Napa River Fish Monitoring

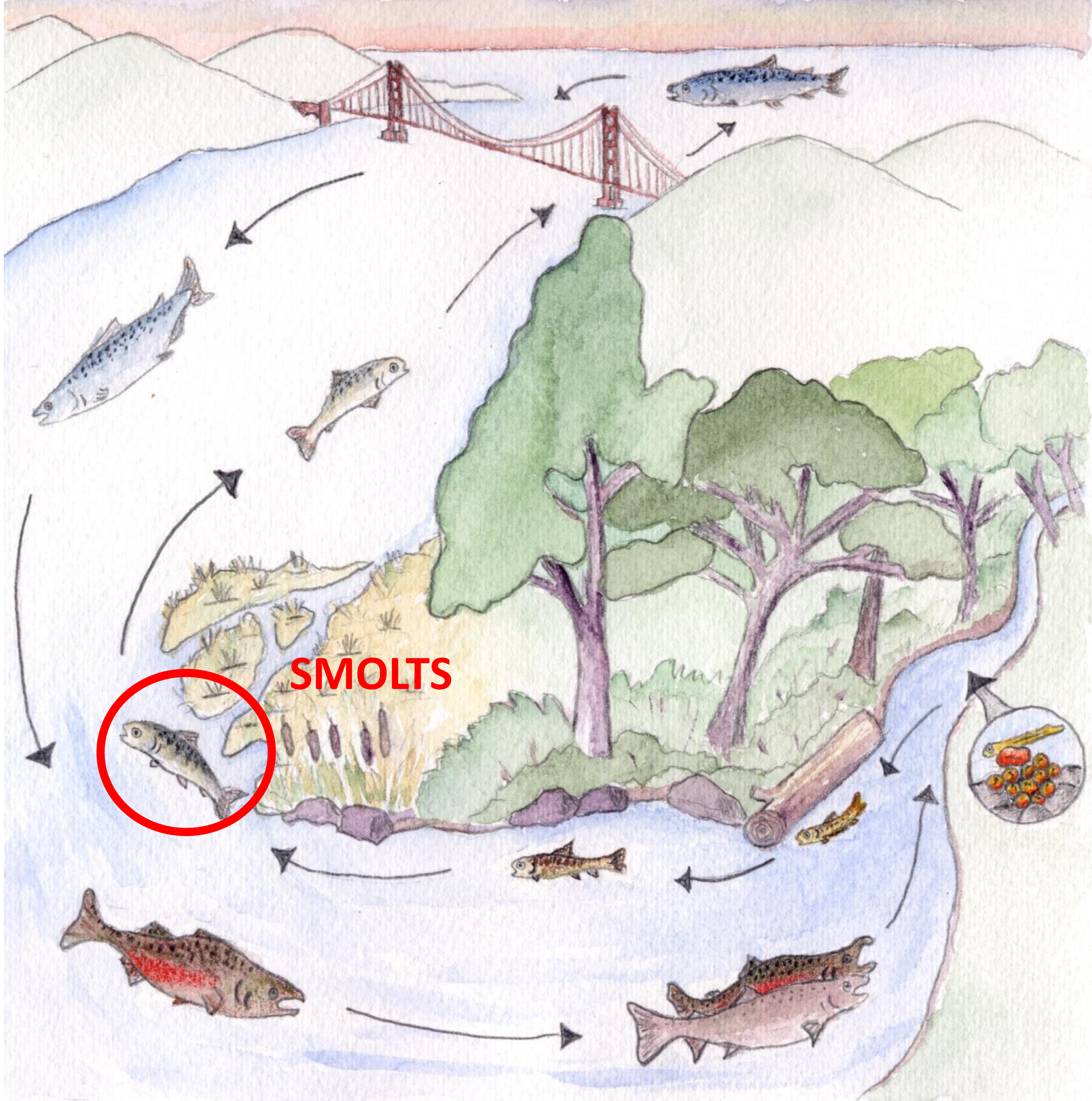
Martin Perales

Napa Resource Conservation District

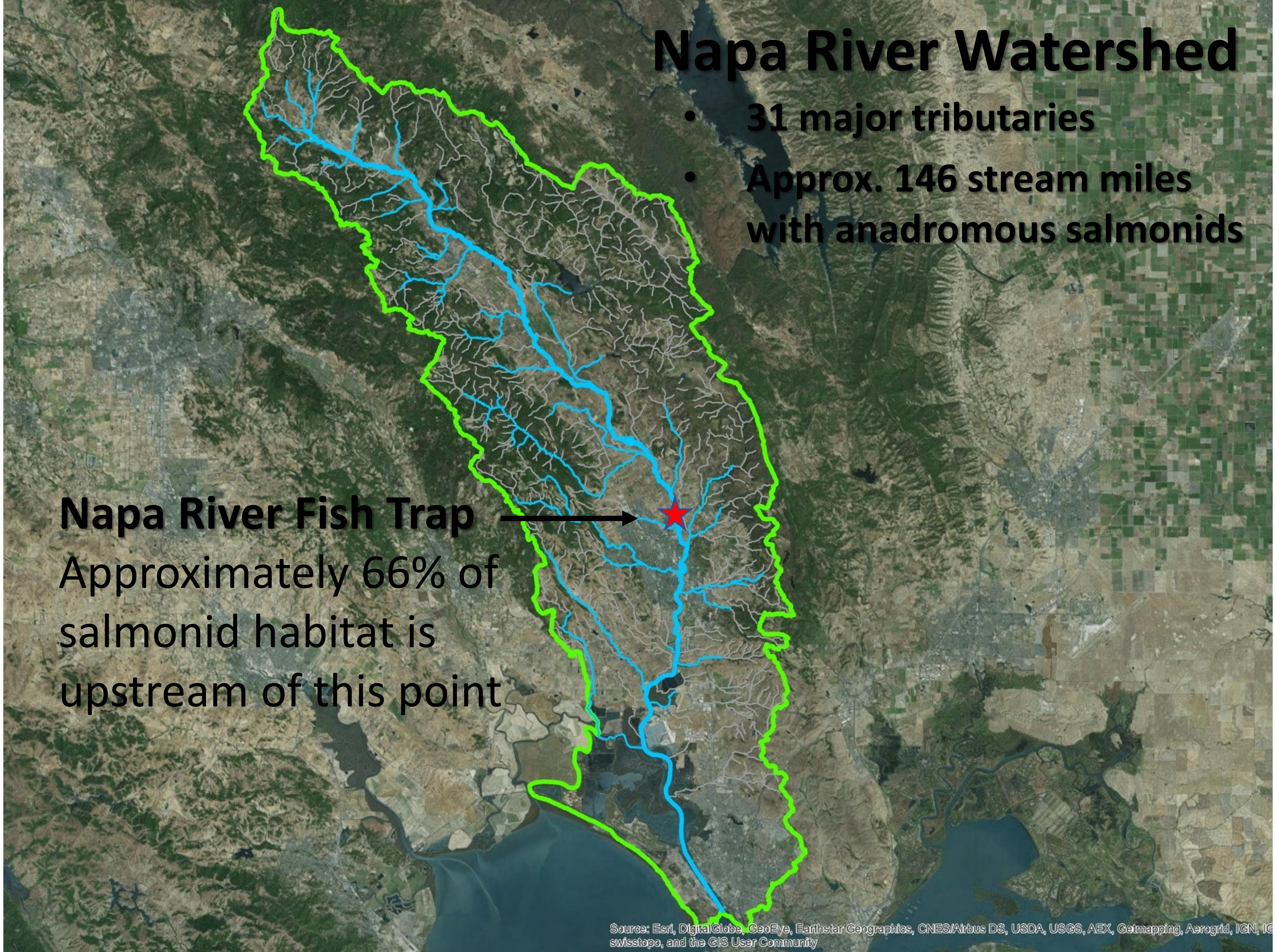
NAPA RCD

Steelhead
