County of Santa Cruz

PLANNING DEPARTMENT
701 OCEAN STREET, 4TH FLOOR, SANTA CRUZ, CA 95060
(831) 454-2580 FAX: (831) 454-2131
KATHLEEN MOLLOY PREVISICH, PLANNING DIRECTOR
www.sccoplanning.com

NOTICE OF INTENT TO ADOPT A MITIGATED NEGATIVE DECLARATION

NOTICE OF PUBLIC REVIEW AND COMMENT PERIOD

Pursuant to the California Environmental Quality Act, the following project has been reviewed by the County Environmental Coordinator to determine if it has a potential to create significant impacts to the environment and, if so, how such impacts could be solved. A Negative Declaration is prepared in cases where the project is determined not to have any significant environmental impacts. Either a Mitigated Negative Declaration or Environmental Impact Report (EIR) is prepared for projects that may result in a significant impact to the environment.

Public review periods are provided for these Environmental Determinations according to the requirements of the County Environmental Review Guidelines. The environmental document is available for review at the County Planning Department located at 701 Ocean Street, in Santa Cruz. You may also view the environmental document on the web at www.sccoplanning.com under the Planning Department menu. If you have questions or comments about this Notice of Intent, please contact Todd Sexauer of the Environmental Review staff at (831) 454-3511.

The County of Santa Cruz does not discriminate on the basis of disability, and no person shall, by reason of a disability, be denied the benefits of its services, programs or activities. If you require special assistance in order to review this information, please contact Bernice Shawver at (831) 454-3137 to make arrangements.

PROJECT: San Vicente Creek Watershed Clematis Control Project

APP #: 171089

APN(S): 058-011-10; 063-071-01

PROJECT DESCRIPTION: The project proposes to treat and control the invasive plant Clematis vitalba (Clematis) on approximately 30 acres within Santa Cruz County's San Vicente Creek watershed. Clematis, a non-native invasive plant, has infested approximately 70 acres within the San Vicente Creek watershed (30 acres on the San Vicente Redwoods property owned by Peninsula Open Space Trust (POST) and Sempervirens Fund (SVF), and 40 acres on the Bureau of Land Management's (BLM) Coast Dairies property). The infestation poses a threat to anadromous fish and other wildlife habitat, water quality, and ecosystem health (including coast redwood habitat) throughout the lower watershed.

PROJECT LOCATION: The proposed project is located within the San Vicente Creek riparian corridor, on the east side of Highway 1, adjacent to the Bonny Doon and North Coast community planning areas, in the unincorporated County of Santa Cruz.

EXISTING ZONE DISTRICT: TP
APPLICANT: Peninsula Open Space Trust
OWNER: Peninsula Open Space Trust
PROJECT PLANNER: John Cairns
EMAIL: john.cairns@santacruzcounty.us
ACTION: Negative Declaration with Mitigations
REVIEW PERIOD: October 13, 2017 through November 13, 2017
This project will be considered at a public hearing by the Zoning Administrator. The time, date and location have not been set. When scheduling does occur, these items will be included in all public hearing notices for the project.

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MITIGATED NEGATIVE DECLARATION

Project: San Vicente Creek Watershed Clematis Control Project **APN(S): 058-011-10; 063-071-01**

Project Description: The project proposes to treat and control the invasive plant *Clematis vitalba* (Clematis) on approximately 30 acres within Santa Cruz County's San Vicente Creek watershed. Clematis, a non-native invasive plant, has infested approximately 70 acres within the San Vicente Creek watershed (30 acres on the San Vicente Redwoods property owned by Peninsula Open Space Trust (POST) and Sempervirens Fund (SVF), and 40 acres on the Bureau of Land Management's (BLM) Coast Dairies property). The infestation poses a threat to anadromous fish and other wildlife habitat, water quality, and ecosystem health (including coast redwood habitat) throughout the lower watershed.

Project Location: The proposed project is located within the San Vicente Creek riparian corridor, on the east side of Highway 1, adjacent to the Bonny Doon and North Coast community planning areas, in the unincorporated County of Santa Cruz.

Owner: Peninsula Open Space Trust (POST) & Sempervirens Fund (SVF)

Applicant: POST and SVF

Staff Planner: John Cairns

Email: john.cairns@santacruzcounty.us

This project will be considered at a public hearing by the Zoning Administrator. The time, date and location have not been set. When scheduling does occur, these items will be included in all public hearing notices for the project.

California Environmental Quality Act Mitigated Negative Declaration Findings:

Find, that this Mitigated Negative Declaration reflects the decision-making body's independent judgment and analysis, and; that the decision-making body has reviewed and considered the information contained in this Mitigated Negative Declaration and the comments received during the public review period; and, that revisions in the project plans or proposals made by or agreed to by the project applicant would avoid the effects or mitigate the effects to a point where clearly no significant effects would occur; and, on the basis of the whole record before the decision-making body (including this Mitigated Negative Declaration) that there is no substantial evidence that the project as revised will have a significant effect on the environment. The expected environmental impacts of the project are documented in the attached Initial Study on file with the County of Santa Cruz Clerk of the Board located at 701 Ocean Street, 5th Floor, Santa Cruz, California.

Review Period Ends: November 13, 2017

Date:______________________________

____

TODD SEXAUER, Environmental Coordinator
(831) 454-3511

Updated 6/29/11

County of Santa Cruz

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CALIFORNIA ENVIRONMENTAL QUALITY ACT (CEQA)
INITIAL STUDY/ENVIRONMENTAL CHECKLIST

Date:	September 11, 2017	**Application Number:**	171089
Project Name:	San Vicente Creek Watershed Clematis Control Project	**Staff Planner:**	John Cairns

I. OVERVIEW AND ENVIRONMENTAL DETERMINATION

APPLICANT:	Peninsula Open Space Trust (POST)	**APN(s):**	058-011-10; 063-071-01
OWNER:	Peninsula Open Space Trust (POST) & Sempervirens Fund (SVF)	**SUPERVISORAL DISTRICT:**	3

PROJECT LOCATION: The proposed project is located within the San Vicente Creek riparian corridor, on the east side of Highway 1, adjacent to the Bonny Doon and North Coast community planning areas, in the unincorporated County of Santa Cruz (Figure 1, Project location, attached). The County of Santa Cruz is bounded on the north by San Mateo County, on the south by Monterey and San Benito counties, on the east by Santa Clara County, and on the south and west by the Monterey Bay and the Pacific Ocean.

SUMMARY PROJECT DESCRIPTION:

The project proposes to treat and control the invasive plant *Clematis vitalba* (Clematis) on approximately 30 acres within Santa Cruz County's San Vicente Creek watershed. Clematis, a non-native invasive plant, has infested approximately 70 acres within the San Vicente Creek watershed (30 acres on the San Vicente Redwoods property owned by Peninsula Open Space Trust (POST) and Sempervirens Fund (SVF), and 40 acres on the Bureau of Land Management's (BLM) Coast Dairies property). The infestation poses a threat to anadromous fish and other wildlife habitat, water quality, and ecosystem health (including coast redwood habitat) throughout the lower watershed. The population has been identified as a "Red Alert" by the California Invasive Plant Council, as one of only two documented occurrences in the state. Additionally, this invasive vegetation management project was identified as a priority in the in the San Vicente Creek Watershed Plan for Salmonid Recovery, published in 2014 by the Resource Conservation District of Santa Cruz County. The proposed project would entail the removal of the 30 acres of Clematis by a variety of methods (discussed further below) over a period of three years. Figure 2 depicts the project site and management units. Within 2 years' time, POST and SVF plans to be working with BLM to construct a plan to eradicate the remaining 40 acres of Clematis downstream from the project. This plan would be predicated upon the treatment methods proven most effective in this project.

ENVIRONMENTAL FACTORS POTENTIALLY AFFECTED: *All of the following potential environmental impacts are evaluated in this Initial Study. Categories that are marked have been analyzed in greater detail based on project specific information.*

- ☐ Aesthetics and Visual Resources
- ☐ Agriculture and Forestry Resources
- ☐ Air Quality
- ☒ Biological Resources
- ☒ Cultural Resources
- ☒ Geology and Soils
- ☐ Greenhouse Gas Emissions
- ☒ Hazards and Hazardous Materials
- ☒ Hydrology/Water Supply/Water Quality
- ☐ Mineral Resources
- ☐ Noise
- ☐ Population and Housing
- ☐ Public Services
- ☐ Recreation
- ☐ Transportation/Traffic
- ☐ Tribal Cultural Resources
- ☐ Utilities and Service Systems
- ☐ Mandatory Findings of Significance

DISCRETIONARY APPROVAL(S) BEING CONSIDERED:

- ☐ General Plan Amendment
- ☐ Land Division
- ☐ Rezoning
- ☐ Development Permit
- ☐ Sewer Connection Permit
- ☒ Coastal Development Permit
- ☐ Grading Permit
- ☒ Riparian Exception
- ☐ LAFCO Annexation
- ☒ Other: Land Clearing Permit

OTHER PUBLIC AGENCIES WHOSE APPROVAL IS REQUIRED (e.g., permits, financing approval, or participation agreement):

Permit Type/Action	Agency
Lake or Streambed Alteration Agreement (1602)	California Department of Fish and Wildlife
Coastal Development Permit (LCP)	California Coastal Commission (via LCP)

DETERMINATION:

On the basis of this initial evaluation:

☐ I find that the proposed project COULD NOT have a significant effect on the environment, and a NEGATIVE DECLARATION will be prepared.

☒ I find that although the proposed project could have a significant effect on the environment, there will not be a significant effect in this case because revisions in the project have been made or agreed to by the project proponent. A MITIGATED NEGATIVE DECLARATION will be prepared.

☐ I find that the proposed project MAY have a significant effect on the environment, and an ENVIRONMENTAL IMPACT REPORT is required.

☐ I find that the proposed project MAY have a "potentially significant impact" or "potentially significant unless mitigated" impact on the environment, but at least one effect 1) has been adequately analyzed in an earlier document pursuant to applicable legal standards, and 2) has been addressed by mitigation measures based on the earlier analysis as described on attached sheets. An ENVIRONMENTAL IMPACT REPORT is required, but it must analyze only the effects that remain to be addressed.

☐ I find that although the proposed project could have a significant effect on the environment, because all potentially significant effects (a) have been analyzed adequately in an earlier EIR or NEGATIVE DECLARATION pursuant to applicable standards, and (b) have been avoided or mitigated pursuant to that earlier EIR or NEGATIVE DECLARATION, including revisions or mitigation measures that are imposed upon the proposed project, nothing further is required.

Todd Sexauer

Todd Sexauer, Environmental Coordinator

10-5-17

Date

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Figure 1

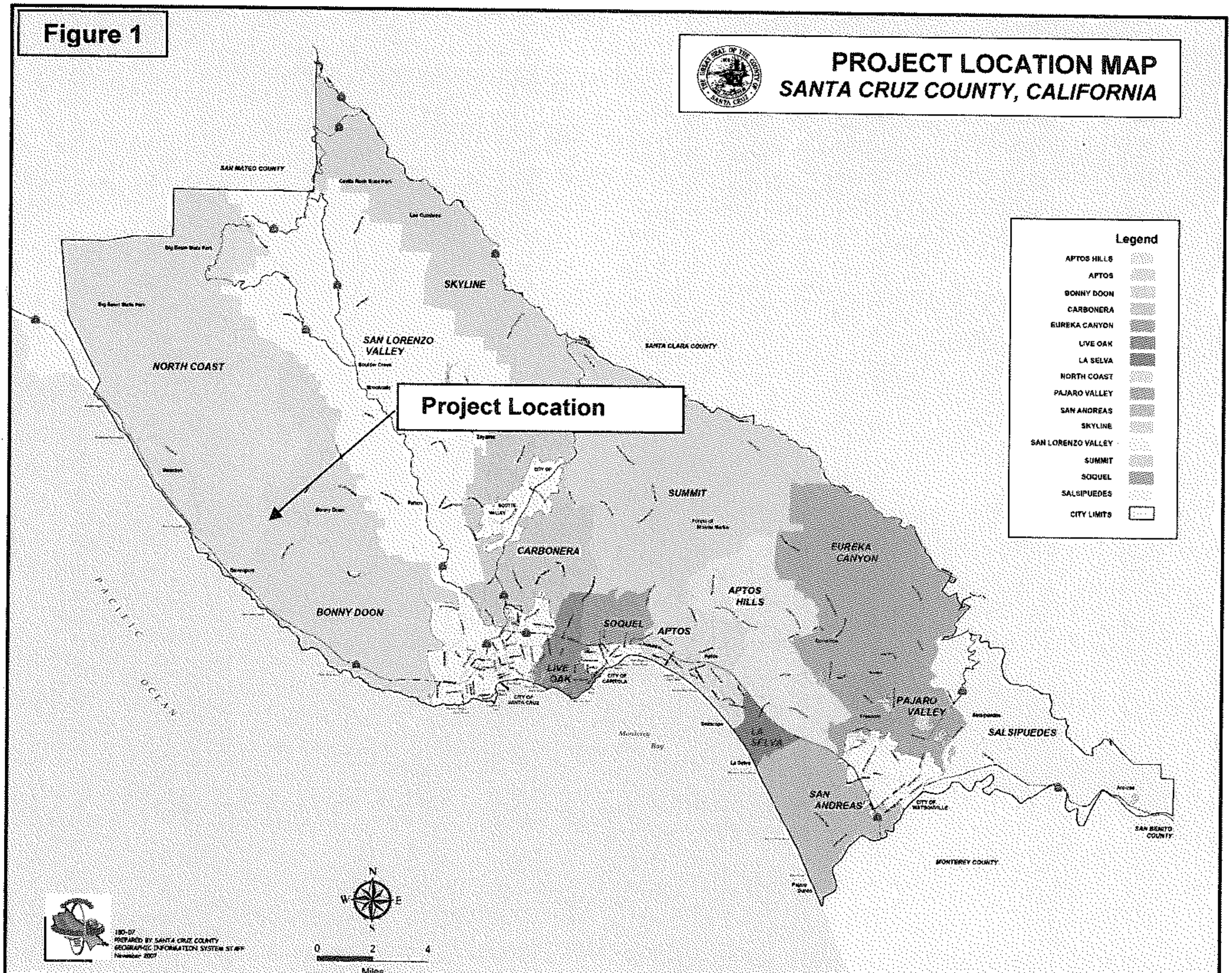
PROJECT LOCATION MAP
SANTA CRUZ COUNTY, CALIFORNIA
Legend
APTOS HILLS
APTOS
BONNY DOON
CARBONERA
EUREKA CANYON
LIVE OAK
LA SELVA
NORTH COAST
PAJARO VALLEY
SAN ANDREAS
SKYLINE
SAN LORENZO VALLEY
SUMMIT
SOQUEL
SALSIPUEDES
CITY LIMITS
Project Location
SAN MATEO COUNTY
SANTA CLARA COUNTY
MONTEREY COUNTY
SAN BENITO COUNTY
NORTH COAST
SKYLINE
SAN LORENZO VALLEY
SUMMIT
CARBONERA
BONNY DOON
SOQUEL
APTOS
APTOS HILLS
EUREKA CANYON
LIVE OAK
LA SELVA
PAJARO VALLEY
SALSIPUEDES
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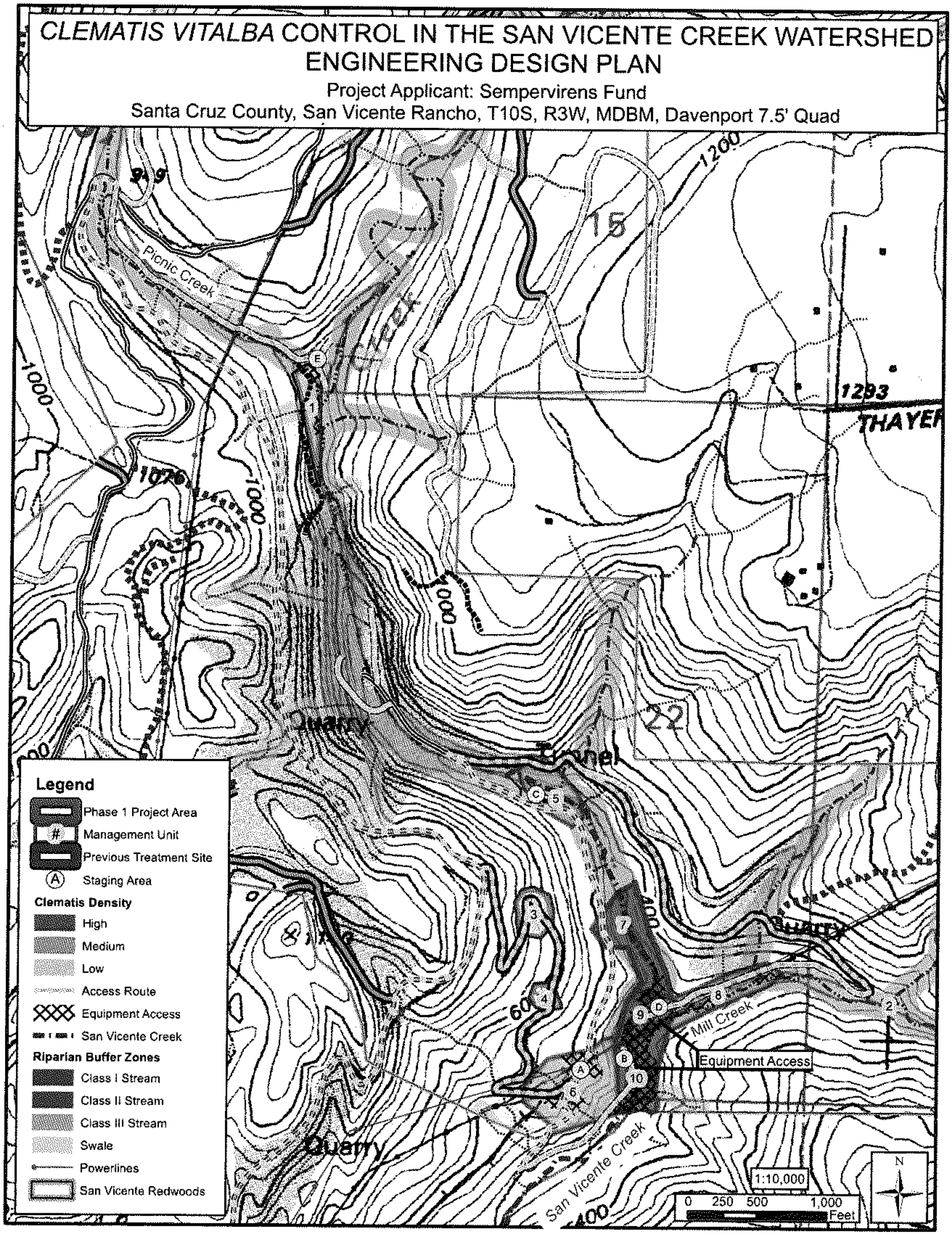
Figure 2


CLEMATIS VITALBA CONTROL IN THE SAN VICENTE CREEK WATERSHED
ENGINEERING DESIGN PLAN
Project Applicant: Sempervirens Fund
Santa Cruz County, San Vicente Rancho, T10S, R3W, MDBM, Davenport 7.5' Quad
Picnic Creek
Quarry
Tunnel
Mill Creek
San Vicente Creek
Equipment Access
THAYER
1293
1200
1000
1076
15
22
Legend
Phase 1 Project Area
Management Unit
Previous Treatment Site
Staging Area
Clematis Density
High
Medium
Low
Access Route
Equipment Access
San Vicente Creek
Riparian Buffer Zones
Class I Stream
Class II Stream
Class III Stream
Swale
Powerlines
San Vicente Redwoods
1:10,000
0 250 500 1,000
Feet
N

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II. BACKGROUND INFORMATION

EXISTING SITE CONDITIONS:

Parcel Size (acres):	837 acres (project area 30 acres)
Existing Land Use:	Open Space
Vegetation:	Native Riparian & Nonnative Invasive
Slope in area affected by project:	☒ 0 - 30% ☐ 31 – 100% ☐ N/A
Nearby Watercourse:	San Vicente Creek; Mill Creek
Distance To:	Site is located directly within the riparian corridor.

ENVIRONMENTAL RESOURCES AND CONSTRAINTS:

Water Supply Watershed:	Yes	Fault Zone:	No
Groundwater Recharge:	Yes	Scenic Corridor:	No
Timber or Mineral:	Yes/Partial	Historic:	No
Agricultural Resource:	No	Archaeology:	Yes/Partial
Biologically Sensitive Habitat:	Yes	Noise Constraint:	No
Fire Hazard:	Yes/Partial	Electric Power Lines:	Yes
Floodplain:	No	Solar Access:	No
Erosion:	Yes/Partial	Solar Orientation:	No
Landslide:	Yes	Hazardous Materials:	No
Liquefaction:	No	Other:	

SERVICES:

Fire Protection:	CRZ-FSA48	Drainage District:	Zone 7
School District:	Pacific Elementary SD, Bonny Doon Union SD	Project Access:	Yes
Sewage Disposal:	CSA-12	Water Supply:	N/A

PLANNING POLICIES:

Zone District:	CA	Special Designation:	
General Plan:	R-M		
Urban Services Line:	☐ Inside	☒ Outside	
Coastal Zone:	☒ Inside	☐ Outside	

ENVIRONMENTAL SETTING AND SURROUNDING LAND USES:

Natural Environment

Santa Cruz County is uniquely situated along the northern end of Monterey Bay approximately 55 miles south of the City of San Francisco along the Central Coast. The Pacific Ocean and

Monterey Bay to the west and south, the mountains inland, and the prime agricultural lands along both the northern and southern coast of the county create limitations on the style and amount of building that can take place. These natural features create an environment that attracts both visitors and new residents every year. The natural landscape provides the basic features that set Santa Cruz apart from the surrounding counties and require specific accommodations to ensure building is done in a safe, responsible and environmentally respectful manner.

The California Coastal Zone affects nearly one third of the land in the urbanized area of the unincorporated County with special restrictions, regulations, and processing procedures required for development within that area. Steep hillsides require extensive review and engineering to ensure that slopes remain stable, buildings are safe, and water quality is not impacted by increased erosion. The farmland in Santa Cruz County is among the best in the world, and the agriculture industry is a primary economic generator for the County. Preserving this industry in the face of population growth requires that soils best suited to commercial agriculture remain active in crop production rather than converting to other land uses.

The San Vicente Creek watershed is located in the Santa Cruz Mountains, nine miles north of the City of Santa Cruz. The watershed drains an 11.1 square mile area, and the main stem of San Vicente Creek flows for approximately 9.3 miles before entering the Monterey Bay National Marine Sanctuary and Pacific Ocean just south of the town of Davenport. The watershed also includes 11.3 miles of tributary streams, including Mill Creek, a portion of which is included in the project site. Approximately 2.5 miles of the main stem channel of San Vicente Creek and 0.25 miles of tributaries are thought to be potentially usable coho rearing habitat (RCDSCC 2014). The elevation in the project site ranges from 800 feet at Management Unit 1 to 240 feet at Management Unit 10. (See Figure 2, Engineering Design Plan, for Management Unit location detail.)

A flat area near the stream channel supports clusters of riparian tree species, including red alder (*Alnus rubra*) and coast redwood (*Sequoia sempervirens*). There are also openings with large patches of elk clover (*Aralia californica*), mixed with poison oak (*Toxicodendron diversilobum*), redwood sorrel (*Oxalis oregana*), and California hedge nettle (*Stachys bullata*), among other species (RCDSCC 2014). With added complexity, the floodplain of San Vicente Creek and Mill Creek in the area of the thickest Clematis infestation could be potentially prime high-water refugia habitat for anadromous fish in high-flow events.

The dominant soil in the project area (comprising most of Management Units 2-4 and 6-10) is Ben Lomond - Felton complex. This soil is found in concave areas near drainages. It is made up of approximately 35 percent Ben Lomond sandy loam and 35 percent Felton sandy loam. It is deep and well drained, formed in residuum derived from sandstone or granitic rock, with weathered sandstone or granite at a depth of 46 inches.

Management Unit 1, higher in the watershed, has a different soil, Lompico - Felton complex, described as made up of 30 percent Lompico loam and 25 percent Felton sandy loam, deep and well drained. It formed in residuum derived from sandstone, shale, siltstone or mudstone. It is centered on the usually dry lower reaches of Picnic Creek, which goes sub-surface due to karst in this area. In this area was an isolated patch of Clematis <1 acre that has been treated by hand pulling and piling on tarps several times in the past 3 years. The treatment to date has reduced the incidence of Clematis at this site; however, in 2015 new seedlings were located in San Vicente Creek, 500 feet below the original pulling zone. The seedlings were pulled, but the stretch of creek above the San Vicente Quarry shall continue to be monitored.

A third soil type underlies Management Unit 5, which is below the outlet of the tunnel (karst) that goes below the San Vicente Quarry. This mapped soil is Pits - Dumps complex. Pits indicate the open excavations from which soil material has been removed. Dumps are uneven areas of accumulated waste material. Included with this complex are small areas of rock outcrop. This soil type makes up the old quarry and waste disposal sites. Management Unit 5 is located along steep side slopes adjacent to San Vicente Creek, intermingled with English ivy in the northern part of the Unit. There are many native species also present, and percent cover of Clematis varies from 5% to 80%. Access in this Management Unit would be difficult as terrain is generally steep and rocky along this portion of San Vicente Creek.

Management Units 7 and 8 on the north side have Pits - Dumps complex along their northern margins. This is due to the steep limestone overburden area that consists of old quarry fill. Much of the nearby overburden is colonized by jubata grass. Management Unit 7 is along the rocky banks of San Vicente Creek and up the steep slope on the edge of the riparian area. Percent cover in this zone ranges from <10% on the northern fringe, to near 100% at the south boundary of this Unit.

Management Units 9 and 10 are the most heavily invaded parts of the project area, along the broader floodplain sections of San Vicente Creek, above and below the Mill Creek confluence. There is much aerial climbing in these Units and therefore numerous seedlings. The ground also has a think mat of Clematis near the center of Units 9 & 10. The percent cover of Clematis is near 100% on the floodplain and near the water and tapers off on the on the edge of the riparian area. Some clearing of dense Clematis occurred in 2015 and 2016 in a two-acre patch adjacent to San Vicente Creek. This site was subsequently planted and is a trial area for testing methods to date.

Management Unit 8 is upstream along Mill Creek, adjacent to dense Clematis growth. Some of this area is difficult to access due to willows and other intertwined riparian vegetation. A small stand of Acacia was cut in the lower part of Unit 8 in 2014, and it is now thick Acacia sprouts, Clematis, and poison oak.

Management Unit 2 is a very small outlier in Mill Creek. Ten single-stem plants were found in 2016 and were pulled. This area has a rocky streambed with an adjacent trail. There is an aggressive population of *Tradescantia* in the vicinity.

All of the Clematis population is in the riparian corridor of San Vicente Creek or Mill Creek, except for Management Units 3 & 4 and the upper portion of Management Unit 6. Management Unit 6 is mostly small patches of Clematis with coverage <50%. Management Unit 6, under the PG&E transmission lines from where the source population may have originated. It is located in the upland site of the previous Quarry Camp, a hub with approximately 10 homes and a hostel during the quarry period of around 1904-1955 (when the town was wiped out by a landslide). The Clematis present at this upland site is relatively sparse and intertwined with native vegetation and weeds.

Management Units 3 & 4 consist of strands of outliers along the switchback road from Warrenella Road, the main property access, to San Vicente Creek. Several of these outlier populations have been treated multiple times; however, new sprouts and seedlings can still be found. Prior to the suppression efforts, there were vines 3-cm across growing into redwoods trees at the tight road switchback. Red and white striped flags have been hung at removal locations along the road to help with monitoring of this diffusely populated Unit.

Other than the presence of Clematis, weedy species such as French broom (*Genista monspessulana*), jubata grass (*Cortaderia jubata*), forget-me-not (*Myosotis latifolia*), acacia (*Acacia* sp.), Himalaya berry (*Rubus armeniacus*), poison hemlock (*Conium maculatum*), tall sock-destroyer (*Torilis arvensis*), cut-leaved geranium (*Geranium dissectum*), and spiderwort (*Tradescantia* sp.) are prevalent in and around the Project Site. (Most of these species do not threaten tree cover in the watershed, and do not pose the same threat to anadromous fish recovery as Clematis. The RCDSCC, with support from the Project Partners, is planning a large woody debris (LWD) installation project to enhance pool formation and habitat complexity in the same reaches of San Vicente and Mill Creek. The invasive species control project is not going to precede the LWD project, therefore, access to the Clematis vines would be somewhat hindered by the downed material.

PROJECT BACKGROUND:

In 2011, the 8,532-acre property known as San Vicente Redwoods (formerly CEMEX) was purchased by a consortium of land conservation nonprofits; consisting of Peninsula Open Space Trust (POST), Sempervirens Fund (SVF), Save the Redwoods League (League), the Land Trust of Santa Cruz County (LTSCC), and the Nature Conservancy (TNC). San Vicente Redwoods is owned by POST and SVF, and the League holds a Conservation Easement over the property. As part of the ongoing stewardship of the property, POST, SVF, and the League actively identify and implement habitat restoration projects.

The treatment of *Clematis vitalba* (Clematis) in San Vicente Creek has been explicitly identified in local planning documents and also addresses priorities identified in a number of other plans at a regional and state level.

At the local level, the Project implements recommendations set forth in the San Vicente Watershed Plan for Salmonid Recovery (the Recovery Plan), published by the Resource Conservation District of Santa Cruz County (RCDSCC). The Recovery Plan recommends full watershed eradication of Cape ivy and Clematis to reduce potential impacts to natural geomorphic processes on floodplain areas and to the health and longevity of floodplain trees resulting from complete cover of Cape ivy / Clematis (recommendation #14 & 19). In addition, the Recovery Plan recommends preventing new colonization of invasive species within project sites (recommendation #19) (RCDSCC, 2014).

By removing invasive exotic vegetation from riparian zones, the project would implement Priority 1, Immediate Threat Abatement Action, recommended for San Vicente Creek in the NOAA Fisheries Service Volume II Recovery Plan for the Evolutionary Significant Unit of Central California Coast Coho Salmon (NOAA, 2012). The project would implement Priority 2 action for San Vicente Creek as identified within the NOAA Fisheries Service Coastal Multispecies Public Draft Recovery Plan: California Coastal Chinook Salmon ESU, Northern California Steelhead DPS and Central California Coast Steelhead DPS (NOAA, 2015). The Project directly addresses the present or threatened destruction, modification, or curtailment of coho habitat or range, and carries out Recovery Action Step 14.1.1.1 to remove invasive exotic vegetation from riparian zones (NMFS, 2012).

The project supports natural resource management actions underway and recommendations set forth within the California Natural Resources Agency's Safeguarding California: Reducing Climate Risk plan, including developing management practices to help safeguard species and ecosystems from climate risk (Biodiversity and Habitat Sector Plan) and implementing forest management for the overall health and protection of watersheds (Forestry Sector Plan) (Resources Agency, 2014).

In December 2016, the project was selected as the recipient of $1.14M in Proposition 1 funding administered by the California Department of Fish & Wildlife (CDFW). The proposed project would build upon previous work on *Cape Ivy* in the watershed, which was conducted by the RCDSCC on the Bureau of Land Management's Coast Dairies property. In addition, the proposed project site is also the location of a planned large wood project that the RCDSCC is planning to implement to further improve habitat for salmonids.

In addition to the support of the project partners, POST and SVF, the project has received written support by Save the Redwoods League, the Bureau of Land Management, the Resource Conservation District of Santa Cruz County, and the University of California at Santa Cruz.

The goal of the project is to treat and control the invasive Clematis on approximately 30 acres of the San Vicente Redwoods property, within the San Vicente Creek watershed. The infestation threatens anadromous fish and other wildlife habitat, water quality, and ecosystem health (including coast redwood habitat) throughout the lower watershed. The project would address the Clematis infestation in the watershed by controlling the invasive on the San Vicente Redwoods property, monitoring and documenting the success or failure of treatment methods used, and identifying opportunities for follow up work on the Clematis population on BLM's Coast Dairies property (previously treated by BLM and the RCDSCC starting in 2014). A plan to collaborate with BLM and implement the removal of the remaining 40 acres of Clematis on the adjacent parcel would begin within 2 years' time. The ultimate goal is to eradicate the plant from the watershed and share the results of the project as a case study to inform land management and invasive plant management efforts more broadly.

The project would enhance riparian and instream habitat to protect important spawning and rearing grounds and aid the recovery of Central California Coast (CCC) Evolutionary Significant Unit of coho salmon (*Oncorhynchus kisutch*) and CCC steelhead (*Oncorhynchus mykiss*). In addition, the upper watershed of San Vicente Creek contains outstanding redwood stands, some of which provide structural characteristics, potentially suitable for marbled murrelet and other old-growth forest-dependent species. San Vicente Creek and its main tributary, Mill Creek, supply water to the town of Davenport. Treating Clematis in the lower watershed would help prevent its spread upstream where the invasive would further impact forest health and water quality in the headwaters.

DETAILED PROJECT DESCRIPTION:

A Background on Clematis

Clematis is an extremely aggressive and invasive non-native plant that grows quickly and spreads easily, creating thick tangled vining vegetation that covers the ground and climbs upwards along the trunks of trees, eventually outcompeting native vegetation and threatening native biodiversity. The vine can grow up to seven times faster than ivy and each plant can produce over 100,000 seeds, which are then spread by wind, water, wildlife, and human interaction. Clematis can also sprout from stem fragments, making control and eradication particularly challenging (Shearin, n.d.).

As an invasive species, Clematis is just beginning to receive attention in California. There are only two documented infestations in the state: one in Marin County in Muir Woods National Monument, which was reported to Calflora in 2015, and the second in the San Vicente Creek watershed (Calflora). Clematis is not listed as a noxious weed by the California Department of Food and Agriculture, but in 2014, the California Invasive Plant Council (Cal-IPC) placed it on the "red alert" list for new weeds in California (DiTomaso 2014). The spread of Clematis in California is a concern because it invades wildland areas and once established is extremely difficult to eradicate.

Clematis is listed as a Class B noxious weed by the Oregon Department of Agriculture (ODA) and as a Class C noxious weed by the Washington State Noxious Weed Control Board (NWCB). At its annual symposium in 2014, the California Invasive Plant Council noted the presence of Clematis along approximately 7 miles of San Vicente Creek (DiTomaso 2014). And in February 2014 RCDSCC noted in the Recovery Plan the presence of Clematis (along with Cape Ivy and other invasive species) in the San Vicente Creek watershed as well as its potential impact on salmonid habitat recovery there. The Recovery Plan further notes that additional research needs to be done in order to understand the threat of Clematis and treatment options in the watershed (RCDSCC 2014).

Because Clematis is not yet widespread in California, local treatment protocols and best practices for control of the invasive have not been documented. In Oregon, the East Multnomah Soil and Water Conservation District (EMSWCD) has prepared treatment recommendations for the Four County Cooperative Weed Management Area, including Clackamas, Clark, Multnomah, and Washington Counties. The EMSWCD has developed an early detection and rapid response program to help detect and eradicate new invasive plants (including Clematis and ten other invasive plants) before they get out of control, and provides free control services in certain areas (EMSWCD, n.d). Over a decade ago, the Washington State Noxious Weed Control Board published written findings, including treatment approaches and responses for infestations primarily located west of the Cascade Mountains (WSNWCB 1999). West (1991) in discussing Clematis infestations in New Zealand notes that this variety of Clematis is a deciduous, woody climber that can live for 40 years or more, can grow to over 10 meters in length in one season, and can reach 15 to 20 cm in diameter. Additional research from New Zealand, discussed further below, details treatment methods used there (including biological controls) as well as the ecological impacts of Clematis.

While very informative, the information about Clematis and recommendations for treatment from Oregon, Washington, and New Zealand may not be appropriate for the San Vicente Creek watershed because of differing growth patterns, climate differences (e.g., higher average rainfall in Oregon and Washington) and other variables. With limited information about Clematis, understanding species is solely based on literature review, personal communication with local botanists and ecologists, and pilot treatments. As more is learned about this species and its behavior in the San Vicente Creek watershed, knowledge of the species and approach may change.

What is certain is that the effects of Clematis on the riparian forest habitat in the San Vicente Creek watershed, if left unmanaged, would have profound impacts on the anadromous fish populations (and other aquatic and terrestrial wildlife) in the watershed. As Clematis quickly takes over riparian areas, killing native vegetation and trees along the way, the degradation of riparian habitat manifests in changes to leaf litter inputs into the waterways, nutrient cycling, stream bank stability, light availability, and interception of solar radiation, resulting in impacts to water quality (e.g., increased turbidity), stream dynamics, water temperature, and food systems in the watershed (RCDSCC, 2014).

Both CDFW and National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS) have made substantial investments in maintaining and restoring coho salmon in this watershed. The agencies have conducted surveys and released juvenile coho through the captive breeding program (discussed in more detail below). In addition to funding the Recovery Plan, CDFW has recently awarded a grant to the RCDSCC to implement a large woody debris restoration project in the watershed. Habitat for anadromous fish is present below mile 3.4 on the creek's mainstem (restricted upstream by an old quarry) and in roughly the first half-mile of Mill Creek below a sizeable non-functional dam. Surveys by NOAA and CDFW from 2006 to 2013 have found coho in San Vicente Creek even when coho were not found in most of the other surveyed local creeks (CDFW 2015 and RCDSCC 2014). Although less surveying has been done for steelhead, the creek also appears to support a relatively robust steelhead run (RCDSCC 2014).

At the downstream end of San Vicente Creek, a 245-foot tunnel dug through bedrock in 1906 to construct the railroad and a 142-foot long concrete box culvert under Highway 1 confine the creek and prevent a sand bar from forming and blocking the creek's exit to the ocean. Thus, there is a year round connection between the creek and the ocean, offering coho, steelhead, and other aquatic species year-round access to San Vicente Creek. While there are some benefits to the year-round connection, this infrastructure reduces the quality of downstream habitat and makes the lower creek channel more susceptible to the influence of stormwater flooding and sea level rise.

When this challenge is combined with the impassible obstacles upstream, the reaches of San Vicente Creek that are infested with Clematis are critically important for anadromous fish habitat restoration. If the Clematis now present in San Vicente Creek migrates to other watersheds within the Santa Cruz Mountains it would become not a localized problem but a regionally significant problem that further jeopardizes anadromous fish recovery efforts on California's central coast. Furthermore, in the San Vicente Creek watershed and in the Santa Cruz Mountains generally, Clematis is an extreme threat to coast redwood (*Sequoia sempervirens*) forests because the weed creates a monoculture and is not height limited in growth. In fact, Clematis has climbed upwards of 100 feet on redwoods and other trees in the watershed (Hamey 2016). As noted in NOAA's CCC Coho Salmon Recovery Plan, California's redwood forests are some of the last areas where coho salmon persist. Because of California's strict regulations for forest harvest, many redwood forests retain ecosystem processes that provide for salmon spawning, rearing, and sheltering. This emphasizes the importance of healthy redwood forests in salmonid survival on the central coast (NOAA 2012).

Over the past few years, POST and SVF have conducted reconnaissance to understand the extent of the Clematis infestation and have worked with POST stewardship volunteers and

UCSC student interns to implement pilot treatment measures in an attempt to curtail the spread of Clematis. Collectively, they have treated approximately three acres of the infestation to date with varying degrees of success. Treatment approaches have included hand pulling, cutting, herbicide applications, and native plant species enhancement. Downstream, the Bureau of Land Management (BLM) and RCDSCC have been working with the Veterans Conservation Corps to address Cape ivy and Clematis on the Coast Dairies Property. POST and SVF have focused on small outlier populations of Clematis on the San Vicente Redwoods Property, working with volunteers to pull up all visible vines and as much root mass as possible (see Figure 2, Engineering Design Plan, Management Units 1,2,3, and 4).

Because Clematis reproduces vegetatively after removal, non-flowering stems were suspended above ground or piled on tarps and left to dry out. These areas have been monitored every month for regrowth during spring and summer and every two to three months during the rest of the year. Once the cut material desiccated it was returned to the ground to decompose. With regular check-ups, the small outlier populations appear to be under control using this approach. In order to limit seed production, treatment has also focused on vines climbing up tall trees in the heavily infested areas, since most seed production is aerial (See Figure 2, Engineering Design Plan, throughout Management Unit 10 near the Mill Creek and San Vicente Creek confluence). Vines in the trees were cut as far up from the ground as possible and were also severed at the ground. When the vines re-grew from the ground, some reached the vines from the trees that had gone limp and sagged down, allowing the rapidly growing vines to quickly recolonize the tree. These areas have also been monitored and re-treated every month during the spring and summer growing season but are not yet controlled. Small patches on the edge of the main Clematis infestation along San Vicente Creek have also been treated intensively with handwork and minimal cut stump herbicide application (See Figure 2, Engineering Design Plan, Management Unit 5). In these areas, where Clematis is entangled with native vegetation and other weeds in thick mats, the Clematis vines were cut and pulled from native vegetation. Plants were either removed by following vines to the roots and digging them up, or cutting them off and treating the cut stem sparingly with aquatic approved herbicide at least 15 feet from aquatic features, per the Pest Control Advisor recommendations (Trumbo 2015) and Best Management Practices. The vines were piled on tarps, with no vines left in ground contact. After 1-2 months in the dry season (or longer in the wet season), when the vines lost sprouting capability, the tarps were flipped over and removed. The regrowth on these sites was rapid, and comprised of approximately 30% native species and 70% non-native species, including Clematis, French broom, jubata grass, forget-me-not, English ivy, Geranium, and spiderwort. Follow-up treatments are needed to re-treat sprouting Clematis and other invasive species. In locations where Clematis coverage is thick, both the residual native species and the weedy seedbank respond vigorously to Clematis removal. POST and SVF have also included native species enhancement (planting) in treatment.

Treatment Methods

Treatment methods would consist of work crews using hand tools to cut and pull Clematis from native vegetation where it is entangled in thick mats. Work crews would also cut and pull Clematis from trees, where it climbs, covers, and chokes out water and sunlight. Clematis stumps would be removed by hand methods as much as possible. In cases where hand methods are not viable (e.g. in areas where access is restricted due to topography) or not recommended because hand digging and root pulling would cause too much soil disturbance, a licensed contractor would apply herbicide judiciously, subject to Best Management Practices and Pest Control Adviser recommendations. The use of mechanical methods (i.e. equipment) may be considered if determined to be ecologically safe and preferable to ensure efficient, successful removal. In areas where removal of Clematis leaves the ground bare and particularly exposed to re-invasion, treatment will also include planting of native seedlings to supplement native species regrowth from the seed bank. Treated areas will be monitored to detect new Clematis infestations, evaluate treatment effectiveness, and guide adaptive management.

Process

Finalization of Treatment Plan: POST and SVF would work with consultant biologist(s) and habitat restoration professionals (with engineer as needed) to develop a baseline assessment of the project site to confirm the mapped boundaries of the infestation, specific treatment approach, and the order of initial treatment in each Management Unit. Site conditions and specific treatment approaches would be used to define Treatment Units. Treatment Unit data would be recorded in the field using the Calflora Observer Pro Weed Manager tool and following data collection methods described in the Monitoring Plan to record information about site status, treatment methods, timing and efficacy.

Year One -- Initial Clematis Treatment: POST and SVF would contract with habitat restoration professionals and the Conservation Corp of Monterey Bay to conduct initial treatments of the Clematis infestation. The work would be a combination of manual methods and chemical treatment of the vines. Control work would start upstream and with outlier populations (Management Units 1, 3, & 5, see Management Unit Map) and work down toward the heart of the invasion (Management Units 6, 10, & 9). Proposed treatment methods would build on the success of control work done to date on the property, and consist of work crews using hand tools to cut and pull Clematis from native vegetation, where it is entangled in thick mats. Plants would be removed by following vines to the roots and digging them up. Any remaining vines in trees would be cut far enough up so they do not touch the ground (cut stems would re-root if they reach the soil). Care would be taken not to leave holes in the soil when removing the plants. Holes would be backfilled with removed soil material or as needed with mulch. This will reduce germination of weed seeds exposed through soil disturbance and minimize erosion. In some locations, native vegetation would need to be removed in conjunction with Clematis because it is completely intertwined. Mechanical methods would be employed as deemed acceptable (see list of Best Management Practices (BMPs) that are followed by operators on San Vicente Redwoods below). When digging is not feasible or would create problems on unstable slopes or other difficult sites, spot spraying may take place with an appropriate herbicide. Herbicide would only be applied by a licensed contractor, subject to Pest Control Adviser recommendations. Areas designated for herbicide treatment would be identified in baseline assessment and data records of treatment would be collected in the Weed Manager tool. Project Partners would work with interns from the University of California at Santa Cruz Environmental Sciences Program, with whom a partnership has already been established, to grow and plant native vegetation where large areas of bare ground are exposed as a result of treatments. Records of the number and types of plantings would be recorded for each treatment unit using the Weed Manager tool.

Year Two – Follow-Up Clematis Treatment: At the start of year two, POST and SVF will monitor progress as described in the Monitoring Plan. Lessons learned in first year about what techniques work best to eradicate Clematis and avoid re-sprouting will be prioritized in the second year. Implementation crews and the biologist will monitor the Project Site throughout the growing season. Any new sprouts would be removed, working again with habitat restoration professionals, CCMB, volunteers, and others for hand pulling, a licensed contractor to apply herbicides as needed, and with UCSC interns to grow and plant native flora. Mechanical methods would be employed as deemed acceptable. Treatments of Management Units would be sequenced the same as in year one. In order to effectively remove this plant, every sprout must be cleared; as such, the focus of the follow-up treatment would be to monitor for re-sprouts and treat them appropriately such that the native seedbank would have an opportunity to respond.

Year Three – Follow-Up Clematis Treatment: At the start of year three, POST and SVF will monitor progress as described in the Monitoring Plan. Lessons learned from years one and two will be applied to year three treatments. Implementation crews and the biologist will monitor the project site according to the Monitoring Plan, and would conduct a third major treatment of the Clematis infestation, again working with habitat restoration professionals, CCMB, and volunteers to conduct hand pulling, a licensed contractor to apply herbicides as needed, and with UCSC interns to grow and plant native flora. Mechanical methods would be employed as deemed acceptable if necessary.

Ongoing Monitoring: As explained in Tasks 4 and 5, above, POST and SVF will monitor the effectiveness of the Clematis treatment and inform adaptive management to ensure that the infestation is controlled.

Best Practices: Project Partners will prepare a report describing qualitatively and quantitatively our procedures, results, and lessons learned to share information publically. The Partners will also summarize learning into a two-page best management practices document to facilitate distribution to stakeholders in California.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact

III. ENVIRONMENTAL REVIEW CHECKLIST

A. AESTHETICS AND VISUAL RESOURCES

Would the project:

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
1. *Have a substantial adverse effect on a scenic vista?*	☐	☐	☐	☒

Discussion: The project site is located across two parcels of the 8,532-acre San Vicente Redwoods Property. The site is not located within a designated scenic corridor as designated in the County's General Plan (1994). The site is not visible from any public roads. The site is located directly within the riparian corridor of San Vicente and Mill Creeks, and the proposed project would result in the removal of nonnative invasive vegetation. In areas of lower density infestation, native vegetation would be left intact. In some cases, complete removal of vegetation would be required, but the project is designed to reestablish and recruit native vegetation. Visual changes would be temporary in nature. Project implementation would not alter the scenic conditions or substantially change the visual quality of the project site as post-construction conditions would be similar to or improved from existing conditions. As a result, no impact would occur from project implementation.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
2. *Substantially damage scenic resources, including, but not limited to, trees, rock outcroppings, and historic buildings within a state scenic highway?*	☐	☐	☐	☒

Discussion: The proposed project site is not visible from Highway 1; and therefore, project construction activities would not impact views from this scenic highway. The site is not visible from any public roads. There would be no views of the project site from a designated or eligible State Scenic Highway. Therefore, no impact to scenic resources associated with a State scenic highway would occur.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
3. *Substantially degrade the existing visual character or quality of the site and its surroundings?*	☐	☐	☐	☒

Discussion: Visual character of the existing site would change very little after project construction. Restoration activities may improve visual quality of the project site as the site would be restored to native habitat conditions. Therefore, the proposed project would have no adverse impact on visual character or quality of the site.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
4. *Create a new source of substantial light or glare which would adversely affect day or nighttime views in the area?*	☐	☐	☐	☒

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact

Discussion: Project implementation would occur during the daytime and would not result in a new source of nighttime lighting. No permanent lighting would be installed as a result of the proposed project. There would be no impact as a result of a new source of glare as there would be no structures associated with the restoration project. The proposed project would have no impact on visual resources from light and glare.

B. AGRICULTURE AND FORESTRY RESOURCES

In determining whether impacts to agricultural resources are significant environmental effects, lead agencies may refer to the California Agricultural Land Evaluation and Site Assessment Model (1997) prepared by the California Department of Conservation as an optional model to use in assessing impacts on agriculture and farmland. In determining whether impacts to forest resources, including timberland, are significant environmental effects, lead agencies may refer to information compiled by the California Department of Forestry and Fire Protection regarding the state's inventory of forest land, including the Forest and Range Assessment Project and the Forest Legacy Assessment Project; and forest carbon measurement methodology provided in Forest Protocols adopted by the California Air Resources Board. Would the project:

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
1. *Convert Prime Farmland, Unique Farmland, or Farmland of Statewide Importance (Farmland), as shown on the maps prepared pursuant to the Farmland Mapping and Monitoring Program of the California Resources Agency, to non-agricultural use?*	☐	☐	☐	☒

Discussion: Proposed project activities would not entail the removal of trees (timber), and the site does not contain productive agricultural soils. There would be no impact on agriculture and forestry resources from the proposed project. Furthermore, the removal of Clematis would improve the recruitment and viability of redwood and other trees.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
2. *Conflict with existing zoning for agricultural use, or a Williamson Act contract?*	☐	☐	☐	☒

Discussion:

The project is not located on agricultural land. The property is not protected under a Williamson Act contract. Thus, the proposed project would have no impact on zoning for agriculture use or on a Williamson Act contract.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
3. *Conflict with existing zoning for, or cause rezoning of, forest land (as defined in Public Resources Code Section 12220(g)), timberland (as defined by Public Resources Code Section 4526), or*	☐	☐	☐	☒

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
timberland zoned Timberland Production (as defined by Government Code Section 51104(g))?				

Discussion: The project is located on land designated as Timber Resource. However, the project does not involve the removal of timber. The proposed project would be classified as watershed management and fish and wildlife habitat management (Santa Cruz County LCP, principal permitted uses within the Coastal Zone, Chapter 13.10.372, Uses in the Timber Production TP District). The project would not negatively affect the resource or access to harvest the resource in the future. The removal of Clematis would improve the recruitment and viability of redwood and other trees. The timber resource may only be harvested in accordance with California Department of Forestry timber harvest rules and regulations. No impact would occur.

4. *Result in the loss of forest land or conversion of forest land to non-forest use?*	☐	☐	☐	☒

Discussion: The project would not result in the loss of forest land or conversion of forest land to non-forest use. See discussion under B-3 above. No impact is anticipated.

5. *Involve other changes in the existing environment which, due to their location or nature, could result in conversion of Farmland, to non-agricultural use or conversion of forest land to non-forest use?*	☐	☐	☐	☒

Discussion: The proposed project would not result in conversion of Farmland, to non-agricultural use or conversion of forest land to non-forest use. Some of the areas selected for ecological restoration are subject to routine flooding, which prevents economically viable agricultural production (Dobler pers. comm.).

