are limiting steelhead viability in Pinole Creek and, if found to be limiting, develop and implement measures to reduce water temperatures where needed.	2	5	Alameda County, City of San Leandro, Contra Costa County	1.50					2	Cost based on installing a minimum of 3 stream flow temperature gauges at a rate of $500/gauge. Cost does not account for data management or maintenance.
SanLC-CCCS-10.1.2	Recovery Action	Water Quality	Reduce toxicity and pollutants										

San Leandro Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
SanLC-CCCS-10.1.2.1	Action Step	Water Quality	Identify and provide solutions for point and non-point sources contributing to poor water quality and pollution.	2	5	Alameda County, City of San Leandro, Contra Costa County, RWQCB						0	Action is considered In-Kind
SanLC-CCCS-10.1.2.2	Action Step	Water Quality	Map, assess, and replace leaking septic systems in Canyon community	2	20	Contra Costa County						TBD	
SanLC-CCCS-10.1.2.3	Action Step	Water Quality	Work with the sanitary district to expand sewer service to neighborhoods on septic systems.	2	20	City of San Leandro						TBD	
SanLC-CCCS-13.1	Objective	Channel Modification	Address the present or threatened destruction, modification, or curtailment of the species habitat or range										
SanLC-CCCS-13.1.1	Recovery Action	Channel Modification	Prevent or minimize impairment to floodplain connectivity (impaired quality & extent)										
SanLC-CCCS-13.1.1.1	Action Step	Channel Modification	Minimize or avoid channelization in areas that provide winter refuge and seasonal habitat for juvenile steelhead	2	10	Alameda County, City of San Leandro, Contra Costa County						0	Action is considered In-Kind
SanLC-CCCS-13.1.1.2	Action Step	Channel Modification	Ensure that all existing channel designed for flood conveyance incorporate features that enhance steelhead migration under high and low flow conditions.	2	10	Alameda County, City of San Leandro, Contra Costa County						0	Action is considered In-Kind
SanLC-CCCS-13.1.1.3	Action Step	Channel Modification	Develop Bank Stabilization and Floodplain Guidelines for use by private and public entities.	2	10	Alameda County, City of San Leandro, Contra Costa County						0	Action is considered In-Kind
SanLC-CCCS-13.1.1.4	Action Step	Channel Modification	Evaluate design alternatives to rip-rap bank repairs and incorporate fish habitat features.	2	10	Alameda County, City of San Leandro, Contra Costa County						0	Action is considered In-Kind
SanLC-CCCS-13.1.1.5	Action Step	Channel Modification	Conserve open space in contiguous landscapes, protect floodplain areas and riparian corridors, and develop conservation easements.	2	10	Alameda County, CDFW, City of Moraga, City of San Leandro, Contra Costa County, RCD						TBD	
SanLC-CCCS-13.1.2	Recovery Action	Channel Modification	Prevent or minimize impairment to water quality (increased turbidity, suspended sediment, and/or toxicity)										
SanLC-CCCS-13.1.2.1	Action Step	Channel Modification	Conduct rehabilitation activities that reconnect channels to floodplains.	2	10	Alameda County, City of San Leandro, Contra Costa County						0	Costs accounted for in above recovery actions.
SanLC-CCCS-13.1.2.2	Action Step	Channel Modification	Develop and implement strategies that slow urban runoff during the spawning and migration season (slow it, spread it, sink it).	2	10	Alameda County, City of San Leandro, Contra Costa County						TBD	Cost based on amount and type of strategies needed to reduce urban runoff. Cost estimate for infiltration ponds ranges between $12,000 to $35,000/pond.
SanLC-CCCS-13.1.3	Recovery Action	Channel Modification	Prevent or minimize impairment to passage and migration										

San Leandro Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
SanLC-CCCS-13.1.3.1	Action Step	Channel Modification	Ensure that existing engineered and modified channels incorporate features that enhance steelhead migration under high and low flow conditions.	2	10	Alameda County, City of San Leandro, Contra Costa County						0	Action is considered In-Kind
SanLC-CCCS-13.1.3.2	Action Step	Channel Modification	Incorporate velocity refuge features in all existing engineered and modified channels.	2	10	Alameda County, City of San Leandro, Contra Costa County						0	Cost accounted for in other action steps.
SanLC-CCCS-13.1.3.3	Action Step	Channel Modification	Install features that provides shelter for emigrating juvenile salmonids - focus efforts on areas, such as flood control channels, where shelter is most limited.	2	10	Alameda County, City of San Leandro, Contra Costa County						0	Cost accounted for in other action steps: Habitat Complexity and Floodplain Connectivity.
SanLC-CCCS-13.1.3.4	Action Step	Channel Modification	Minimize or prevent any future channel modification in potentially high value seasonal habitat and migration (staging) areas.	2	10	Alameda County, City of San Leandro, Contra Costa County						0	Action is considered In-Kind
SanLC-CCCS-13.1.4	Recovery Action	Channel Modification	Prevent or minimize impairment to habitat complexity (reduced large wood and/or shelter)										
SanLC-CCCS-13.1.4.1	Action Step	Channel Modification	Identify locations where channel modification has resulted in decreased shelter, LWD frequency, and habitat complexity, and develop and implement site specific plans to provide shelter and velocity refuge for migrating and rearing steelhead.	2	10	Alameda County, City of San Leandro, Contra Costa County	69.00	69.00				138	Cost based on fish/habitat restoration model at a rate of $137,833/project.
SanLC-CCCS-13.1.4.2	Action Step	Channel Modification	Encourage retention and recruitment of large woody debris to rehabilitate existing stream complexity, pool frequency, and depth.	2	10	Alameda County, City of San Leandro, Contra Costa County						0	Action is considered In-Kind
SanLC-CCCS-13.1.4.3	Action Step	Channel Modification	Prevent the removal of habitat forming structures (LWD, boulders, vegetation, etc.) in all natural waterways.	2	10	Alameda County, City of San Leandro, Contra Costa County						0	Action is considered In-Kind
SanLC-CCCS-13.1.5	Recovery Action	Channel Modification	Prevent or minimize impairment to estuary (impaired quality and extent)										
SanLC-CCCS-13.1.5.1	Action Step	Channel Modification	Identify and remove structures impairing or reducing the historical tidal prism, where feasible, and benefits to salmonids and/or the estuarine environment are predicted.	2	10	Alameda County, City of San Leandro, Contra Costa County						TBD	Cost to be determined based on the number and type of structures found and the feasibility of their removal.
SanLC-CCCS-14.1	Objective	Disease /Predation /Competition	Address disease or predation										
SanLC-CCCS-14.1.1	Recovery Action	Disease /Predation /Competition	Prevent or minimize reduced density, abundance, and diversity										
SanLC-CCCS-14.1.1.1	Action Step	Disease /Predation /Competition	Identify locations within the watershed that support exotic piscivorous fish species, and develop and implement a plan to decrease the effects of predation by these species. Consider provision of instream habitat and cover that provides refuge for salmonids, and/or the elimination of instream conditions that support and favor exotic species.	2	10	Alameda County, City of San Leandro, Contra Costa County						TBD	Cost based on amount of exotic piscivorous fish species to be removed. Cost for pikeminnow eradication estimated at $9.38/fish.

San Leandro Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
SanLC-CCCS-22.1	Objective	Residential /Commercial Development	Address the present or threatened destruction, modification, or curtailment of the species habitat or range										
SanLC-CCCS-22.1.1	Recovery Action	Residential /Commercial Development	Prevent or minimize impairment to floodplain connectivity (impaired quality & extent)										
SanLC-CCCS-22.1.1.1	Action Step	Residential /Commercial Development	Design new development to allow streams to meander in historical patterns; protecting riparian zones and their floodplains or channel migration zones averts the need for bank erosion control in most situations.	2	10	City of San Leandro						0	Action is considered In-Kind
SanLC-CCCS-22.1.1.2	Action Step	Residential /Commercial Development	Minimize or avoid new development within riparian zones and the 100 year floodprone zones.	2	10	City of San Leandro						0	Action is considered In-Kind
SanLC-CCCS-22.1.1.3	Action Step	Residential /Commercial Development	Minimize or avoid future development in floodplains or off channel habitats.	2	10	City of San Leandro						0	Action is considered In-Kind
SanLC-CCCS-22.1.2	Recovery Action	Residential /Commercial Development	Prevent or minimize impairment to water quality (increased turbidity, suspended sediment, and/or toxicity)										
SanLC-CCCS-22.1.2.1	Action Step	Residential /Commercial Development	Develop filter or buffer systems that reduce pollutants from entering streams and waterways of San Leandro Creek.	2	10	City of San Leandro						TBD	Cost based on amount of system needed to reduce pollutants to level protective of sensitive species. Cost estimate for filter or buffer of pollutants ranges between $8,000 to $2,200,000/Mgal.
SanLC-CCCS-22.1.2.2	Action Step	Residential /Commercial Development	Implement education programs and install signs to promote public awareness of salmon and steelhead and their habitats within the Pinole Creek watershed.	3	10	City of San Leandro	2.50	2.50				5	Cost based on placing a minimum of 5 signs at a rate of $1,000/sign.
SanLC-CCCS-23.1	Objective	Roads/Railroads	Address the present or threatened destruction, modification, or curtailment of the species habitat or range										
SanLC-CCCS-23.1.1	Recovery Action	Roads/Railroads	Prevent or minimize alterations to sediment transport (road condition/density, dams, etc.)										
SanLC-CCCS-23.1.1.1	Action Step	Roads/Railroads	Address sediment and runoff sources from road networks and other actions that deliver sediment and runoff to stream channels.	2	10	Alameda County, City of San Leandro, Contra Costa County						TBD	Cost to be determined following an analysis of the road network. Methods for treating sediment sources varies.
SanLC-CCCS-23.1.2	Recovery Action	Roads/Railroads	Prevent or minimize impairment to stream hydrology (impaired water flow)										
SanLC-CCCS-23.1.2.1	Action Step	Roads/Railroads	Conduct actions that hydrologically disconnect roads.	2	10	Alameda County, City of San Leandro, Contra Costa County						0	Action is considered In-Kind
SanLC-CCCS-23.1.2.2	Action Step	Roads/Railroads	Prevent or restrict the construction of new roads near high valve habitat areas or sensitive habitat areas.	2	10	Alameda County, City of San Leandro, Contra Costa County						0	Action is considered In-Kind
SanLC-CCCS-23.1.3	Recovery Action	Roads/Railroads	Prevent or minimize impairment to passage and migration										
SanLC-CCCS-23.1.3.1	Action Step	Roads/Railroads	Ensure that all future road/stream crossing provide passage for all steelhead life stages.	1	10	Alameda County, City of San Leandro, Contra Costa County						0	Action is considered In-Kind

San Leandro Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
SanLC-CCCS-25.1	Objective	Water Diversion/ Impoundment	Address the present or threatened destruction, modification, or curtailment of the species habitat or range										
SanLC-CCCS-25.1.1	Recovery Action	Water Diversion/ Impoundment	Prevent or minimize impairment to passage and migration										
SanLC-CCCS-25.1.1.1	Action Step	Water Diversion/ Impoundment	Design all habitat enhancements to function within the anticipated range of flows.	2	5	East Bay Municipal Utilities District (EBMUD)						0	Action is considered In-Kind
SanLC-CCCS-25.1.1.2	Action Step	Water Diversion/ Impoundment	Install instream habitat enhancement features designed to increase the quantity and quality of fry and juvenile steelhead habitat by creating habitats with depth, velocity, and cover components that favor these life stages.	2	5	East Bay Municipal Utilities District (EBMUD)						0	Cost accounted for in HABITAT COMPLEXITY and FLOODPLAIN COMPLEXITY.
SanLC-CCCS-25.1.2	Recovery Action	Water Diversion/ Impoundment	Prevent or minimize impairment to stream hydrology (impaired water flow)										
SanLC-CCCS-25.1.2.1	Action Step	Water Diversion/ Impoundment	During winter and spring implement moderate winter baseflows downstream of all reservoirs to provide adequate water depths necessary for upstream and downstream migration.	1	20	East Bay Municipal Utilities District (EBMUD)						TBD	
SanLC-CCCS-25.1.2.2	Action Step	Water Diversion/ Impoundment	During winter and spring implement periodic migrant attractant flows necessary to attract adult fish upstream, and encourage outmigration of smolts.	1	5	East Bay Municipal Utilities District (EBMUD)						TBD	
SanLC-CCCS-25.1.2.3	Action Step	Water Diversion/ Impoundment	To provide stream channel maintenance flows, during winter and spring, implement periodic large pulse "maintenance" flows from reservoirs. When possible, time these flows so that they coincide with natural rainfall events.	1	5	East Bay Municipal Utilities District (EBMUD)						TBD	
SanLC-CCCS-25.1.2.4	Action Step	Water Diversion/ Impoundment	During summer and fall, manage release rates so that depths and velocities favoring fry and juvenile steelhead are provided.	1	5	East Bay Municipal Utilities District (EBMUD)						TBD	
SanLC-CCCS-25.1.2.5	Action Step	Water Diversion/ Impoundment	Ramp all reservoir releases (flood maintenance releases, fisheries passage releases, summer baseflow, and other planned releases) as necessary to minimize deleterious effects of flow increases/decreases.	1	5	East Bay Municipal Utilities District (EBMUD)						TBD	
SanLC-CCCS-25.1.2.6	Action Step	Water Diversion/ Impoundment	Establish and implement a comprehensive stream flow program to improve survival at all life stages by improving the spatial and temporal pattern of surface flows throughout spawning, rearing, and migration areas.	1	5	East Bay Municipal Utilities District (EBMUD)	79.00					79	Cost based on stream flow/precipitation model at a rate of $78,100/project.
SanLC-CCCS-25.1.2.7	Action Step	Water Diversion/ Impoundment	Develop flow schedules below Chabot and San Leandro reservoirs that maximize current and potential habitat conditions.	1	5	East Bay Municipal Utilities District (EBMUD)						0	Cost accounted for in above action step.