Oncorhynchus mykiss

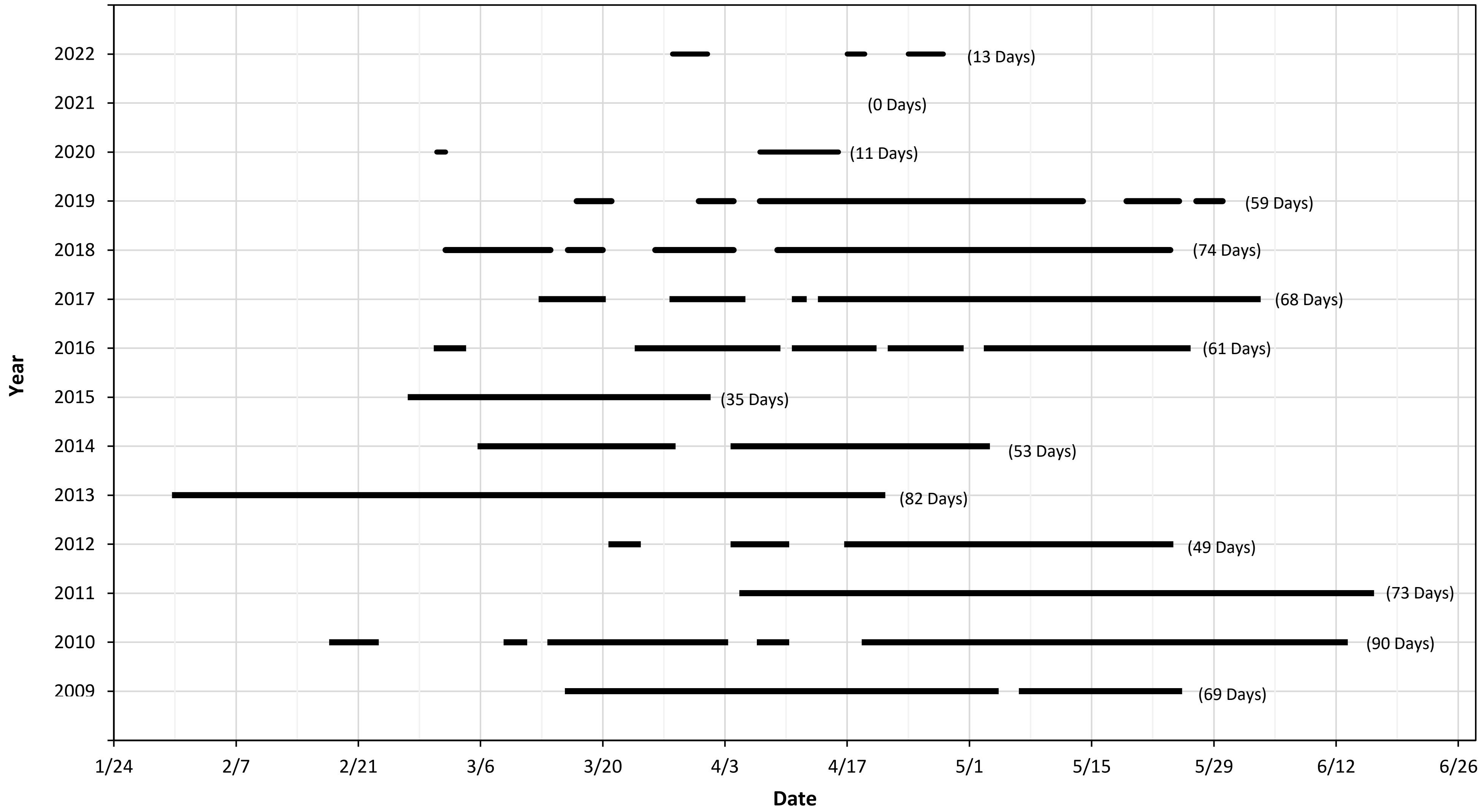
- Listed as Threatened under the Federal Endangered Species Act
- Anadromous form of Rainbow Trout
- Young spend 1-4 years in freshwater


