A River Reborn:Restoration and Monitoring in the Former Footprint of Klamath Dams: Morning Session

A Concurrent Session at the 43rd Annual Salmonid Restoration Conference
Redding, California, May 1, 2026

Session Coordinators: Bob Pagliuco, *Marine Habitat Resource Specialist, NOAA Fisheries Restoration Center*; and Mike Belchik *Sr. Water Policy Analyst, Yurok Tribe*

The Klamath River once supported the third-largest salmon runs in the U.S. West Coast. Between 1918 and 1962, PacifiCorp built four hydroelectric dams—J.C. Boyle, Copco Nos. 1 & 2, and Iron Gate—that blocked migratory fish passage and degraded river ecosystems. After decades of advocacy by tribal nations and environmental groups, the Klamath Hydroelectric Settlement Agreement was reached, paving the way for dam removal. Physical removal began in mid-2023 and was completed in September, 2024. The removal of the Klamath River dams marks a historic step toward restoring one of the West Coast's most important salmon runs, but success won't be measured in months—or even just a few years. Restoration and monitoring need to occur to understand the outcomes of this landscape scale project. This session will highlight the current and future restoration efforts in the footprints of the former reservoirs on the Klamath River and highlight what the first year of physical and biological monitoring has revealed thus far after the largest dam removal in history.

Presentations

- **Klamath Dams and Downriver Nutrient Dynamics: Past, Present, and Future**
  John R. Oberholzer Dent, M.S., *Biologist, Karuk Tribe Department of Natural Resources*……..…..Slide 4

- **Effects of Dam Removal on Klamath River Aquatic Food Webs**
  Claire Inouye, M.S. student, *Cal Poly Humboldt Department of Environmental Science & Managemen*t……...Slide 39

- **Rebuilding Tributaries in the Former Reservoir Footprint to Support a Newly Free-Flowing Klamath River**
  Dan Chase, *M.S. Biologist*, and Dave Coffman, P.E.*,Resource Environmental Solutions (RES)*……..……Slide 93

- **Beyond the Reservoir Footprint: Restoring Tributaries to the Klamath River After the World's Largest Dam Removal Project**
  Max Ramos, M.S., *Restoration Engineer*, William Nuckoles, M.S., *Restoration Engineer, Yurok Tribe Fisheries Department Technical Services Program*……..…….....Slide 151

- **How Best to Remove a Fish Passage Barrier:, Blast or no Blast? A Case Study of the Jenny Creek Barrier Removal Implementation Determination**
  Evan Bulla, *Project Manager, Trout Unlimited*……..……Slide 205

- **Modernizing Fisheries Data in the Klamath Basin: A Collaborative Leap Forward**
  Monica Diaz, *Pacific States Marine Fisheries Commission*..……Slide 227

Klamath Dams and Downriver Nutrient Dynamics: Past, Present, and Future

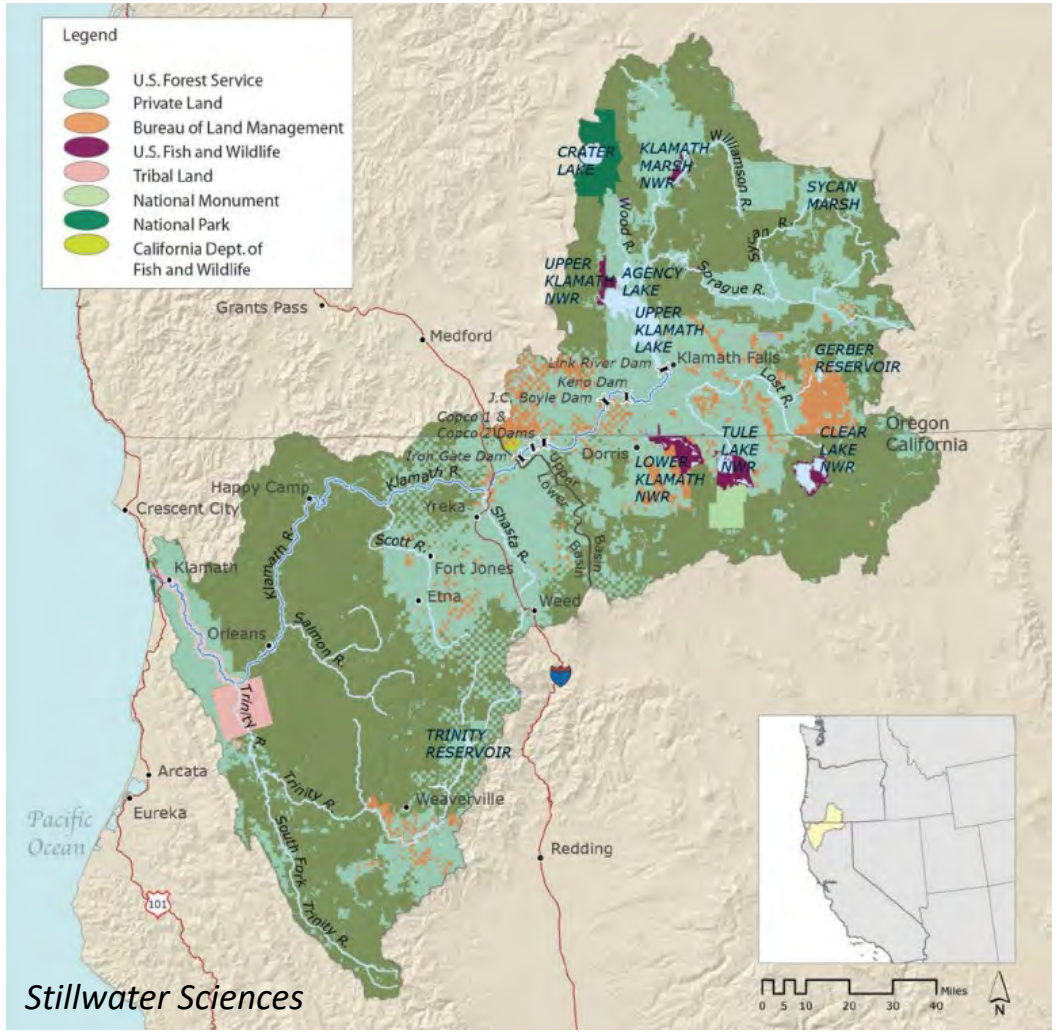
John R. Oberholzer Dent
Karuk Tribe Department of Natural Resources

Eli Asarian
Riverbend Sciences

Jacob Kann
Aquatic Ecosystem Sciences

Confluence of Klamath and Salmon Rivers 1/17/2024 during dam removal / *J.R. Oberholzer Dent*

Nutrients underwrite aquatic ecology



Stillwater Sciences

- **The Klamath Basin is nutrient-polluted** due to agriculture and grazing, development, draining of wetlands, mining, logging, erosion of volcanic soils, and other colonial anthropogenic activity
- **Eutrophy enables** excess biomass, cyanobacterial blooms, and resulting **water quality impairment** (DO, pH, fish disease, algal toxins, disrupted fishing and ceremony)
- **Dam impacts on** nutrient dynamics are typically conceived at the scale of the reservoir, not **downriver free-flowing reaches**

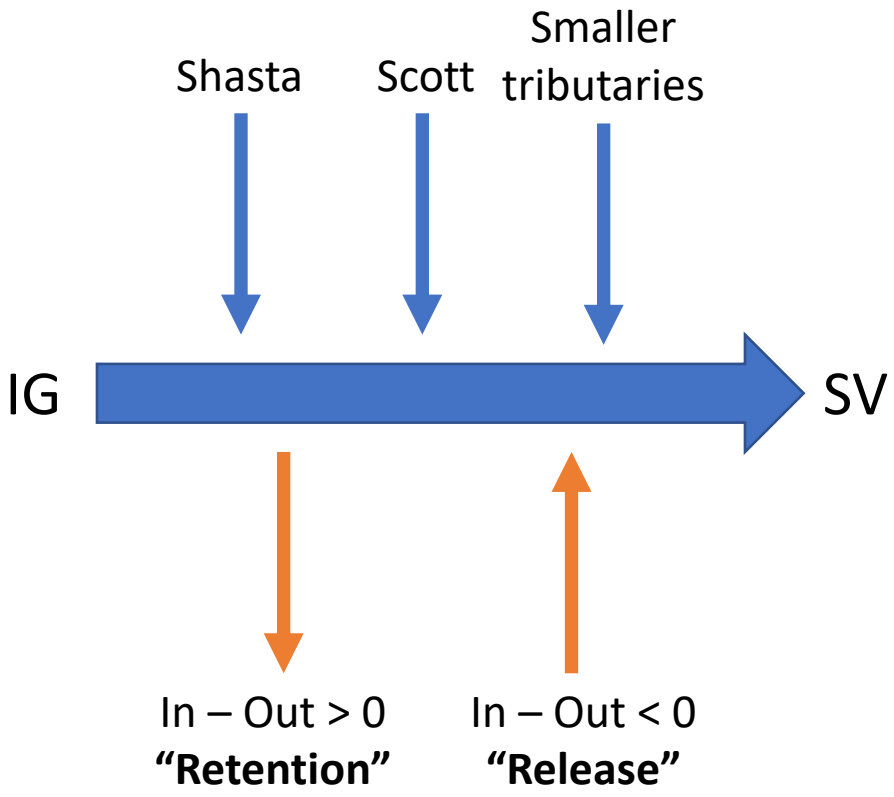
What can we learn from 20 years of tribal nutrient monitoring?

1. How do dams impact nutrient dynamics in downriver reaches?
2. How does dam removal impact the river ecosystem through nutrient vectors?
3. What might future nutrient dynamics in the mid and lower Klamath River look like after dam removal?

…And why do nutrients matter?

Cal Poly Humboldt

Nutrient budgets, retention, and release



Retention (+)	Release (–)
Inorganic/dissolved: uptake, denitrification, sorption **Organic/particulate**: mineralization, settling	**Inorganic/dissolved**: nitrogen fixation, desorption **Organic/particulate**: decay, bed resuspension

Not the same as nutrient spiraling – gross vs. net retention

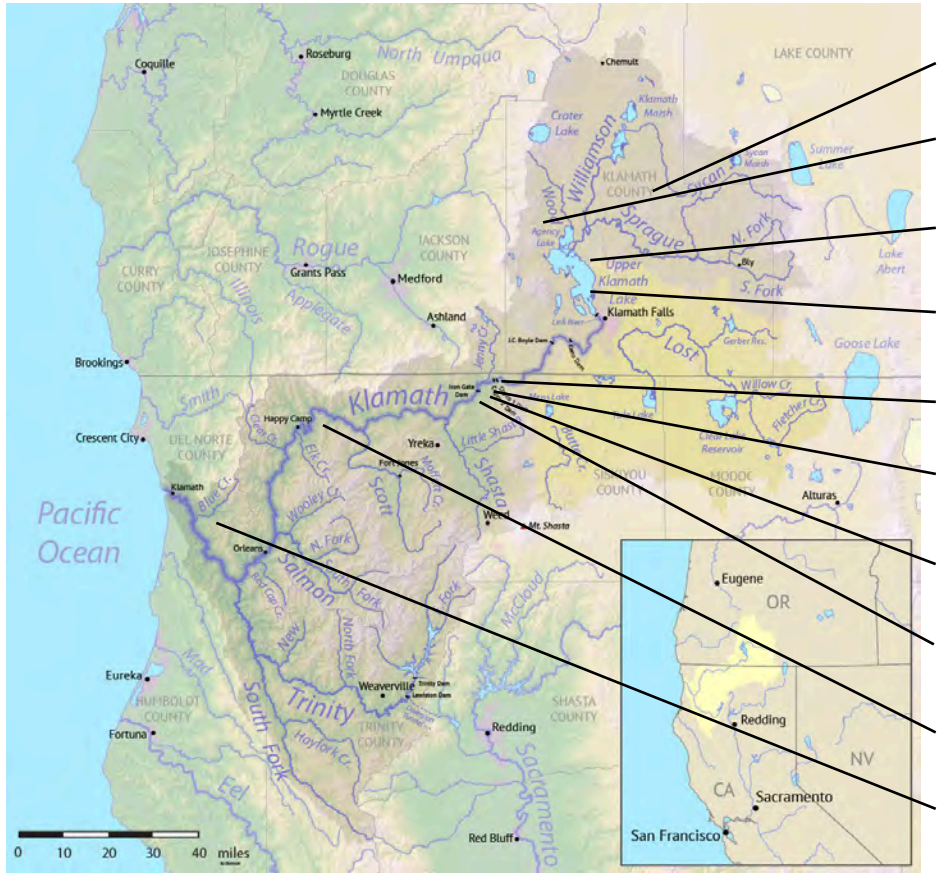
In-river Net Retention =
Load In (mainstem + tribs)
– Load Out (mainstem)

Load (kg/d) = Concentration (mg/L) * Discharge (cfs) * 2.45

Regressions with discharge, season, and antecedent conditions

USGS NWIS, area-weighted accretions

Long-term tribal research on Klamath Basin nutrients



Including but not limited to:

Walker, J.D., & Kann, J. 2022. *Spatial and Temporal Nutrient Loading Dynamics in the Sprague River Basin, OR, Water Years 2002 – 2020.* Prepared for Klamath Tribes.

Kann, J. 2020. *Nutrient Loading and Concentration Dynamics in the Sevenmile Creek System – 2019.* Prepared for Klamath Tribes.

Walker, W.W., Walker, J.D., & Kann, J. 2012. *Evaluation of Water and Nutrient Balances for the Upper Klamath Lake Basin in Water Years 1992-2010.* Prepared for Klamath Tribes.

Walker, J.D., & Kann, J. 2022. *Water and Nutrient Balances of Upper Klamath Lake, Water Years 1992-2018.* Prepared for Klamath Tribes.

Asarian, E. and J. Kann. 2011. *Phytoplankton and Nutrient Dynamics in Iron Gate and Copco Reservoirs 2005-2010.* Prepared for Klamath Tribal Water Quality Consortium.

Asarian, E., J. Kann, and W. Walker. 2009. *Multi-year Nutrient Budget Dynamics for Iron Gate and Copco Reservoirs, California.* Prepared for Karuk Tribe

Kann, J., & Asarian, E. 2007. *Nutrient Budgets and Phytoplankton Trends in Iron Gate and Copco Reservoirs, California, May 2005 – May 2006.* Prepared for CA Water Board.

Kann, J., & Asarian, E. 2005. *2002 Nutrient and Hydrologic Loading to Iron Gate and Copco Reservoirs, California*. Prepared for Karuk Tribe.

Asarian, E., & Kann, J. 2006. *Klamath River Nitrogen Loading and Retention Dynamics 1996-2004*. Prepared for Karuk Tribe.

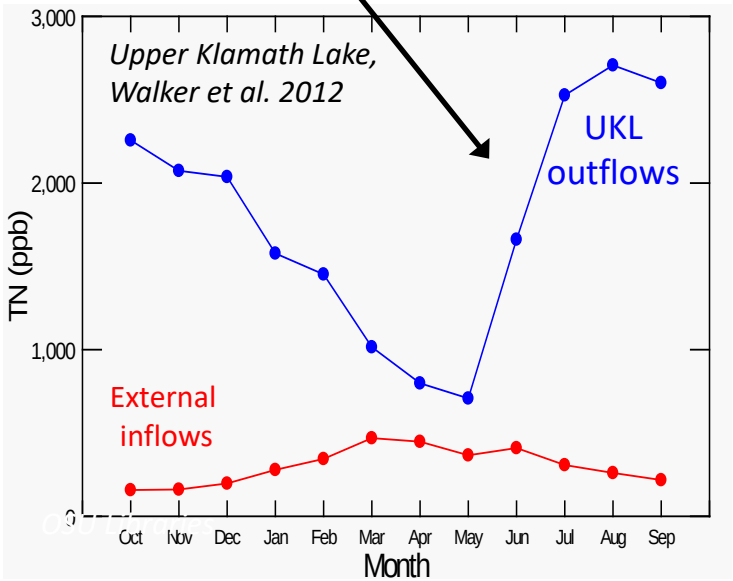
Asarian, E., J. Kann, and W. Walker. 2010. *River Nutrient Loading and Retention Dynamics in Free-Flowing Reaches, 2005-2008.* Prepared for Yurok Tribe.

Tribal science departments have collected high-frequency, quality-assured, **long-term** sampling records which enable the use of advanced methodologies and analysis of basin-wide nutrient dynamics in a large, inter-jurisdictional watershed.

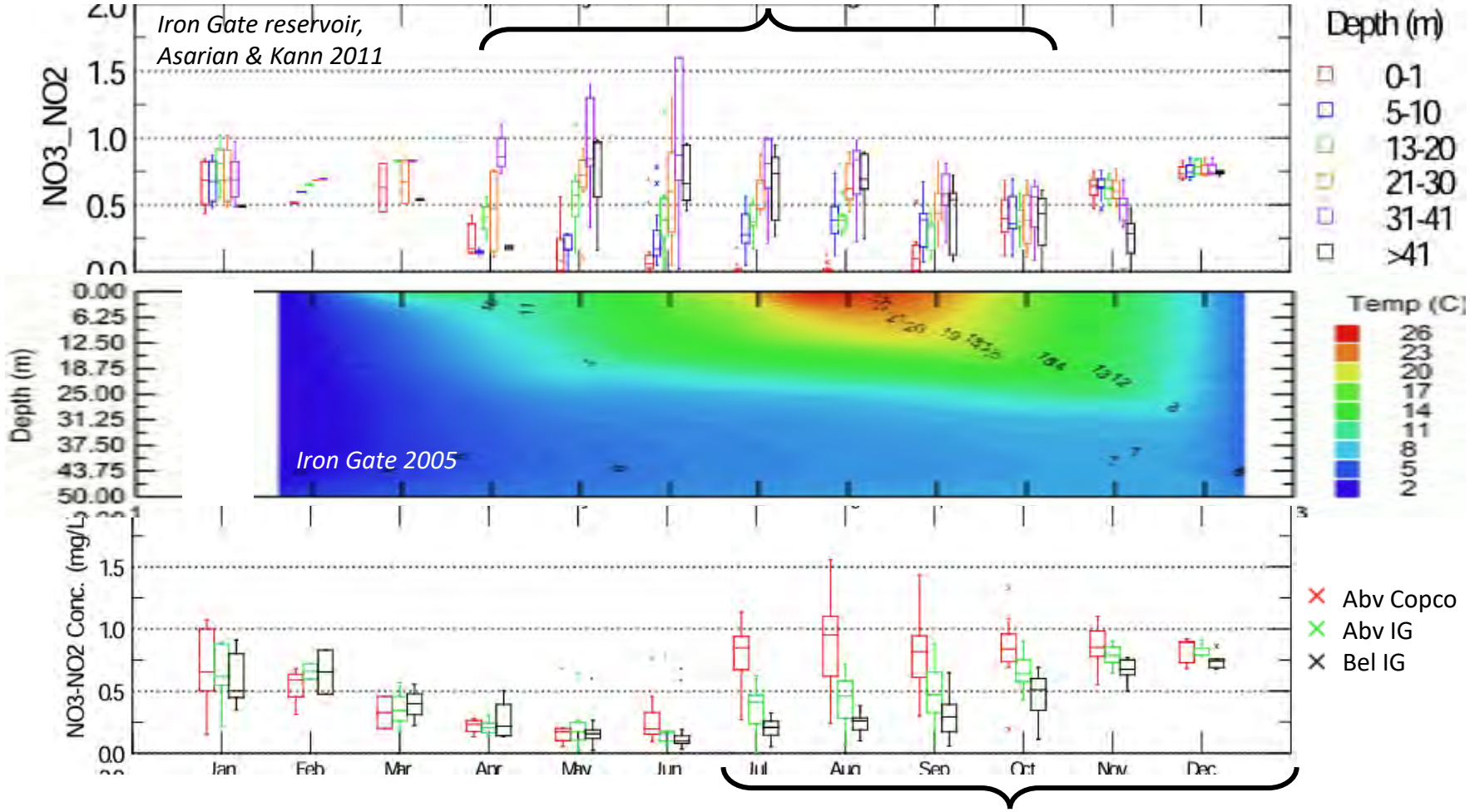
Place-based tribal datasets can drive new understandings of aquatic ecology at large

Reservoirs delay nutrient subsidies from Upper Klamath Lake

1. *AFA* bloom collapses, releasing atmospherically fixed nitrogen (**~July**)



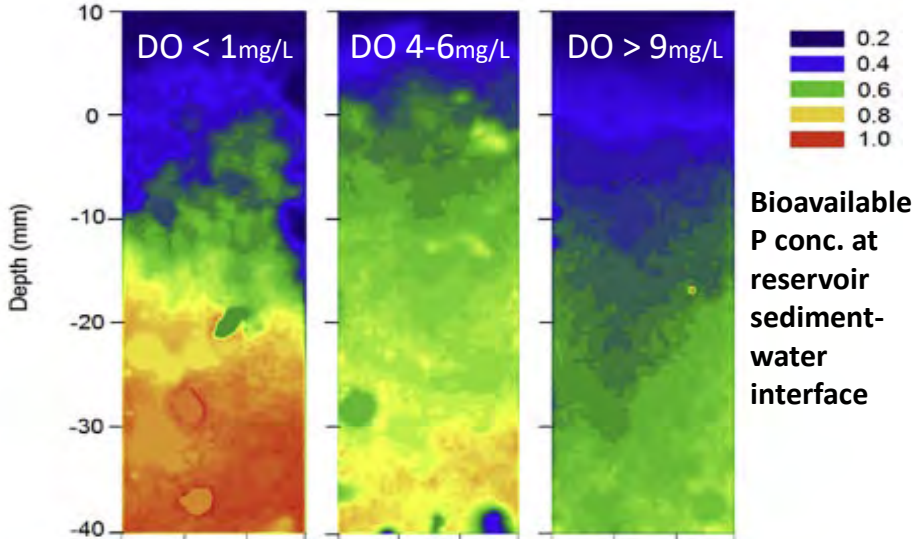
2. Stratification period (**summer and fall**): uptake (*Microcystis*) and settling, nitrate stored at bottom



3. Outlet conc remains low until layer mixing in **winter**

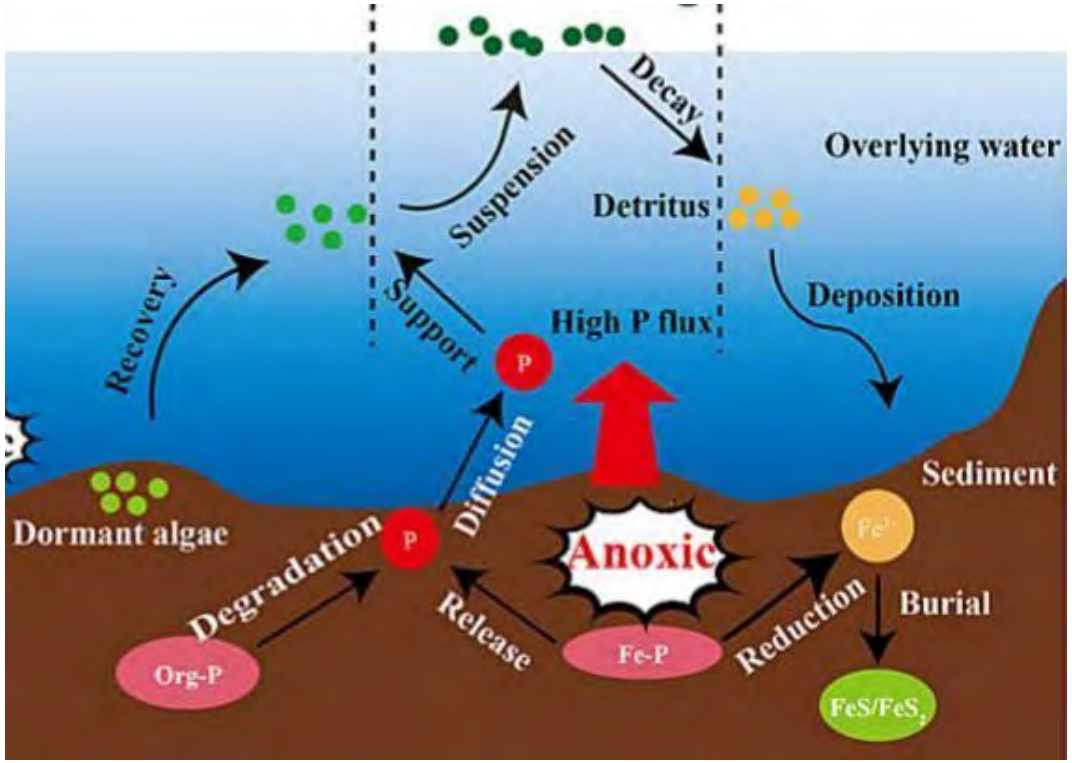
Summer nutrient release from reservoirs

Reservoirs are conventionally assumed to retain nutrients… but some, especially older, release bioavailable N and P from the anoxic hypolimnion during warm season stratification



Bioavailable P conc. at reservoir sediment-water interface

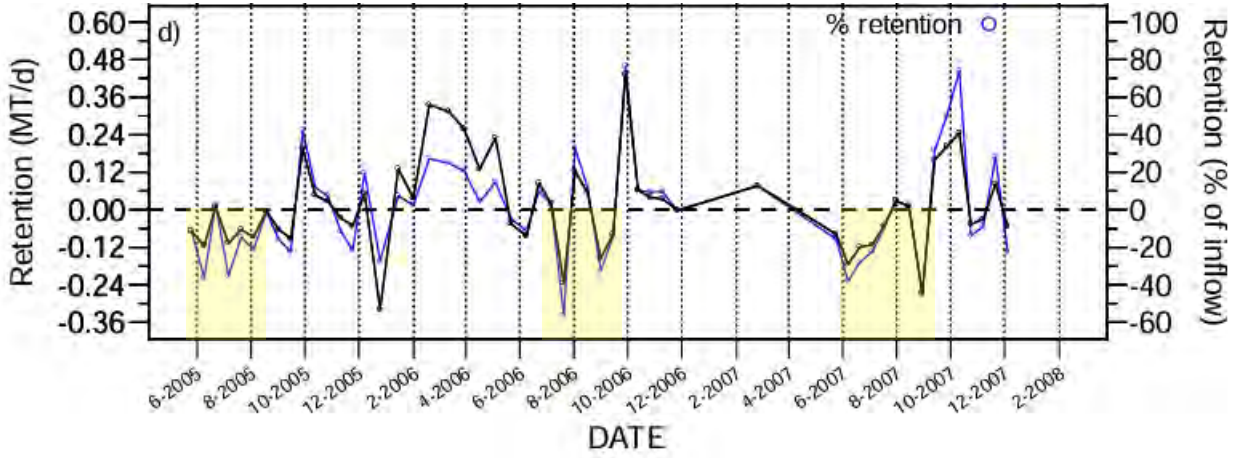
Wang, J., et al. *Environ. Pollut.* **2016**, 219, 858–865.



Lv, Y., et al. Sci. Total Environ. **2024**, 917, 170490.

Klamath reservoirs had net retention of TN and TP on an annual basis, but significant P release during late summer and fall months

Copco reservoir TP retention (Asarian et al. 2009):



New report:

Nutrients and Nutrient Retention in the Klamath River, CA, 2005-2023: Seasonality, Hydrology, and Trends

John R. Oberholzer Dent, Eli Asarian, and Jacob Kann

Thanks to:

Karuk Tribe Water Quality Program

Yurok Tribe Water Quality Program

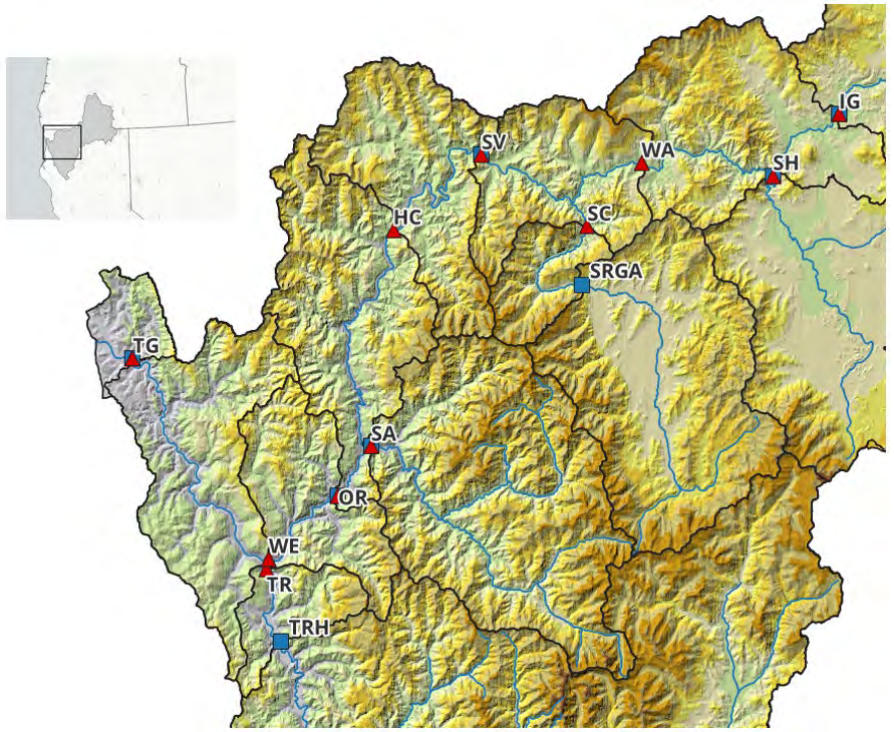
Quartz Valley Indian Reservation

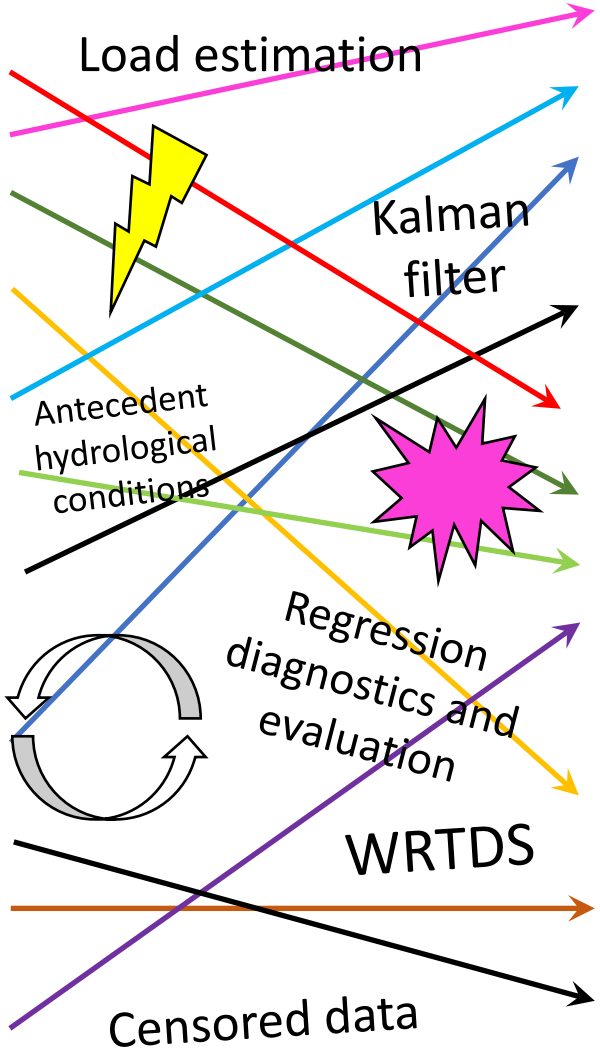
Klamath Tribal Water Quality Consortium

As well as EPA, Pacificorp, CA Water Board

Data, methods, and products

- 1,967 samples from seven mainstem sites
- 1,060 samples from four large tributaries
- 683 samples from other tributaries
- Daily discharge from six USGS gages
- Hydrological data from PRISM, SnowView



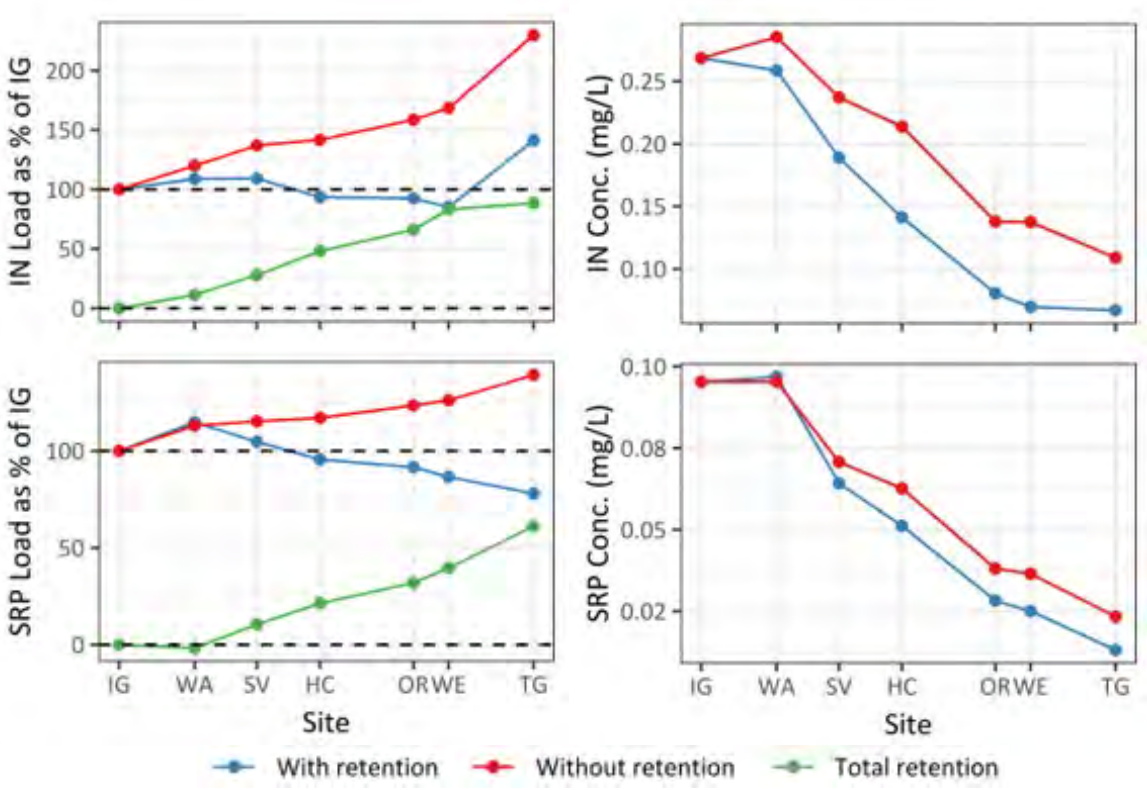


For six nutrient parameters (TN, IN, ON, TP, SRP, PP) from 2005-2023

- Daily time series of nutrient concentrations and loads at seven mainstem sites and four tributary sites
- Monthly summaries of retention in absolute (kg/d), areal (mg/m^2/d), and relative (%/mi/d) terms for six reaches
- Monthly summaries of precipitation and snow hydrology for HUC-8s

Nutrient retention in free-flowing reaches

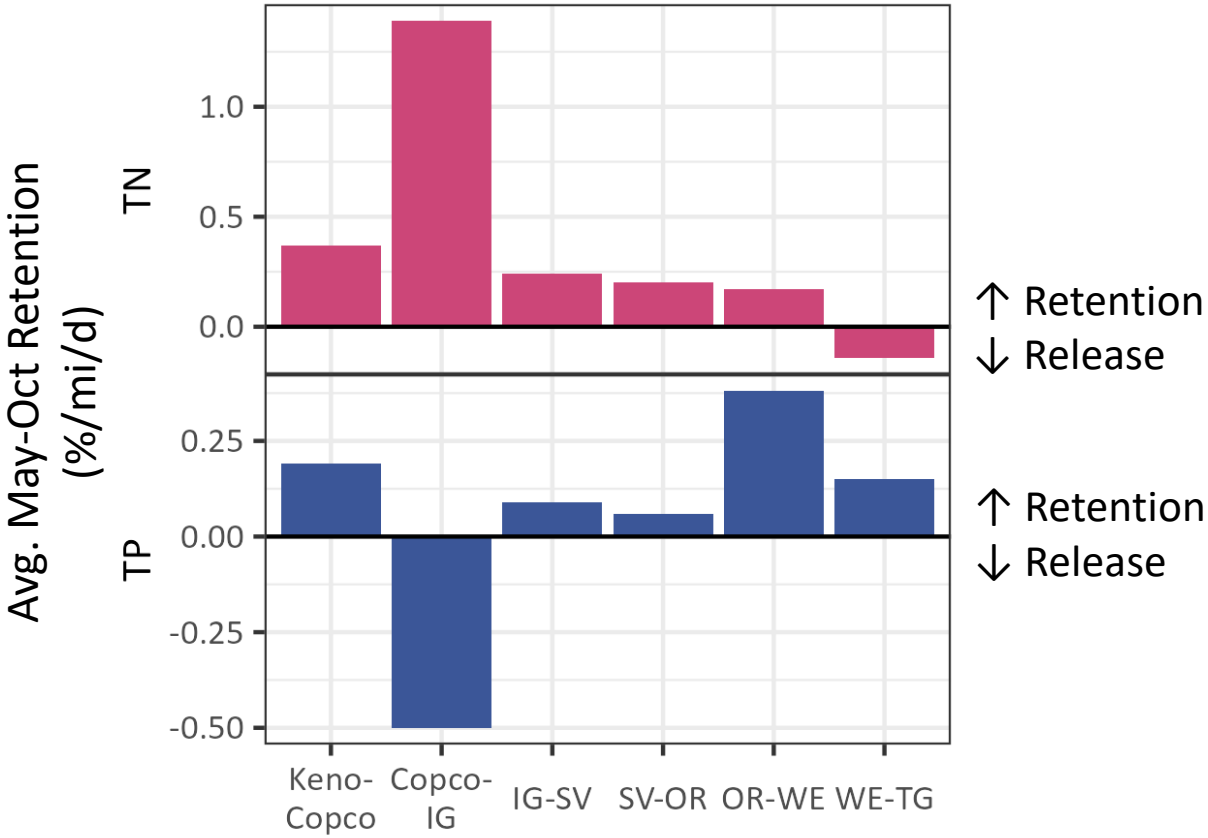
Despite tributary inputs, nutrient loads and concentrations are significantly reduced by in-river retention in free-flowing reaches



Oberholzer Dent et al. 2026

Reservoir dynamics depend on physical parameters (e.g., depth)

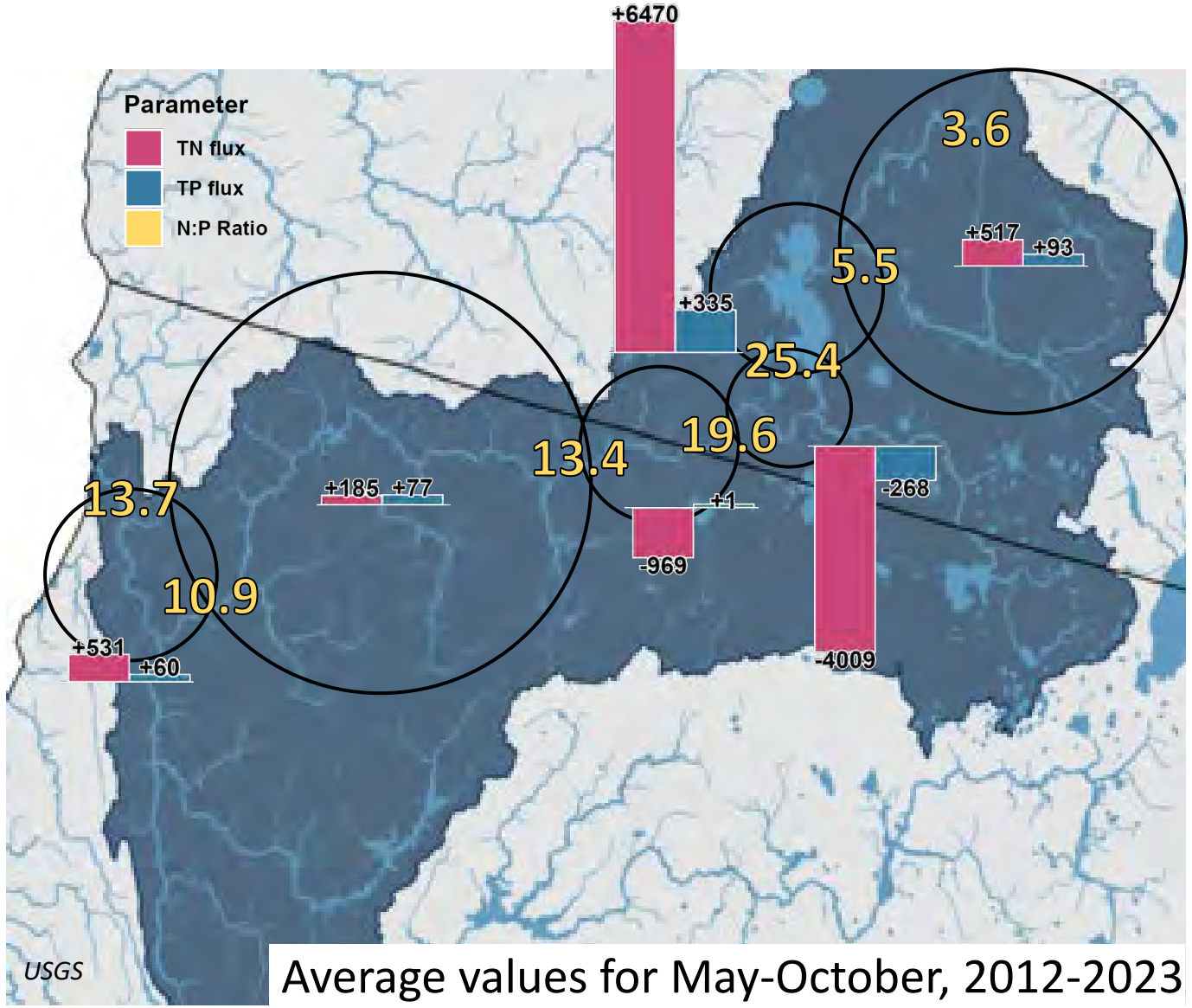
Putting it all together:



Asarian et al. 2009, 2010
Oberholzer Dent et al. 2026

Headwaters to mouth: Nutrient flux and stoichiometry

Low N:P ratios trigger cyanobacterial dominance via nitrogen fixation – balanced “Redfield” ratio at ~16:1 N:P

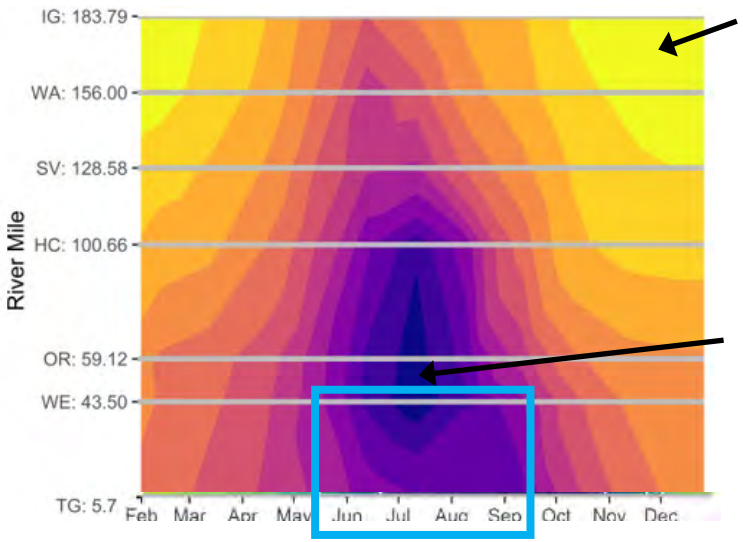


Average values for May-October, 2012-2023

1. Upper Basin: Agricultural pollution, erosion, degradation of wetlands
2. Within Upper Klamath Lake: N-fixing cyanobacterial blooms due to low N:P ratios, internal P cycling
3. Keno Reservoir and Klamath Irrigation Project diversions: water re-routed through KIP - loads go down but concentration goes up with less water
4. Hydroelectric reach: Settling, transformation, and cycling in reservoirs (now removed)
5. Below Iron Gate to Orleans: Tributary inputs are reduced by in-river retention processes
6. Orleans to Turwar: N-fixing biota return as N:P ratios go down

Nitrogen limitation and fixation over 175 mi

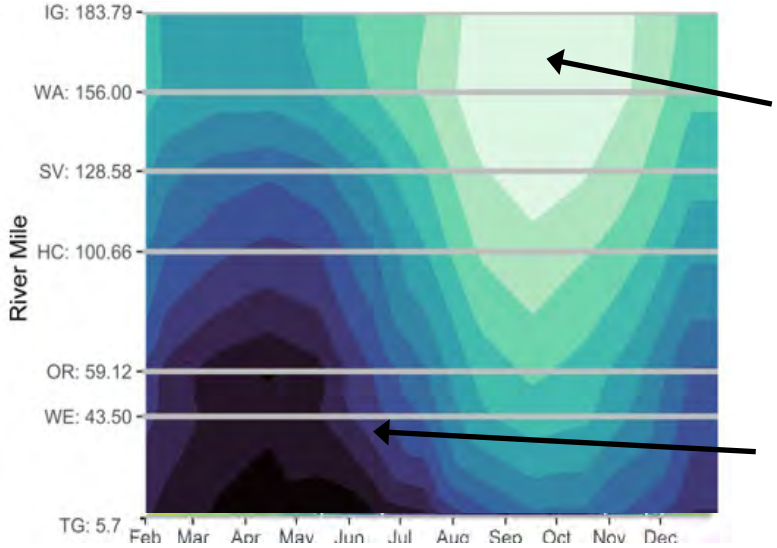
IN Conc.



Peak in winter during reservc mixing

Minimum in summer during max retention

SRP Conc.

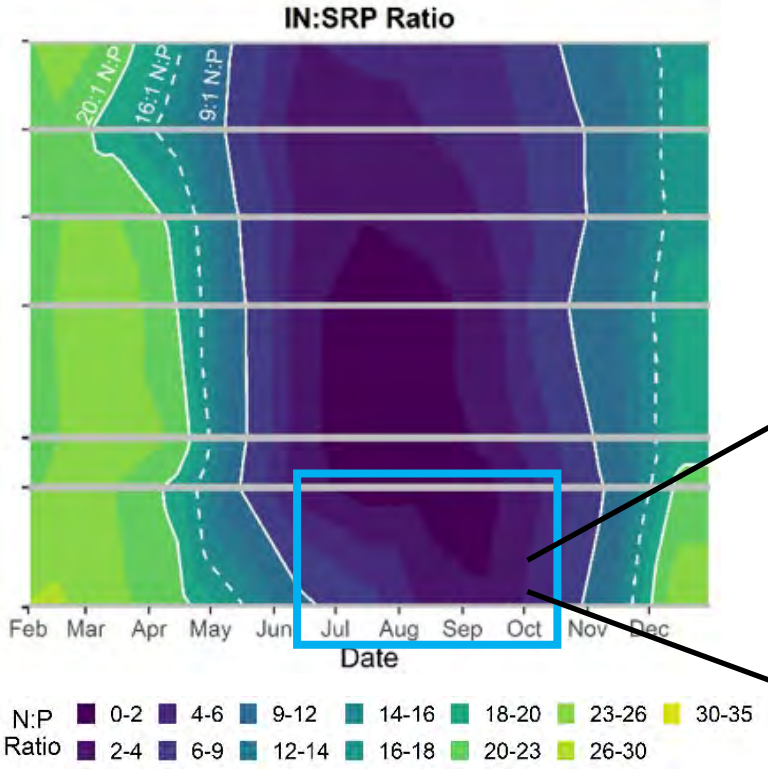


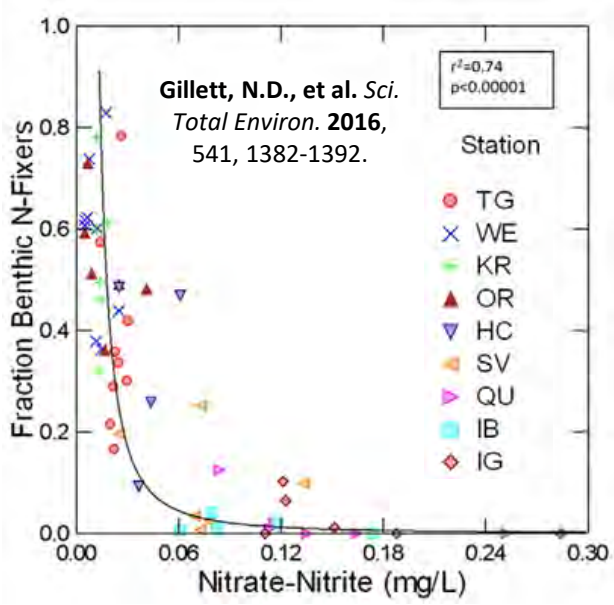
Peak in fall during low flows and reservoir release

Minimum in spring during diluting flows

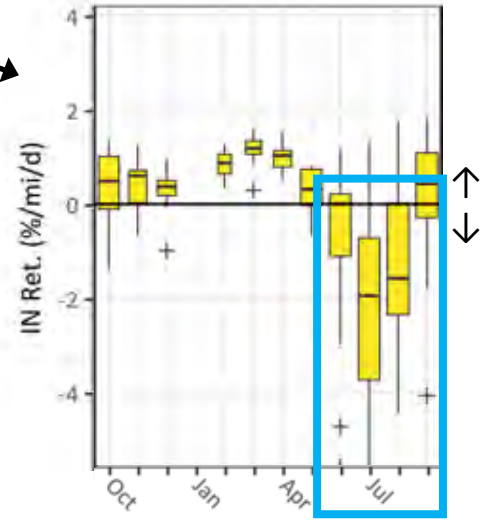
Oberholzer Dent et al. 2026

IN:SRP Ratio





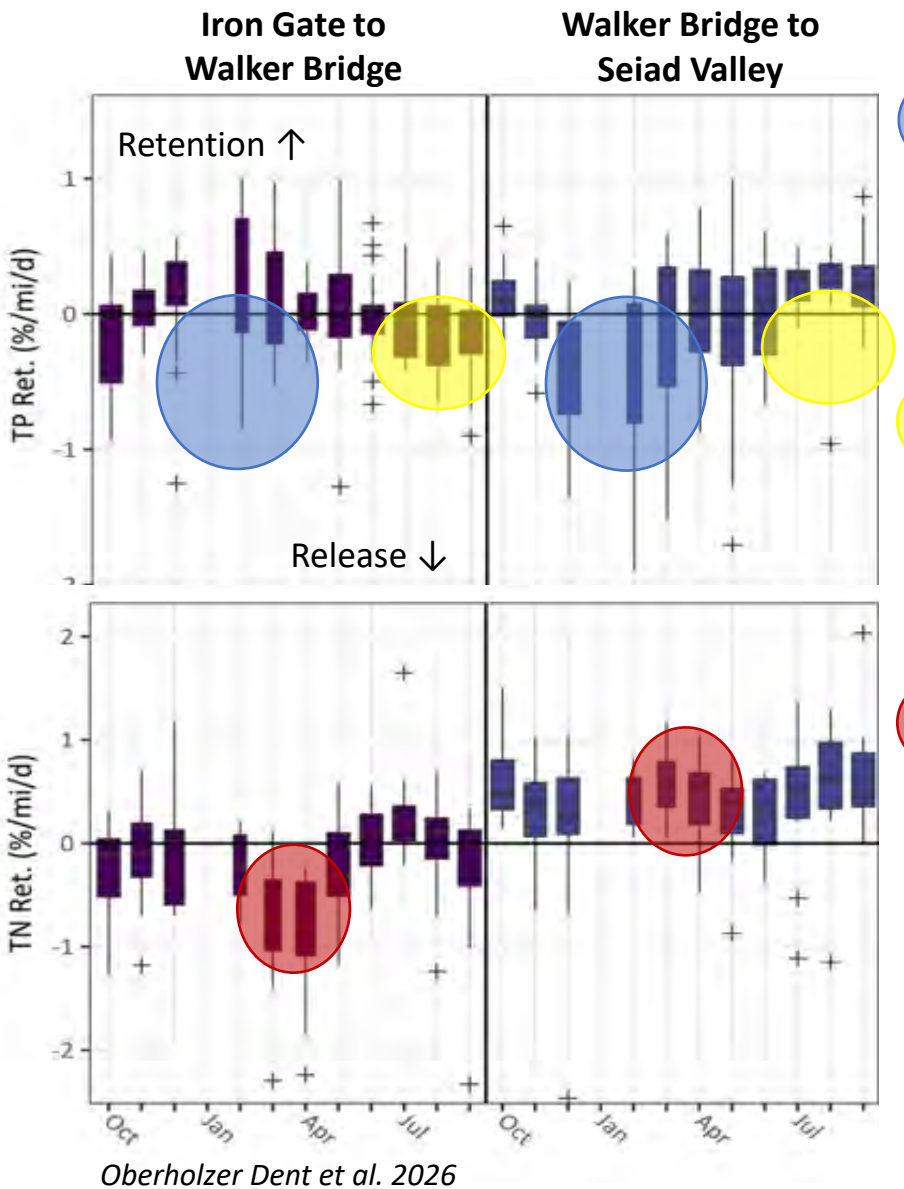
Weitchpec to Turwar



↑ Retention
↓ Release

N fixers reverse IN retention in summer and increase IN concentration

Unique dynamics below Iron Gate propagate eutrophication

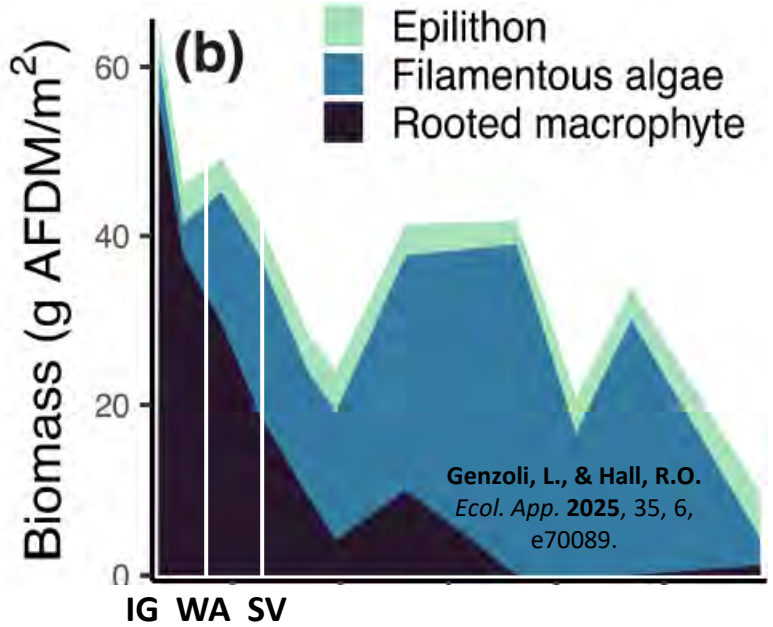


Oberholzer Dent et al. 2026

1. Artificially stable hydrology does not flush nutrients from sediments during **winter** and macrophytes trap nutrients

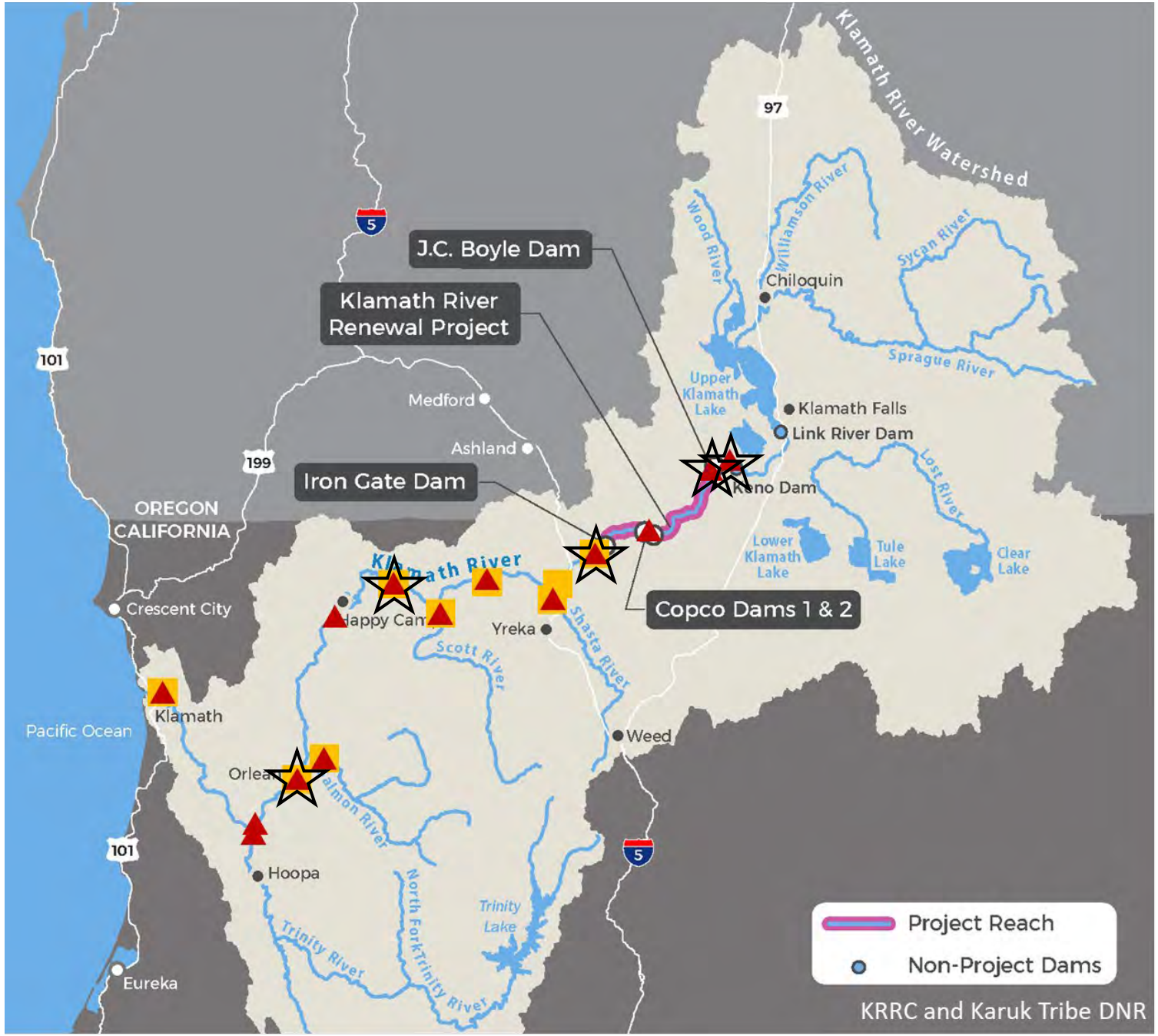
2. Bioavailable P is released from anoxic sediments during **summer**, exacerbating eutrophication

3. Rooted aquatic plants overwinter until **spring** high flows, creating a source of nutrients via decay and export downriver, supporting excess biomass



How do dams impact nutrient dynamics in downriver reaches?

