Episodic river channel form

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Stillwater Sciences

PRESENTATION OVERVIEW

1. What are the elements of “river channel form”?
2. Why should episodic channels differ from their perennial counterparts?
3. What *is* the form of episodic rivers?

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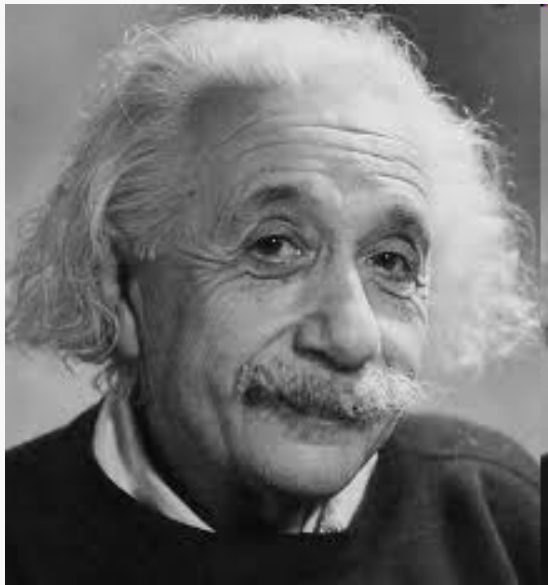
- In-channel and riparian vegetation
- Changes in the above over time

→ **All interact in space & time**

"*As a young man, my fondest dream was to become a geographer. However while working in the customs office I thought deeply about the matter and concluded it was far too difficult a subject. With some reluctance, I then turned to Physics as a substitute*."

- Albert Einstein
(Unpublished Letters)



PRESENTATION OVERVIEW

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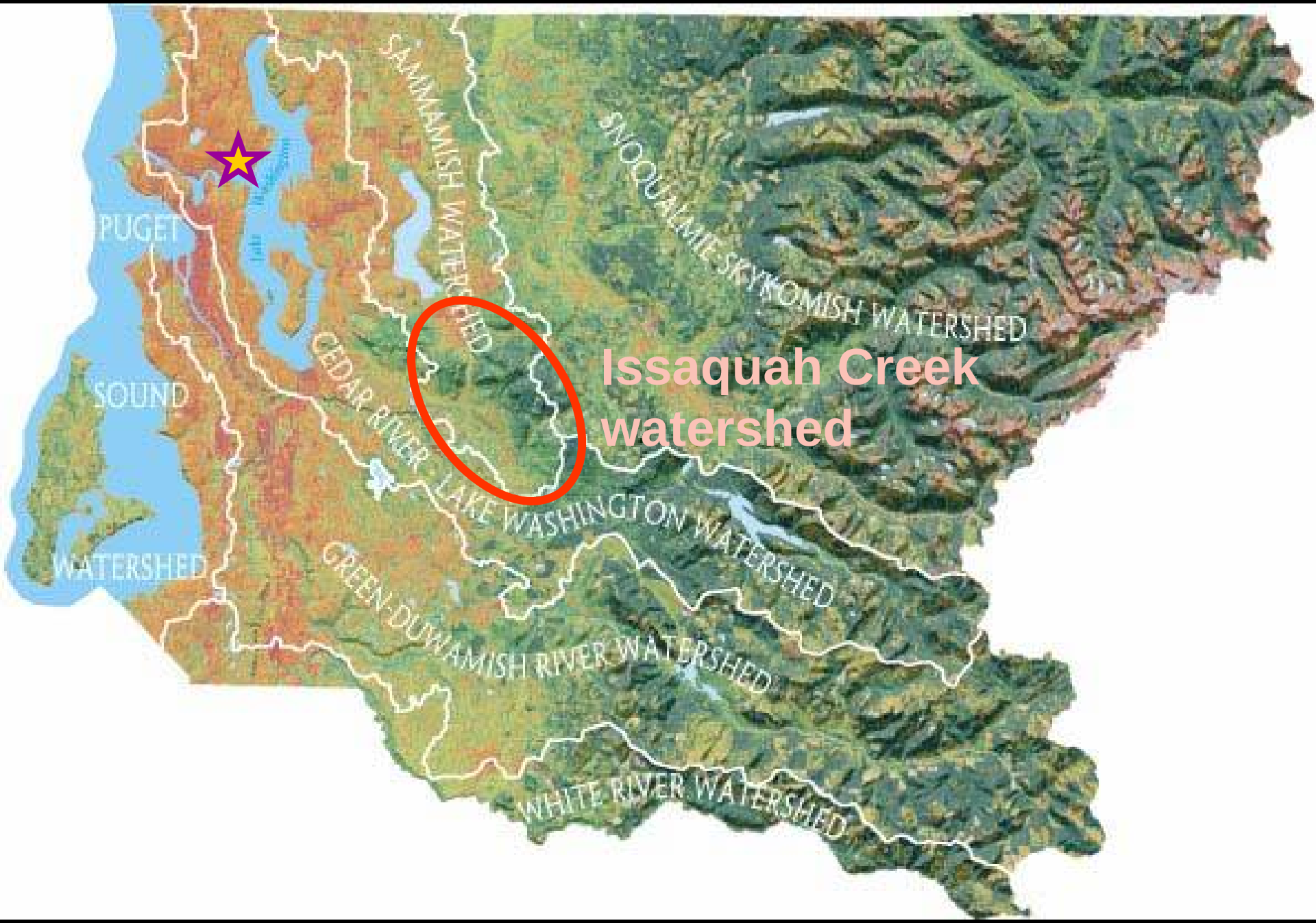
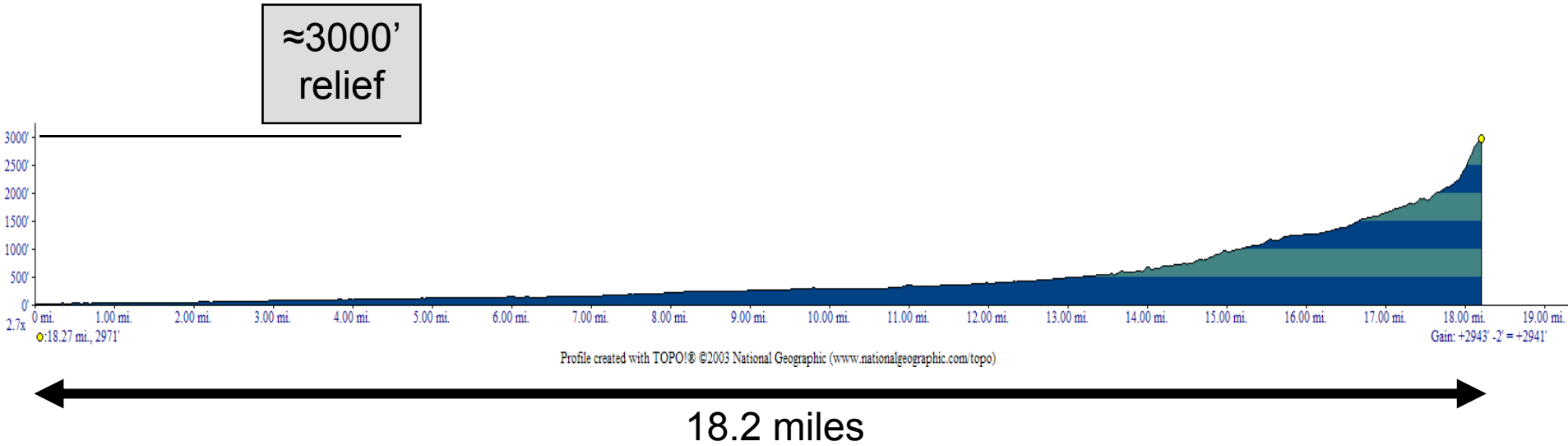
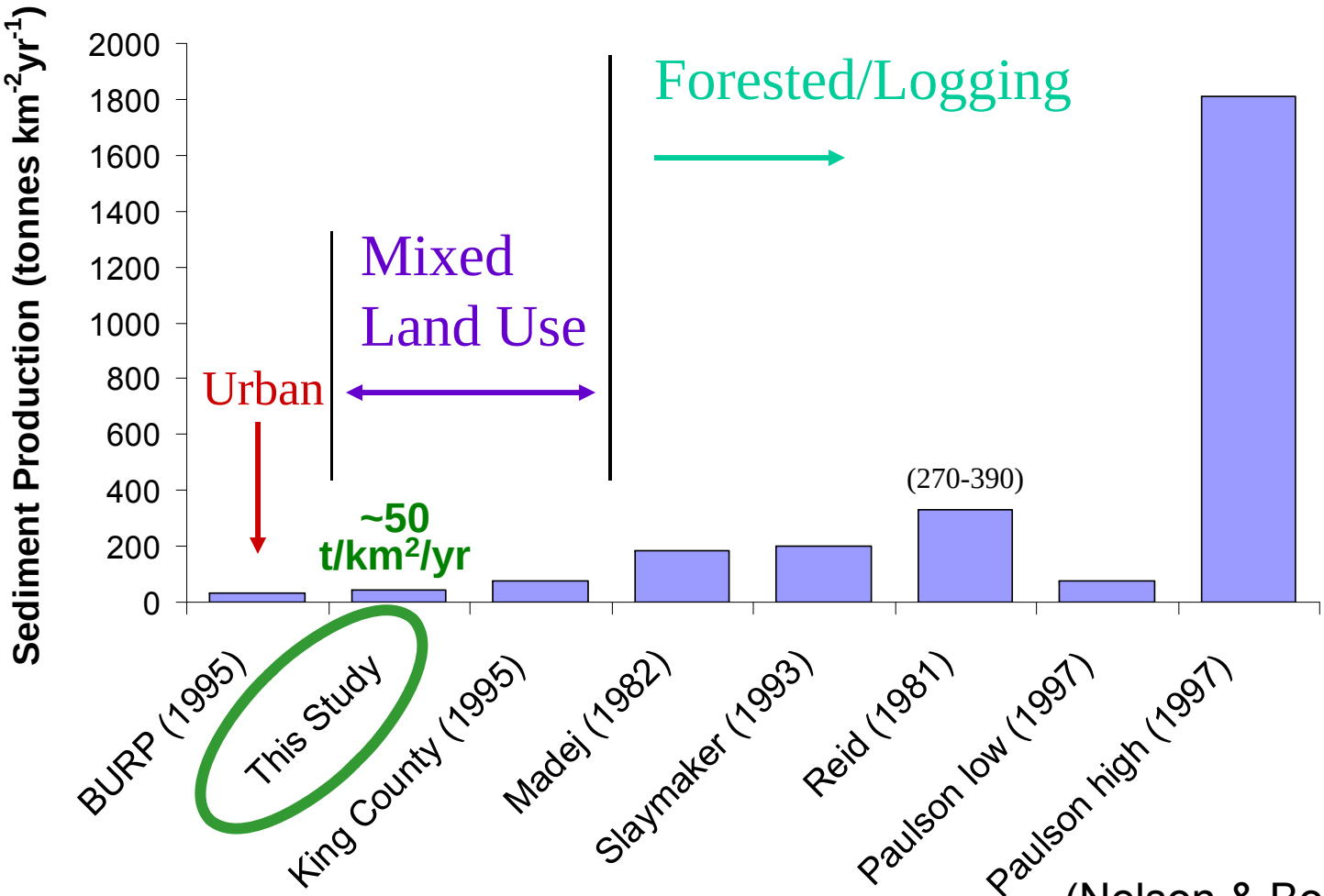
Issaquah Creek
Santa Paula Creek


PUGET
SOUND
WATERSHED
SAMMAMISH WATERSHED
SNOQUALMIE-SKYKOMISH WATERSHED
CEDAR RIVER
LAKE WASHINGTON WATERSHED
GREEN-DUWAMISH RIVER WATERSHED
WHITE RIVER WATERSHED
Issaquah Creek watershed

