RiversEdge West Riparian Restoration Conference 2020

Challenges of Implementing Sustainable Restoration and Mitigation in Highly Dynamic Riverine Ecosystems

Protecting and Restoring Dynamic Riverine Ecosystems: A Case Study from Southern California

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STILLWATER SCIENCES

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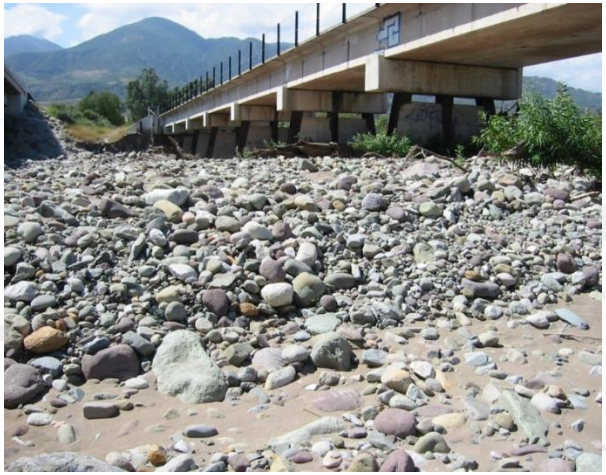
Stillwater Sciences

IMPLEMENTING SUSTAINABLE RESTORATION & MITIGATION IN HIGHLY DYNAMIC RIVERINE ECOSYSTEMS

- The need for more resilient and sustainable approaches to river and riparian restoration is garnering increased recognition
- This typically requires enhanced focus on maintaining or restoring natural riverine processes and *working with the river* when designing and constructing river and riparian restoration projects
- This approach can promote projects that are more cost-effective and likely to maintain desired ecosystem functions and multiple benefits well into the future





CHALLENGES

- However, maintaining a more natural range of ecosystem dynamics creates its own challenges
- Most engineers, construction firms, regulatory agencies, and stakeholders are used to dealing with a *static* desired future condition as the goal of restoration
- We need to replace that with acceptance of a *dynamic* future condition that creates a *shifting mosaic of habitat* that varies in time and space
- This is great for ecological functioning but also raises concerns about risk to key infrastructure and liability
- When, Where, and How can we promote acceptance of a "messier river" as a key restoration project goal?

Case Study: The Santa Clara River – A Biodiversity Hotspot

Santa Clara River and tributaries:

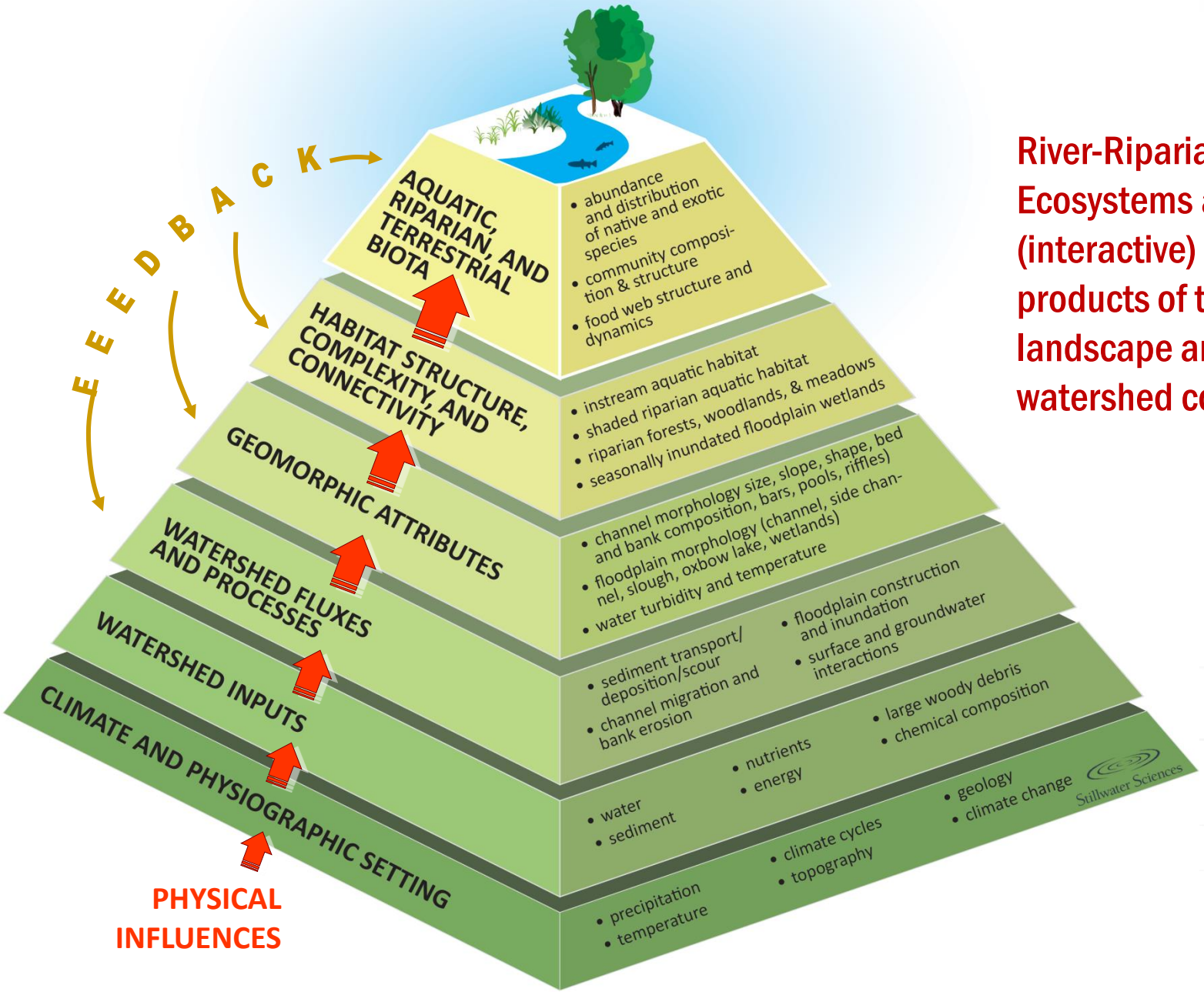
- Still in predominantly natural state
- Home to many disappearing animals and plants
- Some of the last major riparian-floodplain wetlands in Southern California
- Home to 18 Threatened & Endangered Species

Restoration Design, Implementation, Monitoring, and Crediting

Inform efforts to acquire, restore, and maintain floodplain lands

- Gather and synthesize existing information
- Understanding biophysical processes and attributes (how does it work?)
- Estimate “trajectory” (what if we do nothing?)
- Develop attributes of a “restored” condition (what do we want?)
- Develop restoration strategies and assess feasibility (how, where, and what can we reasonably achieve?)
- How do we determine “success” in restoring processes and habitats in dynamic systems?

ECOLOGICAL LINKAGES CONCEPTUAL MODEL



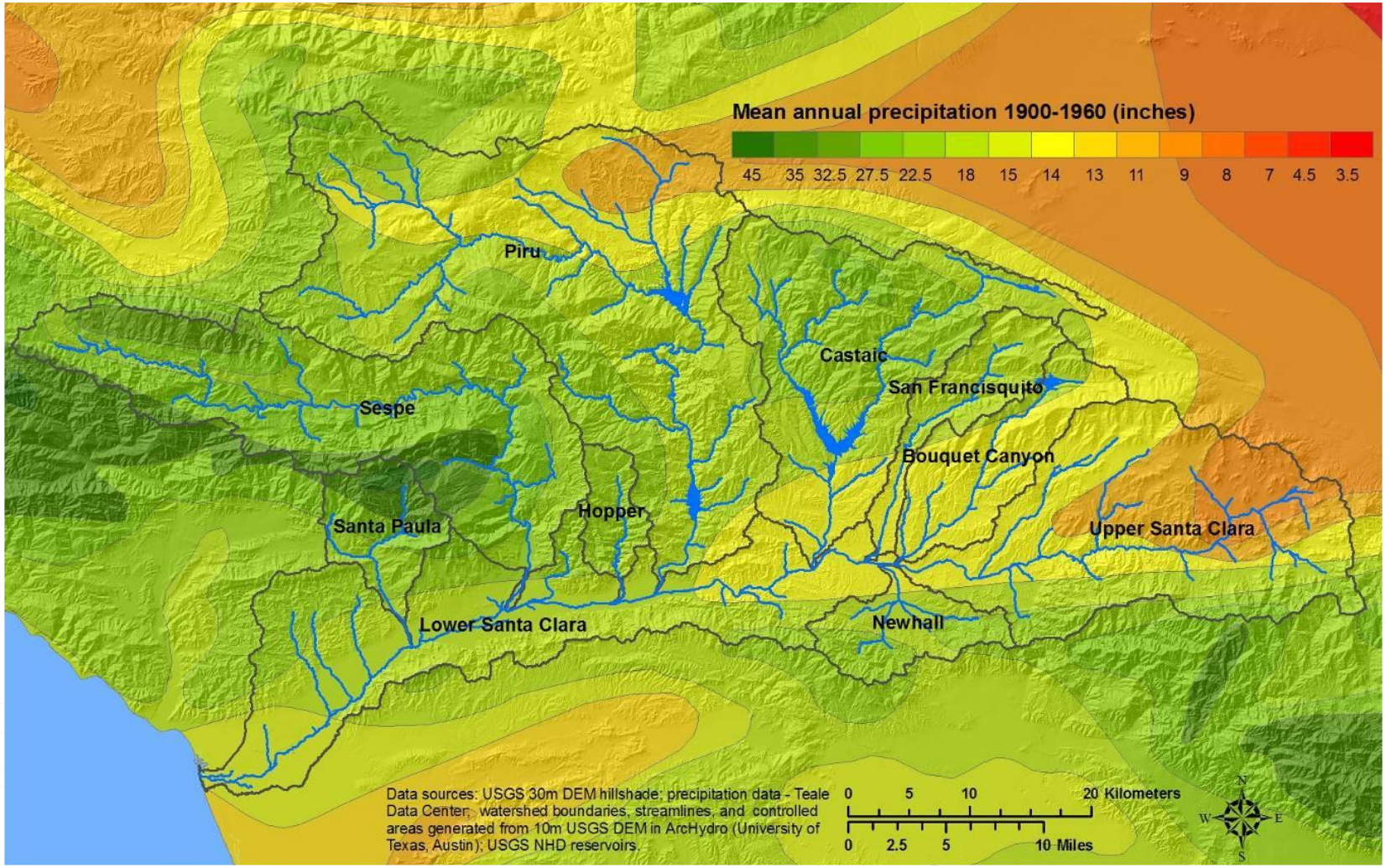
River-Riparian Ecosystems are (interactive) products of their landscape and watershed context

