Challenges in Estimating Sediment Supply Rates from Local Watersheds to the South Bay

Laurel Collins

Example Watersheds

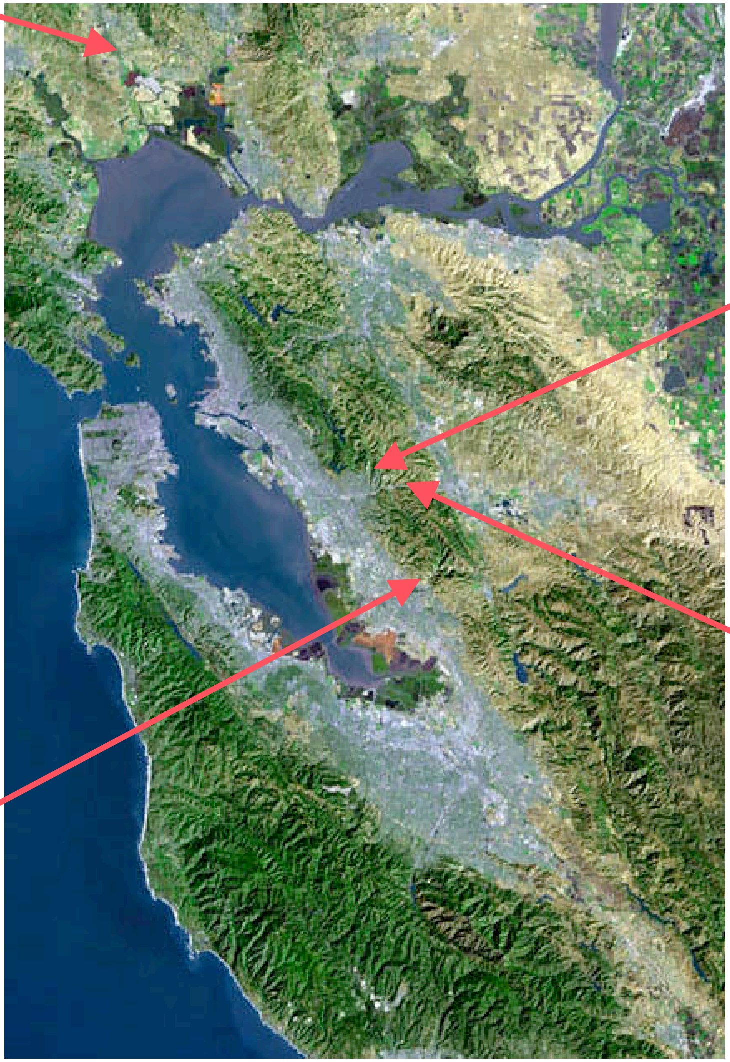
Sonoma and Schell Creeks Watershed:

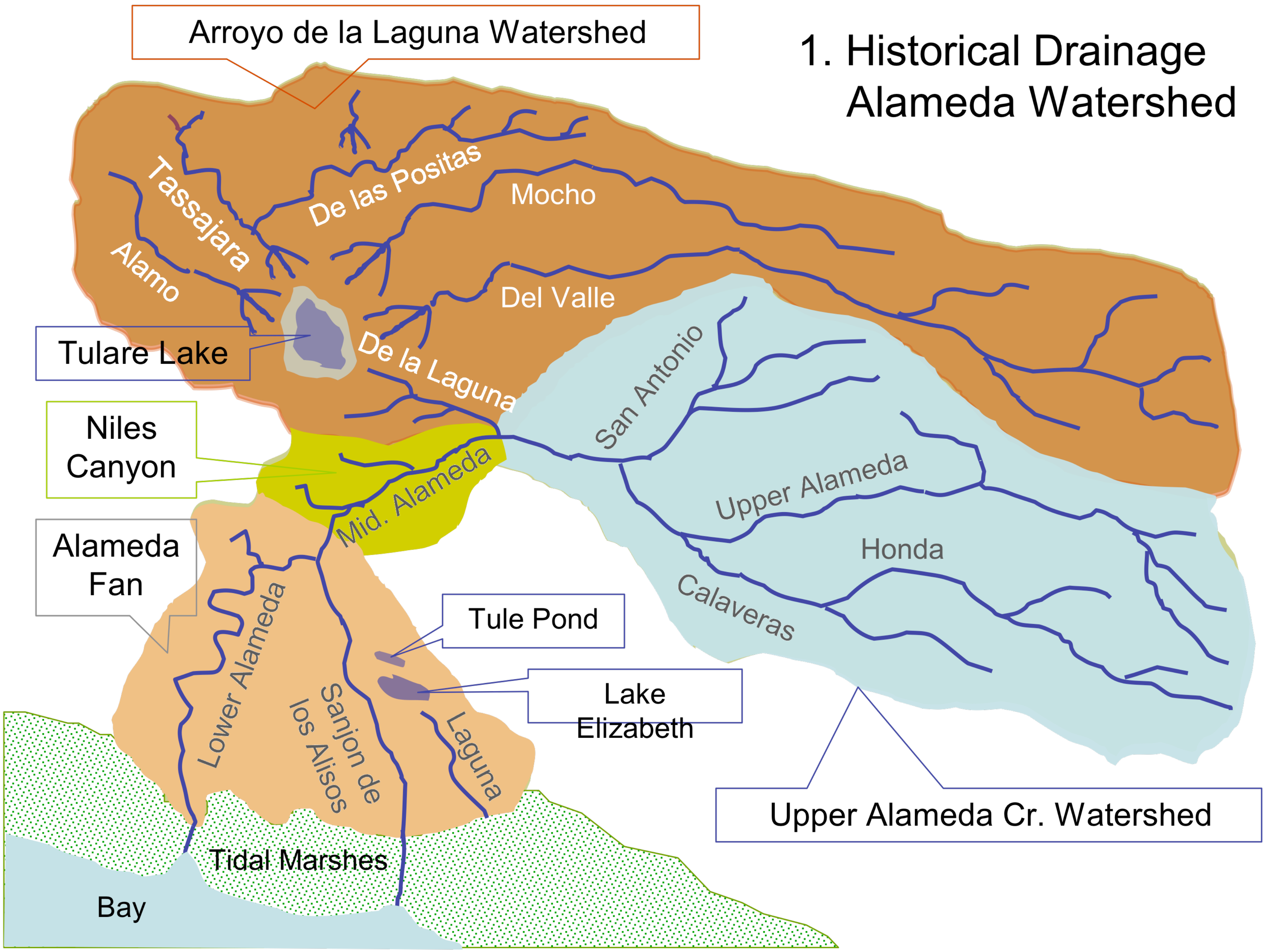
San Lorenzo Watershed:

Crow Creek

Eden Creek

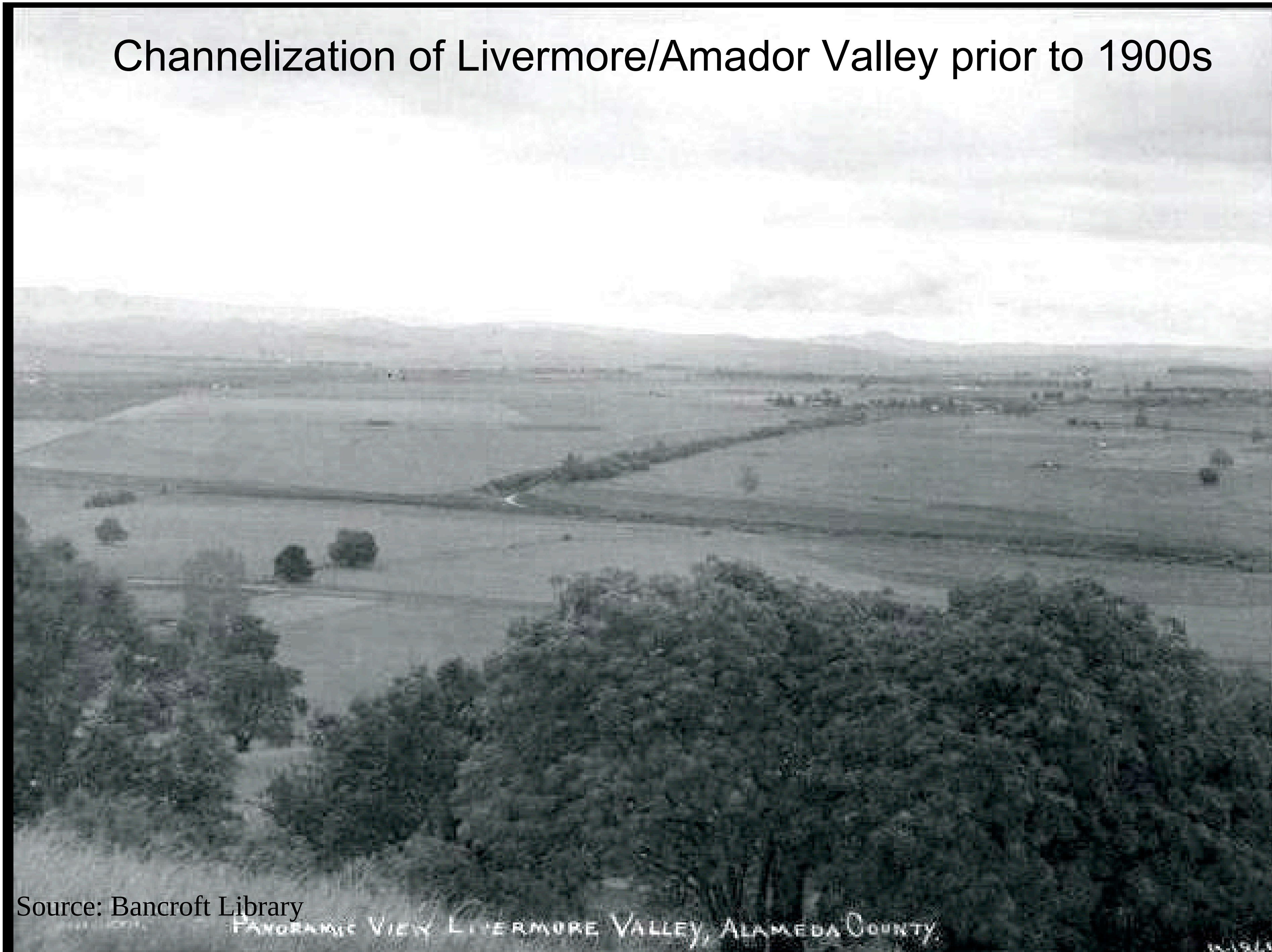
Alameda Watershed:



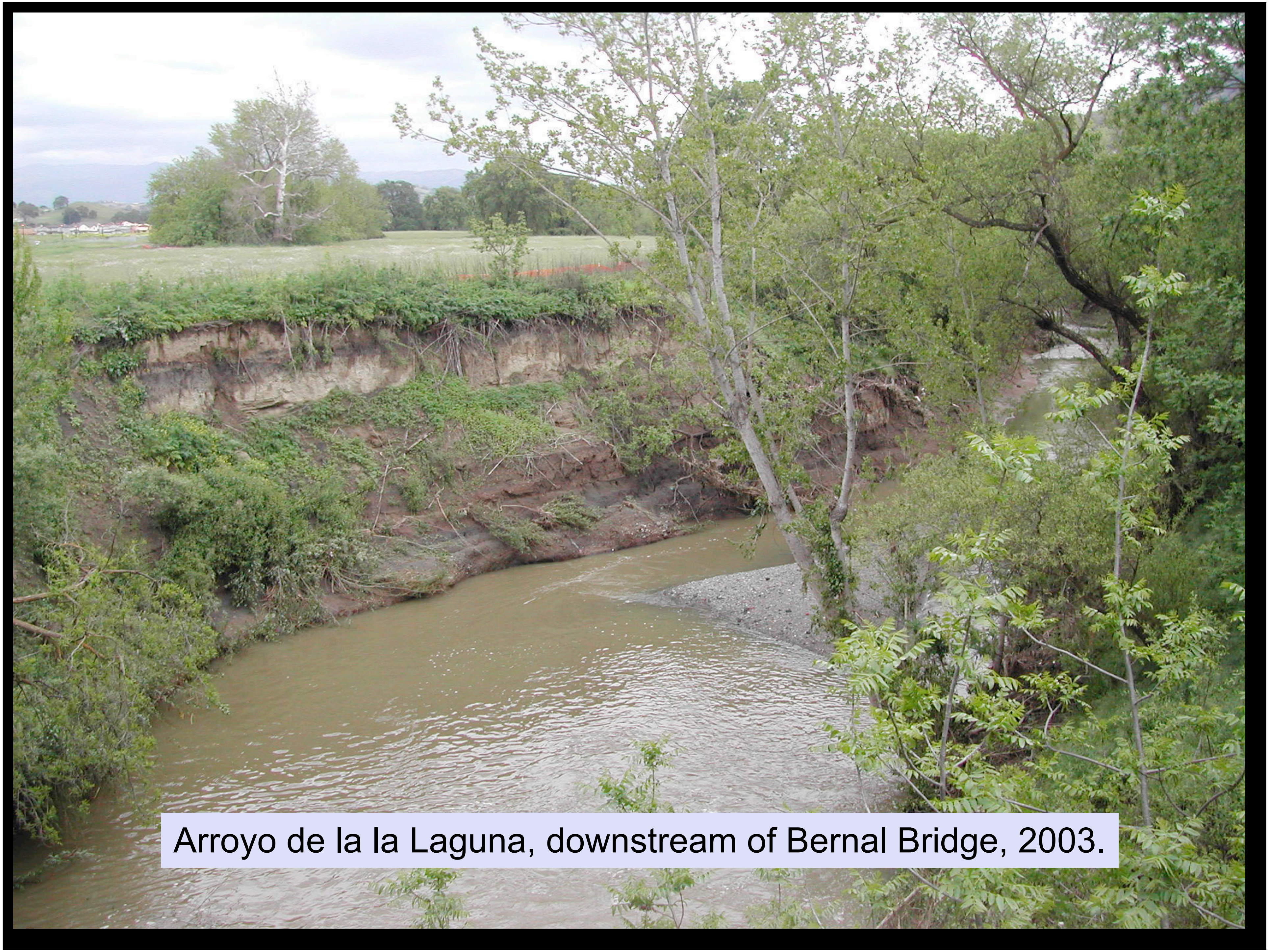


1. Historical Drainage
Alameda Watershed
Arroyo de la Laguna Watershed
Tassajara
De las Positas
Mocho
Alamo
Del Valle
Tulare Lake
De la Laguna
San Antonio
Niles Canyon
Mid. Alameda
Upper Alameda
Honda
Calaveras
Alameda Fan
Lower Alameda
Sanjon de los Alisos
Laguna
Tule Pond
Lake Elizabeth
Tidal Marshes
Bay
Upper Alameda Cr. Watershed

Channelization of Livermore/Amador Valley prior to 1900s



Source: Bancroft Library



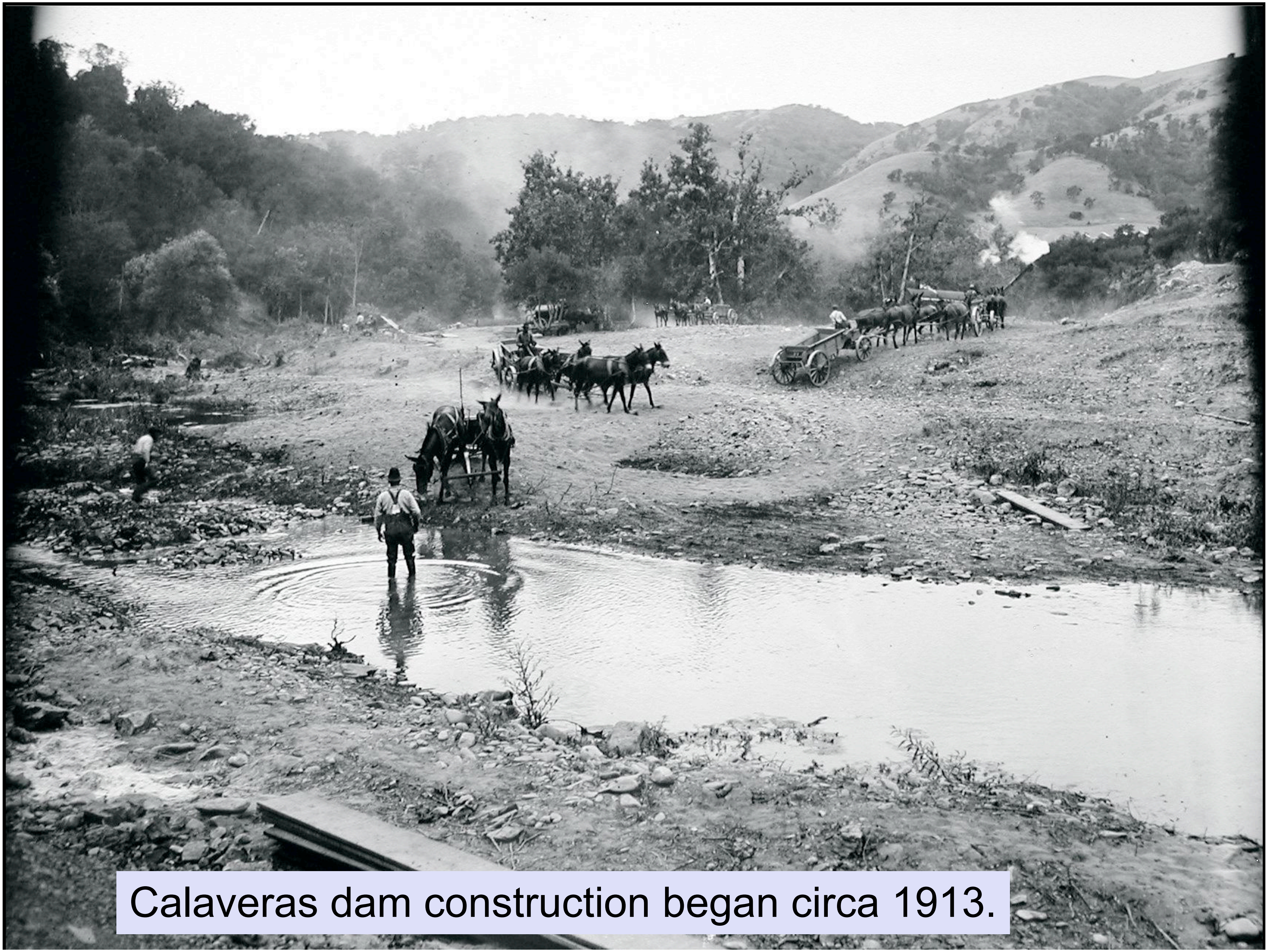
Arroyo de la la Laguna, downstream of Bernal Bridge, 2003.