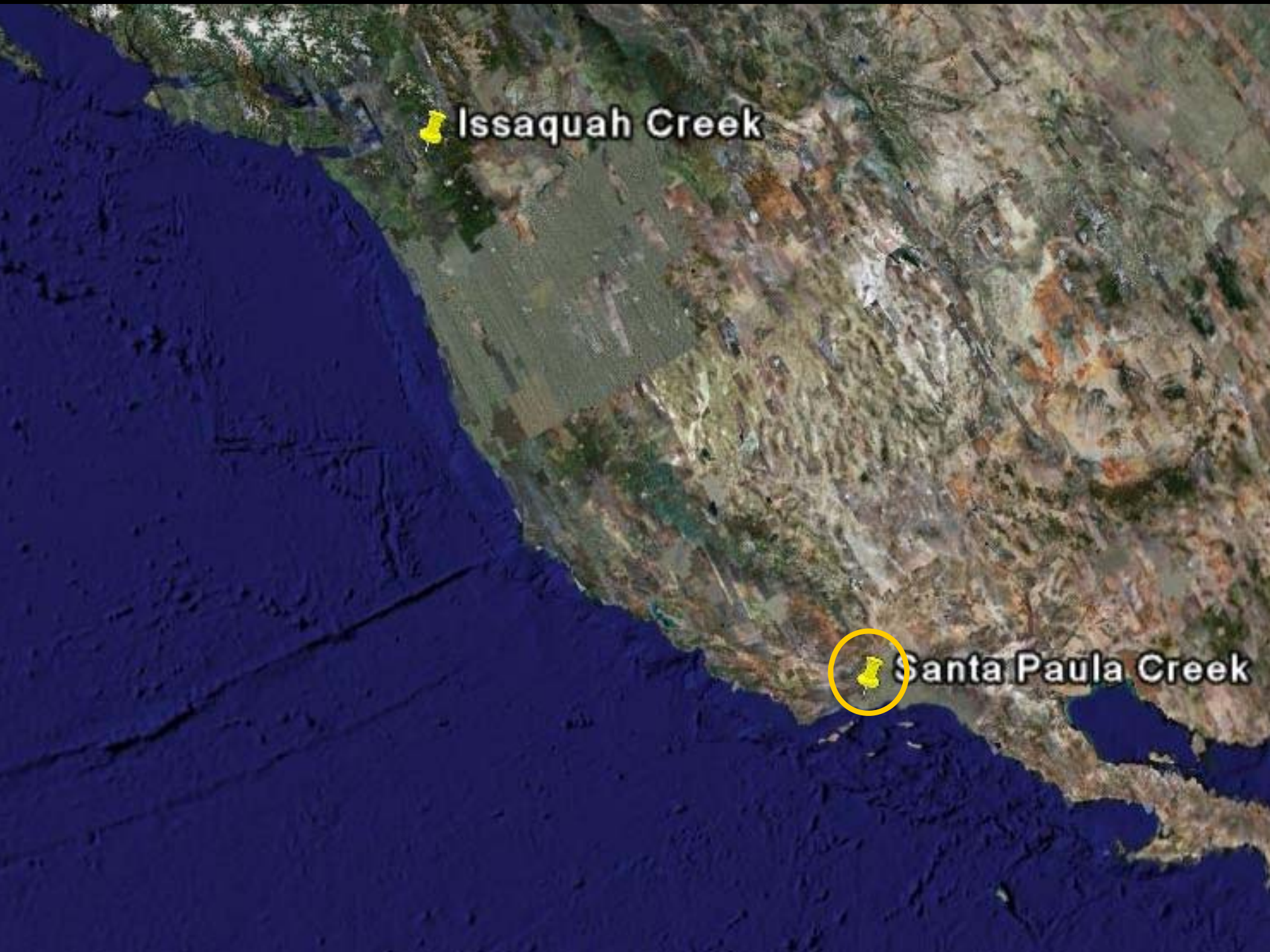


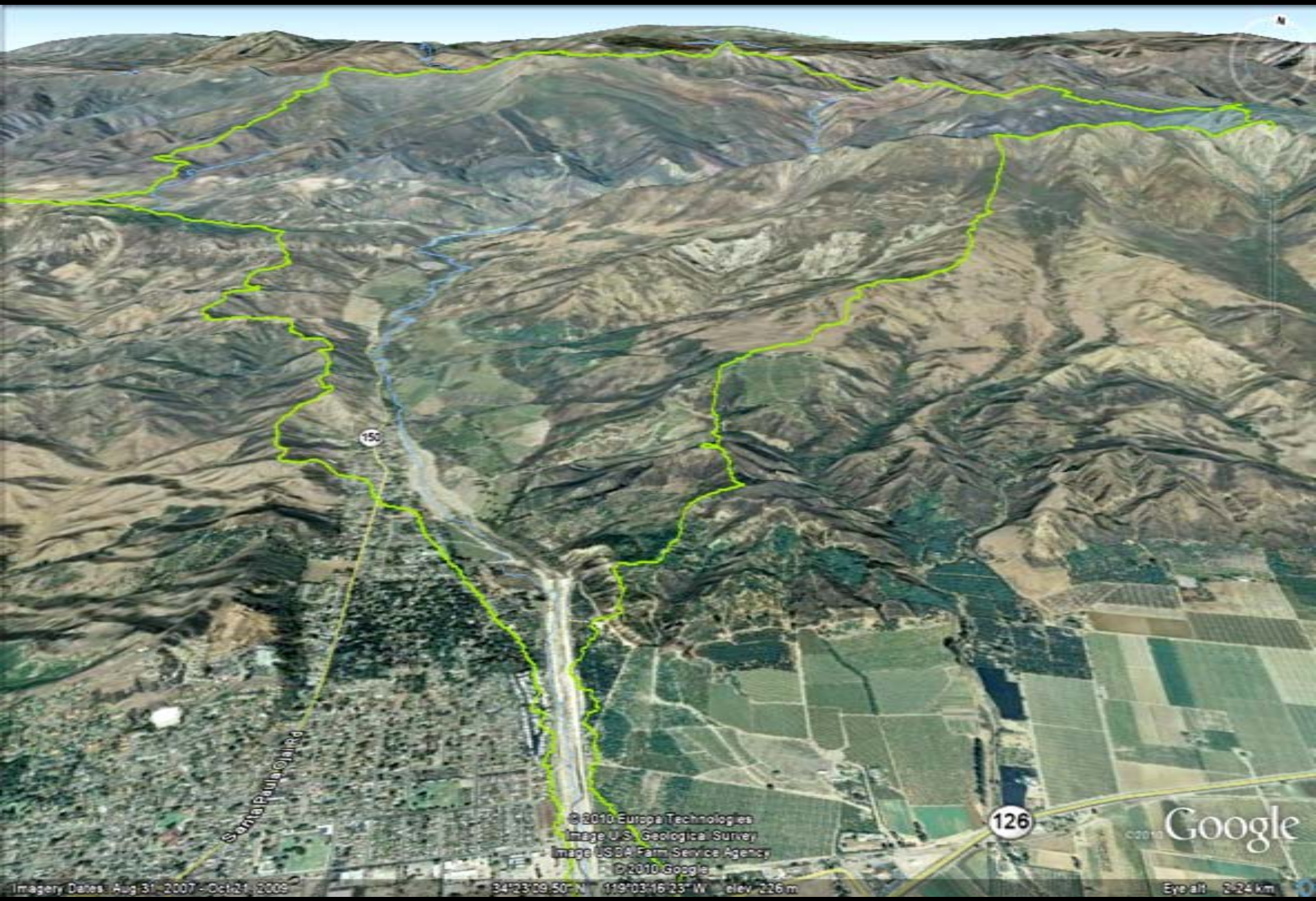
ISSAQUAH CREEK PROFILE

Sediment production from Pacific Northwest watershed studies



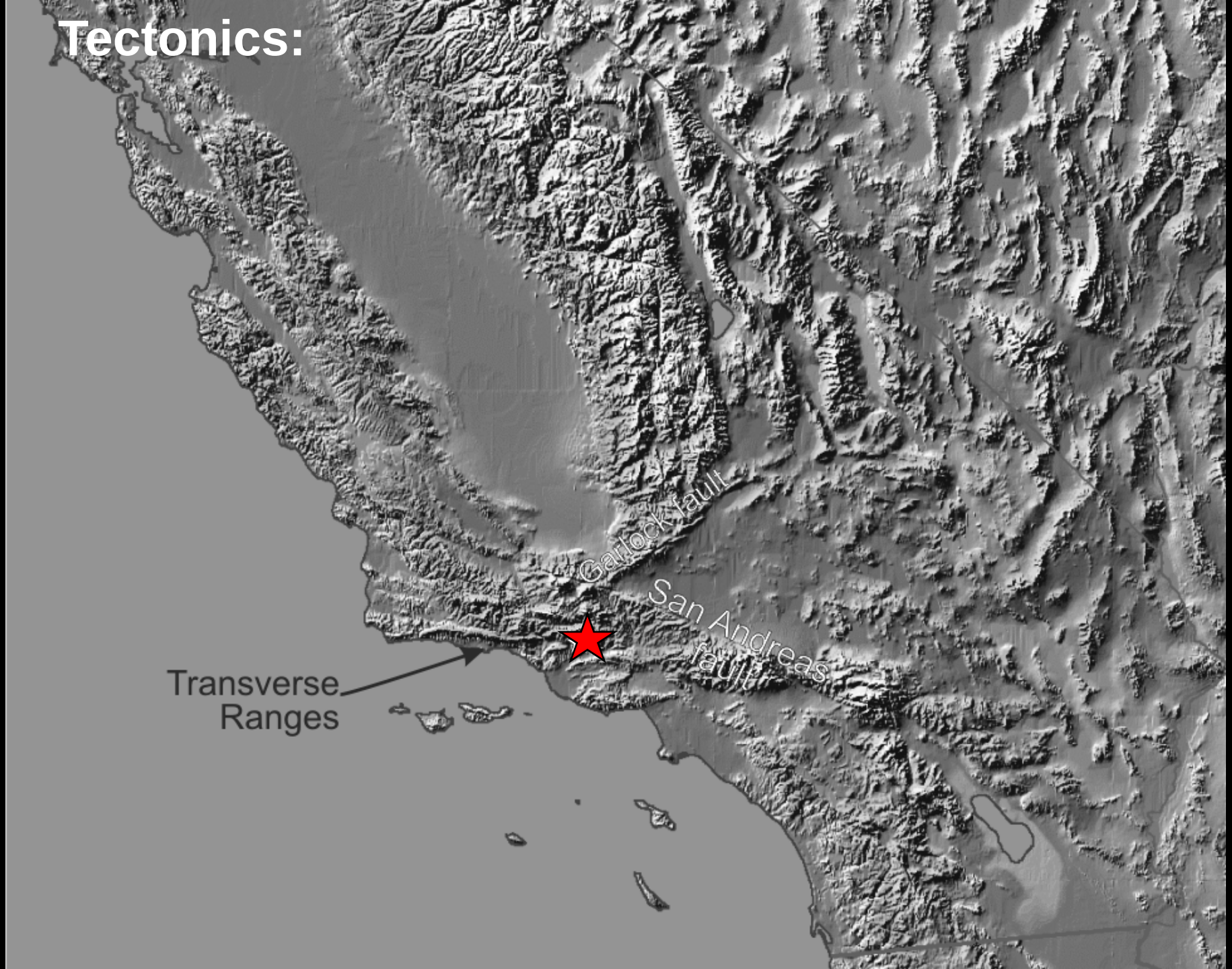
(Nelson & Booth, 2002)

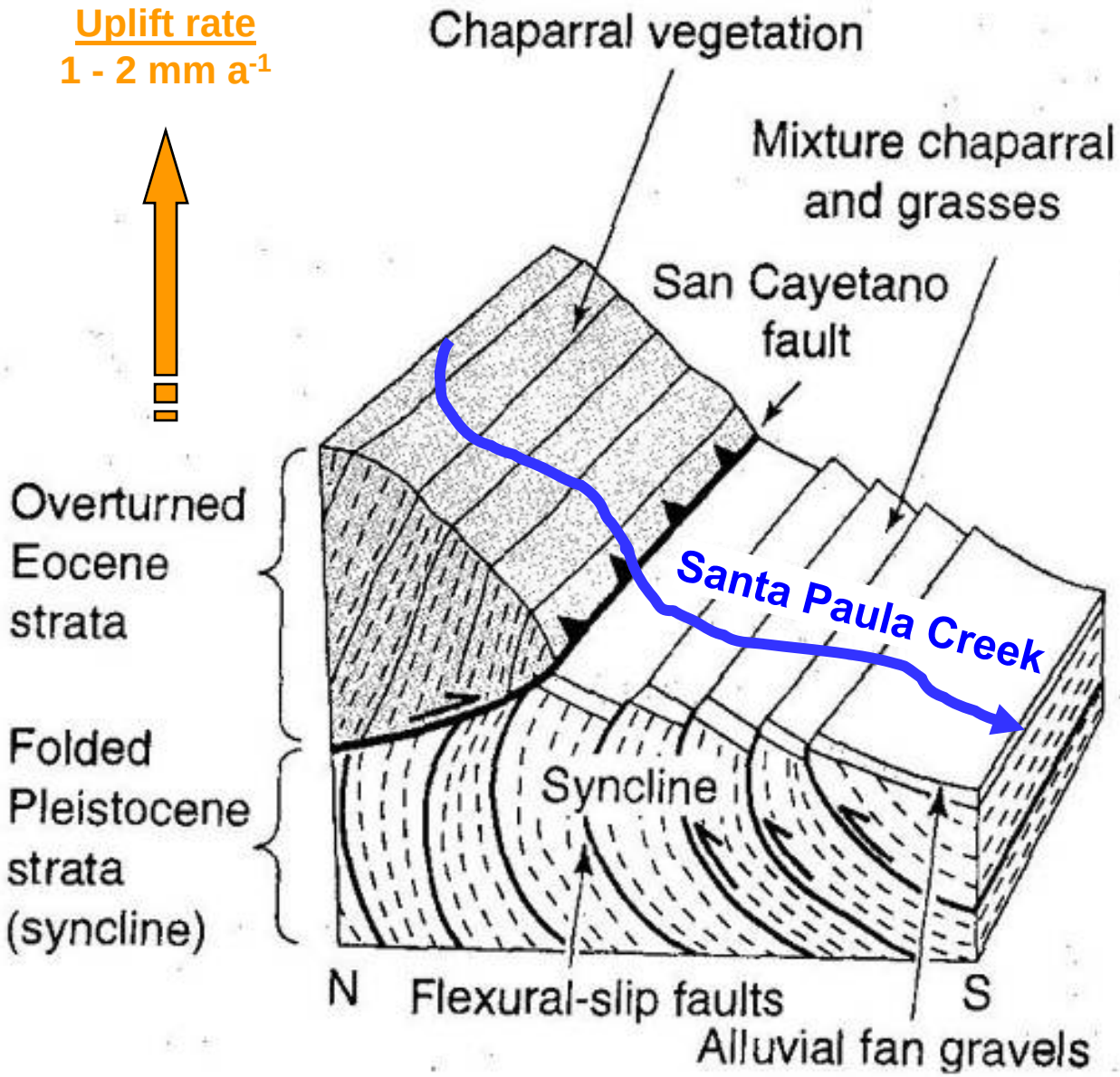

Issaquah Creek
Santa Paula Creek


150
Santa Paula Creek
126
© 2010 Europa Technologies
Image U.S. Geological Survey
Image USDA Farm Service Agency
© 2010 Google
Google
Imagery Dates: Aug 31, 2007 - Oct 21, 2009
34°23'09.50" N 119°03'16.23" W elev 226 m
Eye alt 3.24 km

Why are these rivers "different"?

Tectonics:

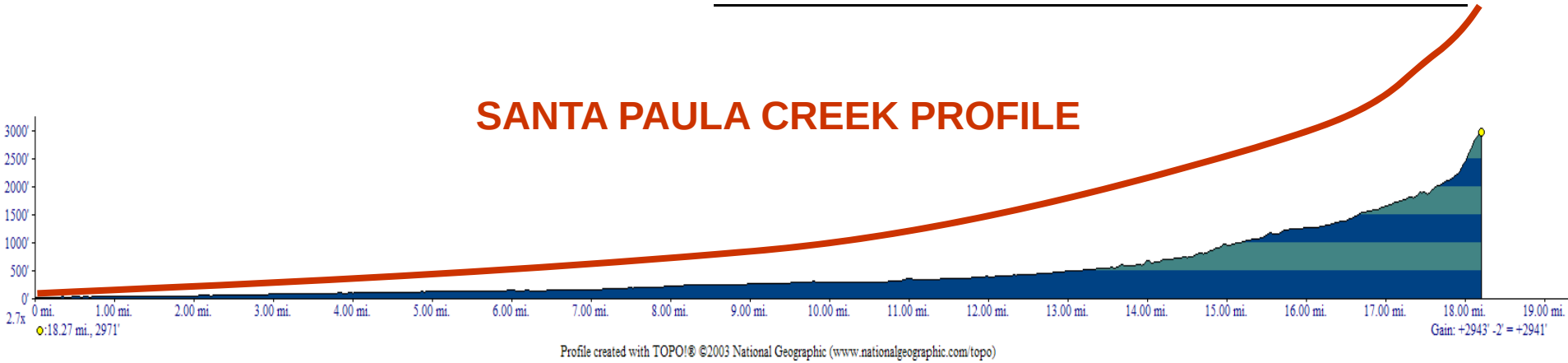




From Keller and Pinter (2002)

