8th Spring-run Chinook Symposium

July 26-28, 2016 in Chico, CA

Overview

- Sponsors:
  - PG&E
  - Northern California Water Association
  - Friends of Butte Creek
  - California Conservation Corps

The year's Symposium will highlight regional status reports on Spring-run Chinook populations, instream flow studies and fish passage assessments, water conservation and transactions, and how to translate research and genetics into implementation and recovery actions.

Field tours will include visits to the legendary spawning grounds in Upper Butte Creek and PG&E's hydroelectric retrofit projects; salmon and steelhead fish passage in Lower, Deer, Mill and Antelope Creek that have been prioritized for instream flow enhancement and fish passage projects; a Clear Creek Spring Chinook Restoration tour; and a tour of Lower Butte Creek Water Diversions.

Presentations

Translating Research & Studies Into Implementation and Recovery Actions

(Slide 4) *Active Management: The Missing Link for Recovery of Central Valley Spring Chinook*
Brad Cavallo, President, Senior Scientist, Cramer Fish Sciences

(Slide 25) *"A Call For Action" — Implementing Restoration Projects for Spring Run Chinook in the Klamath River Basin*
David J. Bandrowski, Yurok Tribe

(Slide 66) *Restoration in the Sacramento Valley—Tipping the Scale toward Recovery*
Eric M. Ginney, Environmental Science Associates

Active management: the missing link for recovery of Central Valley spring Chinook

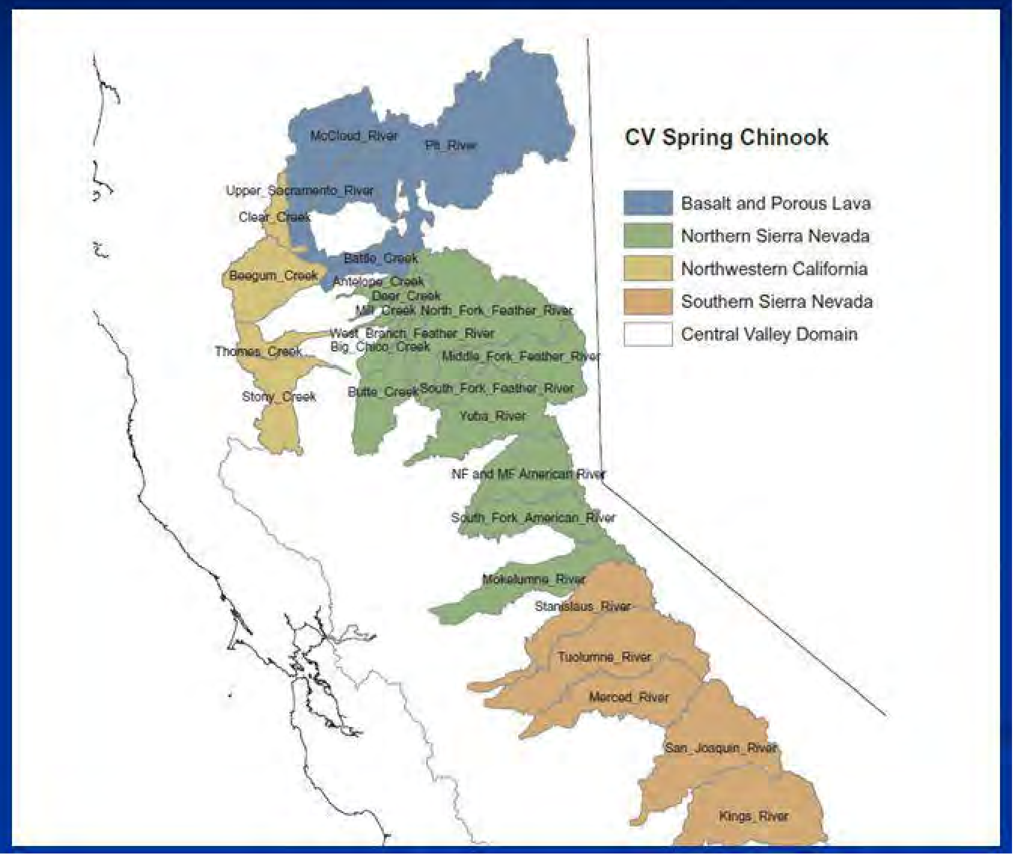
BRAD CAVALLO AND STEVEN ZEUG

Spring Chinook Recovery Criteria

2

Eight populations at ***low risk*** of extinction distributed throughout the Central Valley

- (1) Northwestern
- (2) Basalt and Porous Lava
- (4) Northern Sierra
- (2) Southern Sierra



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Spring Chinook Recovery Criteria

Populations We Have (or Expect to Have)

- (1) Northwestern
  - ➢ Clear Creek
- (2) Basalt and Porous Lava
  - ➢ Battle Creek
- (4) Northern Sierra
  - ➢ Deer, Mill and Butte Creeks
- (2) Southern Sierra
  - San Joaquin River

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Spring Chinook Recovery Criteria

4

Minimally, what additional populations will we need?

- 1 in Basalt and Porous Lava
- 1 in Northern Sierra
- 1 in Southern Sierra

What tribs to focus on and how should we get there?

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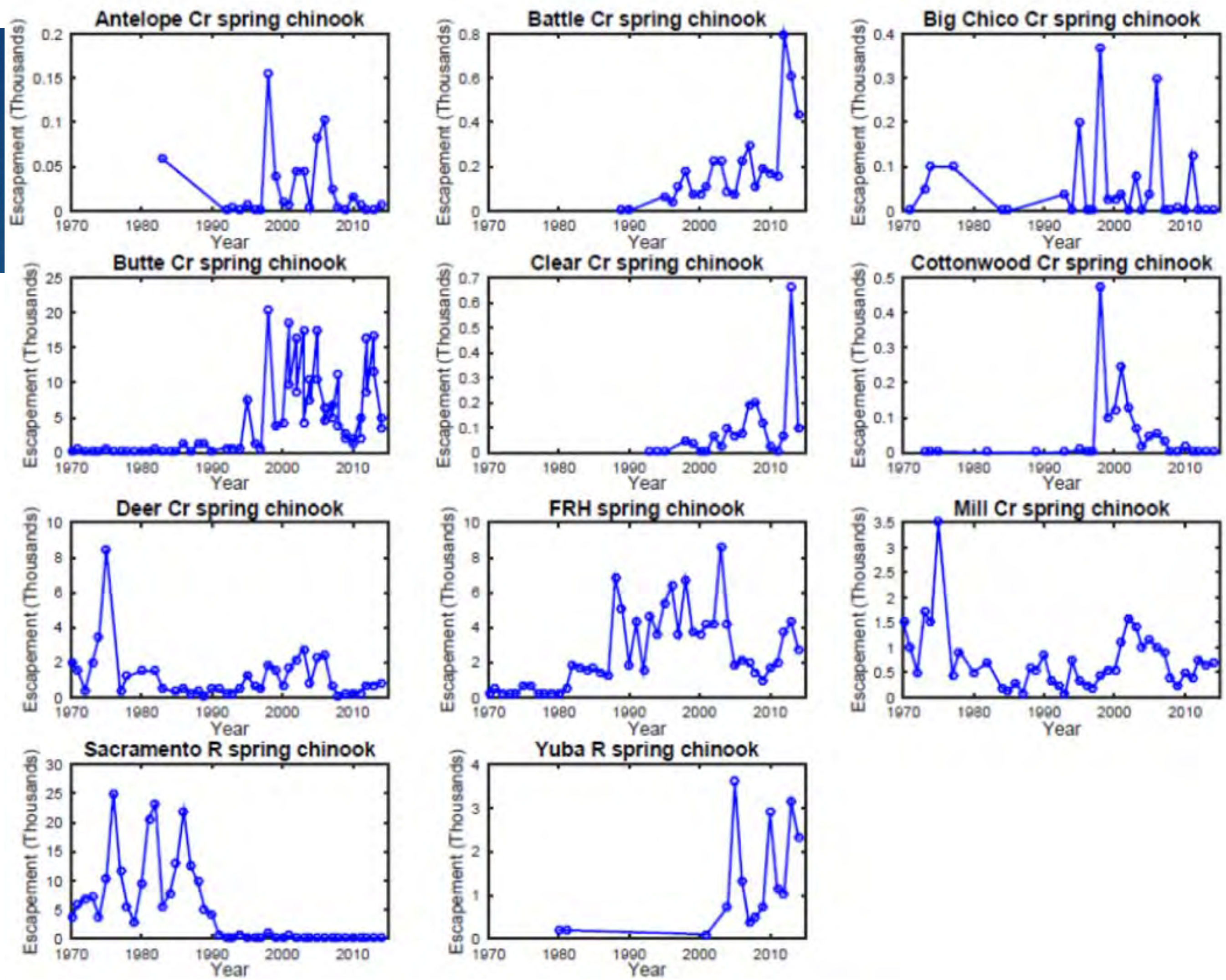

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What is needed to achieve recovery? How can we get there?

6

Two successful strategies are apparent:

1. Protect and improve passage, flows and habitats in spring Chinook suitable tributaries

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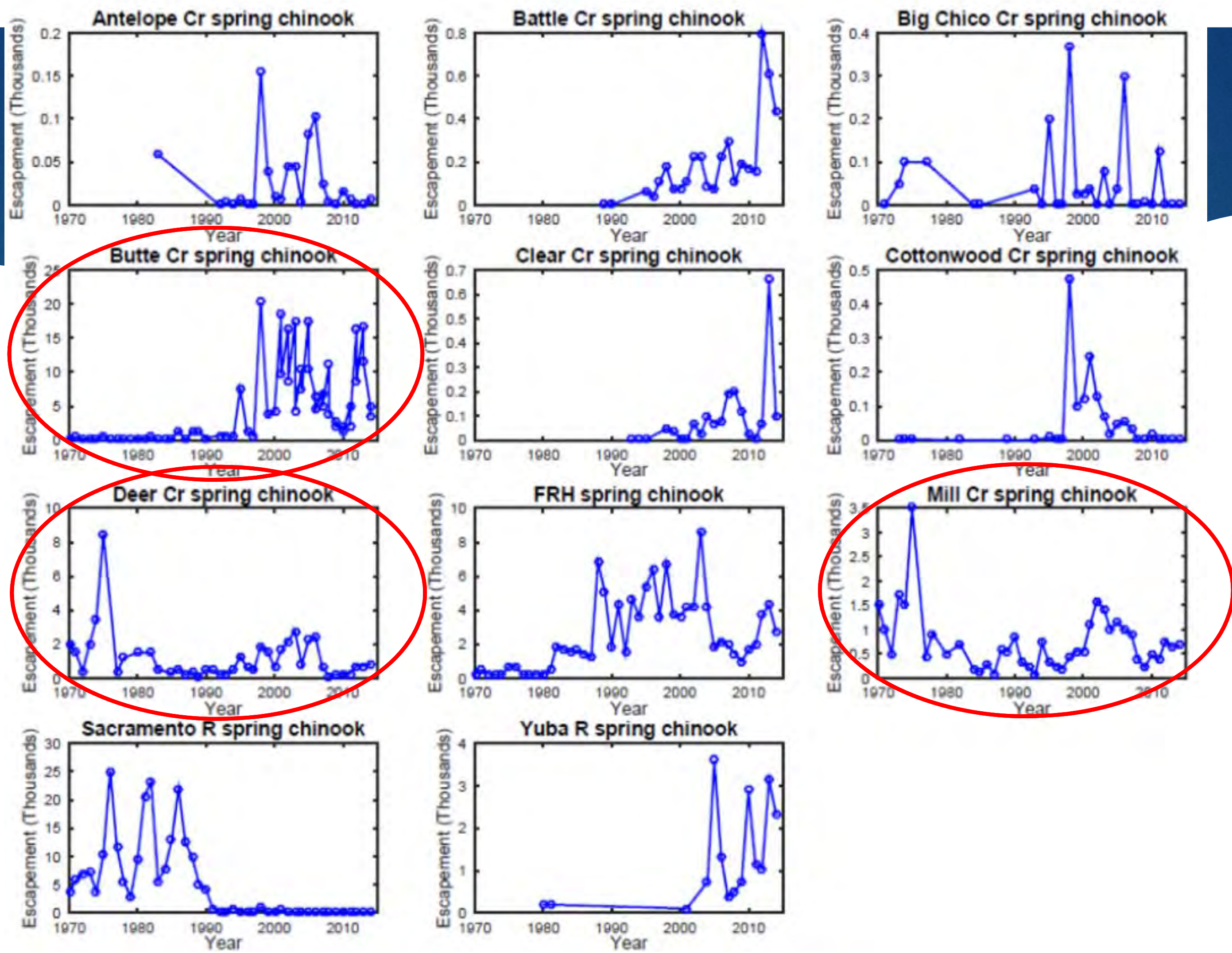
Antelope Cr spring chinook
Battle Cr spring chinook
Big Chico Cr spring chinook
Butte Cr spring chinook
Clear Cr spring chinook
Cottonwood Cr spring chinook
Deer Cr spring chinook
FRH spring chinook
Mill Cr spring chinook
Sacramento R spring chinook
Yuba R spring chinook
Escapement (Thousands)
Year

7


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FISH SCIENCES

What is needed to achieve recovery? How can we get there?

8

Two successful strategies are apparent:

1. Protect and improve passage, flows and habitats in spring Chinook suitable tributaries
2. #1 ***plus*** manage to minimize fall Chinook introgression and hatchery stray impacts generally

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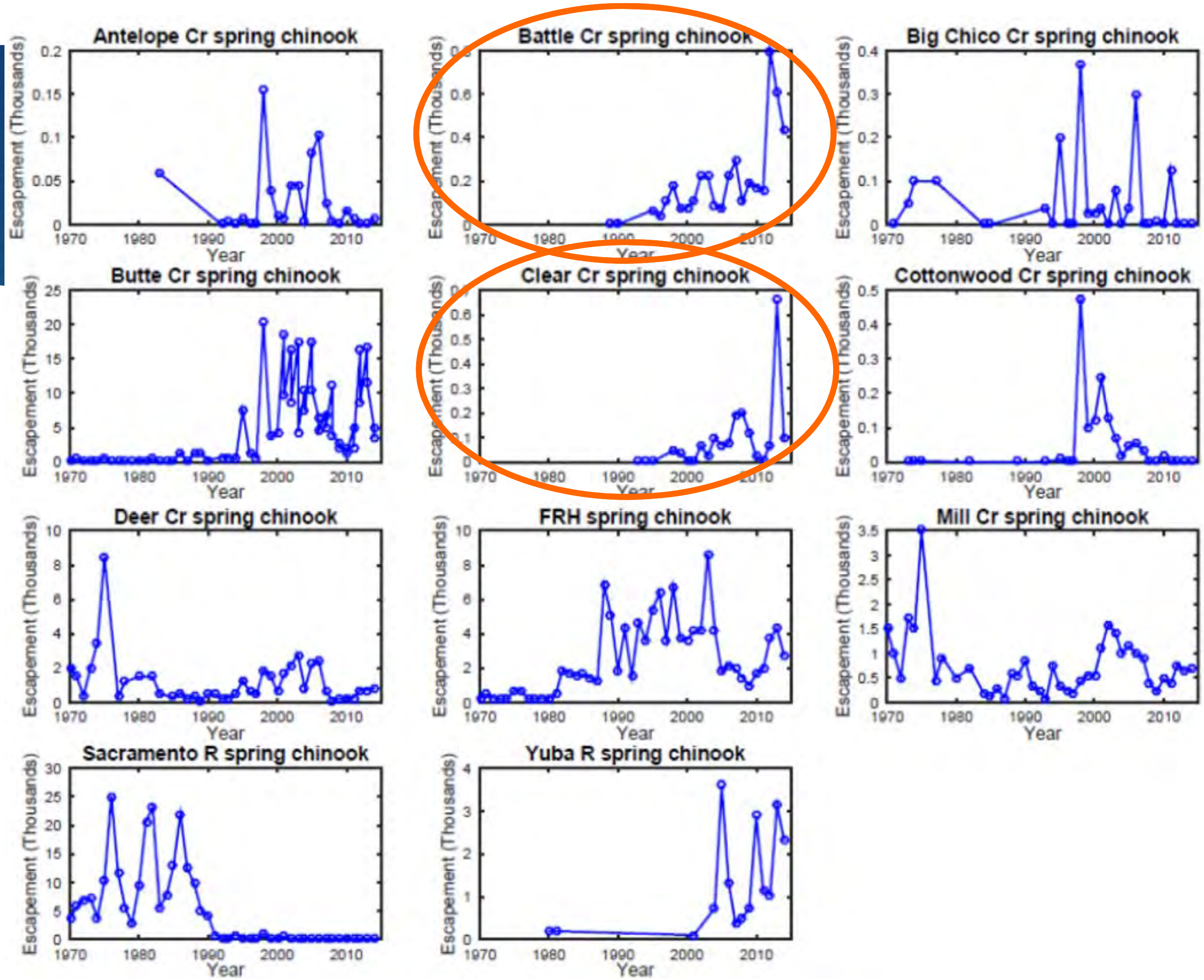
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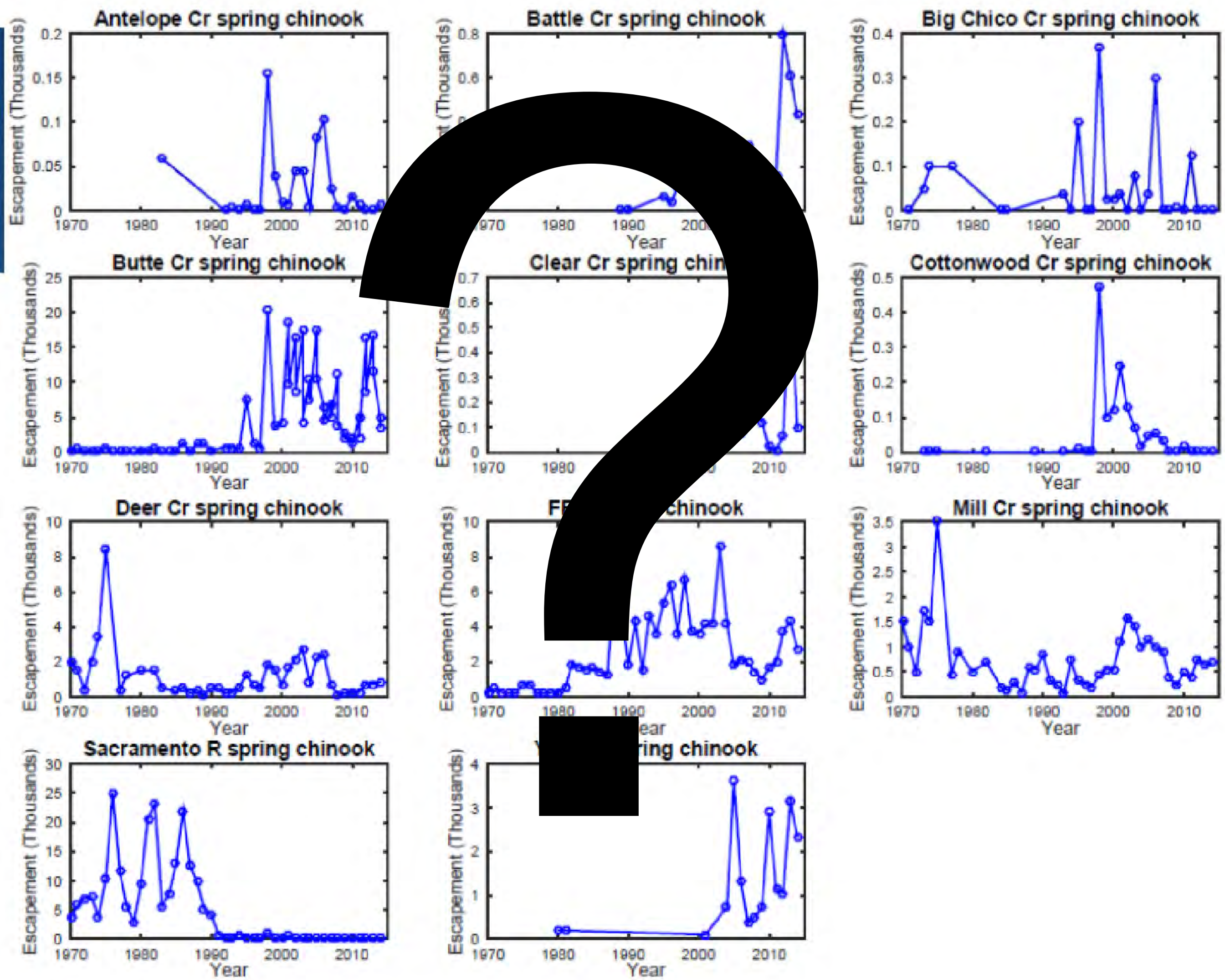
FRH spring chinook
Mill Cr spring chinook
Sacramento R spring chinook
Yuba R spring chinook
Escapement (Thousands)
Year

What is needed to achieve recovery? How can we get there?

10

Which tributaries remain where Strategy #1 (Protect and Improve) is likely to produce a population with low extinction risk?



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What is needed to achieve recovery? How can we get there?

12

Which tributaries remain which are amenable to Strategy #2?

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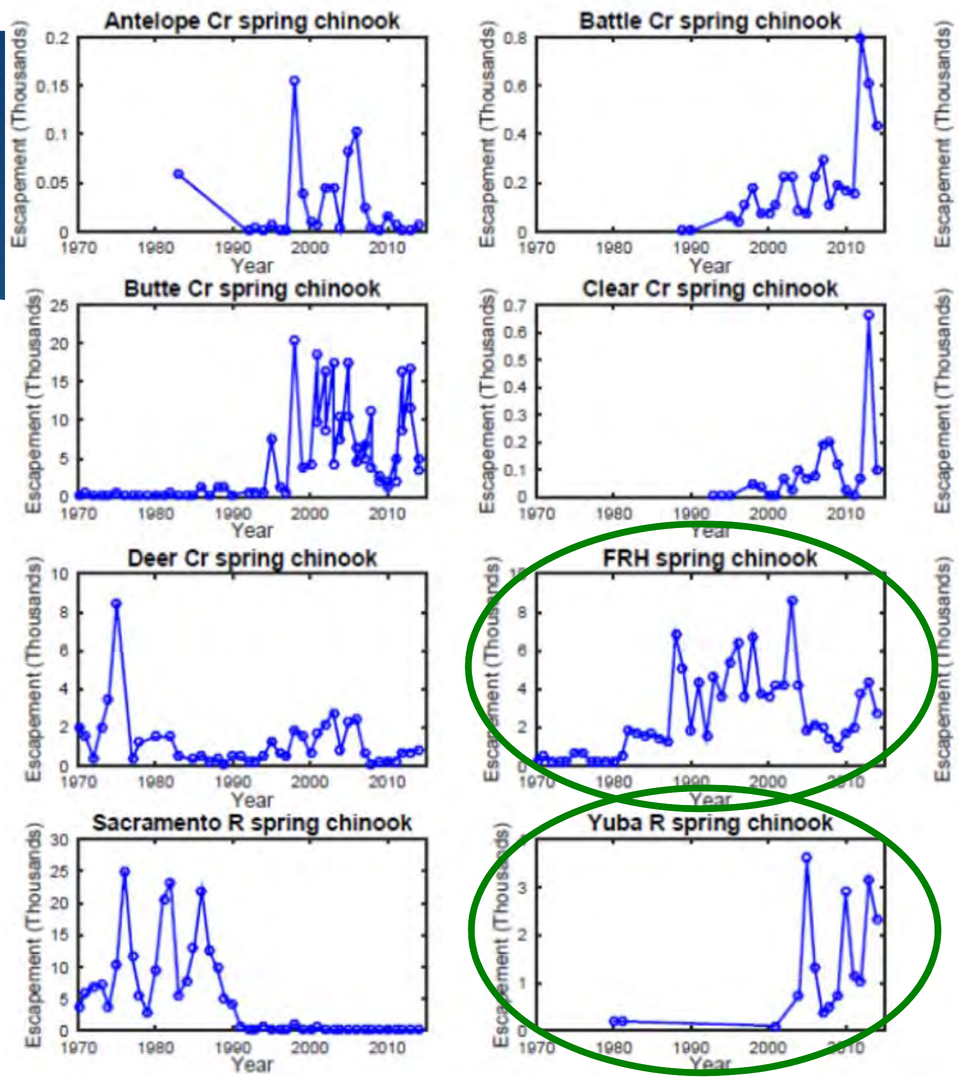
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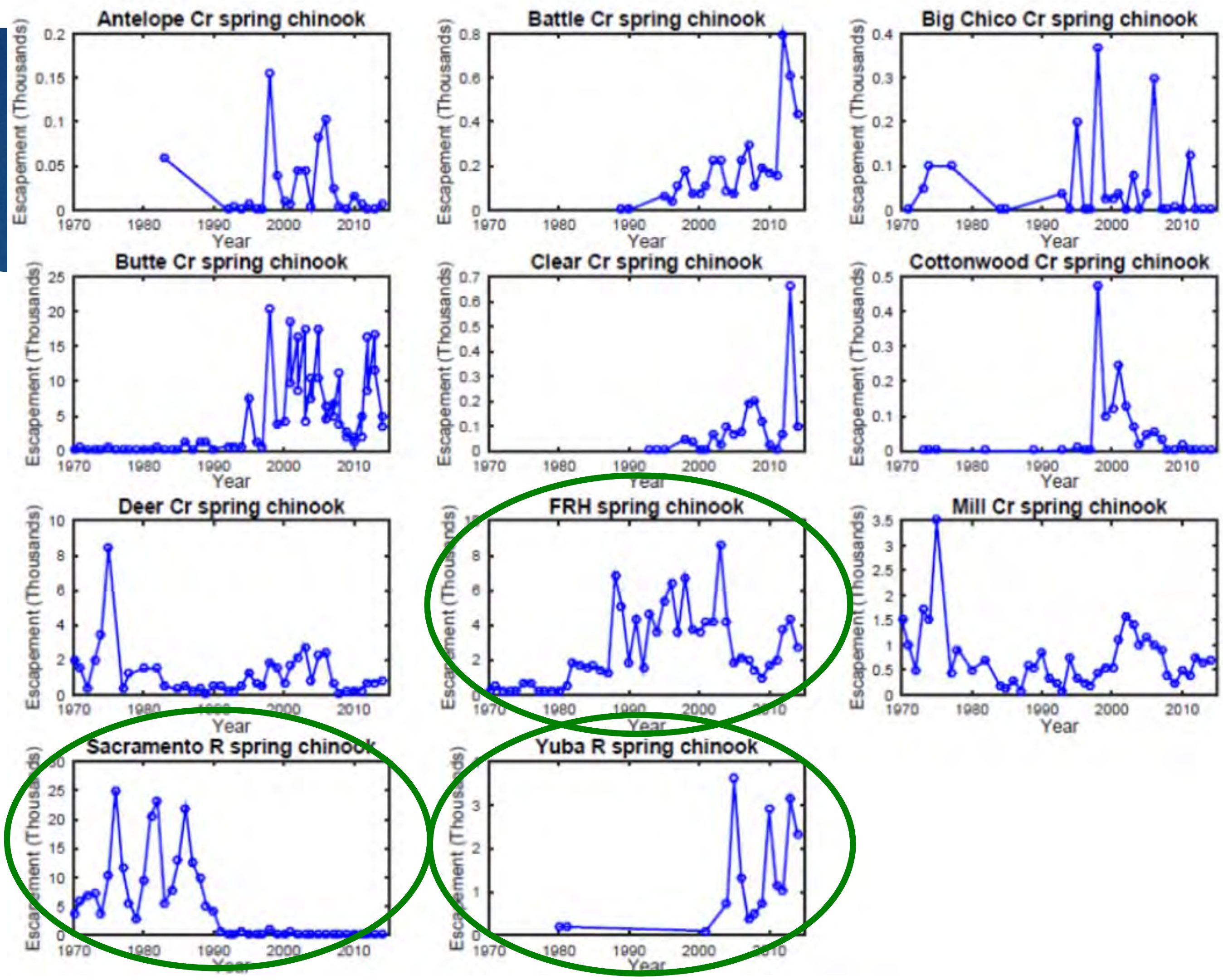
Yuba R spring chinook
Escapement (Thousands)
Year

14



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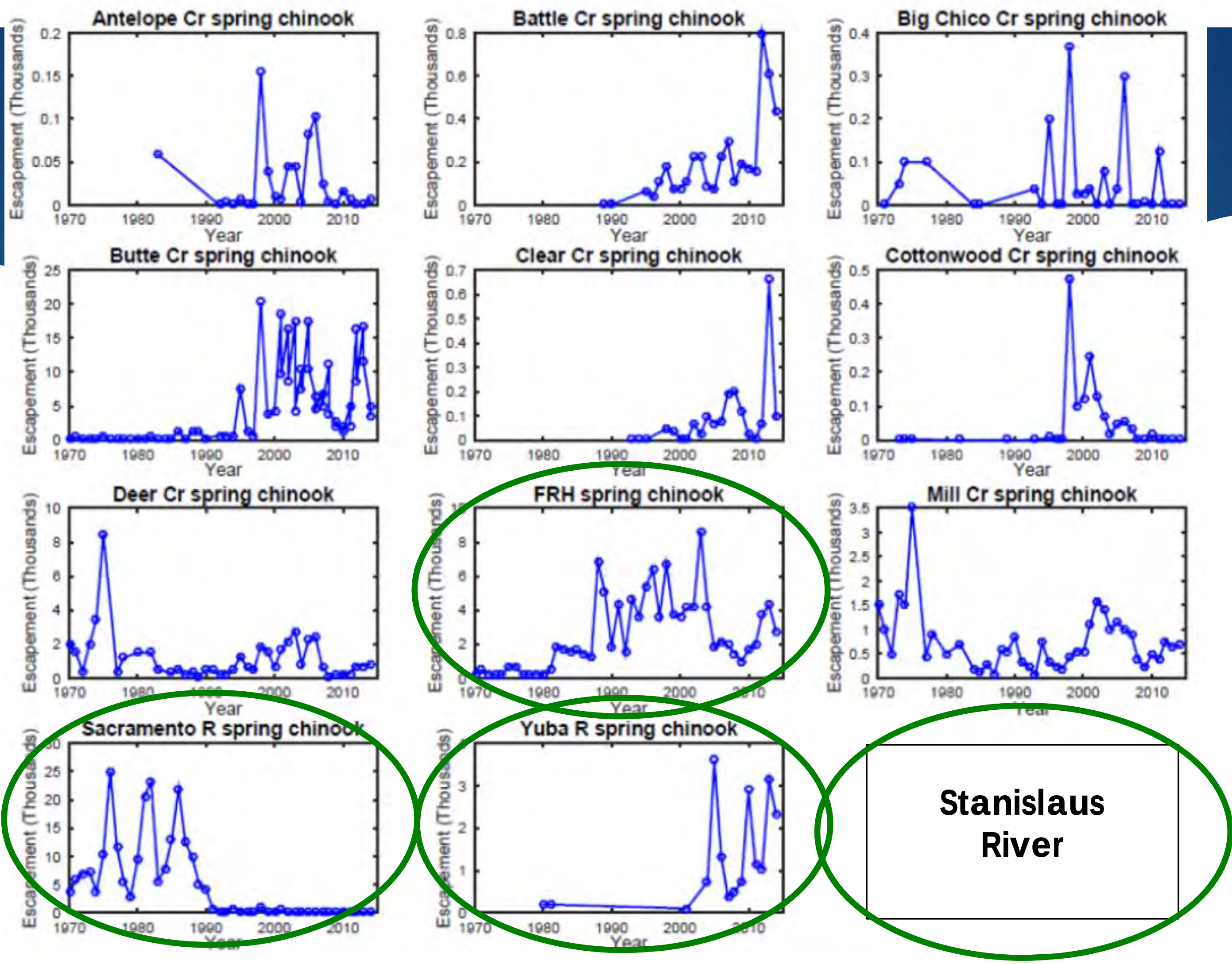

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What management actions?

Clear Creek

Battle Creek @ CNFH

What are the arguments against this strategy?

17

1. Its artificial (and therefore "icky")
2. Harmful to fall Chinook
3. Not necessary if we release hatchery Chinook in-river

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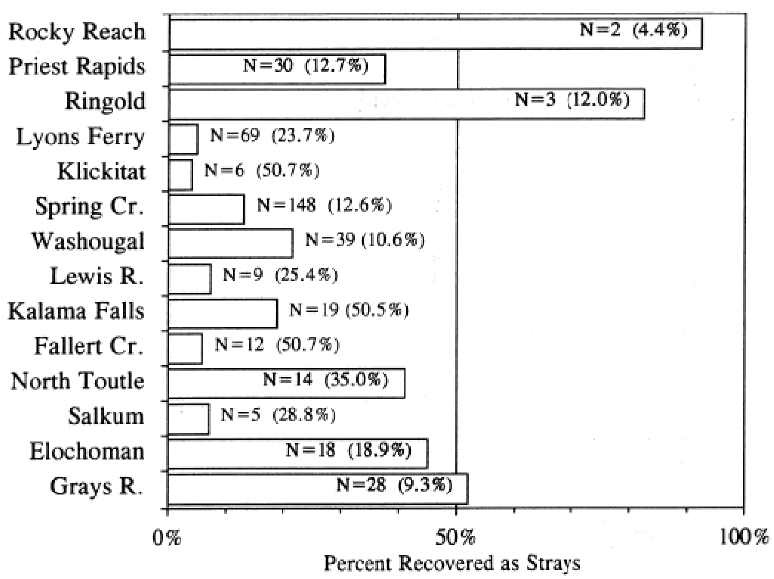
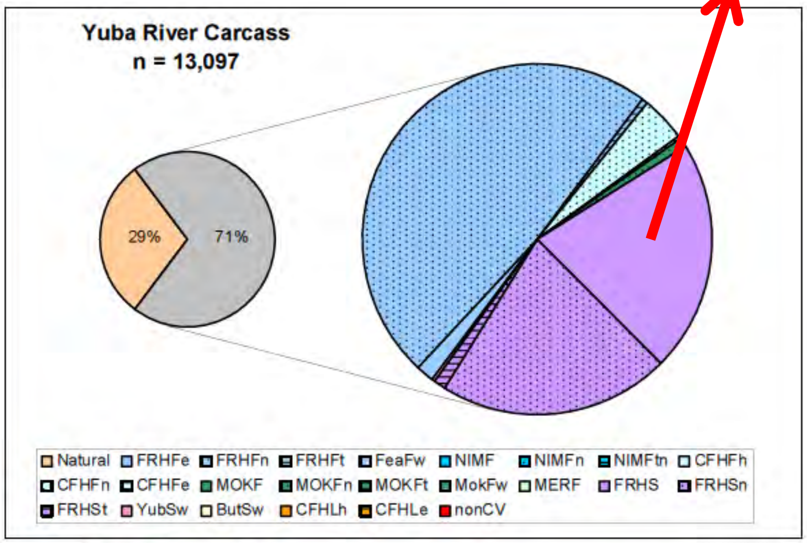
In-river hatchery releases not enough

- In-river releases ***still*** stray

On-site release straying rates from Vander Haegen and Doty (1995)



FRH In-river releases



In-river hatchery releases not enough

19

- In-river releases ***still*** stray
- Rivers with hatcheries on or adjacent to them will always have large numbers of hatchery fish present, even if inter-basin straying is drastically reduced by release strategies
  - Feather River, Yuba River, Sacramento River
- Introgression with natural origin fall Chinook will still be a problem without additional actions

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Other advantages

- Integration with other recovery actions
  - Establish populations prior to dam passage (Upper Yuba River Salmon Passage project).
- Acquire tissue samples to monitor and inform recovery
- Low cost and can be implemented quickly relative to other actions (dam passage)

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How will we move forward?