SMOLTS

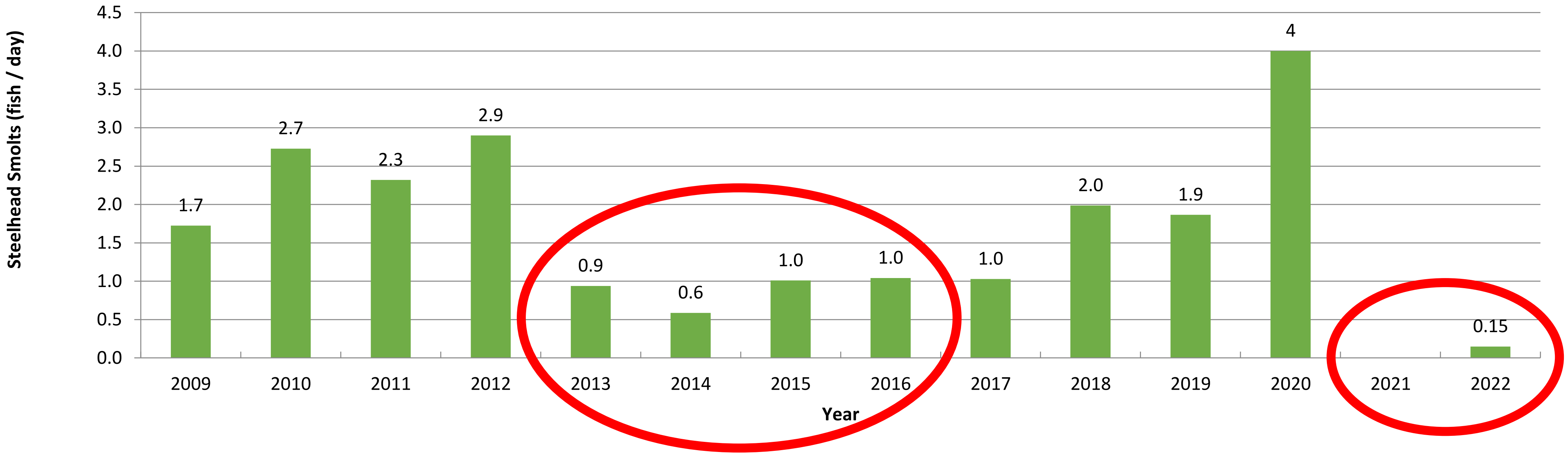
Napa River Fish Trap

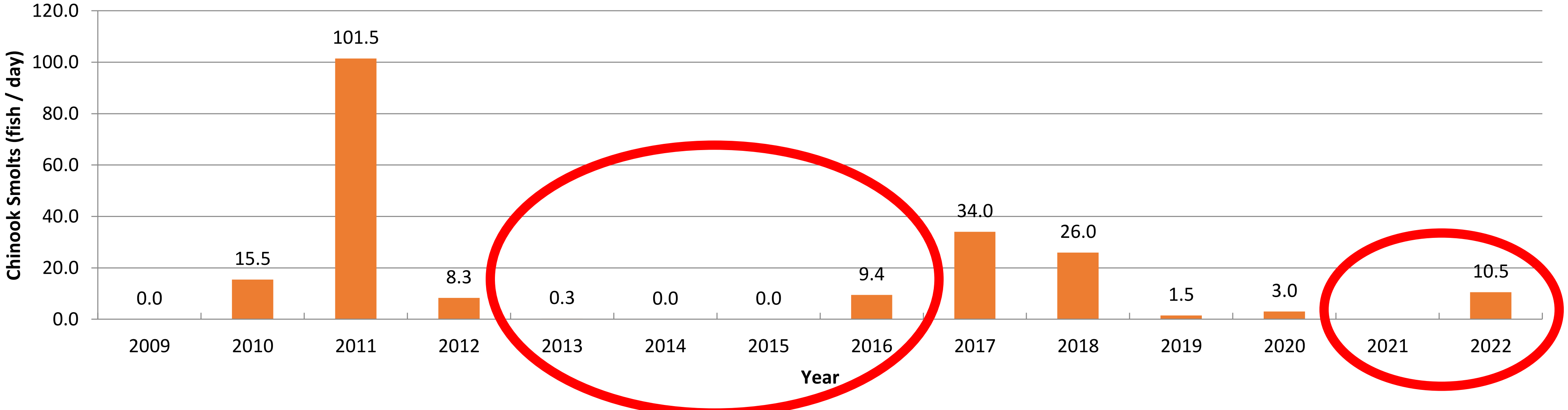

Napa River Watershed
• 31 major tributaries
• Approx. 146 stream miles with anadromous salmonids
Napa River Fish Trap
Approximately 66% of salmonid habitat is upstream of this point
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IG
swisstopo, and the GIS User Community

Sampling dates - Rotary Screw Trap

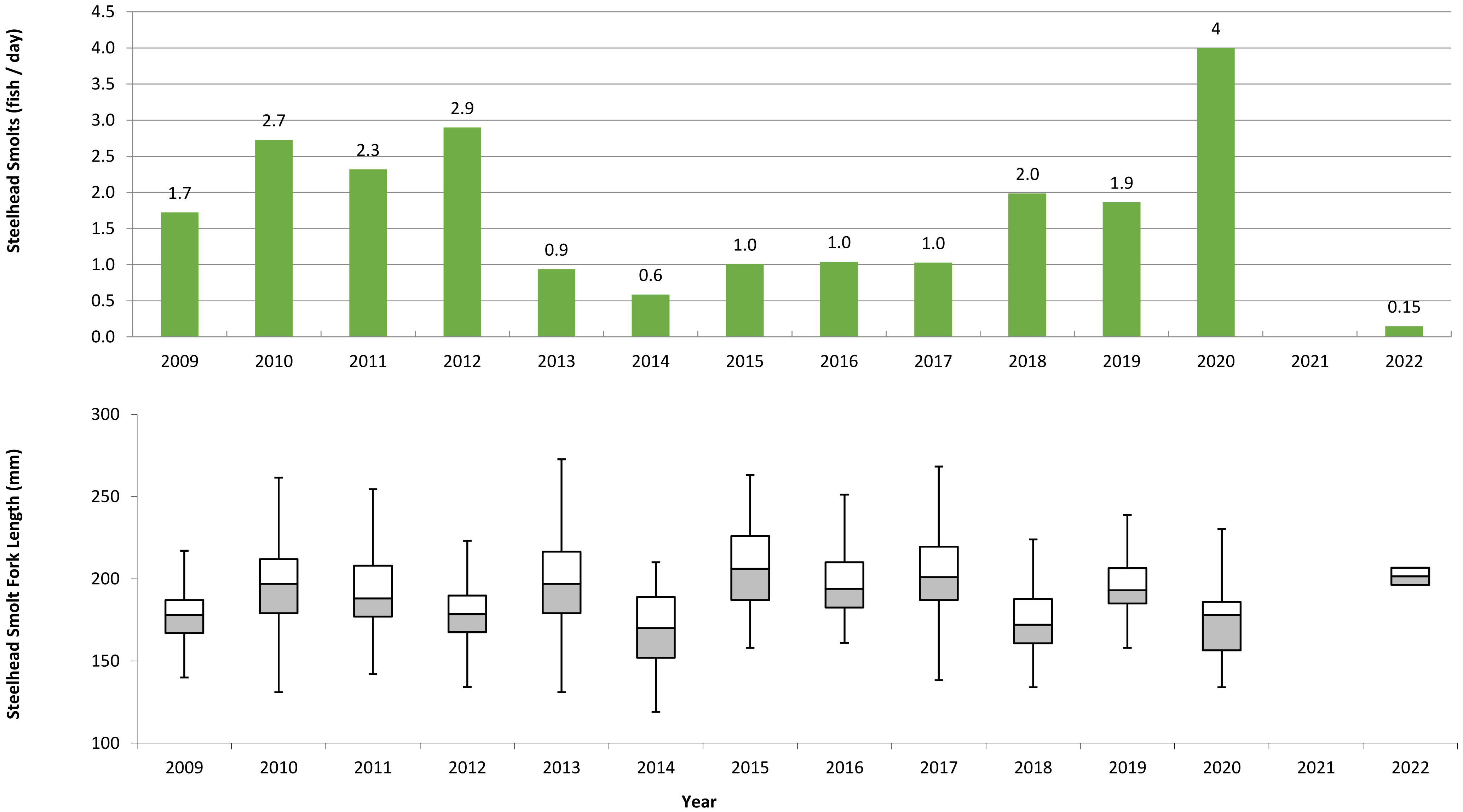


Steelhead vs Chinook production





Steelhead smolt catches through time



PIT tagging


mm 1 2


RIDGID


Napa River
PIT Tag Antenna
February 2018
Antenna #1
Antenna #2
FLOW

First confirmation of self-sustaining population

Table 1. PIT tagged steelhead re-detected by the Napa River PIT tag antenna in subsequent years.