≈5000’ relief

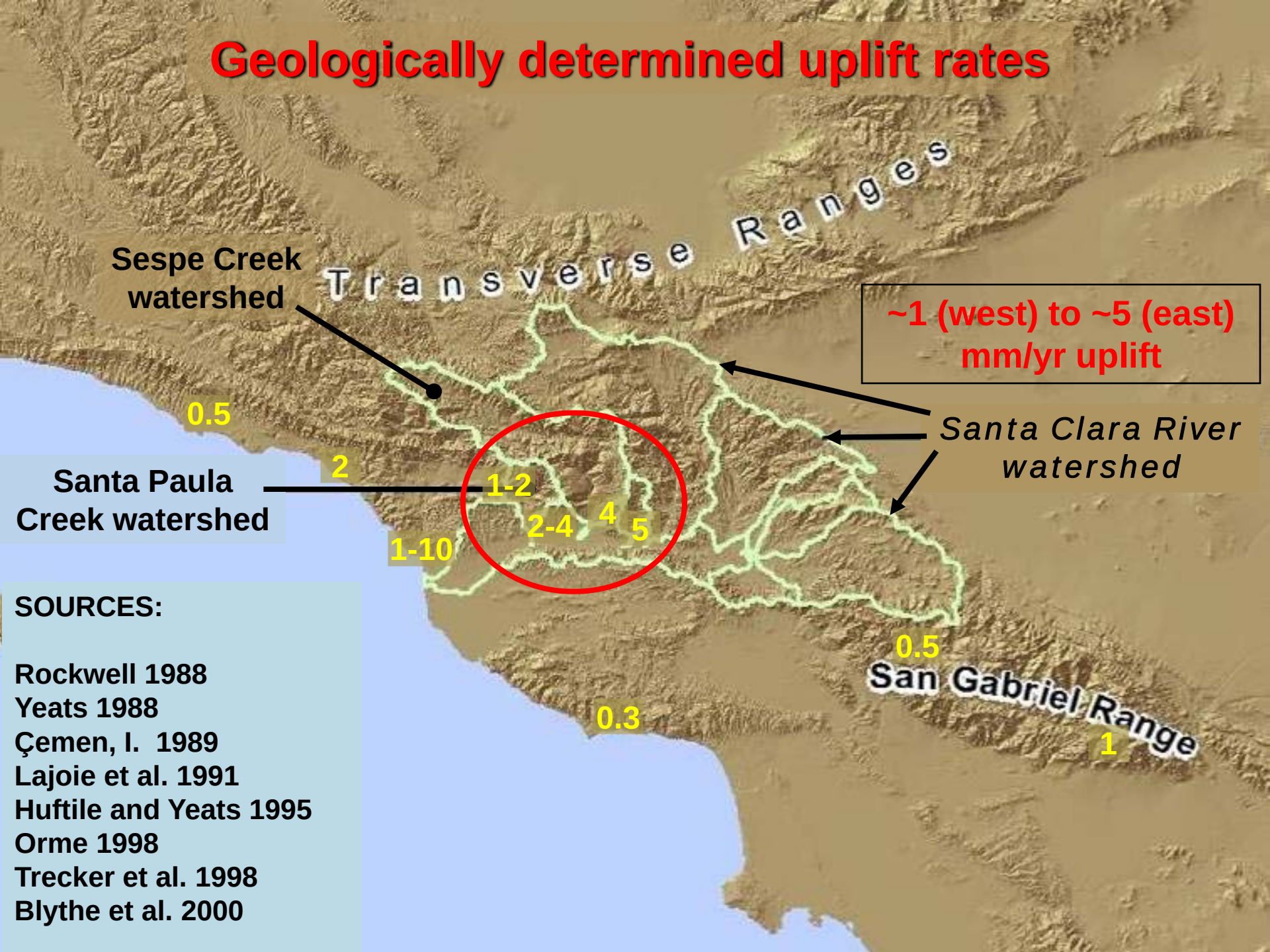
SANTA PAULA CREEK PROFILE



18.2 miles

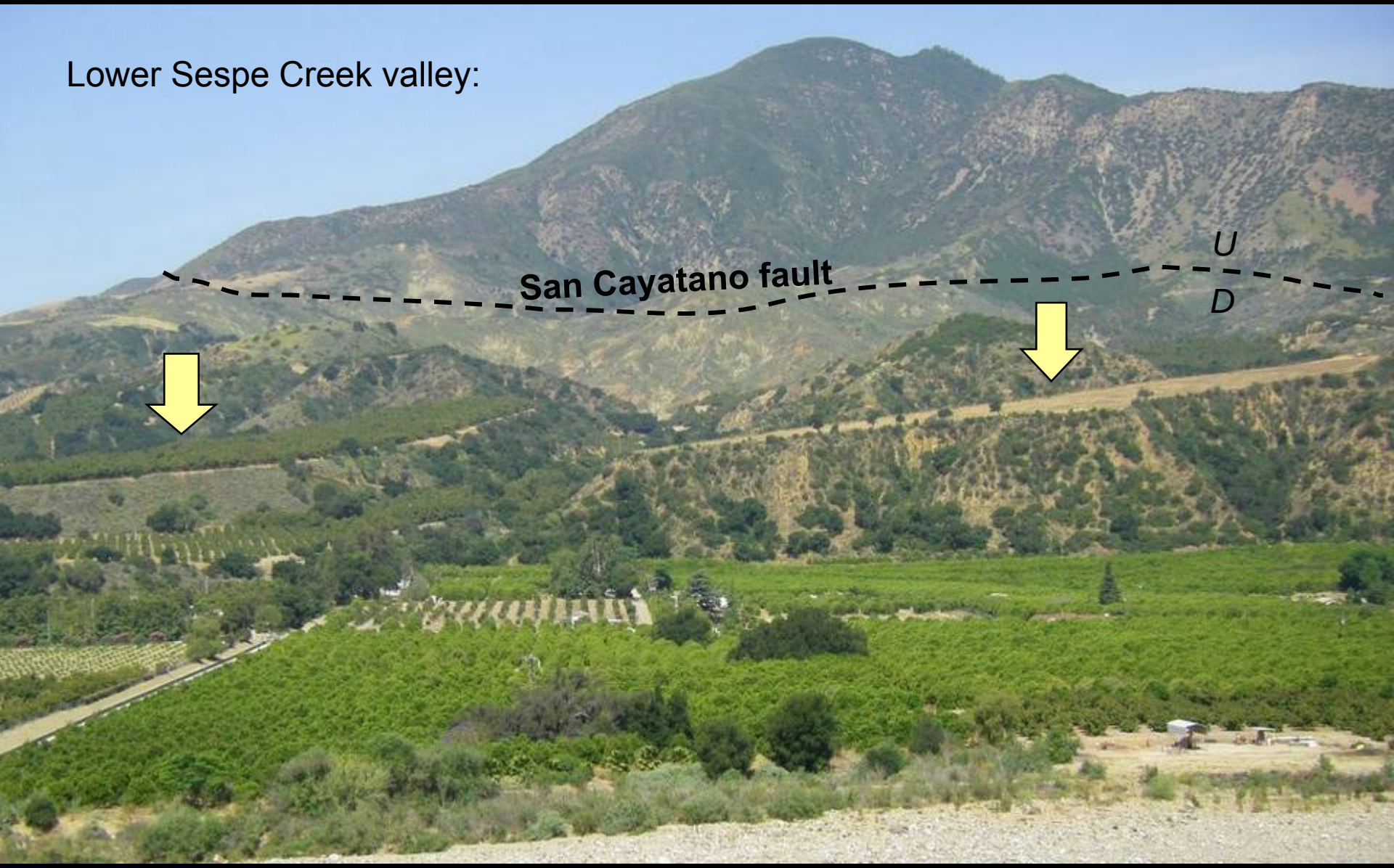
ISSAQUAH CREEK PROFILE

Geologically determined uplift rates

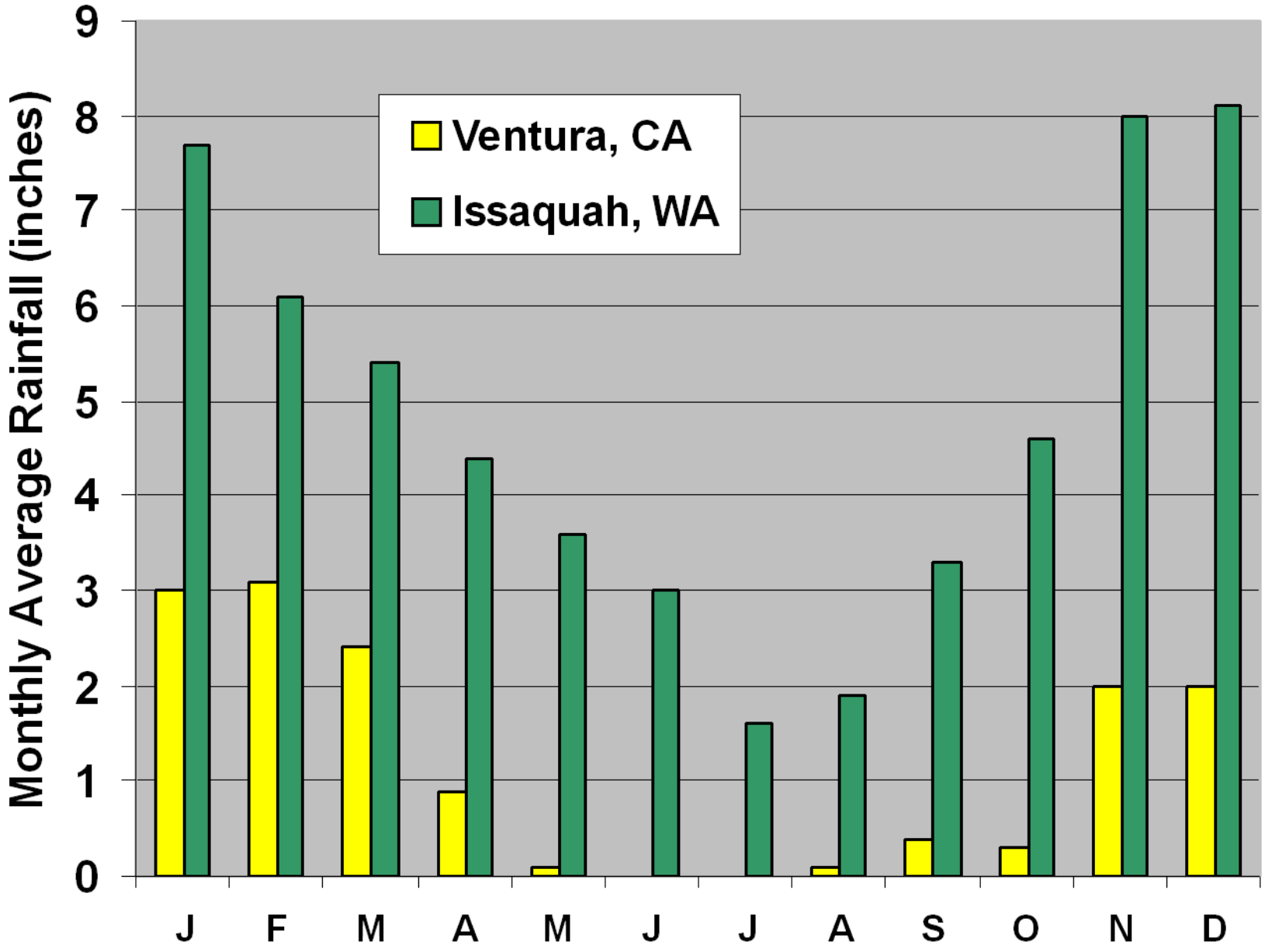


SOURCES:

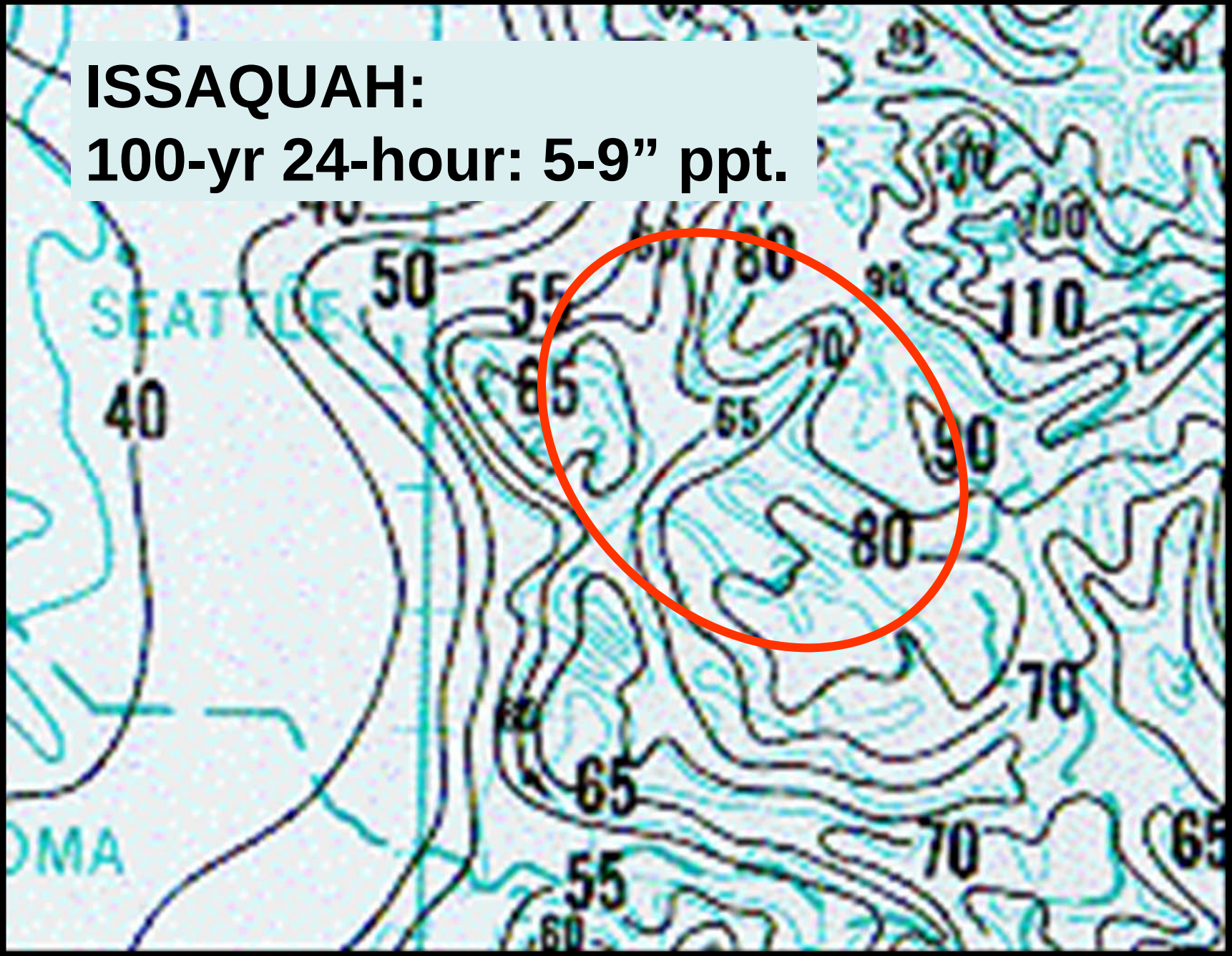
Rockwell 1988
Yeats 1988
Çemen, I. 1989
Lajoie et al. 1991
Huftile and Yeats 1995
Orme 1998
Trecker et al. 1998
Blythe et al. 2000


Lower Sespe Creek valley:
San Cayatano fault
U
D

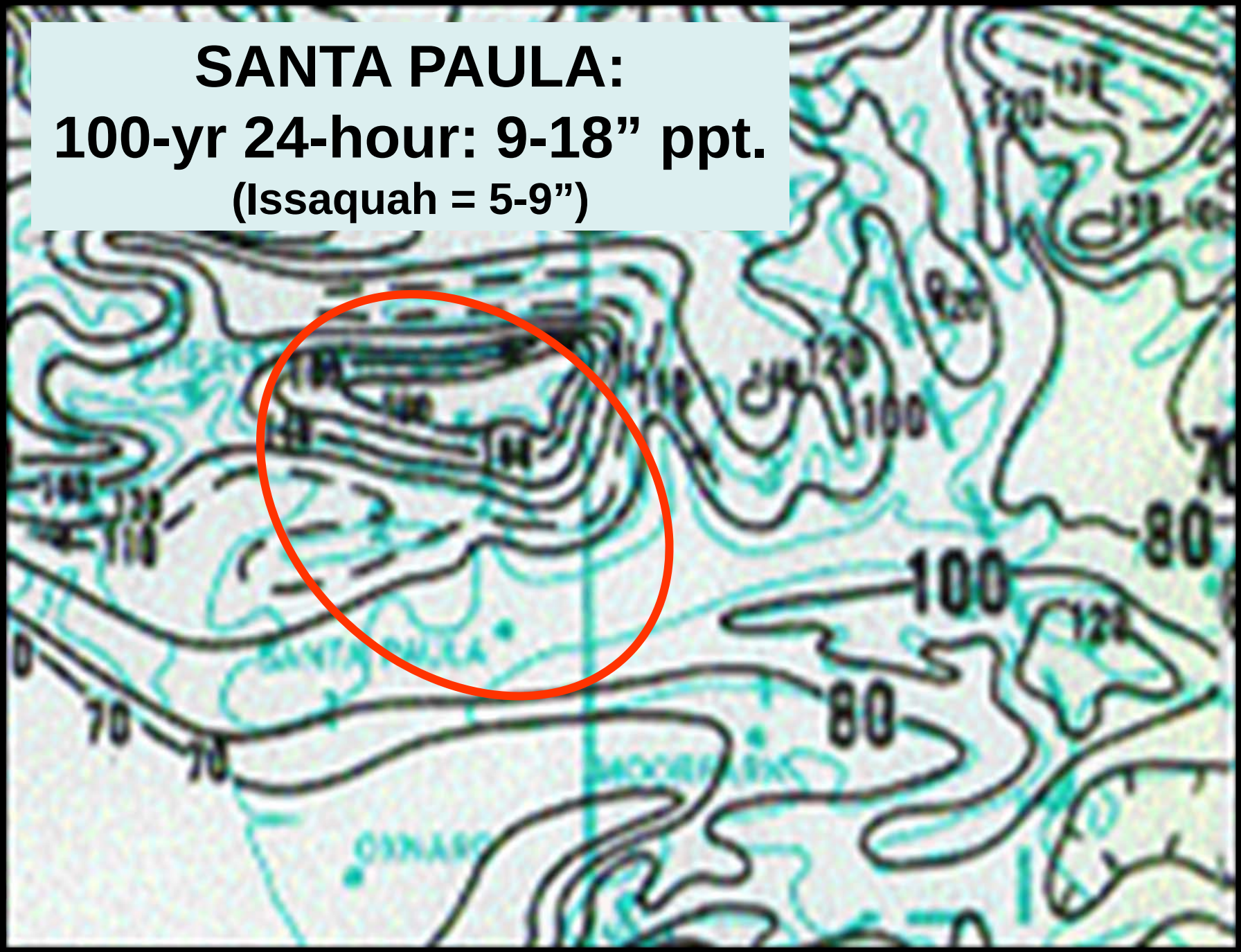
Climate:


Monthly Average Rainfall (inches)
0
1
2
3
4
5
6
7
8
9
Ventura, CA
Issaquah, WA
J
F
M
A
M
J
J
A
S
O
N
D

ISSAQUAH:
100-yr 24-hour: 5-9” ppt.



SANTA PAULA:
100-yr 24-hour: 9-18” ppt.
(Issaquah = 5-9”)

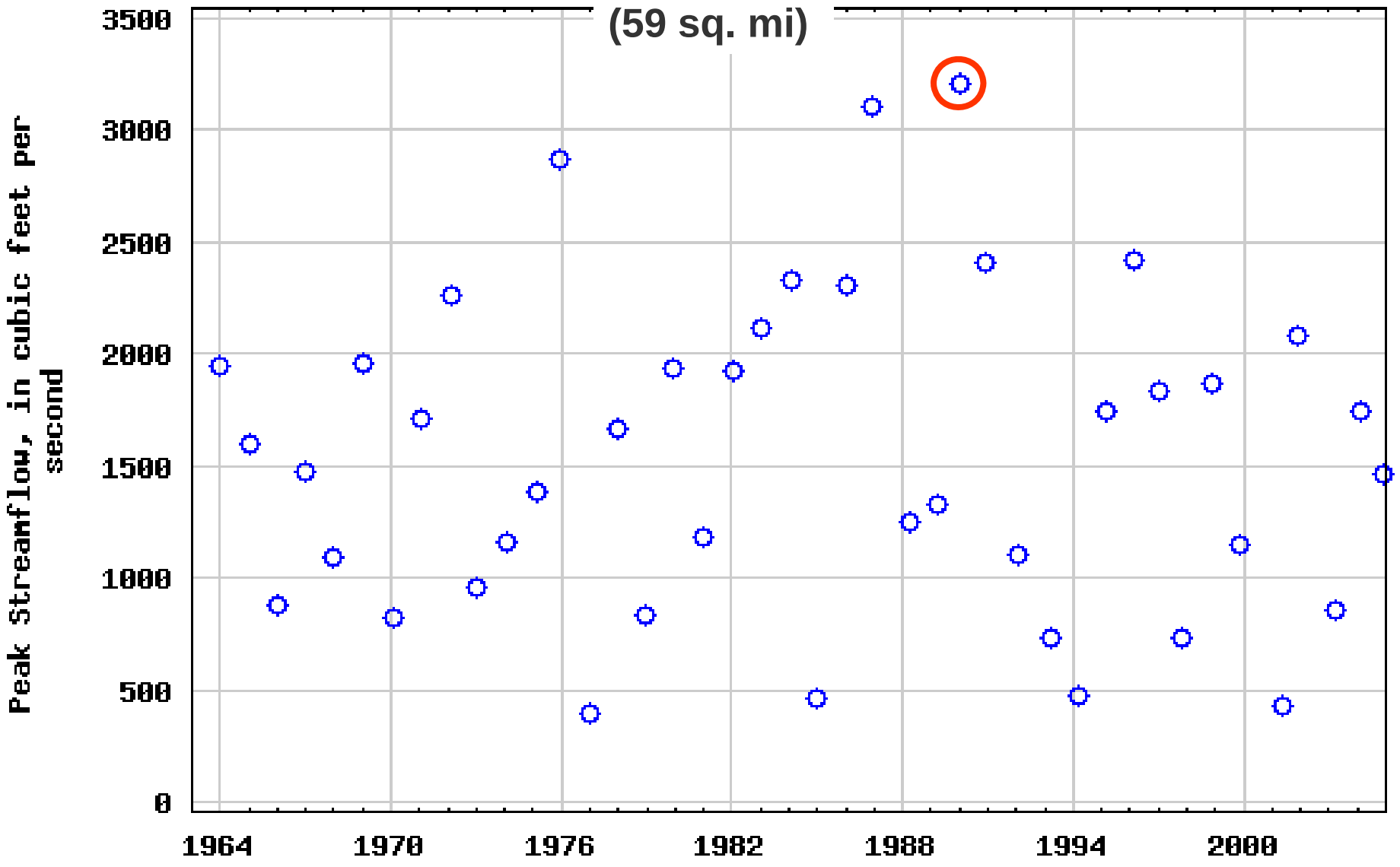


“The maximum intensity of precipitation…at intervals of 10 to 100 years is greater in portions of the San Gabriel and San Bernardino Mountains in southern California than anywhere else in the continental United States.”