A Call for Action
Implementing Restoration Projects for Spring Run Chinook in the Klamath River Basin

THE WATERSHED CENTER
HAYFORK, CALIFORNIA

Spring-Run Chinook Symposium
July 26, 2016

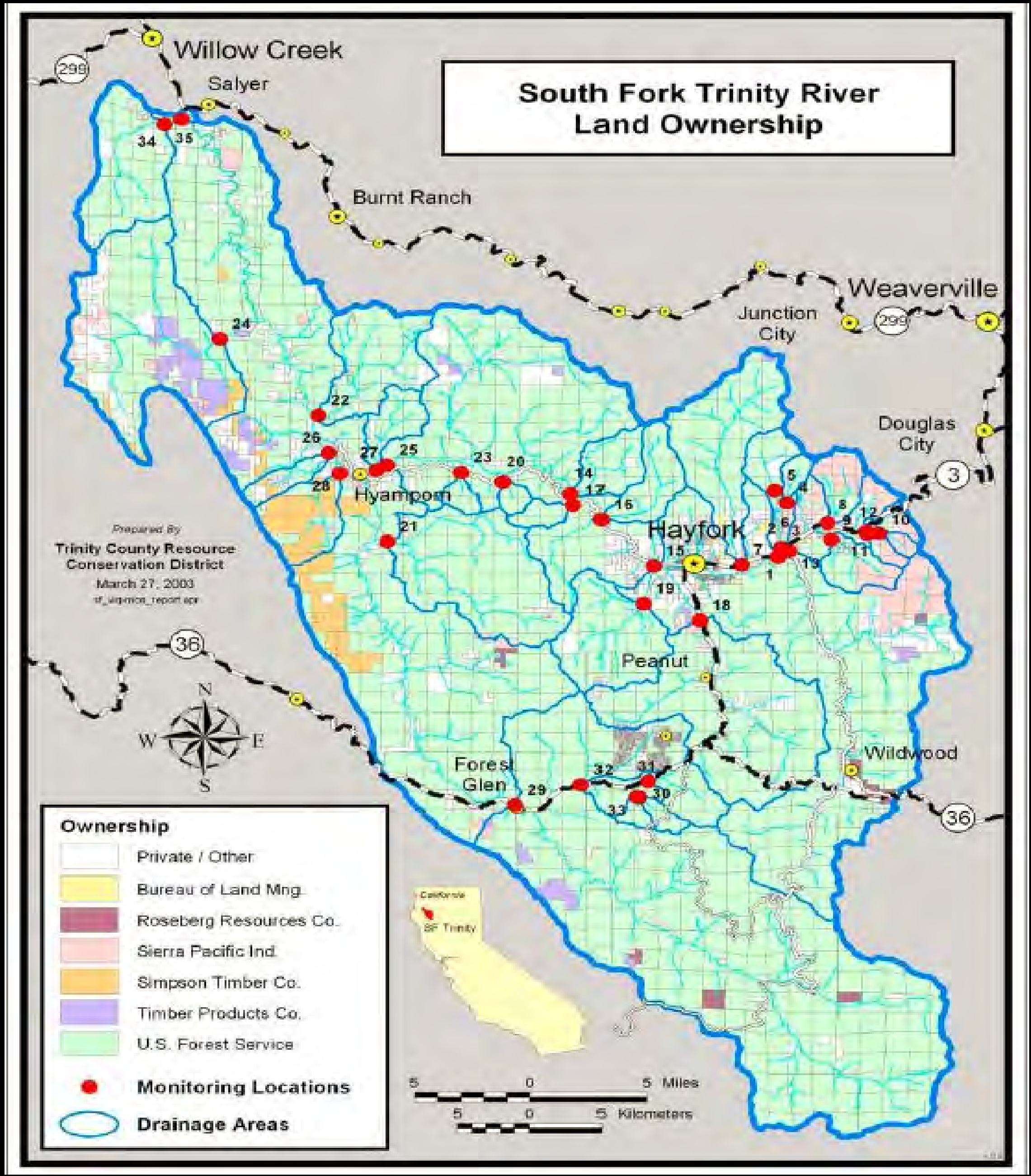
David (DJ) Bandrowski P.E.
Yurok Tribe – Fisheries Division

DISCUSSION TOPICS – SOUTH FORK TRINITY

- Setting The Stage – Historical Context and The Need for Restoration
- Complex Logistics – What are the Constraints and Challenges
- The Approach – Aggressive Techniques for In-River Restoration
- Pencil to Paper – Planning, Analysis, and Design Phase
- Learning by Doing – Physical and Biological Monitoring
- Future Vision – Embracing Uncertainty and Moving Forward


N
W
E
S
Yurok


S. Fork Trinity River - Longest Free Flowing River in California

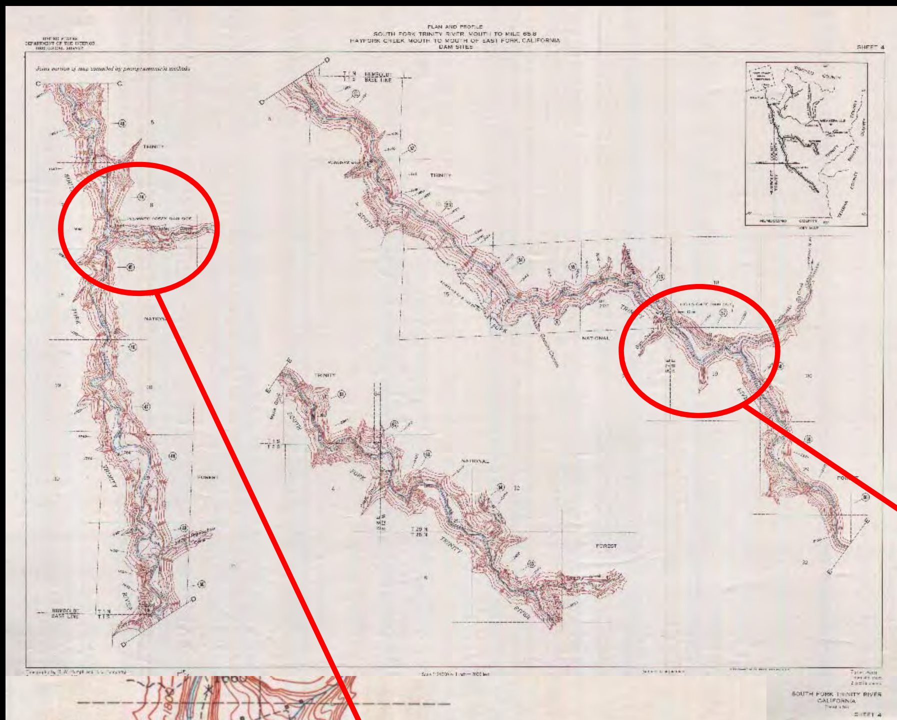


Every Fish Counts

In 1963 Spring Chinook populations were estimated at **10,000**
In 2015 there were only **32** fish counted.

Save our spring chinook

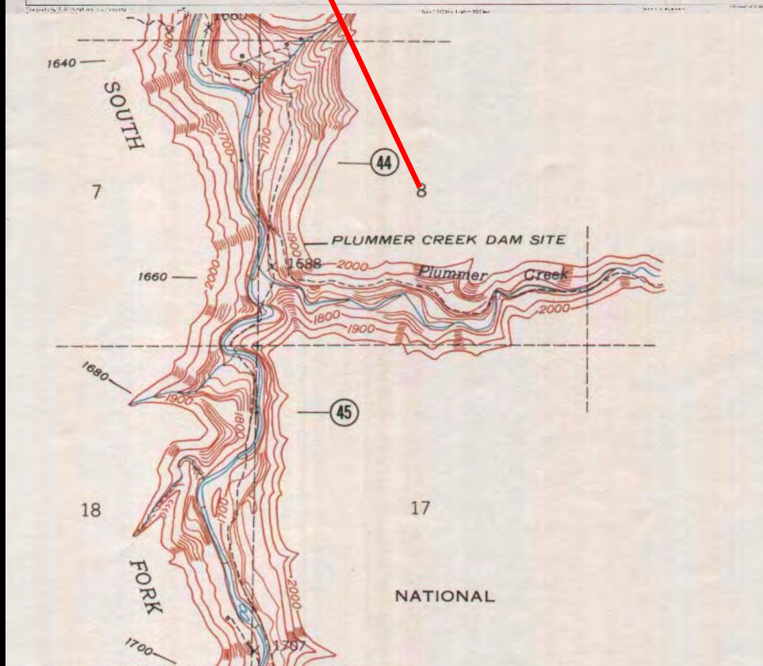
HISTORICAL CONTEXT - THE NEED FOR RESTORATION

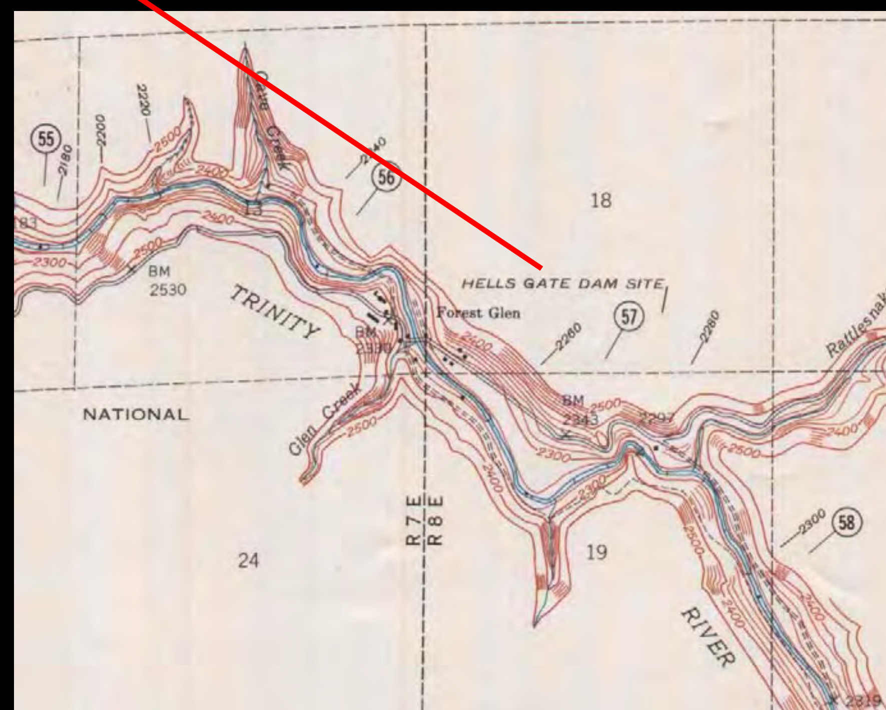


PLAN AND PROFILE
SOUTH FORK TRINITY RIVER, MOUTH TO MILE 65.8
HAYFORK CREEK, MOUTH TO MOUTH OF EAST FORK, CALIFORNIA
DAM SITES

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

Topography by R. W. Rumph and H. L. Pumphrey
Surveyed in 1948 and 1949





HISTORICAL CONTEXT - THE NEED FOR RESTORATION

Floods of December 1964 and January 1965 in the Far Western States

Part 1. Description

GEOLOGICAL SURVEY WATER-SUPPLY PAPER 1866-A

Prepared in cooperation with the States of California, Idaho, Nevada, Oregon, and Washington, and with other agencies

The highest peak flow was 95,400 cubic feet per second (2,700 m^3/s) on January 20 in the 1964 Flood

FIGURE 22.—Main Street, Klamath, Calif., after flood of December 23, 1964. Klamath River floodflows destroyed the town and damaged U.S. Highway 101 and the Douglas Memorial Bridge. Photograph by Eureka Newspapers, Inc.

HISTORICAL CONTEXT - THE NEED FOR RESTORATION

FIGURE 52.—Sediment, several feet deep, left by receding Trinity River floodwaters near Hoopa, Calif., December 1964. Photograph by George Porterfield, Water Resources Division, U.S. Geological Survey.

WATER RESOURCES RESEARCH, VOL. 18, NO. 6, PAGES 1643–1651, DECEMBER 1982

Effects of Aggradation and Degradation on Riffle-Pool Morphology in Natural Gravel Channels, Northwestern California

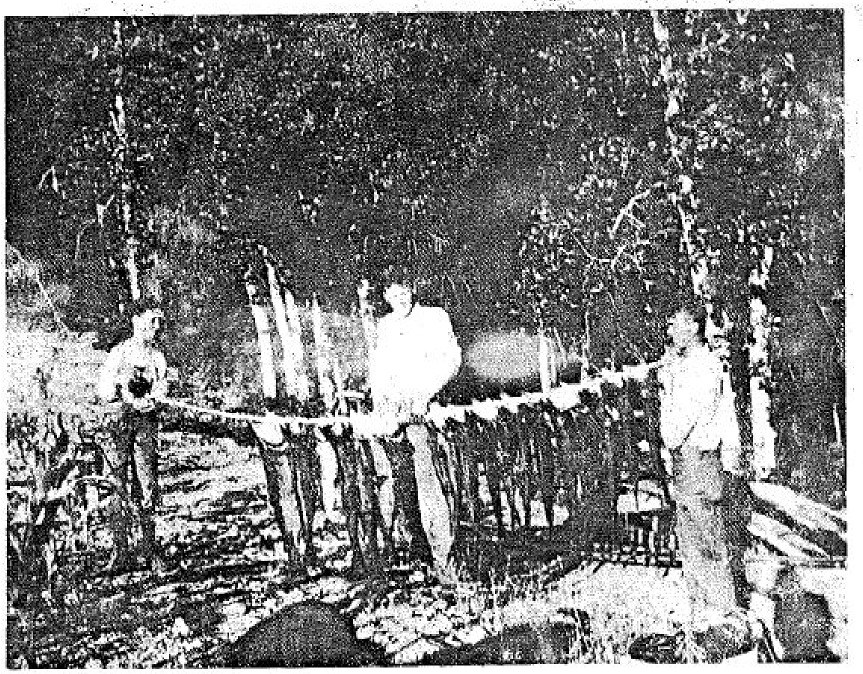
THOMAS E. LISLE

Pacific Southwest Forest and Range Experiment Station, Forest Service, U.S. Department of Agriculture Arcata, California 95521

After the flood of December 1964, 12 gaging sections in northern California widened as much as 100% and aggraded as much as 4 m, and then degraded to stable levels during a period of 5 years or more. As channels aggraded, bed material became finer, and low to moderate flow through gaging sections in pools became shallower, faster, and steeper. Comparisons of longitudinal profiles also show the diminishment of pools as well as a decrease in bar relief accompanying the excessive sediment load. As gaging sections degraded, hydraulic geometries recovered to a limited degree; full recovery probably depends on channel narrowing and further depletion of sediment supply. The hydraulic changes with aggradation indicate an increase in the effectiveness of moderate discharges (less than 1- to 2-year recurrence interval, annual flood series) to transport bed load and shape the bed. Bars become smaller, pools preferentially fill, and riffles armored with relatively small gravel tend to erode headward during falling stages and form a gentler gradient. Excess sediment can thus be more readily transported out of channels when additional contributions from watersheds are usuall slight.

HISTORICAL CONTEXT - THE NEED FOR RESTORATION

Action Plan for Restoration of the South Fork Trinity River Watershed and its Fisheries



prepared for

U.S. Bureau of Reclamation
and
The Trinity River Task Force

by

Pacific Watershed Associates
Arcata, California
February, 1994

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
NORTHERN DISTRICT

SOUTH FORK TRINITY RIVER
SEDIMENT INVESTIGATION

Table 1 - Sediment Yield (in 1,000's of C.Y.)

Values are based on a 30 Year Study Period W.Y. 1961- W.Y. 1990	Engelund-Hansen Equation (TOTAL LOAD)			Meyer-Peter and Muller Equation (BEDLOAD)		
	Forest Glen	Hyampom	Salyer	Forest Glen	Hyampom	Salyer
Totals	5832	16093	76241	1935	5955	10765
Annual Average (30 years)	194	536	2541	65	199	359
Cumulative Drainage Areas (miles²)	208	764	898	208	764	898
Total Sediment Yield per mile²	28.0	21.1	84.9	9.3	7.8	12.0
Annual Average per mile²	0.93	0.70	2.83	0.31	0.26	0.40
Individual Basin Summary						
Individual Drainage Areas (miles²)	208	556	134	208	556	134
Total Sediment Yield per mile²	28.0	18.5	448.9	9.3	7.2	21.5
Annual Average per mile²	0.93	0.62	14.96	0.31	0.24	0.72

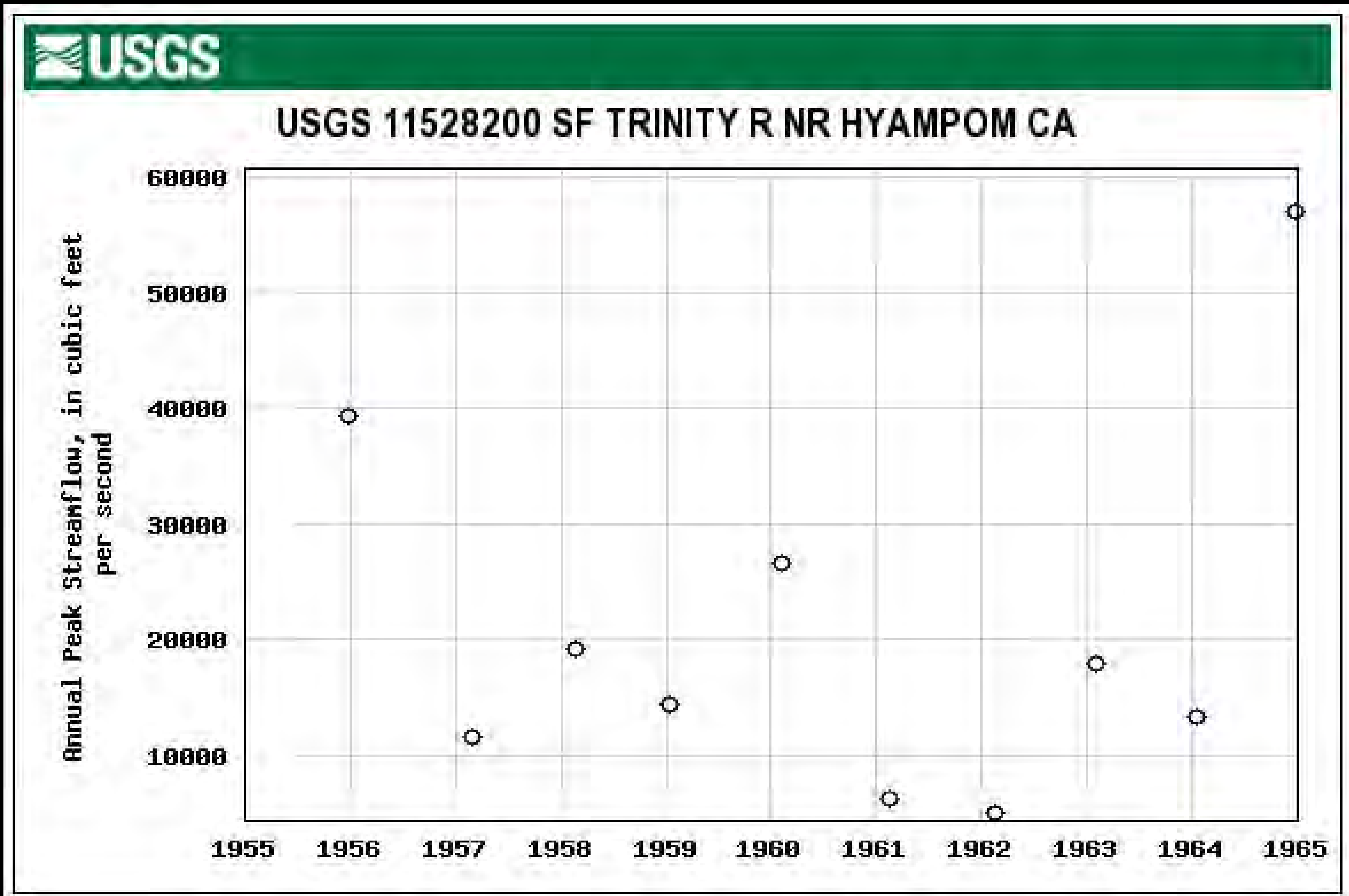
FEBRUARY 1992

Douglas P. Wheeler
Secretary for Resources
The Resources Agency

Pete Wilson
Governor
State of California

David N. Kennedy
Director
Department of Water Resources

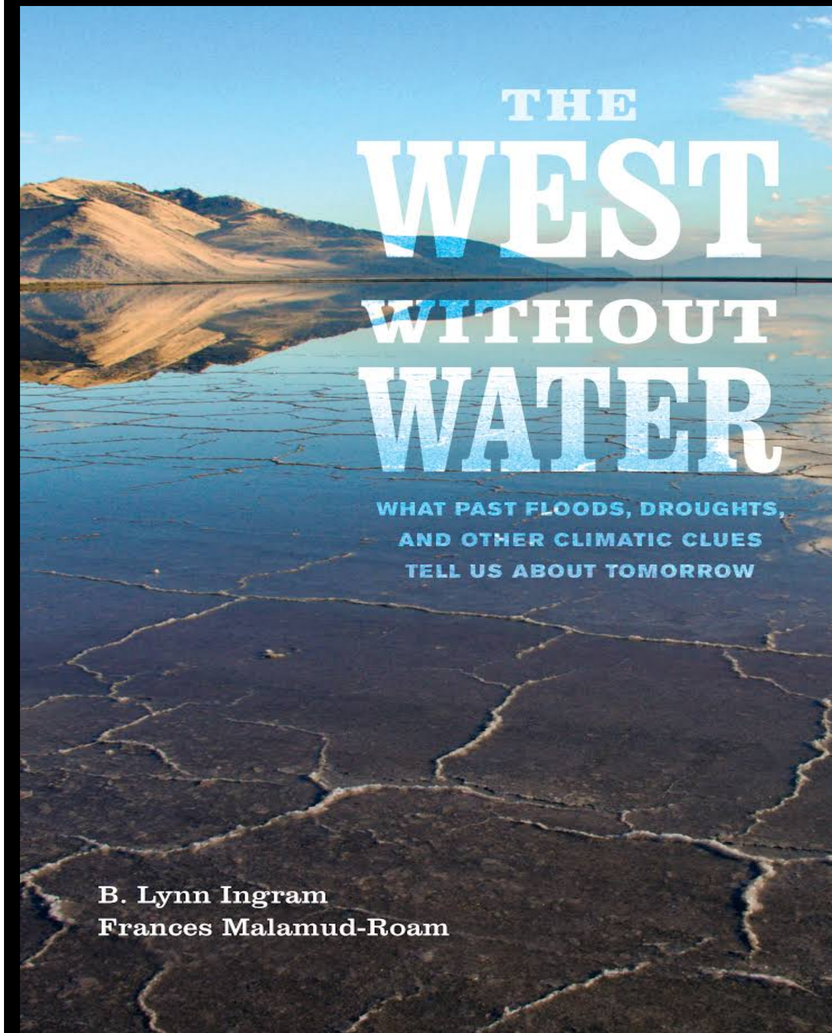
Historical Flows on the South Fork

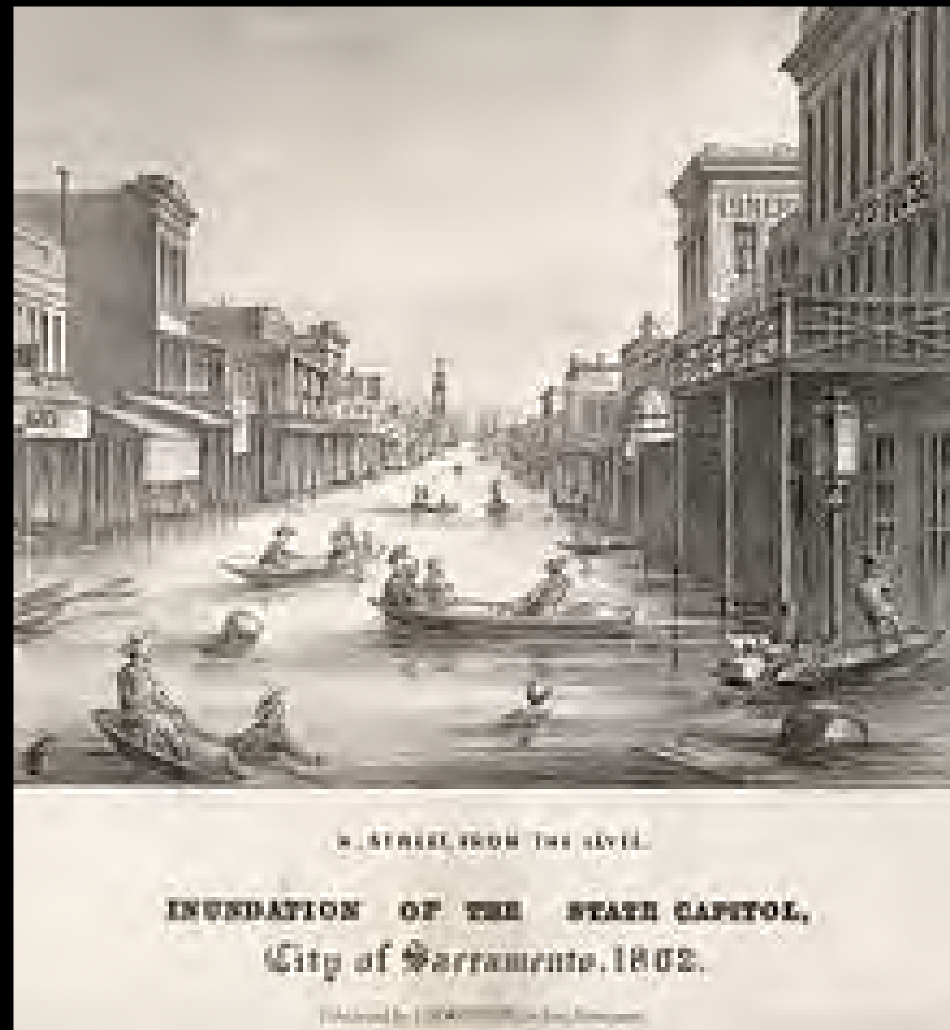


SOUTH FORK FLOWS – JANUARY 2016

SOUTH FORK FLOWS – JANUARY 2016

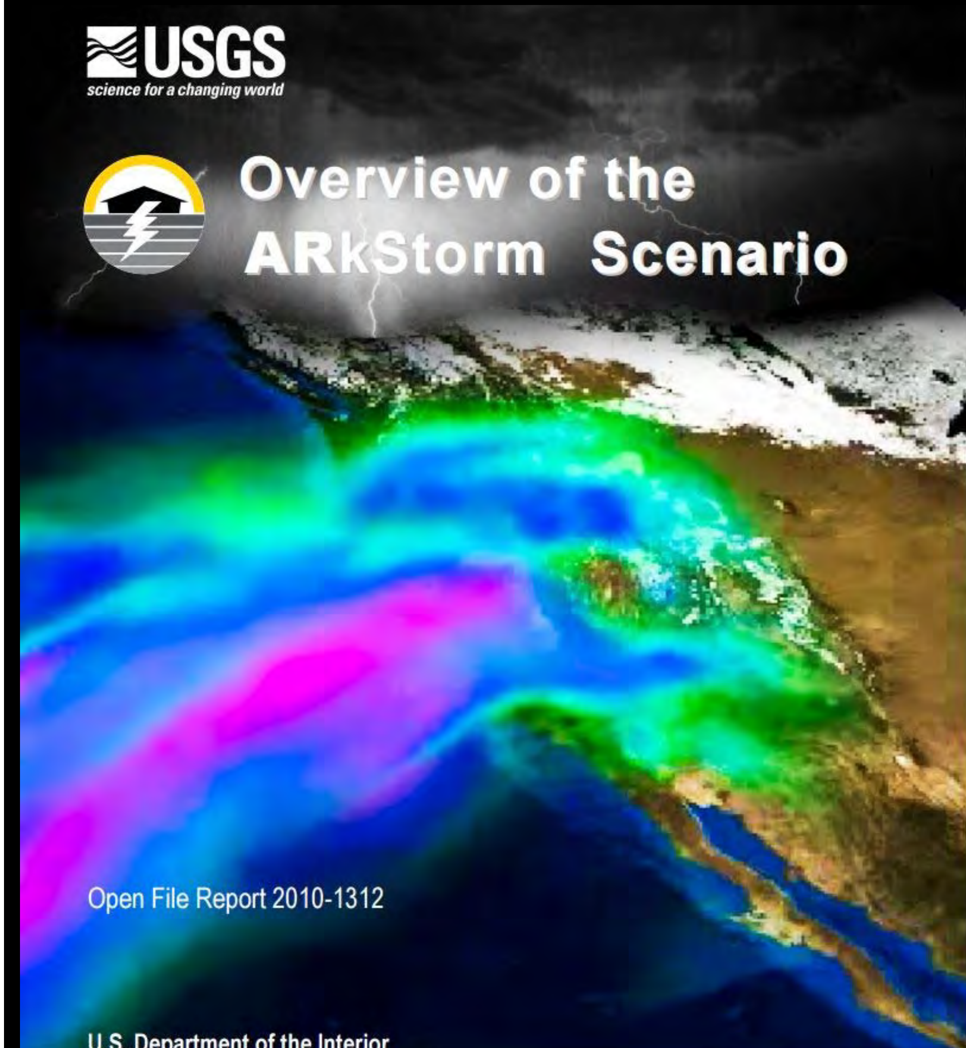
CLUES IN HISTORY – INFORMING US TODAY



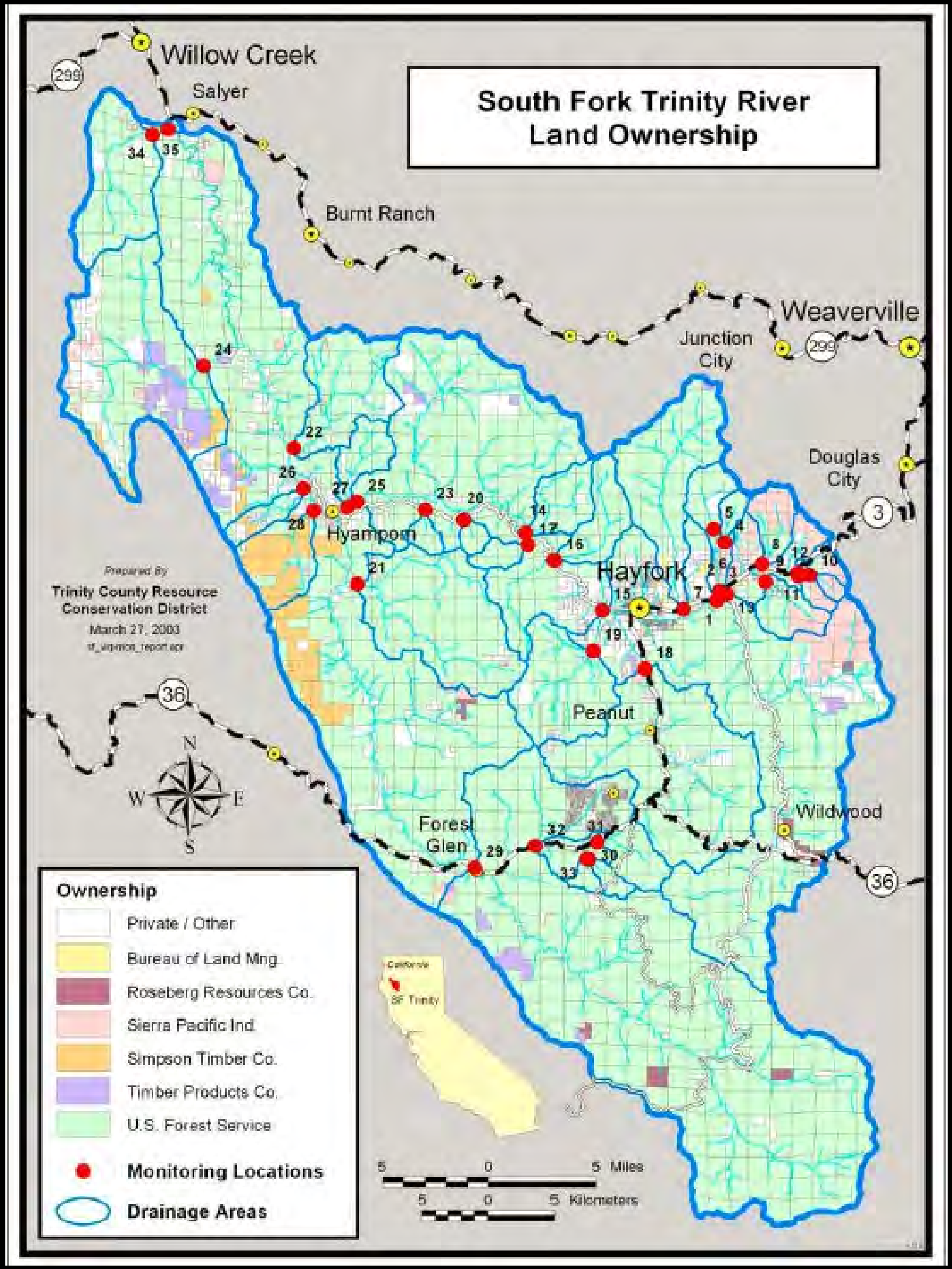


The Great Flood of 1862 was the largest flood in the recorded history of Oregon, Nevada, and California, occurring from December 1861 to January 1862. It was preceded by weeks of continuous rains (or snows in the very high elevations) that began in Oregon in November 1861 and continued into January 1862