Date Tagged	Tagging Location	Length (mm)	Weight (g)	Re-Detection Date	Days between tagging and re-detection
4/1/2016	Napa River RST	192	65.1	3/1/2018	699
4/2/2016	Napa River RST	201	85.1	3/1/2018	698
5/12/2017	Napa River RST	193	68.4	2/17/2019	646
3/18/2018	Napa River RST	190	63.5	3/11/2020	724
4/17/2018	Napa River RST	185	68.1	2/17/2020	671
4/23/2018	Napa River RST	185	65.1	3/19/2019	330

Napa River Fish Community

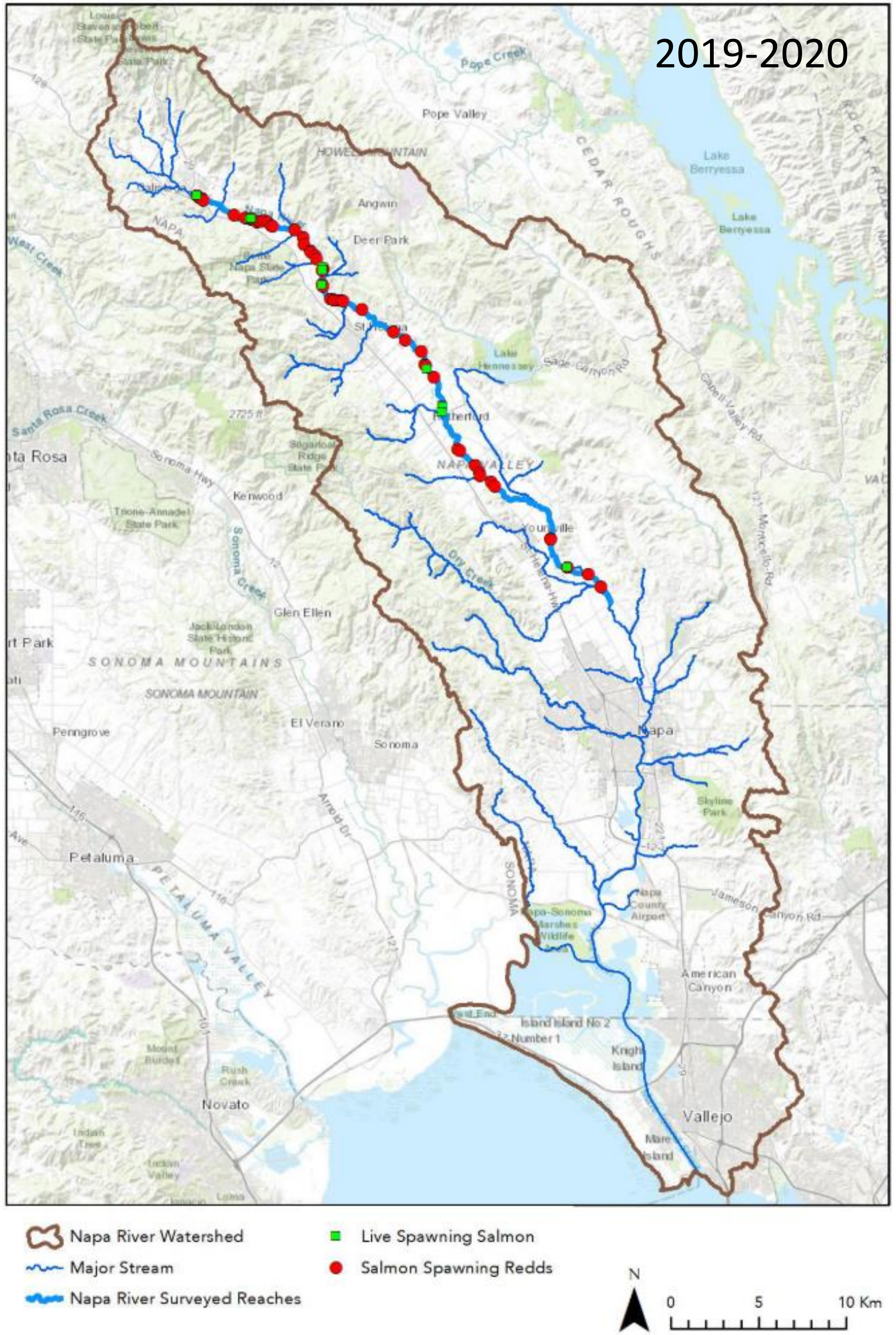
29 species in freshwater streams