C. AIR QUALITY

The significance criteria established by the Monterey Bay Unified Air Pollution Control District (MBUAPCD) has been relied upon to make the following determinations. Would the project:

1. *Conflict with or obstruct implementation of the applicable air quality plan?*	☐	☐	☐	☒

Discussion: The project would not conflict with or obstruct any long-range air quality plans of the Monterey Bay Air Resources District (MBARD). The North Central Coast Air Basin does not meet state standards for ozone and particulate matter (PM10). Therefore, the regional pollutants of concern that would be emitted by the project are ozone precursors (Volatile Organic Compounds [VOCs], nitrogen oxides [NOx]), and dust. No

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact

impact is anticipated.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
2. *Violate any air quality standard or contribute substantially to an existing or projected air quality violation?*	☐	☐	☒	☐

Discussion: The project would not conflict with or obstruct implementation of the regional air quality plan. The proposed project would restore native species and riparian habitat at the site. After completion, the project would not affect the operational GHG emissions of any source locally or elsewhere in the state, nor would it conflict with any local or state plan, policy or regulation to reduce GHG emissions. This impact is would be less than significant.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
3. *Result in a cumulatively considerable net increase of any criteria pollutant for which the project region is non-attainment under an applicable federal or state ambient air quality standard (including releasing emissions which exceed quantitative thresholds for ozone precursors)?*	☐	☐	☒	☐

Discussion: The project would result in a small, short-term incremental increase in emissions of criteria pollutants from vehicles (see Transportation section) and operation of light power equipment. This would not be expected to make a considerable contribution to cumulative criteria pollutant levels. The impact on ambient air quality would be less than significant.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
4. *Expose sensitive receptors to substantial pollutant concentrations?*	☐	☐	☐	☒

Discussion: The project would not be expected to result in substantial pollutant concentrations at nearby sensitive receptors. There would be a very small, short-term incremental increase in CO and other pollutant concentrations along roadways used by project crew and personnel travelling to and from the site. This would not result in substantial pollutant concentrations. Impacts would be less than significant.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
5. *Create objectionable odors affecting a substantial number of people?*	☐	☐	☐	☒

Discussion: The project treatment would not result in substantial pollutant concentrations or create objectionable odors affecting a substantial number of people. Impacts would be less than significant.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
D. BIOLOGICAL RESOURCES *Would the project:*				
1. *Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special status species in local or regional plans, policies, or regulations, or by the California Department of Fish and Wildlife, or U.S. Fish and Wildlife Service?*	☐	☒	☐	☐

***Discussion*:** The Clematis project area is located in the lower San Vicente Creek watershed, which supports listed anadromous salmonids (steelhead and coho), below the San Vicente Quarry. The majority of the invasive population is located on the broad, rocky floodplain adjacent to San Vicente Creek and Mill Creek. Several small outlier segments of the population are located on the hillside west of San Vicente Creek, with another small outlier on lower Picnic Creek near the confluence with San Vicente Creek. The vegetation communities are largely a factor of surface water conditions, ground water conditions, historic seed bank and distribution of seed from surrounding seed sources. Dominant native species include redwood, Douglas-fir, moisture-dependent species such as lady fern (*Athyrium filix-femina* var. *cyclosorum*), western chain fern (*Woodwardia fimbriata*), giant horsetail (*Equisetum telmateia* subsp. *braunii*), Pacific oenanthe (*Oenanthe sarmentosa*), Douglas's water hemlock (*Cicuta douglasii*), wild ginger (*Asarum caudatum*), redwood clover (*Oxalis oregana*), giant trillium (*Trillium chloropetalum*), sedge (*Carex* spp.), nutsedge (*Cyperus* spp.), and rush (*Juncus* spp.), among others. Dominant invasive species include Clematis (*Clematis vitalba)*, French broom (*Genista monspessulana*), jubata grass (*Cortaderia jubata*), forget-me-not (*Myosotis latifolia*), English ivy (*Hedera helix*), geranium, poison hemlock and spiderwort, among others.

Based on the field investigation done by Nadia Hamey (Hamey, pers. comm. 2017), review of available databases and literature, familiarity with local fauna, and on-site habitat suitability, a total of 34 special-status animal species were considered in this evaluation. A total of 22 special-status plant species were considered possibly present in the vicinity, but were not identified. The remaining species that turned up in scoping are not expected to occur on site based on the lack of suitable habitat (e.g., tidal, serpentine, vernal pool, vernal swale and dune habitats), local extirpations, lack of connectivity between areas of suitable and occupied habitat, etc.

Attachment 4 provides status and habitat requirements for each of the special-status animal species with potential to occur in the Clematis removal project area. The California Natural Diversity Data Base (CNDDB), maintained by the California Department of Fish and Wildlife indicates that several special status species have been observed in proximity to the project site. Avoidance/recovery measures for these species are described below.

Table 2 provides a summary of the special-status vascular plant species with habitat within the 9-Quad scoping area. As shown in the table, there is a possibility of occurrence of approximately 22 special status plant species within the vicinity of the Clematis removal project area; however, no special status species have been identified.

Consultation

The project applicant has had a general biological consultation with the U.S. Fish and Wildlife Service and California Department of Fish and Wildlife (CDFW). CDFW Environmental Scientists and Santa Cruz County Planning staff have made site visits. Habitat for several listed species including coho, steelhead, and California Red-legged frog is present within the project area. Mitigation measures have been be incorporated into the project design for avoidance to minimize the potential for any possible impacts to sensitive species.

Sensitive Natural Communities

One sensitive natural community is found within the project area: North Central Coast Short-Run Coho Stream, Steelhead (*Oncorhynchus mykiss irideus).*

San Vicente Creek is approximately 10-feet wide from top of bank to top of bank and flows north to south through the project area. Much of the project area on the floodplain is considered a wetland. Avoidance/recovery measures for the riparian area are described below.

Special Status Wildlife

FISH

Coho Salmon (*Oncorhynchus kisutch*)

Central California Coast Evolutionary Significant Unit (ESU) coho salmon are listed as endangered under the federal ESA and endangered under the California ESA In the San Vicente Creek watershed, coho are present in the lower reaches of the San Vicente Creek mainstem. A tunnel and limestone karst form a barrier to anadromy in the mainstem where the creek goes underground at an old quarry site, approximately 3.2 miles upstream of the mouth. Below the tunnel, San Vicente Creek is accessible to migrating salmonids.

The Coho salmon population in the San Vicente Creek system has been augmented historically and is currently sustained by hatchery releases. Reproducing Coho require beds of loose, silt-free, coarse gravel for spawning; and juveniles also need cover, cool water, and sufficient dissolved oxygen to thrive. The San Vicente Creek watershed provides some of the least developed habitat available within this ESA. Critical habitat includes all naturally accessible stream channels to the ordinary high water mark. Mitigations for coho salmon and steelhead are outlined below in BIO-1. With mitigation incorporated, project impacts would be less than significant.

Steelhead (*Oncorhynchus mykiss irideus*)

Central California Coast ESU steelhead are listed as federally threatened and are a State Species of Special Concern. Steelhead can utilize the mainstem of San Vicente Creek up to the tunnel and the lower reaches of Mill Creek. By removing invasive exotic vegetation from riparian zones, the project would enhance riparian and instream habitat to protect important spawning and rearing grounds and aid the recovery of Central California Coast (CCC) Evolutionary Significant Unit of coho salmon (Oncorhynchus kisutch) and CCC steelhead (Oncorhynchus mykiss). To protect the beneficial uses of water mitigations for avoidance and minimization of water quality impacts are outlined below in BIO-1-5. With mitigation incorporated, project impacts would be less than significant.

AMPHIBIANS

California Red-Legged Frog (*Rana draytonii*)

The San Vicente watershed has been known to support the California red-legged frog, a federally threatened and state species of concern. CNDDB records documented the species within the project area in 2011, although the species was noted as recently as 2015 (Hamey, Registered Professional Forester, pers. comm.). Per discussions with the US Fish & Wildlife Service (USFWS) (Mitcham, pers. comm.), protocol level surveys to determine presence/absence would not be appropriate in this habitat given the mobility of the species and prolific breeding that can occur, especially during wet years such as 2016/2017. Assuming the species are likely present within the project area, the project includes implementation of take avoidance/recovery measures in consultation with the Resource Conservation District of Santa Cruz County (RCDSCC) Technical Program Director Kelli Camara's existing 10(a)(1)(A) recovery permits for clematis removal activities.

To avoid impacts to California red-legged frog, the project will proceed in accordance with the avoidance measures outlined in BIO-1. These measures are based on guidelines developed by the U.S. Fish and Wildlife Service (USFWS, 2008) in consultation with USFWS staff Chad Mitcham and RCDSCC staff Kelli Camara. With mitigation incorporated, project impacts would be less than significant.

REPTILES

Western Pond Turtle (*Emys marmorata*)

The western pond turtle is a CDFW Species of Special Concern. Western pond turtles occur in a variety of permanent and intermittent aquatic habitats, but most frequently inhabit lowland streams, rivers, and sloughs. In streams they avoid fast-moving and shallow water, and tend to be concentrated in pools, backwater areas, and estuaries. Occupied habitats often contain aquatic vegetation, deep water cover, as well as good basking sites. Pond turtles are usually absent from heavily shaded streams. Nests may be excavated more than 0.25 miles from water, and are generally located in exposed (unshaded) upland locations in friable soils. The nesting season extends from April through August.

The nearest CNDDB records are from Highland Springs near Highway 9 at Ben Lomond, approximately 5.3 miles northeast of the project area, and the lagoon at Waddell Creek, 6 miles Northwest. It is unlikely that suitable western pond turtle habitat is present in the project area and the species has not been recorded anywhere in the San Vicente watershed. Because this species is primarily aquatic, project activities will be less than significant. To avoid impacts to the Western Pond Turtle, the project will proceed in accordance with the mitigation measures outlined in BIO-2.

BIRDS (CDFW Species of Special Concern, Sensitive Species)

Avoidance and minimization measures for potential impacts to listed or nesting bird species are outlined in BIO-7.

Marbled Murrelet (*Brachyramphus marmoratus*)

The marbled murrelet is listed as endangered under the State ESA and threatened under the federal ESA. While there have been no known detections of marbled murrelet within or adjacent to the project site, there have been several detections in the broader area. In 2013 and 2015 there were acoustic monitoring detections on the Laguna parcels of the San Vicente Redwoods property, 2.4 miles east of the project area. Surveys conducted in 2008 and 2009 on the adjacent Redwood Meadows Ranch to the east of the project area did not detect marbled murrelets in 12 surveys, but they did detect osprey (*Pandion haliaetus*), great horned owl (*Bubo virginianus*), Vaux's swift (*Chautura vauxii*), and sharp-shinned hawk (*Accipiter striatus*).

Suitability of habitat was assessed throughout the project area and immediate surroundings by Nadia Hamey in 2017 (Nadia Hamey, pers comm.). Characteristics such as large platform limbs, moss and lichen presence, platform position in the mid-canopy, and adequate screen tree cover were analyzed. No trees with structure that are classified as potentially suitable habitat have been identified. Project activities are not anticipated to impact this species.

Vaux's Swift (*Chaetura vauxi)*

The Vaux's swift is a CDFW Species of Special Concern (nesting only). The species generally occurs in association with conifer forests that have at least some mature characteristics. Vaux's swifts nest and roost in hollow snags or in senescing live trees with heartwood decay. Nest and roost trees are usually more than 20 inches in diameter and frequently have broken tops. Pileated woodpecker cavities are also used for nesting and roosting. The species feeds aerially on small insects, often over water, but also over grasslands and forested areas. During the non-breeding season, they roost communally in hollow trees or chimneys. Vaux's swifts are possibly present in the project area, however project activities are not expected to impact snags nor anticipated to impact this species.

***Black swift** (Cypseloides niger)*

Black swift is a CDFW Species of Special Concern. The species require a specialized habitat for nesting, in forested areas near rivers. Nests are often located behind waterfalls or on damp cliffs, where the environment is dark, wet, steep, and inaccessible to predators, and which provides the swifts with an unobstructed flyway to approach the nest. Project activities are not anticipated to impact this species.

Olive-sided Flycatcher (*Contopus cooperi*)

The olive-sided flycatcher is a federal Species of Concern. In this region, it occurs primarily in coniferous forests and eucalyptus groves, frequently perching atop tall trees or snags from which it hawks insects. It prefers forests with more open canopies, and often occurs in association with openings or edges. Nests are built in trees. Olive-sided flycatchers occur as a breeding species in the Scotts Creek watershed and are absent (migrants) in winter. Suitable nesting and foraging habitat is present in the project area. Project activities are not anticipated to impact this species.

Yellow Warbler (*Dendroica petechia brewsteri*)

The yellow warbler is a CDFW Species of Special Concern (nesting only). Yellow warblers are found primarily in riparian habitats dominated by deciduous trees such as alders, willows, maples, sycamores, and cottonwoods. The species has been recorded from adjacent Scotts Creek watershed and suitable nesting and foraging habitat for yellow warblers is present in the project area. Project activities are not anticipated to impact this species.

Purple Martin (*Progne subis*)

The purple martin is a CDFW Species of Special Concern (nesting only). It is a very rare and localized breeder in in upper elevation knobcone pine and redwood forests in Santa Cruz County. Tall, old snags with woodpecker holes are required for nesting. Martins often forage over water. Project activities are not expected to impact snags nor anticipated to impact this species.

Red-breasted Sapsucker (*Sphryapicus ruber*)

The red-breasted sapsucker is a federal Species of Concern (nesting only). It is a cavity nester that potentially occurs in most forest and woodland habitats. This species is expanding its breeding range in Santa Cruz County, but is more common during fall and winter. Suitable nesting and foraging habitat may be present in the project area. Project activities are not anticipated to impact this species.

BIRDS OF PREY (OWLS and LISTED RAPTOR SPECIES)

Golden Eagle (*Aquila chrysaetos*)

The golden eagle is a CDFW Fully Protected Species. Golden eagles require wide-open country for foraging, and prey predominantly on jackrabbits and ground squirrels. Nests typically are built on cliffs throughout the range of this species, although in the oak/grass savannas of the inner California coast ranges most nests are built in trees, principally secluded oaks, cottonwoods, and sycamores. This species is not known to nest within or near the project area, although there are potentially suitable cliffs nearby. Potentially suitable foraging habitat is present on open grassland habitat within the San Vicente Creek watershed. Project activities are not anticipated to impact this species.

Long-eared Owl (*Asio otus*)

The long-eared owl is a CDFW Species of Special Concern (nesting only). In California long-eared owls typically inhabit dense tree or shrub thickets within or adjacent to open habitat areas, which are favored for hunting. In the Santa Cruz Mountains they have been associated with conifer forests and mixed conifer/broadleaf forests. Rodents comprise the bulk of the diet. Long-eared owls use abandoned nests of corvids, hawks, and squirrels for nesting. Nests tend to have dense surrounding cover and are located either in a tree or in a thicket of tall shrubs, often found near water. This is a very rare, localized nesting species in the County and a secretive, highly nocturnal species. Many local owl observations are likely those of migrants. Because long-eared owls tend to hunt in open-areas, project activities are unlikely to affect foraging habitat for this species. Nesting has not been documented within or near the project area. With mitigation incorporated in mitigation measure BIO-7, project impacts would be less than significant.

American Peregrine Falcon (*Falco peregrinus anatum*)

The American peregrine falcon was recently de-listed as state or federally Endangered, but is a state CDFW Fully Protected Species. Peregrine falcons occur in a variety of habitats, but require open areas for foraging. Food consists almost exclusively of birds that are caught on the wing. Nesting has been documented in the San Vicente Quarry, adjacent to the project area, however, project activities are not anticipated to impact this species.

Osprey (*Pandion haliaetus*)

The osprey is a CDFW Species of Special Concern (nesting only). It is a bird of large rivers, lakes, and coastlines where it preys almost exclusively on fish. Ospreys nest on rock pinnacles and in the tops of snags, live trees, or similar artificial structures near water, but may occasionally be found up to a mile from water. Osprey was detected in 2009 adjacent to the project area during a marbled murrelet survey on Redwood Meadows Ranch. Throughout the osprey's range, when available, snags surrounded by water are preferred as nest sites. Nests are large, conspicuous, and often easily located. Project activities are not anticipated to impact this species.

BIRDS OF PREY (UNLISTED RAPTOR SPECIES)

Sharp-shinned Hawk (*Accipiter striatus*)

The sharp-shinned hawk occurs year-round in Santa Cruz County and is known to nest in the San Vicente Creek watershed. Sharp-shinned hawks typically nest in relatively dense stands of second growth conifers, building a new nest each year. The species forages in a range of forested and lightly wooded habitats. Small birds comprise the bulk of the diet. Although no nest sites are currently known from the project area, potentially suitable nesting habitat is present. With mitigation incorporated in mitigation measure BIO-7, project impacts would be less than significant.

Cooper's Hawk (*Accipiter cooperii*)

The Cooper's hawk occurs in the Santa Cruz County year-round, but is more common as a migrant and wintering bird. Cooper's hawks tend to occur in more open forests than do sharp-shinned hawks, and nesting is most often associated with broadleaf woodlands or mixed conifer/broadleaf forests. Dense surrounding cover is preferred in the vicinity of the nest site. Nests typically are built in broadleaf trees. Cooper's hawks show a greater tendency to reuse previous nests than do sharp-shinned hawks. The diet is composed chiefly of small birds, but small mammals, reptiles, and amphibians are also taken. Potentially suitable Cooper's hawk nesting habitat and foraging habitat may be present within the project area. With mitigation incorporated in mitigation measure BIO-7, project impacts would be less than significant.

Great Horned Owl (*Bubo virginianus*)

This is a common widespread species, found in virtually all habitat types in North America, including conifer forests. Great horned owls nest in trees and on cliffs. In trees it uses abandoned stick nests of other raptors, corvids, squirrels and woodrats. This species was detected in 2008 and 2009 adjacent to the project area during a marbled murrelet survey on Redwood Meadows Ranch. Great horned owls may nest within or adjacent to the project area. With mitigation incorporated in mitigation measure BIO-7, project impacts would be less than significant.

Western Screech Owl (*Otus kennicottii*), Northern Pygmy Owl (*Glaucidium gnoma*), and Northern Saw-whet Owl (*Aegolius acadicus*)

These three species of small owls inhabit forested areas and nest in woodpecker holes and natural cavities in snags. Nests typically are difficult to find. Any of these three species may nest in the project area. With mitigation incorporated in mitigation measure BIO-7, project impacts would be less than significant.

Red-shouldered Hawk (*Buteo lineatus*)

The red-shouldered hawk most frequently occurs in association with streams and riparian woodlands, but may nest in any forest type except very dense second-growth. Stick nests are constructed in either broadleaf or coniferous trees, generally quite high up and against the bole. Unlike most other buteos, red-shouldered hawks forage both in wooded and open areas. Red-shouldered hawks may nest within or adjacent to the project area, particularly along watercourses. With mitigation incorporated in mitigation measure BIO-7, project impacts would be less than significant.

Red-tailed Hawk (*Buteo jamaicensis*)

This very common and widespread hawk occurs throughout North America. It requires open areas for foraging, where it preys chiefly on small mammals. Red-tailed hawks build large stick nests either on cliffs or in trees. Nests rarely are built in the forest interior because this species is not adept at flying through forest cover and also tends to select nesting sites that allow a commanding view of the landscape. Thus, suitable nest trees usually are prominent specimens that are situated in the open, on ridgetops, or at the forest edge. Red-tailed hawks may nest in the vicinity or the project area. With mitigation incorporated in mitigation measure BIO-7, project impacts would be less than significant.

Turkey Vulture (*Cathartes aura*)

The turkey vulture is a common, widespread scavenger that occurs in a variety of habitats throughout North America. The species generally forages over relatively open country, scanning the ground for carrion. Turkey vultures usually nest in large fissures or cavities on sheer cliffs, but may also occasionally use hollow snags or large empty stick nests of other species in dead or live trees. Due to the infrequency with which tree nests are used, the likelihood is low that turkey vultures nest within or adjacent to the project area, thus, project activities are not anticipated to impact this species.

MAMMALS

Bats

Six bat species that are either CDFW or USFWS Species of Concern potentially occur in association with coniferous forest habitats of the project area. These include Townsend's big-eared bat *(Corynorhinus townsendii*), pallid bat (*Antrozous pallidus*), Western red bat (*Lasiurus blossevillii*), long-eared myotis (*Myotis evotis*), fringed myotis (*M. thysanodes*), long-legged myotis (*M. volans*), and Yuma myotis (*M. yumaensis*). Bat species distribution and abundance within the San Vicente Creek watershed is not well known. Townsend's big-eared bat (*Corynorhinus townsendii*) are known to have a maternal roost in the San Vicente Quarry adjacent to the project area. No critical habitat such as roosting or nursery sites would be impacted by project activities, therefore, project activities are not anticipated to impact this species.

Ringtail (*Bassariscus astutus*)

The ringtail is a CDFW Fully Protected Species. Ringtails are highly nocturnal and occur in forest and shrub habitats. Refuge and denning sites include snags, hollow trees and logs, caves, burrows, and abandoned woodrat nests. The species is primarily carnivorous. Ringtail distribution and abundance in the Santa Cruz Mountains is poorly known. Suitable habitat may be present within the project area. Key habitat elements noted above, including wood rat nests, will be maintained throughout the project area. Project activities are not anticipated to impact this species.

San-Francisco Dusky-footed Woodrat (*Neotoma fuscipes annectens*)

The San Francisco dusky-footed woodrat is a CDFW Species of Special Concern. Dusky-footed woodrats occur in the vicinity of the project area and are common and widespread throughout forested and chaparral habitats of the Santa Cruz Mountains. Woodrat houses (lodges or nests) made of sticks are usually built at the base of a shrub or tree. Individual houses may be occupied by successive generations for decades. In the event that a Woodrat nests is found in the project area, they will be flagged for avoidance with special treatment flagging, see BIO-6. Project activities are not anticipated to impact this species.

American Badger (*Taxidea taxus*)

The American badger is a CDFG Species of Special Concern. In California, Badgers occupy a diversity of habitats, the principle requirements including sufficient food, friable soils, and relatively open, uncultivated ground. Grasslands, savannas, and mountain meadows near timberline are preferred. Local populations have been very sparse for many years; however, according to recent research, Badgers are re-occupying the area. The closest know occurrences are approximately 4.3 miles southeast of the project area on coastal grasslands at California State Parks Wilder Ranch. Open grassland habitat is present approximately 1 mile from the project area; however, suitable habitat is not present within the project area. Threats to Badgers include agricultural and urban developments, as well as rodent poisoning. Badgers prey primarily on burrowing rodents such as gophers and make their homes in larger burrows as well. Project activities are not anticipated to impact this species.

PLANTS

The project area has been assessed for the potential presence of several rare plant species, described in Attachment 5. Special-Status Vascular Plant Species with Potential to Occur within project area. No special status plant species were detected. Botanical reconnaissance will continue during site visits and monitoring through spring 2017. If any listed plant species are discovered, they will be flagged for avoidance during treatment activities. Active or passive regeneration of native plants shall follow eradication. See mitigation measure BIO-5 for more native vegetation avoidance and minimization measures. With mitigation incorporated, project impacts would be less than significant.

Restoration species, often collected nearby from seed and cuttings, include but are not limited to:

Elk Clover (*Aralia californica)*
Wild Strawberry (*Fragaria vesca)*
Thimbleberry (*Rubus parviflorus)*
California Blackberry (*Rubus ursinus)*
Yerba Buena (*Clinopodium douglasii)*
California sagebrush (*Artemisia californica)*
California figwort (*Scrophularia californica)*
Willow (*Salix sp.)*
Rush (*Juncus sp.)*
Redwood sorrel (*Oxalis oregana)*
Coast redwood (*Sequoia sempervirens)*
Sticky Monkey-flower (*Mimulus aurantiacus)*

Exotic Species

In addition to Clematis, the project area has other weedy species such as French broom, (*Genista monspessulana*), jubata grass (*Cortaderia jubata*), forget-me-not (*Myosotis latifolia*), acacia (*Acacia* sp.), Himalaya berry (*Rubus armeniacus*), poison hemlock (*Conium maculatum*), tall sock-destroyer (*Torilis arvensis*), cut-leaved geranium (*Geranium dissectum*), and spiderwort (*Tradescantia* sp.). Most of these species do not threaten tree cover in the watershed, and do not pose the same threat to anadromous fish recovery as Clematis; however, in order to be successful at restoring the habitat value of the site, these invasive species would also have to be controlled. Invasive plant species monitoring and control efforts according to a proactive and adaptive Management Plan for the property are planned to continue.

TERRESTRIAL NATURAL PLANT COMMUNITIES

In addition to querying the CNDDB for plant taxa in the vicinity, the CNDDB was consulted for sensitive plant communities. The terrestrial natural communities noted as occurring within the 9-quad query area are not present within the area potentially impacted by the proposed treatment.

<u>**Species Protection Measures**</u>

Mitigation Measure BIO-1: California red-legged frog Mitigations:

1. Prior to operations occurring in the wet season, a qualified biologist will conduct a

biological resources education program for workers, and will appoint a crew member to act as an on-site biological monitor. The educational program will include a description of the California red-legged frog and its habitat, and the guidelines that must be followed by all project personnel to avoid take of the species. Educational programs will be conducted for new personnel before they join project activities. Color photographs will be used in the training session, and a qualified person will be on hand to answer questions. For purposes of protection of red-legged frogs, the wet season begins with the first frontal rain system depositing a minimum of 0.25 inches of rain after October 15 and ending on April 15. In the absence of rain events that total at least 0.25 inches as measured at the Ben Lomond rain gauge, wet season restrictions would nevertheless apply on November 30.

2. For wet-season operations, before project activities begin each day, a biological monitor will inspect under any equipment left overnight to look for California red-legged frogs. If a red-legged frog is found, the red-legged frog will not be relocated or captured, and all activities that could result in take will cease and the sighting will be reported to CDFW, USFWS, and the County of Santa Cruz, along with measures being implemented to avoid take of the individual. Activities related to the observation shall not commence until approved by the agencies.

3. A biological monitor will be on-site during all ground-disturbing project activities, to ensure that there is no take of this species. If red-legged frogs are observed, work will be postponed within that area and the project biologist will determine if removal activities can continue in that area at a later date.

Mitigation Measure BIO-2: Western Pond Turtle Mitigations:

To avoid potential impacts to western pond turtles, at the beginning of each day before any equipment work a biological monitor will inspect under equipment to look for turtles. If a turtle is found, the turtle will not be relocated or captured, all activities that could result in take will cease and the sighting will be reported to CDFW and the County along with measures being implemented to avoid take of the individual.

Mitigation Measure BIO-3: Herbicide Avoidance and Minimization Measures:

1. A 60-foot buffer zone adjacent to standing or flowing water would be established within which there would be no foliar application of herbicides (Attachment 6). Within the 60-foot buffer, as well as areas greater than 60 feet from surface waters but where there is potential for herbicides to reach aquatic habitats via runoff or drift, only aquatic-safe formulations of herbicides would be used (e.g., Milestone, Garlon 3A), and they would be applied only by brushing directly onto stumps. The more toxic Garlon 4 Ultra would not be used.

2. No herbicide shall be applied within 15 feet of aquatic features.

3. Herbicide use would strive to minimize toxicity while providing the most effective control to minimize applications for herbicides approved for use in and near aquatic environments, including restriction for use within buffer zones. Herbicides are planned to include – Milestone (Active ingredient: aminopyralid), and Rodeo (Active ingredient: glyphosate). If these herbicides are not available, a suitable alternative would be utilized of an herbicide approved for over-water use.

4. Herbicides would be judiciously applied directly to stumps, and foliar application would not be used in any areas subject to potential drift to surface water bodies. Stump application of all herbicides would be conducted by a State of California Qualified Applicator or by staff under their supervision. Experimentation with ways to limit the dripping of any herbicide around the target cut stump would be experimented with. Ideas include incorporating a rubber gasket that slides around the cut vine surface prior to application.

5. Herbicides would not be applied within 24 hours of predicted rain events (40 percent chance or greater for rainfall) to reduce the potential for runoff of herbicides into surface water bodies.

6. Foliar application of herbicides or other spray application methods would not be applied when wind speeds exceed 10 miles per hour to reduce likelihood of drift into surface water bodies.

7. Chemical treatment would be conducted in accordance with the property Management Plan, Best Management Practices, Pest Control Adviser Recommendations and an approved treatment plan.

8. Contractors must have all necessary licensing by CDPR for herbicide application. Use of herbicides would be consistent with label instructions and Material Safety Data Sheets documents would be maintained.

9. Integrated Pest Management Approaches: Applicants would also use non-chemical methods such as hand pulling or chip deposition on seed stock to prevent seedling germination, thus reducing the need for herbicides.

10. A liquid herbicide would be applied to each cut vine within 60 minutes of felling; a typical vine requires ¼ to ½ an ounce of diluted solution, which must be applied to the cambium layer, directly beneath the bark. The cut stump formulation may be diluted or adjusted at the judgment of the project manager. The rate of material used shall not exceed the amount allowable per acre per year, by U.S. Environmental Protection Agency regulations.

11. Drift from foliar application would be avoided by implementing measures, such as

avoiding windy days (e.g., avoid spraying when wind speeds are more than 7 miles per hour) and using proper spraying techniques, and following all CDPR regulations. Herbicide would only be applied by hand during dry weather and low wind conditions.

12. The lowest effective concentration needed for effectiveness would be used, typically specified as a range on the product label. Note that concentration is dependent on method of application: cut stump mixtures are more highly concentrated than foliar mixtures.
13. No herbicides would be intentionally applied to non-target species.
14. All containers of materials would be labeled, used, stored, recorded, reported and disposed of according to CDPR regulations.
15. Because the restrictions on use are so numerous and species/application dependent, the label instructions or CDPR website would be consulted for a complete (and evolving) set of use guidelines and restrictions.

Mitigation Measure BIO-4: General Avoidance and Minimization Measures:

1. The number of access routes, number and size of staging areas, and the total area of the activity will be limited to the minimum necessary to achieve the project goal. Where impacts occur in these staging areas and access routes, sites will be restored to pre-treatment condition or better. Equipment staging will occur on previously disturbed areas, utilizing the least intensive treatment methods and equipment feasible,
2. When possible, existing ingress or egress points will be used and work will be performed from the top of the creek banks.
3. Staging areas will be located more than 100 feet from the riparian corridor.
4. Work will occur from 30 minutes before sunrise to 30 minutes prior to sundown.
5. Work will not occur on days with a 50% chance of rain or greater.

Mitigation Measure BIO-5: Vegetation Avoidance and Minimization Measures:

1. Disturbance of native forbs, shrubs, or woody perennials in the clematis removal area will be avoided or minimized to the fullest possible extent. Site preparation activities may occur over several years for weed control. In that case, identification and marking of the extent of desirable vegetation will be conducted each year prior to site preparation activities and these areas will be left intact. Areas of desirable vegetation may expand to occupy areas of undesirable vegetation after they are subject to management measures.

3. Any stream bank area left barren of vegetation as a result of the implementation or

maintenance of the practices will be restored.

4. Native plants characteristic of the local habitat type will be the preferred alternative for revegetation. However non-invasive non-native species, such as common barley, may be used for temporary erosion control.

5. The spread or introduction of invasive plant species will be avoided to the maximum extent possible by avoiding areas with established native vegetation during treatment wherever possible, restoring disturbed areas of native communities with native species where appropriate, and post-project monitoring and control of invasive species being treated as part of the project.

6. The spread of exotic plant pathogens such as SOD shall be limited by following the guidelines set by the California Oak Mortality Task Force, which monitors distribution of sudden oak death and disseminates current information. All equipment entering or leaving the project area will be inspected to assure that it is free of any foliar materials (leaves, twigs, branches) and soil. If need be, equipment will be washed to remove accumulations of soil and organic debris, according to the guidelines provided by the California Oak Mortality Task Force, www.suddenoakdeath.org. Restoration planting stock will be from a facility free of SOD. No host foliage will be brought to or removed from the project area.

Mitigation Measure BIO-6: San Francisco Dusky-Footed Woodrat:

1. In the event that a Woodrat nests are found in the project area, they will be flagged for avoidance with special treatment flagging.

Mitigation Measure BIO-7: Protection of Nesting Birds:

1. If covered activities are scheduled during the bird nesting season (February 1 and August 15), a focused survey for active nests of such birds will be conducted by a qualified biologist within 15 days prior to the beginning of project related activities. Surveys will be conducted in all suitable habitat located in and adjacent to the project area, in staging, storage and stockpile areas, and along transportation routes on the property. The minimum survey radii surrounding the work area is typically the following: i) 250 feet for passerines; ii) 500 feet for small raptors, such as *Accipiter* sp., and for tri-colored blackbird colonies; and iii) 1,000 feet for larger raptors such as *Buteos* sp.. The bird survey methodology and the results of the survey will be submitted to the CDFW prior to commencement of project activities.

2. An active nest is defined as a nest having eggs or chicks present. If active nests are found, POST and SVF will consult with CDFW and the USFWS regarding appropriate action to comply with the Migratory Bird Treaty Act of 1918 and the FGC of California. If a lapse in project-related work of 15 days or longer occurs, another

focused survey will be conducted before project work is reinitiated. If active nests are found, the Permittee will consult with the CDFW and the USFWS prior to resumption of project activities within the buffer distance (listed below).

3. Active nest sites will be designated as "Ecologically Sensitive Areas" and protected (while occupied) during treatment with the establishment of a fence barrier or flagging surrounding the nest site. The typical minimum distances of the protective buffers surrounding each identified nest site is usually the following: i) 1,000 feet for large raptors such as *Buteos*; ii) 250 feet for small raptors such as *Accipiters*; iii) 250 feet for passerines. A biological monitor will monitor the behavior of the birds (adults and young, when present) at the nest site to ensure that the buffers are adequately sized and that birds are not disturbed by project-related activities. The biological monitor does not need to be present at all times, but shall monitor for two hours at the beginning of each new phase of treatment. Buffers will be maintained during project treatment until the young have fully fledged, are no longer being fed by the parents, and have left the nest site, as determined by the biological monitor.

4. No trees, shrubs or wetland and marsh habitat will be disturbed that contain active bird nests until all eggs have hatched, and young have fully fledged (are no longer being fed by the adults, and have left the nest site). No habitat removal or modification will occur within the nest buffer, even if the nest continues to be active beyond the typical nesting season for the species, until the young have fully fledged and will no longer be adversely affected by the project.

		Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
2.	*Have a substantial adverse effect on any riparian habitat or sensitive natural community identified in local or regional plans, policies, regulations (e.g., wetland, native grassland, special forests, intertidal zone, etc.) or by the California Department of Fish and Wildlife or U.S. Fish and Wildlife Service?*	☐	☒	☐	☐

Discussion: The project site includes approximately 11 acres of riparian corridor, along San Vicente Creek, Mill Creek and Picnic Creek. This project is intended to enhance and restore the native riparian vegetation within the project site. While short-term disturbance of the riparian corridor may occur as a consequence of project implementation, the protections for riparian habitat already included as part of the project, and any additional measures incorporated into the project pursuant to agency consultation, would ensure that the project does not have a substantial adverse effect on any riparian habitat or sensitive natural community. The impact would therefore be less than significant. See mitigation

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact

measures BIO-1 through BIO-7.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
3. *Have a substantial adverse effect on federally protected wetlands as defined by Section 404 of the Clean Water Act (including, but not limited to marsh, vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means?*	☐	☐	☒	☐

Discussion: Restoration activities would not result in hydrological interruptions since the project activities would not interfere with the stream channel, bed and bank to a significant degree. Impacts would be less than significant.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
4 *Interfere substantially with the movement of any native resident or migratory fish or wildlife species or migratory wildlife corridors, or impede the use of native wildlife nursery sites?*	☐	☐	☒	☐

Discussion: The enhancement and restoration of wetland and upland habitat would have no effect on fish passage through San Vicente Creek and Mill ecosystem, nor would project activities interfere with movement of wildlife through the riparian corridor or upland areas. The proposed project would enhance riparian habitat for more likely future riparian tree recruitment.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
5. *Conflict with any local policies or ordinances protecting biological resources (such as the Sensitive Habitat Ordinance, Riparian and Wetland Protection Ordinance, and the Significant Tree Protection Ordinance)?*	☐	☐	☒	☐

Discussion: The project does not conflict with any local policies or ordinances protecting biological resource. The project complies with the Santa Cruz County Riparian and Wetland Protection Ordinance. Other than wetlands (including streams) and riparian corridors, the project site does not appear to contain sensitive habitat, as defined in the Santa Cruz County Sensitive Habitat Ordinance (Santa Cruz County Code Section 16.32.040). See BIO-1-5 for avoidance and minimization measures.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
6. *Conflict with the provisions of an adopted Habitat Conservation Plan, Natural Community Conservation Plan, or other approved local, regional, or state habitat conservation plan?*	☐	☐	☐	☒

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact

Discussion: The San Vicente Redwoods property is not within the boundaries of any Habitat Conservation Plan or Natural Community Conservation Plan. The proposed project would not conflict with the provisions of any adopted Habitat Conservation Plan Natural Community Conservation Plan, or other approved local, regional, or state habitat conservation plan.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
7. *Produce nighttime lighting that would substantially illuminate wildlife habitats?*	☐	☐	☐	☒

Discussion: The project would not result in or involve any nighttime lighting. No impact of this kind would occur.

E. CULTURAL RESOURCES

Would the project:

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
1. *Cause a substantial adverse change in the significance of a historical resource as defined in CEQA Guidelines Section 15064.5?*	☐	☒	☐	☐

Discussion: The historic settlement of Bella Vista/ Quarry Camp consisting of rubble remains, is located near to upper extent of one of the main areas of concentrated Clematis. Bella Vista was located just before the quarry across from the confluence of Mill Creek into San Vicente Creek. It was first established around 1920 when a hostel was erected for single quarry workers. It could house up to fifty employees and was operated by Frank Bellangero and Gino Catterni, as well as the former's wife, Angelina. Over the years the settlement grew. Throughout the 1920s, improvements were made to the hostel, expanding its capacity to 100 men.[1] Bella Vista is now gone, having been destroyed by a massive landslide on March 7, 1962[2]. However, some ornamental plantings, a concrete staircase, and sheet metal are present on the site.

The proposed project proposes to treat and control the invasive plant Clematis on approximately 30 acres, some of which falls within remains of the former town of Bella Vista. As a result, a small potential exists for significant impacts to historical resources associated with the remaining portions of the historic town of Bella Vista. The following mitigation would reduce potential impacts to below a level of significance:

Mitigation Measure CUL-1:

In order to avoid potential adverse impacts to the remains of the historic town of Bella Vista, the following mitigation shall be conducted.

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[1] Santa Cruz Trains, Railroads of the Monterey Bay – Railroads: Santa Cruz Portland Cement Company Railroad, July 21, 2017, by Derek R. Whaley

[2] The Wildest Ride in Town – Davenport's Cement Plant Railroad System, by Alverda Orlando

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact

1. Onsite training shall be conducted by a historian with expertise in the history of the town of Bella Vista and the associated quarry to educate the Clematis removal team on the history of the town. Education will also focus on the importance of preservation of the site in its current condition. The training shall inform the Clematis removal team that any artifacts discovered on the site shall not be disturbed and left as discovered. Care shall be taken no to impact any potential artifacts associated with the town of Bella vista during soil disturbance associated with Clematis removal.
2. Photo documentation of substantial artifacts discovered shall be submitted to the County Planning Department following the discovery. County Planning shall determine if any further action is required in order to avoid impacts to the resource during Clematis removal.
3. No staging for Clematis removal shall occur within the boundaries of the historic town of Bella Vista.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
2. *Cause a substantial adverse change in the significance of an archaeological resource pursuant to CEQA Guidelines Section 15064.5?*	☐	☒	☐	☐

Discussion: A property-wide records check for documented cultural resources and prior archaeological surveys throughout the property was completed by the Northwest Information Center, Information Center File No. 12-0751. No archaeological sites were recorded in the vicinity of proposed invasive species control project. No cultural resources have subsequently been discovered or recorded in proximity to the proposed project. Surveys of the area encompassed by the project was conducted by the project Forester, Nadia Hamey, who has a current archaeological certificate from Cal Fire.

Mitigation Measure CUL-2:

Surveys for cultural resources shall continue during future fieldwork and monitoring activities. In order to protect any undiscovered cultural resources that may be located within the project area, the Forester or a designee with archaeological training will inspect the project area regularly during project implementation to determine if any artifacts are revealed. If a potentially significant archaeological site is discovered during project implementation, the following procedures apply:

1) The person who made the discovery shall immediately notify the Forester.

2) No treatment shall occur within 100 feet of the identified boundaries of the new site until the protection measures are proposed and agreed to.

4) A report shall be filed with a State Archaeologist. The minimum information provided

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact

shall include:

(a) A statement that the information is confidential.
(b) The mapped location of the site.
(c) A description of the site.
(d) Protection measures, and
(e) Site records, if site records are required.

Since the project would not involve significant ground disturbing activities, and no archaeological sites have been located, impacts to archaeological sites are anticipated to be less than significant with implementation of mitigation measures.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
3. *Disturb any human remains, including those interred outside of formal cemeteries?*	☐	☒	☐	☐

Discussion: A property-wide records check for documented cultural resources and prior archaeological surveys throughout the property was completed by the Northwest Information Center, Information Center File No. 12-0751. No archaeological sites were recorded in the vicinity of proposed invasive species control project. Although impacts are expected to be less than significant, the following mitigation will be implemented in the event unforeseen resources are discovered.

Mitigation Measure CUL-2:

Pursuant to Section 16.40.040 of the Santa Cruz County Code, if at any time during site preparation, excavation, or other ground disturbance associated with this project, human remains are discovered, the responsible persons shall immediately cease and desist from all further site excavation and notify the sheriff-coroner and the Planning Director. If the coroner determines that the remains are not of recent origin, a full archeological report shall be prepared and representatives of the local Native California Indian group shall be contacted. Disturbance shall not resume until the significance of the archeological resource is determined and appropriate mitigations to preserve the resource on the site are established.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
4. *Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature?*	☐	☐	☐	☒

Discussion: No unique paleontological resources, sites or unique geologic features are expected to occur within the project area. No impact is expected to occur.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
F. GEOLOGY AND SOILS *Would the project:*				
1. *Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:*				
A. *Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault? Refer to Division of Mines and Geology Special Publication 42.*	☐	☐	☐	☒
B. *Strong seismic ground shaking?*	☐	☐	☐	☒
C. *Seismic-related ground failure, including liquefaction?*	☐	☐	☐	☒
D. *Landslides?*	☐	☐	☐	☒

***Discussion (A through D)*:** The proposed project would not expose people or structures to potential substantial adverse effects due to rupture of a known earthquake fault, seismic ground shaking, or liquefaction, and the potential exposure to landslides is low given the nature of the proposed work. No known landslides are within the project area. No structures are located within the proposed project area.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
2. *Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse?*	☐	☐	☐	☒

***Discussion*:** Project activities would not result in potential for landslide, lateral spreading subsidence, liquefaction or collapse. No impact would occur.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
3. *Develop land with a slope exceeding 30%?*	☐	☐	☐	☒

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact

Discussion: The project would not involve any development. No impact would occur.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
4. *Result in substantial soil erosion or the loss of topsoil?*	☐	☒	☐	☐

Discussion: Some potential for erosion or the loss of topsoil exists during the implementation phase of the project, particularly in cases where Clematis has formed thick groundcover and may need to be removed by mechanical methods. However, this potential is minimal due to erosion control measures that will be in place.

Mitigation Measure GEO-1: Erosion Control

Any bare soil exceeding 100 contiguous square feet resulting from project activities will be treated with standard erosion control measures. Bare areas will be seeded, covered in jute netting or natural straw wattles will be placed depending on the slope and distance from waterways. Disturbed areas will also be planted and/or to be maintained to minimize surface erosion. In addition, a component of the project is to actively re-vegetate treatment areas with native plants as propagated from on-site stock, the successful establishment of which will mitigate areas of unstable soil.

Impacts from soil erosion or loss of topsoil would be considered less than significant with implementation of the above mitigation.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
5. *Be located on expansive soil, as defined in Section 1802.3.2 of the California Building Code (2007), creating substantial risks to life or property?*	☐	☐	☐	☒

Discussion: Expansive soils shrink and swell as a result of moisture changes. This can cause heaving and cracking of slabs-on-grade, pavements, and structures founded on shallow foundations. Although portions of the project site may be located on expansive soils, the proposed project does not involve construction of new structures or buildings that would expose risks to life or property due to expansive soils. No impact would occur.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
6. *Have soils incapable of adequately supporting the use of septic tanks, leach fields, or alternative waste water disposal systems where sewers are not available for the disposal of waste water?*	☐	☐	☐	☒

Discussion: No septic systems are proposed as part of the project. No impacts would occur.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
7. *Result in coastal cliff erosion?*	☐	☐	☐	☒

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact

Discussion: The proposed project is not located in the vicinity of a coastal cliff or bluff; and therefore, would not contribute to coastal cliff erosion. No impact is anticipated.

G. GREENHOUSE GAS EMISSIONS

Would the project:

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
1. *Generate greenhouse gas emissions, either directly or indirectly, that may have a significant impact on the environment?*	☐	☐	☒	☐

Discussion: Santa Cruz County has recently adopted a Climate Action Strategy (CAS) intended to establish specific emission reduction goals and necessary actions to reduce greenhouse gas levels to pre-1990 levels as required under AB 32 legislation. The strategy intends to reduce greenhouse gas emissions and energy consumption by implementing measures such as reducing vehicle miles traveled through the County and regional long range planning efforts and increasing energy efficiency in new and existing buildings and facilities (County of Santa Cruz, 2013).

The proposed project could be responsible for an incremental increase in greenhouse gas emissions by usage of fossil fuels during any mechanical removal (e.g. via excavator) of vegetation. All project construction equipment would be required to comply with the Regional Air Quality Control Board emissions requirements for construction equipment. Following construction, the direct and indirect GHG emissions associated with other sources within the county or state would be unchanged by the project. Project construction emissions would be relatively small, if not negligible, and would cease upon project completion. As a result, GHG emissions from project construction activities would not substantially contribute to the global GHG emissions burden and their impact would be less than significant.

For the construction phase of projects, the MBUAPCD has established a significance threshold of 82 pounds per day of PM10 emissions, and states that this threshold would not be expected to be exceeded by projects involving minimal earthmoving or grading on up to 8.1 acres per day. PM10 emissions from construction activities are mostly from earth moving and movement of vehicles and equipment over bare earth surfaces. Since the project involves neither significant earthmoving nor significant use of mobile equipment, the MBUAPCD's PM10 threshold for construction activities would not be expected to be exceeded.

The MBUAPCD states that construction-related emissions of ozone precursors, including volatile organic compounds (VOC) and oxides of nitrogen (NOx), are typically associated with use of diesel-powered equipment. Minimal diesel-powered equipment is proposed to be used in the project.

Small amounts of pollutants would be emitted by gasoline-powered equipment used in the

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact

project, including chainsaws/mowers, and by vehicles used by crew and personnel to access the site. Vehicle emissions would include tailpipe emissions and dust emissions from travel over unpaved roads on the San Vicente Redwoods property. Given the modest amount of new traffic that would be generated by the project, the short-term nature of project implementation, and the use of only light gasoline-powered equipment, there is no indication that new emissions of VOCs or NOx would exceed MBUAPCD thresholds for these pollutants and therefore there would not be a significant contribution.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
2. *Conflict with an applicable plan, policy or regulation adopted for the purpose of reducing the emissions of greenhouse gases?*	☐	☐	☐	☒

Discussion: The proposed project would restore native species and riparian habitat at the site. After completion, the project would not affect the operational GHG emissions of any source locally or elsewhere in the state, nor would it conflict with any local or state plan, policy or regulation to reduce GHG emissions. No impact is expected to occur.

H. HAZARDS AND HAZARDOUS MATERIALS

Would the project:

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
1. *Create a significant hazard to the public or the environment as a result of the routine transport, use or disposal of hazardous materials?*	☐	☐	☒	☐

Discussion: The proposed project would not create a significant hazard to the public or the environment. No routine transport or disposal of hazardous materials is proposed. However, during implementation, fuel and herbicides may be used at the project site. The following mitigation would be implemented to ensure that no impacts would occur. Impacts are expected to be less than significant with the incorporation of mitigation.

Mitigation Measure HAZ-1: Herbicide Application

Garlon-3A herbicide use on the property is subject to the following measures. As noted previously, specific input by a Pest Control Adviser (PCA) will be obtained prior to application of herbicide.

1. Conduct a review of the CNDDB and identify sensitive natural resources within the project including but not limited sensitive plants, habitats, animals or riparian areas.
2. Conduct on-site field evaluations. Review riparian areas and appropriateness of various herbicide treatments.
3. Identify avoidance areas such as sensitive species locale(s), buffer zones and other potential constraints using flagging or some other field identification method.
4. Determine best timing of treatments and schedule based on site-specific locale.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact

5. Develop an Herbicide Spill Prevention Plan.
6. Designate routes of travel, water sources and mixing sites. A Spill Kit must be on-site. These actions will reduce the risk of contamination of water by accidental spills.
7. An Emergency Response Preparedness Plan, including a First Aid Kit will be on site.
8. Anyone who handles herbicides must participate in a training program that describe the materials used and the measures to follow, including Herbicide Spill Prevention and Emergency Response Preparedness, as well as site-specific considerations.
9. Identify the closest area of cell phone reception and familiarize all volunteers with that location.
10. Daily: Check wind speed/weather.
11. Daily: Check mixing and loading tanks, herbicide application equipment and other equipment for wear/tear, leaks.
12. Selective application techniques shall be used whenever practicable so that desirable vegetation is not adversely affected.
13. For directed foliar spray, provide selective control of vegetation by directing the application toward target species. The nozzle tip, pressure and sprayer configuration shall be such to produce a coarser droplet to minimize drift.
14. For cut stem treatments, apply the herbicide judiciously to the stump immediately after cutting.
15. Applications will not be performed when the National Weather Service forecasts a >70% probability of measurable precipitation (>0.25") within the next 24 hour period.
16. Applications will cease when wind speed measured on site exceeds 7 mph sustained.
17. The following special precautions must be observed during periods of inclement weather:
18. Applications must not be made in, immediately prior to, or immediately following rain when runoff could be expected.
19. Applications must not be made when wind and/or fog conditions have the potential to cause drift.
20. Basal bark applications must not be made when stems are wet.
21. The following minimum buffer widths from streams, wetlands and other sensitive habitat must be maintained: No buffer requirement for herbicides approved for aquatic use without surfactant; 100 foot buffer requirement for herbicides not approved for aquatic use.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
2. *Create a significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment?*	☐	☐	☒	☐

Discussion: Please see discussion under H-1 above. Project impacts would be considered

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact

less than significant.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
3. *Emit hazardous emissions or handle hazardous or acutely hazardous materials, substances, or waste within one-quarter mile of an existing or proposed school?*	☐	☐	☐	☒

Discussion: The project site is not within 0.25-mile of a school. The nearest schools are Pacific Elementary School and Bonny Doon Elementary School, both of which are more than one mile from the project site. No impacts are anticipated.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
4. *Be located on a site which is included on a list of hazardous materials sites compiled pursuant to Government Code Section 65962.5 and, as a result, would it create a significant hazard to the public or the environment?*	☐	☐	☐	☒

Discussion: The project site is not listed on the "Cortese List" of hazardous materials sites compiled pursuant to Government Code Section 65962.5. No impacts are anticipated from project implementation.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
5. *For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project result in a safety hazard for people residing or working in the project area?*	☐	☐	☐	☒

Discussion: The project site is not located within two miles of a public airport or under a current airport land use plan. There are no public airports within 30 miles of the project site. No impact would occur.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
6. *For a project within the vicinity of a private airstrip, would the project result in a safety hazard for people residing or working in the project area?*	☐	☐	☐	☒

Discussion: The project site is not located in the vicinity of a private airstrip. The closest private airstrips to the project are the Las Trancas Airport – 17CL, which is located 11.8 miles northwest of the project site in Davenport, and the Bonny Doon Village Airport, which is located 12.2 miles to the northeast of the project site in Bonny Doon. No impact would occur.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
7. *Impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan?*	☐	☐	☐	☒

Discussion: The proposed project would not conflict with implementation of the County of Santa Cruz Local Hazard Mitigation Plan 2010-2015 (County of Santa Cruz, 2010). Therefore, no impacts to an adopted emergency response plan or evacuation Plan would occur from project implementation.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
8. *Expose people or structures to a significant risk of loss, injury or death involving wildland fires, including where wildlands are adjacent to urbanized areas or where residences are intermixed with wildlands?*	☐	☐	☐	☒

Discussion: The project would be located several miles upstream on/around San Vicente and Mill Creeks, surrounded by thousands of acres of open space land, with the closest residences being located on San Vicente St. (Davenport) and off of Via Venado and Bonny Doon/Thayer Roads (Bonny Doon). Project activities would not expose people or structures to risks involving wildland fires.

I. HYDROLOGY, WATER SUPPLY, AND WATER QUALITY

Would the project:

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
1. *Violate any water quality standards or waste discharge requirements?*	☐	☐	☐	☒

Discussion: The proposed project would not result in a significant change to post-construction stormwater runoff or impact how stormwater is handled. The project would not violate any water quality standards or wastewater discharge requirement, and with the following mitigation measure in place, no impact on water quality would occur.

Mitigation Measure HYD-1: Water Quality Avoidance and Minimization:

a) Ground based equipment will not operate during the winter period, which is October 15 to April 15.

b) Equipment will not operate within the channel zone.

c) All erosion control measures shall be installed as soon as practical following treatment and prior to the start of any rain which causes overland flow across or along the disturbed surface. All inactive areas (defined as a five-day period) will have all necessary soil stabilization practices in place two days after identification of inactivity and/or before a rain event, whichever comes first.

d) Any bare soil exceeding 100 contiguous square feet resulting from project activities will

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact

be treated with standard erosion control measures. Bare areas will be seeded, covered in jute netting or natural straw wattles will be placed depending on the slope and distance from waterways. Bare areas will also be replanted with local native species as necessary.

e) During the project activities, all trash and food that would attract potential predators of salmonids (e.g. raccoons, piscivors, etc.) must be properly contained, removed from the work site, and disposed of daily.

f) All refueling, maintenance, and staging of equipment and vehicles will occur at least 60 feet from riparian habitat or water bodies.

g) Supervisors will insure that all vehicles and equipment are inspected for fuel leaks, oil leaks, and other fluid leaks before and during their use to ensure that aquatic and upland habitats are not contaminated. Prior to the onset of work, the project Supervisor will ensure that a plan is in place for prompt and effective response to accidental spills. All workers will be informed of the importance of preventing spills and of the appropriate measures to take shall a spill occur. A spill kit shall be kept on site at all times.

h) Hydraulic fluids in mechanical equipment working within the active stream channel will not contain organophosphate esters.

i) Notification to CDFW and NMFS if any take or impacts to salmonids are observed.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
2. *Substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level (e.g., the production rate of pre-existing nearby wells would drop to a level which would not support existing land uses or planned uses for which permits have been granted)?*	☐	☐	☐	☒

Discussion: The proposed project would not substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level. The proposed project would have no impact on groundwater.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
3. *Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner which would result in substantial erosion or siltation on- or off-site?*	☐	☒	☐	☐

***Discussion*:** The project would temporarily alter the existing drainage pattern through the large-scale removal of invasive vegetation, which in some cases forms thick, ground-covering mats. No long-term effects would result. An erosion control plan would also be required per Section 16.22.060 of the County Code.