1. P **pollution in the Upper Basin contributes to** N-fixing algae blooms in UKL, resulting in **massive nutrient exports to the Klamath River**
2. Stratification and **cycling in reservoirs creates** uneven seasonal concentration patterns for N and P, resulting in **highly skewed and dynamic N:P ratios** exacerbated by reservoir P release in summer and fall
3. Free-flowing reaches retain significant nutrients, but these **processes are disrupted in reaches directly below dams**, likely due to macrophyte cover enabled by artificially stable flows



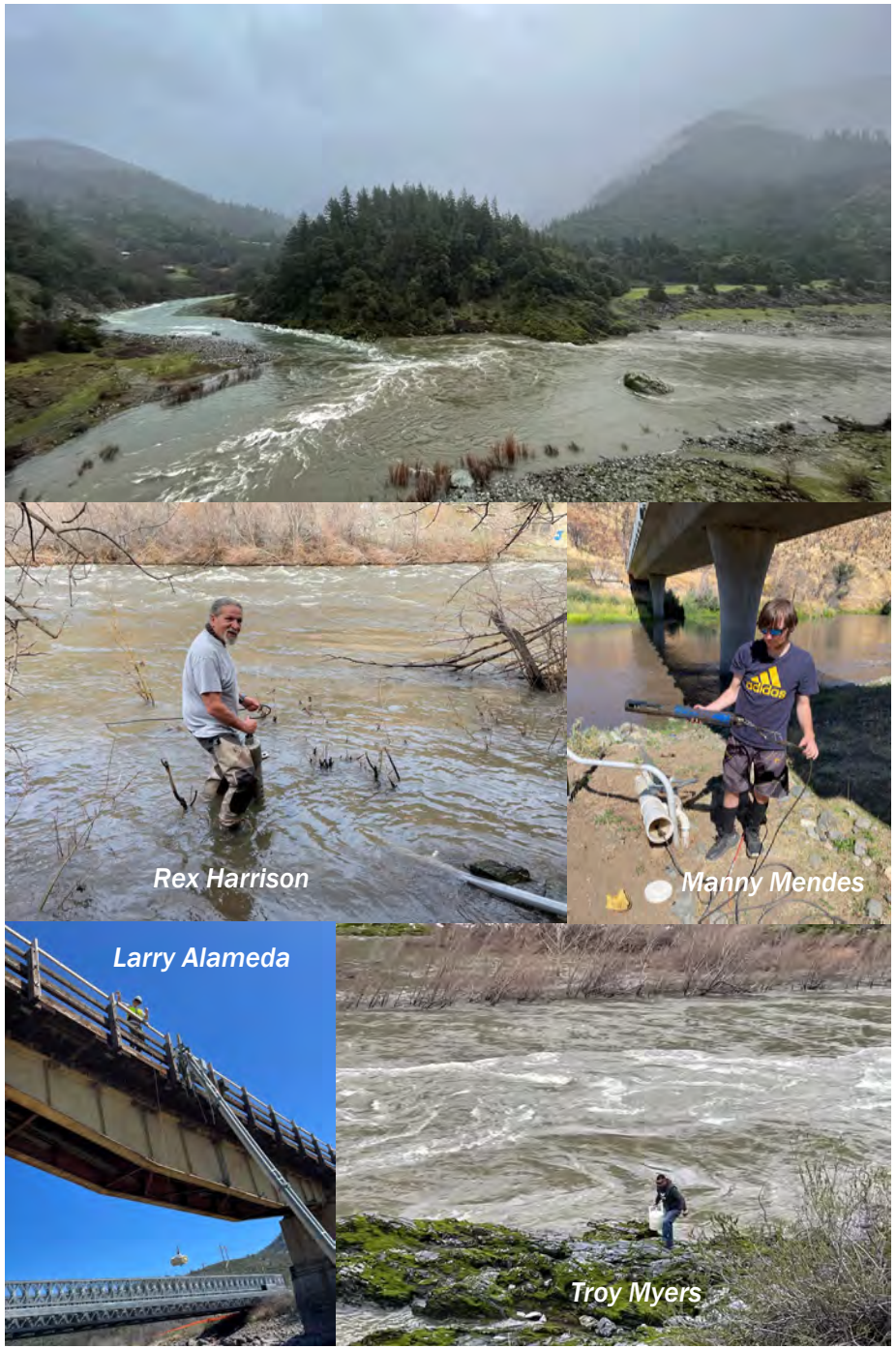
Karuk and Yurok tribal water quality monitoring

- 9 continuous monitoring stations (temperature, conductivity, dissolved oxygen, pH, turbidity)
- ▲ 14 grab sampling locations (nutrients, sediment, microcystin, heavy metals)
- ☆Next slides focus on sites below Keno (lowest remaining dam), below JC Boyle, below Iron Gate, at Seiad Valley, and at Orleans

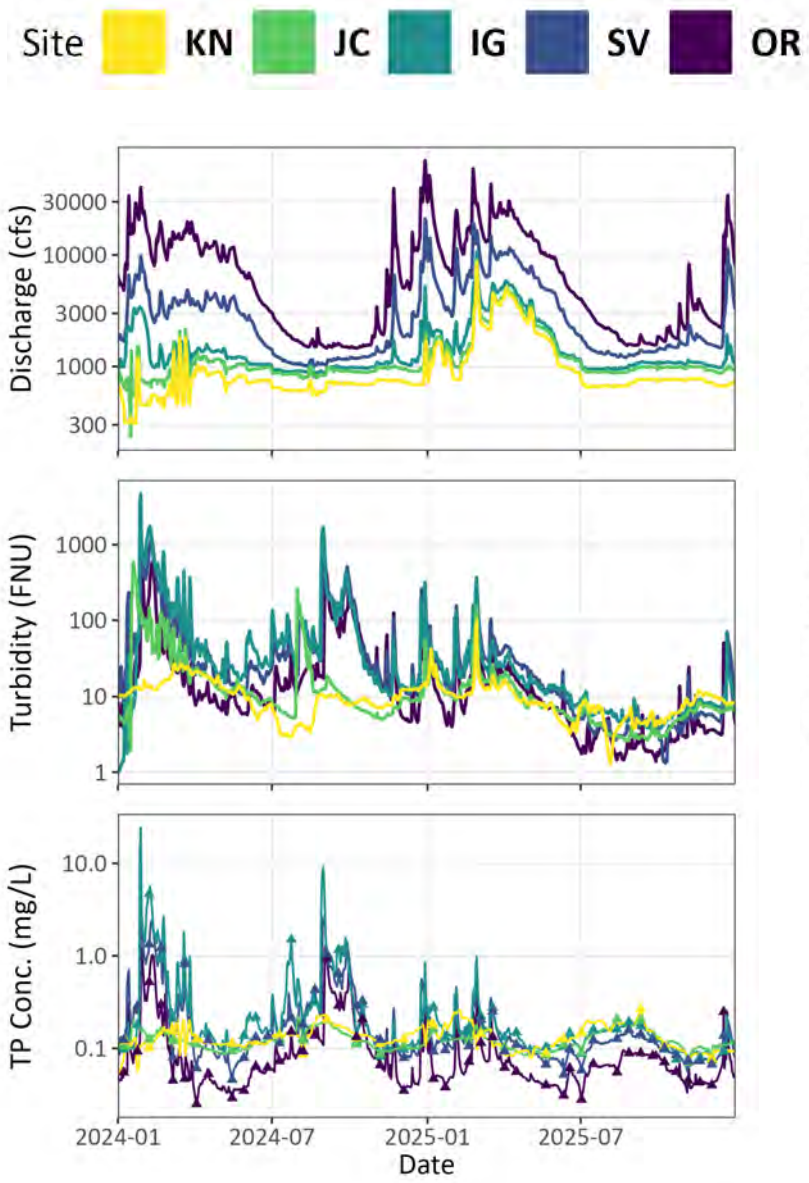
Nutrient loads from reservoirs

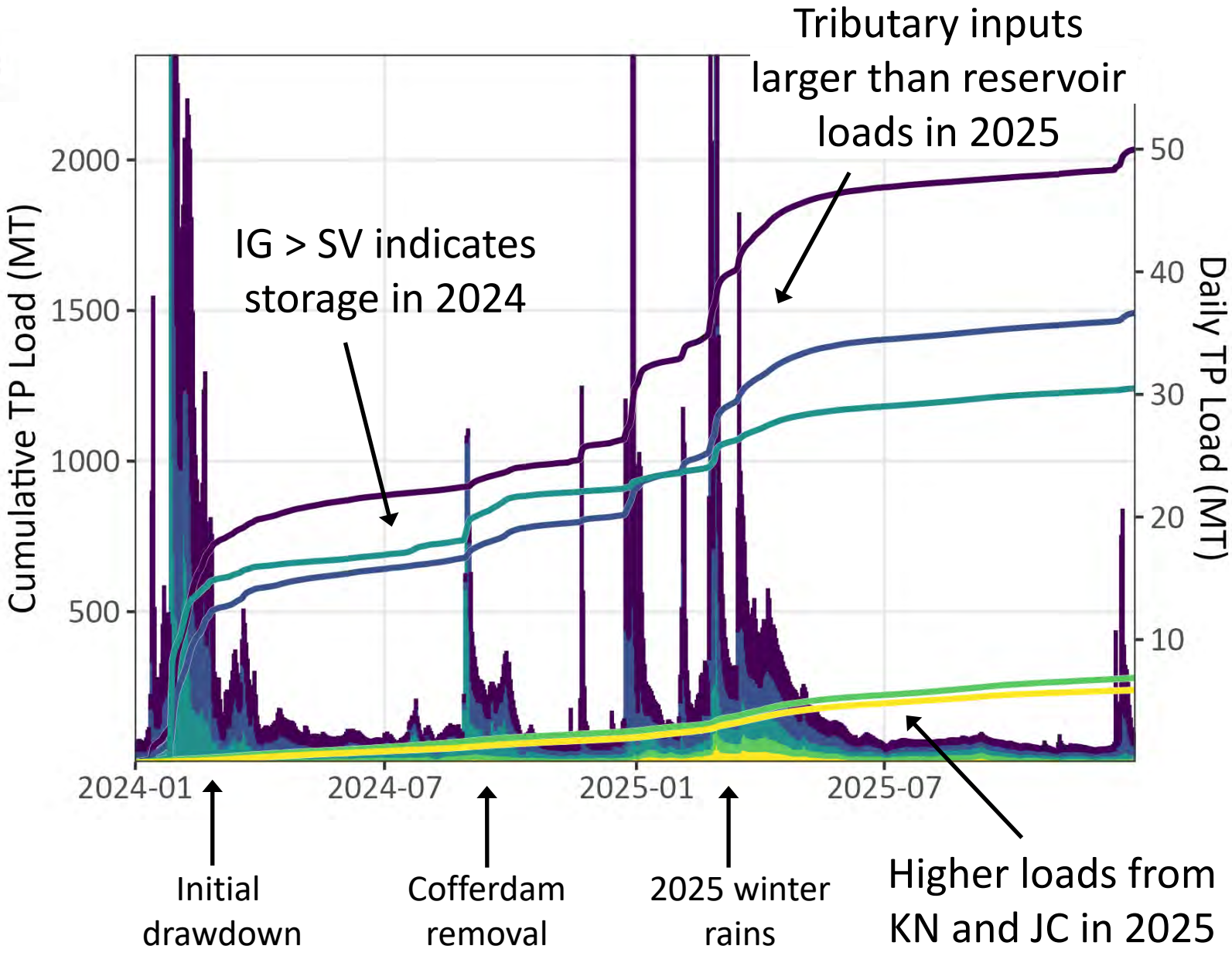
- Effective modeling using turbidity and season
- Suspended sediments 2-3% N and 0.3-0.4% P by mass
- Max measured conc: 73.4 mg/L TN, 9.71 mg/L TP
  (Walker Bridge, 2/7/2024)
- Max estimated conc: ~100 mg/L TN, ~10 mg/L TP
- Loads in 2024 ~100x higher than previous years
- IG more export in 2024, JC more in 2025

Total Loads (MT)	TN		TP	
	2024	2025	2024	2025
JC Boyle	1016	1891	104	177
Iron Gate (Total)	4254	2488	932	313

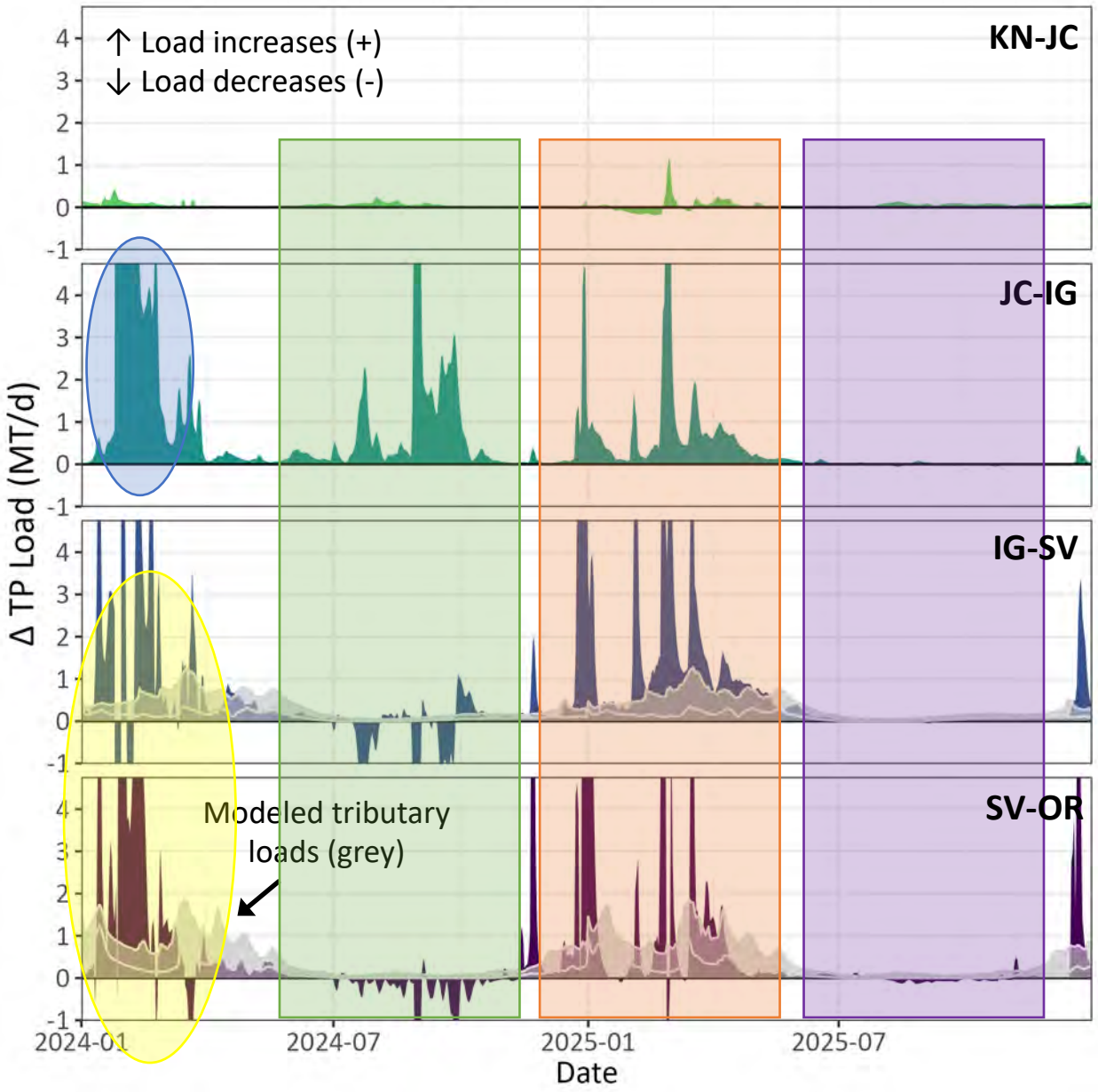


Tracking nutrient loads moving downriver

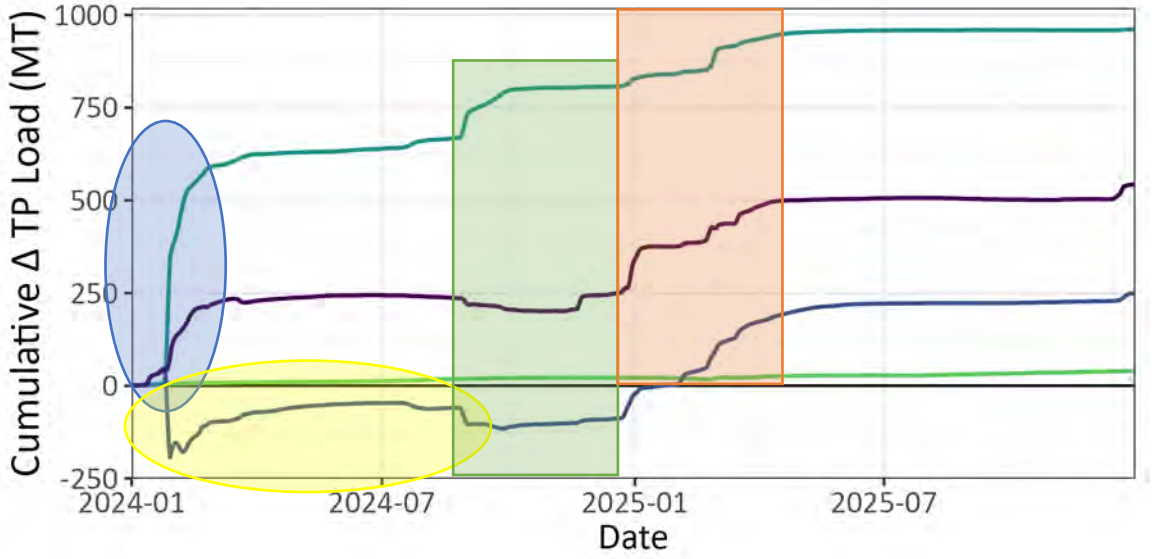




Changes in load reveal storage, remobilization, and recovery

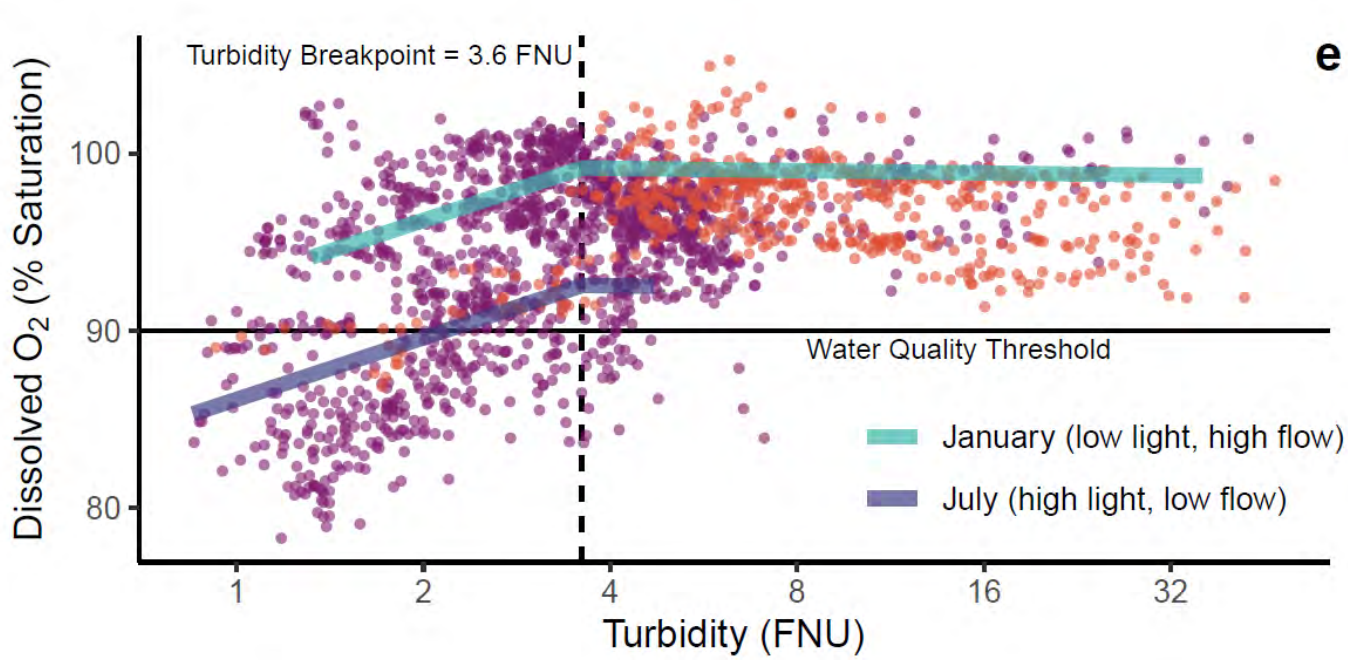


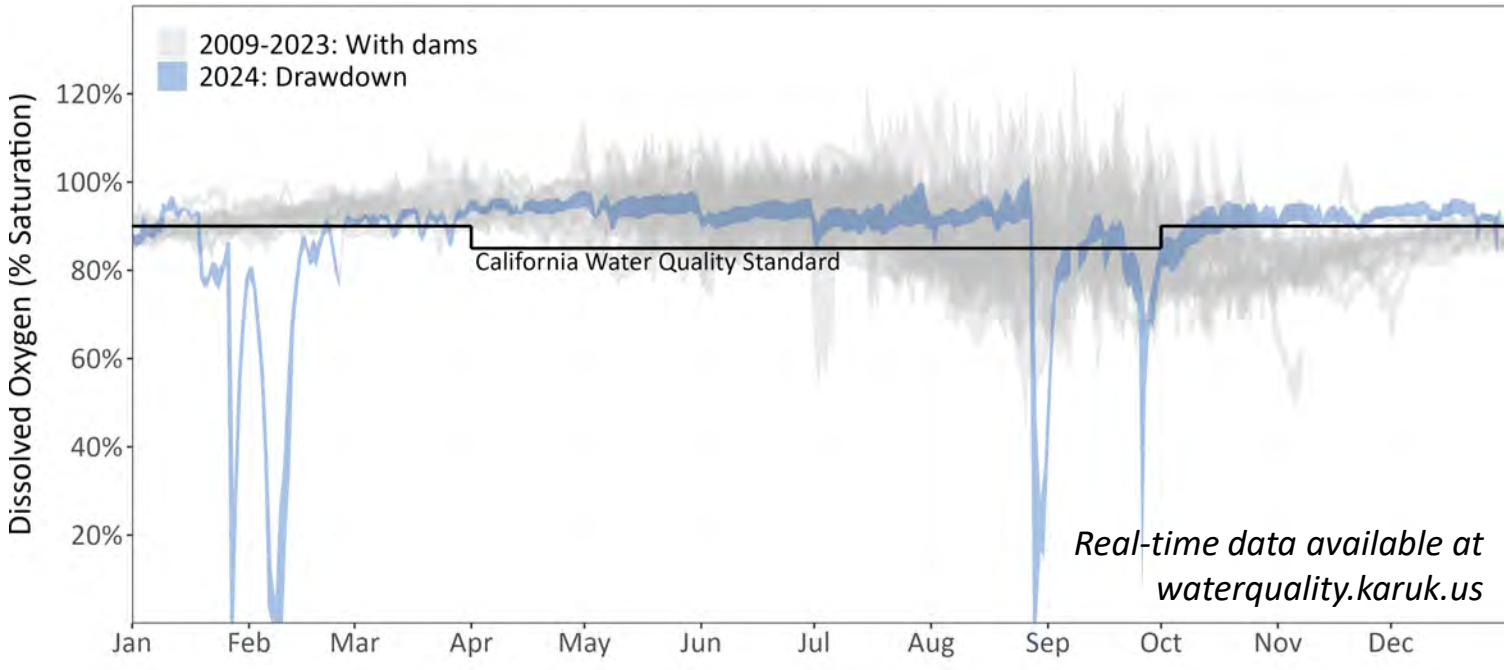
1. Highest loads from IG and Copco
2. Mixed storage/release through 2024
3. Low-flow deposition of cofferdam loads
4. Reservoir loads in 2025 had comparable magnitude to lower basin tributaries
5. Small summer decreases (present in all reaches) show return of typical river retention processes



High nutrients did not impair DO outside of peak sediment loads

- Organic matter fueled high respiration during peak loads, resulting in short-term anoxia
- But for most of the year DO minima were the highest on record
- Turbidity reduces ecosystem metabolism





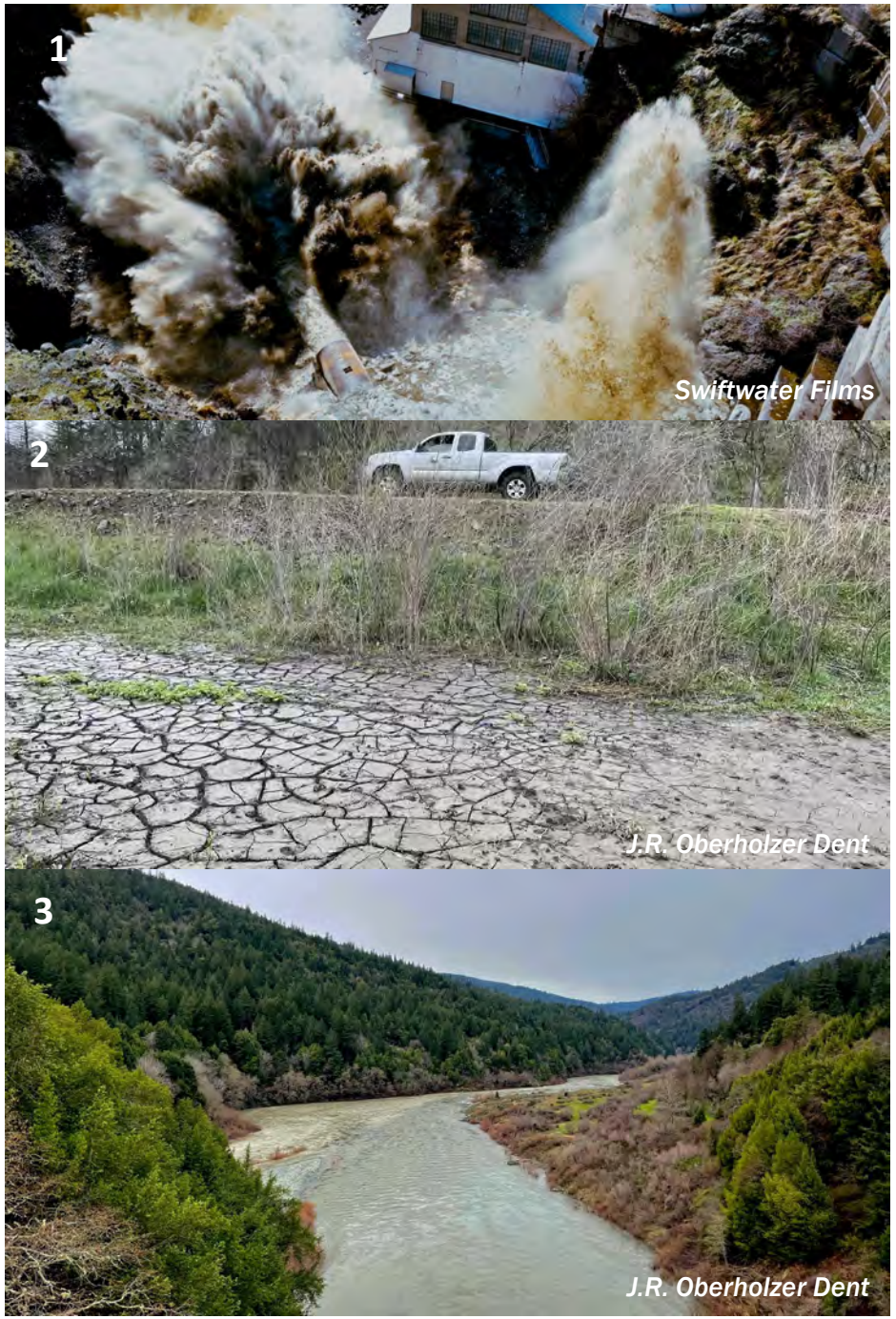
Genzoli, L., Oberholzer Dent, J.R., Hall, R.O., & Johnson, G. *In review*. **Debris flows suppressed riverine metabolism following high-severity wildfire on the Klamath River, California**. *Geophysical Research Letters.*

How did dam removal impact the river ecosystem through nutrient vectors?

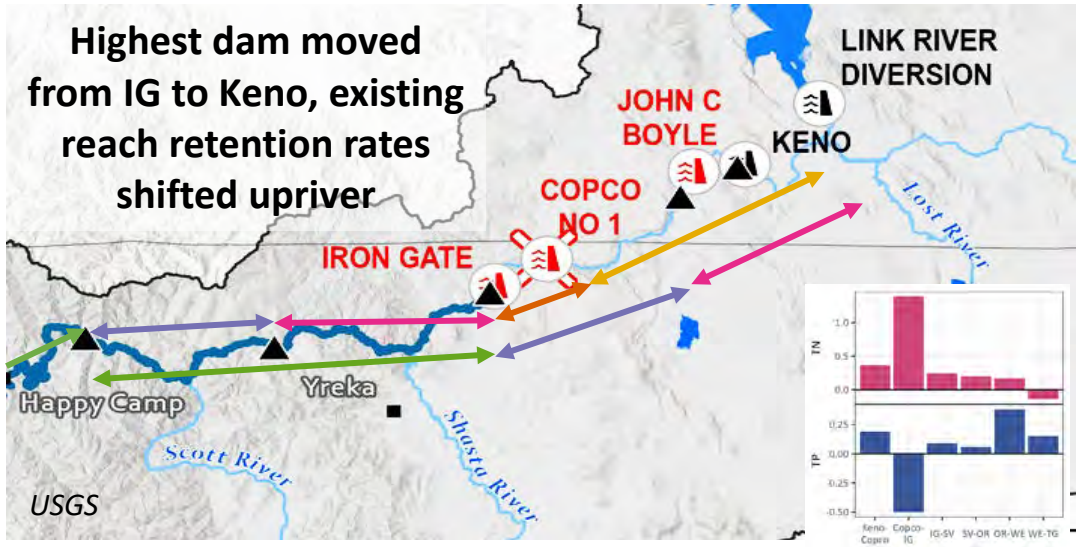
1. **Unprecedented nutrient concentrations** and loads with initial drawdown, **but high turbidity prevented excessive primary productivity** (Genzoli et al., *in review*)

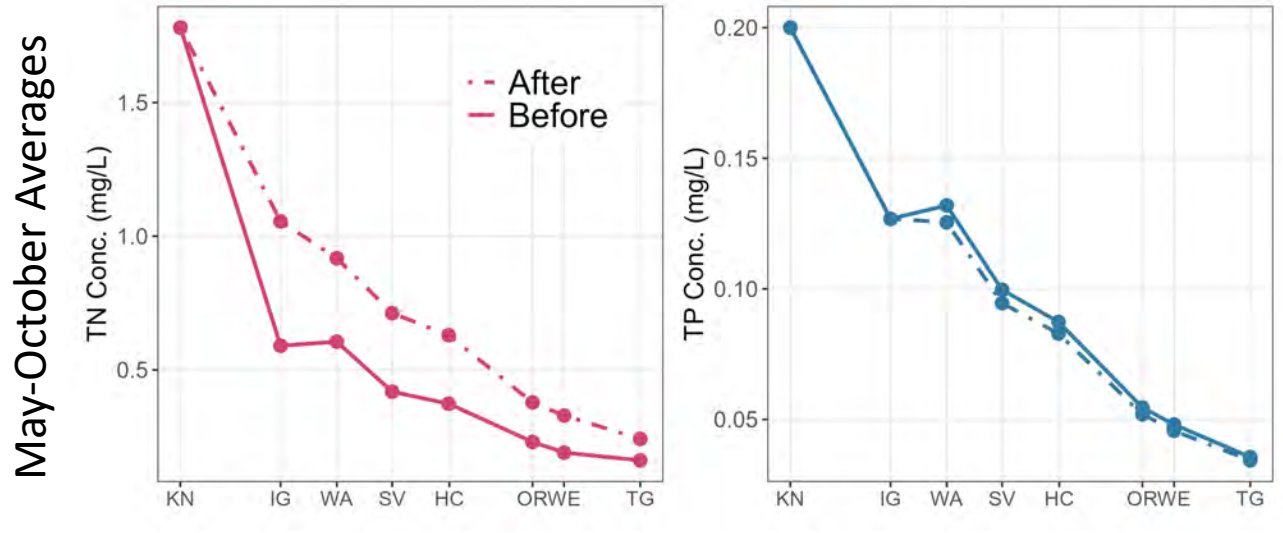
2. **Significant nutrient deposition and remobilization** in mainstem Klamath – plus late flushing from JC Boyle

3. **Nutrient loads appear to be swiftly decreasing following dam removal**; reservoir sediment releases comparable to tributary inputs in 2025



Simulating dams out – TN ↑, TP ↓, TN:TP ↑



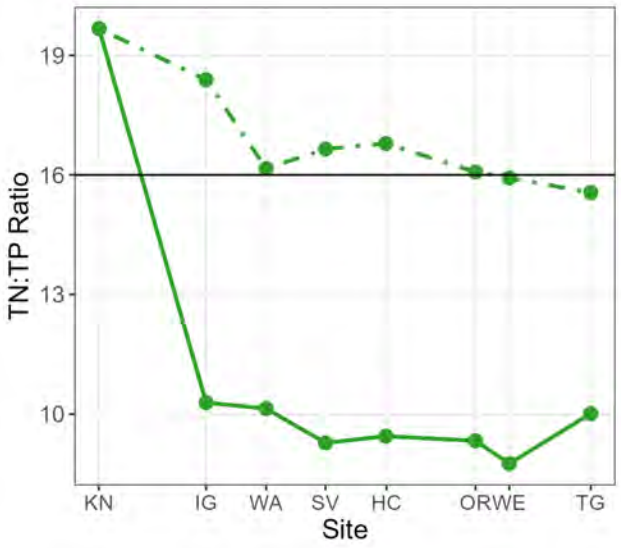


Before: Keno —27 km, $Ret_{Keno-Copco}$→ Copco —17 km, $Ret_{Copco-IG}$→ IG —34 km, Ret_{IG-WA}→ WA —27 km, Ret_{WA-SV}→ SV

After: Keno —34 km, Ret_{IG-WA}→ —27 km, Ret_{WA-SV}→ —44 km, Ret_{SV-HC}→ SV

Constrained by:

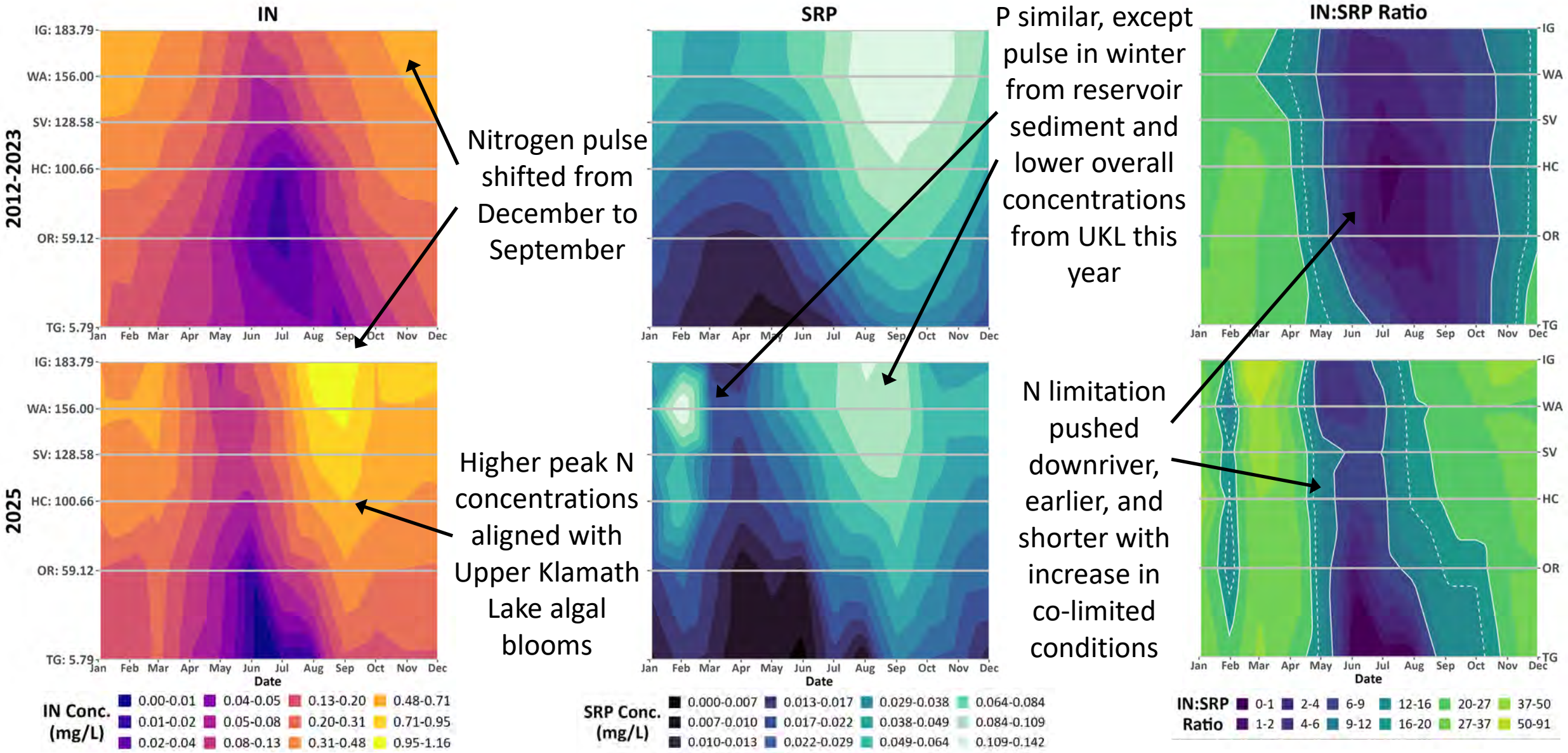
- Turnover time for aquatic plant communities after hydrological regime change
- Slope and other geomorphic factors that are distinct in the hydroelectric reach
- Potential legacy erosion of reservoir sediments



Oberholzer Dent et al. 2026

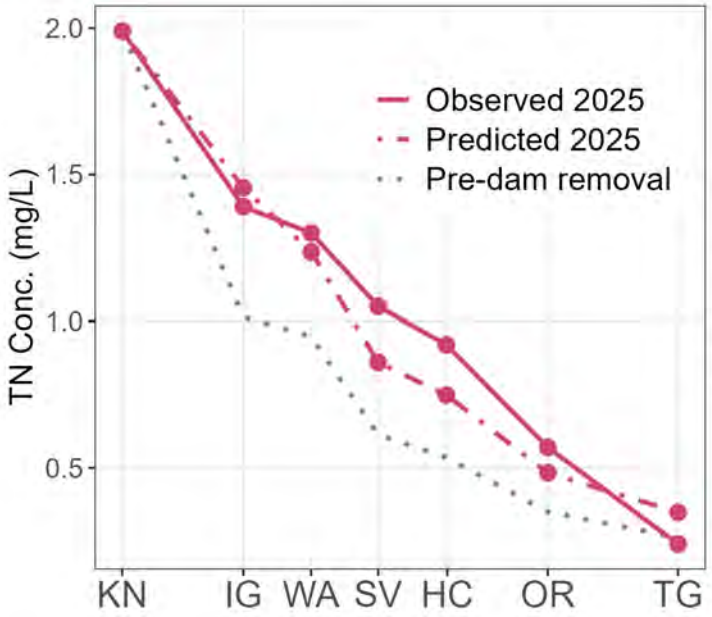
Large increase in TN, slight decrease in TP, TN:TP ratios much closer to 16:1 balance!

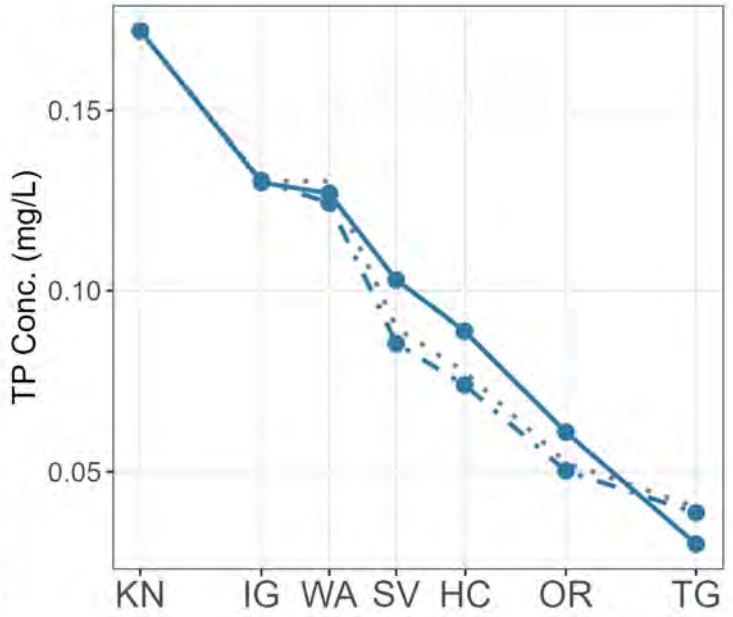
Concentration changes in 2025 post-dam removal

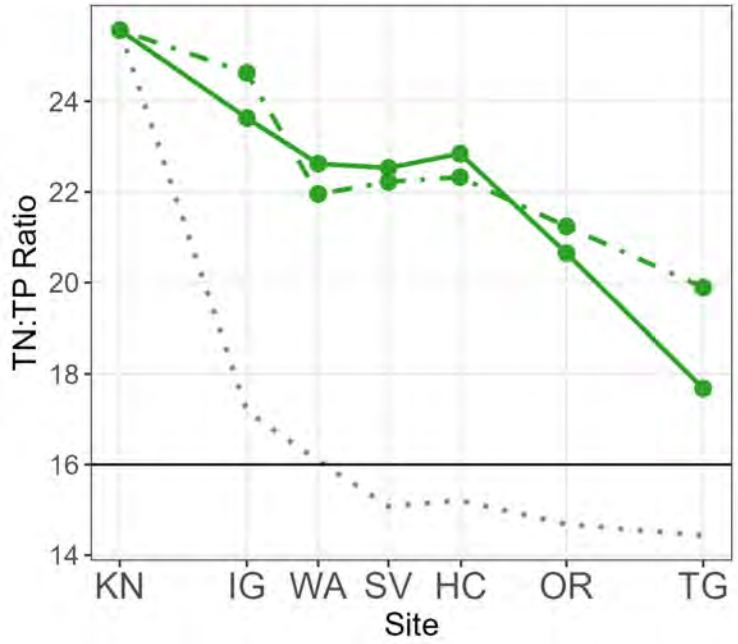


When is dam removal disturbance “over”?

- Conditions in 2025 were remarkably similar to long-term predictions
- Concentrations mostly higher than predicted, may reflect legacy input from dam removal
- TN:TP ratios dramatically increased *(note: not the same as IN:SRP ratio shown on previous slide)*







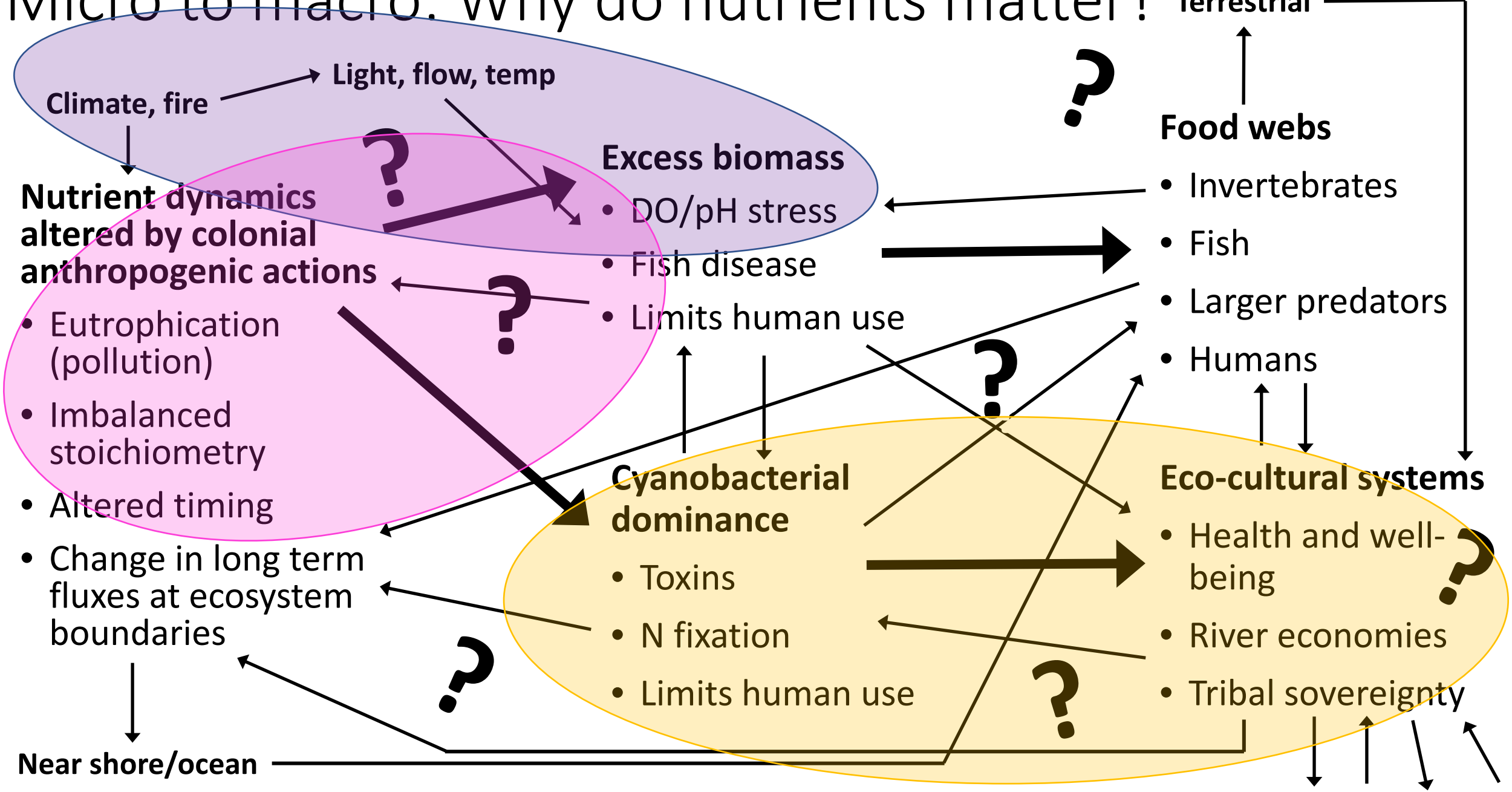
However, note unusual conditions in UKL in 2025…

Ecosystem change is happening! We need continued water quality monitoring.

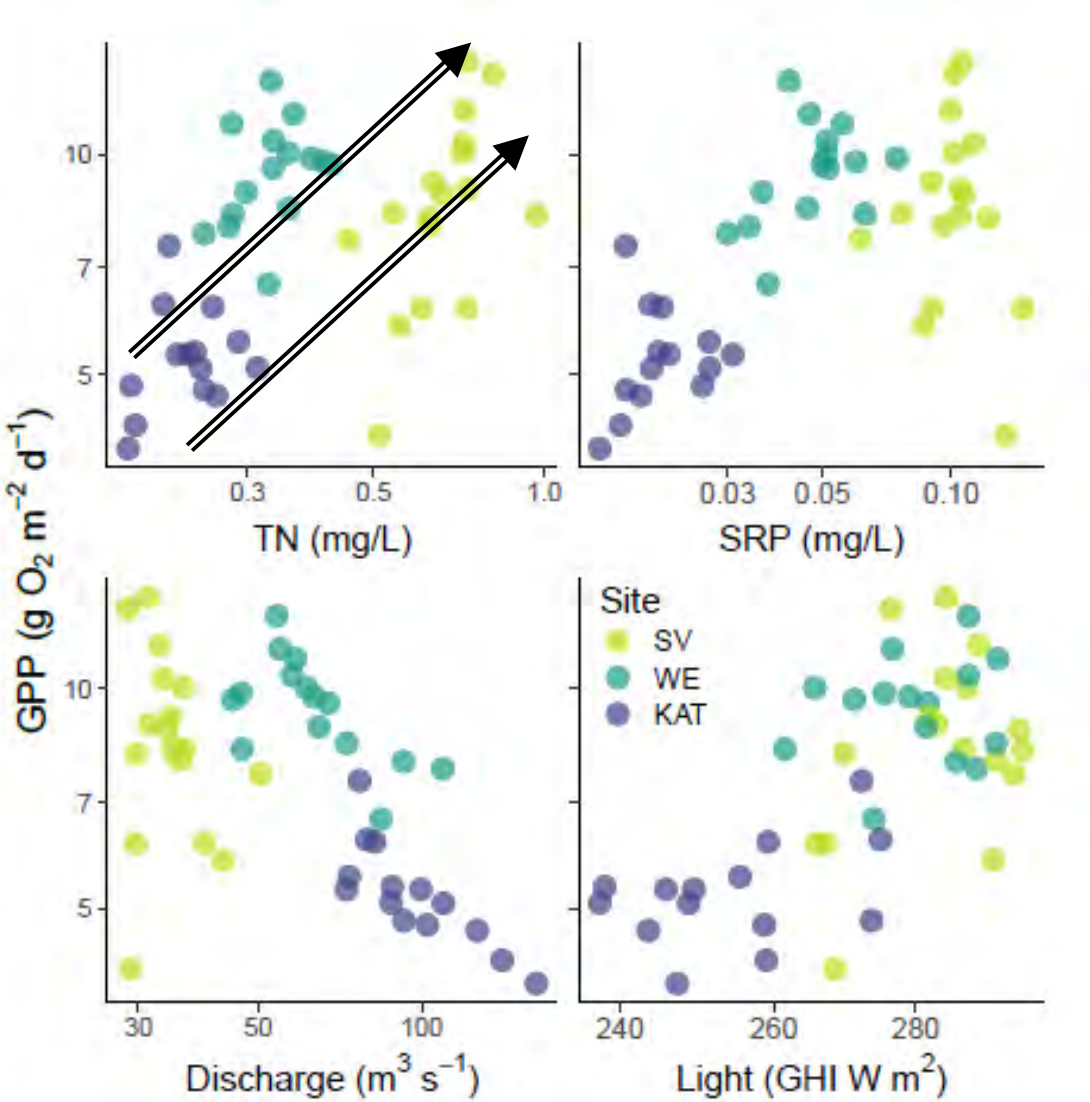
What might future nutrient dynamics in Klamath River look like after dam removal?

1. **Peak N** concentration **changed from winter to summer** without reservoirs delaying UKL subsidies from N fixation
2. Increased N, similar P results in **much higher TN:TP ratios; N limitation reduced** in time, space, and severity
3. **Limited reservoir sediment pulse** associated with winter storms

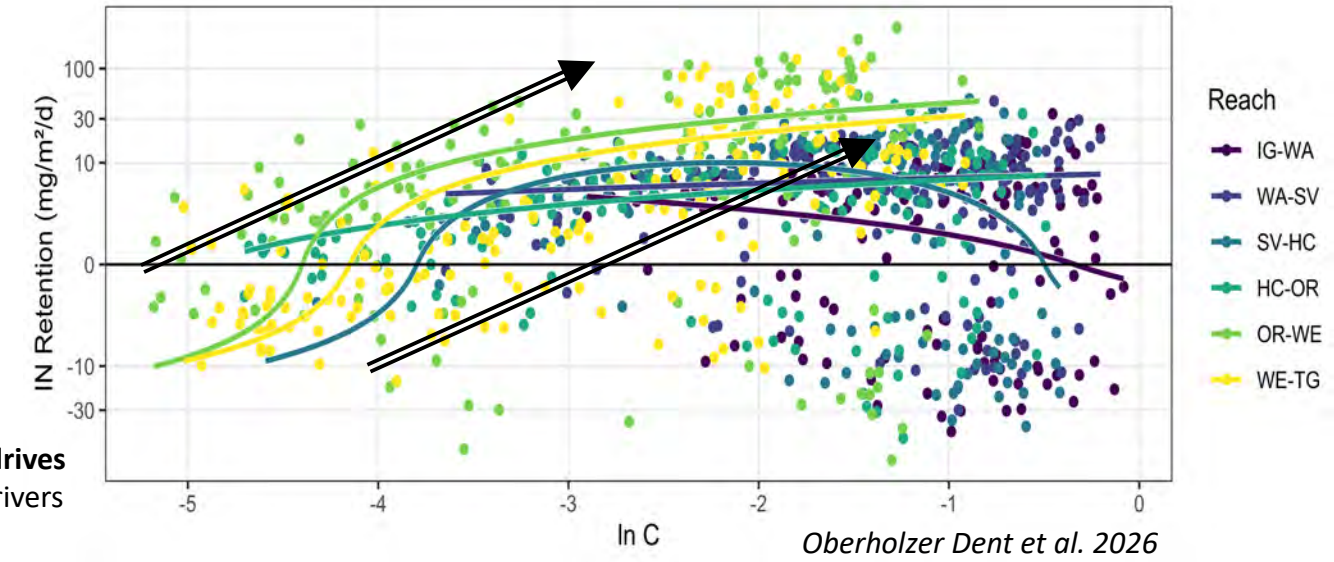
Micro to macro: Why do nutrients matter?



Nutrients drive primary productivity



- Doubling annual mean TN concentration increases mean GPP by 50%
- IN retention increases at higher concentrations in N-limited downriver reaches, suggesting supply limitation
- Meeting nutrient TMDLs would reduce GPP



Oberholzer Dent et al. 2026

Genzoli, L., Asarian, J.E., Oberholzer Dent, J.R., Carter, A.M., & Hall, R.O. 2024. **Nitrogen drives variation in annual primary production in the Klamath River, California.** In L. Genzoli, Drivers and Fates of Primary Production in a Dammed, Eutrophic River. PhD Dissertation

Impairment of cultural beneficial uses

- Water quality impairment from dams well-recorded in tribal literature and oral history
- Swimming, bathing, ceremony impaired
- Traditional food sources contaminated

Diver, S., Oberholzer Dent, J. R., Sarna-Wojcicki, D., Ramos, N., & Reed, R. 2026. **Indigenous well-being indicators and social impact assessment: Redefining restoration success for Klamath River dam removal**. *Environmental Science & Policy*, 176, 104276.

IRNC; 8-11-05
5,350,847 cells/ml
Microcystis

Tribal capacities for improving water quality

- Public health postings for toxic algae
- Participation in TMDL process
- Upper Basin point source pollution control plan
- Long-term, place-based datasets and expertise

Klamath Tribal Water Quality Consortium. 2018. Upper Klamath Basin Nonpoint Source Pollution Assessment and Management Program Plan. 78p. klamathwaterquality.com

Urgent management needs: P pollution in Upper Basin

- N fixing *AFA* in UKL increases TN loads 389%
- *AFA* not historically present in UKL
- TMDL calls for a 40% reduction in P loads
- After 3 decades, avg. concentrations have lowered from 0.101 to 0.093 mg/L, or 23% progress toward the TMDL target of 0.066 mg/L
- P abatement efforts include restoring riparian corridors and wetlands

Walker, J.D., and J. Kann. 2022. Water and Nutrient Balances of Upper Klamath Lake, Water Years 1992-2018. Prepared for the Klamath Tribes Natural Resources Department, Chiloquin, OR.

Eilers, J. M., et al. *Hydrobiologia.* **2004**, 520(1), 7-18.

Reducing P inputs to UKL is the key to improving eutrophic conditions throughout the basin

Unique value of long-term, place-based tribal datasets

- High-resolution, high-confidence data collected with “best science” methodologies by local tribal members
- Contributed to multiple TMDLs in the Klamath Basin
- Encouraging results for future dam removals
- Nuanced understanding of disturbance, recovery, and restoration
- New insights into aquatic ecology and ecological theory
- Scientific analogues to Traditional Ecological Knowledge
- Supports public health and eco-cultural restoration
- Strengthens tribal sovereignty and management of tribal lands

See also…

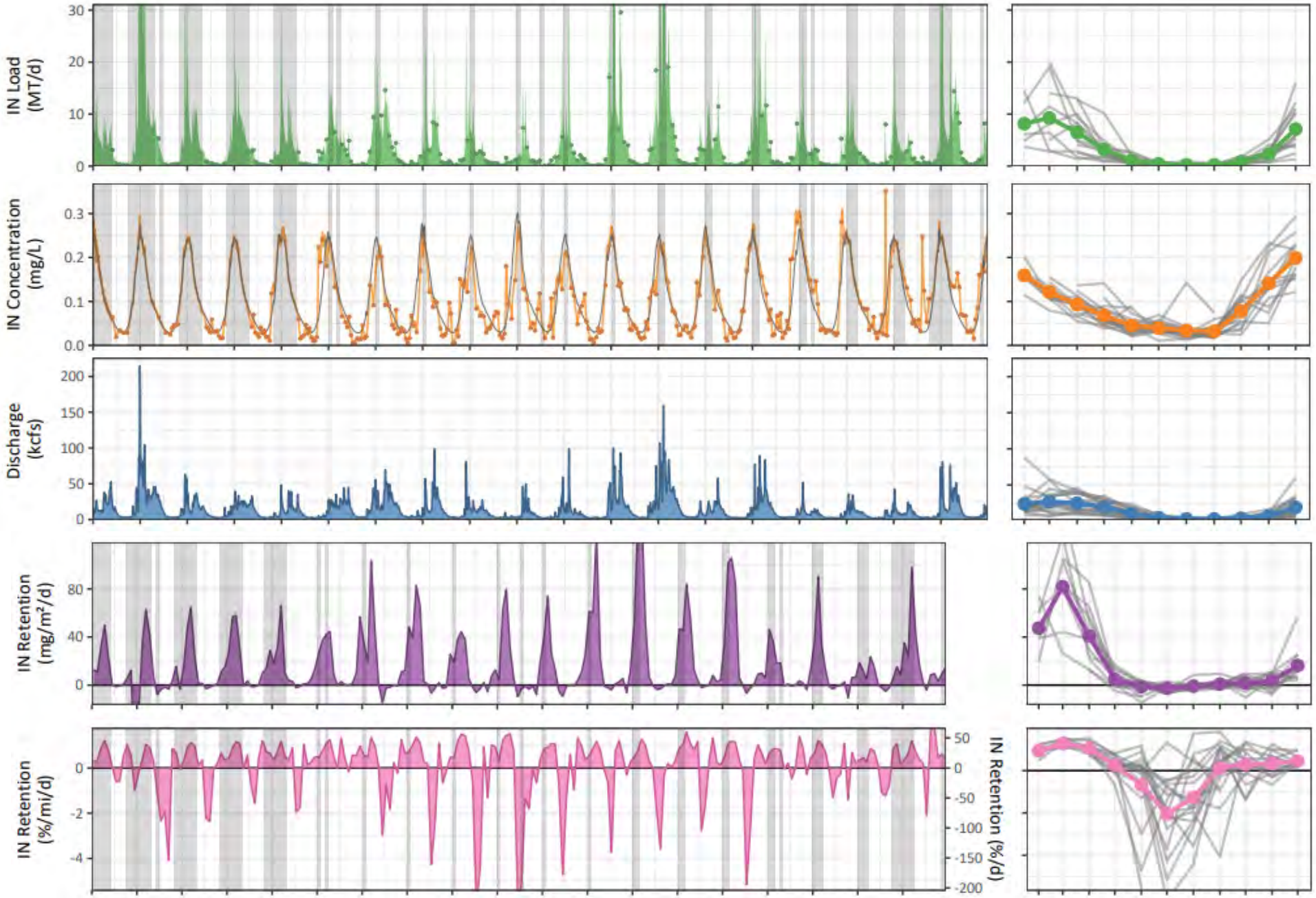
Special issue in progress for *Freshwater Science* focused on tribal science for dam removal!

Yôotva!

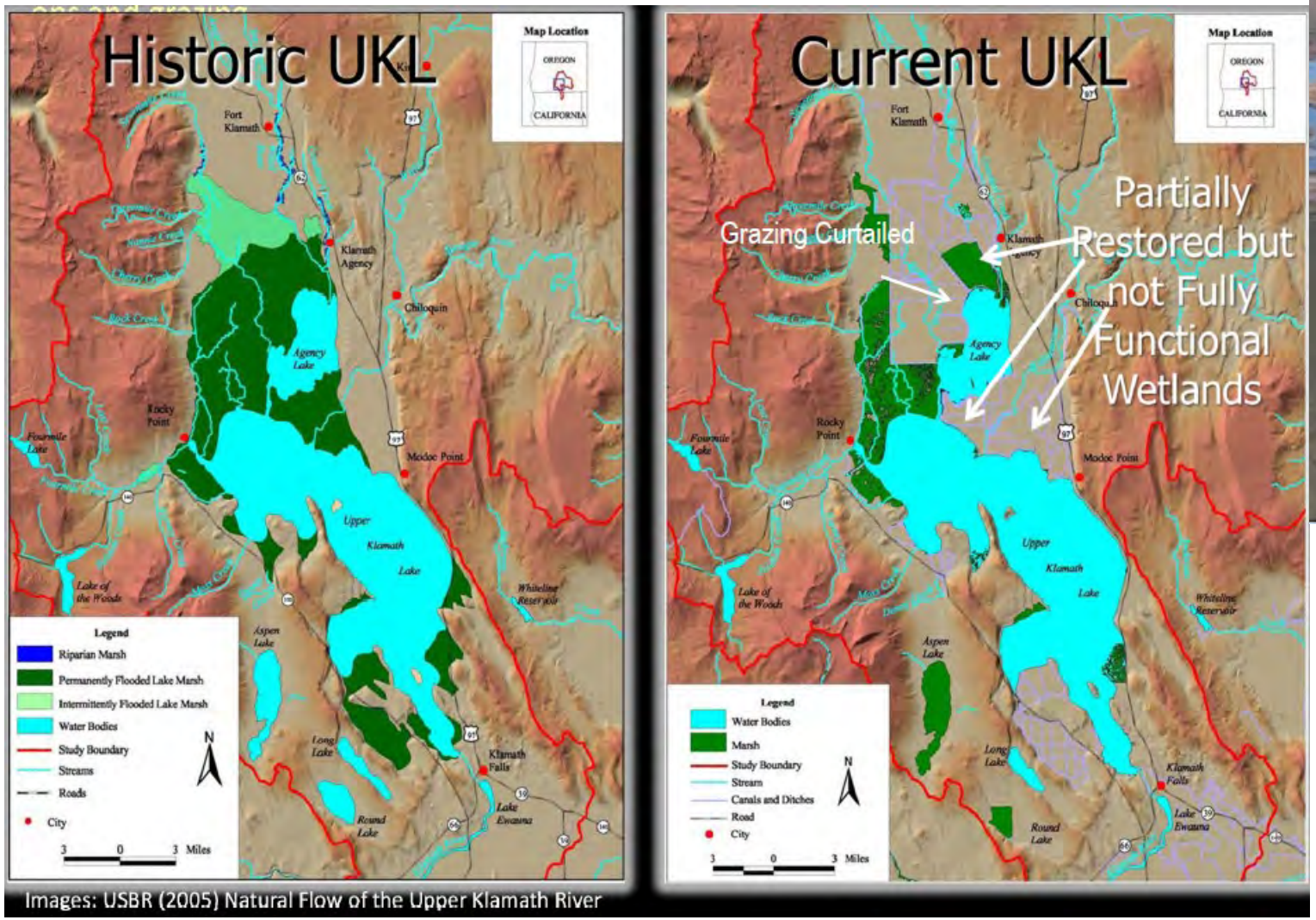
Questions and feedback?

