Lagunitas Creek Watershed
Fine Sediment Reduction and Habitat Enhancement Plan
San Francisco Bay Regional Water Quality Control Board

Photo credit: Stillwater Sciences

Mike Napolitano, Engineering Geologist
28 June 2013

Today's Presentation

Photo credit: Marin County Free Library

Lagunitas Creek at Irving Bridge in 1889

- San Francisco Bay Water Quality Board
- What is a TMDL?
- Story of sediment and channel changes in Lagunitas
- Proposed actions to achieve water quality objectives
- Public process and schedule

San Francisco Bay Regional Water Quality Control Board

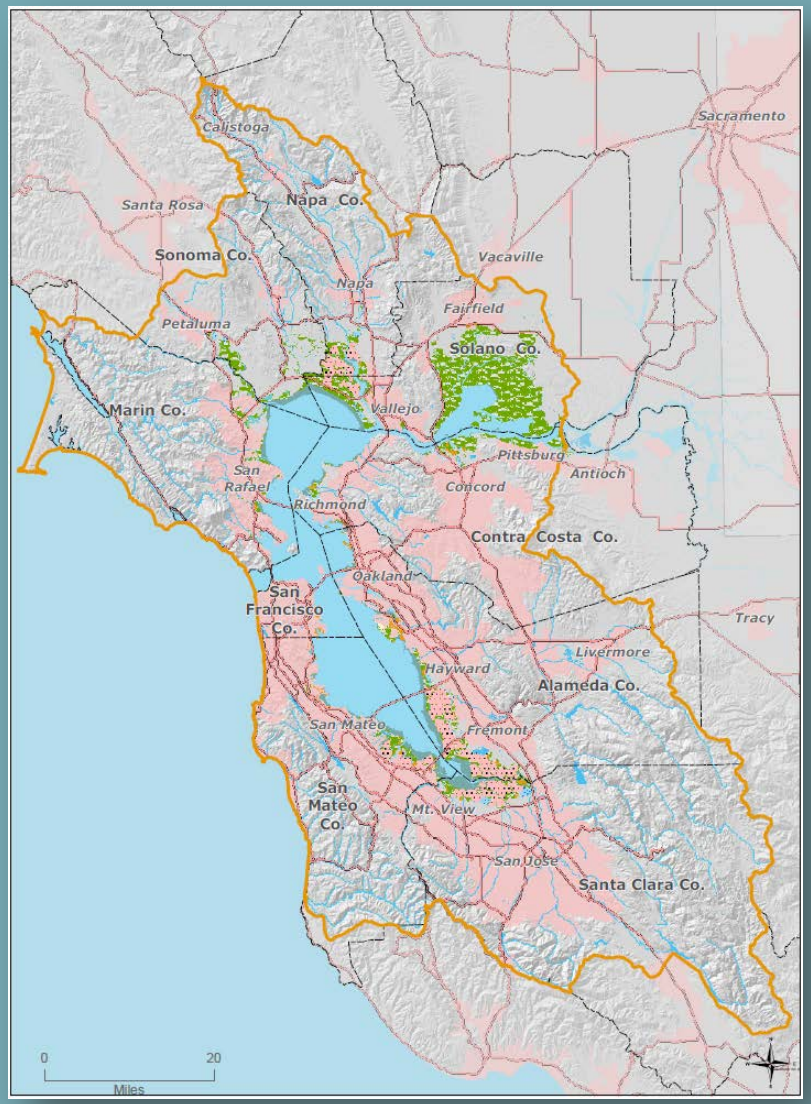
In 1967, the state legislature established regional water quality control boards

To protect beneficial uses of water for the use and enjoyment of its people

Implement state Porter-Cologne Act and federal Clean Water Act

The San Francisco Bay Region includes the Lagunitas Creek Watershed

Our master planning document is called the Basin Plan



San Francisco Bay Region (Basin Plan)

Beneficial uses of water (examples include):

- water supply
- recreation
- preservation of rare and endangered species

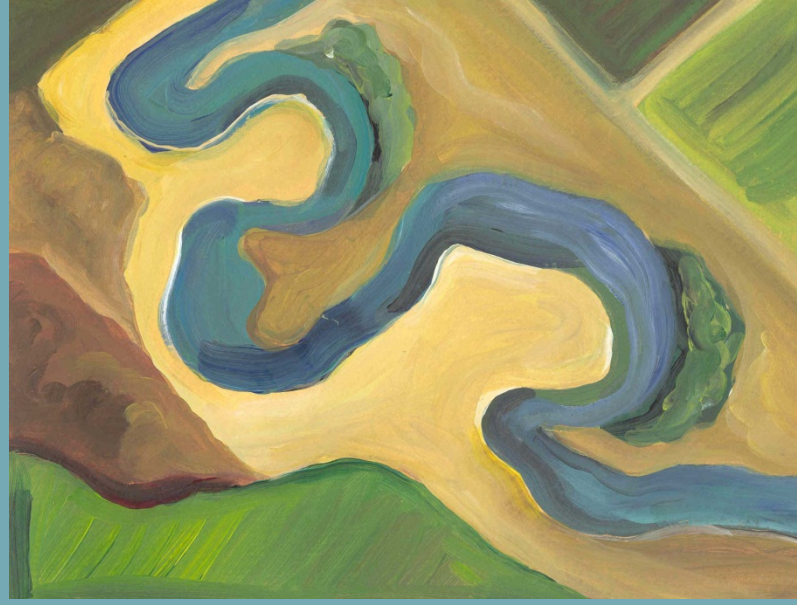
Water quality objectives (in this case):