Mitigation Measure HYD-2: Minimizing Contaminants and Sediment Movement:

The following water quality protection and erosion and sediment control mitigation measures would be implemented, based on standard County requirements, to minimize construction-related contaminants and mobilization of sediment to San Vicente Creek in the project area.

The mitigation measures will be selected to achieve maximum sediment removal and represent the best available technology that is economically achievable and are subject to review and approval by the County. The County will perform routine inspections of the construction area to verify the mitigation measures are properly implemented and maintained. The County will notify contractors immediately if there is a noncompliance issue and will require compliance.

The mitigation measures will include, but are not limited to, the following.

- All mechanical earthwork involving rivers, ephemeral drainages, and culverts, will occur in the dry season (generally between June 1 and October 15).
- Equipment used in and around drainages and wetlands will be in good working order and free of dripping or leaking engine fluids. All vehicle maintenance will be performed at least 300 feet from all drainages and wetlands. Any necessary equipment washing will be carried out where the water cannot flow into drainages or wetlands.
- Exposed bare soil shall be treated to minimize soil erosion by planting and/or packing with mulch. In areas where, due to steepness of slope or lack of slash and debris, planting or mulching is not feasible, another method of effective erosion control will be implemented, such as applying erosion control blankets or installing wattles. For areas disturbed from May 1 to October 15, treatment shall be completed prior to the start of any rain that causes overland flow across or along the disturbed surface that could deliver sediment into a watercourse or lake in quantities deleterious to the beneficial uses of water.
- An herbicide spill prevention plan is in-use on the property per the Property Management Plan – Herbicide Application Best Management Practices Table 7-1 (attached), and shall be followed during project activities.
- During initial treatments, research will involve understanding the biology of the pests, chemical and non-chemical options for controlling them, and any secondary

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact

effects of the control techniques. Non-chemical techniques to control invasive plants (cutting, digging, mowing, etc.) will be considered along with chemical methods (herbicides).

- The landowners, stewardship volunteers, Property Manager, and/or Conservation Easement Holder will monitor sites to ascertain results of the management actions.
- The effectiveness of the methods will be evaluated in light of the site goals, and this information will be used to modify and improve control priorities, methods and plans. Follow-up monitoring will be necessary to contain the spread of the invasive plant and then eradicate it completely from the site.

Implementation of the above mitigation measures would ensure that water quality impacts to San Vicente Creek and Mill Creek are reduced to a less than significant level.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
4. *Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which would result in flooding, on- or off-site?*	☐	☐	☒	☐

***Discussion*:** Although the proposed project would alter the existing drainage patterns of the site, it would not increase the rate or amount of surface water runoff. Stormwater flows are conveyed by the ditch located south of the site. This ditch would be avoided during project construction. The proposed project would have no impact on flooding on- or off-site. Impacts would be less than significant.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
5. *Create or contribute runoff water which would exceed the capacity of existing or planned storm water drainage systems, or provide substantial additional sources of polluted runoff?*	☐	☐	☐	☒

***Discussion*:** The proposed project would not create or contribute runoff water that would exceed the capacity of existing or planned stormwater drainage systems. Stormwater from agricultural fields south of the site may flow into the wetland habitat. There would be no impact to stormwater runoff volumes or sources.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
6. *Otherwise substantially degrade water quality?*	☐	☐	☒	☐

***Discussion*:** The proposed project would not substantially degrade water quality as there would be no increase in impervious surface. Restoration and enhancement of wetland

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact

habitat would result in improved water quality conditions. Construction of the proposed project could release sediment and other pollutants that could migrate to surface waters. The grading and other activities would be required to perform under a SWPPP prepared in conformance with requirements of SWRCB's "General Permit for Discharges of Stormwater Associated with Construction Activities (General Permit)." The General Permit presents a very specific process for construction projects to comply with the CWA's provisions that relate to the control of pollutant discharge from "nonpoint" sources. The General Permit provides for compliance with the regulations through submittal of a Notice of Intent to comply with the format and content of the process developed for the General Permit, which includes development and implementation of a SWPPP.

Construction impacts on water quality would be minimized through implementation of a SWPPP. Also see discussion under I-3 above. Impacts would be less than significant.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
7. *Place housing within a 100-year flood hazard area as mapped on a federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map?*	☐	☐	☐	☒

***Discussion*:** Although the project site is located within a 100-year flood hazard area as mapped on Flood Insurance Rate Map (FEMA 2013), implementation of the project would not involve placement of any new housing or structures within a 100-year flood hazard area. Therefore the project would have no impact on flood hazards associated with housing.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
8. *Place within a 100-year flood hazard area structures which would impede or redirect flood flows?*	☐	☐	☐	☒

***Discussion*:** Although the project site is located within the 100-year floodplain, wetland restoration activities would not substantially impede or redirect flood flows as the culverts that carry flows west from the site would not be altered. Restoration and protection of wetland habitat within the project site would provide a beneficial impact on surrounding residences and agricultural fields by providing a designated wetland available to capture and store flood waters. Construction and operation of the proposed project would have no adverse impact on flood flows.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
9. *Expose people or structures to a significant risk of loss, injury or death involving flooding, including flooding as a result of the failure of a levee or dam?*	☐	☐	☒	☐

***Discussion*:** Construction of the proposed project would not expose workers to risk of loss, injury or death involving flooding because even if the culverts (or upstream dams)

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact

were to fail, flooding at the site would be gradual and not result in loss, injury or death. Rail lines and upland areas provide access to and from the site when it is inundated. The risk associated with this impact is low and potential significance of this impact would be less than significant.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
10. Inundation by seiche, tsunami, or mudflow?	☐	☐	☒	☐

Discussion: Tsunamis are triggered in a body of water by a sudden movement, such as a large-scale slump or slide, which is often caused by earthquakes, movement of the oceans crust, or large explosions. Tsunamis have extremely long wave periods and wavelengths and can travel at great speeds. The project site is located approximately 2 miles inland from the Pacific Ocean and within a 0-5 meter tsunami inundation zone (2005 Op Area Emergency Management Plan). A tsunami generated by a Richter magnitude 6.8+ earthquake on the San Gregorio fault could arrive just minutes after the initial shock.

The lack of warning time from such a nearby event would result in higher causalities than if it were a distant tsunami where the Tsunami Warning System for the Pacific Ocean could warn threatened coastal areas in time for evacuation (County of Santa Cruz 2010). Although unlikely, construction of the project could expose workers to inundation by tsunami if one were to occur during the construction window. The risk associated with this impact is low and potential significance of this impact would be less than significant.

J. LAND USE AND PLANNING

Would the project:

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
1. Physically divide an established community?	☐	☐	☐	☒

Discussion: The project site is located within the 8,532-acre San Vicente Redwoods property, which is owned by Peninsula Open Space Trust (POST) and Sempervirens Fund, with the closest established communities being Davenport (properties on San Vicente Street) and Bonny Doon (residential properties in the Thayer Road area). There is no established community in the vicinity of the project site. Therefore, the project would not divide an established community. No impact would occur.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
2. Conflict with any applicable land use plan, policy, or regulation of an agency with jurisdiction over the project (including, but not limited to the general plan, specific plan, local coastal program, or zoning ordinance) adopted for the purpose of avoiding or mitigating an environmental effect?	☐	☐	☒	☐

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact

Discussion: The proposed project would conform to the applicable land use plans, policies and regulations either through project design or with the implementation of mitigation measures. General Plan Policy 5.1.8, Chemicals within Sensitive Habitats, prohibits the use of insecticides, herbicides, or any toxic chemical substance in sensitive habitats, except when an emergency has been declared, when the habitat itself is threatened, or when a substantial risk to public health and safety exists. The infestation of Clematis poses a threat to anadromous fish and other wildlife habitat, water quality, and ecosystem health (including coast redwood habitat) throughout the lower watershed. The population has been identified as a "Red Alert" by the California Invasive Plant Council, as one of only two documented occurrences in the state. Therefore, herbicide application would be consistent with General Plan Policy 5.1.4. General Plan Policy 5.1.14 Removal of Invasive Plant Species encourages the removal of invasive species and their replacement with characteristic native plants, except where such invasive species provide significant habitat value and were removal of such species would severely degrade the existing habitat. The project proposes the removal of the highly invasive Clematis from the watershed in an effort to stop the spread to other parts of the county and state. Removal and eradication would assist in native habitat restoration. Therefore, the project would be consistent with the applicable policies and objectives in the General Plan and would comply with all applicable zoning and land use ordinances in the SCCC. The project would not conflict with any regulations or policies adopted for the purpose of avoiding or mitigating an environmental effect. Impacts would be considered less than significant.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
3. *Conflict with any applicable habitat conservation plan or natural community conservation plan?*	☐	☐	☐	☒

Discussion: The project does not conflict with any applicable habitat conservation plans or natural community conservation plans. No impact would occur.

K. MINERAL RESOURCES

Would the project:

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
1. *Result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the state?*	☐	☐	☐	☒

Discussion: The project does not entail the extraction of any mineral resources or the removal of any material other than nonnative invasive vegetation. Therefore, no impact is anticipated from project implementation.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
2. *Result in the loss of availability of a locally-important mineral resource recovery site delineated on a local general*	☐	☐	☐	☒

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact

plan, specific plan or other land use plan?

Discussion: The project site is zoned.

L. NOISE

Would the project result in:

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
1. *Exposure of persons to or generation of noise levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies?*	☐	☐	☐	☒

Discussion: Activities associated with the proposed project would result in a temporary increase in noise from the operation vehicles accessing the project area, operation of ground-based equipment, and presence of field crews at the project site. This increase in noise is expected to be intermittent and minor. Trucks and on-road vehicles would arrive at the project area via Highway 1, Cement Plant Road, and Warrenella Road, the closest available access route. Residents in nearby communities would not experience increased noise levels. Per County Policy average hourly noise levels shall not exceed the General Plan threshold of 50 Leq during the day and 45 Leq during the night. No impact would occur.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
2. *Exposure of persons to or generation of excessive groundborne vibration or groundborne noise levels?*	☐	☐	☐	☒

Activities associated with the proposed project would result in a temporary and intermittent increase in ambient noise levels if ground-based equipment is used. No significant groundborne vibration would exist. No impact would occur.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
3. *A substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project?*	☐	☐	☐	☒

Discussion: Operation of the project would not result in an increase in ambient noise levels in the project vicinity. No permanent increase in ambient noise would result from the proposed project. No impact would occur.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
4. *A substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project?*	☐	☐	☒	☐

Discussion: As mentioned in L-1 above, implementation of the proposed project would result in a temporary increase in noise levels in the vicinity of the project. However, this

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact

increase in construction noise would be minor and short in duration. Residents in Davenport and Bonny Doon are not anticipated to hear any activities associated with the project. It is anticipated that temporary and periodic increases in noise levels, if detectable at the closest nearby residences, would be less than significant.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
5. *For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project expose people residing or working in the project area to excessive noise levels?*	☐	☐	☐	☒

Discussion: The project area is not located within 2 miles of a public airport or in an area with an airport land use plan. Project activities would not expose people residing or working in the project area to excessive noise levels. No impact would occur.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
6. *For a project within the vicinity of a private airstrip, would the project expose people residing or working in the project area to excessive noise levels?*	☐	☐	☐	☒

Discussion: The proposed project is not within two miles of a private airstrip. Therefore, the proposed project would not expose people residing or working in the project area.

M. POPULATION AND HOUSING

Would the project:

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
1. *Induce substantial population growth in an area, either directly (for example, by proposing new homes and businesses) or indirectly (for example, through extension of roads or other infrastructure)?*	☐	☐	☐	☒

Discussion: The proposed project would not induce substantial population growth in an area because the project does not propose any physical or regulatory change that would remove a restriction to or encourage population growth in an area. The project proposes only to restore wetland and riparian habitat and would not induce population growth. No impact would occur.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
2. *Displace substantial numbers of existing housing, necessitating the construction of replacement housing elsewhere?*	☐	☐	☐	☒

Discussion: The proposed project would not displace any existing housing. No impact would occur.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
3. *Displace substantial numbers of people, necessitating the construction of replacement housing elsewhere?*	☐	☐	☐	☒

Discussion: The proposed project would not displace a substantial number of people since the project is intended to restore wetland and riparian habitat. No impact would occur.

N. PUBLIC SERVICES

Would the project:

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
1. *Would the project result in substantial adverse physical impacts associated with the provision of new or physically altered governmental facilities, need for new or physically altered governmental facilities, the construction of which could cause significant environmental impacts, in order to maintain acceptable service ratios, response times, or other performance objectives for any of the public services:*				
a. *Fire protection?*	☐	☐	☐	☒
b. *Police protection?*	☐	☐	☐	☒
c. *Schools?*	☐	☐	☐	☒
d. *Parks?*	☐	☐	☐	☒
e. *Other public facilities; including the maintenance of roads?*	☐	☐	☐	☒

Discussion (a through e): The proposed project would not create any temporary or long-term demands on public services and there would be no new fire protection, police, schools, or other public facilities constructed to serve the proposed project. The intent of the project is to restore and enhance wetland and upland habitat in the ecosystem. The project would have a positive impact on Santa Cruz County and the Davenport Sanitation District Water Line Infrastructure.

O. RECREATION

Would the project:

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
1. *Would the project increase the use of existing neighborhood and regional parks or other recreational facilities such that substantial physical deterioration of the facility would occur or be accelerated?*	☐	☐	☐	☒

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact

Discussion: The project site is located entirely within land owned and managed by Peninsula Open Space Trust (POST) and Sempervirens Fund. No recreational access to this part of the property would be provided. The closest public recreational resource are the beach in Davenport, the future trails at Cotoni- Coast Dairies National Monument, and the future trails on San Vicente Redwoods approximately 0.9 miles east and 1.3 miles north of the Picnic Creek Clematis patch. Recreational use is not planned to occur in this part of the property in the future, therefore, the proposed project would not result in an increase in the use of this area, or any other existing neighborhood and regional parks.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
2. *Does the project include recreational facilities or require the construction or expansion of recreational facilities which might have an adverse physical effect on the environment?*	☐	☐	☐	☒

Discussion: The project as proposed does not include construction or expansion of recreational facilities, therefore, the project would have no impact on the environment as a result of constructing or expanding recreational facilities.

P. TRANSPORTATION/TRAFFIC

Would the project:

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
1. *Conflict with an applicable plan, ordinance or policy establishing measures of effectiveness for the performance of the circulation system, taking into account all modes of transportation including mass transit and non-motorized travel and relevant components of the circulation system, including but not limited to intersections, streets, highways and freeways, pedestrian and bicycle paths, and mass transit?*	☐	☐	☐	☒

Discussion: The proposed project would not conflict with an applicable plan, ordinance or policy guiding transportation systems. The project requires daily access for work crews and intermittent access for groups of volunteers. Restoration ecologists and practitioners would access the site from Highway 1 to Old Cement Plant Road to Warrenella Road, then down to San Vicente Creek. Temporary traffic trips to the project site would be limited to a few trips a day at the peak. Therefore, project traffic would not impact traffic on Highway 1 or other roads in the vicinity of the project.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
2. *Conflict with an applicable congestion management program, including, but not*	☐	☐	☐	☒

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
limited to level of service standards and travel demand measures, or other standards established by the county congestion management agency for designated roads or highways?				

Discussion: The proposed project would not conflict with an applicable congestion management program or with either the goals and/or policies of the RTP or with monitoring the delivery of state and federally-funded projects outlined in the RTIP. No impact would occur.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
3. *Result in a change in air traffic patterns, including either an increase in traffic levels or a change in location that results in substantial safety risks?*	☐	☐	☐	☒

Discussion: No change in air traffic patterns would result from project implementation. Therefore, no impact is anticipated.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
4. *Substantially increase hazards due to a design feature (e.g., sharp curves or dangerous intersections) or incompatible uses (e.g., farm equipment)?*	☐	☐	☐	☒

Discussion: The proposed project consists of the restoration of wetland, riparian and associated upland habitat. No increase in hazards would occur from project design or from incompatible uses. No impact would occur from project implementation.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
5. *Result in inadequate emergency access?*	☐	☐	☐	☒

Discussion: The proposed project would not restrict emergency access for police, fire, or other emergency vehicles. No impact would occur from project implementation.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
6. *Conflict with adopted policies, plans, or programs regarding public transit, bicycle, or pedestrian facilities, or otherwise decrease the performance or safety of such facilities?*	☐	☐	☐	☒

Discussion: The proposed project design would comply with current road requirements to prevent potential hazards to motorists, bicyclists, and/or pedestrians. No impact would occur.

Q. TRIBAL CULTURAL RESOURCES

1. *Would the project cause a substantial adverse change in the significance of a*

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
tribal cultural resource, defined in Public Resources Code section 21074 as either a site, feature, place, cultural landscape that is geographically defined in terms of the size and scope of the landscape, sacred place, or object with cultural value to a California Native American tribe, and that is:				
A. Listed or eligible for listing in the California Register of Historical Resources, or in a local register of historical resources Code section 5020.1(k), or	☐	☐	☐	☒
B. A resource determined by the lead agency, in its discretion and supported by substantial evidence, to be significant pursuant to criteria set forth in subdivision (c) of Public Resources Code Section 5024.1. In applying the criteria set forth in subdivision (c) of Public Resources Code Section 5024.1, the lead agency shall consider the significance of the resource to a California Native American tribe.	☐	☐	☐	☒

Discussion: The project proposes to establish eradication of the invasive plant species *Clematis vitalba*. Section 21080.3.1(b) of the California Public Resources Code (AB 52) requires a lead agency formally notify a California Native American tribe that is traditionally and culturally affiliated within the geographic area of the discretionary project when formally requested. As of this writing, no California Native American tribes traditionally and culturally affiliated with the Santa Cruz County region have formally requested a consultation with the County of Santa Cruz (as Lead Agency under CEQA) regarding Tribal Cultural Resources. As a result, no Tribal Cultural Resources are known to occur in or near the project area. Therefore, no impact to the significance of a Tribal Cultural Resource is anticipated from project implementation.

R. UTILITIES AND SERVICE SYSTEMS

Would the project:

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
1. Exceed wastewater treatment requirements of the applicable Regional Water Quality Control Board?	☐	☐	☐	☒

Discussion: The proposed project would not generate wastewater. Therefore, wastewater

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact

treatment requirements would not be exceeded. No impacts would occur.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
2. *Require or result in the construction of new water or wastewater treatment facilities or expansion of existing facilities, the construction of which could cause significant environmental effects?*	☐	☐	☐	☒

Discussion: The proposed ecological restoration project would not require water or wastewater treatment. No impacts are expected to occur.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
3. *Require or result in the construction of new storm water drainage facilities or expansion of existing facilities, the construction of which could cause significant environmental effects?*	☐	☐	☐	☒

Discussion: The proposed ecological restoration project would not generate increased runoff; therefore, it would not result in the need for new or expanded drainage facilities. No impact would occur.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
4. *Have sufficient water supplies available to serve the project from existing entitlements and resources, or are new or expanded entitlements needed?*	☐	☐	☐	☒

Discussion: In the event of a dry year, the restoration planting would occur earlier to attempt to take advantage of natural moisture. No impact is anticipated.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
5. *Result in determination by the wastewater treatment provider which serves or may serve the project that it has adequate capacity to serve the project's projected demand in addition to the provider's existing commitments?*	☐	☐	☐	☒

Discussion: The proposed project would only use small amounts of water for watering restoration during the plant establishment period. No wastewater would be generated. No impacts are expected to occur from project implementation.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
6. *Be served by a landfill with sufficient permitted capacity to accommodate the project's solid waste disposal needs?*	☐	☐	☐	☒

Discussion: The proposed project would not generate solid waste for the landfill. No impact is anticipated.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
7. *Comply with federal, state, and local statutes and regulations related to solid waste?*	☐	☐	☐	☒

Discussion: The project would comply with all federal, state, and local statutes and regulations related to solid waste disposal. No impact would occur.

S. MANDATORY FINDINGS OF SIGNIFICANCE

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
1. *Does the project have the potential to degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, reduce the number or restrict the range of a rare or endangered plant or animal community, reduce the number or restrict the range of a rare or endangered plant or animal or eliminate important examples of the major periods of California history or prehistory?*	☐	☒	☐	☐

Discussion: The potential to degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, reduce the number or restrict the range of a rare or endangered plant or animal or eliminate important examples of the major periods of California history or prehistory were considered in the response to each question in Section III (A through Q) of this Initial Study. Resources that have been evaluated as significant would be potentially impacted by the project, particularly Air Quality, Biological Resources, and Cultural Resources. However, mitigation has been included that clearly reduces these effects to a level below significance. These mitigation measures include best management practices to avoid air quality and water quality impacts, measures to avoid impacts to anadromous fish, California red-legged frogs, and nesting birds and measures to protect cultural resources in the event of a discovery. As a result of this evaluation, there is no substantial evidence that, after mitigation, significant effects associated with this project would result. Therefore, this project has been determined not to meet this Mandatory Finding of Significance.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
2. *Does the project have impacts that are individually limited, but cumulatively considerable? ("cumulatively considerable" means that the incremental effects of a project are considerable when viewed in connection with the effects of*	☐	☐	☒	☐

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
past projects, the effects of other current projects, and the effects of probable future projects)?				

Discussion: In addition to project specific impacts, this evaluation considered the projects potential for incremental effects that are cumulatively considerable. As a result of this evaluation, there were determined to be no areas with potentially significant cumulative impacts. As a result of this evaluation, there is no substantial evidence that, after mitigation, there are cumulative effects associated with this project. Therefore, this project has been determined not to meet this Mandatory Finding of Significance.

	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
3. *Does the project have environmental effects which will cause substantial adverse effects on human beings, either directly or indirectly?*	☐	☐	☒	☐

Discussion: In the evaluation of environmental impacts in this Initial Study, the potential for adverse direct or indirect impacts to human beings were considered in the response to specific questions in Section III (A through Q). As a result of this evaluation, there were determined to be potentially significant effects to human beings related to the following: Agriculture and Forestry Resources, Biological Resources, Cultural Resources, Geology and Soils, and Hydrology/Water Supply/Water Quality. However, mitigation has been included that clearly reduces these effects to a level below significance. As a result of this evaluation, there is no substantial evidence that, after mitigation, there are adverse effects to human beings associated with this project. Therefore, this project has been determined not to meet this Mandatory Finding of Significance.

IV. REFERENCES USED IN THE COMPLETION OF THIS INITIAL STUDY

Bungard, R. A., Daly, G. T., McNeil, D. L., Jones, A. V., & Morton, J. D. (1997). Clematis vitalba in a New Zealand native forest remnant: does seed germination explain distribution? New Zealand Journal of Botany, 35(4), 525-534.

Calflora, Interactive Distribution Map, 2016. Retrieved from http://www.calflora.org/entry/dgrid.html?crn=8710

California Department of Fish and Game. 1996, Stream Inventory Report, San Vicente Creek. Report. By Allan Renger, Dawn Fisher, Jennifer Nelson, Tom Laidig, and Twyla Anderson. California Department of Fish and Wildlife. 2015, California State Wildlife Action Plan, 2015, Update: A Conservation Legacy for Californians. Edited by Armand G. Gonzales and Junko Hoshi, PhD. Prepared with assistance from Ascent Environmental, Inc., Sacramento, CA.

California Department of Fish and Wildlife, 2013, "Santa Cruz County Big Basin Coastal Watershed Stream Habitat Assessment Reports; San Vicente Creek."

California Department of Natural Resources. 2014. Safeguarding California; Implementing Action Plans. Sacramento, CA.

California Invasive Species Compendium, 2015, retrieved from http://www.cabi.org/isc/datasheet/14280 Cal-IPC. 2012. Preventing the Spread of Invasive Plants: Best Management Practices for Land Managers (3rd ed.). Cal-IPC Publication 2012-03.

County of Santa Cruz, 2013. County of Santa Cruz Climate Action Strategy. Approved by the Board of Supervisors on February 26, 2013.

County of Santa Cruz, 2010. *County of Santa Cruz Local Hazard Mitigation Plan 2010-2015.* Prepared by the County of Santa Cruz Office of Emergency Services.

County of Santa Cruz, 1994. 1994 General Plan and Local Coastal Program for the County of Santa Cruz, California. Adopted by the Board of Supervisors on May 24, 1994, and certified by the California Coastal Commission on December 15, 1994.

California Invasive Plant Council, Berkeley, CA. Available at www.cal-ipc.org.

DiTomaso, Joseph M., "New Weed Alerts!" UC Davis, 2014.

Ditomaso, Joseph M. Weeds of California and other Western States, University of California Agricultural and Natural Resources Book, n.d.

East Multnomah Soil and Water Conservation District, Weeds to Report/Early Detection and Rapid Response, n.d., Retrieved from http://emswcd.org/on-your-land/weeds/weeds-to-report.

Federal Emergency Management Agency (FEMA), 2013. Flood Zone Designations available online at: http://msc.fema.gov/webapp/http://www.fema.gov/national-flood-insurance-program-flood-hazard-mapping#10

Flint, L.E., and Flint, A.L., 2012, Simulation of climate change in San Francisco Bay Basins, California: Case studies in the Russian River Valley and Santa Cruz Mountains: U.S. Geological Survey Scientific Investigations Report 2012–5132.

French, Sara and Rob Cuthrell, "Review of the Ecology, Status, and Threats to Salmonids in Laguna Creek, Santa Cruz County, California," Amah Mutsun Land Trust, 2016.

Gourlay, A. H., Wittenberg, R., Hill, R. L., Spiers, A. G., & Fowler, S. V. (2000). The biological control programme against Clematis vitalba in New Zealand. In Proceedings of the X international symposium on biological control of weeds (pp. 799-806).

Heller, N.E. and E.S. Zavaleta. Biodiversity management in the face of climate change: A review of 22 years of recommendations. Biological Conservation, 2009.

King County Noxious Weed Control Program, "Best Management Practices; Old Man's Beard Clematis Vitalba Control," January 2010. Retrieved from http://your.kingcounty.gov/dnrp/library/water-and-land/weeds/BMPs/Old-mans-beard-Clematis-vitalba-control.pdf

MBUAPCD, 2008. Monterey Bay Unified Air Pollution Control District (MBUAPCD), CEQA Air Quality Guidelines. Prepared by the MBUAPCD, Adopted October 1995, Revised: February 1997, August 1998, December 1999, September 2000, September 2002, June 2004 and February 2008.

MBUAPCD, 2013a. Monterey Bay Unified Air Pollution Control District, NCCAB (NCCAB) Area Designations and Attainment Status – January 2013. Available online at http://www.mbuapcd.org/mbuapcd/pdf/Planning/Attainment_Status_January_2013_2.pdf

MBUAPCD, 2013b. Triennial Plan Revision 2009-2011. Monterey Bay Air Pollution Control District. Adopted April 17, 2013.

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

National Marine Fisheries. 2015. Coastal Multispecies Plan, Volume 1V, Central California Coast Steelhead Public Draft, 2015. National Marine Fisheries Service West Coast Region Santa Rosa, California.

Ogle, C. C., La Cock, G. D., Arnold, G., & Mickleson, N. (2000). Impact of an exotic vine Clematis vitalba (F. Ranunculaceae) and of control measures on plant biodiversity in indigenous forest, Taihape, New Zealand. Austral Ecology, 25(5), 539-551.

Oregon Department of Agriculture, Oregon Noxious Weed Profiles, Clematis Vitalba, n.d. Retrieved from http://www.oregon.gov/oda/programs/weeds/oregonnoxiousweeds/pages/aboutoregonweeds.aspx

Point Blue, Climate and Hydrology Report for San Vicente Watershed, Watershed Analyst, n.d. Retrieved from http://geo.pointblue.org/watershed-analyst/reports/report_3304110203_.html

Reinhart, K. O., Gurnee, J., Tirado, R., & Callaway, R. M. (2006). Invasion through quantitative effects: intense shade drives native decline and invasive success. Ecological Applications, 16(5), 1821-1831.

Resource Conservation District of Santa Cruz County, "San Vicente Creek Watershed Plan for Salmonid Recovery," 2014.

Shearin, Kathy, EMSWCD Program Coordinator, Sustainable Urban Landscapes, "Old Man's Beard," East Multnomah Soil and Water Conservation District, as a project for the Clackamas, Clark, Multnomah, and Washington Counties Cooperative Weed Management Area, n.d. Retrieved from https://www.portlandoregon.gov/bes/article/172621

Vittoz P. and Engler R. 2007. Seed dispersal distances: a simplification for data analyses and models. Bot. Helv.

Washington State Noxious Weed Control Board, Old Man's Beard, Clematis Vitalba, 2010. Retrieved from http://www.nwcb.wa.gov/searchResults.asp?class=C

Washington State Noxious Weed Control Board, "Written Findings of the Washington State Noxious Weed Control Board," 1999. Retrieved from http://www.nwcb.wa.gov/siteFiles/Clematis_vitalba.pdf

West, C., Literature Review of the Biology of Clematis Vitalba (old Man's Beard). 1991. Issue 725 of DSIR Land Resources vegetation report, Christchurch.

Attachment 1

Mitigation Monitoring and Reporting Program

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County of Santa Cruz

PLANNING DEPARTMENT
701 OCEAN STREET, 4TH FLOOR, SANTA CRUZ, CA 95060
(831) 454-2580 FAX: (831) 454-2131 TDD: (831) 454-2123
KATHLEEN MOLLOY PREVISICH, PLANNING DIRECTOR

MITIGATION MONITORING AND REPORTING PROGRAM for San Vicente Creek Watershed Clematis Control Project Application Nos. 171089 September 11, 2017

No.	Environmental Impact	Mitigation Measures	Responsibility for Compliance	Method of Compliance	Timing of Compliance
Biological Resources					
BIO-1	*Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special status species in local or regional plans, policies, or regulations, or by the California Department of Fish and Wildlife, or U.S. Fish and Wildlife Service?*	**California red-legged frog Mitigations:** 1. Prior to operations occurring in the wet season, a qualified biologist will conduct a biological resources education program for workers, and will appoint a crew member to act as an on-site biological monitor. The educational program will include a description of the California red-legged frog and its habitat, and the guidelines that must be followed by all project personnel to avoid take of the species. Educational programs will be conducted for new personnel before they join project activities. Color photographs will be used in the training session, and a qualified person will be on hand to answer questions. For purposes of protection of red-legged frogs, the wet season begins with the first frontal rain system depositing a minimum of 0.25 inches of rain after October 15 and ending on April 15. In the absence of rain events that total at least 0.25 inches as measured at the Ben Lomond rain gauge, wet season restrictions would nevertheless apply on November 30. 2. For wet-season operations, before project activities begin each day, a biological monitor will inspect under any equipment left overnight to look for California red-legged frogs. If a red-legged frog is found, the red-legged frog will not be relocated or captured, and all activities that could result in take will cease and the sighting will be reported to CDFW, USFWS, and the County of Santa Cruz, along with measures being implemented to avoid take of the individual. Activities related to the observation shall not commence until approved by the agencies. 3. A biological monitor will be on-site during all ground-disturbing project activities, to ensure that there is no take of this species. If red-legged frogs are observed, work will be postponed within that area and the project biologist will determine if removal activities can continue in that area at a later date.	Applicant	Compliance monitored by the County Planning Department, USFWS and approved biologist.	To be implemented prior to and during project construction
BIO-2		**Western Pond Turtle Mitigations:** To avoid potential impacts to western pond turtles, at the beginning of each day before any equipment work a biological monitor will inspect under equipment to look for turtles. If a turtle is found, the turtle will not be relocated or captured, all activities that could result in take will cease and the sighting will be reported to CDFW and the County along with measures being implemented to avoid take of the individual.	Applicant	Compliance monitored by the County Planning Department and CDFW approved biologist.	To be implemented prior to and during project construction
BIO-3		**Herbicide Avoidance and Minimization Measures:**	Applicant	Compliance	To be implemented

No.	Environmental Impact	Mitigation Measures	Responsibility for Compliance	Method of Compliance	Timing of Compliance
		1. A 60-foot buffer zone adjacent to standing or flowing water would be established within which there would be no foliar application of herbicides (Attachment 5). Within the 60-foot buffer, as well as areas greater than 60 feet from surface waters but where there is potential for herbicides to reach aquatic habitats via runoff or drift, only aquatic-safe formulations of herbicides would be used (e.g., Milestone, Garlon 3A), and they would be applied only by brushing directly onto stumps. The more toxic Garlon 4 Ultra would not be used. 2. No herbicide shall be applied within 15 feet of aquatic features. 3. Herbicide use would strive to minimize toxicity while providing the most effective control to minimize applications for herbicides approved for use in and near aquatic environments, including restriction for use within buffer zones. Herbicides are planned to include – Milestone (Active ingredient: aminopyralid), and Rodeo (Active ingredient: glyphosate). If these herbicides are not available, a suitable alternative would be utilized of an herbicide approved for over-water use. 4. Herbicides would be judiciously applied directly to stumps, and foliar application would not be used in any areas subject to potential drift to surface water bodies. Stump application of all herbicides would be conducted by a State of California Qualified Applicator or by staff under their supervision. Experimentation with ways to limit the dripping of any herbicide around the target cut stump would be experimented with. Ideas include incorporating a rubber gasket that slides around the cut vine surface prior to application. 5. Herbicides would not be applied within 24 hours of predicted rain events (40 percent chance or greater for rainfall) to reduce the potential for runoff of herbicides into surface water bodies. 6. Foliar application of herbicides or other spray application methods would not be applied when wind speeds exceed 10 miles per hour to reduce likelihood of drift into surface water bodies. 7. Chemical treatment would be conducted in accordance with the property Management Plan, Best Management Practices, Pest Control Adviser Recommendations and an approved treatment plan. 8. Contractors must have all necessary licensing by CDPR for herbicide application. Use of herbicides would be consistent with label instructions and Material Safety Data Sheets documents would be maintained. 9. Integrated Pest Management Approaches: Applicants would also use non-chemical methods such as hand pulling or chip deposition on seed stock to prevent seedling germination, thus reducing the need for herbicides. 10. A liquid herbicide would be applied to each cut vine within 60 minutes of felling; a typical vine requires ¼ to ½ an ounce of diluted solution, which must be applied to the cambium layer, directly beneath the bark. The cut stump formulation may be diluted or adjusted at the judgment of the project manager. The rate of material used shall not exceed the amount allowable per acre per year, by U.S. Environmental Protection		monitored by the County Planning Department and approved Pest Control Adviser.	prior to and during project construction.

No.	Environmental Impact	Mitigation Measures	Responsibility for Compliance	Method of Compliance	Timing of Compliance
		Agency regulations. 11. Drift from foliar application would be avoided by implementing measures, such as avoiding windy days (e.g., avoid spraying when wind speeds are more than 7 miles per hour) and using proper spraying techniques, and following all CDPR regulations. Herbicide would only be applied by hand during dry weather and low wind conditions. 12. The lowest effective concentration needed for effectiveness would be used, typically specified as a range on the product label. Note that concentration is dependent on method of application: cut stump mixtures are more highly concentrated than foliar mixtures. 13. No herbicides would be intentionally applied to non-target species. 14. All containers of materials would be labeled, used, stored, recorded, reported and disposed of according to CDPR regulations. 15. Because the restrictions on use are so numerous and species/application dependent, the label instructions or CDPR website would be consulted for a complete (and evolving) set of use guidelines and restrictions.			
BIO-4		**General Avoidance and Minimization Measures:** 1. The number of access routes, number and size of staging areas, and the total area of the activity will be limited to the minimum necessary to achieve the project goal. Where impacts occur in these staging areas and access routes, sites will be restored to pre-treatment condition or better. Equipment staging will occur on previously disturbed areas, utilizing the least intensive treatment methods and equipment feasible, 2. When possible, existing ingress or egress points will be used and work will be performed from the top of the creek banks. 3. Staging areas will be located more than 100 feet from the riparian corridor. 4. Work will occur from 30 minutes before sunrise to 30 minutes prior to sundown. 5. Work will not occur on days with a 50% chance of rain or greater.	Applicant	Compliance monitored by the County Planning.	To be implemented prior to and during project construction.
BIO-5		**Vegetation Avoidance and Minimization Measures:** 1. Disturbance of native forbs, shrubs, or woody perennials in the clematis removal area will be avoided or minimized to the fullest possible extent. Site preparation activities may occur over several years for weed control. In that case, identification and marking of the extent of desirable vegetation will be conducted each year prior to site preparation activities and these areas will be left intact. Areas of desirable vegetation may expand to occupy areas of undesirable vegetation after they are subject to management measures. 3. Any stream bank area left barren of vegetation as a result of the implementation or maintenance of the practices will be restored. 4. Native plants characteristic of the local habitat type will be the preferred alternative for revegetation. However non-invasive non-native species,	Applicant	Compliance monitored by the County Planning Department and CDFW approved biologist.	To be implemented prior to, during, and following project construction.

No.	Environmental Impact	Mitigation Measures	Responsibility for Compliance	Method of Compliance	Timing of Compliance
		such as common barley, may be used for temporary erosion control. 5. The spread or introduction of invasive plant species will be avoided to the maximum extent possible by avoiding areas with established native vegetation during treatment wherever possible, restoring disturbed areas of native communities with native species where appropriate, and post-project monitoring and control of invasive species being treated as part of the project. 6. The spread of exotic plant pathogens such as SOD shall be limited by following the guidelines set by the California Oak Mortality Task Force, which monitors distribution of sudden oak death and disseminates current information. All equipment entering or leaving the project area will be inspected to assure that it is free of any foliar materials (leaves, twigs, branches) and soil. If need be, equipment will be washed to remove accumulations of soil and organic debris, according to the guidelines provided by the California Oak Mortality Task Force, www.suddenoakdeath.org. Restoration planting stock will be from a facility free of SOD. No host foliage will be brought to or removed from the project area.			
BIO-6		**San Francisco Dusky-Footed Woodrat:** 1. In the event that a Woodrat nests are found in the project area, they will be flagged for avoidance with special treatment flagging.	Applicant	Compliance monitored by the County Planning Department and CDFW approved biologist.	To be implemented prior to and during project construction.
BIO-7		**Protection of Nesting Birds:** 1. If covered activities are scheduled during the bird nesting season (February 1 and August 15), a focused survey for active nests of such birds will be conducted by a qualified biologist within 15 days prior to the beginning of project related activities. Surveys will be conducted in all suitable habitat located in and adjacent to the project area, in staging, storage and stockpile areas, and along transportation routes on the property. The minimum survey radii surrounding the work area is typically the following: i) 250 feet for passerines; ii) 500 feet for small raptors, such as Accipiter sp., and for tri-colored blackbird colonies; and iii) 1,000 feet for larger raptors such as Buteos sp.. The bird survey methodology and the results of the survey will be submitted to the CDFW prior to commencement of project activities. 2. An active nest is defined as a nest having eggs or chicks present. If active nests are found, POST and SVF will consult with CDFW and the USFWS regarding appropriate action to comply with the Migratory Bird Treaty Act of 1918 and the FGC of California. If a lapse in project-related work of 15 days or longer occurs, another focused survey will be conducted before project work is reinitiated. If active nests are found, the Permittee will consult with the CDFW and the USFWS prior to resumption of project activities within the buffer distance (listed below). 3. Active nest sites will be designated as "Ecologically Sensitive Areas"	Applicant	Compliance monitored by the County Planning Department and CDFW or USFWS approved biologist.	To be implemented prior to and during project construction.

No.	Environmental Impact	Mitigation Measures	Responsibility for Compliance	Method of Compliance	Timing of Compliance
		and protected (while occupied) during treatment with the establishment of a fence barrier or flagging surrounding the nest site. The typical minimum distances of the protective buffers surrounding each identified nest site is usually the following: i) 1,000 feet for large raptors such as Buteos; ii) 250 feet for small raptors such as Accipiters; iii) 250 feet for passerines. A biological monitor will monitor the behavior of the birds (adults and young, when present) at the nest site to ensure that the buffers are adequately sized and that birds are not disturbed by project-related activities. The biological monitor does not need to be present at all times, but shall monitor for two hours at the beginning of each new phase of treatment. Buffers will be maintained during project treatment until the young have fully fledged, are no longer being fed by the parents, and have left the nest site, as determined by the biological monitor. 4. No trees, shrubs or wetland and marsh habitat will be disturbed that contain active bird nests until all eggs have hatched, and young have fully fledged (are no longer being fed by the adults, and have left the nest site). No habitat removal or modification will occur within the nest buffer, even if the nest continues to be active beyond the typical nesting season for the species, until the young have fully fledged and will no longer be adversely affected by the project.			
N/A	*Have a substantial adverse effect on any riparian habitat or sensitive natural community identified in local or regional plans, policies, regulations (e.g., wetland, native grassland, special forests, intertidal zone, etc.) or by the California Department of Fish and Wildlife or U.S. Fish and Wildlife Service*	See mitigation measures BIO-1 through BIO-7.	Applicant	Compliance monitored by the County Planning Department and USFWS or CDFW approved biologist.	To be implemented prior to, during, and following project construction.
Cultural Resources					
CUL-1	*Cause a substantial adverse change in the significance of a historical resource as defined in CEQA Guidelines Section 15064.5?*	In order to avoid potential adverse impacts to the remains of the historic town of Bella Vista, the following mitigation shall be conducted. 1. Onsite training shall be conducted by a historian with expertise in the history of the town of Bella Vista and the associated quarry to educate the Clematis removal team on the history of the town. Education will also focus on the importance of preservation of the site in its current condition. The training shall inform the Clematis removal team that any artifacts discovered on the site shall not be disturbed and left as discovered. Care shall be taken no to impact any potential artifacts associated with the town of Bella vista during soil disturbance	Applicant	Compliance monitored by the County Planning Department.	To be implemented prior to and during project construction

No.	Environmental Impact	Mitigation Measures	Responsibility for Compliance	Method of Compliance	Timing of Compliance
		associated with Clematis removal. 2. Photo documentation of substantial artifacts discovered shall be submitted to the County Planning Department following the discovery. County Planning shall determine if any further action is required in order to avoid impacts to the resource during Clematis removal. 3. No staging for Clematis removal shall occur within the boundaries of the historic town of Bella Vista.			
CUL-2	*Cause a substantial adverse change in the significance of an archaeological resource pursuant to CEQA Guidelines Section 15064.5?*	Surveys for cultural resources shall continue during future fieldwork and monitoring activities. In order to protect any undiscovered cultural resources that may be located within the project area, the Forester or a designee with archaeological training will inspect the project area regularly during project implementation to determine if any artifacts are revealed. If a potentially significant archaeological site is discovered during project implementation, the following procedures apply: 1. The person who made the discovery shall immediately notify the Forester. 2. No treatment shall occur within 100 feet of the identified boundaries of the new site until the protection measures are proposed and agreed to. 4. A report shall be filed with a State Archaeologist. The minimum information provided shall include: a. A statement that the information is confidential. b. The mapped location of the site. c. A description of the site. d. Protection measures, and e. Site records, if site records are required. Since the project would not involve significant ground disturbing activities, and no prehistoric archaeological sites have been located within the immediate project vicinity, impacts to archaeological sites are anticipated to be less than significant with implementation of mitigation measures.	Applicant	Compliance monitored by the County Planning Department and qualified archeologist.	To be implemented prior to and during project construction.
CUL-3	*Disturb any human remains, including those interred outside of formal cemeteries?*	Pursuant to Section 16.40.040 of the Santa Cruz County Code, if at any time during site preparation, excavation, or other ground disturbance associated with this project, human remains are discovered, the responsible persons shall immediately cease and desist from all further site excavation and notify the sheriff-coroner and the Planning Director. If the coroner determines that the remains are not of recent origin, a full archeological report shall be prepared and representatives of the local Native California Indian group shall be contacted. Disturbance shall not resume until the significance of the archeological resource is determined and appropriate mitigations to preserve the resource on the site are established.	Applicant	Compliance monitored by the County Planning Department and qualified archeologist.	To be implemented prior to and during project construction.

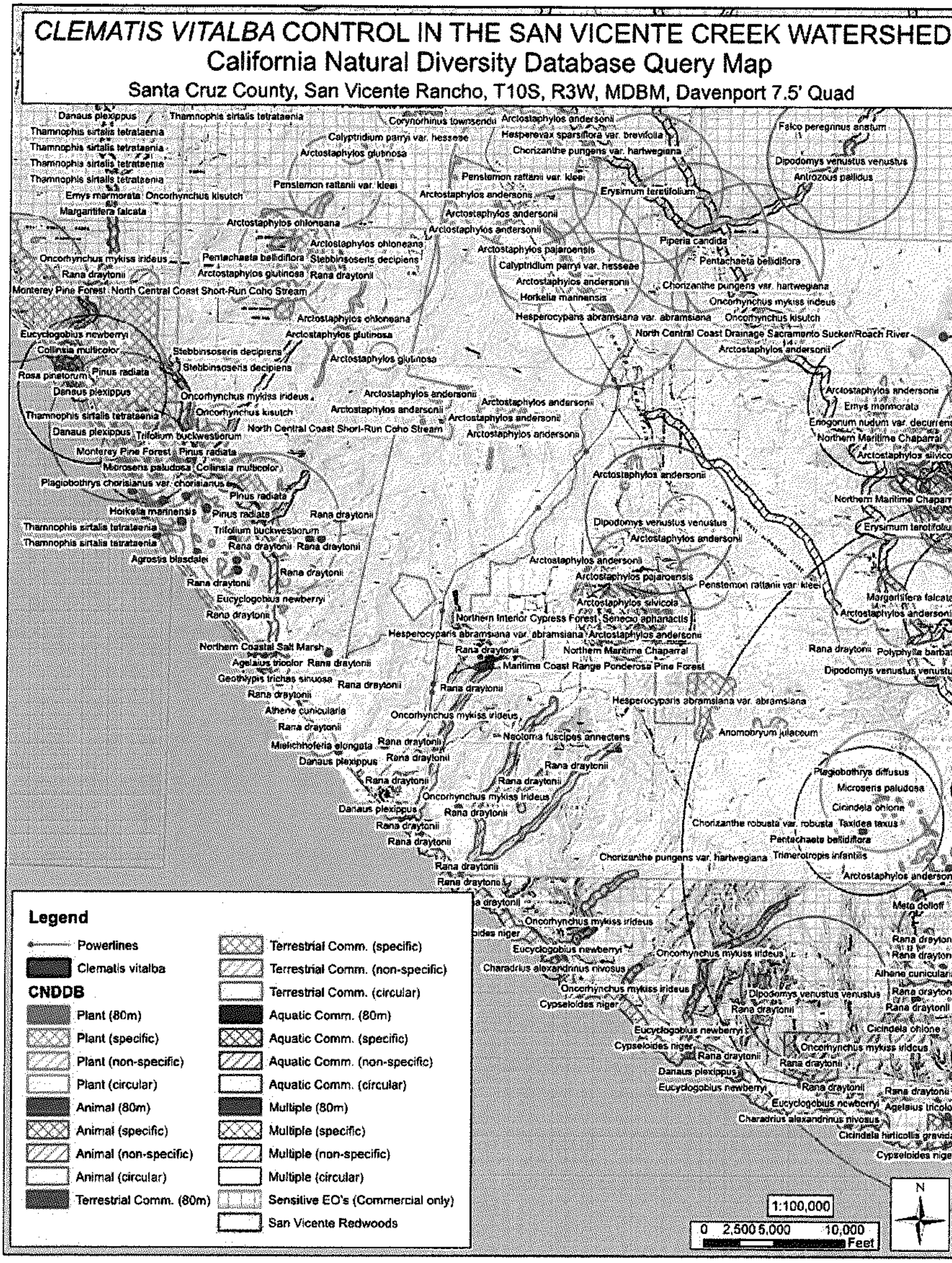
No.	Environmental Impact	Mitigation Measures	Responsibility for Compliance	Method of Compliance	Timing of Compliance
Geology and Soils					
GEO-1	*Result in substantial soil erosion or the loss of topsoil?*	**Erosion Control:** Any bare soil exceeding 100 contiguous square feet resulting from project activities will be treated with standard erosion control measures. Bare areas will be seeded, covered in jute netting or natural straw wattles will be placed depending on the slope and distance from waterways. Disturbed areas will also be planted and/or to be maintained to minimize surface erosion. In addition, a component of the project is to actively re-vegetate treatment areas with native plants as propagated from on-site stock, the successful establishment of which will mitigate areas of unstable soil.	Applicant	Compliance monitored by the County Planning Department and applicant.	To be implemented prior to and during project construction.
Hazards and Hazardous Materials					
HAZ-1	*Create a significant hazard to the public or the environment as a result of the routine transport, use or disposal of hazardous materials?*	**Herbicide Application** Garlon-3A herbicide use on the property is subject to the following measures. As noted previously, specific input by a Pest Control Adviser (PCA) will be obtained prior to application of herbicide. 1. Conduct a review of the CNDDB and identify sensitive natural resources within the project including but not limited sensitive plants, habitats, animals or riparian areas. 2. Conduct on-site field evaluations. Review riparian areas and appropriateness of various herbicide treatments. 3. Identify avoidance areas such as sensitive species locale(s), buffer zones and other potential constraints using flagging or some other field identification method. 4. Determine best timing of treatments and schedule based on site-specific locale. 5. Develop an Herbicide Spill Prevention Plan. 6. Designate routes of travel, water sources and mixing sites. A Spill Kit must be on-site. These actions will reduce the risk of contamination of water by accidental spills. 7. An Emergency Response Preparedness Plan, including a First Aid Kit will be on site. 8. Anyone who handles herbicides must participate in a training program that describe the materials used and the measures to follow, including Herbicide Spill Prevention and Emergency Response Preparedness, as well as site-specific considerations. 9. Identify the closest area of cell phone reception and familiarize all volunteers with that location. 10. Daily: Check wind speed/weather. 11. Daily: Check mixing and loading tanks, herbicide application equipment and other equipment for wear/tear, leaks. 12. Selective application techniques shall be used whenever practicable so that desirable vegetation is not adversely affected. 13. For directed foliar spray, provide selective control of vegetation by	Applicant	Compliance monitored by the County Planning Department and approved Pest Control Adviser.	To be implemented prior to and during project construction.

No.	Environmental Impact	Mitigation Measures	Responsibility for Compliance	Method of Compliance	Timing of Compliance
		directing the application toward target species. The nozzle tip, pressure and sprayer configuration shall be such to produce a coarser droplet to minimize drift. 14. For cut stem treatments, apply the herbicide judiciously to the stump immediately after cutting. 15. Applications will not be performed when the National Weather Service forecasts a >70% probability of measurable precipitation (>0.25") within the next 24 hour period. 16. Applications will cease when wind speed measured on site exceeds 7 mph sustained. 17. The following special precautions must be observed during periods of inclement weather: 18. Applications must not be made in, immediately prior to, or immediately following rain when runoff could be expected. 19. Applications must not be made when wind and/or fog conditions have the potential to cause drift. 20. Basal bark applications must not be made when stems are wet. 21. The following minimum buffer widths from streams, wetlands and other sensitive habitat must be maintained: No buffer requirement for herbicides approved for aquatic use without surfactant; 100 foot buffer requirement for herbicides not approved for aquatic use.			
Hydrology, Water Supply, and Water Quality					
HYD-1	*Violate any water quality standards or waste discharge requirements?*	**Water Quality Avoidance and Minimization:** a. Ground based equipment will not operate during the winter period, which is October 15 to April 15. b. Equipment will not operate within the channel zone. c. All erosion control measures shall be installed as soon as practical following treatment and prior to the start of any rain which causes overland flow across or along the disturbed surface. All inactive areas (defined as a five-day period) will have all necessary soil stabilization practices in place two days after identification of inactivity and/or before a rain event, whichever comes first. d. Any bare soil exceeding 100 contiguous square feet resulting from project activities will be treated with standard erosion control measures. Bare areas will be seeded, covered in jute netting or natural straw wattles will be placed depending on the slope and distance from waterways. Bare areas will also be replanted with local native species as necessary. e. During the project activities, all trash and food that would attract potential predators of salmonids (e.g. raccoons, piscivors, etc.) must be properly contained, removed from the work site, and disposed of daily. f. All refueling, maintenance, and staging of equipment and vehicles will occur at least 60 feet from riparian habitat or water bodies. g. Supervisors will insure that all vehicles and equipment are inspected for	Applicant	Compliance monitored by the County Planning Department, CDFW, NMFS, and applicant.	To be implemented prior to and during project construction.