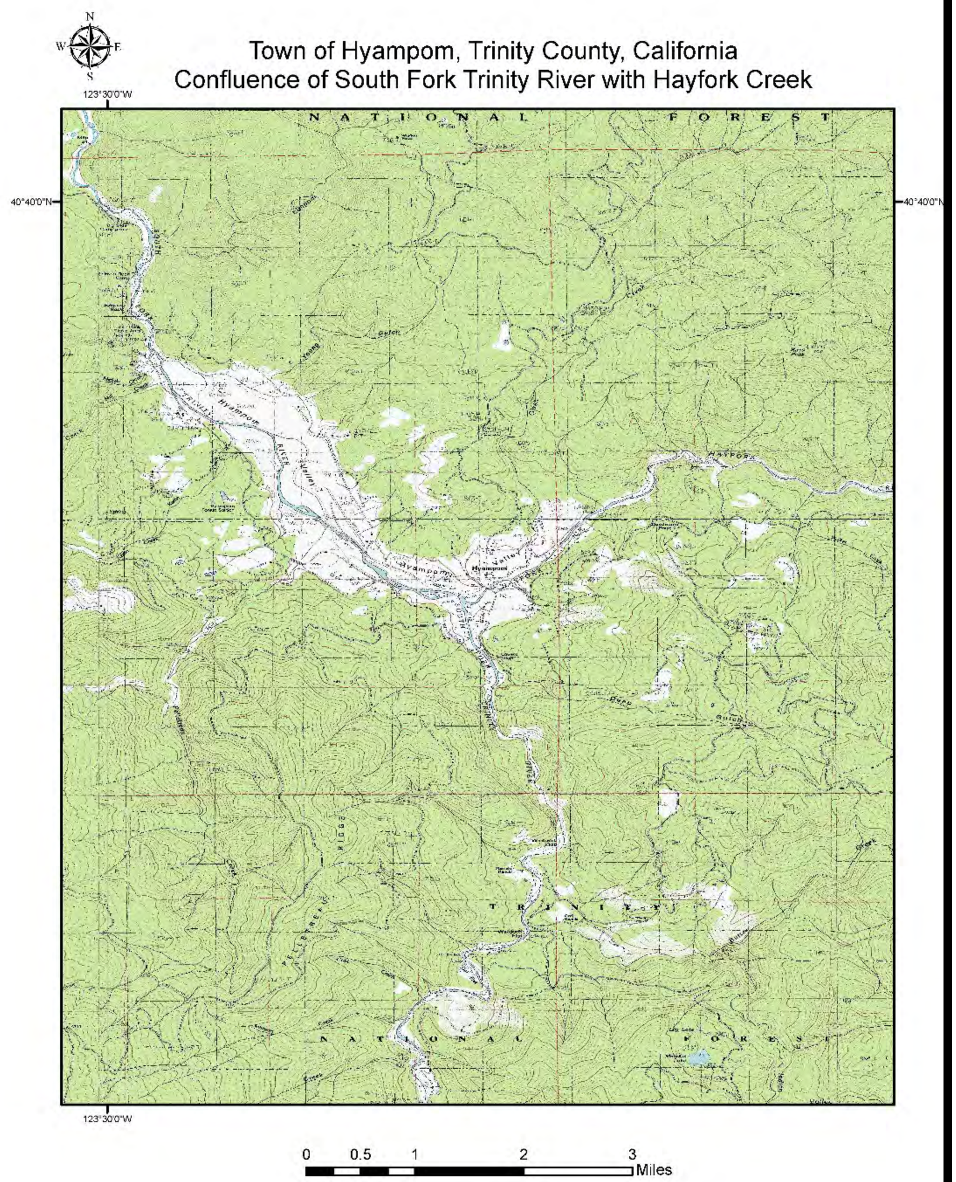
ARKSTORM – ATMOSPHERIC RIVER 1000 STORM



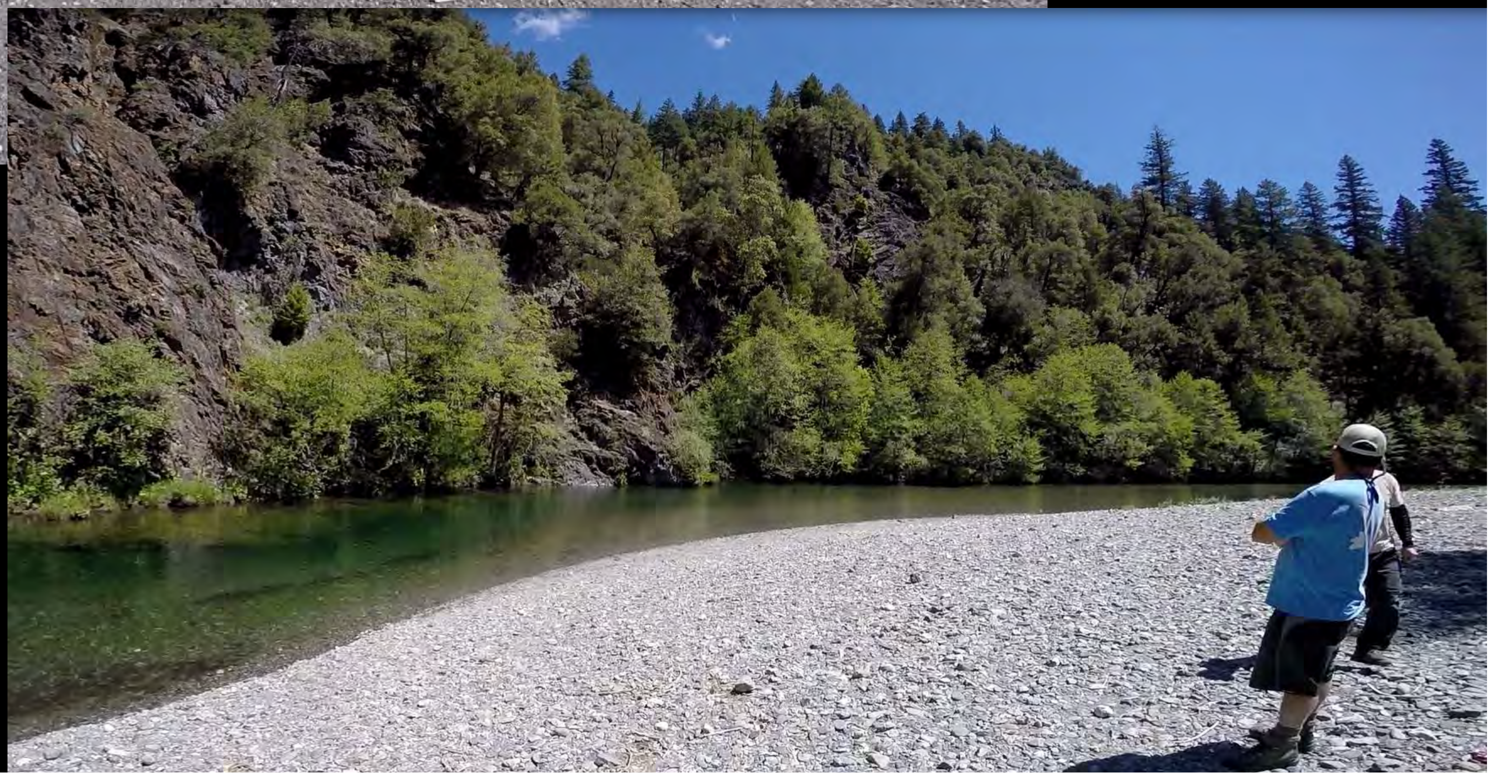
Complex Logistics – What are the Constraints and Challenges



COMPLEX LOGISTICS – WHAT ARE THE CONSTRAINTS AND CHALLENGES



Complex Logistics – What are the Constraints and Challenges



TRAIL AND ERROR – LEARNING BY DOING APPROACH

"If we worked on the assumption that what is accepted as true really is true, then there would be little hope for advance" - Orville Wright

"Isn't it astonishing that all these secrets have been preserved for so many years just so we could discover them!" - Orville Wright

The Wright brothers, Orville (August 19, 1871 – January 30, 1948) and Wilbur (April 16, 1867 – May 30, 1912), were two American brothers, inventors, and aviation pioneers who are credited with inventing and building the world's first successful airplane and making the first controlled, powered and sustained heavier-than-air human flight, on December 17, 1903.

THE APPROACH - AGGRESSIVE TECHNIQUES FOR IN-RIVER RESTORATION

Tecta Creek – Tributary to the Klamath
Photos Courtesy of Rocco Fiori

THE APPROACH - AGGRESSIVE TECHNIQUES FOR IN-RIVER RESTORATION

Photos of Tucannon River, WA

THE APPROACH - AGGRESSIVE TECHNIQUES FOR IN-RIVER RESTORATION

Photos of The Klamath -Hunter Cr.
And Trinity River

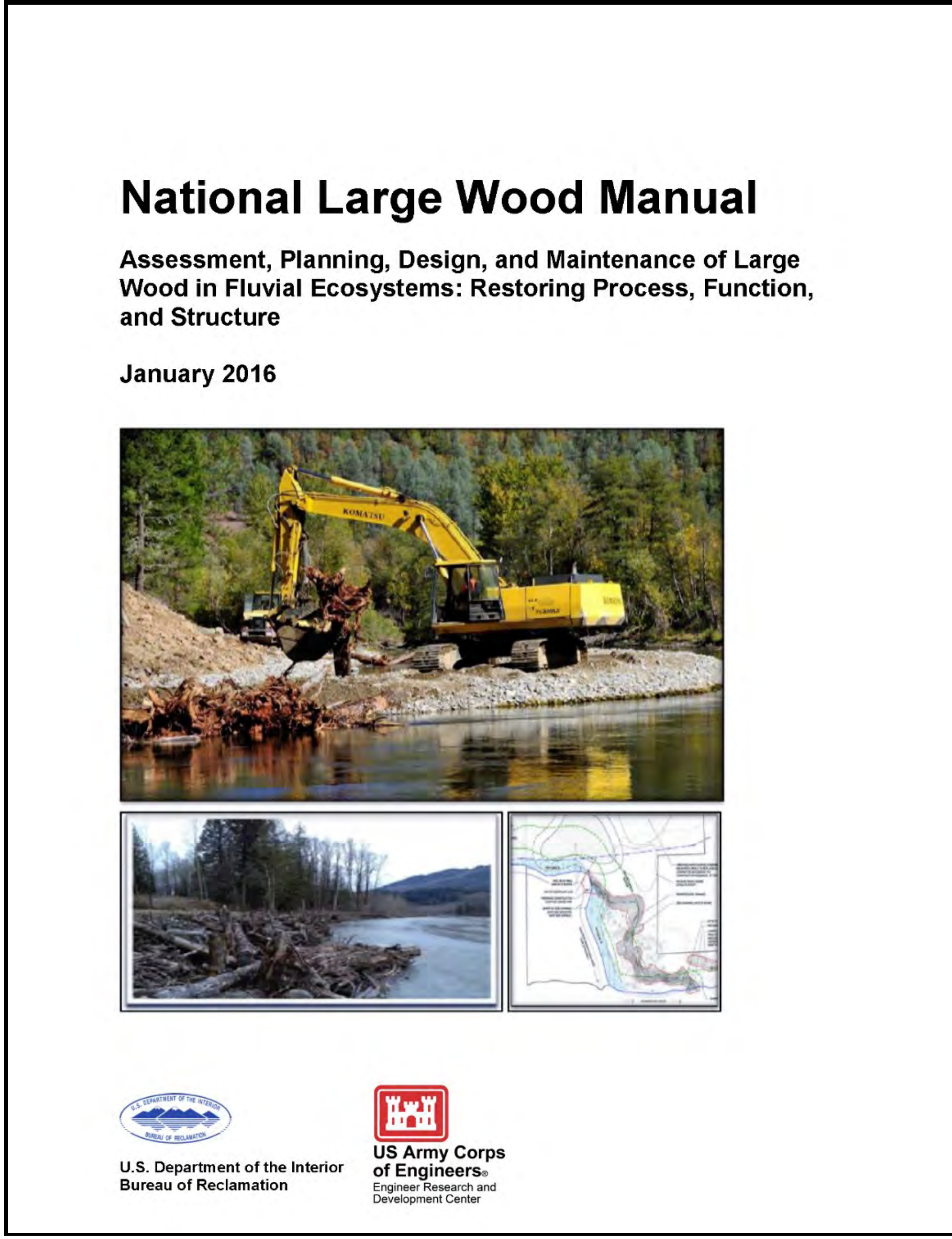
THE APPROACH - AGGRESSIVE TECHNIQUES FOR IN-RIVER RESTORATION

Photos of The Elwha River – Post Dam Removal 2015

THE APPROACH - AGGRESSIVE TECHNIQUES FOR IN-RIVER RESTORATION

Photos of Courtesy of Brian Bair, LLC
Near Welches OR (Sandy River, and
Tributary to the Sandy)

NATIONAL LARGE WOOD MANUAL – DESIGN GUIDANCE


National Large Wood Manual

Assessment, Planning, Design, and Maintenance of Large Wood in Fluvial Ecosystems: Restoring Process, Function, and Structure

January 2016

U.S. Department of the Interior
Bureau of Reclamation

US Army Corps of Engineers®
Engineer Research and Development Center

Chapter 1. Large Wood Introduction

Chapter 2. Large Wood and the Fluvial Ecosystem Restoration Process

Chapter 3. Ecological and Biological Considerations

Chapter 4. Geomorphology and Hydrology Considerations

Chapter 5. Watershed-Scale and Long-Term Considerations

Chapter 6. Engineering Considerations

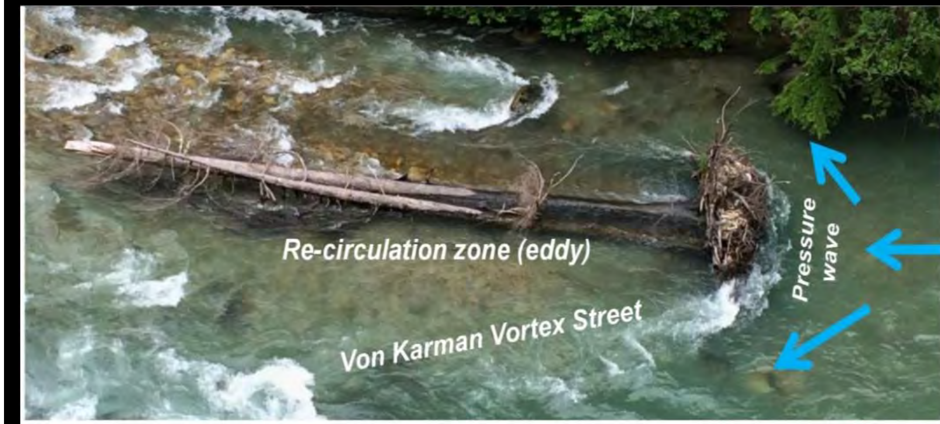
Chapter 7. Risk Considerations

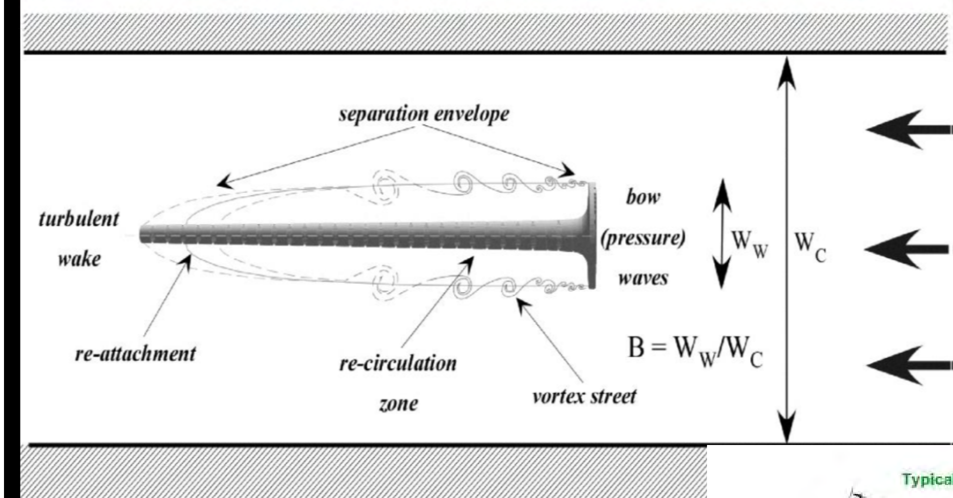
Chapter 8. Regulatory Compliance, Public Involvement, and Implementation

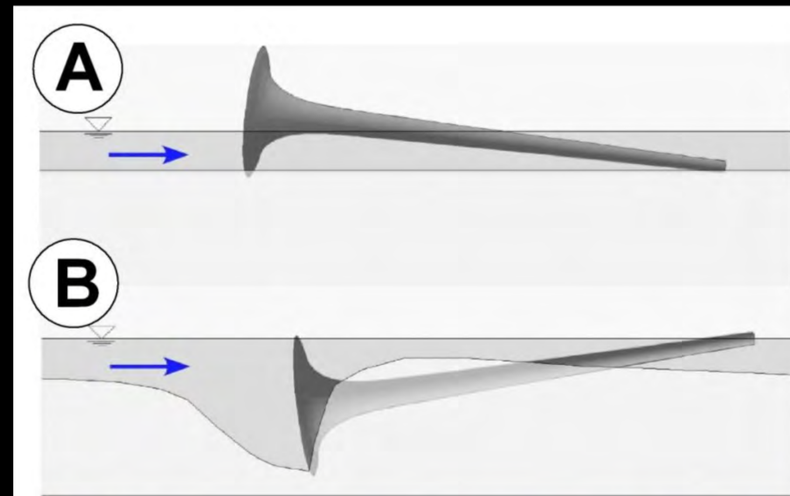
Chapter 9. Assessing Ecological Performance

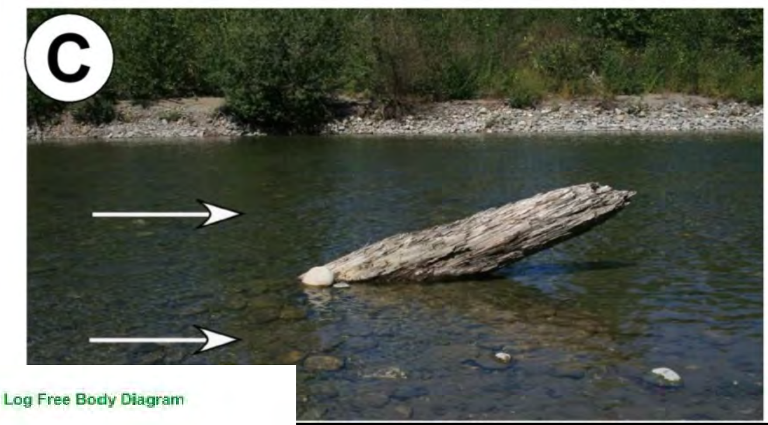
Chapter 10. Large Wood Bibliography

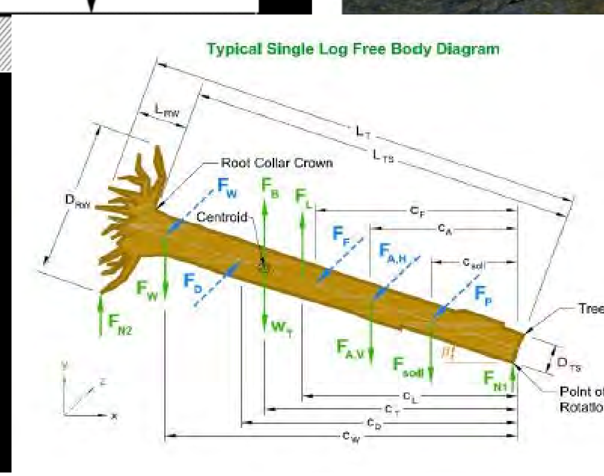
PENCIL TO PAPER – PLANNING, ANALYSIS, AND DESIGN PHASE



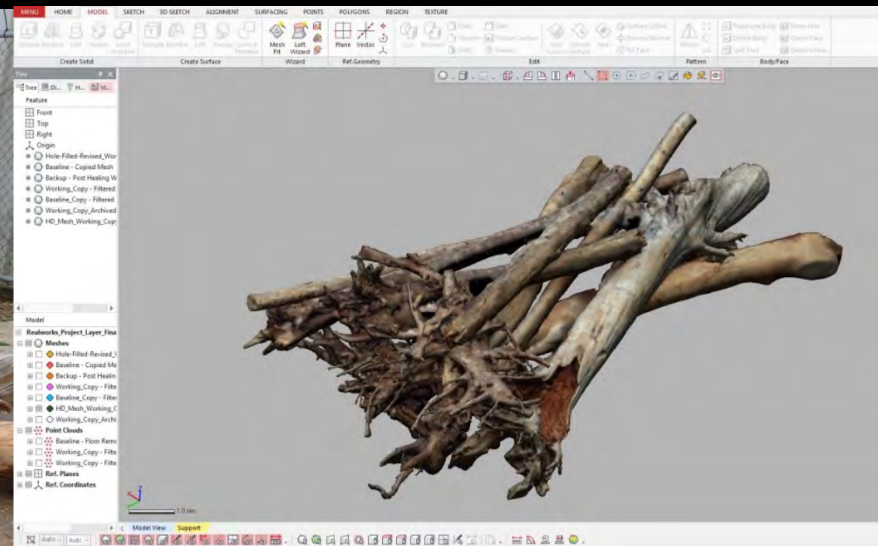








Modeling the Natural Environment - Replication Prototyping and Reverse Engineering Complex Geometries to Help Understand Natural Systems



Comparing Numerical Models to Laboratory Flume Based Evaluation

DESIGNING/BUILDING – FASTER – CHEAPER – BETTER
THINKING OUTSIDE THE BOX

"Failure is simply the opportunity to begin again, this time more intelligently."

"Obstacles are those frightful things you see when you take your eyes off your goal." - Henry Ford

Henry Ford (July 30, 1863 – April 7, 1947) was an American industrialist, the founder of the Ford Motor Company, and the sponsor of the development of the assembly line technique of mass production.

MODELING RIVERS USING STRUCTURE FOR MOTION (SFM)
JARVERNICK – GEOMORPHOLOGY 2014


Geomorphology xxx (2014) xxx–xxx

Contents lists available at ScienceDirect

Geomorphology

journal homepage: www.elsevier.com/locate/geomorph

Modeling the topography of shallow braided rivers using Structure-from-Motion photogrammetry

L. Javernick [a,*], J. Brasington [b], B. Caruso [a]

[a] Department of Civil and Natural Resources Engineering, University of Canterbury, Private Bag 4800, Christchurch 8140, New Zealand
[b] School of Geography, Queen Mary University of London, London E1 4NS, United Kingdom

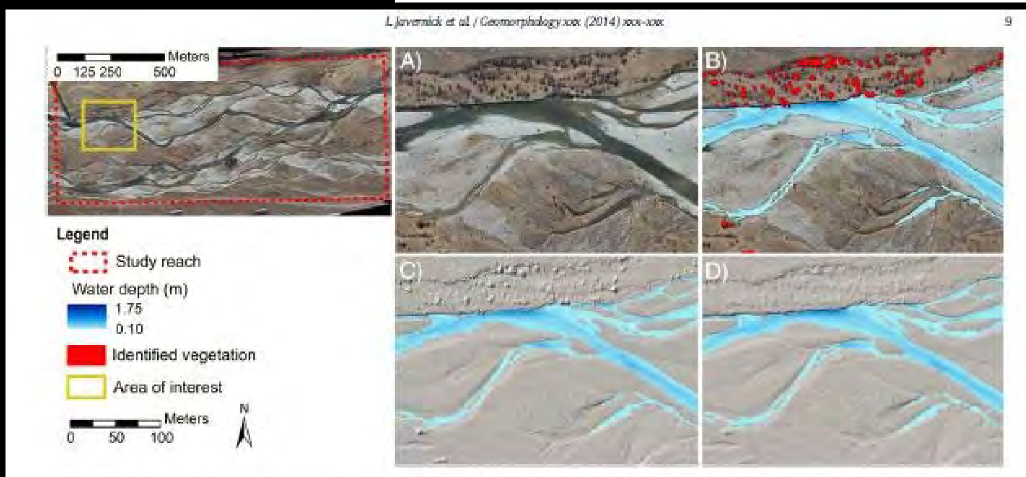
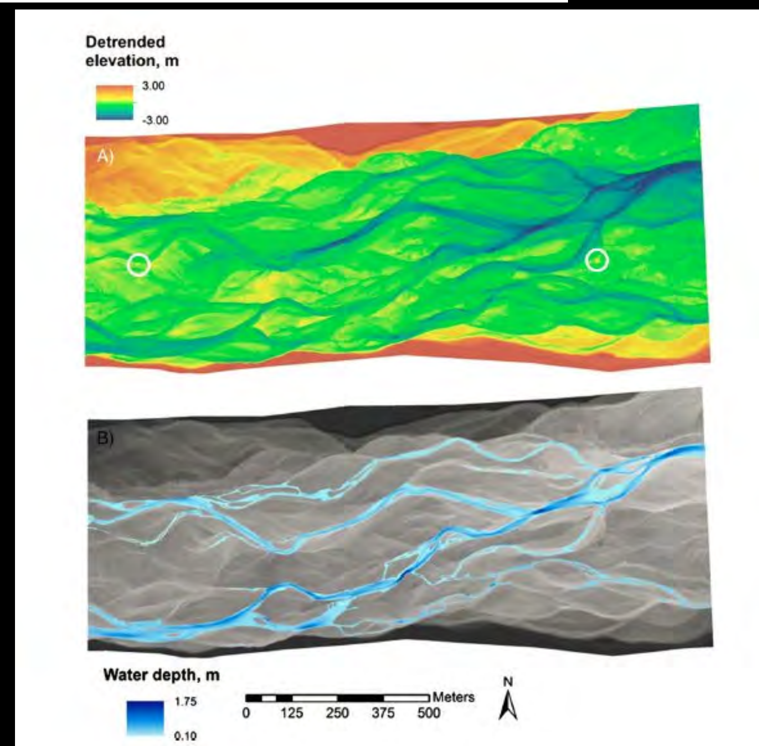


Fig. 6. ToPCAT vegetation noise reduction. A) example area, B) vegetation identified using ≥0.4 m threshold, C) topographic detail of SfM + ToPCAT raster, and D) topographic detail of SfM-Veg raster.



Pencil to Paper – Planning, Analysis, and Design Phase

1. Flight
    a. Airplane = Cessna
    b. Speed = 92 MPH (80 Knots)
    c. Elevation = 2500 feet
    d. Photos Interval = 1 second /175 feet along flight path
    e. 75% Overlap
    f. Total images = ~10,000 at Fine Resolution (15 MB)

Equipment:

2. Nikon D3200 24MP camera
    a. Lens, 35mm G DX
    b. Remote intervalometer, on/off control on the go
    c. Wifi connection for image review and refine settings
    d. 7” tablet for image review and navigation
    e. External power supply for camera (no image limit)
    f. 64GB memory card (capacity + 4000 images)

Settings:

1) Lenses:
    a) 2 stops down from wide open (for maximum sharpness at maximum light gathering)
        i) f 4 for the 35mm G DX
    b) No filters, no additional image distortion
2) Shutter speed:
    a) 1/1000 sec
    b) ISO (sensitivity) set to automatic

PENCIL TO PAPER – PLANNING, ANALYSIS, AND DESIGN PHASE

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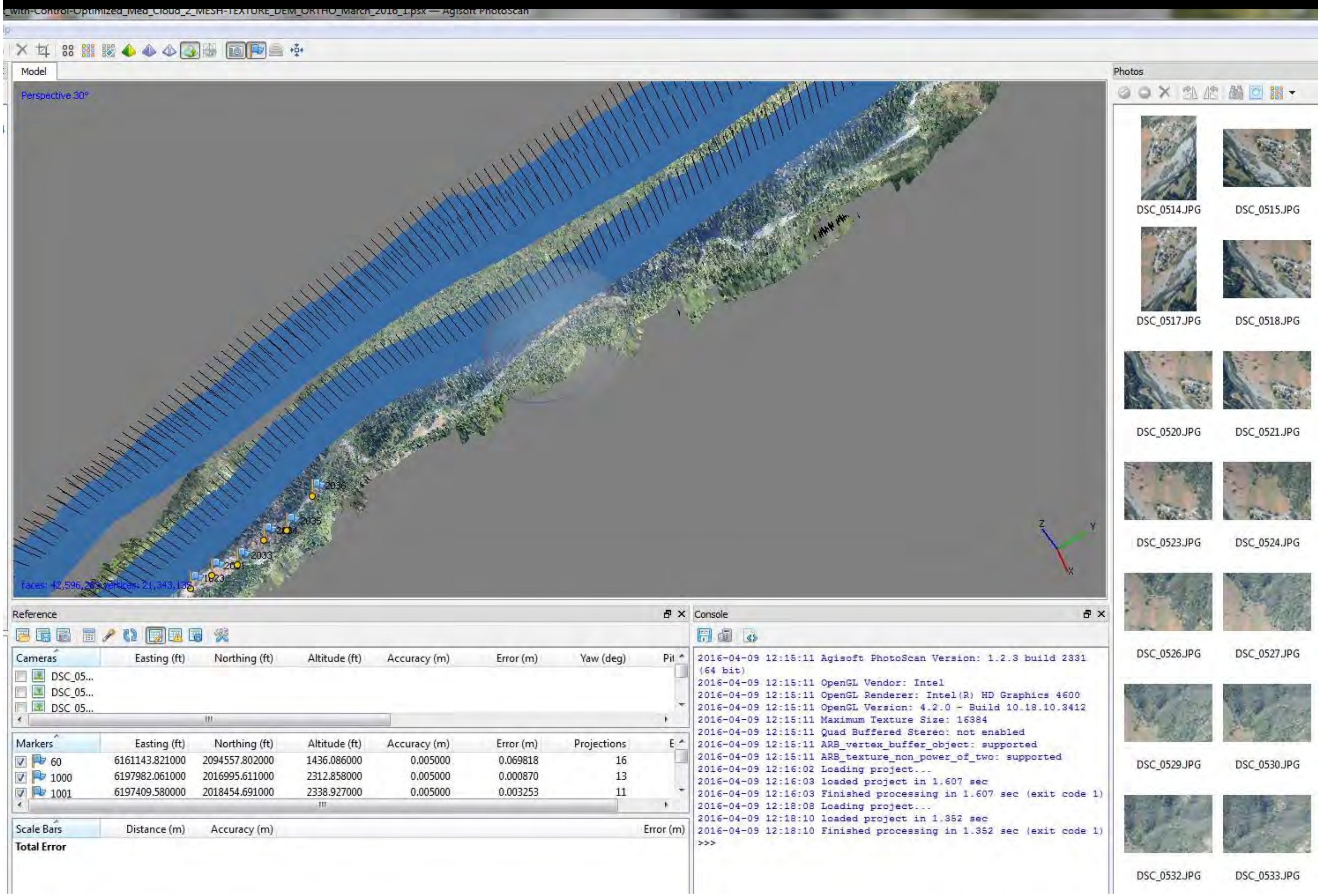
PENCIL TO PAPER – PLANNING, ANALYSIS, AND DESIGN PHASE