- 15 native species
  - 2 Salmonids
    - Steelhead
    - Chinook Salmon

Assemblage dominated by native species

Napa River - potentially important system for native lamprey

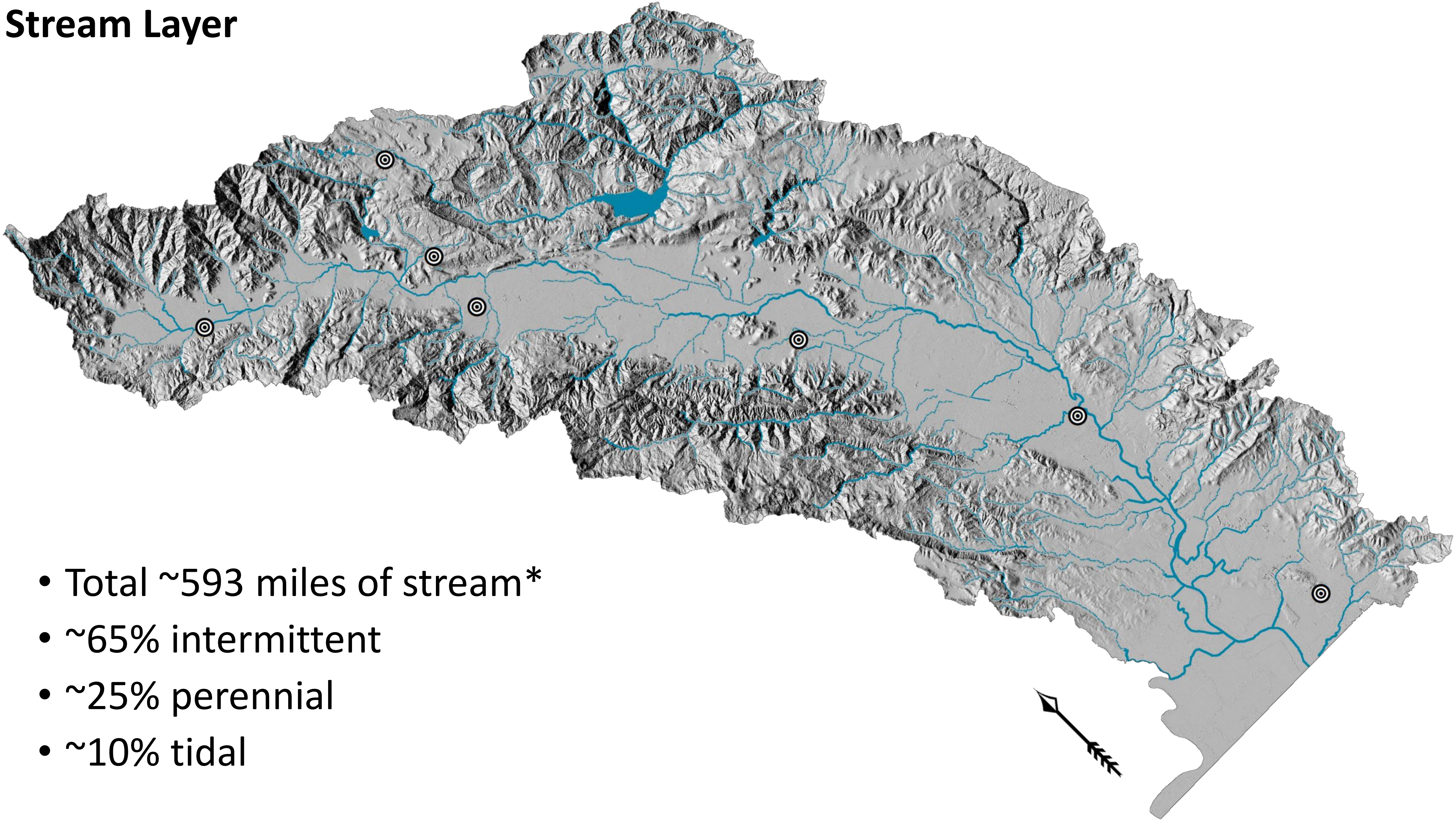
Adult spawner surveys






Update on collective fish barrier remediation efforts

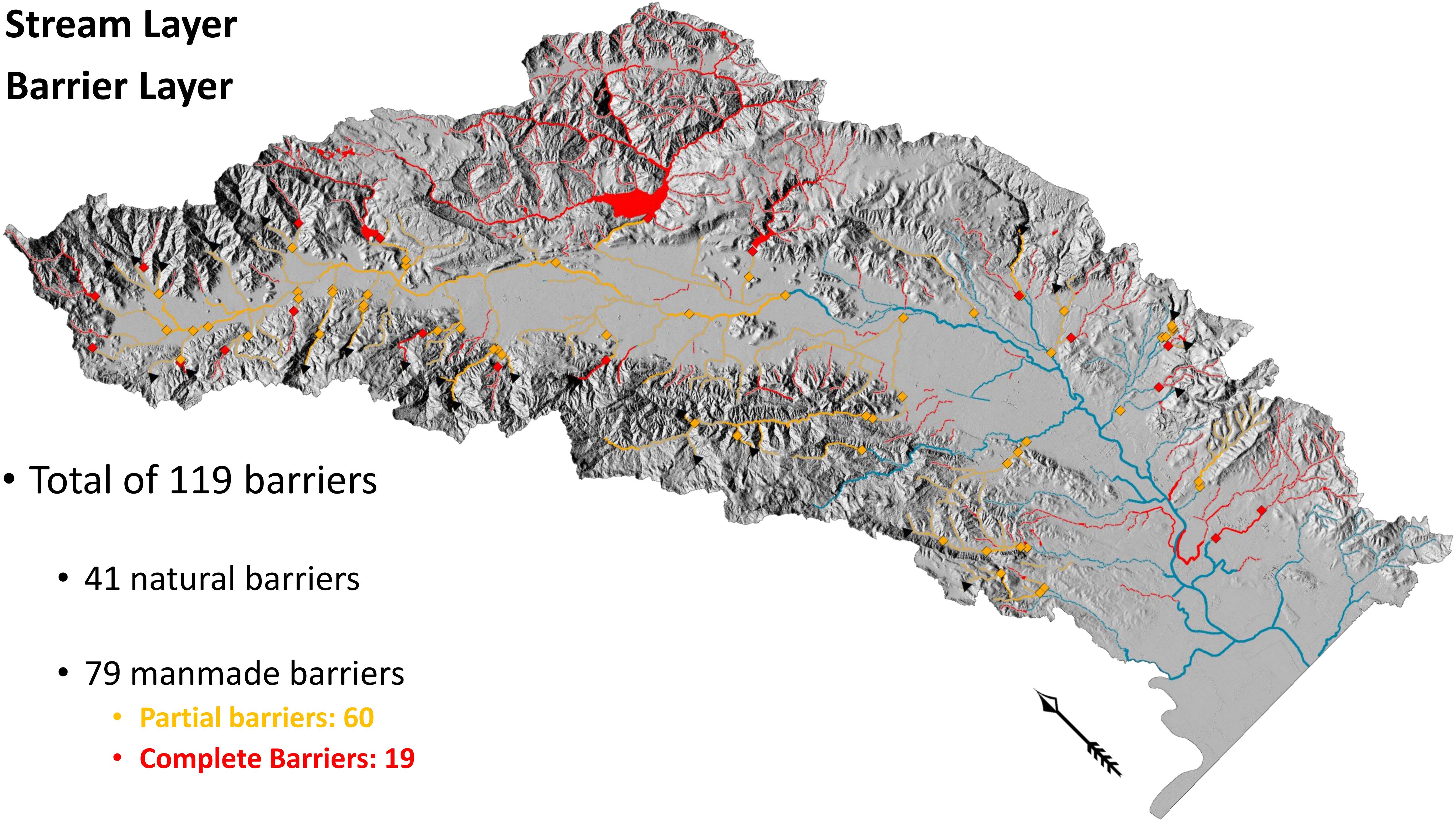
Stream Layer



- Total ~593 miles of stream*
- ~65% intermittent
- ~25% perennial
- ~10% tidal

Stream Layer

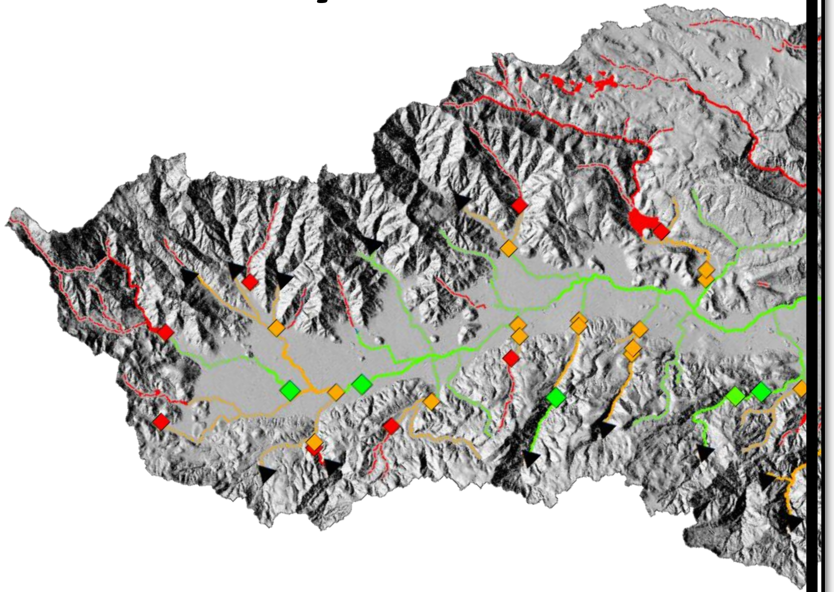