San Lorenzo Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
SLoA-CCCS-1.1	Objective	Estuary	Address the present or threatened destruction, modification, or curtailment of the species habitat or range										
SLoA-CCCS-1.1.1	Recovery Action	Estuary	Increase quality and extent of estuarine habitat										
SLoA-CCCS-1.1.1.1	Action Step	Estuary	Restore and enhance ecological function within the San Lorenzo Creek estuary and San Francisco Bay.	2	100	Alameda County, City of San Lorenzo	2.50	2.50	2.50	2.50	2.50	50	Cost based on treating 1 acre (assume 10% of total estuarine habitat) at a rate of $49,200/acre. Cost could be higher depending on engineering and oversight.
SLoA-CCCS-1.1.1.2	Action Step	Estuary	Develop and implement Estuary Protection and Enhancement Guidelines to maintain estuary function and provide information for estuary restoration.	2	25	Alameda County						TBD	Developing guidelines may only take several years and less than $100k. However, implementing recommendations may take several decades and cost millions of dollars. Thus, the cost is difficult to estimate at this time since the future recommendations are unknown at this time.
SLoA-CCCS-1.1.1.3	Action Step	Estuary	Improve estuarine freshwater inflow	3	100	Alameda County, City of San Lorenzo						TBD	
SLoA-CCCS-2.1	Objective	Floodplain Connectivity	Address the present or threatened destruction, modification, or curtailment of the species habitat or range										
SLoA-CCCS-2.1.1	Recovery Action	Floodplain Connectivity	Rehabilitate and enhance floodplain connectivity										
SLoA-CCCS-2.1.1.1	Action Step	Floodplain Connectivity	Improve over-winter survival by increasing the frequency and functionality of floodplain habitats.	2	10	Alameda County, City of San Lorenzo	536	536				1,072	Cost based on treating 0.3 miles (assume 1 project/mile with 80 acres/mile) at a rate of $44,640/acre.
SLoA-CCCS-2.1.1.2	Action Step	Floodplain Connectivity	Implement actions that re-establish the hydrologic connection between stream channels and adjacent floodplain habitat.	1	50	Alameda County, City of San Lorenzo, FEMA, Private Landowners, USACE						TBD	The number, scope and duration of actions is unknown at this time.
SLoA-CCCS-3.1	Objective	Hydrology	Address the present or threatened destruction, modification, or curtailment of the species habitat or range										
SLoA-CCCS-3.1.1	Recovery Action	Hydrology	Improve flow conditions										
SLoA-CCCS-3.1.1.1	Action Step	Hydrology	Implement storm water management actions so that patterns of water runoff, including surface and subsurface drainage, match, to the greatest extent possible, the natural hydrologic pattern for the watershed in timing, quantity, and quality.	2	25	Alameda County, City of San Lorenzo, Private Landowners, RWQCB						0	Action is considered In-Kind
SLoA-CCCS-3.1.1.2	Action Step	Hydrology	Study the potential to release water from Don Castro and/or Cull reservoirs to maintain suitable rearing temperatures and migratory flows in downstream habitats (e.g., pulse flow programs for adult upstream migration and smolt outmigration). Implement recommendations arising from study.	1	25	Alameda County						TBD	Cost is TBD and dependent on results of study.
SLoA-CCCS-3.1.1.3	Action Step	Hydrology	Monitor, identify problems, and prioritize need for changes to water diversion to restore and/or maintain steelhead habitat.	3	10	Alameda County, City of San Lorenzo	39.50	39.50				79	Cost based on stream flow/precipitation model at a rate of $78,100/project.
SLoA-CCCS-3.1.1.4	Action Step	Hydrology	Encourage water conservation and the use of native vegetation in new landscaping to reduce the need for watering and application of herbicides, pesticides, and fertilizers.	3	100	Alameda County, NRCS, Private Landowners, RCD, RWQCB						0	Action is considered In-Kind

San Lorenzo Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
SLoA-CCCS-3.1.1.5	Action Step	Hydrology	Use the most recent update of NMFS' Water Diversion Guidelines in determinations regarding water diversions	2	100	Alameda County, City of San Lorenzo, SWRCB						0	Using NMFS guidelines not expected to result in higher costs. Action is considered In-Kind
SLoA-CCCS-3.1.1.6	Action Step	Hydrology	Identify and eliminate depletion of summer base flows from unauthorized water uses.	2	10	Alameda County, CDFW, CDFW Law Enforcement, NMFS, NMFS OLE, SWRCB						0	Cost is expected to be low and already captured through existing state and federal resources. Action is considered In-Kind
SLoA-CCCS-3.1.1.7	Action Step	Hydrology	Request that SWRCB review and/or modify water use based on the needs of juvenile salmonids.	2	10	Alameda County, CDFW, NMFS, SWRCB						0	Requesting SWRCB review water uses in San Lorenzo Creek is not expected to cost more than already allocated staff time. Action is considered In-Kind
SLoA-CCCS-3.1.1.8	Action Step	Hydrology	Require streamflow gauging devices to determine the level of impairment to natural flow.	2	10	Alameda County, CDFW, NMFS, USGS						TBD	cost is TBD since the number of devices necessary is unknown at this time.
SLoA-CCCS-3.1.1.9	Action Step	Hydrology	Reduce storm runoff through increased infiltration and retention (ACFCWCD 2002). First conduct a study to research the issue, then implement recommendations from the study.	2	50	Alameda County, CDFW, NMFS, NRCS, Private Consultants, Private Landowners, RCD, RWQCB						TBD	Cost is TBD since the potential solutions are not yet known and will result from the future study.
SLoA-CCCS-5.1	Objective	Passage	Address the present or threatened destruction, modification, or curtailment of the species habitat or range										
SLoA-CCCS-5.1.1	Recovery Action	Passage	Modify or remove physical passage barriers										
SLoA-CCCS-5.1.1.1	Action Step	Passage	Identify high priority barriers and restore passage per NMFS' Guidelines for Salmonid Passage at Stream Crossings (NMFS 2001a).	2	10	Alameda County, City of San Lorenzo, RCD	150					150	Cost is an estimate for passage assessment, prioritization, and feasibility study. Costs for addressing passage will be determined following an assessment, prioritization, and feasibility plan.
SLoA-CCCS-5.1.1.2	Action Step	Passage	Investigate modifying or removing Cull Reservoir dam to allow upstream and downstream steelhead passage (ACFCWCD 2002). If modification or removal is feasible, implement recommendations from study.	1	25	Alameda County, CDFW, NMFS						0	Cost accounted for in above action step.
SLoA-CCCS-5.1.1.3	Action Step	Passage	Investigate modifying or removing Don Castro Dam to allow upstream and downstream steelhead passage (ACFCWCD 2002). If modification or removal is feasible, implement recommendations from study.	1	25	Alameda County, CDFW, NMFS						0	Cost accounted for in above action step.
SLoA-CCCS-5.1.1.4	Action Step	Passage	Modify the box culvert on Crow Creek as per recommendations of Love (2001) and (ACFCWCD 2002).	1	10	Alameda County, CDFW, NMFS						TBD	
SLoA-CCCS-5.1.1.5	Action Step	Passage	Assess fish passage and flood hazards associated with the two double barrel culverts upstream of the box culvert at the confluence with Crow Creek (ACFCWCD 2002). If feasible, implement recommendations from assessment to rectify problem.	1	10	Alameda County, CDFW, NMFS						TBD	
SLoA-CCCS-5.1.1.6	Action Step	Passage	Investigate providing fish passage at the CalTrans drop-structure on Eden Creek (ACFCWCD 2002) once passage above Don Castro reservoir is achieved. If feasible, implement recommendations from investigation to re-establish fish passage at this location.	2	10	Alameda County, CDFW, NMFS						TBD	

San Lorenzo Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
SLoA-CCCS-5.1.1.7	Action Step	Passage	Assess the function and impacts of the many failing post-and-wire bank revetment sites throughout the watershed, and address as necessary (ACFCWCD 2002).	3	20	CDFW, NMFS, NRCS, Private Landowners, RCD						TBD	
SLoA-CCCS-5.1.1.8	Action Step	Passage	Implement the recommendations of the study(ies) investigating modification or removal of Don Castro Dam and Cull Canyon Dam.	2	25	Alameda County, CDFW, NMFS, Private Consultants, RWQCB						TBD	
SLoA-CCCS-5.1.1.9	Action Step	Passage	Assess fish passage in the 4.6 mile concrete channel between the San Francisco Bay and Foothilll Boulevard. If feasible, implement recommendations from assessment to rectify problem.	1	10	Alameda County, City						TBD	
SLoA-CCCS-6.1	Objective	Habitat Complexity	Address the present or threatened destruction, modification, or curtailment of the species habitat or range										
SLoA-CCCS-6.1.1	Recovery Action	Habitat Complexity	Improve frequency of primary pools, LWD and shelters										
SLoA-CCCS-6.1.1.1	Action Step	Habitat Complexity	Encourage retention and recruitment of large woody debris to maintain current stream complexity, pool frequency, and depth.	2	100	Alameda County, City of San Lorenzo, RCD						0	Action is considered In-Kind
SLoA-CCCS-6.1.1.2	Action Step	Habitat Complexity	Encourage landowners to implement woody debris restoration projects as part of their ongoing operations in stream reaches where large woody debris is lacking.	2	100	Alameda County, City						TBD	Cost uncertain at this time, However, cost of incorporating LWD into ongoing operations is expected to be low.
SLoA-CCCS-6.1.1.3	Action Step	Habitat Complexity	Where feasible, increase woody cover and habitat complexity within pool and flatwater habitat units throughout the San Lorenzo Creek watershed. High priority tributaries include Crow and Palomares creeks (if passage above Don Castro is achieved) (ACFCWCD 2002).	2	10	Alameda County, City of San Lorenzo, RCD	16.00	16.00				32	Cost based on treating 0.5 mile (assume 1 project/mile in 50% high IP) at a rate of $31,200/mile. Cost likely higher with greater engineering and oversight.
SLoA-CCCS-6.1.1.4	Action Step	Habitat Complexity	Where feasible, design and engineer pool enhancement structures to increase the number and quality of pools. This must be done where the banks are stable or in conjunction with stream bank stabilization to prevent erosion. High priority tributaries include reaches accessible to steelhead.	2	20	Alameda County, City of San Lorenzo, NRCS, Private Landowners, RCD, USACE	34.50	34.50	34.50	34.50		138	Cost based on fish/habitat restoration model at a rate of $137,833/project. Cost for individual projects accounted for in above action steps.
SLoA-CCCS-6.1.1.5	Action Step	Habitat Complexity	Maintain current LWD, boulders, and other structure-providing features to maintain current stream complexity, pool frequency, and depth.	3	100	Alameda County, City of San Lorenzo, Private Landowners						0	Maintenance responsibilities and costs are usually incorporated into the restoration project agreement, and are not likely to have a separate cost. Action is considered In-Kind
SLoA-CCCS-6.1.1.6	Action Step	Habitat Complexity	Complete habitat assessments within Castro Valley Creek, Cull Creek, Palomares Creek (sections not assessed in 2000), and San Lorenzo Creek (below Foothill Boulevard and above Eden Creek confluence) (ACFCWCD 2002).	2	5	Alameda County, CDFW, City of San Lorenzo, RCD						TBD	TBD since length of surveyed streams is difficult to estimate at this time.
SLoA-CCCS-7.1	Objective	Riparian	Address the present or threatened destruction, modification, or curtailment of the species habitat or range										
SLoA-CCCS-7.1.1	Recovery Action	Riparian	Improve riparian conditions										
SLoA-CCCS-7.1.1.1	Action Step	Riparian	Assess riparian canopy and impacts of exotic vegetation (e.g., Arundo donax, ivy, etc.), prioritize and develop riparian habitat reclamation and enhancement programs.	2	20	Alameda County, CDFW, NMFS, NOAA RC	25.00	25.00	25.00	25.00		100	