- sedimentation
- habitat condition

Plans and policies to achieve water quality standards (in this case):

- a plan to reduce fine sediment supply and enhance habitat

TMDL in Plain English



Artwork by Sandi Potter

TMDL is a national program mandated by the federal Clean Water Act to:

- Identify “impaired” waters
- Determine pollution sources
- Develop plans to restore water quality

Story of sediment and habitat changes

Lagunitas Creek in 1889 in Camp Taylor

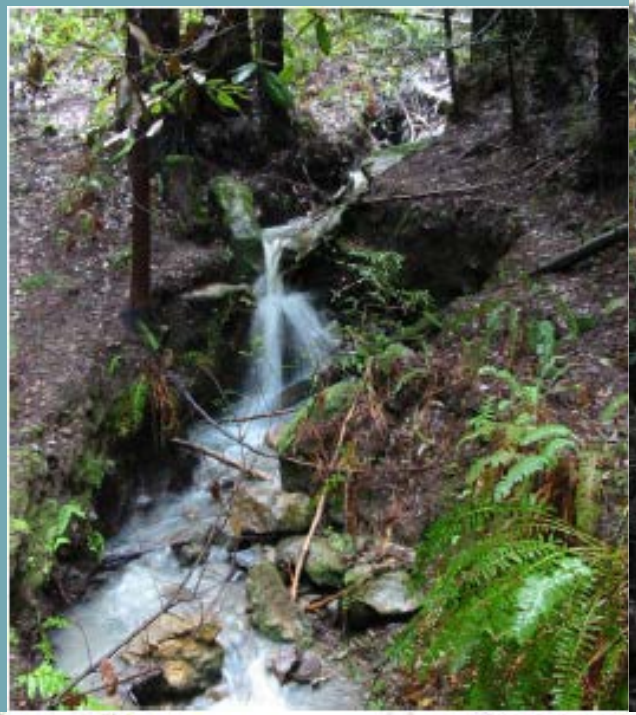
Credit : Anne T Kent California Room, Marin County Free Library

More than 50% of habitat for salmon and steelhead lost to dams

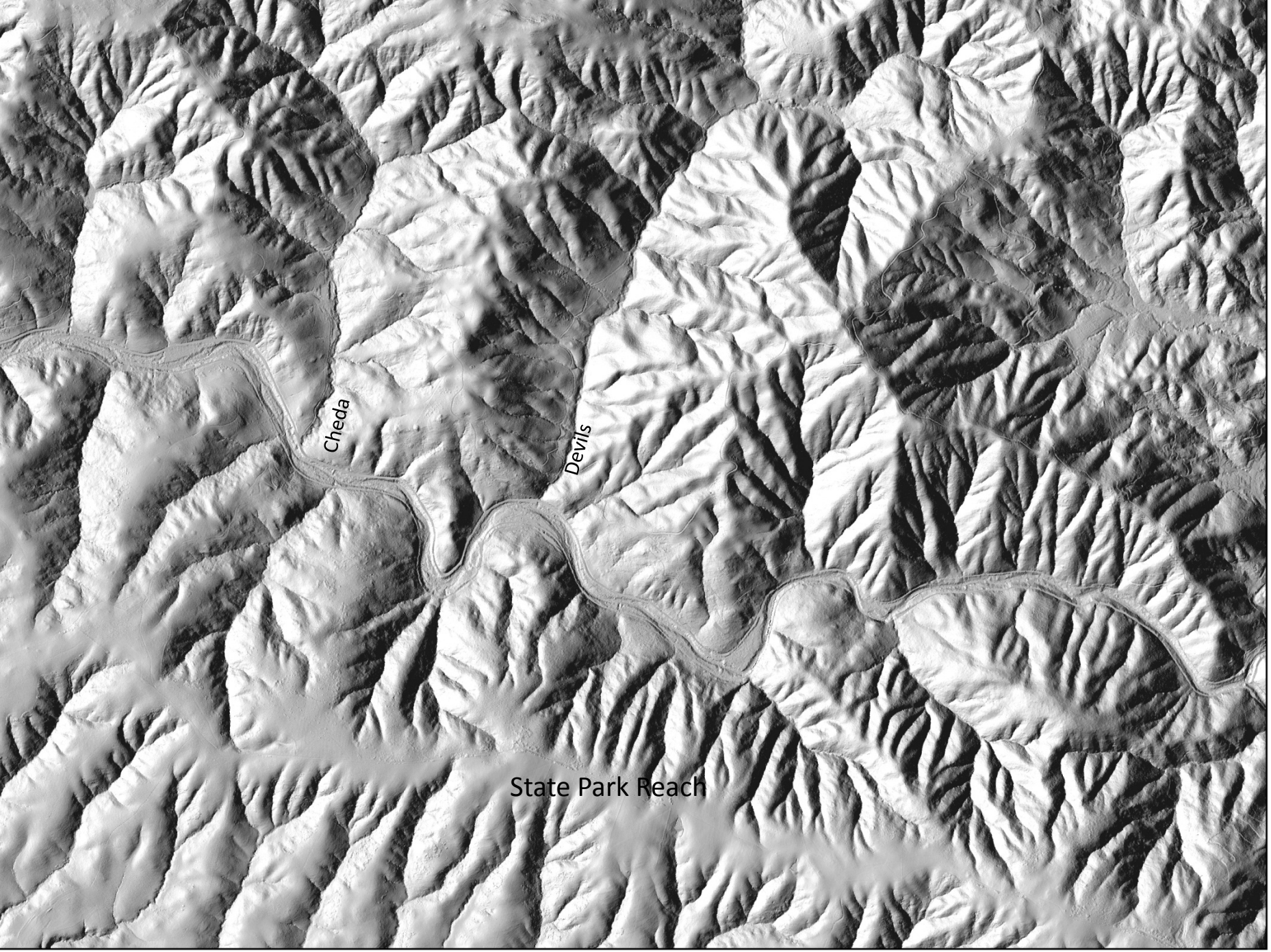
Lagunitas Limiting Factors Analysis
Limiting Factors for Coho Salmon and Steelhead