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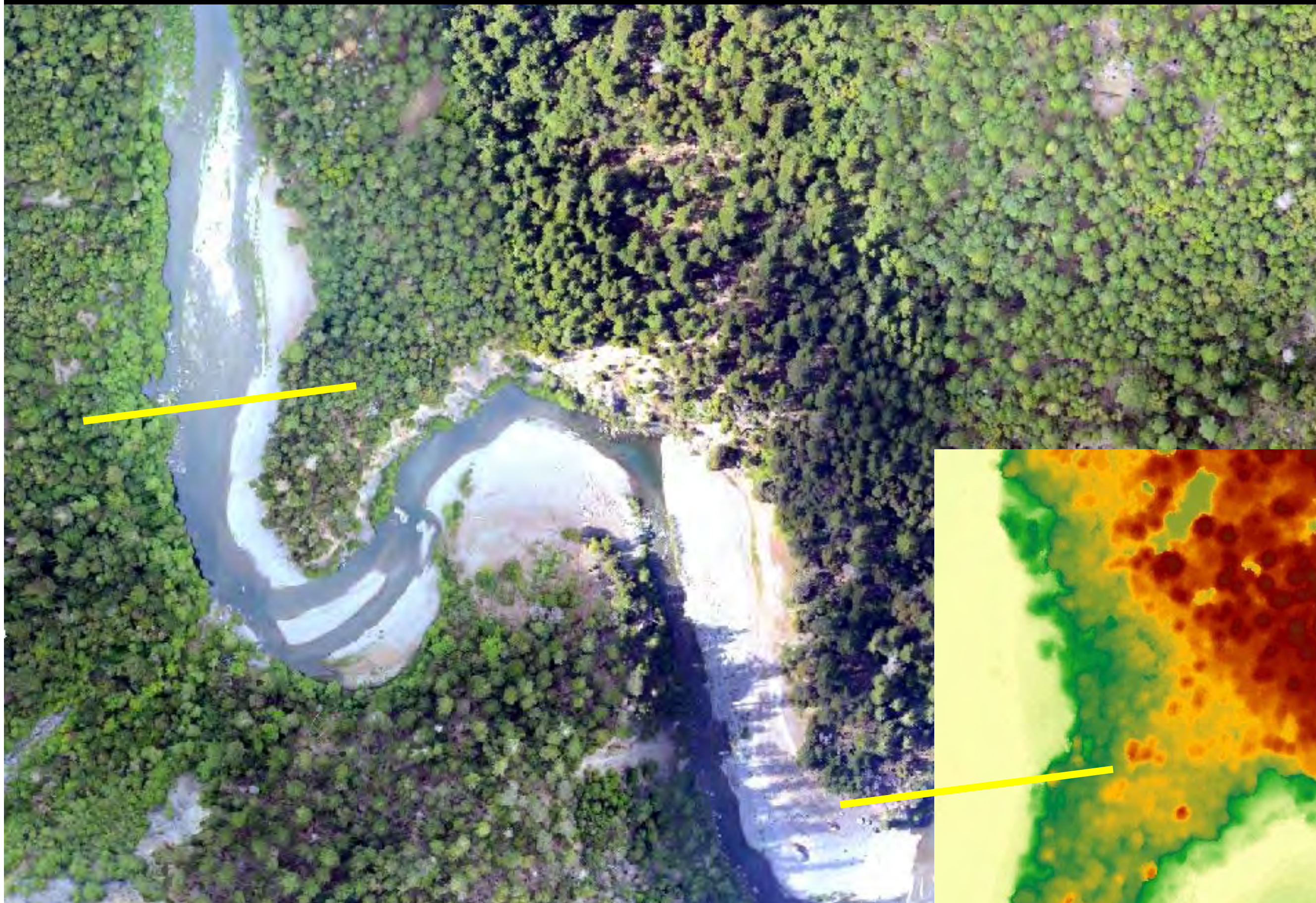
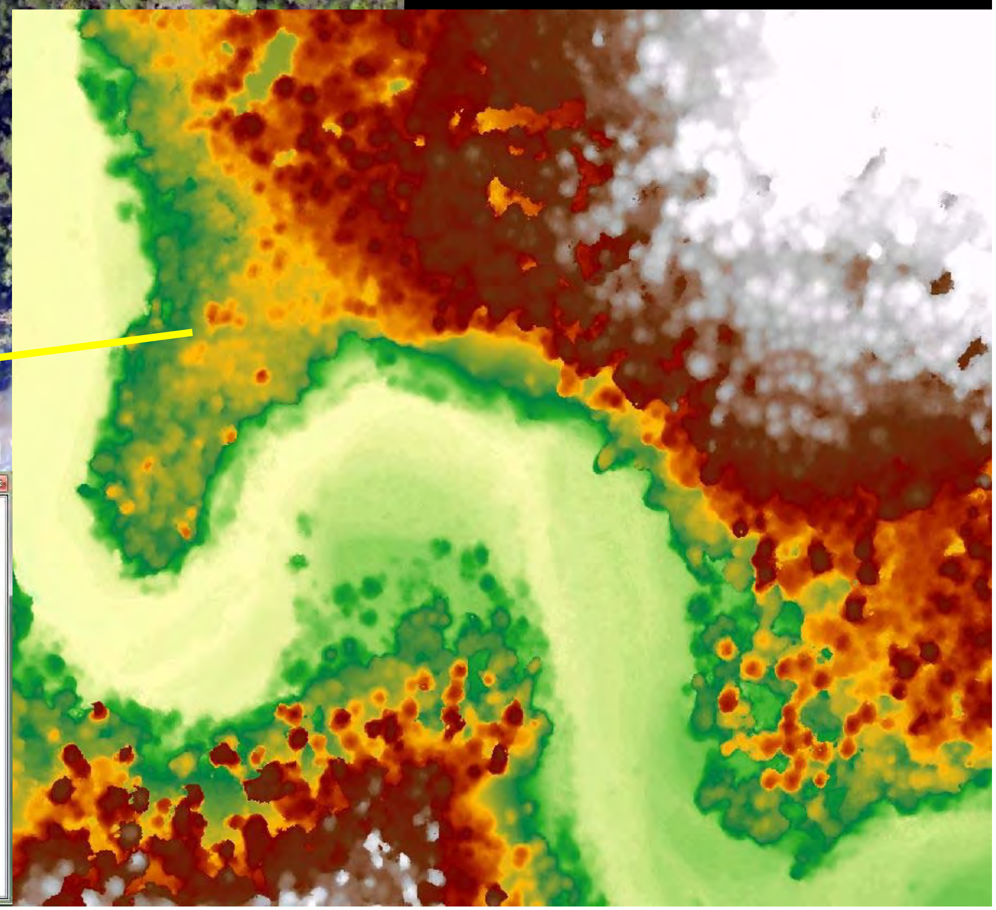
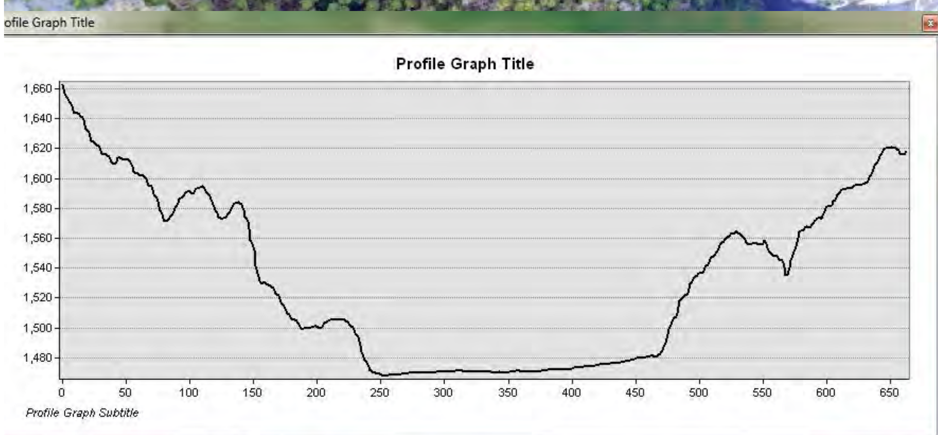
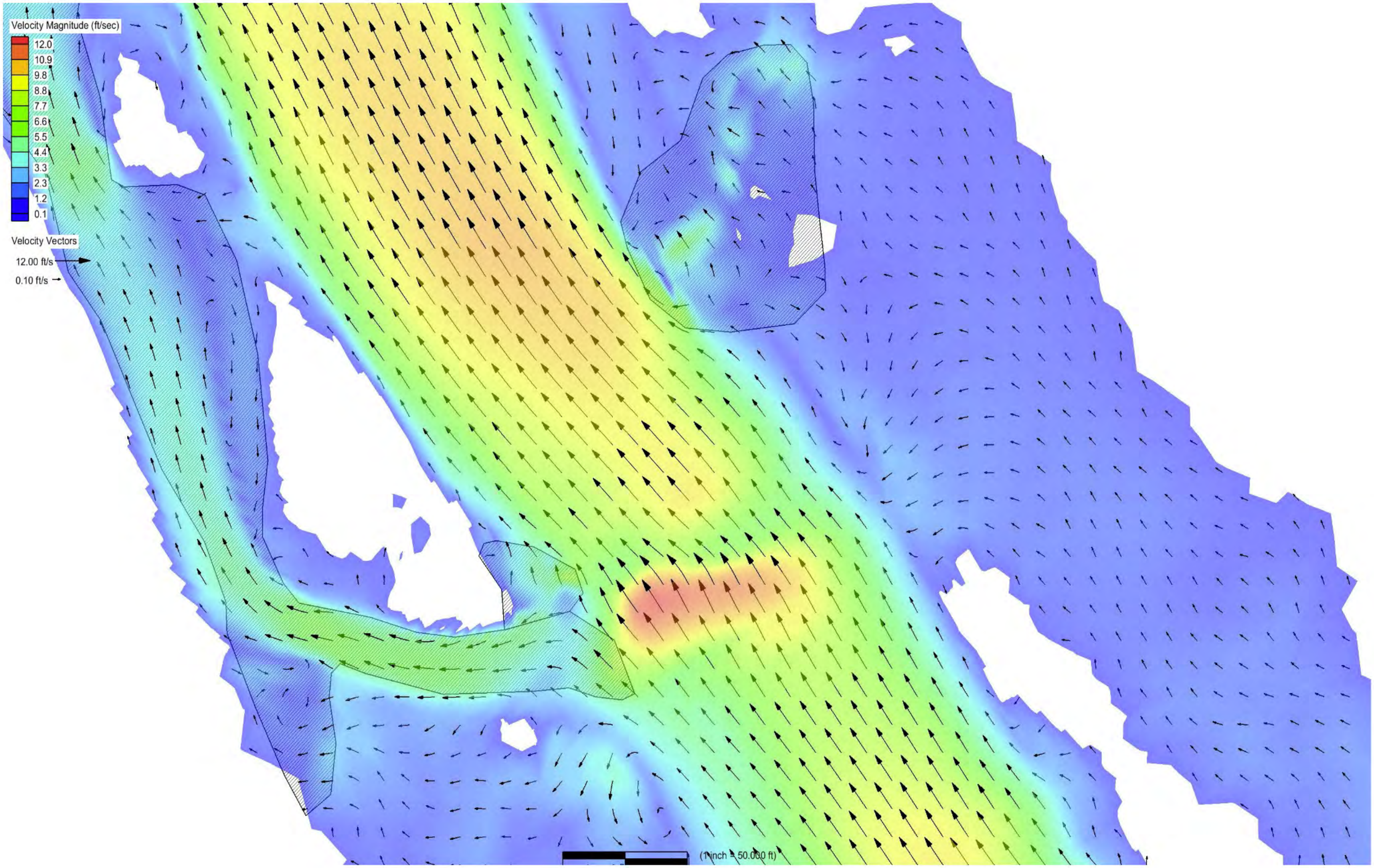


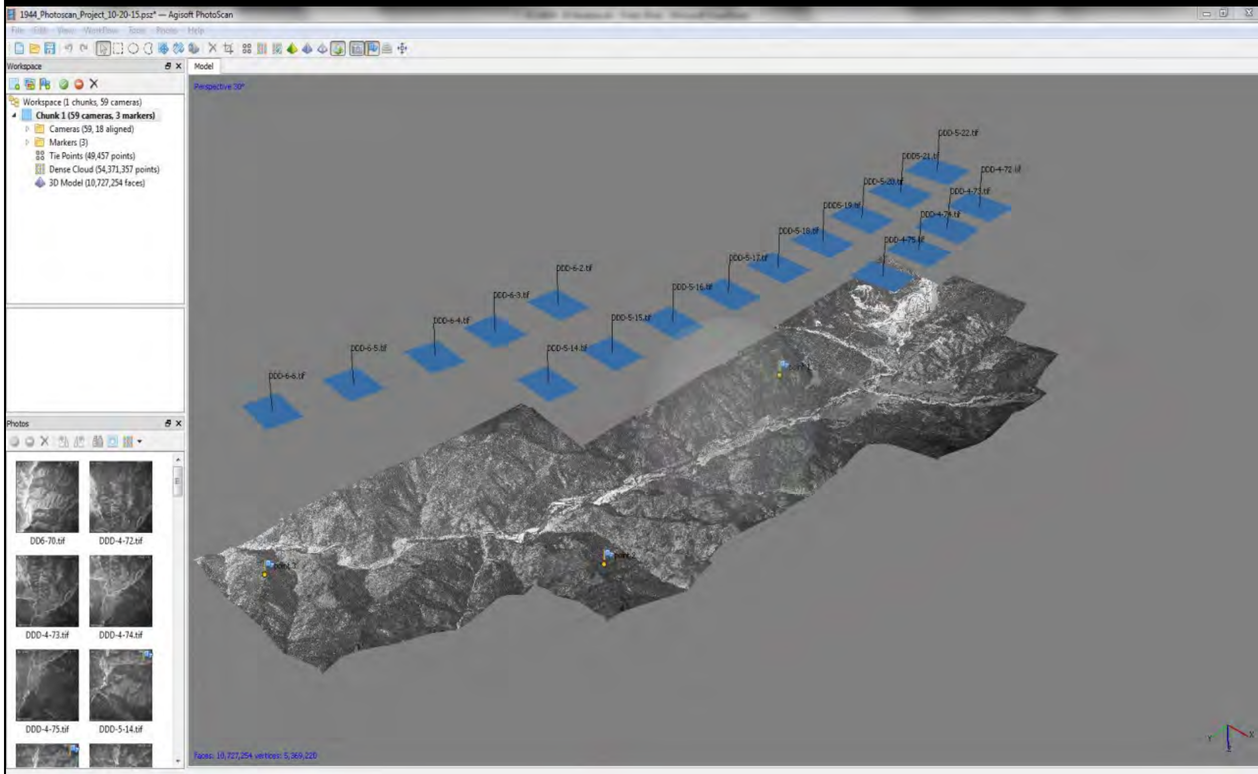


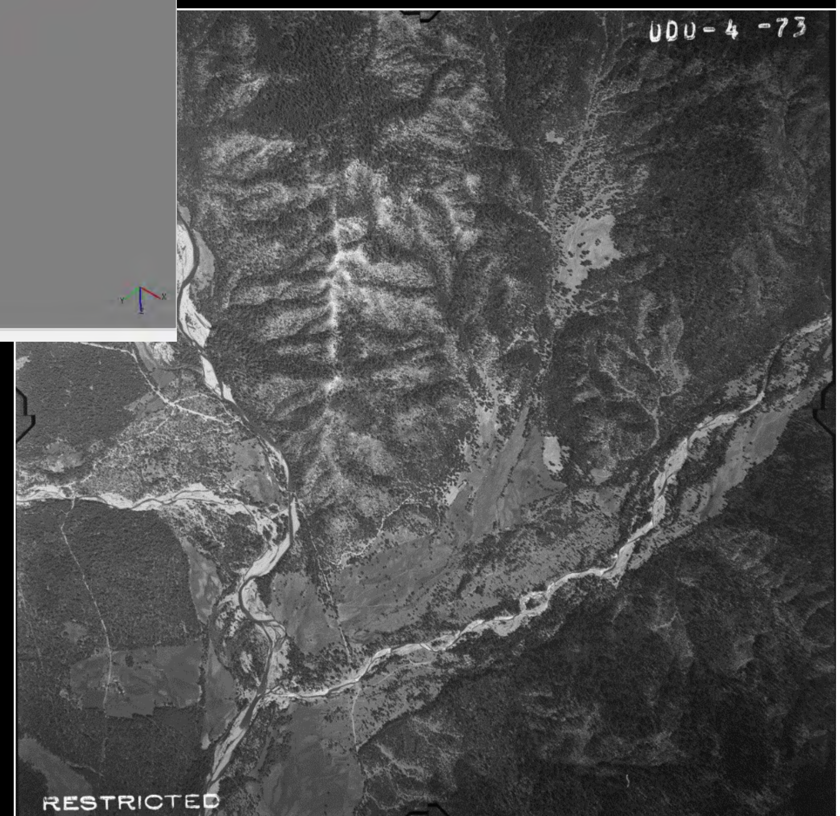


PENCIL TO PAPER – PLANNING, ANALYSIS, AND DESIGN PHASE

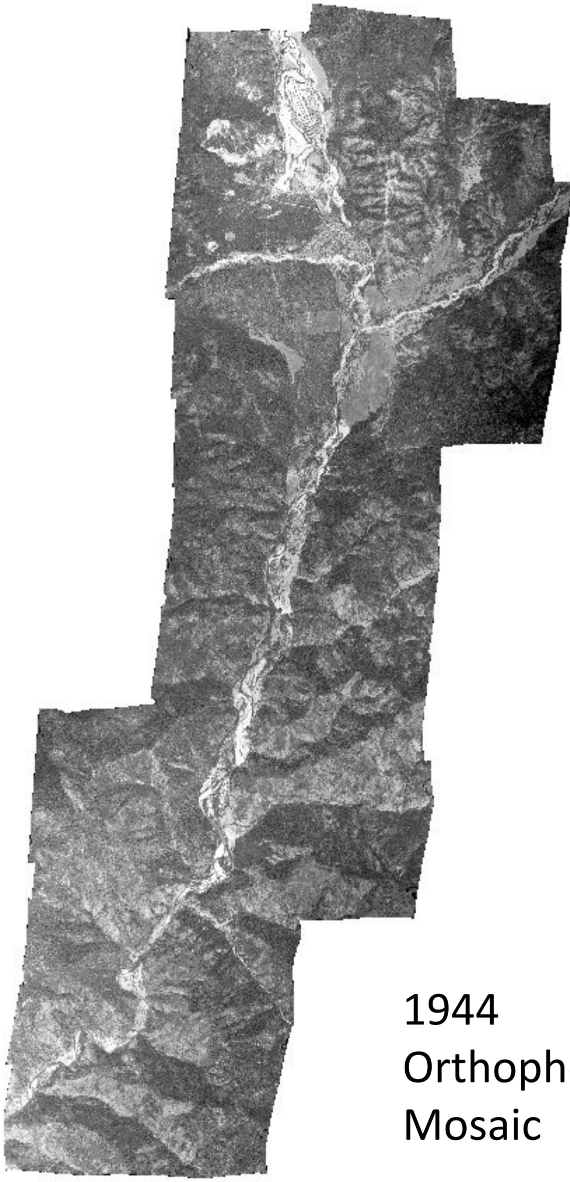


USING HISTORICAL AERIAL IMAGERY FOR GEOMORPHIC COMPARISON

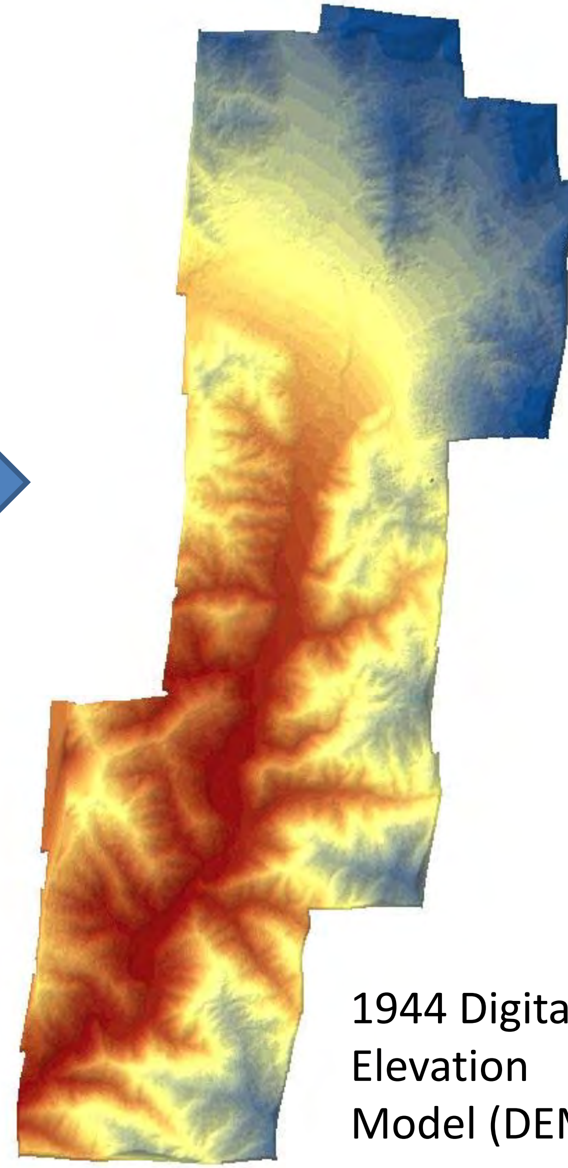




HARNESSING SFM AND PHOTOGRAMMETRY TO MODEL THE PAST

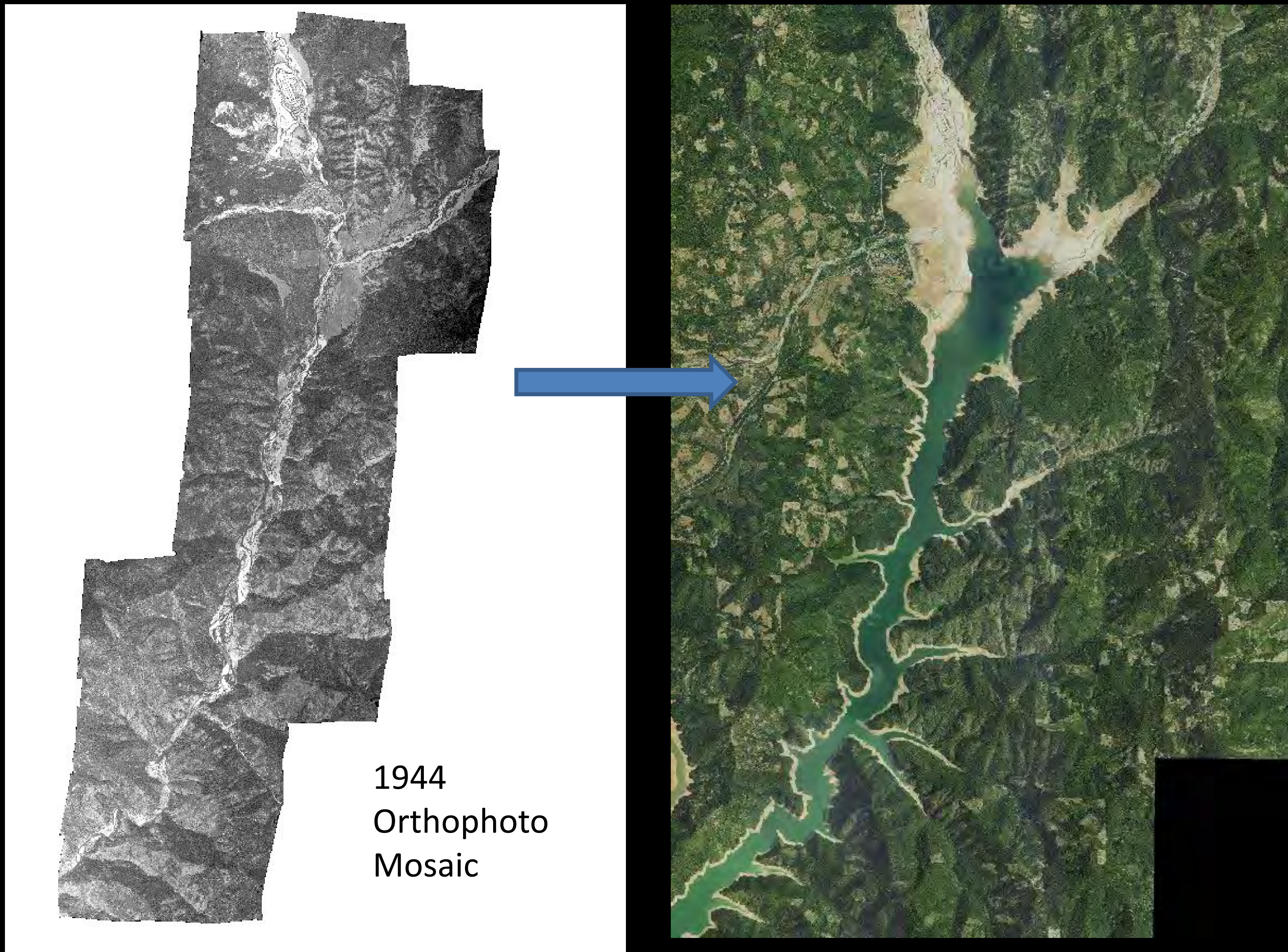


1944 Orthophoto Mosaic



1944 Digital Elevation Model (DEM)

Comparing the Past and Present – Evolution Modeling



PHYSICAL AND BIOLOGICAL MONITORING

Future Vision – Embracing Uncertainty and Moving Forward

Theodore Judah (March 4, 1826 – November 2, 1863) was an American railroad and civil engineer who was a central figure in the original promotion, establishment, and design of the first Transcontinental Railroad. He found investors for what became the Central Pacific Railroad (CPRR). As chief engineer, he performed much of the land survey work to determine the best route for the railroad over the Sierra Nevada mountains.

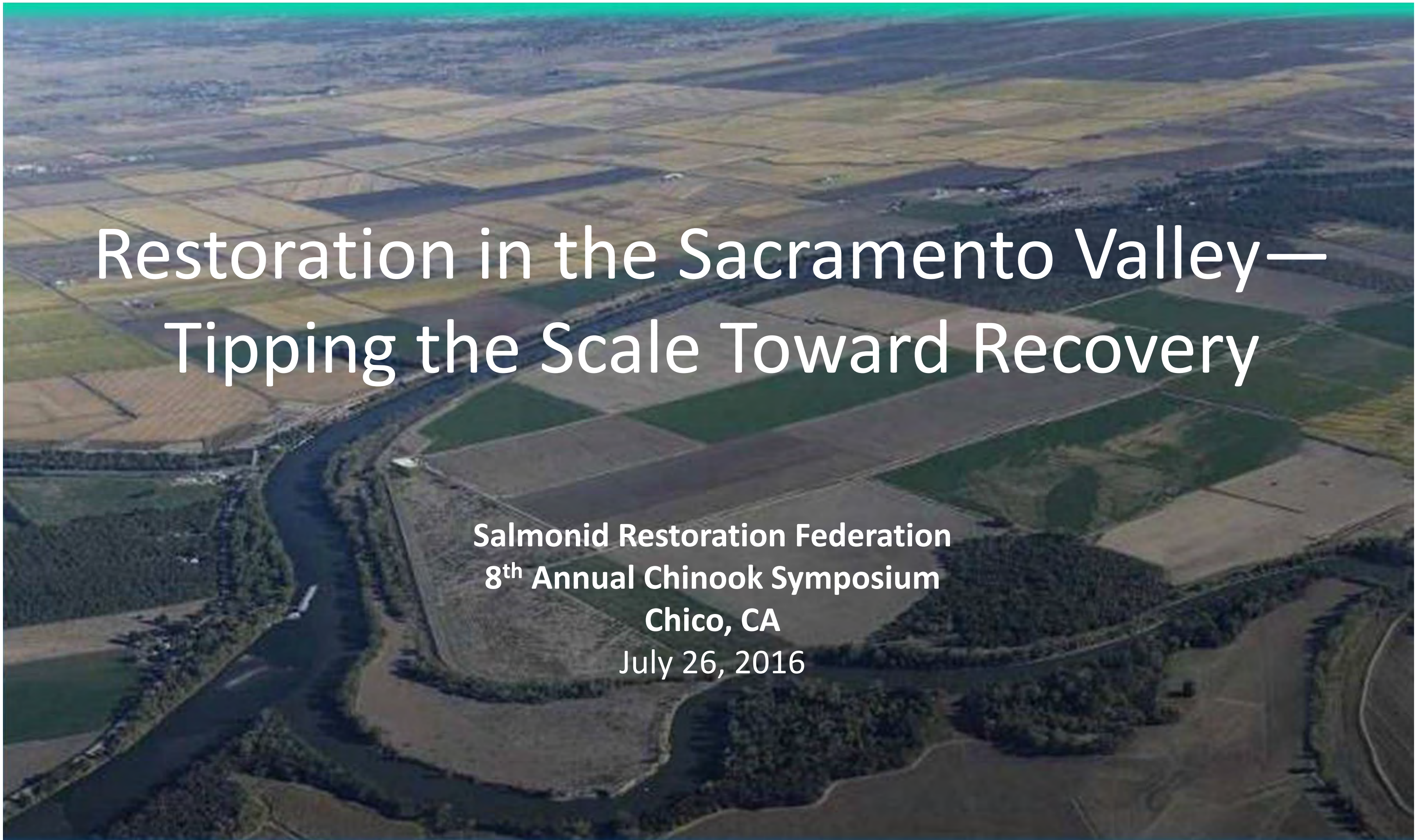
Future Vision – Embracing Uncertainty and Moving Forward

Tell me and I'll forget. Show me, and I may not remember. Involve me, and I'll understand.

- Native American Saying -

DJ Bandrowski P.E., Project Engineer
djbandrowski@yuroktribe.nsn.us
906-225-9137



Restoration in the Sacramento Valley—Tipping the Scale Toward Recovery

Salmonid Restoration Federation
8th Annual Chinook Symposium
Chico, CA
July 26, 2016

Eric M. Ginney eginney@esassoc.com

Environmental Science Associates (ESA)

Context

- The efforts of everyone here today are important.
- Katz et al: **levees and drainage starve salmon**, robbing the river ecosystem of the very basis of its foodweb. Nigiri concepts offer a reconciled approach to gaining desirable fish growth.
- Only 5% of the Central Valley's floodplains left connected to rivers
- Central Valley levee system is documented as being inadequate of providing public safety and protecting assets, let alone of providing adequate habitat to recover and sustain endangered populations of salmonids.
- Investment in flood system estimated to best meet California's needs is approximately $20 billion in the next 20 years and is ultimately more than $100 billion.
- The recent 2014 Water Bond (Proposition 1) was just $7.5 billion.

- **Where and how can we adapt our limited investment in restoration and flood infrastructure to yield a resilient system that provides public safety as well as the important hydrogeomorphic processes needed to sustain abundant fish and wildlife populations?**
- **If those investments cannot be made at this time, where and how can we identify opportunities to provide surrogate habitats (e.g., managed winter flooding for fish and waterbirds) that mimic these important natural processes?**

Presentation Overview

1. Welcome to the Land of the Spring-run
2. Physical and ecological processes that occur when Central Valley rivers flood.
3. Pre-Euro-American configuration of floodplains and flood basins
4. Restoration Targets
5. Menu of flood system modifications (incl. projects)
6. A vision for integrated stewardship

Welcome…to the Land of the

- Living in Chico since 1991
- Paul Ward, Allen Harthorn, Nat Bingham, Mitch Farro, Ron Yoshiyama, Mike Kossow – Spring Run Workgroup
- CalFed sponsored work on Butte Cr & other Spring-run tribs
- *But it's not all about the upper watersheds*
- Maslin et al – non-natal rearing of juvenile salmonids…
- Sommer et al – Yolo Bypass research…

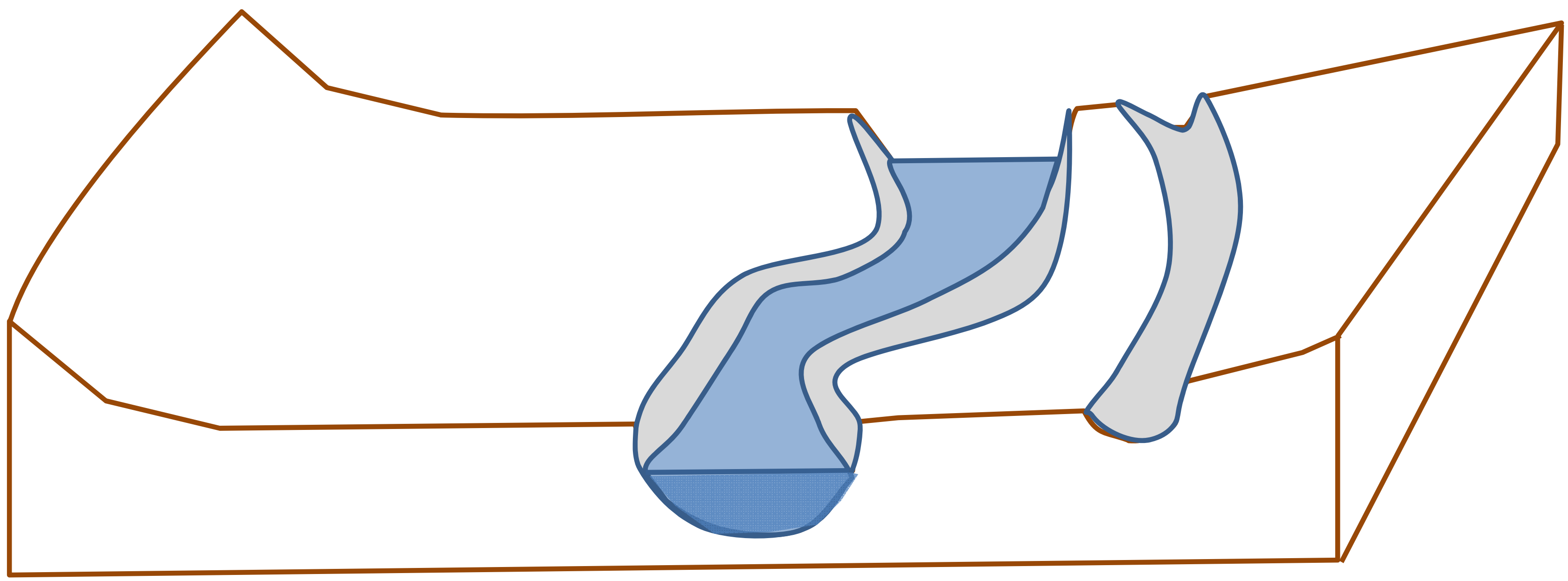
2. Physical and Ecological Processes of Floodplain Inundation

"[R]estoring even small floodplain systems demonstrably benefits a variety of fishes, especially native fishes such as Chinook salmon and splittail. The natives are clearly adapted for the seasonal pattern of flooding (Sommer *et al.* 2004). They move onto the floodplain as soon as it floods and mostly leave with the receding waters, avoiding being stranded except where artificial structures and ponds prevent it (Sommer *et al.* 2005)."