San Lorenzo Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
SLoA-CCCS-7.1.1.2	Action Step	Riparian	Develop a Large Wood Recruitment Plan that assesses instream wood needs, and sites potentially responsive to wood recruitment or placement, and develop a riparian strategy to ensure long term natural recruitment of wood via large tree retention.	2	20	Alameda County, City of San Lorenzo, RCD						0	Cost accounted for in HABITAT COMPLEXITY.
SLoA-CCCS-7.1.1.3	Action Step	Riparian	Restore and protect riparian vegetation to improve migration and summer/overwintering habitat for steelhead.	2	100	Alameda County, City, RCD						0	Cost accounted for in RIPARIAN.
SLoA-CCCS-7.1.1.4	Action Step	Riparian	Increase riparian canopy levels, where necessary, by planting native riparian trees along the stream where shade canopy is not at acceptable levels. In many cases, planting will need to be coordinated to follow bank stabilization or upslope erosion control projects.	3	100	Alameda County, City of San Lorenzo, NMFS, NOAA RC, NRCS, Private Landowners, RCD						TBD	Cost accounted for.
SLoA-CCCS-7.1.1.5	Action Step	Riparian	Promote streamside conservation measures, including conservation easements, setbacks, and riparian buffers.	2	100	Alameda County, CDFW, City of San Lorenzo, NMFS, NOAA RC, Private Landowners						0	Promoting conservation measures is a low cost undertaking. Action is considered In-Kind
SLoA-CCCS-8.1	Objective	Sediment	Address the present or threatened destruction, modification, or curtailment of the species habitat or range										
SLoA-CCCS-8.1.1	Recovery Action	Sediment	Improve instream gravel quality										
SLoA-CCCS-8.1.1.1	Action Step	Sediment	Conduct road and sediment reduction assessments to identify sediment-related and runoff-related problems and determine level of hydrologic connectivity.	2	10	Alameda County, City, RCD, Sonoma County	25.00	25.00				50	
SLoA-CCCS-8.1.1.2	Action Step	Sediment	Institute erosion control projects using biotechnical erosion control methods that can restore streambank integrity and increase habitat values (Kobernus 1998).	2	20	Alameda County, City of San Lorenzo, Private Landowners, RCD						TBD	Cost is TBD since the number, scope, and location of future projects is unknown.
SLoA-CCCS-10.1	Objective	Water Quality	Address the present or threatened destruction, modification, or curtailment of the species habitat or range										
SLoA-CCCS-10.1.1	Recovery Action	Water Quality	Improve stream temperature conditions										
SLoA-CCCS-10.1.1.1	Action Step	Water Quality	Plant native vegetation to promote streamside shade: increase the canopy by planting native species where shade canopy is not at acceptable levels.	2	10	Alameda County, City, NRCS, Private Landowners, RCD						TBD	Cost unknown since number and scope of future projects are unknown. However, riparian planting is generally a low-cost restoration action (approximately $37k/acre (NMFS 2008)). Cost likely accounted for in other action steps.
SLoA-CCCS-10.1.2	Recovery Action	Water Quality	Improve stream water quality conditions										
SLoA-CCCS-10.1.2.1	Action Step	Water Quality	Assess and remove sources of toxins from watershed areas or streams.	2	10	Alameda County, City						TBD	Cost based on installing a minimum of 3 continuous monitoring stations at a rate of $5,000/station. Cost estimate for filter or buffer systems for pollutant ranges between $8,000 to $2,200,000/Mgal.
SLoA-CCCS-10.1.2.2	Action Step	Water Quality	Decrease the amount of trash entering creeks.	2	25	Alameda County, City of San Lorenzo						0	This recommendation should be part of ongoing urban improvements. Action is considered In-Kind

San Lorenzo Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
SLoA-CCCS-10.1.2.3	Action Step	Water Quality	Address water pollution from non-point sources within lower San Lorenzo Creek through outreach, education and enforcement.	2	10	Alameda County, City of San Lorenzo, RWQCB						0	Cost accounted for in above action step.
SLoA-CCCS-11.1	Objective	Viability	Address other natural or manmade factors affecting the species' continued existence										
SLoA-CCCS-11.1.1	Recovery Action	Viability	Increase density, abundance, spatial structure, and diversity based on the biological recovery criteria										
SLoA-CCCS-11.1.1.1	Action Step	Viability	Conduct a comprehensive assessment of watershed processes (e.g., hydrology, geology, fluvial-geomorphology, water quality, and vegetation), instream habitat, and factors limiting steelhead production.	1	10	Alameda County, City, RCD	69.00	69.00				138	Cost based on fish/habitat restoration model at a rate of $137,833/project. Additional parameters likely will increase overall cost of model.
SLoA-CCCS-11.1.1.2	Action Step	Viability	Investigate reintroducing steelhead into newly accessible habitat following projects that address passage barriers.	2	50	CDFW, NMFS, NOAA SWFSC						0	Action is considered In-Kind
SLoA-CCCS-11.1.1.3	Action Step	Viability	Utilize CDFW approved implementation, effectiveness, and validation monitoring protocols when assessing efficacy of restoration efforts.	2	100	Alameda County, City, Private Landowners, RCD						TBD	Cost is uncertain since the number, location and scope of future restoration actions is unknown. However, the cost per individual project is approximately $100k.
SLoA-CCCS-13.1	Objective	Channel Modification	Address the present or threatened destruction, modification, or curtailment of the species habitat or range										
SLoA-CCCS-13.1.1	Recovery Action	Channel Modification	Prevent or minimize impairment of floodplain connectivity (impaired quality & extent)										
SLoA-CCCS-13.1.1.1	Action Step	Channel Modification	Set-back existing levees in strategic areas to increase flood-flow detention and promote flood-tolerant land uses.	3	30	Alameda County, FEMA, Private Landowners, RCD, USACE						TBD	Cost based on amount of levees to be set-back to improve habitat/channel conditions. Cost estimate for set-back levee is $41.93/linear foot.
SLoA-CCCS-13.1.1.2	Action Step	Channel Modification	Implement alternatives to bank hardening and promote bioengineering solutions where feasible.	2	100	Alameda County, City, Private Landowners, USACE						0	Action is considered In-Kind
SLoA-CCCS-13.1.1.3	Action Step	Channel Modification	Eliminate the use of gabion baskets and undersized rock within the bankfull channel.	3	100	Alameda County, CalTrans, City, FEMA, NMFS, Private Landowners, RCD, USACE						0	BMP not expected to have any associated costs.
SLoA-CCCS-13.1.1.4	Action Step	Channel Modification	Discourage stabilization projects which will lead to additional instability either up- or downstream.	2	100	Alameda County, CDFW, NMFS, USACE						0	BMP that is not expected to increase project costs.
SLoA-CCCS-13.1.1.5	Action Step	Channel Modification	Thoroughly investigate the ultimate cause of channel instability prior to engaging in site specific channel modifications and maintenance. Identify and target remediation of watershed process disruption as an overall priority.	2	100	Alameda County, Private Landowners						TBD	Cost uncertain since number, scope and location of future projects is unknown at this time.
SLoA-CCCS-13.1.2	Recovery Action	Channel Modification	Prevent or minimize adverse alterations to riparian species composition and structure										

San Lorenzo Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
SLoA-CCCS-13.1.2.1	Action Step	Channel Modification	Design proposed levees to account for minimal maintenance associated with an intact and functioning riparian zone.	3	100	Alameda County, FEMA, Private Landowners, USACE						0	Cost associated with design changes to levees is expected to be small.
SLoA-CCCS-13.1.2.2	Action Step	Channel Modification	Where new levees or similar flood control projects are planned, develop setbacks to allow the river to respond to natural hydrologic process and remain in equilibrium. At a minimum, setbacks should accommodate a 100 year event.	2	100	Alameda County, City, FEMA, Private Landowners, USACE						TBD	Cost is TBD since the number and size of future levee development is unknown at this time.
SLoA-CCCS-13.1.2.3	Action Step	Channel Modification	Minimize or prevent the use of new flood control projects or additions from facilitating new development (as opposed to protecting existing infrastructure).	1	100	Alameda County, City						0	Avoiding development in sensitive habitat is not expected to appreciably increase project costs.
SLoA-CCCS-22.1	Objective	Residential/ Commercial Development	Address the present or threatened destruction, modification, or curtailment of the species habitat or range										
SLoA-CCCS-22.1.1	Recovery Action	Residential/ Commercial Development	Prevent or minimize impairment to stream hydrology (impaired water flow)										
SLoA-CCCS-22.1.1.1	Action Step	Residential/ Commercial Development	As mitigation for hydrograph consequences, municipalities and the county should investigate funding of larger detention devices in key watersheds with ongoing channel degradation or in sub-watersheds where impervious surface area > 10 percent.	3	5	Alameda County, CDFW, City of San Lorenzo, NMFS						TBD	Investigating funding larger detention devices is not expected to cost much. Implementing the devices will be much more expensive.
SLoA-CCCS-22.1.1.2	Action Step	Residential/ Commercial Development	Create flood refuge habitat, such as hydrologically connected floodplains with riparian forest, and use streamway concept where appropriate.	2	25	Alameda County, CDFW, City of San Lorenzo, NMFS, Private Landowners						TBD	Number, location and scope of future projects is uncertain at this time.
SLoA-CCCS-22.1.1.3	Action Step	Residential/ Commercial Development	Where existing infrastructure exists within historical floodplains or offchannel habitats, and restoration is found feasible, encourage willing landowners to restore these areas through conservation easements, etc.	2	25	CDFW, NMFS, Private Landowners						0	Encouraging landowners to restore floodplain areas is not expected to cost much.
SLoA-CCCS-22.1.2	Recovery Action	Residential/ Commercial Development	Prevent or minimize adverse alterations to riparian species composition and structure										
SLoA-CCCS-22.1.2.1	Action Step	Residential/ Commercial Development	Maintain intact and properly functioning riparian buffers to filter and prevent fine sediment input from entering streams and to provide shade.	2	100	Alameda County, City, Private Landowners						0	Action is considered In-Kind
SLoA-CCCS-22.1.2.2	Action Step	Residential/ Commercial Development	Promote the re-vegetation of the native riparian plant community within inset floodplains and riparian corridors to ameliorate instream temperature and provide a source of future large woody debris recruitment.	2	10	Alameda County, CDFW, City of San Lorenzo, NMFS, Private Landowners, Public	99.50	99.50				199	Cost based on treating 0.1 mile (assume 1 project/mile in 5% high IP with 80 acres/mile) at a rate of $24,862/acre.
SLoA-CCCS-22.1.2.3	Action Step	Residential/ Commercial Development	Institutionalize programs to purchase land/conservation easements to encourage the re-establishment and/or enhancement of natural riparian communities.	2	25	Alameda County, CDFW, Farm Bureau, Land Trusts, NMFS, NRCS, RCD						TBD	Institutionalizing programs to purchase land is not expected to be much cost. Buying the land, on the other hand, is likely to be very expensive. Cost based on fair market value, land turnover, and participation from landowners.