In habitat that remains, salmon and steelhead populations are limited primarily by winter habitat conditions

Most channels in the watershed are deeply incised

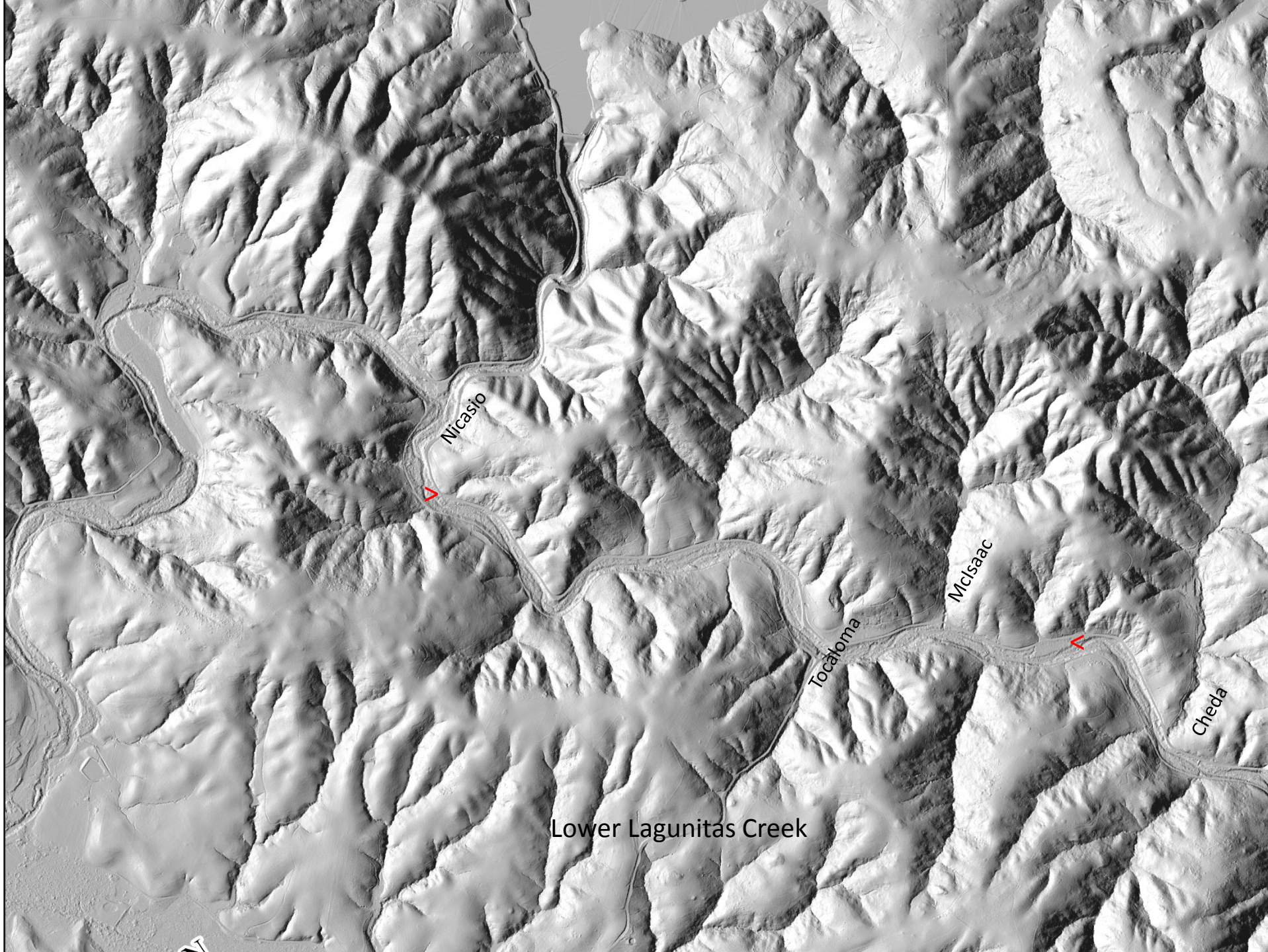


Arroyo
Larsen
Woodacre
San Geronimo Valley

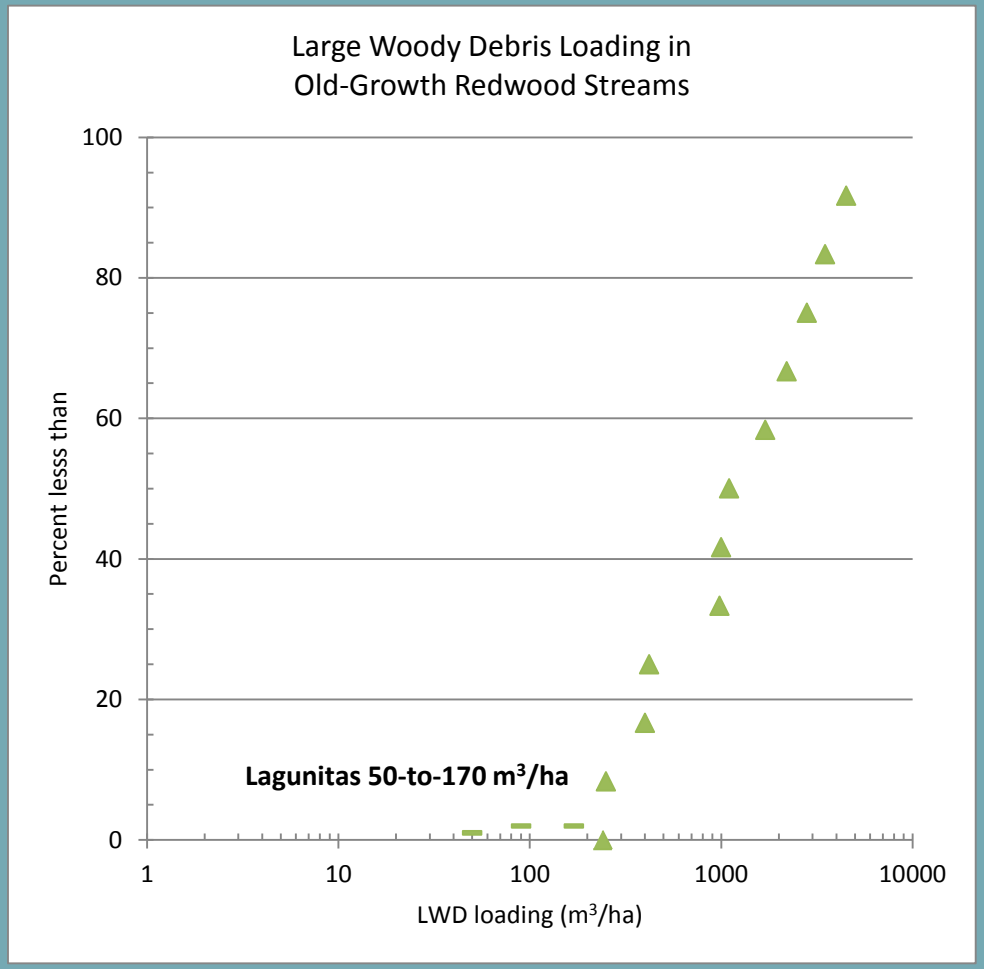

Cheda