VEGETATION-PROCESS LINKAGES AND DRIVERS

1. Flood Dynamics
2. Climate
3. Groundwater Availability
4. Floodplain Development
5. Invasion by Arundo

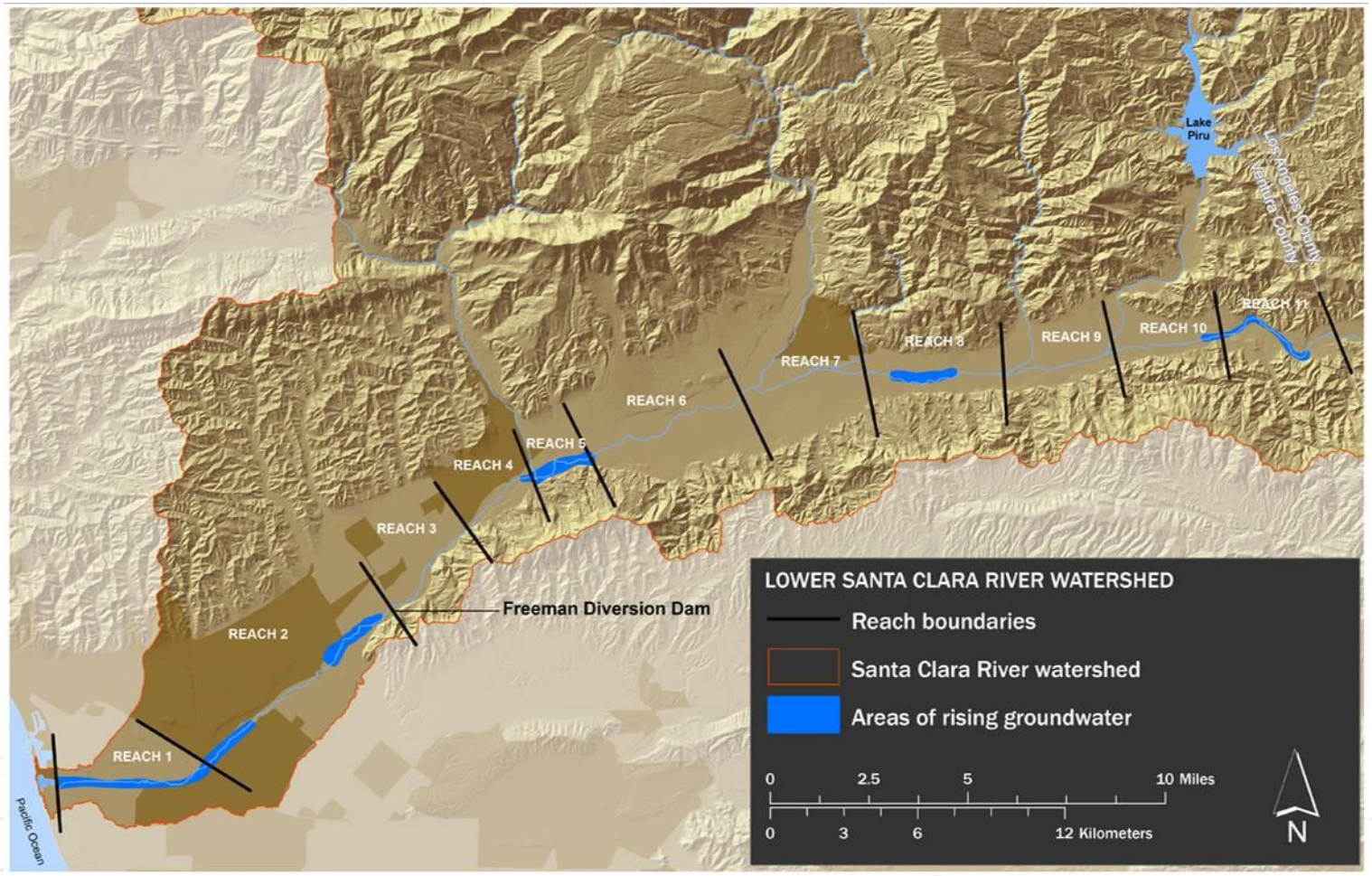
CLIMATE

- Semi-arid, Mediterranean climate
- Arid inland and moister, cooler coast



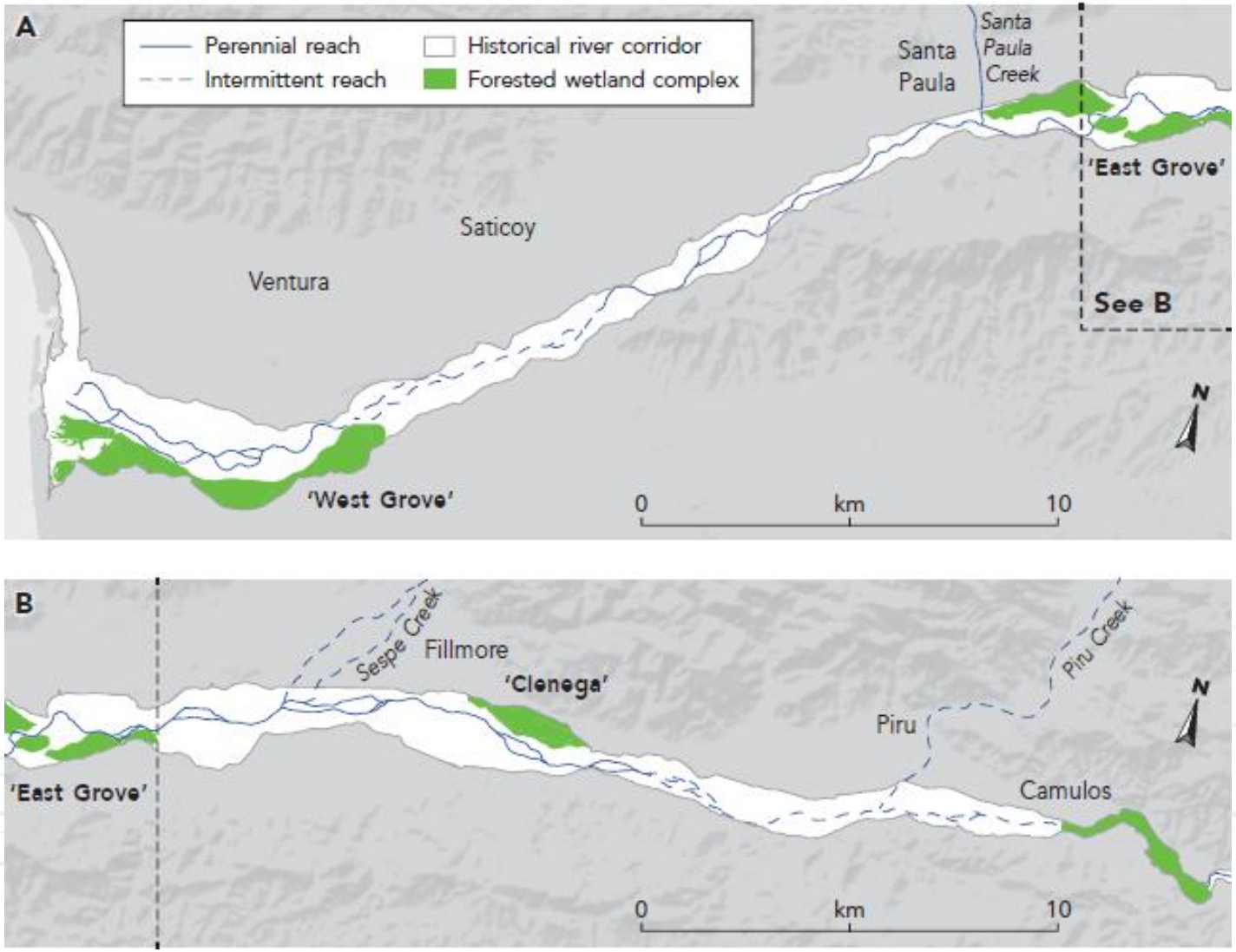
GROUNDWATER AVAILABILITY

- Gaining vs. losing reaches



HISTORICAL ANALYSIS

- Dry Season Flow and Historical Forested Wetlands



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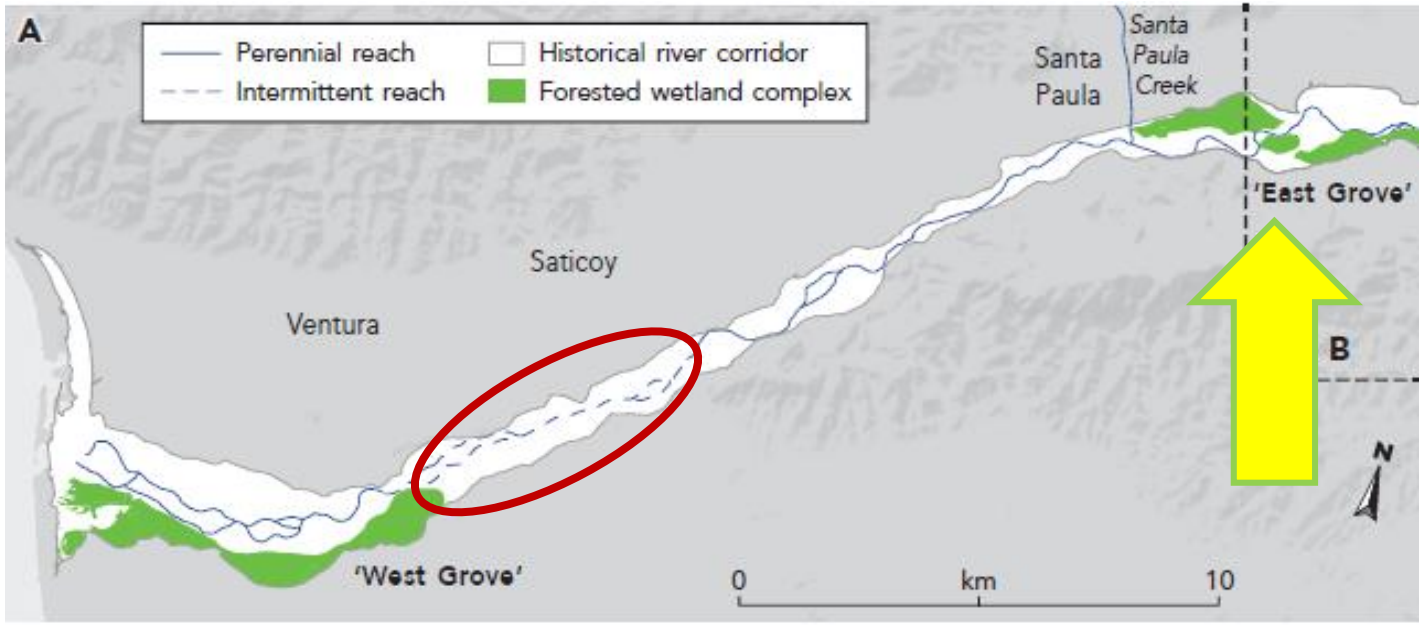
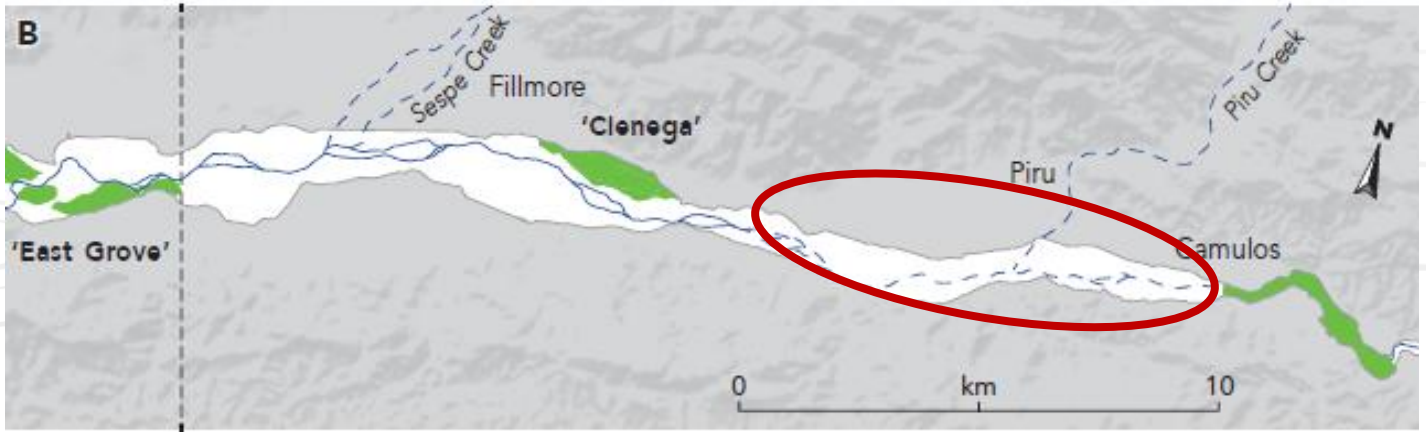
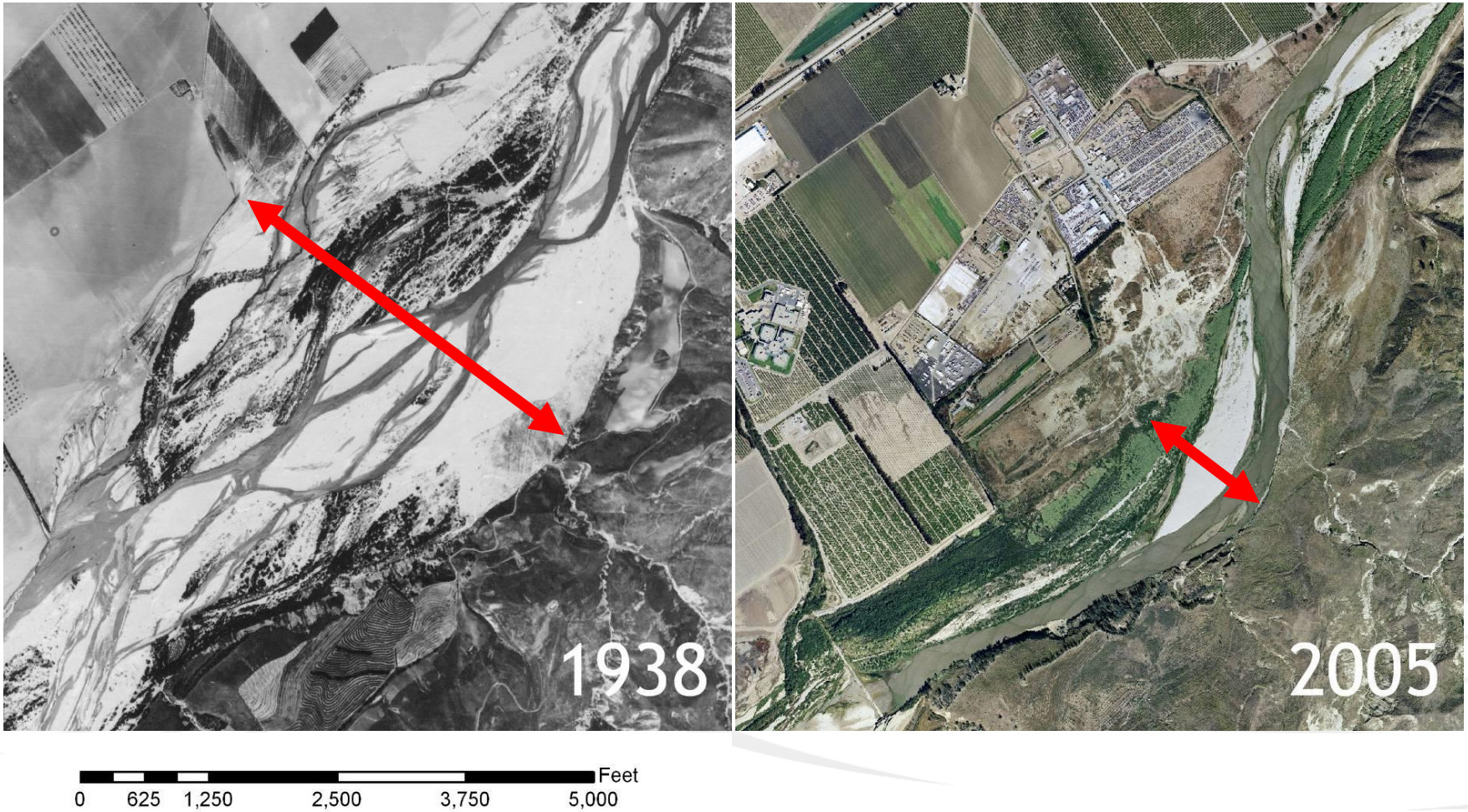