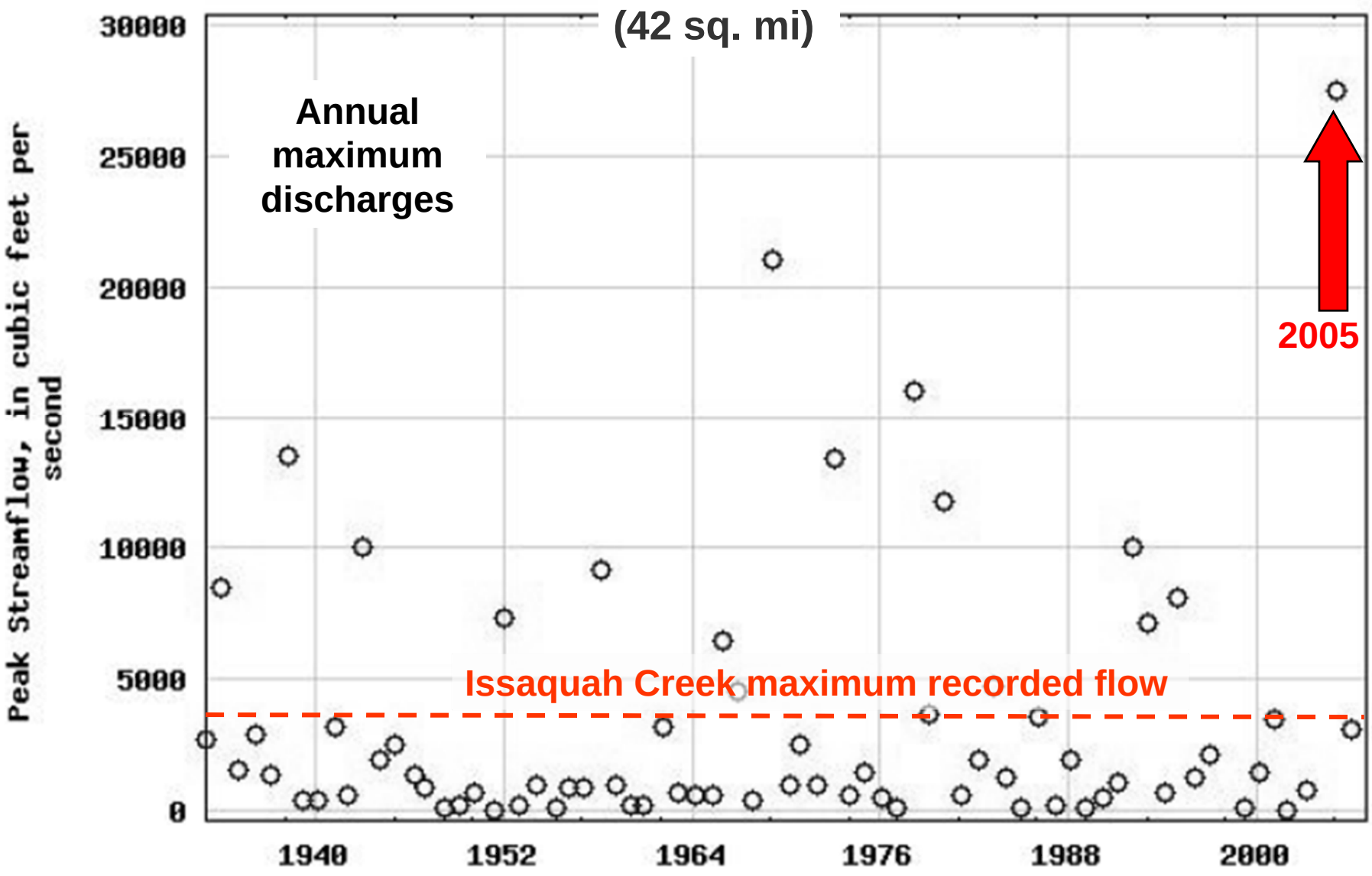
Western Regional Climate Center
(http://www.wrcc.dri.edu/)

USGS

USGS 12121600 ISSAQUAH CREEK NEAR MOUTH NEAR ISSAQUAH, WA



USGS 11113500 SANTA PAULA CREEK NEAR SANTA PAULA, CA

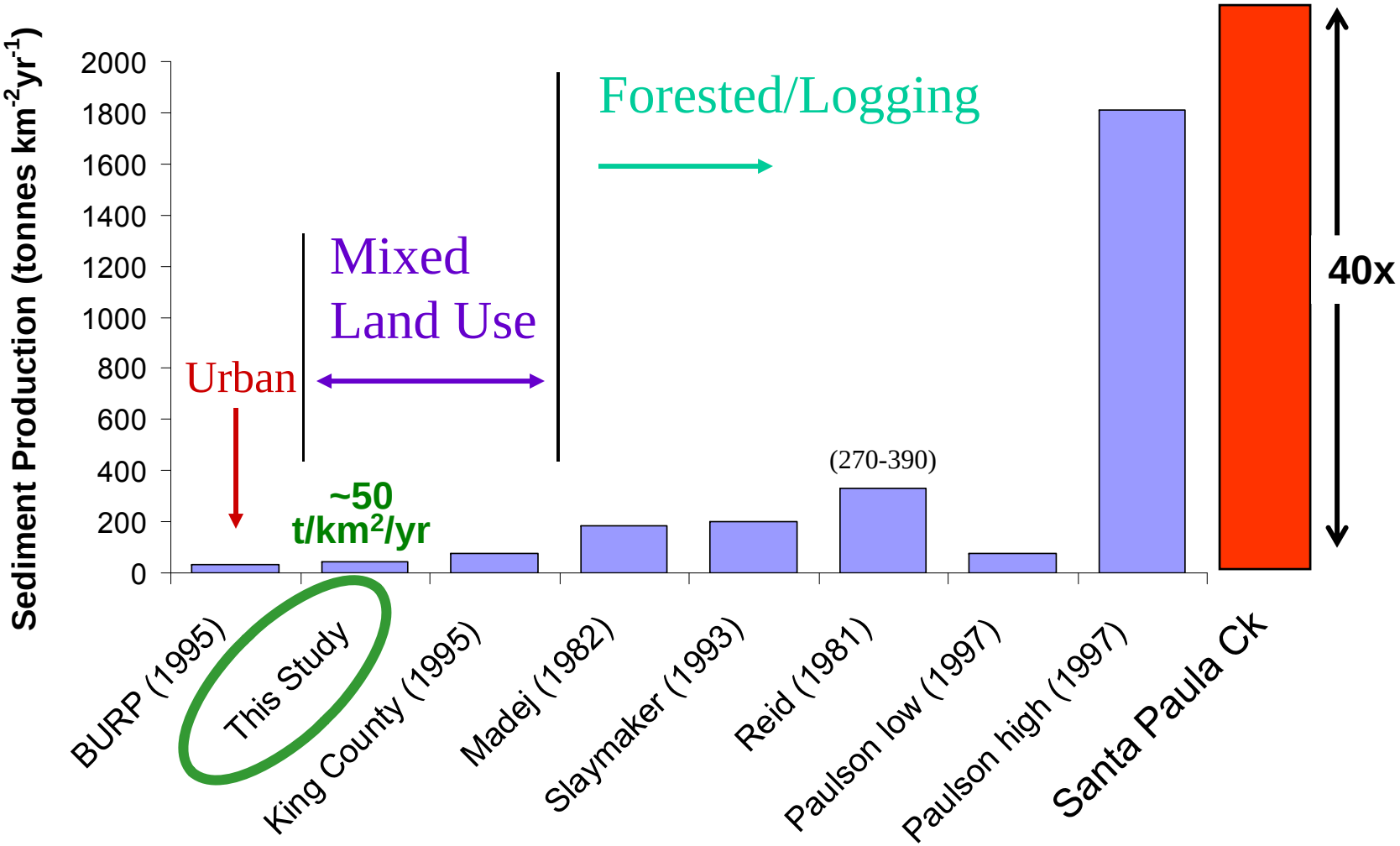


Predicted hillslope sediment delivery by subwatershed

Santa Paula Creek:

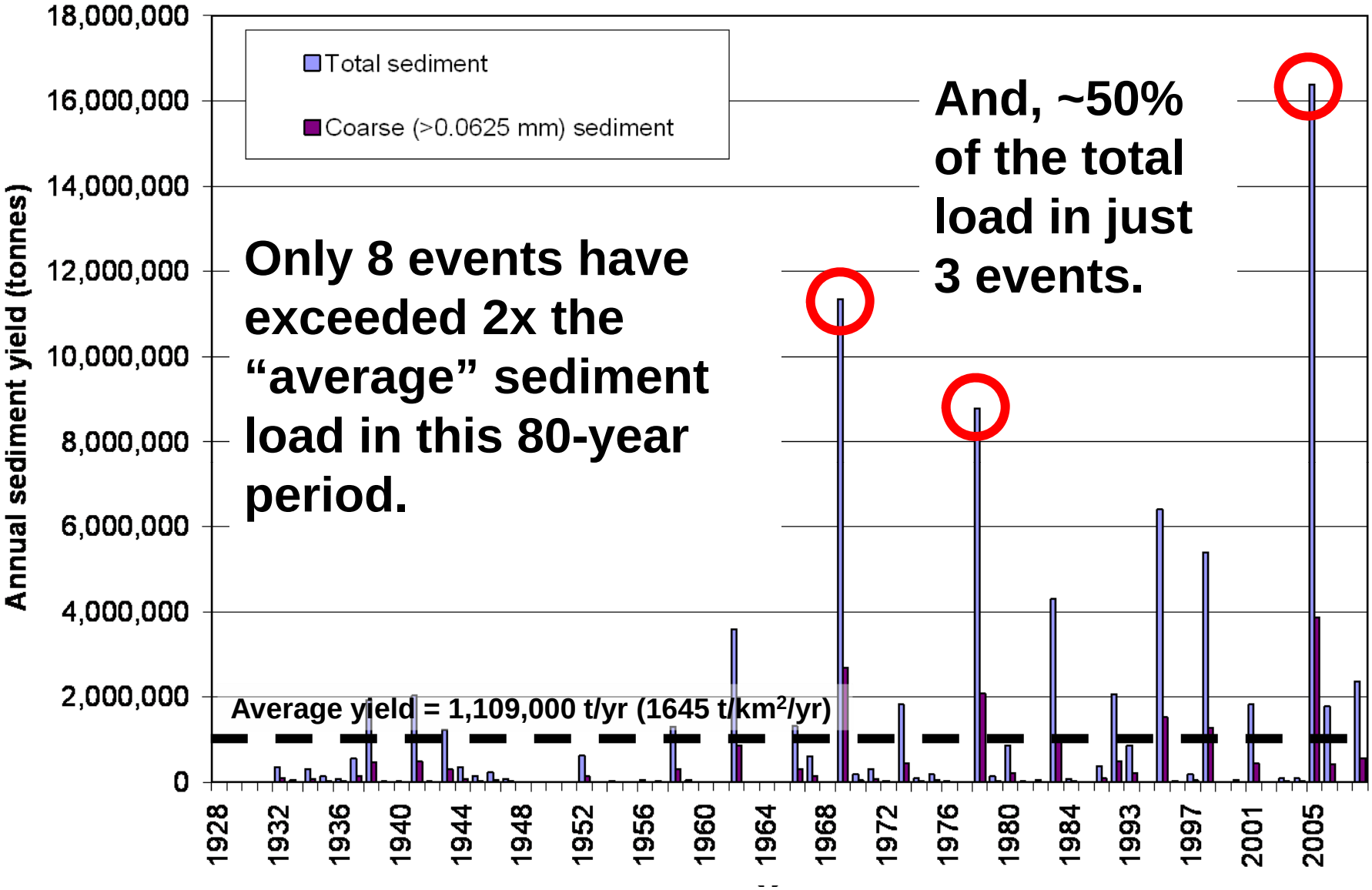
Tributary	**Total annual load ($t\ a^{-1}$)**	**Annual load ($t\ km^{-2}\ a^{-1}$)**	**Landscape lowering rate ($mm\ a^{-1}$)**
Sisar Creek	44,000	2,300	0.9
Upper Santa Paula Creek (to Sisar Ck. confluence)	73,000	1,700	0.7
SPC at Harvey Diversion Dam	146,000	2,100	0.8
Mud Creek	24,000	5,800	2.2
Santa Paula Creek at mouth	**252,000**	**2200**	**0.8**

Sediment production from Pacific Northwest watershed studies



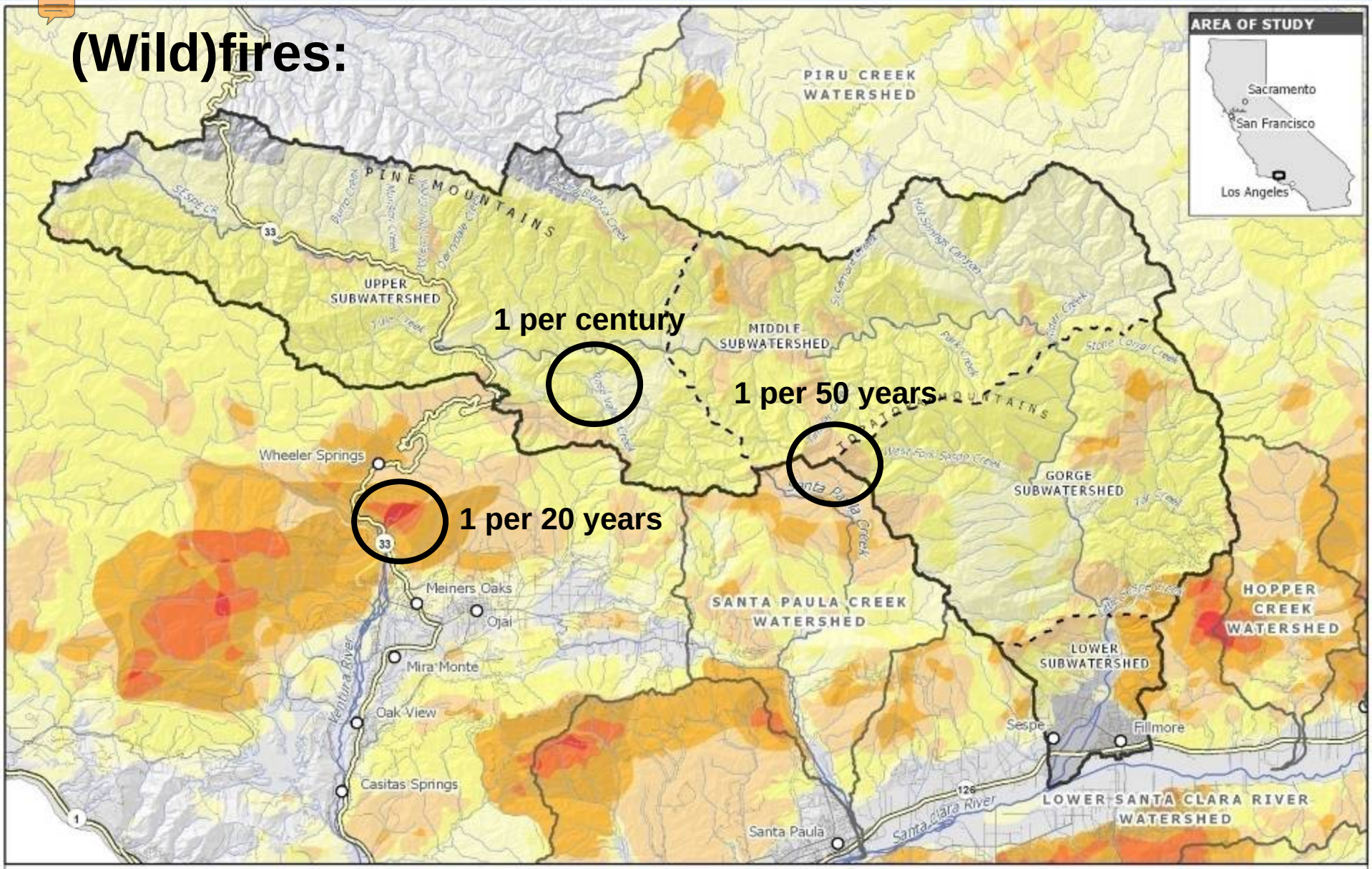
Fine sediment delivery:

Coarse sediment delivery:



Calculated sediment load for Sespe Creek at Fillmore [USGS gage 11113000]

(Wild)fires:



Frequency of burn events in the Sespe Creek watershed and vicinity

Sespe Creek Watershed
Sta. Clara River Subwatersheds
Sespe Subwatersheds

Fire Frequency (1878-2007)

1 2 3 4 5 6 7 8 9 10 11

Data Sources: Shaded relief: USGS 10m DEM; Watersheds: Stillwater Sciences; Cities, Roads, and Rivers: ESRI; Public Lands: CASIL; Fire Boundaries : CDF FRAP; Fire Frequency: SWS