Devils
State Park Reach

Some channels
Are complex and
Connected to
floodplains

Wood formed bar-pool
units and side channels
In Tocaloma Reach


Nicasio
Tocaloma
McIsaac
Cheda
Lower Lagunitas Creek

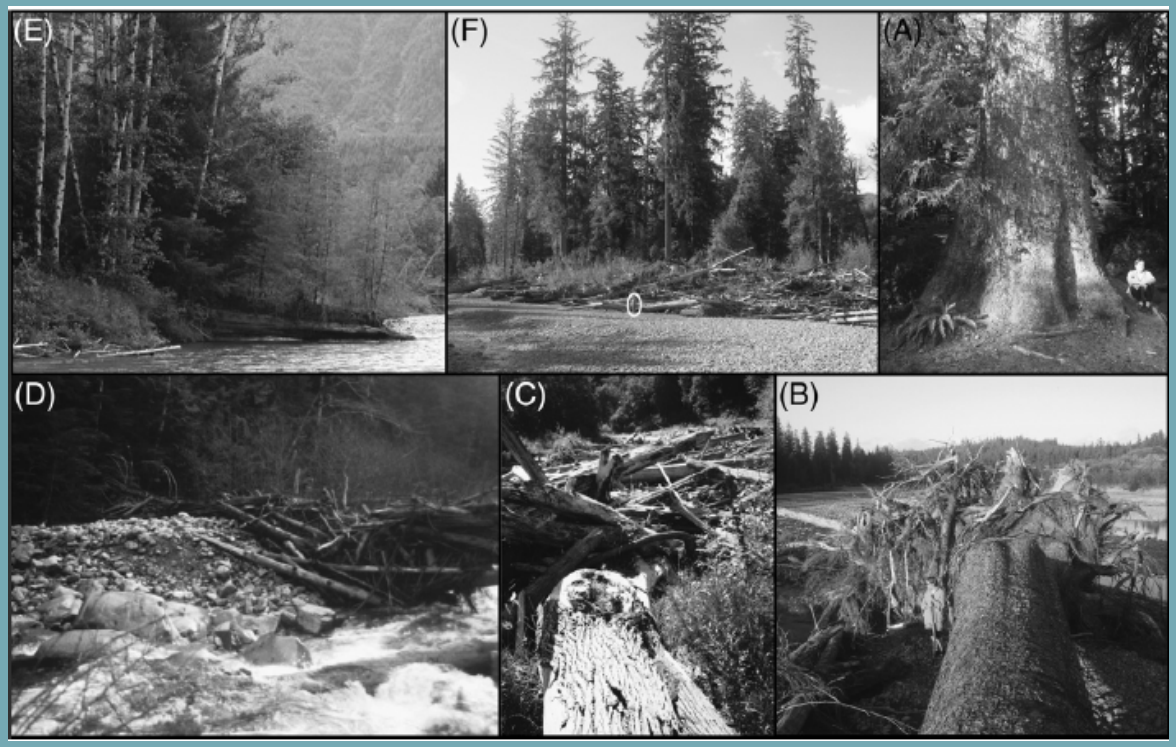
Significant wood deficit in Lagunitas and its tributaries