No.	Environmental Impact	Mitigation Measures	Responsibility for Compliance	Method of Compliance	Timing of Compliance
		fuel leaks, oil leaks, and other fluid leaks before and during their use to ensure that aquatic and upland habitats are not contaminated. Prior to the onset of work, the project Supervisor will ensure that a plan is in place for prompt and effective response to accidental spills. All workers will be informed of the importance of preventing spills and of the appropriate measures to take shall a spill occur. A spill kit shall be kept on site at all times. h. Hydraulic fluids in mechanical equipment working within the active stream channel will not contain organophosphate esters. i. Notification to CDFW and NMFS if any take or impacts to salmonids are observed.			
HYD-2	*Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner which would result in substantial erosion or siltation on- or off-site?*	**Minimizing Contaminants and Sediment Movement:** The following water quality protection and erosion and sediment control mitigation measures would be implemented, based on standard County requirements, to minimize construction-related contaminants and mobilization of sediment to San Vicente Creek in the project area. The mitigation measures will be selected to achieve maximum sediment removal and represent the best available technology that is economically achievable and are subject to review and approval by the County. The County will perform routine inspections of the construction area to verify the mitigation measures are properly implemented and maintained. The County will notify contractors immediately if there is a noncompliance issue and will require compliance. The mitigation measures will include, but are not limited to, the following. • All mechanical earthwork involving rivers, ephemeral drainages, and culverts, will occur in the dry season (generally between June 1 and October 15). • Equipment used in and around drainages and wetlands will be in good working order and free of dripping or leaking engine fluids. All vehicle maintenance will be performed at least 300 feet from all drainages and wetlands. Any necessary equipment washing will be carried out where the water cannot flow into drainages or wetlands. • Exposed bare soil shall be treated to minimize soil erosion by planting and/or packing with mulch. In areas where, due to steepness of slope or lack of slash and debris, planting or mulching is not feasible, another method of effective erosion control will be implemented, such as applying erosion control blankets or installing wattles. For areas disturbed from May 1 to October 15, treatment shall be completed prior to the start of any rain that causes overland flow across or along the disturbed surface that could deliver sediment into a watercourse or lake in quantities deleterious to the beneficial uses of water. • An herbicide spill prevention plan is in-use on the property per the Property Management Plan – Herbicide Application Best Management Practices Table 7-1 (attached), and shall be followed during project activities. • During initial treatments, research will involve understanding the biology	Applicant	Compliance monitored by the County Planning Department and applicant.	To be implemented prior to and during project construction.

No.	Environmental Impact	Mitigation Measures	Responsibility for Compliance	Method of Compliance	Timing of Compliance
		of the pests, chemical and non-chemical options for controlling them, and any secondary effects of the control techniques. Non-chemical techniques to control invasive plants (cutting, digging, mowing, etc.) will be considered along with chemical methods (herbicides). • The landowners, stewardship volunteers, Property Manager, and/or Conservation Easement Holder will monitor sites to ascertain results of the management actions. • The effectiveness of the methods will be evaluated in light of the site goals, and this information will be used to modify and improve control priorities, methods and plans. Follow-up monitoring will be necessary to contain the spread of the invasive plant and then eradicate it completely from the site.			

Attachment 2



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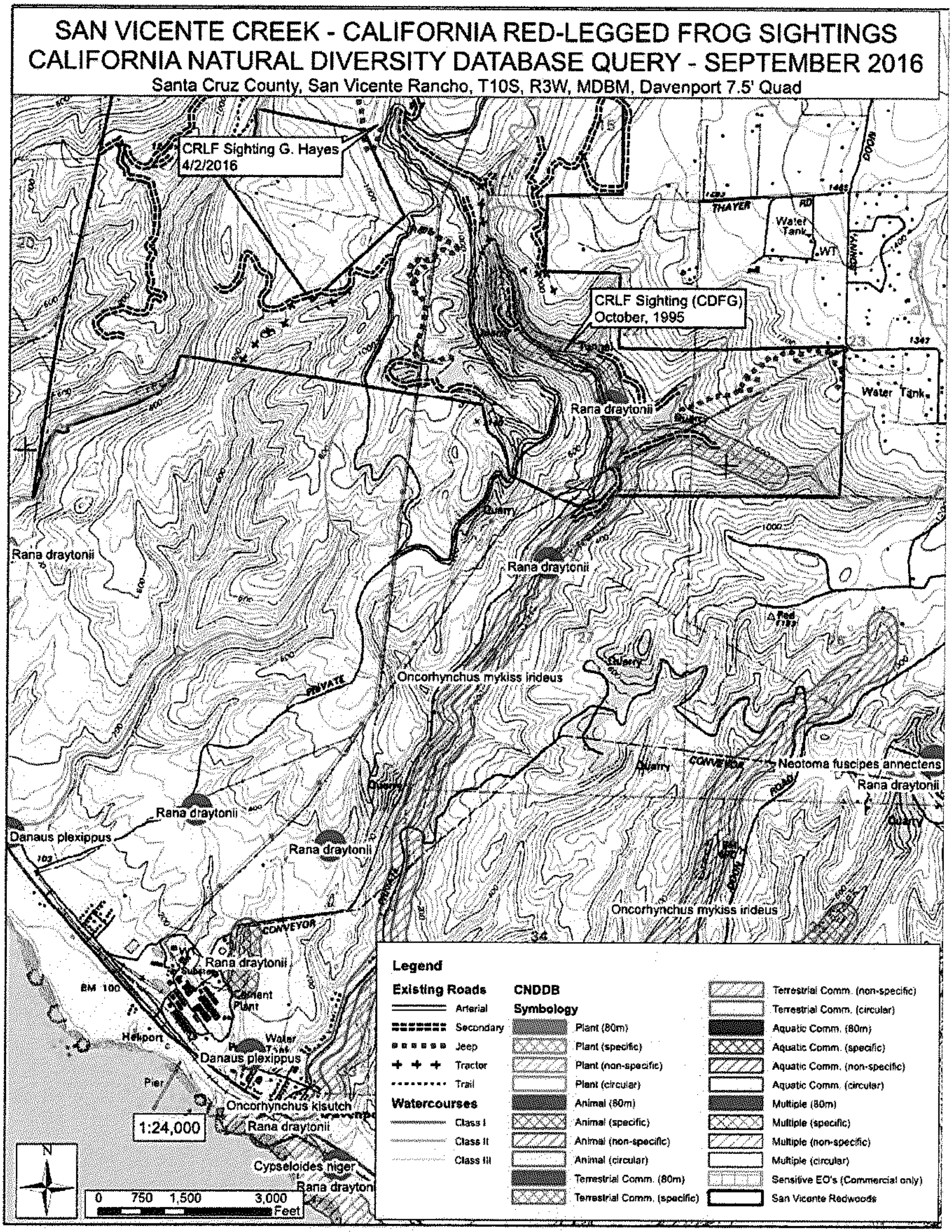
Attachment 3



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Attachment 4

California Natural Diversity Database Query Results

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Selected Elements by Scientific Name

California Department of Fish and Wildlife

California Natural Diversity Database

Query Criteria: Imported file selection

Clematis Control in the San Vicente Creek Watershed

Species	Element Code	Federal Status	State Status	Global Rank	State Rank	Rare Plant Rank/CDFW SSC or FP
Accipiter cooperii Cooper's hawk	ABNKC12040	None	None	G5	S4	WL
Adela oplerella Opler's longhorn moth	IILEE0G040	None	None	G2	S2	
Agelaius tricolor tricolored blackbird	ABPBXB0020	None	Candidate Endangered	G2G3	S1S2	SSC
Agrostis blasdalei Blasdale's bent grass	PMPOA04060	None	None	G2	S2	1B.2
Amsinckia lunaris bent-flowered fiddleneck	PDBOR01070	None	None	G2G3	S2S3	1B.2
Anomobryum julaceum slender silver moss	NBMUS80010	None	None	G5?	S2	4.2
Antrozous pallidus pallid bat	AMACC10010	None	None	G5	S3	SSC
Arctostaphylos andersonii Anderson's manzanita	PDERI04030	None	None	G2	S2	1B.2
Arctostaphylos glutinosa Schreiber's manzanita	PDERI040G0	None	None	G1	S1	1B.2
Arctostaphylos ohloneana Ohlone manzanita	PDERI042Y0	None	None	G1	S1	1B.1
Arctostaphylos regismontana Kings Mountain manzanita	PDERI041C0	None	None	G2	S2	1B.2
Arctostaphylos silvicola Bonny Doon manzanita	PDERI041F0	None	None	G1	S1	1B.2
Ardea herodias great blue heron	ABNGA04010	None	None	G5	S4	
Arenaria paludicola marsh sandwort	PDCAR040L0	Endangered	Endangered	G1	S1	1B.1
Athene cunicularia burrowing owl	ABNSB10010	None	None	G4	S3	SSC
Brachyramphus marmoratus marbled murrelet	ABNNN06010	Threatened	Endangered	G3G4	S1	
Calasellus californicus An isopod	ICMAL34010	None	None	G2	S2	
California macrophylla round-leaved filaree	PDGER01070	None	None	G3?	S3?	1B.2
Calyptridium parryi var. hesseae Santa Cruz Mountains pussypaws	PDPOR09052	None	None	G3G4T2	S2	1B.1
Campanula californica swamp harebell	PDCAM02060	None	None	G3	S3	1B.2

Species	Element Code	Federal Status	State Status	Global Rank	State Rank	Rare Plant Rank/CDFW SSC or FP
Carex saliniformis deceiving sedge	PMCYP03BY0	None	None	G2	S2	1B.2
Charadrius alexandrinus nivosus western snowy plover	ABNNB03031	Threatened	None	G3T3	S2S3	SSC
Chorizanthe pungens var. hartwegiana Ben Lomond spineflower	PDPGN040M1	Endangered	None	G2T1	S1	1B.1
Chorizanthe robusta var. hartwegii Scotts Valley spineflower	PDPGN040Q1	Endangered	None	G2T1	S1	1B.1
Chorizanthe robusta var. robusta robust spineflower	PDPGN040Q2	Endangered	None	G2T1	S1	1B.1
Cicindela hirticollis gravida sandy beach tiger beetle	IICOL02101	None	None	G5T2	S2	
Cicindela ohlone Ohlone tiger beetle	IICOL026L0	Endangered	None	G1	S1	
Cirsium andrewsii Franciscan thistle	PDAST2E050	None	None	G3	S3	1B.2
Clarkia concinna ssp. automixa Santa Clara red ribbons	PDONA050A1	None	None	G5?T3	S3	4.3
Coastal Brackish Marsh Coastal Brackish Marsh	CTT52200CA	None	None	G2	S2.1	
Coelus globosus globose dune beetle	IICOL4A010	None	None	G1G2	S1S2	
Collinsia multicolor San Francisco collinsia	PDSCR0H0B0	None	None	G2	S2	1B.2
Corynorhinus townsendii Townsend's big-eared bat	AMACC08010	None	None	G3G4	S2	SSC
Cypseloides niger black swift	ABNUA01010	None	None	G4	S2	SSC
Dacryophyllum falcifolium tear drop moss	NBMUS8Z010	None	None	G2	S2	1B.3
Danaus plexippus pop. 1 monarch - California overwintering population	IILEPP2012	None	None	G4T2T3	S2S3	
Dipodomys venustus venustus Santa Cruz kangaroo rat	AMAFD03042	None	None	G4T1	S1	
Elanus leucurus white-tailed kite	ABNKC06010	None	None	G5	S3S4	FP
Emys marmorata western pond turtle	ARAAD02030	None	None	G3G4	S3	SSC
Eriogonum nudum var. decurrens Ben Lomond buckwheat	PDPGN08492	None	None	G5T1	S1	1B.1
Erysimum ammophilum sand-loving wallflower	PDBRA16010	None	None	G2	S2	1B.2

Species	Element Code	Federal Status	State Status	Global Rank	State Rank	Rare Plant Rank/CDFW SSC or FP
Erysimum teretifolium Santa Cruz wallflower	PDBRA160N0	Endangered	Endangered	G1	S1	1B.1
Eucyclogobius newberryi tidewater goby	AFCQN04010	Endangered	None	G3	S3	SSC
Eumetopias jubatus Steller (=northern) sea-lion	AMAJC03010	Delisted	None	G3	S2	
Euphilotes enoptes smithi Smith's blue butterfly	IILEPG2026	Endangered	None	G5T1T2	S1S2	
Falco peregrinus anatum American peregrine falcon	ABNKD06071	Delisted	Delisted	G4T4	S3S4	FP
Fissilicreagris imperialis Empire Cave pseudoscorpion	ILARAE5010	None	None	G1	S1	
Fritillaria agrestis stinkbells	PMLIL0V010	None	None	G3	S3	4.2
Geothlypis trichas sinuosa saltmarsh common yellowthroat	ABPBX1201A	None	None	G5T3	S3	SSC
Hesperevax sparsiflora var. brevifolia short-leaved evax	PDASTE5011	None	None	G4T3	S2	1B.2
Hesperocyparis abramsiana var. abramsiana Santa Cruz cypress	PGCUP04081	Threatened	Endangered	G1T1	S1	1B.2
Hesperocyparis abramsiana var. butanoensis Butano Ridge cypress	PGCUP04082	Threatened	Endangered	G1T1	S1	1B.2
Hoita strobilina Loma Prieta hoita	PDFAB5Z030	None	None	G2	S2	1B.1
Holocarpha macradenia Santa Cruz tarplant	PDAST4X020	Threatened	Endangered	G1	S1	1B.1
Horkelia cuneata var. sericea Kellogg's horkelia	PDROS0W043	None	None	G4T1?	S1?	1B.1
Horkelia marinensis Point Reyes horkelia	PDROS0W0B0	None	None	G2	S2	1B.2
Lasiurus cinereus hoary bat	AMACC05030	None	None	G5	S4	
Laterallus jamaicensis coturniculus California black rail	ABNME03041	None	Threatened	G3G4T1	S1	FP
Limnanthes douglasii ssp. sulphurea Point Reyes meadowfoam	PDLIM02038	None	Endangered	G4T1	S1	1B.2
Lytta moesta moestan blister beetle	IICOL4C020	None	None	G2	S2	
Malacothamnus arcuatus arcuate bush-mallow	PDMAL0Q0E0	None	None	G2Q	S2	1B.2
Margaritifera falcata western pearlshell	IMBIV27020	None	None	G4G5	S1S2	

Species	Element Code	Federal Status	State Status	Global Rank	State Rank	Rare Plant Rank/CDFW SSC or FP
Maritime Coast Range Ponderosa Pine Forest Maritime Coast Range Ponderosa Pine Forest	CTT84132CA	None	None	G1	S1.1	
Meta dolloff Dolloff Cave spider	ILARA17010	None	None	G1	S1	
Microseris paludosa marsh microseris	PDAST6E0D0	None	None	G2	S2	1B.2
Mielichhoferia elongata elongate copper moss	NBMUS4Q022	None	None	G5	S4	4.3
Monolopia gracilens woodland woollythreads	PDAST6G010	None	None	G3	S3	1B.2
Monterey Pine Forest Monterey Pine Forest	CTT83130CA	None	None	G1	S1.1	
N. Central Coast Calif. Roach/Stickleback/Steelhead Stream N. Central Coast Calif. Roach/Stickleback/Steelhead Stream	CARA2633CA	None	None	GNR	SNR	
Neochthonius imperialis Empire Cave pseudoscorpion	ILARAD1010	None	None	G1	S1	
Neotoma fuscipes annectens San Francisco dusky-footed woodrat	AMAFF08082	None	None	G5T2T3	S2S3	SSC
North Central Coast Drainage Sacramento Sucker/Roach River North Central Coast Drainage Sacramento Sucker/Roach River	CARA2623CA	None	None	GNR	SNR	
North Central Coast Short-Run Coho Stream North Central Coast Short-Run Coho Stream	CARA2632CA	None	None	GNR	SNR	
Northern Coastal Salt Marsh Northern Coastal Salt Marsh	CTT52110CA	None	None	G3	S3.2	
Northern Interior Cypress Forest Northern Interior Cypress Forest	CTT83220CA	None	None	G2	S2.2	
Northern Maritime Chaparral Northern Maritime Chaparral	CTT37C10CA	None	None	G1	S1.2	
Oncorhynchus kisutch coho salmon - central California coast ESU	AFCHA02034	Endangered	Endangered	G4	S2?	
Oncorhynchus mykiss irideus steelhead - central California coast DPS	AFCHA0209G	Threatened	None	G5T2T3Q	S2S3	
Orthotrichum kellmanii Kellman's bristle moss	NBMUS56190	None	None	G2	S2	1B.2
Pandion haliaetus osprey	ABNKC01010	None	None	G5	S4	WL
Pedicularis dudleyi Dudley's lousewort	PDSCR1K0D0	None	Rare	G2	S2	1B.2
Penstemon rattanii var. kleei Santa Cruz Mountains beardtongue	PDSCR1L5B1	None	None	G4T2	S2	1B.2

Species	Element Code	Federal Status	State Status	Global Rank	State Rank	Rare Plant Rank/CDFW SSC or FP
Pentachaeta bellidiflora white-rayed pentachaeta	PDAST6X030	Endangered	Endangered	G1	S1	1B.1
Philanthus nasalis Antioch specid wasp	IIHYM20010	None	None	G1	S1	
Pinus radiata Monterey pine	PGPIN040V0	None	None	G1	S1	1B.1
Piperia candida white-flowered rein orchid	PMORC1X050	None	None	G3	S3	1B.2
Plagiobothrys chorisianus var. chorisianus Choris' popcornflower	PDBOR0V061	None	None	G3T2Q	S2	1B.2
Plagiobothrys diffusus San Francisco popcornflower	PDBOR0V080	None	Endangered	G1Q	S1	1B.1
Polygonum hickmanii Scotts Valley polygonum	PDPGN0L310	Endangered	Endangered	G1	S1	1B.1
Polyphylla barbata Mount Hermon (=barbate) June beetle	IICOL68030	Endangered	None	G1	S1	
Rana draytonii California red-legged frog	AAABH01022	Threatened	None	G2G3	S2S3	SSC
Riparia riparia bank swallow	ABPAU08010	None	Threatened	G5	S2	
Rosa pinetorum pine rose	PDROS1J0W0	None	None	G2	S2	1B.2
Senecio aphanactis chaparral ragwort	PDAST8H060	None	None	G3	S2	2B.2
Sidalcea malachroides maple-leaved checkerbloom	PDMAL110E0	None	None	G3	S3	4.2
Silene verecunda ssp. verecunda San Francisco campion	PDCAR0U213	None	None	G5T2	S2	1B.2
Speyeria adiaste adiaste unsilvered fritillary	IILEPJ6143	None	None	G1G2T1	S1	
Stebbinsoseris decipiens Santa Cruz microseris	PDAST6E050	None	None	G2	S2	1B.2
Stuckenia filiformis ssp. alpina slender-leaved pondweed	PMPOT03091	None	None	G5T5	S3	2B.2
Stygobromus mackenziei Mackenzie's Cave amphipod	ICMAL05530	None	None	G1	S1	
Taxidea taxus American badger	AMAJF04010	None	None	G5	S3	SSC
Thamnophis sirtalis tetrataenia San Francisco gartersnake	ARADB3613B	Endangered	Endangered	G5T2Q	S2	FP
Trifolium buckwestiorum Santa Cruz clover	PDFAB402W0	None	None	G2	S2	1B.1

Species	Element Code	Federal Status	State Status	Global Rank	State Rank	Rare Plant Rank/CDFW SSC or FP
Trimerotropis infantilis Zayante band-winged grasshopper	IIORT36030	Endangered	None	G1	S1	
Tryonia imitator mimic tryonia (=California brackishwater snail)	IMGASJ7040	None	None	G2	S2	
Usnea longissima Methuselah's beard lichen	NLLEC5P420	None	None	G4	S4	4.2

Record Count: 106

Attachment 5

Special Status Plant and Wildlife Tables

June 2017

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Table 2: Special-status Vascular Plant Species with Potential to Occur in San Vicente Creek Watershed Clematis Control Project

Species Name, Common Name	Federal/State-listing, CA Rare Plant Rank	Habitat Preferences, Elevation	Phenology, Life Form	Local Distribution	Potential for Occurrence, Presence
Amsinckia lunaris bent-flowered fiddleneck	None/None 1B.2	Steep slopes, openings in coastal scrub, oak woodland, grassland. 50-800 m.	Mar-June Annual herb	Occurs in Scott Creek watershed and Swanton area (coastal slope) on Cal Poly land.	Not likely. Not observed.
Arabis blepharophylla coast rockcress	None/None 4.3	Rocky outcrops, slides. 3-1100 m.	Feb-May Perennial herb	Occurs at Eagle Rock.	Not likely. Not observed.
Arctostaphylos andersonii Anderson's manzanita	None/None 1B.2	Openings and edges of redwood or mixed-evergreen forest, chaparral. 60-792 m.	Nov-May Evergreen shrub	Santa Cruz Mtns. endemic. Suitable habitat present.	Possible. Not observed.
Arctostaphylos silvicola Bonny Doon manzanita	None/None 1B.2	Inland marine sands (Zayante series) in conifer forest, maritime chaparral. 120-600 m.	Feb-Mar Evergreen shrub	Large population at Bonny Doon Ecological Reserve.	Not likely. Not observed.
Calandrinia breweri Brewer's calandrinia	None/None 4.2	Disturbed sites, burned areas, grassy slopes, chaparral, Monterey pine forest. < 1200 m.	Feb-May Annual herb.	Occurs at Big Basin Redwoods State Park and probably elsewhere.	Possible. Not observed.
Calyptridium parryi* var. *hesseae Santa Cruz Mountains pussypaws	None/None 1B.1	Sandy or gravelly openings in chaparral, woodland, forest. Fire-follower. 305-1530 m.	May-Aug Annual herb	Documented near Eagle Rock, though not documented since the 1950s.	Not likely. Not observed.
Carex saliniformis deceiving sedge	None/None 1B.2	Wet openings in coastal prairie, coastal scrub, in redwood/mixed-evergreen forest or oak woodland. 3-230 m.	June-July Perennial rhizomatous herb	Laurel and Felton quad occurrences extirpated; rediscovered in a seep under redwood and live-oak in UCSC upper campus (Felton quad). Suitable habitat present.	Possible. Not observed.

Table 2: Special-status Vascular Plant Species with Potential to Occur in San Vicente Creek Watershed Clematis Control Project

Species Name, Common Name	Federal/State-listing, CA Rare Plant Rank	Habitat Preferences, Elevation	Phenology, Life Form	Local Distribution	Potential for Occurrence, Presence
Chorizanthe pungens* var. *hartwegiana Ben Lomond spineflower	Federally Endangered/None 1B.1	Sandy openings (Zayante series) in maritime chaparral or understory of ponderosa pine forest, or on thin soils derived from Santa Cruz mudstone. 90-610 m.	April-July Annual herb	Occurs at Bonny Doon Ecological Reserve.	Not likely. Not observed.
Chorizanthe robusta* var. *robusta robust spineflower	Federally Endangered/None 1B.1	Inland or coastal marine sand deposits and sandstone outcrops; openings in maritime chaparral. 3-300 m.	Apr-Sep Annual herb	Closest population occurs near Smith Grade sandhills on private land.	Not likely. Not observed.
Collinsia multicolor San Francisco collinsia	None/None 1B.2	Shady, moist slopes in Monterey pine forest, coastal scrub. 30-250 m.	Mar-May Annual herb	Occurs in Scott Creek/Waddell Creek watersheds.	Not likely. Not observed.
Elymus californicus California bottlebrush grass	None/None 4.3	Moist openings in mixed-evergreen/ redwood forest, oak/riparian woodland. < 500 m.	May-Aug Perennial herb	Suitable habitat present.	Possible. Not observed.
Eriogonum nudum* var. *decurrens Ben Lomond buckwheat	None/None 1B.1	Sandy openings (Zayante series) in maritime chaparral, understory of ponderosa pine forest. 90-200 m.	July-Oct Perennial herb	Occurs at Bonny Doon Ecological Reserve.	Not likely. Not observed.

Table 2: Special-status Vascular Plant Species with Potential to Occur in San Vicente Creek Watershed Clematis Control Project

Species Name, Common Name	Federal/State-listing, CA Rare Plant Rank	Habitat Preferences, Elevation	Phenology, Life Form	Local Distribution	Potential for Occurrence, Presence
Erysimum teretifolium Santa Cruz wallflower	Federally and State-Endangered 1B.1	Sandy openings (Zayante series) in maritime chaparral, understory of ponderosa pine forest. 120-610 m.	Mar-July Perennial herb	Occurs at Bonny Doon Ecological Reserve.	Not likely. Not observed.
Hesperocyparis abramsiana* var. *abramsiana Santa Cruz cypress	Federally and State-Endangered 1B.2	Sandstone or granitic-derived soils in maritime chaparral, knobcone-pine forest. 280-800 m.	Evergreen tree	Stands at Bonny Doon Ecological Reserve and Eagle Rock and individual trees along Empire Grade.	Possible. Not observed.
Horkelia marinensis Point Reyes horkelia	None/None 1B.2	Coastal prairie or openings in oak woodland/mixed evergreen forest. 5-755 m.	May-Sep Perennial herb	Suitable habitat present.	Possible. Not observed.
Hosackia gracilis harlequin lotus	None/None 4.2	Ditches, wet areas in meadows. < 700 m.	Mar-July Perennial herb	Occurs at Bonny Doon Ecological Reserve.	Possible. Not observed.
Leptosiphon grandiflorus large-flowered leptosiphon	None/None 4.2	Sandy soil, open grassy flats. < 1200 m.	Apr-July Annual herb	Occurs off of Smith Grade in Bonny Doon area. Local plants appear to belong to unnamed subspecies.	Possible. Not observed.
Micropus amphibolus Mt. Diablo cottonweed	None/None 3.2	Openings on slopes, ridges, shallow soils. 40-900 m.	Mar-June Annual herb	Occurs in Swanton area (coastal slope). Suitable habitat present.	Possible. Not observed.

Table 2: Special-status Vascular Plant Species with Potential to Occur in San Vicente Creek Watershed Clematis Control Project

Species Name, Common Name	Federal/State-listing, CA Rare Plant Rank	Habitat Preferences, Elevation	Phenology, Life Form	Local Distribution	Potential for Occurrence, Presence
Microseris paludosa marsh microseris	None/None 1B.2	Vernally moist to saturated sites in coastal grassland. 5-300 m.	Apr-July Perennial herb	Occurs in Scott Creek watershed.	Possible. Not observed.
Mimulus rattanii* ssp. *decurtatus Santa Cruz County monkeyflower	None/None 4.2	Sandy, open places, especially sandstone outcrops or burns, disturbed areas. 90-1220 m.	Apr-July Annual herb	Occurs at Bonny Doon Ecological Reserve.	Not likely. Not observed.
Monardella sinuata* ssp. *nigrescens northern curly-leaved monardella	None/None 1B.2	Sandy openings (Zayante series) in maritime chaparral, understory of ponde-rosa pine forest. < 300 m.	May-July Annual herb	Occurs at Bonny Doon Ecological Reserve.	Not likely. Not observed.
Pedicularis dudleyi Dudley's lousewort	None/State-listed Rare 1B.2	Shaded, summer-moist banks and cliffs in riparian sites in redwood forest. < 350 m.	Mar-June Perennial herb	Apparently extirpated from Santa Cruz County. Closest occurrence in Portola Redwoods State Park, San Mateo County.	Possible. Not observed.
Penstemon rattanii* var. *kleei Santa Cruz Mtns. beardtongue	None/None 1B.2	Fire/disturbance-follower, in chaparral, mixed hardwood/redwood forest. 400-600 m.	May-June Perennial herb	Occurs off of Empire Grade.	Possible. Not observed.

Table 2: Special-status Vascular Plant Species with Potential to Occur in San Vicente Creek Watershed Clematis Control Project

Species Name, Common Name	Federal/State-listing, CA Rare Plant Rank	Habitat Preferences, Elevation	Phenology, Life Form	Local Distribution	Potential for Occurrence, Presence
Pentachaeta bellidiflora white-rayed pentachaeta	Federally and State Endangered 1B.1	Dry, rocky slopes, grassy areas. < 620 m.	Mar-May Annual herb	Occurs at Eagle Rock. Last documented in 1955. At southern edge of range.	Possible. Not observed.
Pinus radiata Monterey pine	None/None 1B.1	Closed-cone coniferous forest, woodland. 25-185 m.	Evergreen tree	Native stands occur at Swanton and Ano Nuevo.	Only planted Monterey pine observed.
Piperia candida white-flowered rein orchid	None/None 1B.2	Open or shaded sites in mixed-evergreen/ redwood forest. < 1500 m.	Mar-Sep Perennial herb	Occurs near Pine Mtn. at Big Basin Redwoods S.P.	Possible. Not observed.
Plagiobothrys chorisianus* var. *chorisianus Choris's popcorn-flower	None/None 1B.2	Moist depressions, coastal prairie, cha-parral, coastal scrub. < 200 m.	Mar-June Annual herb	Occurs in Scott Creek watershed/Swanton (coastal slope) area.	Possible. Not observed.
Plagiobothrys chorisianus* var. *hickmanii Hickman's popcorn-flower	None/None 4.2	Moist depressions, sandy deposits over clay pans. < 200 m.	Apr-July Annual herb	Not likely.	Possible. Not observed.
Plagiobothrys diffusus San Francisco popcorn-flower	None/State-listed Endangered 1B.1	Moist depressions, seeps in coastal prairie/annual grassland. 30-150 m.	Apr-June	Occurs in Scott Creek watershed.	Not likely. Not observed.

Table 2: Special-status Vascular Plant Species with Potential to Occur in San Vicente Creek Watershed Clematis Control Project

Species Name, Common Name	Federal/State-listing, CA Rare Plant Rank	Habitat Preferences, Elevation	Phenology, Life Form	Local Distribution	Potential for Occurrence, Presence
Sanicula hoffmannii Hoffmann's sanicle	None/None 4.3	Understory or gaps in coastal scrub, mixed-evergreen/redwood/ Monterey pine woodland or forest. < 500 m.	Mar-May Perennial herb	Occurs in Scott Creek/Waddell Creek watersheds.	Possible. Not observed.
Sidalcea malachroides maple-leaved checkerbloom	None/None 4.2	Disturbed, open areas in coastal woodland. < 700 m.	Mar-Aug Perennial herb	No occurrences on Ben Lomond Mtn.	Possible. Not observed.
Silene verecunda* ssp. *verecunda [*S. v.* in *The Jepson Manual*, 2nd ed.] San Francisco campion	None/None 1B.2	Sandy openings, roadcuts, rocky slopes in chaparral, coastal prairie, Monterey pine woodland. < 400 m.	Mar-Aug Perennial herb	Occurs in Swanton area and at Big Basin Redwoods State Park.	Possible. Not observed.
Stebbinsoseris decipiens Santa Cruz microseris	None/None 1B.2	Coastal grassland, grassy slopes, openings in Monterey pine forest. 10-500 m.	Apr-May Annual herb	Occurs in Scott Creek watershed and on ridge between upper Scott/Mill creeks and in Swanton area (coastal slope).	Not likely. Not observed.
Trifolium buckwestiorum Santa Cruz clover	None/None 1B.1	Gravelly areas, margins, disturbed areas in coastal prairie, oak woodland, mixed-evergreen forest. < 700 m.	Apr-Oct Annual herb	Type locality in Scott Creek watershed.	Not likely. Not observed.

Attachment 6

Protection of California Red-legged Frog from Pesticides

October 20, 2006

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Protection of California Red-legged Frog from Pesticides

Back to Endangered Species Project

Stipulated Injunction and Order

Background

On October 20, 2006, the U.S. District Court for the Northern District of California imposed no-use buffer zones around California red-legged frog upland and aquatic habitats for certain pesticides. This injunction and order are part of a settlement reached between U.S. EPA, CropLife America, American Forest and Paper Association, Western Plant Health Association, Oregonians for Food and Shelter, and Syngenta Corporation as co-defendants, and the Center for Biological Diversity as the plaintiff.

The suit by the Center for Biological Diversity alleged that U.S. EPA failed to solicit U.S. Fish & Wildlife Service (FWS) formal consultation on the risks of 66 pesticides to California red-legged frog (CRLF).

This injunction and order will remain in effect for each pesticide listed below until EPA goes through formal 7(A)(2) consultation with FWS on each of the 66 active ingredients, and FWS issues a Biological Opinion including a "not likely to adversely affect" statement for the pesticides. Each pesticide in turn will be removed from the list, as this occurs.

Pesticide Use Restrictions Now Required

Under the injunction and order, no-use buffer zones of 60 feet for ground applications and 200 feet for aerial applications apply from the edge of the following California red-legged frog habitats as defined by the U.S. Fish & Wildlife Service and the Center for Biological Diversity: Aquatic Feature, Aquatic Breeding Habitat, Non- Breeding Aquatic Habitat, and Upland Habitat (details on these habitats are given in a Powerpoint Presentation following the list of prohibited active ingredients). These CRLF habitats are found in 33 counties of California link to map, PDF (455 kb).

The active ingredients for which the no-use buffer zones apply are the following:

2,4-D	Endosulfan	Myclobutanil	Thiobencarb
Acephate	EPTC	Naled	Tribufos (DEF)
Alachlor	Esfenvalerate	Norflurazon	Triclopyr
Aldicarb	Fenamiphos	Oryzalin	Trifluralin
Atrazine	Glyphosate	Oxamyl	Vinclozolin
Azinphos-methyl	Hexazinone	Oxydemeton-methyl	Ziram
Bensulide	Imazapyr	Oxyfluorfen	
Bromacil	Iprodione	Paraquat dichloride	
Captan	Linuron	Pendimethalin	
Carbaryl	Malathion	Permethrin	
Chloropicrin	Mancozeb	Phorate	
Chlorothalonil	Maneb	Phosmet	
Chlorpyrifos	Metam sodium	Prometryn	
Chlorthaldimethyl (DCPA)	Methamidophos	Propanil	
Diazinon	Methidathion	Propargite	
Dicofol	Methomyl	Propyzamide (Pronamide)	
Diflubenzuron	Methoprene	Rotenone	
Dimethoate	Methyl parathion	Simazine	
Disulfoton	Metolachlor	Strychnine	
Diuron	Molinate	Telone (1,3-dichlorpropene)	

In order to assist the public in learning all the details of the stipulated injunction and court order, DPR has developed a presentation, PDF (2.2 mb) file covering all aspects of this document.

As more information becomes available, DPR will post it on this Web site.

For more information:

- Information to Assist Pesticide Users in Determining Whether the California Red-legged Frog Injunction Applies to their Proposed Pesticide Use (Steps and Information for Pesticide Users).
- Stipulated Injunction and Order (document), PDF (182 kb) (October 20, 2006).

If you have more questions about these requirements, contact:
Arty Williams
U.S. EPA Field and External Affairs Division
Washington, D.C.
Phone: (703) 305-5239
E-mail: williams.arty@epa.gov

Attachment 7

San Vicente Creek Watershed Plan for Salmonid Recovery

February 2014

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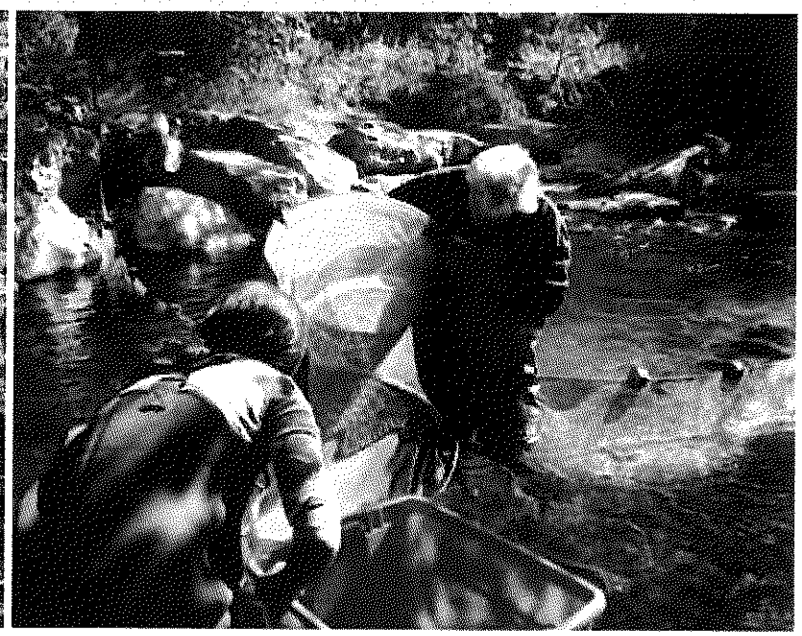
San Vicente Creek Watershed

Plan for Salmonid Recovery

Prepared February 2014

RESOURCE

Contents

Preface iv

Acknowledgements 6

Chapter 1: Primer for San Vicente Creek Watershed 7
- Report Overview 7
- Geography 7
- Climate 7
- Geology 9
- Vegetation Communities 9
- Fish and Wildlife 9
- Land Use—Past and Present 11
- Historic/Existing Data and Reports 12
- Summary 12

Chapter 2: Hydrology 13
- Objectives 13
- Introduction 13
- Methodology 17
- Findings 34

Chapter 3: Geomorphology 36
- Objectives 36
- Introduction 36
- Methodology 39
- Findings 55

Chapter 4: Fisheries 56
- Objectives 56
- Introduction 56
- Methodology 60
- Findings 61

Chapter 5: Large Woody Debris 68
- Objectives 68
- Introduction 68
- Methodology 70
- Findings 72

Chapter 6: Invasive Species 89
- Objectives 89
- Introduction 89
- Methodology 90
- Findings 91

Chapter 7: Plan for Salmonid Recovery 101
- Introduction 101
- Conclusion 101
- Recommendations 102

Appendix A 116

Appendix B 135

Appendix C 142

Appendix D 155

Appendix E 175

References Cited 202

Preface

The successful recovery of salmonid populations is dependent on a complex and unique combination of biological and physical variables within both the freshwater and saltwater habitats for a given species. In order for a watershed to support robust and self-sustaining salmonid runs, the habitats that support these species generally require natural disturbance regimes that constantly create and re-create the essential instream and floodplain habitats required during their freshwater life history stages (i.e., floodplains and backwaters for winter refuge, deep pools for summer refuge, riffles and litter fall for food supply, and sorted and aerated gravels for spawning). As such, the quality of salmonid habitat varies among watersheds and is significantly influenced by wet and dry season instream flows, water temperature, water quality, sediment type and load, pool abundance, natural and man-made barriers to migration, riparian canopy and cover and availability of spawning gravels (Smith, 2002).

While a number of salmonid species are listed as threatened or endangered under the Federal Endangered Species Act (ESA) and/or the California Endangered Species Act (CESA), the Central California Coast (CCC) Evolutionarily Significant Unit (ESU) of coho salmon (*Oncorhynchus kisutch*) is considered one of the most imperiled salmonid runs along the west coast of North America. For millennia salmon have successfully persisted in abundance under ever shifting environmental conditions. However, human alteration of the landscape over the last two centuries, and human harvesting of salmon, has placed significant pressures on coho salmon's ability to survive in freshwater and marine environments. The Recovery Plan for this ESU, published by the National Marine Fisheries Service in 2012, describes the severe peril currently faced by coho salmon throughout much of California.

> "*Central California Coast coho salmon are gravely close to extinction. Despite being listed under the Federal and California Endangered Species Acts, populations of CCC coho salmon continue to decline precipitously. Immediate and focused action is essential to increase the survival of, and provide the highest protection for, remaining populations.*" (NMFS, 2012)

Nowhere is the plight of this species more clear-cut than in the southern extend of the ESU in the Santa Cruz Mountains Diversity Stratum. While the road to successful recovery is daunting, little San Vicente Creek near the town of Davenport in Santa Cruz County represents one of the best opportunities to help jump start recovery of this critically endangered species.

San Vicente Creek is the smallest dependent[1] watershed in the CCC coho salmon ESU, but provides a number of unique benefits to the species from a recovery perspective. Unlike the larger neighboring watersheds of Scotts Creek that has a large lagoon and experiences significant limitations on coho access due to timing of the sandbar breach, San Vicente's lagoon no longer exists due to the alignment of the railway and highway 1. While the lack of a lagoon presents a unique set of ecological challenges, the current situation also creates a unique opportunity as the stream and ocean are connected year round (i.e. no sandbar) and therefore coho and other species have unfetered year-round access to and from the ocean. San Vicente Creek watershed is also regionally unique due to the amount of Karst underlying the upper watershed. This geological formation fosters significant infiltration, subsurface movement, and spring formation providing unusually cool summer water temperatures and high summer baseflows. Finally, with the recent acquisition of the CEMEX Forest by a consortium of conservation partners and the acquisition of Coast Dairies by the Trust for Public Lands in 1998, 61% of the watershed is owned by conservation entities. These characteristics make this little watershed a key recovery watershed for CCC coho salmon.

As well as CCC coho salmon, CCC steelhead (*Oncorhynchus mykiss*) are listed as threatened under the federal ESA as part of the Central California Coast (CCC) Distinct Population Segment (DPS). San Vicente Creek appears to support a robust and sustainable run of this salmonid species. The National Marine Fisheries Service (NMFS), which is charged with protection of federally listed anadramous fish, is in the process of developing a recovery plan for the CCC steelhead and the draft plan is expected to be released to the public in early 2014. According to Jon Ambrose (pers com) of NMFS, plan recommendations will closely overlap with the recommendations put forth in the recently published CCC Coho Recovery Plan. The steelhead plan will provide additional details and recommendations for recovery of steelhead within this DPS and, in conjunction with the coho plan, can be used to identify and guide recovery actions on the SDSF. While steelhead are not technically listed under the CESA, the Department of Fish and Wildllife (formerly Department of Fish and Game) issued the 1996 "Steelhead Restoration and Management Plan for California" in an effort to focus conservation actions on the protection of this species. Finally, the Department of Fish and Wildlife also develops an annual "Statewide Steelhead Task List" to support and guide funding actions through the Fisheries Restoration Grants Program (FRGP). Factors impacting the recovery of coho and steelhead are intertwined and recovery efforts focused on improving habitat for coho will also contribute to the recovery of steelhead.

Through the Resource Conservation District of Santa Cruz County's (RCD) Integrated Watershed Restoration Program (IWRP), the RCD has partnered with the National Marine

1 A "dependent" population is any collection of one or more local breeding units whose population dynamics or extinction risk over 100-year time period is substantially altered by exchanges of individuals with other populations.

Fisheries Service (NMFS), California Department of Fish and Wildlife (DFW) and both the Trust for Public and the U.S. Bureau of Land Management since 2005 on a variety of projects and efforts to increase habitat complexity in San Vicente Creek with the goal of improving survival rates of coho salmon and steelhead at all life stages. Efforts to date have included enhancement and restoration of two backwater ponds that were built on footprints of historic agricultural ponds within San Vicente's floodplain for the purpose of creating winter high-flow refugia and installation of eight large woody debris structures to increase instream habitat complexity and encourage floodplain connectivity. In addition, limited cape ivy *(Delairea odorata)* removal has occurred to encourage the presence of more robust and diverse floral communities and to facilitate natural scour and deposition in floodplains.

While significant traction, action and interest in San Vicente Creek clearly exists, much of the past fisheries restoration and recovery work has happened in an ad-hoc fashion without the support of a larger guiding plan that brings together all of the existing data on the physical and biologic process at play, provides new data to fill known information gaps, and provides a scientifically defensible plan for future recovery actions.

To address this need, the RCD, with funding from the DFW's Fisheries Restoration Grants Program, have partnered with local technical experts to develop a watershed assessment that will culminate in a single regional repository of existing data on priority resources (biological, physical, and socio-economic) and a Restoration Action Plan for Salmonid Recovery for the watershed. The technical focus of this effort is on the fresh-water habitats that support the critical life history stages from spawning adults to outmigrant smolts. This planning effort includes the following components: a summary of historic data on watershed conditions related to salmonid recovery; 4 new assessments focused on known data gaps and potential limiting factors; and a final Restoration Action Plan with specific recommendations based synthesis of the existing data and new assessments. The following document represents the first and second of these efforts and synthesizes the historic and existing, available information on key resources that influence the opportunities and constraints to salmonid recovery in this watershed. The Final Restoration Action Plan will be informed by the historic data, findings from the new assessments (including a geomorphic assessment, a fisheries assessment and a large woody debris and invasive species assessment) and public review and input on by two stakeholder groups: our Local Watershed Steering Committee (a group of interested local stakeholders, large land-holders and local technical experts) and the IWRP Technical Advisory Committee (composed of techincal specialists from our state, federal and local resource agencies). In addition to providing peer review, these two stakeholder groups have provided significant support on identifying and gathering existing reports and data as well as outreach and liaison with the larger community. Please reference the Acknowledgements section for a list of participants from our Local Watershed Steering Committee and the Technical Advisory Committee.

Note that the bulk of this effort will focus on the areas of the watershed with direct influence on the anadromous stream reaches and floodplain as well as the factors directly and indirectly affecting salmon recovery and restoration of natural stream processes. This effort does not aim to evaluate the watershed in its entirety and review resources and issues that are not relevant to salmonid recovery.

Acknowledgements

This report represents the fruits of a multi-year collaborative effort to learn about San Vicente Creek and move the concept of salmonid recovery forward in this small, but important watershed. This report, and subsequent analyses and recommendations were developed through a generous grant from the California Department of Fish and Wildlife through its Fisheries Restoration Grants Program. This report was prepared by RCD staff Sooni Gillett, Carmen Tan and John Morley, AmeriCorps Watershed Stewards Project Interns Jessica Missaghian and Graham Wesolowski, with technical oversight and support from Jim Robins (Alnus Ecological), Mike Podlech, Balance Hydrologics, and RCD Consultant Kelli Camara. In addition to the RCD project team (above), this effort has been conducted under the overall guidance of the Local Watershed Steering Committee and the Integrated Watershed Restoration Program Technical Advisory Committee (IWRP TAC).

In July 2012, the RCD assembled a team of interested stakeholders, land-holders and local technical experts known as the Local Watershed Steering Committee to provide existing resource information, technical review and additional outreach and liaison with the larger community. Local Watershed Steering Committee Members include: Nadia Hamey (Big Creek Lumber), Joe Kiernan and Susan Sogard (National Oceanic & Atmospheric Administration's Southwest Fisheries Science Center, SWFSC), Brian Dietterick (Swanton Pacific Ranch), Aaron Hebert (Sempervirens), Roberta Smith (Resource Conservation District of Santa Cruz County), Melissa Farinha and Michelle Leicester (California Department of Fish and Wildlife), Rick Cooper (Bureau of Land Management) and Shawn Milar (USFWS Coastal Program) and Abigail Adams (Peninsula Open Space Trust). Members of the Local Watershed Steering Committee and the RCD project team had the first of two meetings in June 2012 to discuss project objectives, timelines and Committee interests. The second Watershed Steering Committee Meeting will be held in January 2014 to solicit feedback on assessment results and recommended recovery actions for the San Vicente Creek watershed Restoration Plan for Salmonid Recovery.

The IWRP TAC includes technical staff from DFW, National Marine Fisheries Service (NMFS), Central Coast Regional Water Quality Control Board (CCRWQCB), U.S Fish and Wildlife Service (USFWS), United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS), California Coastal Commission, State Coastal Conservancy, U.S. Army Corps of Engineers and the Santa Cruz County Department of Environmental Health. The author's would like to acknowledged a special debt of gratitude and support for current IWRP TAC members Jon Ambrose (NMFS) and Michelle Leicester (DFW) as well as a past IWRP TAC member Kit Crump, for playing a fundamental role in helping the RCD understand and highlight the opportunities and importance of little San Vicente Creek in realizing local salmonid recovery. Without the support of our state and federal public trust agencies and the willingness of their staff to engage with local conservation groups in a productive and collaborative fashion, we could never have implemented the previous restoration efforts and had this opportunity to stop, reflect, learn, and develop a more comprehensive plan for moving fisheries restoration effort forward in the San Vicente Creek Watershed. We would also like to thank George McMenamin and Ken Moore who provided invaluable guidance, review, and technical support regarding opportunities to restore ecosystem health through invasive weed management and whose on-the-ground expertise will ensure success. Finally, we'd like to thank the key landowners that have agreed to partner with the RCD during the course our work in San Vicente. These people include Tily Shue of the Trust for Public Land, Rick Cooper of BLM, Dave Lunberg of the Davenport Mill, CEMEX, Bryan Largay of the Land Trust of Santa Cruz County and the new landowners of the CEMEX forest POST, Sempervirens, and Save the Redwoods.

Chapter 1: Primer for San Vicente Creek Watershed

REPORT OVERVIEW

The first chapter of this report is meant to provide the reader with a basic primer on the geography, climate, biological resources, and past and present land-uses within the watershed. Subsequent chapters build on this primer and provide more detailed assessments of key physical and biological data. The focus and scope of these assessments was developed collaboratively between the project team and staff from California Department of Fish and Wildlife (DFW) and National Marine Fisheries Service (NMFS). As such, they specifically address a subset of known data gaps (e.g. peak and baseflow hydrology data) and a list of potential limiting factors developed over years of local observation (e.g. floodplain connectivity and gravel availability). These assessments not only reflect a comprehensive analysis of existing data, but synthesize extensive new data collected through this effort on the hydrology, geomorphology, fisheries resources, large woody debris loading and recruitment potential, and mapping of invasive flora. Collectively, chapters 1–6 provide the scientific basis and foundation upon which specific recommendations for recovery actions are based (see chapter 7) and provide a new baseline dataset of existing conditions upon which a host of future analyses can and should be founded.

GEOGRAPHY

Located in the Santa Cruz Mountains, 9 miles north of the City of Santa Cruz, San Vicente Creek watershed drains an 11.1 square mile area (NMFS, 2008). Its headwaters are located at an elevation of approximately 2,600 feet at Camp Ben Lomond and its main stem flows for about 9.3 miles under Highway 1 and the railroad tunnel before entering the Monterey Bay National Marine Sanctuary and Pacific Ocean just south of the town of Davenport. The 11.1 square mile watershed also includes 11.3 miles of tributary streams (DFG, 1996), the most significant of which is Mill Creek (Weppner, et al., 2009). Approximately 2.5 miles of the main stem channel (San Vicente Creek) and 0.25 miles of tributaries (see Figure 1-1 and 1-2) are thought to be potentially usable coho rearing habitat (CDFG, 1998).