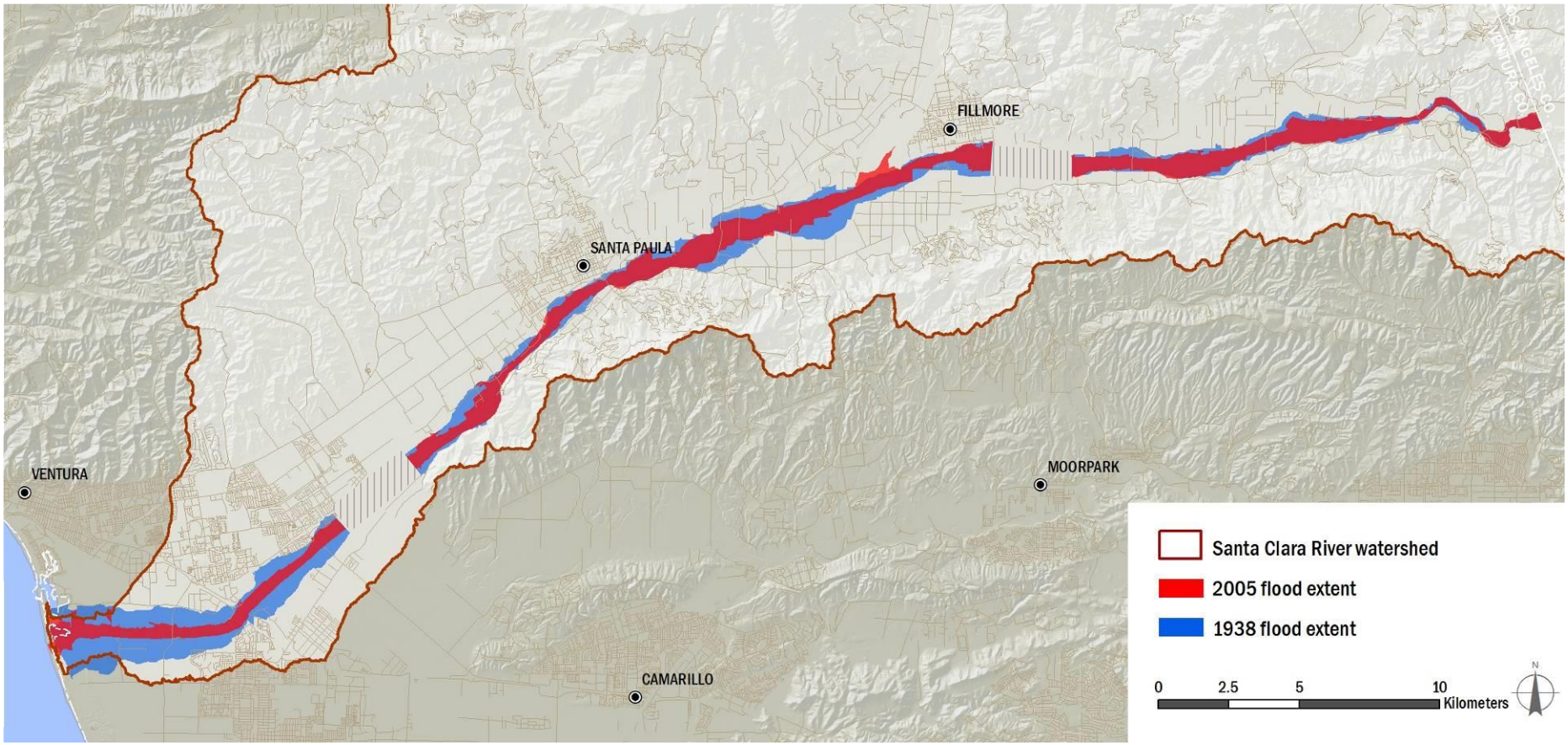
Example of Floodplain Development

- Severely constrained floodplain and limited extent of riparian vegetation



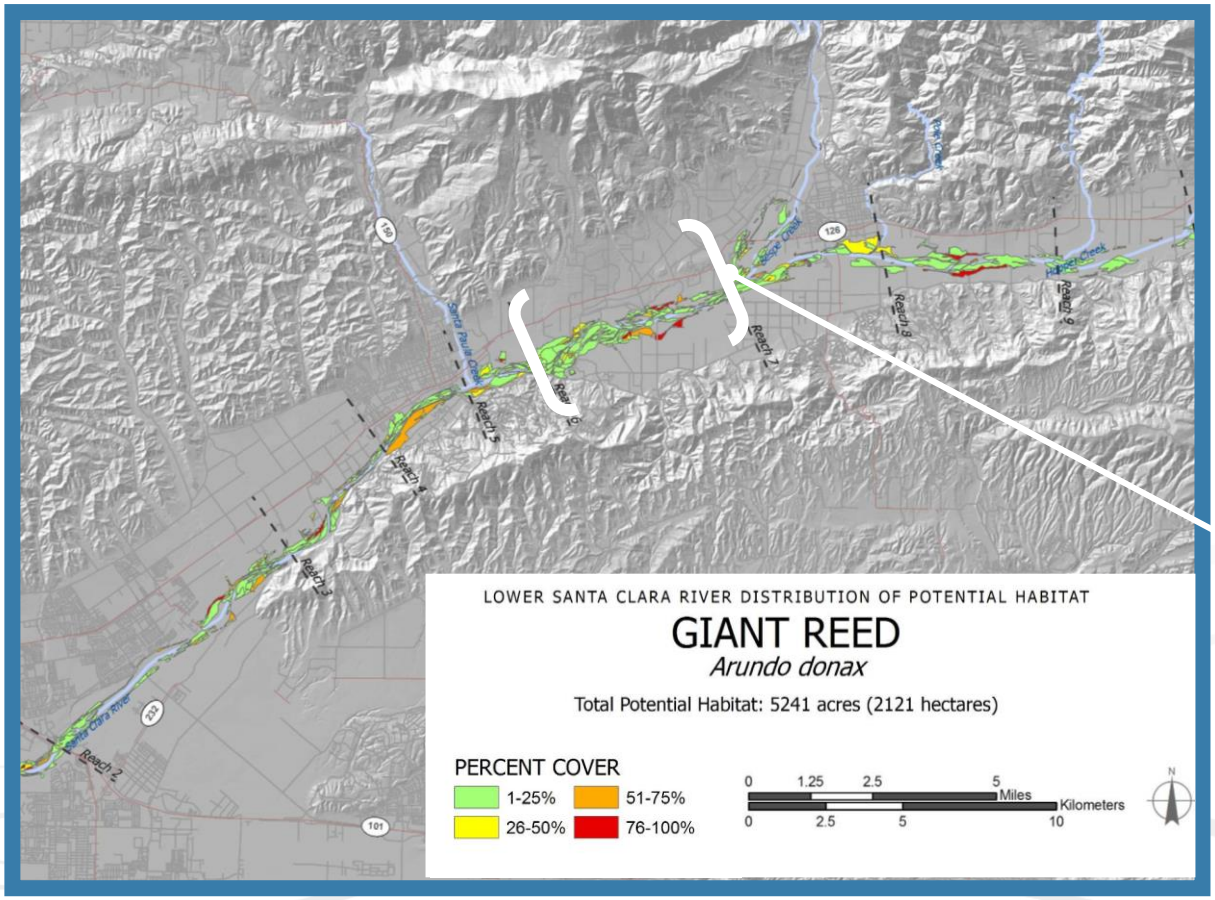
FLOODPLAIN DEVELOPMENT

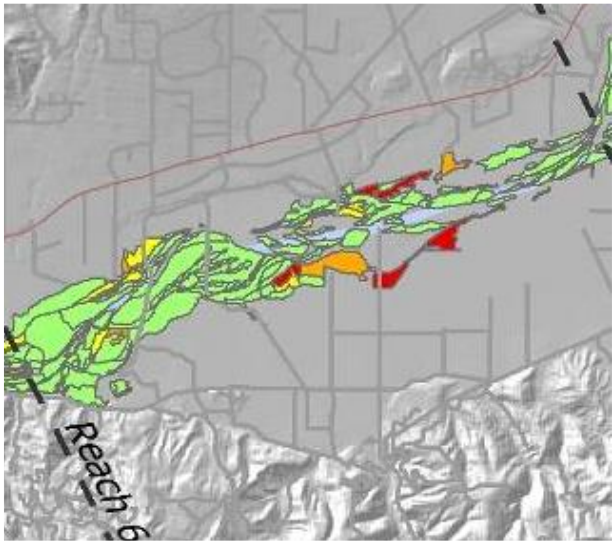
- 60 percent reduction in historical floodplain extent



INVASION BY GIANT REED (*ARUNDO DONAX*)

- Replaces native vegetation
- Alters ecosystem processes





FLOOD DYNAMICS

- Vegetation infilling (encroachment) during drier periods between major floods

pre-high flow

FLOOD DYNAMICS

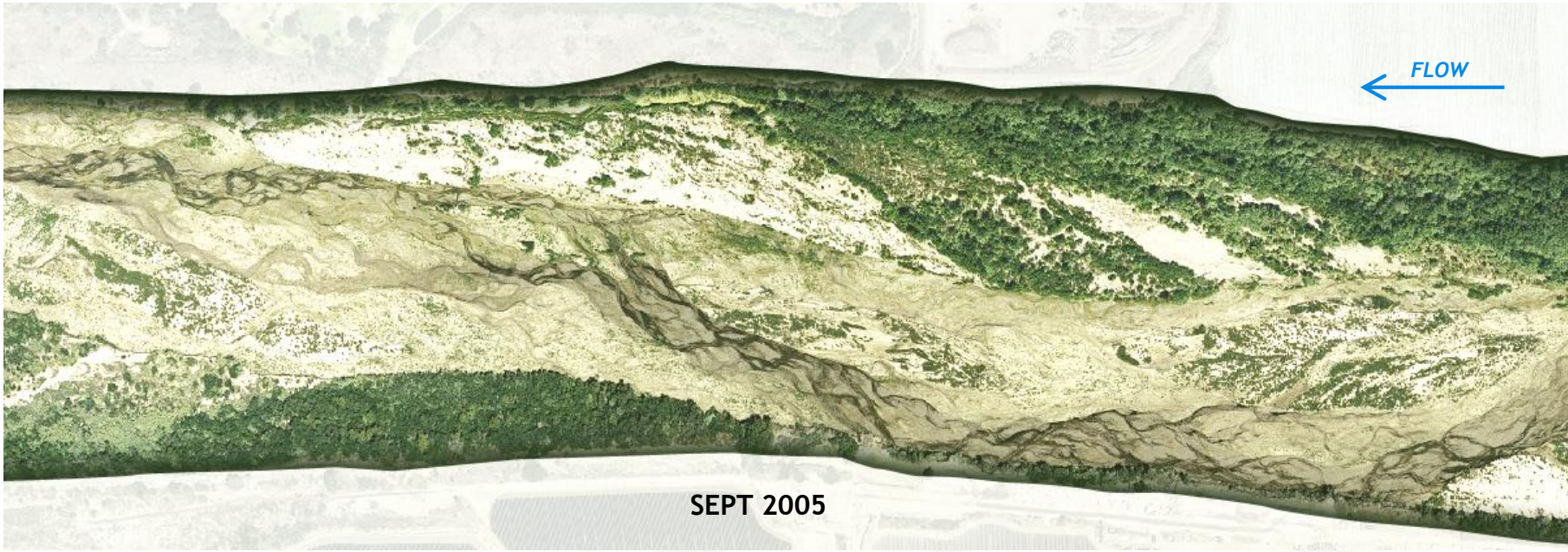
- Vegetation scour and reset after large floods, particularly in El Niño years

high flow

FLOOD DYNAMICS

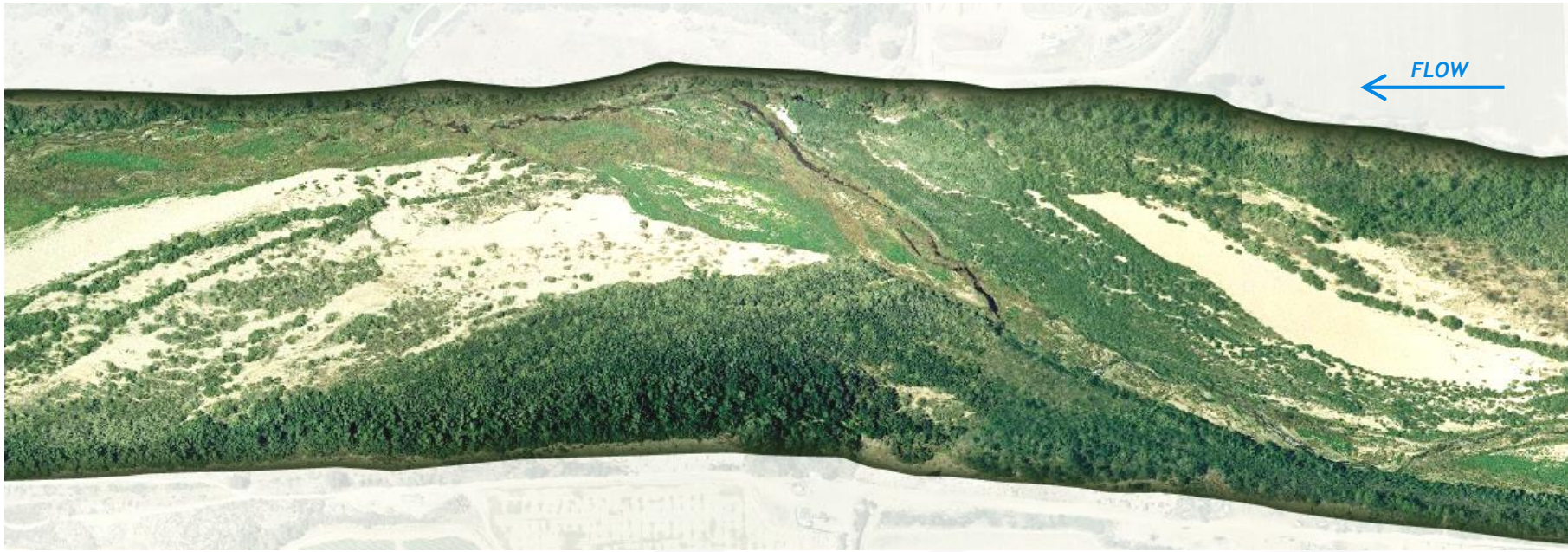
- Rapid vegetation response after large resetting floods

post-high flow



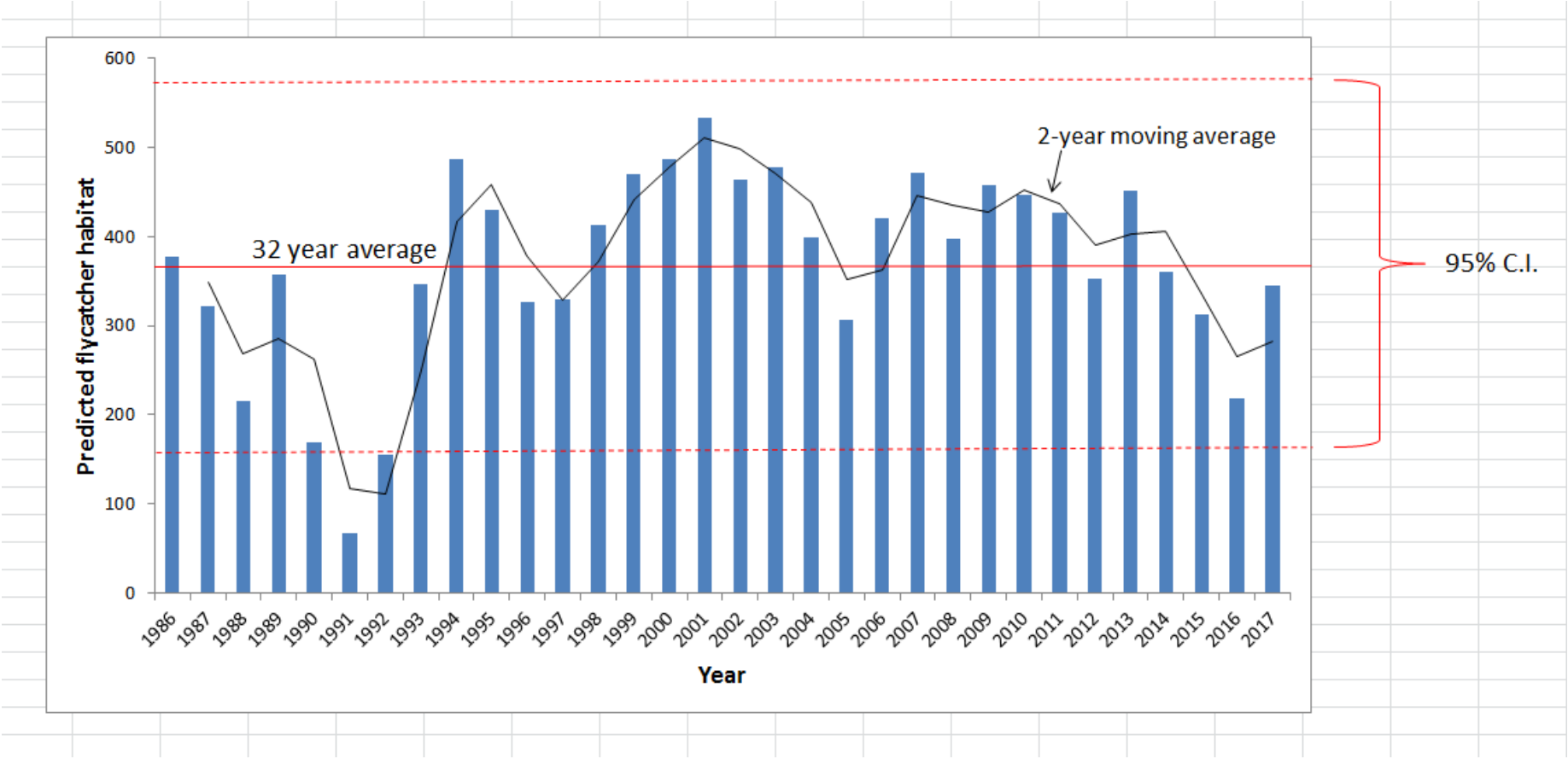
FLOOD DYNAMICS

- Vegetation infilling (encroachment) continues following flood events



pre-high flow

32-year habitat time series for Southwestern Willow Flycatcher along Santa Clara River calculated with the satellite model