Barrier Layer

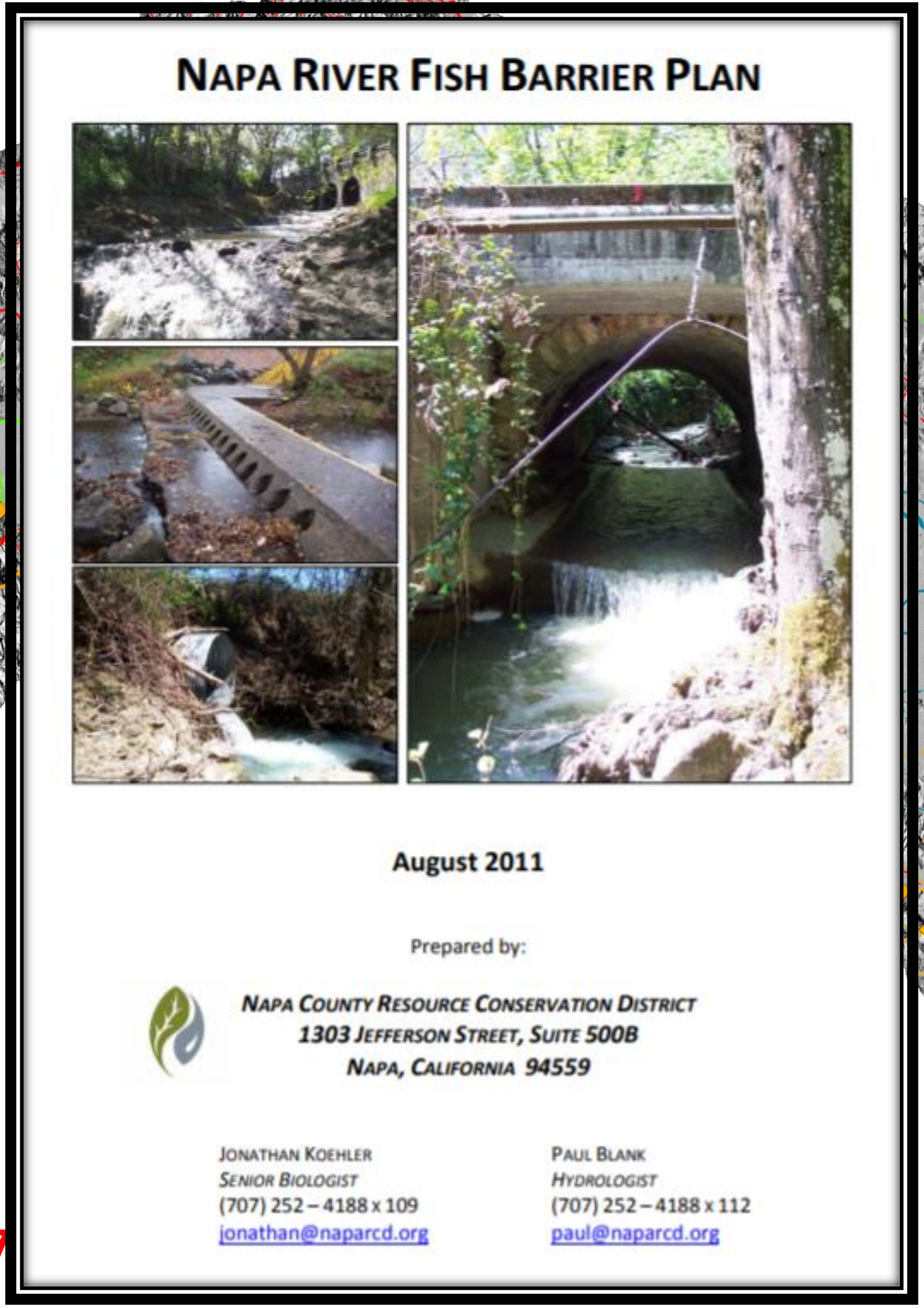


- Total of 119 barriers
  - 41 natural barriers
  - 79 manmade barriers
    - **Partial barriers: 60**
    - **Complete Barriers: 19**

Stream Layer

Barrier Layer





NAPA RIVER FISH BARRIER PLAN

August 2011

Prepared by:

NAPA COUNTY RESOURCE CONSERVATION DISTRICT
1303 JEFFERSON STREET, SUITE 500B
NAPA, CALIFORNIA 94559

JONATHAN KOEHLER
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(707) 252 – 4188 x 109
jonathan@naparcd.org