CLIMATE

Mean annual rainfall in the watershed ranges from about 24 inches at the mouth to upwards of 60 inches in the headwaters along Empire Grade (CDFG, 1988). The geology and precipitation are such that San Vicente Creek sustains summer minimum baseflows of about 1 cubic feet per second (cfs) in nearly all years—a large flow by regional standards and a critically-impor-

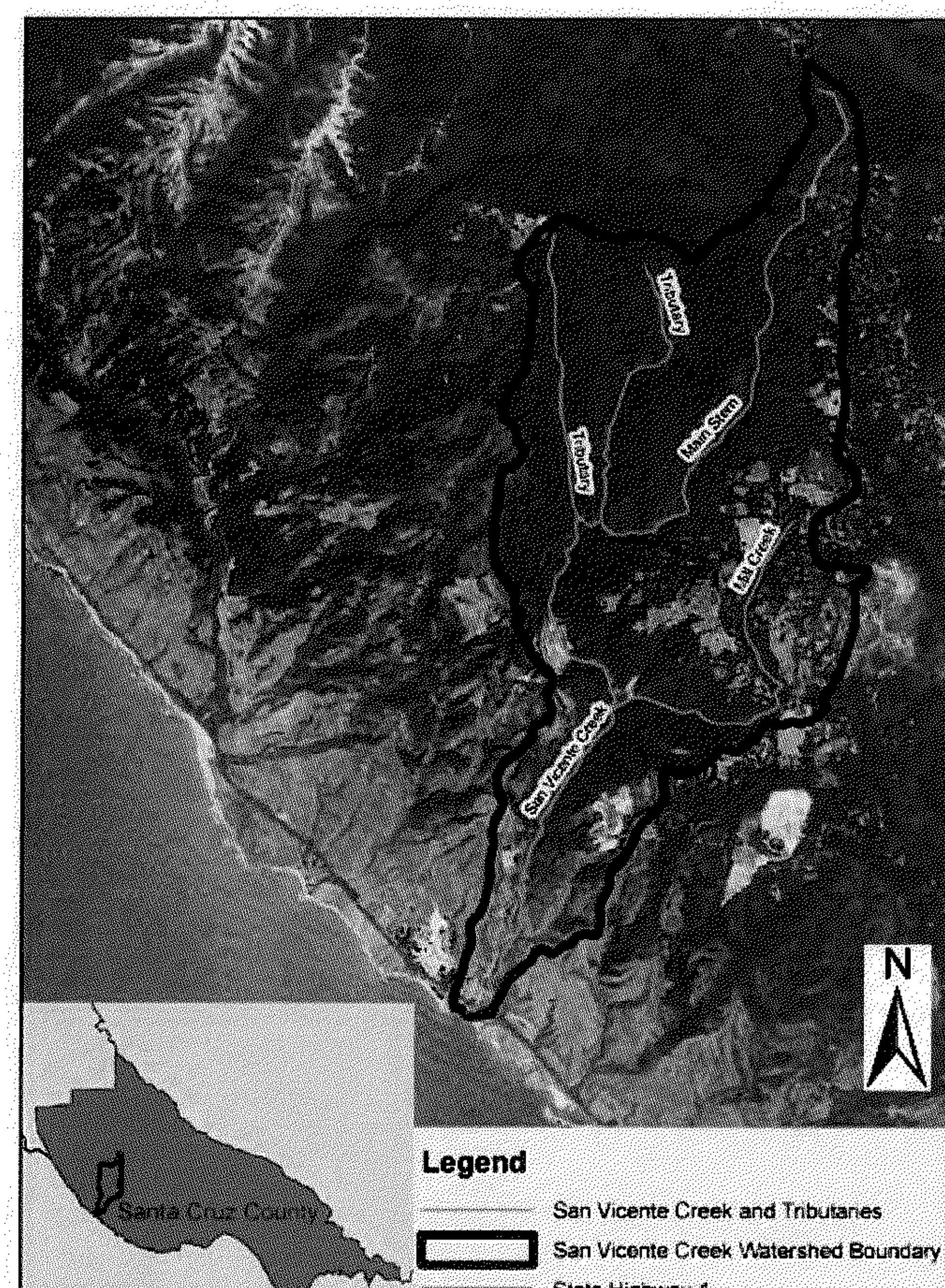


Figure 1-1. San Vicente

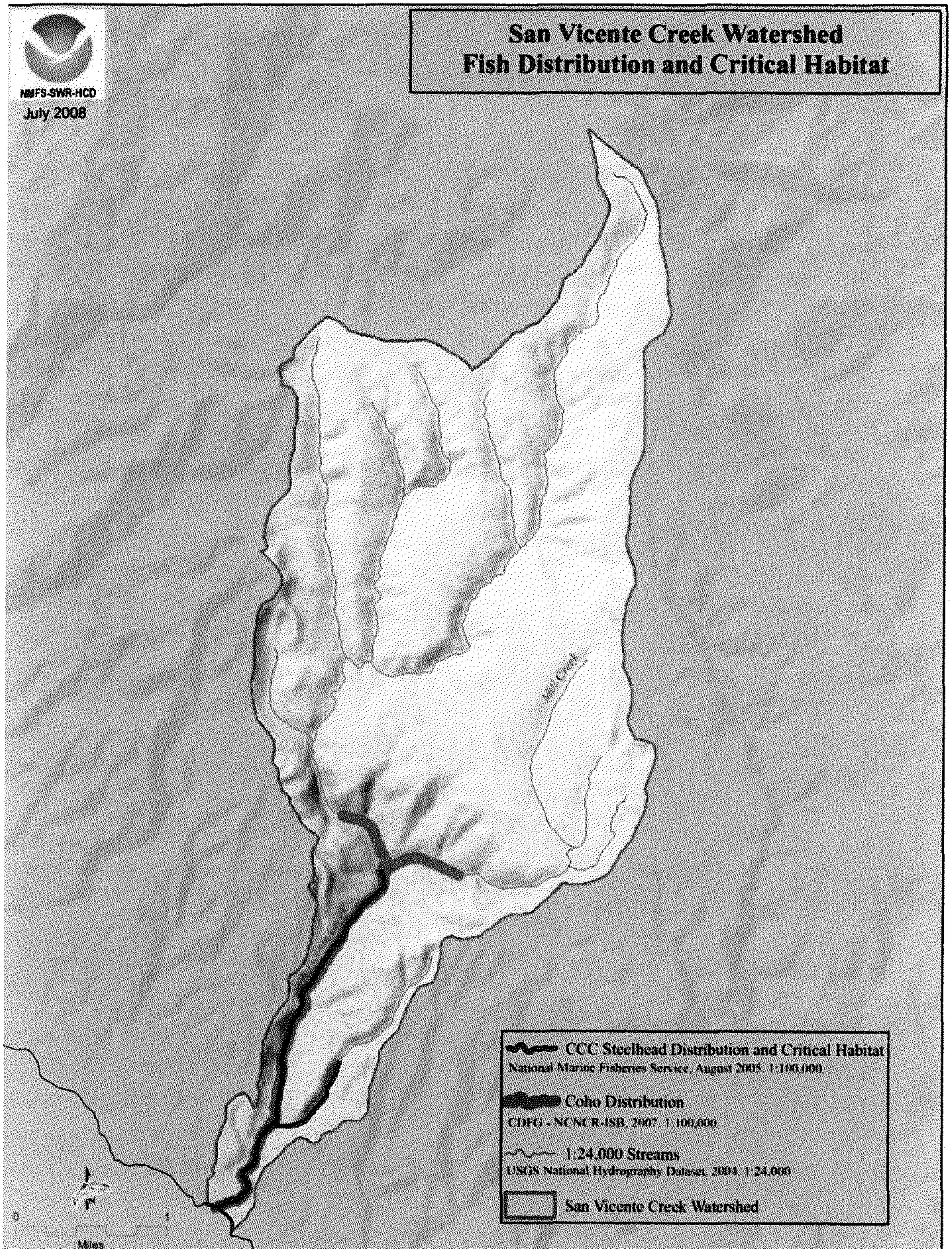


Figure 1-2. San Vicente Creek watershed fish distribution and critical habitat map. The steelhead data from NOAA are 9 years old and the more updated information suggests that the upper limit for steelhead actually extends through the area of coho distribution.

tant attribute in restoring coho salmon and steelhead populations (Balance Hydrologics, 2008).

Extreme weather events throughout the region have had significant effects on the vegetative makeup, stream flow and morphology of San Vicente Creek (Smith, pers. comm.). In the late 1970s, persistent drought conditions resulted in high willow mortality within San Vicente Creek's riparian corridor (Heady, pers. comm.). In the winter of 1982-83, Santa Cruz County received 25 inches of precipitation in a single storm (Griggs and Haddad, 2011). The storm, noted as a 100-year storm event, downed the majority of alders located in the lower watershed (Smith, pers. comm.). Additionally, a landslide caused by the storm forced a portion of the San Vicente Creek channel to migrate to the west, creating both a new channel and a long-term source of sediment deposited within the natural floodplain. While riparian and floodplain disturbance is common and a critical component of most healthy stream systems, disturbance that creates open ground, whether through natural or anthropogenic activities, tend to reduce native vegetative diversity by facilitating the spread of invasive non-native species such as cape ivy (ESA, 2001). This problem is pronounced in the lower reaches of San Vicente Creek. Chapter 6 provides an assessment of the current extent of cape ivy and other invasive species in the watershed.

GEOLOGY

San Vicente Creek is characterized by steep bedrock uplands leading to sequences of elevated marine terraces (Weppner et al., 2009). The bedrock is primarily a mix of granite and limestone, creating karst geology (formed from the dissolution of soluble rocks in limestone, dolomite and gypsum) unique within the region. Karst geomorphic features found in the watershed impact groundwater recharge as karst processes develop zones of enhanced porosity creating an aquifer system with rapid rates of recharge (Tihansky and Knochenmus, 2003). The karst geology significantly regulates water quantity and temperature in the middle and lower reaches of San Vicente Creek through processes of deep percolation into limestone and upwelling of cold groundwater through multiple springs that feed the stream with a perennial source of cool water. Chapter 3 provides a detailed description of the watershed geology and builds on this information with new data and analysis to better understand the role of natural geologic formations on sediment inputs, stream substrate, and the volume, seasonality and temperature of instream flow.

VEGETATION COMMUNITIES

Although redwood forest dominates the watershed, the lower reaches of the creek support a narrow riparian zone that is predominantly alders *(Alnus spp.)* and willows *(Salix spp.)*. The upper reaches are home to some of the most valuable timber stands in all of Santa Cruz County (ESA, 2001). Seventeen native vegetative communities and three communities dominated by introduced non-native species have been documented throughout the Coast Dairies Property, which extends three miles inland from the coast and comprises nearly 7,000 acres within San Vicente Creek watershed (ESA, 2001). Non-native plant species have established a presence in every vegetative community throughout the watershed including but not limited to iceplant (*Carpobrotus edulis*), Italian rygrass *(Lolium multiflorum)*, French broom *(Genista monspessulana)*, Pampass grass *(Cortaderia selloana)* and Cape ivy *(Delairea odorata)* (ESA, 2001). Neighbors living on San Vicente Street have noted removal of cape ivy as a key action for watershed recovery in the area due to the species highly invasive nature and long-term threats to salmonid habitat (Heady, pers. comm.). Chapter 6 of this report provides a comprehensive assessment of invasive plant species with a particular emphasis on distribution and impacts from cape ivy and Chapter 5 provides a comprehensive assessment of riparian conditions as they relate to current and future recruitment of large woody debris into the system.

FISH AND WILDLIFE

Salmonids

As anadramous fish species, both steelhead and coho utilize freshwater for mating/spawning, egg development and early maturation and move to the ocean for a period of rapid growth and weight gain prior to returning to freshwater to spawn. The life cycle begins with the development of eggs into young fish in freshwater streams. Once the eggs hatch, young fish develop in the watercourse and gradually make their way to the ocean. Steelhead trout in this area typically spend two years in fresh water although a few may spend additional years inland before migrating out to sea. The length of time spent in streams depends on environmental and genetic factors, and some individuals never migrate (Barnhart, 1986). Research by Smith (2005) suggests that one of the key environmental factors may be food supply and growth. According to these data, size is a critical factor in determining when a juvenile steelhead will leave freshwater, and once juveniles reach approximately 3.5 inches in forklength by the fall, they tend to outmigrate the following spring. In order to acclimate to saltwater, both steelhead and coho go through a process of smoltification prior to entering the ocean and juvenile fish leaving freshwater are referred to as smolts. Steelhead and coho along the California coast usually spend two years in salt water, attaining sexual maturity and storing fat for their journey back up their natal streams to spawn and restart the life cycle process. While females of both species and most males usually spend two years in the ocean, a portion of male coho, called jacks, are known to return to freshwater after 1 year in the ocean. Due to the abundance of food, anadromous fish species experience most of their growth once they have reached the ocean. Therefore, jacks are generally identified due to their smaller size and weight. While there are many similarities in the life cycle for these species, there are some key differences that should be highlighted. These include:

» **Timing of adult return to freshwater and spawning:** Coho are known to return to their natal streams in the southern portion of the ESU between November and January with the height of spawning peaking in February and March (NMFS 2012, from Moyle 2002). While steelhead spawners generally return to their natal streams later in the winter and spawn through April or May depending on climatic conditions.

» **Juveniles freshwater rearing:** Whereas steelhead often spend multiple years as juveniles in freshwater, the vast majority of juvenile coho salmon only spend one year in freshwater before going to the ocean. As such, coho smolts are generally younger and smaller than most steelhead smolts.

» **Post spawning adults:** While coho adults always die following spawning, some steelhead adults can return to the ocean after spawning, and may repeat that cycle to spawn up to four times, though most repeat spawners do so only twice.

The basic stream attributes for steelhead and coho spawning, rearing, and migration include cool water temperature, high concentrations of dissolved oxygen, adequate water depth, sufficient pool size and frequency, access to cover and slack water, and low fine sediment levels (Barnhart, 1986 and Anderson, 1995). Riparian habitat also can play a major role in either supporting or degrading habitat for these fish. Riparian zones are strips of water-dependent vegetation and associated organisms that follow the path of watercourses. Essential to healthy aquatic ecosystems, these zones help maintain favorable water quality and provide important food and habitat conditions. Trees along the water's edge shade the water, maintaining cool temperatures for anadromous juvenile rearing, as well as maintaining a favorable microclimate for amphibians. Riparian vegetation also stabilizes streambanks and intercepts eroded materials from upslope, minimizing the amount of sediment that enters the stream. Additionally, vegetation adds food and nutrients to the water for use by both fish and aquatic invertebrates. Large woody debris (LWD) falling into the stream course can provide cover for fish, collect and controls the movement of sediment, and create deep scour pools favored by rearing juveniles.

Water temperature is a critical habitat component that can have dramatic effects on growth and development of steelhead and coho. A key complication to understanding the effect of temperature on salmonids is that food availability is the key variable that governs how water temperatures affect fish. While both salmonid species have mortality thresholds with respect to water temperature, higher water temperatures do not always directly relate to lower growth and productivity. Water temperatures above 21.1°C make it difficult for coho salmon and steelhead to extract oxygen from the water. Optimal rearing temperatures for juveniles are 7.22-14.4°C for steelhead and 11.67-14.4°C for coho (Reisner and Bjornn, 1979). That said, temperatures between 14°C and 21°C may have a positive impact on growth if there is ample food supply to keep up with the increased metabolic demand of fish caused by higher water temperatures. Conversely, temperatures at and below the lower end of optimal can slow metabolism significantly and result in muted growth rates; translating to lower ocean survival rates.

All of these habitat conditions need to be considered when working to restore, maintain, or enhance anadromous populations. Data from the 2012 CCC Coho Recovery Plan highlights the need to prioritize restoration actions that increase the extent and availability of "off-channel" habitats such as floodplains, backchannels, alcoves and tributaries. The Plan also calls for implementation of projects that increase the amount of LWD in the stream. Both LWD and off-channel habitats are particularly important for coho, but also valuable to steelhead, for providing refuge to adult and juvenile fish during high flows in the winter and low flows in the summer. In the winter, when flashy flows result in high instream velocities, off-channel habitats and LWD can provide slow water sheltering areas for fish of all sizes. During the summer, deep pools formed through scour downstream of LWD provide salmonids with cool water refuge and cover from predation. Perennial off-channel habitats such as ponds, alcoves and back-channels can provide some of the highest quality summer rearing habitat with high levels of primary productivity and insect production.

Chapter 4 of this report provides a detailed assessment of historic and current trends in the abundance and distribution of salmonids in this watershed and collectively, chapters 2–5 provide a comprehensive understanding of the key habitat elements that support salmonids and processes that sustain these essential habitat components.

Other Biota

In addition to steelhead and coho salmon, other special status species known to occur within San Vicente Creek watershed include: California red-legged frog *(Rana aurora draytonii)*, Peregrine falcon *(Falco peregrinus)*, Western snowy plover *(Charadrius alexandrines)*, Western pond turtle *(Clemmys marmorata)*, Double-crested cormorant, rookery (*Phalacrocorax auritu*), Cooper's hawk, nesting (*Accipiter cooperi*), Sharp-shinned hawk, nesting (*Accipiter striatus*), Golden eagle (*Aquila chrysaetos*), Ferruginous hawk,wintering (*Buteo regalis*), Northern harrier, nesting (*Circus cyaneus*), White-tailed kite, nesting (*Elanus leucurus*), Merlin, wintering (*Falco columbarius*), Long-eared owl nesting (*Asio otus*), Rhinoceros auklet (*Cerorhinca monocerata*), Vaux's swift (*Chaetura vauxi*), Black swift (*Cypseloides niger*), Olive-sided flycatcher (*Contopus boreali*), Loggerhead shrike (*Lanius ludovicianus*), California horned lark (*Eremophila alpestris actia*), Yellow warbler (*Dendroica petechia brewsteri*), Saltmarsh common yellowthroat (*Geothlypis trichas sinuosa*), Grasshopper sparrow, nesting (*Ammodramus savannarum*), Tricolored blackbird, nesting (*Agelaius tricolor*), Pallid bat (*Antrozous pallidus*), Townsend's western big-eared bat (*Corynorhinus t. townsendii*), Yuma, San Joaquin myotis (*Myotis yumanensis*), and S. Francisco dusky-footed woodrat (*Neotoma fuscipes annectens*) (ESA, 2001).

Figure 1-3. Ariel view of Davenport and the Santa Cruz Portland Cement Company.

LAND USE—PAST AND PRESENT

San Vicente Creek watershed has seen a variety of high and low impact land-use over the past 150 years including logging, selective timber harvesting, quarrying, mining, irrigated agriculture, ranching and urbanization. All of these land uses have had direct and indirect impacts on stream habitat and the forces that create and sustain habitat diversity and complexity.

Evidence of historic logging activities has been documented in San Vicente Creek watershed (ESA, 2001) and associated impacts (reduced large woody debris recruitment, road construction and increased sediment loading) have been identified as a threat to multiple life stages of salmonids (Santa Cruz County, 2009). Previously uncut stands of redwood forest were almost completely clear-cut in the watershed between 1870 and 1923. While the robust logging economy provided economic advantages of employment and revenue for the region, clear-cutting of the watershed resulted in significant changes to run-off, debris loading, sediment dynamics, and a host of other natural processes necessary for supporting a self-sustaining salmonid fishery in San Vicente Creek as well as neighboring creeks.

In the early 1900s the arrival of the Santa Cruz Portland Cement Company (see aerial view of cement plant in the left of Figure 1-3) ushered in a new era of land use throughout San Vicente Creek watershed. Rich deposits of limestone buried beneath the earth fueled a thriving cement industry that fueled the local economy for nearly 100 years. In the early 1900s a dam, 90 foot vertical shaft, and tunnel were installed in the upper reach of San Vicente Creek to force surface water down into the tunnel, away from quarry operations. In the early 1920s, the tunnel was expanded to allow a train to stop under the quarry floor so that limestone could be loaded into railcars. While the train was in operation, San Vicente Creek flowed on one side of the tunnel with train tracks on the other (Hamey, pers. comm.). The tunnel (and its associated vertical shaft), located at stream mile 3.4, is still present today and creates an impassable barrier to fish that has completely eliminated fish passage to approximately 50% of the upper San Vicente Creek watershed (Santa Cruz County, 2009).

In 1906 consistent access for people and goods to San Vicente Creek watershed was established through the construction of the Southern portion of the Ocean Shore Railroad which linked Davenport with Santa Cruz. While the rail system in Santa Cruz proper was built in 1876, the connection to the North Coast was not completed until 1906 (Hamman, 1996). As part of construction of the railroad, the lower reach of San Vicente Creek was redirected through a tunnel dug through bedrock (see Figure 1-4), bypassing a historic lagoon and sending the stream directly into the Pacific Ocean. While the tunnel allows year-round access to San Vicente Creek for migrating salmon, the loss of the lagoon eliminated an important element for both salmon and other estuarine dependent species (Becker, 2010). After 1906, salmonids in San Vicente Creek that had previously migrated freely up and down the streams were channeled through tunnels and in some places confronted with new obstructions that they could not pass (ESA, 2001). As such, the combination of intensive upland land uses and lower watershed infrastructure set in motion a number of human induced factors that appear to have impacted salmonid habitat quality and quantity in the watershed.

Timber harvesting, water diversions, and rural residential development occur in the upper watershed. Open pit mining historically occurred in the upper watershed, but was recently terminated. Cattle grazing and agricultural water diversions historically occurred in the lower watershed but were gradually phased out over the past decade. Currently, dominant land-use within the watershed includes residential (more densely populated directly adjacent to the town of Davenport), two quarries located on Mill Creek and one of the unnamed tributaries to San Vicente Creek (County of Santa Cruz County, 2012), logging, agriculture along the coast, grazing and open space, with the dominant land-use being timber. The cement plant, and associated quarry lands, changed ownership a number of times (most recently CEMEX) before

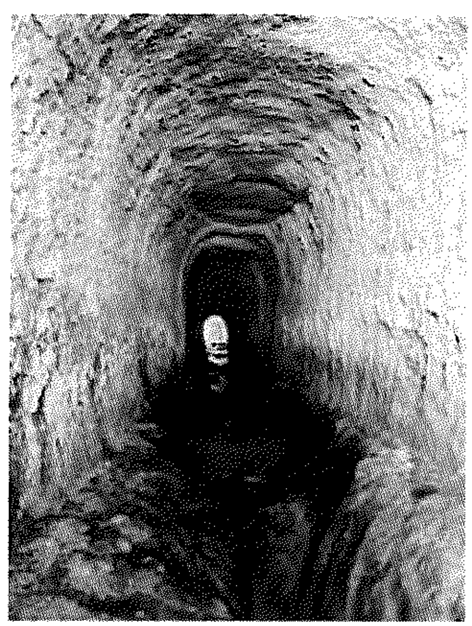


Figure 1-4. San Vicente Creek tunnel under Highway 1.

operations ceased in 2010. In 2012, the CEMEX forestlands was sold to a coalition of conservation organizations including the Peninsula Open Space Trust (POST), Save the Redwoods League, the Sempervirens Fund, and the Nature Conservancy (TNC) collectively known as the Living Landscape Initiative. The entirety of the lower watershed, owned since 1998 by the Trust for Public Land (TPL) is planned for transfer to the Bureau of Land Management (BLM). As previously mentioned, the upper portion is owned by the Living Landscape Initiative with the intent of managing the property with a mix of environmentally responsible forestry practices and resource conservation. It is expected that as property ownership changes to BLM, the management of the lower watershed will be more active and that approved public access will increase and trespassing will decrease. Most of the watershed (99%) is still privately owned, with a large portion (61%) in conservation ownership, which provides unique opportunities for continued species protection and recovery (NMFS, 2010).

HISTORIC/EXISTING DATA AND REPORTS

A critical component of this effort includes identifying, gathering, and organizing a library of existing data and reports that pertain to or inform potential recovery of salmonids in the San Vicente Watershed. In addition to the overview text provided above, Appendix A of this report provides a comprehensive bibliography of all of the data sources and reports the RCD team was able to identify and obtain as part of this effort.

SUMMARY

San Vicente Creek watershed offers a unique opportunity to improve salmonid habitat along the Central California Coast and provide additional support for a small but important stronghold for coho salmon and steelhead. While existing data demonstrates that salmonid populations, and especially populations of coho salmon, have been declining in watersheds south of the Golden Gate Bridge, San Vicente Creek appears to be holding on to a small but self-sustaining coho population as well as a more robust steelhead run. The absence of a sandbar at the mouth of San Vicente Creek watershed provides salmon with year-round access to and from the Pacific Ocean. These characteristics along with small and isolated development, headwaters geology dominated by Karst features in the mainstem, and Santa Margarita Sandstone in the Mill Creek subbasin, exhibit a high capacity for infiltration resulting in a stream with cool and consistent summer baseflows. These are some of the conditions that make this place unique for salmonid recovery. While these factors appear to provide a unique set of benefits to salmonids, the watershed is still recovering from an array of intensive land and resource management actions that have occurred over the past century as well as current impacts from invasive species, on-going land-uses within the watershed, and perturbations of the natural disturbance regimes that salmonids and salmonid habitat rely on. As such, there is clearly a need to comprehensively assess the current conditions and limiting factors in this watershed, identify the high priority restoration objectives for the system and develop a cohesive plan focused on practical, cost-effective, and scientifically based future recovery actions.

Chapter 2: Hydrology

OBJECTIVES

When thinking about recovery of salmonids, water is the fundamental resource that needs to be understood and evaluated. While summer baseflow deficit is considered a critical limiting factor in nearly every salmonid watershed south of the Golden Gate, National Oceanic and Atmospheric Association's (NOAA) 2012 Recovery Plan (NOAA, 2012) does not highlight instream flow impacts as a major threat to recovery in San Vicente Creek based on the number and magnitude of diversions and the high levels of cool baseflows observed throughout the summer in most years. Based on this context, the primary objective of the hydrologic assessment was to verify and quantify the existing hydrologic characteristics and restoration opportunities which currently or could in the future have a positive impact to coho salmon (*Oncorhynchus kisutch*) or steelhead trout (*Oncorhynchus mykiss*) habitat in San Vicente Creek. To address this objective, Balance Hydrologics (Balance) designed the hydrologic assessment with five key questions in mind:

1. What are the sources and rates of low-flows to the mainstem San Vicente Creek? What is the quality of the sources?
2. What are rates and the sources of low flows to San Vicente Creek? How do the flows compare to those in other Santa Cruz Mountains streams? How much more slowly do they recede both seasonally and during dry sequences of years?
3. What are the very large peak flows? How do these compare to those in other streams in the region? How large were the 1982, 1998, 2005 and/or 2011 peak flows, both as recurrences and relative to peaks in other streams?
4. What are the dominant discharges, or channel-forming flows?
5. How does San Vicente Creek compare to other regional salmonid streams in both a hydrologic and water quality sense?

To answer these questions, we carried out several hydrologic subtasks, consistent with the general guidance offered within California Salmonid Stream Habitat Restoration Manual. The specific subtasks included:

» Stream gaging and basic water quality measurement and sampling;

» Synoptic low-flow measurements;

» Peak discharge and dominant or channel-forming flows analysis;

» Region-wide hydrologic and basic water quality comparison;

» Climate change hydrologic analysis.

We will now review work completed in each of these subtasks.

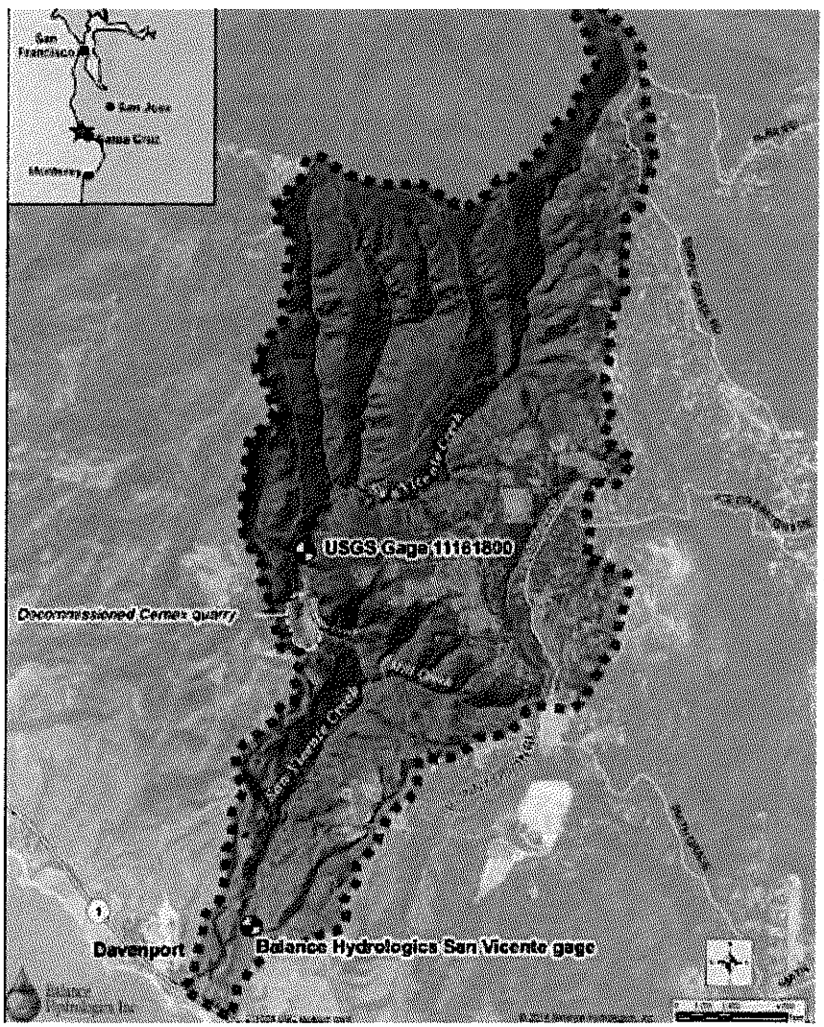


Figure 2-1. San Vicente Creek watershed.

INTRODUCTION

San Vicente Creek drains a watershed area of 11.1 square miles, originating on the western slope of Ben Lomond Mountain and discharging to the Pacific Ocean (Figure 2-1). The Mediterranean climate of the region provides for warm, dry summers and wet, cool winters. Mean annual rainfall in the watershed ranges from 24 inches near the ocean to upward of 60 inches at the headwaters near Empire Grade (County of Santa Cruz, 2000). The large rainfall gradient characteristic of San Vicente Creek is evidence that Ben Lomond Mountain plays a significant role in driving the local precipitation regime. Rainfall is the only source of meteoric water in the watershed as there is no measurable snowfall, and fog does not measurably contribute to stream runoff.

The alluvial groundwater basin is recharged during late fall and winter storm periods, providing the water which re-emerges during the spring and summer dry season months (Creegan

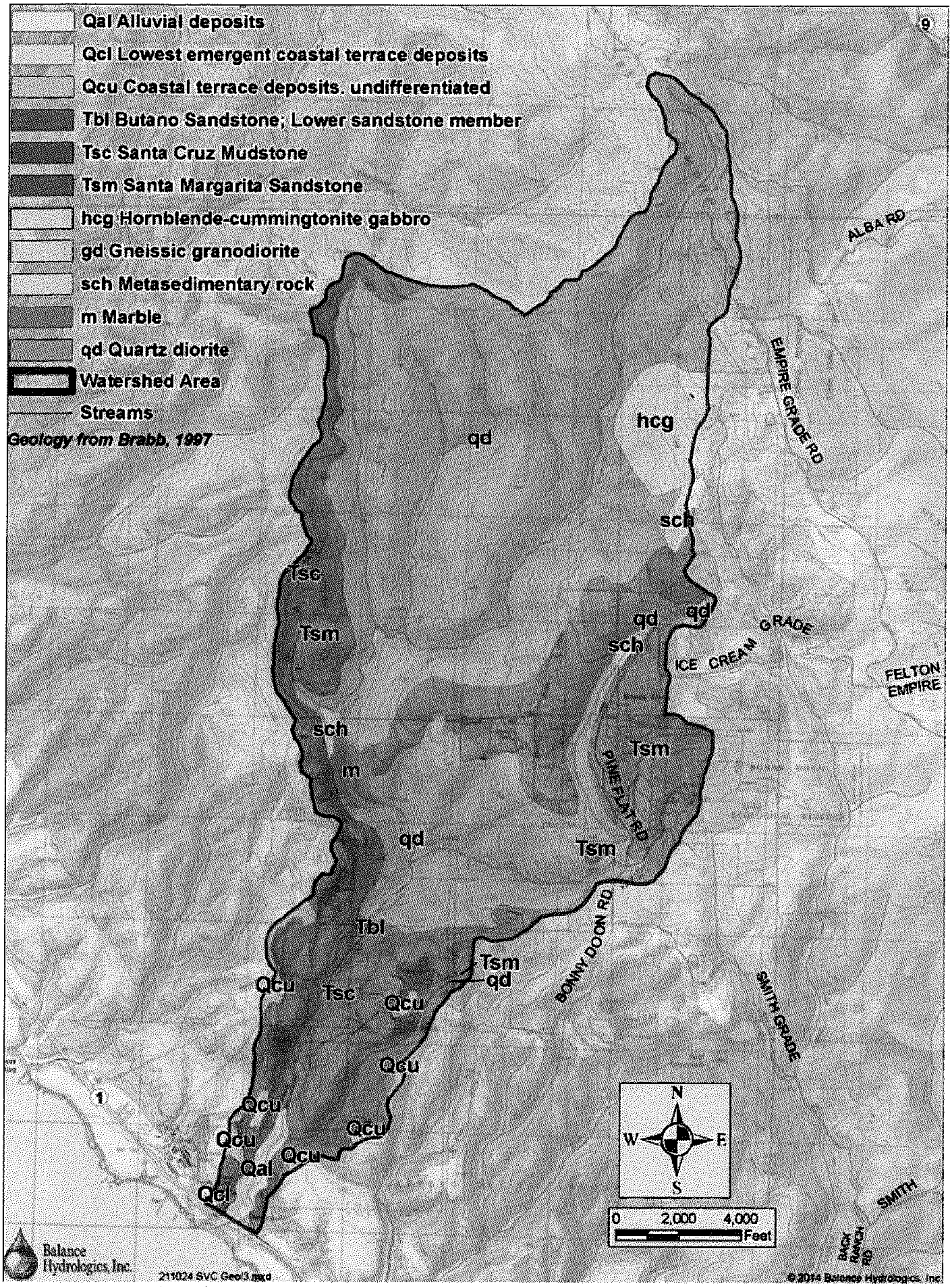


Figure 2-2. San Vicente Creek geology.

and D'Angelo, 1984). The local karst system in the adjoining Liddell Creek basin is known to include trans-watershed divide groundwater transfers (PELA, 2005) to the Liddell system, from the Upper Laguna basin to a lesser extent, and from Reggiardo Creek to a greater extent. Additionally the Santa Margarita Sandstone (Figure 2-2: Tsm) which occurs just south of Bonny Doon, and just east of the now closed Bonny Doon Quarry is known to be an important recharge or supply source to the Liddell marble aquifer (PELA, 2005; Nolan Associates and Johnson, 2007). Given the prevalence of Santa Margarita Sandstone within the headwaters of Mill Creek (Figure 2-2) and just to the east of the decommissioned quarry (Figure 2-1) along upper San Vicente Creek, it is likely that the Santa Margarita is an important recharge zone for the San Vicente basin, possibly providing a large percentage of the flows which sustain the regionally high summer baseflows. Karst geology (Figure 2-2: m) undoubtedly plays an equally important role in San Vicente Creek (Figure 2-2) in terms of groundwater hydrology, and notably the decommissioned marble (locally called limestone) quarry in San Vicente Creek has been identified as being within a groundwater recharge zone (ESA, 2001). Presently the City of Santa Cruz Water Resources Department, the County of Santa Cruz Environmental Health Services Agency, and the Santa Cruz County Water Advisory Commission are pursuing development of a karst-specific protection zone ordinance (KPZ). The purpose of the KPZ would be in general to protect karst features, and specifically protect zones of groundwater recharge in the County that are related to karst, noting that these geologic attributes are regionally rare, yet vitally important to the hydrology of affected basins (see August 21, 2012 County of Santa Cruz Board of Supervisors Agenda item 24, available online at the County's website).

The USGS operated gage number 11161800 in the upper watershed from Water Year[1] 1970 through Water Year 1985, upstream of the decommissioned quarry (See Figures 2-1 and 2-4[2]) and upstream of the primary surface water diversion in the SVC basin (discussed below)[3]. The drainage area at the former USGS gage is 6.07 square miles. The period of record for the former USGS gage provides a useful snapshot of watershed hydrology for diverse climatic conditions (Figure 2-4). Specifically, the record includes the WY1776–77 drought, regionally one of the most severe in the last 50 years, as well as WY1982 which was considered very wet, and resulted in significant local flooding (USGS, 1989). The record also includes several years of average or normal precipitation conditions, as well as less severe dry and wet conditions. Of note in September of WY1977 the USGS reported flows of 0.01 cfs, or for all intents and purposes close to zero. The lowest reported flows for WY1976 were 0.60 cfs. These records indicate that upper San Vicente Creek is characterized by a groundwater basin which is resilient in the face of a one year drought, but which can be challenged by more sustained droughts. The role of how in-basin surface water diversions might have affected flows downstream of the former USGS gage during the WY76–77 drought is unclear. Unfortunately data for the lower watershed during the 1970s drought is lacking, short of observations by watershed residents.

Figure 2-3: Synoptic low flow measurement made in July 2013 as a part of the watershed assessment project.

From our brief introduction above, it is not surprising that surface flow in upper San Vicente Creek is interrupted by karst features as it travels downstream past the former USGS gage location: (1) surface flow is captured upstream of the decommissioned quarry via an Instream inlet and 80 foot vertical shaft connected to a tunnel under the quarry; and (2) surface flow capture occurs via a sinkhole feature located in the decommissioned quarry floor. Captured streamflow re-emerges downstream from a tunnel located at the end of the abandoned rail alignment, formerly used for quarry activities[4]. Captured streamflow re-emerges downstream from a cave located at the end of the abandoned rail alignment, formerly used for quarry activities. The percent of flow that is captured and which re-emerges at the downstream cave has not been quantified to the best of our knowledge. It is also not known if the hydrologic character of re-emergence varies from storm to storm, or wet season to dry season, etc. Further downstream stream

1 A water year extends from October 1st of the previous year through September 30th of the following year. For example, water year 1970 covers the period October 1, 1969 through September 30, 1970. Water year is abbreviated as WY. For example water year 1970 is abbreviated as WY1970, or WY70.

2 The record of rainfall illustrated in Figure 1.2 includes rainfall data for the now defunct NOAA Santa Cruz rainfall station for the period 1878-1996 (http://iridl.ldeo.columbia.edu, station 47916), coupled with rainfall data for the CIMIS DeLaveaga (104) rainfall station for the period 1997-2013. Rainfall data was summed over the rain year: June through May of the subsequent year, and represents a long-term estimation of precipitation conditions in Santa Cruz given the slightly different geographic locations of the precipitation stations.

3 USGS data reports published when the gage was active indicate that there were no known surface water diversions upstream of the gaging station.

4 The tunnel emerges just past the southern tip of the decommissioned quarry on upper San Vicente Creek (see Figure 2-1), which is also the upstream end of Reach 5, as described in the Geomorphology Chapter. At the tunnel exit there is an abandoned rail station that was used for mining activities.

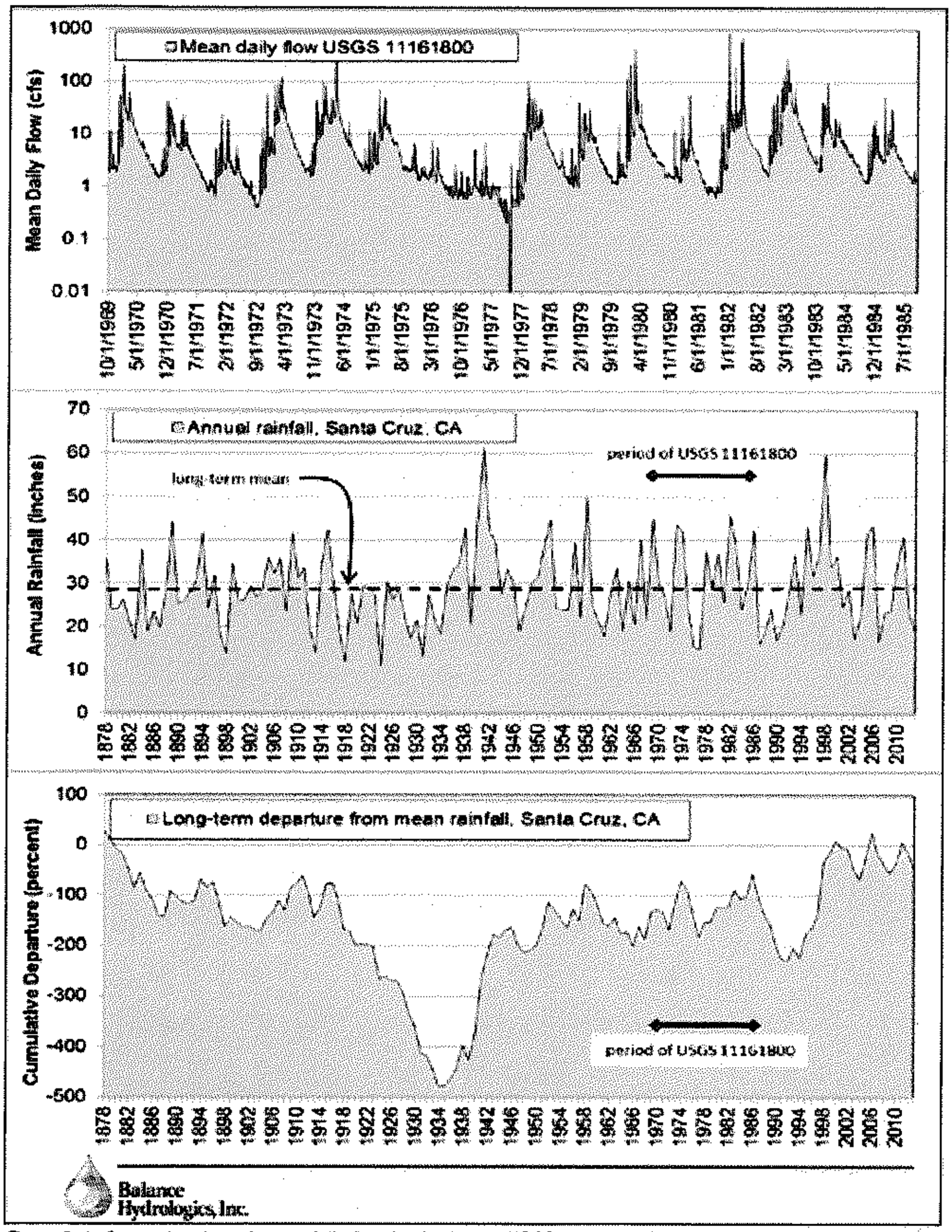


Figure 2-4. Composite plots of mean daily flow for the former USGS gage near San Vicente (top), long-term annual precipitation near Santa Cruz (middle), and long-term cumulative departure of precipitation from the mean, Santa Cruz (bottom).

San Vicente Creek is joined by Mill Creek, which originates in the Town of Bonny Doon. From measurements made as a part of this study it appears that surface flow in San Vicente Creek nearly doubles as a result of contributions from Mill Creek. From the Mill Creek confluence San Vicente continues the journey to the coast in more or less a straight line path, due southwest through partially confined and unconfined valley reaches until it meets a tunnel that carries flow under Highway 1 and the UPRR rail embankment, before emptying into the Pacific Ocean. San Vicente typically conveys surface flow to ocean year-round and occasionally experiences tidal influence through and above the entrance to the tunnel under Highway 1.

For the purpose of the present study, a temporary gaging station was established by Balance Hydrologics in the lower watershed near the CEMEX entry gate at the end of San Vicente Creek Road, as shown on Figure 2-1. Development of surface flow and basic water quality parameters for WY2013 provides an opportunity to compare these conditions for San Vicente Creek with other local watersheds where similar measurements were made. Comparisons with other watersheds are valuable in terms of developing an understanding of how San Vicente Creek compares to other systems. Locally, Laguna Creek offers perhaps the best comparative opportunity because it also bears a strong hydrologic control by karst within its upper basin. As a result we compare gaged flows between San Vicente and Laguna for W20Y13.

According to eWRIMS (California State Water Resources Control Board), there are presently three active surface water diversions along San Vicente and Mill Creeks[5]:

1. RMC Pacific Materials (S008351): pre-1914 appropriative right, 420 acre-feet per year (0.6 cfs) used in 2010–San Vicente Creek near the former USGS stream gage (Figure 2.1) and upstream of the decommissioned quarry;
2. RMC Pacific Materials (S008350): pre-1914 appropriative right, 120 acre-feet per year (0.2 cfs) used in 2010–Mill Creek about 0.5 miles upstream of the San Vicente confluence;
3. Andrew Davidson (A002714): licensed right–76.4 acre-feet per year (0.106 cfs)–Mill Creek.

RMC and their water rights were acquired by CEMEX on March 1, 2005[6]. The CEMEX cement processing facility closed in January 2010 (Barton, 2012). Barton (2012) indicated that

5 There are two other claimed rights along Mill Creek (S016081 and S023930), but together they total only an estimated 0.8 acre-feet per year. As a result these are not discussed because this quantity of water is unlikely to significantly effect Instream habitat for coho or steelhead.

6 When operable, the CEMEX plant required higher diversion rates, estimated at 1.1 cfs in total with 0.8 cfs diverted from San Vicente and 0.3 cfs from Mill Creek (Barton, 2012)

the San Vicente right presently divert surface flows on a regular basis: 0.2 cfs for the town of Davenport water supply and 0.1 cfs for dust control at the decommissioned processing plant. The Davenport water supply is managed by the County of Santa Cruz[7] and includes a water treatment facility, located on the cement plant property. Six-inch pipelines convey diverted surface water to the cement plant property, and water is taken from the pipes to the water treatment plant from where it is ultimately distributed (Reppert, 2002). Staff from the National Oceanic and Atmospheric Administration (2014) have noted that they have observed significant leakage from the water supply pipelines during previous visits to the watershed. Barton (2012) further indicates that the Mill Creek surface diversion is presently inactive, but is left open at a minimal flow by the County of Santa Cruz to keep the line flushed and the water fresh within the line. The County uses the Mill Creek flow as backup if the San Vicente line becomes clogged.

Annual filings of water usage for right S008351 from San Vicente Creek from 2003 – 2008 indicate diversion totals of 300 to 585 acre-feet per year. Annual filings of water usage for right S008350 from Mill Creek, from 2003–2008 indicate diversion totals of 60–299 acre-feet per year. There have been no water usage fillings for rights S008350 or S008351 since 2010. Barton (2012) is the only indication of estimated present use of either water right. However, since it is known that the water supply pipelines leak, the indicated diversion rate of 0.3 cfs for right S008351 is likely an under-estimate of actual rate of diversion. Furthermore, it is thought that the Mill Creek right is presently exercised to some degree, in order to maintain the pipeline free of debris which could otherwise block the pipeline (Ricker, pers. comm.).

There is one known well located within the San Vicente stream corridor (within 50 feet of the active stream), located approximately where the conveyor belt crosses San Vicente Creek, and operated as part of the Coast Dairies (Coast Dairies, 2013). According to field observations, the well is connected to a 6-inch pipeline that runs about 0.3 miles downstream (location of Balance temporary stream gage) and then south about 0.5 miles up a hill to a pond on the ridge. Depending on the depth(s) at which the well is screened, typical pumping rates and durations, etc., it is possible that well operation results in transitory impacts to surface flows along San Vicente Creek. We were however unsuccessful in acquiring well construction and pumping records from the Trust for Public Land, and therefore cannot rationally evaluate this possibility. Some smaller diversions and wells are known to be sited in upper Mill Creek in the vicinity of Bonny Doon. Diversion and pumping rates for these facilities was also not acquired, and therefore relative or direct surface flow impacts is not known. The potential impacts of these diversion on salmonids is currently not quantified and was outside of the scope of this effort.

7 The water supply pipeline is still, however, maintained by CEMEX, not the County of Santa Cruz (Ricker, pers. comm.).

Prior to the present effort and those of the USGS, at least two additional efforts in the last 15 years to characterize surface water hydrology of San Vicente Creek at various locations are known. These efforts include a 2003 project by ESA to collect hydrologic data for CEMEX, and a subsequent initiative completed by Balance Hydrologics in 2008 as a part of the lower off-channel pond design project (Stamm et. al., 2008). In sum these two projects provide one key piece of hydrologic information. During the high flows of WY1998, the lowermost reach of San Vicente Creek within 1,500–2,000 feet of the Highway 1 tunnel was characterized by significant alder mortality and deposition of significant volumes of sediment. From this we surmise that the Highway 1 tunnel acts as a hydraulic bottleneck, promoting a dynamic channel environment along the upstream affected reach, and capable of driving a shifting stream course, and associated re-setting of the riparian corridor.

The remainder of this chapter will be spent reviewing data collected as a part of the stream gaging program, the two sets of synoptic flow measurements, a review of channel-forming flow estimates, a limited regional hydrologic comparison, and results stemming from completion of a first-order estimate of possible effects to watershed hydrology due to climate change.

METHODOLOGY

Stream Gaging

Assessment and Methods

In September 2012, Balance Hydrologics installed a stream gage on San Vicente Creek adjacent to the CEMEX gate at the end of San Vicente Creek Road (SVCG) (Figure 2-1). The drainage area at SVCG is estimated to be 10.5 sq. miles and the site was selected for relatively uniform channel cross section conditions, as well as a lack of nearby streamwood structures, or other physical barriers. The gage was equipped with two pressure transducers (depth sensors), a temperature sensor, and a specific electrical conductance probe. The pressure transducers measure water depth according to an internal calibration which converts a pressure measured across a thin plate to a small voltage which is relayed to the datalogger. Specific electrical conductance (SC) is a measure of the electrical conducting properties of natural waters, and therefore provides a measure of the magnitude or concentration of dissolved salts (salinity), or solids present in the water. The major cations and anions comprising the dissolved load typically include Calcium, Magnesium, Potassium, Sodium, Bicarbonate, Sulfate and Chloride. Because conductance is the reciprocal of resistance, the conductivity probe works by measuring the voltage drop (resistance) across a known length of fluid, from electrodes of known area for a given field temperature. All probes were programmed to record data to memory at 15-minute intervals from the hour. The sensor array was connected to a data logger housed in a weather proof box on the south bank of the creek. The gage was operational for the duration of W20Y13 which included the wet winter, and dry summer seasons. Manual measurements of stage, streamflow and basic water quality conditions (water temperature, specific conductance, and dissolved oxygen) were

Table 2-1. Station Observer Log (sheet 1 of 2)

SAN VICENTE CREEK NEAR DAVENPORT, WATER YEAR 2013

Site Conditions				Streamflow				Water Quality Observations	
Date/Time	Observer(s)	Stage (staff plate)	Hydrograph	Measured Discharge	Estimated Discharge	Instrument Used	Estimated Accuracy	Water Temperature	Specific Conductance at field temp.
(mm/dd/yr)		(feet)	(R/F/ S/B)	(cfs)	(cfs)	(AA/PY)	(e/g/f/p)	(oC)	(µmhos/cm)
10/3/2012 12:25	jp, dr	0.99	B	-	-	-	-	-	-
10/4/2012 12:15	jp, dr	0.98	B	2.42	-	py	g	13.90	309
11/8/2012 14:30	jp	1.0 to 1.01	B	2.50	-	py	g	12.40	266
12/2/2012 12:20	jp	2.93	F	203	-	float	f/p	-	-
12/7/2012 15:45	jp	1.25	F/B	14.87	-	AA	g	11.90	212
12/27/2012 13:55	jp, dr	1.64	F	42.83	-	AA	g	10.40	155
2/1/2013 12:20	dr	1.19	B	stage only	-	-	-	-	-
2/11/2013 0:00	jp	-	-	-	-	-	-	-	-
2/15/2013 17:00	jp	1.13	B	8.76	-	py	g	1.10	210
2/21/2013 17:30	bkh, dr	1.11	B	9.35	-	py	f	-	-
2/22/2013 11:35	jp	1.12	B	stage only	-	-	-	-	-
3/11/2013 11:15	jp	1.10	B	7.79	-	py	g	9.30	201

Observers: jp: Jason Parke; dr: Denis Ruttenberg; bkh: Brian Hastings, jo: Jonathan Owens

Stage: Water level observed on staff plate--arbitrary datum

Hydrograph: Describes stream stage as rising (R), falling (F), steady (S), baseflow (B), or uncertain (U).

Instrument: If measured, typically made using a standard (AA) or pygmy (PY) bucket-wheel ("Price-type") current meter. Extremely low flows are measured with a bucket+stop watch (B) If estimated, from rating curve (R) or visual (V).

Estimated measurement accuracy: Excellent (E) = +/- 2%; Good (G) = +/- 5%; Fair (F) = +/- 9%; Poor (P) estimated percent accuracy given

High-water mark (HWM): Measured or estimated at location of the staff plate

Specific conductance: Measured in micromhos/cm in field; then adjusted to 25degC by equation (1.8813774452 - (0.050433063928 * field temp) + (0.00058561144042 * field temp^2)) * Field specific conductance

Water Quality Observations			High-Water Marks		Remarks
Specific Conductance at 25C	Dissolved oxygen	Additional sampling?	Estimated stage at staff plate	Inferred dates?	
(at 25 oC)	mg/L	(Qbed, etc.)	(feet)	(mm/dd/yr)	
-	-	-	-	-	INSTALLED GAGETODAY. Did not have staff plate on hand will install at next visit - water level marked on 2x4 for reference.
400	6.35	-	3.0 to 3.4 WY12	3/16/12	Installed staff plate. Measured high water mark cross section from WY12 likely from 3/16/12. There has been a couple days of fog after a heat wave a for a few days prior to this.
358		-	none visible	-	Some light rain today however probably not enough to create much flow response.
-	-	Qss, Qbed	-	-	High flow conditions. Sampled Qss with DH48 single vertical at 11:57, 12:30, Tried to sample Qbed with a single vertical at 12:38, 11:27 however did not seem like a good sample.
289	8.65	-	3.10	12/2/12	Sand had buried the bottom part of the staff plate and had to dig out. Sand has heavy muscovite content. Water is clear. Measured cross section from 12-2-12 float test.
220	10.00	-	3.94	12/23/12	Light turbidity conditions. Measured cross section from 12-23-12 flow event.
-	-	-	-	-	Measured high water mark cross section
-	-	-	-	-	Pulled up and a resident came out to warn me of several mountain lions seen at the gage today.
384		-	-	-	Had trouble downloading - will have to return.
		-	-	-	Flow also measured at the old USGS gage in the upper watershed today.
		-	-	-	Replaced datalogger cpu and sent original program. Left wiring the same.
294		-	-	-	Unable to see recent high water mark.

Table 2-1. Station Observer Log (sheet 2 of 2)

SAN VICENTE CREEK NEAR DAVENPORT, WATER YEAR 2013

Site Conditions		Streamflow						Water Quality Observations	
Date/Time	Observer(s)	Stage (staff plate)	Hydrograph	Measured Discharge	Estimated Discharge	Instrument Used	Estimated Accuracy	Water Temperature	Specific Conductance at field temp.
(mm/dd/yr)		(feet)	(R/F/ S/B)	(cfs)	(cfs)	(AA/PY)	(e/g/f/p)	(oC)	(µmhos/cm)
5/8/2013 16:20	dr	1.01	B	stage only	-	-	-	-	-
5/9/2013 16:15	dr	1.02	B	4.95	-	-	-	13.60	250
5/13/2013 15:20	dr	1.00	B	stage only	-	-	-	-	-
6/7/2013 15:30	jp	1.16	B	3.75	-	py	g	13.50	193
7/22/2013 13:30	jo	1.19	B	2.16	-	py	g	-	-
7/24/2013 10:30	jp	1.18	B	stage only	-	-	-	13.80	297
9/9/2013 16:00	jp	1.20	B	1.63	-	py	g	15.10	346
9/27/2013 13:40	dr	1.25	B	1.46	-	py	g	11	335
10/9/2013 13:30	jp	1.205	B	stage only	-	-	-	12.20	334

At old USGS gage

2/21/2013 10:35	bkh, dr	na	B	8.23	-	py	f	-	-

Observers: jp: Jason Parke; dr: Denis Ruttenberg; bkh: Brian Hastings, jo: Jonathan Owens

Stage: Water level observed on staff plate--arbitrary datum

Hydrograph: Describes stream stage as rising (R), falling (F), steady (S), baseflow (B), or uncertain (U).