John R. Oberholzer Dent
Karuk Tribe Department of Natural Resources
joberholzer@karuk.us

Total Loads (MT) (90% PI)	TN		TP	
	2024	2025	2024	2025
JC Boyle	1016 (680, 1561)	1891 (1293, 2842)	104 (66, 172)	177 (114, 285)
Iron Gate (Total)	4254 (2272, 13162)	2488 (1909, 3312)	932 (446, 3030)	313 (221, 457)


IN Load (MT/d)
30
20
10
0
IN Concentration (mg/L)
0.3
0.2
0.1
0.0
Discharge (kcfs)
200
150
100
50
0
IN Retention (mg/m²/d)
80
40
0
IN Retention (%/mi/d)
0
-2
-4
50
0
-50
-100
-150
-200
IN Retention (%/d)

+517
+93
+6470
+1
9
+185
+77
+531
+60
Parameter
TN flux
TP flux
N:P Ratio
Parameter
TN
TP
Parameter
TN
TP
N:P Ratio



Images: USBR (2005) Natural Flow of the Upper Klamath River

Natural sources to UKL: N/P ~ 1.5
(low due to high background geological P in Cascade soils)

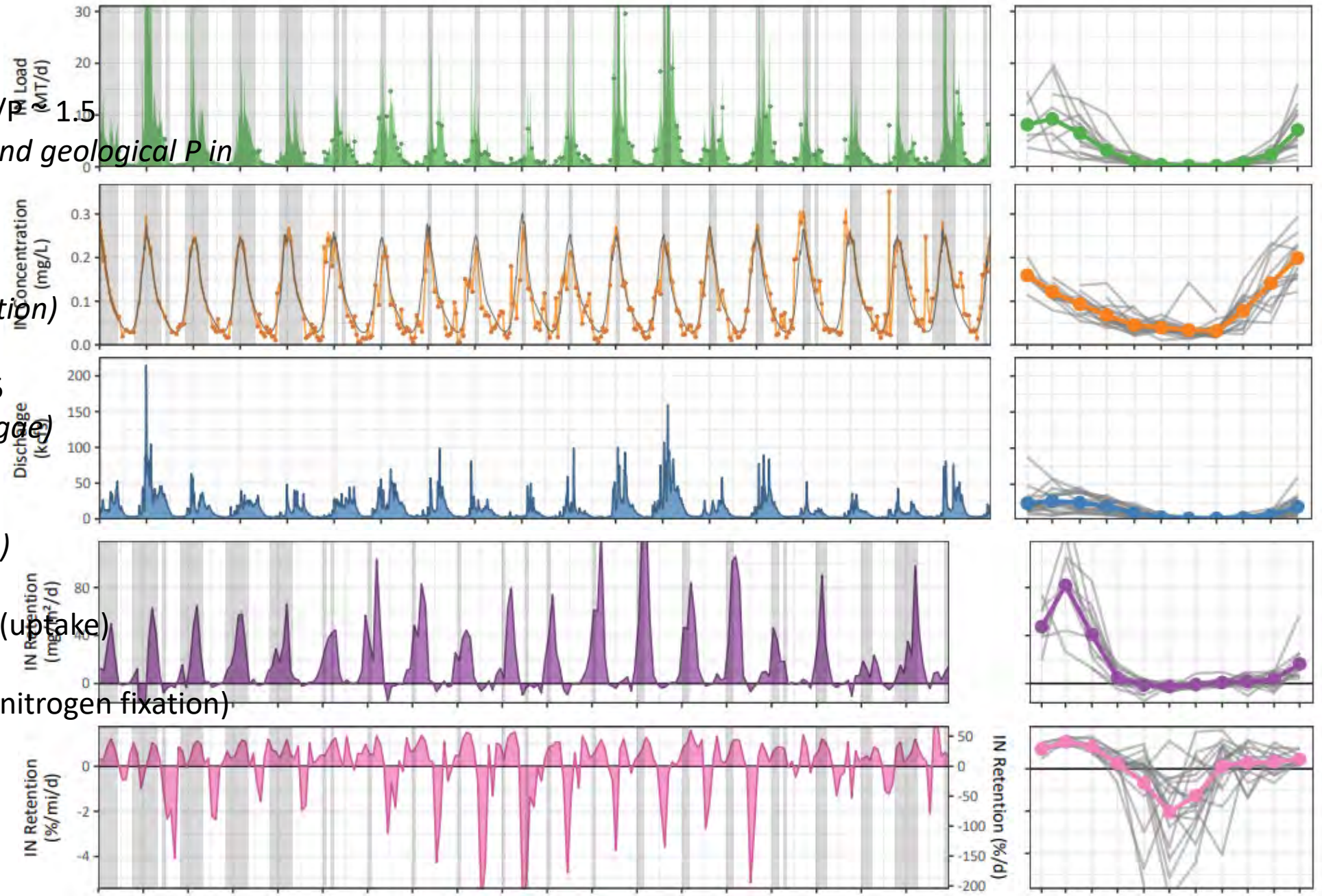
Large tribs: N/P ~ 5
(+330%, agricultural pollution)

UKL outflows: N/P ~ 10-15
(+390%, nitrogen fixing algae)

IG outflows: N/P ~ 9-12
(-12%, uptake and settling)

Klamath River at Orleans: (uptake)

Klamath River at Turwar: (nitrogen fixation)



Effects of Dam Removal on Klamath River Aquatic Food Webs

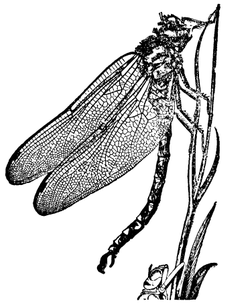
Cal Poly Humboldt:
Claire Inouye
Alison O'Dowd
Karuk Tribe:
Toz Soto

INTRODUCTION

Klamath River at
Horse Creek
Spring 2025

BACKGROUND ON KLAMATH DAMS

- Six dams built between 1902 -1962
- Two upper dams are used for:
  - Irrigation
  - Water storage
  - Recreation
  - Hydroelectric power
- Four lower dams used for:
  - Hydroelectric power
  - Lower four dams removed



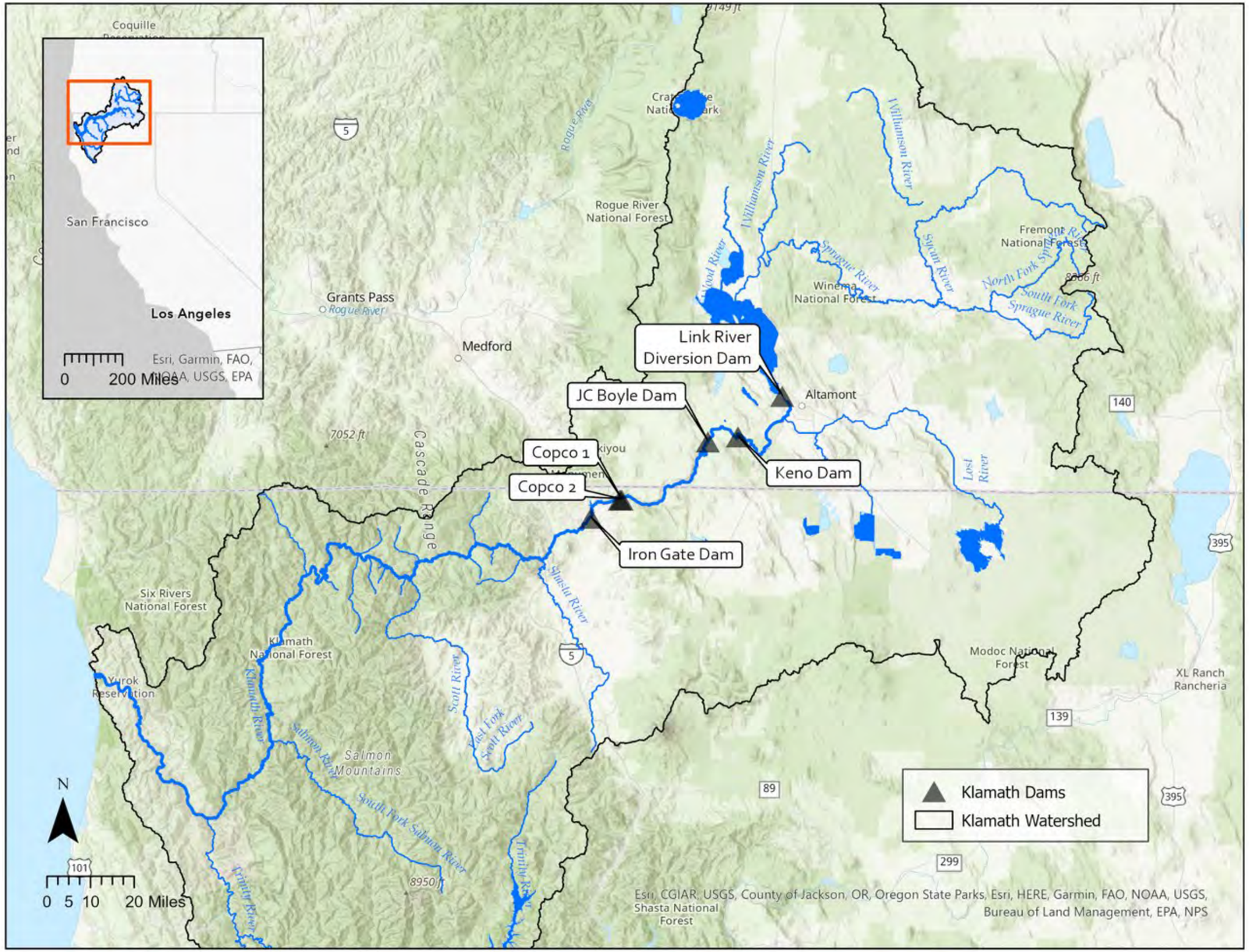
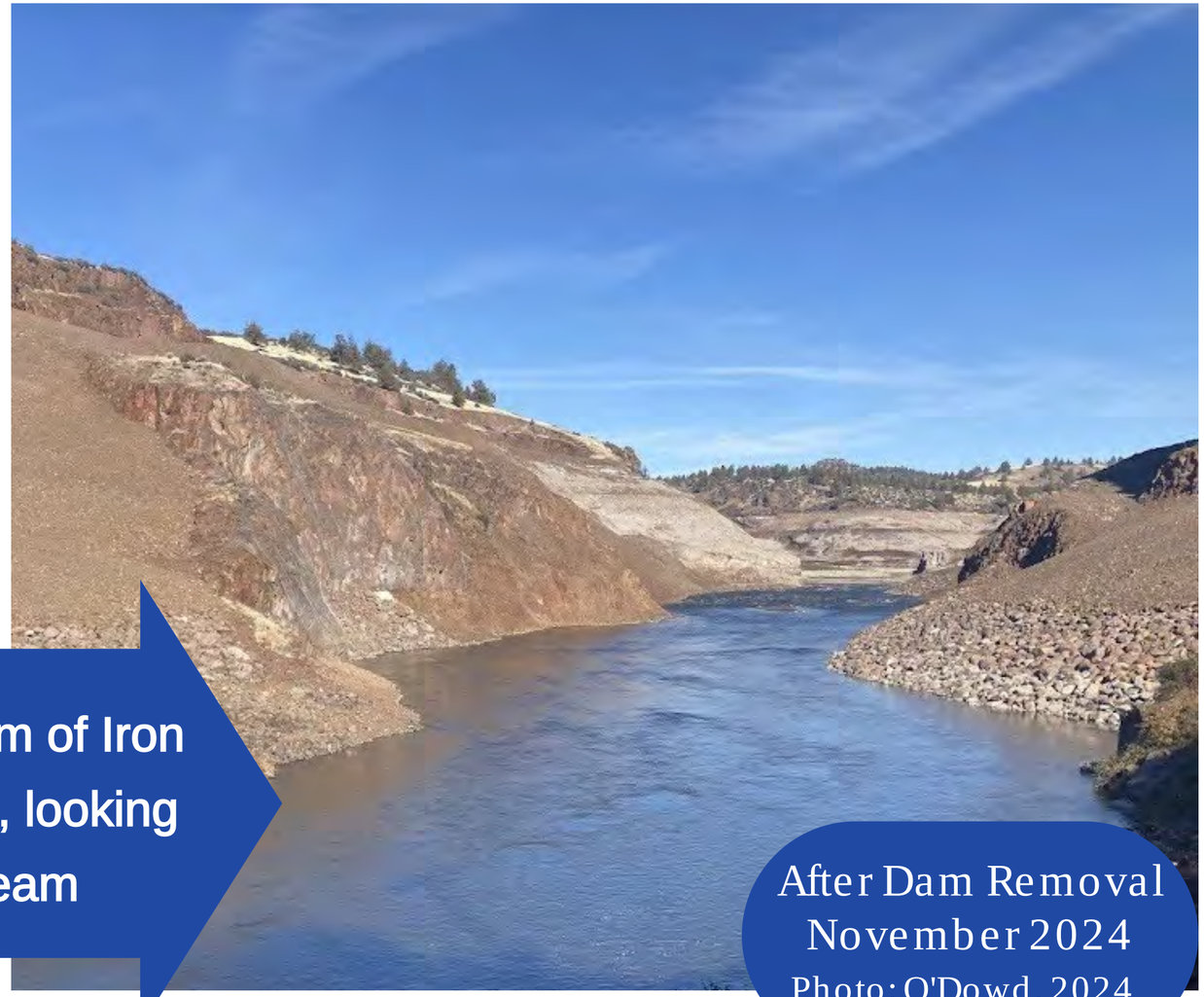


Photo: Cox, 2023

WHERE WE ARE NOW

Before Dam Removal
November 2023
Photo: O'Dowd, 2023

Downstream of Iron Gate Dam, looking upstream



After Dam Removal
November 2024
Photo: O'Dowd, 2024

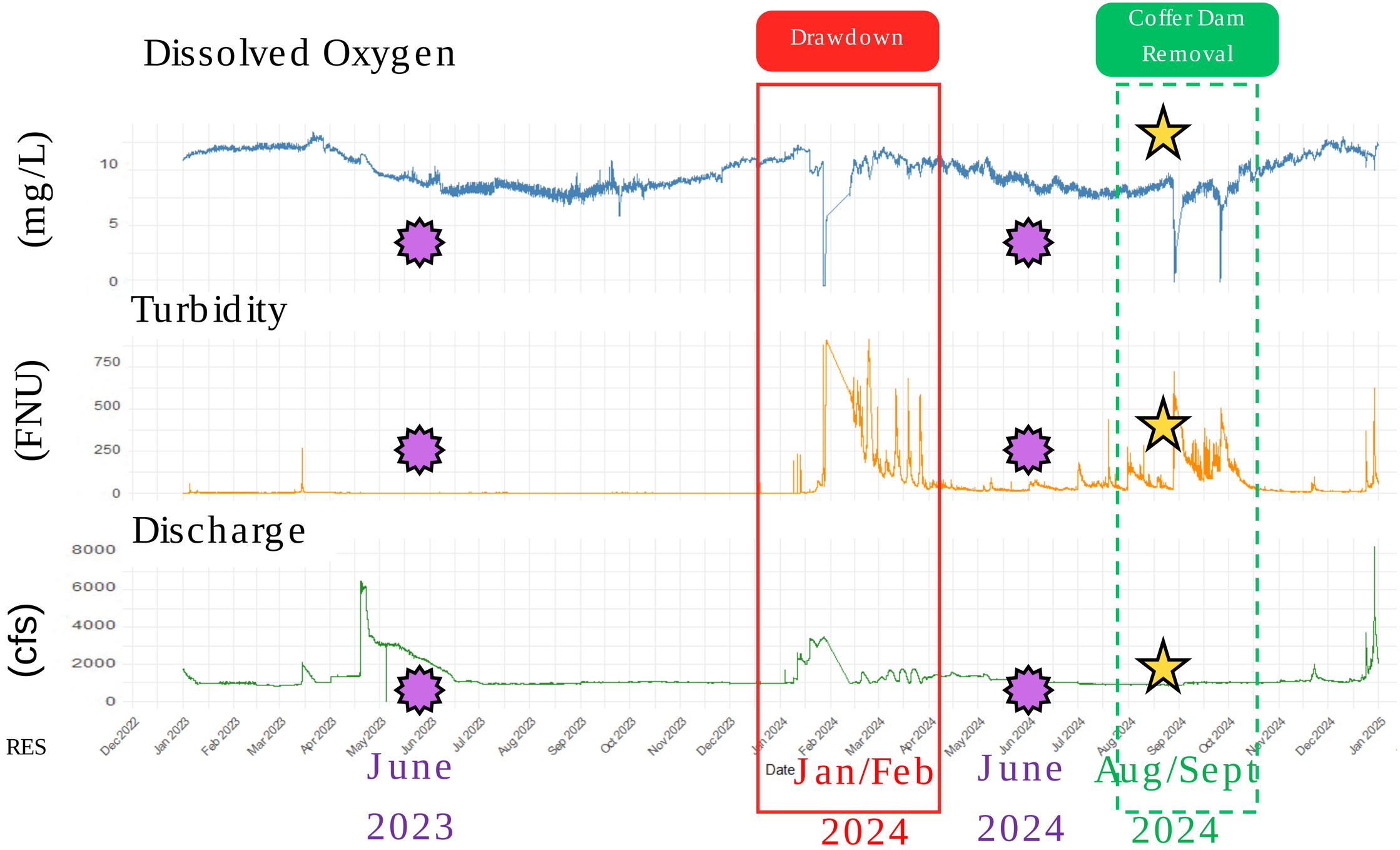
Sediment Impacts

- ~4.2 million tons (dry weight) of sediment stored behind the dams in 3 reservoirs
- 84% of the sediment are fine (silts and clay)
- Expected to mobilize and move quickly downstream
- Potential to directly and indirectly impact the juvenile fish and other aquatic fauna

Iron Gate Reservoir
Fall 2024

Photo: Jason Hartwick/Swiftwater Films

Below Iron Gate Dam



Data from RES

OBSERVED SHORT-TERM IMPACTS OF DAM REMOVAL

01

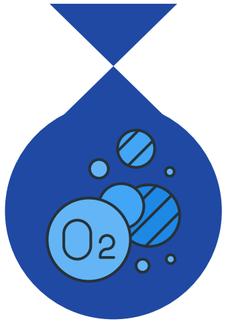
Turbidity

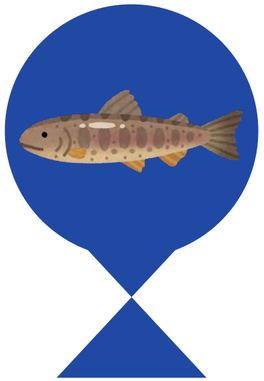
Increase during draw down and coffer dam breach

02

Dissolved Oxygen

Drop during draw down and coffer dam breach





03

Stress on Aquatic Life

Fish, benthic macroinvertebrates plant life

WHY LOOK AT BMI?

Giant Stonefly
(Pteronarcys princeps)

Benthic Macroinvertebrates

- Indicator of stream health
- Food resource for juvenile salmonids

Typically, Salmonids eat...

- Macroinvertebrates in the water column

Caddisflies
(Trichoptera)

Riffle Beetle
(Elmidae)

Non-bitting Midge
(Chironomidae)

Mayfly
(Baetidae)

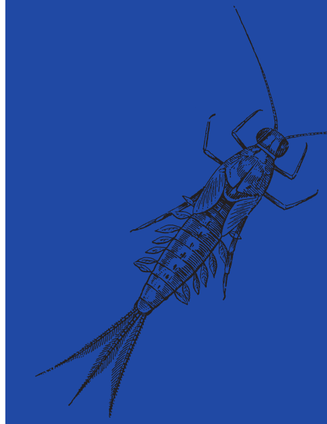
WHAT WE EXPECTED

Mayfly
(Ephemeroptera)

Caddisflies
(Trichoptera)

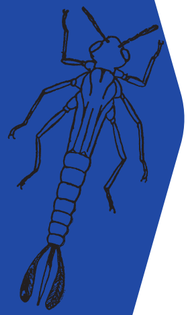
Stonefly
(Plecoptera)

After Dam Removal



Higher overall benthic biomass

Higher Taxonomic Richness



Higher benthic diversity

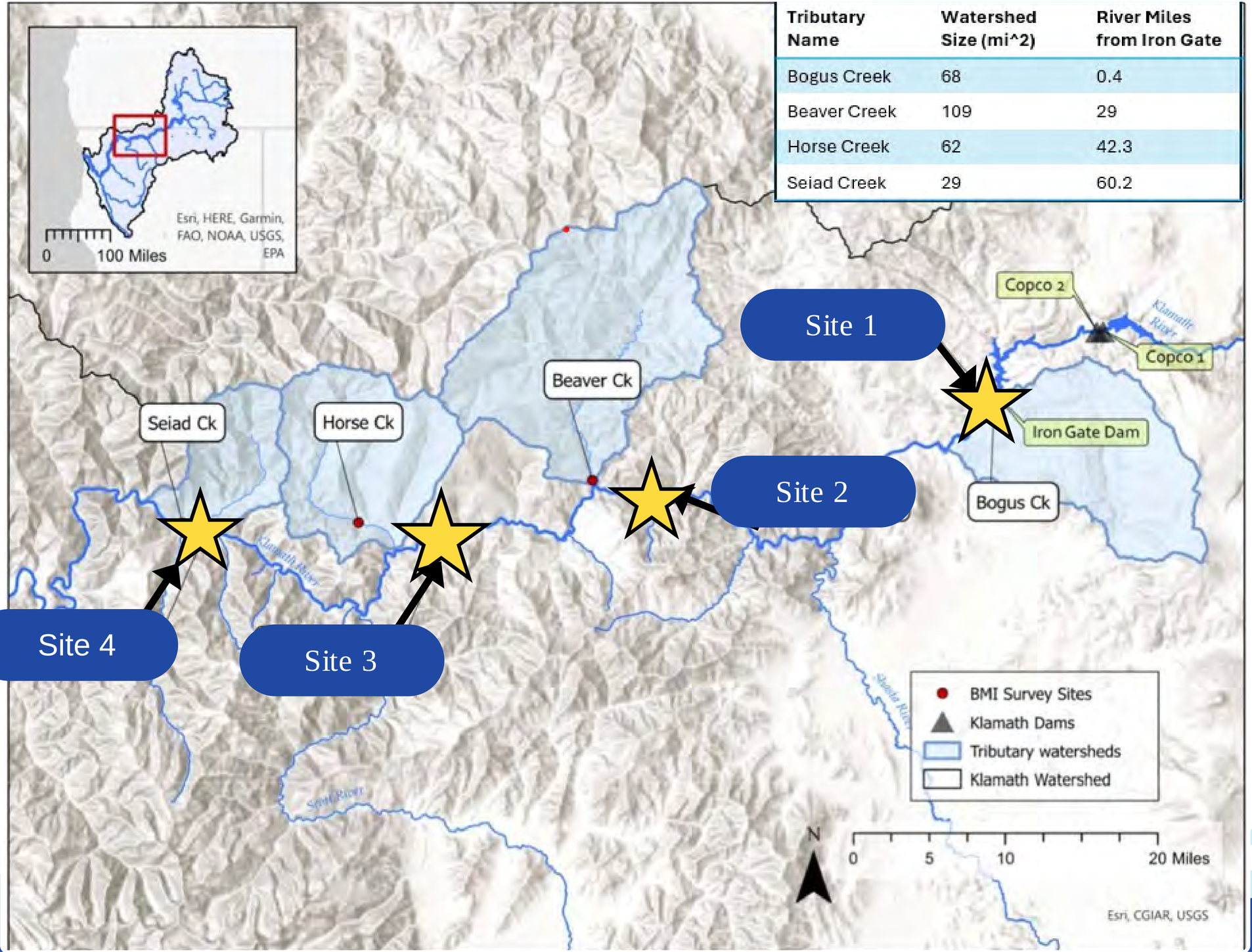
More sensitive taxa

METHODS

Klamath at Horse Creek
Spring 2025

STUDY SITES

Tributary Name	Watershed Size (mi^2)	River Miles from Iron Gate
Bogus Creek	68	0.4
Beaver Creek	109	29
Horse Creek	62	42.3
Seiad Creek	29	60.2



BIOLOGICAL SAMPLING

Drift Sampling:

Collected: Spring 2022-2025

Photo: O'Dowd, 2024

Photo: Inouye, 2024

Fish Diet Sampling:

Collected Spring 2022-2025

Photo: O'Dowd, 2025

Benthic Sampling:

Collected: Fall 2023-2025 and Spring 2022 - 2025

SAMPLING SITE CHARACTERISTICS

AFTER: 2025

	Site Name	River Kilometers from Iron Gate Dam	Drift Samples Collected	Diet Samples Collected	Benthic Samples Collected
	Iron Gate = Site 1	0.3 km	3	20	3
	Gottville = Site 2	40.2 km	3	20	3
	Horse Creek = Site 3	68.1 km	3	20	3
	Seiad Creek = Site 4	96.8 km	3	20	3

SAMPLING SITE CHARACTERISTICS

2022

	Site Name	River Kilometers from Iron Gate Dam	Drift Samples Collected	Diet Samples Collected	Benthic Samples Collected
	Iron Gate = Site 1	0.3 km	3		3
	Gottville = Site 2	40.2 km	3	20	3
	Horse Creek = Site 3	68.1 km		7	
	Seiad Creek = Site 4	96.8 km		23	

SAMPLING SITE CHARACTERISTICS

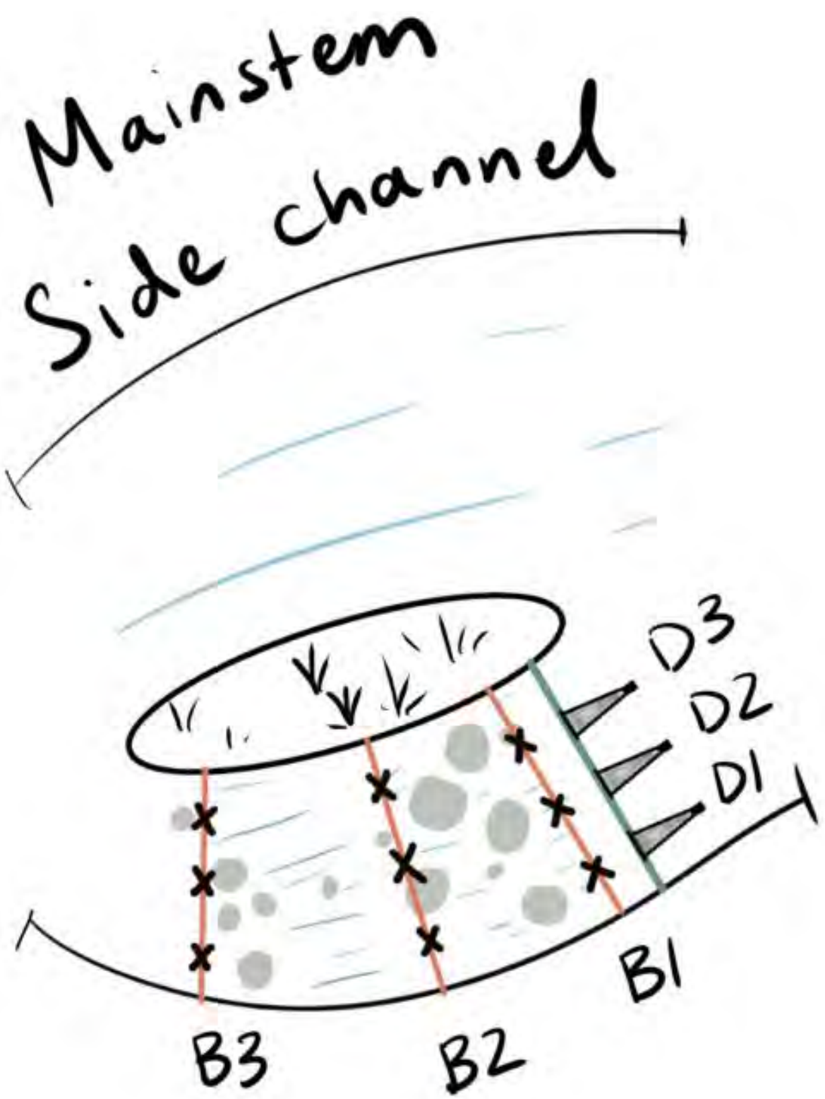
BEFORE: 2022 AND 2023

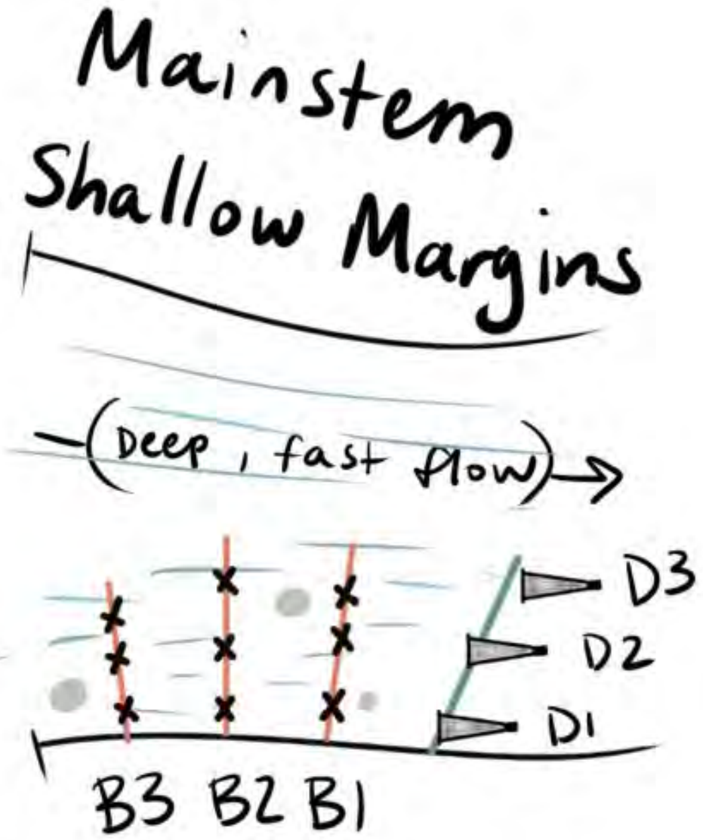
Site Name	River Kilometers from Iron Gate Dam	Drift Samples Collected	Diet Samples Collected	Benthic Samples Collected
Iron Gate = Site 1	0.3 km	6	20	6
Gottville = Site 2	40.2 km	6	40	6
Horse Creek = Site 3	68.1 km	3	27	3
Seiad Creek = Site 4	96.8 km	3	43	3

SAMPLING SITE CHARACTERISTICS

All Years (2022, 2023, and 2025)

	Site Name	River Kilometers from Iron Gate Dam	Drift Samples Collected	Diet Samples Collected	Benthic Samples Collected
	Iron Gate = Site 1	0.3 km	9	40	9
	Gottville = Site 2	40.2 km	9	60	9
	Horse Creek = Site 3	68.1 km	6	47	6
	Seiad Creek = Site 4	96.8 km	6	63	6





Source : Cox, 2023

Flow

WATER QUALITY

Thermistors

- Water temperature taken at 15 minute intervals

- Discharge, turbidity, and dissolved oxygen
  - From RES

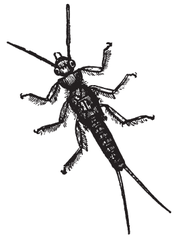
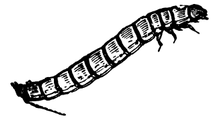
Photo: Indomultimeter Test Instruments

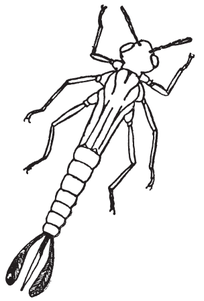
LAB PROCESSING

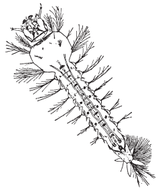
Benthic, Drift, and Diet

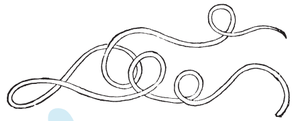
- Processed at Cal Poly Humboldt
- Large samples were sub-sampled (50% or 25%)
- Insects identified to the Family level
  - Non-insects identified to Class
- For diet and drift
  - Identify life stage and measure length for biomass estimates

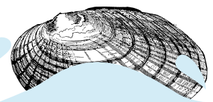
DATA ANALYSIS









Univariate Analysis

- Tested interactions between site and time (before or after dam removal)
  - Site was used as a random effect
- Used both Generalized Linear Models, and Linear Mixed
  - Models depend on components such as data distribution (count, proportion, continuous)

Multivariate Analysis

- PERMANOVA
  - Test differences in community composition
- NMDS
  - Non-Metric Multidimentional Scaling

ECOLOGICAL METRICS

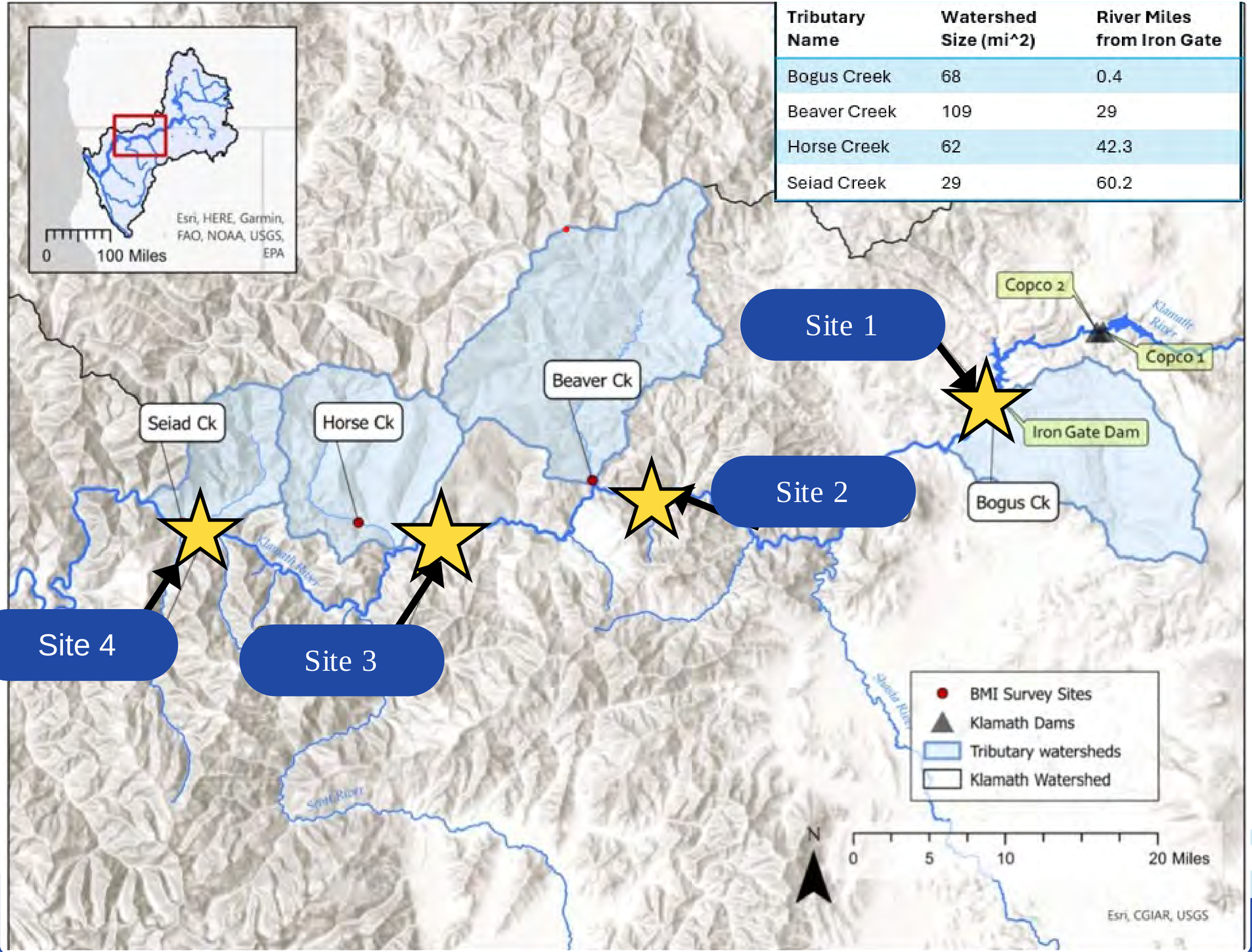
- %EPT (Ephemeroptera, Plecoptera, Trichoptera)
- Taxonomic Richness
- Shannon Diversity
- Drift Density
- Drift Biomass
- Diet Biomass and Gut Fullness
- Fish Condition Factor

Photo: O’Dowd, 2025

RESULTS
DRIFT
BENTHIC
Split Benthic Sub Samples
Sorted Sample (pre acid)
Sorted Debris (pre acid)
ID
Move to Archive

STUDY SITES

Tributary Name	Watershed Size (mi^2)	River Miles from Iron Gate
Bogus Creek	68	0.4
Beaver Creek	109	29
Horse Creek	62	42.3
Seiad Creek	29	60.2



%EPT: EPHEMEROPTERA, PLECOPTERA, AN TRICHOPTERA

Upstream

Downstream

Site 1
Iron Gate

Site 2
Gottville

Site 3
Horse

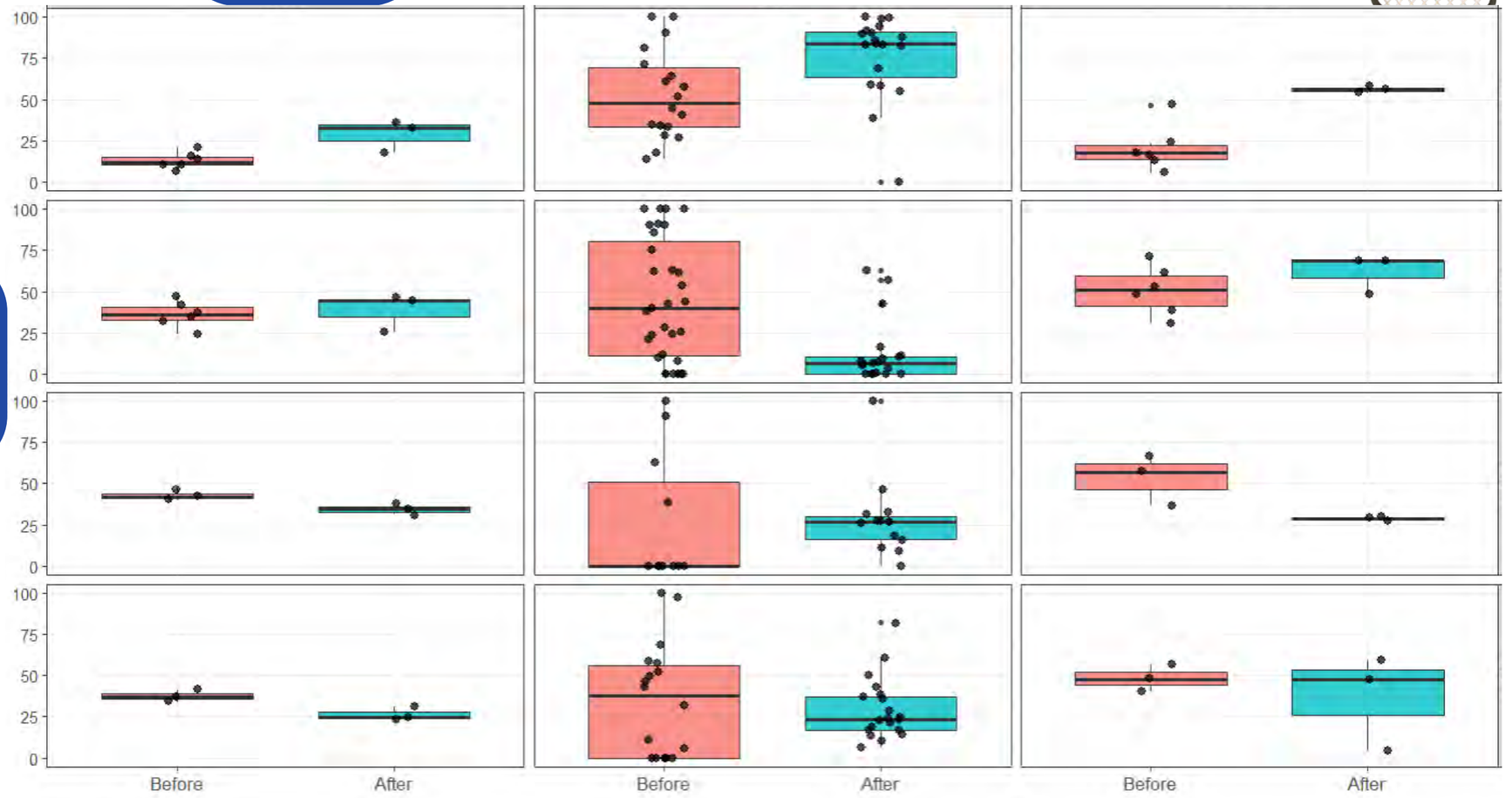
Site 4
Seiad

%EPT

Drift

Diet

Benthic



%EPT: EPHEMEROPTERA, PLECOPTERA, AN TRICHOPTERA

Upstream

Downstream

Site 1
Iron Gate

Site 2
Gottville

Site 3
Horse

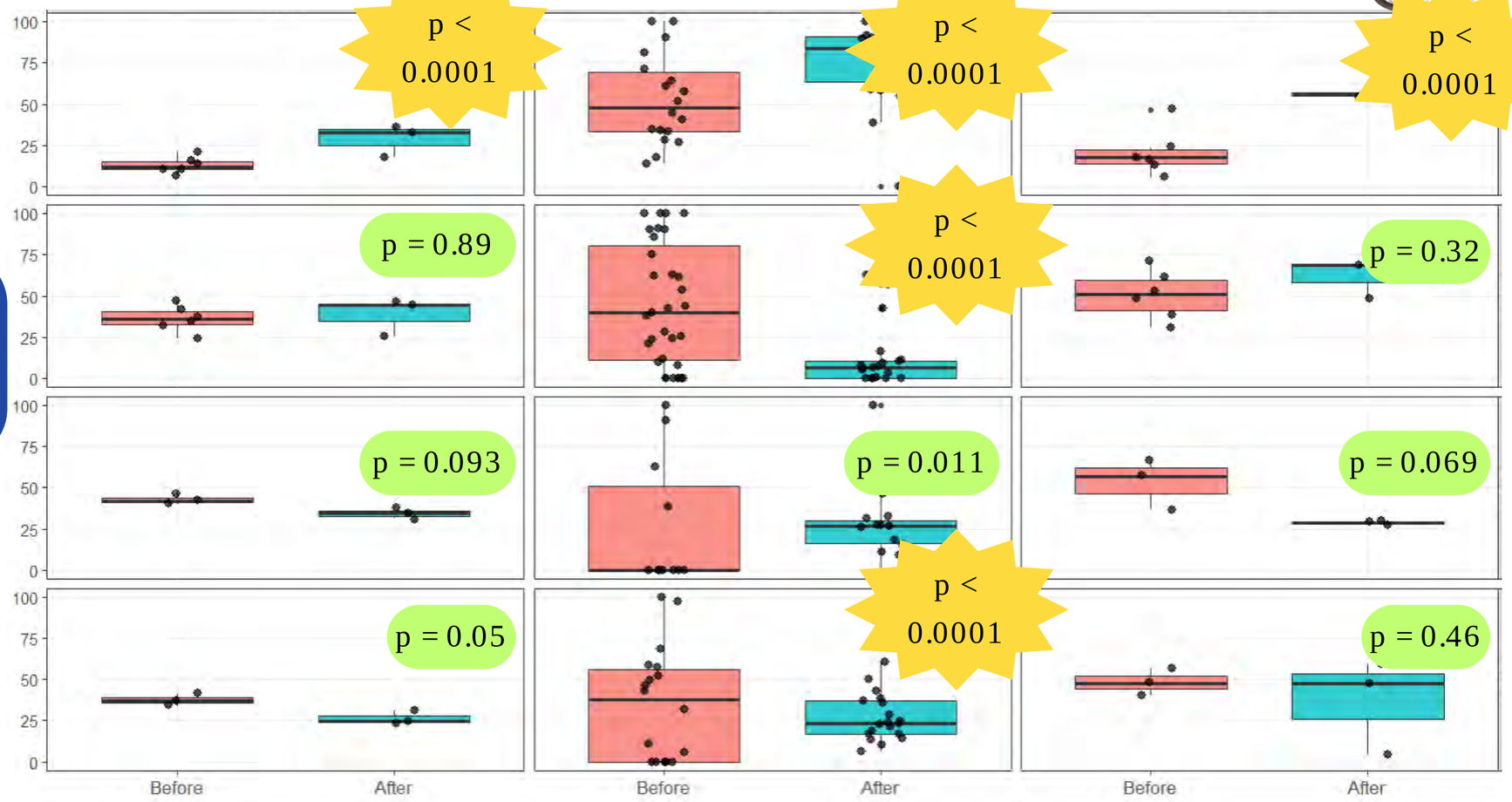
Site 4
Seiad

%EPT

Drift

Diet

Benthic



EPT: EPHEMEROPTERA, PLECOPTERA, AN TRICHOPTERA

Significant Increase at Site 1

Upstream

Downstream

Site 1 Iron Gate

Site 2 Gottville

Site 3 Horse

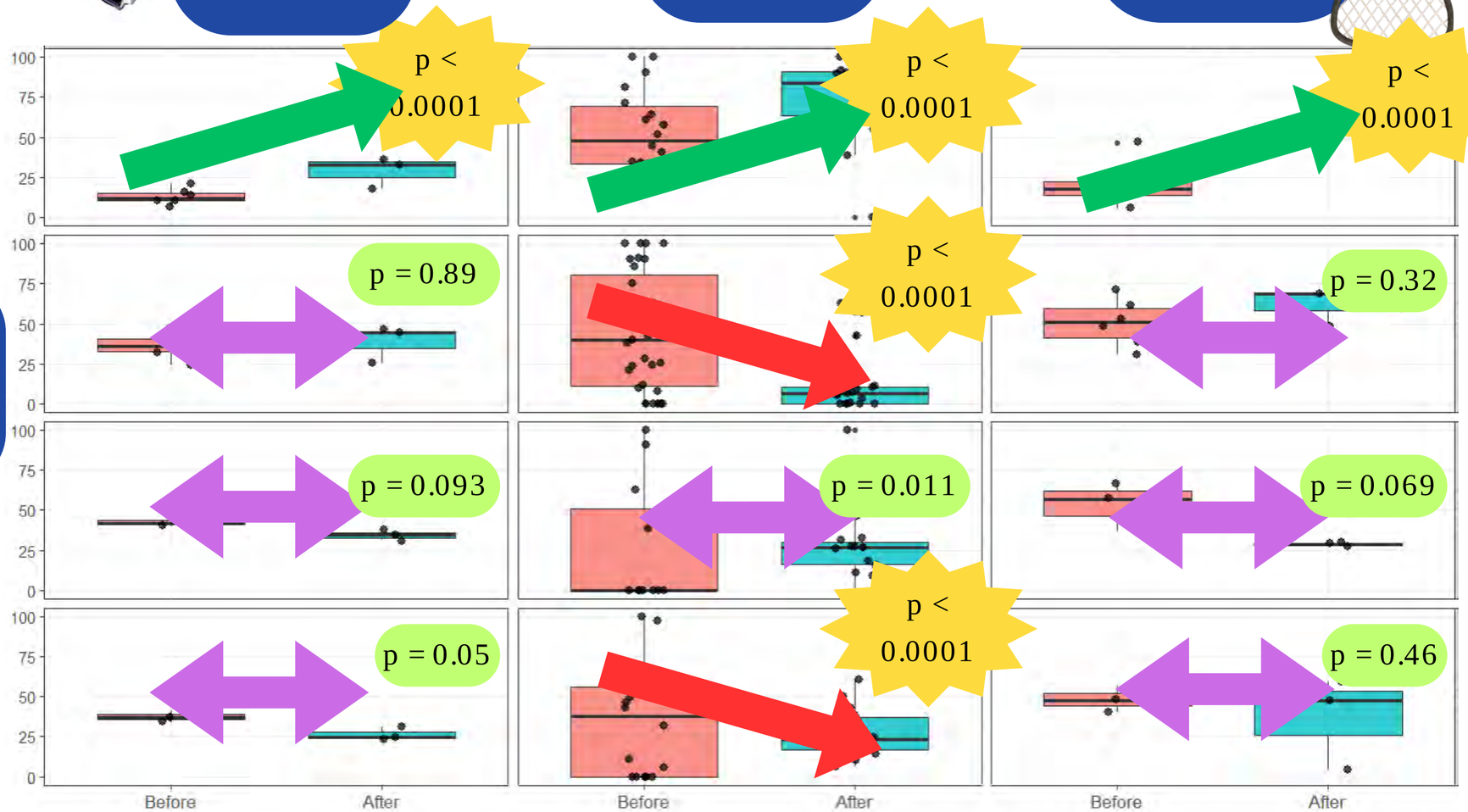
Site 4 Seiad

%EPT

Drift

Diet

Benthic



SHANNON DIVERSITY

No Significant Changes!

Drift

Diet

Benthic

Upstream

Downstream

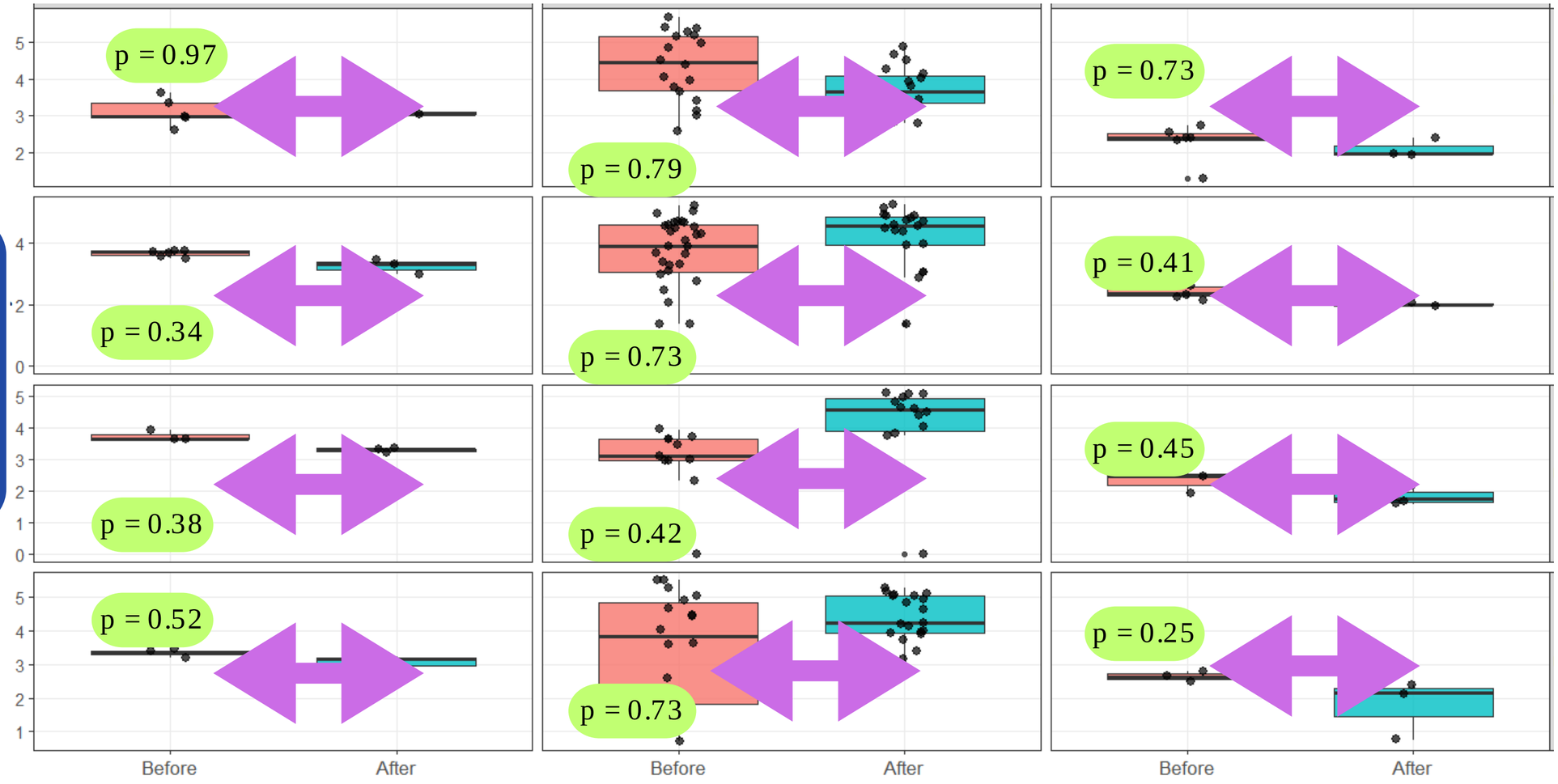
Site 1 Iron Gate

Site 2 Gottville

Site 3 Horse

Site 4 Seiad

Shannon Diversity



TAXONOMIC RICHNESS

Mixed Results
No Clear Trends

Drift

Diet

Benthic

Upstream

Downstream

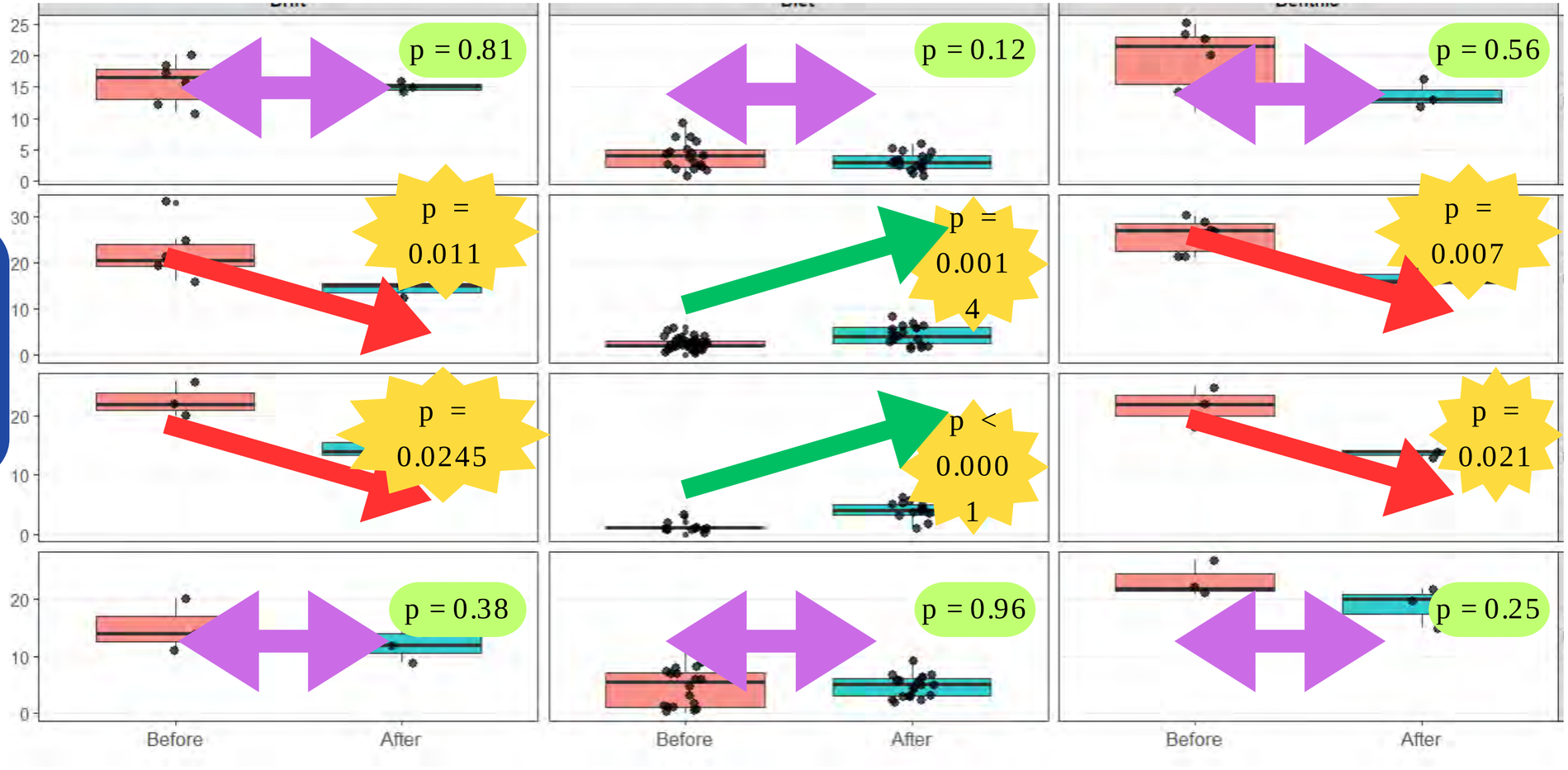
Site 1
Iron Gate

Site 2
Gottville

Site 3
Horse

Site 4
Seiad

Taxonomic Richness



BIOMASS

No Significant Changes!

Drift

Diet

Increase at Site 2 and Site 3

Upstream

Downstream

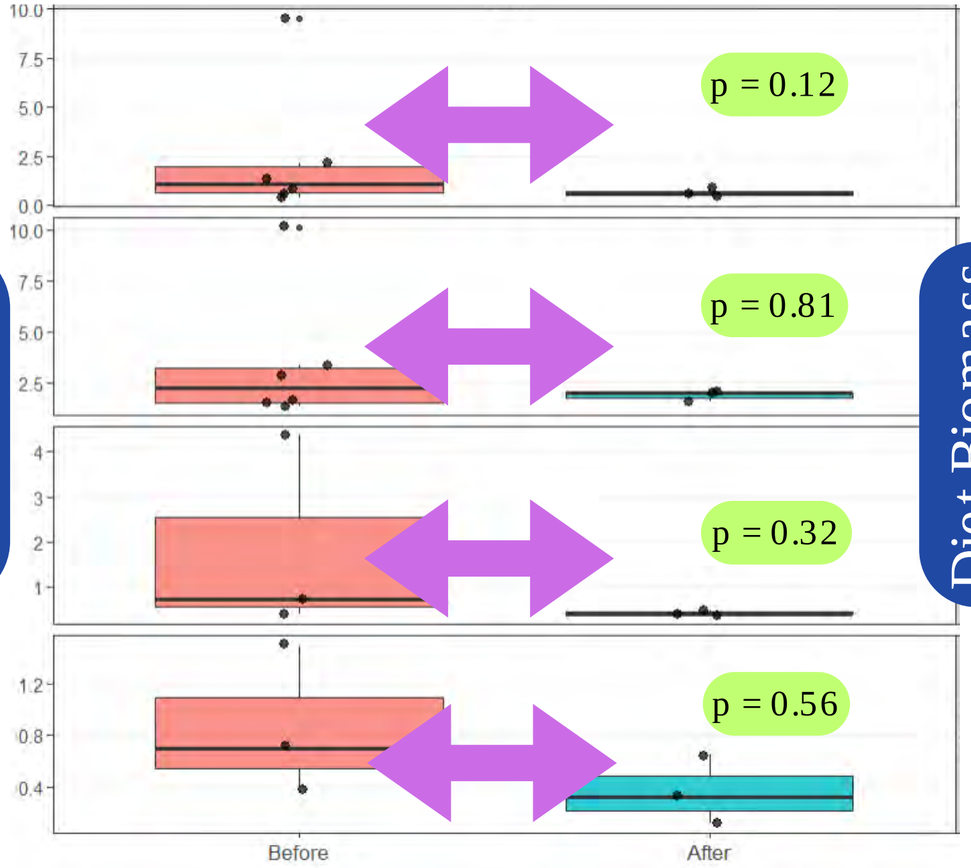
Site 1 Iron Gate

Site 2 Gottville

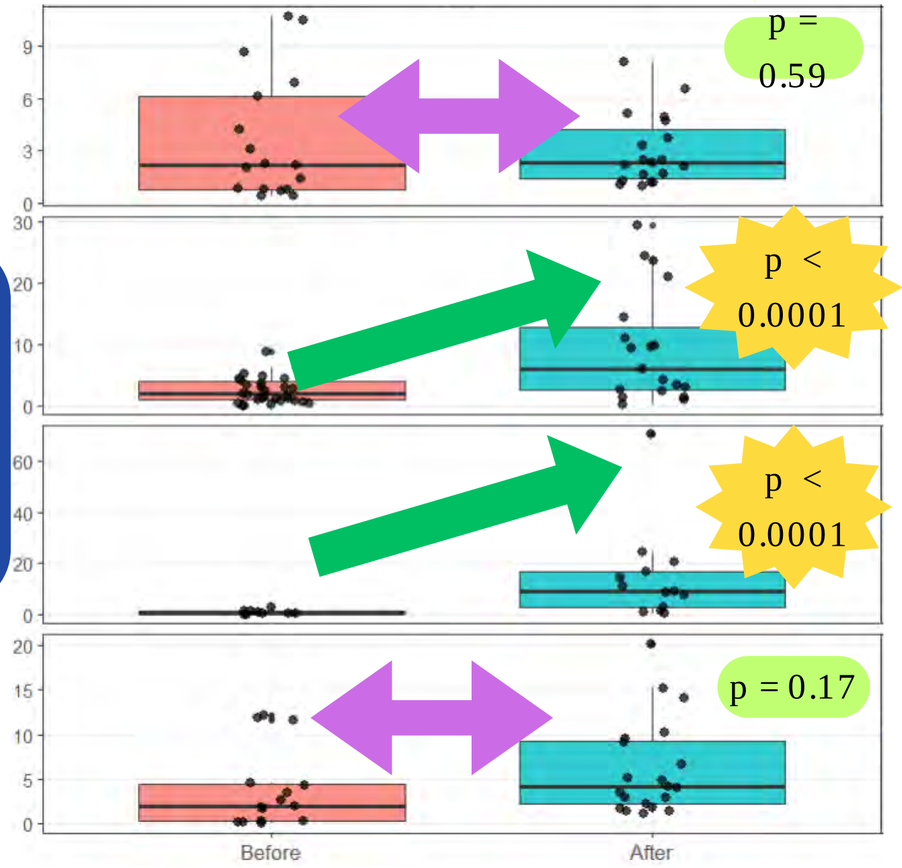
Site 3 Horse

Site 4 Seiad

Drift Biomass



Diet Biomass



FISH CONDITION FACTOR

Significant Increase at all sites!