Important factor in channel habitat simplification and disconnection from floodplain

Large wood forms complex interconnected channel-floodplain habitat

Type & frequency of jams is a function of channel attributes, wood size, and input processes



Collins et al. (2012)

Stable jams are formed by key pieces

Key piece ≡ tree length ≥ $0.5 \cdot W_{bf}$ & tree diameter ≥ $0.5 \cdot d_{bf}$ & an intact root-wad

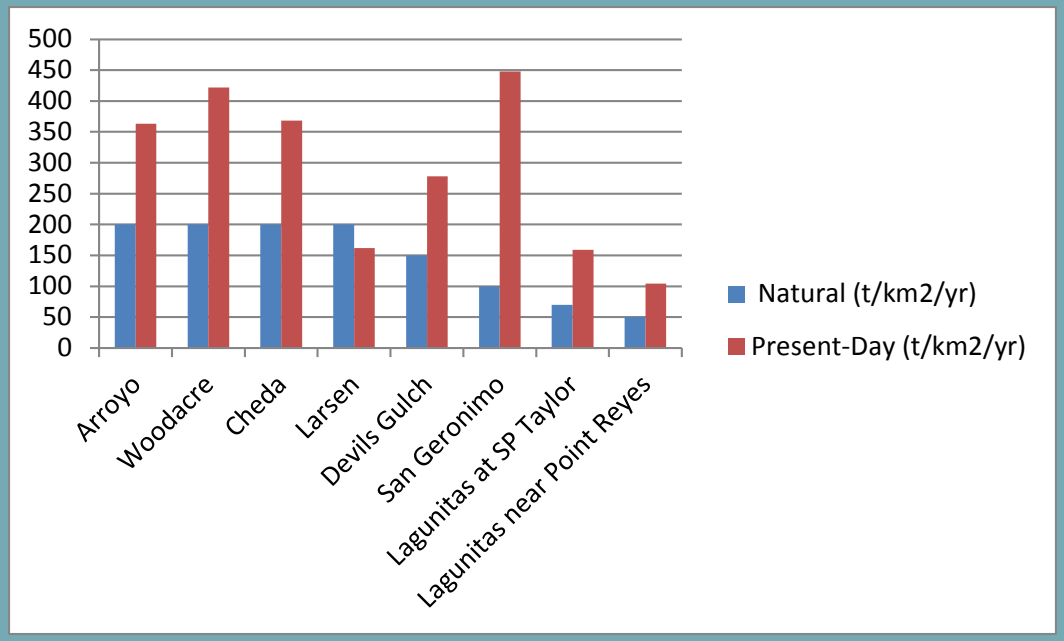
How much sediment and how does it compare to natural?

Taking Action for Clean Water—Bay Area Total Maximum Daily Load Implementation: Lagunitas Creek Sediment Budget

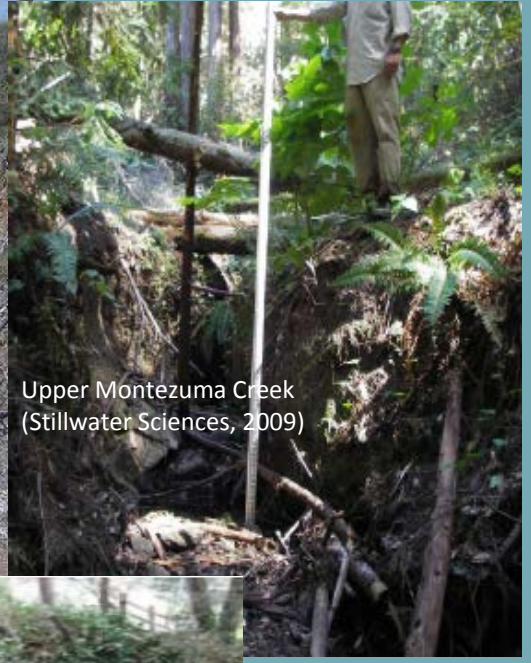
Final Report

Total sediment supply ≥ 2X Natural and richer in fines

Sediment Loads vary by location and are a function of:

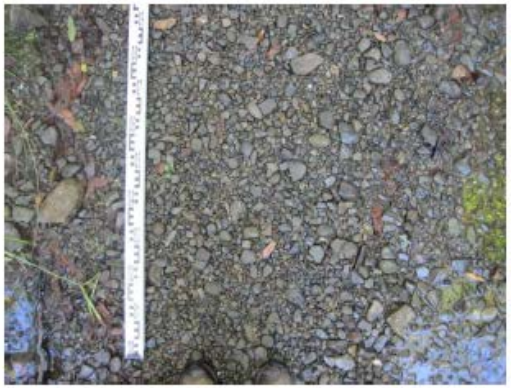


geology, naturally disconnected channels, floodplains, and dams



Major sediment sources

How does sediment supply effect streambed conditions?