Instrument: If measured, typically made using a standard (AA) or pygmy (PY) bucket-wheel ("Price-type") current meter. Extremely low flows are measured with a bucket+stop watch (B) If estimated, from rating curve (R) or visual (V).

Estimated measurement accuracy: Excellent (E) = +/- 2%; Good (G) = +/- 5%; Fair (F) = +/- 9%; Poor (P) estimated percent accuracy given

High-water mark (HWM): Measured or estimated at location of the staff plate

Specific conductance: Measured in micromhos/cm in field; then adjusted to 25degC by equation (1.8813774452 - [0.050433063928 * field temp] + [0.00058561144042 * field temp^2]) * Field specific conductance

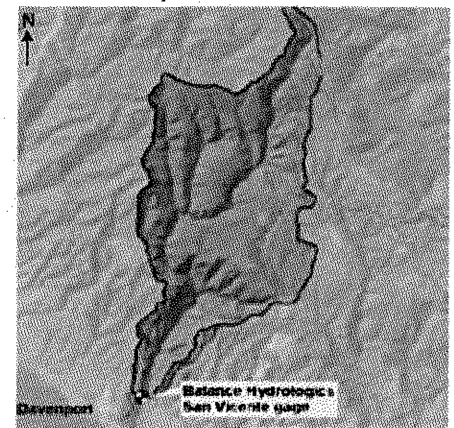
Additional Sampling: Qbed = Bedload, Qss = Suspended sediment, Nutr = nutrients; other symbols as appropriate

Water Quality Observations			High-Water Marks		Remarks
Specific Conductance at 25C	Dissolved oxygen	Additional sampling?	Estimated stage at staff plate	Inferred dates?	
(at 25 oC)	mg/L	(Qbed, etc.)	(feet)	(mm/dd/yr)	
		-	-	-	Stage observation only.
326	6.98	-	-	-	Changed battery but unable to download - software not functioning.
		-	-	-	Returned to download.
252	8.19	-	-	-	Tree has fallen down stream of the gage in the channel and will directly affect the gage with back water. Had to go about 75 ft. downstream to find a decent cross section for a flow measurement.
		-	-	-	Stage observation when passing by gage during channel surveys. Flow measured upstream of the gage and named site #5.
385		-	-	-	Synoptic measurements through the watershed were collected on 7-22-13 and 7-23-13. Download and stage reading only.
434		-	-	-	Back-water at the gage has gotten deeper with increasing debris in the fallen tree constriction downstream. Debris is to large to remove manually. It has been warm for the last week in Santa Cruz.
468	10.20	-	-	-	Good cross section about 40 ft DS of NOAA#15 marker. Note that there is a tree in the channel downstream that has created back water conditions at the gage.
452	6.67	Alkalinity see notes	-	-	Collect alkalinity samples at gage at 13:30; above Mill Cr at 14:15; and on San Vicente above San Vicente at 14:17
-	-	-	- -		No staff plate available at the old USGS gage however there was a brass monument - measure relative to water surface next time. Flow also measured at the Davenport gage today.

Table 2-2. Mean daily average of temporary gage on San Vicente Creek near Davenport, Santa Cruz County, California, water year 2013. Gage located approximately 0.75 miles upstream from HWY 1 tunnel.

Water Year:	**2013**
Stream:	**San Vicente Creek**
Station:	**San Vicente Creek at Davenport, CA**
County:	Santa Cruz County, CA

Station Location Map



approx.scale 1 in : 8640 ft

Station Location

Elevation at the gage is approximatly 61 feet; Latitude: 37° 1'4.29"N, Longitude: 122°11'14.21"W WSG84, Santa Cruz County, CA., Instrumentation is located on the left bank (facing downstream) at the gate at the north end of San Vicente Street. Drainage area above the gage is approximatly 10.5 square miles.

Mean Annual Flow (period of record)

Mean daily flow (MDQ) for WY 2013 is not known at this point, record is incomplete.
There is no known prior monitoring at this location.
Mean monthly flows are presented below.

Peak Flows (WY13)

Date	Time (24-hr)	Gage Ht. (feet)	Discharge (cfs)	Date	Time (24-hr)	Gage Ht. (feet)	Discharge (cfs)
11/30/12	10:45	2.45	125				
12/2/12	11:45	3.07	251				
12/23/12	**16:30**	**3.84**	**657**				
Extreme for Period of Record:		NA					

Period of Record

Gage was installed on 10-3-13 by Balance Hydrologics
Gaging sponsored by CDFW

WY 2013 Daily Mean Flow (cubic feet per second)

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT
1		5.5	43.3	23.9	na	8.1	12.1	4.8	5.0	2.1	2.0	1.7
2		4.2	96.9	22.0	na	7.9	8.8	4.6	4.9	2.2	1.9	1.9
3	1.9	3.3	35.7	20.3	na	7.6	7.9	4.3	5.4	2.1	1.7	2.0
4	2.2	2.5	19.7	19.1	na	7.4	8.7	4.2	5.2	2.0	1.8	2.0
5	2.6	2.1	23.6	20.4	na	7.4	8.5	4.6	5.1	2.1	1.9	2.2
6	2.5	1.8	19.2	25.6	na	11.0	8.1	5.2	4.6	2.2	2.1	2.2
7	2.2	2.2	15.2	21.0	na	8.7	7.8	5.1	4.1	2.2	2.3	1.7
8	2.1	2.5	12.4	19.1	na	9.3	7.5	4.5	3.7	2.4	2.4	1.6
9	2.2	2.9	10.6	na	na	8.3	7.1	4.4	4.2	2.4	2.3	1.4
10	3.0	2.6	9.3	na	na	8.0	7.0	4.8	4.3	2.2	2.1	
11	3.7	2.5	8.4	na	na	7.7	6.8	4.8	4.6	2.1	2.0	1.3
12	4.7	2.5	8.3	16.2	na	na	6.4	3.7	4.1	2.2	2.1	1.9
13	4.7	2.5	7.2	15.9	8.8	na	6.1	3.5	3.7	2.5	2.0	2.2
14	3.8	2.0	6.8	na	na	na	5.7	3.7	3.7	2.4	1.9	2.1
15	3.0	1.6	6.9	na	8.8	7.0	5.8	4.1	3.5	2.2	1.9	1.4
16	2.5	3.2	7.0	na	8.7	6.9	5.8	4.6	4.0	2.7	1.9	1.3
17	2.5	13.1	20.7	na	8.6	6.7	6.1	4.8	4.5	2.7	1.5	1.3
18	2.0	9.6	16.0	na	8.6	6.6	6.3	4.7	4.7	2.2	1.4	1.1
19	2.8	6.1	12.4	na	9.5	6.6	6.3	4.4	4.5	1.8	1.4	1.6
20	3.3	5.8	10.8	na	9.3	6.7	6.2	4.3	4.4	1.8	1.6	1.5
21	2.9	16.3	12.9	na	9.3	6.8	5.8	3.9	3.9	2.0	1.6	1.8
22	5.0	7.8	26.5	na	9.1	6.5	5.4	4.5	3.1	1.8	2.0	4.2
23	4.7	5.9	138.5	na	9.1	6.1	5.0	4.8	2.7	1.9	2.2	2.2
24	4.2	5.2	73.5	na	8.8	5.9	5.1	5.2	3.6	1.8	1.9	1.4
25	4.3	5.0	50.4	na	8.7	5.8	5.2	5.2	4.9	1.9	1.8	1.2
26	3.9	4.6	54.9	na	8.6	5.7	5.4	5.4	5.4	1.9	2.2	1.3
27	3.5	4.7	43.0	na	8.2	5.9	5.4	5.3	4.8	1.7	2.3	1.6
28	3.5	7.4	33.9	na	8.2	6.8	5.4	5.6	3.3	1.6	2.1	1.5
29	3.6	7.0	35.8	na	-	6.4	5.2	5.8	2.5	1.8	2.5	1.4
30	3.6	61.7	29.4	na	-	6.4	5.0	5.9	2.1	1.9	2.5	1.5
31	3.9	43.3	26.1	na	-	8.0	-	5.6	-	1.8	2.0	-
MEAN	#N/A	#N/A	#N/A		#N/A	#N/A	#N/A	#N/A	4.15	2.08	1.97	1.74
MAX. DAY	#N/A	#N/A	#N/A		#N/A	#N/A	#N/A	#N/A	5.40	2.69	2.46	4.18
MIN. DAY	#N/A	#N/A	#N/A		#N/A	#N/A	#N/A	#N/A	2.12	1.58	1.39	1.09
cfs days	#N/A	#N/A	#N/A		#N/A	#N/A	#N/A	#N/A	124.63	64.37	61.22	50.50
ac-ft	#N/A	#N/A	#N/A		#N/A	#N/A	#N/A	#N/A	247.20	127.68	121.42	100.16

Monitor's Comments

1. Daily values with more than 2 to 3 significant figures result from electronic calculations. No additional precision is implied.
2. Mean daily values are based on 15-minute measurements of stage; several stage shifts have been applied to account for changes in bed conditions over the course of the monitoring program.
3. Data are subject to revision, should additional measurement or observer account warrant adjustment of the rating curve
4. Equipment malfunction from January 8, 2013 to February 15, 2013 and March 11-15, 2013

Water Year 2013 Totals:		
Mean flow	-	(cfs)
Max. daily flow	**139**	(cfs)
Min. daily flow	**1.09**	(cfs)
Total	**#N/A**	(cfs-days)
Total Volume	**#N/A**	(ac-ft)

made once monthly and during select winter storms (Table 2-1). Manual measurements of alkalinity and total suspended solids were also made a few times during the course of the monitoring (Table 2-1). Station details and the annual record including basic statistics are provided in Table 2-2.

Creating a Record of Streamflow

Manual observations of stage and streamflow were used to develop a gage-specific stage-to-discharge relationship ("stage-discharge rating curve"). The stage-discharge rating curve coupled with datalogger records of water depth, converted to a record of stage using the manual observations as calibration points, permits the development of a record of streamflow. Corresponding records of stage and streamflow detail conditions at 15-minute intervals throughout WY13. A period of data loss for the stage data occurred from January 9–11, January 14–February 12, and March 11–15 due to equipment malfunction. When field conditions permitted safe entry to the channel, standard streamflow equipment appropriate for the conditions encountered in the field were used and included hand-held, low-flow (Price Pygmy) and high-flow (Price Type-AA, or "Standard") bucket-wheel current meters (c.f., Rantz, 1982). When hydrologic conditions were unsafe to permit entry to the stream, stream velocity-float measurements were conducted and a subsequent channel survey performed to measure the cross-sectional area of flow conditions at the time of the float measurement. Given that conditions at the temporary gage were generally unsafe during peak flows, bedload samples were not collected, as originally envisioned. Nonetheless two suspended sediment samples were collected using a DH-48, dipped into the water column from the streambank (Table 2-1).

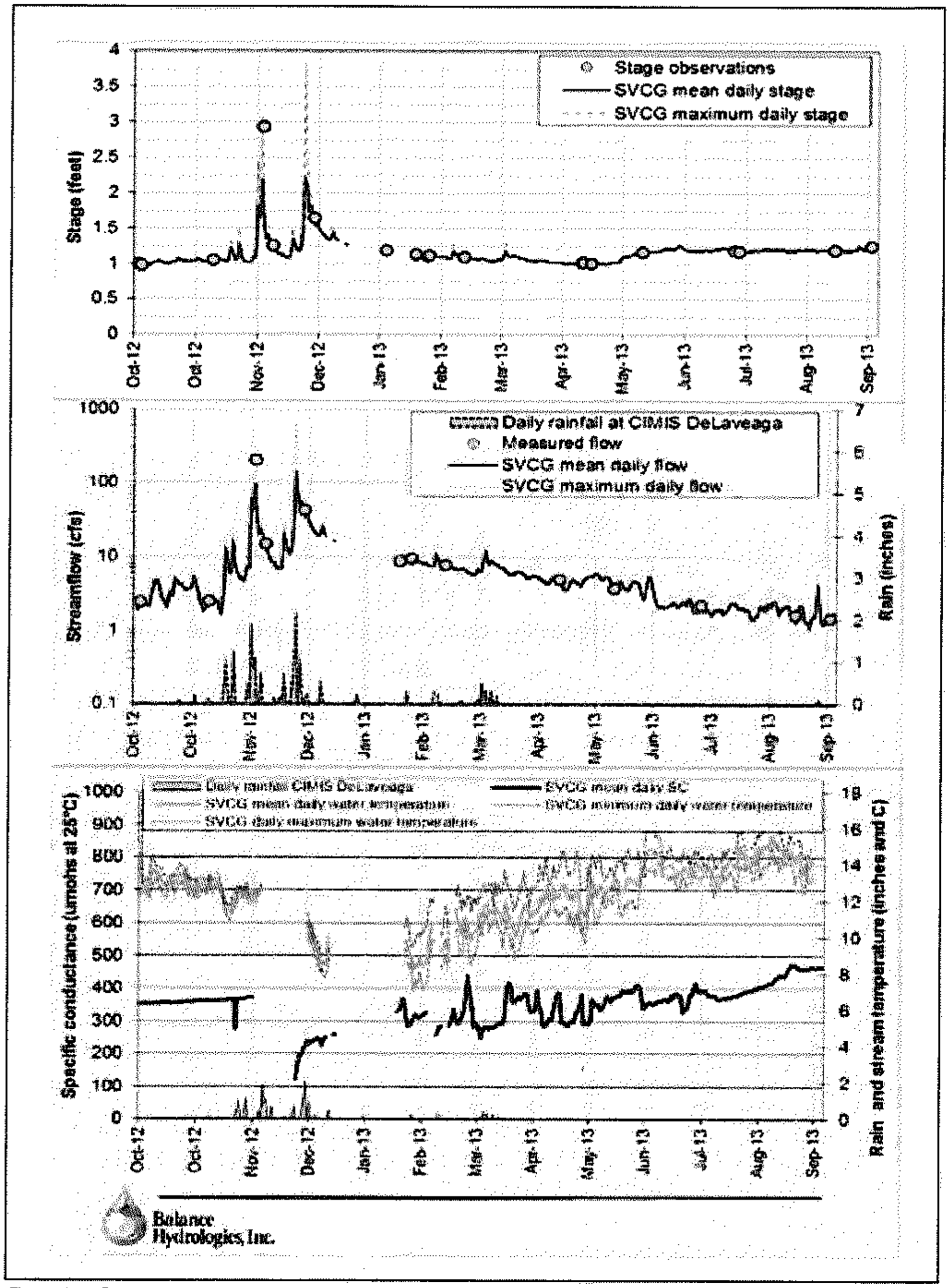
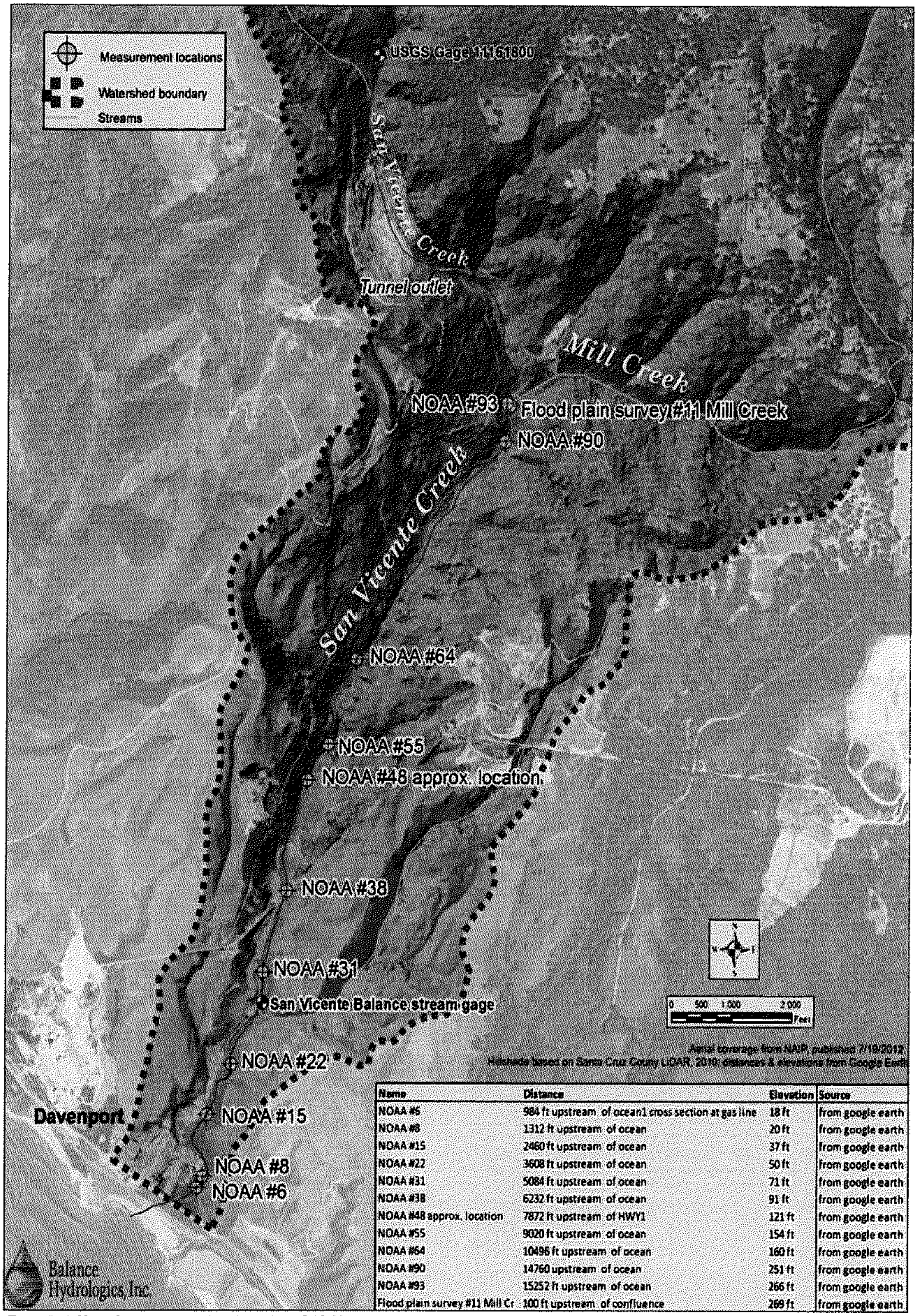


Figure 2-5. Record of mean daily stage (top), mean daily streamflow and local daily precipitation (middle) and water temperature and specific electrical conductance (bottom) for SVCG.

Findings and Results

Figure 2-5 illustrates the WY2013 record of stage, streamflow and water temperature and specific electrical conductance for SVCG. Also provided in Figure 2-5 are manual measurements of the relevant parameters made during the monitoring period, and corresponding precipitation data for the CIMIS DeLaveaga station (same station used in Figure 2-4 in order to remain consistent) along with the streamflow record.

Mean daily baseflows at the beginning of the water year ranged from 1.5 to 6 cfs, largely consistent with baseflows recorded toward the end of the water year (Figure 2-5). Given the very low rainfall totals recorded after the New Year, these results generally reflect what the historic USGS data suggest, namely that San Vicente Creek appears to be hydrologically resilient during dry spells that last one year or less. This seems to be a reliable finding for planning purposes given that similar



Name	Distance	Elevation	Source
NOAA #6	984 ft upstream of ocean1 cross section at gas line	18 ft	from google earth
NOAA #8	1312 ft upstream of ocean	20 ft	from google earth
NOAA #15	2460 ft upstream of ocean	37 ft	from google earth
NOAA #22	3608 ft upstream of ocean	50 ft	from google earth
NOAA #31	5084 ft upstream of ocean	71 ft	from google earth
NOAA #38	6232 ft upstream of ocean	91 ft	from google earth
NOAA #48 approx. location	7872 ft upstream of HWY1	121 ft	from google earth
NOAA #55	9020 ft upstream of ocean	154 ft	from google earth
NOAA #64	10496 ft upstream of ocean	160 ft	from google earth
NOAA #90	14760 upstream of ocean	251 ft	from google earth
NOAA #93	15252 ft upstream of ocean	266 ft	from google earth
Flood plain survey #11 Mill Cr	100 ft upstream of confluence	269 ft	from google earth

Figure 2-6. Map of measurement locations along SVC. Measurements locations were co-located with NOAA monitoring sites when possible. Synoptic measurements were not taken at all NOAA sites.

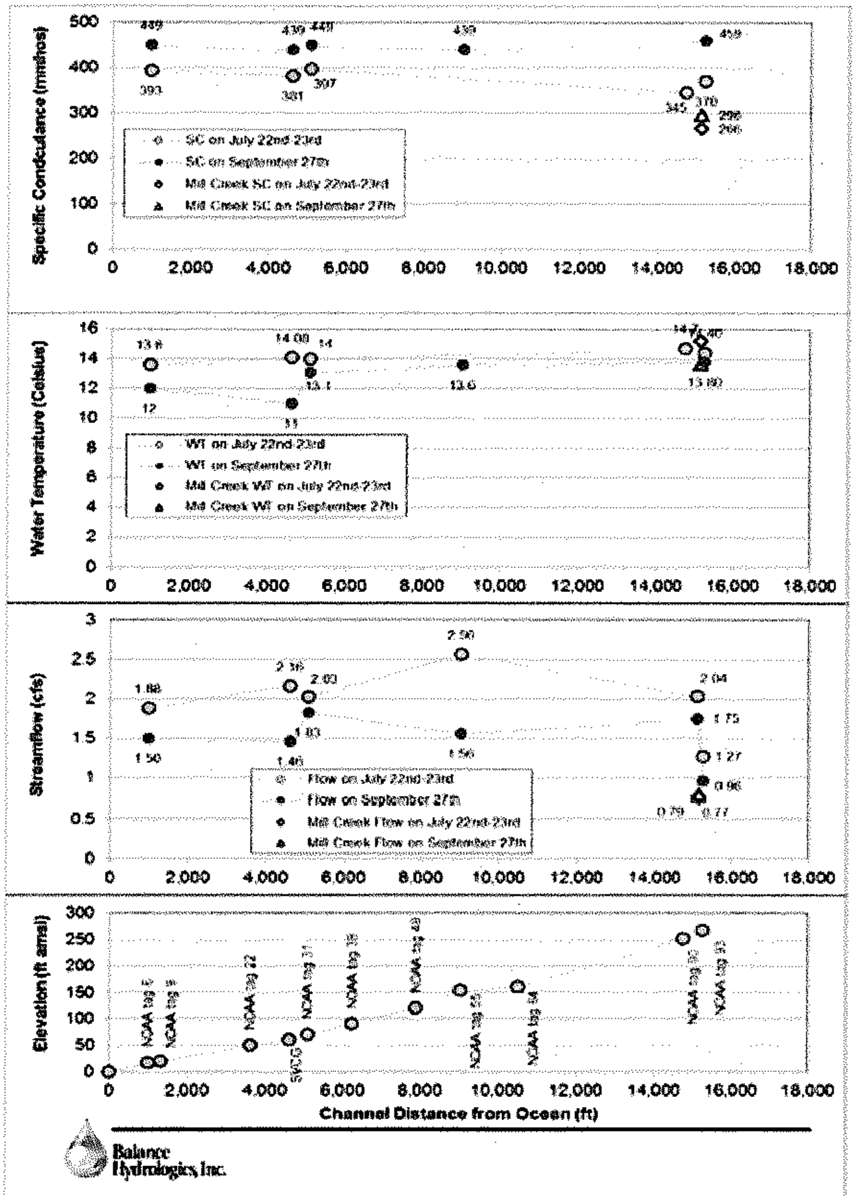


Figure 2-7. Plots of synoptic specific electrical conductance (top), water temperature (middle top), streamflow (middle bottom), and longitudinal stream station (bottom) for San Vicente Creek.

Over the monitoring period, mean daily specific conductivity varied from just over 100 to more than 450 µmohs, normalized to 25 degrees Celsius. Because data was lost during the two December storm events it is possible that SC dipped below 100 µmohs during the actual storm events, as is commonly observed by Balance staff throughout the Santa Cruz north coast. The transition into the dry season brought a general rising trend in SC from July to September, from roughly 350 to 470 µmohs. As shown in the synoptic measurements discussed in the next Section, the trend of higher SC into the summer months is consistent with the geochemical signature of flows contributed by the karst influenced mainstem of San Vicente Creek. This observation is interesting because Mill Creek was measured to provide upwards of 45% of the surface flow component in September (see next Section), and with a lower SC signature (296 µmohs). This suggests that during the summer months, surface flows downstream of the Mill Creek confluence acquired additional salts along the 2+ mile trip to the SVCG gaging station, and attained SC levels pretty consistent with those measured upstream of Mill Creek. The values of SC observed at SVCG are consistent with those measured in the adjacent East Brach Liddell Creek immediately downstream of the discharge point of Liddell Spring, a regional karst drainage feature. From Mill Creek to SVCG however, it is more likely that the Santa Cruz Mudstone (Figure 2-2) provided the salts which elevated the mainstem SC to the measured values. Mean daily water temperature was measured to fluctuate between 8 to 13 degrees Celsius. As with SC, the lower temperatures were measured around the December storm events, whereas the higher temperatures define the beginning and ending conditions to the water year. During late summer and fall 2013 daily maximum water temperatures rose to as high as about 16.5 degrees Celsius. The envelope of daily minimum to maximum water temperatures ranged from less than 0.5 to 3 degrees Celsius. All in all the SC and water temperature conditions measured at SVCG are consistent with the ranges of conditions observed regionally, and are within acceptable ranges for both coho and steelhead.

hydrologic trends emerge for data collected at two different locations in the watershed, separated in time by some 37 years. Two clear peak events were recorded during WY2013, the first on December 2 and the second on December 23 (Figure 2-5). The estimated instantaneous peak flow for December 2 was 251 cfs, or 23.9 cfs per sq. mile and the estimate peak for December 23 was 657 cfs, or about 62 cfs per sq. mile. Following the New Year a few smaller precipitation events occurred, but the water year ended relatively dry. Despite the distance down the coast to the CIMIS DeLaveaga precipitation station, it is instructive to note that the annual rainfall totals for WY2013 at DeLaveaga registered about 66% of the long-term average (19.2 inches vs. 28.9 inches) (Figure 2-4), supporting the conclusion that regionally WY2013 was a dry year.

Synoptic Low-Flow Measurements

Assessment and Methods

Balance conducted two rounds of synoptic low-flow streamflow measurements extending from the Highway 1 tunnel to a point on the mainstem approximately 3 miles upstream, and just upstream of the Mill Creek confluence (Figure 2-6). One set of measurements was conducted on July 22 and 23, and the second set was completed on September 27. Measurements were taken roughly every 1500 feet for a total of 6 measurements, noting that we sited one measurement location just downstream and upstream of Mill Creek in order to assess low-flow contributions from the tributary. At each measurement location we measured streamflow, water temperature, specific conductance, and dissolved oxygen, and photographs were taken.

Findings and Results

Figure 2-7 provides results from synoptic measurements of specific electrical conductance, water temperature and streamflow completed on June 22 and 23 and September 27. Note that all of the measurements on San Vicente Creek were taken downstream of the active diversion managed by the County Sanitation Department for the town of Davenport. In addition, the streamflow measurement data points of 2.04 and 1.75 cfs at station 15,100 feet (mainstem San Vicente just downstream of Mill Creek) represent the sum of flows measured at NOAA tag 93[8] and that measured in Mill Creek just upstream of the confluence. Specifically, these data points were manually added to the plot for illustrative purposes and discussion sake and do not represent actual flow measurements at station 15,100 feet.

Results from the measurements suggest several important attributes to San Vicente low-flow hydrology:

» The two sets of low-flow measurements clearly highlight the significant contribution of flow from Mill Creek during summer months. On September 27 the Mill Creek contribution approached that provided by the much larger mainstem San Vicente Creek watershed. This indicates that recharge zones in Mill Creek should be protected in order to safeguard mainstem San Vicente hydrology, and that Mill Creek is comparably as important as the upper mainstem of San Vicente in providing summertime flows for salmonids;

» The Santa Margarita sandstone, which caps the ridges in the Mill Creek watershed, is an excellent water storage and production formation (as is known to hydrogeologists) and comparable to the karst and granitics within the San Vicente proper watershed;

» By regional standards and in general, streamflows along the mainstem of San Vicente from the Mill Creek confluence downstream to the coast are reasonably consistent, providing a significant benefit for habitat conditions and salmonids. In detail however, fluctuations are evident in our measurements from station to station, and overall we measured a net streamflow loss trend from Mill Creek to the coast. The net loss is relatively minor, from 8 to 14 percent of the streamflows measured just downstream of Mill Creek. For planning purposes it is prudent to acknowledge the loss tendency, albeit a minor one;

» Water temperature is relatively consistent from the Mill Creek confluence downstream to the coast, but with a decreasing trend over that distance, and despite an associated minor streamflow loss tendency. The decreasing trend suggests exchange of surface flows with cooler, shallow sources toward the coast, that are of similar salinities to the upper watershed source waters. A review of the closest climate station on the coast (La Honda, CDEC) with an air temperature record for the summer months indicates a reasonably cool few nights on September 24–26 which could also account for the strong water temperature cooling at the coast on September 27. Regardless, the results suggests that protection of the alluvial aquifers along the mainstem downstream to the coast is warranted from a water temperature regulating perspective;

» Specific electrical conductance is also relatively consistent from the Mill Creek confluence downstream to the coast, and generally comparable with source waters from the upper mainstem. Relatively fresher, or less saline flows from Mill Creek are apparently important nonetheless to achieving the downstream SC consistency. Highlighting yet again the importance of surface flow contributions from Mill Creek.

Peak Discharge and Channel Forming Flow Analysis

Assessment and Methods

Building off of our stream gaging measurements, and analysis completed as part of the 2007 planning component to the lower San Vicente off-channel pond enhancement project (Stamm et.al., 2006), a flood peak analysis was completed. The analysis was completed according to Bulletin 17B of the USGS (United States Geological Survey, 1982) with historic instantaneous peak flow data for the former USGS gage on San Vicente Creek (WY1970-85). The type of analysis completed was a Log-Pearson Type III, and calculations were performed using the NRCS NEH spreadsheet with a local skew of -0.49, and a general skew of 0.302. Using a simple drainage are scaling, results from the USGS data were applied to the SVCG gage site for illustrative purposes. The calculations provide a comprehensive list of potential flood magnitudes of varying return period, and represent general estimates of specified return period flood magnitude, noting that only 15 years of data are available for analysis use.

Findings and Results

Flood frequency analysis results are provided in Table 2-3. Without measurements of bedload it is difficult to estimate a channel-forming flow, but typical assumptions related to the 1.5-2.4-year+ recurrence interval event place channel forming flows on the lower mainstem in the range of 150-500 cfs.

8 NOAA tag 93 is located on mainstem San Vicente Creek just upstream of the Mill Creek confluence.

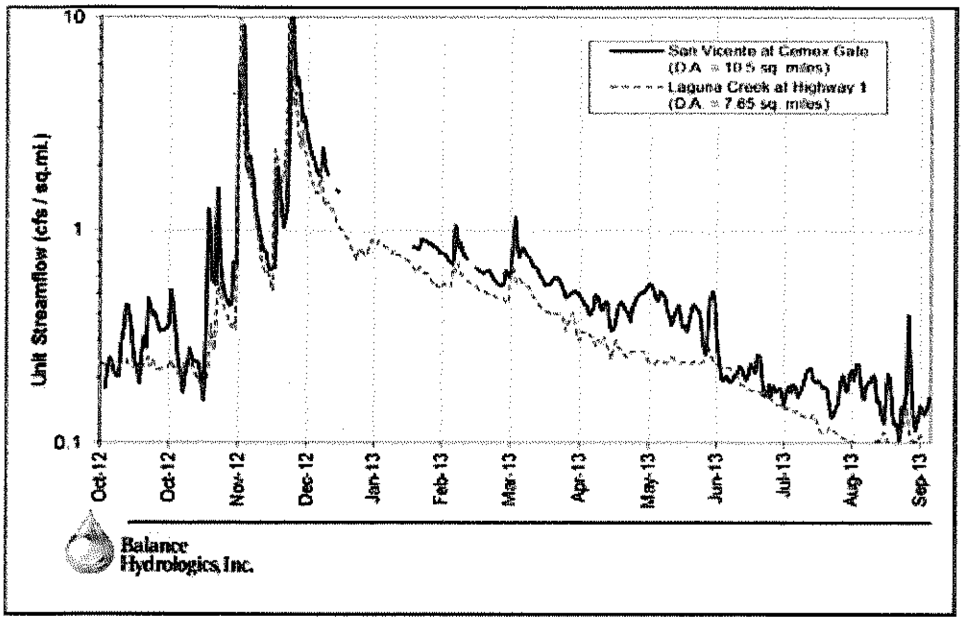


Figure 2-8. Unit streamflow for San Vicente at CEMEX Gate and Laguna Creek at Highway 1, WY2013. The flow record for Laguna Creek has been corrected for City of Santa Cruz water supply diversion. The San Vicente record however has not been corrected for upstream diversions, therefore in WY2013 San Vicente produced even more runoff per unit drainage area as measured at SVCG than what is depicted in Figure 2-8.

Observations made by Balance staff in association with the lower and upper San Vicente off-channel ponds projects suggests that the value is likely closer to 300 cfs+, as large rates of bedload movement were inferred from floods in this general range, and floodplain activation was also observed at the pond locations. This point will be revisited within the geomorphic assessment. The peak flow at SVCG during WY2013 was estimated at 657 cfs. Results provided in Table 2-3 suggest this flow rate is roughly equivalent to a bit more than a 3-year flood. This finding takes on more relevance within the floodplain connectivity discussion of the Geomorphic Assessment.

Table 2-3: Estimated flood frequency statistics for San Vicente Creek.

Return Period (years)	USGS gage (cfs)	SVCG (cfs)
50	2787	4821
20	1681	2909
10	1054	1823
5	584	1011
3	329	569
2	175	304
1.5	91	159

Region-wide Hydrologic and Basic Water Quality

Assessment and Methods

A regional comparison of hydrology and basic water quality between San Vicente several different nearby streams was completed with use of available records, data and reports available to Balance. Comparison of rates of streamflow was made with Laguna Creek because Laguna also shares significant influence from karst within its upper watershed. Basic water or geochemistry comparisons were made with several additional karst water bodies including the adjacent Liddell Spring, as well as Neary Lagoon within the City of Santa Cruz, which drains portions of the UCSC campus. Finally, peak flow comparisons were made with Pilarcitos, Pescadero, and Soquel Creeks, and the San Lorenzo River.

Streamflow comparison with Laguna Creek was accomplished by computing records of mean daily unit streamflow for the SVCG and the Laguna Creek at Highway 1 (Parke and others, 2013) stream gages. The Laguna Creek gage is operated by Balance Hydrologics for the City of Santa Cruz Water Department. The City provided access to the data for this report. Mean daily unit streamflow is computed as the quotient of mean daily flow and drainage area at each gage location. Scaling by drainage area is useful because it makes hydrologic comparisons between differing watersheds, or watershed locations straightforward and possible. The mean daily record of streamflow for Laguna Creek represents the estimated unimpaired flow for that system.

Findings and Results

Figure 2-8 presents WY2013 records of unit streamflow for SVCG and Laguna Creek at Highway 1. A semi-log scale is used to accentuate differences between the two gage locations at lower streamflows. The results indicate pretty definitively that during WY2013, the San Vicente Creek watershed produced more water per unit area than Laguna. These differences are generally more pronounced at lower rates of streamflow, than at higher ones where unit area flow production tends to converge, or swap with Laguna producing higher unit flows. The data also show that flows in San Vicente appear more dynamic than those in Laguna Creek, with reasonably large daily fluctuations evident into the dry season (on both sides of the winter months). Locally, Laguna Creek is known as a stream with a reasonably strong baseflow hydrology. The consistently larger unit baseflow values for San Vicente mainstem vs. Laguna Creek reinforces something that has been acknowledged for a while, but perhaps not quantified, that San Vicente is a prized local stream in terms of baseflow hydrology.

Figure 2-9 illustrates the WY2013 record of 15-minute mean, maximum and minimum water temperature for SVCG along with spot measurements of water temperature on Laguna Creek at Highway 1. Three of the four spot measurements made from

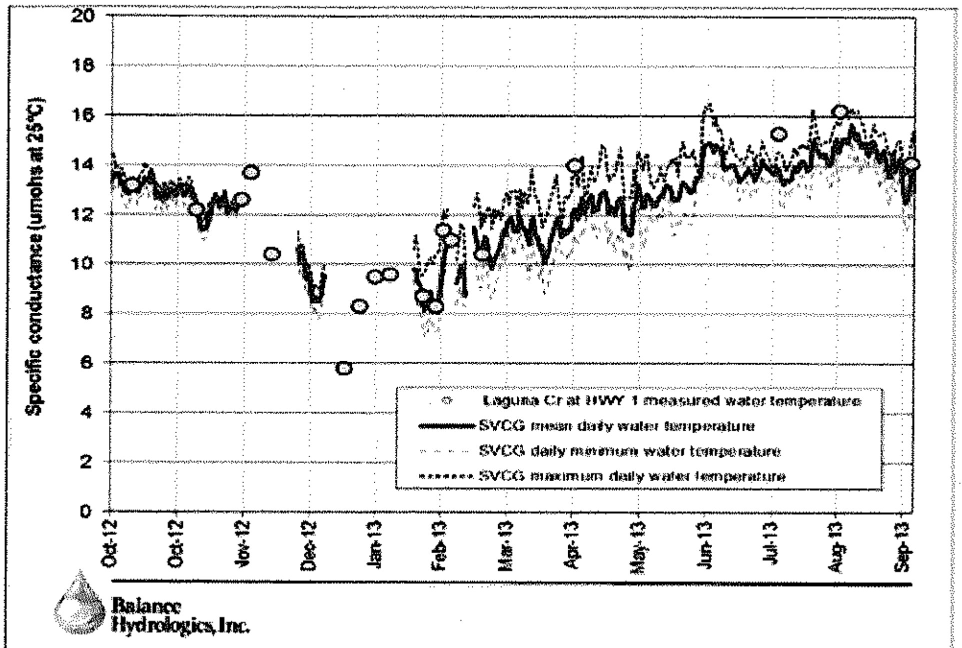


Figure 2-9 Record of 15-minute mean, maximum and minimum water temperature at SVCG along with spot measurements made on Laguna Creek at Highway 1, WY2013.

City of Santa Cruz Water Department (Hastings and Owens, 2012). Results in Figure 2-10 demonstrate that for similar ranges of flow, San Vicente Creek mainstem appears to transport volumes of fine sediment that are similar to those measured on Laguna Creek upstream of the City's diversion (recall within the karst influenced portion of the watershed). On the other hand, both systems transport less fine sediment than Majors Creek, a system known regionally to transport relatively large volumes of suspended sediment. These data further support the notion that locally San Vicente exhibits physical attributes that are conducive or consistent with those required by anadromous fish. This topic is explored in more detail within the Fishery and Geomorphic Assessment Chapters.

April to September on Laguna Creek suggest that San Vicente Creek is on average cooler, despite the similar geologies and coastal climate. Hydrologic data collected for nearby Liddell Spring indicates that baseflows discharged there are generally warmer than those measured at SVCG by a few degrees Celsius. Collectively the data point to the fact that San Vicente supports cool summertime baseflows, a critical condition for support of coho.

On October 9, three water samples were collected for analysis of alkalinity (Appendix B). One sample was collected at the SVCG gage, one sample from Mill Creek just upstream of the confluence and one was collected from San Vicente Creek just upstream of the Mill Creek confluence. The two San Vicente Creek samples had Total Alkalinity as $CaCO_3$ of roughly 150 mg/l, whereas the Mill Creek sample registered about 97 mg/l. Alkalinity for all three samples was attributable to Bicarbonate (HCO_3), as opposed to Carbonate (CO_3). Results for the San Vicente samples are consistent with one measurement made at Neary Lagoon in 2005, an open water body feature within the City of Santa Cruz which drains portions of the karst at UCSC campus (Chartrand and others, 2006). In general the results suggest that San Vicente waters are mildly buffering, and influenced geochemically by the karst, an observation suggested in the discussion of synoptic measurements of SC.

Due to difficulties in safely entering San Vicente at flood flow and at the SVCG gage, we were successful in only obtaining two suspended sediment samples from the right bank of the stream on December 2, 2012. These two samples are plotted in Figure 2-11 along with suspended sediment data for Laguna Creek, and a suspended sediment rating curve for Majors Creek near the City diversion, developed by Balance staff for the

Figure 2-11 presents a comparison of estimated unit flood magnitudes for a range of recurrence intervals for San Vicente, Soquel, Pilarcitos and Pescadero Creeks, as well as the San Lorenzo River. Somewhat surprisingly, the estimated flood magnitudes for San Vicente and the San Lorenzo are pretty similar up to the 10-year recurrence interval flood, above which San Vicente is estimated to far outpace the San Lorenzo on a unit drainage area basis. On the other hand Pilarcitos Creek is shown to far under pace unit flow generation as compared to San Vicente (across the range of recurrence intervals) whereas Soquel and Pescadero outpace San Vicente up to about the 45-year event. Without focusing too much on the estimated magnitudes between streams, the results are difficult to explain, as the geologic evidence suggests that San Vicente Creek should produce disproportionately smaller peaks than other regional systems of similar drainage area. Soils within the upper watershed of San Vicente and, in particular Mill Creek are dominated by sands derived from granitics (San Vicente) and the Santa Margarita Sandstone (Mill Creek). The sandy soils of Mill Creek are classified as very permeable HydroGroup A soils (see County of Santa Cruz GIS online tool) and therefore have a large soil moisture storage capacity. The entirety of the upper San Vicente watershed is mapped as permeable HydroGroup B soils, with a small sliver of HydroGroup A soils, so the Upper San Vicente watershed proper is also characterized by relatively high soil moisture storage capacities. In effect then the upper San Vicente basin including Mill Creek should have a high capacity to deal with large storms because of the occurrence of sandy soils. But the results of Figure 2-11 do not necessarily support this thinking. Furthermore, with the occurrence of karst in the watershed one would suspect there should be an additional damping effect to the magnitude of storm peaks. We are left to suggest that the orographic effect driven by Ben Lomond Mountain for storms approaching from the southwest, west, and slightly north-

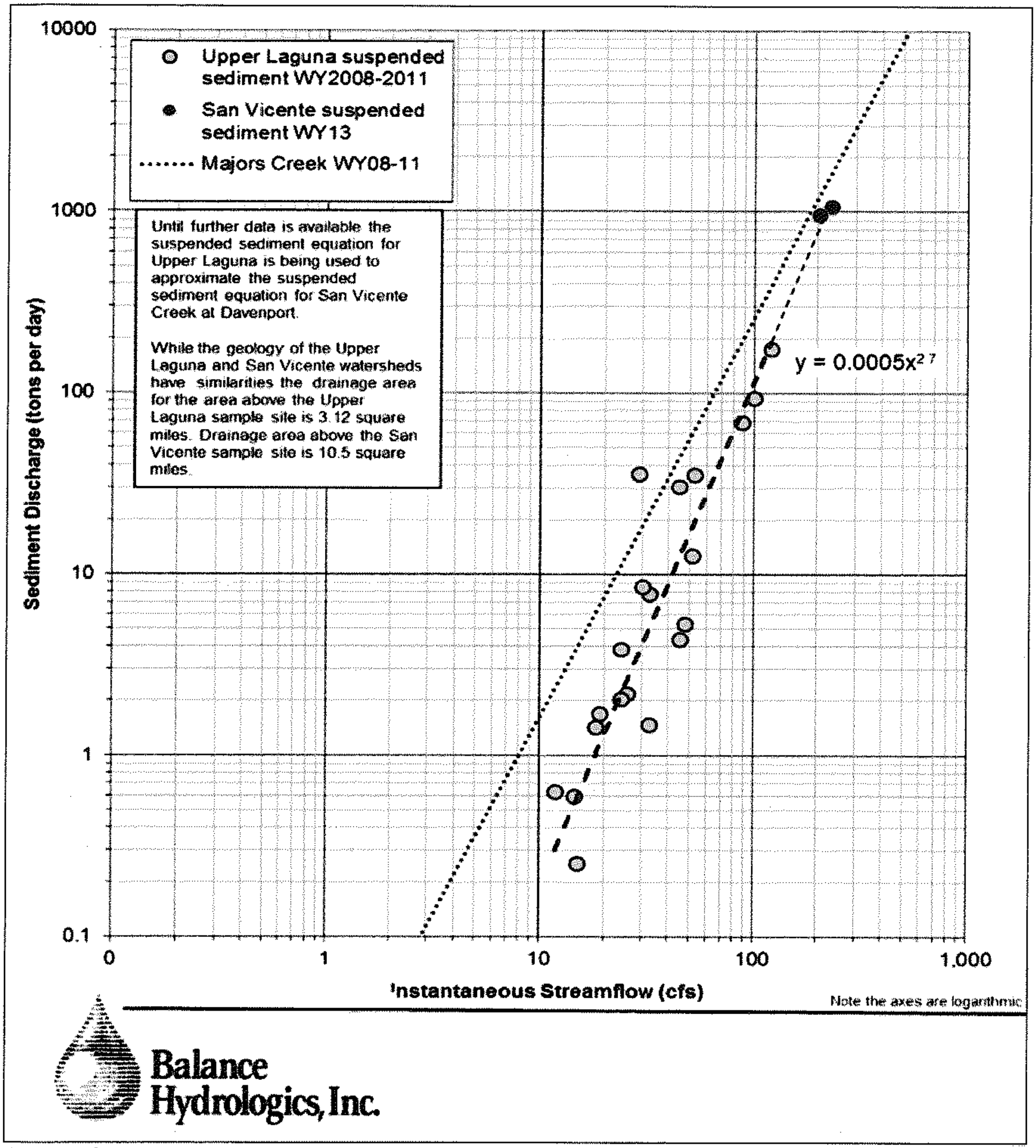


Figure 2-10. Suspended sediment data and rating curves for Santa Cruz County northcoast streams.

west lead to rainfall intensities and total depths which factor more significantly than the sandy soils, and as a result San Vicente produces relatively large peak flows. Practically speaking this raises the probability that the mainstem riparian corridor could experience severe mortality and a general 're-setting' of channel geometries during large magnitude floods. The likelihood of this scenario playing out is accentuated by the confined nature of the lower mainstem, as well as the hydraulic bottleneck effect created by the Highway 1 tunnel. As a result substantial channel shifting and general change should be anticipated within the lower reach, within several thousand feet or so of the Highway 1 tunnel (see Stamm and others, 2008, for further discussion).

Climate Change Hydrologic Analysis

Assessment and Methods

An analysis of potential impacts to streamflow using six different climate change projections, from three different Global Climate Models (GCMs) has been completed. This work is intended to help inform decisions regarding future restoration actions, notably if GCMs predict a significant change in

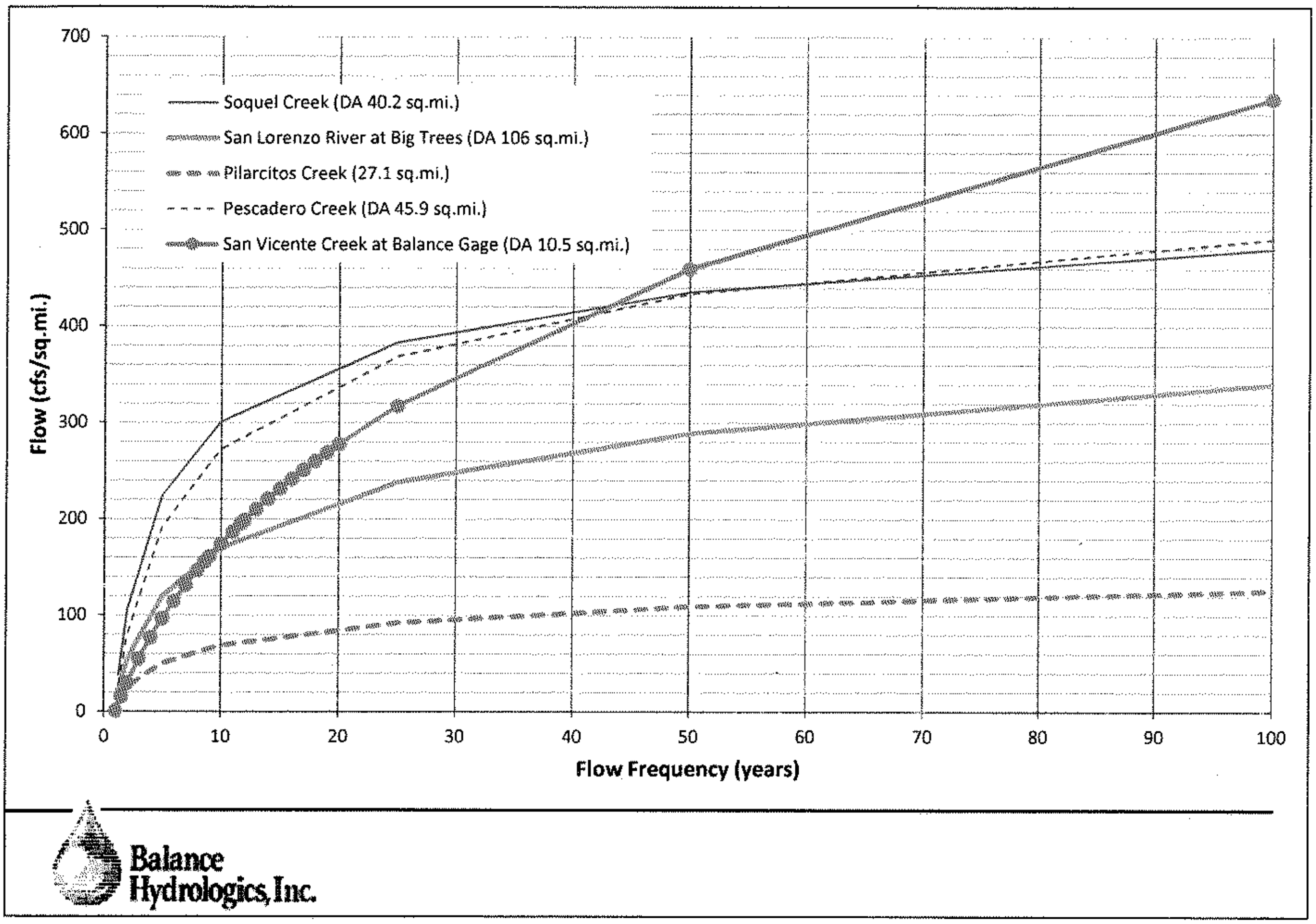


Figure 2-11. Comparative unit flood magnitudes for San Vicente, Soquel, Pilarcitos and Pescadero Creeks and the San Lorenzo River for a range of recurrence intervals.

streamflow character along San Vicente it may be advisable to develop a long-term plan to safeguard water resources in the basin for Instream purposes. Due to uncertainty related to use of downscaled global climate model data for purposes of exploring plausible future what if scenarios at the scale of small basins, a simple statistical model was developed relating global climate model data of precipitation and air temperature to streamflow. A literature review was performed to gain an understanding of what the present state of the science was for climate change in California. This review informed the decision of which climate change projection data to use to drive our statistical model of streamflow.

Global climate models do not provide estimates of streamflow. The grid size used in the global models is not appropriate to drive small watershed sized streamflow models. Most streamflow models require a large investment of time and resources to configure them for a particular watershed and additional time to calibrate them with available data. We used data from three different GCMs, downscaled to 1/8 degree (about 12 km on a side) grid size to drive an in-house created statistical water balance model of streamflow for and extended and correlated record of streamflow at the former USGS San Vicente Creek streamflow gage (USGS 11161800: San Vicente Creek near Davenport). The three GCMs used were:

1. CCSM3: Community Climate System Model Version 3 from UCAR (University Corporation for Atmospheric Research) and NCAR (National Center for Atmospheric Research);
2. GFDL2.1: Geophysical Fluid Dynamics Lab CM2.1 Model from NOAA (National Oceanic and Atmospheric Administration); and
3. PCM1: Parallel Climate Model from NCAR and DOE (Department of Energy).

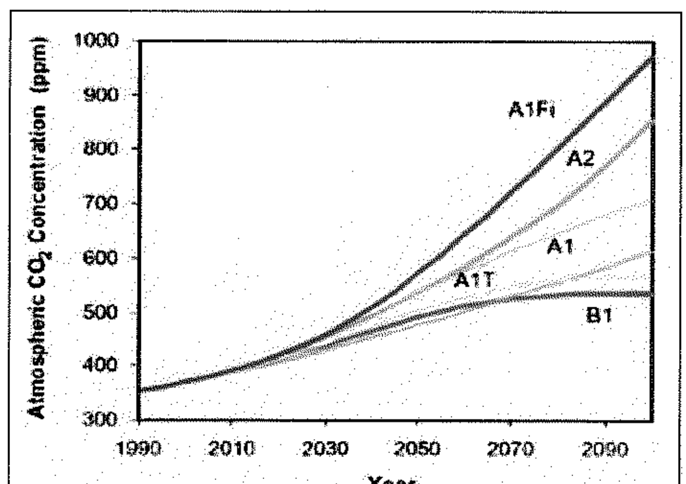


Figure 2-12. IPCC emissions scenarios. Figure from Cayan and others, 2008.