Upstream

Downstream

Site 1
Iron Gate

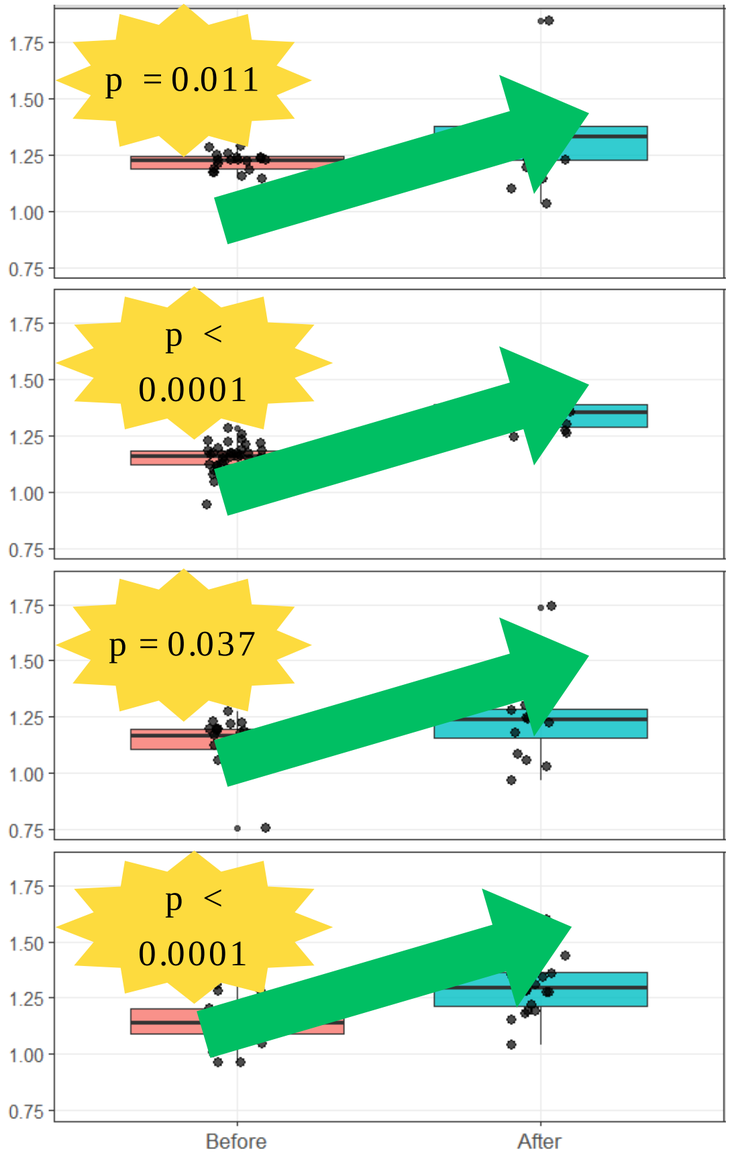
Site 2
Gottville

Site 3
Horse

Site 4
Seiad

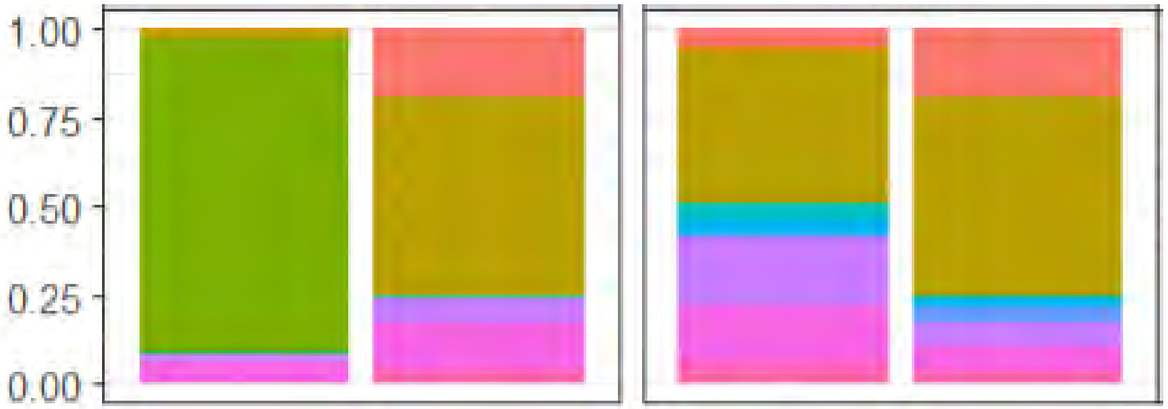
Diet

Fish Condition (K)



FAMILY COMPOSITION AT SITE 1 (IRON GATE)

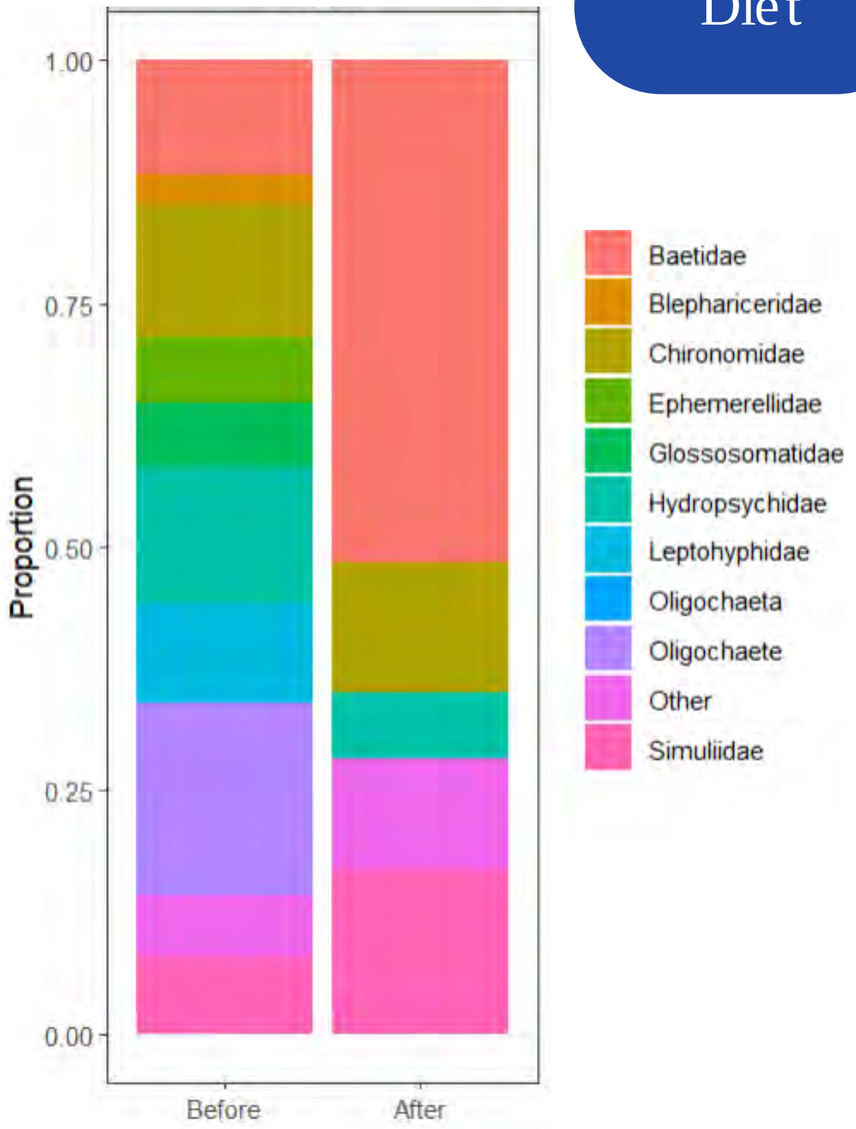
Drift



With Daphniidae

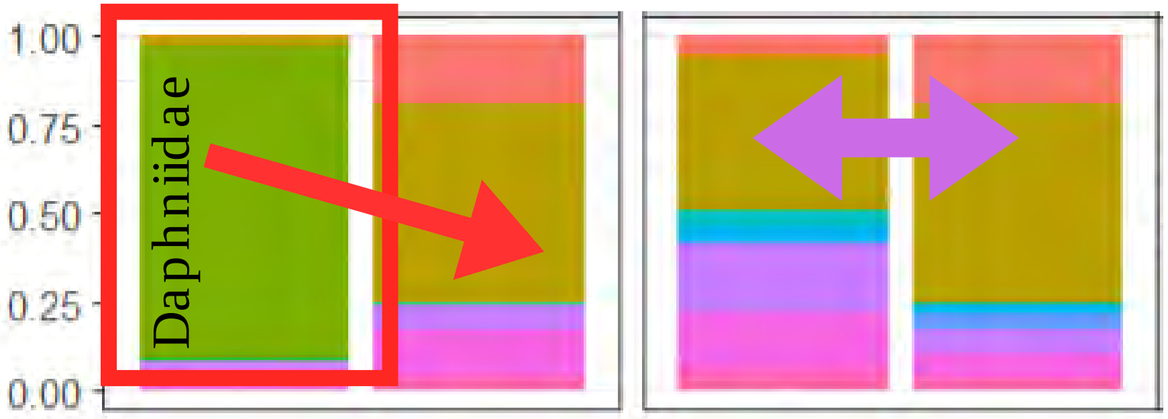
Without Daphniidae

Diet



FAMILY COMPOSITION AT SITE 1 (IRON GATE)

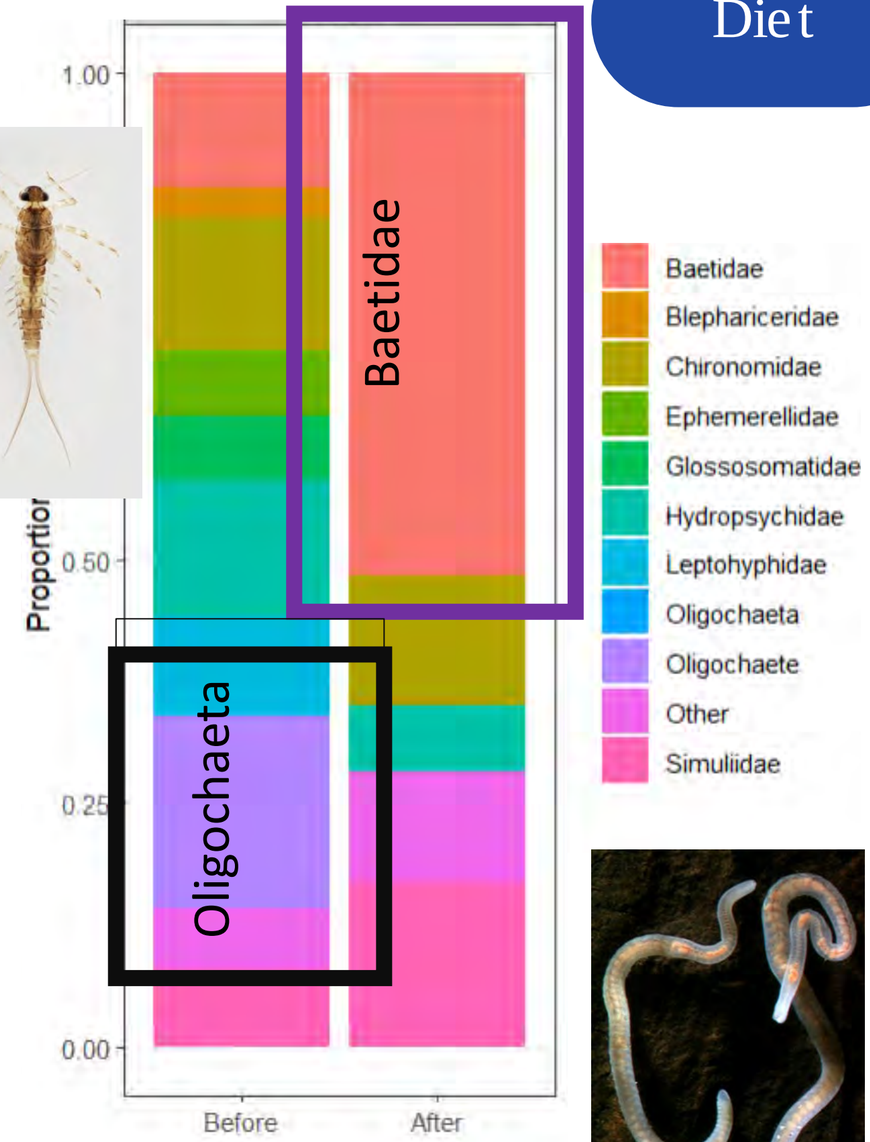
Drift



With Daphnia

Without Daphnia

Diet

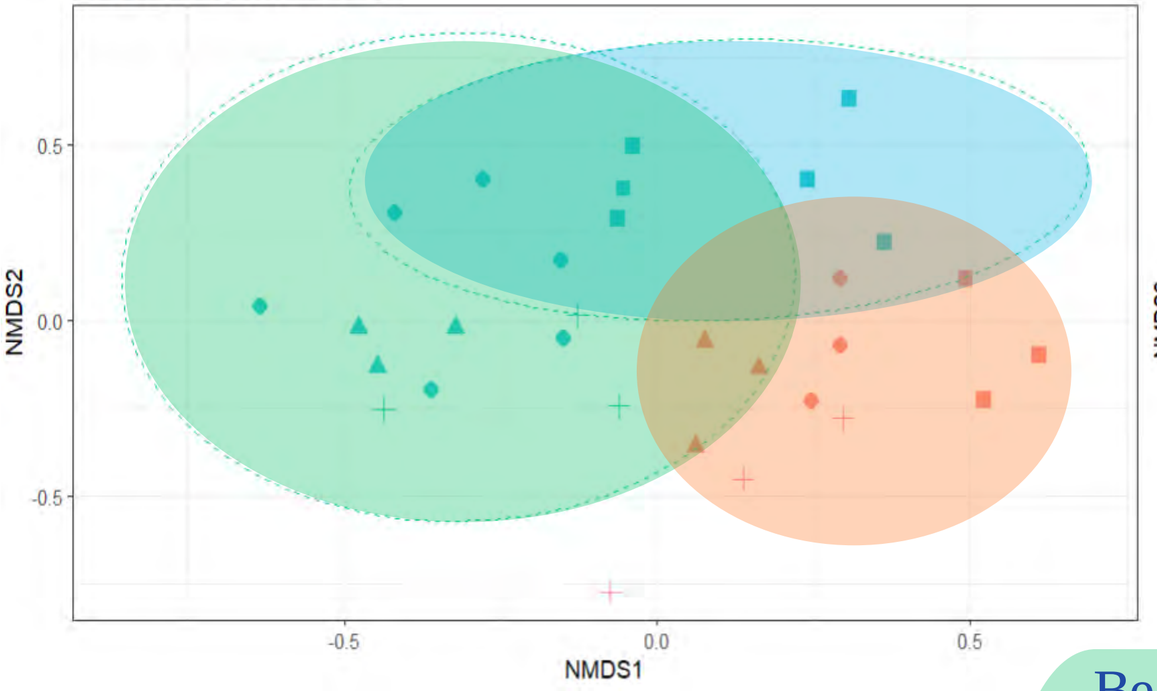


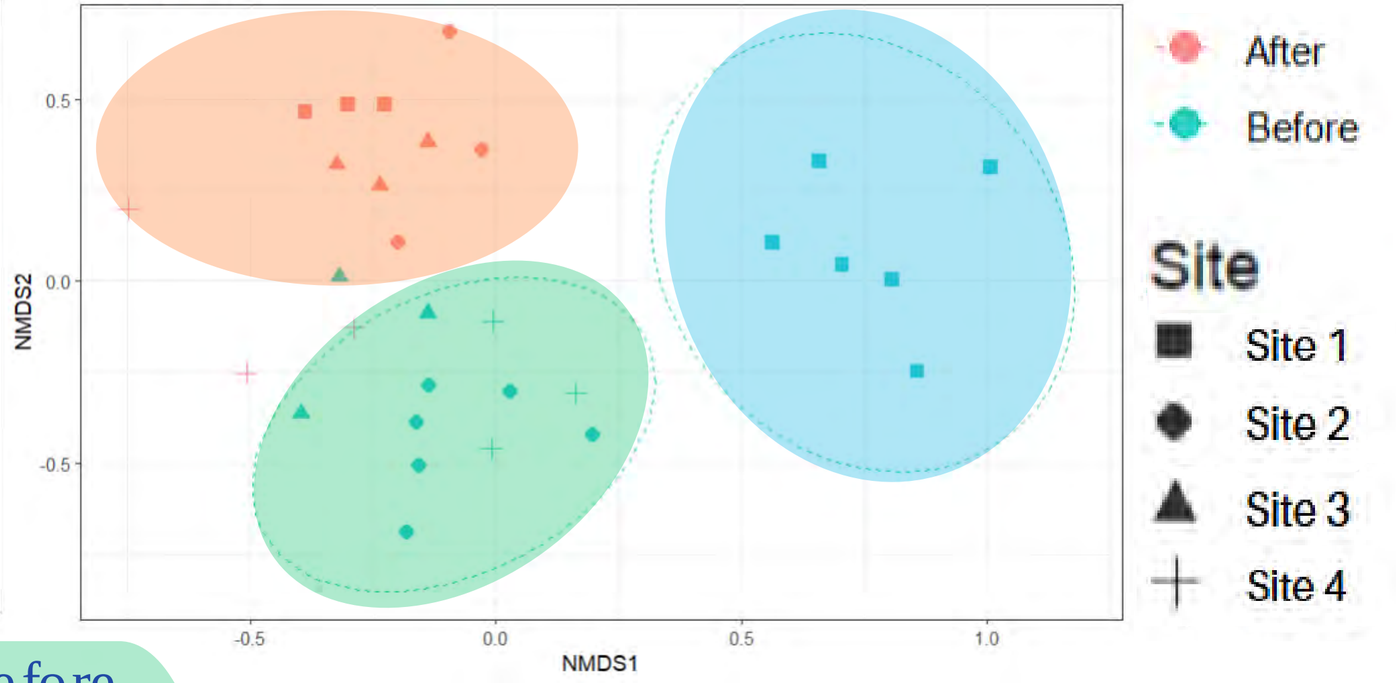
NMDS PLOTS

Drift

Benthic

Before or After





Before
Site 1
(Iron Gate)

Before
Site 2
Site 3
Site 4

After
All Sites

DISCUSSION

Klamath at
Gottville
Spring 2025

BENTHIC AND DRIFT

Dam removal caused strong but spatially variable responses across benthic and drift communites

Site 1 Iron Gate

Largest shift in:

- Increase in %EPT

Plankton

- Strongly influenced pre -dam removal drift patterns

Site 2 and Site 3 Gottville and Horse Creek

These sites saw:

- Declines in richness (in both benthic and drift)

Site 4 Seiad Creek

Very little shift between before and after

- Only change was that the diet %EPT decreased

Upstream

Downstream

FISH DIET AND FISH CONDITION

Fish Diets

Increase diet richness and biomass at:

- Site 2
- Site 3

Shifts in %EPT

- Varied by site

Fish Condition

Improved across all sites!

WHAT WE EXPECTED

Mayfly
(Ephemeroptera)

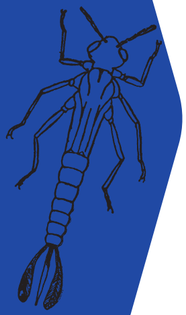
Caddisflies
(Trichoptera)

Stonefly
(Plecoptera)

After Dam Removal

Higher overall benthic biomass

Higher Taxonomic Richness



Higher benthic diversity

More sensitive taxa

WHAT WE EXPECTED

Mayfly
(Ephemeroptera)

Caddisflies
(Trichoptera)

Stonefly
(Plecop

Mixed Results

al

ier overall
enthic biomass

Higher Taxonomic
Richness

Higher benthic
diversity

More sensitive
taxa

TAKE HOME

Effects are more pronounced at Iron Gate (Site 1) and decrease further from the dam

Fish Condition

- Improves across all sites
  - Small sample size

River Resilience

- Did not see a collapse in invertebrate communities

NEXT STEPS

One more year of sampling

More analysis

- Add in turbidity effects
- Look more into shifts in taxa
  - Are the shifts we seeing better fish food?
- Include tributary interaction?

ACKNOWLEDGEMENTS

Committee Members

- Alison O'Dowd
- Darren Ward
- Nick Som

Funder

- California Wildlife Conservation Board's Stream Flow Enhancement Program

Lab Technicians

- Rosa Cox, Amanda Podkomorka , Bree Gentil - Guijosa, Garrett Leonard, Julia Nehl, Michael Paige, Naomi Schumichen , Theo Murphy, Andre Giraldi, Jazmyn Rivera, Kelly Corcoran, King Baptista

Karuk Tribe

- Toz Soto
- Clayton Tuttle
- Ben Harrison
- Aaron Tuttle
- Colton Dixon

UC Davis

- Robert Lusardi
- Brandi Goss
- Sarah Howe
- Sophie Sanchez

RES

- Dan Chase
- Caitlin Boise

UC Berkeley

- Amanda Wik
- Albert Ruhi
- Ted Grantham

WORK CITED

Bellmore, J. R., Pess, G. R., Duda, J. J., O'Connor, J. E., East, A. E., Foley, M. M., Wilcox, A. C., Major, J. J., Shafroth, P. B., Morley, S. A., Magirl, C. S., Anderson, C. W., Evans, J. E., Torgersen, C. E., & Craig, laura S. (2019). Conceptualizing Ecological Responses to Dam Removal: If You Remove It, What's to Come? *BioScience*, *69*(1), 26–39. https://doi.org/10.1093/biosci/biy152

Belchik, M., Hillemeier, D., & Pierce, R. (2004). *The Klamath River Fish Kill of 2002; Analysis of Contributing Factors Yurok Tribal Fisheries Program Final Report*. https://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/california_waterfix/exhibits/docs/PCFFA&IGFR/part2/pcffa_155.pdf

Di Baldassarre, G., Mazzoleni, M., & Rusca, M. (2021). The legacy of large dams in the United States. *Ambio*, *50*(10), 1798–1808. https://doi.org/10.1007/s13280-021-01533-x

Garandeau, R., Edwards, S., Maslin, M., & Benfield, A. (2014). *Biophysical, socioeconomic and geopolitical impacts assessments of large dams: an overview P a g e | 1 Biophysical, socioeconomic and geopolitical impacts assessments of large dams: an overview Introduction: the large dams controversy*. https://www.ucl.ac.uk/hazard-centre/sites/hazard-centre/files/mega-dam-overview.pdf

Guetz, K., Joyal, T., Dickson, B., & Perry, D. (2022). Prioritizing dams for removal to advance restoration and conservation efforts in the western United States. *Restoration Ecology*. https://doi.org/10.1111/rec.13583

Morley, S. A., Foley, M. M., Duda, J. J., Beirne, M. M., Paradis, R. L., Johnson, R. C., McHenry, M. L., Elofson, M., Sampson, E. M., McCoy, R. E., Stapleton, J., & Pess, G. R. (2020). Shifting food web structure during dam removal—Disturbance and recovery during a major restoration action. *PLOS ONE*, *15*(9), e0239198. https://doi.org/10.1371/journal.pone.0239198

Vahedifard, F., Madani, K., AghaKouchak, A., & Thota, S. K. (2021). Are we ready for more dam removals in the United States? *Environmental Research: Infrastructure and Sustainability*. https://doi.org/10.1088/2634-4505/abe639

IMPACTS OF KLAMATH DAMS

Photo: O'Dowd, 2023

Water Quality

- Toxic cyanobacteria blooms
- Higher temperatures from dam releases

Fish Passage

- Lower four dams were impassable to migrating fish and other aquatic species

Fish Health

- *Ceratonova shasta*
- Ich (*Ichthyopthirius multifiliis*)

Indigenous Communties

- Restricted fishing rights and ceremonies. Cultural and spiritual identity closely tied to the river and fishing

LESSONS FROM THE ELWHA DAM REMOVAL

Two Dams on the Elwha River

- Glines Canyon Dam
- Elwha Dam

Main Findings - Morley et al., 2020

- Drift samples shifted to more terrestrial insects during dam removal
  - Juvenile salmonids had fewer terrestrial insects in their diets relative to drift
- Sensitive macroinvertebrate taxa decreased due to the increased sedimentation

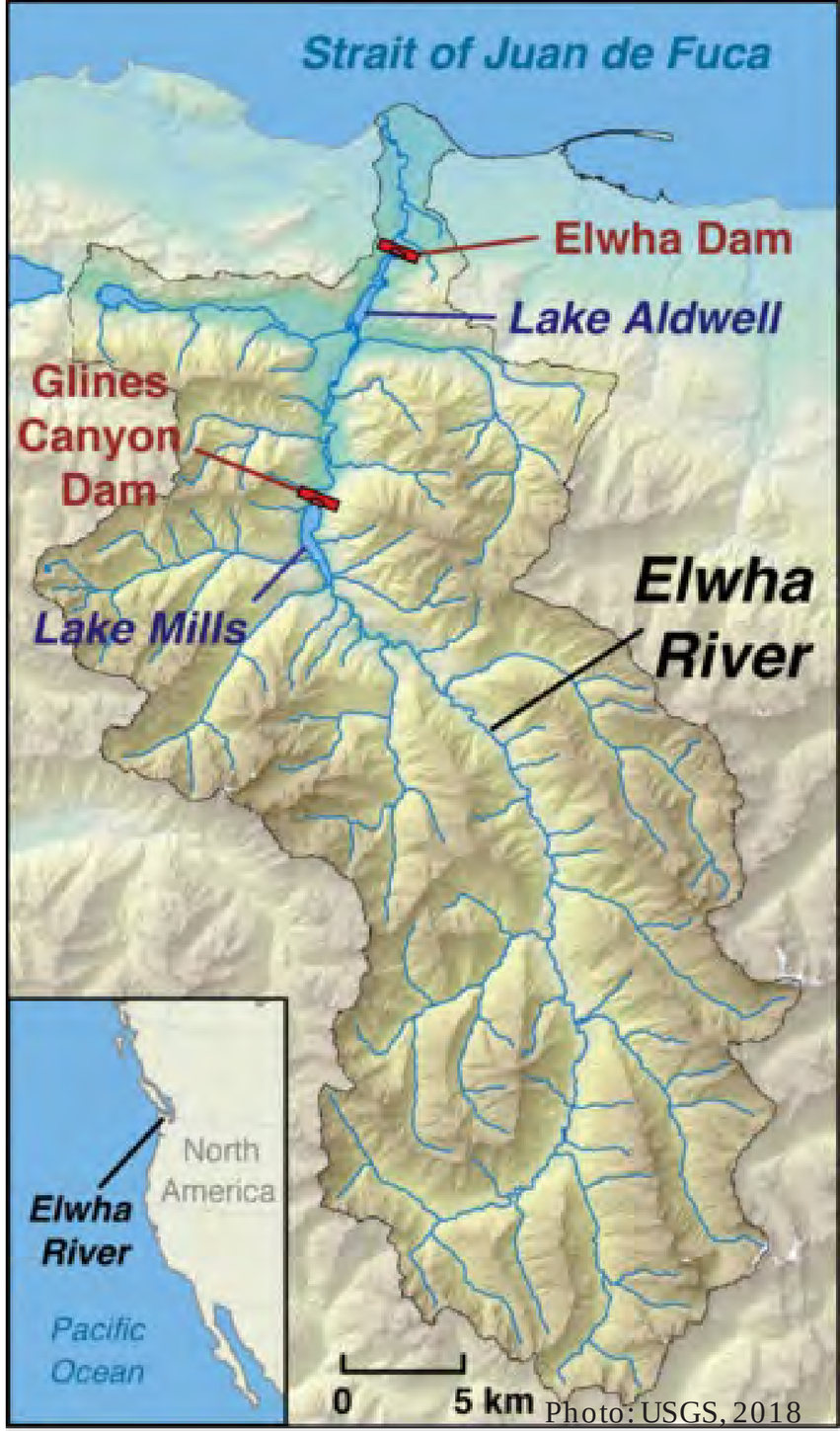
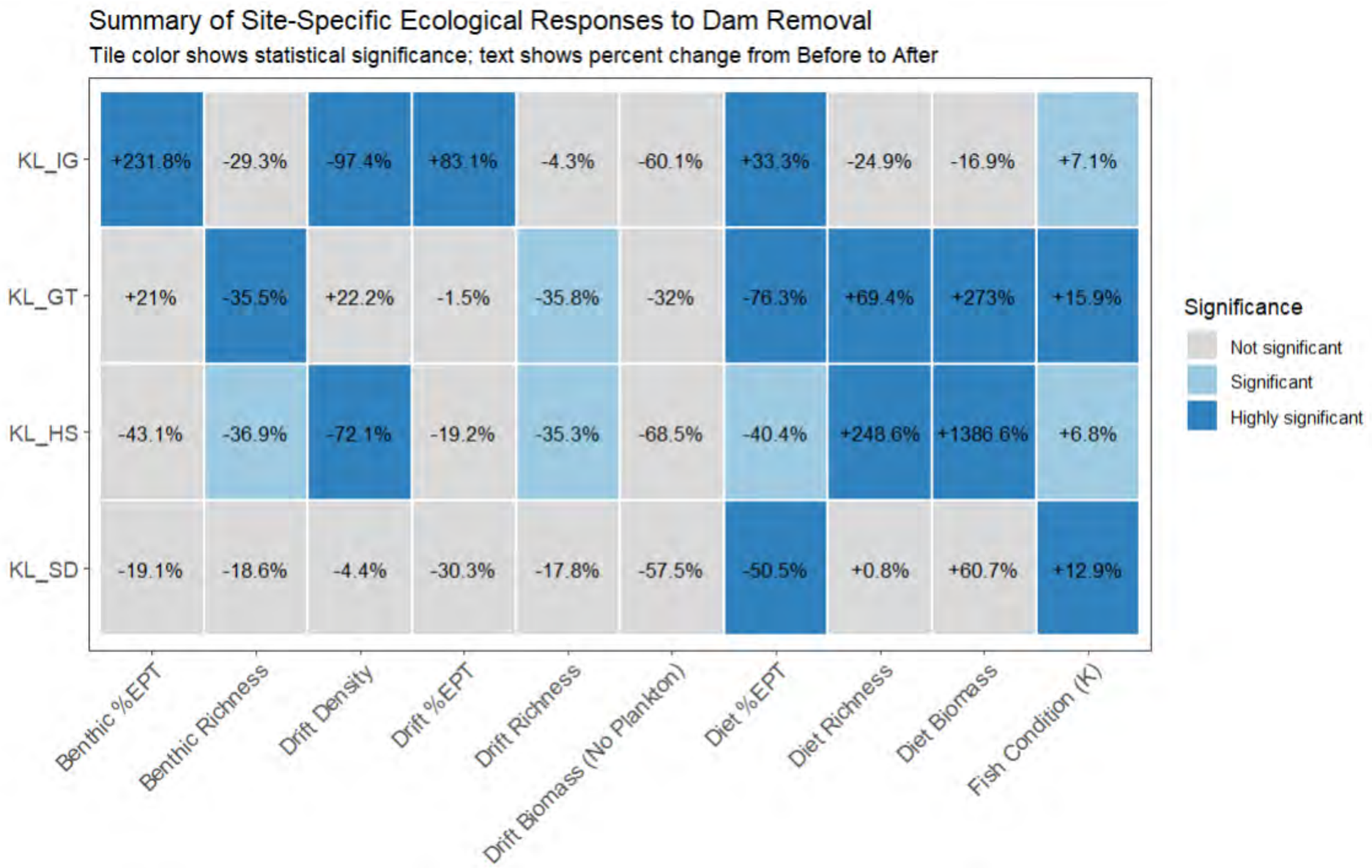


Photo: USGS, 2018

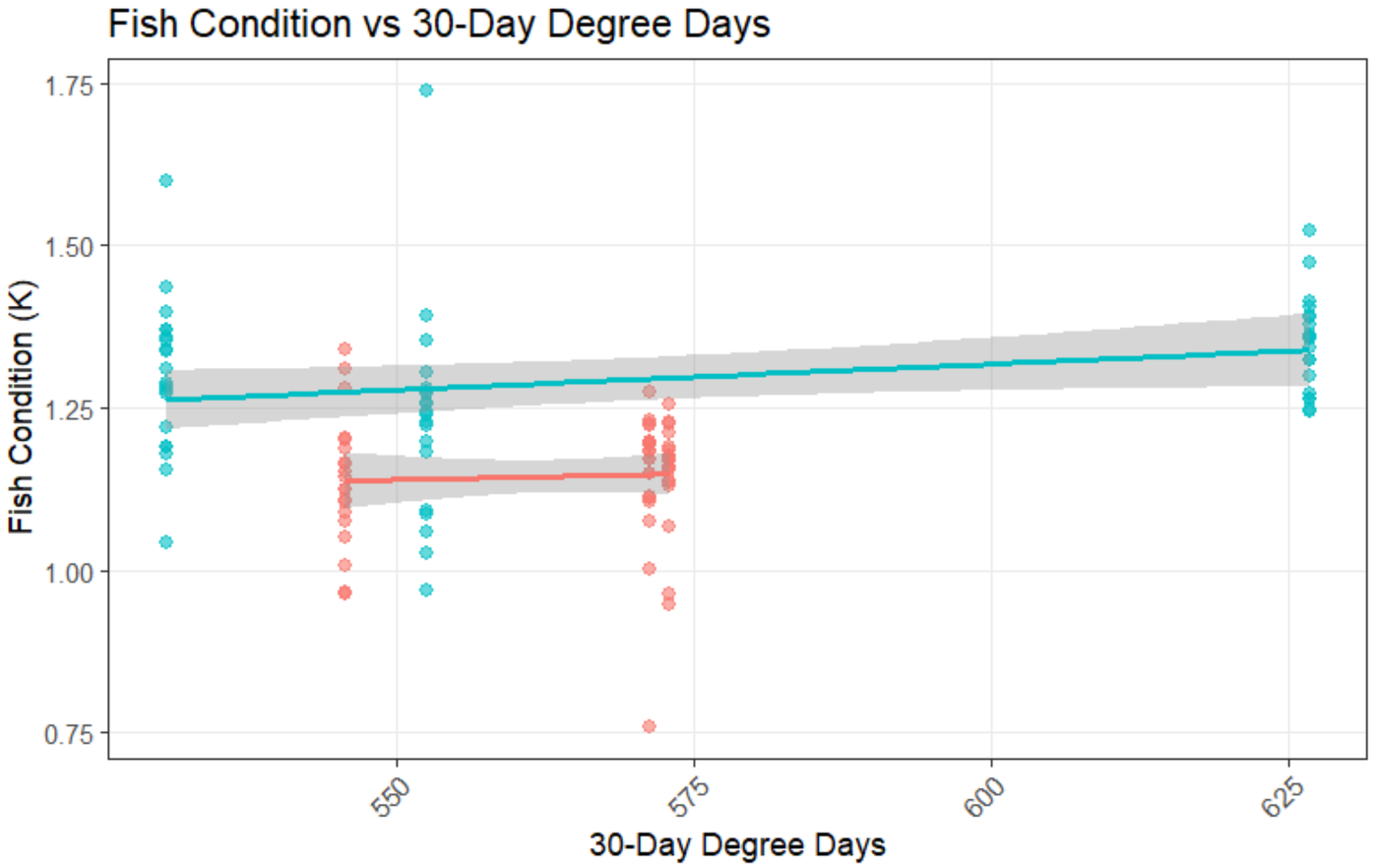
TAKE HOME


Summary of Site-Specific Ecological Responses to Dam Removal
Tile color shows statistical significance; text shows percent change from Before to After
KL_IG
KL_GT
KL_HS
KL_SD
+231.8%
-29.3%
-97.4%
+83.1%
-4.3%
-60.1%
+33.3%
-24.9%
-16.9%
+7.1%
+21%
-35.5%
+22.2%
-1.5%
-35.8%
-32%
-76.3%
+69.4%
+273%
+15.9%
-43.1%
-36.9%
-72.1%
-19.2%
-35.3%
-68.5%
-40.4%
+248.6%
+1386.6%
+6.8%
-19.1%
-18.6%
-4.4%
-30.3%
-17.8%
-57.5%
-50.5%
+0.8%
+60.7%
+12.9%
Benthic %EPT
Benthic Richness
Drift Density
Drift %EPT
Drift Richness
Drift Biomass (No Plankton)
Diet %EPT
Diet Richness
Diet Biomass
Fish Condition (K)
Significance
Not significant
Significant
Highly significant

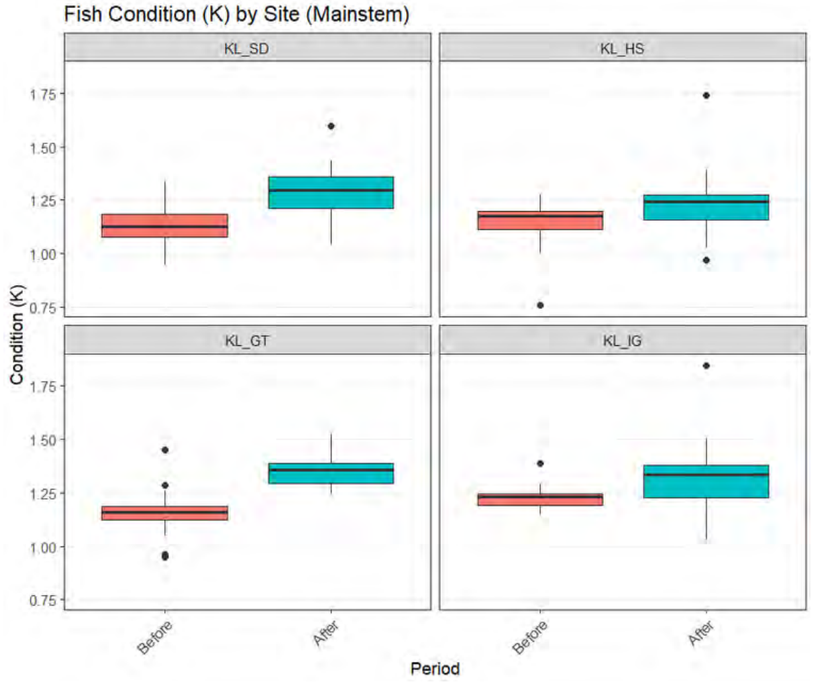
ELWHA VS KLAMATH

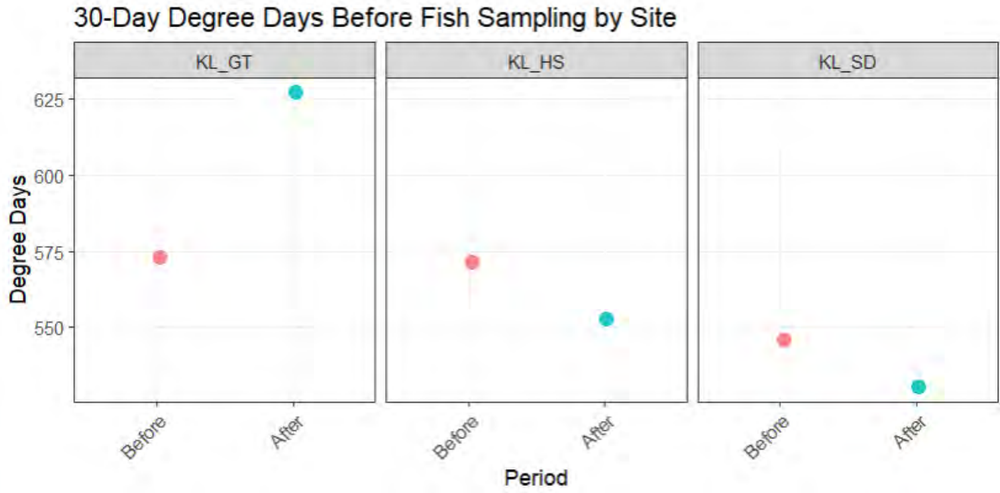
VS

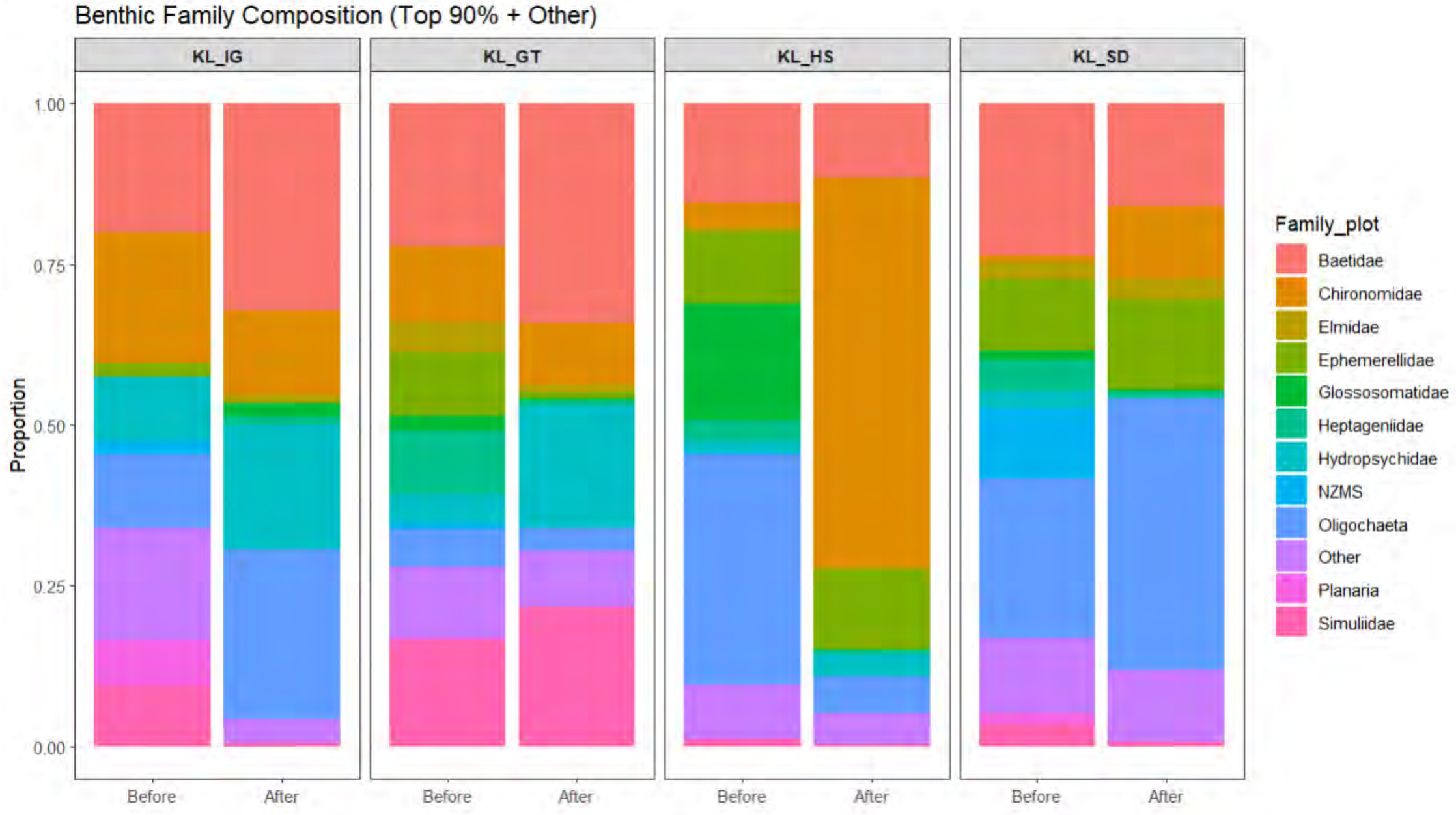
Elwha Dam Removal		Klamath Dam Removal
01	Sediment Budget	01
30 million tonnes of sediment		~ 4.2 million tons (dry weight) of sediment stored behind the dams in 3 reserviors
02	Sediment Type	02
63% coarse 37% silt and clay		16% coarse 84% silt and clayf
03	Sediment Reaching the Ocean	03
> 18 million tonnes 5.54 million tonnes to the river delta 13 million tonnes to marine environment		
04	Time Frame	04
2011 to 2014		2023 to 2024

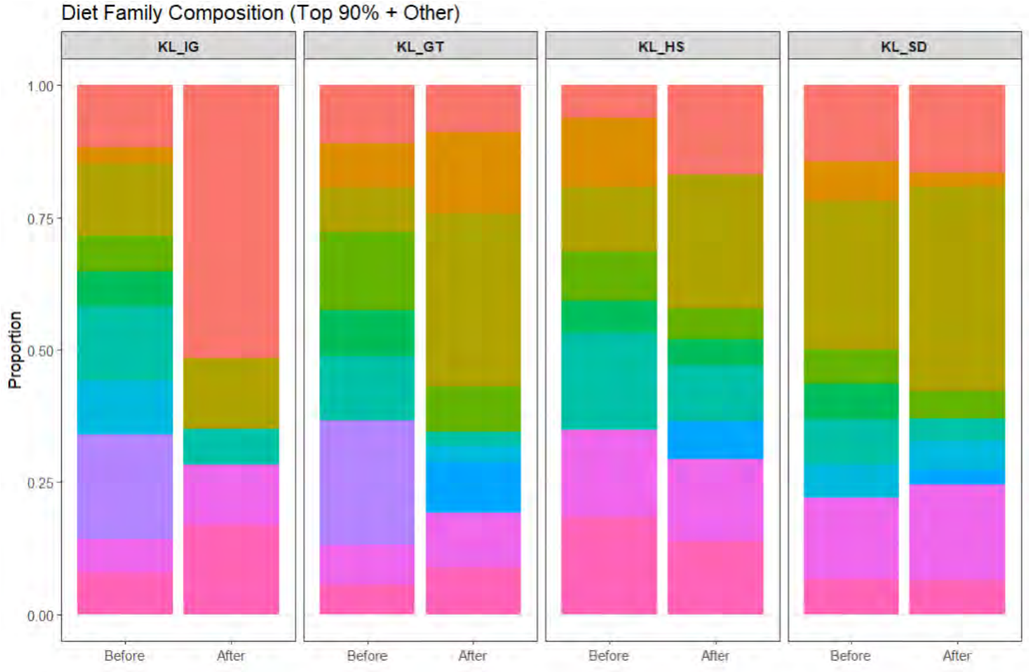

Fish Condition vs 30-Day Degree Days
Fish Condition (K)
1.75
1.50
1.25
1.00
0.75
550
575
600
625
30-Day Degree Days

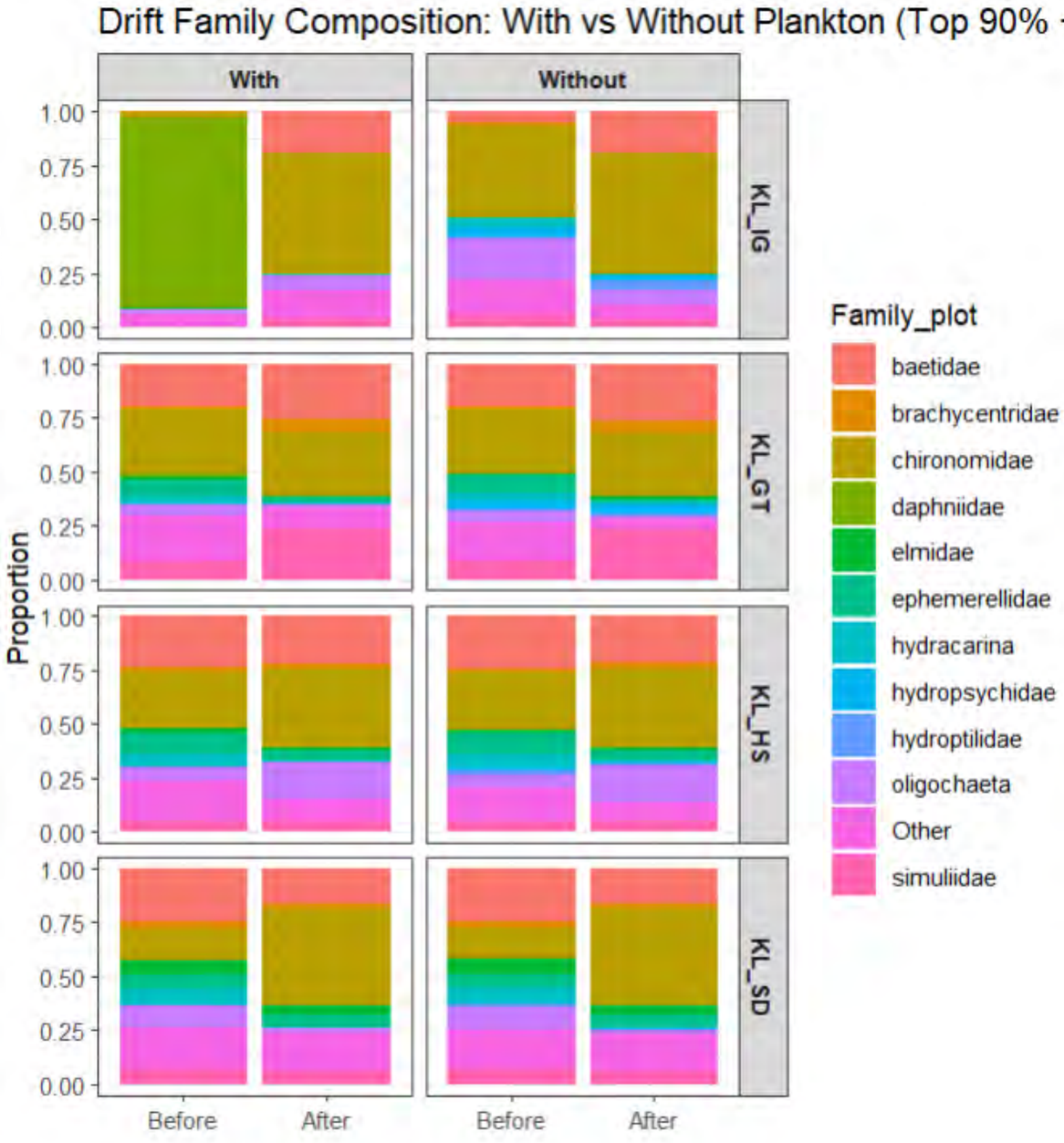
Period
Before
After

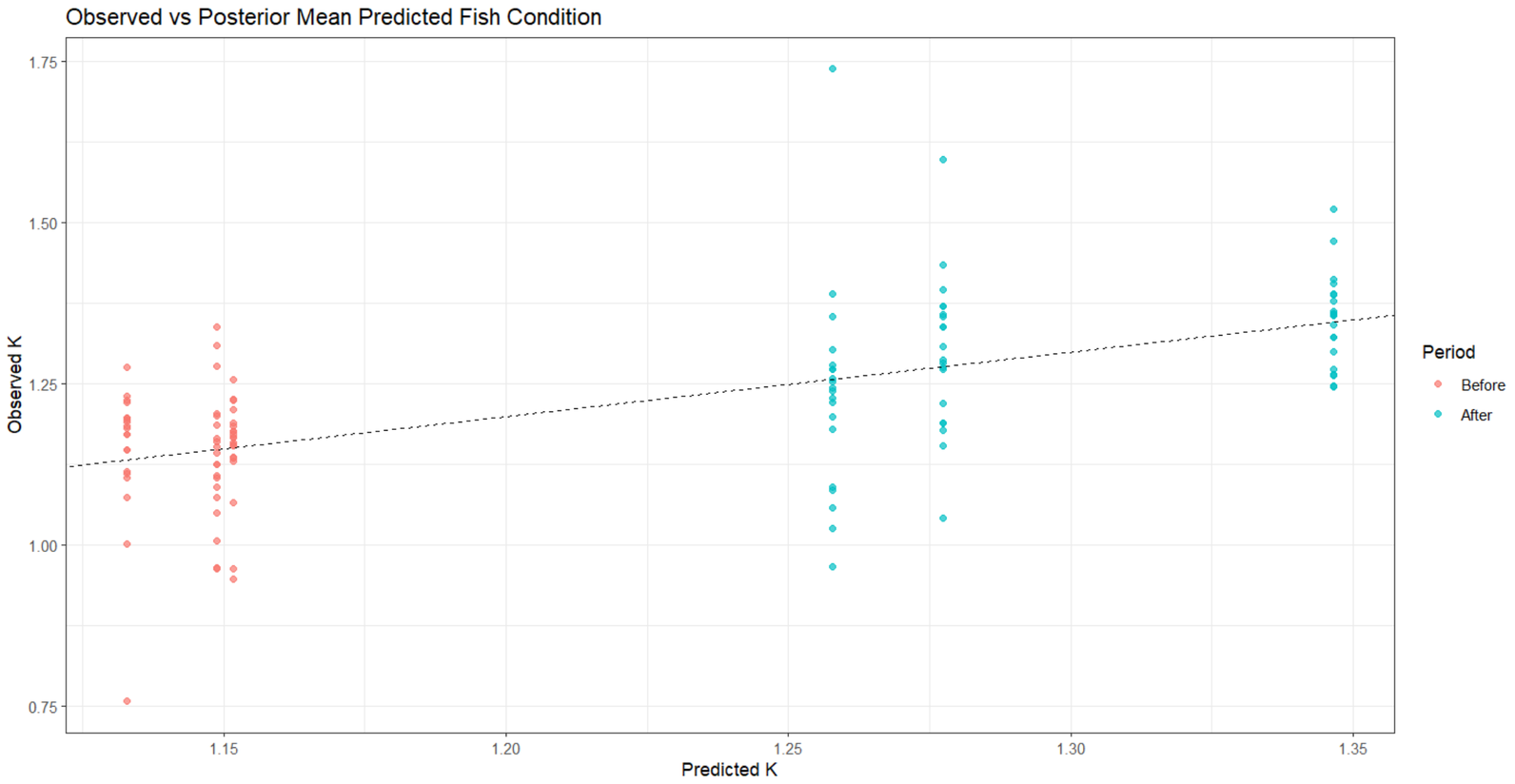

Fish Condition (K) by Site (Mainstem)
KL_SD
KL_HS
KL_GT
KL_IG
Condition (K)
1.75
1.50
1.25
1.00
0.75
Before
After
Period

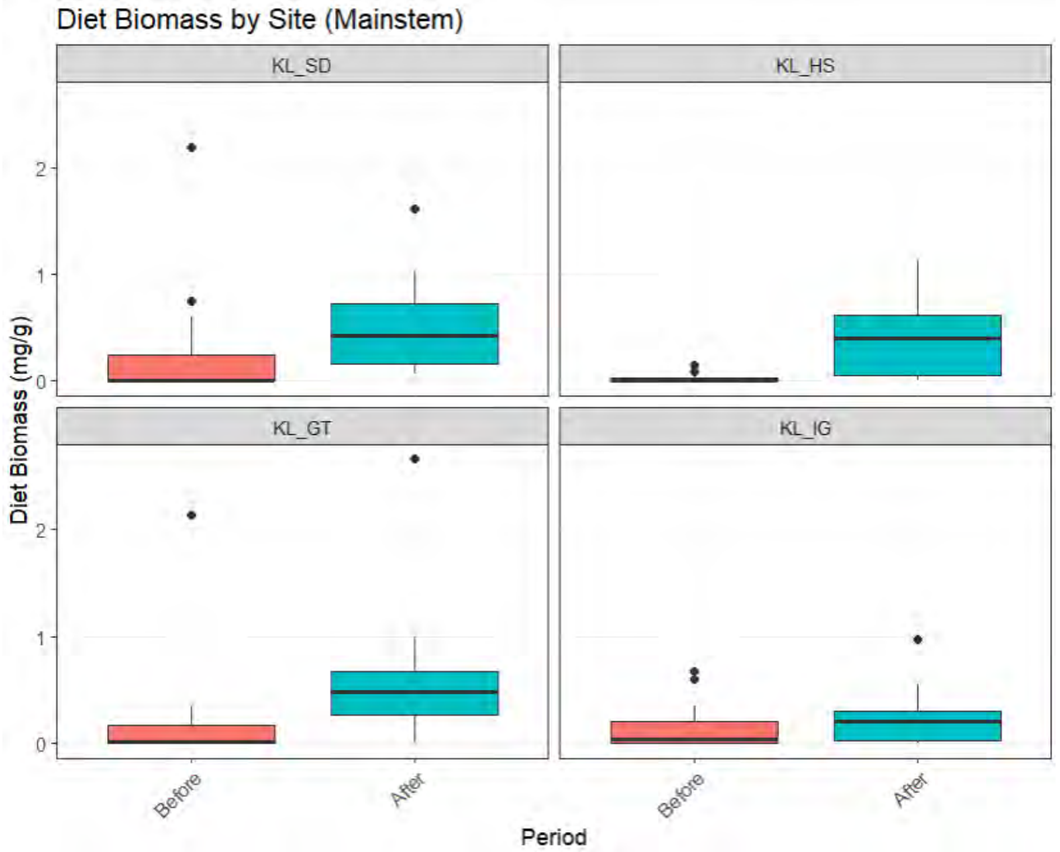

30-Day Degree Days Before Fish Sampling by Site
KL_GT
KL_HS
KL_SD
Degree Days
625
600
575
550
Before
After
Period

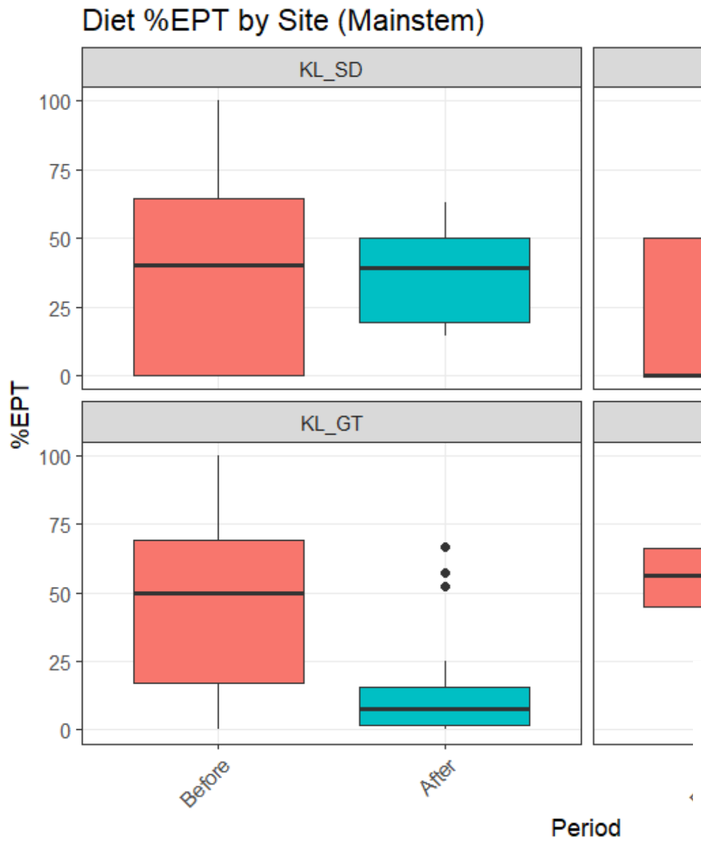

Benthic Family Composition (Top 90% + Other)
KL_IG
KL_GT
KL_HS
KL_SD
Proportion
1.00
0.75
0.50
0.25
0.00
Before
After
Family_plot
Baetidae
Chironomidae
Elmidae
Ephemerellidae
Glossosomatidae
Heptageniidae
Hydropsychidae
NZMS
Oligochaeta
Other
Planaria
Simuliidae

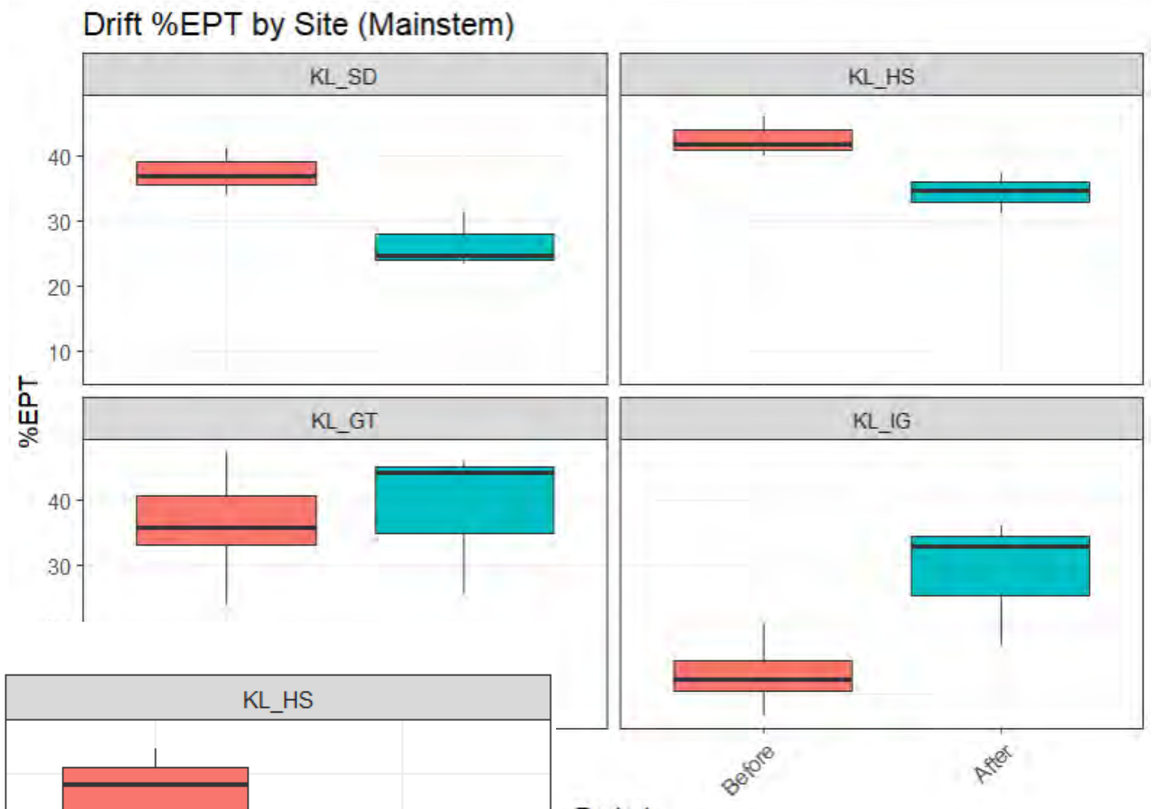

Diet Family Composition (Top 90% + Other)
KL_IG
KL_GT
KL_HS
KL_SD
Proportion
1.00
0.75
0.50
0.25
0.00
Before
After
Family_plot
Baetidae
Blepharicerid
Chironomidae
Ephemerellid
Glossosomat
Hydropsychid
Leptohyphida
Oligochaeta
Oligochaete
Other
Simuliidae