Initial examination of temporal variation in predicted amount of suitable SWFL habitat along the Santa Clara River seem to match well with known timing of flood disturbance (e.g., the 2005 El Nino flood event) and pronounced drought (2014-2016)

Data courtesy of Jim Hatten, USGS

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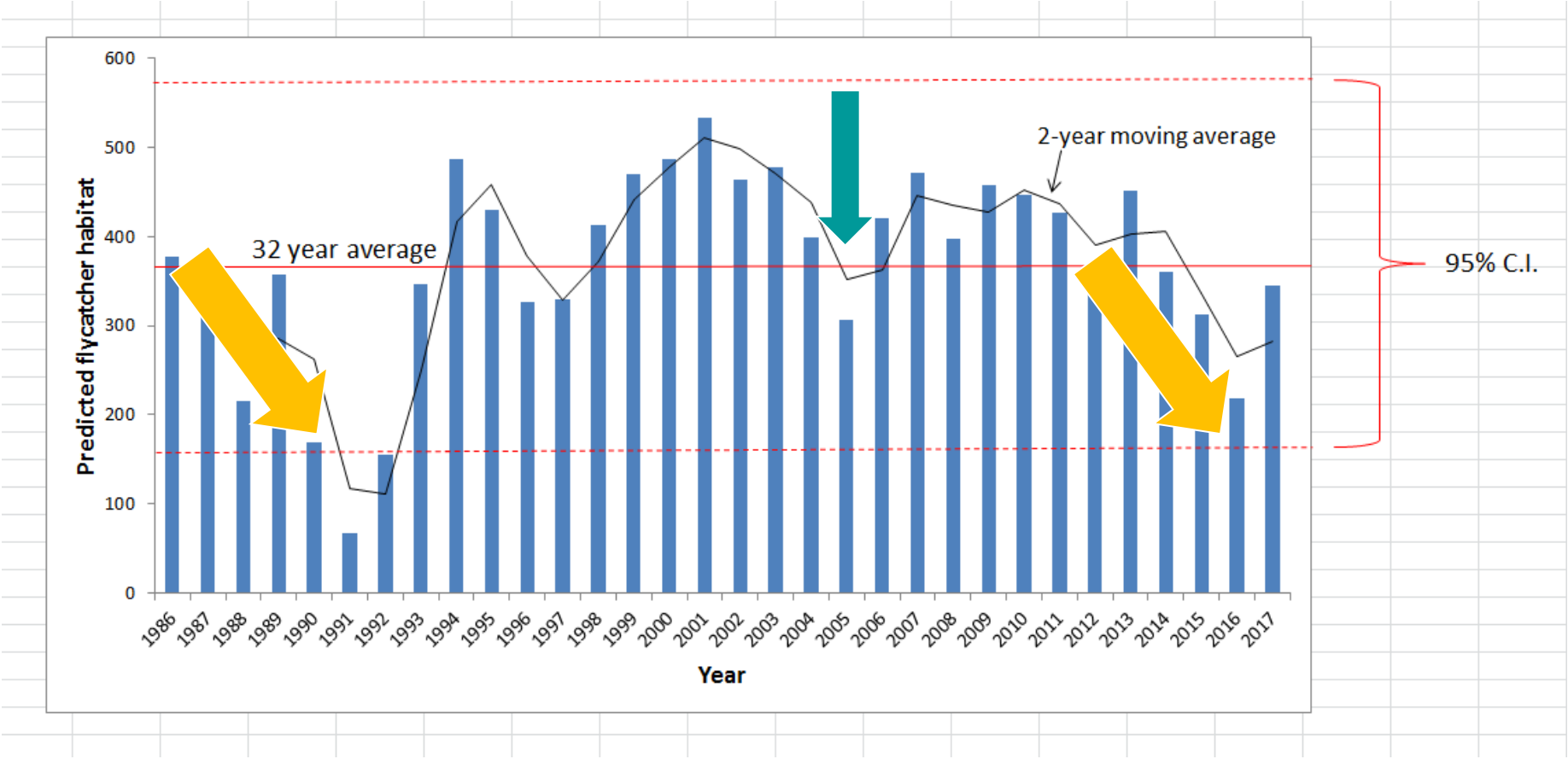

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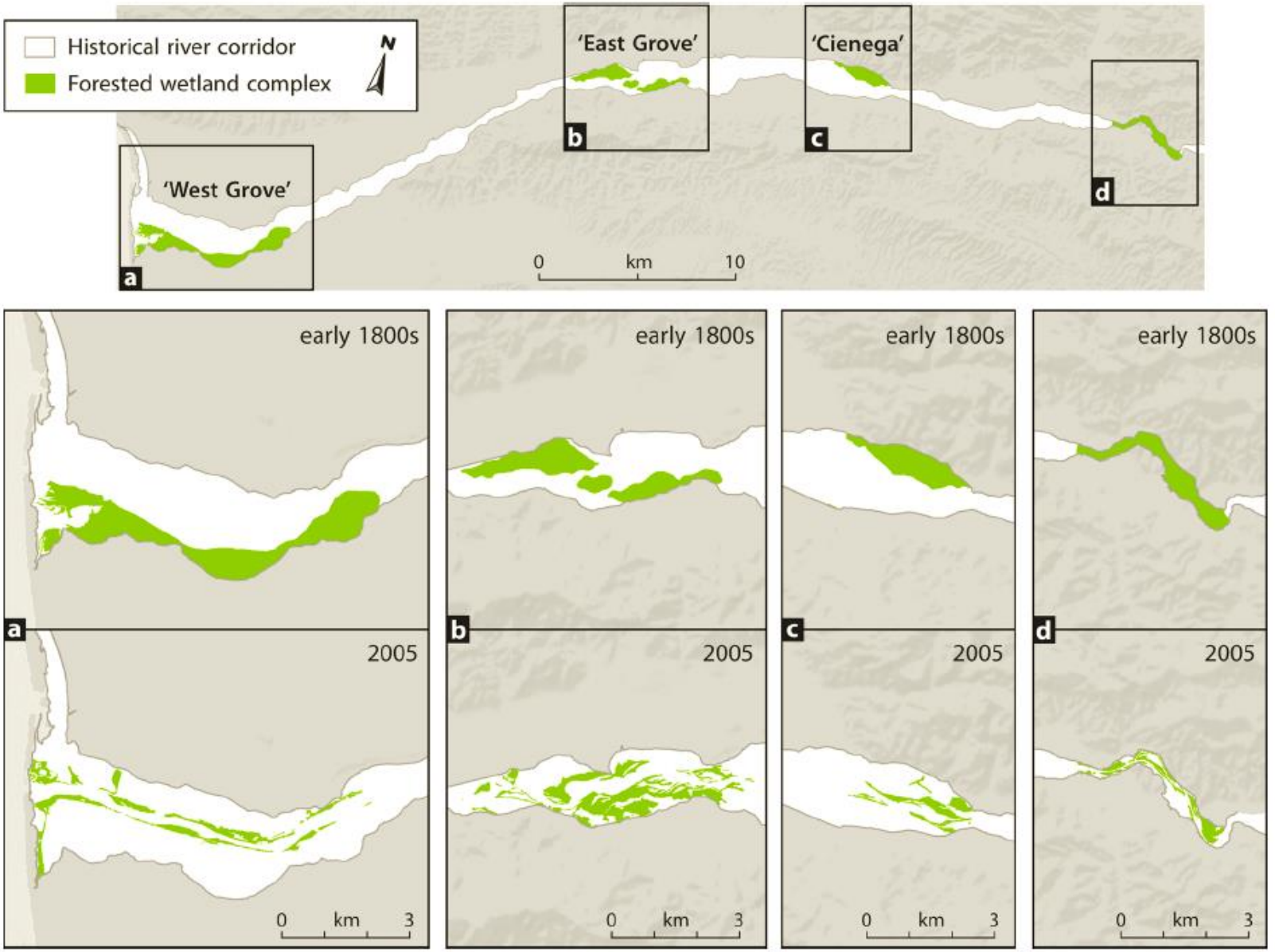
FROM PAST PATTERNS TO FUTURE POTENTIAL



Beller et al. 2015. Landscape Ecology

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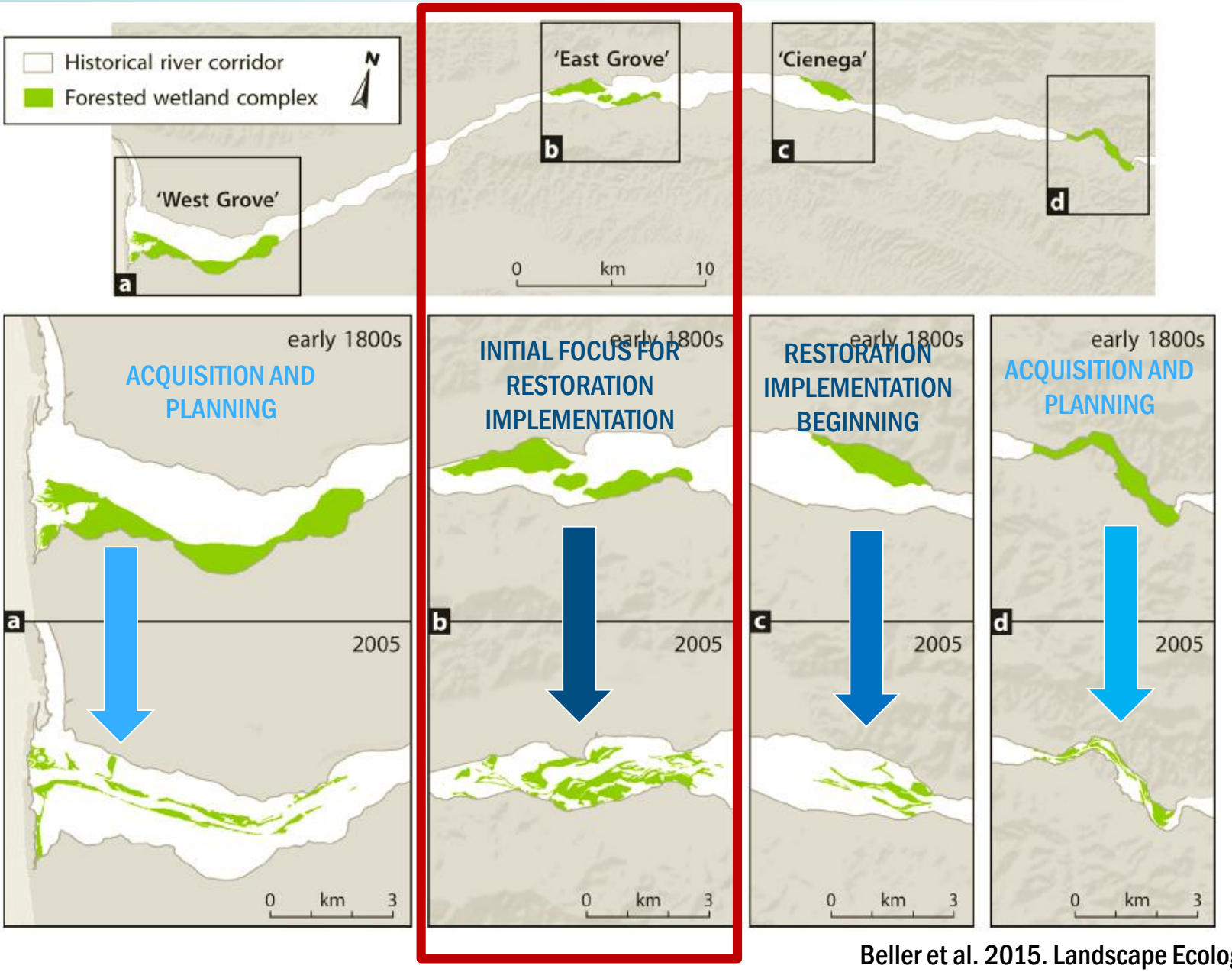
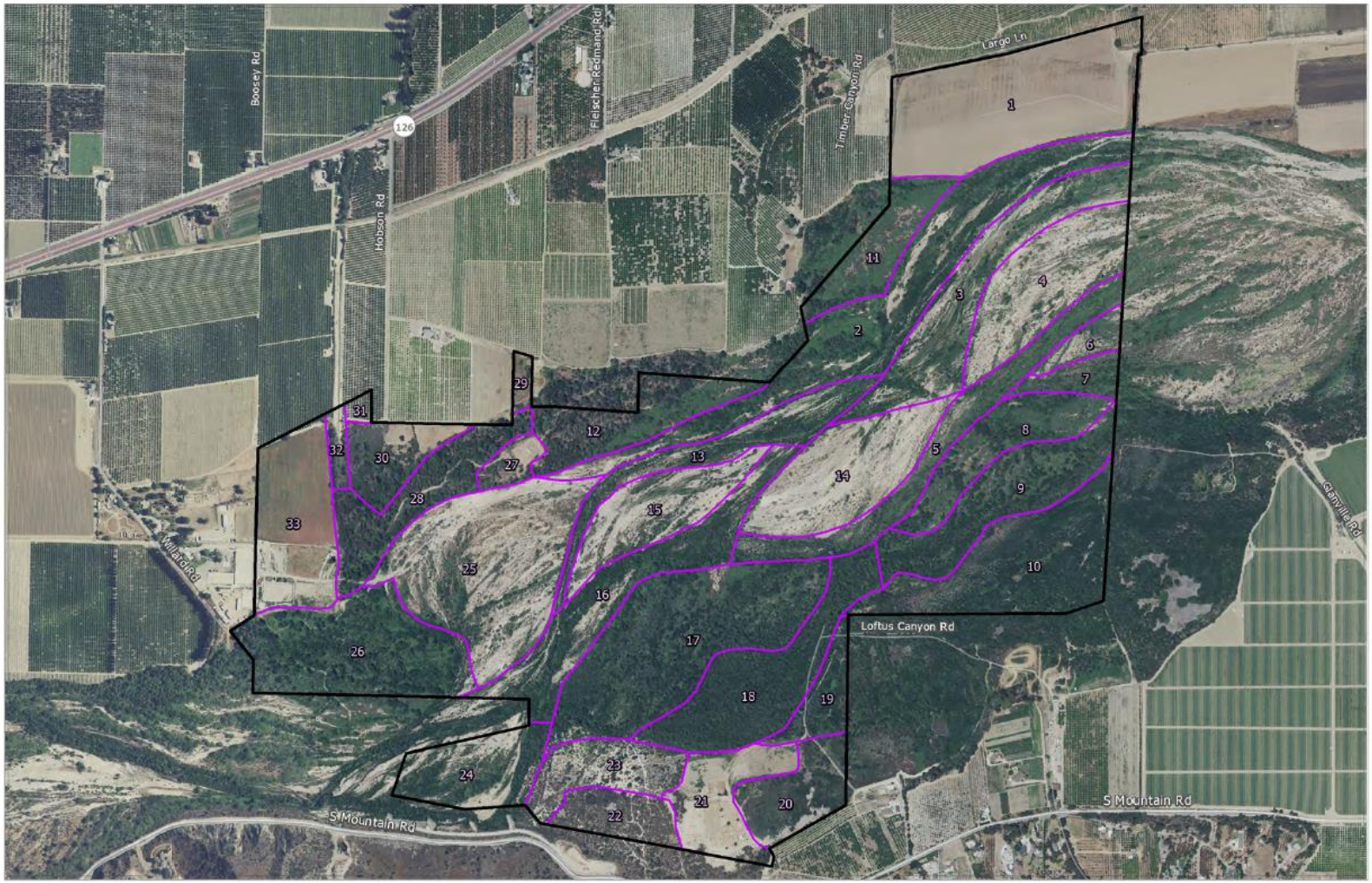