Arroyo de la Laguna downstream of Railroad Xing, 2003

Cyril Williams (1912) reported 5 ft of incision in channel between 1901 and 1911 equaling an incision rate of 0.5 ft/yr. Golder Assoc.(1999) reported incision averaging 0.5 ft/yr between 1962 and 1976 and maximum scour of 10 ft.

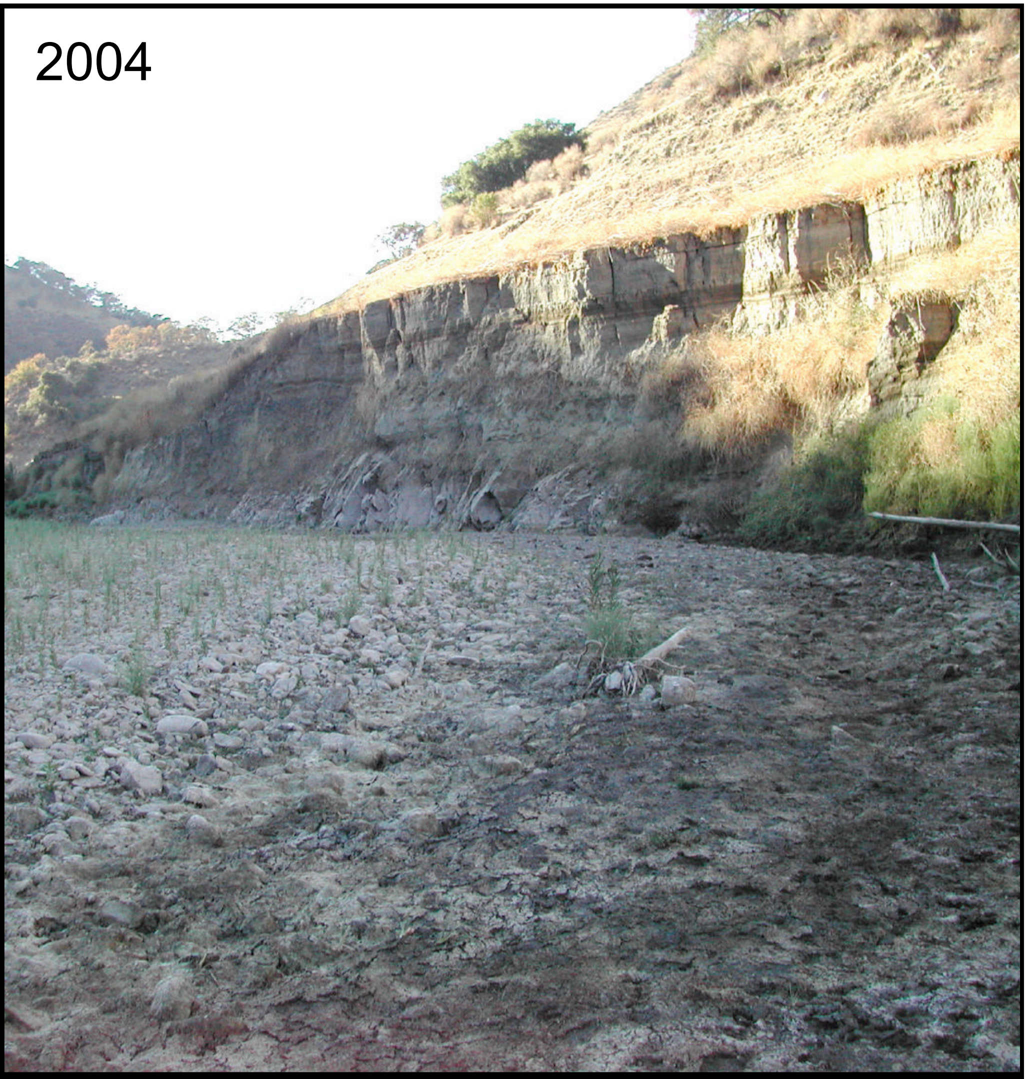
Arroyo de la Laguna, 2003

Some areas have had more than 100 ft of bank loss during the last 25 years.



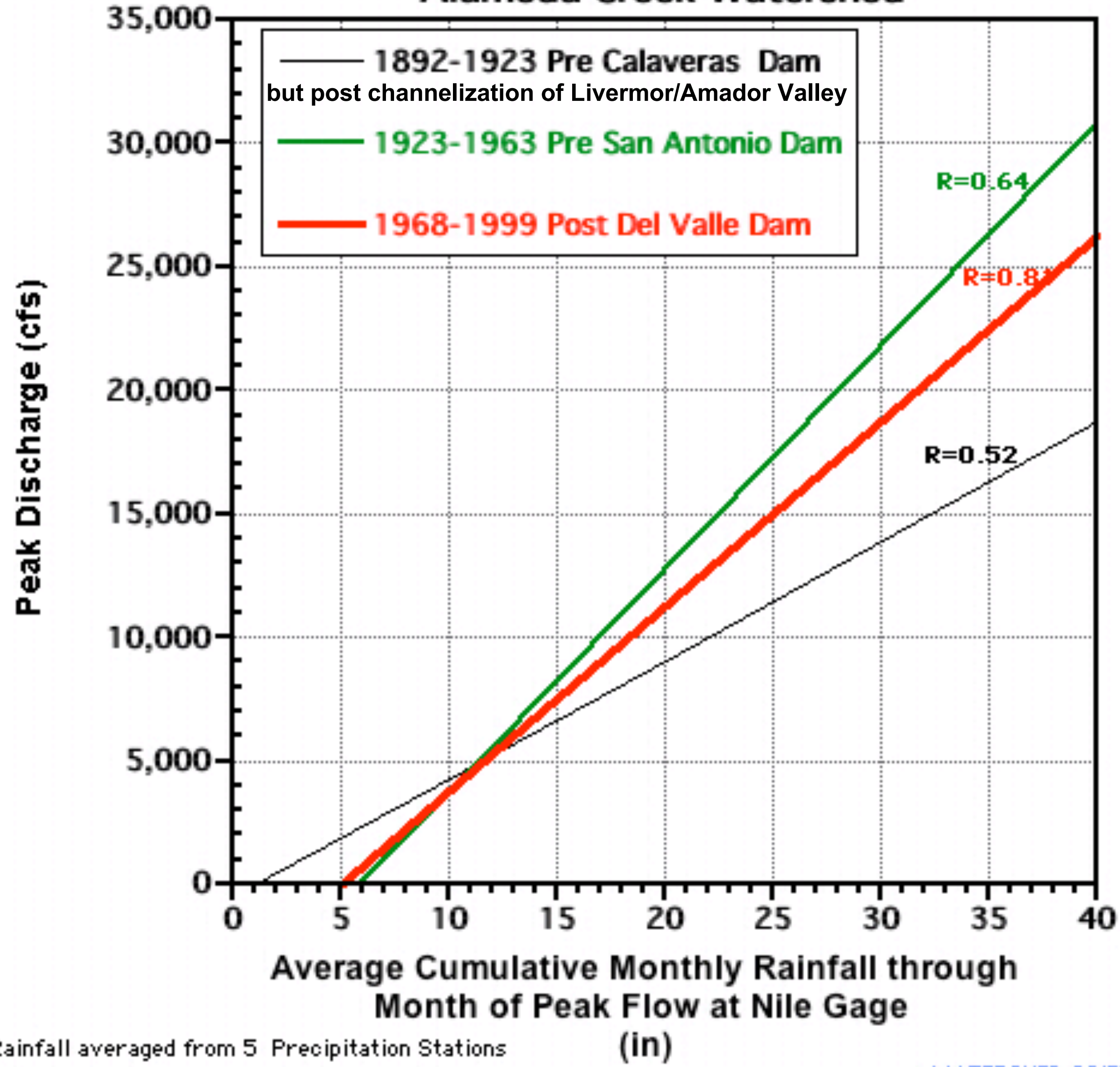
Calaveras dam construction began circa 1913.

Preparing the land at Calaveras Creek for dam construction with hydraulic jets, circa 1913.



Eroded high flow very sandy delta deposits of Arroyo Honda extent to ~20 ft and crossed the lake prior to the water being drawn down for retrofitting of the dam.