San Lorenzo Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
SLoA-CCCS-22.1.2.4	Action Step	Residential/ Commercial Development	Identify areas at high risk of conversion, and develop incentives and alternatives for landowners that discourage conversion.	2	25	Alameda County, CDFW, City of San Lorenzo, NMFS, Private Landowners, RCD						0	Cost of identifying and developing incentives to landowners expected to be low.
SLoA-CCCS-22.1.3	Recovery Action	Residential/ Commercial Development	Prevent or minimize reduced density, abundance, and diversity										
SLoA-CCCS-22.1.3.1	Action Step	Residential/ Commercial Development	Improve education and awareness of agencies, landowners and the public regarding salmonid protection and habitat requirements.	2	100	Alameda County, City, RCD						0	Action is considered In-Kind
SLoA-CCCS-22.1.3.2	Action Step	Residential/ Commercial Development	Educate county and city public works departments, flood control districts, and planning departments, etc., on the critical importance of maintaining riparian vegetation, instream LWD, and LWD recruitment.	2	100	Alameda County, CDFW, City of San Lorenzo, NMFS						0	Cost of training and encouraging partners to maintain riparian health is expected to be low.
SLoA-CCCS-22.1.4	Recovery Action	Residential/ Commercial Development	Prevent or minimize impairment to water quality (increased turbidity, suspended sediment, and/or toxicity)										
SLoA-CCCS-22.1.4.1	Action Step	Residential/ Commercial Development	Disperse discharge from new or upgraded commercial and residential areas into a spatially distributed network rather than a few point discharges, which can result in locally severe erosion and disruption of riparian vegetation and instream habitat.	2	100	Alameda County, City of San Lorenzo						0	Implementing the BMP is not expected to be very costly.
SLoA-CCCS-22.1.4.2	Action Step	Residential/ Commercial Development	New development should minimize storm-water runoff, changes in duration, or magnitude of peak flow.	2	100	Alameda County, City of San Lorenzo						0	Cost of implementing the BMP is expected to be low.
SLoA-CCCS-22.1.4.3	Action Step	Residential/ Commercial Development	Identify areas at increased risk of mass wasting and elevated fine sediment load, and decrease sediment from transportation projects and land management activities in those areas.	2	5	Alameda County, CDFW, NMFS	45.00					45	Cost base on erosion assessment of 10% of total watershed acres at a rate of $15.14/acre.
SLoA-CCCS-22.1.4.4	Action Step	Residential/ Commercial Development	Minimize sediment from existing and future development to magnitudes appropriate to the geologic setting of the watershed	2	100	Alameda County, City of San Lorenzo, Private Landowners						0	Cost of implementing the BMP is expected to be low.
SLoA-CCCS-22.1.4.5	Action Step	Residential/ Commercial Development	Minimize or avoid the use of commercial and industrial products (e.g. pesticides) with high potential for contamination of local waterways.	2	100	Alameda County, City of San Lorenzo						0	Cost of implementing the BMP is expected to be low.
SLoA-CCCS-22.1.4.6	Action Step	Residential/ Commercial Development	Assess efficacy and necessity of ongoing stream maintenance practices and evaluate, avoid, minimize and/or mitigate their impacts to rearing and migrating steelhead.	2	5	CDFW, NMFS, NOAA RC	50.00					50	Estimated cost of $50,000 for an assessment. Cost of other resulting mitigation is unknown since the number, location and scope of future projects is not known.
SLoA-CCCS-22.1.4.7	Action Step	Residential/ Commercial Development	Implement performance standards in Stormwater Management Plans.	2	100	Alameda County, Private Landowners						0	Cost of implementing performance standards is likely low.
SLoA-CCCS-22.2	Objective	Residential/ Commercial Development	Address the inadequacy of existing regulatory mechanisms										
SLoA-CCCS-22.2.1	Recovery Action	Residential/ Commercial Development	Prevent or minimize increased landscape disturbance										
SLoA-CCCS-22.2.1.1	Action Step	Residential/ Commercial Development	Land use zoning should be appropriate to the site and be tolerant to anticipated conditions (e.g., tolerant to frequent flooding).	2	100	Alameda County, City						0	This recommendation should be considered standard practice.
SLoA-CCCS-22.2.1.2	Action Step	Residential/ Commercial Development	Design new developments to avoid unstable slopes, wetlands, areas of high habitat value, and similarly constrained sites that occur adjacent to a CCC steelhead watercourse.	2	100	Alameda County, City of San Lorenzo						0	The cost of implementing the above BMP is uncertain at this time.

San Lorenzo Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
SLoA-CCCS-22.2.1.3	Action Step	Residential/ Commercial Development	Alameda county and municipalities should adopt a policy of "managed retreat" (removal of problematic infrastructure and replacement with native vegetation or flood tolerant land uses) for areas highly susceptible to, or previously damaged from, flooding.	2	50	Alameda County, City of San Lorenzo						TBD	Cost of adopting a new policy is uncertain at this time.
SLoA-CCCS-22.2.1.4	Action Step	Residential/ Commercial Development	Develop policy and guidelines that address land conversion and attempt to minimize conversion-related impacts within the aquatic environment.	2	50	Alameda County, City, RCD						0	Action is considered In-Kind
SLoA-CCCS-22.2.1.5	Action Step	Residential/ Commercial Development	Develop legislation that will fund county planning for environmentally sound growth and water supply and work in coordination with California Dept. of Housing, Association of Bay Area Governments and other government associations (CDFG 2004).	2	10	Alameda County, City of San Lorenzo						0	Action is considered In-Kind
SLoA-CCCS-22.2.1.6	Action Step	Residential/ Commercial Development	Develop and implement ordinances (e.g., Santa Cruz) to restrict subdivisions by requiring a minimum acreage limit for parcelization and in concert with limits on water supply and groundwater recharge areas.	2	5	Alameda County, City, City of San Lorenzo						0	Action is considered In-Kind
SLoA-CCCS-22.2.1.7	Action Step	Residential/ Commercial Development	Minimize or restrict development within riparian zones and the 100-year floodprone zones.	2	100	Alameda County, City of San Lorenzo, Private Landowners						0	Implementing this BMP is not expected to incur appreciable costs.
SLoA-CCCS-22.2.1.8	Action Step	Residential/ Commercial Development	Enforce existing building permit programs to minimize unpermitted construction.	2	100	Alameda County, City of San Lorenzo						0	Cost of ensuring enforcement of existing building permits is expected to be low (i.e., covered as part of already existing enforcement programs).
SLoA-CCCS-22.2.1.9	Action Step	Residential/ Commercial Development	Encourage infill and high density developments over dispersal of low density rural residential in undeveloped areas.	2	100	Alameda County, City						0	Encouraging the county on the above issue is not likely to incur any costs outside of the duties of already salaried state and federal workers. Action is considered In-Kind
SLoA-CCCS-23.1	Objective	Roads/Railroads	Address the present or threatened destruction, modification, or curtailment of the species habitat or range										
SLoA-CCCS-23.1.1	Recovery Action	Roads/Railroads	Prevent or minimize alterations to sediment transport (road condition/density, dams, etc.)										
SLoA-CCCS-23.1.1.1	Action Step	Roads/Railroads	Continue education of Caltrans, County road engineers, and County maintenance staff regarding watershed processes and the adverse effects of improper road construction and maintenance on salmonids and their habitats.	2	100	Alameda County, City of San Lorenzo						0	Action is considered In-Kind
SLoA-CCCS-23.1.1.2	Action Step	Roads/Railroads	Conduct collaborative evaluations of priorities for treatment of road-related CCC steelhead passage barriers, such as the Fish Passage Forum.	2	10	Alameda County, CalTrans, City of San Lorenzo, RCD						0	Fish passage forum and other collaborative evaluations are already in place. Action is considered In-Kind
SLoA-CCCS-23.1.1.3	Action Step	Roads/Railroads	Develop a Steelhead Certification Program for road maintenance staff.	2	3	Alameda County, CDFW, NMFS, Private Consultants, Private Landowners	100.00					100	Estimated cost for development of plan.
SLoA-CCCS-23.1.1.4	Action Step	Roads/Railroads	Conduct outreach and education regarding the adverse effects of roads, and the types of best management practices protective of salmonids.	3	100	Alameda County, City of San Lorenzo, RCD						0	Action is considered In-Kind

San Lorenzo Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
SLoA-CCCS-23.1.1.5	Action Step	Roads/Railroads	Develop a Road Sediment Reduction Plan that prioritizes sites and outlines implementation and a timeline of necessary actions.	2	2	Alameda County, City, RCD	100.00					100	Development of a Road Sediment Reduction Plan may cost up to $100,000.
SLoA-CCCS-23.1.1.6	Action Step	Roads/Railroads	Use best management practices for road construction, maintenance, management and decommissioning (e.g. Hagans & Weaver, 1994; Sommarstrom, 2002; Oregon Department of Transportation, 1999).	1	100	Alameda County, CalTrans, City						0	No cost associated with using best management practices. Action is considered In-Kind
SLoA-CCCS-23.1.1.7	Action Step	Roads/Railroads	Assess and implement actions that hydrologically disconnect roads or reduce sediment sources.	2	20	Alameda County, City, RCD						TBD	
SLoA-CCCS-23.2	Objective	Roads/Railroads	Address the inadequacy of existing regulatory mechanisms										
SLoA-CCCS-23.2.1	Recovery Action	Roads/Railroads	Prevent or minimize alterations to sediment transport (road condition/density, dams, etc.)										
SLoA-CCCS-23.2.1.1	Action Step	Roads/Railroads	For all rural (unpaved) and seasonal dirt roads apply (at a minimum) the road standards outlined in the California Forest Practice Rules.	2	100	Alameda County, Private Landowners, RCD						TBD	Utilizing more stringent road standards will likely increase costs to a small degree.
SLoA-CCCS-23.2.1.2	Action Step	Roads/Railroads	All new crossings and upgrades to existing crossings (bridges, culverts, fills, and other crossings) must accommodate 100-year flood flows and associated bedload and debris.	1	100	Alameda County, Caltrans, Private Landowners						TBD	Utilizing more stringent crossing standards will likely increase costs to a small degree.
SLoA-CCCS-23.2.1.3	Action Step	Roads/Railroads	Limit winter use of unsurfaced roads and recreational trails to decrease fine sediment loads.	2	100	Alameda County, Private Landowners						0	Action is considered In-Kind. Restricting or limiting winter use of trouble roads is not likely to incur high costs.
SLoA-CCCS-23.2.1.4	Action Step	Roads/Railroads	Bridges associated with new roads or replacement bridges (including railroad bridges) should be free span or constructed with the minimum number of bents feasible in order to minimize drift accumulation and facilitate fish passage.	1	100	Caltrans, CDFW, NMFS, Private Landowners, Sonoma County						TBD	Utilizing more stringent crossing standards will likely increase costs to a small degree.
SLoA-CCCS-23.2.1.5	Action Step	Roads/Railroads	Use NMFS Guidelines for Salmonid Passage at Stream Crossings (NMFS 2001a) and appropriate barrier databases when developing new or retrofitting existing road crossings.	1	100	Alameda County, Caltrans, CDFW, NMFS, Private Landowners						TBD	Utilizing more stringent crossing standards will likely increase costs to a small degree.
SLoA-CCCS-23.2.1.6	Action Step	Roads/Railroads	Minimize or restrict new road construction within floodplains, riparian areas, unstable soils or other sensitive areas until a watershed specific road management plan is created and implemented.	1	5	Alameda County, CDFW, NMFS, Private Consultants	100.00					100	estimated cost of plan development
SLoA-CCCS-23.2.1.7	Action Step	Roads/Railroads	Develop a road upgrade fund to supplement FEMA emergency repair funding so problem roads could be upgraded to reduce sediment loading and improve road reliability. Alameda County should seek amendment of FEMA policies to allow improvements that prevent erosion and failure, particularly in watersheds with steelhead.	2	20	Alameda County, CDFW, NMFS, Private Consultants, Private Landowners, RCD						TBD	

Wildcat Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
WCC-CCCS-1.1	Objective	Estuary	Address the present or threatened destruction, modification, or curtailment of the species habitat or range										
WCC-CCCS-1.1.1	Recovery Action	Estuary	Reduce toxicity and pollutants										
WCC-CCCS-1.1.1.1	Action Step	Estuary	Cleanup areas where household and commercial waste has been dumped in the Wildcat Creek Marsh.	3	100	Contra Costa County, EB Parks						TBD	Cost based on amount of waste and area impacted by dumping.
WCC-CCCS-1.1.2	Recovery Action	Estuary	Reduce extent of estuarine shoreline development										
WCC-CCCS-1.1.2.1	Action Step	Estuary	Minimize or prevent development within the Wildcat Creek Marsh and in other marshes along the North Richmond Shoreline.	3	100	Contra Costa County, EB Parks						0	Action is considered In-Kind
WCC-CCCS-1.1.3	Recovery Action	Estuary	Rehabilitate natural river mouth dynamics										
WCC-CCCS-1.1.3.1	Action Step	Estuary	Develop and implement a plan that addresses the concrete-capped sewer line that crosses Wildcat Creek downstream of Richmond Parkway (SFEI 2001; Urban Creeks Council 2010).	3	25	Contra Costa County, EB Parks						TBD	
WCC-CCCS-1.1.4	Recovery Action	Estuary	Increase quality and extent of estuarine habitat										
WCC-CCCS-1.1.4.1	Action Step	Estuary	Re-align levees downstream of Richmond Parkway, in Castro and Wildcat sloughs.	3	5	Contra Costa County, EB Parks	443.00					443	Cost based to treat 1 mile of levees at a rate of $41.93/mile.
WCC-CCCS-2.1	Objective	Floodplain Connectivity	Address the present or threatened destruction, modification, or curtailment of the species habitat or range										
WCC-CCCS-2.1.1	Recovery Action	Floodplain Connectivity	Rehabilitate and enhance floodplain connectivity										
WCC-CCCS-2.1.1.1	Action Step	Floodplain Connectivity	The City and/or County should take actions to acquire or relocate flood prone residences from willing landowners and restore floodplains in these areas. A recommended site from the Urban Creek Council (2010) is the Folsom Avenue properties.	3	100	City, Contra Costa County						TBD	
WCC-CCCS-2.1.1.2	Action Step	Floodplain Connectivity	Add floodplain benches along the channel in areas where the channel has incised.	3	100	City, Contra Costa County, Corps, EB Parks, Private Landowners						TBD	Cost based on amount of incised channel to treat.
WCC-CCCS-2.1.1.3	Action Step	Floodplain Connectivity	Implement actions that re-establish the hydrologic connection between stream channels and adjacent floodplain habitat.	2	5	City, Contra Costa County, USACE	1,071					1,071	Cost based on treating 1 mile at a rate of $1,070,400/mile.
WCC-CCCS-3.1	Objective	Hydrology	Address the present or threatened destruction, modification, or curtailment of the species habitat or range										
WCC-CCCS-3.1.1	Recovery Action	Hydrology	Improve flow conditions										
WCC-CCCS-3.1.1.1	Action Step	Hydrology	Implement storm water management actions so that patterns of water runoff, including surface and subsurface drainage, match, to the greatest extent possible, the natural hydrologic pattern for the watershed in timing, quantity, and quality.	2	25	City, Contra Costa County, Private Landowners						0	Action is considered In-Kind