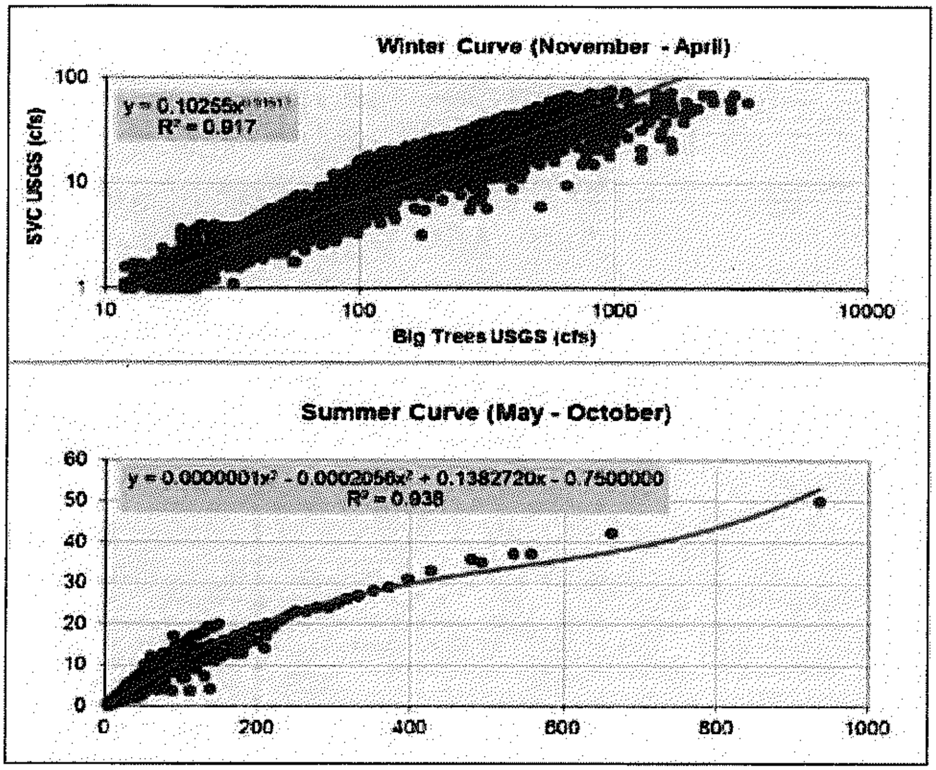


Figure 2-13. Regression models used to extend the USGS San Vicente record of streamflow using the USGS Big Trees gage on the San Lorenzo River.

For each of the three GCMs, monthly mean precipitation (mm) and air temperature (degrees Celsius) computed from the A2 (medium-high) and B1 (low) emission scenarios was used (Figure 2-12). These two emissions scenarios provide all the output desired for the analysis. Specifically, the A2 scenario provides that global (including California) CO_2 emissions exhibit a continual rise throughout the 21st century and by century's end achieve CO_2 concentrations that will be more than triple their pre-industrial levels (Cayan and others, 2008). The B1 scenario on the other hand assumes that global CO2 emissions peak by mid-century at concentrations which are roughly double the pre-industrial level, before dropping below current levels by 2100 (Cayan and others., 2008).

The climate projection data was downloaded from cal-adpat (www.cal-adapt.org) using their tabular downloads option. Data was specified for a 1/8 by 1/8 degree grid (~140 km2) centered just east of Davenport. Cal-adapt is an organization whose aim is to provide access to the vast information and data sources regarding climate change produced by California scientists and researchers. Specifically, the air temperature and precipitation data is sourced from *Scripps Institution of Oceanography: California Nevada Applications Program (CNAP).* The Cal-adapt organization is an outgrowth from a key recommendation of the 2009 California Climate Adaptation Strategy, and includes collaboration between UC Berkeley's Geospatial Innovation Facility (GIF) with funding and advisory oversight by the California Energy Commission's Public Interest Energy Research (PIER) Program, and advisory support from Google.org. The 1/8 degree air temperature and precipitation data are bias corrected using a gridded observed data set (NRA2) with the same grid that is used for the downscaled GCMs.

The gridded observation data set (NRA2) was used to develop the water balance model. The NRA2 data set includes monthly precipitation and surface air temperature observations converted from point measurements (stations) to average values for grid spaces, for the time period 1950-1999. The NRA2 grid is the same as the grid used to downscale the GCM model output and allows the statistical model developed with the historic data to be driven with the downscaled GCM data. The water balance model is stated as:

$$P = ET + Q + R \quad (1)$$

The term P is precipitation (m/day), ET is the evapotranspiration (m/day), Q is streamflow discharge (m^3/day) and R is groundwater recharge (m/day). The equation lacks a change in storage term (ΔS) because we have no idea how storage may change in the watershed over the time period of interest. We also do not have measurements of recharge, as a result the recharge term will be the knob we turn to optimize a fit between the NRA2 data set and our extended and correlated record of flow for San Vicente Creek. Precipitation is a measured or projected parameter, ET is measured and computed with projected average air temperature, and streamflow discharge is a computed parameter given values for the other three terms.

The USGS San Vicente record of streamflow (WY1970–WY1985) was extended based on development of two regression models with the overlapping record of flow for the USGS Big Trees streamflow gage (1160500) (Figure 2-13). Application of the regression models to the Big Trees record results in a record of streamflow for San Vicente Creek for the period WY1936–WY2000. Extension of the flow record to 2000 was done in order to be consistent with the NRA2 data. Despite the differences in geology, the predictive capabilities of the models are quite good (Figure 2-13), and certainly so for the present application. Based on comparison to the gaged record of flow for San Vicente Creek, the skill of the regression models is challenged by conditions of the lowest flows, when the models over predict flow. We note that the correlated record of streamflow for San Vicente Creek is not intended to be used as a model of expected streamflow, but rather to be used as a device for comparing historic conditions with projected conditions.

To supplement the hydrologic climate change analysis we also reviewed the National Academies report on projected sea level rise off the California, Oregon and Washington coasts (National Academies Press, 2012). The report specifically projects sea level rise along coastal California for 2030, 2050 and 2100. Our hydrologic analysis extends to 2050 so the National Academies report provides useful additional information pertinent to lower San Vicente Creek mainstem.

Table 2-4. Summary of water balance model estimates of future hydrologic conditions within San Vicente Creek through 2050.

Like	Percentile Flows	SVC	NRA2	CCSM3 A2		Forecasted Change
		1950-1999			2000-2050	
1977	0 - 20	11	7	8	17	++
2007	20 - 40	11	14	16	13	+
2001	40 - 60	8	11	19	15	++
2006	60 - 80	9	11	4	5	-
1998	80 - 100	11	7	3	1	--
	sums	50	50	50	51	
		SVC	**NRA2**	**CCSM3 b1**		
	Percentile Flows	1950-1999			2001-2050	
	0 - 20	11	7	8	16	++
	20 - 40	11	14	16	14	+
	40 - 60	8	11	19	13	+
	60 - 80	9	11	4	7	-
	80 - 100	11	7	3	1	--
	sums	50	50	50	51	
		SVC	**NRA2**	**GFDL2.1 A2**		
	Percentile Flows	1950-1999			2000-2050	
	0 - 20	11	7	11	18	++
	20 - 40	11	14	14	11	
	40 - 60	8	11	17	16	++
	60 - 80	9	11	5	6	-
	80 - 100	11	7	3	0	--
	sums	50	50	50	51	
		SVC	**NRA2**	**GFDL2.1 B1**		
	Percentile Flows	1950-1999			2000-2050	
	0 - 20	11	7	11	14	+
	20 - 40	11	14	13	11	
	40 - 60	8	11	18	17	++
	60 - 80	9	11	5	3	--
	80 - 100	11	7	3	6	--
	sums	50	50	50	51	
		SVC	**NRA2**	**PCM1 A2**		
	Percentile Flows	1950-1999			2000-2050	
	0 - 20	11	7	8	17	++
	20 - 40	11	14	17	4	--
	40 - 60	8	11	17	19	++
	60 - 80	9	11	4	6	-
	80 - 100	11	7	4	5	--
	sums	50	50	50	51	
		SVC	**NRA2**	**PCM1 B1**		
	Percentile Flows	1950-1999			2000-2050	
	0 - 20	11	7	8	9	-
	20 - 40	11	14	18	9	-
	40 - 60	8	11	16	15	++
	60 - 80	9	11	4	11	+
	80 - 100	11	7	4	7	-
	sums	50	50	50	51	
		SVC	**NRA2**	**AVERAGE**		
	Percentile Flows	1950-1999			2000-2050	
	0 - 20	11	7	9	15	
	20 - 40	11	14	16	10	
	40 - 60	8	11	18	16	
	60 - 80	9	11	4	6	
	80 - 100	11	7	3	3	
	sums	50	50	50	51	

Findings and Results

The full suite of summary data for application of the various GCMs and two emission scenarios to the water balance model is provide in Table 2-4 and Figure 2-14. Results are provided in percentile flow classes for annual flow statistics for the gaged period of record WY1970–WY11985. The utility of this period of record for statistical reasons is that it contains both very dry and very wet periods. Percentile classes of 0-20, 20-40, 40-60, 60-80 and 80-100 are used. The end members in the percentile range represent very dry and very wet conditions, respectively, defined by WY1976 and WY1977 for the very dry conditions and WY1982 for the very wet. Particular values of annual streamflow at these percentile class limits for the gaged period of record defines categorization of the historic (1950-1999) and projected (2000–2050) streamflow data.

The results (Table 2-4 and Figure 2-14) indicate in general that annual conditions *can be expected to become drier* over the projection period, as compared to the historic period. The variability about this projection is large between models, and in one case is projected to not change appreciably from the historic period (PSM1 B1). The ensemble average indicates a somewhat strong tendency toward drier conditions, with a marked decrease in wet and very conditions, and a distinct rise in very dry and average conditions. The results also indicate, importantly, that the quasi-calibrated historic period projections with the GCM data does not agree all that well with the measured or NRA2 gridded data for the same period. Qualitatively this suggests that the overall skill of the model is moderate at best. Therefore the results should be interpreted as possibilities along a trajectory with significant alternative outcomes. Nonetheless the tendency to project drier conditions warrants attention when developing restoration strategies for the foreseeable future and beyond.

The National Academies (National Academies, 2012; see Figure 5.9 therein) projects an estimated 1-foot sea level rise by 2050 within the vicinity of the Monterey Bay. A topographic survey completed in 2007 as a part of the lower off-channel pond design work indicates that the entrance to the Highway 1 tunnel has an invert elevation of approximately 7.0 feet above mean sea level (amsl). Stamm and others (2008) reported that the storm surge associated with the 1998 high flows achieved elevations of roughly 7 feet amsl. Therefore a one foot rise in sea level by 2050 coupled with storm related surges equaling or exceeding 7 feet amsl means that the lowermost mainstem of San Vicente Creek will experience more frequent incidence of sea water, or brackish water intrusion. Interestingly, working off of others modeling efforts, the National Academies (2012) estimates that by 2050 the coast of California could experience a net increase of 250 hours per decade of extreme high coastal waters (defined as higher than the 99.99th percentile water levels, or 4.6 feet above the historical mean sea level). Despite the fact that we do not know what more frequent sea water intrusions to the lowermost San Vicente could means specifically for the general objectives of the present planning effort, it is

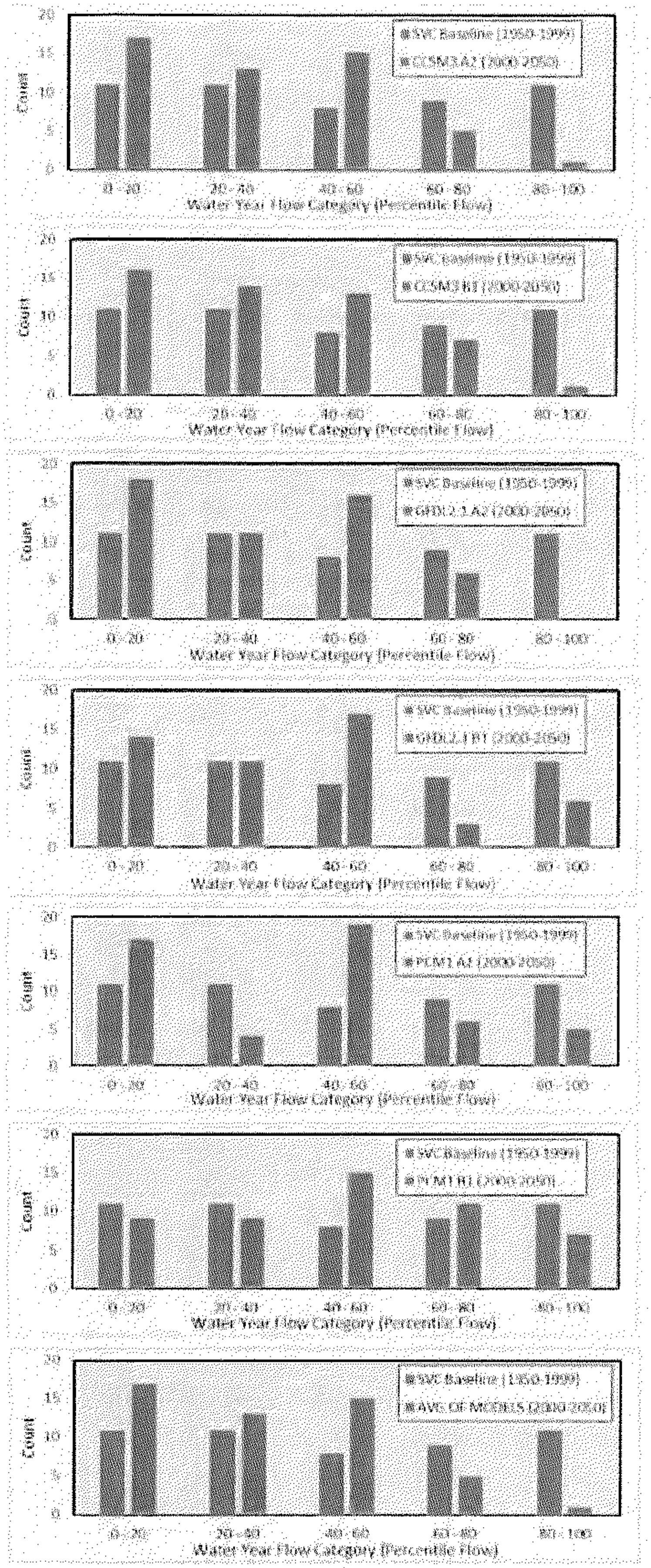


Figure 2-14. Summary of water balance model estimates of future hydrologic conditions within San Vicente Creek through 2050.

justified to anticipate such outcomes, and to provide flexibility within pertinent recommendations to facilitate adaptation to such conditions.

Potential Impacts of Low-Flow Surface Diversions to Salmonids

National Oceanic and Atmospheric Administration (2012) has indicated that surface water diversions are a limiting factor to coho during the summer months within the Santa Cruz County Diversity Stratum. The USGS records for the former SVC gage indicate that flow conditions during the 1976-77 drought were very poor during the late summer months, with 10 days of zero cfs recorded from September 9–18, 1977 (Figure 2-15). The USGS records further indicate that the second year of a 2-year drought (the most severe recorded by the USGS at the SVC gage) was a particularly vulnerable period for salmonids. During consecutive drought years, any impairment to natural surface flows will be more pronounced due to reduced groundwater contributions and overall reduced baseflows. As such, while SCV generally maintains high leves of surface flow due to natural processes and limited divesion, during consecutive drought years, impacts to surface flows via diversion (legal or otherwise) could have a critical impact on salmonids. Furthermore, any additional flows that can be introduced to the system could mean the difference between saving or losing a coho year class during drought.

Synoptic measurements made as a part of this study suggest that during the summer months, Upper San Vicente Creek and Mill Creek contribute most if not all surface flows to the mainstem San Vicente Creek (see Figure 2.7). If Upper San Vicente went dry in September 1977, it is likely that Mill Creek did as well. Under such conditions the mainstem likely had intermittent surface flows, with isolated pools, or perhaps longer stretches of zero surface flow. Climate conditions during WY2014 are setting records across the State of California for low rainfall totals. Given that WY2013 was dry, the WY2013-14 period is shaping up to as dry if not drier than WY1976-77. As such we can anticipate that surface flows in San Vicente Creek could reach very low levels,with possible loss of surface flows along some reaches from the headwaters to the mouth at the Pacific Ocean. The climate change results just presented above suggest a potential for more frequent occurrences of severe dry conditions through 2050, and beyond. With a drier forecast at hand and climate change predictions indicating that these conditions are likely to become more regular, watershed management for salmonid recovery should focus on protecting and increasing instream flows into the anadromous reaches of San Vicente to protect all year classes of coho and steelhead to be greatest extent practicable, especially through times of drought.

Leaking water supply pipelines represent an obvious target of improvement, and a practical means to keep as much water in SVC as possible. Upgrading the diversion facility on Upper SVC and Mill Creek for the Davenport water supply, and replacing aging pipeline infrastructure is likely to represent significant water conservation benefits for Instream resources. For example, the combination of cessation of cement plant water use and upgrading the intakes and pipelines so that so that the amount of water diverted is only the amount needed by Davenport has the potential to increase flow by 0.25-0.8 cfs. The County of Santa Cruz is seeking to submit plans to improve the Davenport water supply system as part of their IRWMP submittal to the State later this year. Consideration of conjunctive water supply options (e.g use of groundwater, surface water, recycled water and new storage) that would allow the town of Davenport to reduce withdrawals from SVC during the dry season ,especially during drought, provide a higher level of overall municipal water supply reliability, and protect critical summer baseflows for salmonids, should also be considered in medium to long term resource planning. Until such a program or programs can be funded, immediate and further evaluation of pipeline losses are needed in order to better determine the short-term significance of such losses, and develop appropriate plans to mitigate losses.

FINDINGS

A. Creegan and D'angelo (1984) completed evaluation of the USGS gage and concluded that the bulk of base flow along the mainstem San Vicente Creek originates from the Upper San Vicente basin proper. Synoptic measurements of low-flow completed in July and September of 2013 indicate however that Mill Creek is a near equally important source of summer baseflows, to those sourced from San Vicente proper. It should be noted that while these findings clearly illustrate the import influence of Mill Creek on downstream baseflows, that the synoptic measurements from San Vicente Creek may be an underestimate of contribution from upper San Vicente due to the unquantified effects of the upstream diversion on downstream flows. Regardless, this finding still represents a significant new finding locally, and clearly suggests the need for and importance of a broad water resources protection plan for the upper basin, as opposed to a plan focused on San Vicente proper, and the karst which occurs there, in order to protect water resources that are vital to the provision of salmonid habitats.

B. Water resources protection in the upper watershed will need to address both the sandy soils which occur in both Upper San Vicente proper and Mill Creek, as well as the karst which defines the decommissioned quarry landscape. Sandy soils and karst are managed differently, and each is characterized by its own set of attributes and issues, requiring deliberate and carefully planning. Ongoing efforts by the City of Santa Cruz Water Resources Department, the County of Santa Cruz Environmental Health Services Agency, and the County of Santa Cruz Water Advisory Commission to develop a karst protection zone ordinance will undoubtedly help in this effort.

C. The alluvial aquifer along the mainstem of San Vicente Creek seems relatively stable, and for WY2013, a dry year, supported pretty consistent surface flows from Mill Creek downstream to the coast. Compared to the nearby Laguna Creek, a stream known to be characterized by reasonably high summer baseflows, San Vicente produces more summertime baseflows per unit area by up to a factor of 2 or more. The relative continuity of surface flows along the mainstem reach coupled with the relatively high baseflow regime of the basin is vital to the provision of salmonid habitat.

D. Summertime baseflows along the mainstem reach are relatively cool and consistent from Mill Creek downstream to the coast. Furthermore, the two set of synoptic flow measurements suggest a slight cooling trend of water temperatures toward the coast. Similar to good baseflows, cool water temperatures is a clear benefit for salmonids.

E. The range of channel flows which maintain the San Vicente physical channel likely ranges from 150 to 500 cfs, with flood observations suggesting the value if possibly close to 300 cfs +. The peak flow of WY2013 of roughly 650 cfs is estimated to represent a 3- to 3.5-year flood.

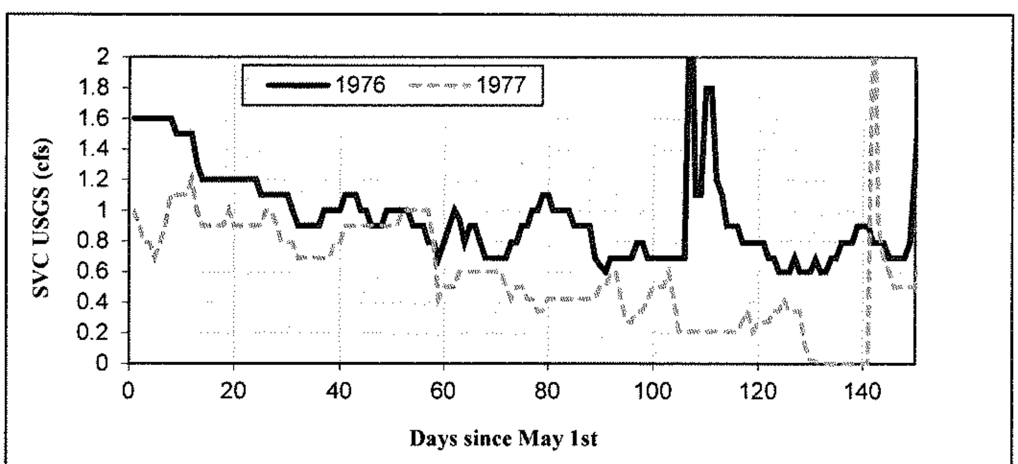


Figure 2-15.Summer time mean daily flow, USGS SanVicente Gage.

F. San Vicente appears to transport a relatively moderate amount of fine sediment during flood stages. An additional physical attribute conducive to salmonid success in the basin.

G. Large floods on San Vicente are likely regionally and relatively large for the size of the basin. This has practical habitat implications for salmonids such that the stream corridor will likely experience complete re-set during floods of significant magnitude. The lower reach of the mainstem is at more risk to substantial change during significant floods due to the contributing deleterious effects of the Highway 1 tunnel. These potentialities clearly point to the notion that habitat protection and enhancement efforts should focus on locations out of the Highway 1 effect zone (within ~2,000 feet), and downstream of Mill Creek.

H. Estimates of hydrologic conditions through 2050 using downscaled climate change projection data for three different GCMs suggests drier conditions than those observed from 1950-1999. Potentially drier conditions in the basin accentuate the importance of developing a water resources protection plan for salmonids, and other Instream resources.

I. Sea level projections for coastal California by 2050 fall within the range of 1-foot above historical mean sea level. This potential outcome coupled with the elevation of the lowermost mainstem of San Vicente suggests an increase in durations and incidences of sea water intrusion upstream of the Highway 1 tunnel. Because we do not understand how this outcome would precisely affect the objectives of the present effort, the recommendation to focus habitat enhancement efforts upstream of the Highway 1 backwater zone seems even more prudent.

Chapter 3: Geomorphology

OBJECTIVES

The goal of this part of the project was to assess the existing geomorphology and geomorphic processes to help guide the types, locations, and suitability of riparian and fisheries restoration projects along San Vicente Creek.

The three main objectives of the geomorphic assessment were to:

1. Identify existing sediment sources within the watershed, including both gravel-sized material that is beneficial to salmonids, as well as finer material that may be detrimental to salmonid habitat;
2. Characterize riffle textures to assess sediment-size distribution, including the amount of gravel-sized material in existing riffles, and;
3. Evaluate stream-floodplain connectivity to consider whether these areas provide sources of instream wood[1], and where- and how much- overbank areas and disconnected backwater habitat already exist or could be enhanced.

To address these objectives, Balance designed the geomorphic assessment with the following key questions in mind:

» What (and where) are the dominant sources of coarse sediment to San Vicente Creek? What (and where) are the dominant sources of fine sediment (coarse sand) to the stream?

» Are spawning gravels in limited supply? What are the characteristic grain-size distributions of riffles? What percent of riffle material is composed of low-density Santa Cruz Mudstone clasts as opposed to higher density quartz diorite? Is fine sediment a problem? How much riffle sediment material is embedded.

» How contiguous is the floodplain along the anadromous reach? How frequently is it engaged? Can even-aged stands of woody vegetation populating floodplain terraces be used to estimate the age of the floodplain?

To answer these questions, we carried out the following four geomorphic subtasks, consistent with the general guidance offered within California Salmonid Stream Habitat Restoration Manual:

1. Geomorphically-based, reach-scale classification;
2. Sediment-source inventory and evaluation;
3. Riffle surficial texture characterizations, and;
4. FloodplaInstream connectivity evaluation.

INTRODUCTION

The geomorphology of the San Vicente Creek Watershed is shaped mostly by its climate and geology. Rainfall increases dramatically with elevation while underlying geology determines erosion rates and dominant processes of channel evolution. Like many of the coastal streams in California, historical flooding events, land use, and development of infrastructure has modified local geomorphology. Heavy rains in January, 1982, caused a landslide down the cliff face adjacent to lower San Vicente Creek. As a result, fallen debris was redirected the creek toward the roadside, where it resides today. In addition, residents historically removed woody debris from the creek in an effort to mitigate flood risk and to keep flow within the active channel (Smith, pers. comm.). Stream channelization and lack of large woody debris in a stream channel can create a more homogeneous stream habitat, resulting in fewer ecological niches and less stable substrate. San Vicente Creek has been noted to lack quality pool habitat and spawning gravel beds (Smith, pers. comm.). Pools are an important component of salmon habitat, and coho tend to selectively use slower, deeper water at early life stages (Healy and Lonzarich, 2000). Pools provide refuge during high flows as well as cover from predators. They provide cooler water temperatures, especially important during low flow periods (NCRWQCB, 2008). Additionally, available spawning gravel is critical because spawner abundance in a stream is partially regulated by the amount of area suitable for spawning (Bjornn and Reiser, 1991). Stream geomorphics (sources and volume of sediment, floodplain connectivity, availability of spawning gravel etc.) significantly impact pool characteristics, abundance, and quality of salmonid habitat.

Geology

The geology of San Vicente Creek Watershed has been mapped by Clark (1981) and Brabb (1989), and described in detail by Environmental Science Associates (2001), P.E. LaMoreaux & Associates (2005). A watershed geology map is provided in Figure 3-1. Geological studies to-date have noted the karst topography found in San Vicente Creek and nearby watersheds—an important geologic component to historical hard-rock mining and surface-ground water connectivity (P.E. LaMoreaux & Associates, 2005). San Vicente Creek Watershed is located in the Coast Range Geomorphic Province, locally characterized by Cretaceous-age crystalline rocks of the Salinian Block and Tertiary-age marine sedimentary rocks. These juxtaposed geologies are the result of tectonic movement (both lateral and vertical) along the San Andreas Fault and together they locally comprise the Santa Cruz Mountains.

Mesozoic- to Paleozoic-age marble outcrops are present in several locations within the watershed and have been actively mined for cement production. These metamorphic rocks are subject to dissolution by groundwater and this results in cre-

1 Floodplains can be initial sources of wood to either the creek itself or the floodplain as trees fall, but can also act as a secondary source- or sink- of wood if floating wood gets temporarily deposited on the floodplain (where wood is also functional), then floats to a new location or into the creek during a larger flood. If a floodplain is too high above the creek, then this floating-off interaction would occur less frequently and decrease wood loading to the creek. Most of the discussion of large wood in the creek is covered in the LWD Assessment chapter

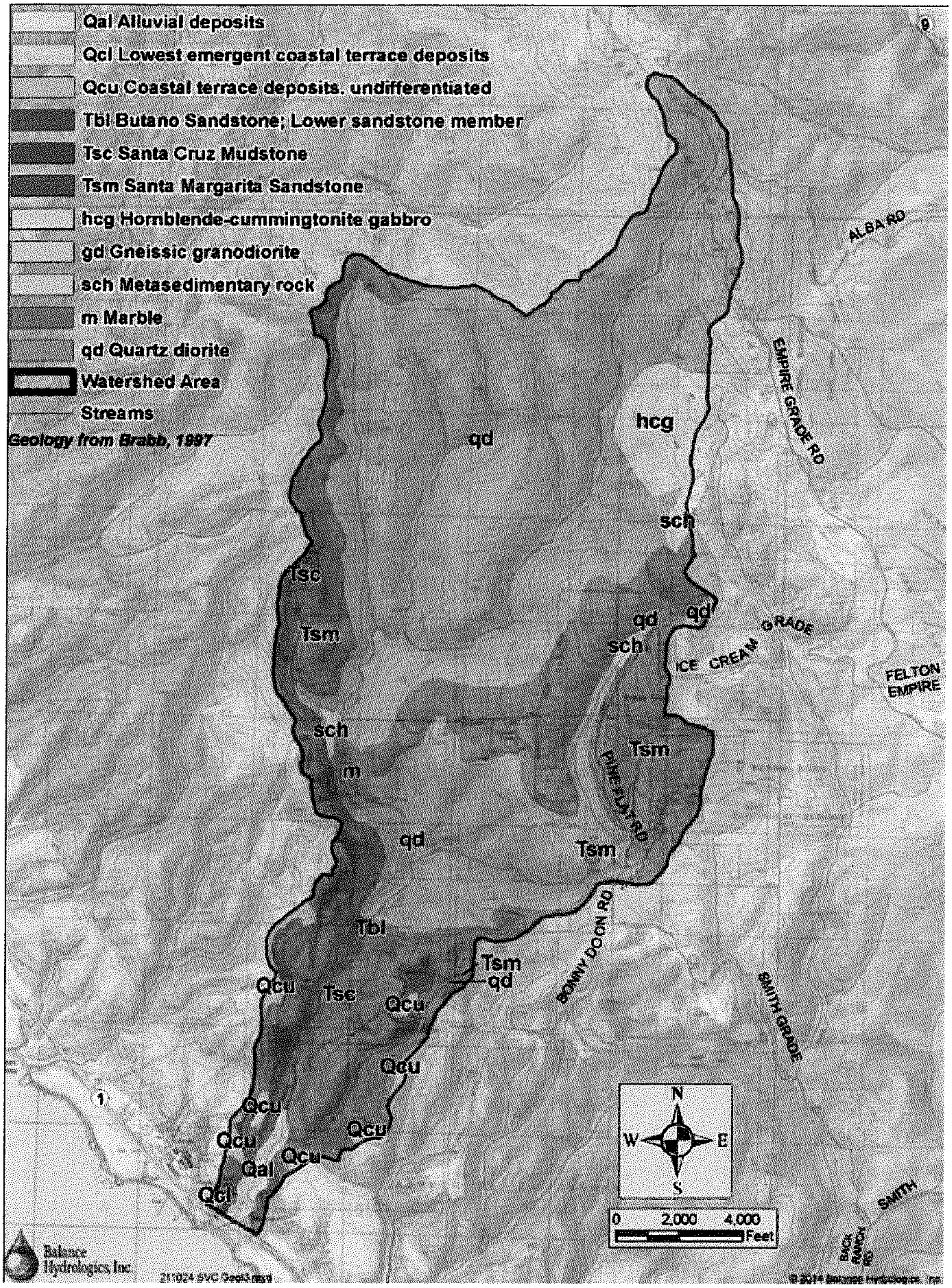
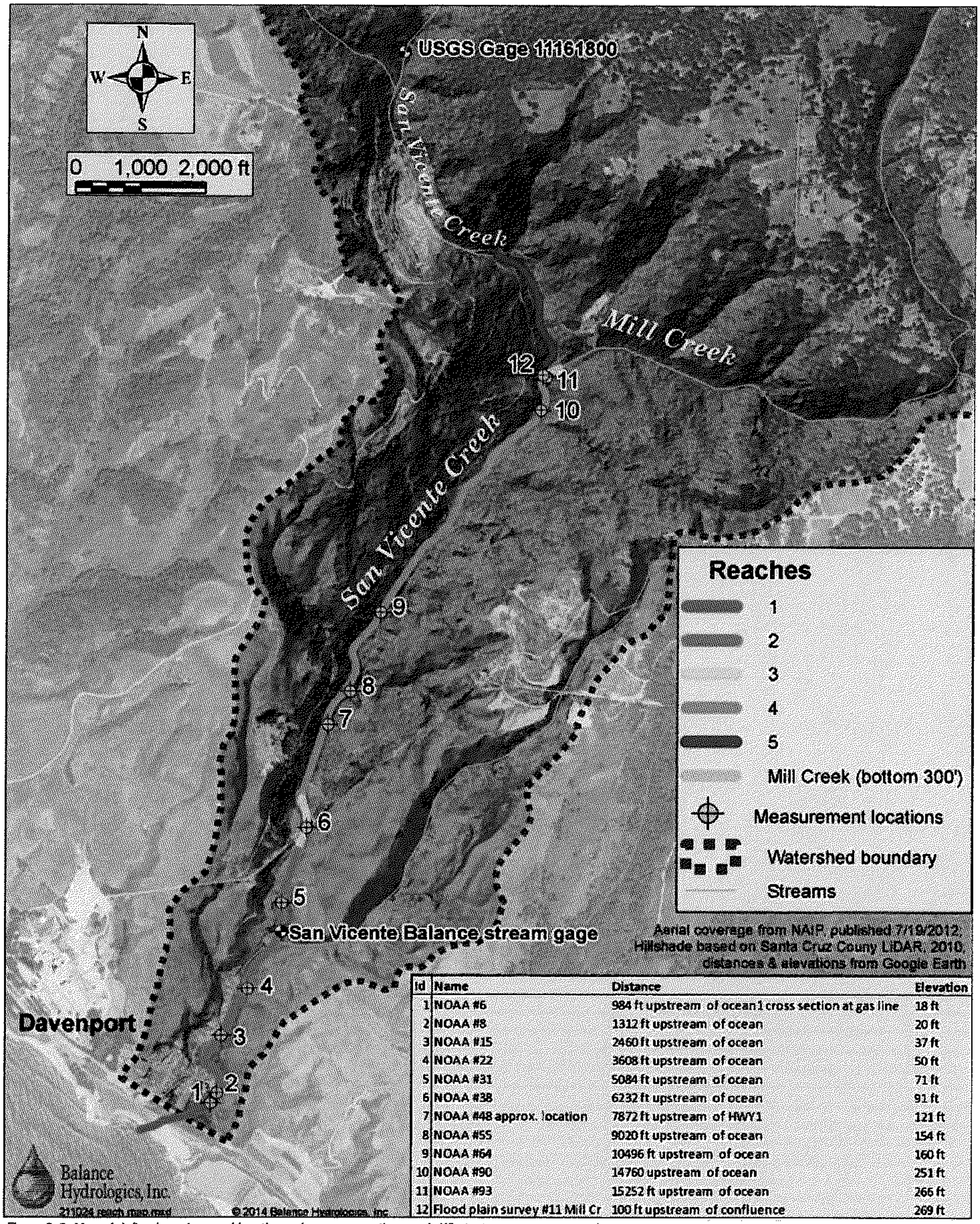


Figure 3-1. Geologic map of the San Vicente Creek watershed.



Id	Name	Distance	Elevation
1	NOAA #6	984 ft upstream of ocean1 cross section at gas line	18 ft
2	NOAA #8	1312 ft upstream of ocean	20 ft
3	NOAA #15	2460 ft upstream of ocean	37 ft
4	NOAA #22	3608 ft upstream of ocean	50 ft
5	NOAA #31	5084 ft upstream of ocean	71 ft
6	NOAA #38	6232 ft upstream of ocean	91 ft
7	NOAA #48 approx. location	7872 ft upstream of HWY1	121 ft
8	NOAA #55	9020 ft upstream of ocean	154 ft
9	NOAA #64	10496 ft upstream of ocean	160 ft
10	NOAA #90	14760 upstream of ocean	251 ft
11	NOAA #93	15252 ft upstream of ocean	266 ft
12	Flood plain survey #11 Mill Cr	100 ft upstream of confluence	269 ft

Figure 3-2. Map of defined reaches, and locations where cross sections and riffle textures were measured.

ation of karst terrain--cave and conduit features in the bedrock that greatly influences water storage and movement. P.E. LaMoreaux & Associates (2005) conducted dye tracer studies in an adjacent watershed, and found that cross-basin conveyance is likely occurring in San Vicente, a process by which groundwater is exported from one watershed to an adjacent watershed. At this time, geologic controls on surface water and groundwater movement into or out of the San Vicente Watershed have not been examined extensively, but some data suggests these processes are at play (P.E. LaMoreaux & Associates, 2005).

The upper portion of the watershed is primarily composed of fractured crystalline rocks (e.g., granite, quartz diorite) and may provide sources of baseflow to the lower watershed via fractured flow. In contrast, the lower watershed is underlain by marine-sedimentary rocks, including the Santa Margarita sandstone and Santa Cruz mudstone, both highly erosive and subject to mass wasting (e.g. landsliding) as the result of watershed disturbances (e.g., road building), flooding or tectonic activity. The mudstone or sandstone is part of a sequence of Tertiary sediment rocks that increase in thickness as the stream flows downstream toward the coastline (Creegan and D'Angelo, 1984). In the middle and upper reaches of the San Vicente Creek, the mudstone or sandstone comes into contact with the Mesozoic or Paleozoic marble unit. The marble unit has been quarried for over 100 years, creating a canyon within the main stem of San Vicente Creek and exposing the basement rocks of old schist, marble and granitics (Weppner and others, 2009). Engineered tunnels at the entrance and the bottom of the abandoned marble quarry has caused San Vicente Creek to flow subsurface at this location which resurfaces immediately downstream of the marble unit.

METHODOLOGY

Stream Morphology and Stream Reach Classification

Assessment and Methods

Using information collected from LiDAR-based topography, stream reconnaissance, and channel morphology, we classified five distinct channel reaches[2] which can be used to characterize geomorphic processes and communicate our observations and measurements (Figure 3-2, Table 3-1). Each reach was classified based on several characteristics including: a) channel slope, b) channel morphology, c) dominant bed material size, and, d) influence of land-uses or modification of channels or hydrology.

2 The choice of reach definitions is not a hard-and-fast rule, but is subjective based on the purpose(s) of a study; in this case the reaches were defined from a geomorphology perspective with an eye toward potential for salmonid-habitiat restoration projects. Other scientists would likely come up with different reach definitions which would be equally valid. For a different type of study, we would likely use a different set of reach classifications.

Table 3-1. Reach-scale classification and descriptions: San Vicente Creek, Santa Cruz County, California

Reach	Reach length		Distance from Pacific Ocean	Reach elevation		Slope	Morphology	Description
	Begin	End	(End)	Begin	End	(overall)		
	(ft)	(ft)	(mi)	(ft)	(ft)	(%)		
Reach 1	0	1,345	0.25	0	22	1.2	pool-riffle	Heavily modified reach, contriction at HWY 1 has potential for inundation during large floods; bimodal substrate: cobble in sand
Reach 2	1,345	5,840	1.11	22	90	1.4	pool-riffle	Reach includes greatest opportunity for aquatic habitat enhancement
Reach 3	5,840	6,590	1.25	90	104	<2	bedrock-controlled	Short reach the begins immediately downstream of the CEMEX conveyor belt and extends upstream to a weir and road-crossing, channel express bedrock chutes and deep pools
Reach 4	6,590	14,145	2.68	104	260	2.1	plane-bed	Steeper channel that expresses muted pool-riffle morphology. Pools are shallow with abundant fines
Reach 5	14,145	16,420	3.11	206	410	6.9	step-pool, pool-riffle	Reach expresses both pool-riffle and step-pool morphology, many steps are natural barriers to fish passage; reach terminates at Quarry tunnel
Mill Creek tributary							step-pool	Reach expresses few pool-riffles and mostly step-pool morphology; natural barriers to fish passage; abundant sediment sources in reach

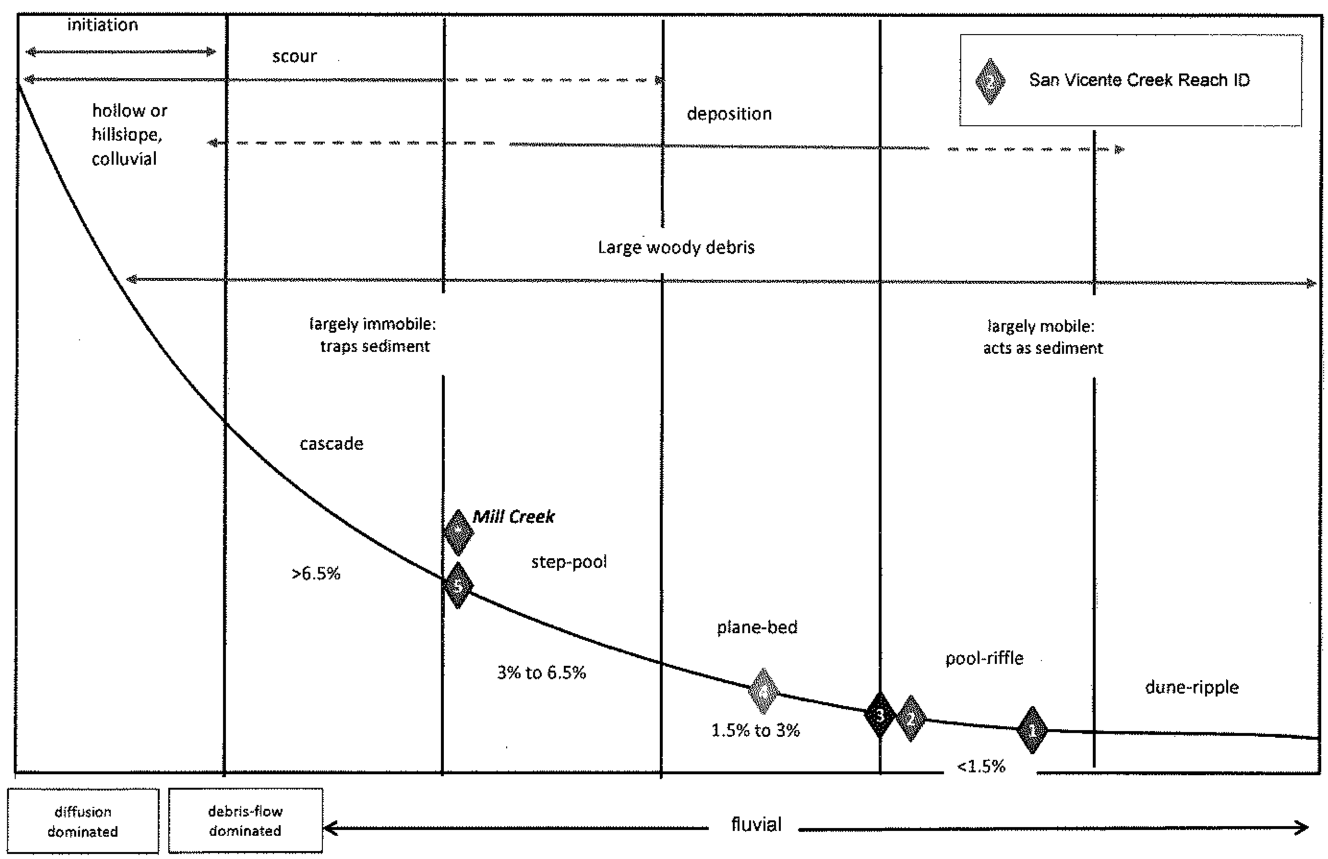
Reaches were identified to facilitate future planning efforts and for communication amongst stakeholders. Montgomery and Buffington (1997) evaluated numerous mountain streams and identified streams tend to develop specific morphologies relative to their overall channel slope. For instance, channels in mountain systems with slopes less than 1.5 percent typically express pool-riffle morphology, whereas slopes between 3 and 6.5 percent typically express step-pool morphology. After evaluating channel slopes and observing channel morphology in San Vicente Creek, Balance found San Vicente Creek expressed similar morphology as might be predicted by Montgomery and Buffington (1997) as shown in Figure 3-3.

Additional characteristics were evaluated to further define the geomorphic reaches shown in Figure 3-2, such as effects of the Highway 1 tunnel and floodplain development on channel backwatering and sedimentation. We further describe each reach and its characteristics in the sections below and summarized in Table 3-1.

Reach 1

Reach 1 begins at the Pacific Ocean (sea-level) and extends upstream approximately 1,300 feet and has been characterized in detail by Stamm and others (2008). Reach 1 exhibits an approximate 1.2 percent slope, and pool-riffle morphology. As the result of channel modifications and construction of Highway 1 and the coastal railroad, San Vicente Creek does not have a sand bar and lagoon at its confluence with the Pacific Ocean. Therefore, salmon can enter or exit when similar creeks in the area have closed sandbars precluding movement between the fresh and salt water environments. However, while the absence of a lagoon and sandbar enable unregulated movement between fresh and salt water, the lack of a lagoon can present limitations for rearing and winter high flow refuge for salmonids, especially steelhead.

Substrate in Reach 1 appears to be bimodal with well-rounded cobbles mantled by large volumes of fine and coarse



Balance Hydrologics, Inc.

Figure 3.3 Channel morphology of reaches in relation to general distribution of alluvial channel types *adapted from Montgomery and Buffington (1997),* **San Vicente Creek, Santa Cruz County, California.** Field identification of channel morphology and slopes measured from LiDAR-based topography are consistent with channel types as reported by the literature and can be used for guidance for future restoration.

211024 Stream profile_FINAL.xlsx

Figure 3-3. Channel morpohology of San Vicente Creek compared to a general distribution of alluvial channel types.

sands, with only small amounts of fine gravel. Mean particle size of riffles has been estimated to 73 mm (cobble). Substrate lithology is mixed with larger material derived from crystalline rock (i.e., diorite) and finer material derived from Santa Cruz mudstone, Santa Margarita sandstone, and to a lesser extent, diorite and limestone. Based on observations, Reach 1 has moderate volumes of instream wood and has recruited older alders into log jams, due to dynamic channel conditions.

Reach 1 has been heavily modified over the years for agricultural use (instream and offstream ponds), floodplain encroachment, former and existing road crossings, channel realignment and filling of the lagoon from construction of Highway 1. We have defined the upstream extent of Reach 1 as a zone of potential backwatering due to the tunnel under Highway 1 which imposes constraints on passage of moderate to extreme flood flows. Anecdotal and field evidence suggests the flood of February 3, 1998 (estimated 80- to 100-year recurrence submerged the tunnel and backwatered the channel to about 22-foot elevation (Stamm et al, 2008). This elevation corresponds to the upper limit of Reach 1. Submergence and backwatering of this reach has the potential to increase sedimentation, bank erosion, and shifts in channel position. As a result, this reach may not be a good candidate for additional enhancement and restoration due to dynamic and uncertain conditions created by such floods.

Reach 2

Reach 2 extends 4,500 feet upstream from the 22-foot elevation contour to approximately 90-feet elevation. Reach 2 exhibits a 1.4 percent slope overall and expresses pool-riffle morphology. Substrate is mostly cobble sourced from crystalline rock (i.e., diorite), however, abundant sand-sized sediment fills pools and backwater. This reach has moderate volumes of instream wood and opportunities for recruitment during floods.

Reach 3

Reach 3 extends roughly 750 feet upstream of Reach 2, and is defined by a bedrock-controlled channel bed between the CEMEX conveyor belt upstream to a weir/road crossing; the overall reach slope is approximately 2 percent. Bedrock is mostly Santa Cruz mudstone which is easily weathered and forms bedrock chutes and occasional deep pools. Cobble and boulder sized material are common in this reach

Reach 4

Reach 4 extends upstream 7,500 feet from Reach 3 to the confluence of Mill Creek. Channel slope through Reach 4 is generally steeper (2.1 percent) than downstream reaches. Channel morphology predicted by Montgomery and Buffington (1997) is "plane bed"—characterized by relatively straight channel (confined or unconfined), lacks discrete bars, comprised of dominantly cobble- and boulder-sized substrate, and lacks rhythmic bedforms (i.e., pool-riffle, step-pool). Although Reach 4 doesn't exhibit all these characteristics, its bedforms are muted, with shallow pools and long riffles. In some areas, the channel does appear confined by topography (valley walls), or in some cases, current and former logging roads.

Reach 5

Reach 5 extends roughly 2,300 feet upstream from the confluence with Mill Creek to the outlet of the old quarry (also referred to as the "tunnel"). This reach exhibits increasingly steeper characteristics defined by boulder step-pool and boulder-cascade morphology. Abundant fines (fine to coarse sand) were observed in pools and may be associated with discharges from the quarry; however, hydrology and sediment transport through the quarry is poorly understood.

Mill Creek

Mill Creek is a perennial tributary to San Vicente Creek and extends roughly 3 miles upstream. The first 500 feet of channel, upstream from its confluence with San Vicente Creek, exhibits some pool-riffle morphology and provides ample fish passage. Above this segment, Mill Creek is a steep channel (greater than 5 percent) and mostly exhibits step-pool and cascade morphology. The uppermost segment of Mill Creek (above Boony Doon Road crossing) exhibits a lower slope and likely pool-riffle morphology. Mill Creek appears highly altered with evidence of two former dams, creek-side skid roads and narrow-gauge railroad beds which have confined the channel. Based on our field reconnaissance, these human confinements have led to bank failures and landslides into the channel from deeply weathered diorite. These conditions provide a source of abundant sediment to downstream reaches as evidenced by pools filled with medium and coarse sand throughout this tributary.

Sediment-Source Inventory and Evaluation

Sediment-Source Background

Our assessment of sediment sources in San Vicente Creek Watershed should be considered within the context of large or infrequent events or recent variations in climate, land-use, geology, and hydrologic conditions. Landslides and debris flows are prevalent in the Santa Cruz Mountains and are well-recognized as sources of sediment to coastal reaches of anadromy. Ellen and others (1988) have mapped landslides in the Santa Cruz Mountains generated by the January 1-3, 1982 rainfall and floods, while Spittler and others (1989) mapped landslide features triggered by the Loma Prieta earthquake. Neither of these studies identified major landslides in the San Vicente Watershed as a result of these historic events. Erosion after wildfires is another potential large source of sediment. The last major wildfire in the San Vicente Creek watershed was in 1948 (15,000 acres; RCD, 2013); however, there are no known studies that document if this fire was a major source of sediment. Finally, notable storms and associated floods are also common sources of landslides and bank failures. 2013 was a year characterized with below average rainfall and after a decade or more absent of large rainfall or flooding events. Water year 1998 was the last year noted for substantial channel changes, debris flows, and landslides. Locally, a flood on March 26, 2011 was moderately large, but not relative to historical floods.

Sediment-Source Assessment and Methods

Our watershed reconnaissance was conducted in February and July of 2013 and included an evaluation of sediment sources to San Vicente Creek. We completed our evaluation using a combination of: a) literature survey, b) a stream walk, and c) remote sensing. A literature survey identified sources of sediment from previous assessments and also provided context for current observations as they relate to recent events that may trigger sediment sources such as earthquakes, wildfires, and large rain events or floods. During our stream walk, we identified near-channel sediment sources (greater than 10 cubic yards) and completed rough measurements/estimates of the volume of material missing and presumed this sediment had entered the channel and aquatic habitat. We also augmented our field assessment with a review of current and historical aerial photographs and available LiDAR to identify sources not readily visible from the channel or existing roads in the watershed. Sediment source locations were mapped as they are shown in Figure 3-4, and Table 3-2 lists the sediment sources, estimated volumes and identifies whether they may be likely future sources for downstream impairment.

Separately, we should mention that the scope of our assessment did not include a formal evaluation of road-related sediment sources. Roads constructed for logging, mining, and recreation have been identified as major sources of sediment in other watershed assessments in the Santa Cruz Mountains (Owens and others, 2006, Best, 2002). Weppner et al., (2009) evaluated over 22 miles of road in San Vicente Creek Watershed. Where feasible, results from this study are incorporated into our assessment.

Findings and Results

Our assessment of San Vicente Creek Watershed identified very few large sediment sources, most of which were limited to the Mill Creek tributary. We may attribute our findings to the absence of significant flood events in recent years and abundance of canopy and ground cover (e.g., cape ivy) which also may obscure or temporarily stabilize former sediment sources. In general, sediment sources were associated with near-channel landslides, bank failures, instream storage, and areas of active karst collapse. We discuss these and historical sources in more detail below by dividing the watershed into three areas: a) the upper watershed (San Vicente Creek above Mill Creek), b) Mill Creek, and c) the lower watershed (below Mill Creek).

Upper San Vicente Creek

The Upper Watershed of San Vicente Creek (above Mill Creek) has a complex history of land-use, most notably, the large marble quarry which began operations in 1906 and continued until the late 1960s. Quarry operations included removal of overburden and rock from the existing channel. These operations required the re-routing of streamflow under the quarry floor through constructed tunnels. As a result, these past operations and channel modifications have disrupted natural channel processes, including sediment erosion, transport and deposition.