Beller et al. 2015. Landscape Ecology

SANTA CLARA RIVER MITIGATION BANK

617 Acres in the Historical East Grove Reach



SANTA CLARA RIVER MITIGATION BANK
Restoration Units

DATA SOURCES
Imagery: NAIP 2016
Roads, cities: ESRI 2016

SCALE & NORTH ARROW

LEGEND

- Mitigation Bank Boundary
- Potential Management Units

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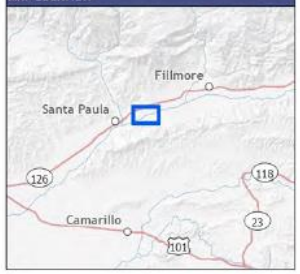
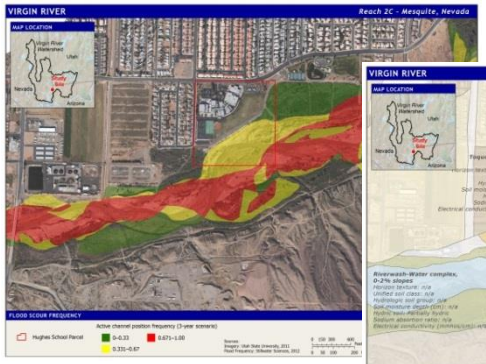
MAP LOCATION

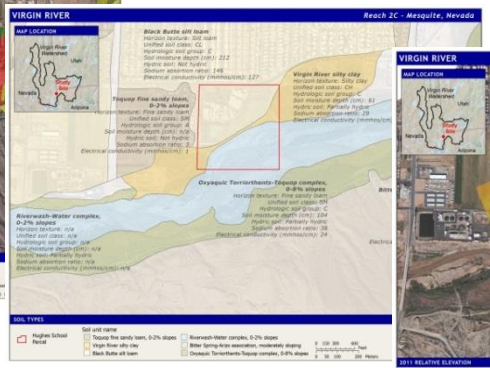


2016 NAIP Natural Color Imagery

Use Ecohydrological Assessment to Determine Biophysical Template for Restoration

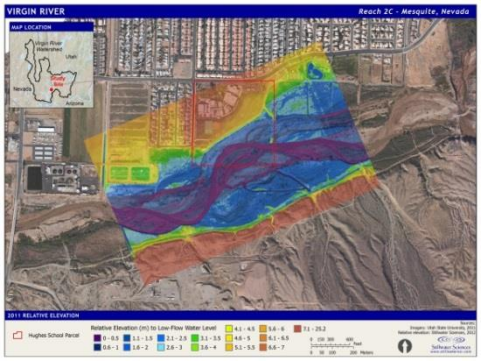


Flood Reset Zone



Soils

(texture & salinity)



Depth to Groundwater (Relative Elevation)

Vegetation Types

Vegetation Structure

(canopy height)

+

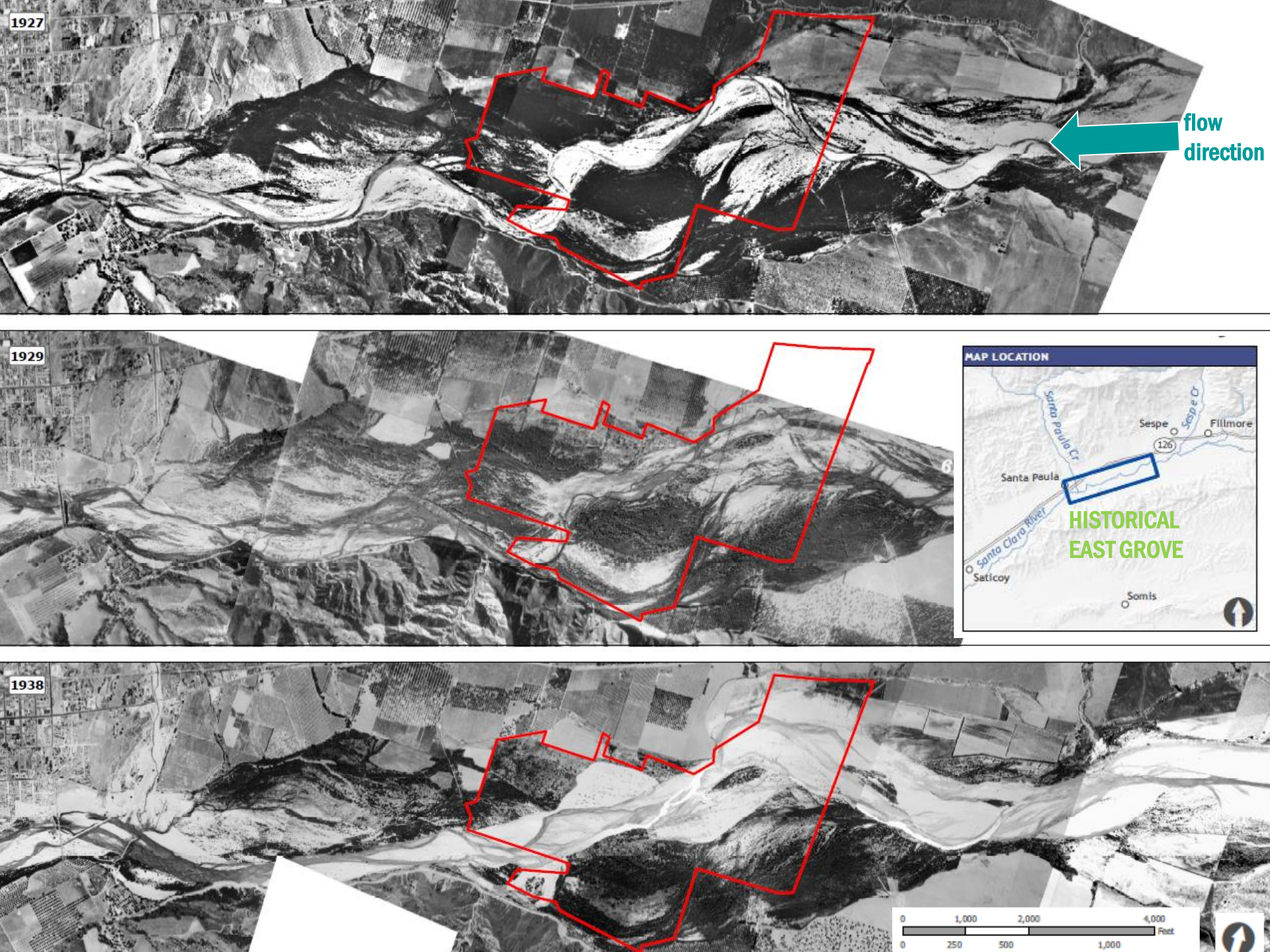
Focal Species Habitat

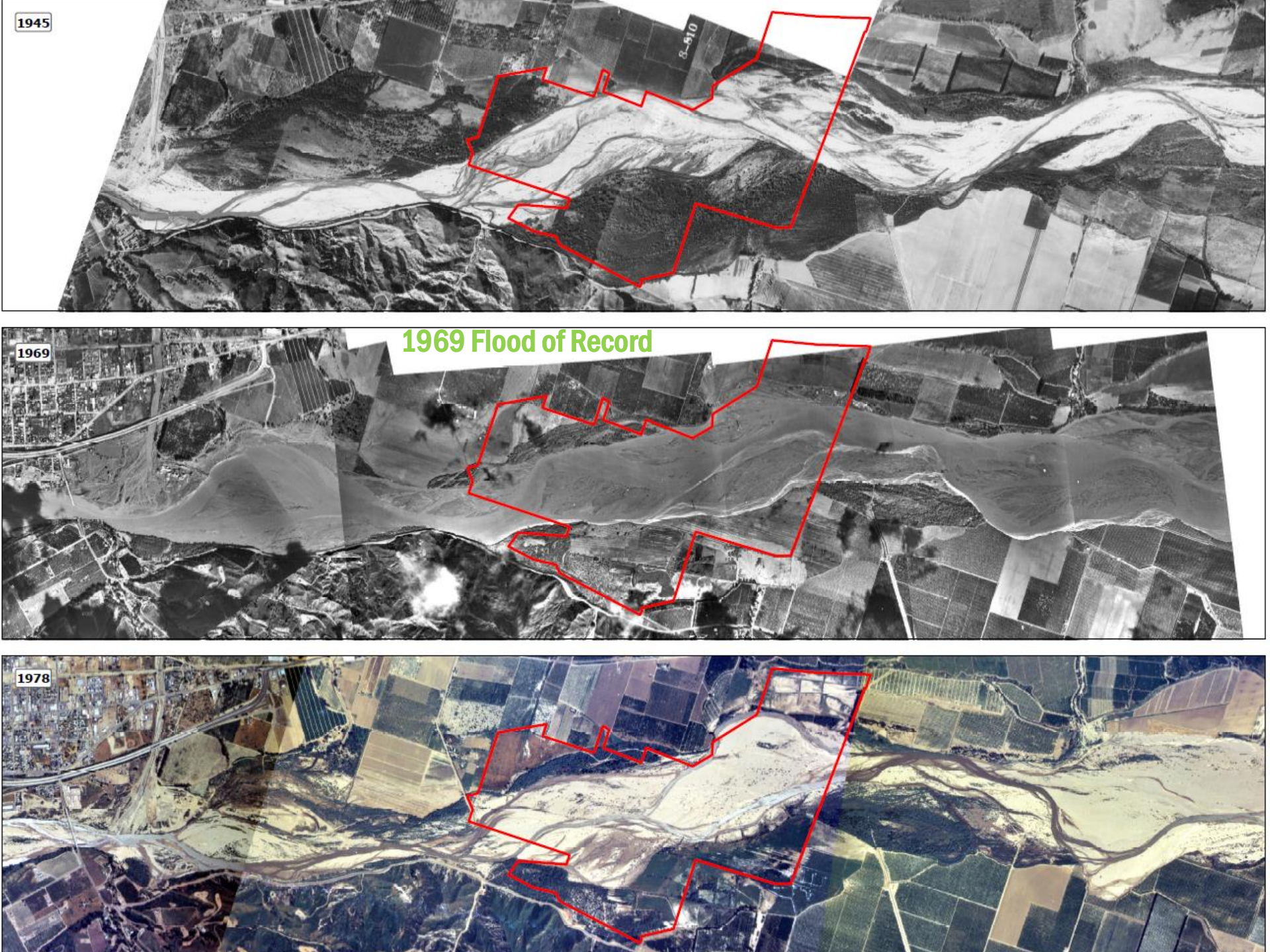
Physical Elements

BIOPHYSICAL TEMPLATE

Biological Elements

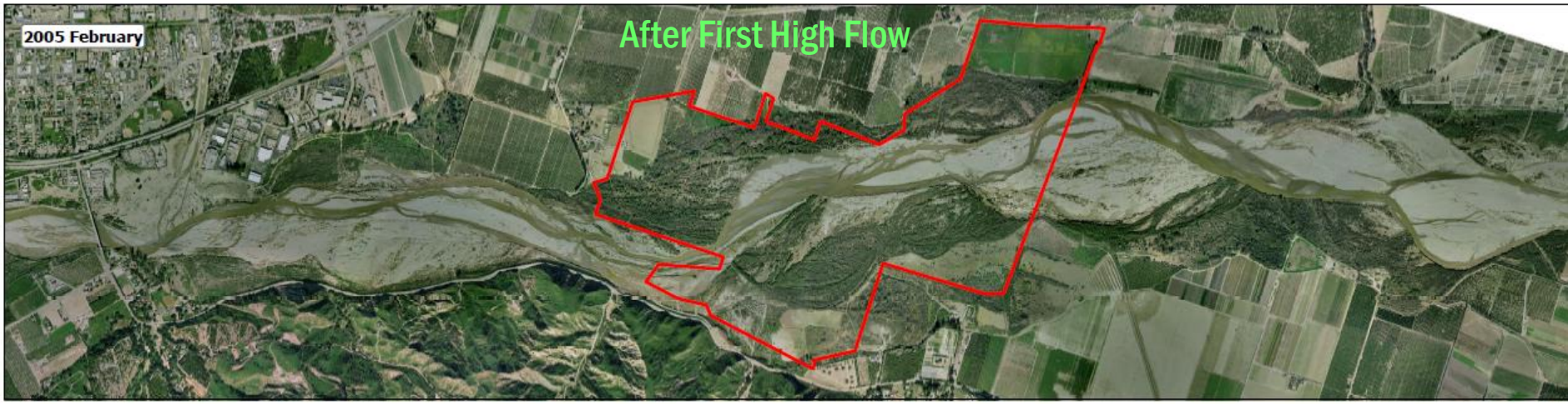
Next: Use Biophysical Template to Define Management Units