Change in Peak Annual Flow Relative to Average Cumulative Rainfall through the Month of Peak Flow Measured at the USGS Niles Gage, Alameda Creek Watershed



Rainfall averaged from 5 Precipitation Stations
located in different parts of the watersehd

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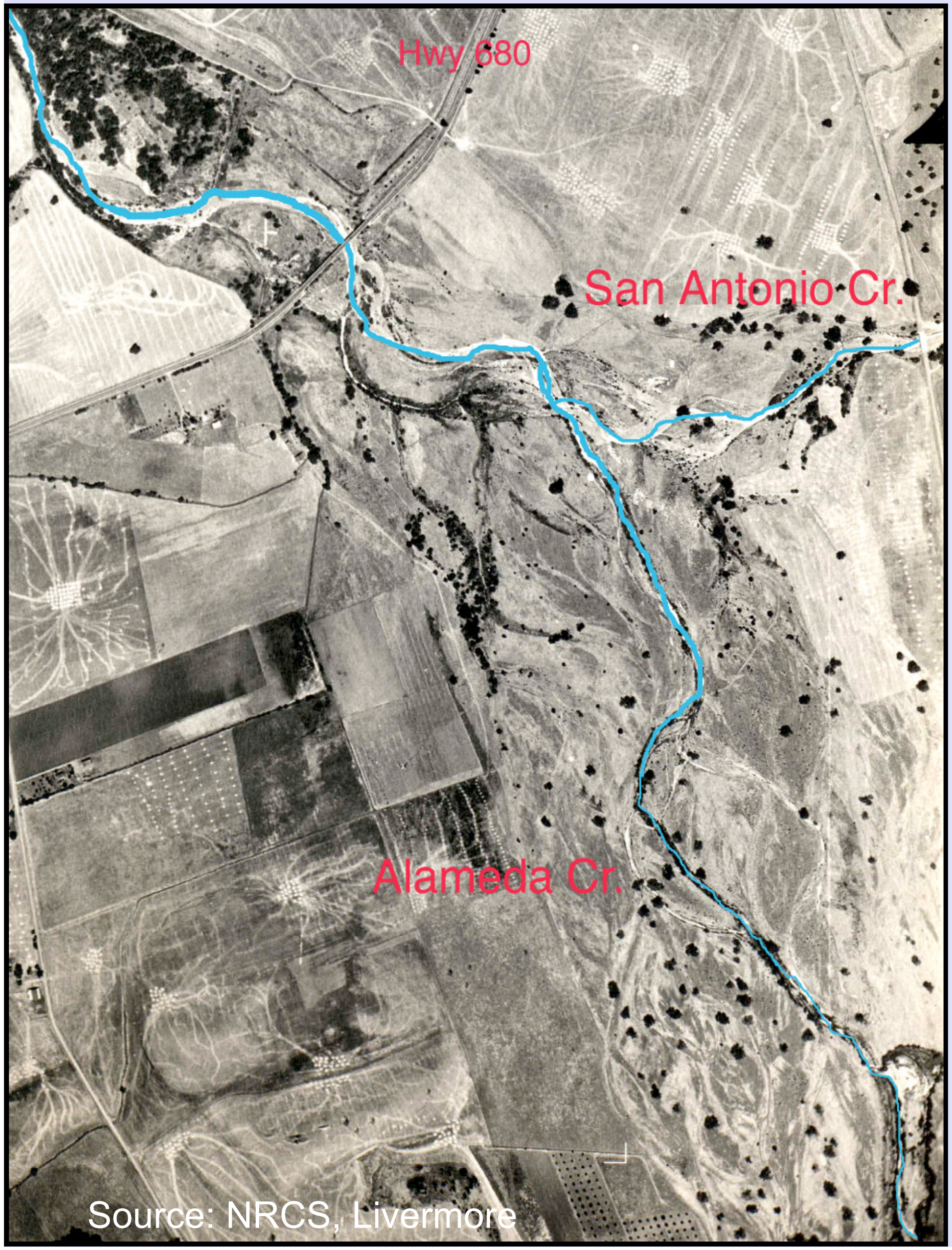
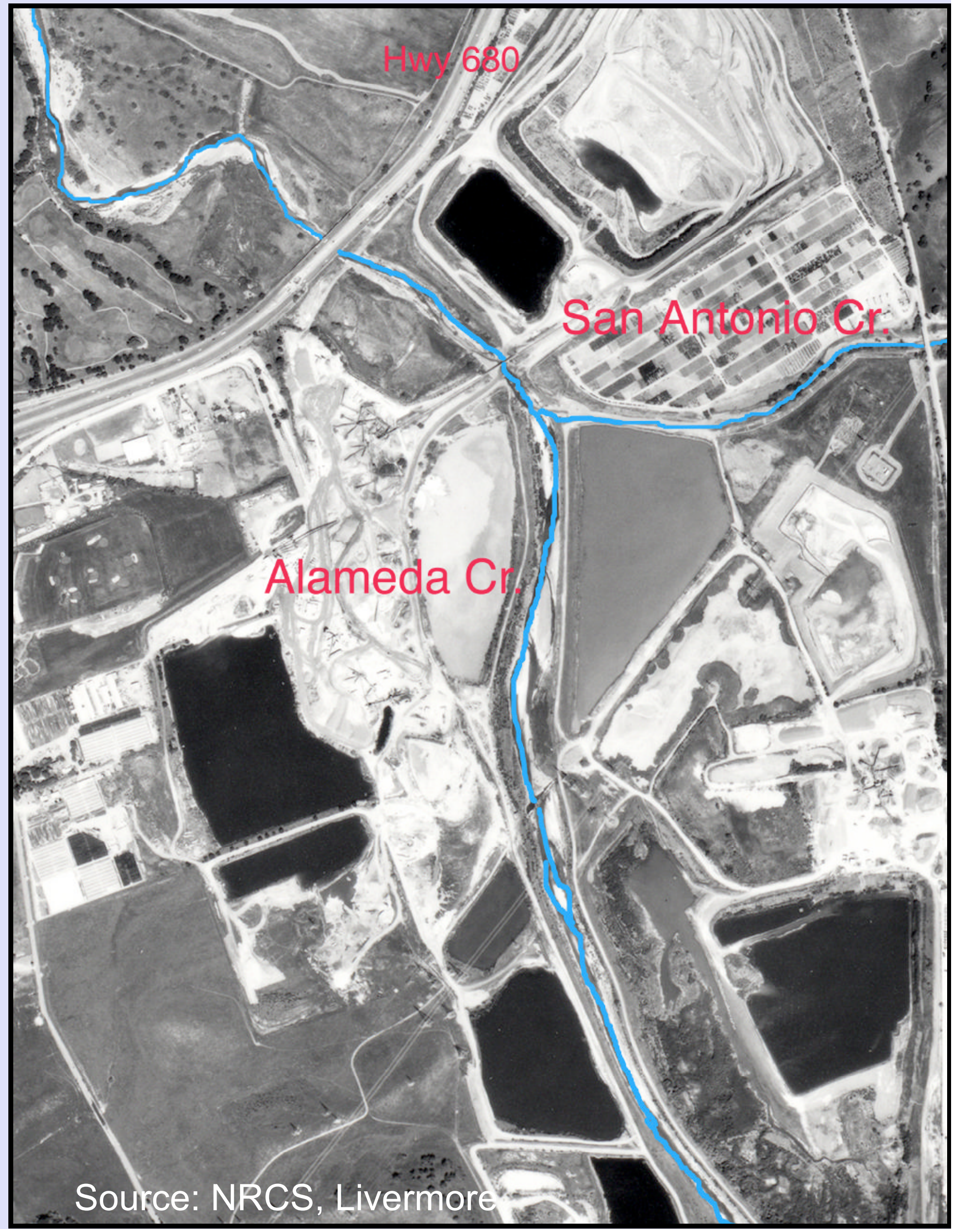
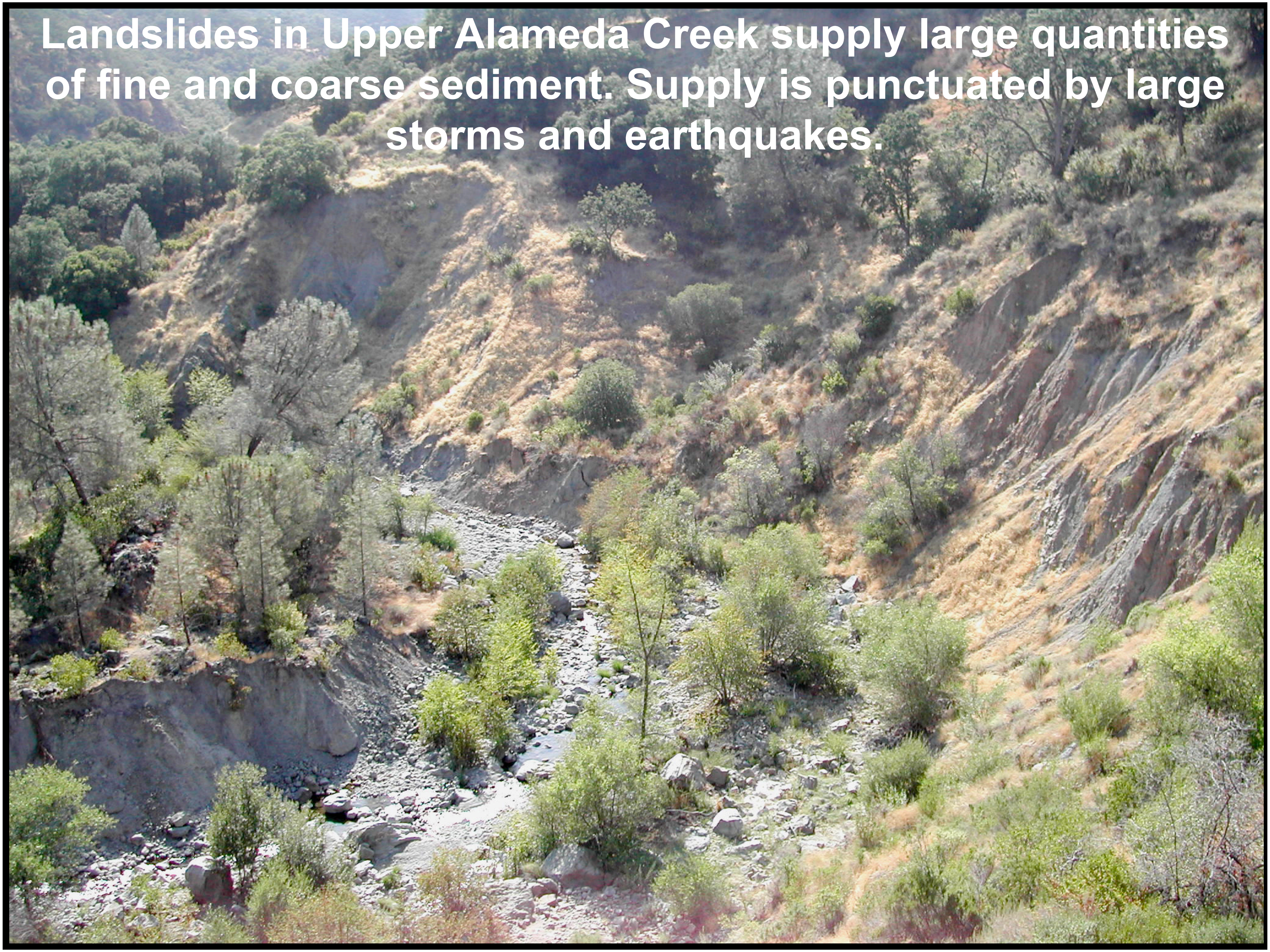
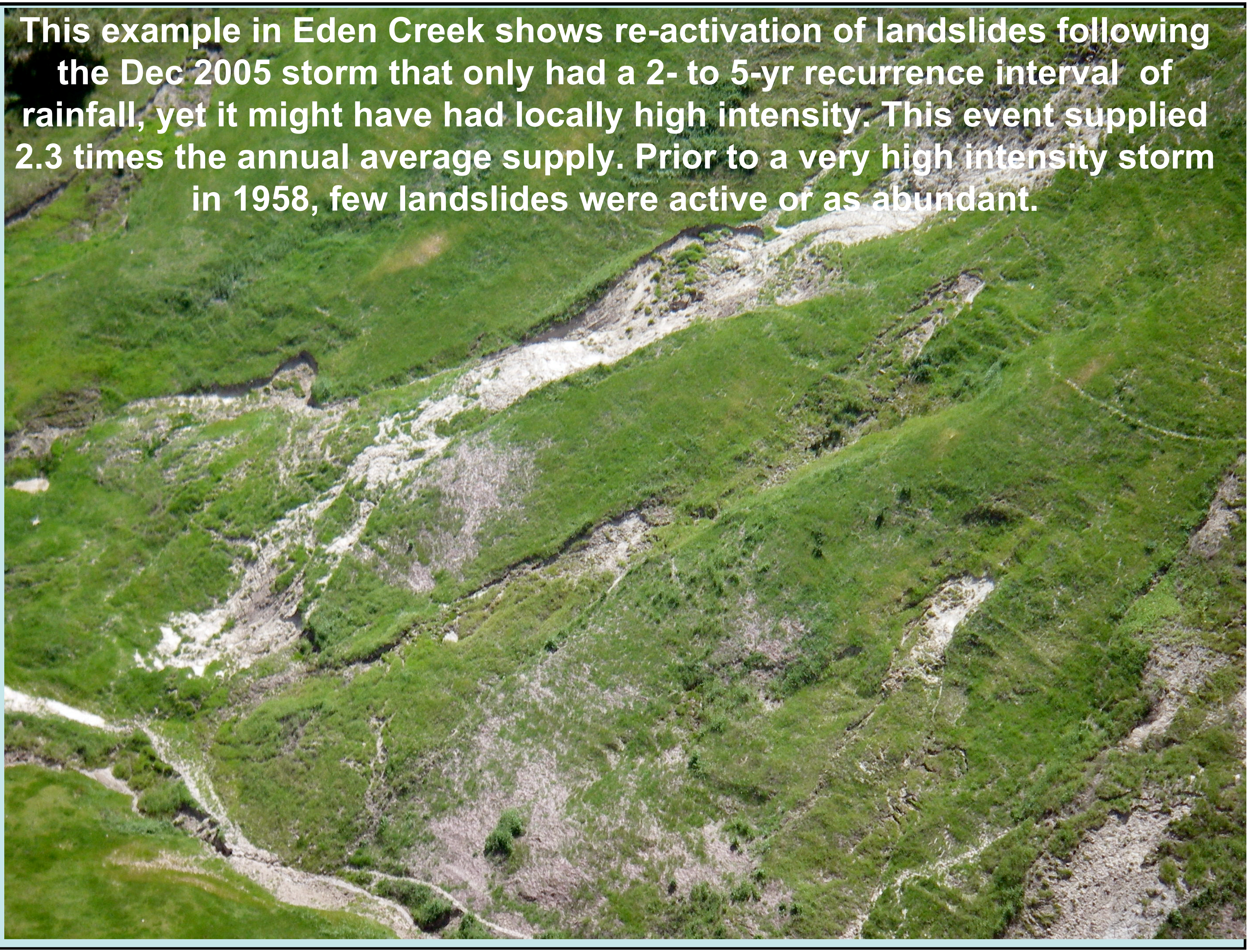
Alameda Creek in Sunol Valley before and after gravel quarrying.