From: Moyle, Peter B., Patrick K. Crain, and Keith Whitener. Patterns in the Use of a Restored California Floodplain by Native and Alien Fishes. San Francisco and Estuary Watershed Science. Volume 5, Issue 3 [July 2007]. Article 1. http://repositories.cdlib.org/jmie/sfews/vol5/iss3/art1

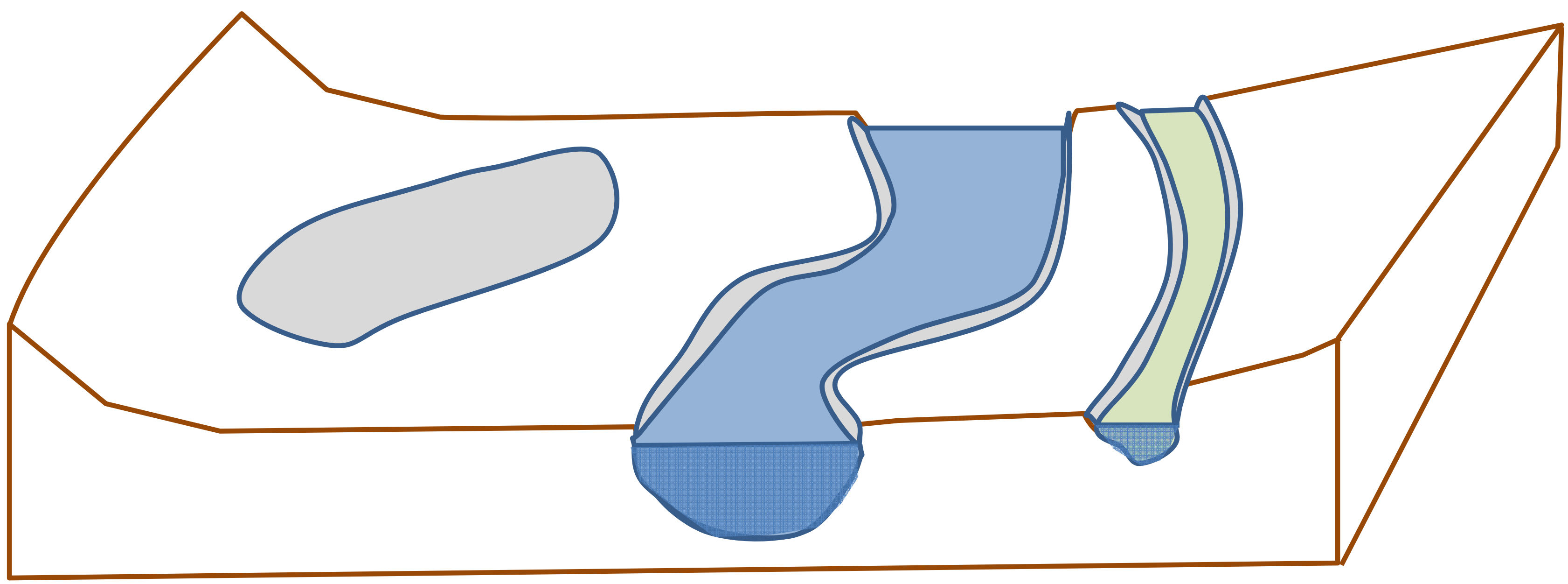
Case 1: Channel flow

- Exposure to light in the water column is **low**
- Phytoplankton densities (and those of higher trophic levels: zooplankton, benthic invertebrates, macroinvertebrates) are **low**



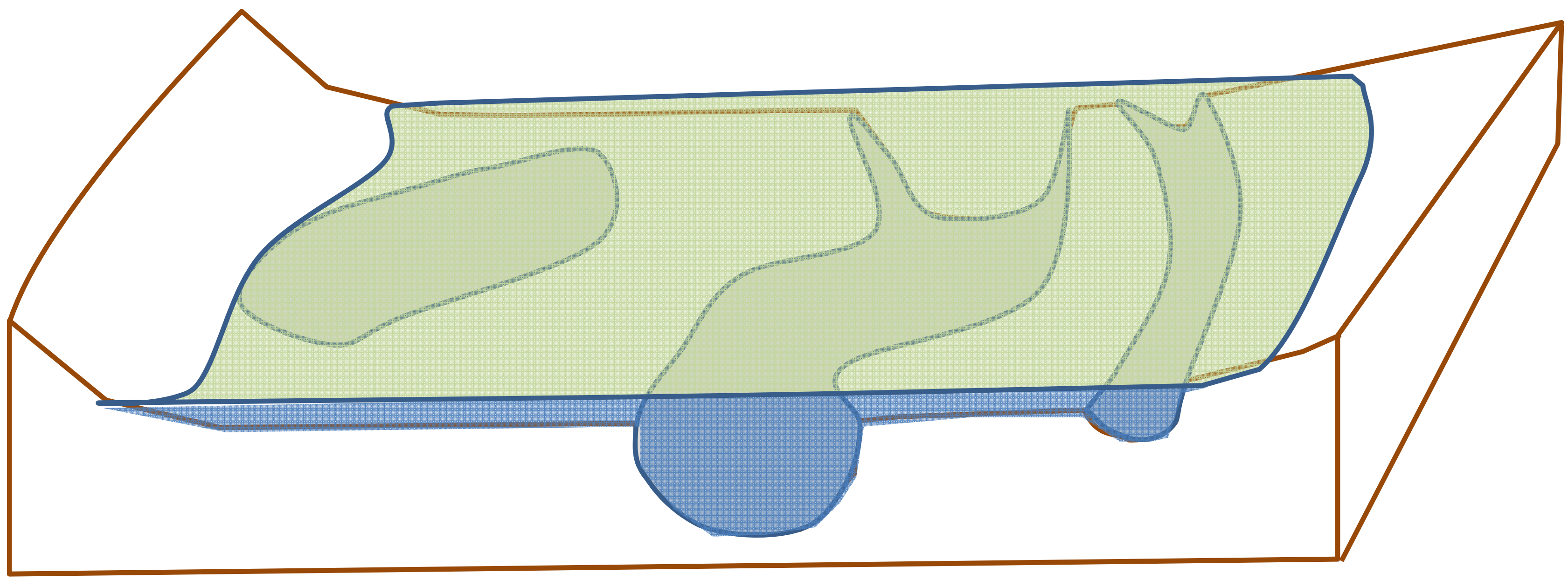
Case 2: Channel and side channel flow

- More of the water column in the side channel is exposed to light
- Velocities are lower in the side channel (higher friction, lower flows), so residence times are higher
- Temperatures increase more quickly in the side channel
- Phytoplankton densities (and those of higher trophic levels) increase more rapidly in the side channel



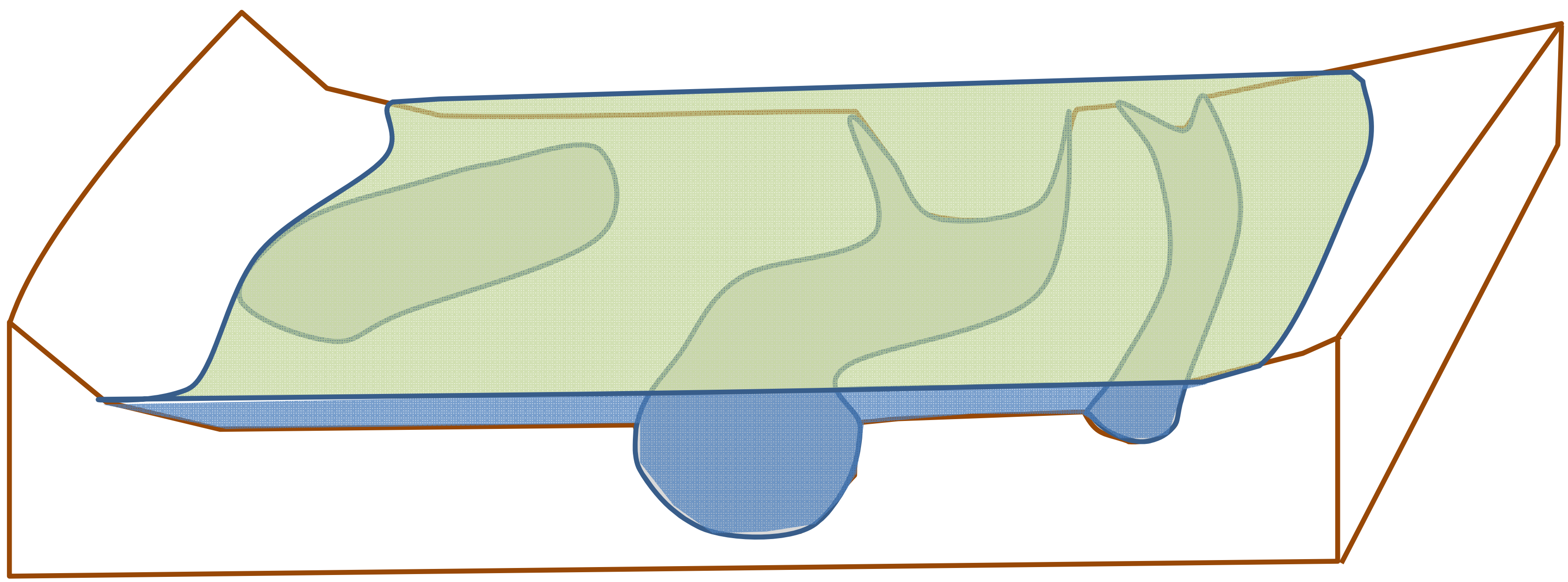
Case 3: Shallow floodplain flow

- Velocities are lower on the floodplain (more roughness, more wetted edge), **so residence times are higher**
- Exposure to light is high on the floodplain, due to shallow flows and the opportunity for sediment to drop out at slower velocities
- Temperature *may* increase more quickly on the floodplain
- Phytoplankton densities (and those of higher trophic levels) increase more rapidly on the floodplain



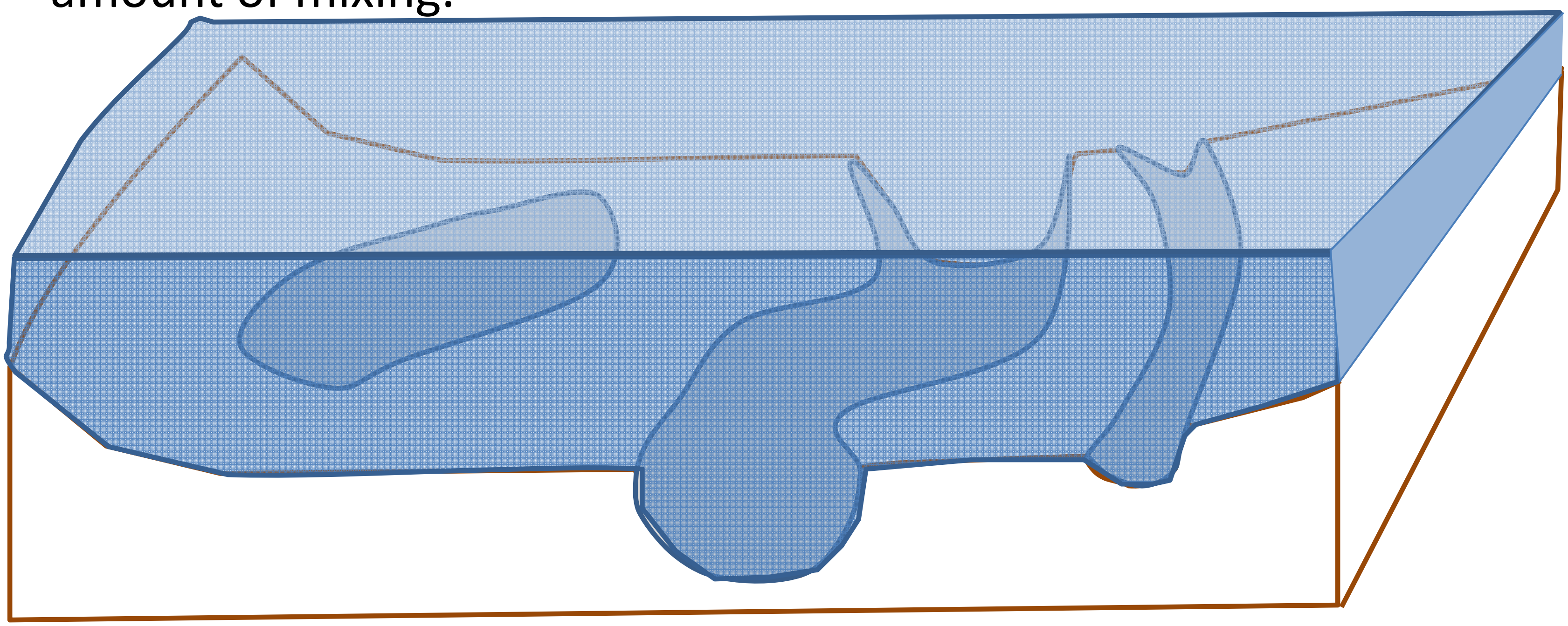
Case 3: Shallow floodplain flow
(continued)

- For cases 2 or 3, if prior flooding has occurred, residual phytoplankton (and higher trophic levels) on the floodplain or in the side channel will “prime” the productivity pump



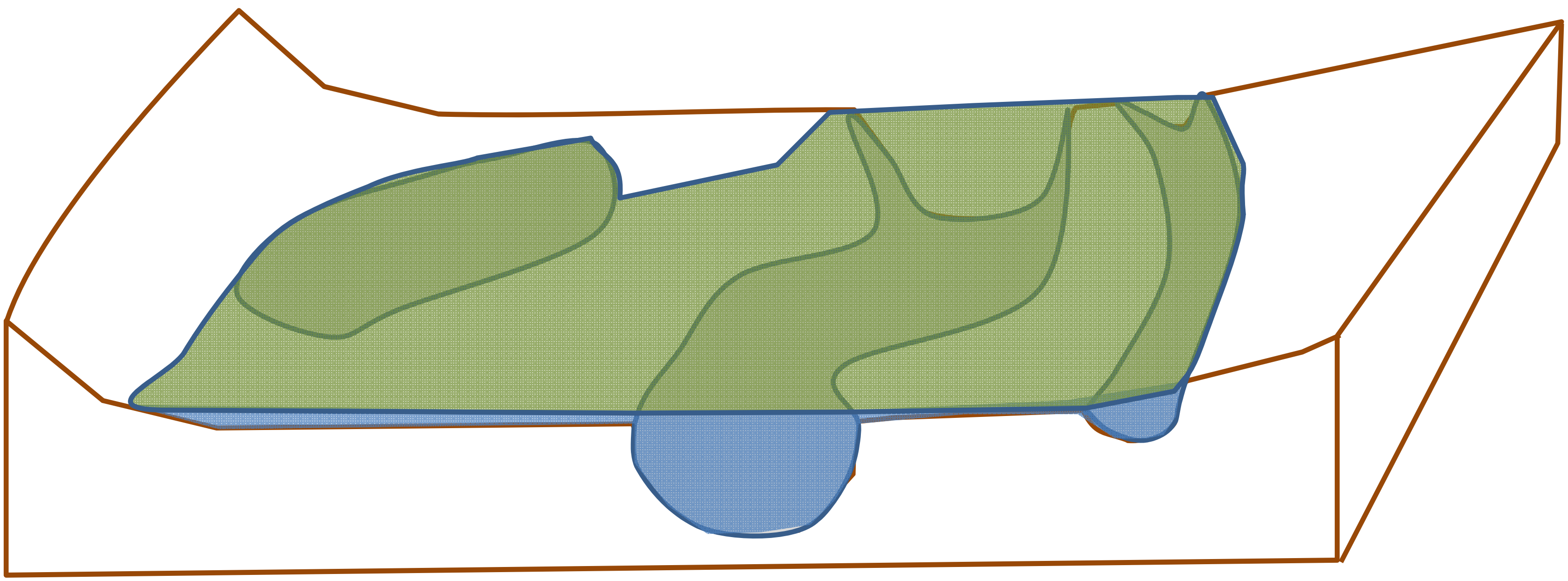
Case 4: Deep floodplain flow

- **Differences** between the river and floodplain conditions **decrease**: water column exposure to light, temperature, velocities and phytoplankton densities (and those of higher trophic levels) on the floodplain trend toward that of the river as flows deepen
- Degree of difference between the river and floodplain conditions will depend primarily on floodplain flow depth, residence time, and amount of mixing.



Case 5: Draining floodplain

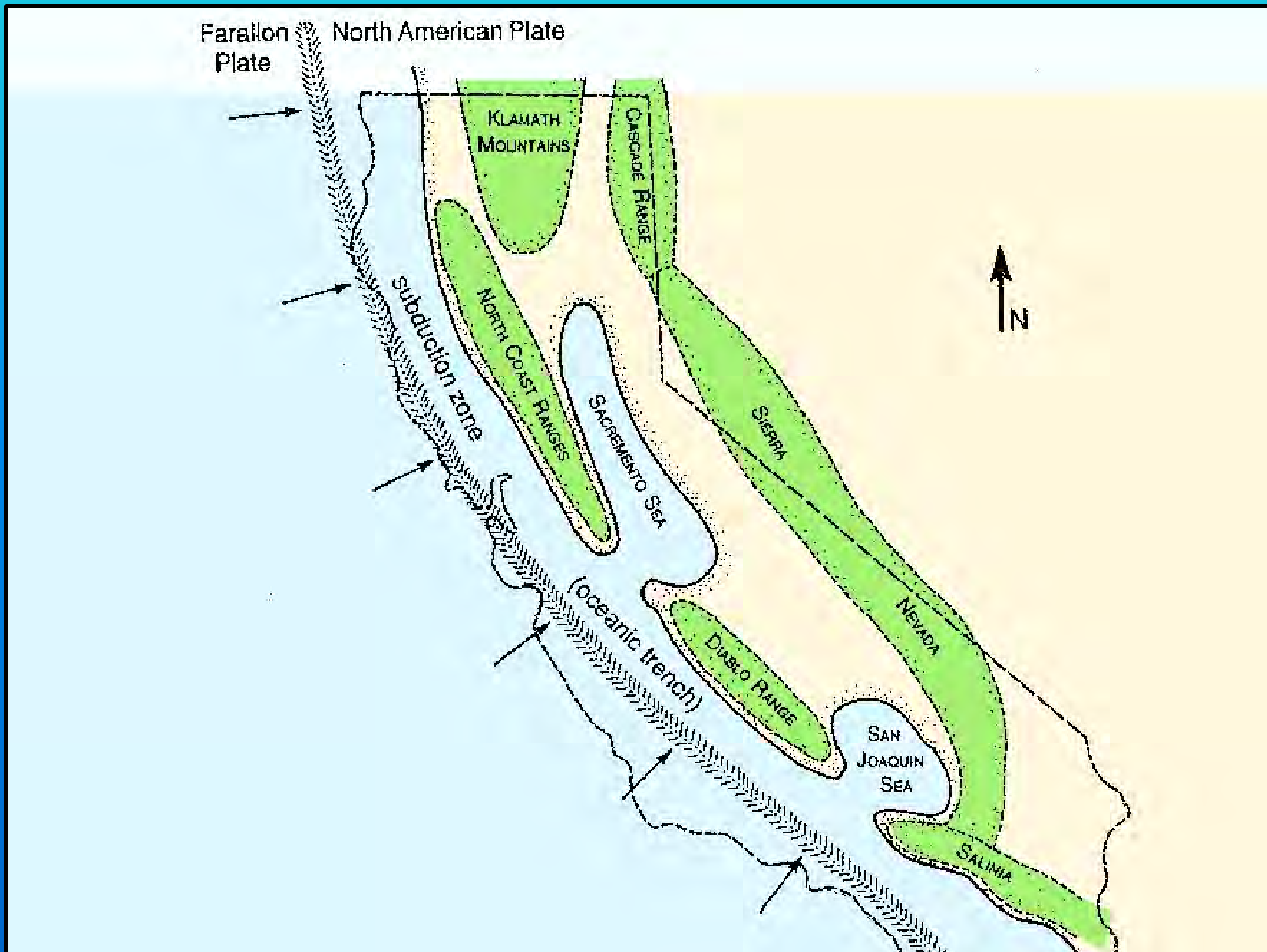
- Water is draining from the floodplain back to the channel, concentrating phytoplankton (and higher trophic levels) on the floodplain and sending an influx of food sources back into the river



3. Pre-Disturbance Conditions

Sacramento Valley

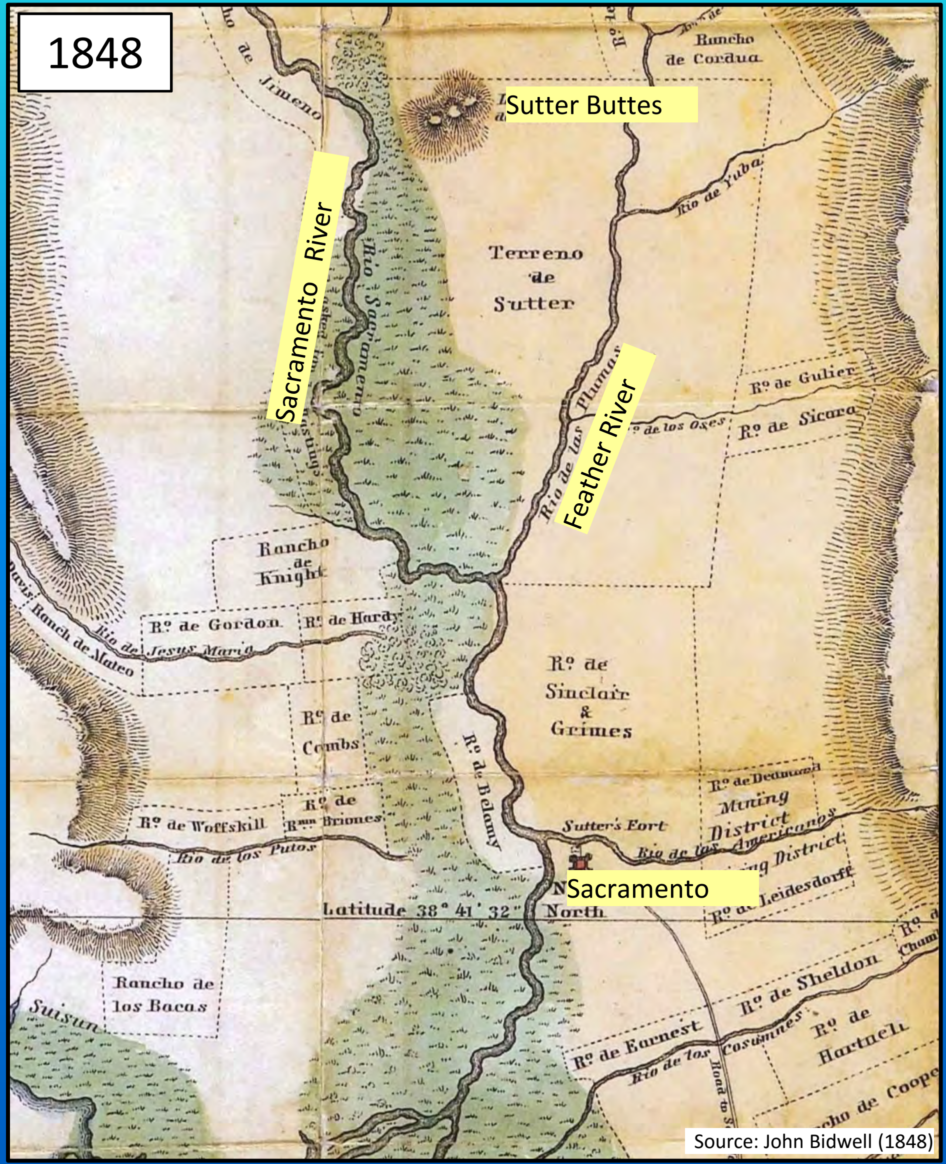
The Sacramento River Valley is an Inland Sea…
…30 million years ago (mid-Oligocene)



Source: The Jepson Manual (1993)

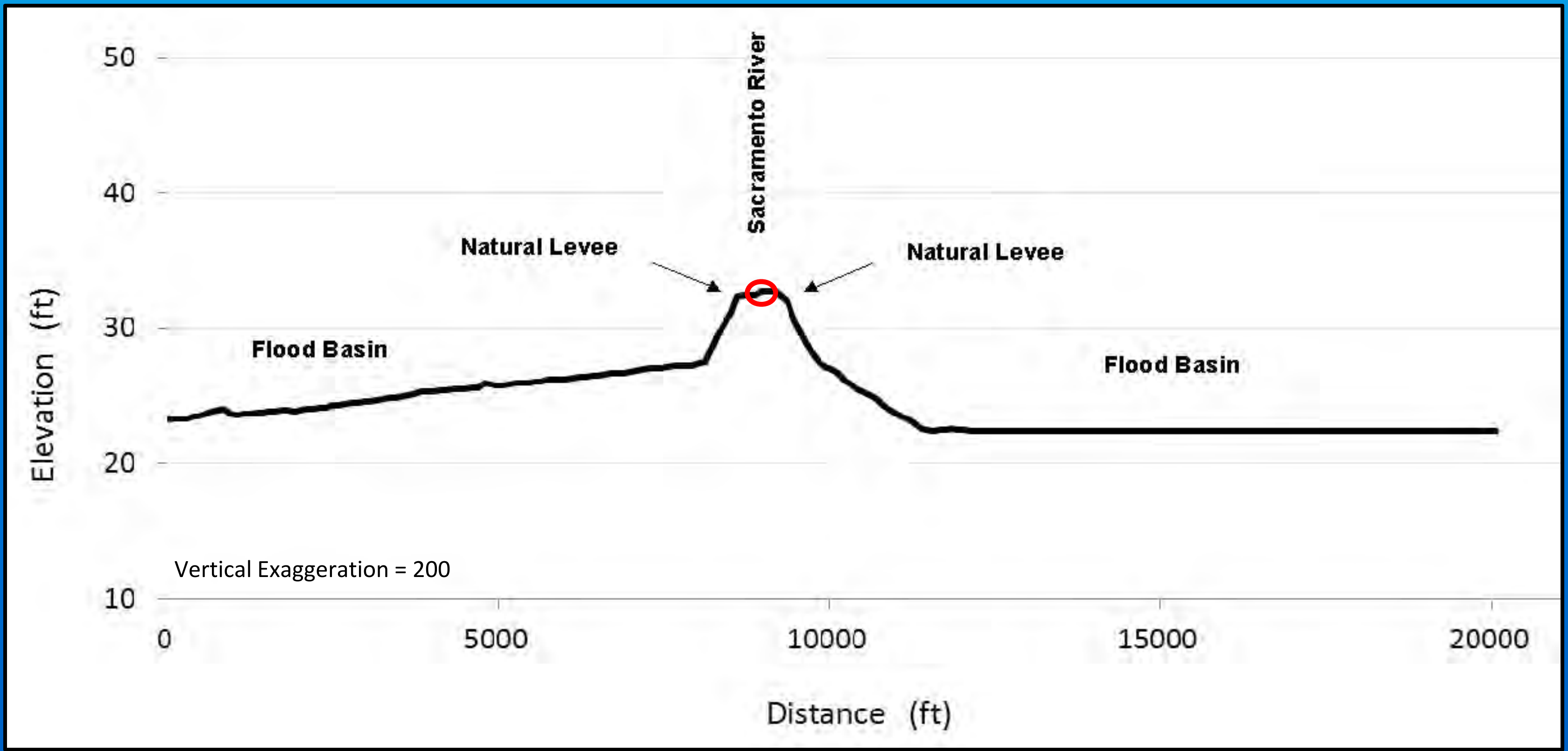
1800 – Natural River System

- 30 million years later, the Sacramento Valley is still a mostly aggrading system.
- Sacramento and Feather Rivers are the sediment delivery system.
- Sacramento and Feather Rivers lack capacity to convey seasonal floods and regularly overtop.



1800 – Natural River System

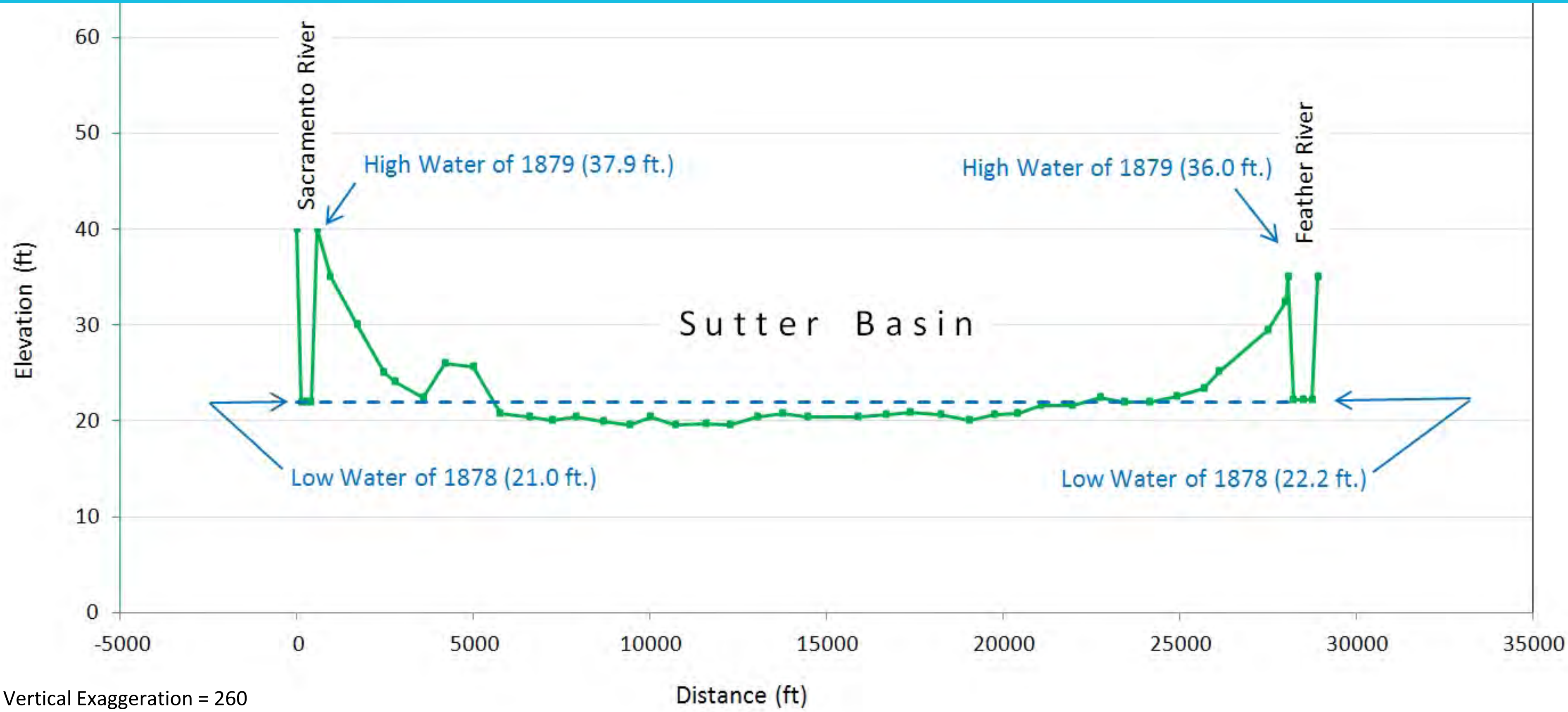
- Sacramento Valley cross-section shows natural river levees and near-bank deposits at higher elevation than adjacent flood basins
- Preferential sediment deposition next to river (coarser material)
- Fine material deposits in flood basins (fertile agricultural soils)



Source: (National Elevation Dataset)

1800 – Natural River System

- 1895 surveys show low water elevations in rivers above the basin floor



Vertical Exaggeration = 260

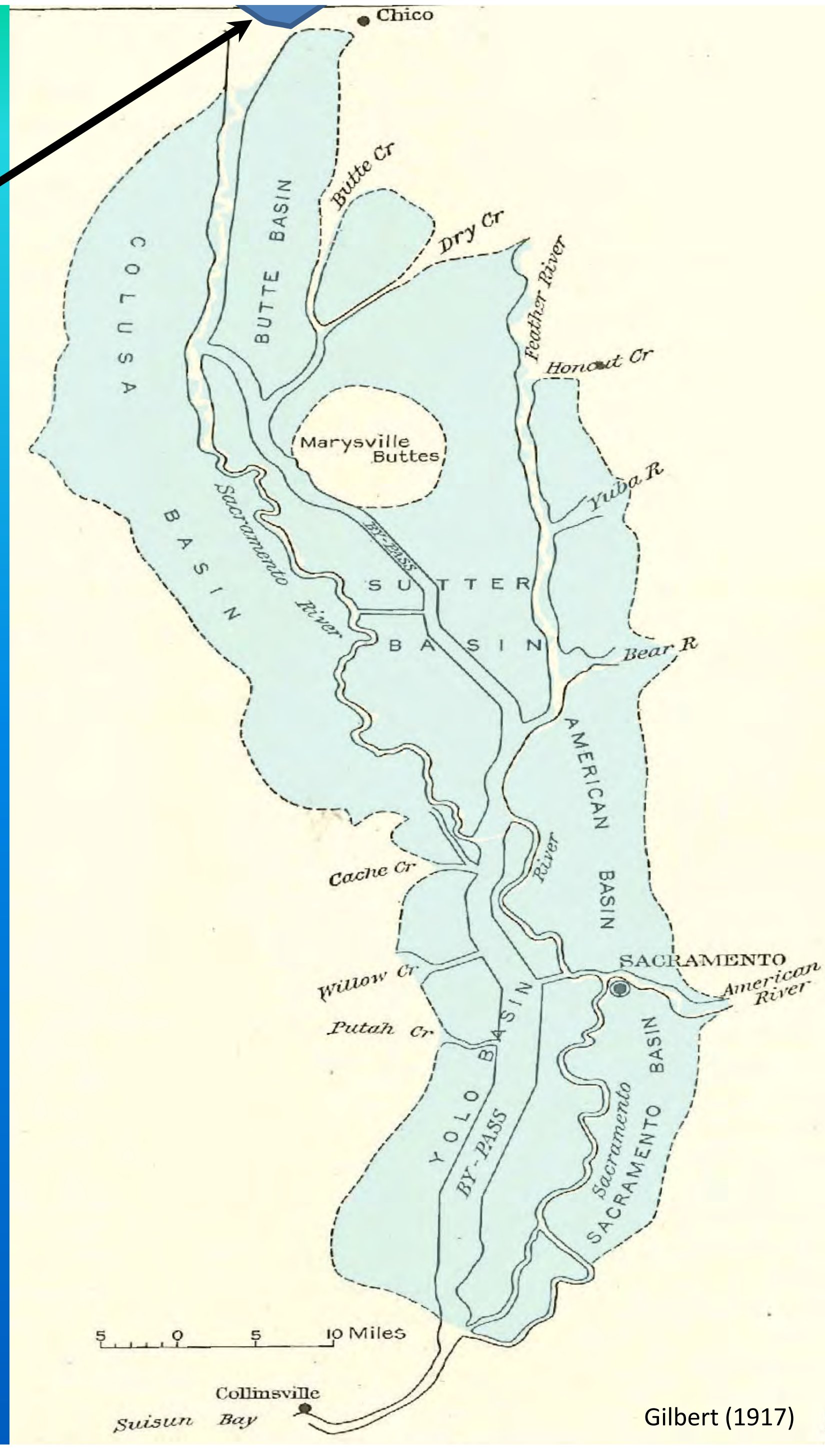
Location is 3.5 miles north of Knights Landing in an east – west alignment.