1927
flow direction
1929
MAP LOCATION
Santa Paula Cr
Sespe
Sespe Cr
Fillmore
126
Santa Paula
Santa Clara River
HISTORICAL EAST GROVE
Saticoy
Somis
1938
0
1,000
2,000
4,000
Feet
0
250
500
1,000

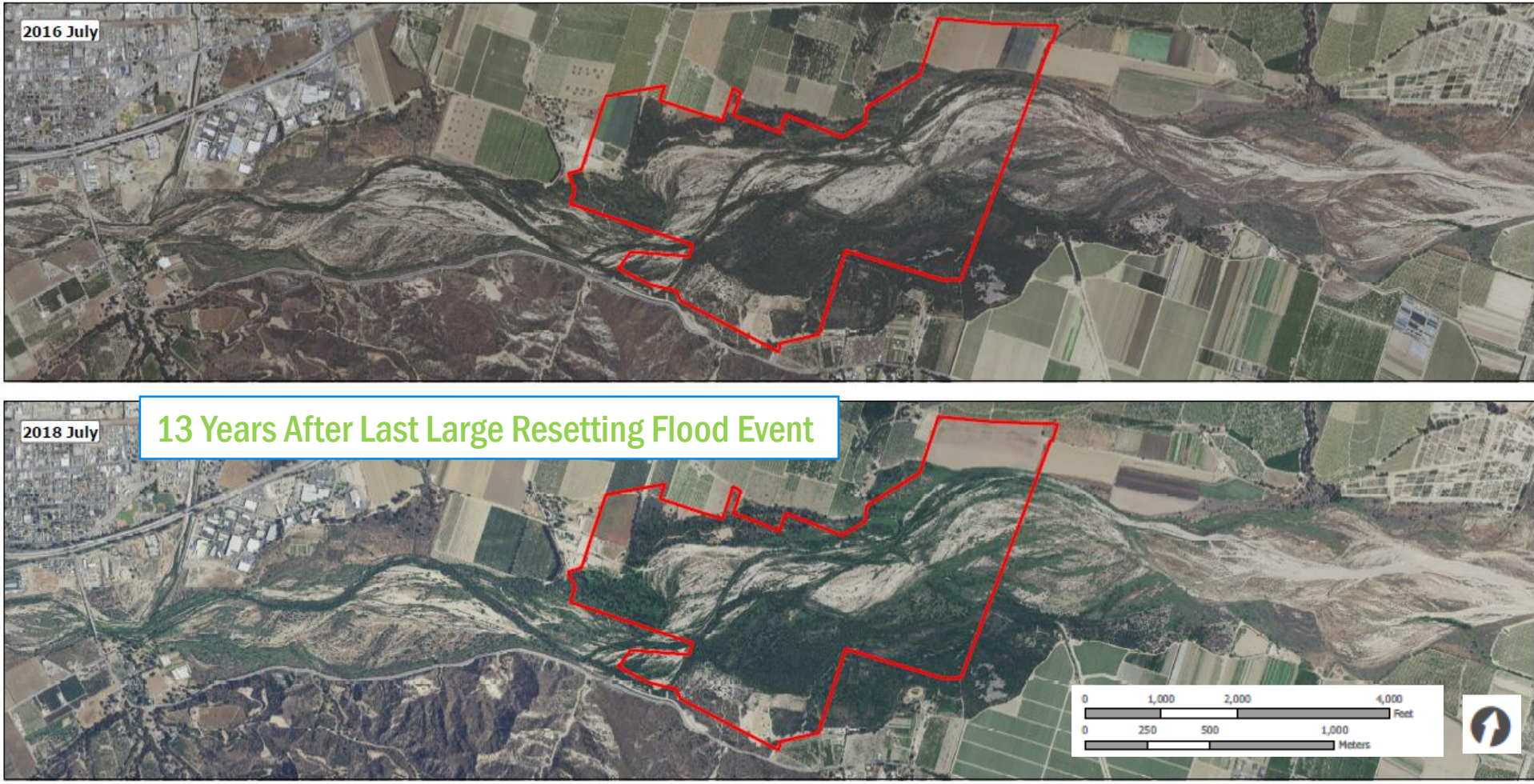

1945
8-810
1969
1969 Flood of Record
1978


1992
1995
2002

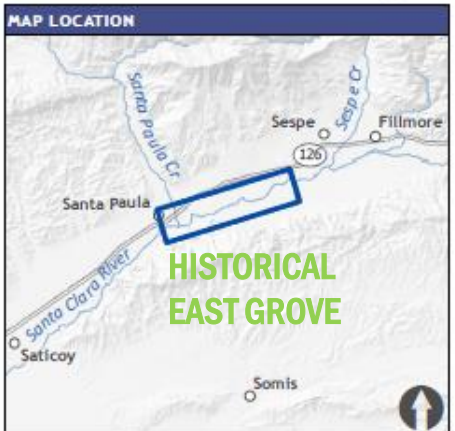

2004


2005 February
After First High Flow

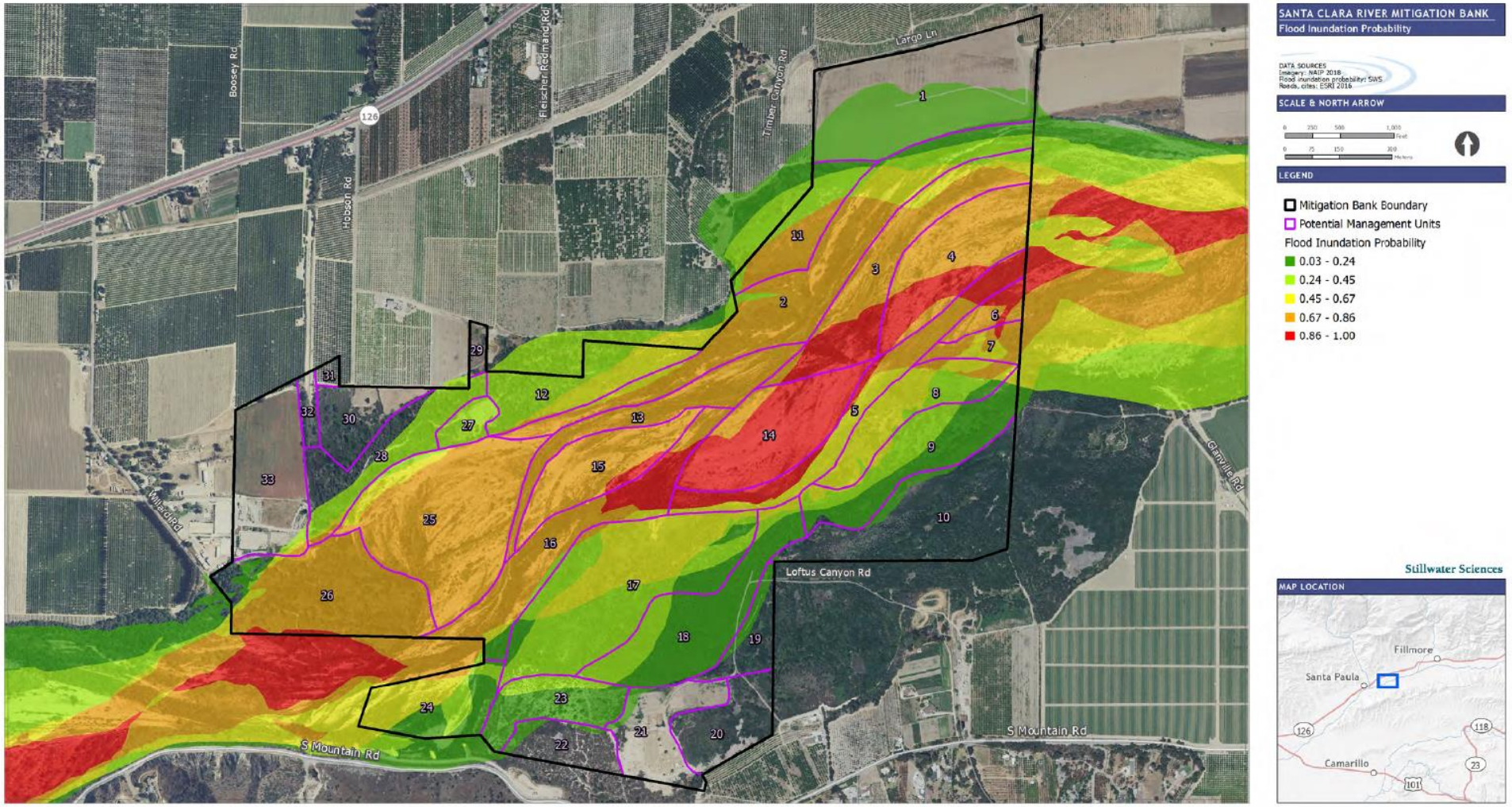

2005 September
After Second High Flow



- River and Floodplain Shaped by Large Episodic Floods
- Peak Flows > 100,000 cfs
- Recurrence Intervals > 10 years
- Primarily in Wet El Nino Years
- Riparian Vegetation Responds in a Cycle of Reset and Recovery

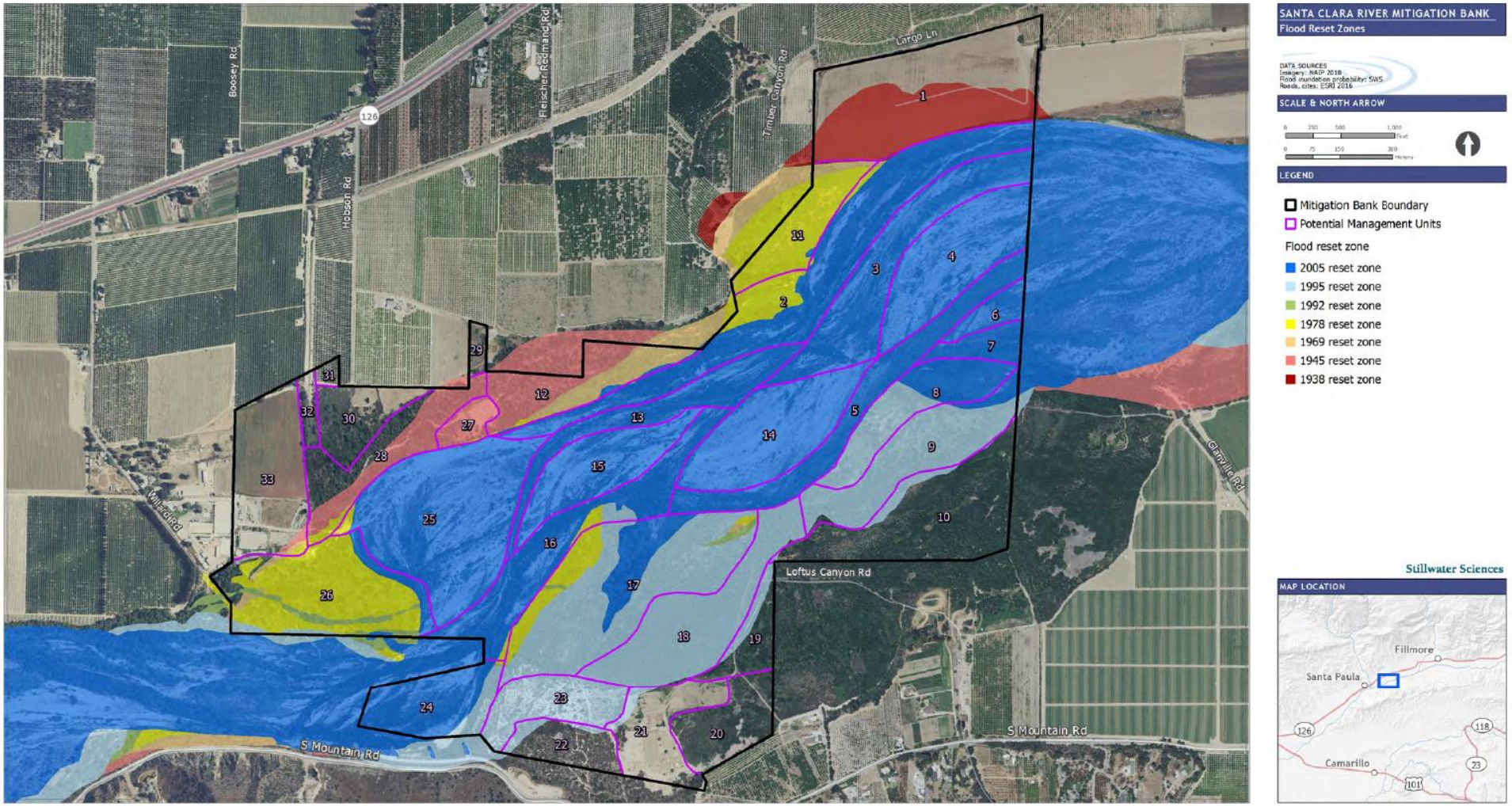


Potential Management Units: Flood Reset Risk



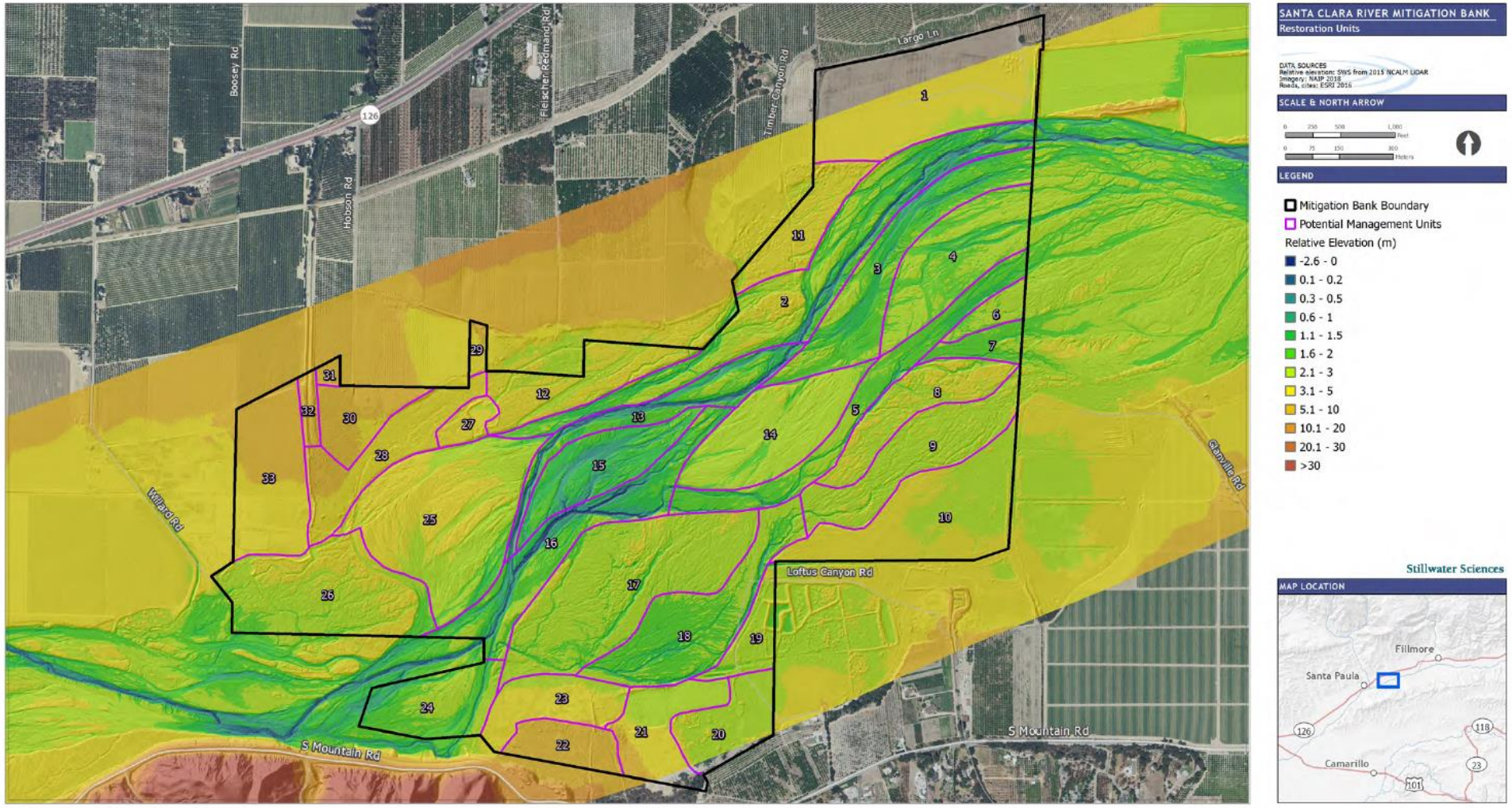
HISTORICAL LOCATION OF ACTIVE CHANNEL – delineate probability zones for risk of resetting by flood scour