Wildcat Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
WCC-CCCS-3.1.1.2	Action Step	Hydrology	Study the potential to release water from Lake Anza and/or Jewel Lake to maintain suitable rearing temperatures and migratory flows in downstream habitats (e.g., pulse flow programs for adult upstream migration and smolt outmigration). Implement recommendations arising from study.	1	10	Contra Costa County, EB Parks	39.50	39.50				79	Cost based on stream flow/precipitation model at a rate of $78,100/project.
WCC-CCCS-3.1.1.3	Action Step	Hydrology	Encourage water conservation and the use of native vegetation in new landscaping to reduce the need for watering and application of herbicides, pesticides, and fertilizers.	3	100	City, Contra Costa County						0	Action is considered In-Kind
WCC-CCCS-3.1.1.4	Action Step	Hydrology	Install streamflow gauging devices to monitor stream flow.	2	5	City, Contra Costa County	3.00					3	Cost based on a minimum of 3 stream flow gauges at a rate of $1,000/gauge. Cost does not account for data management or maintenance.
WCC-CCCS-3.1.1.5	Action Step	Hydrology	Reduce storm runoff through increased infiltration and retention. First conduct a study to research the issue, then implement recommendations from the study.	2	10	City, Contra Costa County, EB Parks	39.50	39.50				79	Cost based on stream flow/precipitation model at a rate of $78,100/project.
WCC-CCCS-5.1	Objective	Passage	Address the present or threatened destruction, modification, or curtailment of the species habitat or range										
WCC-CCCS-5.1.1	Recovery Action	Passage	Modify or remove physical passage barriers										
WCC-CCCS-5.1.1.1	Action Step	Passage	Develop and implement plans to address the following barriers in lower Wildcat Creek: Rumrill Blvd. culvert, 23rd Street culvert, Van Ness St. culvert, Church lane culvert, Vale St. culvert, San Pablo Ave. culvert, and the I-80 culvert. Addressing the San Pablo Ave. culvert should be given the highest priority.	2	10	City of San Pablo, Contra Costa County, USACE	4,169	4,169				8,337	Cost based on providing passage at 7 culverts at a rate of $1,190,974/barrier. Cost for the culvert under I-80 likely to be higher than estimated rate.
WCC-CCCS-5.1.1.2	Action Step	Passage	Investigate modifying or removing the Jewel Lake impoundment to allow upstream and downstream steelhead passage. If modification or removal is feasible, implement recommendations from study.	2	10	EB Parks	135.00	135.00				270	Cost based on adult escapement at a rate of $43,654 and juvenile migration modeling at a rate of $225,916.
WCC-CCCS-5.1.1.3	Action Step	Passage	Implement the agency-preferred alternative (NHC 2013) for addressing steelhead passage conditions at the flood control fish ladder,	1	5	City, Contra Costa County, USACE						TBD	
WCC-CCCS-6.1	Objective	Habitat Complexity	Address the present or threatened destruction, modification, or curtailment of the species habitat or range										
WCC-CCCS-6.1.1	Recovery Action	Habitat Complexity	Increase frequency of primary or staging pools										
WCC-CCCS-6.1.1.1	Action Step	Habitat Complexity	Where feasible, design and engineer pool enhancement structures to increase the number and quality of pools. Priority should be given to improve staging and primary pools in reaches downstream of the I-80 culvert per the recommendations made by EBRPD (2007). However, pool enhancement actions should also be implemented in the Lower Wildcat Canyon reaches to increase the depths of pools (SFEI 2001).	2	10	City, Contra Costa County, EB Parks	536	536				1,071	Cost based on treating 1 mile (assume 1 project/mile) at a rate of $1,070,400. Cost could be coupled with FLOODPLAIN CONNECTIVITY.
WCC-CCCS-6.1.1.2	Action Step	Habitat Complexity	Increase the number of primary pools in Wildcat Creek reaches below I-80 to the extent that more than 40% of summer rearing pools meet primary pool criteria (>2.5 feet).	2	50	City of San Pablo, Contra Costa County						0	Cost accounted for in above action step.
WCC-CCCS-6.1.2	Recovery Action	Habitat Complexity	Increase large wood frequency (BFW 0-10 meters)										

Wildcat Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
WCC-CCCS-6.1.2.1	Action Step	Habitat Complexity	Install large woody debris to increase pools depths and increase shelter in pools. High priority restoration sites identified by EBRPD (2007) include reaches between the railroad trestle and Rumrill Blvd. culvert, Church Lane to Vale Street, Vale Street to San Pablo Ave, and between the San Pablo Avenue and I-80 culverts.	2	20	City of San Pablo, Contra Costa County, EB Parks						0	Cost accounted for in other action steps.
WCC-CCCS-6.1.3	Recovery Action	Habitat Complexity	Improve shelter										
WCC-CCCS-6.1.3.1	Action Step	Habitat Complexity	Ensure cover elements (e.g., undercut banks, large and small wood, rootmass, terrestrial vegetation, aquatic vegetation, boulders, and ledges) in primary and staging pools are incorporated into restoration, flood control, and bank stabilization designs.	3	100	City of San Pablo, Contra Costa County, EB Parks						0	Action is considered In-Kind
WCC-CCCS-6.1.4	Recovery Action	Habitat Complexity	Improve habitat complexity										
WCC-CCCS-6.1.4.1	Action Step	Habitat Complexity	Encourage retention and recruitment of large woody debris to maintain current stream complexity, pool frequency, and depth in reaches where habitat complexity is suitable for steelhead.	2	100	City, Contra Costa County, EB Parks						0	Action is considered In-Kind
WCC-CCCS-6.1.4.2	Action Step	Habitat Complexity	Encourage landowners to implement woody debris restoration projects as part of their ongoing operations in stream reaches where large woody debris is lacking.	2	100	City, Contra Costa County						0	Action is considered In-Kind
WCC-CCCS-6.1.4.3	Action Step	Habitat Complexity	Where feasible, increase woody cover and habitat complexity within pool and flatwater habitat units throughout the Wildcat Creek watershed.	2	20	City, Contra Costa County, EB Parks	8.00	8.00	8.00	8.00		32	Cost based to treat 1 mile (assume 1 project/mile) at a rate of $31,200/mile. Cost likely higher for greater engineering and oversight.
WCC-CCCS-6.1.4.4	Action Step	Habitat Complexity	Complete habitat assessments throughout the Wildcat Creek watershed.	2	10	CDFW, EB Parks, RCD, Urban Creeks Council	138.00	138.00				276	Conduct habitat assessments according to CDFW/NMFS protocols once every five years. Cost based on fish/habitat restoration model at a rate of $137,833/project.
WCC-CCCS-7.1	Objective	Riparian	Address the present or threatened destruction, modification, or curtailment of the species habitat or range										
WCC-CCCS-7.1.1	Recovery Action	Riparian	Improve canopy cover										
WCC-CCCS-7.1.1.1	Action Step	Riparian	Plant riparian vegetation to improve canopy cover. Recommended planting sites from EBRPD (2007) include reaches downstream and upstream of the 23rd Street culvert, downstream of the Church Lane culvert, just downstream of the Vale Street Culvert, just downstream of the San Pablo Avenue culvert, and in the reach between the San Pablo Ave and I-80 culverts.	3	10	City, County, RCD	249.00	249.00				498	Cost based on treating 2 mile with an estimate of 10 acres/mile at a rate of $24,862/acre.
WCC-CCCS-7.1.1.2	Action Step	Riparian	Assess riparian canopy and impacts of exotic vegetation (e.g., Arundo donax, etc.), prioritize and develop riparian habitat reclamation and enhancement programs (CDFG 2004).	2	20	City, Contra Costa County, EB Parks	328	328	328			984	Cost based on treating 1 mile (assume 1 project/mile with 20 acres/mile) at a rate of $49,200/acre.
WCC-CCCS-7.1.1.3	Action Step	Riparian	Develop a Large Wood Recruitment Plan that assesses instream wood needs, and sites potentially responsive to wood recruitment or placement, and develop a riparian strategy to ensure long term natural recruitment of wood via large tree retention.	2	10	City, Contra Costa County, EB Parks	89.50	89.50				179	Cost based on fish/habitat restoration model at a rate of $178,833/project.

Wildcat Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
WCC-CCCS-7.1.1.4	Action Step	Riparian	Promote streamside conservation measures, including conservation easements, setbacks, and riparian buffers (CDFG 2004).	2	100	City, Contra Costa County						0	Action is considered In-Kind
WCC-CCCS-8.1	Objective	Sediment	Address the present or threatened destruction, modification, or curtailment of the species habitat or range										
WCC-CCCS-8.1.1	Recovery Action	Sediment	Improve instream gravel quality										
WCC-CCCS-8.1.1.1	Action Step	Sediment	Replace in-stream structures that constrict storm flows, creating backwater conditions that lead to over-bank flooding and in-channel sedimentation. Recommended actions from the Urban Creeks Council (2010) include the modification/replacement of the Rumrill Road culvert, 23rd Street Bridge, Church Lane culvert, and the BNSF Railroad Trestle Bridge (located at the downstream end of Phase II of the USACE Flood Control Project).	2	30	BNFSF Railway Company, City of San Pablo, Contra Costa County						0	Cost accounted for in HABITAT COMPLEXITY and FLOOD CONNECTIVITY.
WCC-CCCS-8.1.1.2	Action Step	Sediment	Conduct road and sediment reduction assessments to identify sediment-related and runoff-related problems and determine level of hydrologic connectivity.	2	10	City, Contra Costa County, EB Parks, Private Landowners						0	Cost accounted for in ROADS/RAILROADS.
WCC-CCCS-8.1.1.3	Action Step	Sediment	Re-establish natural sediment delivery processes by assessing sediment delivery sources at the sub-watershed scale and prioritizing sediment reduction activities.	2	20	City, Contra Costa County, EB Parks						0	Cost accounted for in other action steps.
WCC-CCCS-8.1.1.4	Action Step	Sediment	Institute erosion control projects using biotechnical erosion control methods that can restore streambank integrity and increase habitat values.	2	20	City, Contra Costa County, EB Parks, Private Landowners						TBD	Cost based on amount of erosion control projects. Cost estimate at a range of $3,681/acre plus riparian revegetation at an estimate of $24,862/acre.
WCC-CCCS-10.1	Objective	Water Quality	Address the present or threatened destruction, modification, or curtailment of the species range or habitat										
WCC-CCCS-10.1.1	Recovery Action	Water Quality	Improve stream temperature conditions										
WCC-CCCS-10.1.1.1	Action Step	Water Quality	Plant native vegetation to promote streamside shade and install large woody debris to increase pools depths. High priority restoration sites identified by EBRPD (2007) include reaches between the railroad trestle and Rumrill Blvd. culvert, Church Lane to Vale Street, Vale Street to San Pablo Ave, and between the San Pablo Avenue and I-80 culverts.	1	100	City, County, RCD						0	Cost accounted for in other action steps.
WCC-CCCS-10.1.1.2	Action Step	Water Quality	Determine site-specific recommendations for improving riparian habitat to remedy high stream temperatures and implement accordingly (CDFG 2004).	2	5	City, Contra Costa County, EB Parks						0	Costs covered under other recovery actions - See Riparian.
WCC-CCCS-10.1.1.3	Action Step	Water Quality	Implement actions to maintain and restore water temperatures to meet habitat requirements for CCC steelhead in assessed streams.	2	25	City, Contra Costa County, EB Parks, Private Landowners						0	Cost accounted for in other action steps.
WCC-CCCS-10.1.2	Recovery Action	Water Quality	Reduce toxicity and pollutants										