Source: California Commissioner of Public Works, 1895

Sacramento River Flood Basins

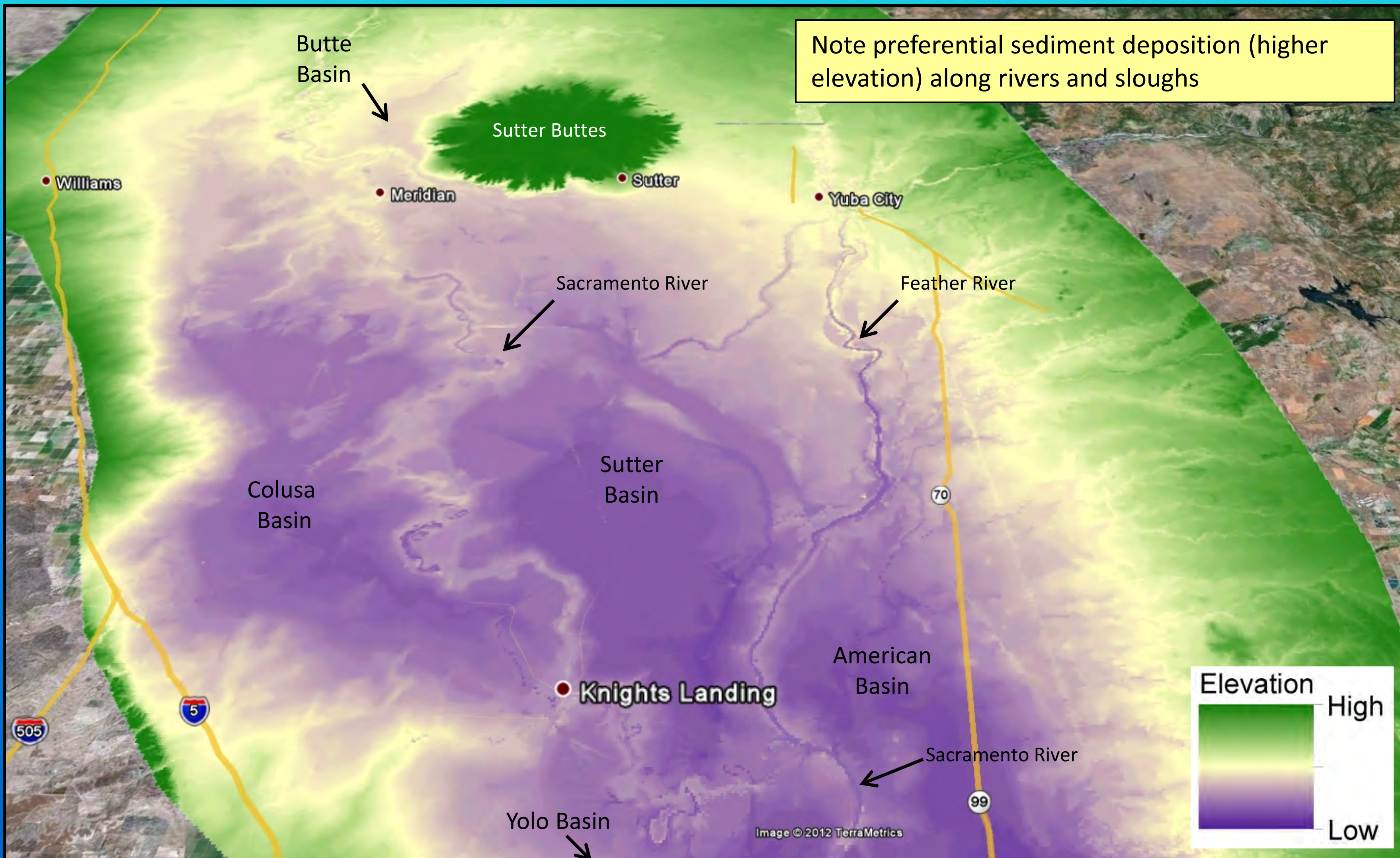
Bosqueo Basin

- 2,131 square miles of flood basins defined by G.K. Gilbert in 1917.
- THIS is the Inland Sea.



Gilbert (1917)

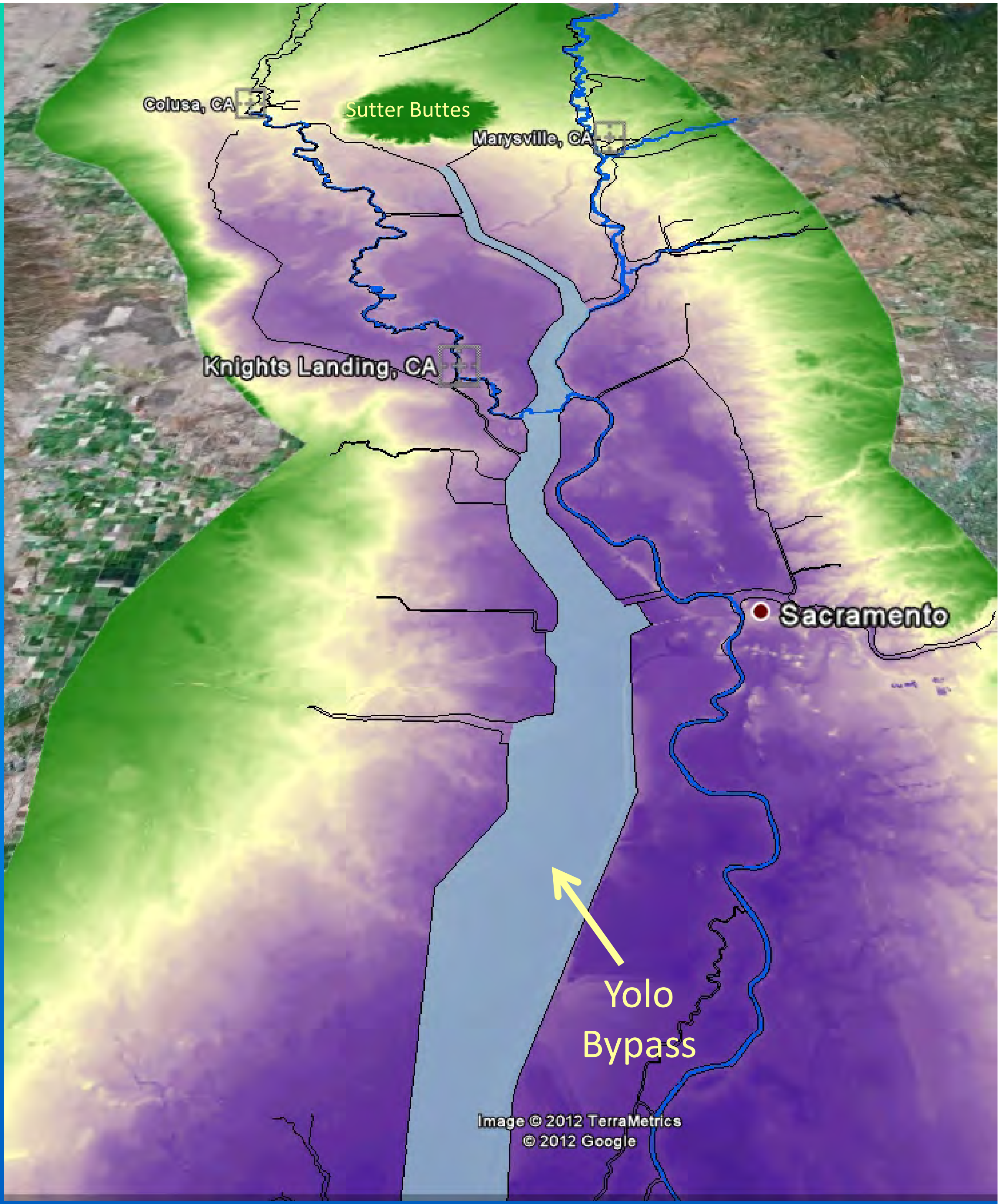
The Surficial Expression of Sacramento Valley Sedimentation Processes – Rivers and Flood Basins



Source: NED and Google Earth

Integration of Geomorphic Function into the Sacramento River Flood Control Project Design

- The modern day levee and bypass system routes flood flows through the historic flood basins
- Result is that the majority of flood flows are not carried by lower Sacramento River but through flood basin bypasses, just as in the early 1800s

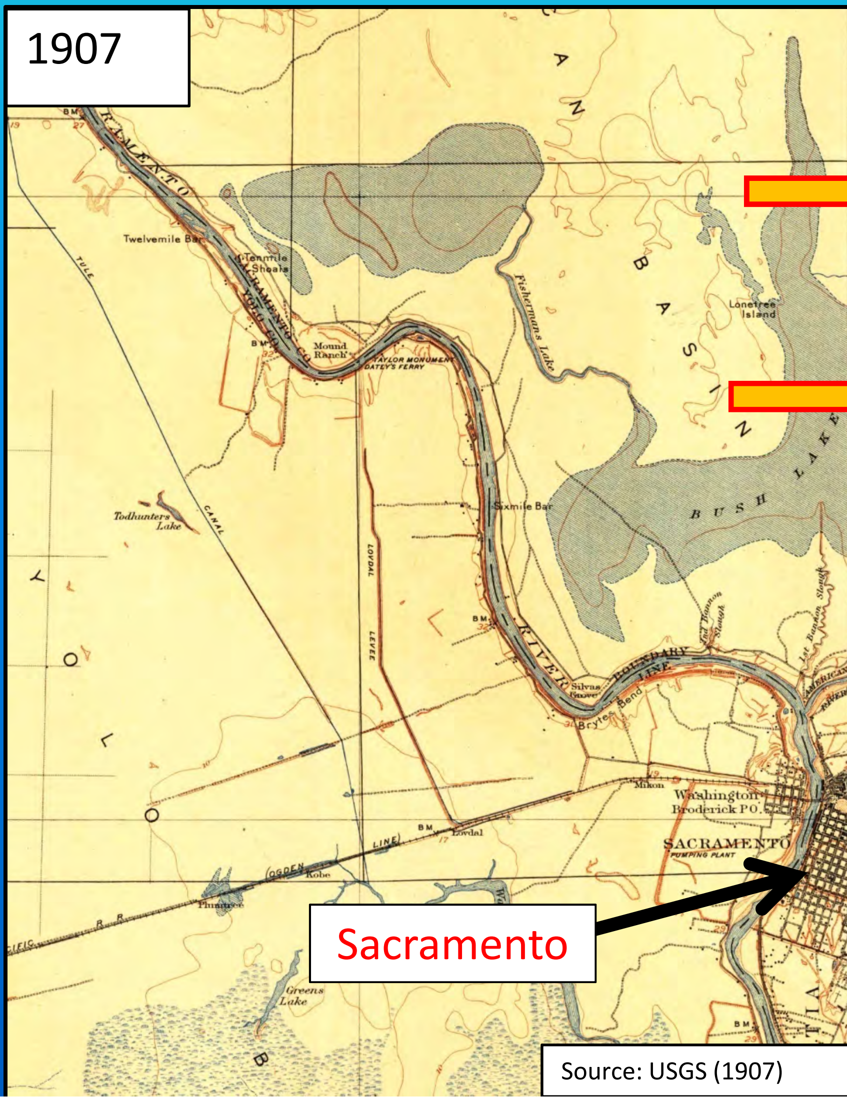


Source: NED and Google Earth

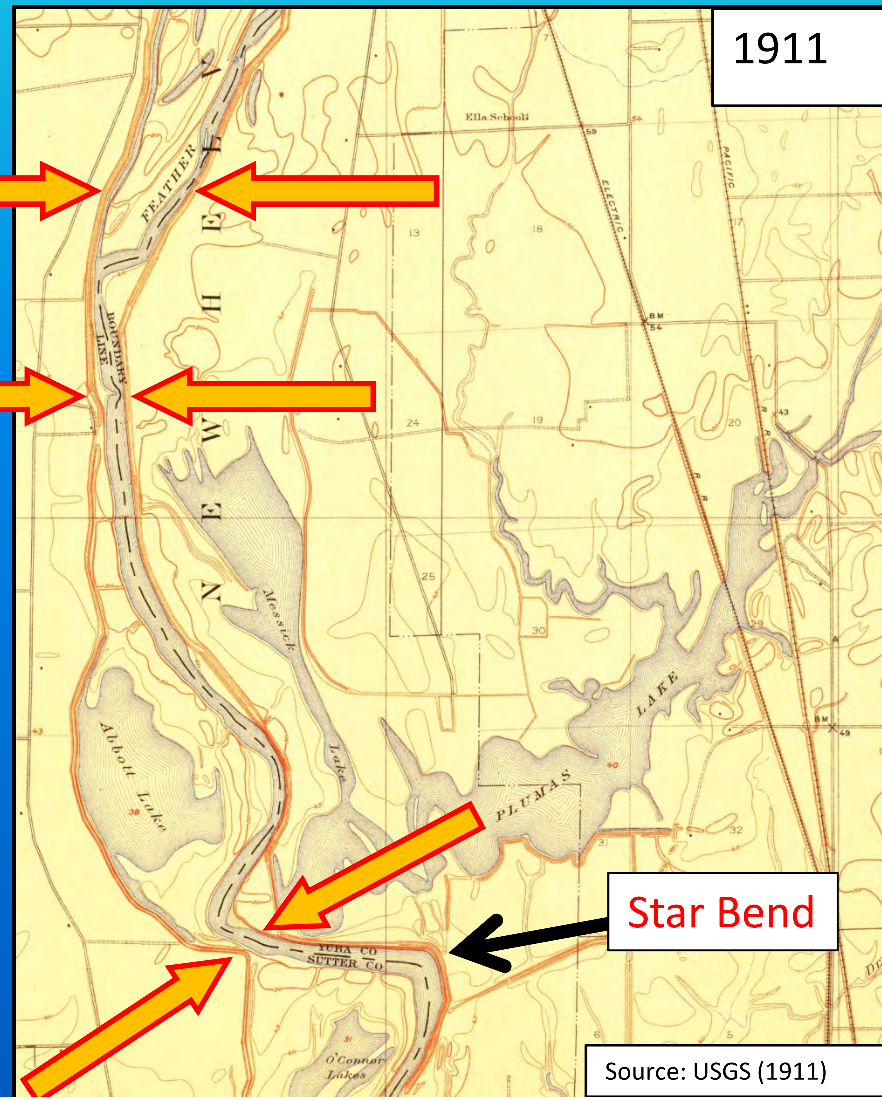
1800 - Natural River System

- Larger and more famous flood basin lakes of the Sacramento Valley

Bush Lake in American Basin

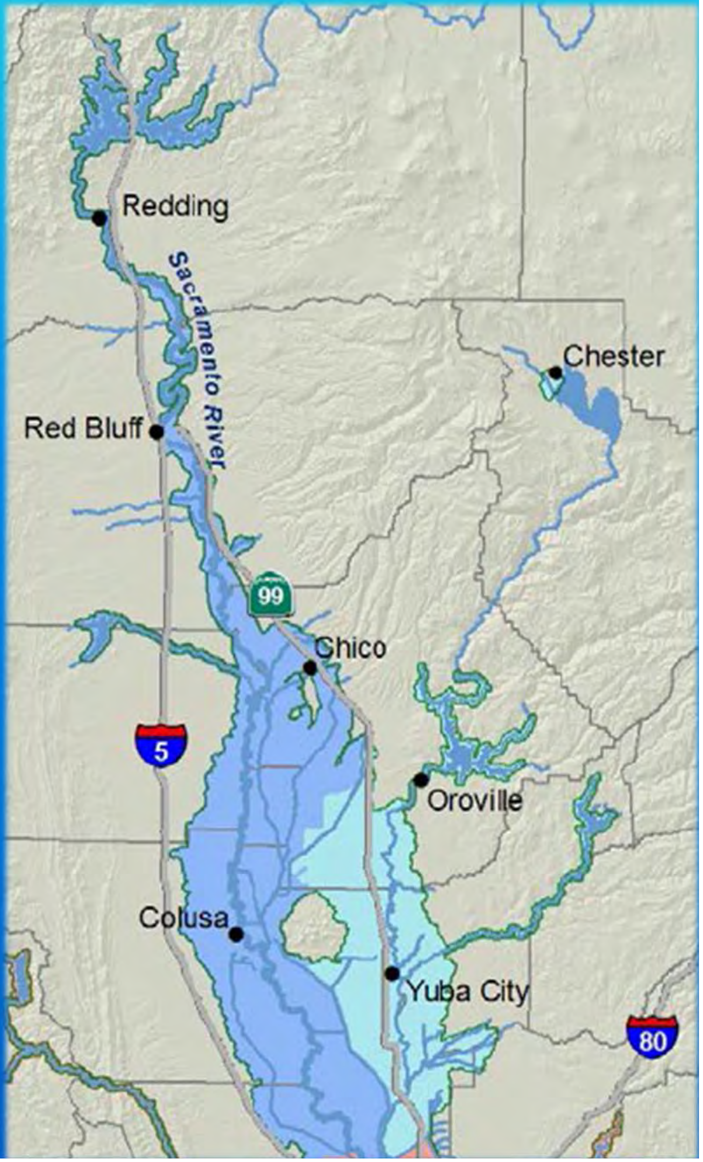


Plumas Lake on Feather River



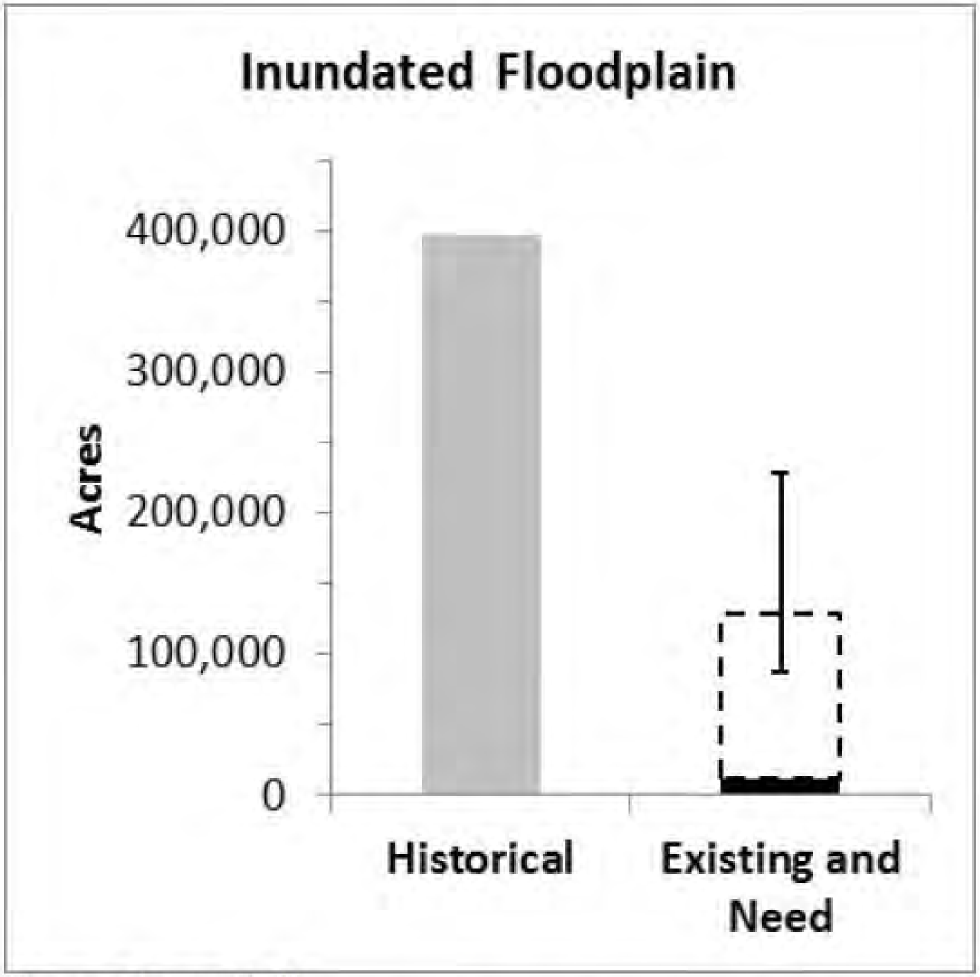
4. Restoration Targets

- Loss of Habitat & Estimated Restoration Needs for AFRP "Fish Doubling Goal"
- *DWR's Central Valley Flood System Conservation Strategy*
- *Used the ESHE model*
  - Upper Sacramento River Conservation Planning Area (CPA) = Sacramento River and tributaries from Red Bluff to the Fremont Weir.
  - Feather River CPA = Feather River, as well as the Yuba and Bear Rivers and other tributaries.



Upper Sacramento River

Recovery of target species may require 106,400 additional acres of floodplain inundated by flows of a timing, duration, and frequency adequate for fish rearing.



Source: Appendix H.

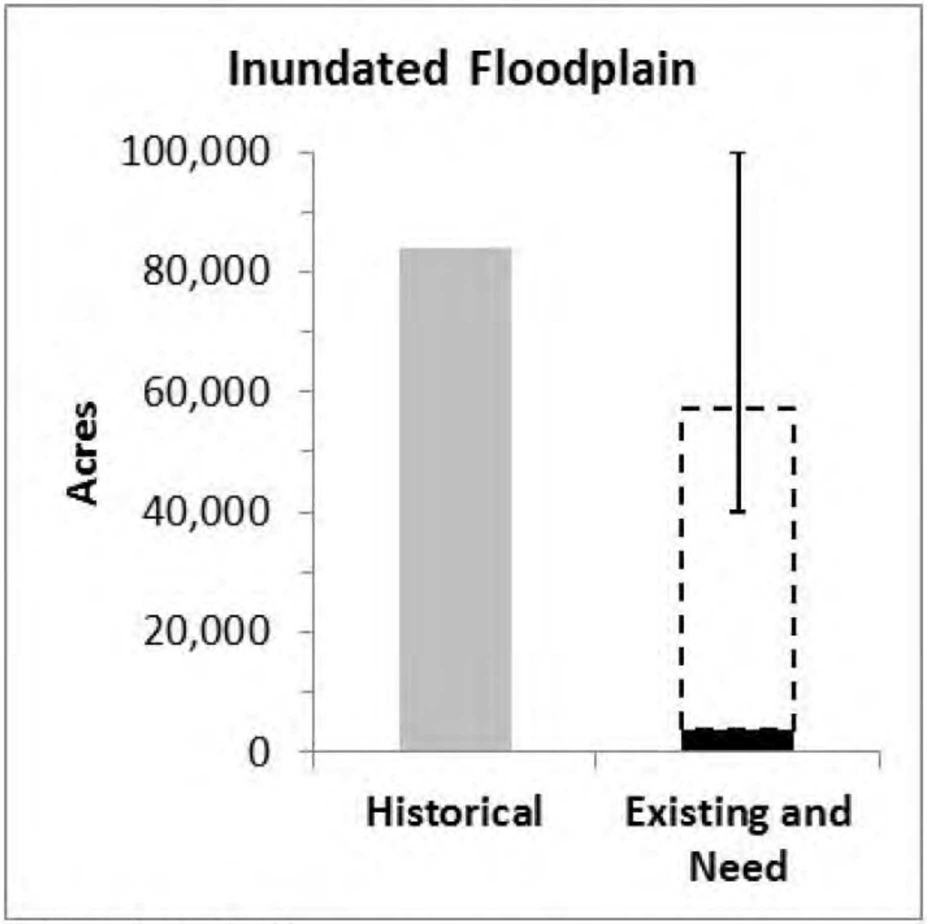
Historical and Existing Inundated Floodplain Area and Amount Needed for Species' Recovery

Upper Sacramento River

Notes: Acreages are for areas inundated for at least 14 days during December–May with a recurrence interval of 3 years or less. Only a small portion of the active floodplain along major river reaches meets these criteria; as currently operated, much of the Sutter Bypass also meets these criteria. The need is the sum of the existing area (shown in black) and the additional area (shown by a dashed outline) needed to provide rearing habitat for the AFRP goal to double salmonid populations. This amount is based on floodplains providing rearing habitat of intermediate suitability (17.5%). The error bar denotes the range from low to high floodplain suitability as rearing habitat (10–25%). The range is large because suitability can have a several-fold effect on the number of fish supported per unit area. These data are results of the analysis presented in Appendix H, and the model used to generate these estimates is further described in USBR 2012. The amount of habitat required to double salmonid populations is more than twice existing habitat because existing populations are supported by both natural production and fish hatcheries.

Feather River

Recovery of target species may require 43,000 additional acres of floodplain inundated by flows of a timing, duration, and frequency adequate for fish rearing.



Source: Appendix H.

Historical and Existing Inundated Floodplain Area and Amount Needed for Species' Recovery

Feather River

Notes: Acreages are for areas inundated for at least 14 days during December–May with a recurrence interval of 3 years or less. Only a small portion of the active floodplain along major river reaches meets these criteria. The need is the sum of the existing area (shown in black) and the additional area (shown by a dashed outline) needed to provide rearing habitat for the AFRP goal to double salmonid populations. This amount is based on floodplains providing rearing habitat of intermediate suitability (17.5%). The error bar denotes the range from low to high floodplain suitability as rearing habitat (10–25%). The range is large because suitability can have a several-fold effect on the number of fish supported per unit area. These data are results of the analysis presented in Appendix H, and the model used to generate these estimates is further described in USBR 2012.

The amount of habitat required to double salmonid populations is more than twice existing habitat because existing populations are supported by both natural production and fish hatcheries.

5. Fixes: What is on the Menu?

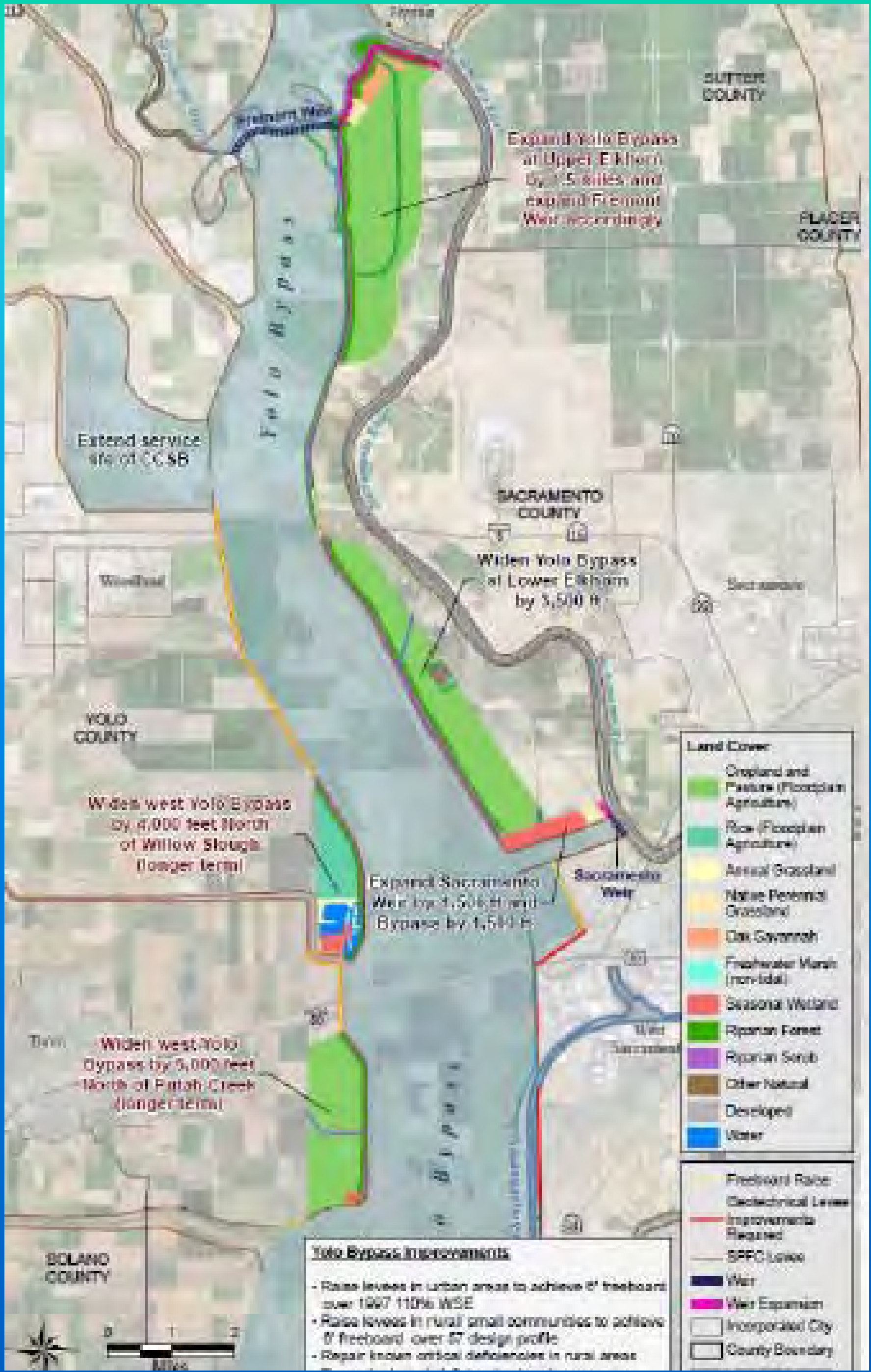
- Use the *Residual* Natural Capital!

- "Natural Floodplains" = direct connection to river
  - Major improvements to flood bypasses
  - Large(r) levee setbacks
  - Smaller levee setbacks
- Process-Based Reconciliation Approaches
  - Mimicking processes we cannot naturally replicate
  - Weirs and backwatering can efficiently use water for fins and feathers.
  - Active diversion and/or pumping of fish onto agricultural lands.
  - Diversion of floodwater to prime productivity pump.

Passive Floodplain Inundation: How do we get surface water onto a floodplain or other surface?

- Increase Q *(we wish)*
- Decrease floodplain height *(most common)*
- Raise the bed of the river *(we should do more of this)*
- Back up/impede flow in the channel *(someone needs to do this!)*

Major Improvements Example:
Yolo Bypass Expansion



Larger Levee Setback Example: Feather River Levee Setback (~6 miles)

Smaller Project Examples:

Projects championed by NCWA members and partners:

- These projects are being completed!!
- The model that is working (KLOG, Wallace, Painters Riffle, Market Street) is a local public agency as a champion that moves the project through permitting, contracting etc.

American Rivers
Rivers Connect Us®

CALIFORNIA TROUT
FISH · WATER · PEOPLE

NCWA
Northern California Water Association

The Nature Conservancy
Protecting nature. Preserving life.®

Sacramento River Forum

Projects championed by NCWA members and partners:

- They address all life stages
  - Upstream migration:
    - Reduce straying in Colusa Basin Drain
    - Reduce stranding behind Fremont and Tisdale Weirs
    - Improve upstream migration in tributaries
    - Protect adult fish in holding areas
  - Spawning:
    - Increase the quantity and quality of spawning habitats in the mainstem & the tributaries
  - Juvenile Growth & Emigration
    - Increase the quantity and quality of rearing habitats
    - Reduce sources of juvenile fish mortality

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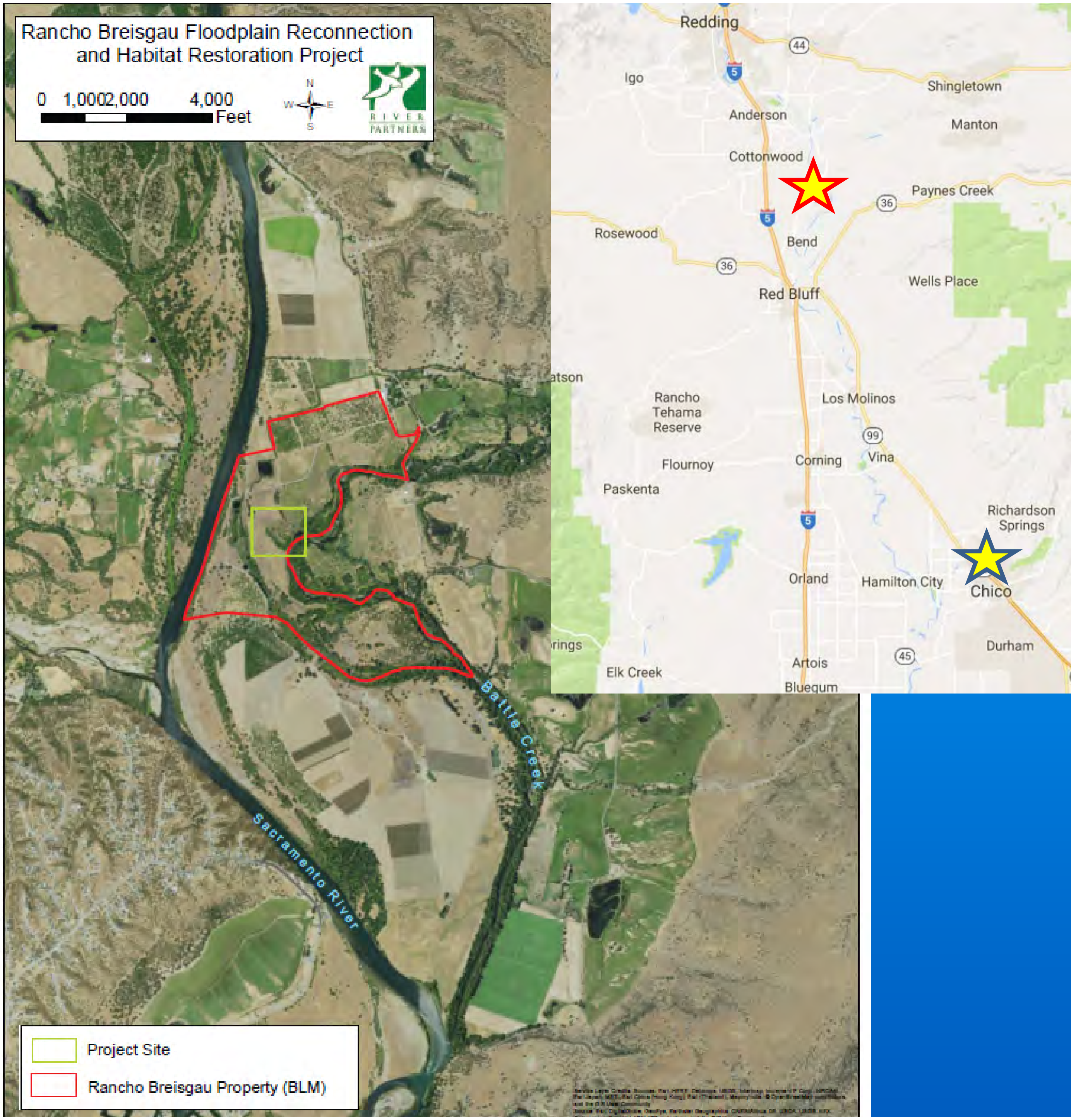
Lessons Learned

- There is a difference in what the landscape can offer from US to DS along the river continuum.
  - Don’t expect a Knaggs Ranch Nigiri platter to be served upstream of Red Bluff.
- Every body needs to eat….so every little bit helps.
- We know enough to act…so act now!
- Local champions partnered with regional experts.