Landslides in Upper Alameda Creek supply large quantities of fine and coarse sediment. Supply is punctuated by large storms and earthquakes.


This example in Eden Creek shows re-activation of landslides following the Dec 2005 storm that only had a 2- to 5-yr recurrence interval of rainfall, yet it might have had locally high intensity. This event supplied 2.3 times the annual average supply. Prior to a very high intensity storm in 1958, few landslides were active or as abundant.


Upstream of San Antonio Creek Confluence and quarries
there is a high proportion of fines to coarse

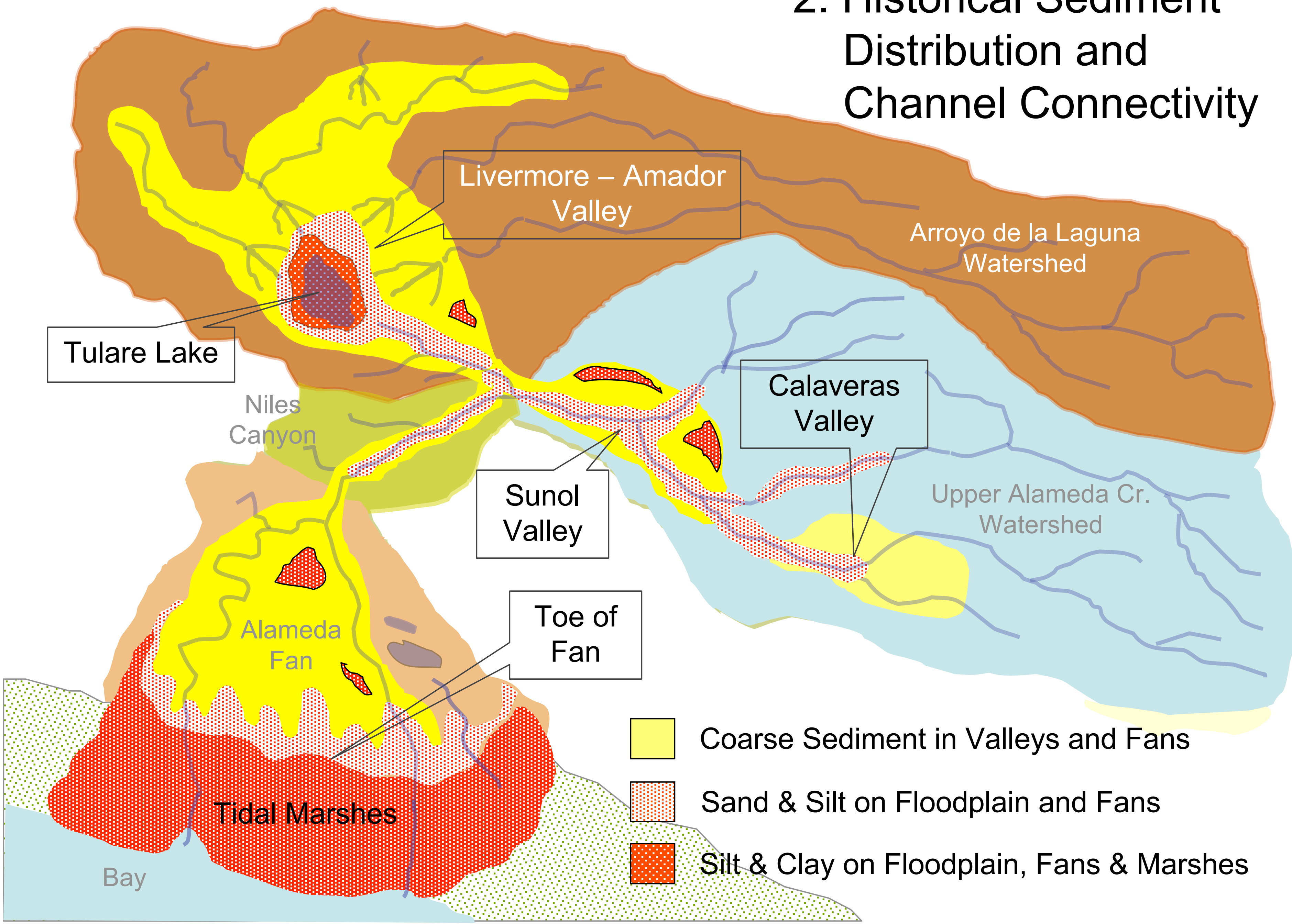

1956

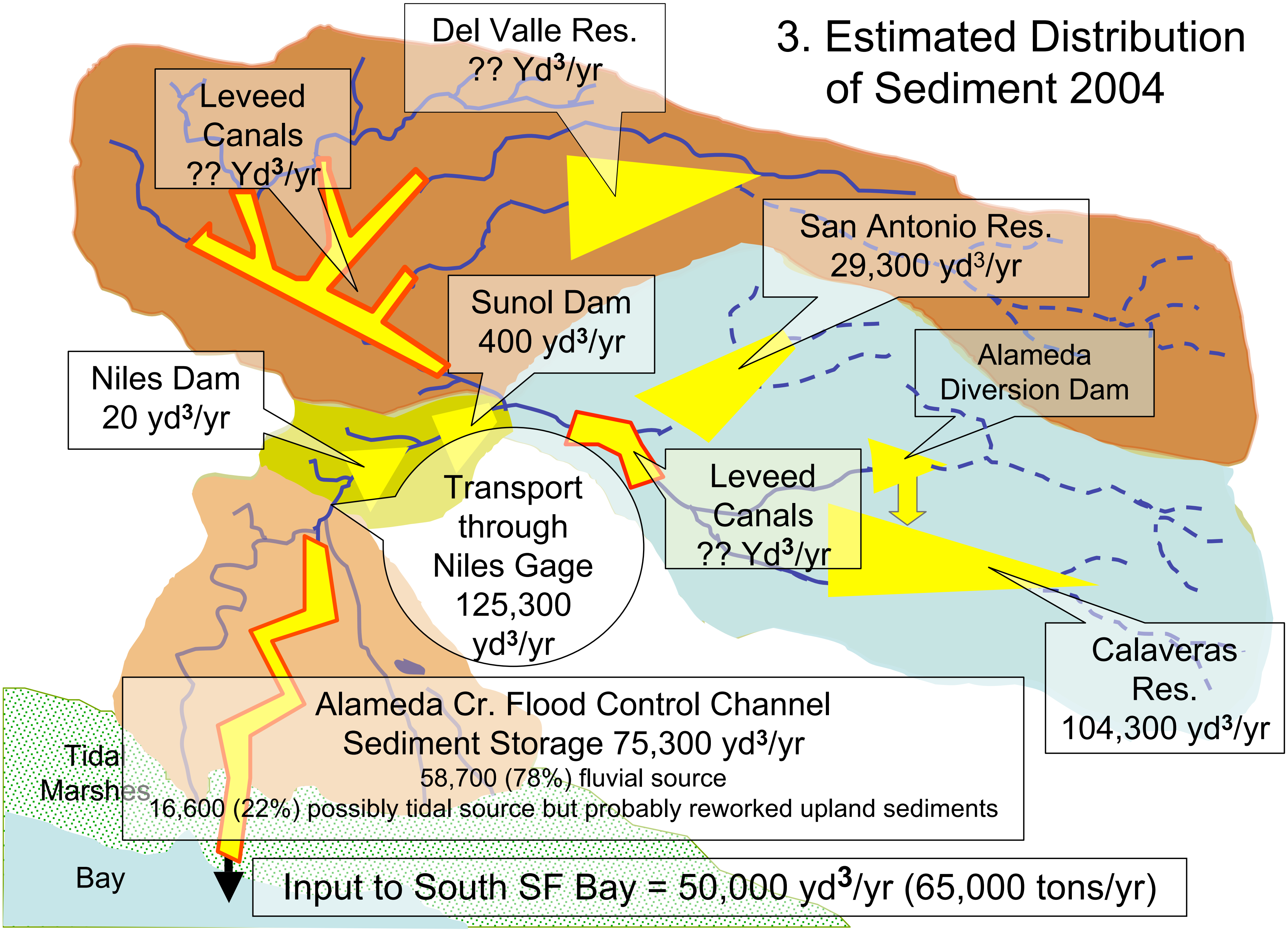
Distributary channels form along the middle and lower alluvial fan and effectively disperse sediment and flood waters. Particle sorting and storage is effective.

Silt dunes making county impossible for automobiles near break in Patterson Creek.

Stated by photographer in 1916 “Heavily silted channel of Alameda Creek, just downstream of Alvarado Bridge. Here the channel was over 20 ft deep about 15 years ago.” Collins estimates <6 ft clearance.

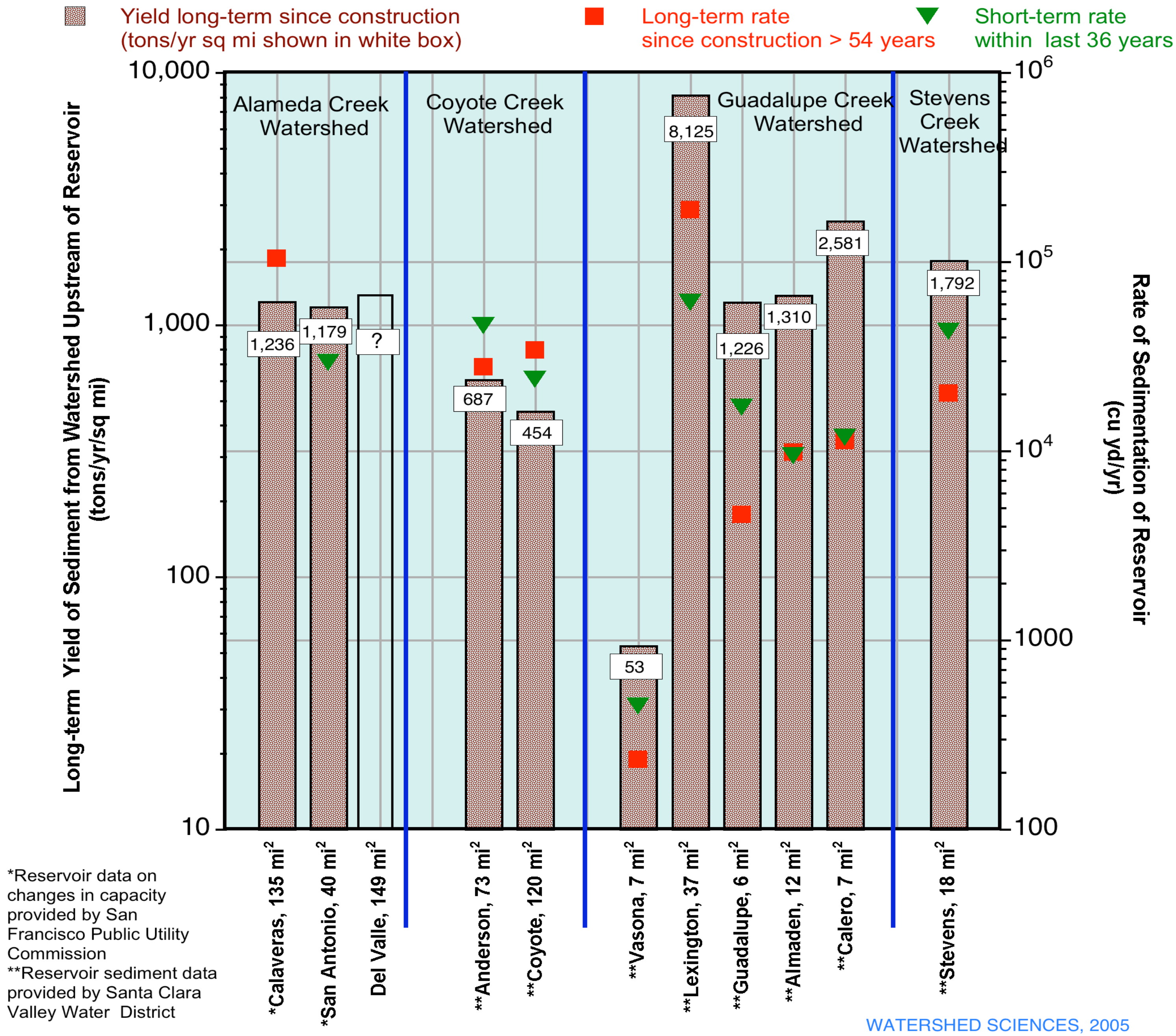
2. Historical Sediment Distribution and Channel Connectivity