Wildcat Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
WCC-CCCS-10.1.2.1	Action Step	Water Quality	Retrofit the San Pablo Casino Parking lot to include bioretention areas or other landscaping features adapted to treat stormwater runoff on the site.	3	100	City, Private Landowners						TBD	Cost for filter or buffer system estimate range between $8,000 to $2,200,000/Mgal.
WCC-CCCS-11.1	Objective	Viability	Address other natural or manmade factors affecting the species' continued existence										
WCC-CCCS-11.1.1	Recovery Action	Viability	Increase density, abundance, spatial structure, and diversity based on the biological recovery criteria										
WCC-CCCS-11.1.1.1	Action Step	Viability	Conduct a comprehensive assessment of watershed processes (e.g., hydrology, geology, fluvial-geomorphology, water quality, and vegetation), instream habitat, and factors limiting steelhead production.	2	10	City, Contra Costa County, EB Parks, RCD, Urban Creeks Council	89.50	89.50				179	Cost based on fish/habitat restoration model at a rate of $178,833/project. Cost likely higher for each additional parameter.
WCC-CCCS-11.1.1.2	Action Step	Viability	Investigate reintroducing steelhead into newly accessible habitat following projects that address passage barriers.	2	50	CDFW, NMFS, NOAA SWFSC						0	Action is considered In-Kind
WCC-CCCS-11.1.1.3	Action Step	Viability	Utilize CDFW approved implementation, effectiveness, and validation monitoring protocols when assessing efficacy of restoration efforts.	2	100	City, Contra Costa County, EB Parks, Private Landowners						TBD	Cost is uncertain since the number, location and scope of future restoration actions is unknown. However, the cost per individual project is approximately $100k.
WCC-CCCS-11.1.1.4	Action Step	Viability	Develop and implement a monitoring program to evaluate the performance of recovery efforts.	2	10	Alameda County, City, RCD						0	Costs associated with assessing population status and trends are covered in the Monitoring Chapter.
WCC-CCCS-11.1.1.5	Action Step	Viability	Monitor population status for response to recovery actions.	2	10	City, Contra Costa County, EB Parks, Urban Creeks Council						0	Costs associated with assessing population status and trends are covered in the Monitoring Chapter.
WCC-CCCS-11.1.1.6	Action Step	Viability	Develop standardized watershed assessments within sub-watersheds to define limiting factors specific to those areas. Encourage all major landowners to develop similar assessment methods.	3	20	EB Parks, RCD, Urban Creeks Council						0	Action is considered In-Kind
WCC-CCCS-11.1.1.8	Action Step	Viability	Measure or estimate the condition of key habitat attributes across the watershed.	2	20	City, Contra Costa County, EB Parks, RCD, Urban Creeks Council						TBD	Cost likely accounted for in other action steps.
WCC-CCCS-13.1	Objective	Channel Modification	Address the present or threatened destruction, modification, or curtailment of the species habitat or range										
WCC-CCCS-13.1.1	Recovery Action	Channel Modification	Prevent or minimize adverse alterations to riparian species composition and structure										
WCC-CCCS-13.1.1.1	Action Step	Channel Modification	Where new levees or similar flood control projects are planned, develop setbacks to allow the river to respond to natural hydrologic process and remain in equilibrium. At a minimum, setbacks should accommodate a 100 year event.	2	100	City, Contra Costa County, FEMA, Private Landowners, USACE						0	Action is considered In-Kind
WCC-CCCS-13.1.1.2	Action Step	Channel Modification	Minimize or prevent the use of new flood control projects or additions from facilitating new development (as opposed to protecting existing infrastructure).	2	100	City, Contra Costa County						0	Action is considered In-Kind
WCC-CCCS-13.1.2	Recovery Action	Channel Modification	Prevent or minimize impairment to stream hydrology (impaired water flow)										

Wildcat Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
WCC-CCCS-13.1.2.1	Action Step	Channel Modification	The City should pursue actions to prevent creek water return (backfilling) through the storm drain network. Recommended actions from Balance Hydrologics (2007) include installing flap gates at outlets in the creek or re-routing pipes to outflow further downstream (at lower elevations).	3	100	City, County						TBD	
WCC-CCCS-13.1.2.2	Action Step	Channel Modification	The City and County should investigate the potential to detain stormwater on a watershed scale.	3	100	City, County						0	Action is considered In-Kind
WCC-CCCS-13.1.3	Recovery Action	Channel Modification	Prevent or minimize impairment to floodplain connectivity (impaired quality and extent)										
WCC-CCCS-13.1.3.1	Action Step	Channel Modification	Restore natural channel geometry and install floodplain benches when conducting creek restoration and flood control.	3	100	City, Contra Costa County, EB Parks						0	Action is considered In-Kind
WCC-CCCS-13.1.3.2	Action Step	Channel Modification	Set-back existing levees in strategic areas to increase flood-flow detention and promote flood-tolerant land uses.	3	30	City, Contra Costa County, FEMA, Private Landowners, RCD, USACE						TBD	Cost based on amount of set-back levees needed to restore habitat and channel function and value. Cost for levee set-back estimate at $41.93/linear foot.
WCC-CCCS-13.1.3.3	Action Step	Channel Modification	Thoroughly investigate the ultimate cause of channel instability prior to engaging in site specific channel modifications and maintenance. Identify and target remediation of watershed process disruption as an overall priority.	2	100	Contra Costa County, Private Landowners						0	Action is considered In-Kind
WCC-CCCS-22.1	Objective	Residential /Commercial Development	Address the present or threatened destruction, modification, or curtailment of the species habitat or range										
WCC-CCCS-22.1.1	Recovery Action	Residential /Commercial Development	Prevent or minimize impairment to water quality (increased turbidity, suspended sediment, and/or toxicity)										
WCC-CCCS-22.1.1.1	Action Step	Residential /Commercial Development	Disperse discharge from new or upgraded commercial and residential areas into a spatially distributed network rather than a few point discharges, which can result in locally severe erosion and disruption of riparian vegetation and instream habitat.	2	100	City, Contra Costa County						0	Implementing the BMP is not expected to be very costly.
WCC-CCCS-22.1.1.2	Action Step	Residential /Commercial Development	New development should minimize storm-water runoff, changes in duration, or magnitude of peak flow.	2	100	City, Contra Costa County						0	Implementing the BMP is not expected to be very costly.
WCC-CCCS-22.1.1.3	Action Step	Residential /Commercial Development	Identify areas at increased risk of mass wasting and elevated fine sediment load, and decrease sediment from transportation projects and land management activities in those areas.	2	5	City, Contra Costa County, EB Parks, RCD	12.00					12	Cost based on erosion assessment of 10% of total watershed acres at a rate of $15.14/acre.
WCC-CCCS-22.1.1.4	Action Step	Residential /Commercial Development	Ensure toxic waste products from urban activities receive the appropriate treatment before being discharged into any body of water that may enter any steelhead waters.	2	100	City, Contra Costa County						0	Implementing the BMP is not expected to be very costly.
WCC-CCCS-22.1.1.5	Action Step	Residential /Commercial Development	Avoid, or at a minimum minimize, the use of commercial and industrial products (e.g. pesticides) with high potential for contamination of local waterways.	2	100	City, Contra Costa County						0	Implementing the BMP is not expected to be very costly.
WCC-CCCS-22.1.1.6	Action Step	Residential /Commercial Development	Assess efficacy and necessity of ongoing stream maintenance practices and evaluate, avoid, minimize and/or mitigate their impacts to rearing and migrating steelhead.	2	5	City, Contra Costa County, EB Parks						0	Assessing efficacy and necessity of ongoing stream maintenance practices are part of existing and subsequent ESA consultations and other permitting requirements.
WCC-CCCS-22.1.2	Recovery Action	Residential /Commercial Development	Prevent or minimize reduced density, abundance, and diversity										

Wildcat Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
WCC-CCCS-22.1.2.1	Action Step	Residential /Commercial Development	Improve education and awareness of agencies, landowners and the public regarding salmonid protection and habitat requirements.	2	100	RCD, Urban Creeks Council						0	Action is considered In-Kind
WCC-CCCS-22.1.2.2	Action Step	Residential /Commercial Development	Educate county and city public works departments, flood control districts, and planning departments, etc., on the critical importance of maintaining riparian vegetation, instream LWD, and LWD recruitment.	2	100	City, Contra Costa County, EB Parks, RCD, Urban Creeks Council						0	Cost of training and encouraging partners to maintain riparian health is expected to be low.
WCC-CCCS-22.1.2.3	Action Step	Residential /Commercial Development	Design and implement education programs to promote public awareness of steelhead habitat within urban creek settings.	2	100	City, Contra Costa County, EB Parks, RCD, Urban Creeks Council	3.75	3.75	3.75	3.75	3.75	75	Cost estimate from CDFG 2004.
WCC-CCCS-22.1.3	Recovery Action	Residential /Commercial Development	Prevent or minimize adverse alterations to riparian species composition and structure										
WCC-CCCS-22.1.3.1	Action Step	Residential /Commercial Development	Maintain intact and properly functioning riparian buffers to filter and prevent fine sediment input from entering streams and to provide shade.	2	100	City, Contra Costa County, EB Parks, Private Landowners						0	This recommendation should be considered standard practice.
WCC-CCCS-22.1.3.2	Action Step	Residential /Commercial Development	Promote the re-vegetation of the native riparian plant community within inset floodplains and riparian corridors to ameliorate instream temperature and provide a source of future large woody debris recruitment.	2	50	City, Contra Costa County, EB Parks, RCD, Urban Creeks Council						TBD	Cost is TBD since the number, location and scope of future actions is uncertain at this time.
WCC-CCCS-22.1.4	Recovery Action	Residential /Commercial Development	Prevent or minimize impairment to stream hydrology (impaired water flow)										
WCC-CCCS-22.1.4.1	Action Step	Residential /Commercial Development	As mitigation for hydrograph consequences, municipalities and counties should investigate funding of larger detention devices in key watersheds with ongoing channel degradation or in sub-watersheds where impervious surface area > 10 percent.	3	5	CDFW, City, Contra Costa County, NMFS						TBD	Investigating funding larger detention devices is not expected to cost much. Implementing the devices will be much more expensive.
WCC-CCCS-22.1.5	Recovery Action	Residential /Commercial Development	Prevent or minimize impairment to the estuary (impaired quality and extent)										
WCC-CCCS-22.1.5.1	Action Step	Residential /Commercial Development	Identify locations of persistent illegal dumping activities and then install signs, lighting or barriers to discourage future dumping. Signs should indicate the fines and penalties for illegal dumping, and a phone number for reporting incidents.	3	5	City of Richmond, City of San Pablo, Contra Costa County, EB Parks	5.00					5	Estimated cost for the design and installation of signs and other materials related to education of illegal dumping. Enforcement of these laws are considered In-Kind under existing laws and regulations.
WCC-CCCS-22.1.5.2	Action Step	Residential /Commercial Development	Prevent illegal dumping through special cleanup events where communities are provided with the resources to properly dispose of illegally dumped materials and residents are informed of illegal dumping impacts.	3	5	City of Richmond, City of San Pablo, Contra Costa County, EB Parks	2.50					3	Cost for cleanup supplies is estimated to fairly low at a rate of $500/project.
WCC-CCCS-22.2	Objective	Residential /Commercial Development	Address the inadequacy of existing regulatory mechanisms										
WCC-CCCS-22.2.1	Recovery Action	Residential /Commercial Development	Prevent or minimize increased landscape disturbance										
WCC-CCCS-22.2.1.1	Action Step	Residential /Commercial Development	Land use zoning should be appropriate to the site and be tolerant to anticipated conditions (e.g., tolerant to frequent flooding).	2	100	City, Contra Costa County						0	Action is considered In-Kind