Rancho Breisgau Floodplain Reconnection
and Habitat Restoration Project
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Feet
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RIVER PARTNERS
Battle Creek
Sacramento River
Project Site
Rancho Breisgau Property (BLM)
Redding
Igo
Anderson
Cottonwood
Shingletown
Manton
Paynes Creek
Rosewood
Bend
Red Bluff
Wells Place
Rancho
Tehama
Reserve
Los Molinos
Flournoy
Corning
Vina
Paskenta
Richardson
Springs
Orland
Hamilton City
Chico
Durham
Elk Creek
Artois
Bluegum
44
5
36
99
45

Rancho Breisgau Floodplain Reconnection and Habitat Restoration Project
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350
Feet
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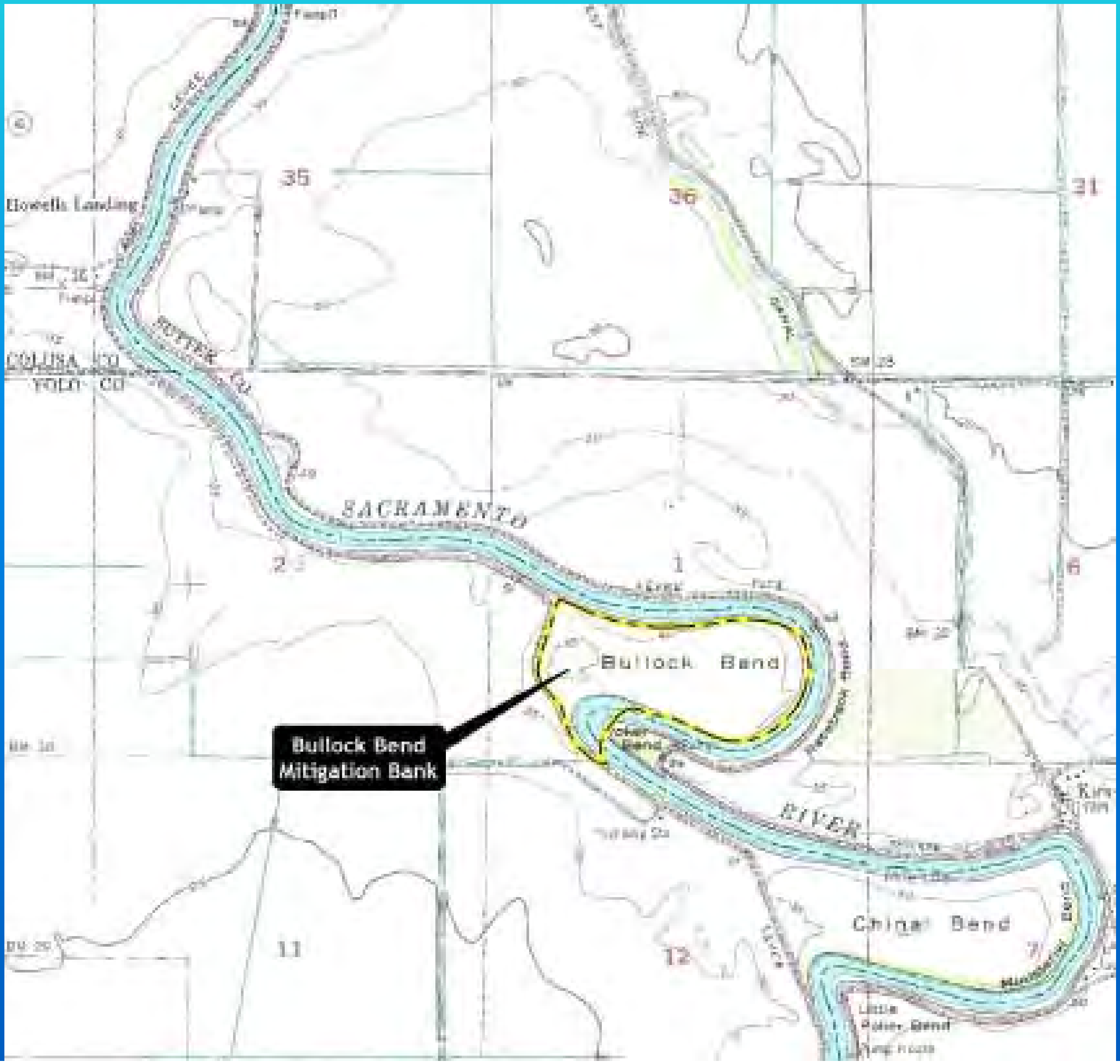
RIVER PARTNERS
Battle Creek
Project Site Boundary (Approx. 10 acres)

Bullock Bend Floodplain

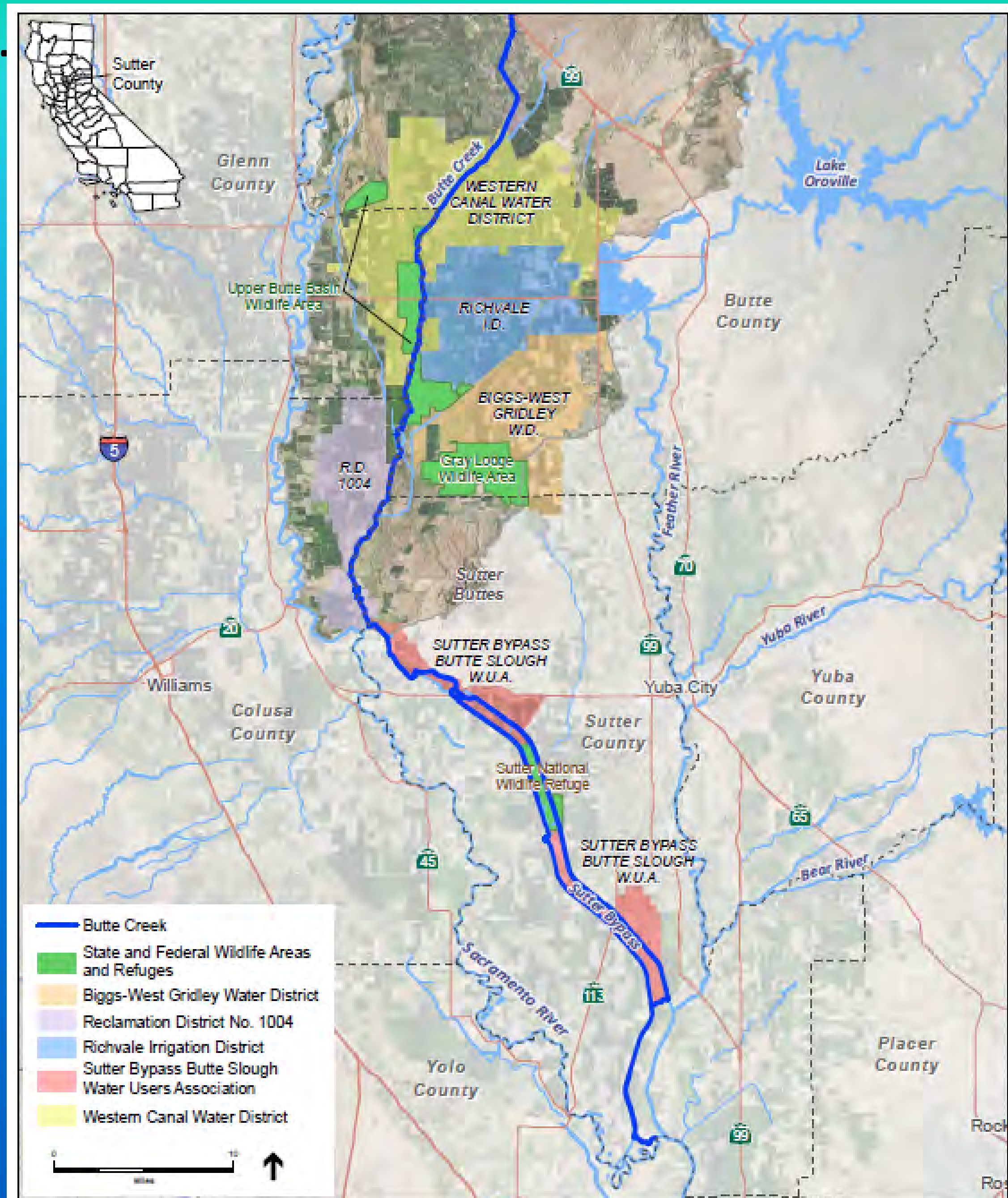


Bullock Bend Floodplain (~160 acres)

Trying new things: Process-Based Reconciliation Approaches

- Weirs and backwatering can efficiently use water for fins and feathers.
- Active diversion and/or pumping of fish onto agricultural lands
- Diversion of floodwater to prime productivity pump

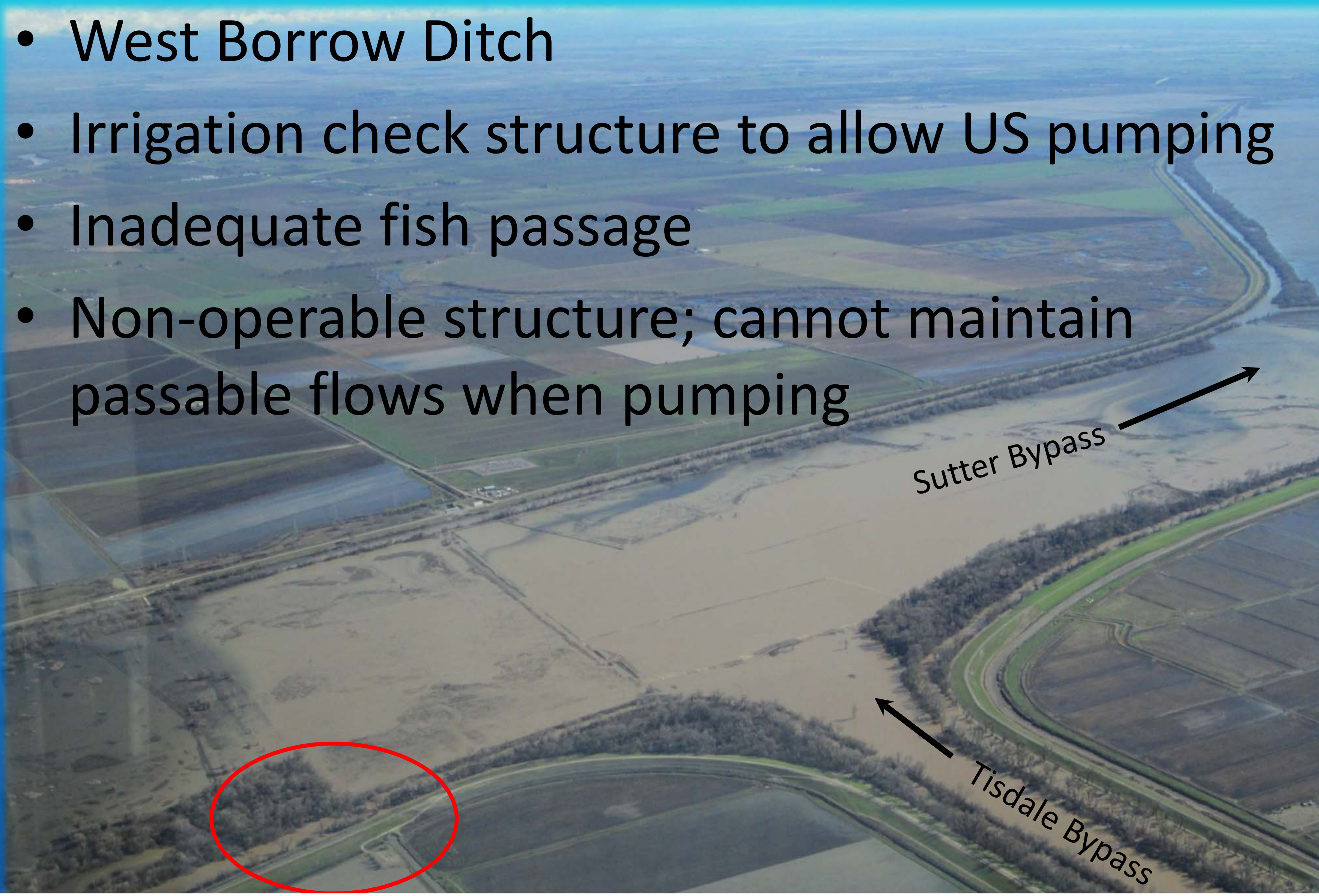
Bu em



Sutter County
Glenn County
Butte Creek
WESTERN CANAL WATER DISTRICT
Lake Oroville
Upper Butte Basin Wildlife Area
RICHVALE I.D.
Butte County
BIGGS-WEST GRIDLEY W.D.
R.D. 1004
Gray Lodge Wildlife Area
Feather River
Sutter Buttes
SUTTER BYPASS BUTTE SLOUGH W.U.A.
Yuba River
Williams
Yuba City
Yuba County
Colusa County
Sutter County
Sutter National Wildlife Refuge
SUTTER BYPASS BUTTE SLOUGH W.U.A.
Bear River
Sutter Bypass
Sacramento River
Yolo County
Placer County
Butte Creek
State and Federal Wildlife Areas and Refuges
Biggs-West Gridley Water District
Reclamation District No. 1004
Richvale Irrigation District
Sutter Bypass Butte Slough Water Users Association
Western Canal Water District

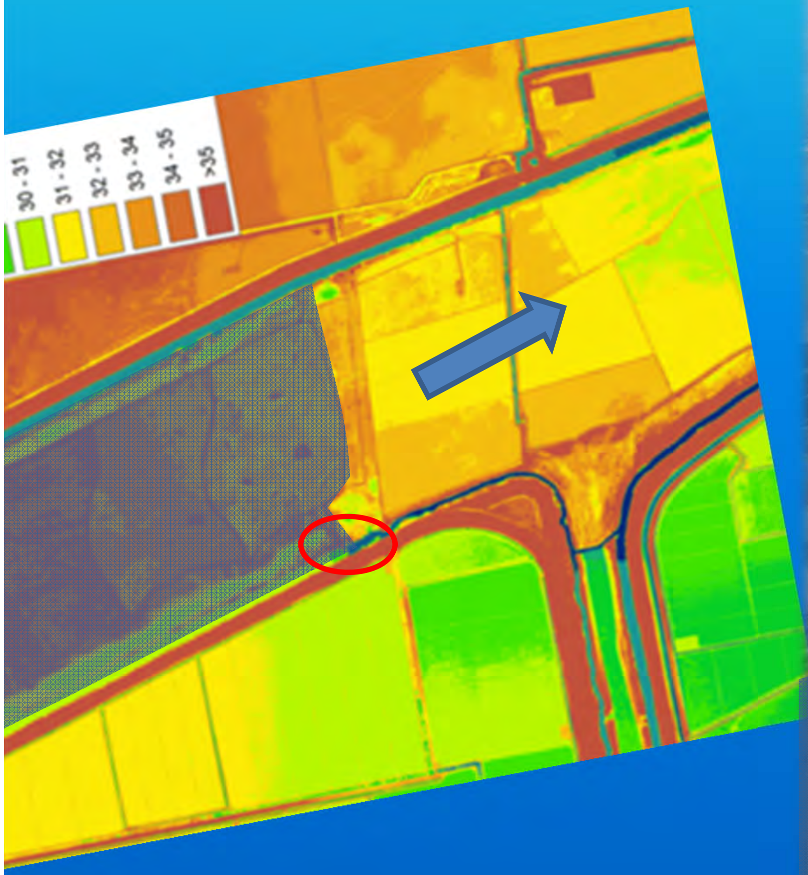
Weir 1 (Sutter Bypass)

- West Borrow Ditch
- Irrigation check structure to allow US pumping
- Inadequate fish passage
- Non-operable structure; cannot maintain passable flows when pumping



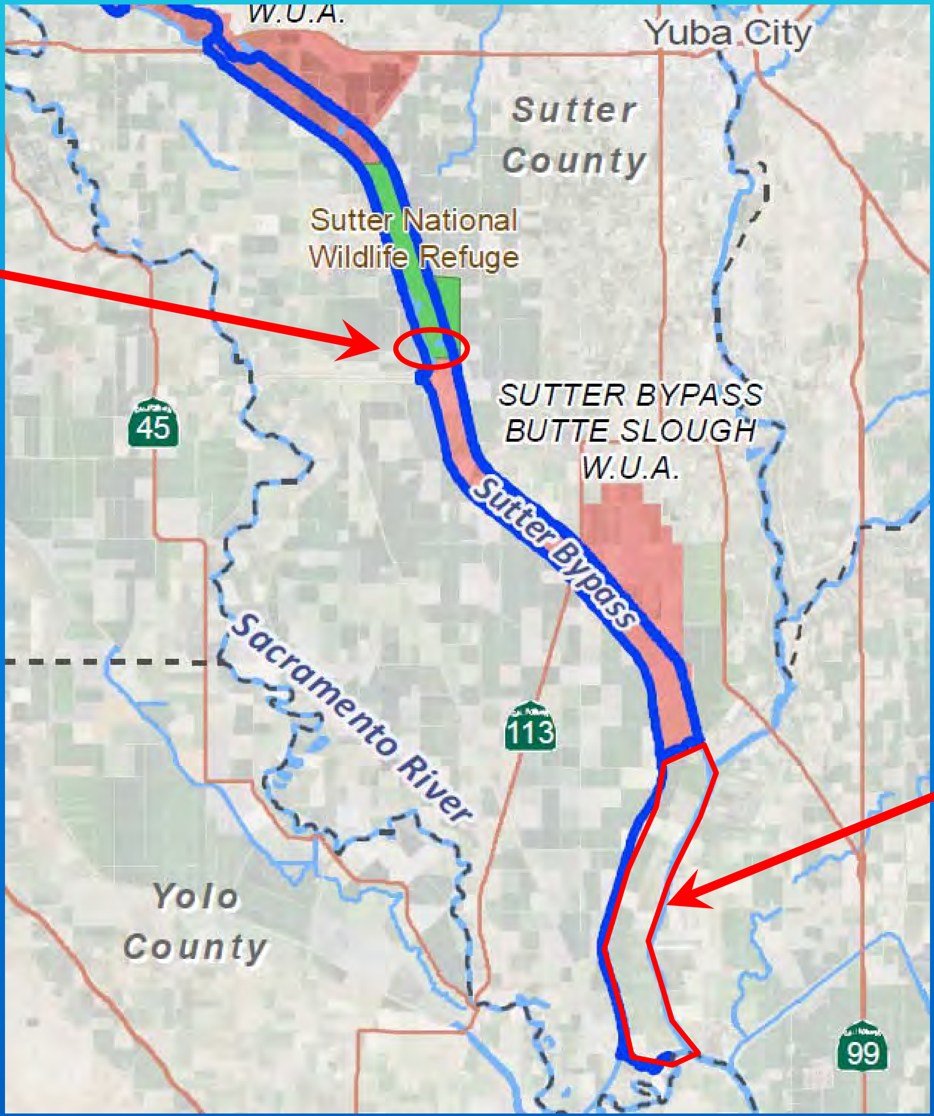
Weir 1 (Sutter Bypass)

Weir 1 (Sutter Bypass)



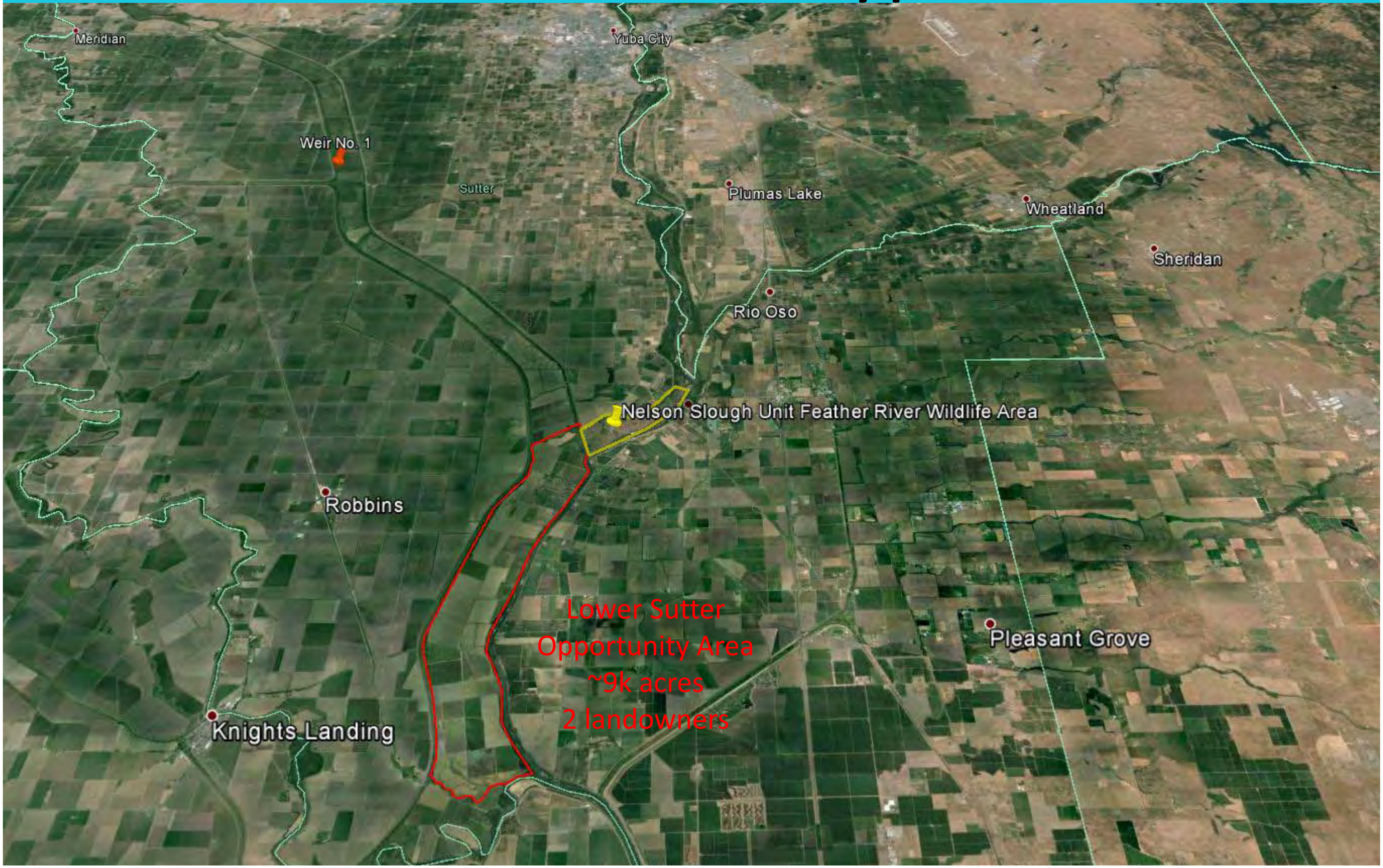
Lower Sutter Bypass

Weir 1
Opportunity Area



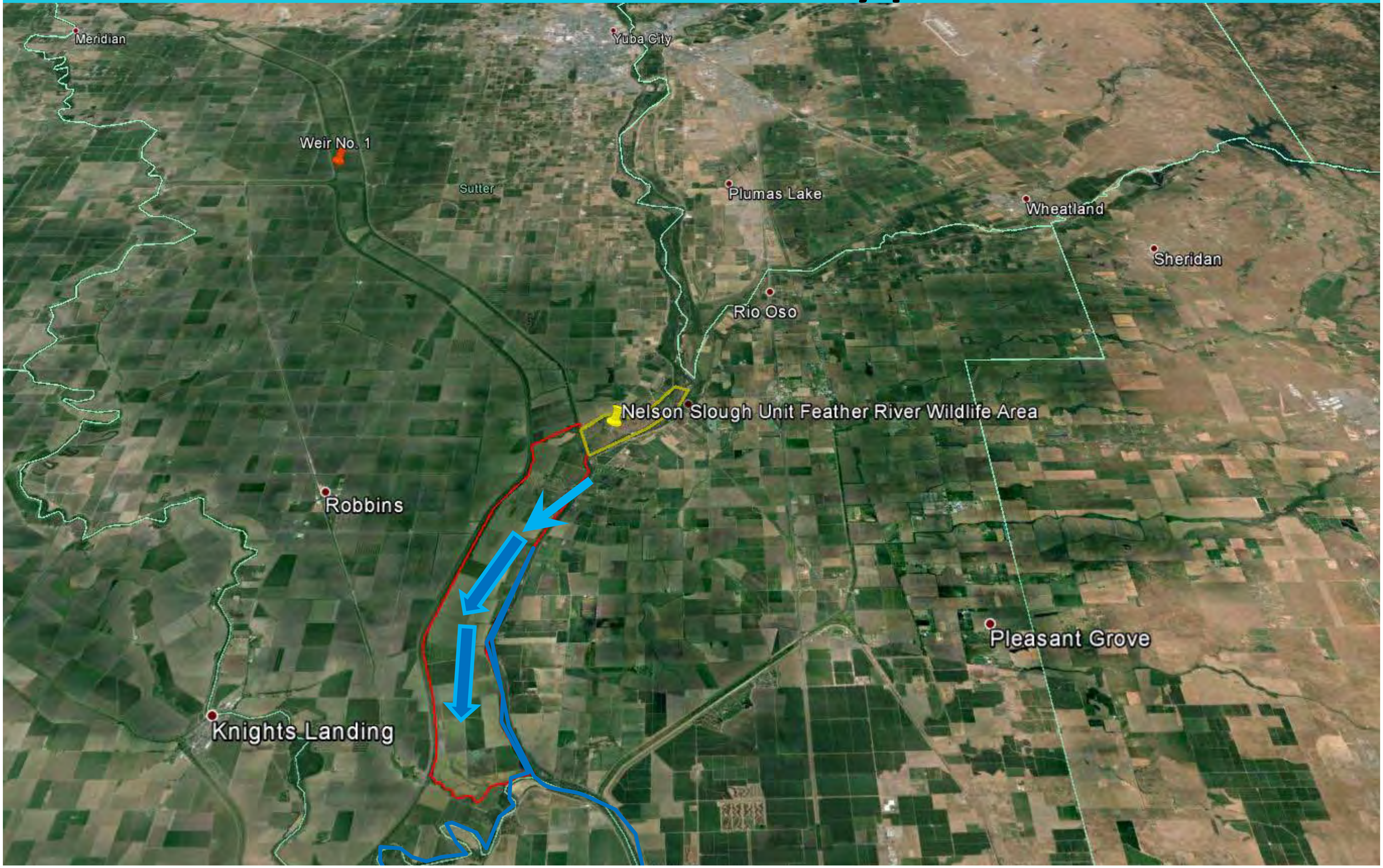
Lower Sutter
Opportunity Area

Lower Sutter Bypass



Lower Sutter Bypass

Lower Sutter Bypass



Lower Sutter Bypass

STATE OF CALIFORNIA

The Resources Agency

The Reclamation Board

NELSON BEND

MODIFICATION PROJECT

FEATHER RIVER – SUTTER COUNTY

OPERATION & MAINTENANCE MANUAL

Prepared By

Department of Water Resources

1972

- 2 -

Description of Project:

I. The project improved and stabilized the west bank overflow area and the channel of the Feather River. The improvements provide protection against the formation of Feather River overflow channels into the Sutter Bypass and to retard the deposition of sediments in the Sutter Bypass. This reduces the possibility of a main channel shift in the Feather River.

II. a. A 900-foot spur levee from the Feather River right bank levee across Nelson Slough to the rock weir together with a 300-foot training levee. Two 48-inch pipes provide summer drainage for Nelson Slough.

b. A 2,200-foot long quarry rock weir.

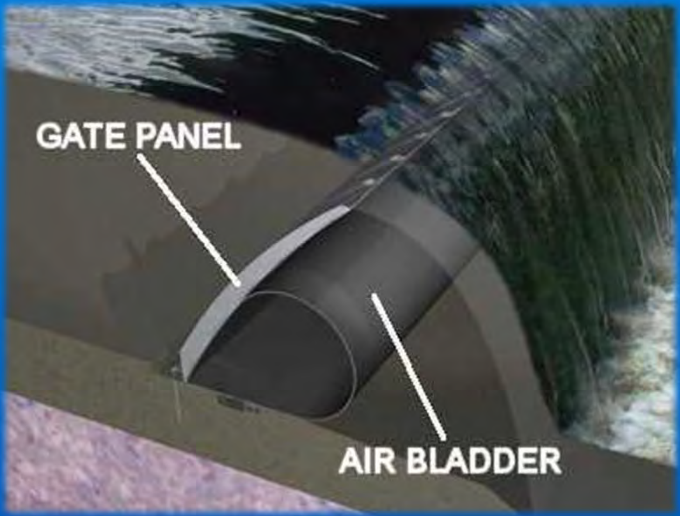
c. A 300-foot training levee together with a 210-foot tie-in levee at the south end of the weir.

d. Filling of channels and grading immediately upstream and downstream from the weir.

e. Filling a break in the right bank of the Feather River at and downstream from Nelson Bend.

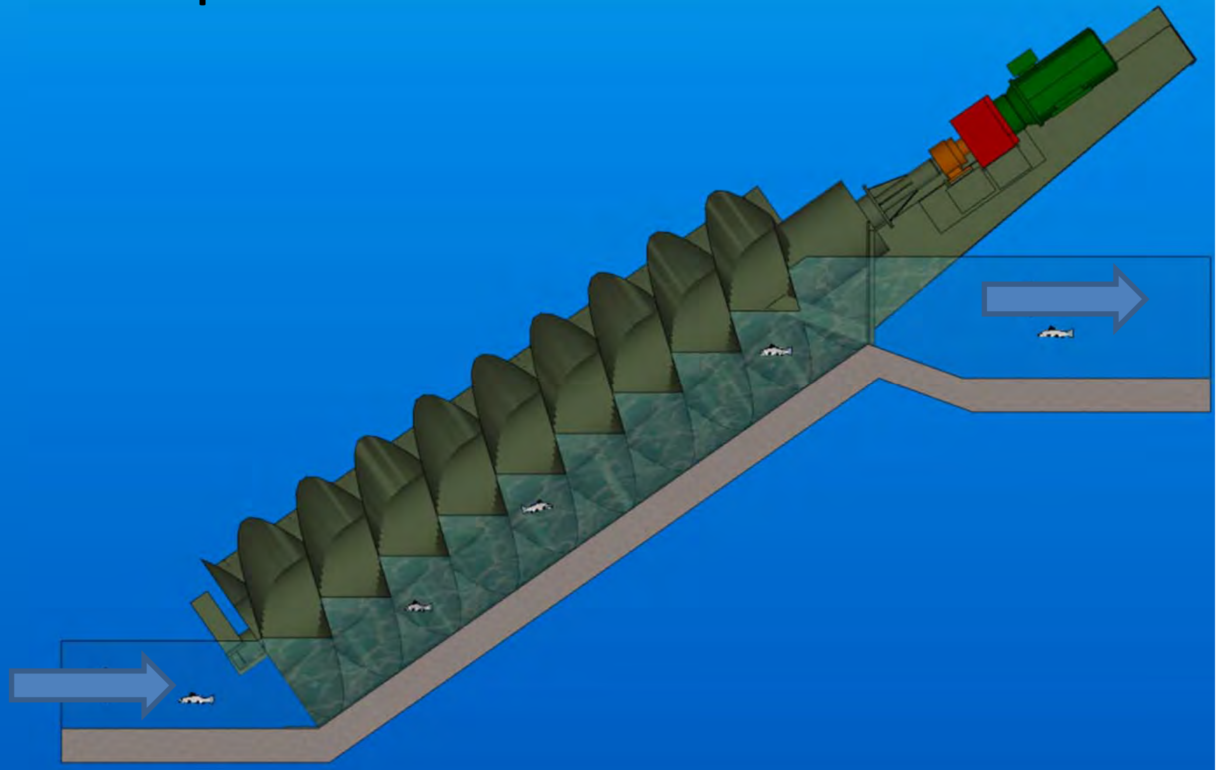
How to get fish onto other floodplains (ag lands)?

- Bladder dams in channel bed
- Impede flow through channel—force floodplain inundation or diversion to irrigation ditch system
- May need to bypass fish screens



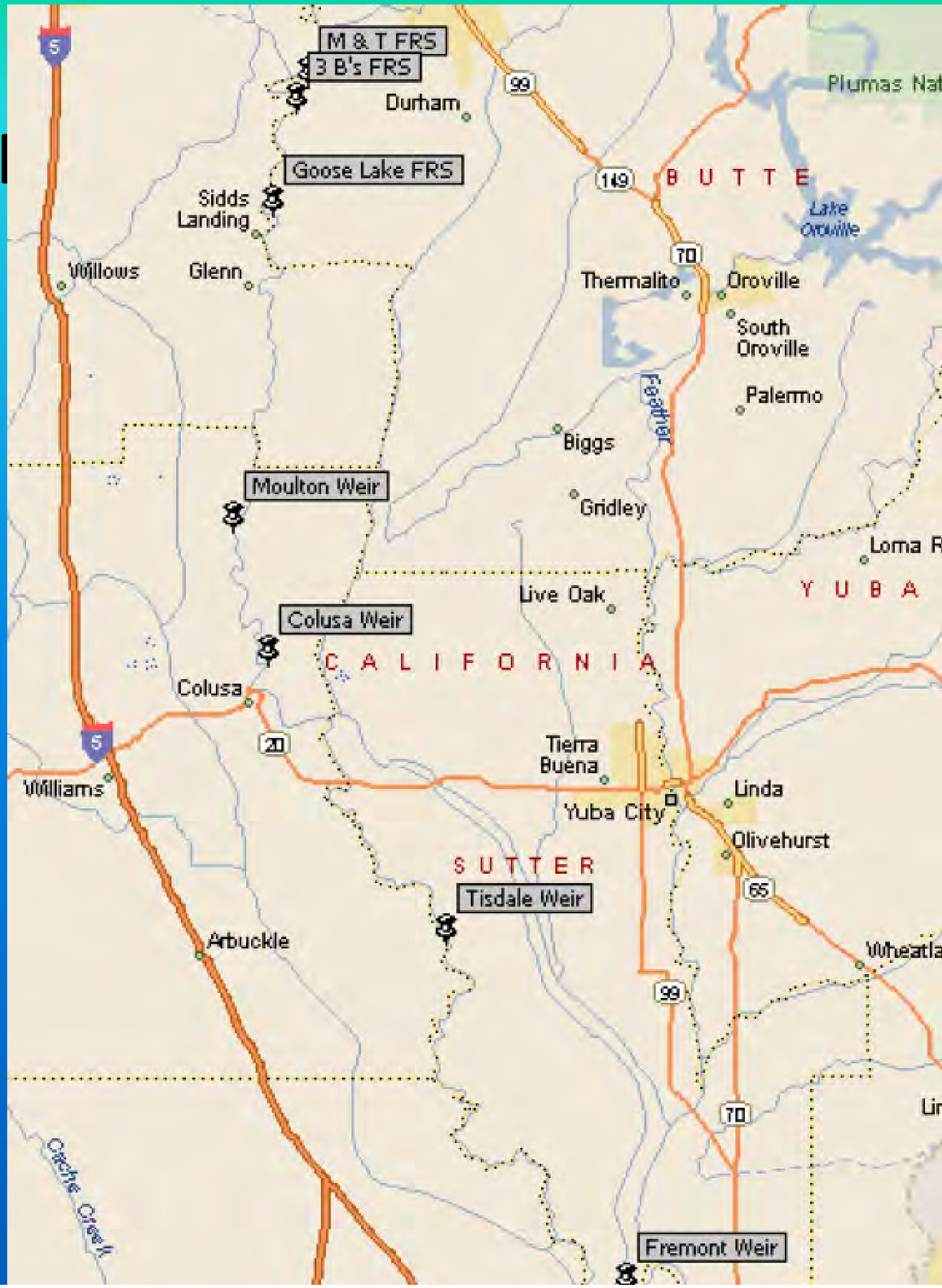
How to get fish onto other floodplains (ag lands)?