Linkages between sediment delivery and streambed conditions in the Lagunitas Creek watershed, Marin County, California

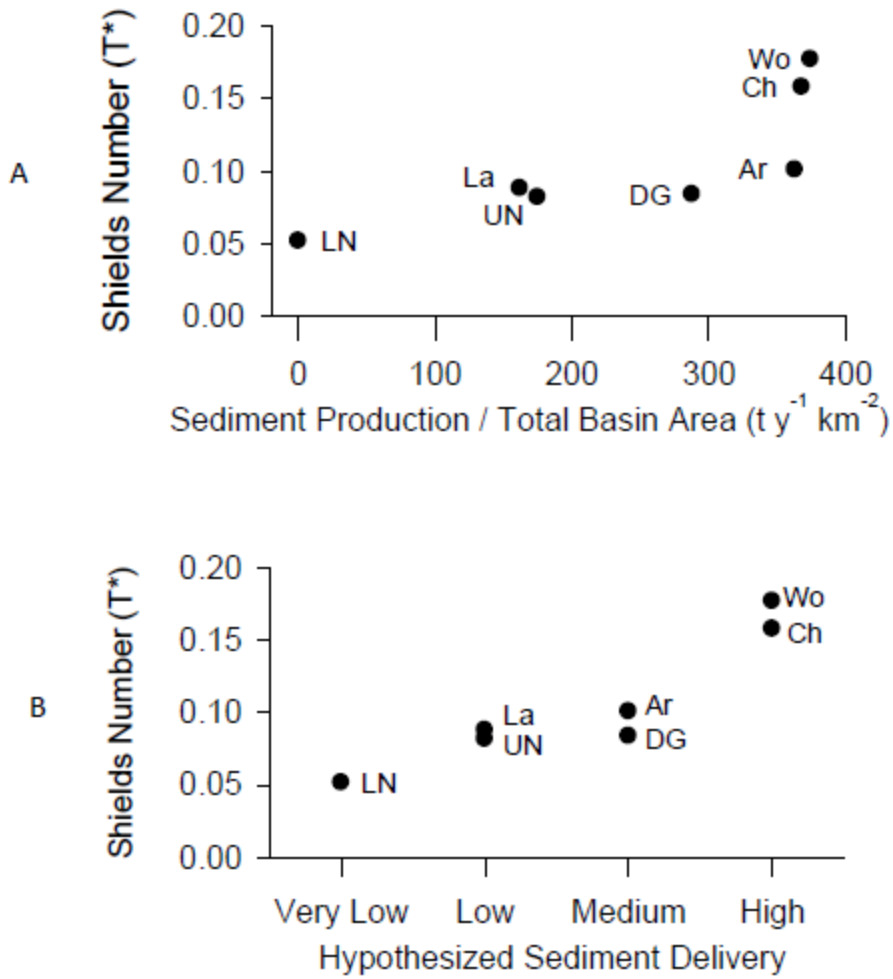
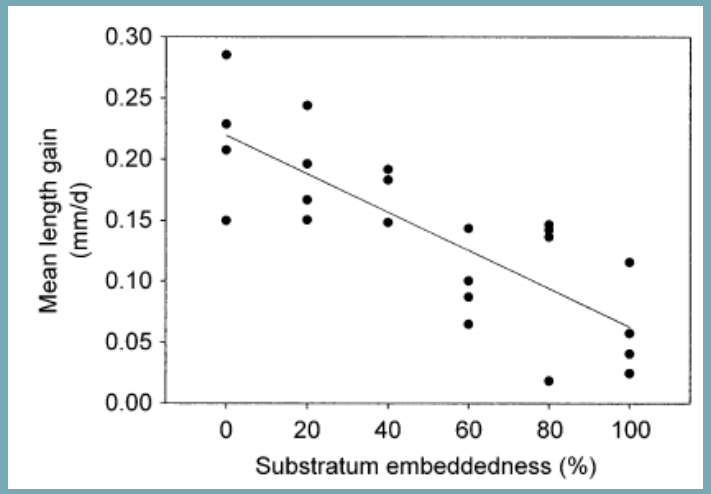


Figure 7. Reach-average Shields stress (τ^*) versus a quantitative estimate of sediment production (A) and a qualitative assessment of sediment delivery (B).