Wildcat Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
WCC-CCCS-22.2.1.2	Action Step	Residential /Commercial Development	Design new developments to avoid or minimize effects to unstable slopes, wetlands, areas of high habitat value, and similarly constrained sites that occur adjacent to a CCC steelhead watercourse.	2	100	City, Contra Costa County						TBD	The cost of implementing the above BMP is uncertain at this time.
WCC-CCCS-22.2.1.3	Action Step	Residential /Commercial Development	Contra Costa County and municipalities should adopt a policy of "managed retreat" (removal of problematic infrastructure and replacement with native vegetation or flood tolerant land uses) for areas highly susceptible to, or previously damaged from, flooding.	2	50	City, Contra Costa County						0	Action is considered In-Kind
WCC-CCCS-22.2.1.4	Action Step	Residential /Commercial Development	Develop policy and guidelines that address land conversion and attempt to minimize conversion-related impacts within the aquatic environment.	2	50	City, Contra Costa County, RCD, Urban Creeks Council						0	Action is considered In-Kind
WCC-CCCS-22.2.1.5	Action Step	Residential /Commercial Development	Develop legislation that will fund county planning for environmentally sound growth and water supply and work in coordination with California Dept. of Housing, Association of Bay Area Governments and other government associations (CDFG 2004).	2	10	City, Contra Costa County						0	Action is considered In-Kind
WCC-CCCS-22.2.1.6	Action Step	Residential /Commercial Development	Develop and implement ordinances (e.g., Santa Cruz) to restrict subdivisions by requiring a minimum acreage limit for parcelization and in concert with limits on water supply and groundwater recharge areas.	3	5	City, Contra Costa County						0	Action is considered In-Kind
WCC-CCCS-22.2.1.7	Action Step	Residential /Commercial Development	Minimize or avoid development within riparian zones and the 100-year floodprone zones.	2	100	City, Contra Costa County, Private Landowners						0	Implementing this BMP is not expected to incur appreciable costs.
WCC-CCCS-22.2.1.8	Action Step	Residential /Commercial Development	Enforce existing building permit programs to minimize unpermitted construction.	2	100	City, Contra Costa County						0	Cost of ensuring enforcement of existing building permits is expected to be low (i.e., covered as part of already existing enforcement programs).
WCC-CCCS-22.2.1.9	Action Step	Residential /Commercial Development	Encourage infill and high density developments over dispersal of low density rural residential in undeveloped areas.	2	100	City, Contra Costa County						0	Encouraging the county is not likely to incur any costs outside of the duties of already salaried state and federal workers.
WCC-CCCS-22.2.1.10	Action Step	Residential /Commercial Development	Minimize degradation of steelhead habitat through proper land-use zoning.	2	100	City, Contra Costa County						0	Action is considered In-Kind
WCC-CCCS-22.2.2	Recovery Action	Residential /Commercial Development	Prevent or minimize impairment to the estuary (impaired quality and extent)										
WCC-CCCS-22.2.2.1	Action Step	Residential /Commercial Development	Implement existing ordinances or create new ordinances to regulate waste management and eliminate illegal dumping in the Wildcat Creek Marsh through methods such as fines.	3	100	City of Richmond, City of San Pablo, Contra Costa County, EB Parks						0	Action is considered In-Kind
WCC-CCCS-23.1	Objective	Roads/Railroads	Address the present or threatened destruction, modification, or curtailment of the species habitat or range										
WCC-CCCS-23.1.1	Recovery Action	Roads/Railroads	Prevent or minimize alterations to sediment transport (road condition/density, dams, etc.)										
WCC-CCCS-23.1.1.1	Action Step	Roads/Railroads	Investigate and address road-related sediment sources within the Wildcat Creek watershed.	2	10	City, Contra Costa County	54.50	54.50				109	Cost based on road inventory of 95 miles at a rate of $1,148/mile.

Wildcat Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
WCC-CCCS-23.1.1.2	Action Step	Roads/Railroads	Continue education of County/City road engineers, and County/City maintenance staff regarding watershed processes and the adverse effects of improper road construction and maintenance on salmonids and their habitats.	2	100	City, Contra Costa County						0	Action is considered In-Kind
WCC-CCCS-23.1.1.3	Action Step	Roads/Railroads	Conduct collaborative evaluations of priorities for treatment of road-related CCC steelhead passage barriers, such as the Fish Passage Forum.	2	10	CalTrans, City, Contra Costa County, EB Parks, RCD, Urban Creeks Council						0	Fish passage forum and other collaborative evaluations are already in place.
WCC-CCCS-23.1.1.4	Action Step	Roads/Railroads	Develop a Steelhead Certification Program for road maintenance staff.	2	3	City, Contra Costa County	100.00					100	Estimated cost for development of plan.
WCC-CCCS-23.1.1.5	Action Step	Roads/Railroads	Decommission and rehabilitate riparian road systems and/or upgrade roads (and skid trails on forestlands) that deliver sediment into adjacent watercourses.	2	10	City, Contra Costa County, EB Parks, Private Landowners	239.50	239.50				479	Cost based for decommissioning 19 miles at a rate of $25,200/mile. Cost likely higher due to amount of urbanization with riparian corridors and public infrastructure.
WCC-CCCS-23.1.1.6	Action Step	Roads/Railroads	Conduct outreach and education regarding the adverse effects of roads, and the types of best management practices protective of salmonids.	3	100	City, Contra Costa County, EB Parks, RCD, Urban Creeks Council						0	Action is considered In-Kind
WCC-CCCS-23.1.1.7	Action Step	Roads/Railroads	Develop a Road Sediment Reduction Plan that prioritizes sites and outlines implementation and a timeline of necessary actions.	2	2	City, Contra Costa County, RCD	100.00					100	Development of a Road Sediment Reduction Plan may cost up to $100,000.
WCC-CCCS-23.1.1.8	Action Step	Roads/Railroads	Use best management practices for road construction, maintenance, management and decommissioning (e.g. Hagans & Weaver, 1994; Sommarstrom, 2002; Oregon Department of Transportation, 1999).	1	100	CalTrans, City, Contra Costa County, EB Parks, Private Landowners						0	No cost associated with using best management practices.
WCC-CCCS-23.1.1.9	Action Step	Roads/Railroads	Assess and implement actions that hydrologically disconnect roads or reduce sediment sources.	2	20	City, Contra Costa County, RCD						TBD	Cost based on amount of roads needed to be hydrologically disconnected. Road inventory should identify number and type of roads.
WCC-CCCS-23.1.1.10	Action Step	Roads/Railroads	All new crossings and upgrades to existing crossings (bridges, culverts, fills, and other crossings) must accommodate 100-year flow event and associated sediment transport.	2	100	Caltrans, City of Richmond, City of San Pablo, Contra Costa County, USACE						0	Action is considered In-Kind
WCC-CCCS-23.2	Objective	Roads/Railroads	Address the inadequacy of existing regulatory mechanisms										
WCC-CCCS-23.2.1	Recovery Action	Roads/Railroads	Prevent or minimize alterations to sediment transport (road condition/density, dams, etc.)										
WCC-CCCS-23.2.1.1	Action Step	Roads/Railroads	Reduce sediment sources from road networks, maintenance activities, and other actions that deliver sediment to stream channels through improved, or new, laws and policies, and/or enforcement of existing laws and policies.	2	100	City, Contra Costa County						TBD	Cost based on amount of sediment delivered from road network.
WCC-CCCS-23.2.1.2	Action Step	Roads/Railroads	For all rural (unpaved) and seasonal dirt roads apply (at a minimum) the road standards outlined in the California Forest Practice Rules.	2	100	City, Contra Costa County, Private Landowners, RCD						TBD	Utilizing more stringent road standards will likely increase costs to a small degree.
WCC-CCCS-23.2.1.3	Action Step	Roads/Railroads	Limit winter use of unsurfaced roads and recreational trails to decrease fine sediment loads.	2	100	Contra Costa County, EB Parks, Private Landowners						0	Limiting winter use on trouble roads is not likely to incur high costs.

Wildcat Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
WCC-CCCS-23.2.1.4	Action Step	Roads/Railroads	Bridges associated with new roads or replacement bridges (including railroad bridges) should be free span or constructed with the minimum number of bents feasible in order to minimize drift accumulation and facilitate fish passage.	1	100	Caltrans, City, Contra Costa County, EB Parks, Private Landowners, Sonoma County						TBD	Utilizing more stringent crossing standards will likely increase costs to a small degree.
WCC-CCCS-23.2.1.5	Action Step	Roads/Railroads	Use NMFS Guidelines for Salmonid Passage at Stream Crossings (NMFS 2001a) and appropriate barrier databases when developing new or retrofitting existing road crossings.	1	100	Caltrans, City, Contra Costa County, EB Parks, Private Landowners						0	Action is considered In-Kind
WCC-CCCS-23.2.1.6	Action Step	Roads/Railroads	Establish a moratorium on new road construction within floodplains, riparian areas, unstable soils or other sensitive areas until a watershed specific road management plan is created and implemented.	2	5	City, Contra Costa County, FEMA, USACE						0	Implementation of this action should result in no additional costs.
WCC-CCCS-23.2.1.7	Action Step	Roads/Railroads	Develop a road upgrade fund to supplement FEMA emergency repair funding so problem roads could be upgraded to reduce sediment loading and improve road reliability. The County and cities should seek amendment of FEMA policies to allow improvements that prevent erosion and failure, particularly in watersheds with steelhead.	2	20	City, Contra Costa County						TBD	

Codornices Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
CodC-CCCS-1.1	Objective	Estuary	Address the present or threatened destruction, modification, or curtailment of the species habitat or range										
CodC-CCCS-1.1.1	Recovery Action	Estuary	Increase quality and extent of estuarine habitat										
CodC-CCCS-1.1.1.1	Action Step	Estuary	Develop an estuary rehabilitation and enhancement plan in efforts to reclaim historically tidal influenced areas.	3	10	City of Albany, City of San Pablo	169.50	169.50				339	Cost based on estuary use/residence model at a rate of $338,679/project.
CodC-CCCS-1.1.1.2	Action Step	Estuary	Investigate water quality (D.O., temperature, salinity) conditions for rearing steelhead in potential tidal marsh rehabilitation sites.	3	10	City of Albany, City of San Pablo	7.50	7.50				15	Cost based on installing a minimum of 3 continuous water quality monitoring stations at a rate of $5,000/station.
CodC-CCCS-2.1	Objective	Floodplain Connectivity	Address the present or threatened destruction, modification, or curtailment of the species habitat or range										
CodC-CCCS-2.1.1	Recovery Action	Floodplain Connectivity	Rehabilitate and enhance floodplain connectivity										
CodC-CCCS-2.1.1.1	Action Step	Floodplain Connectivity	Identify areas where floodplain connectivity can be re-established in low gradient response reaches.	3	10	City of Albany, City of San Pablo	128.00	128.00				256	Cost based on wetland restoration model at a rate of $255,968/project.
CodC-CCCS-2.1.1.2	Action Step	Floodplain Connectivity	Design and implement floodplain rehabilitation projects that target velocity refuge for migrating salmonids.	3	10	City of Albany, City of San Pablo						TBD	Costs will vary depending on methods implemented and extent of rehabilitation. Cost estimated at $44,640/acre.
CodC-CCCS-2.1.1.3	Action Step	Floodplain Connectivity	Design and implement floodplain rehabilitation projects that target winter rearing habitat for juvenile steelhead.	3	10	City of Albany, City of San Pablo						TBD	Costs will vary depending on methods implemented and extent of rehabilitation.
CodC-CCCS-5.1	Objective	Passage	Address the present or threatened destruction, modification, or curtailment of the species habitat or range										
CodC-CCCS-5.1.1	Recovery Action	Passage	Modify or remove physical passage barriers										
CodC-CCCS-5.1.1.1	Action Step	Passage	Utilize vegetation methods and bio-techniques to establish a low flow channel throughout the flood control channel. Incorporate features that create velocity refuge during high flow events for immigrating adults.	1	5	City of Albany, City of San Pablo						0	Action is considered In-Kind
CodC-CCCS-5.1.1.2	Action Step	Passage	Modify or remove passage impediments.	1	5	City of Albany, City of San Pablo	5,666					5,666	Cost based on treating a total of 8 crossings (1 total barrier, 3 partial, 4 unknown) at a rate of $1,190,974 for total barrier and $639,247 for partial barriers.
CodC-CCCS-6.1	Objective	Habitat Complexity	Address the present or threatened destruction, modification, or curtailment of the species habitat or range										
CodC-CCCS-6.1.1	Recovery Action	Habitat Complexity	Increase large wood frequency										
CodC-CCCS-6.1.1.1	Action Step	Habitat Complexity	Evaluate and prescribe an appropriate number of key LWD pieces to enhance summer rearing conditions in potential steelhead spawning and rearing areas throughout the watershed.	2	10	City of Albany, City of San Pablo						TBD	Cost based on treating 1 mile (assume 1 project/mile) at a rate of $31,200/mile. If ELJ used, estimate $124,800/ELJ.
CodC-CCCS-6.1.2	Recovery Action	Habitat Complexity	Increase frequency of primary pools										
CodC-CCCS-6.1.2.1	Action Step	Habitat Complexity	Evaluate and prescribe habitat features that will increase primary pool depth and frequency for winter and summer rearing juveniles, and quality staging pools for migrating/staging adults.	2	10	City of Albany, City of San Pablo						0	Cost accounted for in above action step.
CodC-CCCS-6.1.3	Recovery Action	Habitat Complexity	Improve shelter										