PAUL BLANK
HYDROLOGIST
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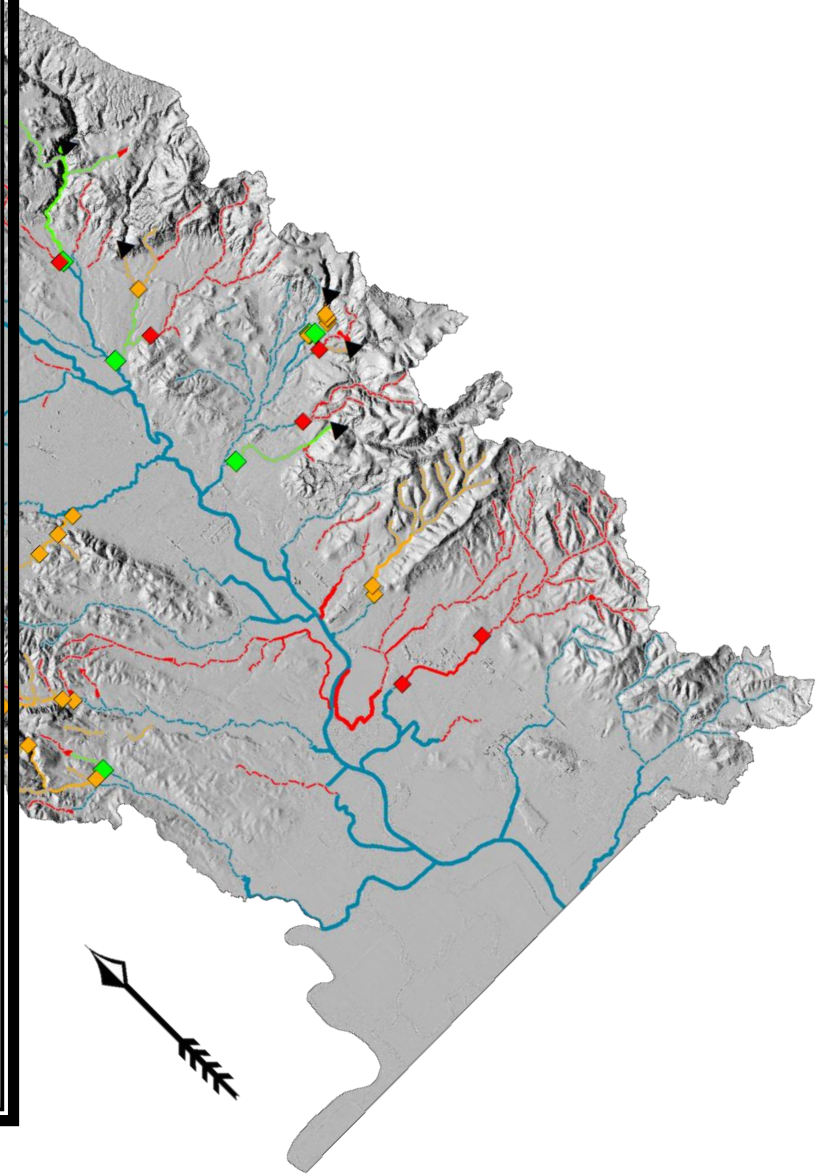
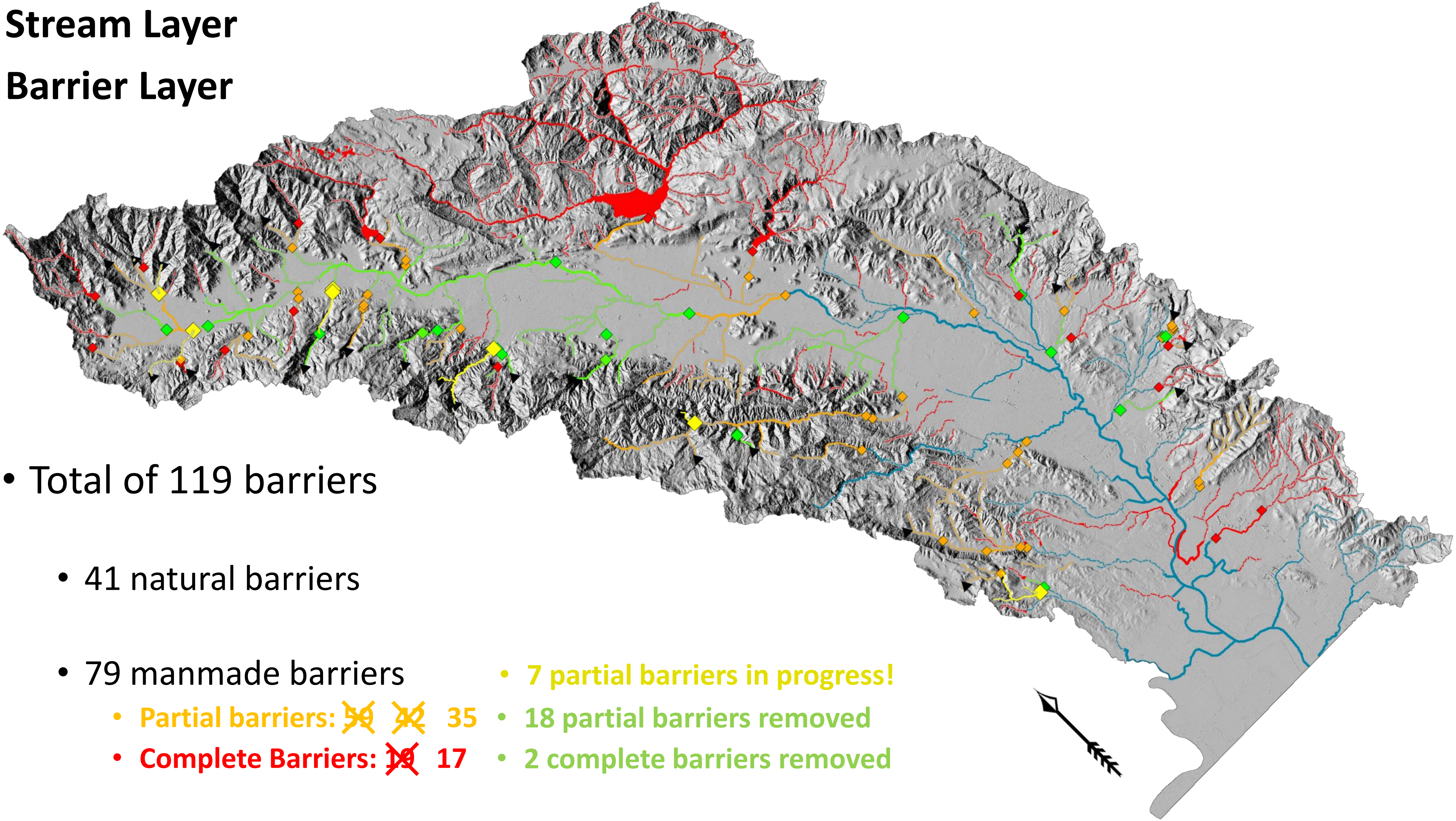


- Total of 119 barriers
  - 41 natural barriers
  - 79 manmade barriers
    - Partial barriers: ~~60~~ 42
    - Complete Barriers: ~~19~~ 17