3. Estimated Distribution of Sediment 2004
Del Valle Res. ?? Yd³/yr
Leveed Canals ?? Yd³/yr
San Antonio Res. 29,300 yd³/yr
Sunol Dam 400 yd³/yr
Alameda Diversion Dam
Niles Dam 20 yd³/yr
Transport through Niles Gage 125,300 yd³/yr
Leveed Canals ?? Yd³/yr
Calaveras Res. 104,300 yd³/yr
Alameda Cr. Flood Control Channel Sediment Storage 75,300 yd³/yr
58,700 (78%) fluvial source
16,600 (22%) possibly tidal source but probably reworked upland sediments
Tidal Marshes
Bay
Input to South SF Bay = 50,000 yd³/yr (65,000 tons/yr)

Sedimentation Data for Large Reservoirs in Alameda and Santa Clara Counties



*Reservoir data on changes in capacity provided by San Francisco Public Utility Commission
**Reservoir sediment data provided by Santa Clara Valley Water District

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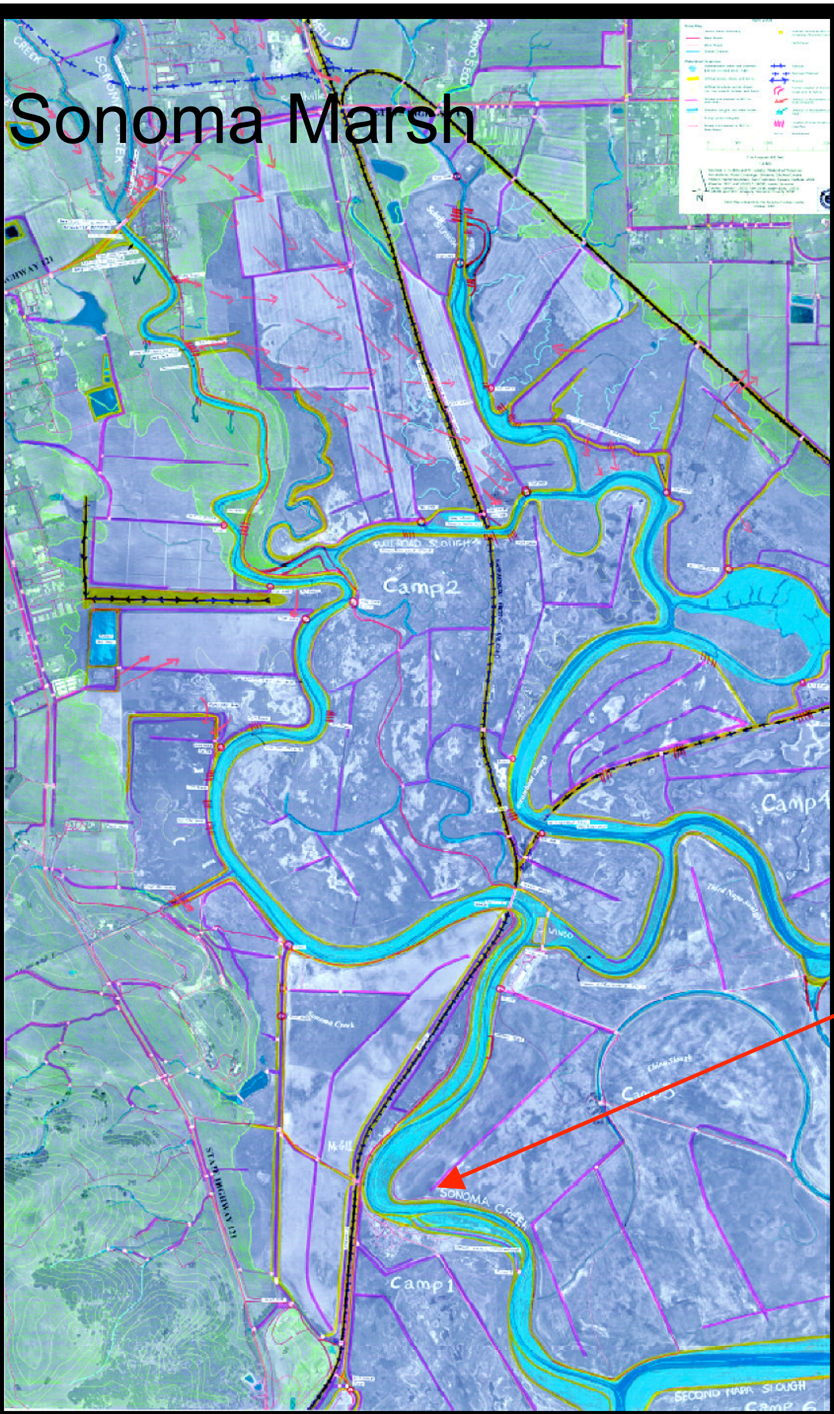
Sediment Storage Dynamics of Alameda Creek Watershed

- Assume at least 60,000 cu yd/yr of sediment stored at Del Valle Reservoir, then a minimum of about 194,000 cu yd/yr would be stored in all reservoirs upstream of the Niles gage. This estimate is probably quite conservative.

- Of the 60% of the total sediment load transported past Niles Gage that is deposited in the Alameda Creek Flood Control Channel, 34% has been removed by desilting activities.

- The remaining 40% of the total load that is not deposited in the Flood Control Channel represents 50,136 cu yd/yr supplied to the bay. Spread over one sq mi, its rate of deposition would be 0.6 in/yr (15 mm/yr).

Sonoma Marsh

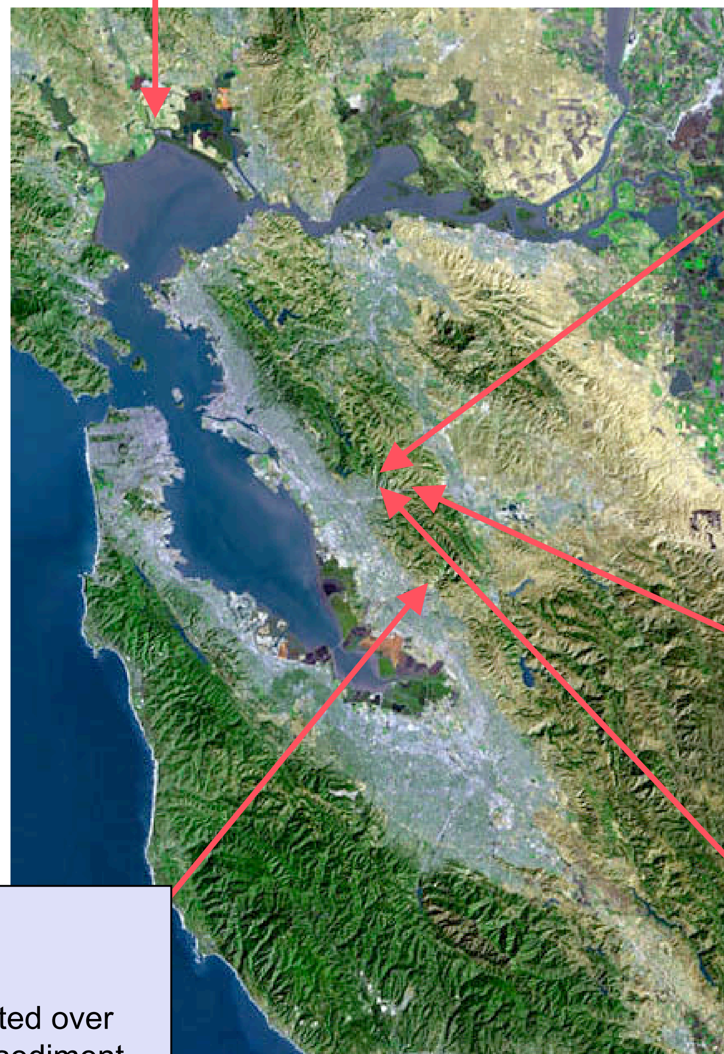


Estimated Sediment Supply Yields

Sonoma and Schell Creeks Watershed:

Rate: 246,364 yd^3/yr
Yield: 2,000 $yd^3/yr/mi^2$

Long-term supply to upland tidal transition to Sonoma Marsh is a minimum estimate based upon calculating sediment that has filled the tidal sloughs over last 125 years, been dredged to form levees, and been spread onto diked marshes that had levee failures, and assuming that an additional 25% has deposited in the Bay and not been redistributed back in the sloughs.
DA = 127 mi^2



San Lorenzo Watershed:

Rate:
46,200 yd^3/yr short-term
23,540 yd^3/yr long-term
Yield:
4,200 $yd^3/yr/mi^2$ short-term
2,140 $yd^3/yr/mi^2$ long-term

Sediment supply estimated for Crow Creek using field measure-Ments for long-term estimates over 165 years, and extrapolation Methods for short-term 5-year period. DA = 11.0 mi^2