Potential Management Units: Floodplain Age



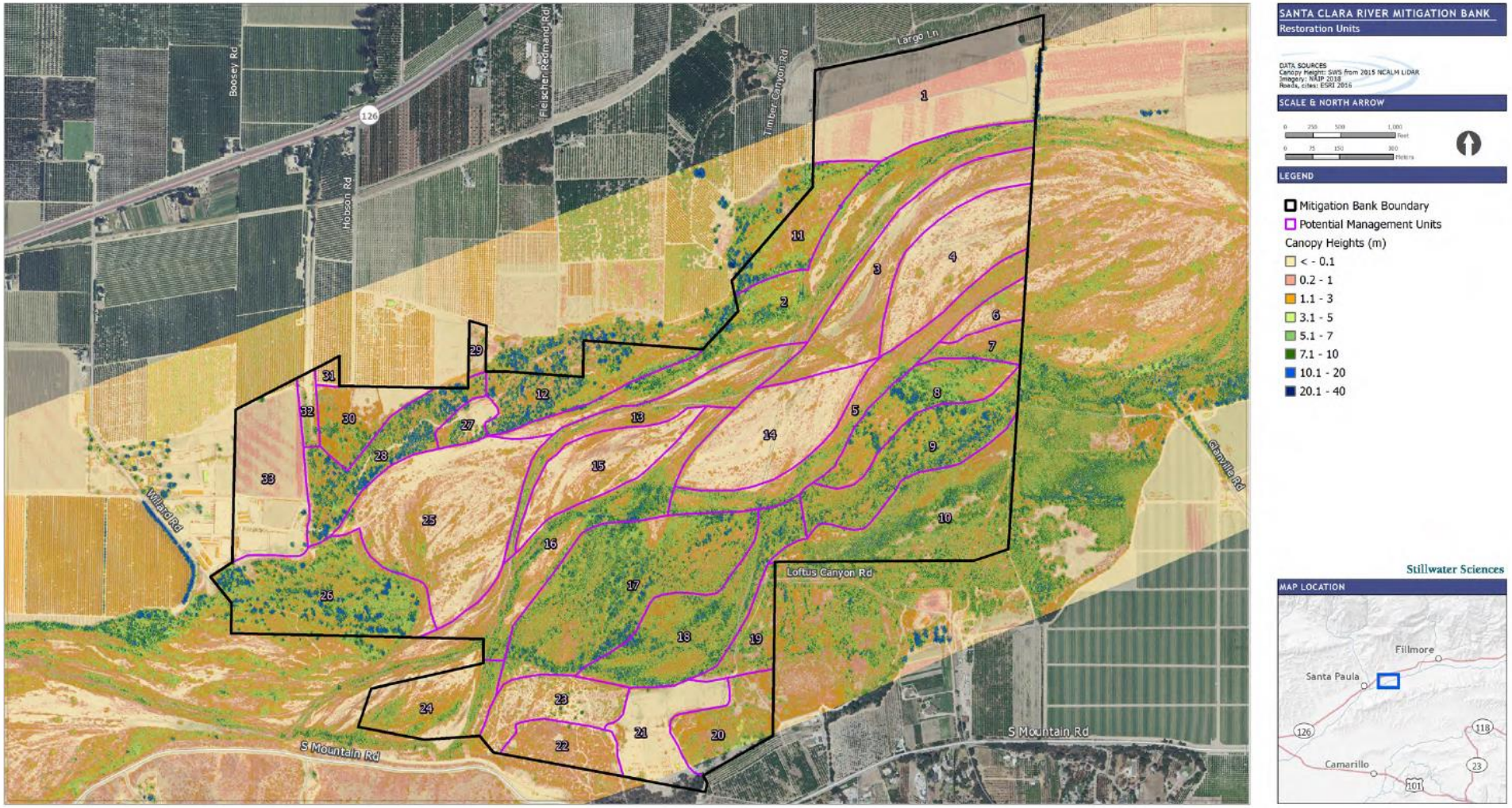
FLOOD RESET AREAS DURING HISTORICAL HIGH FLOW EVENTS were mapped to help determine floodplain age (time since last reset)

Potential Management Units: Relative Elevation Depth To Groundwater



RELATIVE ELEVATION from Oct 2015 LIDAR to defines geomorphic landforms and likely depth to groundwater

Potential Management Units: Canopy Height



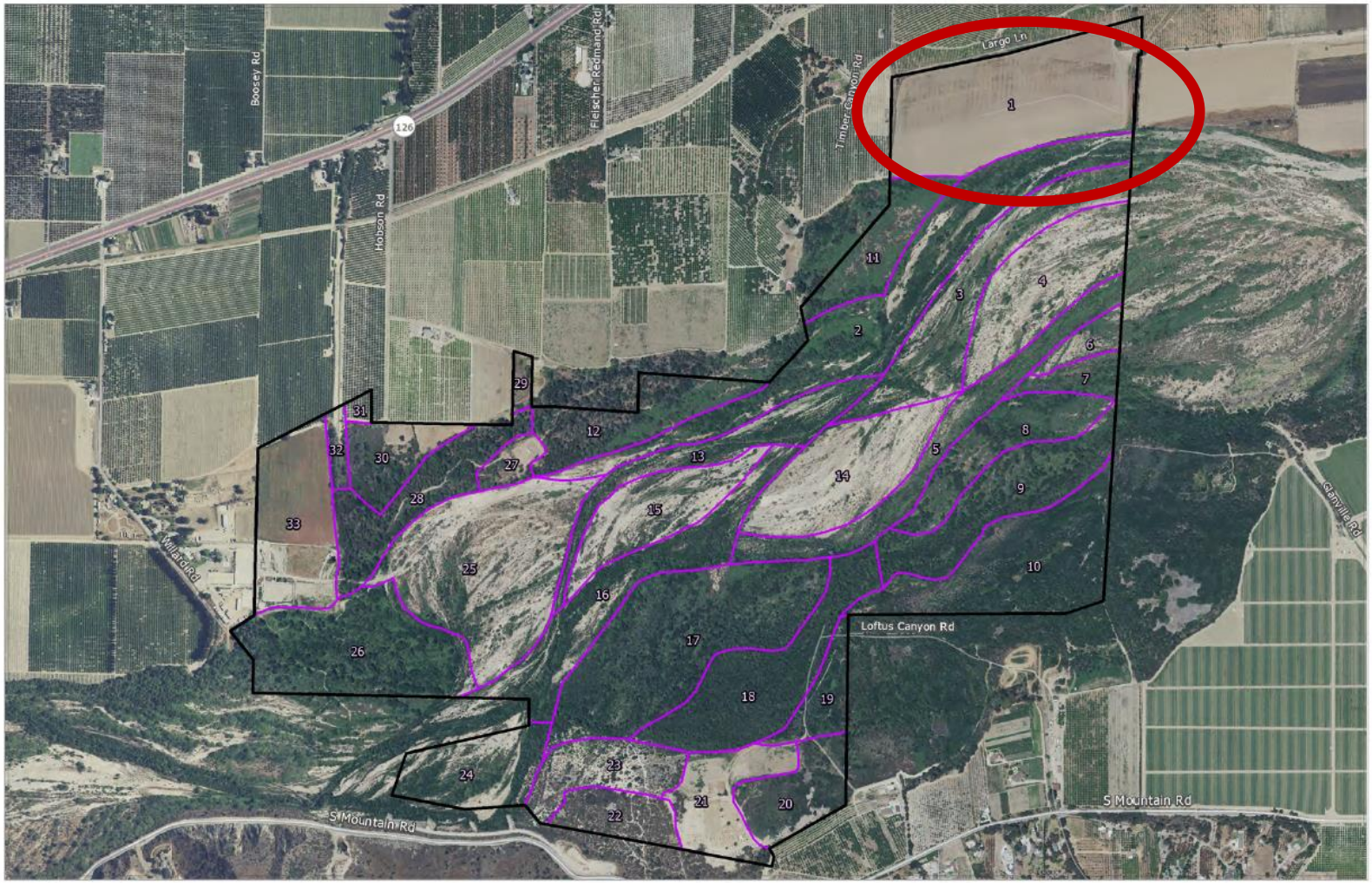
CANOPY HEIGHT from Oct 2015 LIDAR

MITIGATION CREDITING

- Wetlands and Other Waters of the US
  - Riverine Mosaic Re-establishment
  - Riverine Mosaic Rehabilitation
  - Riverine Mosaic Enhancement

- Species Habitat
  - Southwestern Willow Flycatcher
  - Yellow-billed Cuckoo
  - Least Bell's Vireo
  - Western Pond Turtle

Potential Management Units: Example Unit 1



2016 NAIP Natural Color Imagery

Developing Restoration Strategy for Each Unit

EXAMPLE – UNIT 1
CURRENT CONDITIONS

1) Existing Agricultural Field

2) Low Relative Elevation but Disconnected from River by Berm

3) Tributary/Barranca Input - Potential Water Quality Concerns

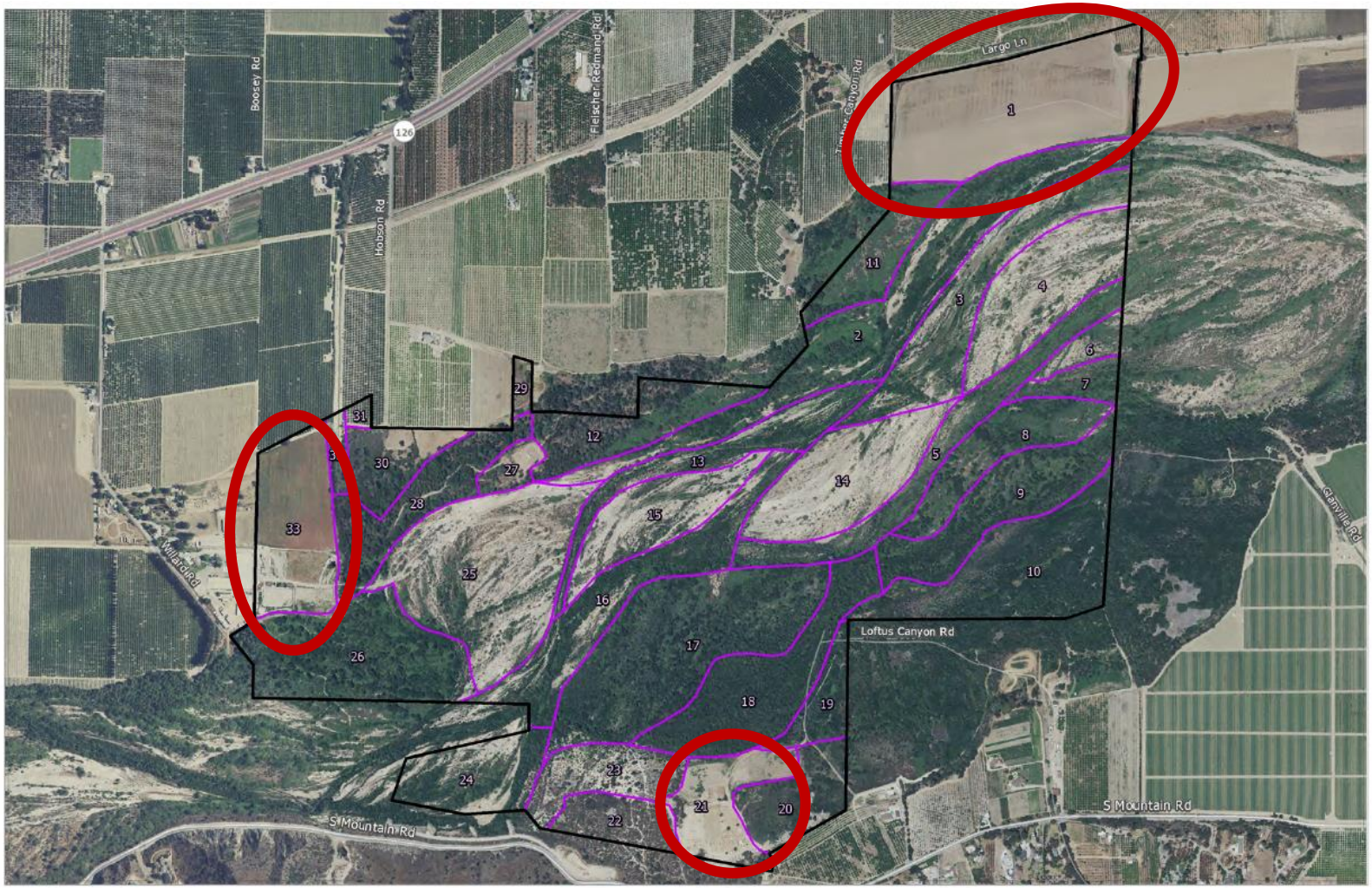
4) Most of Unit (except southern edges) likely at low risk of flood reset/scour