- Archimedes Screw Pumps
  - Large-bladed helicoid
  - Can pass large fish = pescalators



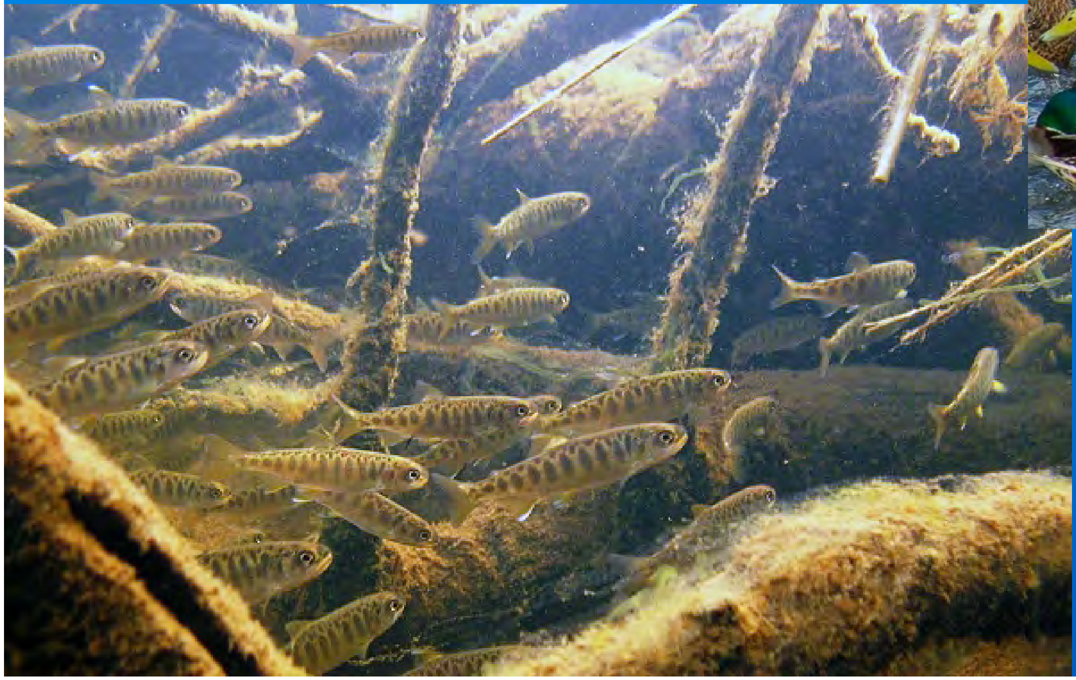
Sacramento River System Weirs

Sacra … eirs


M & T FRS
3 B's FRS
Durham
Goose Lake FRS
Sidds Landing
Willows
Glenn
Moulton Weir
Colusa Weir
Colusa
Williams
Arbuckle
Tisdale Weir
Fremont Weir
Cache Creek
Plumas Nati
B U T T E
Lake Oroville
Thermalito
Oroville
South Oroville
Palermo
Feather
Biggs
Gridley
Loma Ri
Y U B A
Live Oak
C A L I F O R N I A
Tierra Buena
Yuba City
Linda
Olivehurst
S U T T E R
Wheatlar
Lin
5
99
149
70
20
65

Sacramento River System Weirs

6. Vision for Integrated Stewardship



The Sac Valley Waterbird Success Story

- North American Waterfowl Management Plan (NAWMP) (1986), an international treaty signed by Canada, the United States and Mexico.
- The NAWMP was a direct response to declining numbers of North American waterfowl.

- Sacramento Valley lies near the southern end of the Pacific Flyway migratory route
- One of the most prominent wintering sites for migratory waterfowl.
- Central Valley Joint Venture (1988) focused on habitat regeneration.

- Air quality concerns = the practice of burning stubble was sharply curtailed by the California Legislature in 1991 (Rice Straw Burning Act, AB 1378).
- Alternative to burning = flood post-harvest rice fields to accelerate decomposition of rice stubble.
- 46% increase in Sacramento Valley acreage that is inundated during winter (Elphick and Oring 1998, Fleskes et al. 2005).
- Of the 525,000 acres planted to rice each year in the Sacramento Valley, about 350,000 acres are re-flooded following harvest.

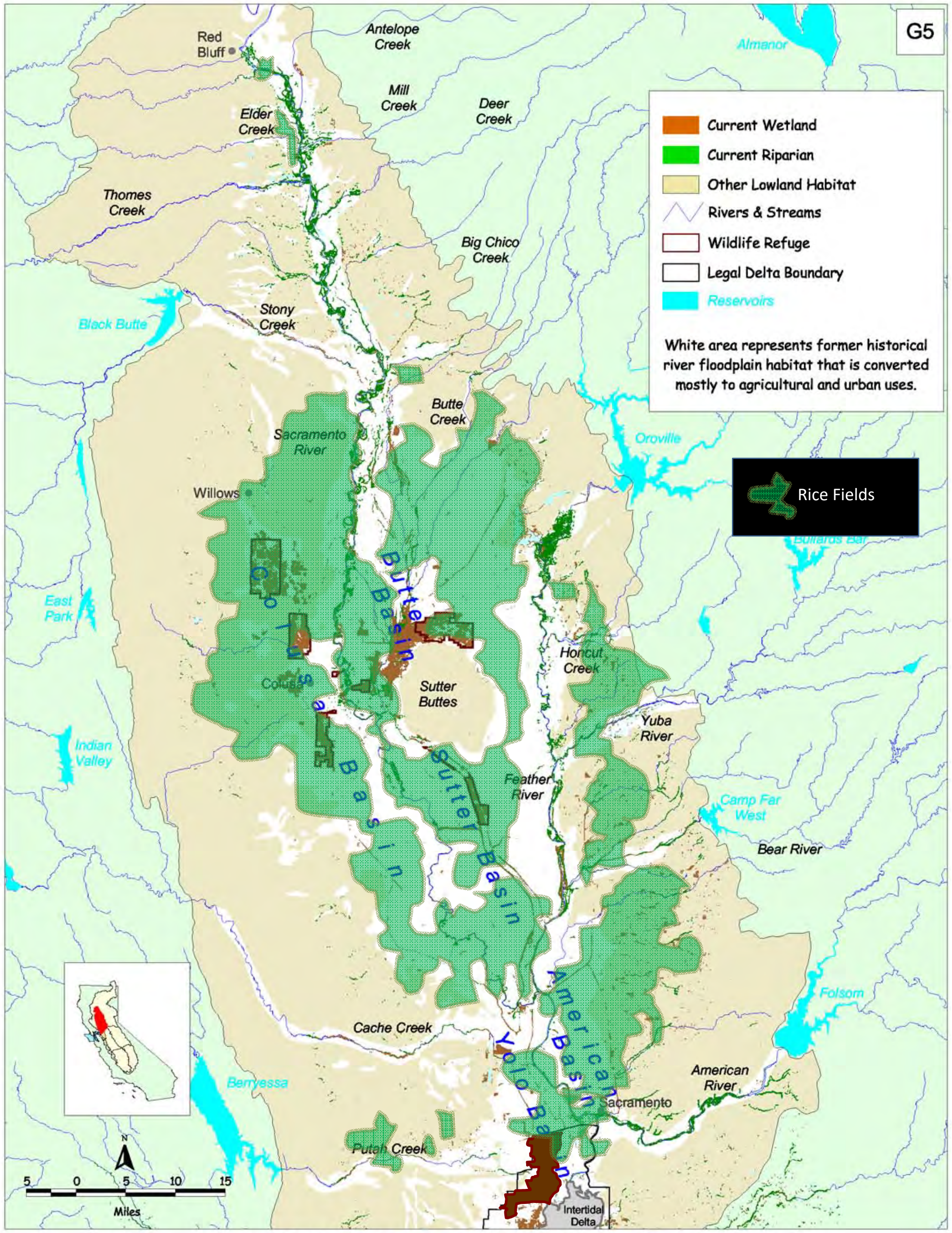
- This is a double benefit:
  - For the farmer, flooding helps in the decomposition of the rice straw, which otherwise would require burning or baling and removal.
  - The flooding also creates favorable conditions for waterfowl
  - Eliminating burning of the rice straw also reduces harmful emissions to the atmosphere.
- Ricelands provide about 60 percent of all the food that wintering waterfowl consume in the Sacramento Valley each year.

Today, ~4.7 million ducks, ~570,000 geese (Garone 2011) and ~300,000 shorebirds (Shuford et al. 1998) are estimated to winter in the Central Valley.

2014 marked the highest count ever recorded for waterfowl and shorebirds in the Central Valley.

- **West Coast bird populations are profiting from the winter productivity of farm fields managed as surrogate wetlands.**
- ***"But fish don't have wings to fly over levees."***
- **Having agriculture adopt wetland mgt for benefits of birds was the biggest (*largely unrecognized*) conservation success of the last 50 years.**
- **<u>The next big step is integrating management for native fish.</u>**

We have the room—we just need to do it!



Sacramento Valley Current River Floodplain Ecosystem

Acequias

The customary law of the acequia is older than and at variance with the Doctrine of Prior Appropriation, which is based on the principle of "first in use, first in right."

Acequia norms incorporate not just priority but **principles of equity and fairness.**

Prior Appropriation considers water to be <u>a commodity owned by private individuals.</u>

Acequia systems treat water as a community resource that irrigators have a shared right to use, manage, and protect.

Managed by a "mayordomo"

Mayordomo

Lit. - steward or servant.

- An elected official responsible for the day-to-day management of an acequia, oversees the distribution of water among members of the community acequia and managed supplies and conflicts.
- In some places, mayordomos were required to **carry performance bonds** to insure they performed their duties faithfully and with fairness/respect for all beneficial needs.


Central Valley Salmon Partnership
Sac Valley Mayordomos
-Manage summer irrigation & winter water
-Balance the needs of humans, fish, and birds


Thank you!

4. The Feather River

- My experience:
  - Contractor to FERC for relicensing / NEPA
  - Contractor to DWR for restoration planning (license compliance)
  - Contractor to City of Oroville (Feather River Consolidated Master Plan)

The Feather River – a truncated system

- Holding habitat relegated to valley floor
- Floodplain connectivity nearly completely eliminated
- Hydrology impaired (SWP operations)

Focus on maximizing ecosystem function in a constrained system

- In regulated rivers, ecosystem functions are telescoped into a shorter reach below the dam.
- Initial rehabilitation efforts in regulated rivers have focused on gravel augmentation and spawning habitat.
- Growing awareness that rearing habitat is a limiting factor in successfully increasing escapement.

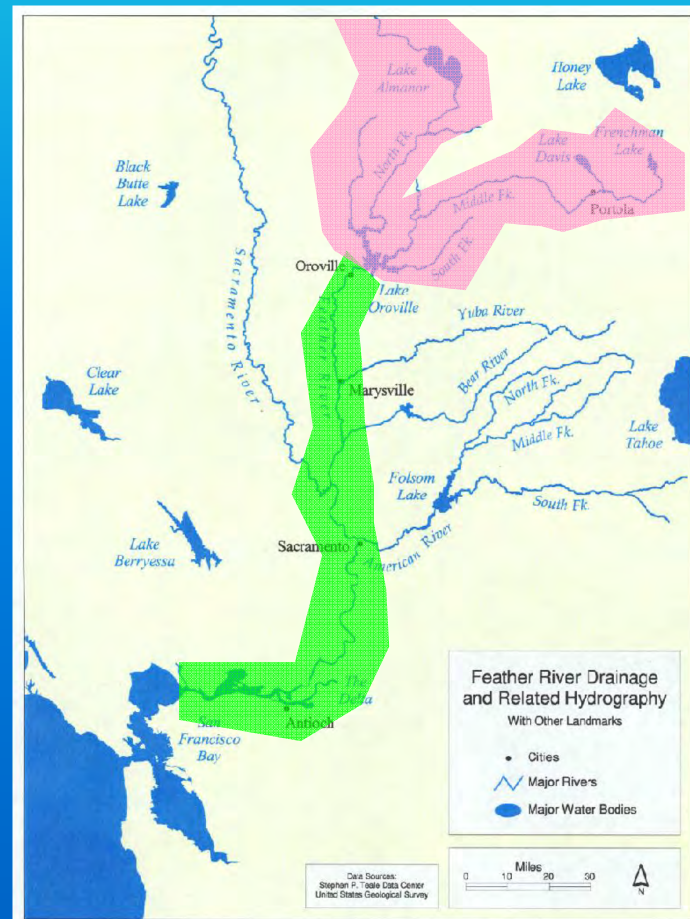


Figure 2

Focus on maximizing ecosystem function in a constrained system

- In regulated rivers, ecosystem functions are telescoped into a shorter reach below the dam.
- Initial rehabilitation efforts in regulated rivers have focused on gravel augmentation and spawning habitat.
- Growing awareness that rearing habitat is a limiting factor in successfully increasing escapement.

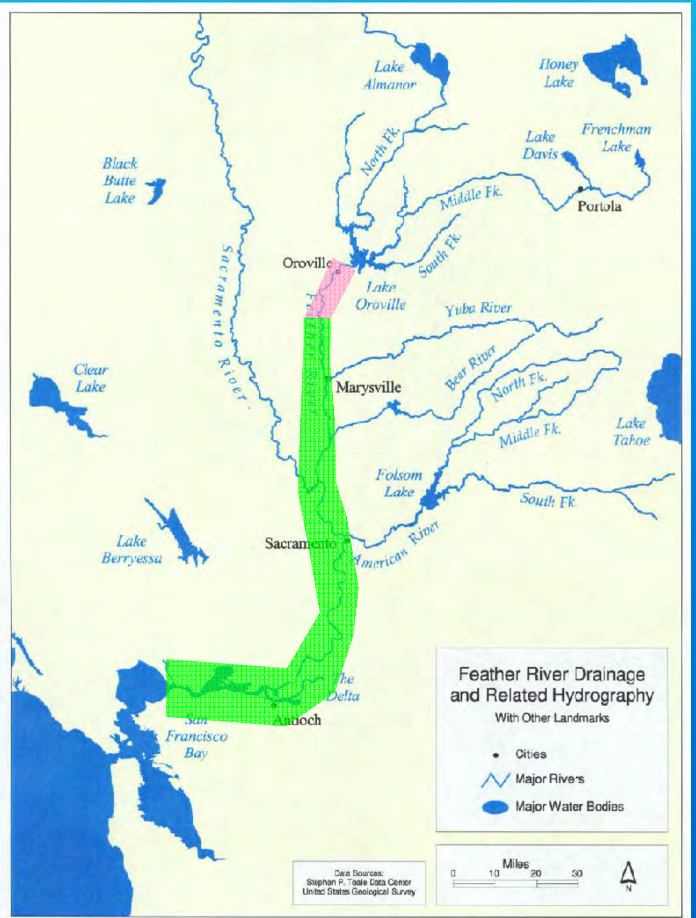


Figure 2

FERC License – Settlement Agreement

SETTLEMENT AGREEMENT

FOR LICENSING OF THE OROVILLE FACILITIES

FERC Project No. 2100

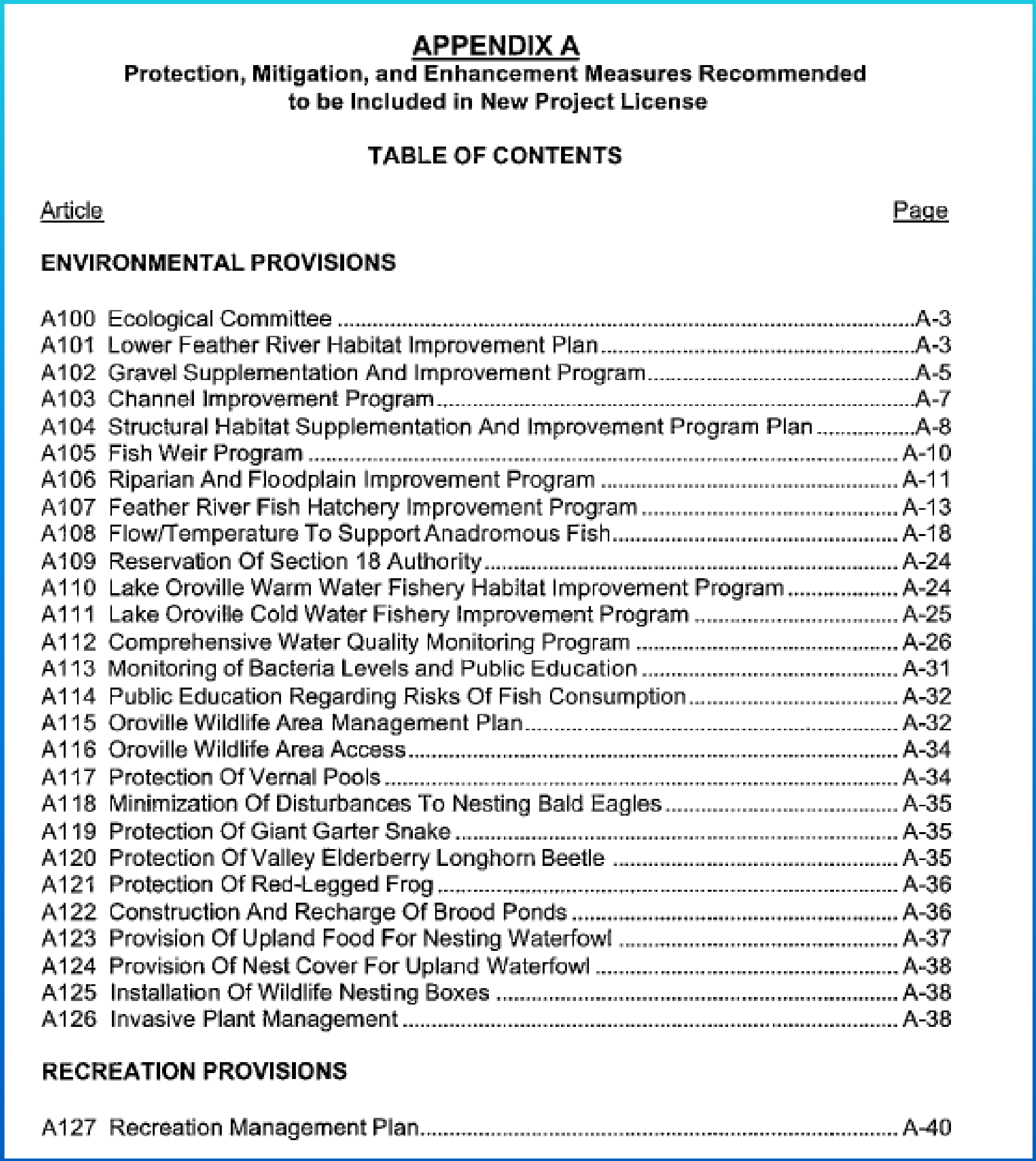
March 2006

State of California
Resources Agency
Department of Water Resources

EXHIBITS AND APPENDICES

Appendix A	-	Protection, Mitigation, and Enhancement Measures Recommended to be Included in New Project License
Appendix B	-	Measures Agreed to Among the Parties But Not to be Included in New Project License
Appendix C	-	Ecological Committee
Appendix D	-	SWRCB Collaborative Process Participation Statement
Appendix E	-	Forest Service Draft 4(e) Conditions
Appendix F	-	Draft Agreement for Habitat Expansion
Appendix G	-	List of Authorized Representatives

FERC License – Settlement Agreement



APPENDIX A

Protection, Mitigation, and Enhancement Measures Recommended to be Included in New Project License

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RECREATION PROVISIONS

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ENVIRONMENTAL PROVISIONS

A106

- Gravel extraction operator to complete work
- Cost capped at $5 Million (not incl gravel profits)
- Includes consideration of benefits of pulse flows, but no obligation to implement them.

DWR License Compliance Planning

OROVILLE FACILITIES
FERC PROJECT NO. 2100

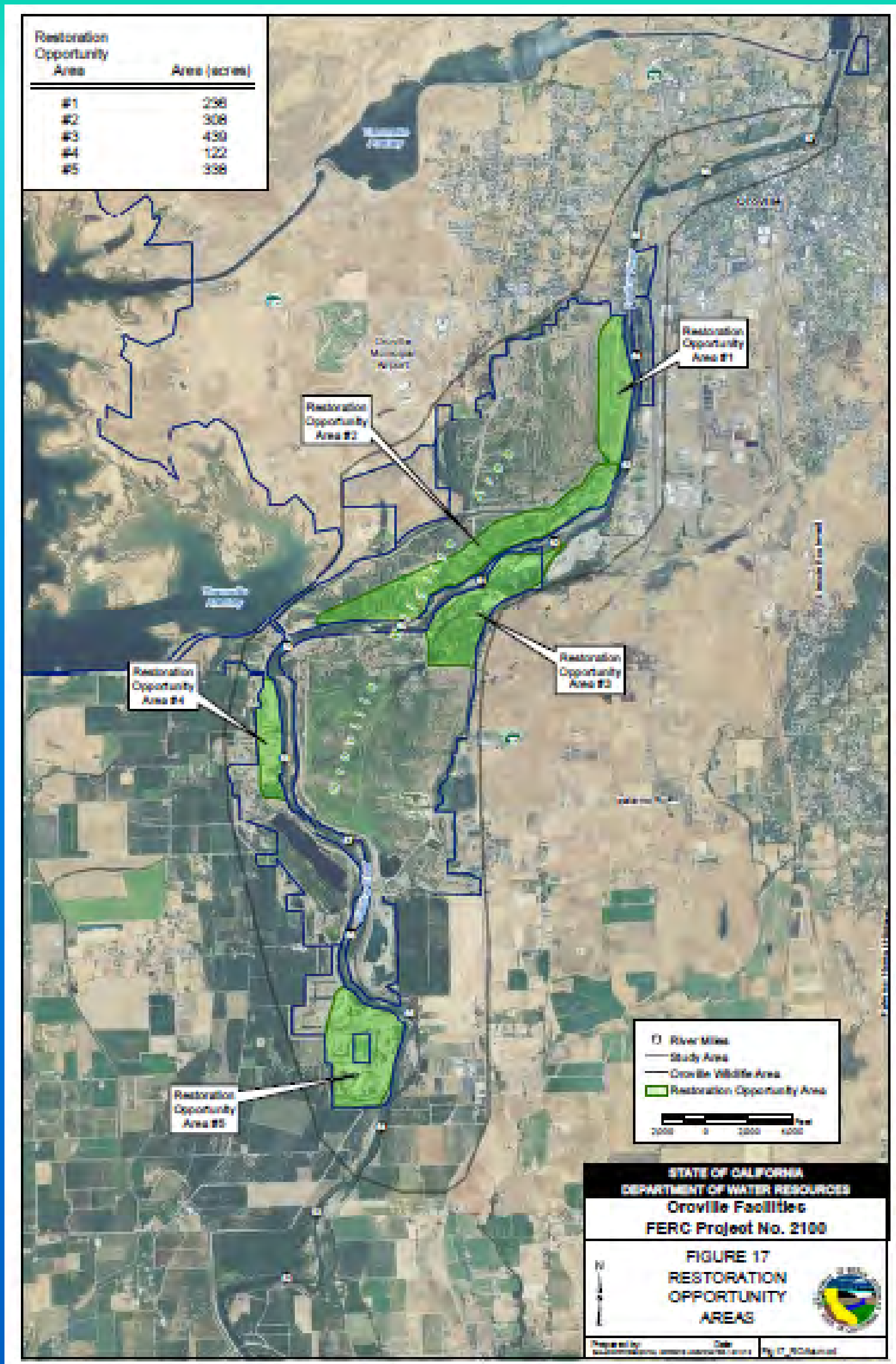
DRAFT
SETTLEMENT AGREEMENT
ARTICLE A106

FLOODPLAIN & RIPARIAN RESTORATION PLANNING TECHNICAL REPORT

State of California
California Natural Resources Agency
Department of Water Resources

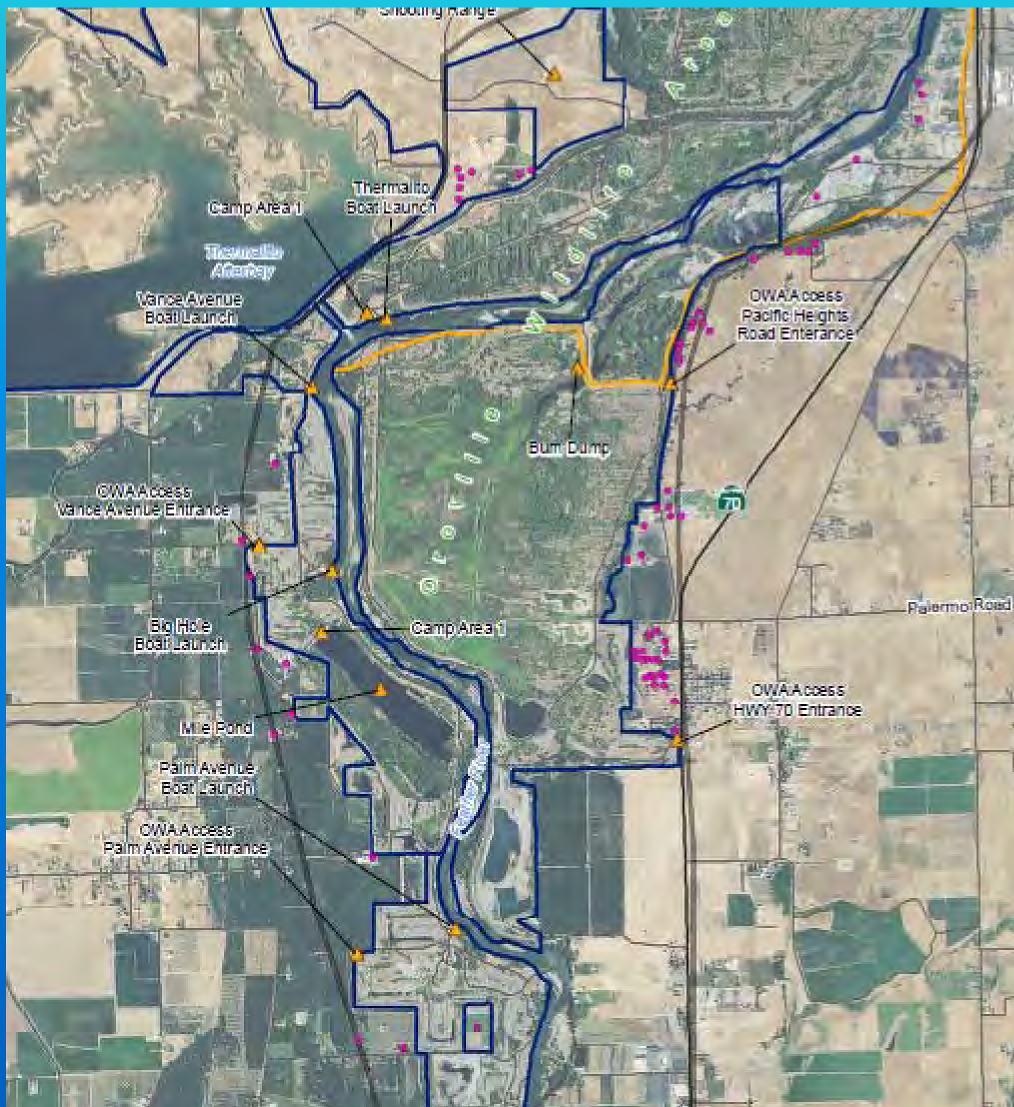
October 2013

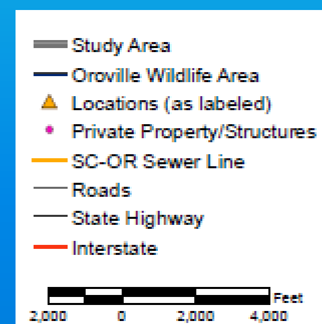
Edmund Gerald Brown, Jr. **Governor** **State of California**	John Laird **Secretary for Resources** **California Natural Resources Agency**	Mark Cowin **Director** **Department of Water Resources**



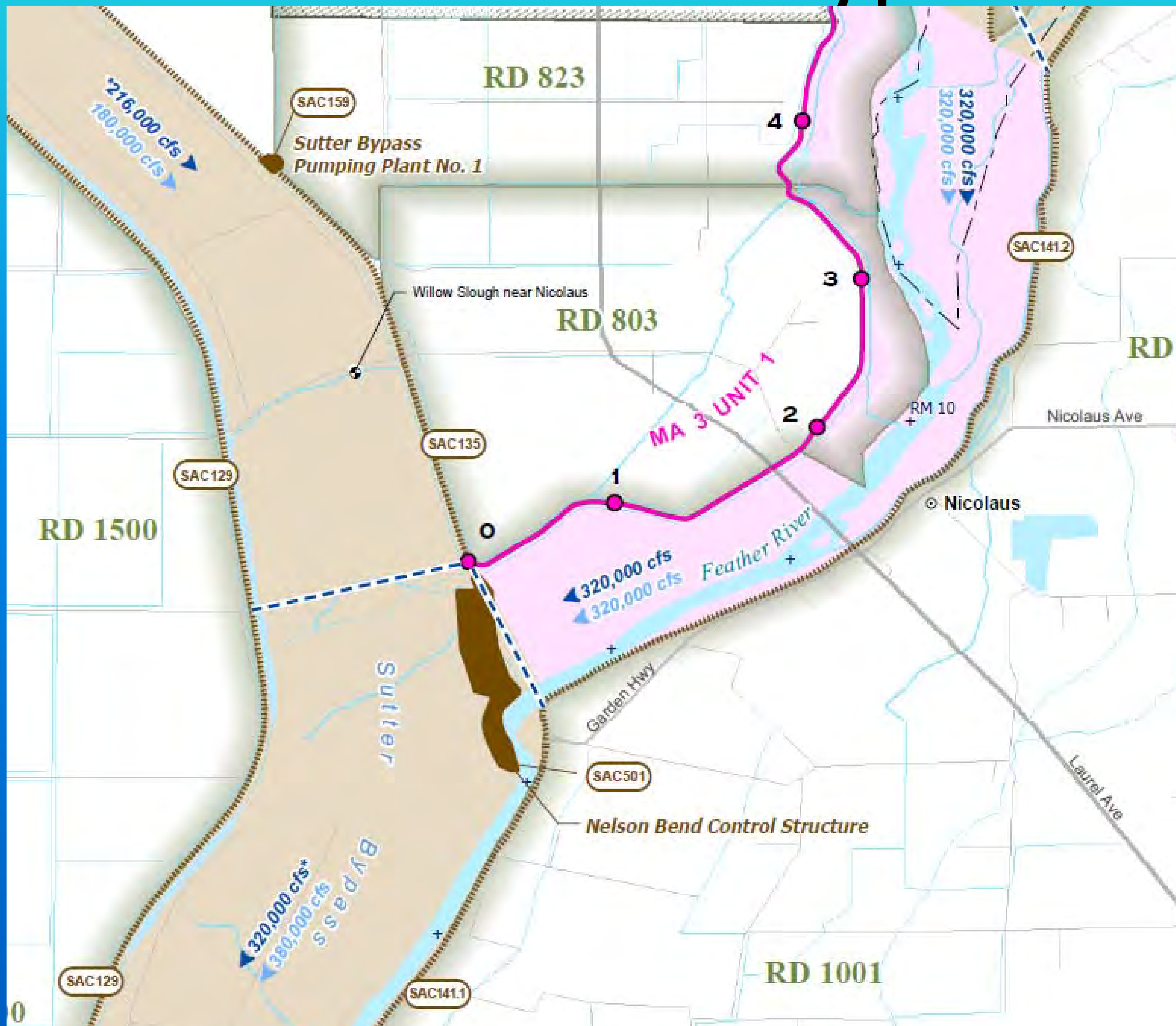
Oroville Wildlife Area (OWA)

OWA – Unit D


Shooting Range
Thermalito Boat Launch
Camp Area 1
Thermalito Afterbay
Vance Avenue Boat Launch
OWA Access Pacific Heights Road Enterance
Burn Dump
OWA Access Vance Avenue Entrance
Big Hole Boat Launch
Camp Area 1
Mile Pond
OWA Access HWY 70 Entrance
Palm Avenue Boat Launch
OWA Access Palm Avenue Entrance
Palermo Road
Oroville Wildlife Area
Feather River
70


Study Area
Oroville Wildlife Area
Locations (as labeled)
Private Property/Structures
SC-OR Sewer Line
Roads
State Highway
Interstate
Feet
2,000 0 2,000 4,000

Lower Sutter Bypass



Lower Sutter Bypass