Table 3-2. Sediment Sources: San Vicente Creek Watershed, Santa Cruz County, California

Sed. Source ID	Reach/Location	Type	Estimated sediment volume (missing) (CY)	Estimated sediment volume storage (CY)	Future source of sediment?	Description
1	Upper San Vicente watershed	road-related	3,500			Based on Weppner and others (2009), currently being addressed by Big Creek Lumber
2	East Fork, Upper watershed	other	100			Karst collapse
3	Upper San Vicente Creek	storage		1,500		Storage behind dam at old USGS gaging weir
4	Upper San Vicente Creek	storage		150		storage behind old dam
5	Upper San Vicente Creek	storage		150		storage behind old dam
6	Upper San Vicente Creek	landslide	unknown	--		landslide (1982?)
7	Upper San Vicente Creek Quarry	storage	unknown	>10,000		storage of sediment on quarry floor in bar, delta and overbank deposits
8	Mill Creek tributary	landslide	550		yes	landslide into Mill Creek
9	Mill Creek tributary	landslide	350		yes	toe of old landslide into Mill Creek
10	Mill Creek tributary	bank failure	2,000		yes	Skid road failure along Mill Creek
11	Mill Creek tributary	bank failure	300		yes	Skid road failure along Mill Creek
12	Mill Creek tributary	debris flow material	unknown	>5000	yes	Deposits may have originated from bank failures and landslides upstream
13	Unnamed, spring-fed tributary to Reach 2	other		50	yes	Large volume of sediment filled half of restored backwater pond after March 26, 2011 flood; potential source is from 'Shale Quarry'

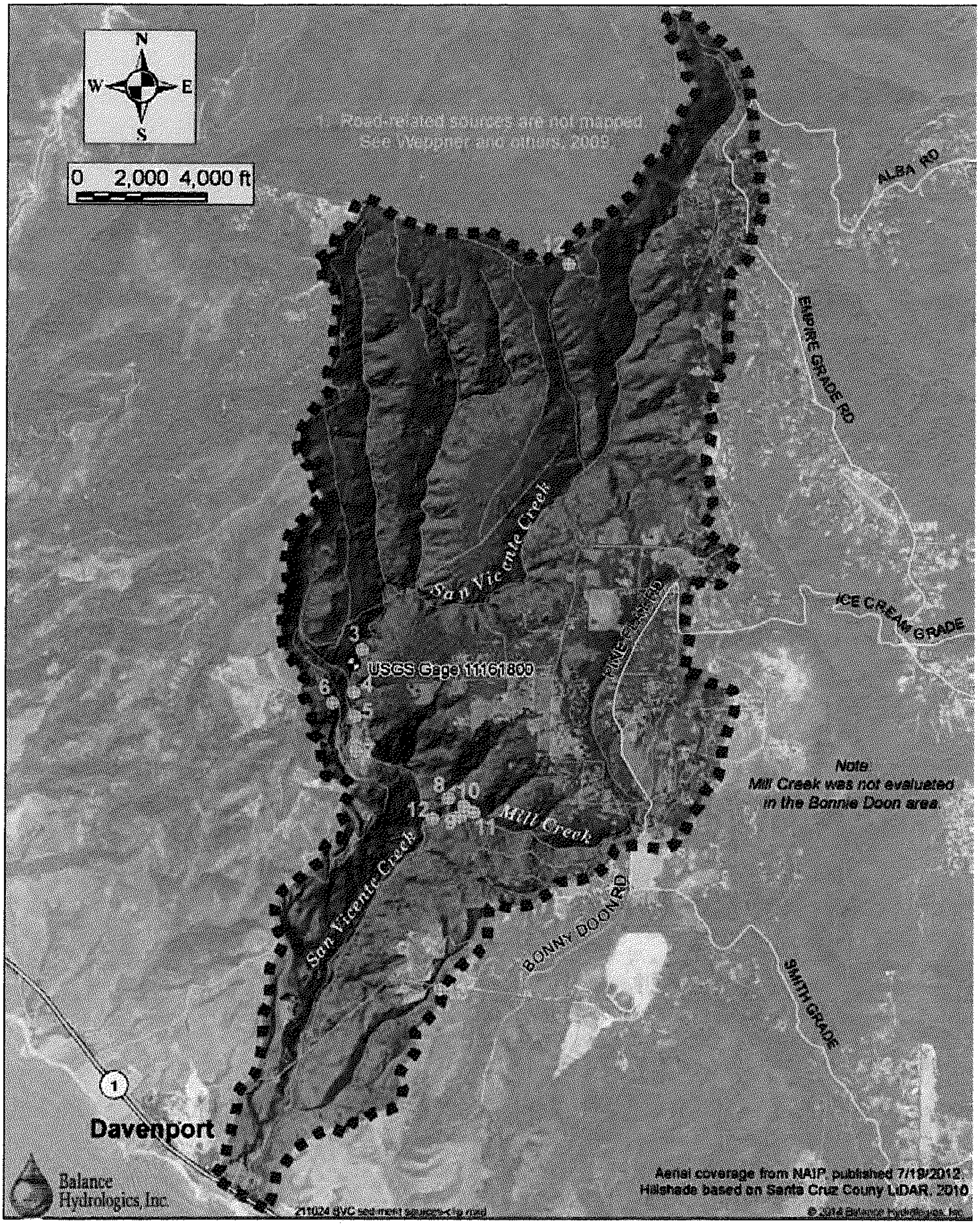


Figure 3-4. Map of recorded sediment-source areas.

Similarly, road building, water diversions, and rural residential development are components of the Upper Watershed.

Upper San Vicente Creek sediment evaluation

Tunheim (2001) completed an assessment of the Upper San Vicente Creek in 2001 shortly after the 1998 flood and identified three main sources of sediment: a) overburden disposal areas associated with quarry activities; b) residential areas in Bonny Doon, and; c) channel bank erosion along significant sections of Upper San Vicente Creek (above the Quarry). We attempted to evaluate these previously documented sources during our 2013 assessment and we found that these may not be significant sources today, but instead relicts of past large, infrequent events such as the 1998 flood.

Alternatively, unimproved roads can be one of the largest direct and indirect, short-lived or chronic sources of sediment to streams (Reid and Dunne, 1984). The San Vicente Creek watershed has a history of logging and quarrying, both executed using a myriad of roads constructed through the watershed. Weppner et al., (2009) identified a number of road-related sediment sources. Weppner et al., (2009) projected that, if left untreated, over 50 stream crossings could contribute nearly 2,000 cubic yards of sediment over the next two decades and road-related erosion could contribute roughly 1,500 cubic yards of sediment from over the next 10 years.

While our study did not focus on road-related sources of sediment, we did observe a number of road improvements that were being carried out by Big Creek Lumber in response to the recommendations in Weppner et al., (2009). Continued road drainage improvements will likely decrease fine sediment to San Vicente Creek.

A recent feature in the East Fork of San Vicente Creek, was identified by others as a potential sediment source (Hamey, N., pers. comm.). Our assessment concludes that this feature is more likely karst collapse as evidenced by some exposed marble bedrock. The sudden break in slope along this tributary caused by the collapse can provide the impetus for continued mass wasting and sediment production; however, in its current condition, the feature was not identified as a major sediment source, due to the absence of sediment storage or accumulation downstream.

Upper San Vicente Creek flow diversion

Historical quarrying activities and water diversion infrastructure effectively re-routed San Vicente Creek, and similarly, sediment transport, under most streamflow conditions. First, San Vicente Creek, above the quarry, is intercepted by the former USGS weir and Davenport Diversion Dam. This dam is roughly 25 feet high and completely filled by sediment. Historically, sediment was reportedly removed from behind this dam on a frequent basis to maintain storage for Davenport's water diversion (Hamey, N., pers. comm.). Sediment includes sand, gravels and cobbles. It is assumed that the removed sediment was discharged downstream. This diversion is still active diverts a portion of the baseflow observed during our reconnaissance.

Upper San Vicente Creek vertical shaft 1

Approximately 0.25 miles downstream of the USGS weir, a second dam, roughly 10 feet high, provides additional sediment storage (mostly sand, some gravels, and angular cobbles). At this dam, we observed 100 percent of flows entering a vertical shaft that reportedly conveys most low flows 90-feet down and under the quarry floor, and presumably discharges back into San Vicente Creek downstream of the quarry. During high-flow events (or when the upper shaft clogs), when sediment is transported, flow and sediment is conveyed over this dam and down a steep bedrock waterfall/channel to the quarry floor.

Upper San Vicente Creek quarry floor and vertical shaft 2

The quarry floor acts like a large floodplain where large, active sediment bars and overbank deposit features were observed along a dry, dynamic channel. Sediment in the channel was mostly composed of angular cobbles in a sandy matrix. The channel meanders across the floor of the quarry to a tunnel entrance and a large vertical shaft, locally known as the 'glory hole'. The entrance to the shaft was choked with large wood, rock and sediment. Under these conditions, and in the absence of streamflow, it is uncertain whether the engineered tunnel conveys any flows or sediment to the downstream reaches of San Vicente Creek. Upstream of the entrance, we observed large deltaic deposits of coarse sand which suggests that during high flows backwatering occurs and promotes deposition of these sediments. Using observations and aerial photography, we estimate roughly 10,000 cubic yards of sediment (sands, gravels, cobbles) is sequestered in the form of bars, overbank, and deltaic deposits on the quarry floor. In the absence of quarry activities since the 1960s, it is difficult to assess what component of this estimate is from historical quarry activities versus sediment transported from upstream areas.

Observations of the outlet of this tunnel, some distance downstream, did not suggest an abundance of sediment of the size and origin found deposited on the quarry floor. Based on these observations, we tentatively conclude that sediment from the upper watershed is not regularly transported to the lower watershed; however, we do not fully understand the dynamics of sediment transport through the quarry over the longer term. Additional study may be required to better understand sediment dynamics through the quarry such as repeated surveys of sediment in the quarry or paired bedload measurements above and below the quarry tunnel over a range of events. However, access to these locations is difficult and may be infeasible during wet conditions.

Mill Creek Tributary

We walked Mill Creek 0.25 miles upstream from its confluence until steeper terrain and dense vegetation prevented further egress. The first 500 feet of channel is a gentle (<2 percent) pool-riffle system which quickly transforms into a steeper, step-pool and cascade channel cut into highly weathered diorite. We observed pools filled with coarse sands and fines. Sources of fine sediment appear to originate from near-channel disturbances. For instance, remains of former skid-roads and railroad grades were observed along the channel and likely confined the former channel to its existing condition today. As the channel attempts to reclaim its former channel width and form (meanders), the resulting hydraulic forces create sediment sources that include on-going bank failures and near-channel landslides into Mill Creek.

While bedrock exposures at bank failures and landslide scarps suggest diorite as the source, upstream portions of the watershed are mapped as Santa Margarita sandstone. This lithology has been described by others as very friable (Clark, 1981) and has been the source of other sediment issues in the Santa Cruz Mountains (Hecht, B., pers. comm.). Creegan and D'Angelo (1984) described the majority of the fine sediment originating from further upstream, specifically the Bonny Doon area. A field assessment of the Bonny Doon area was limited because of private property. However, a review of recent and historical aerials did not suggest any major and current sediment sources from private lands in the Bonny Doon area (that are visible from the air), but we do not conclude that sources do not exist.

Between Bonny Doon and the reach we walked, Mill Creek includes two diversion dams located 0.45 and 0.7 miles above the confluence (Creegan and D'Angelo, 1984). While our reconnaissance did not include observations of these dams, previous assessments suggest that they are silted in with the potential to release stored sediment in the event of dam failure (Creegan and D'Angelo, 1984). Previous assessments by the NRCS discounted dam and sediment removal due to limited access and uncertainty with channel stability once removed.

Measureable overbank storage of fine sediment observed at the confluence with San Vicente Creek may have originated from upstream bank failures, landslides and sediment releases from the upstream dams. While these deposits are located above the active channel, they are likely mobile in large events. Removal of these deposits may be difficult given their location and limited access; however, stabilization of these deposits using vegetation may be a more feasible option.

Lower San Vicente Creek

Our assessment of lower watershed included a reconnaissance of the entire channel from the Highway 1 tunnel upstream to the confluence with Mill Creek (Reaches 1-4). In the context of limited or lack of large events over the past 15 years, we did not identify measurable (>10 CY) sources of sediment to the channel, although we note that much of San Vicente Creek appears to have exhibited an historical period of incision, likely as the result of logging and road building 100 years ago. Today, the channel exhibits general dynamic equilibrium with only occasional evidence of continued incision, or widening of meander magnitude.

A reconnaissance of an unnamed tributary in the eastern portion of the watershed was made impossible by thick vegetation, although a review of current and historical aerial photographs reveals that this tributary drains a former quarry area, also known as the 'Shale Quarry'. Santa Cruz County (2009) identified 'Shale Quarry' as a major sediment source. Reportedly, holding ponds, constructed in the Shale Quarry, frequently were blown out by storms and released large volumes of sediment to San Vicente Creek (Santa Cruz County, 2009). In 2011, a large deposit of fine sand was observed in a recently restored backwater habitat, located at the receiving end of this unnamed tributary. The sediment resulted in approximately 50 percent reduction in backwater habitat at this location.

Other sources of sediment may exist in the near channel environment. Reach 1, for example, has been characterized as a reach subject to backwatering from extreme floods (e.g., 1998). In moderate-to-large floods, former deposits from backwatering can be mined by the creek. These processes may be currently active today based on the percent fines we see in some of the Reach 1 riffles.

In an effort to identify the source rock of fine sediment found in the lower watershed, we qualitatively investigated lithology of fine sediment deposited in pools and riffles. We note that determining the lithology for grains less than 2 mm becomes increasingly difficult. Nevertheless, we observed an abundance of coarse sand composed of mafic minerals (i.e., dark, ferromagnesian) which may suggest that a good portion of the fines are derived from diorite.

Previous assessments have identified sediment sources associated with old quarry overburden or operations and suggest that marble may be a dominant source of fines. Creegan and D'Angelo (1984) observed an increased percentage of marble in the channel after the 1982 flood. Today, very little marble is observed in the channel and suggests that these sources may have become less significant and the formerly observed marble has been transported through the system or buried by new sources of sediment that originate from other lithologies.

Similarly, while Santa Cruz mudstone is mapped throughout much of the lower watershed (Brabb, 1989), we did not identify it as the source rock for many of the fines found in pools and riffles within Reaches 1 through 4. Its absence is likely because this unit is weakly cemented, highly friable and quickly degrades through both physical and chemical weathering. Similarly, density of Santa Cruz mudstone is significantly less than the diorites and marbles and is therefore sediment originating from this unit is more subject to transport as bedload or suspended load during periods of high flow.

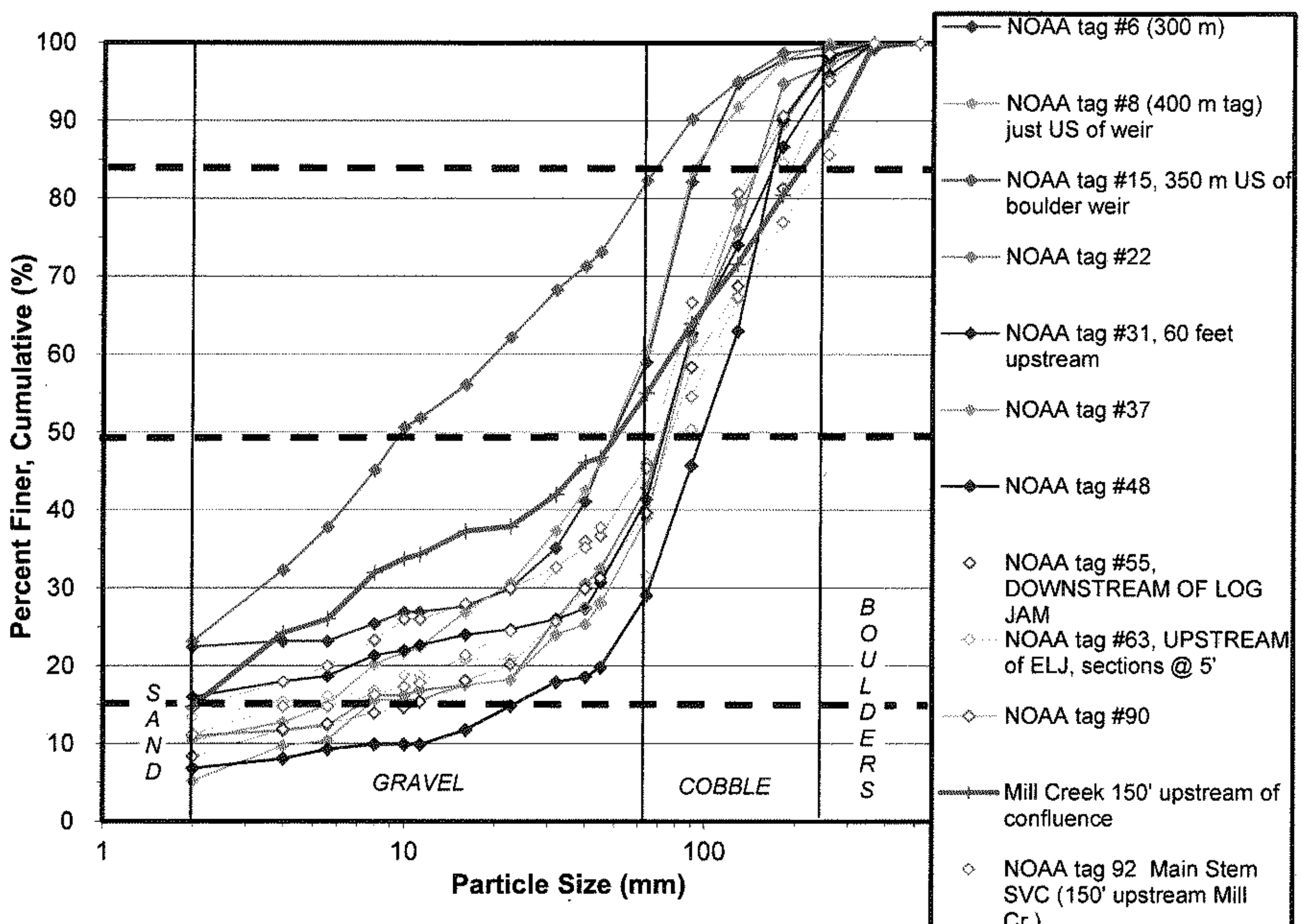
Conclusions of Sediment-Source Findings and Results

In conclusion, our sediment-source assessment identified few active sediment sources relative to other watersheds in the Santa Cruz Mountains identified by others. Many of the sediment sources that exist appear to be in the upper watershed. Along the mainstem of San Vicente Creek, in the upper watershed, sediment may be effectively stored (temporarily or long-term) within the decommissioned Quarry; however, sediment transport dynamics through the decommissioned quarry are poorly understood and additional study may be necessary. Previously identified as a sediment source by the County, Shale Quarry, located within an unnamed tributary in the eastern portion of the watershed, continues to contribute fines to downstream areas. The most obvious source of sediment seems to originate from the Mill Creek tributary where on-going bank failures and landslides are attributed to legacy-logging impacts and quarrying impacts that confined the creek channel. Steep terrain in the Mill Creek tributary may be the most limiting factor for implementing channel restoration or mitigation measures.

Riffle Surficial-Texture Characterization

Assessment and Methods

In July 2013, Balance selected and evaluated 12 riffles within San Vicente Creek, between Highway 1 and just above the confluence with Mill Creek (Figure 3-2). Riffle surficial textures were evaluated using a modified version of the Sampling Frame and Template Procedure (SFT; Bunte and others, 2009). At each riffle, Balance employed a fixed-interval sampling grid with sampling extending from bankfull to bankfull. The grid provided an unbiased sampling at intervals approximating 1-foot (although we did select the upstream and downstream extent of the sampling within the larger riffle). At each riffle, we collected between 130 and 200 data points, measured the median diameter, and classified the sample as: a) sand or finer (< 2 mm), b) gravel (2-64 mm), c) cobble (64-256 mm) or d) boulder (>256 mm). Lithology source and absence or presence of embeddedness was noted for each sample. Data were entered into a spreadsheet and each riffle (as a whole) was characterized using particle-size distribution analysis, frequency analysis by sample class, and percent embeddedness. Please note that by the method for this study, "percent" embededness is not the extent to which an average clast is embedded, but the percent of clasts that are embedded either a small amount or a large amount.



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Data collected by Sample Frame Template Method in July 2013. Riffle # 3 at NOAA tag 15 was much finer than the other riffles.

Figure 3-5. Sediment-size distribution of riffle-surface material.

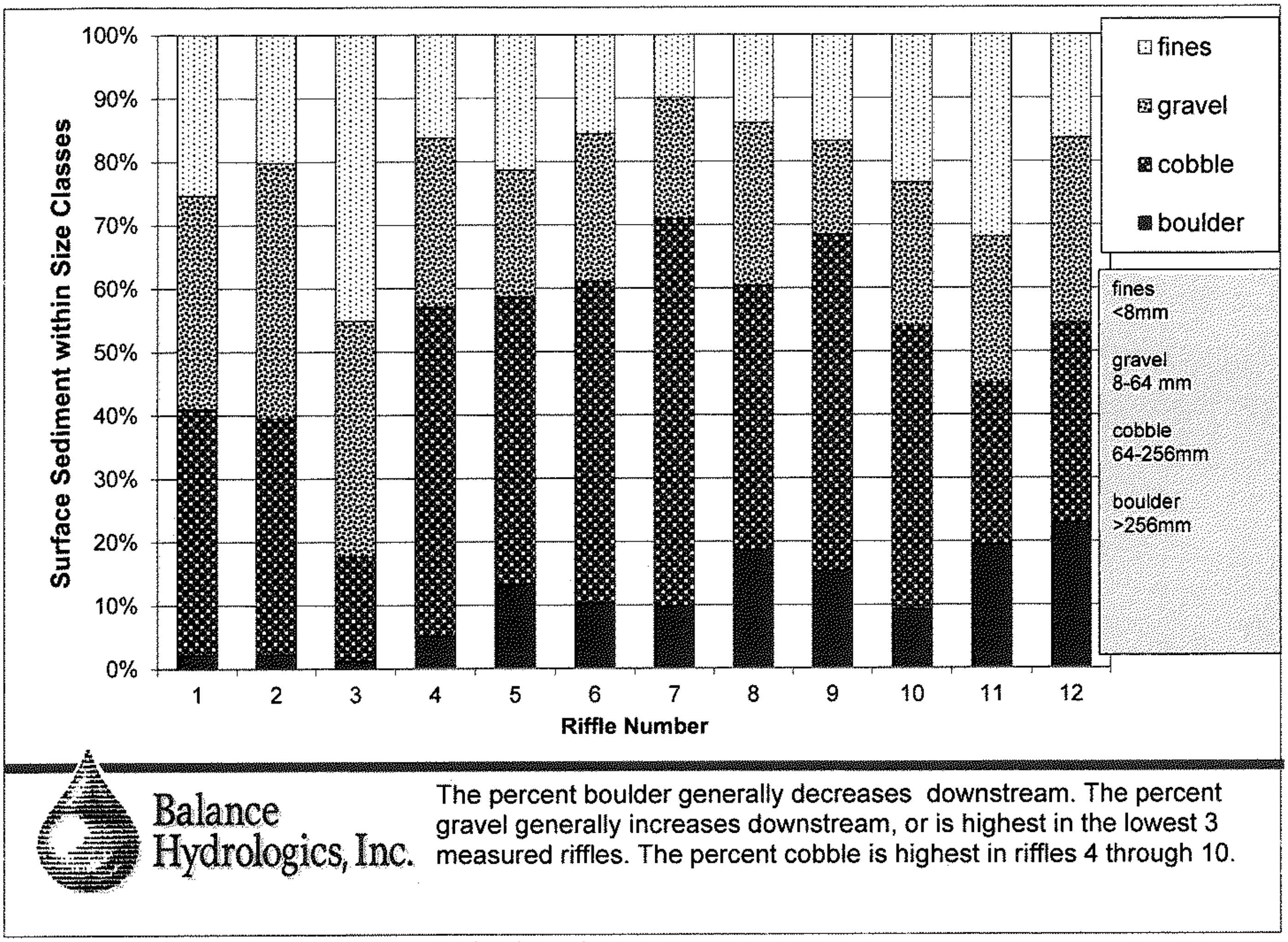

Figure 3-6. Riffle-surface texture measurements, San Vicente Creek July 2013.

We note that water year 2013 (WY2013) was a below-average rainfall year despite having an above-average peak flow. WY2013 also follows several average to below-average years in terms of precipitation and runoff. Riffle conditions may not reflect "typical" conditions and could be changed in a peak flood such as those conditions observed by Creegan and D'Angelo (1984) after the big-flood years of 1981 and 1982. The last significant flood in San Vicente may have been WY2008 or WY1998. Interpretation of our results and observations should be placed in the context of the historical hydrology.

Findings and Results

Riffles selected for evaluation are located in Figure 3-2. Particle size distributions for all 12 riffles are presented in Figure 3-5.

For each riffle, the percent of samples falling into four sediment size classes (i.e., fines, gravels, cobbles, boulders) are presented in Figure 3-6.

Riffle-surface size results

We characterized riffles within the lower and middle San Vicente Creek watershed as a coarse system, but with a near normal distribution, whereas our median and mean for each riffle were approximately the same with few exceptions (Figure 3-6). Overall, riffles expressed a median diameter (D50) of 67.

Percent gravel results

More importantly, we note that gravels comprised a range between 15 percent and 46 percent of riffles in San Vicente Creek (Figure 3-6). Moreover, riffles in the lower reaches of San Vicente Creek (Reaches 1 and 2) exhibited the highest within this range. For instance, riffles 1-3 exhibited more than 30 percent gravels. Alternatively, Reach 4 (riffles 7 and 9 in particular) expressed the lowest abundance of gravels, 19 and 15 percent, respectively. We recognize that range of size and abundance of gravels may not be an indicator of usable habitat given that our sampling was limited to riffles and did not include pool-tail outs—a more common location for spawning. Gravel requirements also differ with life stage, thus the appropriate gravel size and abundance may vary with the functions of each life stage (Kondolf, 2000). With that said, our data may suggest Reach 2 may be the highest priority for planning efforts to protect and enhance general salmonid spawning habitat solely on the fact that riffles in this reach may provide the best opportunities. Although one riffle in Reach 1 exhibits an abundance of gravels, we note other physical constraints within Reach 1 may hinder restoration and planning efforts in this reach, as noted in other sections of this report. Above all, we note that riffle textures can and will change from year to year and from flood to flood. While these results may characterize conditions in late WY2013, they should be interpreted with caution when extrapolating them to future studies or in context of interpretations from earlier studies. As stated earlier, a large event can 're-set' channel patterns and sediment dynamics within San Vicente Creek.

Pool tail-out locations

As noted above, our study was focused on riffle texture while other studies (CDFW, 2013) have evaluated gravel abundance on pool tail-outs, a separate morphology unit from riffles and the preferred location for spawning (i.e., building redds). CDFW concluded that gravel abundance ranged between 15 and 47 percent in these specific morphology units of the stream. These data suggest gravels are in low to moderate abundance and support our findings.

Gravel-lithology results

Because gravel sources are important to protect in future planning efforts, we attempted to describe the origin or lithology of gravels provides information about the location in the watershed where they were derived. The lithology of gravels varies from riffle to riffle because of factors such as changes in basin geology, channel slope, and frequency of large floods. When we examined the lithology of gravels in each riffle, and across all riffles, we found that over 70 percent of riffles were primarily derived from the watershed's crystalline rocks, more specifically, diorite. While we also identified some gravel- and cobble-sized material comprised of local mudstone and sandstone, we note that these materials were incompetent—easily reduced to sand-sized material or smaller and, therefore, provide only temporary substrate for salmonids.

Based on the dominant lithology of gravels as diorite and exposure or mapping of diorite in the watershed, we would assume that most of the gravels likely originate from the upper watershed and along a short segment of the mainstem immediately downstream of the confluence with Mill Creek (Figure 3-1). However, this conclusion is complicated by the fact that the decommissioned marble quarry, along the mainstem of San Vicente Creek, may interrupt both conveyance of flow and sediment to downstream reaches, although our understanding of the effects of the decommissioned quarry on these processes is poor. While the quarry has been decommissioned for 45

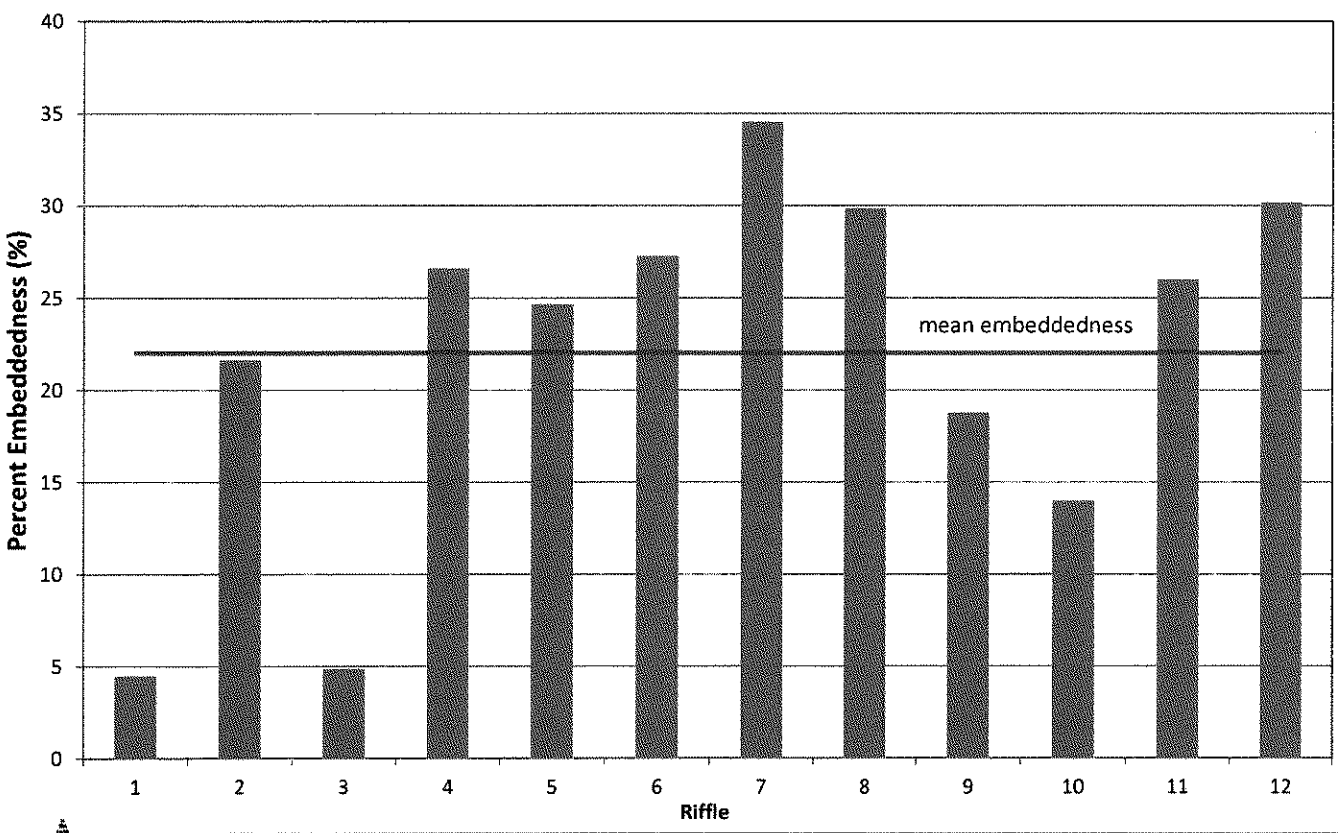

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Figure 3-7. Percent of clasts in the measured riffles that were assessed to be embedded.

years, we still observe coho presence in San Vicente Creek and a moderate level of gravel abundance in downstream reaches. In the absence of knowing the dynamics of sediment and streamflow through the quarry, and if we are to assume that sources above the decommissioned quarry are captured, Reach 6 and Mill Creek may be the more obvious sources of gravels. Patterns or trends in gravel abundance among riffles sampled may not relate to the source of gravels, but instead, be attributed to sorting and storage as the result of a particular flood—which, at this time, we do not have a full understanding. Nevertheless, we do know Mill Creek is largely underlain by diorite and therefore, should be protected as a source of gravels.

Understanding gravel abundance may provide a good proxy for material used by salmonids; however, additional information is needed to evaluate whether those gravels can be modified or moved by salmonids (i.e., spawning) and to better understand salmonid abundance to determine whether spawning gravels (as a proxy for redd formation) could be a limiting factor for salmonid populations in San Vicente.

Percent of fine sediment in riffles results

Studies of spawning gravels have related the percentage of fines as the most significant effect on salmonid embryo survival (Kondolf, 1988, Kondolf and Wolman, 1993, Tappel and Bjornn, 1983). Coho were found to have lower rates of survivability when riffles include 30 percent or more of fines measuring 6.4 mm or smaller. We evaluated our riffle textures in the context of these findings. However, because we used standard phi sizes for our analysis we characterized fines as sediment grains less than 8mm for the purpose of this analysis. Riffles were grouped in bins including:

» Fines < 8mm;

» Gravel;

» Cobble;

» Boulder.

Sediment less than 8mm comprised between 10 and 45 percent of riffles, while only two riffles (Riffle 3, Riffle 11: Mill Creek) exhibited greater than 30 percent of sediment 8mm or less. We note that riffles with more than 30 percent fines were located downstream of recent or on-going disturbances or channel modifications. For instance, Riffle 3 (Reach 2) is located below recent introduction of instream wood to the creek for habitat restoration objectives. These structures may be inducing new hydraulics to the reach segment as both bed and bar materials are noticeably reorganized. Similarly, riffle 11 is located in Mill Creek and downstream of numerous and active sediment sources identified as part of this study and discussed in detail in subsequent sections of this report. When we compare the percent fines from riffles evaluated in the mainstem of San Vicente Creek (upstream of the confluence) and Mill Creek, we observe more than twice the percent of fines in Mill Creek. This result, although based on a single riffle in each reach, may further support the contention that the major sources of fine sediment originate from the Mill Creek tributary. While Mill Creek is also a potential source of gravel-sized material, it is also a known source of finer material that is not advantageous for salmonids.

Embeddedness results

Percent embeddedness for sampled riffles is shown in Figure 3.7.

While the percent of fines is one metric used to evaluate spawning habitat suitability, embeddedness is another metric that provides additional information. The literature describes multiple definitions for embeddedness and methods of measurement (Sylte and Fishchenich, 2002). Therefore, comparison between studies should be used with caution. For the purposes of this study, embeddedness is defined as the degree that spawning-sized substrate is held tightly into the channel bottom by other finer sediment, making the construction of redds by spawning salmonids difficult. Absence or presence of embeddedness was recorded for each sample collected by difficulty of removal of gravel or cobble sized particles from the bed and the observation of algae or sediment staining. CDFW (1998) has characterized good spawning substrate as less than 25 percent embedded.

We observed varying conditions of embeddedness in the riffles in San Vicente Creek, ranging between 4.5 and 35 percent with a mean of 22 percent across all riffles. Percent embeddedness for sampled riffles is shown in Figure 3.7. Please note that "percent" embeddedness is not the extent to which an average clast is embedded, but the percent of clasts that are embedded either a small amount or a large amount. Creegan and D'Angelo (1984) reported the presence of embeddedness throughout San Vicente Creek, while McGinnis (1991) reported between values 25 and 50 percent embeddedness and more recently CDFW (2013) reported similar results for pool-tail outs. Combined, these studies suggest San Vicente Creek experiences a moderate level of embeddedness that has not measurably changed over the years and suggests fine sediment continues to have an impact on salmonid habitat.

Mineralogy of sediment results

Based on our assessment of riffle texture, salmonid spawning-sized substrate is largely sourced from diorite. Diorite is mapped throughout the upper watershed, specifically in areas above the old quarry and USGS gaging station (Brabb, 1989). It also exists in lower portions of Mill Creek and along the mainstem, a short distance downstream of the Mill Creek confluence. Our qualitative assessment of the upper watershed found an abundance of gravel-sized substrate stored along instream bars, behind large woody debris and old dams previously used for diversion of flow for quarrying operations. Additional storage of gravel was observed along a wide floodplain on the quarry floor; however, hydrology and sediment transport from the quarry to downstream reaches is poorly understood. A tunnel exists between the quarry and downstream reaches of San Vicente Creek and was observed blocked by abundant wood and sediment. Observations of the reach below the tunnel outlet (Reach 5) did not suggest that sediment observed in the quarry is currently reaching downstream reaches. As noted earlier with sediment sources in the quarry, possible studies such as paired bedload measurments above and below the quarry may provide insight into sediment dynamics including transport or gravel sized material to downstream reaches.

Floodplain-to-Creek Connectivity Evaluation

Floodplain-to-creek connectivity is a factor that can be considered for evaluating how well a creek system is functioning. A creek that is poorly connected to its floodplain rarely inundates its floodplain, and therefore rarely exchanges sediment and wood with the floodplain. A well connected floodplain would usually flood one or more times per year and serves as a buffer by attenuating peak flows and by being both a source and a sink for sediment and wood.

While floodplain-to-creek connectivity is an important indicator of natural geomorphic processes, it is also considered critical for supporting salmonids as inundated and accessible floodplains provide winter-flood refuge for all life stages, and can provide significant inputs of food into streams systems through mobilization of organic matter and insects. In many cases, creeks also meander across the floodplain leaving relict channels and oxbow or back-water type features; these lower elevation features would be inundated more frequently and for a longer duration, and therefore might be more important from a fishery perspective. A well connected floodplain, in both the horizontal and longitudinal directions, is thus a dynamic environment that serves important alluvial, riparian, refuge, and habitat functions.

As such, improving floodplain connectivity can be a critical objective of stream and salmonid restoration. Increased frequency and duration of flooding of floodplains can be accomplished by lowering the floodplain elevations (such as by mechanical removal of vegetation and soil), by raising the channel bed[3] of the creek (such as by adding large-wood structures that fully span the channel), or selectively redirecting flows toward abandoned back-water channels (also by placing large wood or other instream structures).

Floodplain Geomorphology

In San Vicente Creek, floodplains are generally formed by alluvial sands, gravels, and cobbles that were carried by the creek and deposited in those locations. Floodplains can be formed or eroded in small increments by high flows on a year-to-year time frame, or can be formed suddenly (over several hours) by very high flows. Large or small perturbations to floodplains are often a result of wood jams that create backwater areas or cause the creek to cut a new path around the wood jam. Floodplain terraces created by episodic large storm events can persist for long periods of time and can sometimes be identified and dated by even-aged stands of riparian trees, such as alders.

More importantly, floodplain terraces that are formed by very-large storm events are often at a higher elevation than the water levels generated by year-to-year peak flows. These high-floodplain terraces will typically be poorly connected with the creek channel. Examples of this type of high-floodplain terrace are:Just upstream of the Highway 1 tunnel, a substantial backwater event occurred in February 1998 and caused the deposition of sediment upstream for several hundred feet or more (Stamm and others, 2008).

Another substantial channel and floodplain-forming event (of which we still see evidence) occurred during January 1982.

Some reaches of the San Vicente Creek channel and floodplain have also been directly changed by land-use practices; also, much of the channel and floodplain has been (or may continue to be) indirectly affected by changes in sediment and wood loading to the creek that may affect how the creek interacts with the floodplain. For example, if creek-side trees were cut and removed at some point in the past, then some of those removed trees would not be able to eventually fall into the creek to start-- or add to-- log jams which force high flows onto floodplains. This potentially reduced number of log jams also traps less sediment behind them, and does not replenish previous large wood in the creek that had been previously been trapping sediment; this lack of replacement wood could lead to incision below a level at which the creek and floodplain can interact frequently.

In some locations, the creek bank has migrated until it has encountered bedrock; in these locations, a floodplain is limited to one side of the creek channel. In other locations the creek has cut shallowly into bedrock, but floodplains or terraces still exist above the level of the bedrock. We observed bedrock creek banks in Reaches 2, 3, 4, and 5.

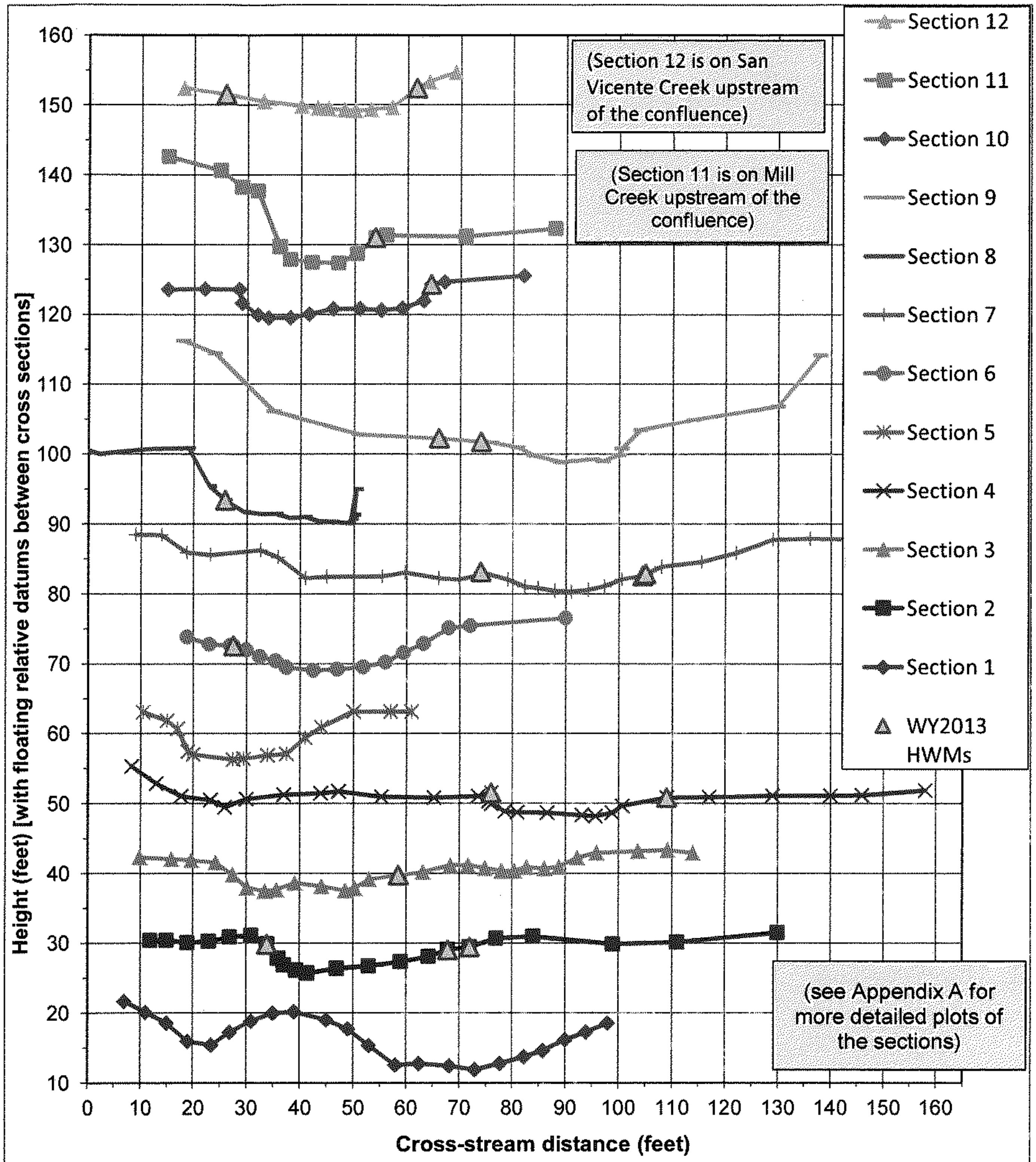
In canyon locations, where there are steep valley slopes, there may be no floodplains or very minimal floodplains; this can be a natural condition based on the slope of the creek channel where minimal alluvium would be expected to collect and form floodplains along the sides of the channel, but can also be caused if large amounts of material have been pushed to the edge of the creek from the side. Canyon morphology is common in the sections of San Vicente Creek and Mill Creek upstream of the locations where cross sections were surveyed.

Floodplain-to-Creek Connectivity Evaluation Methods

Balance evaluated floodplain connectivity by surveying twelve channel and floodplain cross sections. High-water marks[4] (HWMs) were also surveyed as an indication of water height during previous high flows. The surveys were performed with auto level, tripod, survey rod, and fiberglass measuring tape;

3 Channel sediment then fills in upstream of the cross-stream log structure; some of this sediment should be placed at the same time the logs are placed to reduce the chances of undercutting or cutting around the structure.

4 High-water marks (HWMs) are by their nature approximate, and sometimes can be difficult to assign an accurate date to, so some HWMs that we surveyed may have been from previous larger floods, or subsequent lower flows than the December 23, 2012 date that we assigned to the HWMs in the field. HWMs were found over a 1-foot or ½-foot range of elevations at many sites.



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The cross-section surveys show varying degrees of floodplain connectivity. Well connected floodplains would ideally be inundated one or more times per year during most years. This frequency of inundation generally corresponds to a floodplain that is 2 to 2.5 feet above the channel bottom.

Figure 3-8. Cross-section survey measurements: San Vicente Creek, July 2013.

relative datums were used for each individual site. Locations were marked with a hand-held GPS unit, and are shown in Figure 3.2. We surveyed the cross sections on July 22 and 23, 2013; other measurements (riffle texture and creek discharge) were made at the same location at the same time.

Site selection was not random or regular. Most sites were selected because the sampling team deemed them to be representative of broader conditions, thus may be slightly biased. We selected some sites because they would make good analogs for future restoration (sites 3 and 7 for example). Site 4 was selected because it was the site of a recently completed restoration project. Site 11 is on Mill Creek a short distance upstream of the confluence with San Vicente Creek. Site 12 is on San Vicente Creek a short distance upstream of the confluence with Mill Creek.

The highest flow of water year 2013 occurred December 23, 2012, and was approximately 657 cfs (at the Balance Hydrologics creek gaging station), which we calculated to be approximately a three to four year return-period high flow. This was the most prominent HWM that we observed and measured, although HWMs were not found at every cross section. Those WY-2013 HWMs were usually two to three feet above the low-flow water surface (see Appendix C).

Older HWMs, which were often evidenced by scarring of bark on creek-side alders (caused by floating debris) were higher than the water year 2013 HWMs. We do not know the dates or the flow rate of the peak flows that caused those bark scars, but they indicated flood levels that were five to six feet above the low-flow water surface (or about two to three feet higher than the water year 2013 HWMs).

We have related the height of the HWMs to the height above the low-flow water surface, and to the height of the floodplain at each cross section. We have also estimated the inundated width of the combined channel and floodplain as an indicator of floodplain connectivity.

Floodplain-to-Creek Connectivity Results

The cross-sections are shown together in Figure 3-8, and individually in Appendix C (Figures B.1 to B.12), the results are shown in Table 3-3. At most locations, the water year 2013 HWMs were two to three feet above the low-flow water level.

» At seven of the 12 cross sections, the floodplain was not inundated by the water year 2013 high flow.

» At two of the 12 cross sections, the floodplain was just barely inundated by the water year 2013 high flow.

» At three of the 12 cross sections, the floodplain was just moderately inundated by the water year 2013 high flow.

Floodplain-to-Creek Connectivity Interpretation

Vertical Floodplain Connectivity

Based on the estimate of the water year 2013 peak flow as having approximately a three to four year return period, we have evaluated floodplain connectivity based on this expected frequency of inundation. However, because the return-period calculations are based on limited data, the return-period estimate is only approximate; if the actual return period of that peak flow was lower (e.g. two years), then several locations would have better floodplain connectivity than currently evaluated.

We also used "width of inundation" as a factor in evaluating floodplain connectivity for floodplains that have a range of elevations (see Table 3-3 and Appendix C). The wider the inundation, the better connected a floodplain is to the channel.

» In **Table 3-3**, an evaluation of "good" floodplain connectivity is based on sites where the floodplain was moderately inundated by the WY 2013 high flows. Sites 3, 7 and 10 were evaluated as "good".

» In **Table 3-3**, an evaluation of "marginal" floodplain connectivity is based on sites where the floodplain was only barely inundated by the WY 2013 high flows. Sites 3 and 9 were evaluated as "marginal"; these sites could change to "good" if the water year 2013 peak flow were actually more frequent level of flooding.

» In **Table 3-3**, an evaluation of "poor" floodplain connectivity is based on sites where the floodplain was not inundated by the WY 2013 high flows. Sites 1, 2, 5, 6, 8, 11, and 12 were evaluated as having "poor" floodplain connectivity.

In most cases, sites with poor floodplain connectivity would still be candidates for restoration projects. However, more material would need to be removed to connect the creek to the floodplain in the "poor" locations, even if wood structures were added to trap sediment and raise the bed of the creek.

Longitudinal Floodplain Connectivity

We did not quantify the upstream-to downstream extents that the cross sections represented, but we did note the well-connected floodplains did not extend very far upstream and downstream. We also noted that the poorly connected sections seemed to extend for considerable distance upstream and downstream. We occasionally noted backwater channels on the floodplains; these also typically did not extend very far longitudinally, usually about 100 feet or less.

Floodplain Complexity

We define floodplain complexity as the number and/or depth of features other than a broad, flat alluvial surface. Features such as relict channel beds, oxbows, high-flow cutoffs, wetlands, and connected- or disconnected backwater channel increase floodplain complexity. We found some features like this but not many. In Figure 3-8 and Appendix C, cross section 1 has a backwater channel on the left side; cross section 3 has a high-flow cutoff across the right side of the point bar; cross section 4 has a relict channel on the left side; cross section 7 has a shallow backwater channel on the left side of the low floodplain. Restoration projects that lower floodplains or raise the creek bed should also specifically create features that increase the complexity of floodplains. Because of the sediment load in San

Table 3-3. Floodplain-to-creek connectivity parameters: San Vicente Creek near Davenport

Based on the level of WY 2013 high-water marks compared to the floodplains, only a few localized sites along San Vicente Creek have good floodplain connectivity. Because the water year 2013 high flow was a 3 to 4 year peak flow, well connected floodplains should have been moderately inundated. Sites that were just barely inundated during water year 2013 would likely not have been inundated during a year with a 1.5 to 2 year peak flow.

Cross Section Location	Reach Location	Closest NOAA tag #	Height from WSE to WY 2013 HWMs (feet)	Height from WSE to flood-plain/ terrace (feet)	Inundation depth on floodplain based on WY 2013 HWMs (feet)	Width of inundation at HWM elevation (feet)	Degree of floodplain connectivity	Width of primary floodplain or terrace (feet)
Section 1	1	6	no HWM	6	not inundated	no HWM	poor	34
Section 2	1	8	2 to 3	4	not inundated	36	poor	30
Section 3	2	15	1.7	2.5 to 3.2	not inundated	31 or more	marginal	30
Section 4	2	22	2 to 2.5	2 to 2.5	0.5	74	good	50
Section 5	2	31	no HWM	5 to 6	not inundated	na	poor	11
Section 6	3	38	3	3 and 6	not inundated	35	poor	4 and 30
Section 7	4	48	1.5 to 2	1.5 and 5	0.5 and not	63	good	39 and 14
Section 8	4	55	2.6	9.5	not inundated	24	poor	17
Section 9	4	64	2 to 2.5	2 to 3	just barely	30	marginal	25
Section 10	4	90	4.5	3.6	0.9	50	good	13
Section 11	4	Mill Cr.	3.3	3.6	not inundated	18	poor	34
Section 12	5	93	2 to 2.7	no floodplain	no floodplain	36	poor	none

Notes:

WY 2013 = water year 2013, which started October 1, 2012, and finished September 30, 2013.

WSE = water surface elevation (when surveyed, July 22 and 23, 2013).

HWM = high-water mark (evidence found of water levels from previous high-water)

HWMs are by their nature approximate, and sometimes can be difficult to assign an accurate date to, so some HWMs that we surveyed may have been from previous larger floods than the December 2012 dates that we assigned to the HWMs in the field.

HWMs were found over a range of elevations at many sites, so often a height range is given in the Table above. For sites where HWMs were not surveyed, we have assummed similar relative heights from the other sites.

» "poor" floodplain connectivity is based on floodplains not inundated by the WY 2013 high flows

» "marginal" floodplain connectivity is based on floodplains barely inundated by the WY 2013 high flows

» "good" floodplain connectivity is based on floodplains moderately inundated by the WY 2013 high flows

Vicente Creek, low floodplain areas fill in relatively quickly, so if it is desired to keep complex features at a low elevation, flood hydraulics need to be considered and perhaps used to site the features where high velocity will maintain or scour them during storms. Large wood or log structures can be used to focus high flows to improve or maintain complex habitat features.

Duration of inundation

For fisheries, the *duration* of inundation of the floodplain or backwater areas is also important. Figure 3.9 shows the hydrograph of the December 23, 2012 storm which was a typical duration for a large storm, and was slightly above average in terms of peak flow (657 cfs). The duration of floodplain inundation varies site by site, but if 300 cfs causes inundation at a site, then the duration of inundation would have been approximately three hours. The inundation duration for sites with lower habitat areas, like backwater channels that provide high-flow refuge, that might have been inundated by 100 cfs would have been approximately 15 hours.

For the purpose of categorizing the degree of vertical floodplain connectivity, we defined the "floodplain" as the broad flat area next to the creek that appeared to an alluvial surface. For restoration or enhancement projects a broader and more useful definition of "floodplain" could be the wide flat area, plus lower areas of relic channels, high-flow over-flow channels, oxbows, and connected or disconnected back-water channels; these lower areas would get inundated more often and for a longer duration and therefore might be more useful for fish refuge and habitat.

In larger, low-gradient or snow-melt river systems long periods of floodplain inundation create conditions that are favorable for fish to interact with floodplains and complex habitat features.