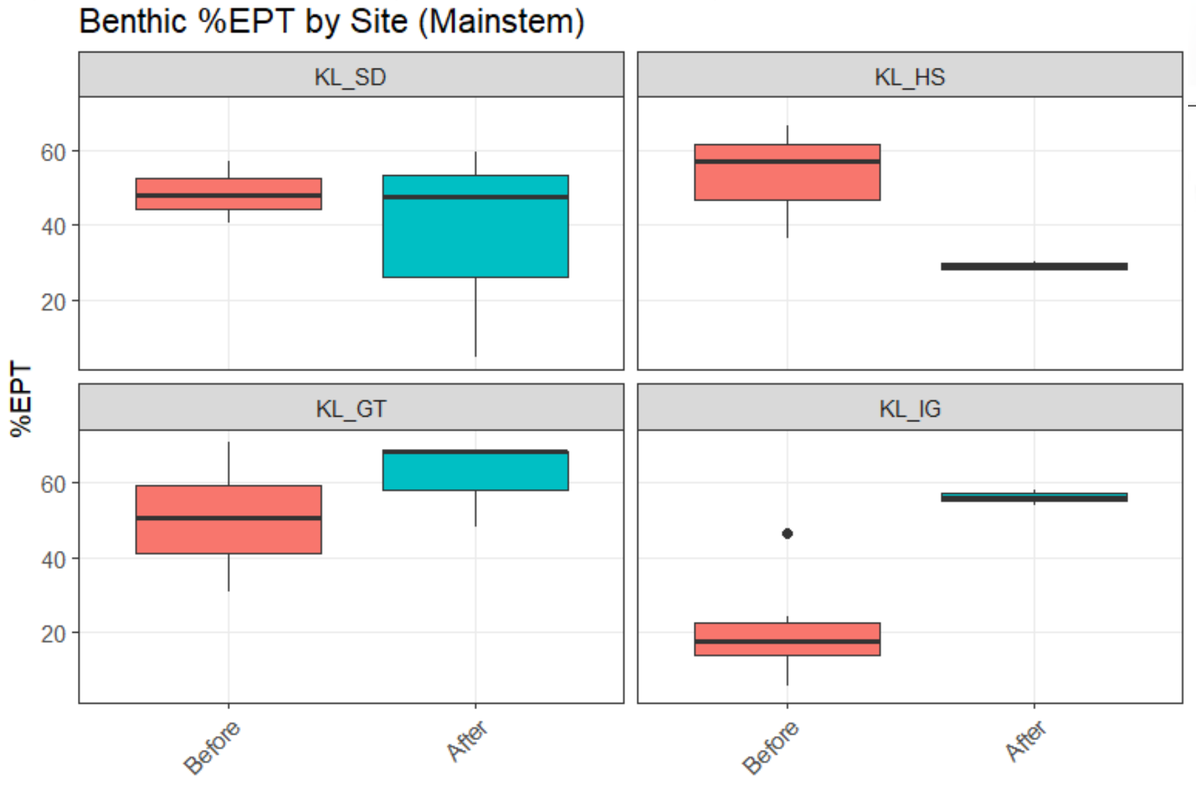

Drift Family Composition: With vs Without Plankton (Top 90% +
With
Without
KL_IG
KL_GT
KL_HS
KL_SD
Proportion
1.00
0.75
0.50
0.25
0.00
Before
After
Family_plot
baetidae
brachycentridae
chironomidae
daphniidae
elmidae
ephemerellidae
hydracarina
hydropsychidae
hydroptilidae
oligochaeta
Other
simuliidae

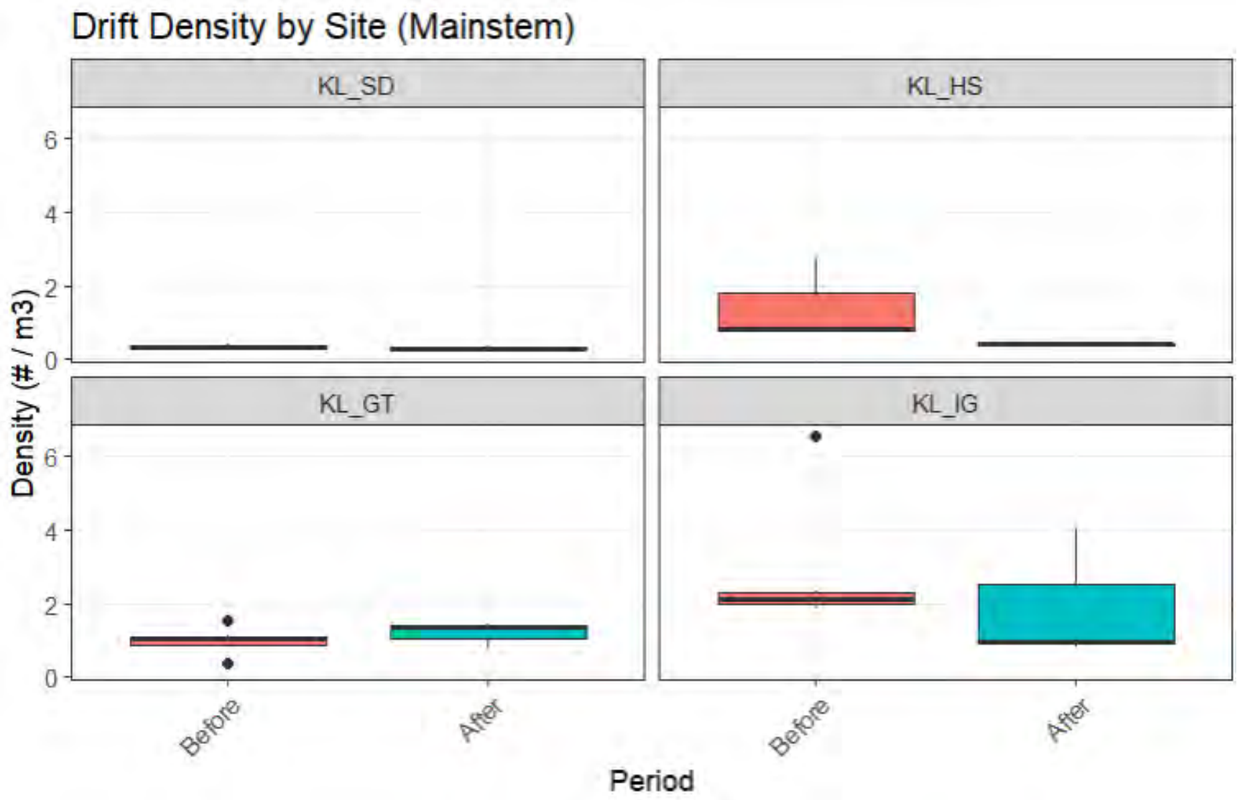

Observed vs Posterior Mean Predicted Fish Condition
Observed K
Predicted K
1.75
1.50
1.25
1.00
0.75
1.15
1.20
1.25
1.30
1.35
Period
Before
After

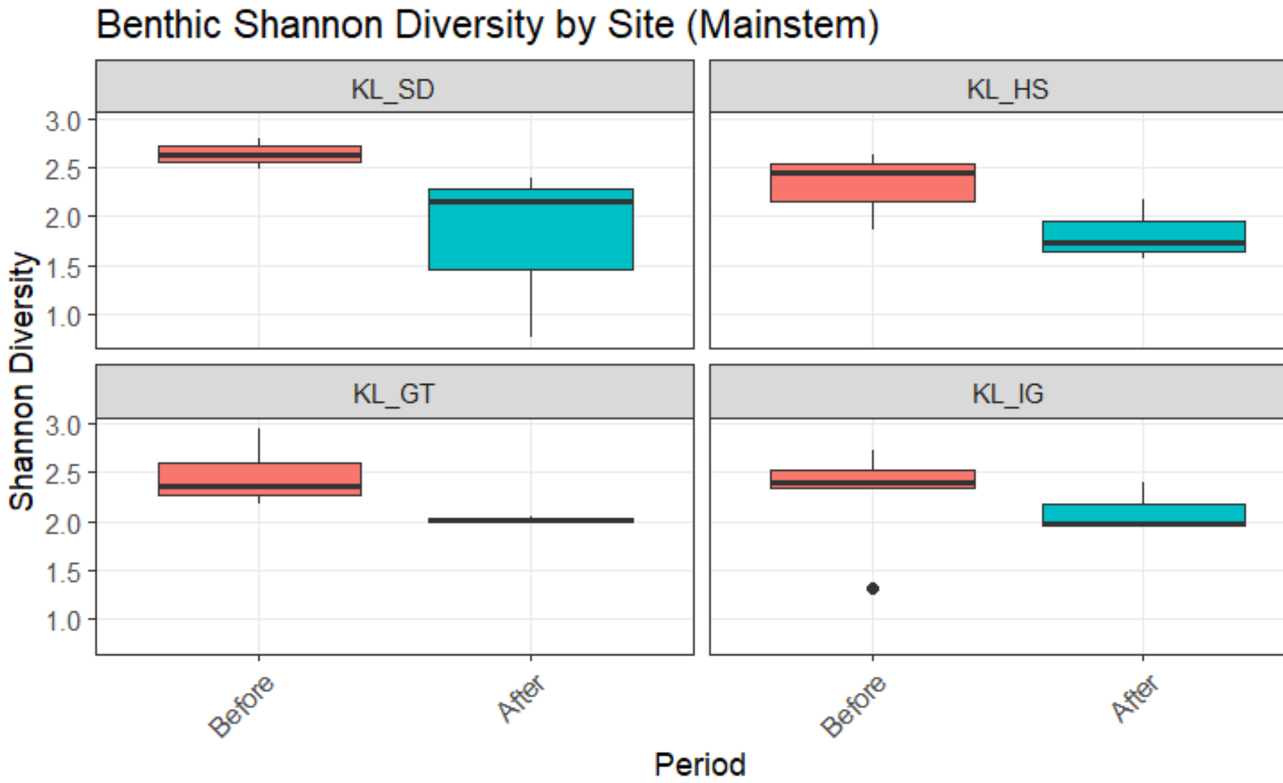

Diet Biomass by Site (Mainstem)
KL_SD
KL_HS
KL_GT
KL_IG
Diet Biomass (mg/g)
0
1
2
Before
After
Period


Diet %EPT by Site (Mainstem)
KL_SD
KL_HS
KL_GT
KL_IG
%EPT
100
75
50
25
0
Before
After
Period

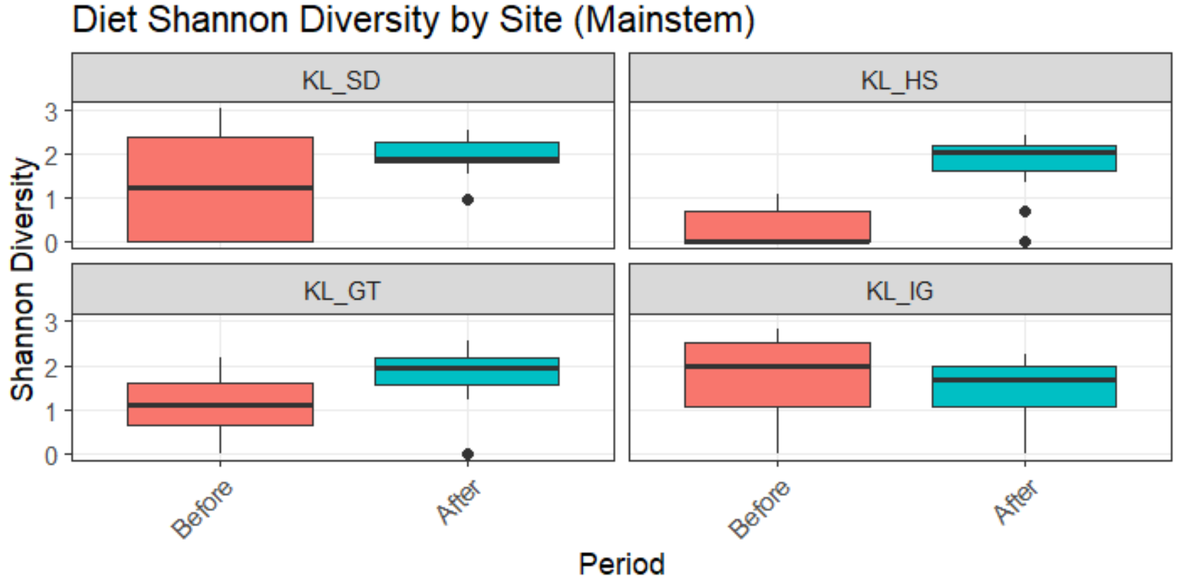

Drift %EPT by Site (Mainstem)
KL_SD
KL_HS
KL_GT
KL_IG
%EPT
40
30
20
10
Before
After
Period


Benthic %EPT by Site (Mainstem)
KL_SD
KL_HS
KL_GT
KL_IG
%EPT
60
40
20
Before
After

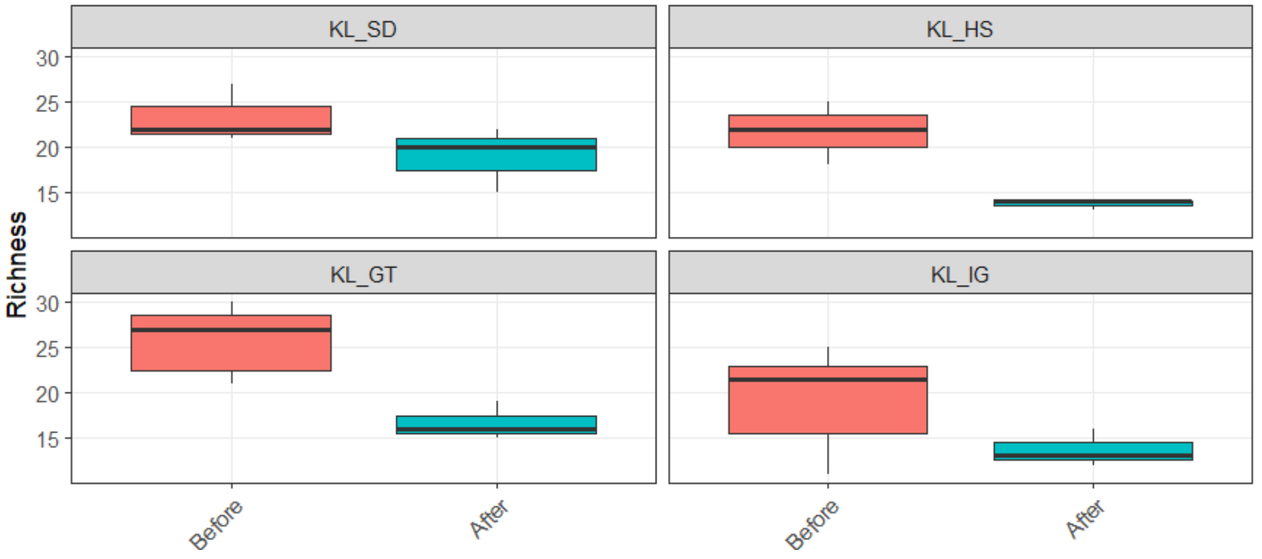

Drift Density by Site (Mainstem)
KL_SD
KL_HS
KL_GT
KL_IG
Density (# / m3)
0
2
4
6
Before
After
Period


Benthic Shannon Diversity by Site (Mainstem)
KL_SD
KL_HS
KL_GT
KL_IG
Shannon Diversity
1.0
1.5
2.0
2.5
3.0
Before
After
Period

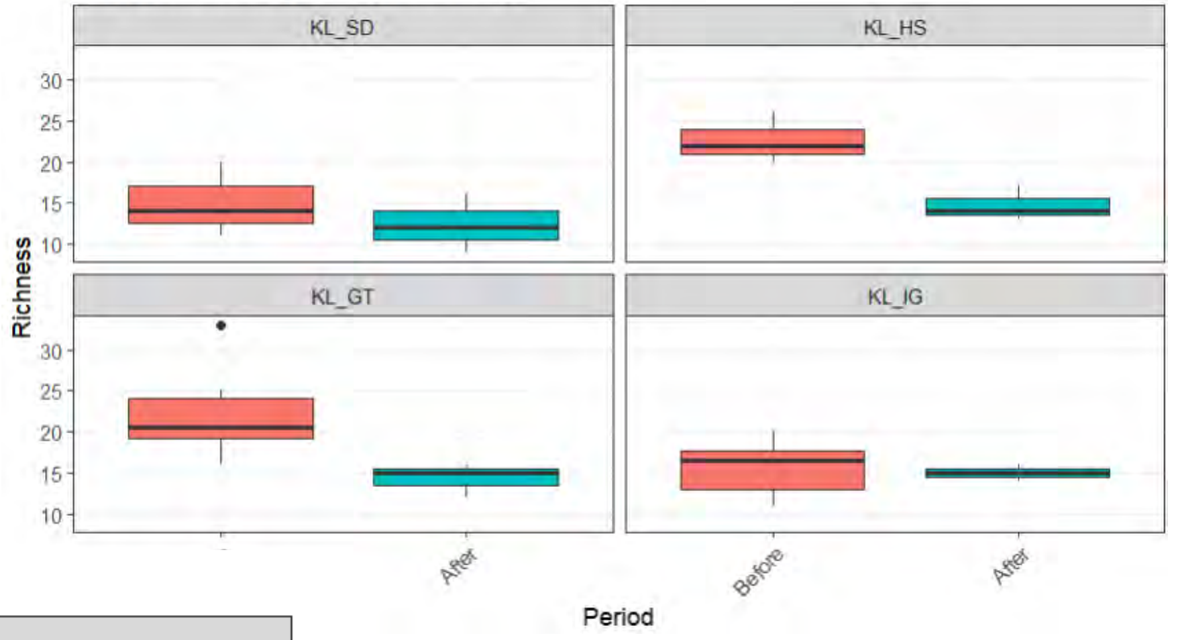
Drift Shannon Diversity by Site (Mainstem)
KL_SD
KL_HS
KL_GT
KL_IG
Shannon Diversity
3.0
3.5
Before
After
Period


Diet Shannon Diversity by Site (Mainstem)
KL_SD
KL_HS
KL_GT
KL_IG
Shannon Diversity
0
1
2
3
Before
After
Period

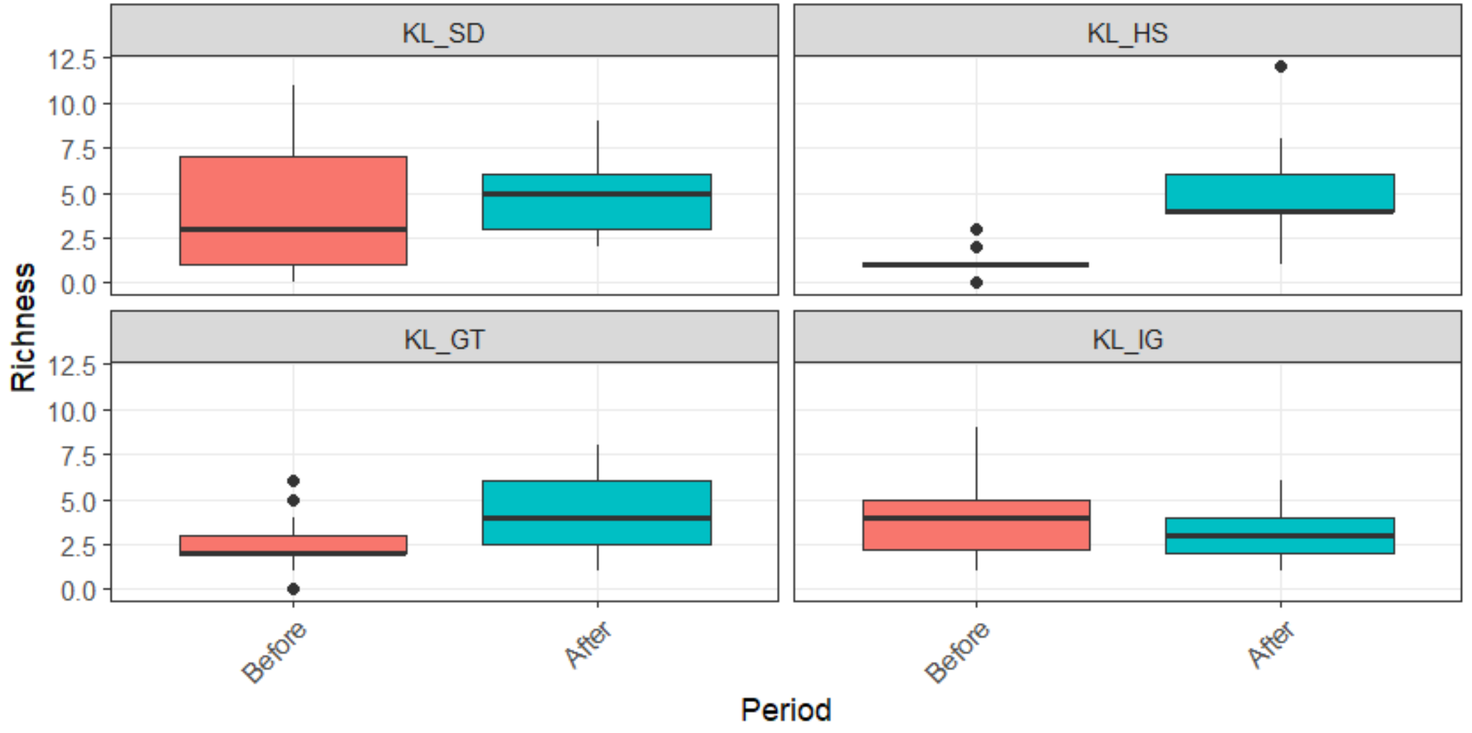
Benthic Richness by Site (Mainstem)



Drift Richness by Site (Mainstem)



Diet Richness by Site (Mainstem)



Rebuilding Tributaries in the Former Reservoir Footprint to Support a Newly Free-Flowing Klamath River

Salmonid Restoration Federation

May 1, 2026

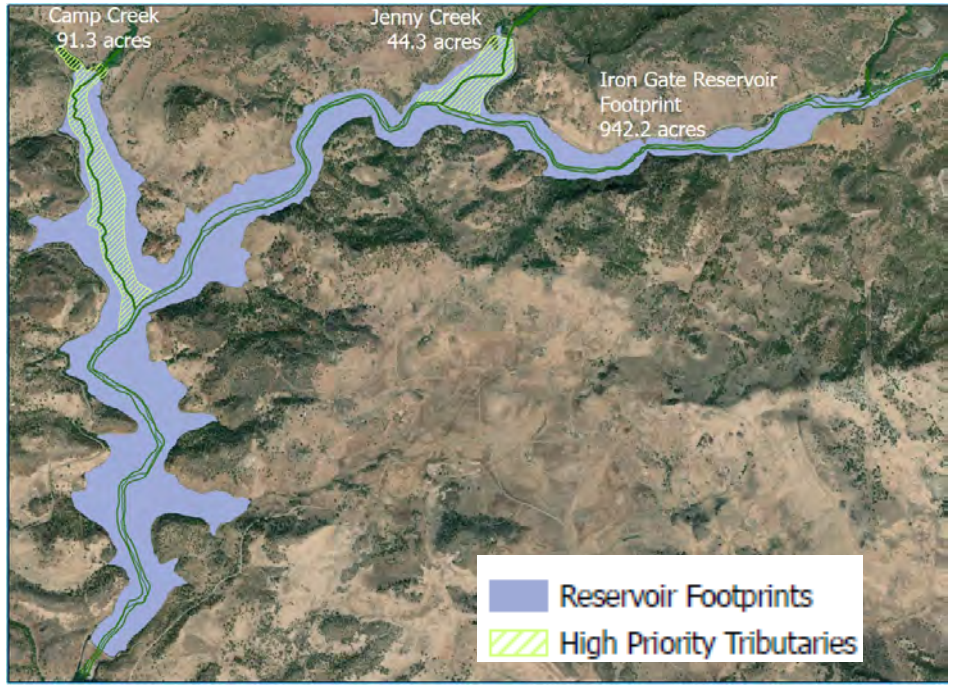
Presenter: Dan Chase
Director, Fisheries and Aquatics

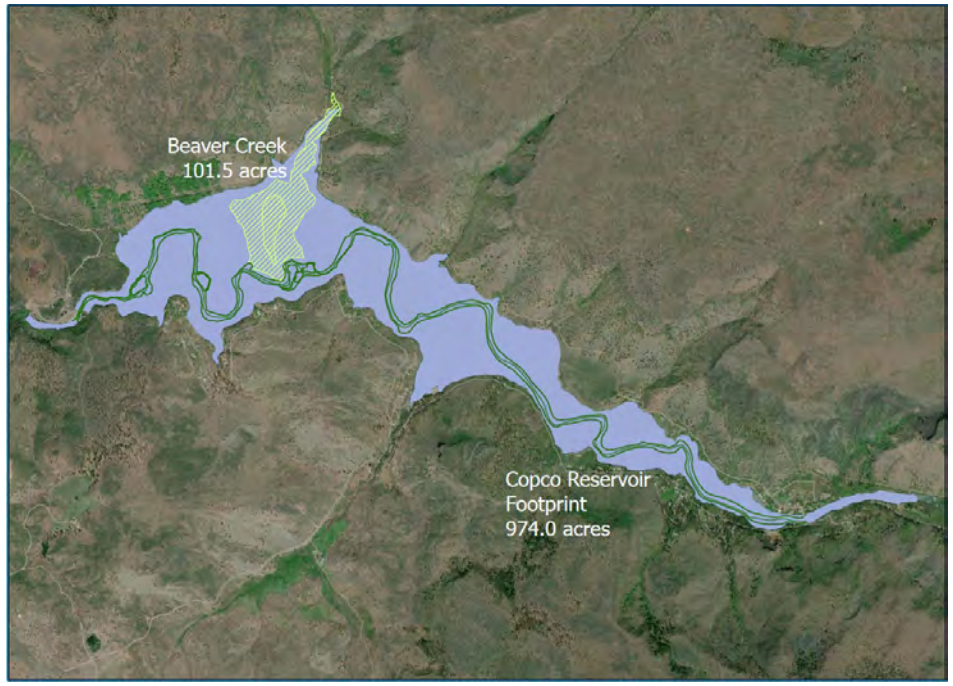
res
Restoring a resilient earth for a modern world

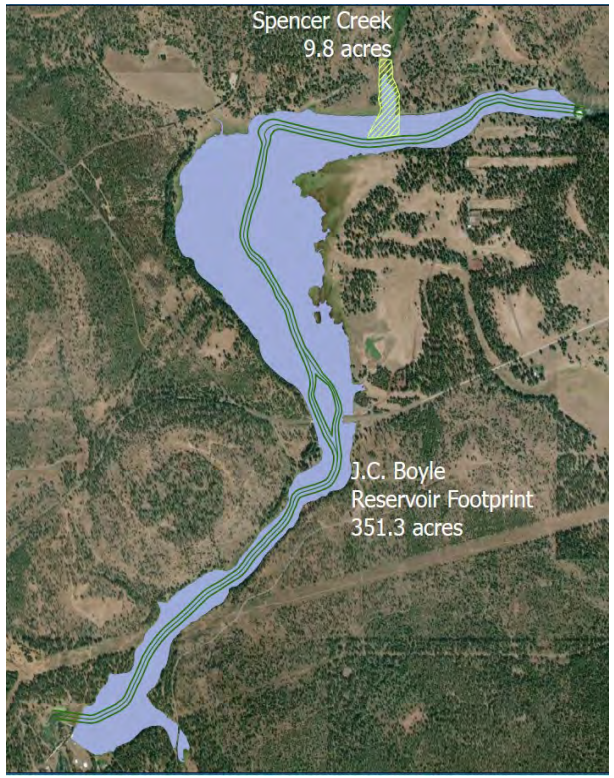
Co-author: Dave Coffman
Director, Northern California and Southern Oregon

© Copyright 2026 RES

Dams, Tributaries, and Reservoir Footprints







© Copyright 2026 RES

Overview

I. Tributary Restoration Work Completed

II. Restoration Work Ahead for KRRP

© Copyright 2026 RES

RES' Role on the Project - Full Delivery Model

- Regulatory approvals' process
  - Develop and Design
    - Biological resource protection measures – aquatic and terrestrial
    - Stream restoration
    - Revegetation
    - Water Quality
- Implementation → Performance
  - All of the above
- Long-term monitoring and maintenance – includes reporting
- Performance guarantee

© Copyright 2026 RES

Project Contributors

© Copyright 2026 RES

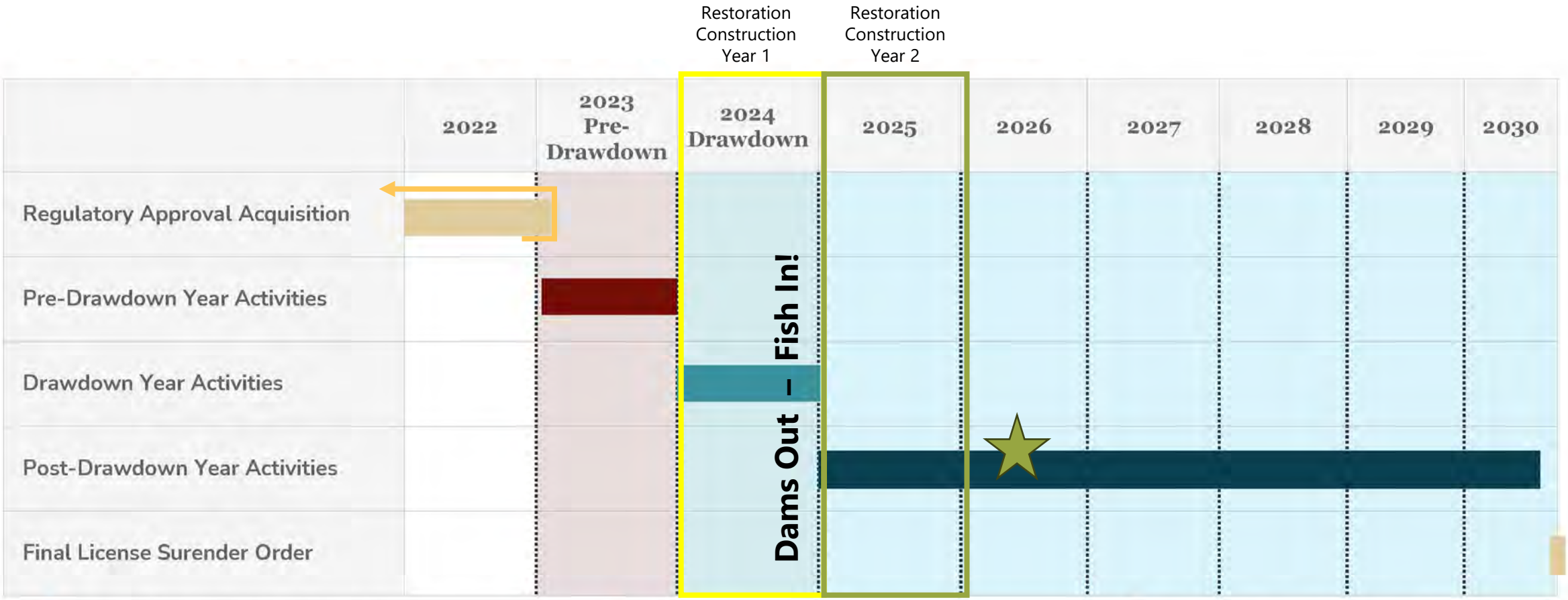
Advocating for Change

Dams impacted cultural ceremonies, practices, and culturally-significant resources

Photo: kqed.org/news/11622280/fish-blood-in-their-veins-but-few-salmon-in-their-river

© Copyright 2026 RES

Dam Removal and Restoration Project Timeline



Pre-Drawdown Year:

- Dam/tunnel modifications
- Road/bridge improvements
- CoY Waterline Replacement
- Fall Creek Hatchery Construction
- Water Quality/Quantity Monitoring
- Copco No. 2 Dam Removal

Drawdown Year:

- Dam and infrastructure removal
- Initial reservoir restoration

Post-Drawdown Years:

- Site Restoration
- Monitoring/Adaptive Management

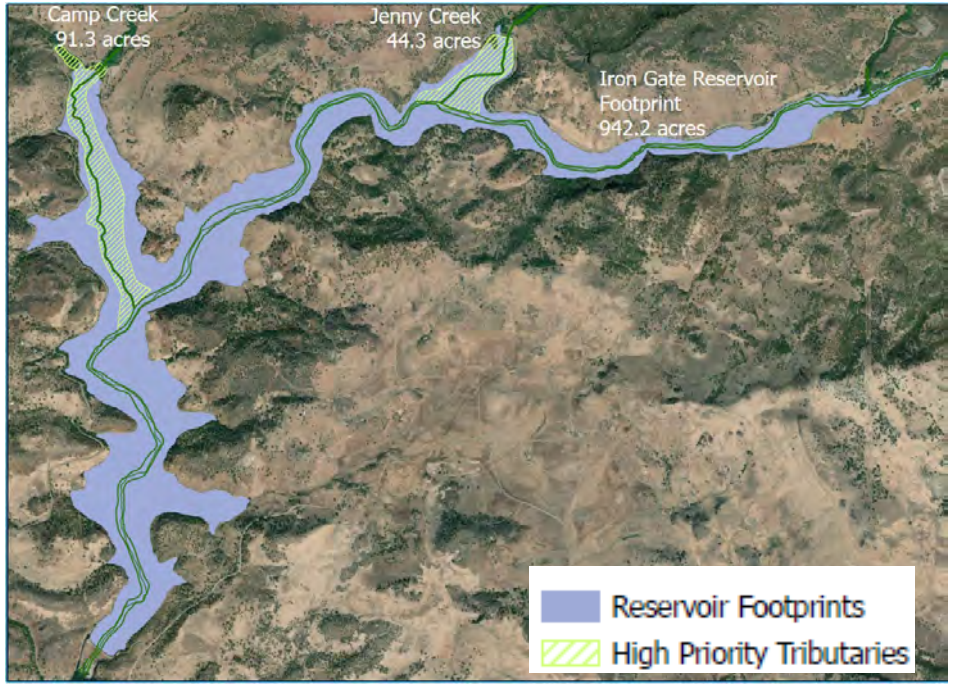
Sediment Evacuation and Fish Passage Impediment Removal

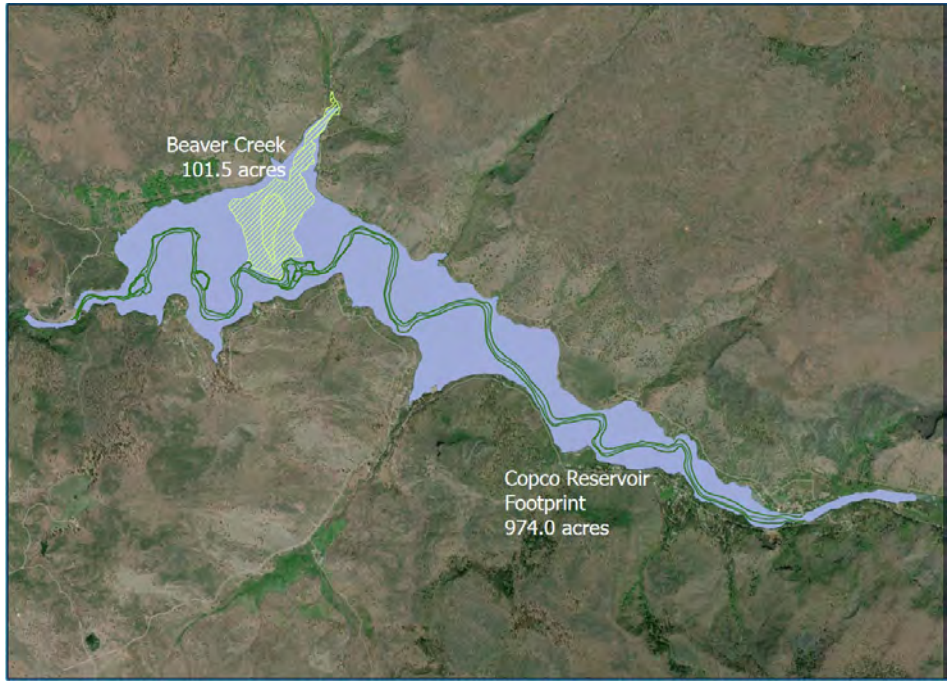
Revegetation Efforts

Large Wood Loading

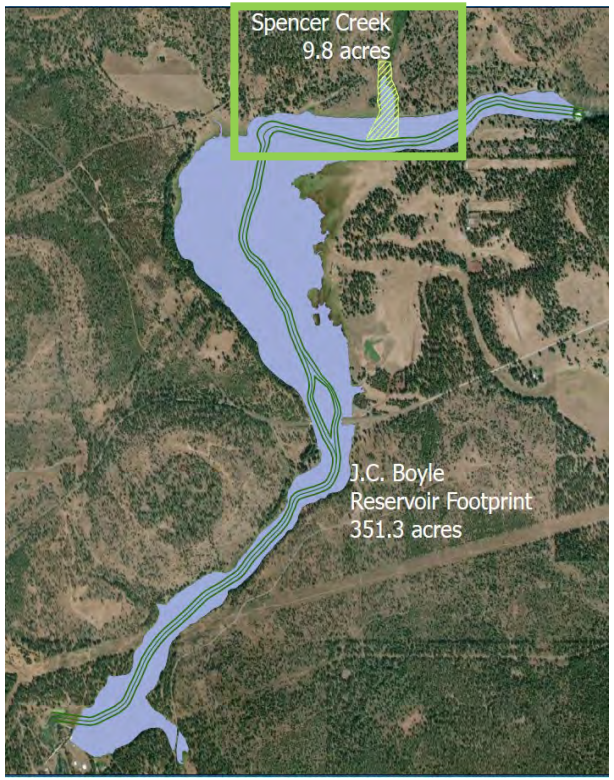
© Copyright 2026 RES

Tributaries and Reservoir Footprints





Summer 2024



© Copyright 2026 RES

Spencer Creek – Drawdown 2024

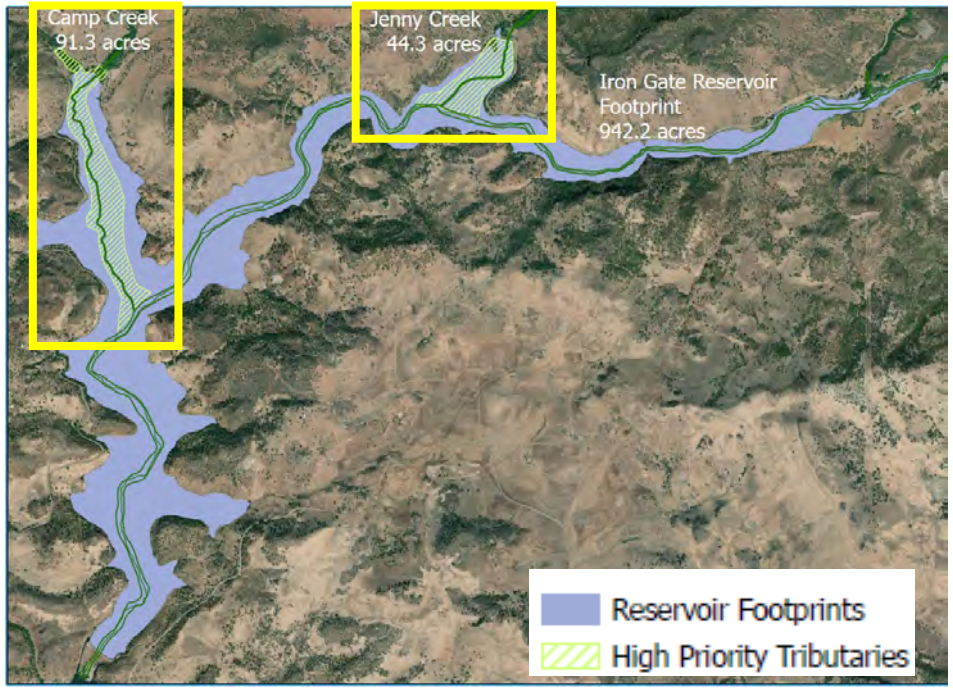
Spencer Creek – Klamath River – August 2024

Spencer Creek – Klamath River – Mar 2026

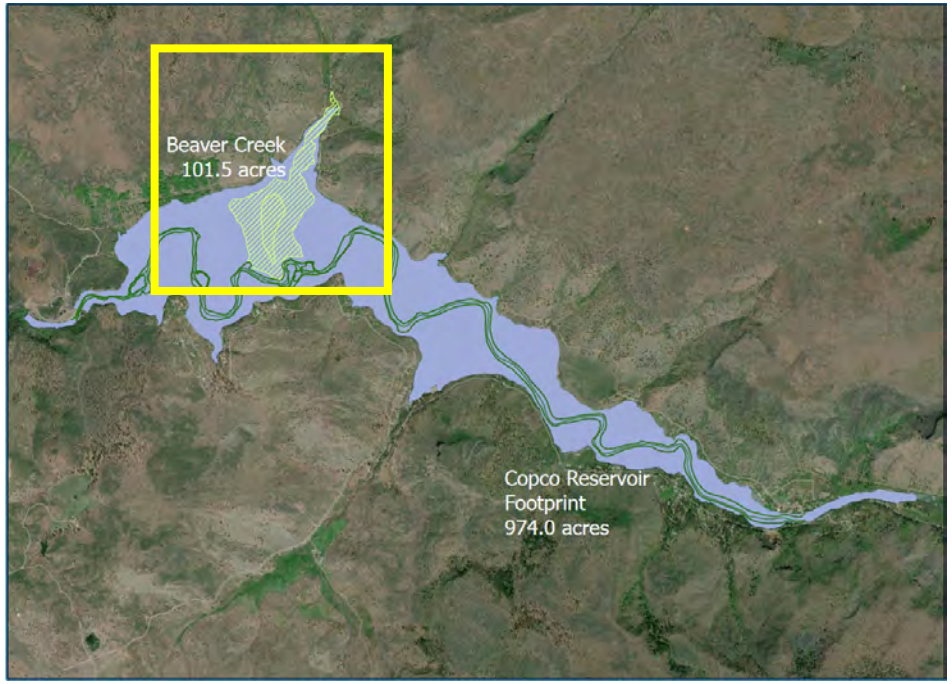
Spencer Creek – Klamath River – Mar 2026

Tributaries and Reservoir Footprints

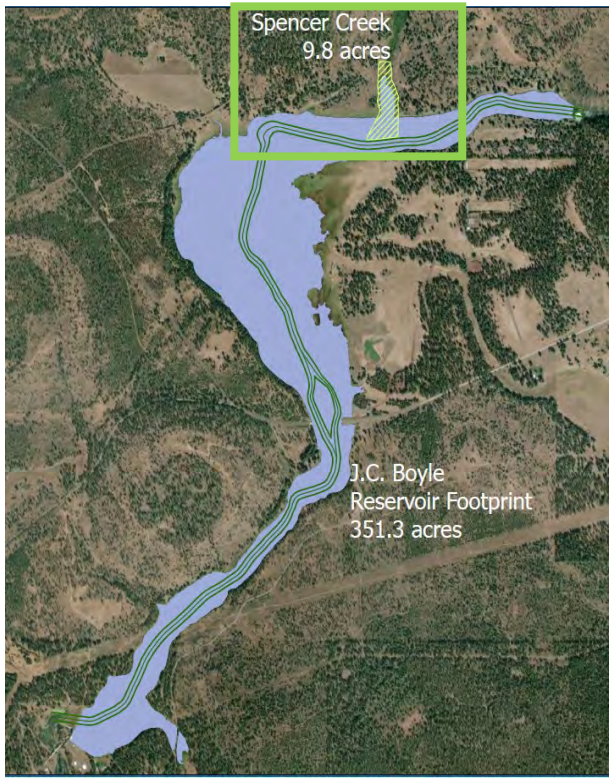
Summer 2025



Summer 2025



Summer 2024



© Copyright 2026 RES

High Priority Tributary Construction 2025

- Construction conducted Summer 2025
- Prior to ground disturbance work fish relocation, nesting bird, western pond turtle, and cultural resources clearances performed
- Tributary construction work taking place at three locations with crews from RES, Yurok Tribe Construction Company, Stantec, Shasta Indian Nation, and AECOM

Jenny Creek, June 2025 Photo: RES

Camp-Scotch Creek Complex Restoration 2025

- Yurok Tribe Construction Company (YTCC) began construction late June 2025
- Over 8,250 linear feet of stream
- Over 190k CYs of earthwork
- Over 350 large wood structures and 6 valley spanning vanes placed
- Completed by 10/10/25

Photo: Yurok Tribe Construction Company

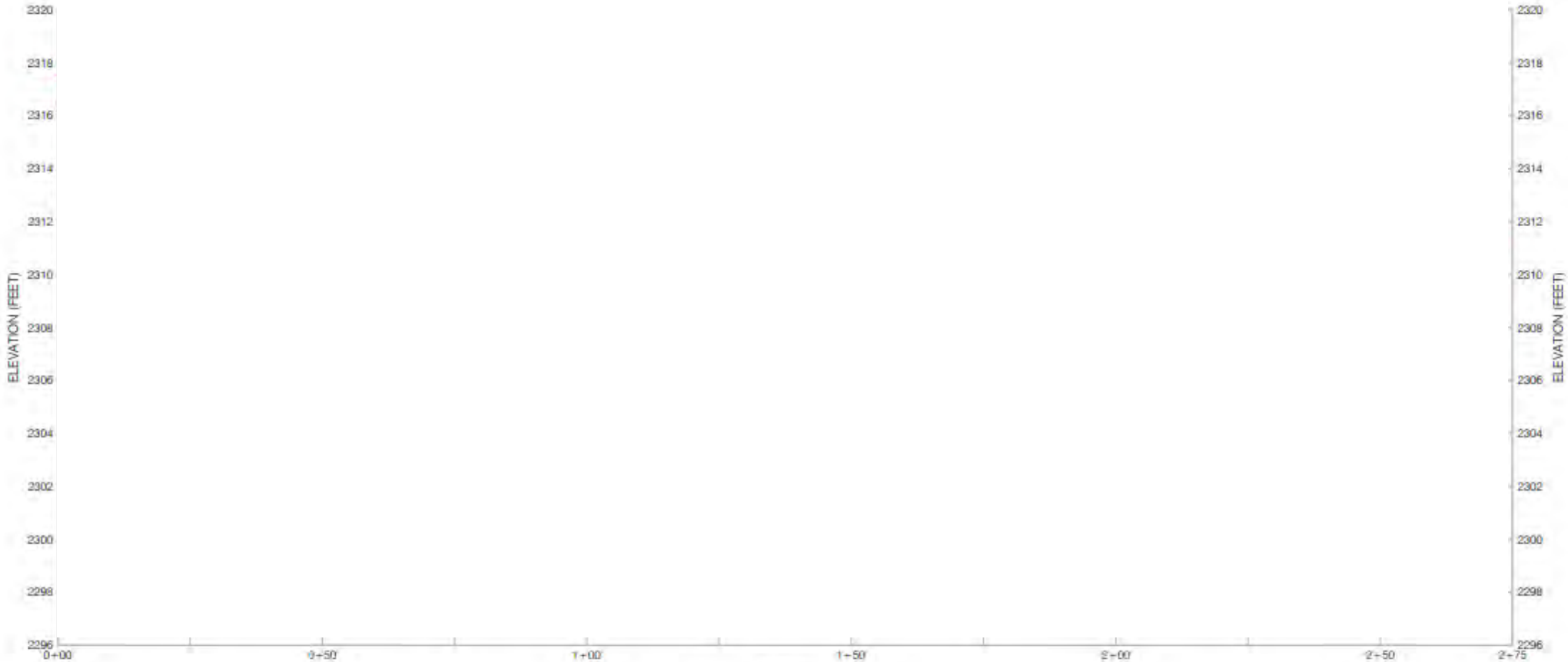
Floodplain grading and material processing.

© Copyright 2026 RES

CAMP CREEK 2025 POST-CONSTRUCTION CONDITIONS
CROSS SECTION 1
SCOTCH CREEK
SCOTCH REACH 2
PP C1
CAMP REACH 1
PP S2
CROSS SECTION 3
PP S1
PP C2
PP 3
CAMP AND SCOTCH CONFLUENCE REACH 3
CROSS SECTION 4
PP 4
PP 5
CROSS SECTION 2
COPCO ROAD
CAMP REACH 4
CAMP REACH 5
PP 6
CAMP CREEK
CROSS SECTION 5
PP 8
PP 7
PP 10
PP 9
FLOW
PP 11
CROSS SECTION 6
CAMP REACH 6
CAMP REACH 7
CAMP REACH 8
PP 12
PP 13
KLAMATH RIVER
PP 14
PP 15
CROSS SECTION 9
FLOW
CROSS SECTION 7
PP 16
PP 17
PP 18
CAMP REACH 10
CROSS SECTION 8
CAMP REACH 9
CROSS SECTION 10
PP 19
PP 22
PP 21
PP 20
PLANFORM LEGEND
2025 POST-CONSTRUCTION THALWEG
2025 PRE-CONSTRUCTION THALWEG
CROSS SECTION
PP # PHOTO POINT
400 200 0 400
SCALE IN FEET
SOURCE: BASE MAP IMAGERY FROM DRONE FLIGHT ON OCTOBER 17, 2025
CAMP CREEK 2025
POST-CONSTRUCTION CONDITIONS
MONITORING MAP OVERVIEW
REVISED DATE: 3/24/2026
DRAWN BY: LEW
res
HGS, LLC. A RES COMPANY
2125 19TH STREET, SUITE 200
SACRAMENTO, CA 95818
P: 804.353.6017
WWW.RES.US
SHEET 1 OF 28
R:\Projects\CA\107489-Lower Klamath Project\CAD\Survey\Camp & Scotch Creek\Annual Monitoring\Camp Scotch Monitoring_1 SITE MAP_ Laura Whittaker_ 3/24/2026 5:06 PM

CAMP CREEK 2025 POST-CONSTRUCTION CONDITIONS

CAMP AND SCOTCH CREEK CROSS SECTION 3 NEAR STATIONS 6+69 AND 13+31



CROSS SECTIONS ARE VIEWED LOOKING DOWNSTREAM/ UPSTATION
HORIZONTAL SCALE: 1" = 20'
VERTICAL SCALE: 1" = 4'

LEGEND

2025 POST-CONSTRUCTION THALWEG

2025 PRE-CONSTRUCTION THALWEG FROM MARCH 2025 LIDAR

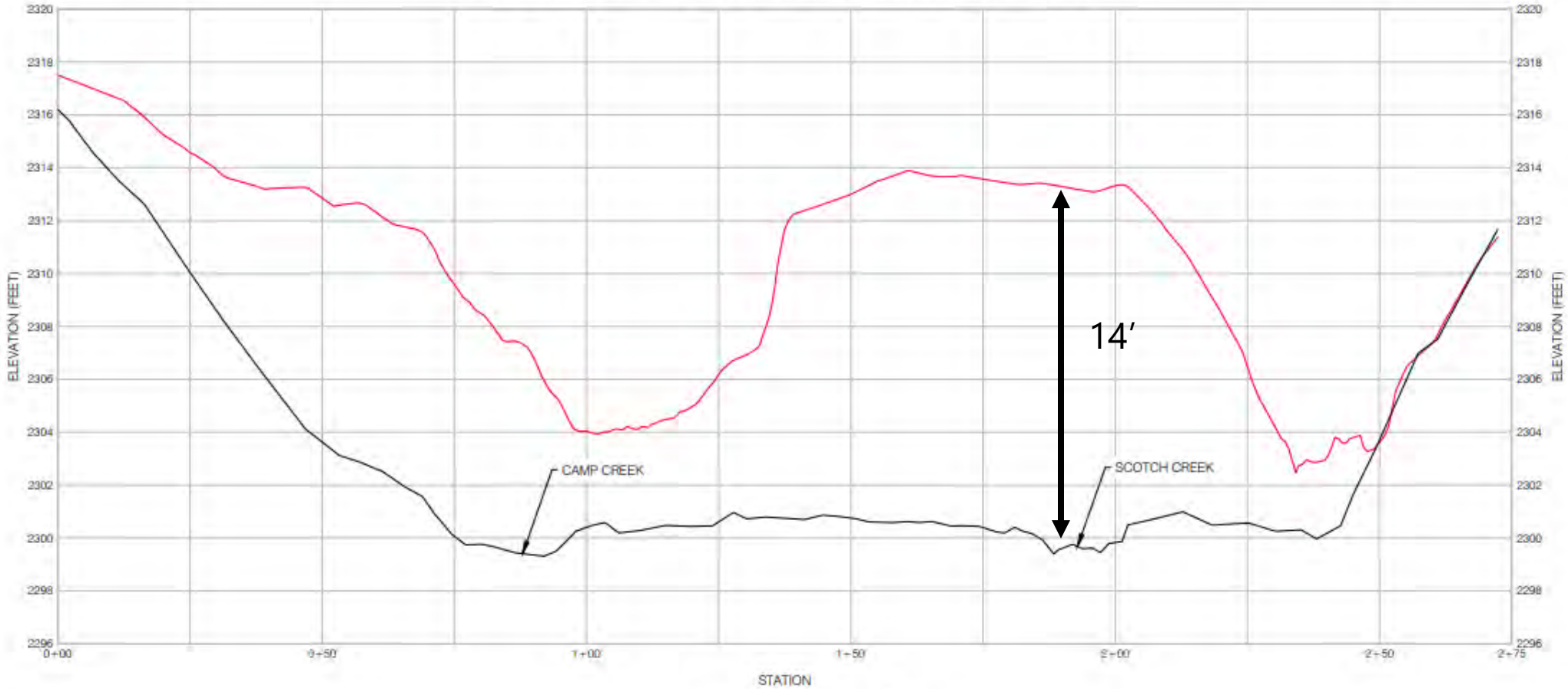
CAMP CREEK 2025
POST-CONSTRUCTION CONDITIONS
CROSS SECTION 3

REVISED DATE: 3/24/2026 | DRAWN BY: LEW

HGS, LLC. A RES COMPANY
2125 19TH STREET, SUITE 200
SACRAMENTO, CA 95818
P: 804.353.6017
WWW.RES.US

CAMP CREEK 2025 POST-CONSTRUCTION CONDITIONS

CAMP AND SCOTCH CREEK CROSS SECTION 3 NEAR STATIONS 6+69 AND 13+31



CROSS SECTIONS ARE VIEWED LOOKING DOWNSTREAM/ UPSTATION
HORIZONTAL SCALE: 1" = 20'
VERTICAL SCALE: 1" = 4'

LEGEND

2025 POST-CONSTRUCTION THALWEG

2025 PRE-CONSTRUCTION THALWEG FROM MARCH 2025 LIDAR

CAMP CREEK 2025
POST-CONSTRUCTION CONDITIONS
CROSS SECTION 3

REVISED DATE: 3/24/2026 DRAWN BY: LEW

HGS, LLC. A RES COMPANY
2125 19TH STREET, SUITE 200
SACRAMENTO, CA 95818
P: 804.353.6017
WWW.RES.US

Construction of a boulder vane.

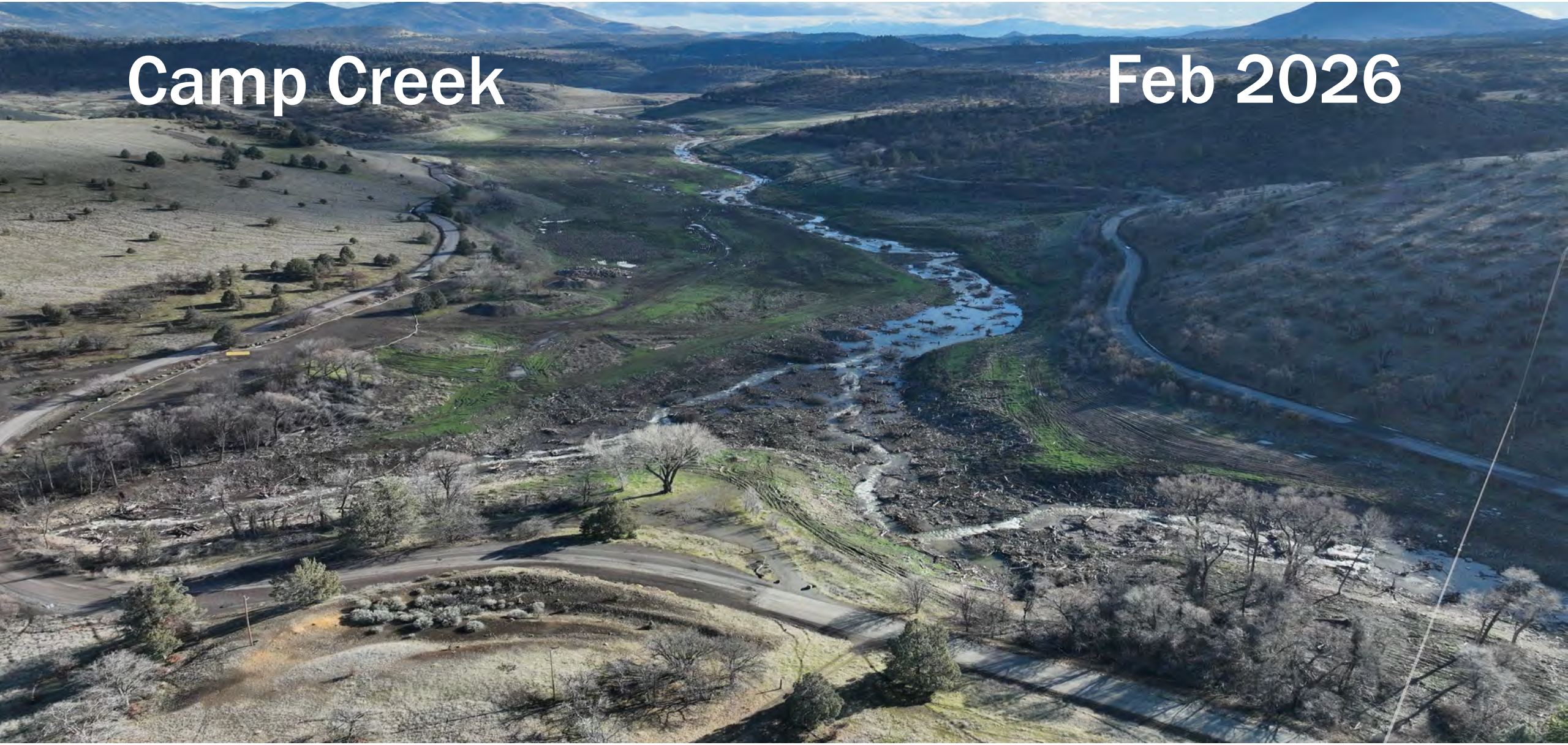
© Copyright 2026 RES

Floodplain Habitat Creation

Large woody structures placed in the Camp Creek riverscape.