Codornices Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
CodC-CCCS-6.1.3.1	Action Step	Habitat Complexity	Increase shelter and habitat complexity features that improve survival of emigrating juvenile and adult steelhead; include efforts in areas such as flood control channels that lack habitat complexity.	2	10	City of Albany, City of San Pablo						0	Cost accounted for in above action step.
CodC-CCCS-7.1	Objective	Riparian	Address the present or threatened destruction, modification, or curtailment of the species habitat or range										
CodC-CCCS-7.1.1	Recovery Action	Riparian	Improve canopy cover										
CodC-CCCS-7.1.1.1	Action Step	Riparian	Identify areas where canopy cover is impaired, and prescribe and implement measures to improve riparian habitat.	2	10	City of Albany, City of San Pablo	50.00	50.00				100	Cost based on treating 0.5 miles (assume 1 project/mile in 5% high IP) at a rate of $
CodC-CCCS-7.1.1.2	Action Step	Riparian	Ensure that mature trees within the steam riparian corridor are not disturbed or lost due to land management activities.	2	10	City of Albany, City of San Pablo						0	Existing programs and outreach are considered In-Kind.
CodC-CCCS-8.1	Objective	Sediment	Address the present or threatened destruction, modification, or curtailment of the species habitat or range										
CodC-CCCS-8.1.1	Recovery Action	Sediment	Improve instream gravel quality to reduce embeddedness										
CodC-CCCS-8.1.1.1	Action Step	Sediment	Evaluate, design, and implement gravel quality and quantity strategies to the extent that the maximum amount of spawning and incubation habitat is achieved.	3	10	City of Albany, City of San Pablo						TBD	Costs will vary depending on methods implemented and extent of rehabilitation. Cost for gravel augmentation estimated at $38/cu. yd.
CodC-CCCS-8.1.1.2	Action Step	Sediment	Add channel roughness (logs, boulders) in strategic locations to encourage spawning tailout formations and gravel sorting.	2	5	City of Albany, City of San Pablo						0	Costs will vary depending on methods implemented and extent of rehabilitation. Cost accounted for in above action step (see HABITAT COMPLEXITY and FLOODPLAIN COMPLEXITY).
CodC-CCCS-10.1	Objective	Water Quality	Address the present or threatened destruction, modification, or curtailment of the species habitat or range										
CodC-CCCS-10.1.1	Recovery Action	Water Quality	Improve instream temperature conditions										
CodC-CCCS-10.1.1.1	Action Step	Water Quality	Identify if water temperatures are limiting steelhead viability in Codornices Creek and, if found to be limiting, develop and implement measures to reduce water temperatures where needed.	3	10	City of Albany, City of San Pablo	0.75	0.75				2	Cost based on installing a minimum of 3 stream temperature gauges at a rate of $500/gauge.
CodC-CCCS-10.1.2	Recovery Action	Water Quality	Reduce toxicity and pollutants										
CodC-CCCS-10.1.2.1	Action Step	Water Quality	Identify and provide solutions for point and non-point sources contributing to poor water quality and pollution.	2	5	City of Albany, City of San Pablo	15.00					15	Cost based on installing a minimum of 3 continuous water quality stations at a rate of $5,000/station. Cost does not account for data management or maintenance.
CodC-CCCS-13.1	Objective	Channel Modification	Address the present or threatened destruction, modification, or curtailment of the species habitat or range										
CodC-CCCS-13.1.1	Recovery Action	Channel Modification	Prevent or minimize impairment to floodplain connectivity (impaired quality & extent)										
CodC-CCCS-13.1.1.1	Action Step	Channel Modification	Minimize or prevent channelization in areas that provide winter refuge and seasonal habitat for juvenile steelhead	2	10	City of Albany, City of San Pablo						0	Action is considered In-Kind

Codornices Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
CodC-CCCS-13.1.1.2	Action Step	Channel Modification	Ensure that all existing channel designed for flood conveyance incorporate features that enhance steelhead migration under high and low flow conditions.	2	10	City of Albany, City of San Pablo						0	Action is considered In-Kind
CodC-CCCS-13.1.1.3	Action Step	Channel Modification	Develop Bank Stabilization and Floodplain Guidelines for use by private and public entities.	3	10	City of Albany, City of San Pablo						0	Existing programs and outreach are considered In-Kind.
CodC-CCCS-13.1.1.4	Action Step	Channel Modification	Evaluate design alternatives to rip-rap bank repairs and incorporate fish habitat features.	3	10	City of Albany, City of San Pablo						TBD	Costs will vary depending on methods implemented.
CodC-CCCS-13.1.1.5	Action Step	Channel Modification	Conserve open space in contiguous landscapes, protect floodplain areas and riparian corridors, and develop conservation easements.	3	10	City of Albany, City of San Pablo						TBD	Costs for conservation easements vary.
CodC-CCCS-13.1.2	Recovery Action	Channel Modification	Prevent or minimize impairment to water quality (increased turbidity, suspended sediment, and/or toxicity										
CodC-CCCS-13.1.2.1	Action Step	Channel Modification	Conduct rehabilitation activities that reconnect channels to floodplains.	2	10	City of Albany, City of San Pablo	321.50	321.50				643	Cost based on treating 0.6 miles (assume 1 project/mile in 25% of flood channel) at a rate of $1,070,400/mile.
CodC-CCCS-13.1.2.2	Action Step	Channel Modification	Develop and implement strategies that slow urban runoff in the northern watershed during the spawning and migration season (slow it, spread it, sink it).	3	10	City of Albany, City of San Pablo						TBD	Cost based on amount of impervious soils contributing to increased runoff and methods to treat. Flood retention basins, engineered wetlands, and bypass channels are potential possibilities.
CodC-CCCS-13.1.3	Recovery Action	Channel Modification	Prevent or minimize impairment to passage and migration										
CodC-CCCS-13.1.3.1	Action Step	Channel Modification	Ensure that existing engineered and modified channels incorporate features that enhance steelhead migration under high and low flow conditions.	2	10	City of Albany, City of San Pablo						0	Action is considered In-Kind
CodC-CCCS-13.1.3.2	Action Step	Channel Modification	Incorporate velocity refuge features in all existing engineered and modified channels.	2	10	City of Albany, City of San Pablo						TBD	Costs will vary depending on methods implemented and extent of rehabilitation.
CodC-CCCS-13.1.3.3	Action Step	Channel Modification	Install features that provides shelter for emigrating juvenile salmonids - focus efforts on areas, such as flood control channels, where shelter is most limited.	2	10	City of Albany, City of San Pablo	316.50	316.50				633	Cost based on treating 0.6 miles (assume 1 project/mile in 25% of flood channel) at a rate of $1,070,400. This action step should be coordinated with other action steps to reduce cost and redundancy.
CodC-CCCS-13.1.3.4	Action Step	Channel Modification	Minimize or prevent any future channel modification in potentially high value seasonal habitat and migration (staging) areas.	2	10	City of Albany, City of San Pablo						0	Action is considered In-Kind
CodC-CCCS-13.1.4	Recovery Action	Channel Modification	Minimize or prevent impairment to habitat complexity (reduced large wood and/or shelter)										
CodC-CCCS-13.1.4.1	Action Step	Channel Modification	Identify locations where channel modification has resulted in decreased shelter, LWD frequency, and habitat complexity, and develop and implement site specific plans to provided shelter and velocity refuge for migrating and rearing steelhead.	2	10	City of Albany, City of San Pablo	69.00	69.00				138	Cost based on fish/habitat restoration model at a rate of $137,833/project.
CodC-CCCS-13.1.4.2	Action Step	Channel Modification	Encourage retention and recruitment of large woody debris to rehabilitate existing stream complexity, pool frequency, and depth.	2	10	City of Albany, City of San Pablo						0	Existing programs and outreach are considered In-Kind.
CodC-CCCS-13.1.4.3	Action Step	Channel Modification	Minimize or prevent the removal of habitat forming structures (LWD, boulders, vegetation, etc.) in all natural waterways.	2	10	City of Albany, City of San Pablo						0	Existing programs and outreach are considered In-Kind.
CodC-CCCS-13.1.5	Recovery Action	Channel Modification	Prevent or minimize impairment to estuary (impaired quality and extent)										

Codornices Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
CodC-CCCS-13.1.5.1	Action Step	Channel Modification	Develop Estuary Enhancement Projects to improve rearing habitat for juveniles and smolts.	3	10	City of Albany, City of San Pablo	25.00	25.00				50	Cost based on treating 0.7 acres (assume 10% of total estuarine acres) at a rate of $49,200/acre. Cost likely higher with greater level of engineering and maintenance involved.
CodC-CCCS-14.1	Objective	Disease/ Predation /Competition	Address disease or predation										
CodC-CCCS-14.1.1	Recovery Action	Disease/ Predation /Competition	Prevent or minimize reduced density, abundance, and diversity										
CodC-CCCS-14.1.1.1	Action Step	Disease/ Predation /Competition	Identify locations within the watershed that support exotic piscivorous fish species, and develop and implement a plan to decrease the effects of predation by these species. Consider provision of instream habitat and cover that provides refuge for salmonids, and/or the elimination of instream conditions that support and favor exotic species.	3	10	City of Albany, City of San Pablo						TBD	Cost based on amount of exotic piscivorous fish species to be removed. Cost for pikeminnow eradication estimated at $9.38/fish.
CodC-CCCS-22.1	Objective	Residential/ Commercial Development	Address the present or threatened destruction, modification, or curtailment of the species habitat or range										
CodC-CCCS-22.1.1	Recovery Action	Residential/ Commercial Development	Prevent or minimize impairment to floodplain connectivity (impaired quality & extent)										
CodC-CCCS-22.1.1.1	Action Step	Residential/ Commercial Development	Design new development to allow streams to meander in historical patterns; protecting riparian zones and their floodplains or channel migration zones averts the need for bank erosion control in most situations.	3	10	City of Albany, City of San Pablo						0	Existing programs and outreach are considered In-Kind.
CodC-CCCS-22.1.1.2	Action Step	Residential/ Commercial Development	Minimize or avoid new development within riparian zones and the 100 year floodprone zones.	3	10	City of Albany, City of San Pablo						0	Existing programs and outreach are considered In-Kind.
CodC-CCCS-22.1.1.3	Action Step	Residential/ Commercial Development	Minimize or avoid future development in floodplains or off channel habitats.	3	10	City of Albany, City of San Pablo						0	Existing programs and outreach are considered In-Kind.
CodC-CCCS-22.1.2	Recovery Action	Residential/ Commercial Development	Prevent or minimize impairment to water quality (increased turbidity, suspended sediment, and/or toxicity)										
CodC-CCCS-22.1.2.1	Action Step	Residential/ Commercial Development	Develop filter or buffer systems that reduce pollutants from entering streams and waterways of Codornices Creek.	2	10	City of Albany, City of San Pablo						TBD	Cost based on amount and size of filter or buffer system needed to reduce pollutants. Cost range from $8,000/Mgal to $2,201,426/Mgal.
CodC-CCCS-22.1.2.2	Action Step	Residential/ Commercial Development	Implement education programs and install signs to promote public awareness of salmon and steelhead and their habitats within the Codornies Creek watershed.	3	10	City of Albany, City of San Pablo	2.50	2.50				5	Cost based on installing a minimum of 5 signs at a cost of $1,000/sign.
CodC-CCCS-23.1	Objective	Roads/Railroads	Address the present or threatened destruction, modification, or curtailment of the species habitat or range										
CodC-CCCS-23.1.1	Recovery Action	Roads/Railroads	Prevent or minimize alterations to sediment transport (road condition/density, dams, etc.)										
CodC-CCCS-23.1.1.1	Action Step	Roads/Railroads	Address sediment and runoff sources from road networks and other actions that deliver sediment and runoff to stream channels.	3	10	City of Albany, City of San Pablo	38.00	38.00				76	Cost based on amount of road network in riparian corridor. Cost estimated for 66 miles of road at a rate of $1,148/mile
CodC-CCCS-23.1.2	Recovery Action	Roads/Railroads	Prevent or minimize impairment to stream hydrology (impaired water flow)										
CodC-CCCS-23.1.2.1	Action Step	Roads/Railroads	Conduct actions that hydrologically disconnect roads.	3	10	City of Albany, City of San Pablo						TBD	Costs will vary depending on methods implemented.

Codornices Creek, Central California Coast Steelhead (Interior San Francisco Bay) Recovery Actions

Action ID	Level	Targeted Attribute or Threat	Action Description	Priority Number	Action Duration (Years)	Recovery Partner	Costs ($K)						Comment
							FY 1-5	FY 6-10	FY 11-15	FY 16-20	FY 21-25	Entire Duration	
CodC-CCCS-23.1.3	Recovery Action	Roads/Railroads	Prevent or minimize impairment to passage and migration										
CodC-CCCS-23.1.3.1	Action Step	Roads/Railroads	Ensure that all future road/stream crossing provide passage for all steelhead life stages.	3	10	City of Albany, City of San Pablo						0	Cost accounted for in above action step.
CodC-CCCS-23.1.3.2	Action Step	Roads/Railroads	Identify and remedy all road/stream crossings that impair or prevent steelhead migration.	1	10	City of Albany, City of San Pablo						0	Cost accounted for in other action step: PASSAGE