0 1 2 4 Miles
0 2.5 5 10 Kilometers

Stillwater Sciences
July 2008

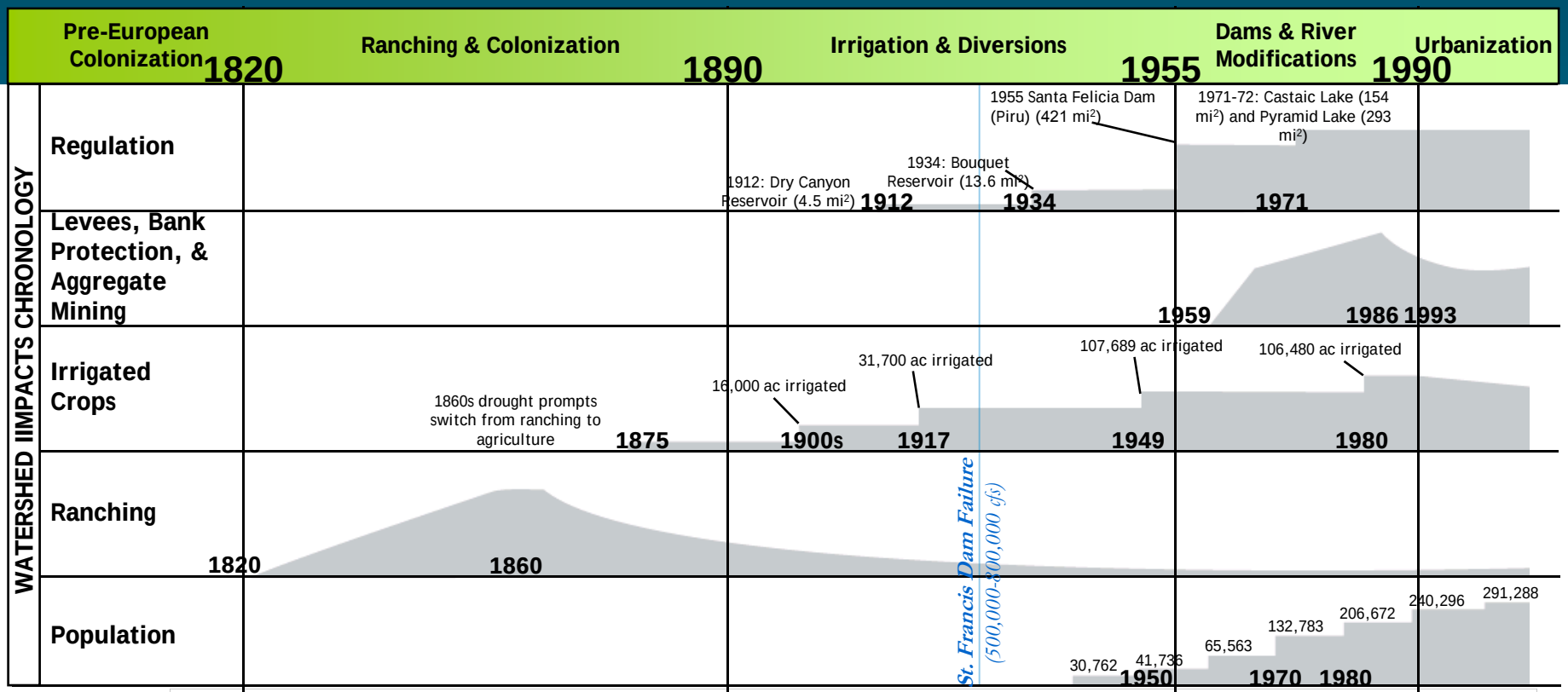
Fire-related hillslope and tributary sediment production and delivery

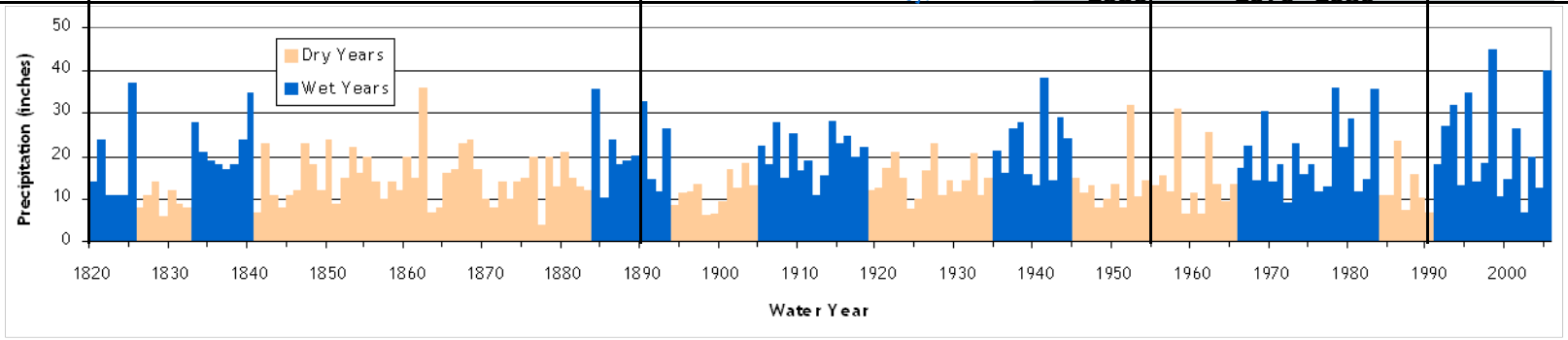
View of runoff along upper Aliso Canyon in areas recently burned during the 2009 Station Fire.

View of new vegetation growth on hillslopes previously burned during the 2007 Buckweed Fire.

Human activity:

Infrastructure & land use, Lower Santa Clara R.





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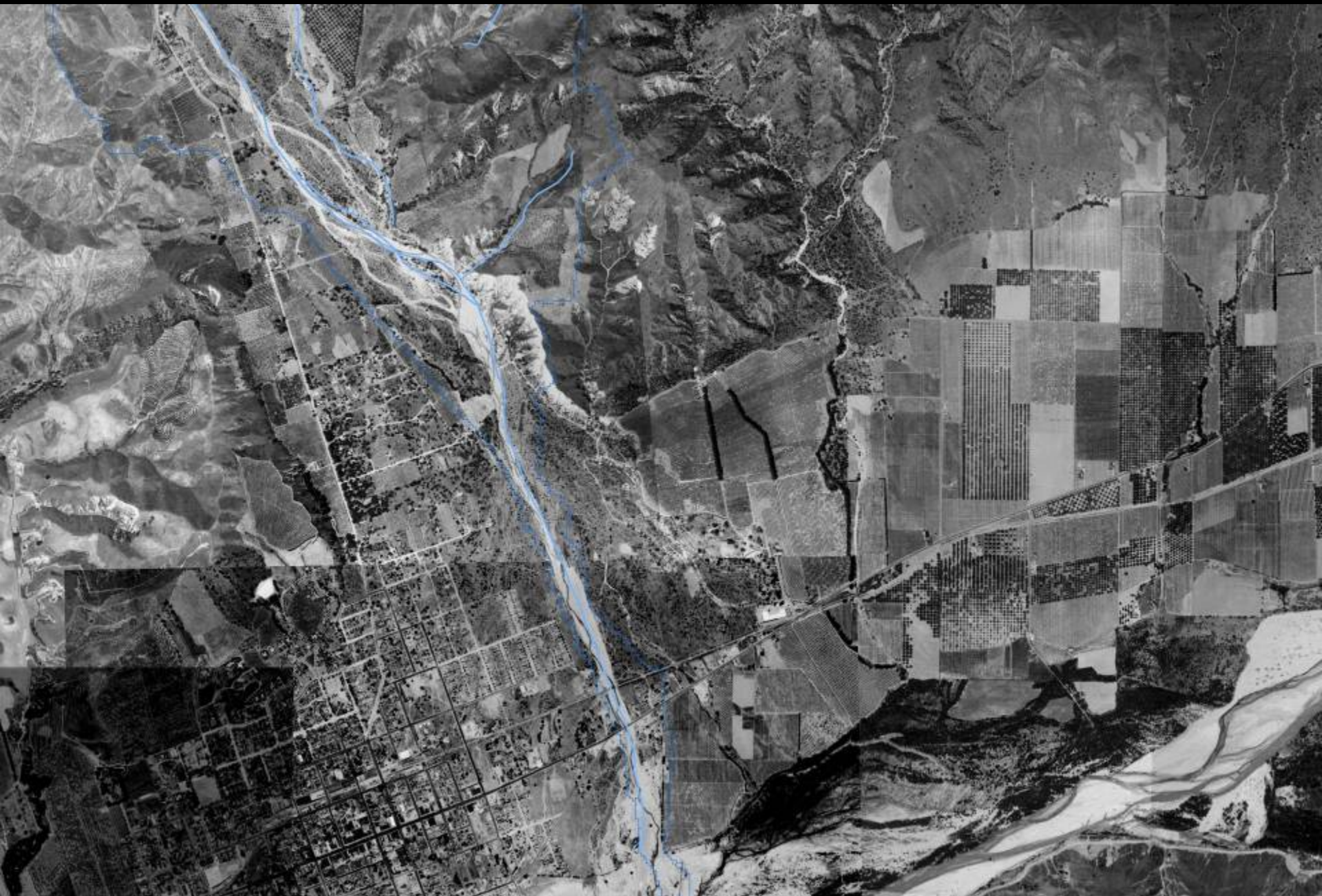
Lower Santa Paula Creek (1938)