CAMP CREEK 2025 POST-CONSTRUCTION CONDITIONS
SECTION 1
SCOTCH CREEK
SCOTCH REACH 2
PP C1
CAMP REACH 1
PP S2
CROSS SECTION 3
PP S1
PP C2
PP 3
CAMP AND SCOTCH CONFLUENCE REACH 3
CROSS SECTION 4
PP 4
PP 5
CROSS SECTION 2
COPCO ROAD
CAMP REACH 4
CAMP REACH 5
PP 6
CAMP CREEK
CROSS SECTION 5
PP 8
PP 7
PP 10
PP 9
FLOW
PP 11
CROSS SECTION 6
CAMP REACH 6
CAMP REACH 7
CAMP REACH 8
PP 12
PP 13
KLAMATH RIVER
PP 14
PP 15
CROSS SECTION 9
FLOW
CROSS SECTION 7
PP 16
PP 17
PP 18
CAMP REACH 10
CROSS SECTION 8
CAMP REACH 9
CROSS SECTION 10
PP 19
PP 22
PP 21
PP 20
PLANFORM LEGEND
2025 POST-CONSTRUCTION THALWEG
2025 PRE-CONSTRUCTION THALWEG
CROSS SECTION
PP # PHOTO POINT
400 200 0 400
SCALE IN FEET
SOURCE: BASE MAP IMAGERY FROM DRONE FLIGHT ON OCTOBER 17, 2025
CAMP CREEK 2025
POST-CONSTRUCTION CONDITIONS
MONITORING MAP OVERVIEW
REVISED DATE: 3/24/2026
DRAWN BY: LEW
HGS, LLC. A RES COMPANY
2125 19TH STREET, SUITE 200
SACRAMENTO, CA 95818
P: 804.353.6017
WWW.RES.US
SHEET 1 OF 28
R:\Projects\CA\107489-Lower Klamath Project\CAD\Survey\Camp & Scotch Creek\Annual Monitoring\Camp Scotch Monitoring_1 SITE MAP_ Laura Whittaker_ 3/24/2026 5:06 PM

Camp Creek
June 2025


Camp Creek
Feb 2026

Camp Creek
June 2025

Camp Creek
Feb 2026

Jenny Creek Restoration 2025

Construction is complete

- In-water work was completed by YTCC Sept 2025
- 2,900 linear feet of stream
- Over 55K cubic yards of earthwork
- 74 large wood structures
- 100 habitat boulders placed
- 6 channel and 1 valley spanning vane placed
- 0.27 acre off channel pond created

Jenny Creek, July 2025 Photo: RES

Jenny Creek – Assisted Sediment Evacuation - April 2024

Jenny Creek

September 2023

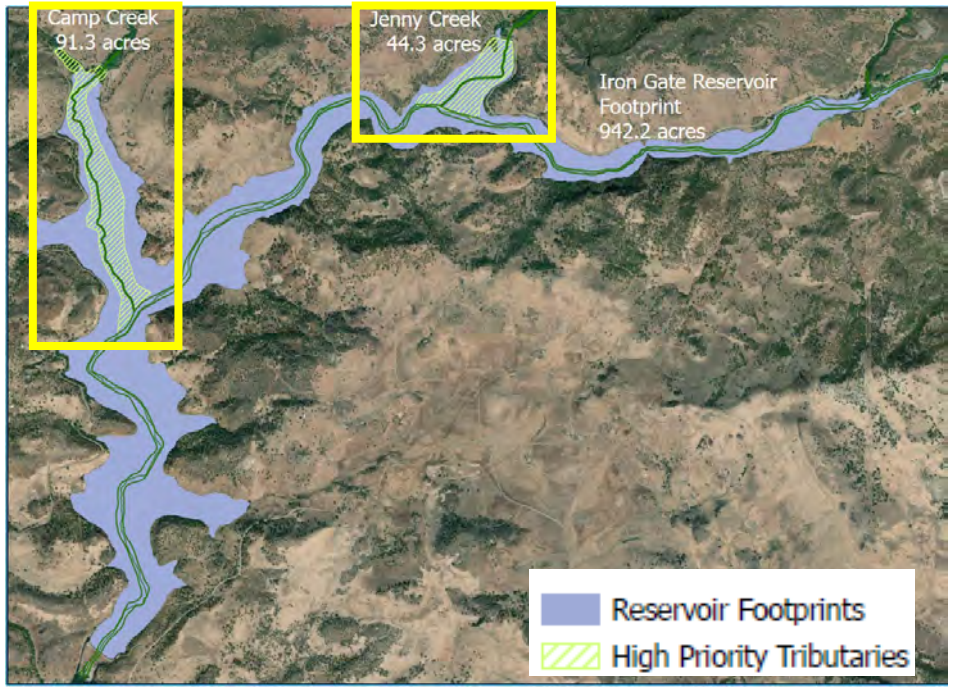
ght 2026 RES

Jenny Creek
June 2025

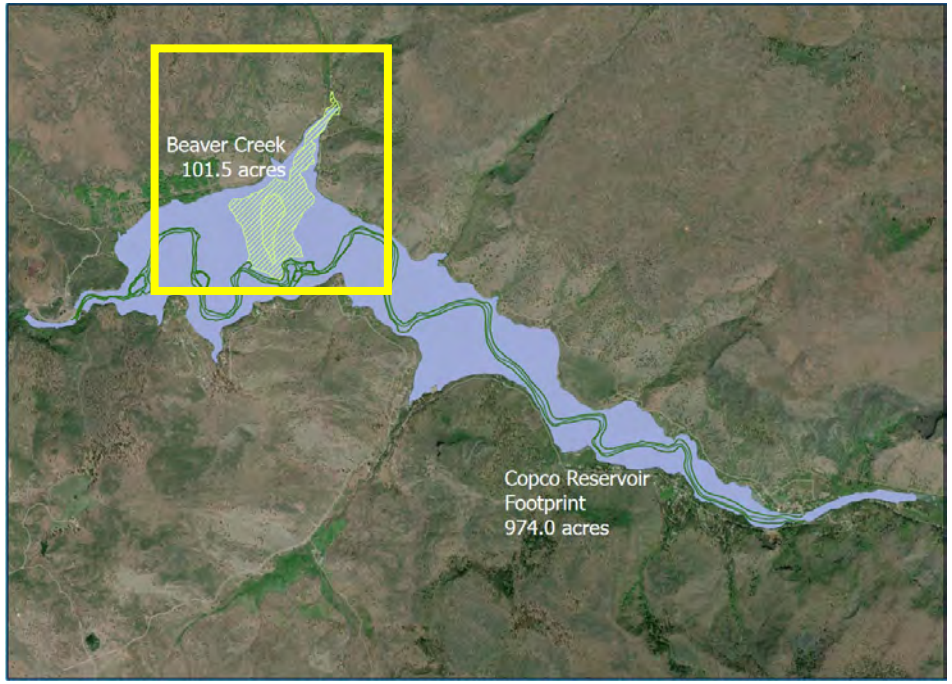
Jenny Creek
Feb 2026

Tributaries and Reservoir Footprints

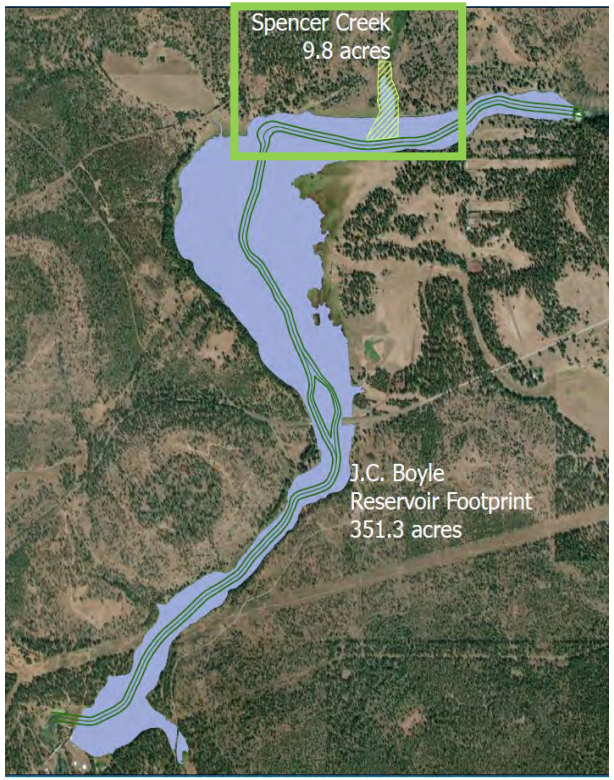
Summer 2025



Summer 2025



Summer 2024

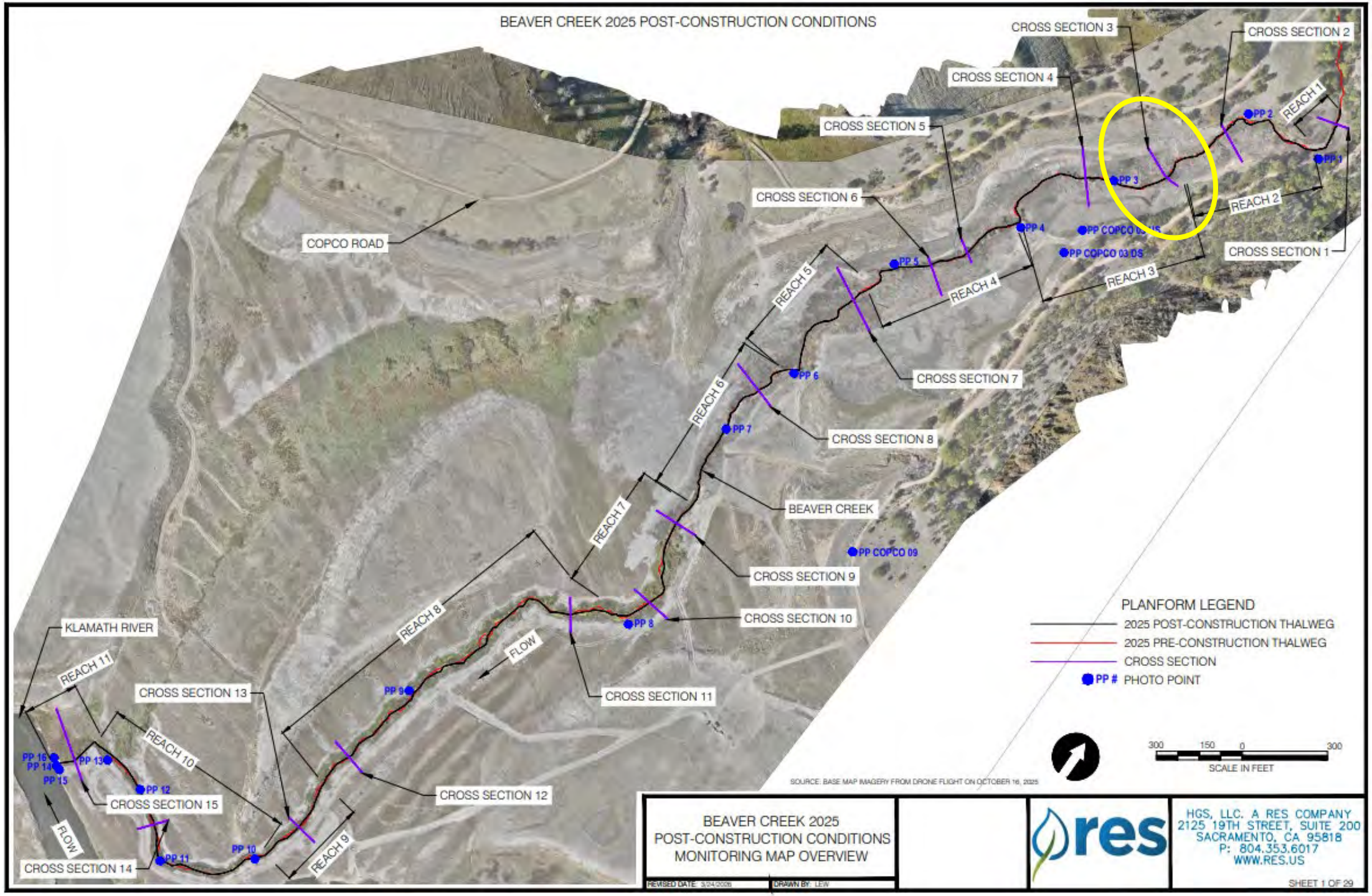


© Copyright 2026 RES

Beaver Creek Restoration 2025

- RES construction July-Oct 2025
- Over 6,400 linear feet of stream length
- Over 74K cubic yards of earthwork
- Over 389 large wood structures placed
- 32 beaver dam analogs (BDAs) installed over ~3,800 linear feet of stream
- •3 acres of reservoir sediments mechanically manipulated to lower the artificial floodplain surface by 0.5 – 1.0 feet.

Beaver Creek, August 2025. Photo: RES


BEAVER CREEK 2025 POST-CONSTRUCTION CONDITIONS
CROSS SECTION 3
CROSS SECTION 2
CROSS SECTION 4
CROSS SECTION 5
REACH 1
PP 2
PP 1
PP 3
REACH 2
CROSS SECTION 6
COPCO ROAD
PP 4
PP COPCO 03 DS
CROSS SECTION 1
PP 5
REACH 5
REACH 4
REACH 3
CROSS SECTION 7
PP 6
REACH 6
PP 7
CROSS SECTION 8
BEAVER CREEK
REACH 7
PP COPCO 09
CROSS SECTION 9
KLAMATH RIVER
REACH 8
PP 8
CROSS SECTION 10
FLOW
REACH 11
CROSS SECTION 13
PP 9
CROSS SECTION 11
PP 16
PP 14
PP 15
PP 13
REACH 10
PP 12
CROSS SECTION 12
CROSS SECTION 15
FLOW
PP 11
PP 10
REACH 9
CROSS SECTION 14
PLANFORM LEGEND
2025 POST-CONSTRUCTION THALWEG
2025 PRE-CONSTRUCTION THALWEG
CROSS SECTION
PP # PHOTO POINT
300 150 0 300
SCALE IN FEET
SOURCE: BASE MAP IMAGERY FROM DRONE FLIGHT ON OCTOBER 16, 2025
BEAVER CREEK 2025
POST-CONSTRUCTION CONDITIONS
MONITORING MAP OVERVIEW
REVISED DATE: 3/24/2026
DRAWN BY: LEW
res
HGS, LLC. A RES COMPANY
2125 19TH STREET, SUITE 200
SACRAMENTO, CA 95818
P: 804.353.6017
WWW.RES.US
SHEET 1 OF 29

res

Incised and narrow channel

BEAVER CREEK CROSS SECTION 3 NEAR STATION 8+70

CROSS SECTIONS ARE VIEWED LOOKING DOWNSTREAM/ UPSTATION
HORIZONTAL SCALE: 1" = 20'
VERTICAL SCALE: 1" = 4'

LEGEND

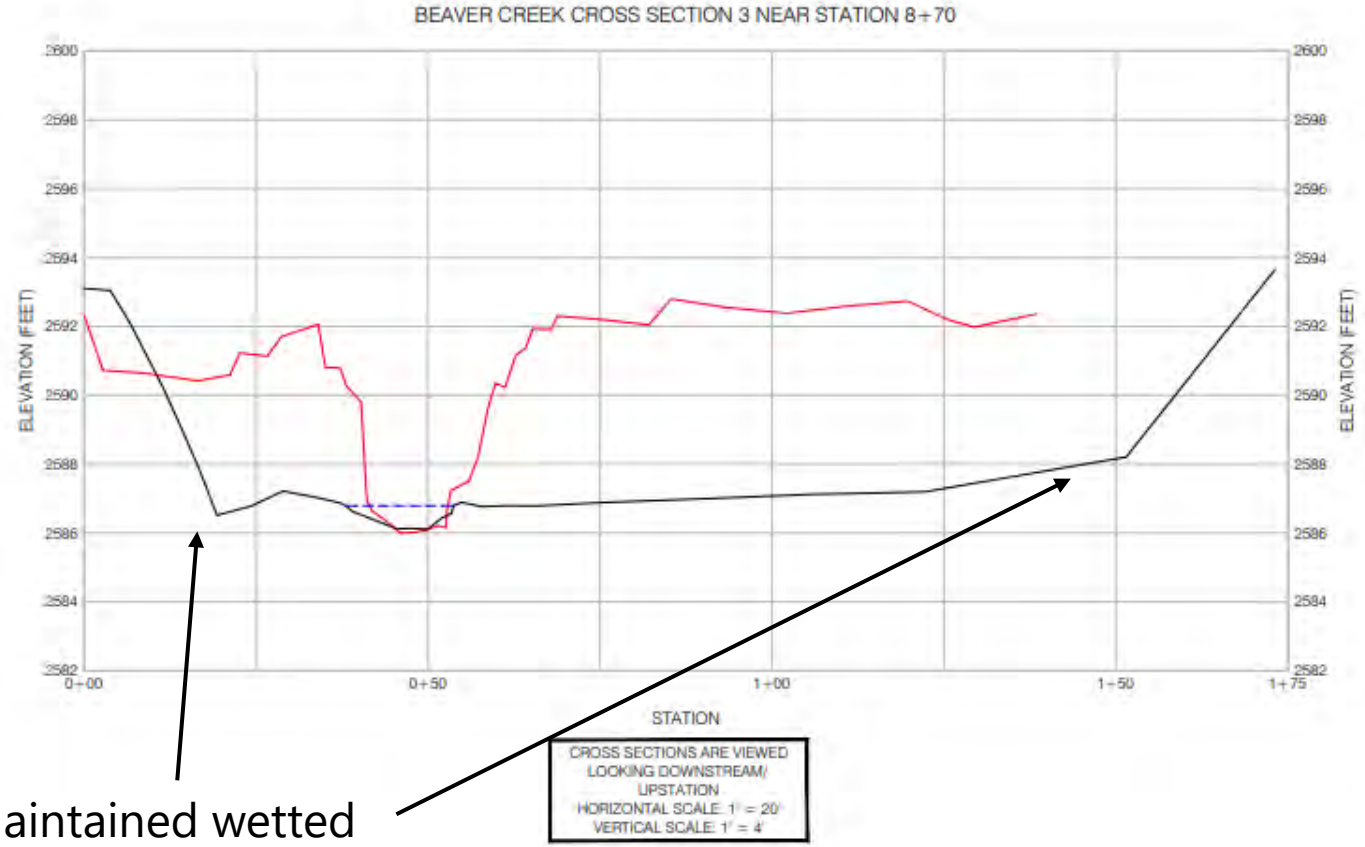
- 2025 POST-CONSTRUCTION THALWEG
- 2025 POST-CONSTRUCTION WATER SURFACE (LOW FLOW)
- 2025 PRE-CONSTRUCTION THALWEG (MEASURED)

BEAVER CREEK 2025
POST-CONSTRUCTION CONDITIONS
CROSS SECTION 3

REVISED DATE: 3/24/2026 | DRAWN BY: LEW

HGS, LLC, A RES COMPANY
2125 19TH STREET, SUITE 200
SACRAMENTO, CA 95818
P: 804.353.6017
WWW.RES.US

BEAVER CREEK 2025 POST-CONSTRUCTION CONDITIONS



- Maintained wetted channel location
- pulled back banks ~130 ft across

BEAVER CREEK 2025
POST-CONSTRUCTION CONDITIONS
CROSS SECTION 3

REVISED DATE: 3/24/2026 DRAWN BY: LEW

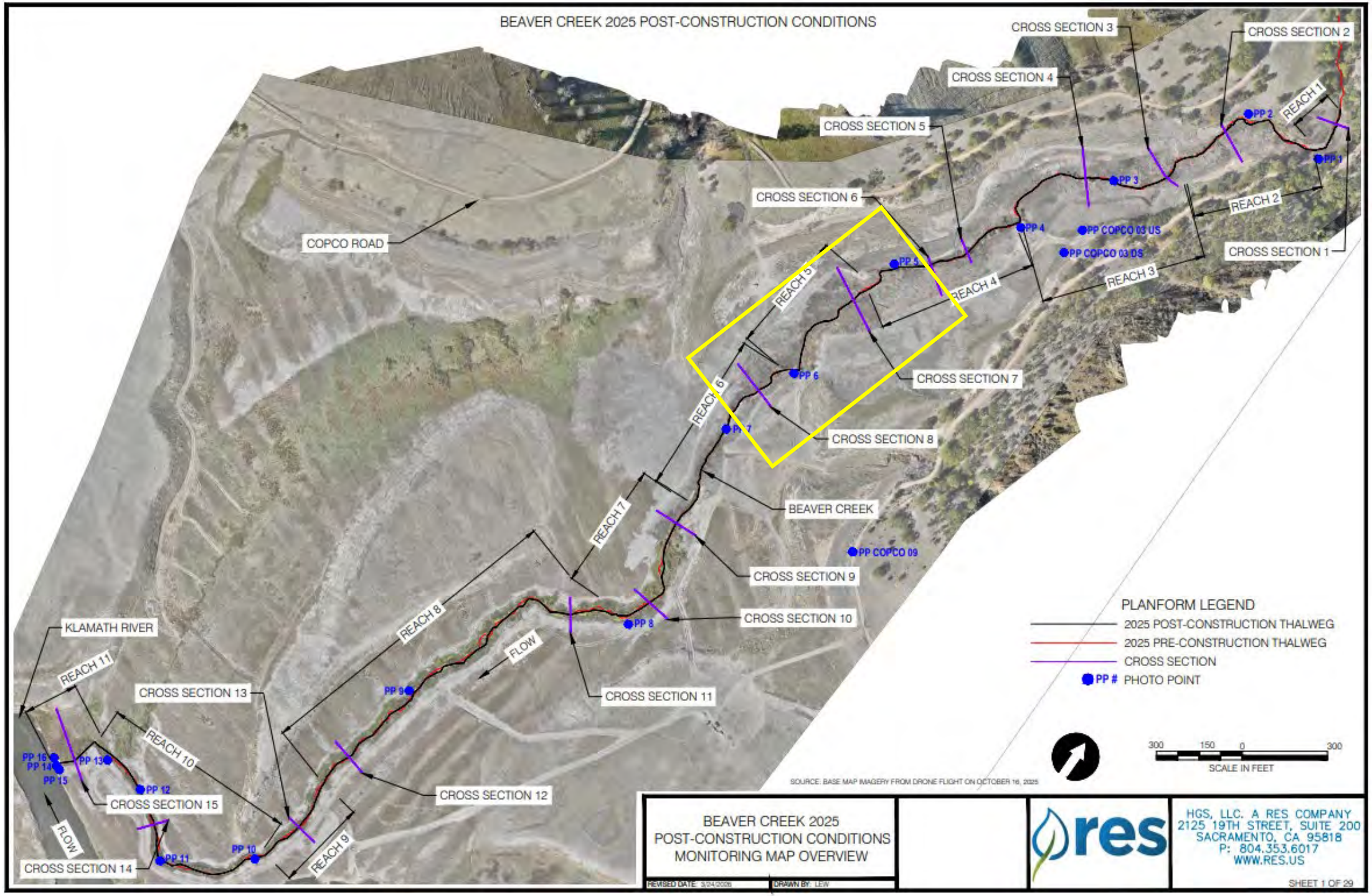
HGS, LLC, A RES COMPANY
2125 19TH STREET, SUITE 200
SACRAMENTO, CA 95818
P: 804.353.6017
WWW.RES.US

Beaver Creek Restoration 2025

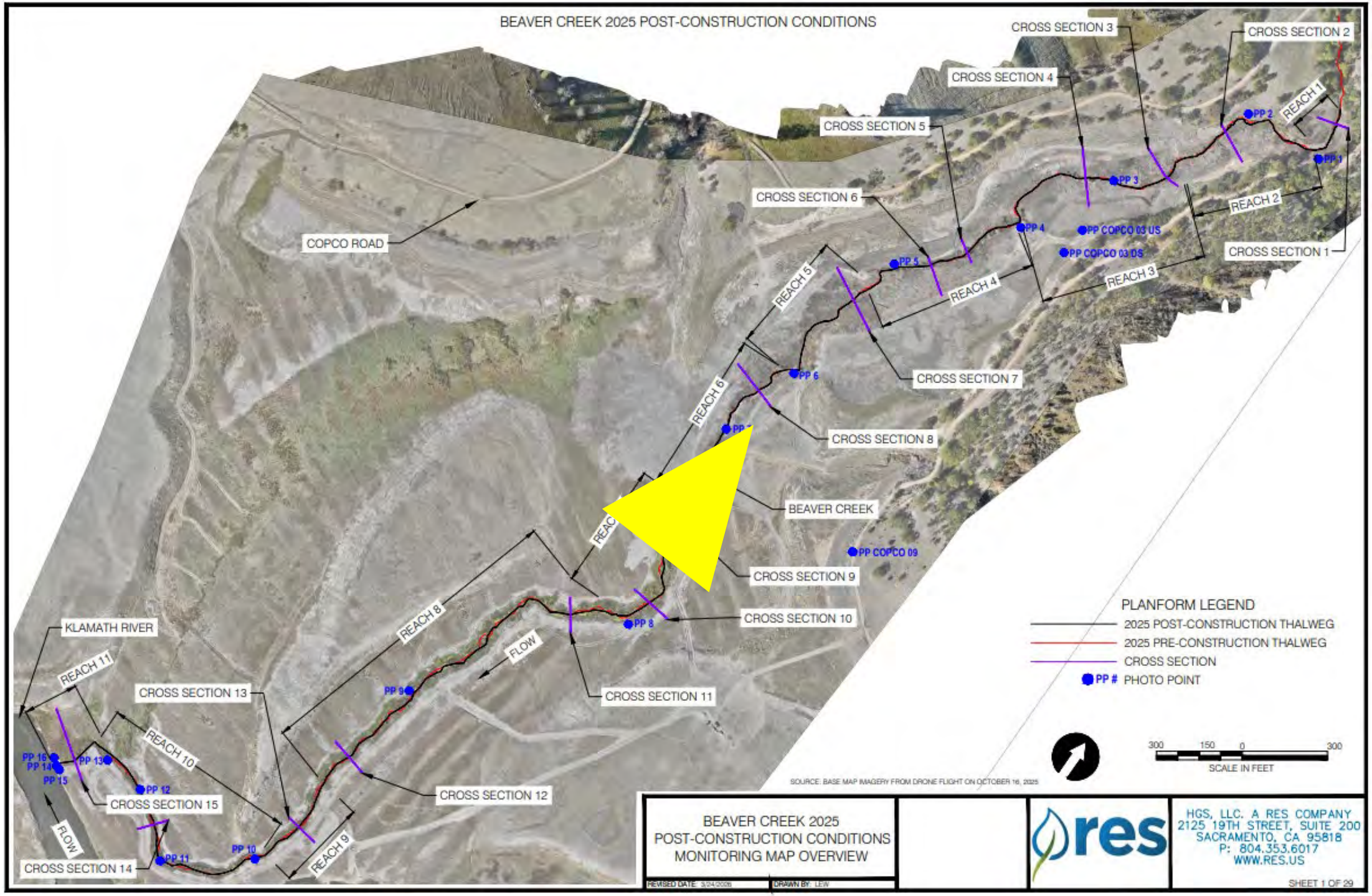
Upper restoration section of Beaver Creek

- Lowering floodplain and resetting channel profile

Beaver Creek, August and September 2025


BEAVER CREEK 2025 POST-CONSTRUCTION CONDITIONS
CROSS SECTION 3
CROSS SECTION 2
CROSS SECTION 4
CROSS SECTION 5
REACH 1
PP 2
PP 1
PP 3
CROSS SECTION 6
REACH 2
COPCO ROAD
PP 4
PP COPCO 03 US
PP COPCO 03 DS
CROSS SECTION 1
PP 5
REACH 5
REACH 4
REACH 3
CROSS SECTION 7
PP 6
REACH 6
PP 7
CROSS SECTION 8
BEAVER CREEK
REACH 7
PP COPCO 09
CROSS SECTION 9
REACH 8
CROSS SECTION 10
PP 8
KLAMATH RIVER
REACH 11
FLOW
PP 9
CROSS SECTION 11
CROSS SECTION 13
REACH 10
PP 16
PP 14
PP 15
PP 13
PP 12
CROSS SECTION 12
CROSS SECTION 15
FLOW
PP 11
PP 10
REACH 9
CROSS SECTION 14
PLANFORM LEGEND
2025 POST-CONSTRUCTION THALWEG
2025 PRE-CONSTRUCTION THALWEG
CROSS SECTION
PP # PHOTO POINT
300 150 0 300
SCALE IN FEET
SOURCE: BASE MAP IMAGERY FROM DRONE FLIGHT ON OCTOBER 16, 2025
BEAVER CREEK 2025
POST-CONSTRUCTION CONDITIONS
MONITORING MAP OVERVIEW
REVISED DATE: 3/24/2026
DRAWN BY: LEW
res
HGS, LLC. A RES COMPANY
2125 19TH STREET, SUITE 200
SACRAMENTO, CA 95818
P: 804.353.6017
WWW.RES.US
SHEET 1 OF 29

res


BEAVER CREEK 2025 POST-CONSTRUCTION CONDITIONS
CROSS SECTION 3
CROSS SECTION 2
CROSS SECTION 4
CROSS SECTION 5
REACH 1
PP 2
PP 1
PP 3
CROSS SECTION 6
REACH 2
COPCO ROAD
PP 4
PP COPCO 03 US
PP COPCO 03 DS
CROSS SECTION 1
PP 5
REACH 5
REACH 4
REACH 3
CROSS SECTION 7
PP 6
REACH 6
CROSS SECTION 8
BEAVER CREEK
PP COPCO 09
CROSS SECTION 9
CROSS SECTION 10
PP 8
KLAMATH RIVER
REACH 8
FLOW
REACH 11
PP 9
CROSS SECTION 11
CROSS SECTION 13
REACH 10
PP 16
PP 14
PP 13
PP 15
PP 12
CROSS SECTION 12
CROSS SECTION 15
FLOW
PP 11
PP 10
REACH 9
CROSS SECTION 14
PLANFORM LEGEND
2025 POST-CONSTRUCTION THALWEG
2025 PRE-CONSTRUCTION THALWEG
CROSS SECTION
PP # PHOTO POINT
300 150 0 300
SCALE IN FEET
SOURCE: BASE MAP IMAGERY FROM DRONE FLIGHT ON OCTOBER 16, 2025
BEAVER CREEK 2025
POST-CONSTRUCTION CONDITIONS
MONITORING MAP OVERVIEW
REVISED DATE: 3/24/2026
DRAWN BY: LEW
res
HGS, LLC. A RES COMPANY
2125 19TH STREET, SUITE 200
SACRAMENTO, CA 95818
P: 804.353.6017
WWW.RES.US
SHEET 1 OF 29

res

Beaver Creek
June 2025

Beaver Dam Analog construction

© Copyright 2026 RES

Lower Section of Beaver Creek – Beaver Dam Analogs

August 2025

Feb 2026 – Post high flow event

Photo: Matt Mais, Yurok Tribe

Revegetating the Former Reservoir Footprints

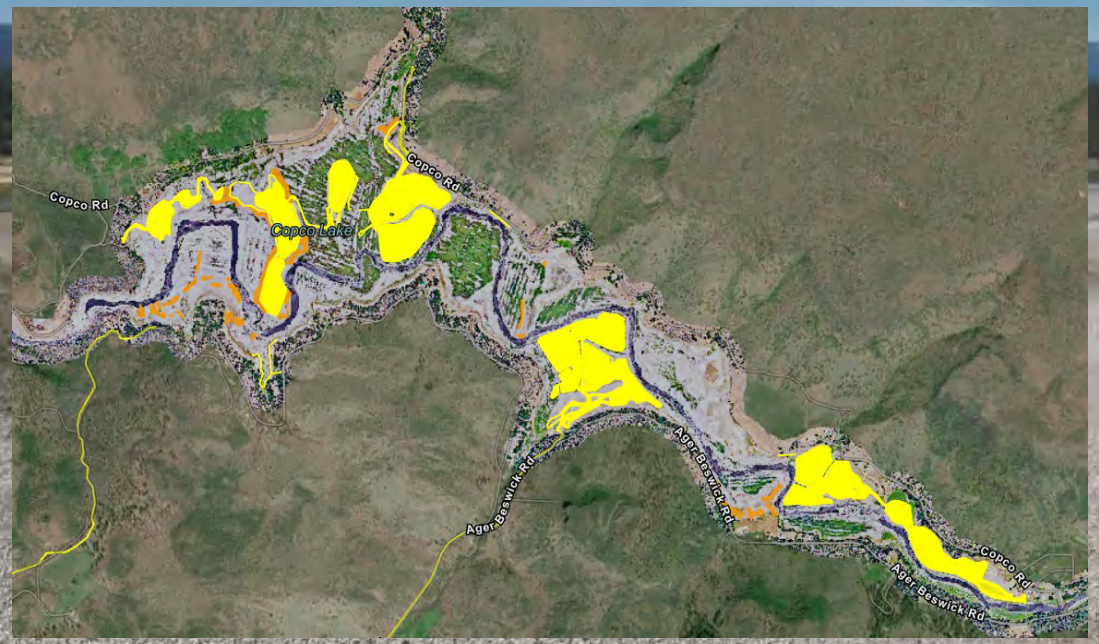
Copco Reservoir Footprint - January 2024

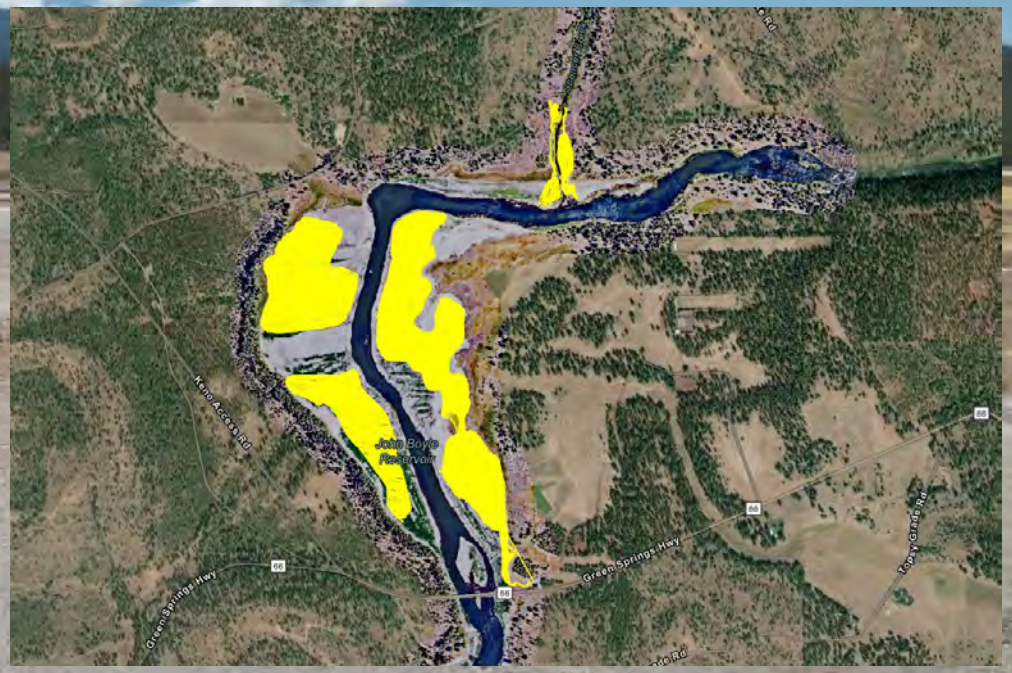
Former Copco Reservoir Footprint - March 2024

Klamath River - Copco Valley – Copco Lake Footprint

Photo: Joel Ophoff

Seedbed Preparation





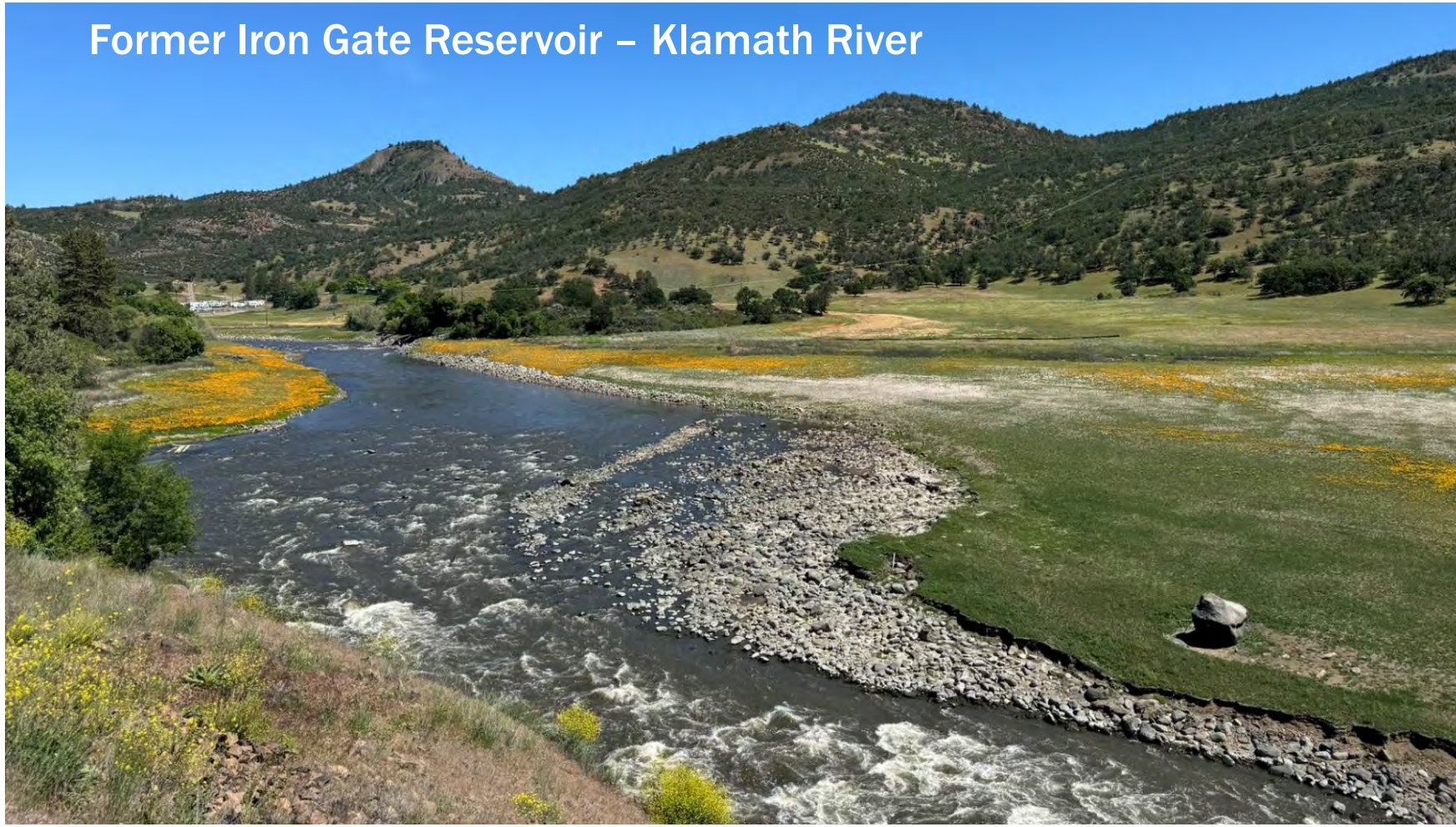
Seedbed Preparation at JCB, September 2024 Photo: Nathan McCanne

What's Next

2026-Onward

- Monitoring and Maintenance
  - Revegetation
  - High Priority Tributaries
  - Fish Passage
  - Water Quality
- Reporting
- 5 years and success criteria met

- RES – Full-time on-site presence



© Copyright 2026 RES

RES Project Partners

KLAMATH RIVER RENEWAL CORPORATION

McMillen

Kiewit

THE KLAMATH TRIBES
KLAMATH · MODOC · YAHOOSKIN

GREAT SEAL OF THE KARUK TRIBE

SHASTA INDIAN NATION

CAMAS

Stantec

TROUT UNLIMITED

USGS

RDG RIVER DESIGN GROUP

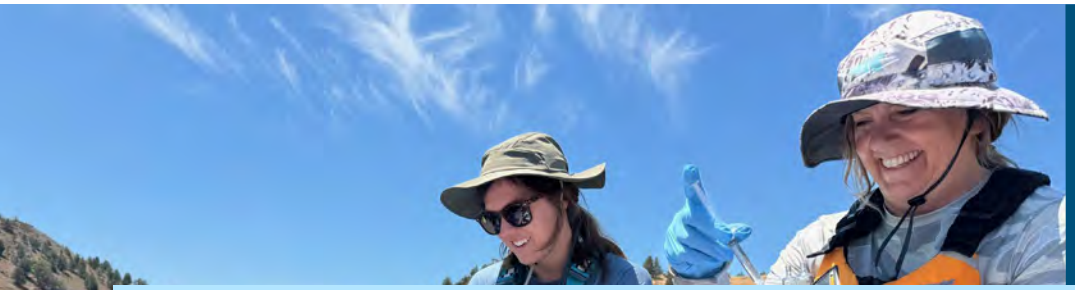
Ross Taylor & Associates

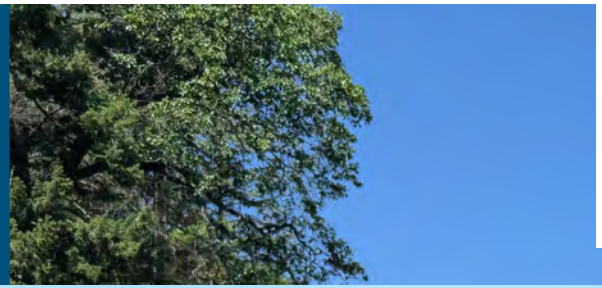
CROMAN CORP

cbec eco engineering
A Verdantas Company

res

Molecular Time Capsule – eDNA Collection





scientific reports

Explore content ~ About the journal ~ Publish with us ~

nature > scientific reports > articles > article

Article | Open access | Published: 01 July 2025

A molecular specimen bank for contemporary and future study captures landscape-scale biodiversity baselines before Klamath River dam removal

Dylan J. Keel, Katie Karpenko, Scott M. Blankenship, Gregg Schumer, Oshun O'Rourke, Carl O. Ostberg, Daniel A. Chase & Jeffrey J. Duda

Scientific Reports **15**, Article number: 20679 (2025) | Cite this article

1:30 Friday - Dylan Keel: *The Klamath River Renewal Project Molecular Library, Describing Landscape-scale Aquatic Biodiversity Change Following Historic Dam-Removal and Restoration*

Check out the article

Project Contacts

Dave Coffman
Klamath Restoration Program Manager
dcoffman@res.us

Dan Chase
Lead Fisheries Biologist
dchase@res.us

Dave Meurer
Director of Community Affairs
dmeurer@res.us

RES Klamath Story Map

Beaver Creek – Helicopter Wood Aug 2024

Upper Klamath River Tributary Post Dam Removal Salmonid Restoration

Max Ramos &
William Nuckoles

Upper Klamath River Tributary Post Dam Removal Salmonid Restoration

Funders:

NOAA Fisheries

Transformational Habitat Restoration and Coastal Resilience Grant

Award: 18 million

USBR

Aquatic Ecosystem Restoration Program

Award: 10 million

Foundational Study: Klamath River Reservoir Reach Habitat Assessment and Restoration Plan **(K3RP)**

FINAL REPORT • December 2022

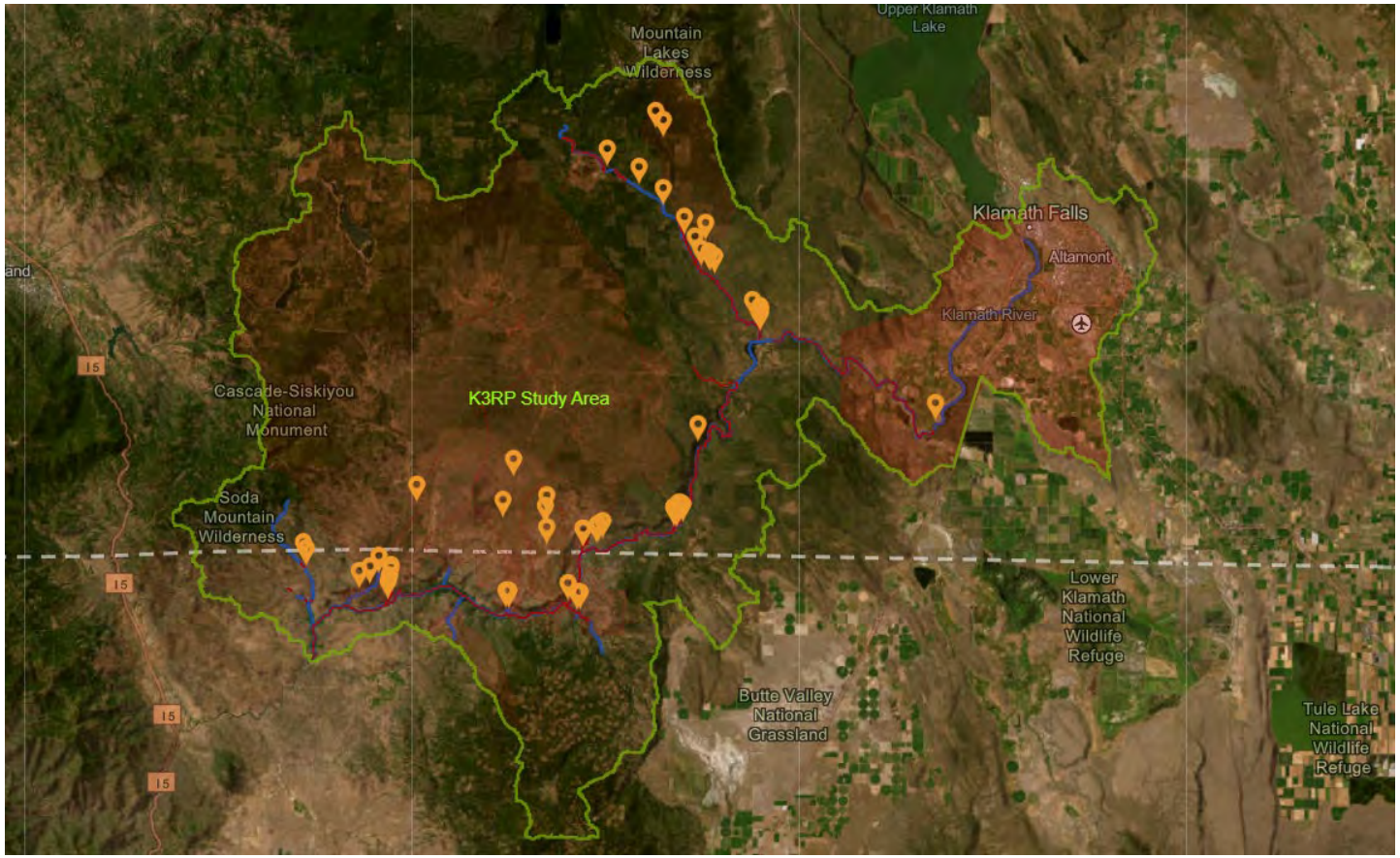
Klamath Reservoir Reach Restoration Prioritization Plan **(K3RP)**

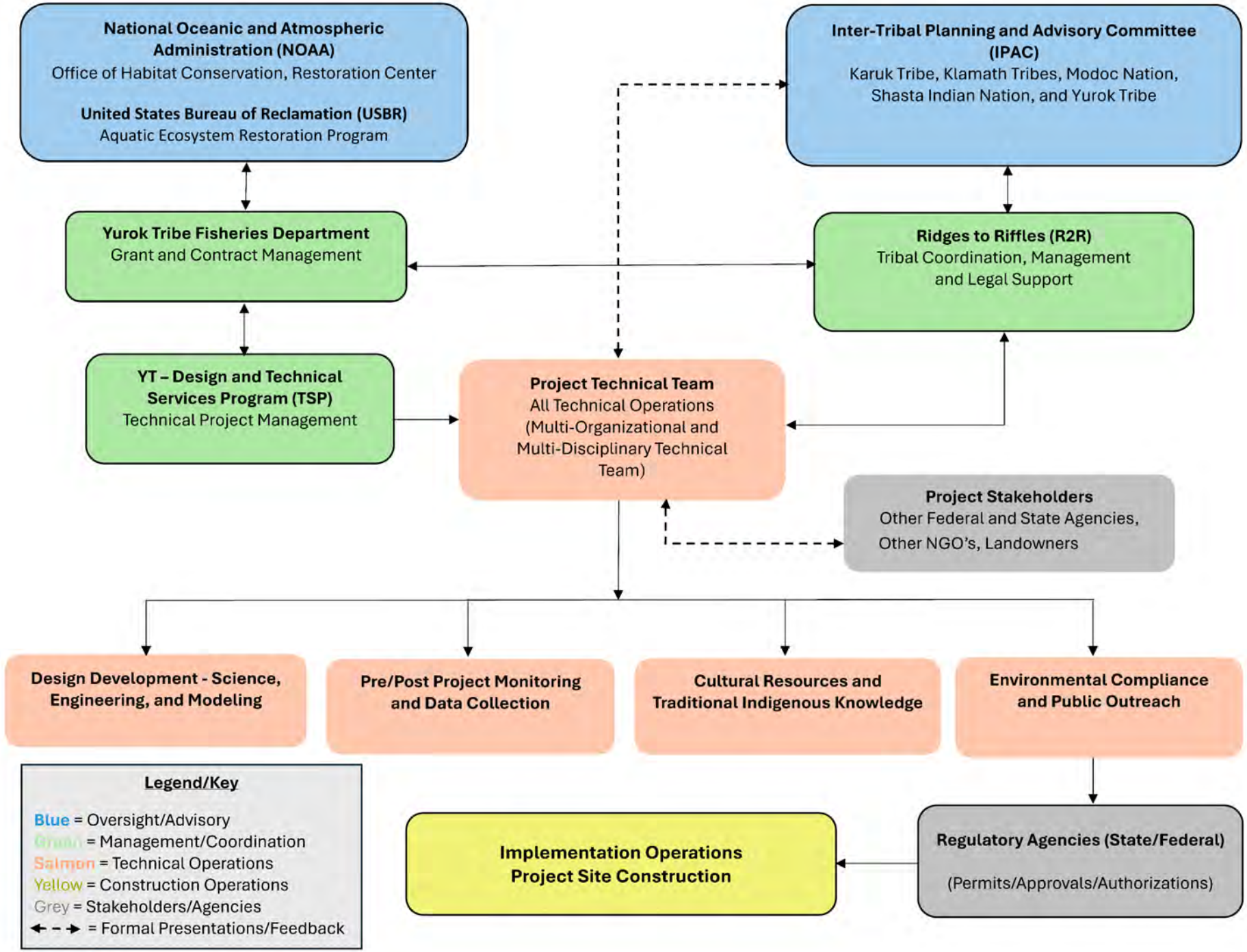
A Summary of Habitat Conditions and Potential Restoration Actions for the Mainstem Klamath River and Tributaries between Iron Gate Dam and Link River Dam

Restoration Type	Number of Projects Identified
Habitat	82
Flow	144
Diversion Screening	70

16 TAC Representatives Ranking
High, Medium, Low Priority

Authors:
Chris O'Keefe – PSMFC
Bob Pagliuco – NOAA Restoration Center
Nell Scott – TU
Tommy Cianciolo – TU
Brett Holycross – PSMFC




National Oceanic and Atmospheric Administration (NOAA)
Office of Habitat Conservation, Restoration Center
United States Bureau of Reclamation (USBR)
Aquatic Ecosystem Restoration Program
Inter-Tribal Planning and Advisory Committee (IPAC)
Karuk Tribe, Klamath Tribes, Modoc Nation, Shasta Indian Nation, and Yurok Tribe
Yurok Tribe Fisheries Department
Grant and Contract Management
Ridges to Riffles (R2R)
Tribal Coordination, Management and Legal Support
YT – Design and Technical Services Program (TSP)
Technical Project Management
Project Technical Team
All Technical Operations (Multi-Organizational and Multi-Disciplinary Technical Team)
Project Stakeholders
Other Federal and State Agencies, Other NGO's, Landowners
Design Development - Science, Engineering, and Modeling
Pre/Post Project Monitoring and Data Collection
Cultural Resources and Traditional Indigenous Knowledge
Environmental Compliance and Public Outreach
Legend/Key
Blue = Oversight/Advisory
Green = Management/Coordination
Salmon = Technical Operations
Yellow = Construction Operations
Grey = Stakeholders/Agencies
= Formal Presentations/Feedback
Implementation Operations
Project Site Construction
Regulatory Agencies (State/Federal)
(Permits/Approvals/Authorizations)

Intertribal Planning and Advisory Committee (IPAC)

- Restoration collaborative of local Klamath basin tribes.
- Deliberately leading all restoration project design from the beginning.

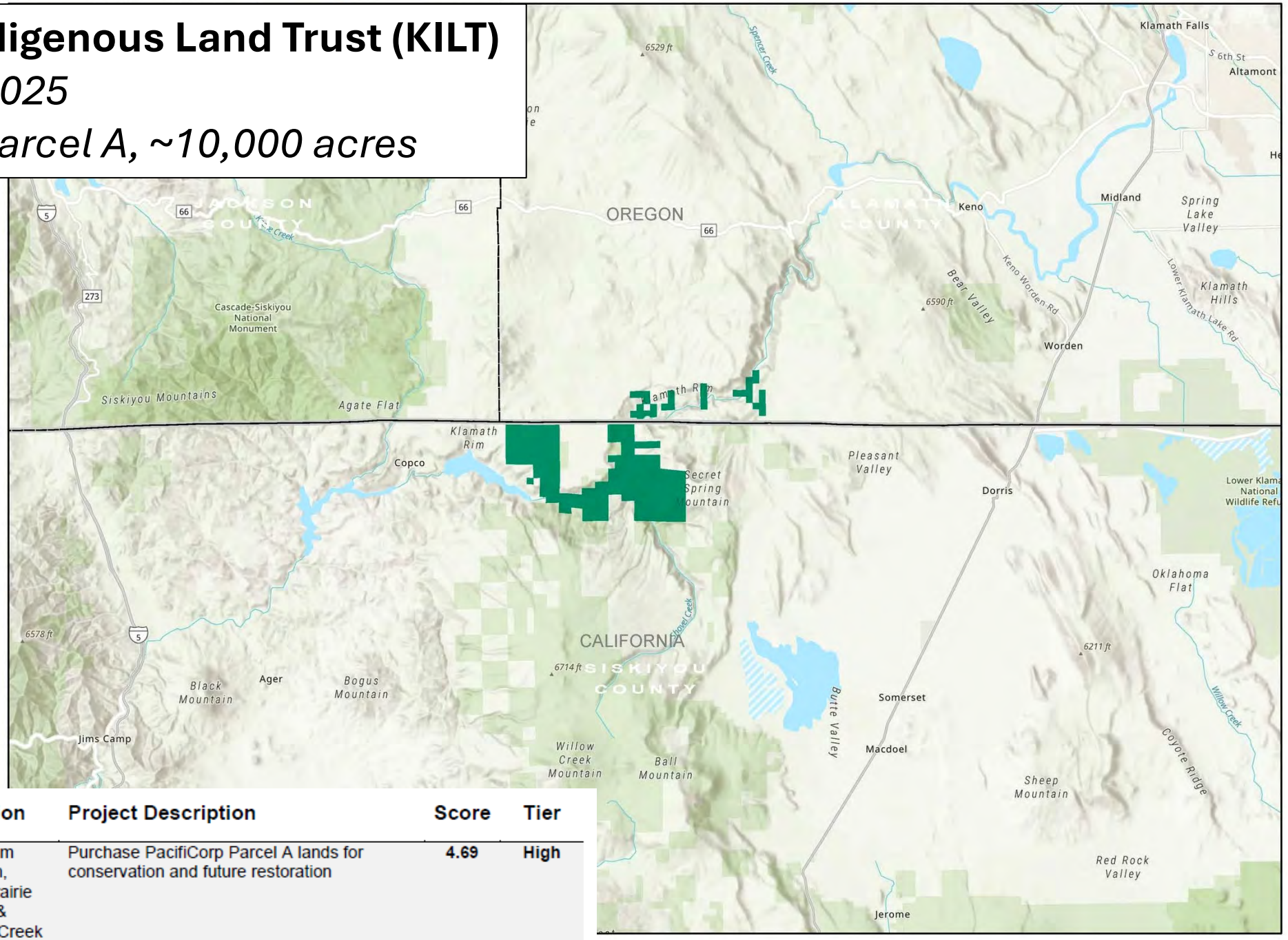
Modoc Nation

SHASTA INDIAN NATION

Klamath Indigenous Land Trust (KILT)

December 2025

PacifiCorp Parcel A, ~10,000 acres

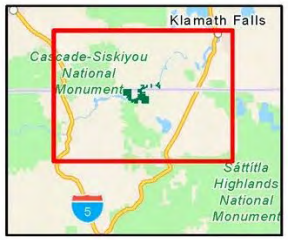


K3RP

Rank	Project	Location	Project Description	Score	Tier
1	#108	Mainstem Klamath, Long Prairie Creek, & Shovel Creek	Purchase PacifiCorp Parcel A lands for conservation and future restoration	**4.69**	**High**

Klamath Ranch Lands

- Overview-



Klamath Ranch Parcels

County

State

0 2.25 4.5 Miles

N

PACIFICORP

GIS SUPPORT SERVICES

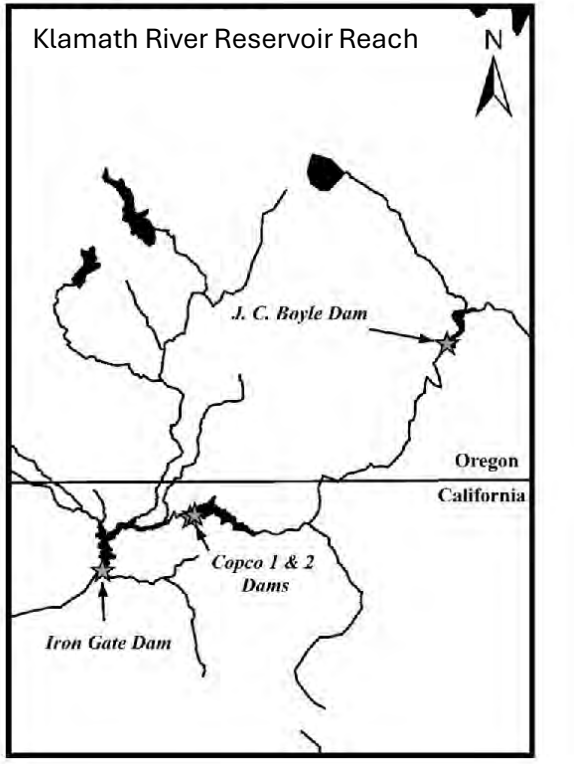
Solutions Group

glsdept@pacificorp.com

Data is projected in UTM Zone 10, NAD83, meters.

PacifiCorp makes no representations or warranties as to the accuracy, completeness or fitness for a particular purpose with respect to the information contained in this map. PacifiCorp shall have no responsibility or liability to any person or entity resulting from the use of any information furnished in this map.

Goals and Objectives



Overall Project Goal: Increase the quantity and quality of habitat in the Klamath River Reservoir Reach (KRRR) for spring and fall-run Chinook salmon, steelhead, Pacific lamprey, coho salmon and other species, incorporating TIK and inter-tribal objectives from IPAC.

Goals and Objectives

Complimentary project goals to restore KRRR habitats.

A. Stream and Floodplain Habitat Restoration

B. Infrastructure Limiting Factors Assessment

C. Fish Passage Restoration

D. Watershed-Scale Water Quality Restoration

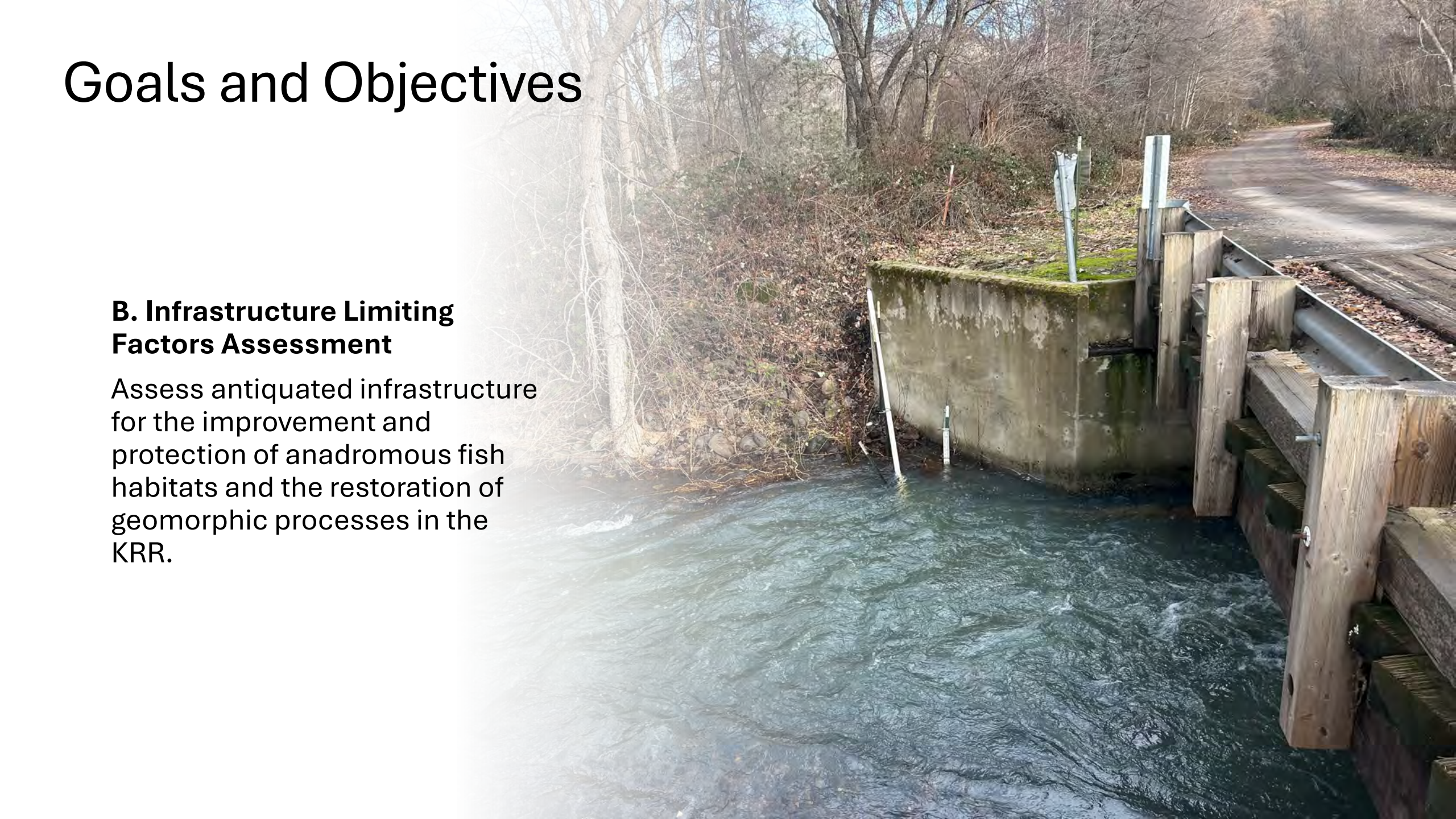
Goals and Objectives

A. Stream and Floodplain Habitat Restoration

Restore and enhance degraded Klamath River, tributary and floodplain habitats in the KRRR critical for the log-term success of anadromous fish.

Shovel Creek channel simplification in the 1980's

Goals and Objectives



B. Infrastructure Limiting Factors Assessment

Assess antiquated infrastructure for the improvement and protection of anadromous fish habitats and the restoration of geomorphic processes in the KRR.

Goals and Objectives

C. Fish Passage Restoration

Improve anadromous fish access to essential habitats in the KRR for all life stages and improve water quality.