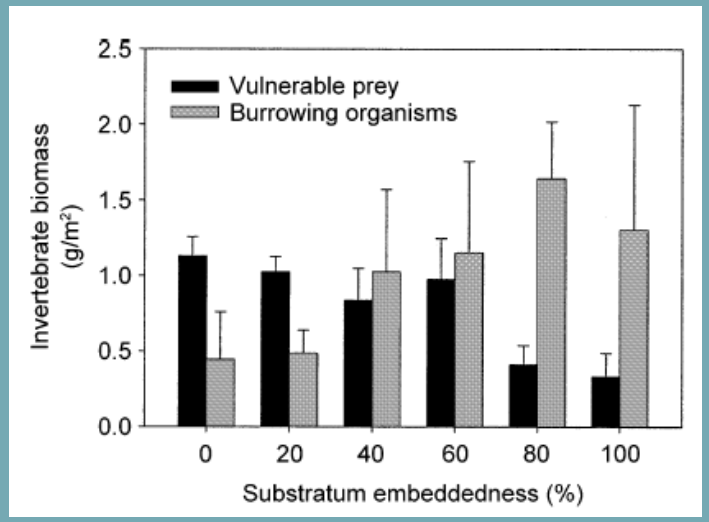
Suttle et al. (2004)

FIG. 1. Juvenile steelhead over 100%, 80%, and 0% embedded substrates (left to right).

Growth of juvenile steelhead



$R^2 = 0.63$; $P < 0.0001$



$R^2 = 0.42$; $P < 0.001$

Proposed Actions

Photo credit: Dewey Livingston Nicasio Creek circa 1900

- Primary focus to increase wood in channels on public lands
- Explore floodplain restoration on Lagunitas below Nicasio
- Encourage construction engineered jams in San Geronimo watershed in reaches where safety and property are protected
- Additional efforts to reduce fine sediment delivery from roads, primarily in San Geronimo watershed

Chronic fine sediment supply from roads

- Very high road density (> 7 mi/mi^2) in San Geronimo Creek watershed where about 30% of sediment delivery to channels is road-related
- We applaud efforts of Marin County Open Space District and MMWD

Tributary channels

High bed mobility, poorly sorted bed, incised, and simple channels

Source: Cover (2012)