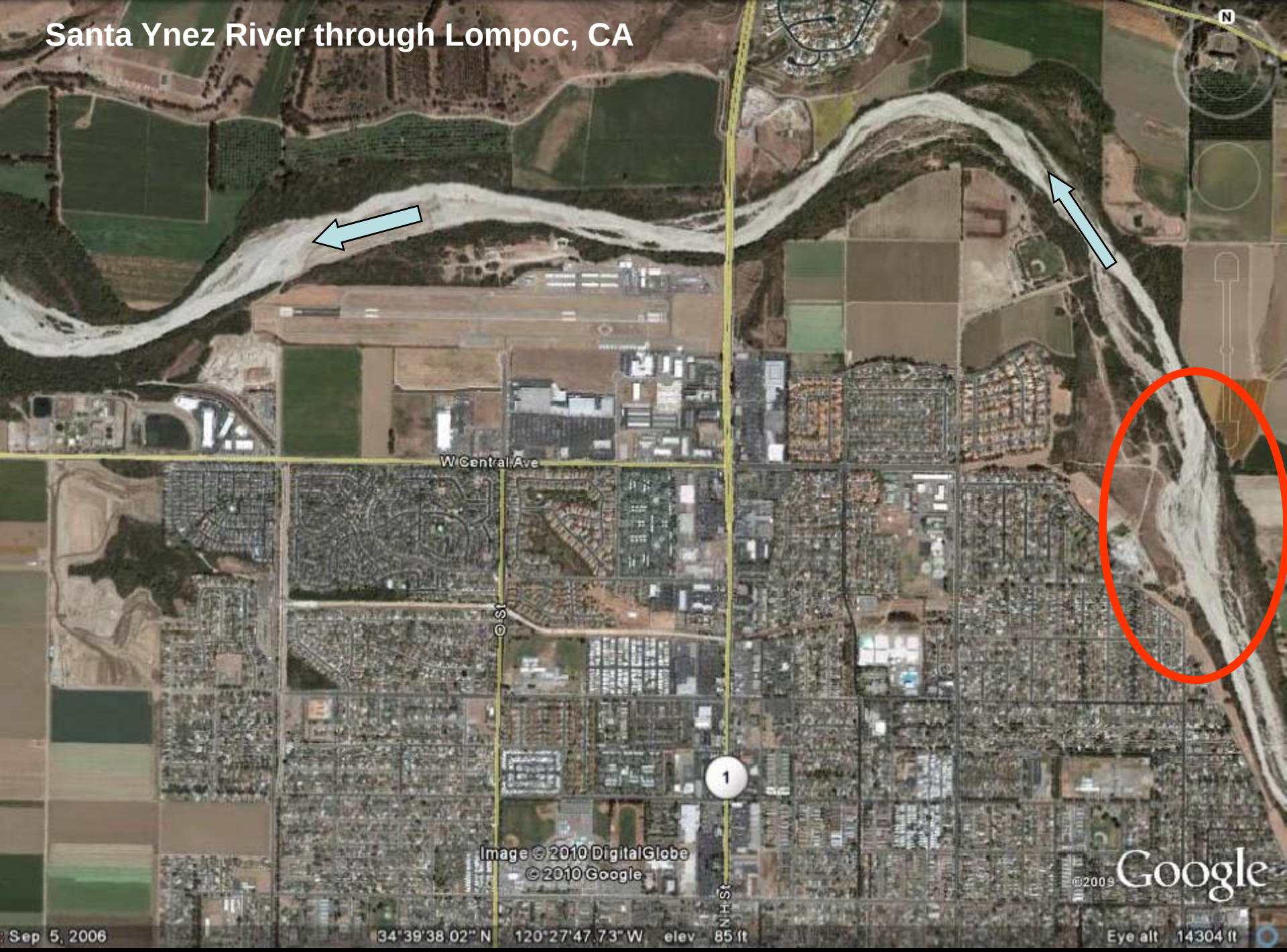


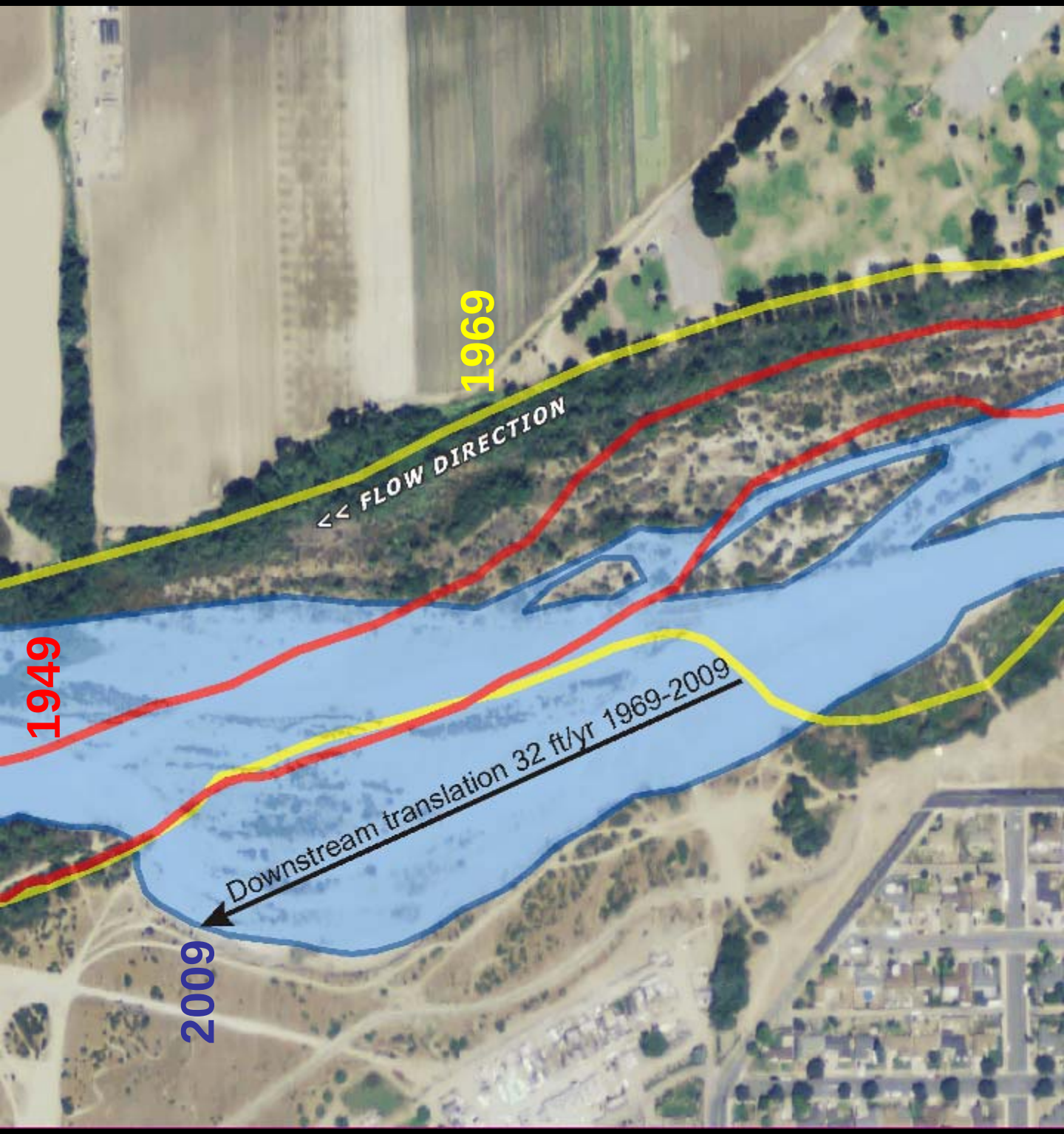
Lower Santa Clara River

Snoqualmie River nr. Carnation, WA

Los Angeles River

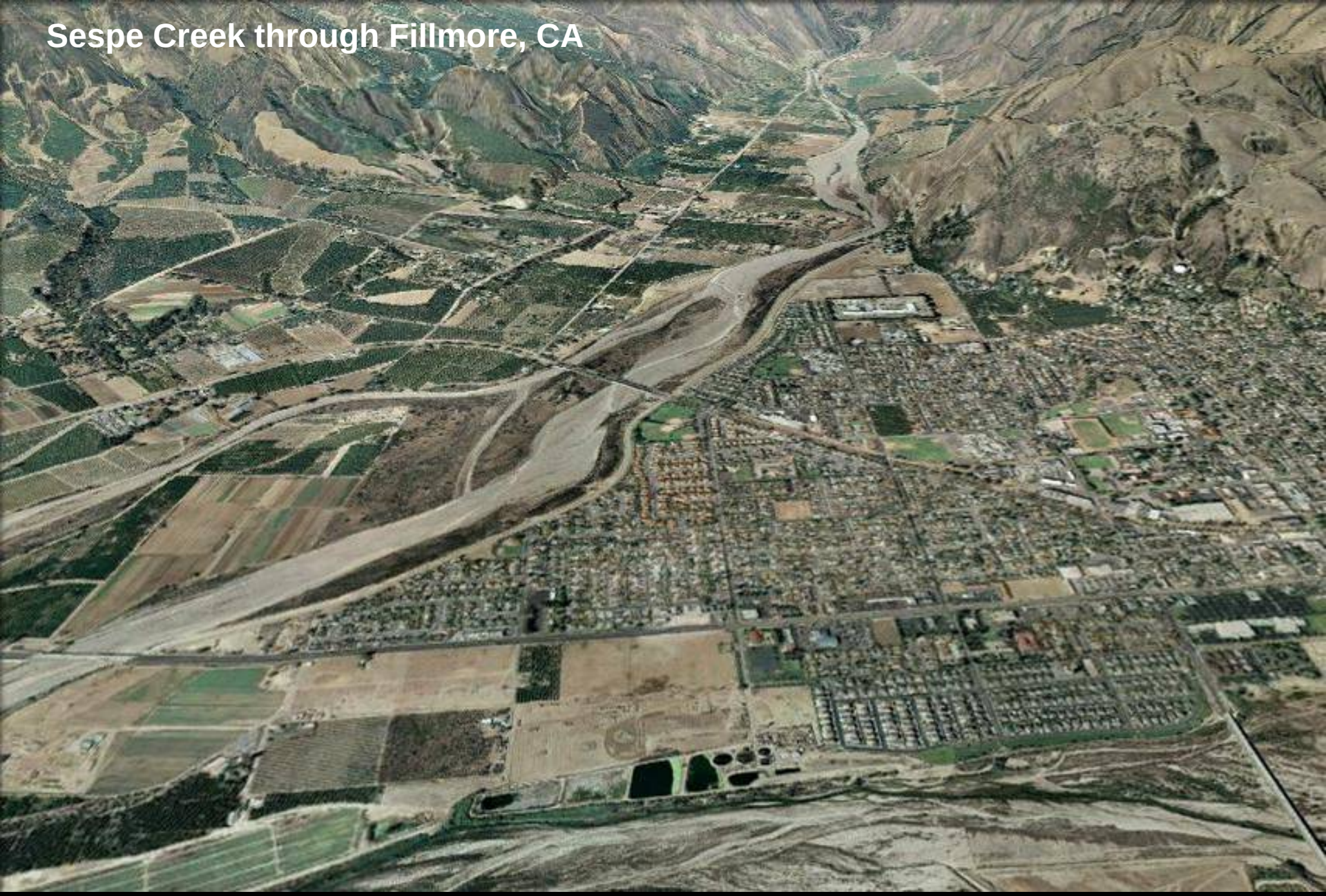
Santa Ynez River through Lompoc, CA



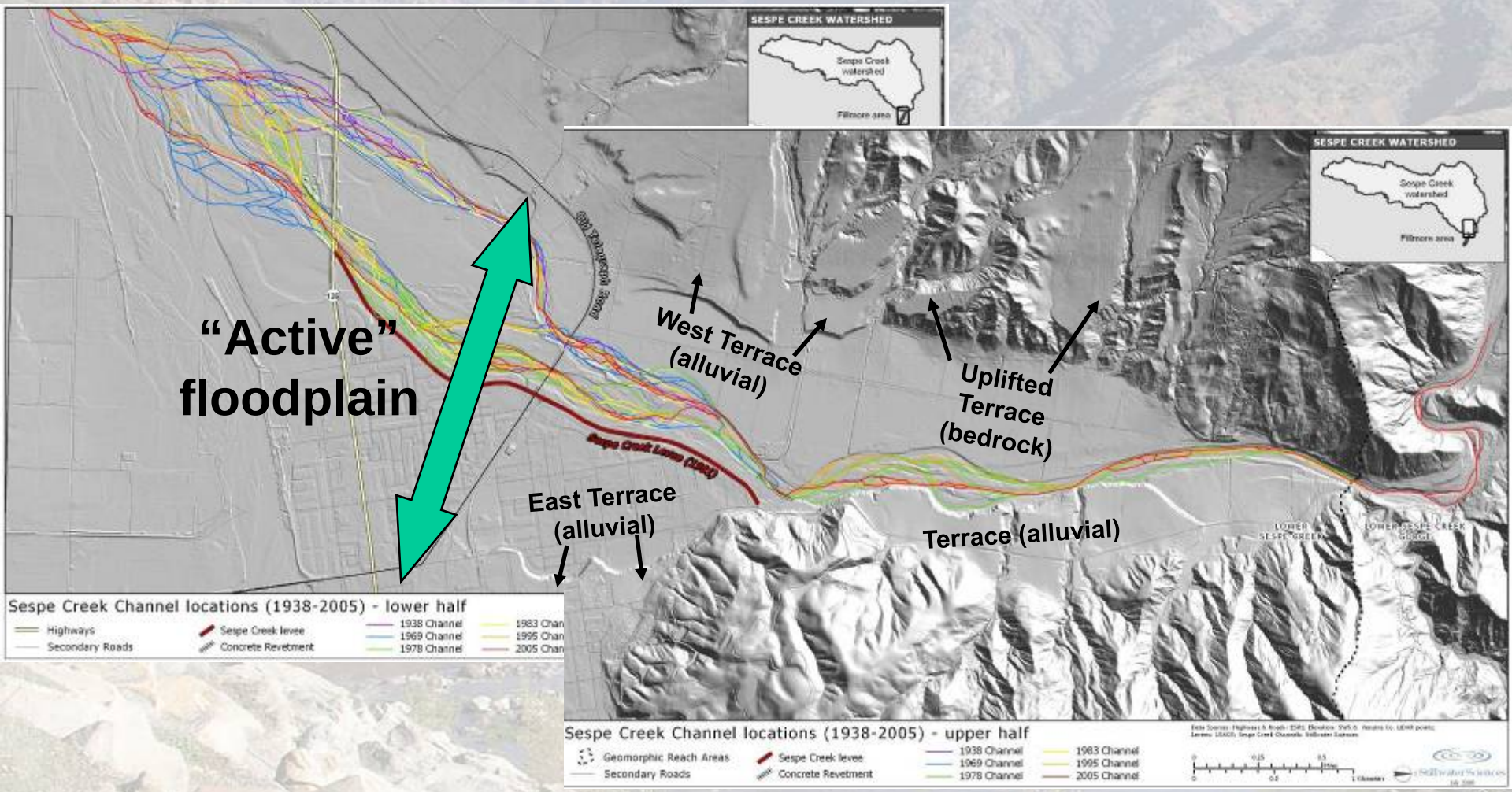

1969
<< FLOW DIRECTION
1949
Downstream translation 32 ft/yr 1969-2009
2009

Santa Clara River above Santa Paula, CA

Distributary channels on coalescing alluvial fans:


Sespe Creek through Fillmore, CA

Thalweg Locations in Lower Sespe Creek (1938–2005)



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Newhall Creek

Santa Paula Creek below Harvey Diversion Dam

Upper Santa Clara River

Upper Santa Clara River

Hasley Canyon, Upper Santa Clara River watershed

San Antonio Creek

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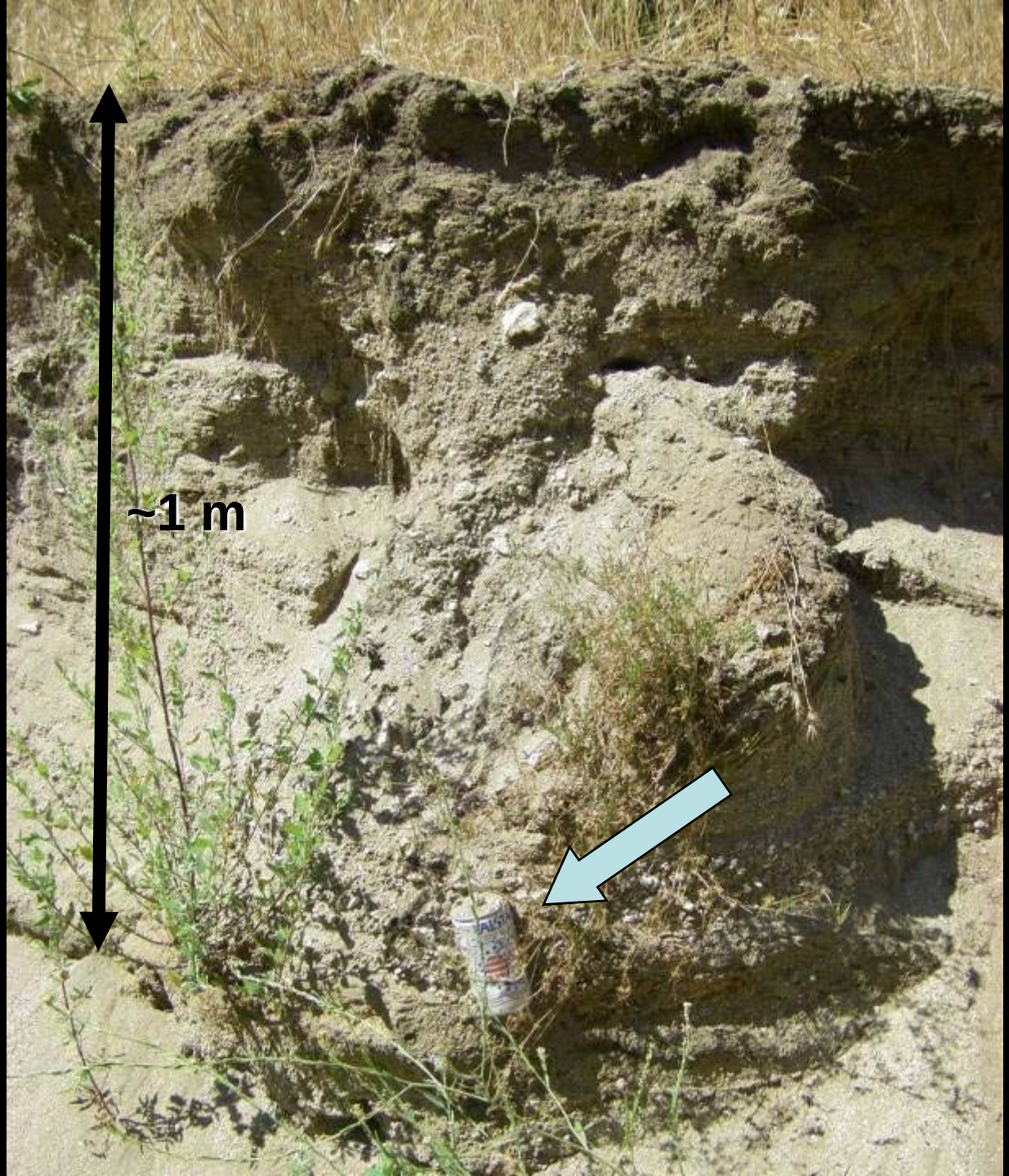
Mud Creek

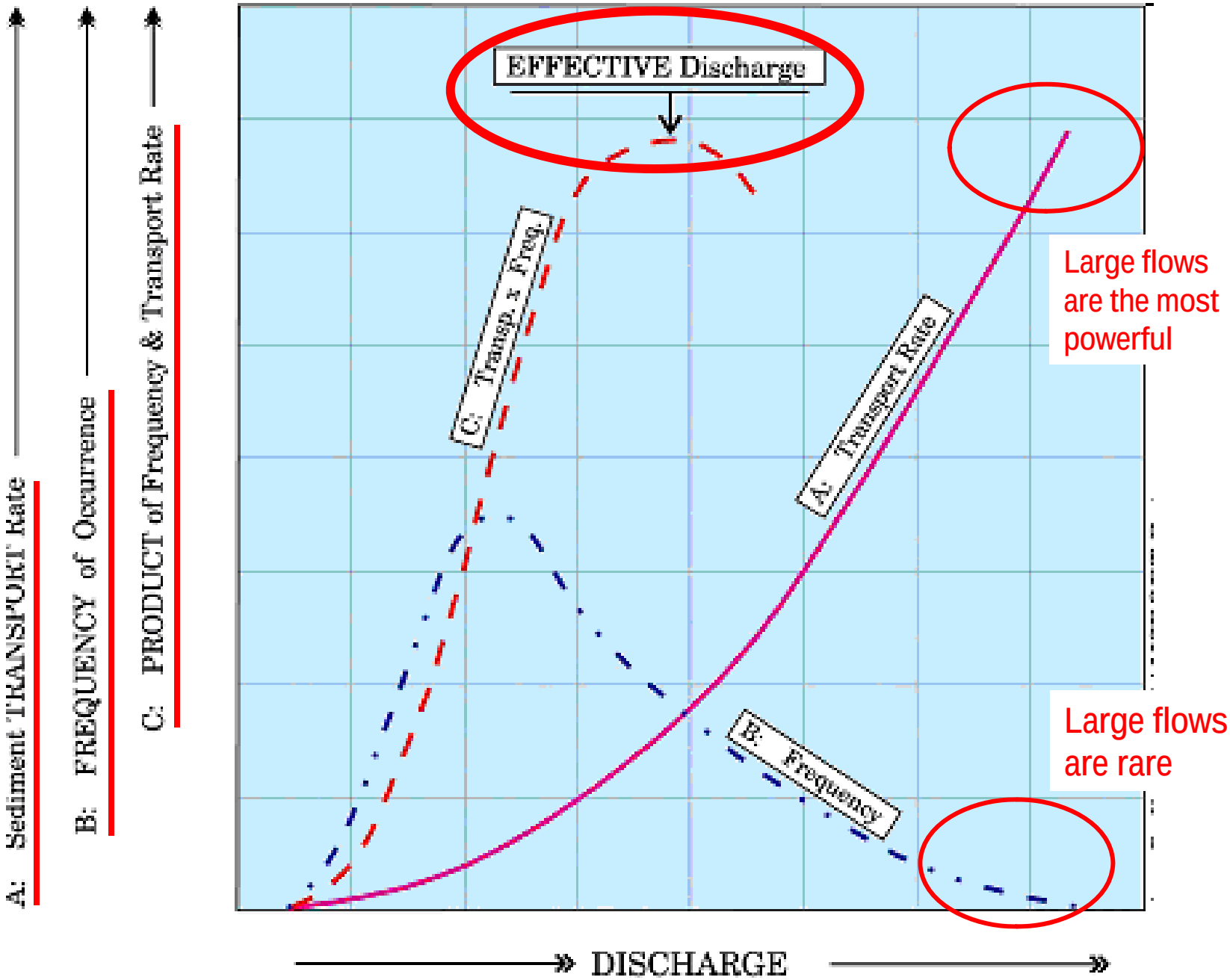
Grade control structure 10’ d/s

Upper San Francisquito Creek

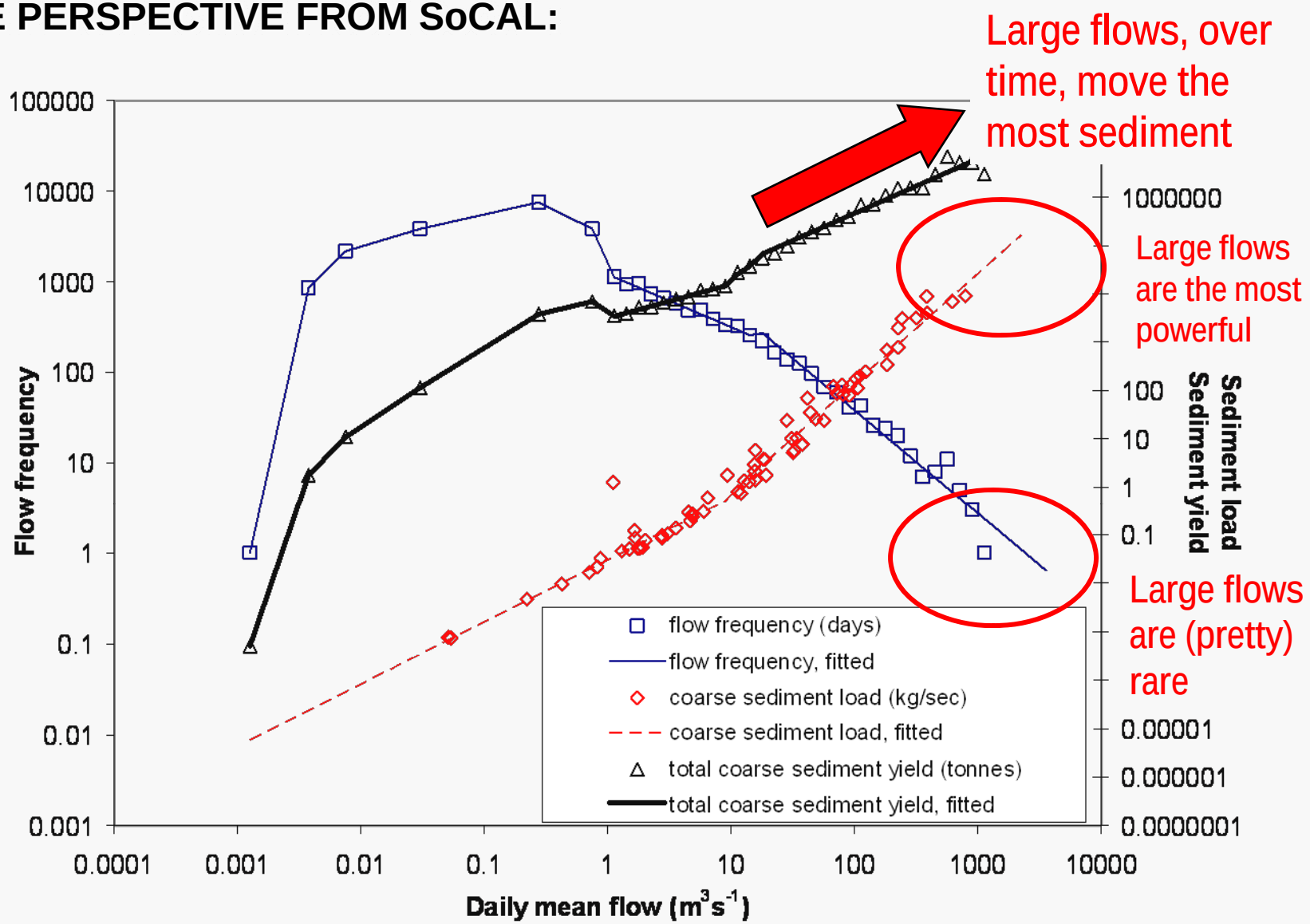

~1 m

FALSTAFF
FINE ★ LIGHT ★ BEER
FALSTAFF ★ SINCE ★ 1876
NET CONTENTS 12 FLUID

WHAT IS THE "DOMINANT (or "effective") DISCHARGE"?



THE PERSPECTIVE FROM SoCAL:



Flow frequency and coarse (>0.0625 mm) sediment load for long-term daily mean flow record for Sespe Creek at Fillmore [USGS gage 11113000].