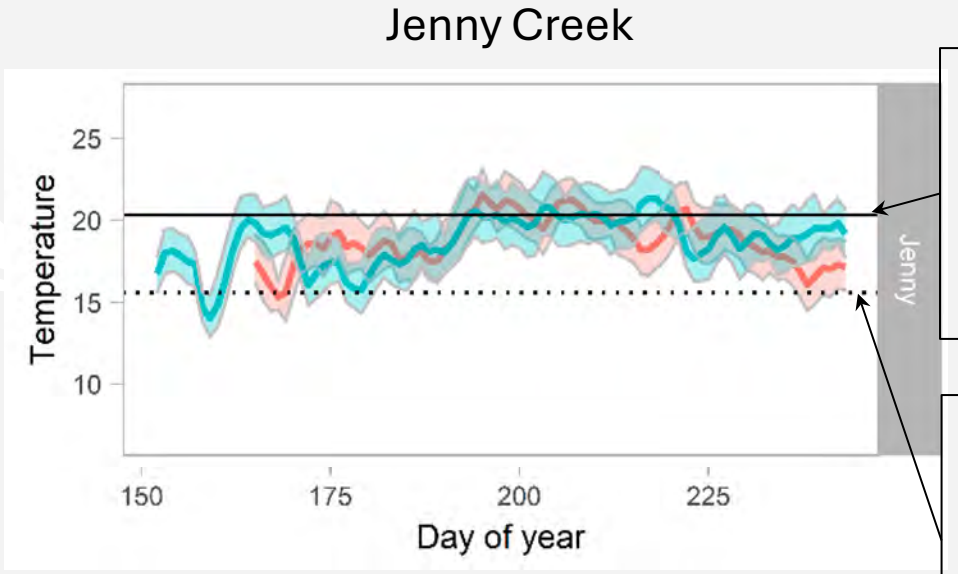
Jenny Creek Landslide
K3RP Survey, June 2021

Goals and Objectives

D. Watershed-Scale Water Quality Restoration

Improve water quality and quantity for reestablishing fish populations including altered sediment supply, and degraded riparian forest condition limiting factors.

Red is 2018
Blue is 2019



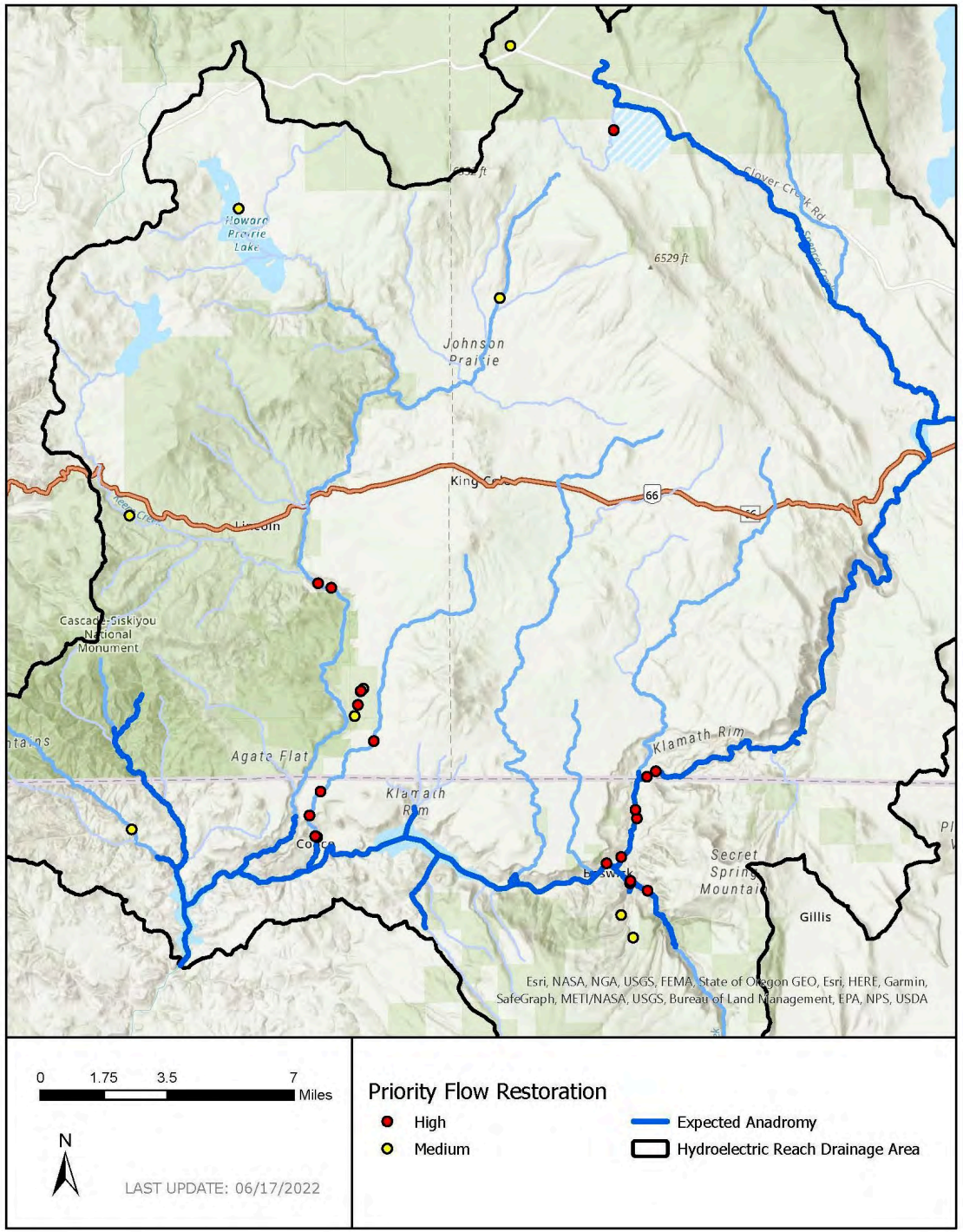
Detrimental to juvenile salmon growth >20.3°C or ***68.5°F***

Suboptimal for juvenile coho salmon growth >15.6°C or ***60.1°F***

K3RP Fish Habitat Restoration Projects

Rank	Project	Location	Project Description	Score	Tier
3	#95	Spencer Creek	Make Buck Lake a lake again <OR> regrade channels in the lake to improve habitat conditions, add LWD, BDAs, vegetation, and cattle fencing to the depositional valley 14J	4.34	High
4	#99	Shovel Creek	Regrade stream channel to allow for full floodplain reconnection in this reach, and add cattle fencing	4.17	High
5	#47	Jenny Creek	Develop Upper Jenny Creek riparian and fencing plan to address water quality and temperature	4.16	High
7	#110	Fall Creek	Assess impacts of agricultural practices and determine if a water quality improvement project would benefit Fall Creek	4.00	High
12	#49	Klamath Mainstem	Activate floodplains downstream of Shovel Creek and create a constructed side channel for rearing, spawning, and high water refugia	3.83	High
18	#111	Long Prairie Creek	Assess impacts of agricultural practices and determine if a water quality improvement project would benefit Long Prairie Creek	3.64	High
20	#96	Spencer Creek	Reconnect floodplain, add BDAs and LWD, and add cattle fencing to the depositional valley 12I	3.56	High
25	#66	Shovel Creek	Remove cattle operation or work with landowner to keep cattle out of the riparian area and revegetate the riparian zone. Modify or remove the three diversion infrastructures used for cattle to ensure fish passage. If cattle removal is not possible, add cattle fencing.	3.5	High
30	#63	Shovel Creek	Move the lower Shovel Creek road crossing upstream of the lower floodplain reconnection project site or create a channel spanning bridge at the current site	3.41	Medium
31	#101	Jenny Creek	Add LWD for habitat complexity and to reconnect the floodplain	3.38	Medium
32	#100	Jenny Creek	Add LWD and remove the parking lot near the confluence with the reservoir	3.36	Medium
56	#52	Long Prairie Creek	Reconnect the floodplain and add complexity just upstream of the culvert on the river right channel by adding LWD	2.74	Medium
65	#33	Grouse Spring Creek	Address the ford/stream crossing in the lower reach	2.4	Low
73	#46	Jenny Creek	Assess potential to rework landslide deposits to provide fish passage	2.08	Low

K3RP Instream Flow Restoration Projects

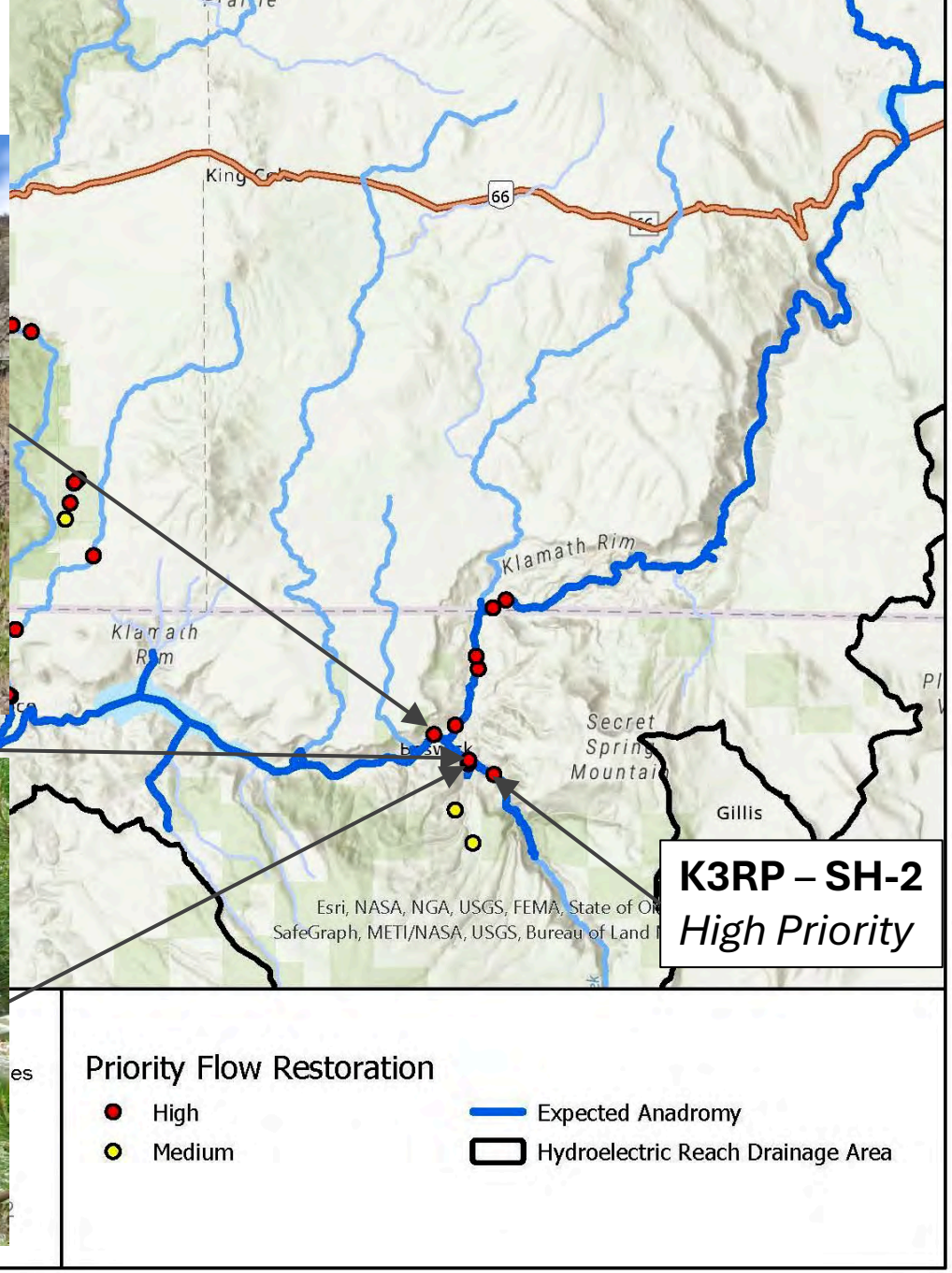


K3RP Instream Flow Restoration Projects

K3RP - KL-1
High Priority

K3RP – SH-1
High Priority

K3RP – GS-1
High Priority

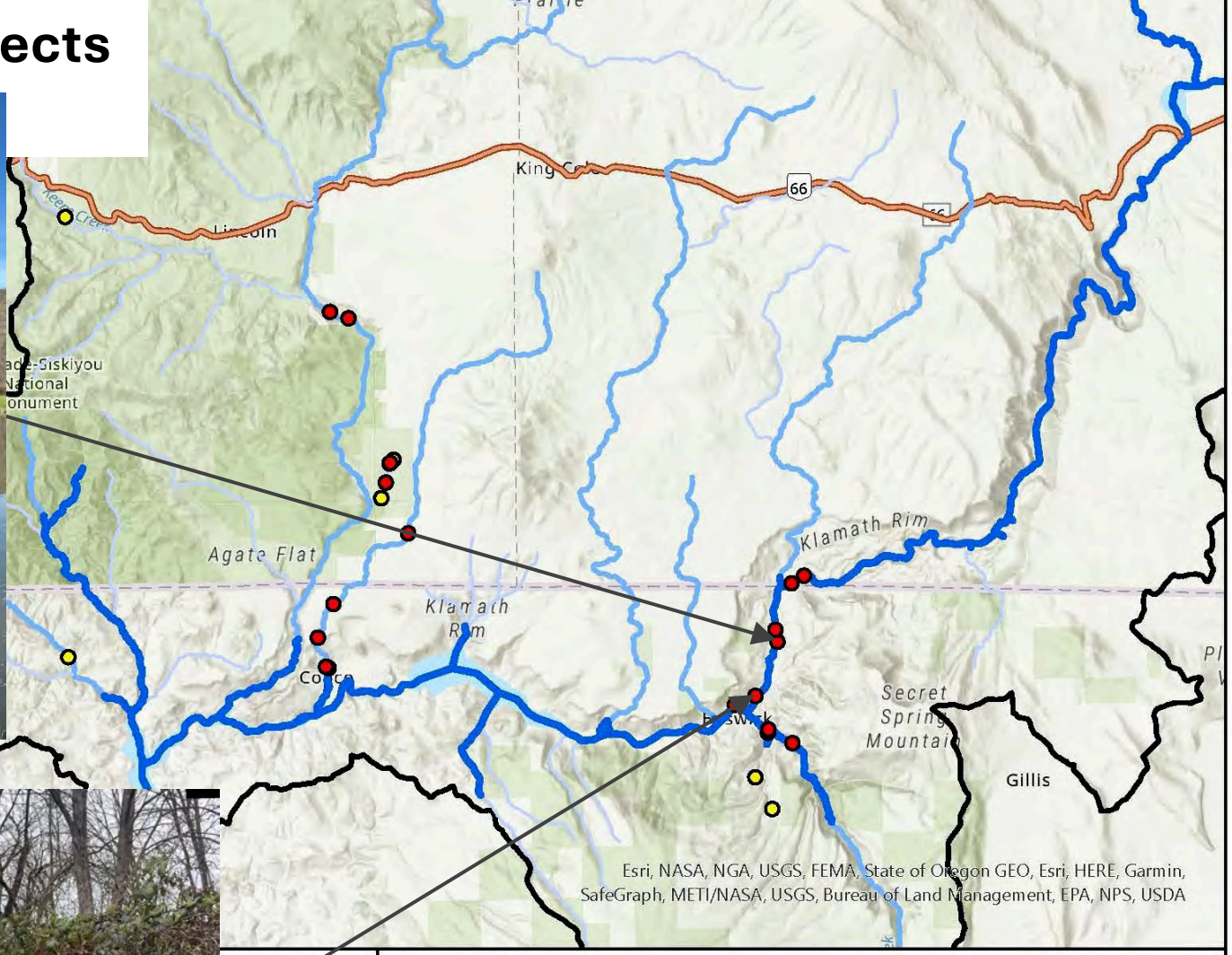


K3RP – SH-2
High Priority

K3RP Instream Flow Restoration Projects

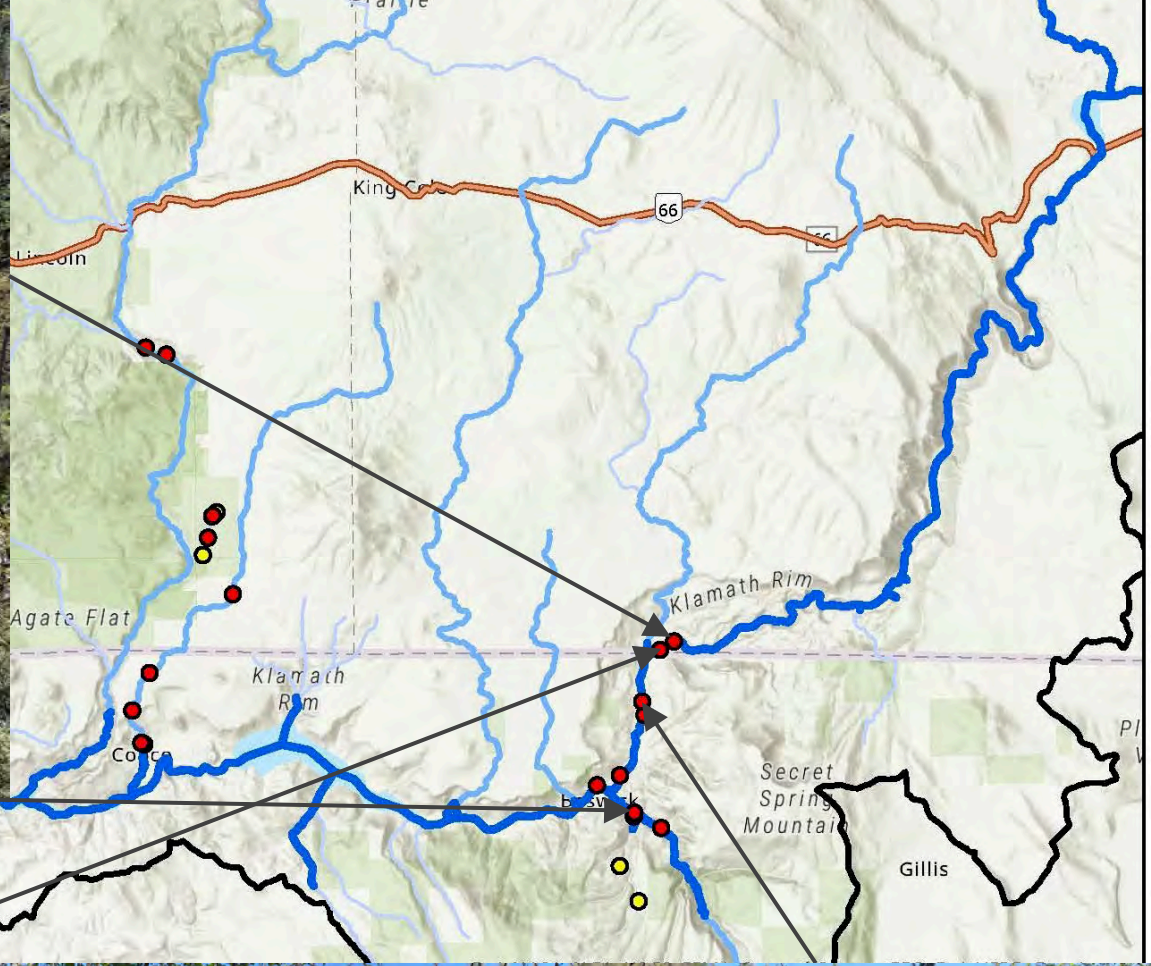
K3RP – KL-3
High Priority

K3RP - KL-2
High Priority



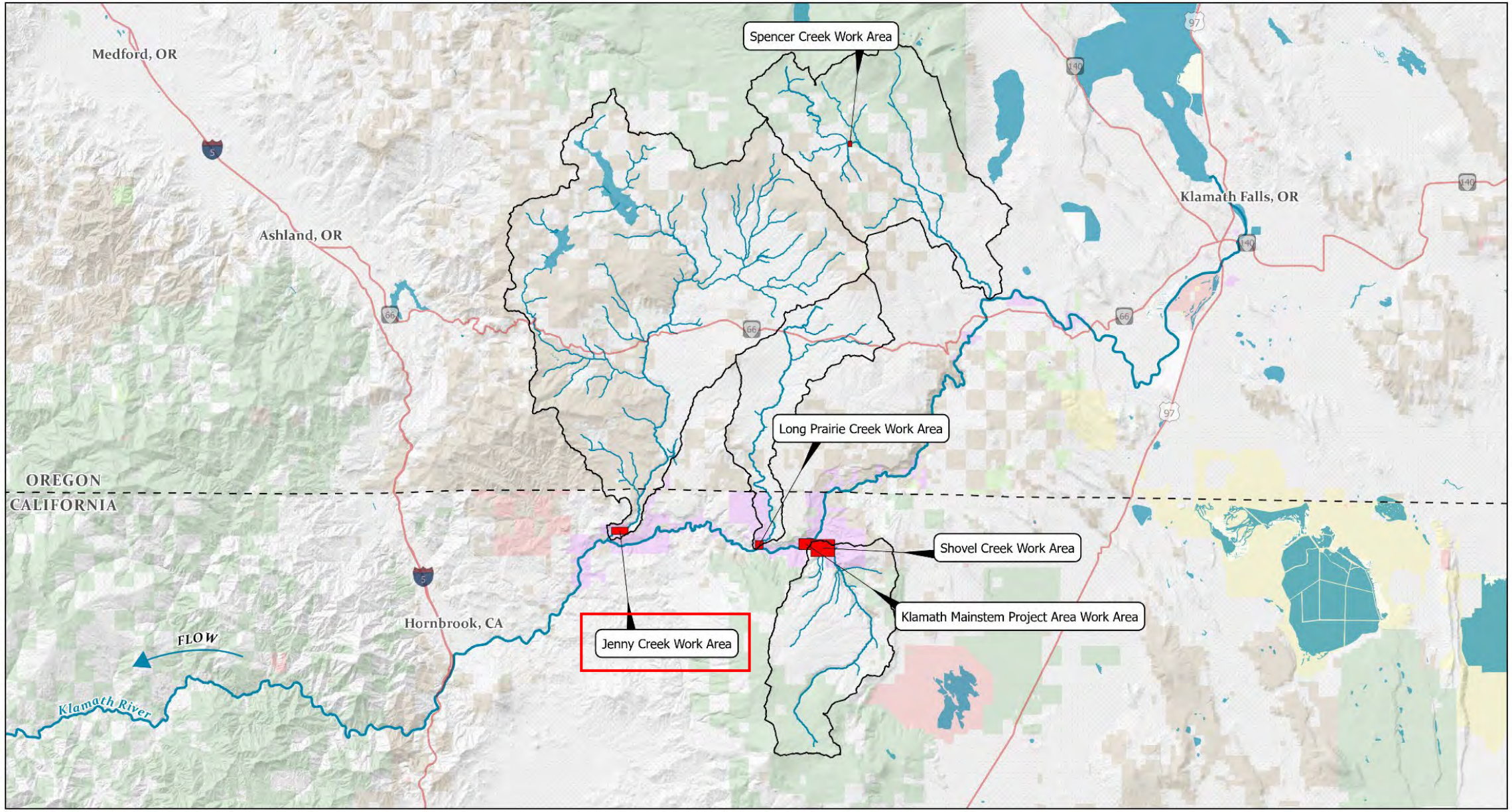
K3RP Instream Flow Restoration Projects

K3RP - KL-6
High Priority



K3RP – KL-5
High Priority

K3RP – KL-4
High Priority



Datums:
Horizontal: NAD 1983 (2011) StatePlane California I FIPS 0401 (US Feet)
Vertical: NAVD88

Sources:
USGS, BLM, TIGER

Yurok Tribe

OR/CA Border
Project Work Areas
Major Roads
Watershed Boundary
Klamath River
Primary Channel
Channel Tributary
Water Bodies
Marsh/Wet Meadow
PPL/PacificCorp
Bureau of Land Management
Fish and Wildlife Service
US Forest Service
State
State Department of Forestry
Private Land
N
0 3 6
Miles

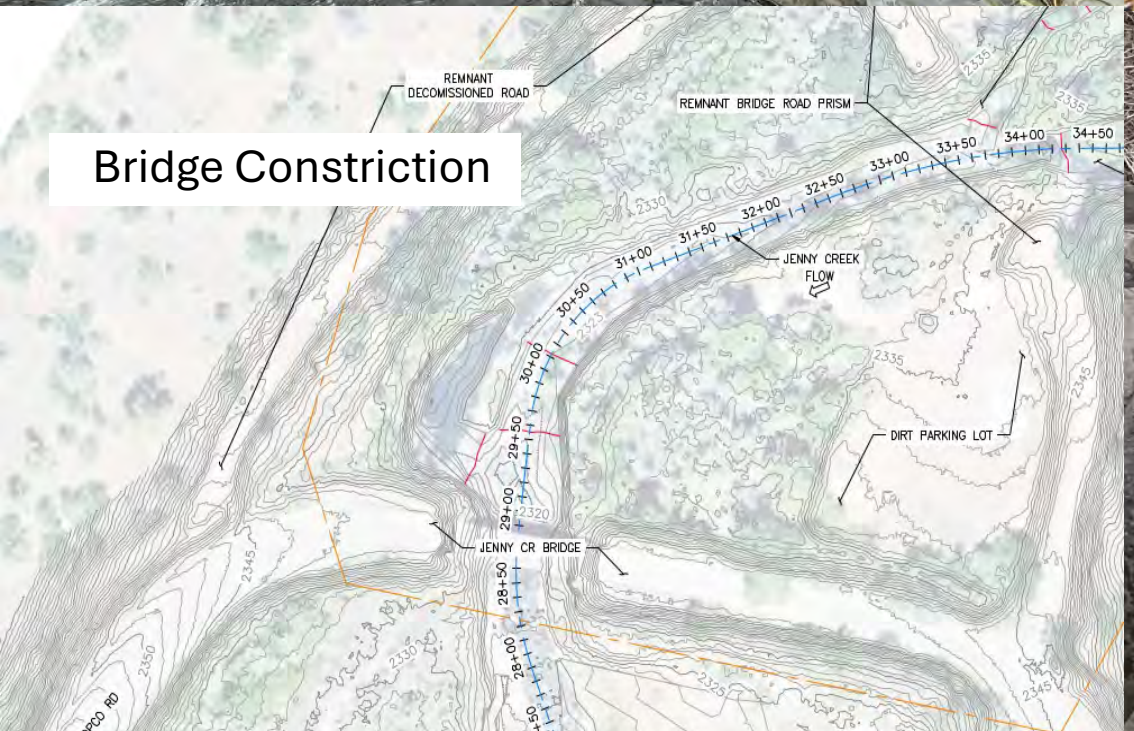
Upper Klamath Tributary Post Dam Removal Salmonid Restoration Project

Figure 1-1
Project Locations Map

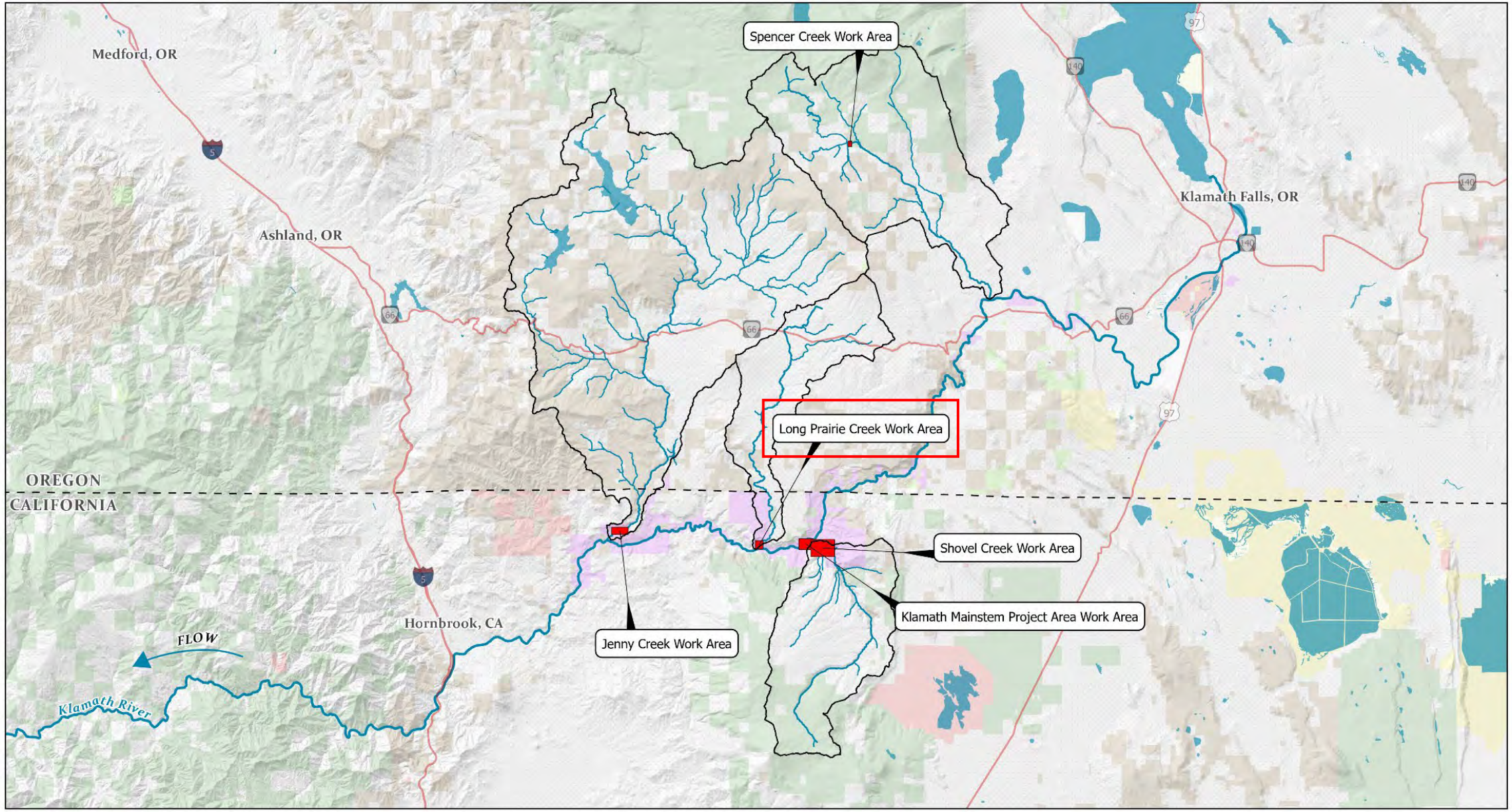
Jenny Creek Conditions

High Gradient (2 – 9%)

Bridge Constriction



Large Substrate



Datums:
Horizontal: NAD 1983 (2011) StatePlane California I FIPS 0401 (US Feet)
Vertical: NAVD88

Sources:
USGS, BLM, TIGER

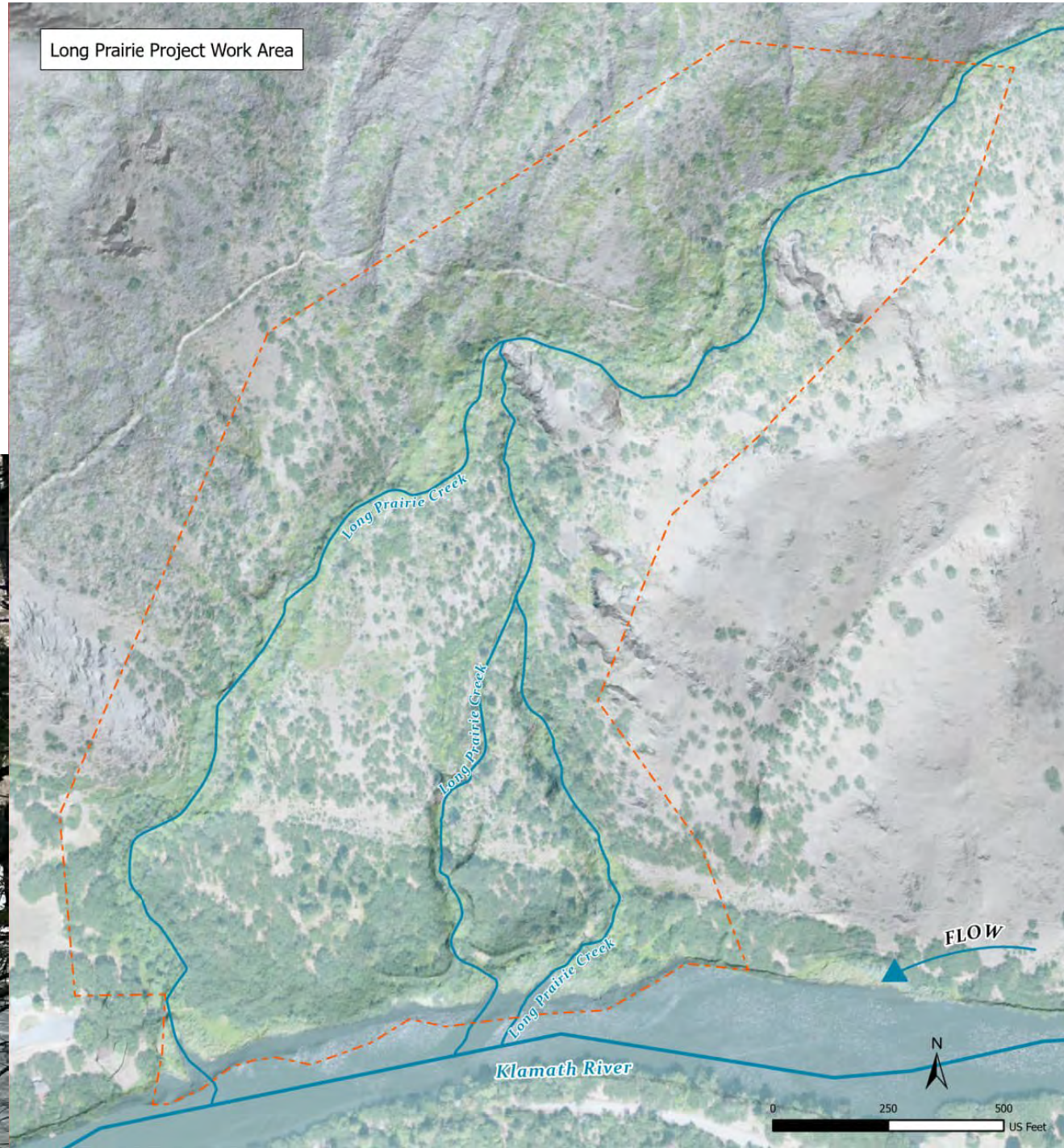
Yurok Tribe

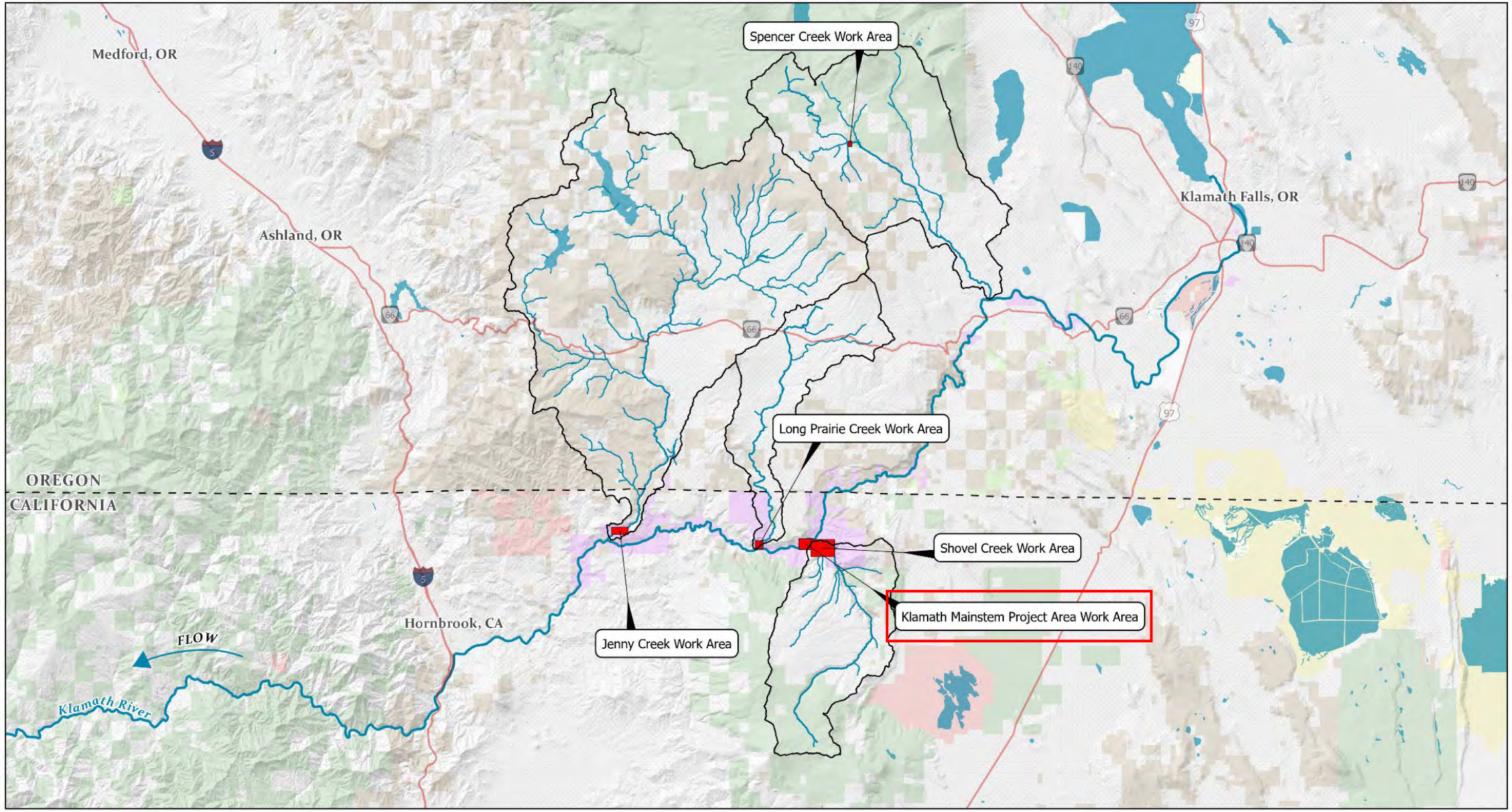
OR/CA Border
Project Work Areas
Major Roads
Watershed Boundary
Klamath River
Primary Channel
Channel Tributary
Water Bodies
Marsh/Wet Meadow
PPL/PacificCorp
Bureau of Land Management
Fish and Wildlife Service
US Forest Service
State
State Department of Forestry
Private Land
N
0 3 6
Miles

Upper Klamath Tributary Post Dam Removal Salmonid Restoration Project

Figure 1-1
Project Locations Map

Long Prairie Creek Conditions





Datums:
Horizontal: NAD 1983 (2011) StatePlane California I FIPS 0401 (US Feet)
Vertical: NAVD88

Sources:
USGS, BLM, TIGER

Yurok Tribe

OR/CA Border
Project Work Areas
Major Roads
Watershed Boundary
Klamath River
Primary Channel
Channel Tributary
Water Bodies
Marsh/Wet Meadow
PPL/PacificCorp
Bureau of Land Management
Fish and Wildlife Service
US Forest Service
State
State Department of Forestry
Private Land

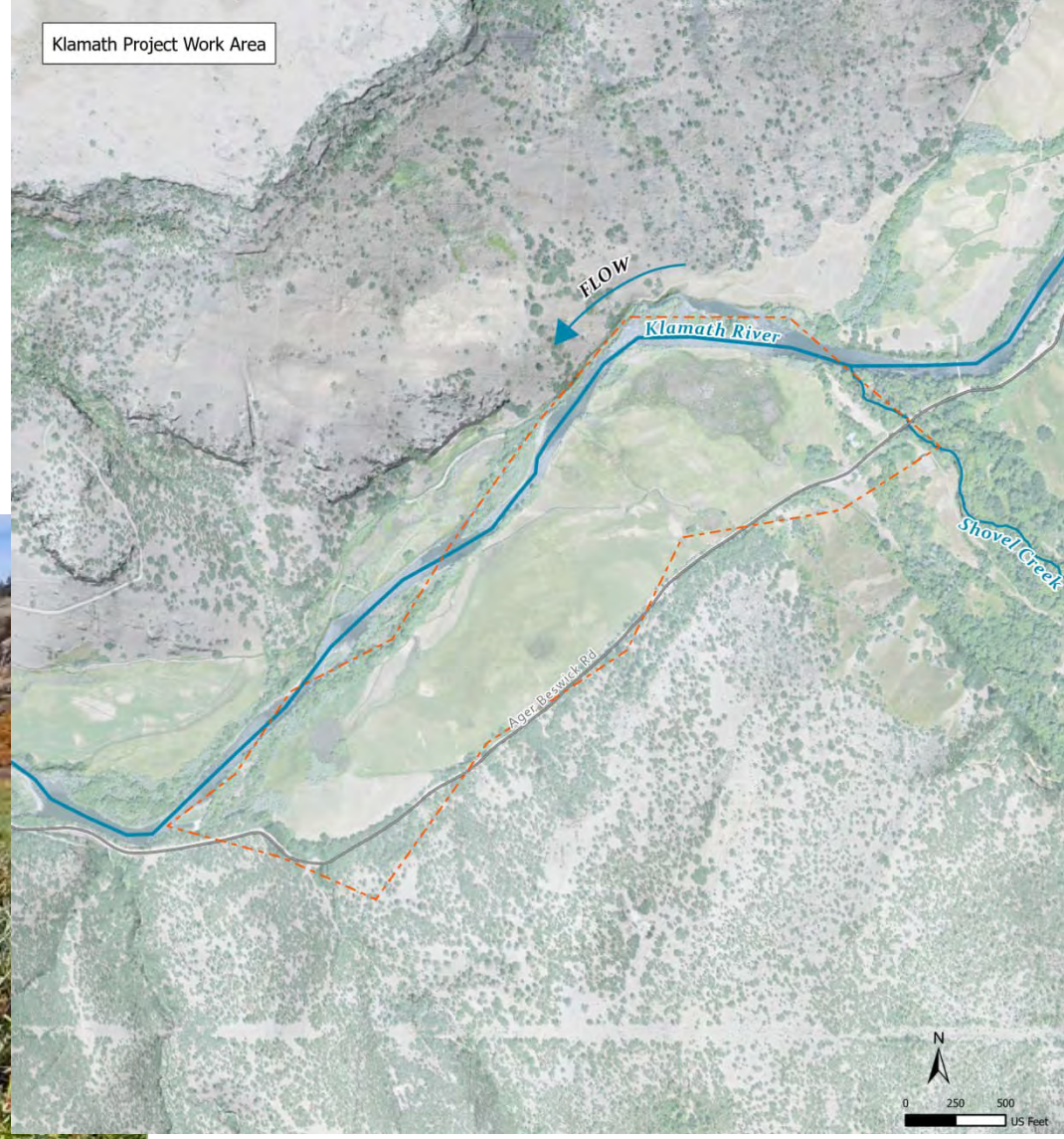
N

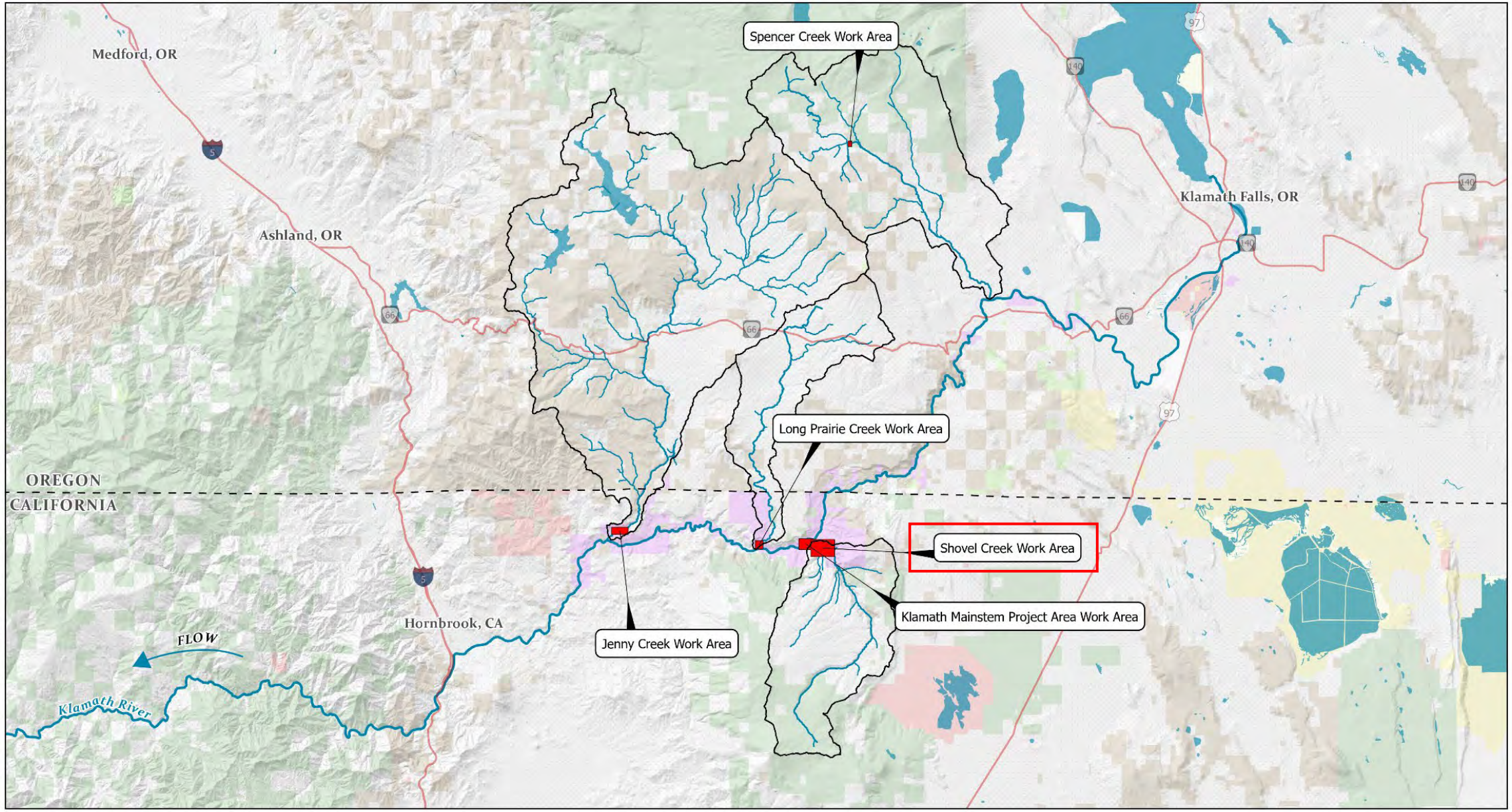
0 3 6
Miles

Upper Klamath Tributary Post Dam Removal Salmonid Restoration Project

Figure 1-1
Project Locations Map

Klamath Bench Conditions





Datums:
Horizontal: NAD 1983 (2011) StatePlane California I FIPS 0401 (US Feet)
Vertical: NAVD88

Sources:
USGS, BLM, TIGER

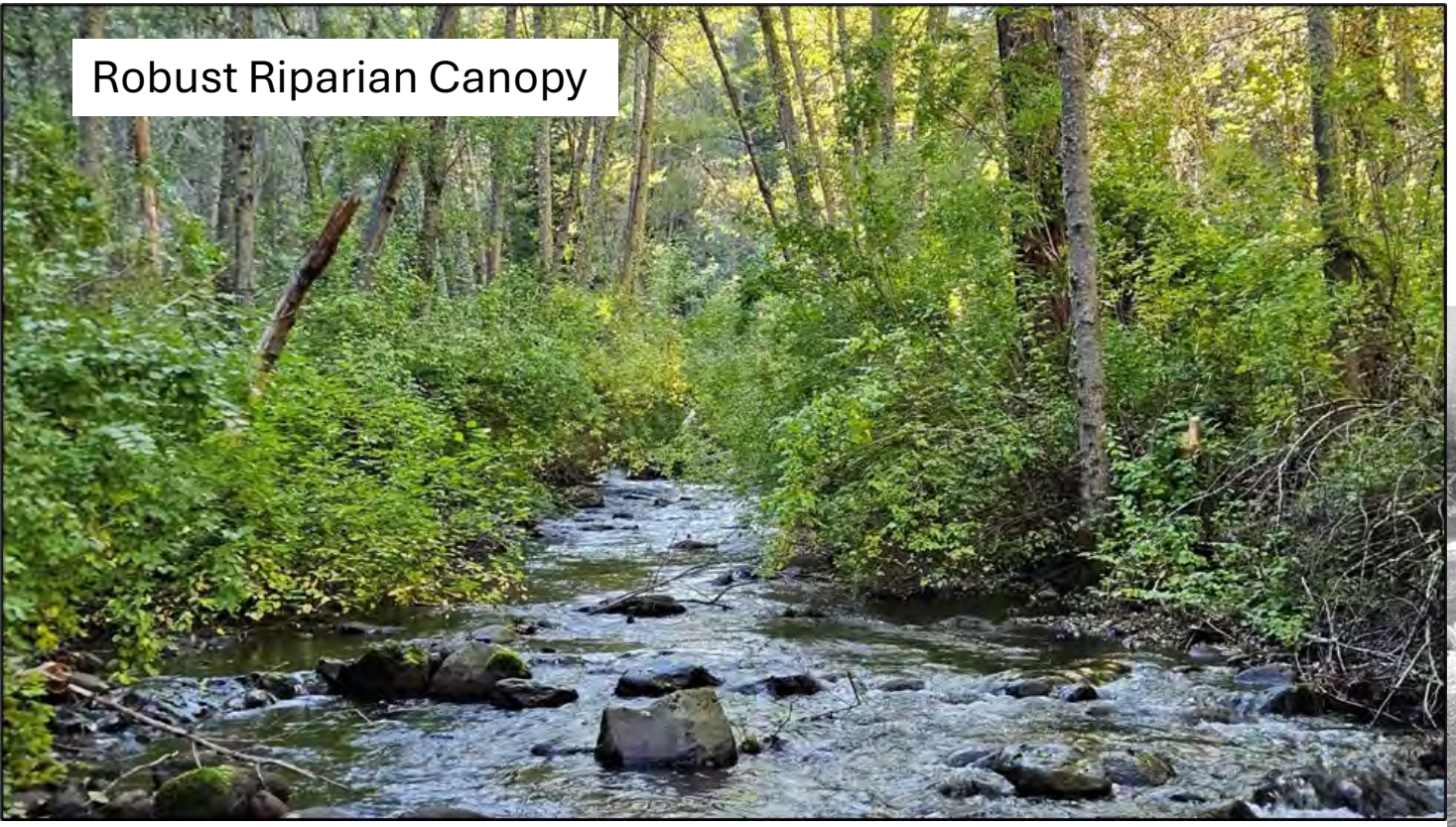
Yurok Tribe

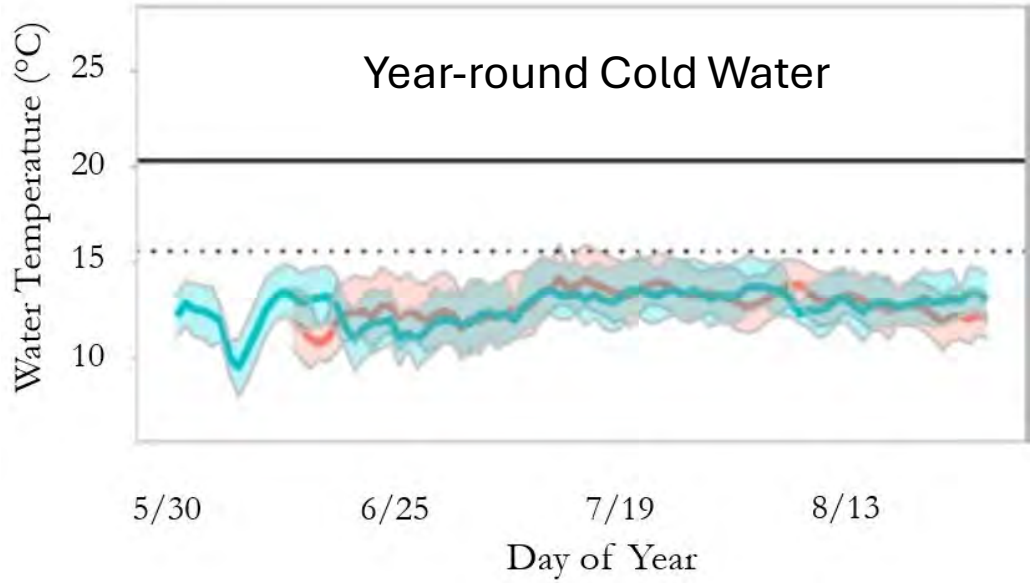
OR/CA Border
Project Work Areas
Major Roads
Watershed Boundary
Klamath River
Primary Channel
Channel Tributary
Water Bodies
Marsh/Wet Meadow
PPL/PacificCorp
Bureau of Land Management
Fish and Wildlife Service
US Forest Service
State
State Department of Forestry
Private Land
N
0 3 6
Miles

Upper Klamath Tributary Post Dam Removal Salmonid Restoration Project

Figure 1-1
Project Locations Map

Shovel Creek Conditions

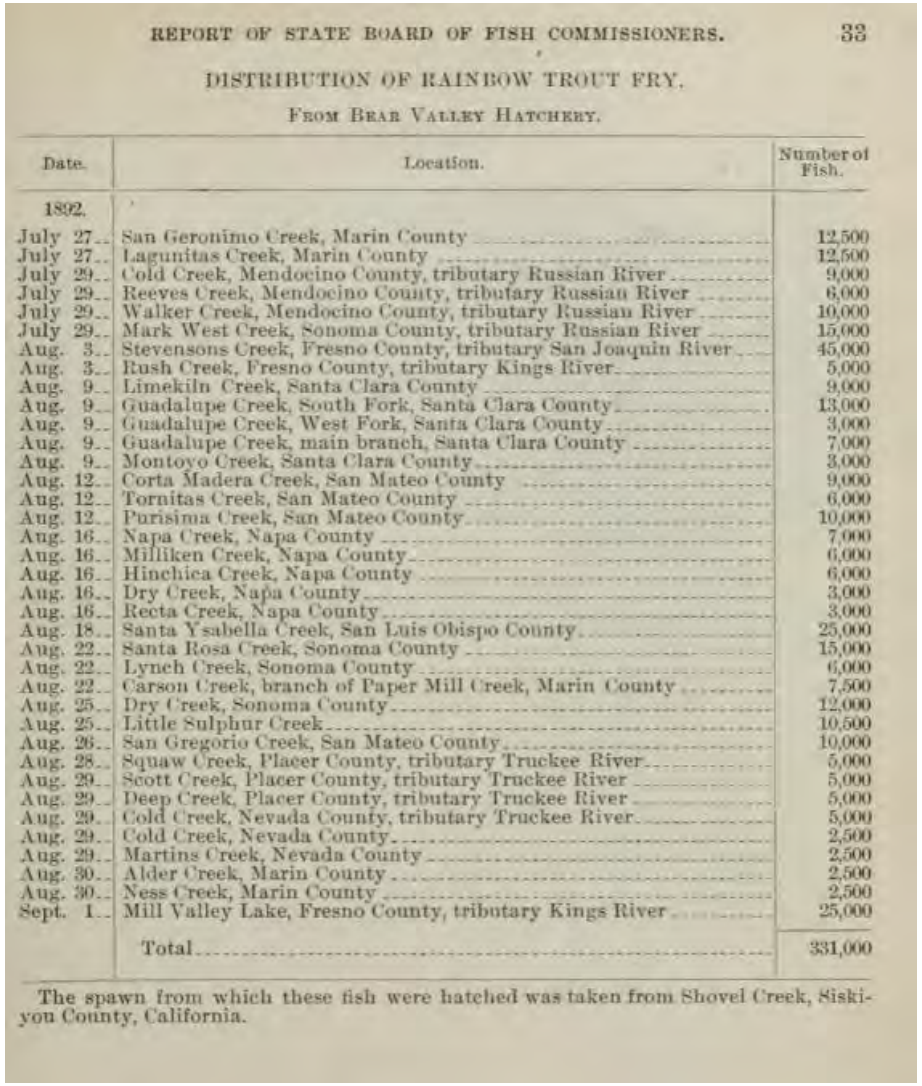




Limiting Factors

Historic Channel Manipulation

Shovel Creek Egg-Taking Facility



REPORT OF STATE BOARD OF FISH COMMISSIONERS. 33

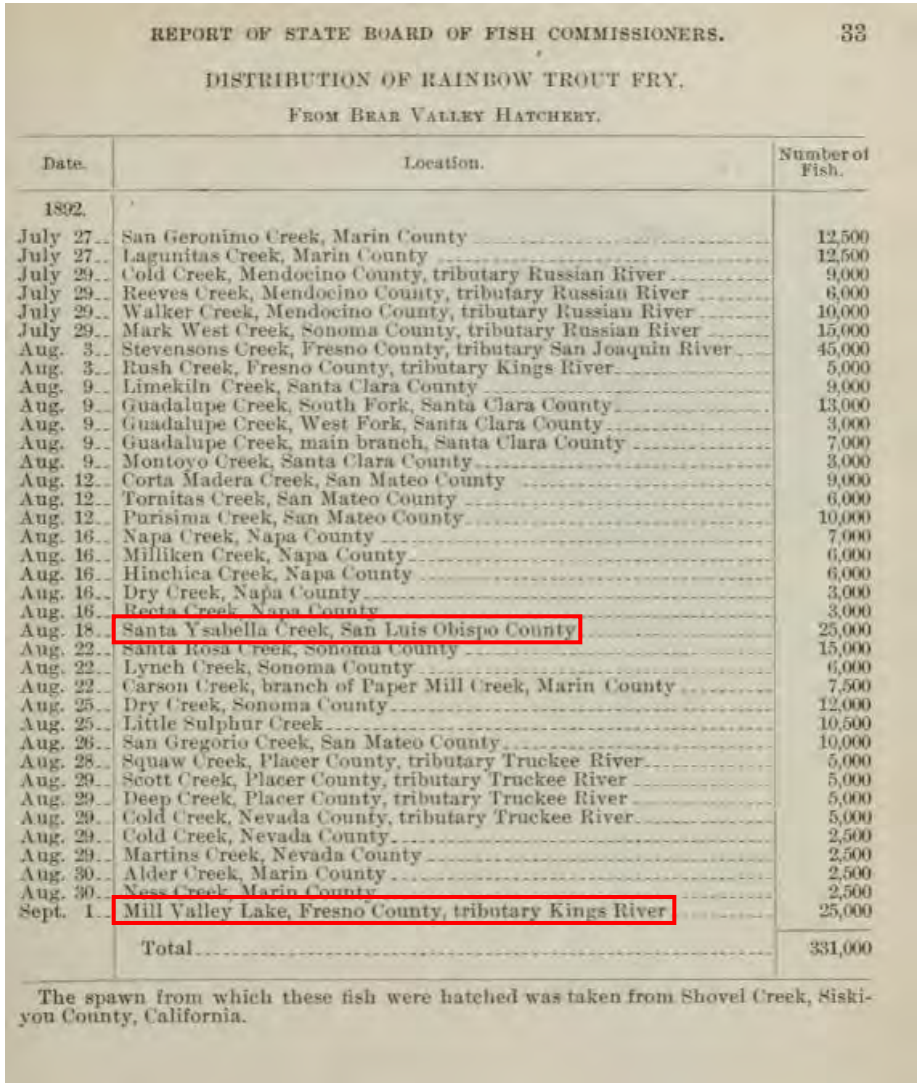
DISTRIBUTION OF RAINBOW TROUT FRY.

FROM BEAR VALLEY HATCHERY.

Date.	Location.	Number of Fish.
1892.		
July 27..	San Geronimo Creek, Marin County	12,500
July 27..	Lagunitas Creek, Marin County	12,500
July 29..	Cold Creek, Mendocino County, tributary Russian River	9,000
July 29..	Reeves Creek, Mendocino County, tributary Russian River	6,000
July 29..	Walker Creek, Mendocino County, tributary Russian River	10,000
July 29..	Mark West Creek, Sonoma County, tributary Russian River	15,000
Aug. 3..	Stevensons Creek, Fresno County, tributary San Joaquin River	45,000
Aug. 3..	Rush Creek, Fresno County, tributary Kings River	5,000
Aug. 9..	Limekiln Creek, Santa Clara County	9,000
Aug. 9..	Guadalupe Creek, South Fork, Santa Clara County	13,000
Aug. 9..	Guadalupe Creek, West Fork, Santa Clara County	3,000
Aug. 9..	Guadalupe Creek, main branch, Santa Clara County	7,000
Aug. 9..	Montoyo Creek, Santa Clara County	3,000
Aug. 12..	Corta Madera Creek, San Mateo County	9,000
Aug. 12..	Tornitas Creek, San Mateo County	6,000
Aug. 12..	Purisima Creek, San Mateo County	10,000
Aug. 16..	Napa Creek, Napa County	7,000
Aug. 16..	Milliken Creek, Napa County	6,000
Aug. 16..	Hinchica Creek, Napa County	6,000
Aug. 16..	Dry Creek, Napa County	3,000
Aug. 16..	Recta Creek, Napa County	3,000
Aug. 18..	Santa Ysabella Creek, San Luis Obispo County	25,000
Aug. 22..	Santa Rosa Creek, Sonoma County	15,000
Aug. 22..	Lynch Creek, Sonoma County	6,000
Aug. 22..	Carson Creek, branch of Paper Mill Creek, Marin County	7,500
Aug. 25..	Dry Creek, Sonoma County	12,000
Aug. 25..	Little Sulphur Creek	10,500
Aug. 26..	San Gregorio Creek, San Mateo County	10,000
Aug. 28..	Squaw Creek, Placer County, tributary Truckee River	5,000
Aug. 29..	Scott Creek, Placer County, tributary Truckee River	5,000
Aug. 29..	Deep Creek, Placer County, tributary Truckee River	5,000
Aug. 29..	Cold Creek, Nevada County, tributary Truckee River	5,000
Aug. 29..	Cold Creek, Nevada County	2,500
Aug. 29..	Martins Creek, Nevada County	2,500
Aug. 30..	Alder Creek, Marin County	2,500
Aug. 30..	Ness Creek, Marin County	2,500
Sept. 1..	Mill Valley Lake, Fresno County, tributary Kings River	25,000
	Total	331,000

The spawn from which these fish were hatched was taken from Shovel Creek, Siskiyou County, California.