Painted rocks in Cheda Creek before and after peak flow ≤ 50% of bankfull

Add wood to enhance complexity & sediment sorting & to reduce shear stress

Reduce chronic fine sediment supply from roads

Lagunitas Creek in the State Park Reach

Incised, simplified, wood poor channels, with poorly sorted substrate

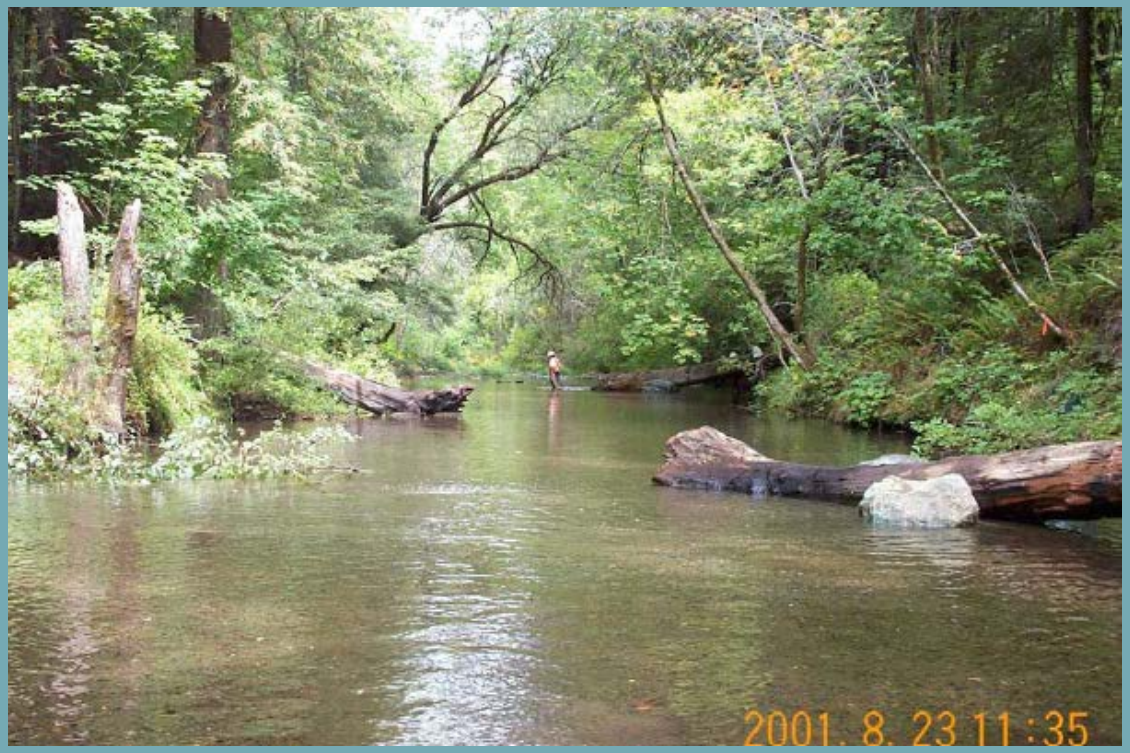


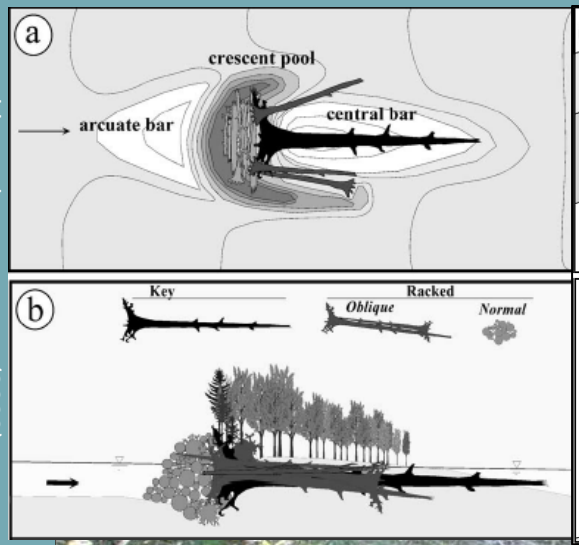
Photo credit: MMWD

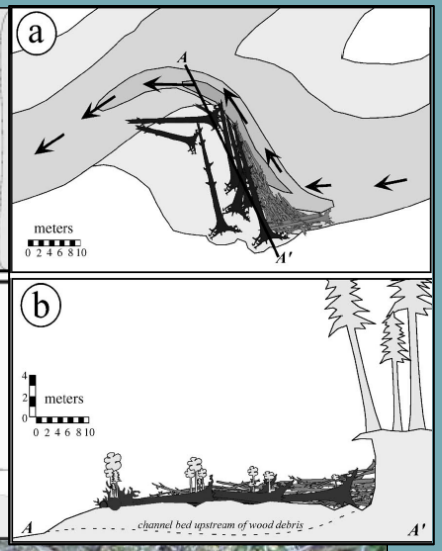
In near-term apply natural process-form relationships to construct jams comprised of key pieces. In medium- and long-term increase key piece recruitment

Engineered wood jams based on natural analogs

≥ 10 bar-apex jams
In State Park reach

Abbe and Montgomery (2003)





≥ 5 flow-deflector jams
In State Park Reach

Photo credit: The Nature Conservancy

Or designed by the channel

Tocaloma Reach

Intact floodplain and complex habitat

Need to protect from future incision and accelerate natural recovery of wood loading

Lower Lagunitas Creek

Incised and simplified

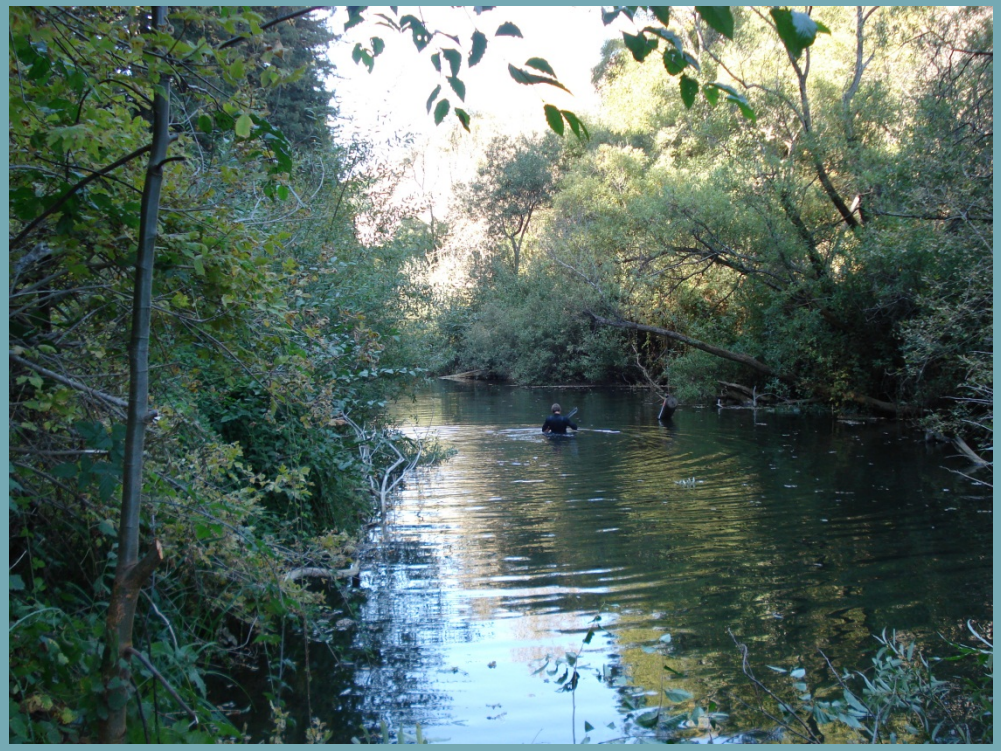


Photo Credit: Graham Matthews & Associates

Re-aggrade and reconnect to the floodplain to protect Tocaloma and expand floodplain habitat area along Lagunitas Creek

Progress toward coho recovery

- 50% reduction in sediment supply
- ≥ 100% increase in large wood in channels
- ≥ 100% increase in floodplain side channels and alcoves
- Hypothesized ≥ 100% increase in smolt production

Photo credit: MMWD

Public Process and Next Steps

- Informal input through end of July
- Public review draft anticipated in October 2013
- Regional Board consideration anticipated in January 2014

Photo credit: MMWD

For questions, please contact Mike Napolitano at mnapolitano@waterboards.ca.gov or 510-622-2397