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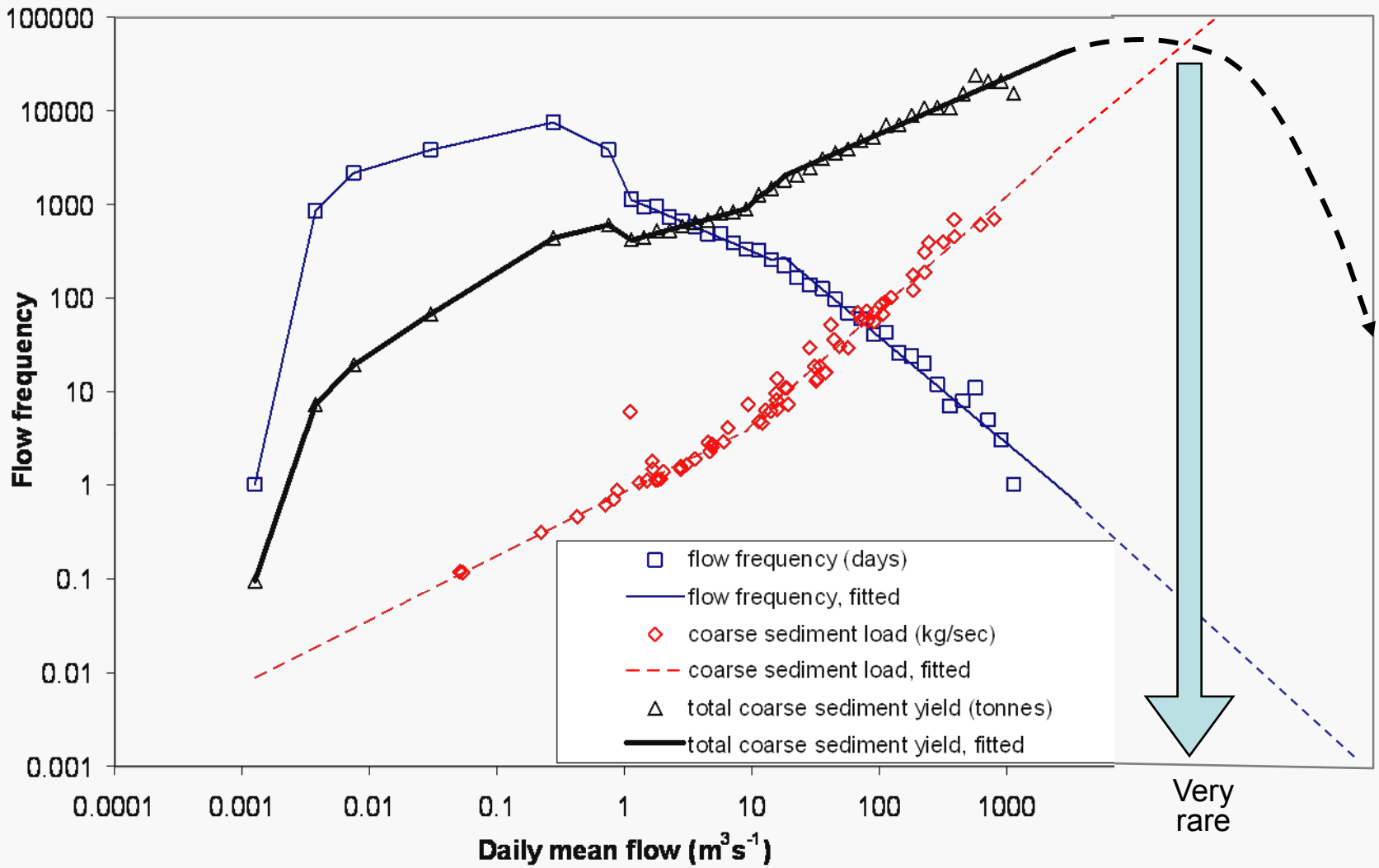

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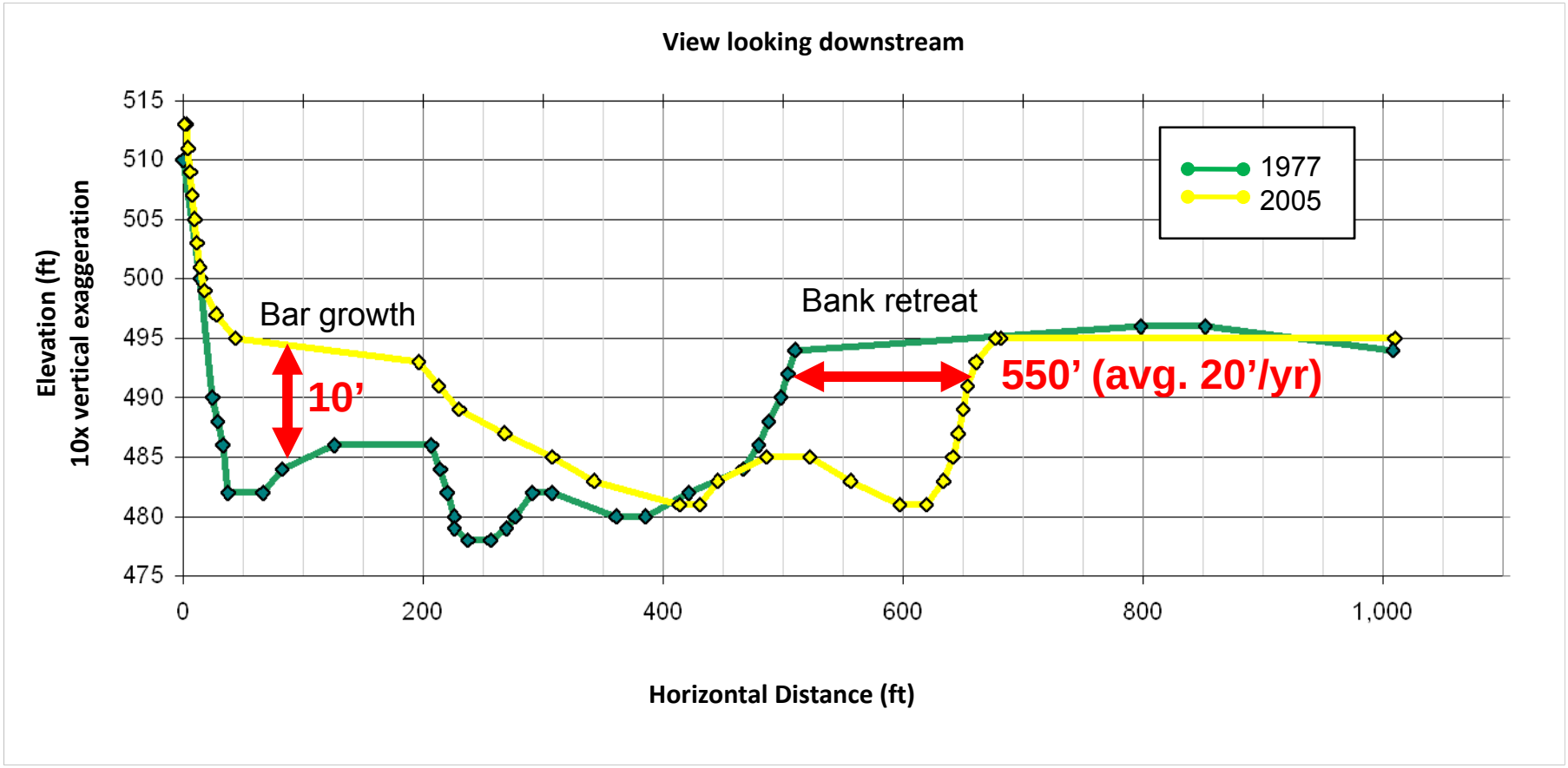
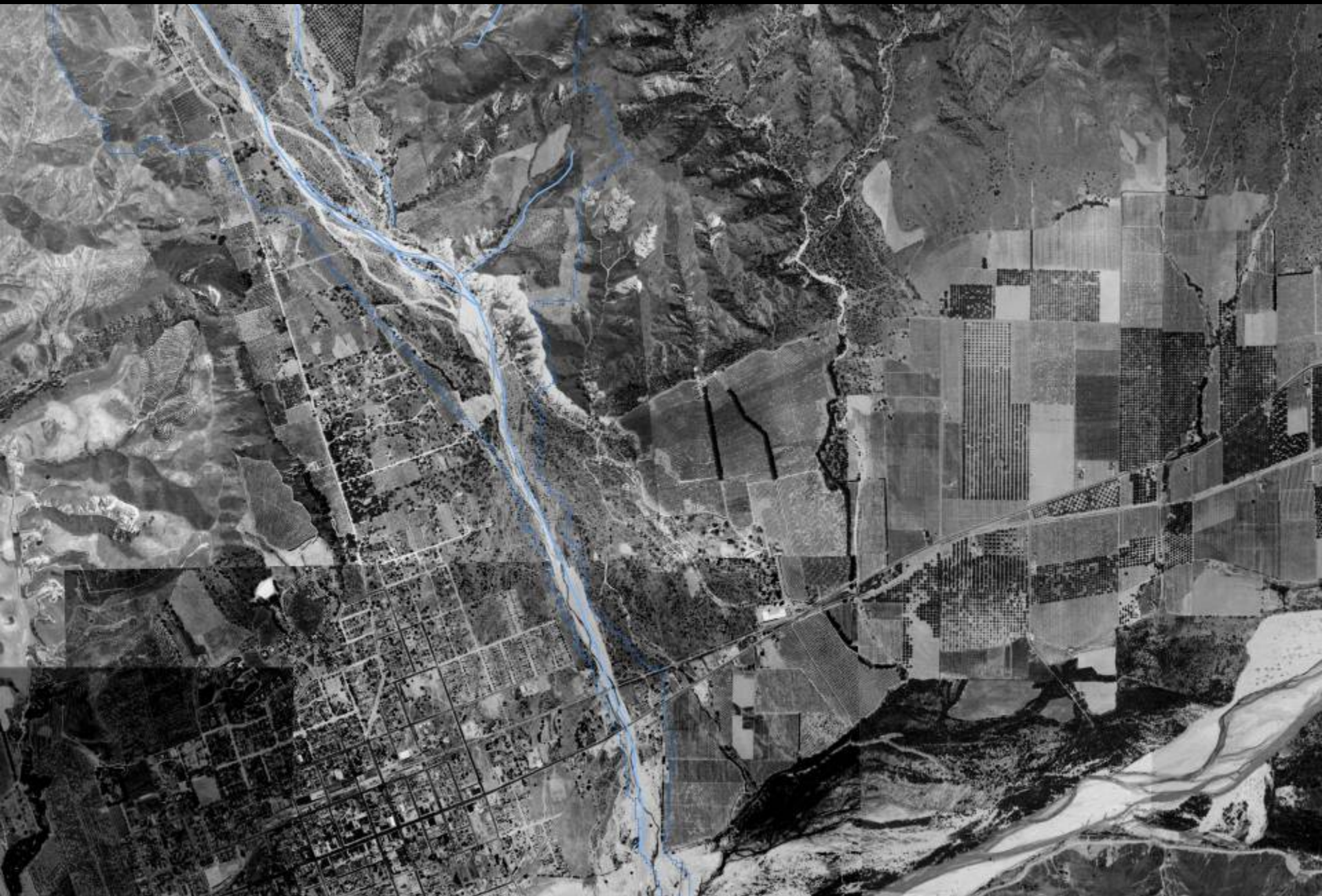
Sespe Creek Cross-Section Analysis (1977 & 2005)

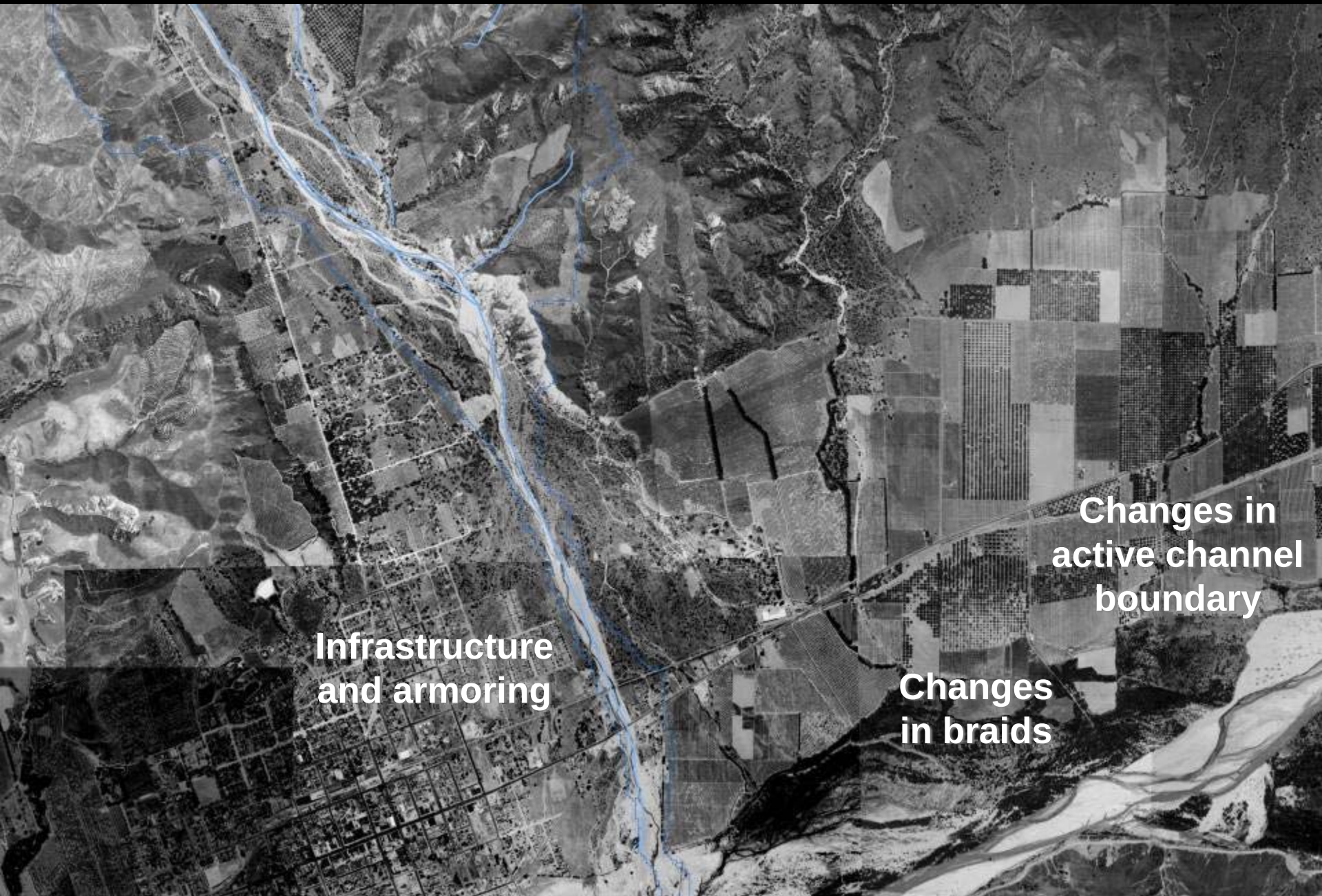


Lower Santa Paula Creek (1938)



Lower Santa Paula Creek (2005)

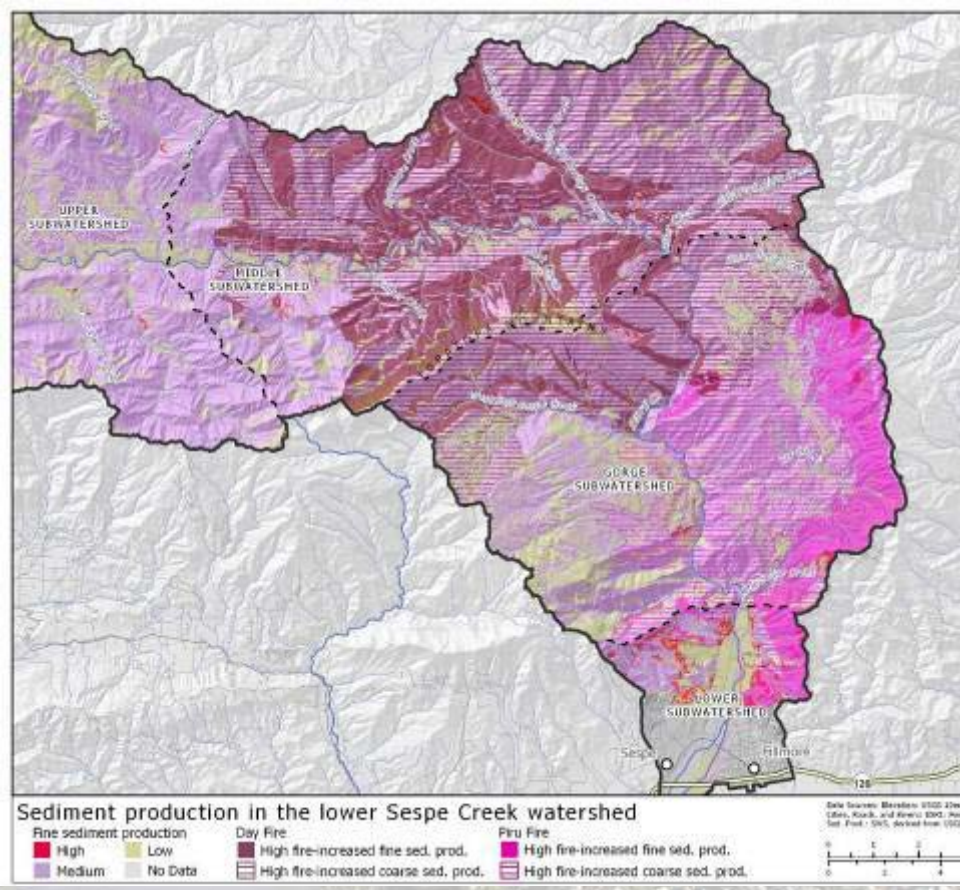
Lower Santa Paula Creek (1938)