Rate: 4,386 yd^3/yr
Yield: 1,843 $yd^3/yr/mi^2$

Long-term sediment based upon deposition in Hollis Reservoir over 50 years.
DA = 2.38 mi^2

Rate: 27,606 yd^3/yr
Yield: 4,382 $yd^3/yr/mi^2$

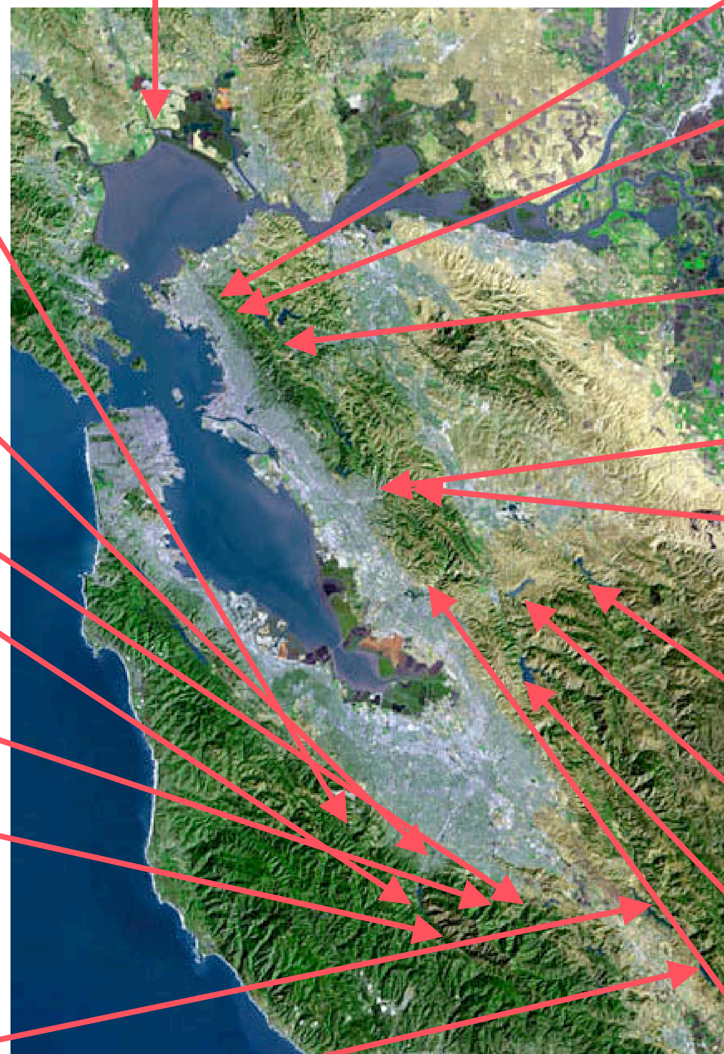
Short-term 17-year period for Cull Creek based upon reservoir filling and dredging. DA = 6.3 mi^2

Alameda Watershed:

Rate: 125,300 yd^3/yr
Yield: 406 $yd^3/yr/mi^2$

Sediment supply to Niles Gage estimated over a 39-year period that is based upon a sediment rating curve from limited sampling but continuous discharge records. Functional DA = 309 mi^2

Landscape Lowering Rates Calculated from Sediment Yield Analyses



Sonoma and Schell Watershed:

0.57 mm/yr
Upstream of Sonoma Tidal Marsh

Wildcat Watershed*:**

0.66 mm/yr
Lower Canyon downstream of Jewel Res.

1.22 mm/yr
Upstream of Jewel Res., downstream of Anza Res.

Stevens Watershed*:

0.33 mm/yr*
Upstream of Stevens Cr. Res.

Guadalupe Watershed*:

0.01 mm/yr*
Upstream of Vasona Res. Downstream of Lexington

0.45 mm/yr*
Upstream of Calero Res.

1.50 mm/yr*
Upstream of Lexington Res.

0.23 mm/yr*
Upstream of Guadalupe Res.

0.24 mm/yr*
Upstream of Almaden Res.

Coyote Creek Watershed*:

0.13 mm/yr*
Upstream of Anderson Res., downstream of Coyote Res.

0.08 mm/yr*
Upstream of Coyote Cr. Res

San Lorenzo Watershed:

1.23 mm/yr
Crow Cr. upstream of Cull Cr. confluence

1.29 mm/yr **
Upstream of Cull Res.

0.54 mm/yr
Upstream of Hollis Res.

Alameda Watershed:

0.12 mm/yr -?? (minimum)
Upstream of Del Valle Res.

0.22 mm/yr
Upstream of San Antonio Res.

0.23 mm/yr
Upstream of Calaveras Res.

0.12 mm/yr
Upstream of Niles Gage, downstream of large Res.

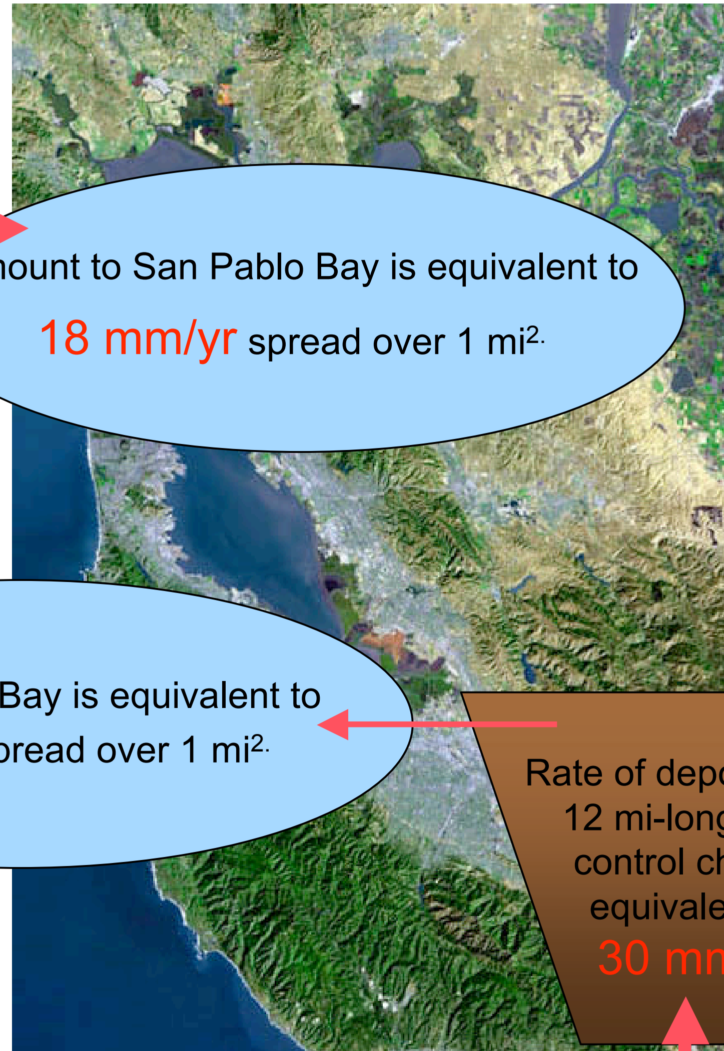
Sources :
•Santa Clara Co. Water District Dredged Sediment Volumes
•**Alameda Co. Flood Control and Water Conservation District Dredged Sediment Volumes
•***SFEI, 2001. Wildcat Creek: a Scientific Study of Physical Processes

Estimated Deposition Rates in Tidal Reaches and to the Bay

Sonoma and Schell Watershed:

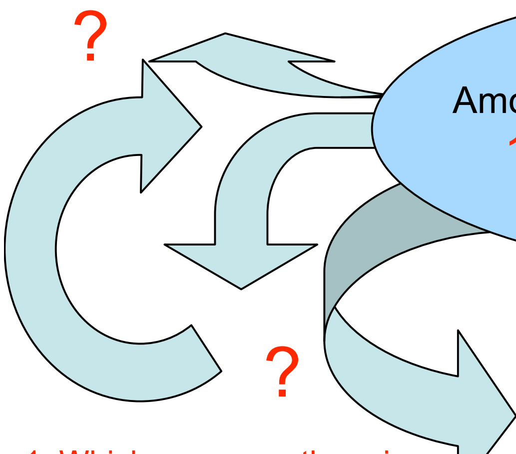
0.57 mm/yr
Upstream of Sonoma Tidal Marsh

Rate of deposition in 15 mi of tidal marsh sloughs
41 mm/yr.
Just 10.5-mi Sonoma slough
37 mm/yr.



Amount to San Pablo Bay is equivalent to
18 mm/yr spread over 1 mi^2.

Amount to South Bay is equivalent to
15 mm/yr spread over 1 mi^2.



Rate of deposition in 12 mi-long flood control channel equivalent to
30 mm/yr.

1. Which areas are the primary sources?
2. How can our sediment and water management practices facilitate restoration?
3. Is it okay to proceed with restoration by accepting the basic premise that sediment supplies will continue to be higher than under natural conditions but we may be highly challenged to develop accurate predictions of supply and distribution in the bay.

Alameda Watershed:

0.12 mm/yr
Upstream of Niles Gage, downstream of large Res.