EXAMPLE – UNIT 1

RESTORATION AND MANAGEMENT ACTIONS
RIVERINE MOSAIC RE-ESTABLISHMENT CREDITS

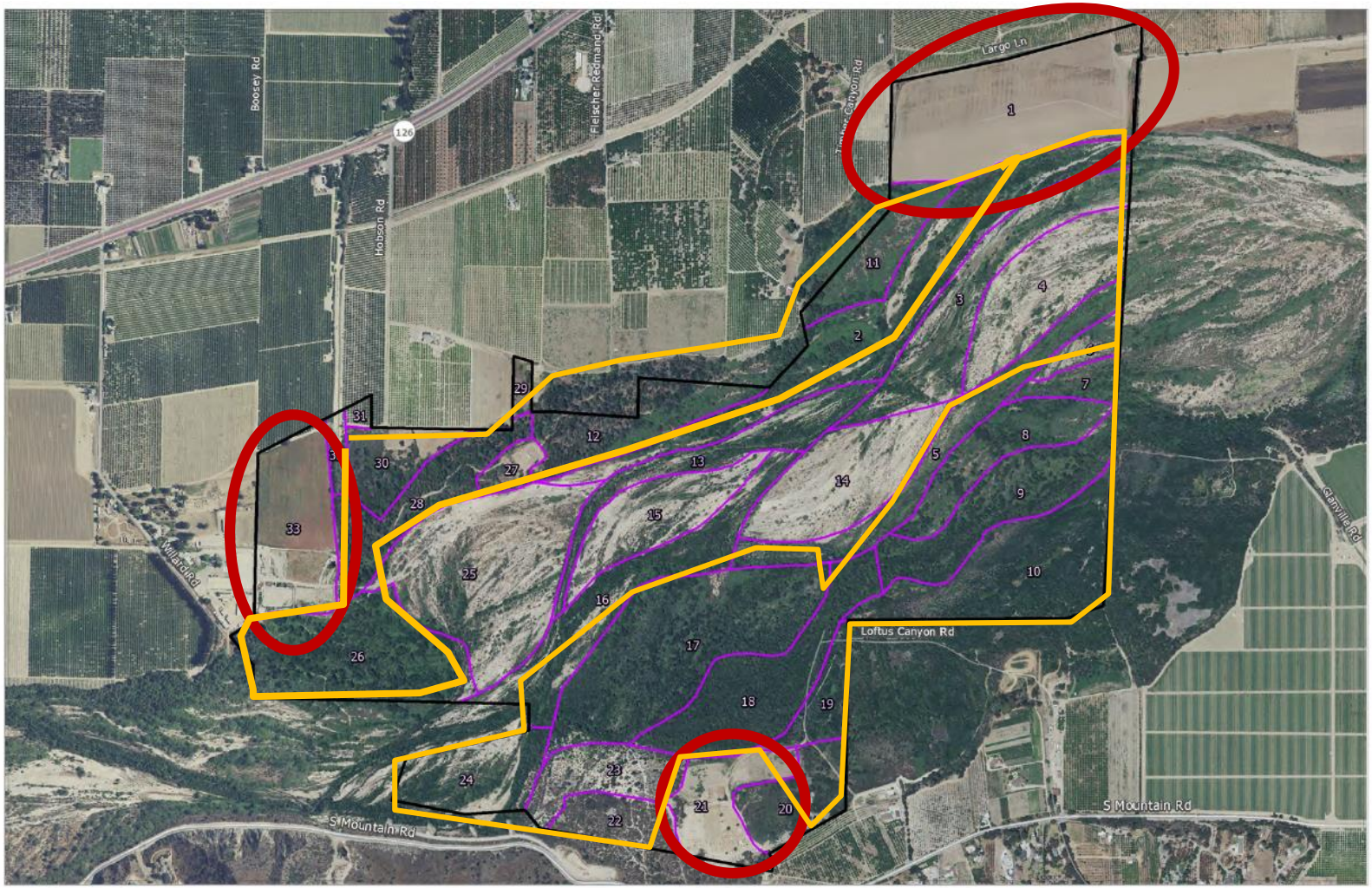
- Breach/remove berm to ***reconnect floodplain*** with river
- Recontour to ***provide topographic complexity*** (side channels, seasonal wetlands for SWFL and other species), higher areas for grasses and forbs (larger insects for cuckoos)
- ***Allow tributary inflow*** into the unit by breaching berms on east edge - consider potential need for WQ treatment wetland; horticultural revegetation
- ***Active revegetation*** with irrigation as needed
- ***Promote passive revegetation***, especially in constructed swales and back channel features that could serve as natural riparian recruitment areas and/or provide seasonal or perennial (?) wetland and aquatic habitat (especially in the lower, wetter SE corner of the unit)
- Consider ***riparian-upland transition habitat plantings*** along northern edge

Riverine Mosaic Re-Establishment Credits



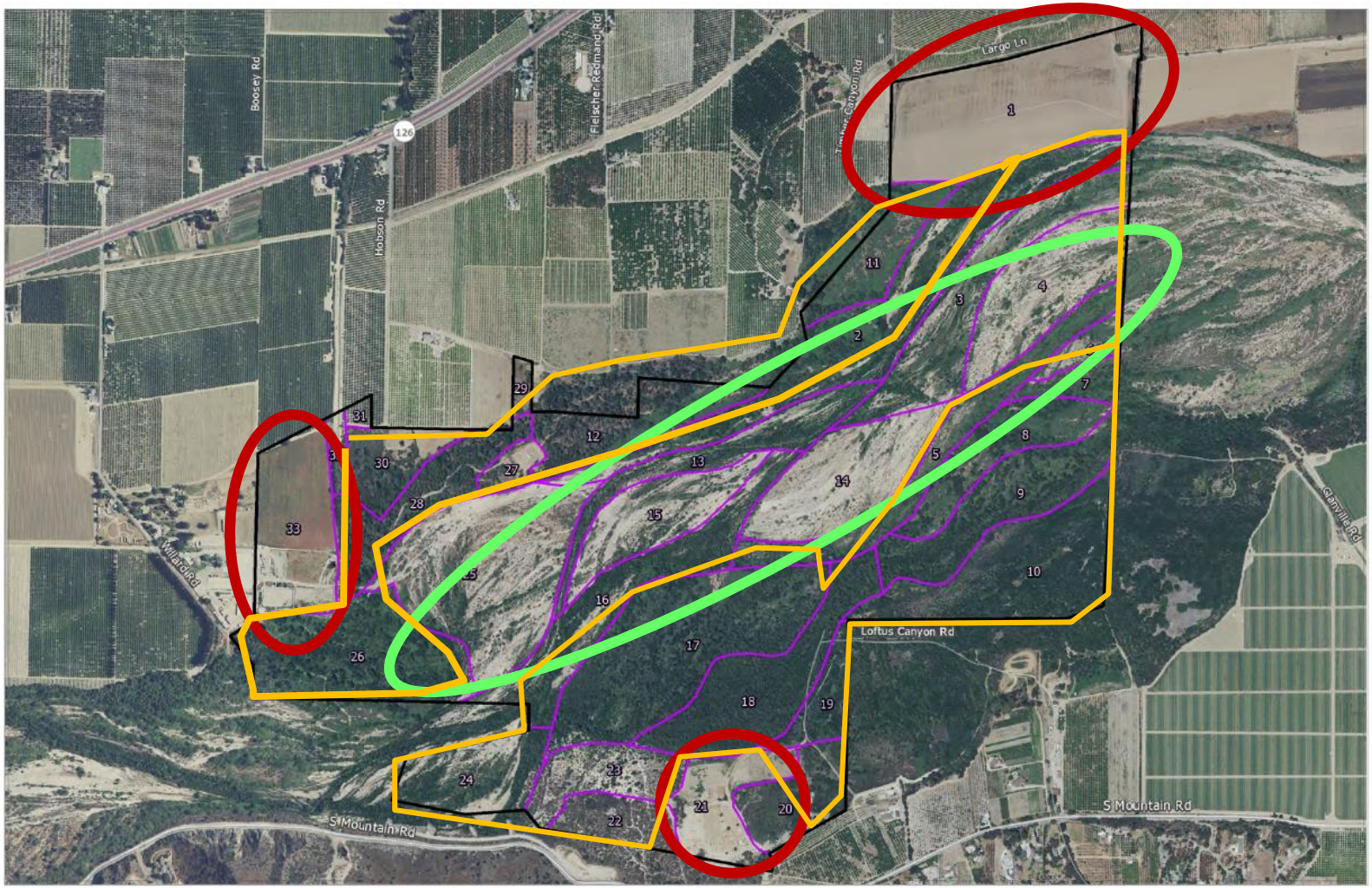
(1) Reconnect Historical Floodplain Areas That Have Been Decoupled From the River to Restore More Fluvial Geomorphic Processes , (2) Regrade to Restore Topographic Complexity, and (3) Plant Native Species

Riverine Mosaic Credits: Re-Establishment and Rehabilitation



(1) RED = Re-Establishment, (2) ORANGE = Rehabilitation

Riverine Mosaic Credits: Re-Establishment, Rehabilitation, and Enhancement



(1) RED = Re-Establishment, (2) ORANGE = Rehabilitation, (3) GREEN = Enhancement

FOR MORE INFORMATION

- Santa Clara River Parkway Website (includes project reports plus vegetation layers viewable with Google Earth):
  - parkway.scrwatershed.org
- Riparian Summit 2017 at UC Davis – Special Case Study Session on the Santa Clara River
  - Ripariansummit.ucdavis.edu
- Email: bruce@stillwatersci.com

Santa Clara River Case Study Session at Riparian Summit 2017 at UC Davis

https://ripariansummit.ucdavis.edu/

Bruce Orr: The Santa Clara River Parkway: An Example of Large-Scale River Corridor Restoration Planning in a Semi-Arid California Landscape

Jenny Marek: Strategic Habitat Conservation in the Santa Clara River

James Hatten: The importance of monitoring and modeling bird populations to support riparian management in an urbanized/agricultural matrix in southern California

Laura Riege: Floodplain Restoration and Protection Along the Santa Clara River Parkway: Multiple Techniques for Multiple Benefits

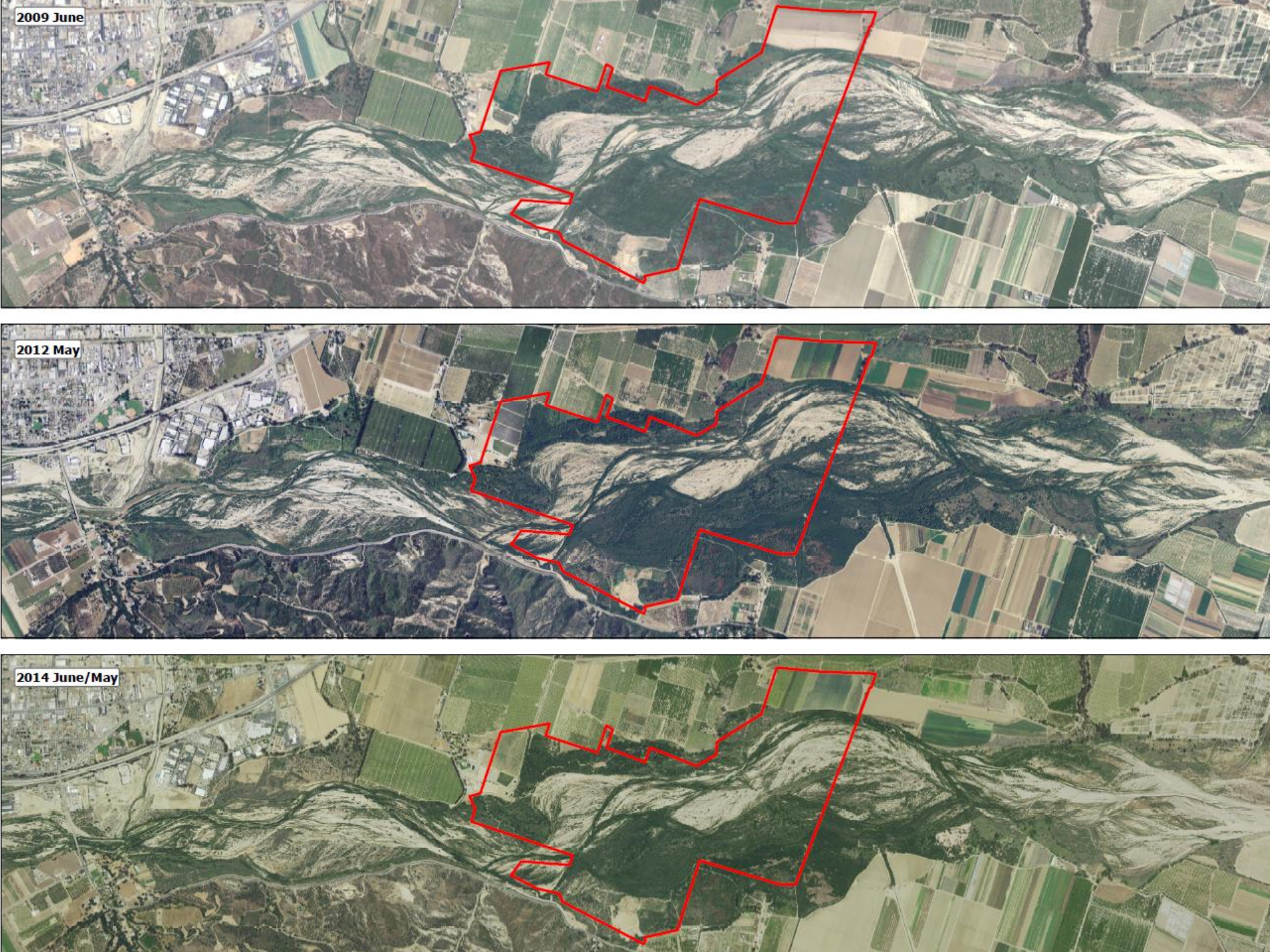
Catherine MacCalvin: Finding Balance through a Habitat Conservation Plan for Endangered Steelhead and Water Resources Management along the Santa Clara River

Candice Meneghin: Santa Clara River Steelhead Coalition

CalTrout Video: Santa Clara River – Restoring Resilience
https://www.youtube.com/watch?v=MDNO305RU64

WETLANDS & WATERS MITIGATION CREDITING

404/401/1600 Credit Type	Proposed Restoration Work	Suitable Aquatic Resources to Mitigate
Riverine Mosaic Re-establishment	Restore wetlands/waters in existing uplands where they historically occurred	Riparian forest, riparian woodland, riparian scrub, scrub shrub wetland, perennial river, seasonal wetland, perennial emergent marsh, seasonal wetland and swales, and floodplain wetlands
Riverine Mosaic Rehabilitation	Remove *Arundo* and other invasive species in wetlands/waters within high and medium ranked *Arundo* priority removal management units, revegetate through a mix of active and passive approaches	
Riverine Mosaic Enhancement	Remove *Arundo* aand other invasive species in wetlands/waters within low ranked *Arundo* priority removal management units; revegetate through a mix of active and passive approaches	


2009 June
2012 May
2014 June/May