Shovel Creek Egg-Taking Facility



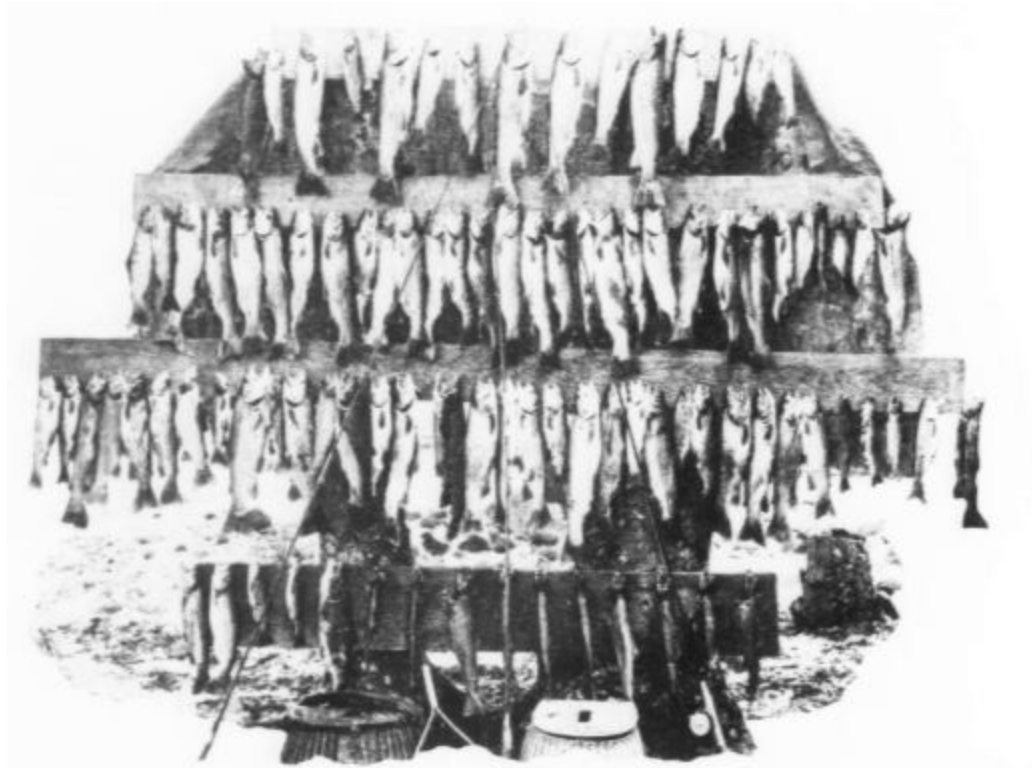
REPORT OF STATE BOARD OF FISH COMMISSIONERS. 33

DISTRIBUTION OF RAINBOW TROUT FRY.

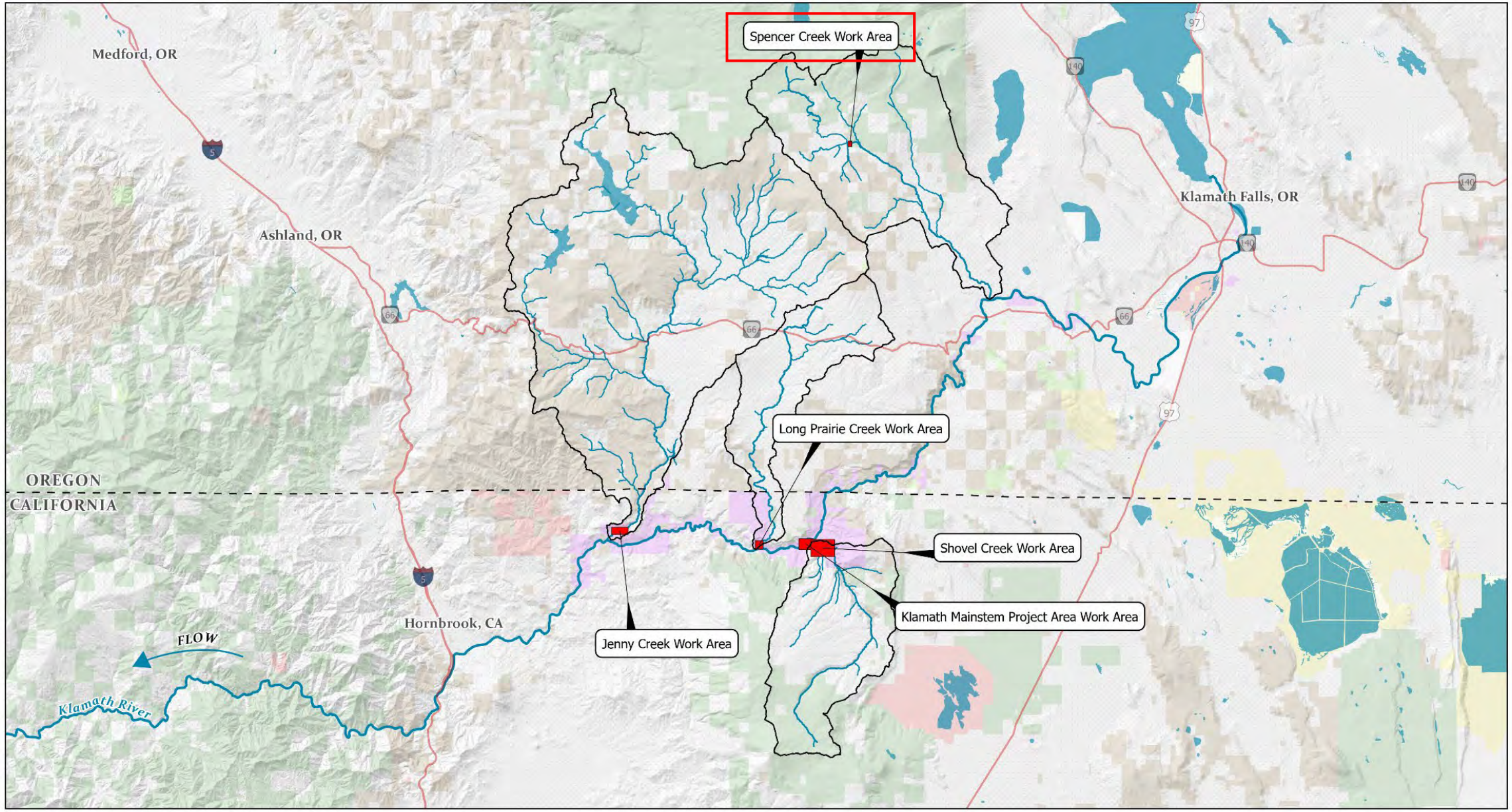
FROM BEAR VALLEY HATCHERY.

Date.	Location.	Number of Fish.
1892.		
July 27..	San Geronimo Creek, Marin County	12,500
July 27..	Lagunitas Creek, Marin County	12,500
July 29..	Cold Creek, Mendocino County, tributary Russian River	9,000
July 29..	Reeves Creek, Mendocino County, tributary Russian River	6,000
July 29..	Walker Creek, Mendocino County, tributary Russian River	10,000
July 29..	Mark West Creek, Sonoma County, tributary Russian River	15,000
Aug. 3..	Stevensons Creek, Fresno County, tributary San Joaquin River	45,000
Aug. 3..	Rush Creek, Fresno County, tributary Kings River	5,000
Aug. 9..	Limekiln Creek, Santa Clara County	9,000
Aug. 9..	Guadalupe Creek, South Fork, Santa Clara County	13,000
Aug. 9..	Guadalupe Creek, West Fork, Santa Clara County	3,000
Aug. 9..	Guadalupe Creek, main branch, Santa Clara County	7,000
Aug. 9..	Montoyo Creek, Santa Clara County	3,000
Aug. 12..	Corta Madera Creek, San Mateo County	9,000
Aug. 12..	Tornitas Creek, San Mateo County	6,000
Aug. 12..	Purisima Creek, San Mateo County	10,000
Aug. 16..	Napa Creek, Napa County	7,000
Aug. 16..	Milliken Creek, Napa County	6,000
Aug. 16..	Hinchica Creek, Napa County	6,000
Aug. 16..	Dry Creek, Napa County	3,000
Aug. 16..	Recta Creek, Napa County	3,000
Aug. 18..	Santa Ysabella Creek, San Luis Obispo County	25,000
Aug. 22..	Santa Rosa Creek, Sonoma County	15,000
Aug. 22..	Lynch Creek, Sonoma County	6,000
Aug. 22..	Carson Creek, branch of Paper Mill Creek, Marin County	7,500
Aug. 25..	Dry Creek, Sonoma County	12,000
Aug. 25..	Little Sulphur Creek	10,500
Aug. 26..	San Gregorio Creek, San Mateo County	10,000
Aug. 28..	Squaw Creek, Placer County, tributary Truckee River	5,000
Aug. 29..	Scott Creek, Placer County, tributary Truckee River	5,000
Aug. 29..	Deep Creek, Placer County, tributary Truckee River	5,000
Aug. 29..	Cold Creek, Nevada County, tributary Truckee River	5,000
Aug. 29..	Cold Creek, Nevada County	2,500
Aug. 29..	Martins Creek, Nevada County	2,500
Aug. 30..	Alder Creek, Marin County	2,500
Aug. 30..	Ness Creek, Marin County	2,500
Sept. 1..	Mill Valley Lake, Fresno County, tributary Kings River	25,000
	Total	331,000

The spawn from which these fish were hatched was taken from Shovel Creek, Siskiyou County, California.



One hundred and thirty-two beauties caught by eight of the party



Datums:
Horizontal: NAD 1983 (2011) StatePlane California I FIPS 0401 (US Feet)
Vertical: NAVD88

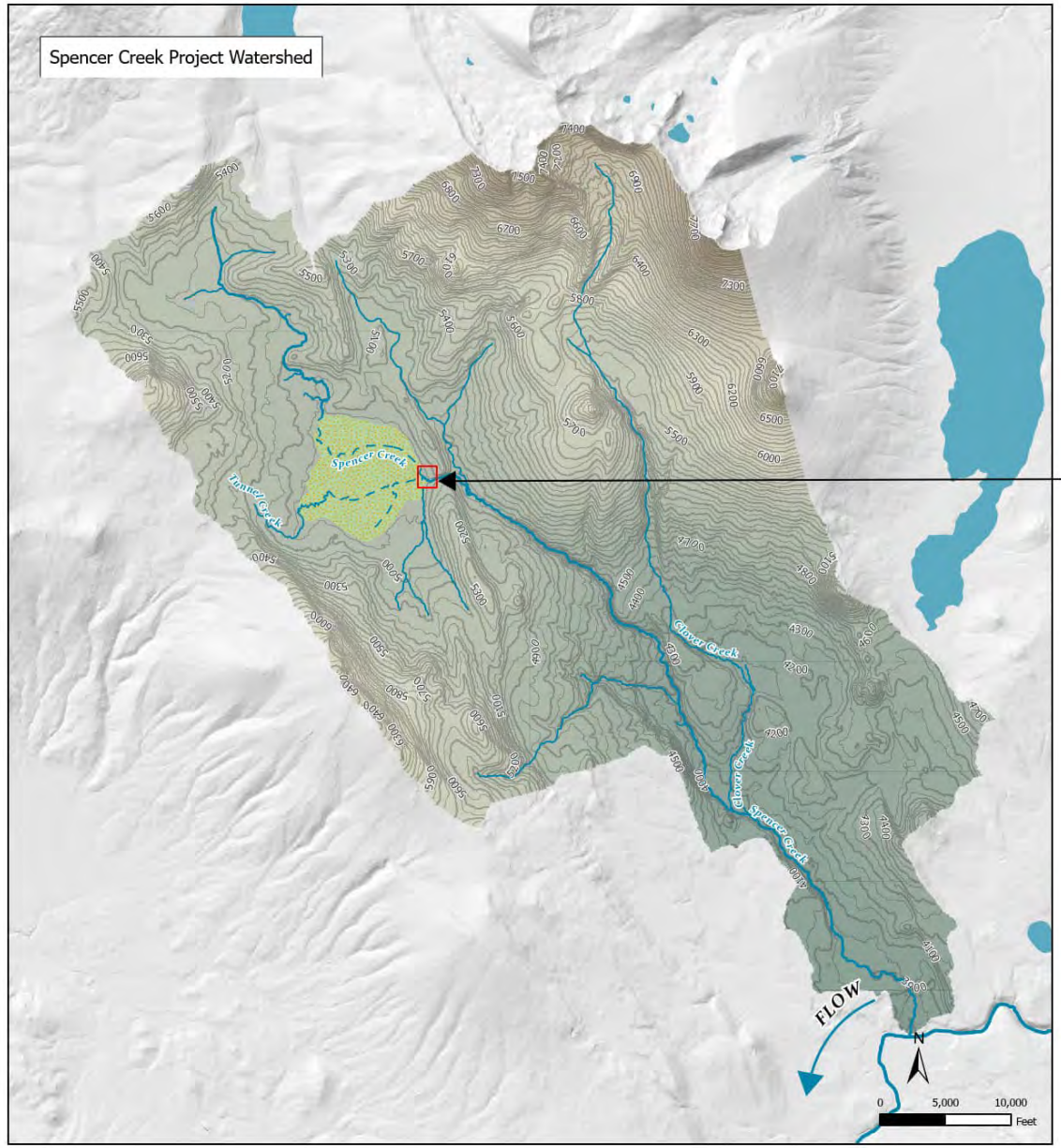
Sources:
USGS, BLM, TIGER

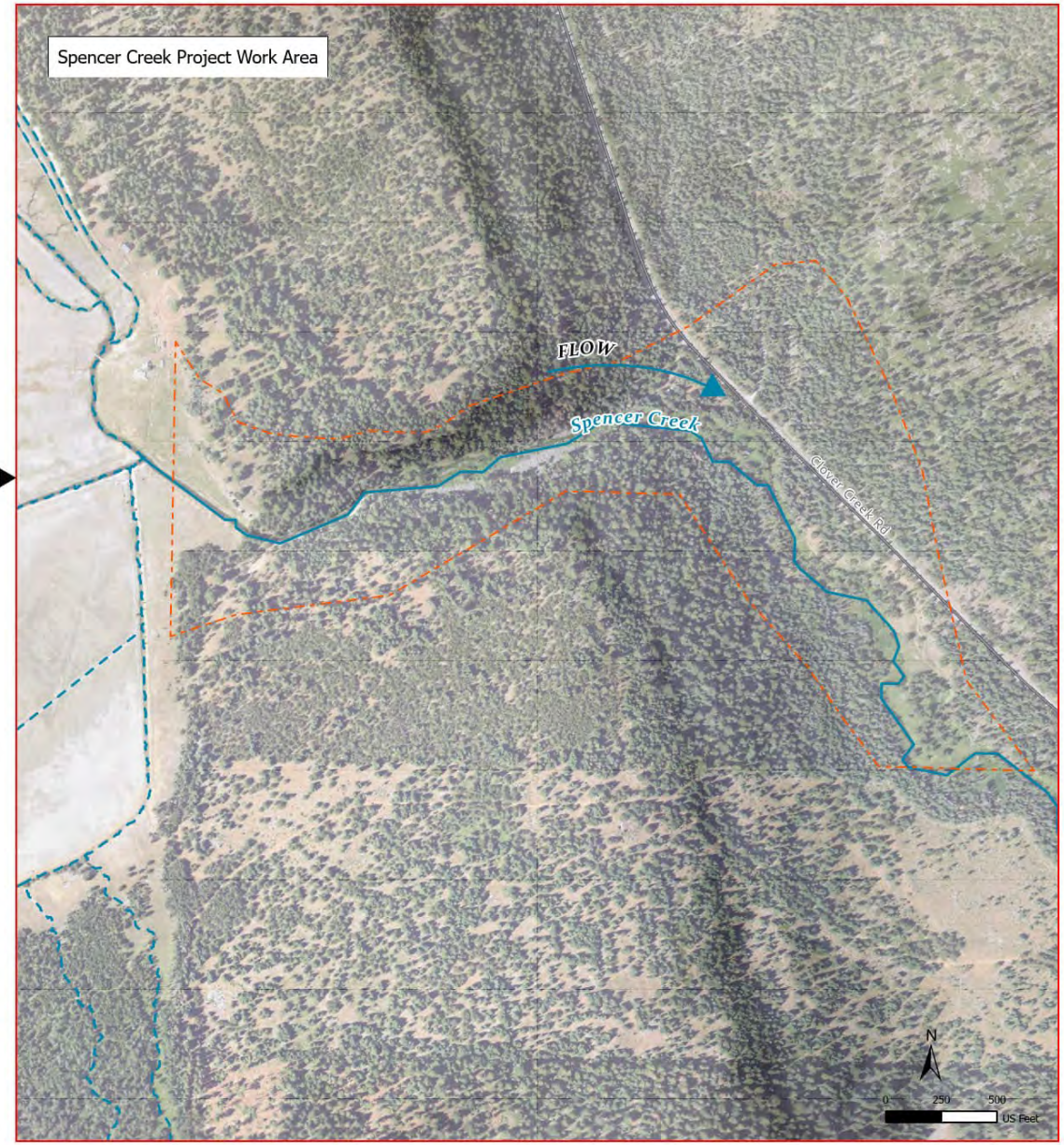
Yurok Tribe

OR/CA Border
Project Work Areas
Major Roads
Watershed Boundary
Klamath River
Primary Channel
Channel Tributary
Water Bodies
Marsh/Wet Meadow
PPL/PacificCorp
Bureau of Land Management
Fish and Wildlife Service
US Forest Service
State
State Department of Forestry
Private Land
N
0 3 6
Miles

Upper Klamath Tributary Post Dam Removal Salmonid Restoration Project

Figure 1-1
Project Locations Map





Datums:
Horizontal: NAD 1983 (2011) StatePlane Oregon South 3602 FIPS (Intl Feet)
Vertical: NAVD88

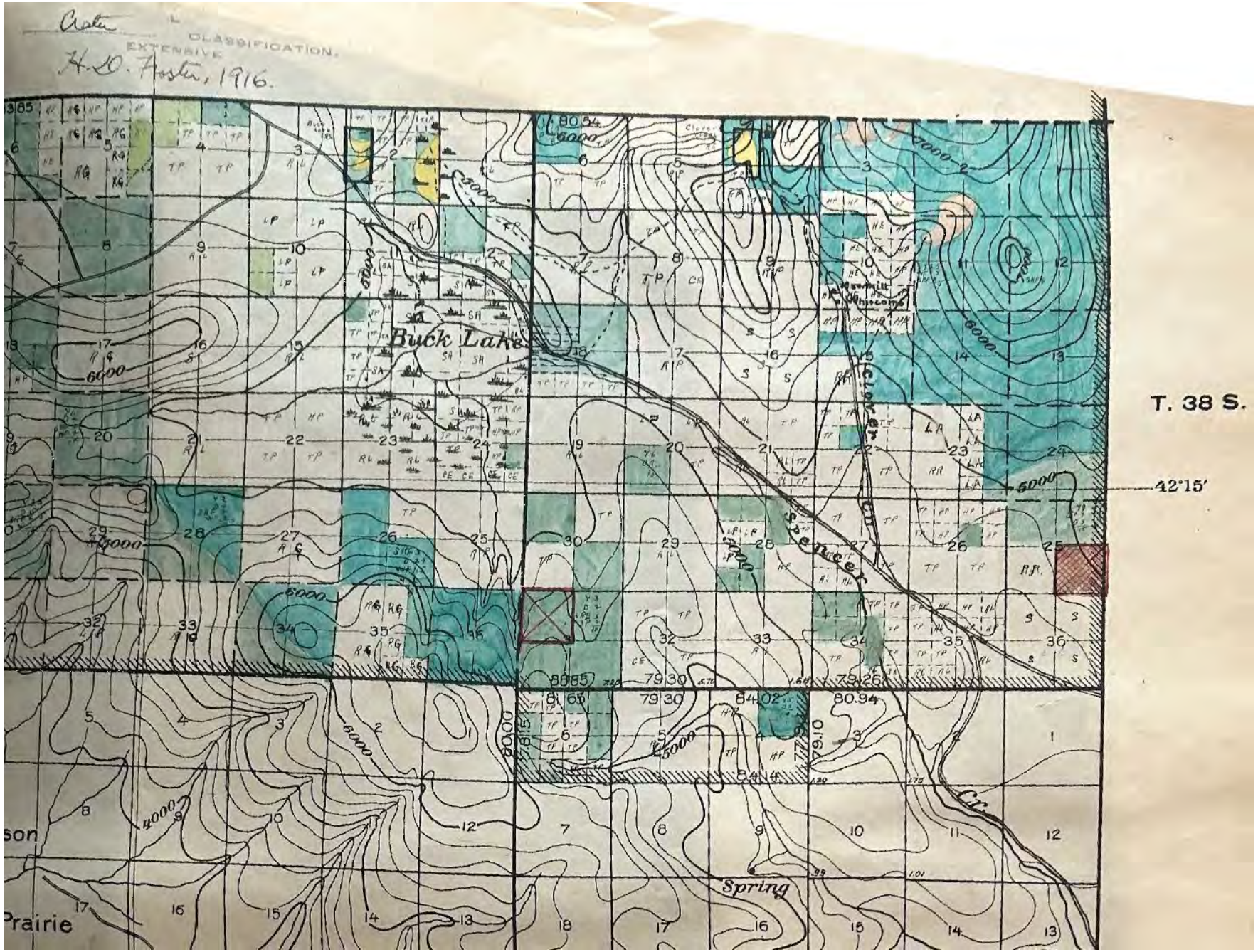
Sources:
USGS, TIGER, Yurok Tribe LiDAR

Spencer Creek watershed Area (left) and Spencer Creek project work area (right).

Project Work Area
Klamath River
Primary Channel
Channel Tributary
Canal
Water Bodies
Buck Lake Irrigation Complex
Contour Interval
100 ft
50 ft

Upper Klamath Tributary Post Dam Removal Salmonid Restoration Project

Figure 6-1
Spencer Creek Project Watershed and Work Area


CLASSIFICATION.
EXTENSIVE
H. O. Foster, 1916.
Buck Lake
Spring
Prairie
T. 38 S.
42°15'

POSTED
NO TRESPASSING
KEEP OUT

Project Task / Project Phase	Task Deliverable	Approx. Milestone Date
Data Collection and Analysis Phase	Updated lidar and Aerial Imagery of Project Site. Ground water analysis, Geological Investigations, Piezometer Installation, Flow Measurements, etc.	Start = October 2024 Finalize = December 2027
Existing Conditions Investigations	Existing conditions hydrograph construction and hydraulic modeling. Existing infrastructure investigation and ecosystem limitations	Start = October 2024 Finalize = June 2027
Conceptual Design – Alternative Analysis Phase	Development of Conceptual Designs and Alternative Analysis for Habitat Restoration and Infrastructure Improvement Components	Start = October 2024 Finalize = January 2026
Concept Design Review	Agency/Stakeholder review and approval	February 2026
30% Design Phase	Development of 30% Designs with Engineering Analysis, Hydraulic Modeling, Basis of Design Report with Drawings for Habitat Restoration and Infrastructure Improvement Components (Approval and Concurrence with Internal Partners and Local Stakeholders)	Start = February 2026 Finalize = May 2026
30% Design Phase Review	Agency/Stakeholder review and approval	June 2026
Environmental Compliance Phase	Using 30% Design Information – Development of CEQA/NEPA Approvals with State and Federal Agencies; Includes all associated Permits and Approvals for Construction	Start = June 2026 Finalize = April 2027
60% Design Phase	Development of 60% Designs with Engineering Analysis, Hydraulic Modeling, Basis of Design Report with Drawings for Habitat Restoration and Infrastructure Improvement Components (Approval and Concurrence with Internal Partners and Local Stakeholders)	Start = July 2026 Finalize = September 2026
60% Design Phase Review	Agency/Stakeholder review and approval	October 2026
90% Design phase (Note: Final 10% Design is Completed During Construction)	Finalize all Design Components to the 90% Level for Construction Operations: (Approval and Concurrence with Internal Partners and Local Stakeholders)	Start = November 2026 Finalize = February 2027
90% Design Phase Review	Agency/Stakeholder Final Plan Review and Approval	February 2027
Construction Operations Phase	Implement all Habitat Restoration and Infrastructure Improvement Components	Start = May 2027 End = August 2028
As-Built Documentation and Report Development Phase	Final As-Built Data Collection Documentation Phase – Including Final Reporting and Invoicing Submissions	Start = November 2027 End = August 2028

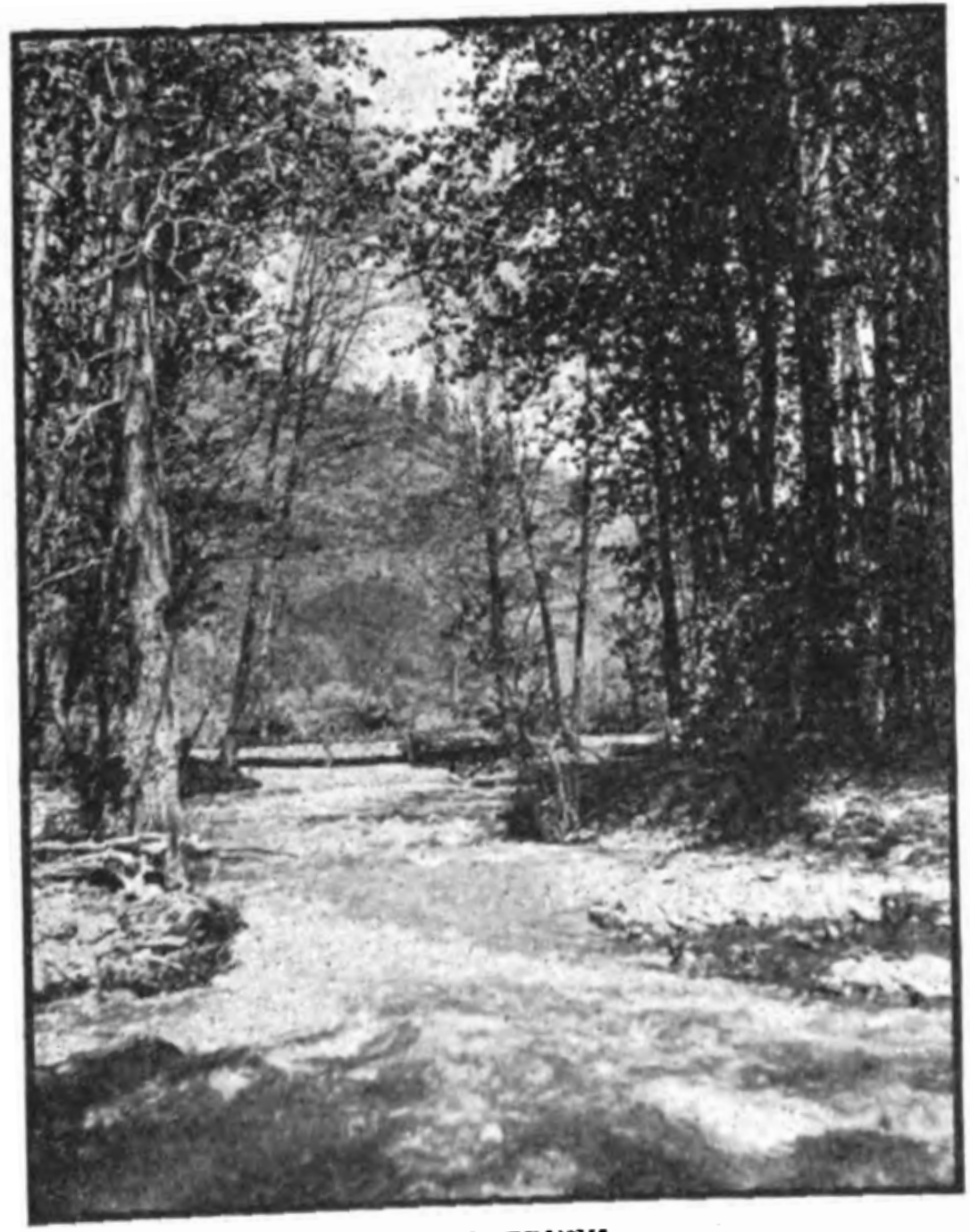
Special Thanks

Sami Jo Difuntorum
James Sarmento
Vanessa Castle
Molli Meyers
Jeff Mitchell
DJ Bandrowski
Bob Pagliuco
Ken Sandusky
Evan Bulla
Nell Scott
Shahnie Rich
Leaf Hillman
Jennifer Chenoweth
Josh Chenoweth
Frankie Meyers

And everyone working towards restoring the Klamath Basin!

Bull River Ranch

Fishing a famous riffle in Shovel Creek.



Cummins, Photo. SHOVEL CREEK.

—women may here comfortably engage in this most exhilarating sport

DR. FILBEN DARES IMMERSION *Our host, the mascot of the party*

A FISHING TOURNEY. DR. EVANS AND ROLLO V. WATT IN THE LEAD DOWN STREAM

FISHING FOR THE FAMILY BREAKFAST

How Best to Remove a Fish Passage Barrier
-Blast or No Blast-

Jenny Creek Barrier Removal Project

KLAMATH RIVER RENEWAL CORPORATION

res

Background/History

-Built in the 1960's for a nearby campground
-Blocks 1 mile of anadromous habitat
-CDFW Passage Assessment Number 764931
-Klamath Reservoir Reach Restoration Prioritization Plan
-Started Fundraising in 2023
-Exciting Times

Secured Funding with State and Federal Partners

- United States Fish and Wildlife Service X2
- California Department of Fish and Wildlife
- Pacific States Marine Fisheries Commission
- California Fish Passage Forum

Contracted with Resource Environmental Solutions for Project Design

- Develop the Jenny Creek Barrier Removal Approach Memorandum

-Jenny Creek Watershed Overview

-210 Square Miles

-22.8 Miles of Stream Length

-Step-Pool Bedforms

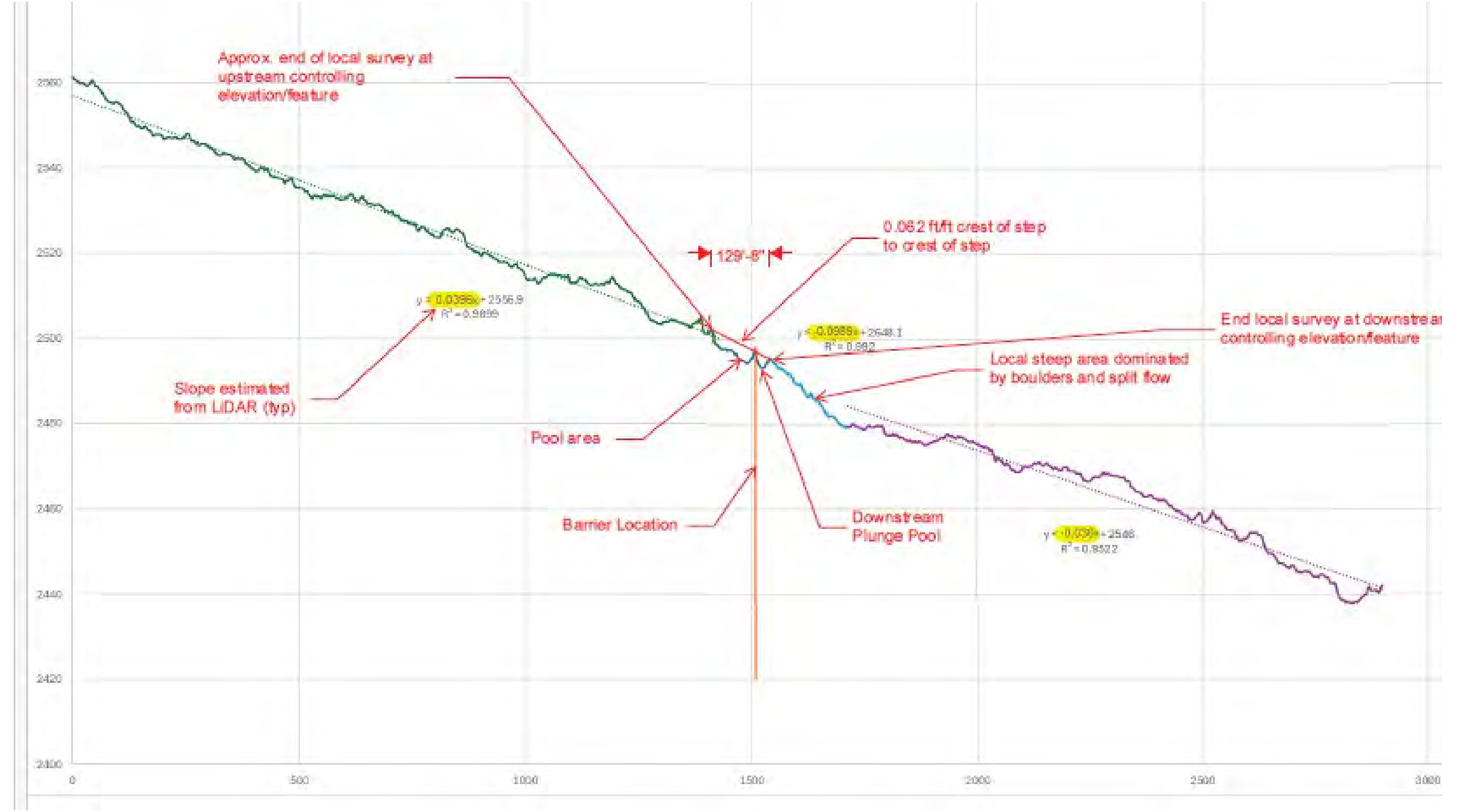
-Jenny Creek Falls Located Above the Barrier

-Flow Influenced by Howard Prairie Reservoir

-Rogue River Irrigation Project Diverts 30% of Flows

-Transfer 16.5 cfs from Spring Creek (a tributary of Jenny Creek) to Fall Creek

-Monthly Average Flows Range from 15-300 cfs


Approx. end of local survey at upstream controlling elevation/feature
129'-6"
0.062 ft/ft crest of step to crest of step
End local survey at downstrea controlling elevation/feature
Local steep area dominated by boulders and split flow
Slope estimated from LiDAR (typ)
Pool area
Barrier Location
Downstream Plunge Pool
2560
2540
2520
2500
2480
2460
2440
2420
2400
0
500
1000
1500
2000
2500
3000

JENNY CREEK BARRIER REMOVAL - PHASE 1

ALTERNATIVE 1

REVISIONS

res

JENNY CREEK BARRIER REMOVAL - PHASE 1

ALTERNATIVE 2

REVISIONS

GRAPHIC SCALE: 1" = 20'

0 20 40 60

SOURCE: AERIAL IMAGE COURTESY OF RES, LLC DRONE FLIGHT ON MARCH 21, 2024

res

RES, LLC, A RES COMPANY
2120 I 6TH STREET, SUITE 200 SACRAMENTO, CA 95818
P: 916.363.6017
WWW.RES.US

JENNY CREEK BARRIER REMOVAL - PHASE 1

ALTERNATIVE 3

REVISIONS

Primary Barrier Removal Approach

- Divert water out of the channel during construction
- Manual labor using jackhammers, grinders, and other hand tools to break up and remove the concrete
- 6-weeks for the construction
- Increased project cost due to increased labor time
- Could not be completed within the in-water work period in 2025

Secondary Barrier Removal Approach

- Explosives to break up the concrete
- Manual labor to remove the concrete
- Concrete debris will enter Jenny Creek
- Temporary water quality impacts due to concrete rubble entering Jenny Creek
- 2-weeks for the construction
- Decreased project costs
- Could be completed during the in-water work period in 2025

Develop the Design with Permitting and Tribal Consultation

- Multiple Site Visits and Meetings to Refine the Design
- Build Trust With Partners

- California Department of Fish and Wildlife
- United States Fish and Wildlife Service
- Yurok Tribe
- Shasta Indian Nation
- National Oceanic and Atmospheric Administration
- State Water Resources Control Board

CDFW Cutting the Green Tape

- Habitat Restoration and Enhancement Act

➢Small Habitat Restoration Project

-Less Than 5 Acres

-Less Than 500 Linear Feet

-Streamlined Permitting

➢General 401 Water Quality Certification

➢CEQA Compliance for Notice of Exemption

➢Section 106, National Historic Preservation Act

➢Section 7, Endangered Species Act

➢U.S. Army Corps of Engineers Nationwide 27 Permit

Implementation

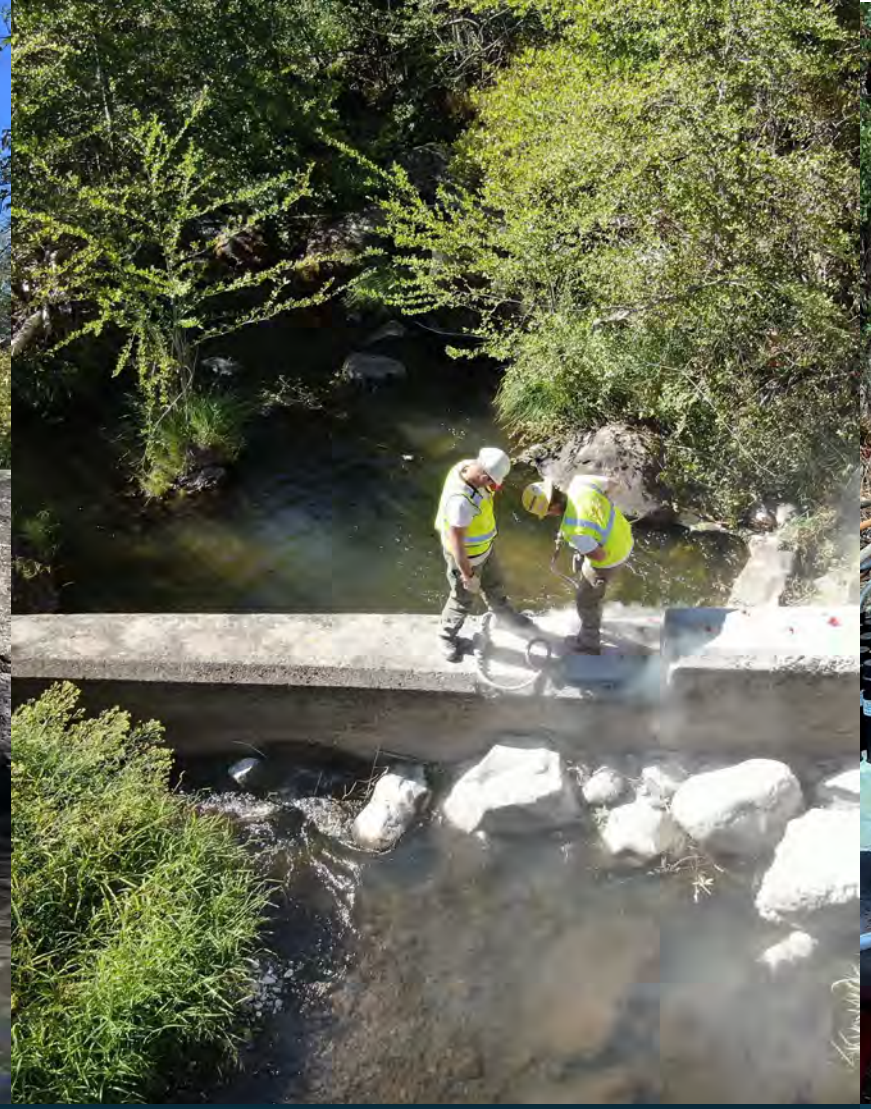
Alternative 2—Full Removal

Secondary Barrier Removal Approach

Explosives and Hand Crews

Jenny Creek Barrier Removal Project

- Construction Began on September 9, 2025
- Improve Road Access for Equipment
- In Water Work Period ends on September 30, 2025



CDFW Habitat Restoration Crew, Yreka, CA
Brought in to remove the dam

Concrete Removal

Question

KLAMATH BASIN FISHERIES COLLABORATIVE

The Collaborative facilitates access to fisheries data among state, federal, tribal, and non-profit organizations within the Klamath Basin.

Mouth of the Klamath River
(photo credit: Thomas Dunklin)

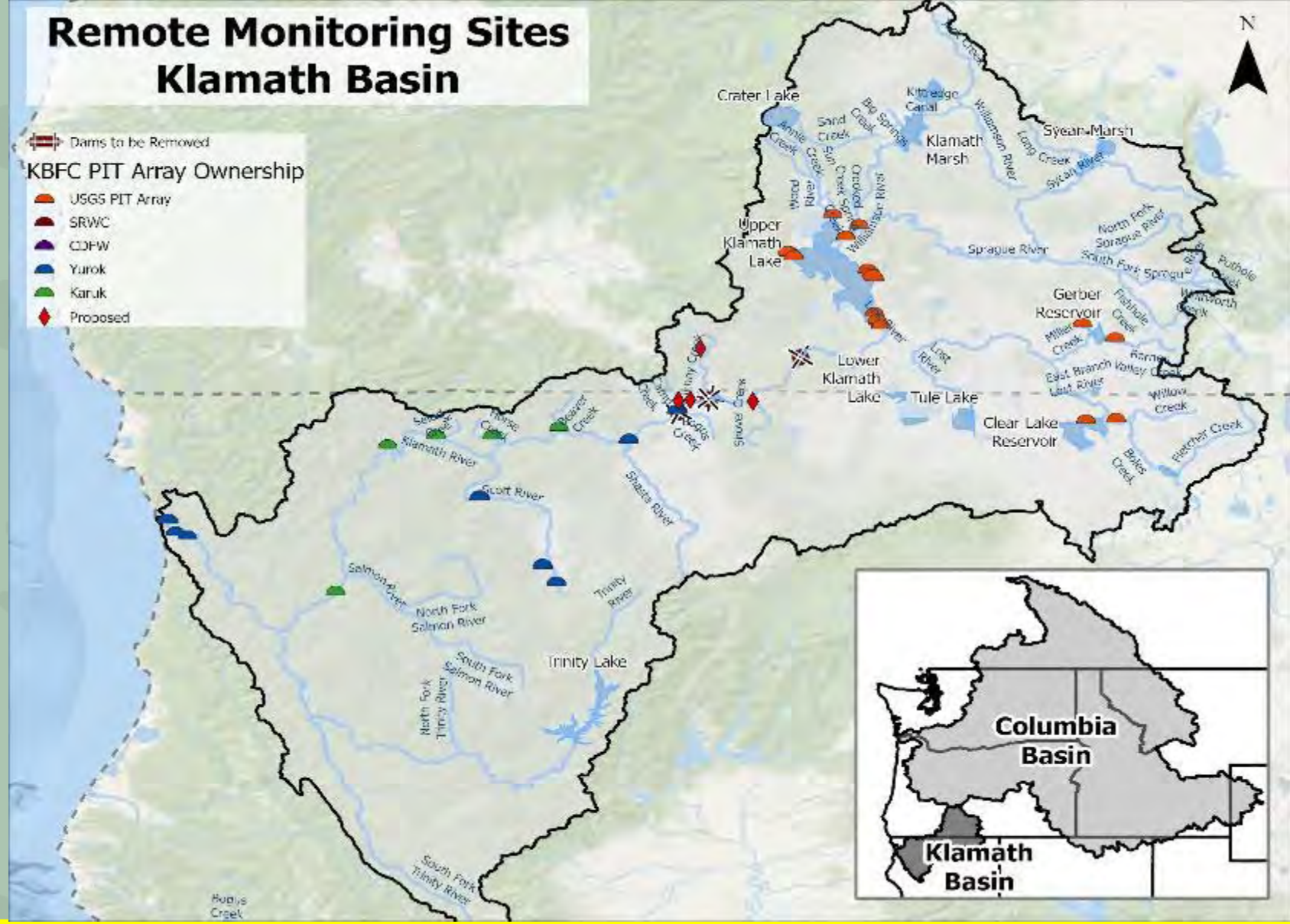
Monica Diaz, PSMFC Project Lead Supporting the KBFC.
KBFC Leadership Team

USGS science for a changing world

Klamath Basin Fisheries Collaborative

Klamath Basin Fisheries Collaborative (KBFC)

- Shared interests
- Dam removal
- PIT tag projects
- Cross-project assessments
- Broad-scale reporting



Klamath Basin Fisheries Collaborative

KBFC Purpose

- Facilitate access to fisheries PIT tag data and associated metadata
- Build a network of collaborators
- Advance research to inform fisheries management and restoration actions

Klamath Basin Fisheries Collaborative

Fostering information sharing and coordination among data collection entities working across the Basin interested in monitoring and evaluating Klamath River Basin restoration efforts.

Leadership Team

Guides the Collaborative

Fosters communication among members

Annual Meeting

Bringing together those using PIT tag technology for fisheries monitoring, research, and management in the Klamath Basin.

Working Groups

Science & Technology: discusses PIT tag detection, tagging efforts, critical questions, and data gaps.

Other groups as needed

KBFC Database

Standardized PIT tag data and associated metadata.

Facilitates data submittal from electronic capture applications.

Participants

Interested participants are welcomed to all meetings and working groups

Members agree to the KBFC Data Sharing Agreement & Operating Guidelines, and have access to the KBFC database

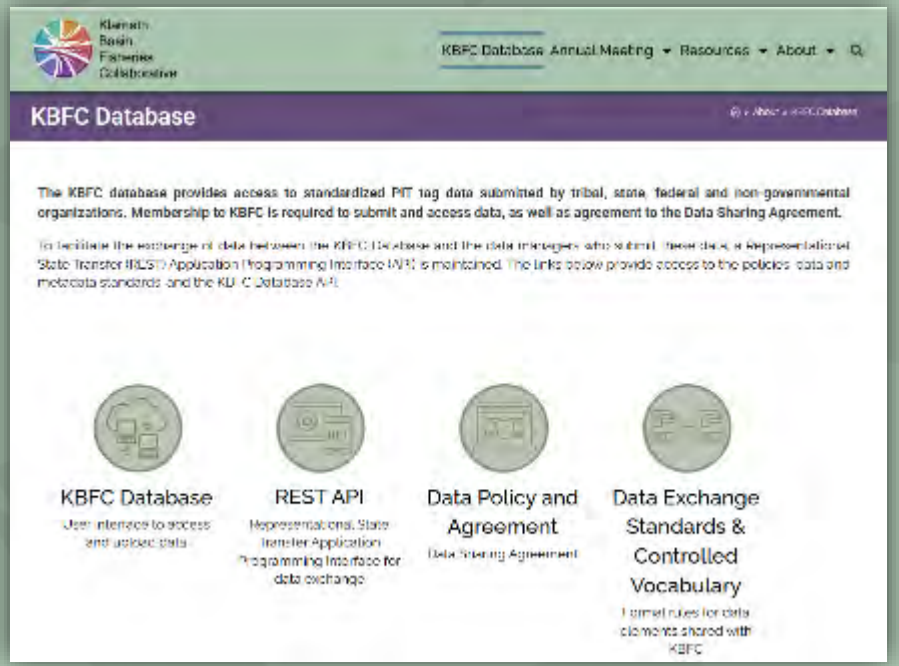
Pacific States Marine Fisheries Commission

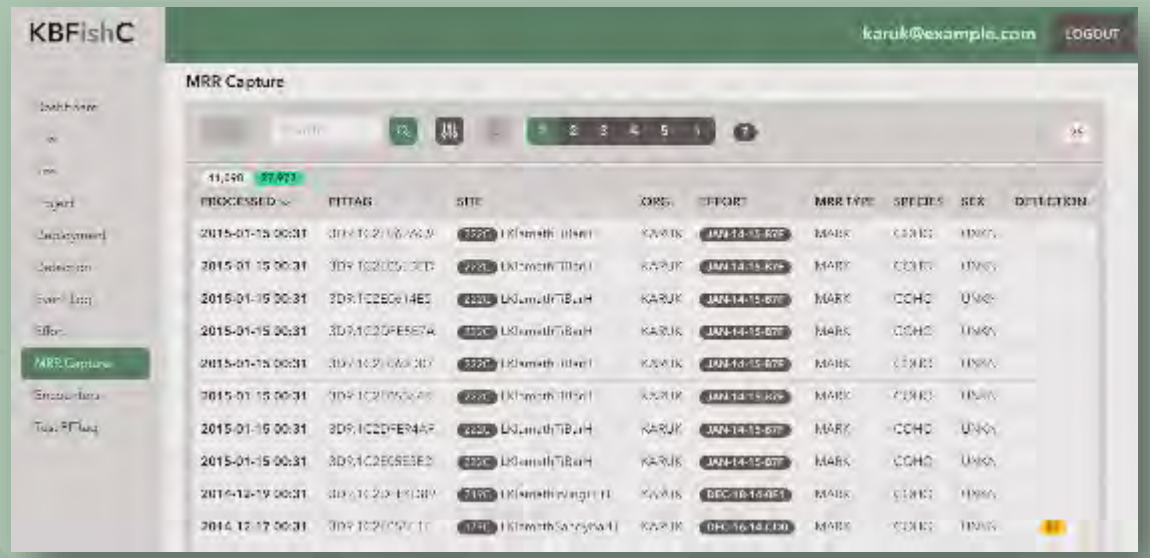
USGS science for a changing world

Klamath Basin Fisheries Collaborative

KBFC Database

- Web-based platform for users to view, input and download data



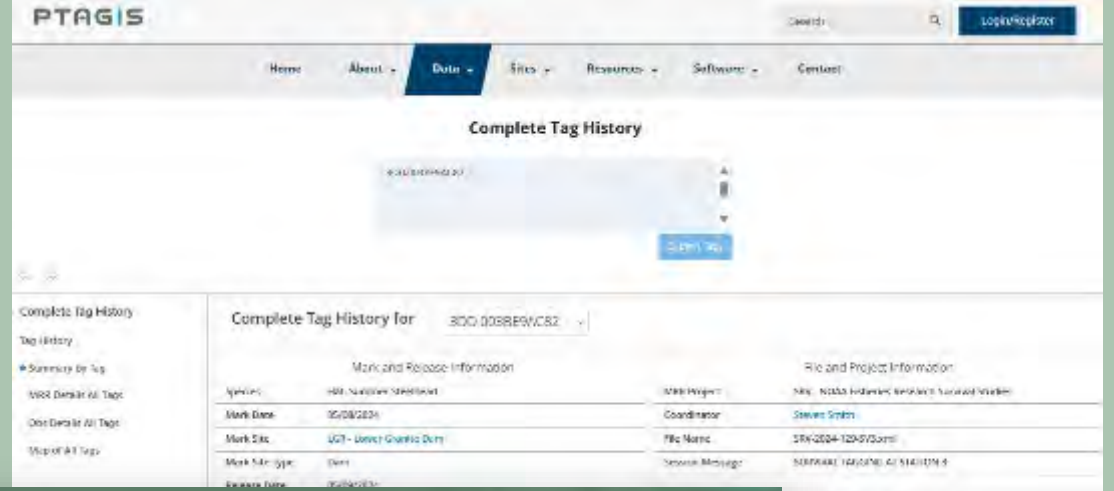


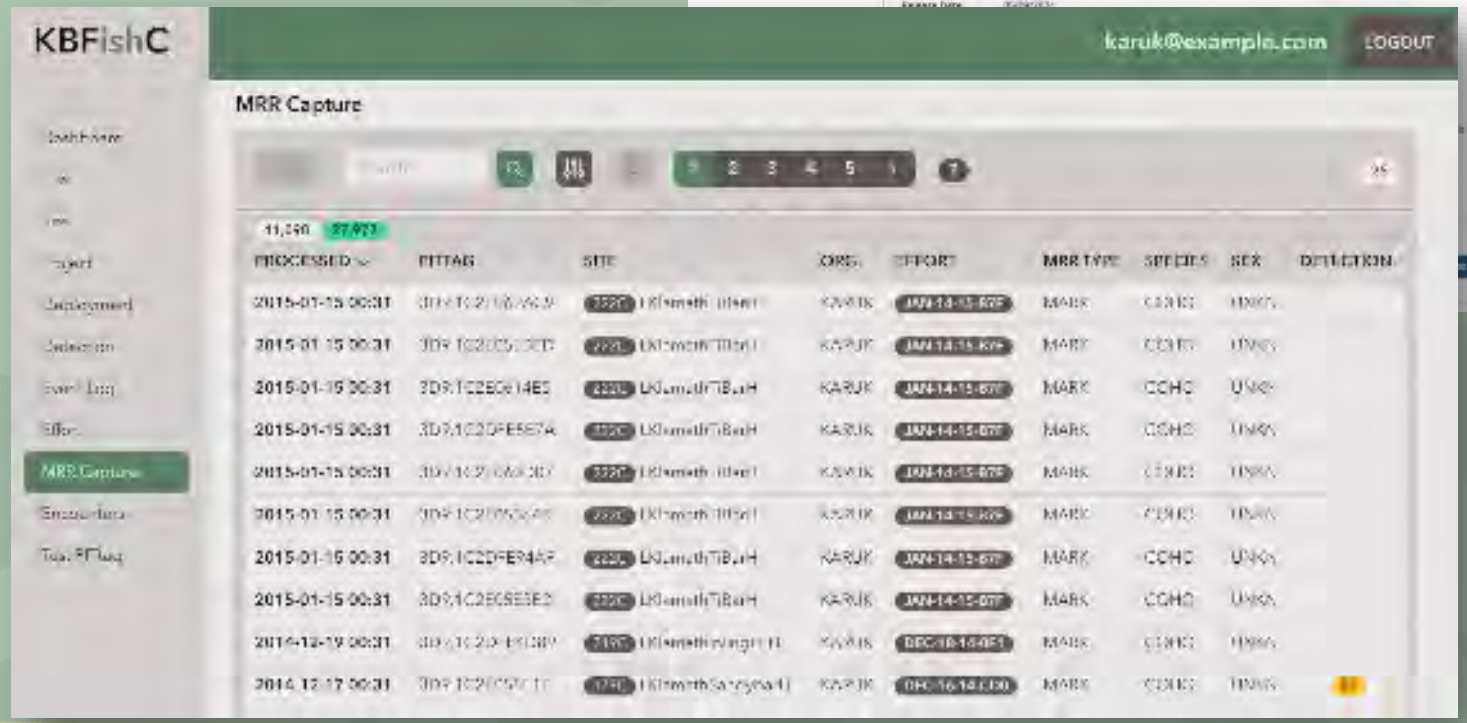
Klamath Basin Fisheries Collaborative

Tag Search History

Captures and Detections

Unknown Tags





Klamath Basin Fisheries Collaborative

Avian Predation

Leavenworth National Fish Hatchery (4/2023) ---> UNKWR- Site N- Northeast (10/2023)

PTAGIS MRR Site Locations: Map (ptagis.org)

Pacific States Marine Fisheries Commission

USGS science for a changing world

Klamath Basin Fisheries Collaborative

Avian Predation

Williamson River Weir (2016/2018/2019) ---> Badger Island (2020)

PTAGIS MRR Avian Colony Locations: Map (ptagis.org)

USGS science for a changing world

Klamath Basin Fisheries Collaborative

Survey123

Survey Form

PIT Tag Reader

SerialMagic Keys Pro

Mark, Recapture, Recovery (MRR)

Remote Deployments

Klamath Basin Fisheries Collaborative

KBFC Database…Moving forward

Finalized the Controlled Vocabulary, Data Sharing Agreement and Data Submission Templates

Data starts to be accessible to KBFC Members

Start process to convert legacy data to current data specifications

Start creating Survey 123 forms.

2024 Aug Nov Dec **2025** Jan

June July Oct **2026** Mar

Test and finalize Survey 123 forms with partners

Survery123 training in the field

Started process to automate data transfer process with some partners using Survey123.

Refinements and updates to the KBFC shared database per Leadership requests

Pacific States Marine Fisheries Commission

USGS science for a changing world

Klamath Basin Fisheries Collaborative

…Moving Forward

Finalized the Controlled Vocabulary, Data Sharing Agreement and Data Submission Templates

Data starts to be accessible to KBFC Members

Start process to convert legacy data to current data specifications

Start creating Survey 123 forms.

2024 Aug Nov Dec **2025** Jan

June July Oct **2026** Mar

Test and finalize Survey 123 forms with partners

Survery123 training in the field

Started process to automate data transfer process with some partners using Survey123.

Refinements and updates to the KBFC shared database per Leadership requests

Email Questions: project@kbfishc.org
Website: https://www.kbfishc.org/

Klamath Basin Fisheries Collaborative

KBFC Database — Listening & Improving

What We Heard

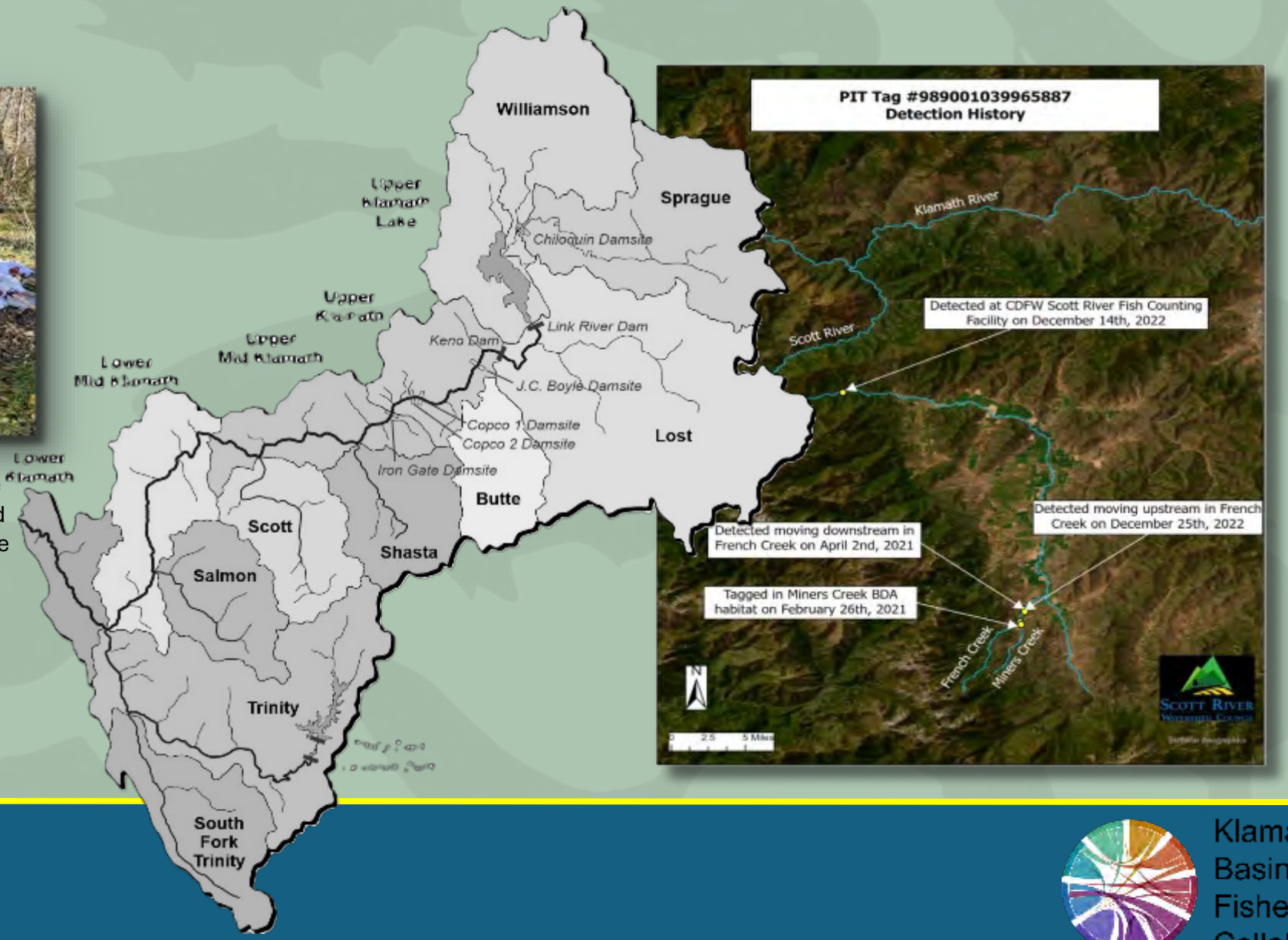
- Leadership meeting sparked key conversations about improving the database to meet member needs
- Members want better access to data and features that make sense for their workflows
- Modernizing the data uploading process moved too fast while members were still learning the system, causing confusion
- Standardizing legacy data at the same time made it unclear what data and which years were in the system
- Personnel and funding constraints made it difficult for partners to standardize their own legacy data

What We're Doing Now

- Streamlining data features to simplify standardized input going into the database
- Simplifying data visibility so members can clearly see what's available
- Adjusting the pace of modernization to match where members are in learning the system
- PSMFC hired dedicated support to lead the legacy data conversion process for partners

Inform Management Across the Klamath Basin

Photo provided by SRWC: Collaborative tagging events with the Pulikla Tribe and Scott River Watershed Council using the KBFC Survey123 forms.



Pacific States Marine Fisheries Commission

USGS science for a changing world

Klamath Basin Fisheries Collaborative

KBFC Leadership

Scott River
Watershed Council

USGS
science for a changing world

KBFC Annual Meeting
May 19th
Klamath Falls, OR

May 20th Leadership Meeting

Klamath Basin Fisheries Collaborative

KBFC Website

Email Questions: project@kbfishc.org

Website: https://www.kbfishc.org/

Klamath Basin Fisheries Collaborative