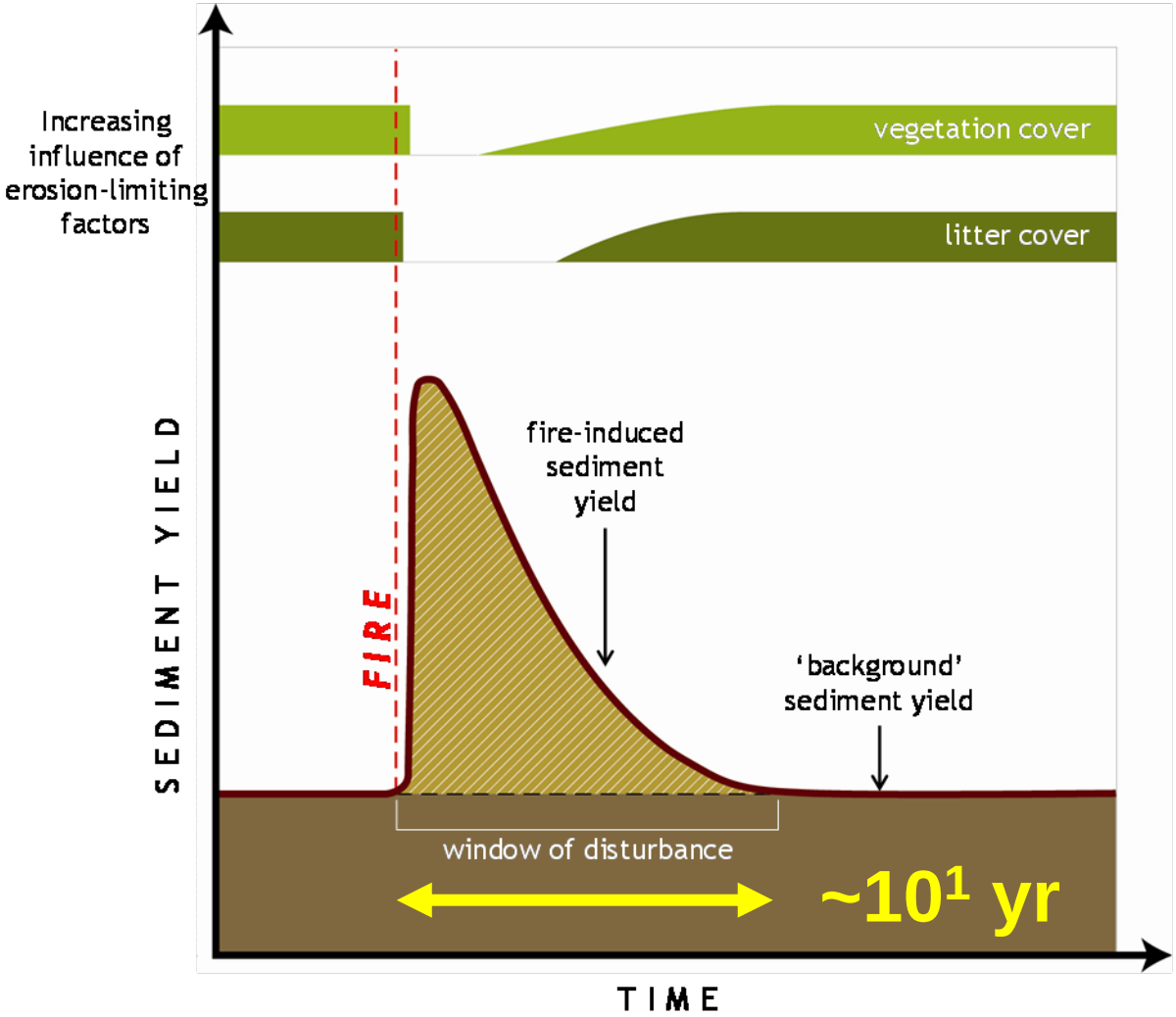
Lower Santa Paula Creek (2005)

Wildfire Sediment Production

- Watershed-wide predictions:
  - BAER (USFS 2006)
    - **6.1-fold increase** (1,663 t km^{-2} a^{-1} to 10,188 t km^{-2} a^{-1})
  - GLU (this study)
    - **4.7-fold increase** (1,760 t km^{-2} a^{-1} to 8,200 t km^{-2} a^{-1})
  - Scott and Williams (1978)
    - **3-fold increase** based on max. possible increase in Fire Factor

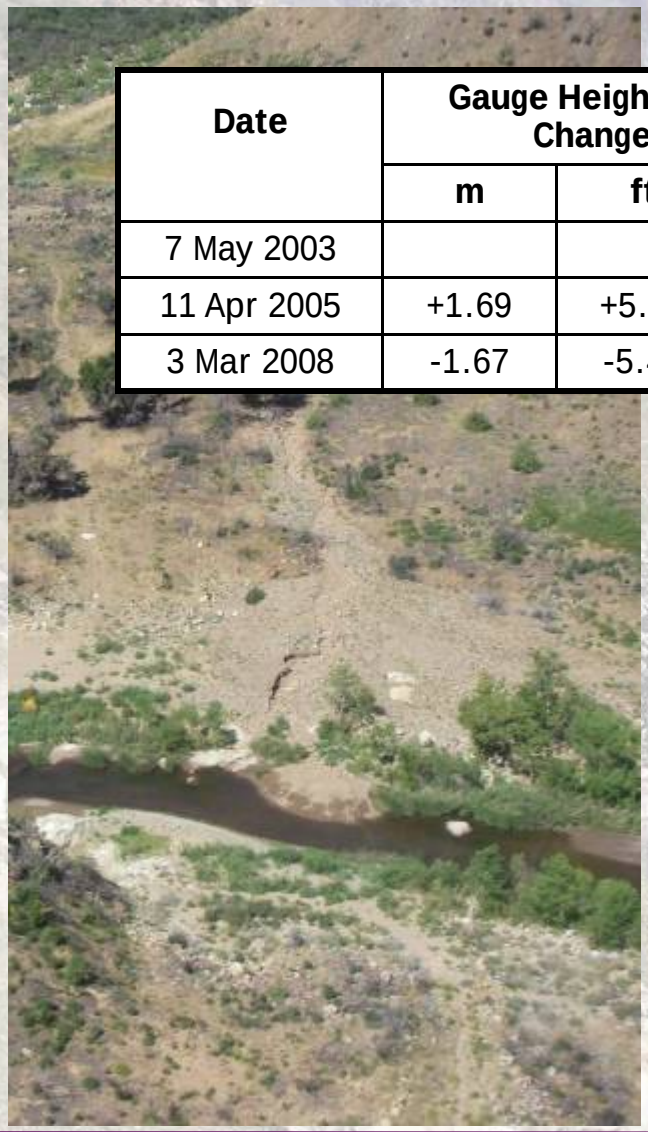


Predicted GLU-predicted fine-sediment production for pre-fire and post-fire (Day and Piru fires)

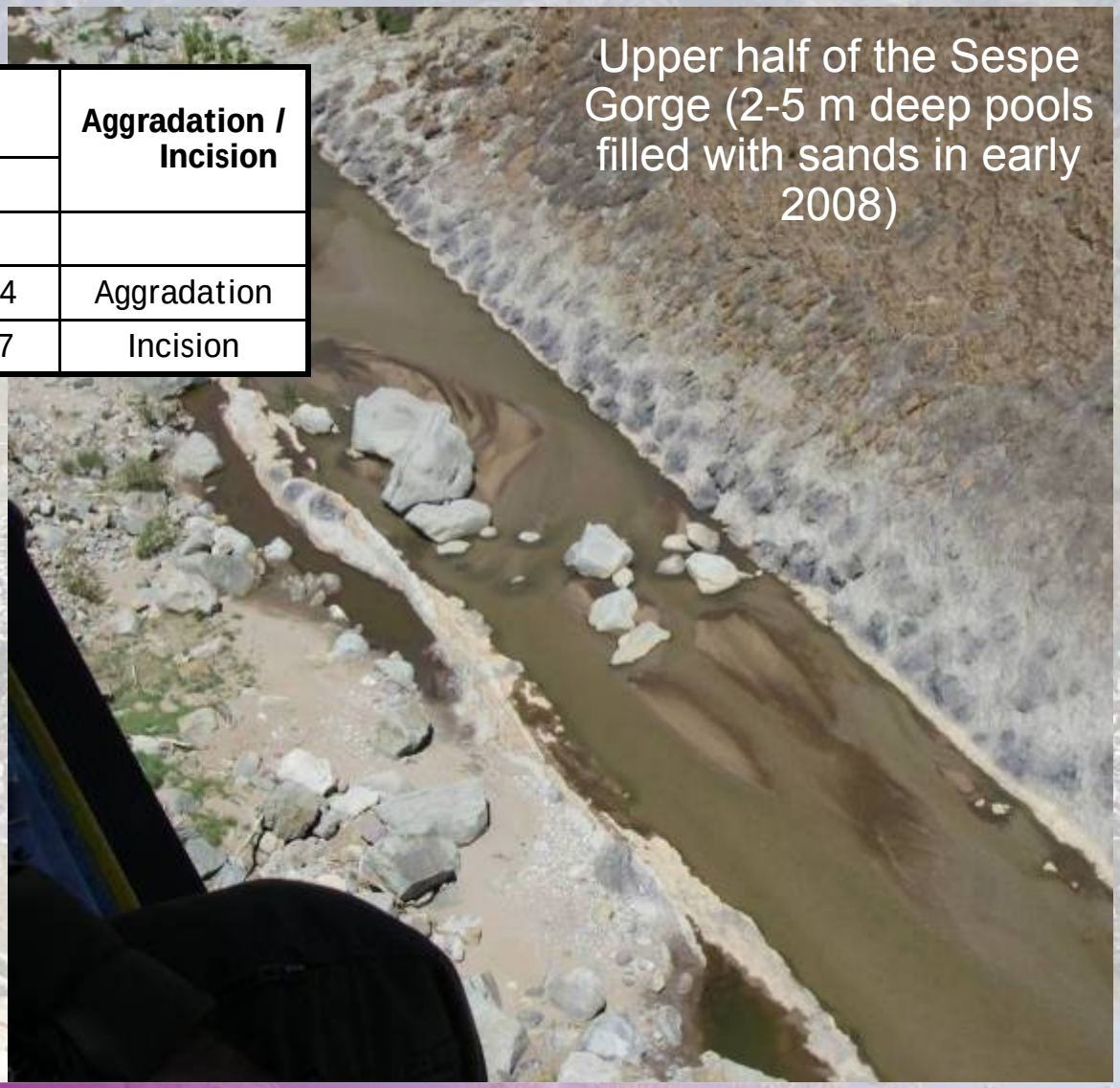


Sediment yield and associated vegetation and litter recovery during the fire-induced 'window of disturbance' (based on Shakesby and Doerr 2006).

Post-fire sediment delivery - field evidence



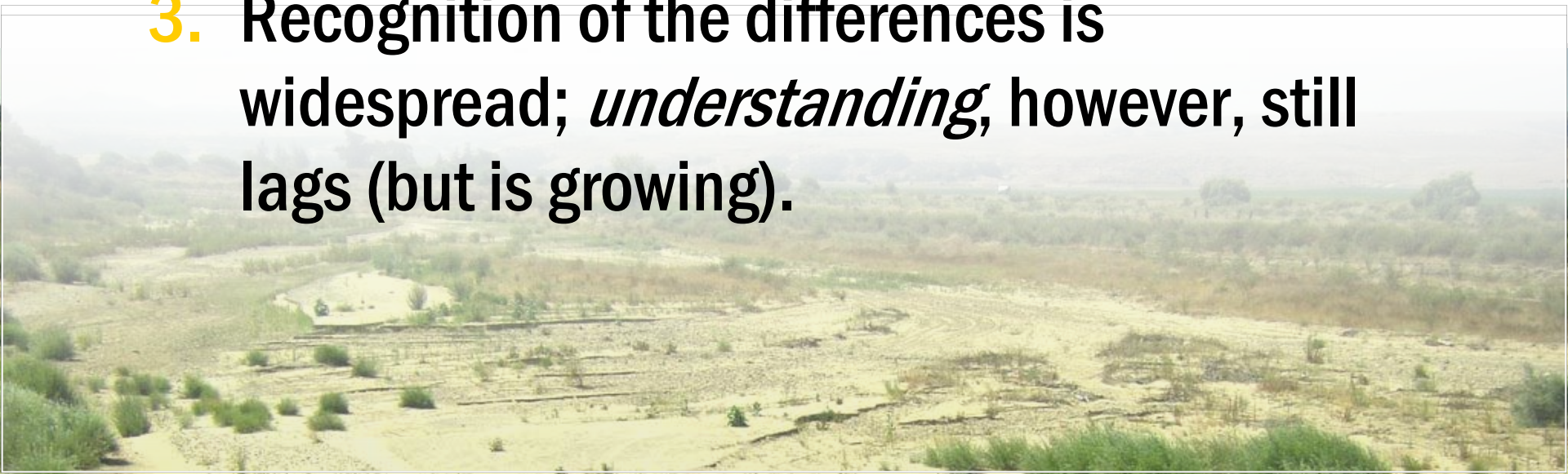
Date	Gauge Height Change		Aggradation / Incision
	m	ft	
7 May 2003			
11 Apr 2005	+1.69	+5.54	Aggradation
3 Mar 2008	-1.67	-5.47	Incision

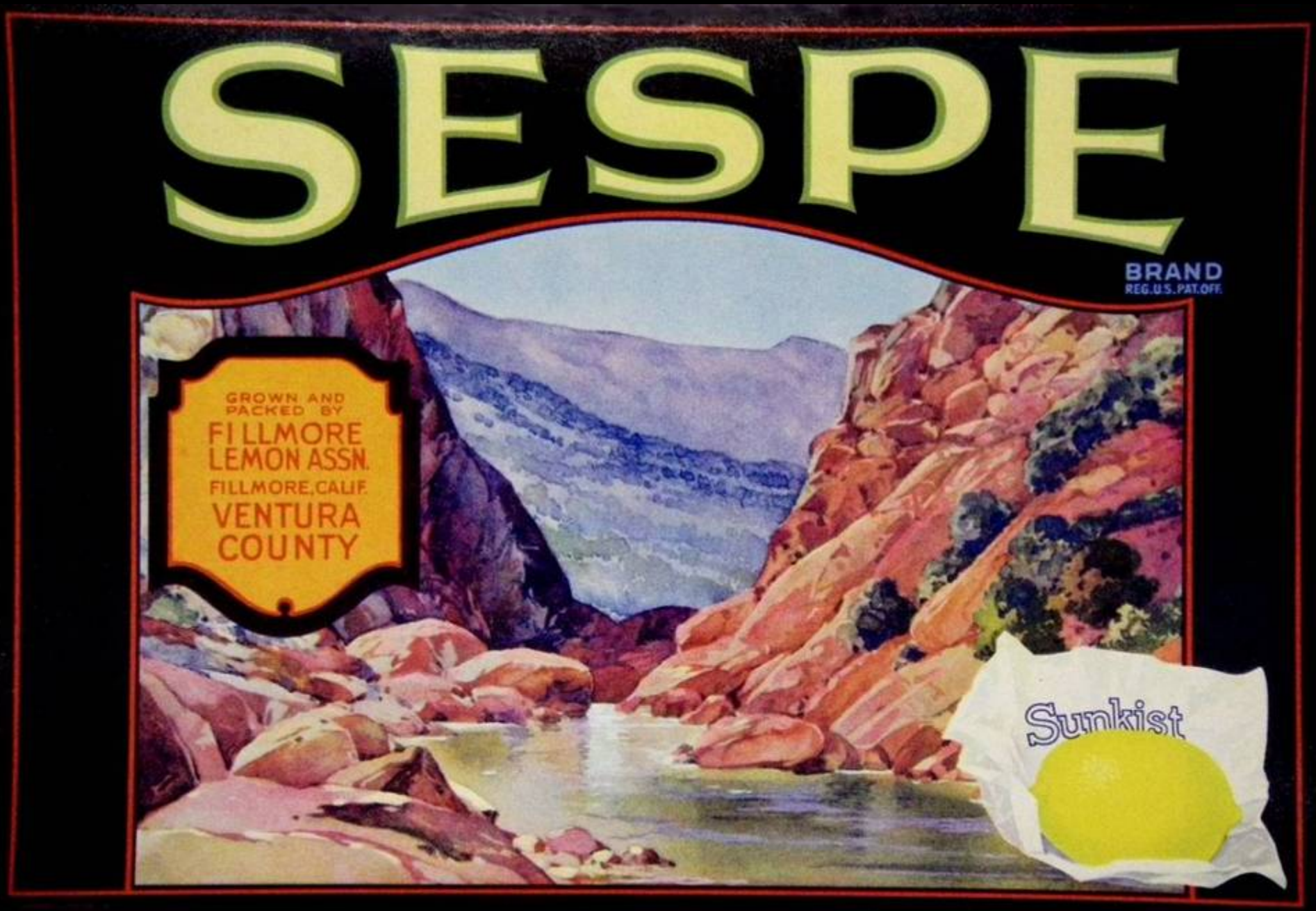


Upper half of the Sespe Gorge (2-5 m deep pools filled with sands in early 2008)

SUMMARY

1. Geology, climate, and watershed disturbance all contribute to “episodic channel form.”
2. Humid-region paradigms are enticingly misleading.
3. Recognition of the differences is widespread; *understanding*, however, still lags (but is growing).




SESPE
BRAND
REG. U.S. PAT. OFF.
GROWN AND PACKED BY
FILLMORE LEMON ASSN.
FILLMORE, CALIF.
VENTURA COUNTY
Sunkist