Stream Layer

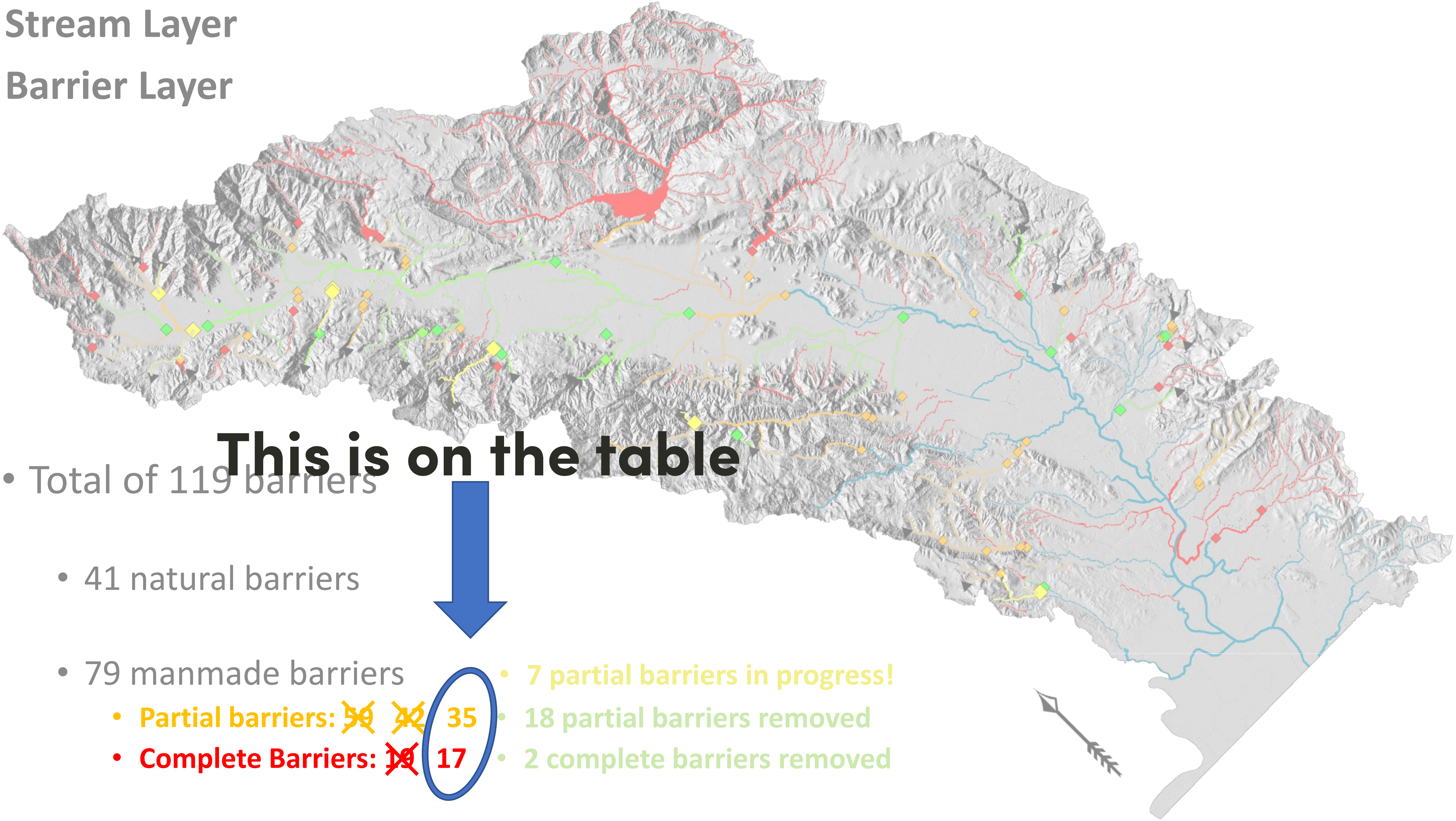
Barrier Layer



- Total of 119 barriers
  - 41 natural barriers
  - 79 manmade barriers
    - Partial barriers: ~~59~~ ~~42~~ 35
    - Complete Barriers: ~~19~~ 17
    - 7 partial barriers in progress!
    - 18 partial barriers removed
    - 2 complete barriers removed

Stream Layer

Barrier Layer



This is on the table

- Total of 119 barriers
  - 41 natural barriers
  - 79 manmade barriers
    - Partial barriers: ~~59~~ ~~42~~ 35
    - Complete Barriers: ~~19~~ 17

- 7 partial barriers in progress!
- 18 partial barriers removed
- 2 complete barriers removed

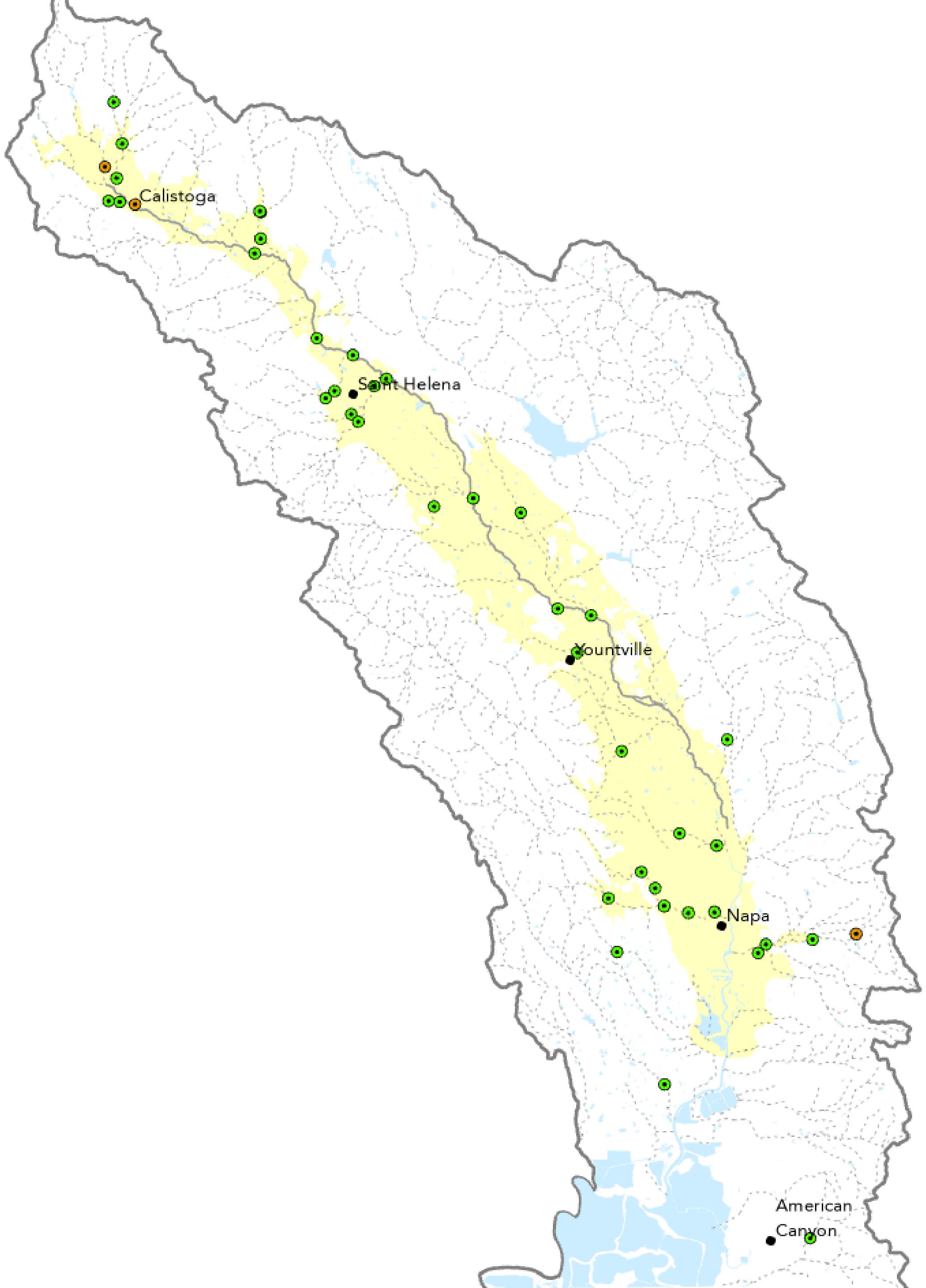
Formed advisory committee to develop a watershed strategy for fish habitat enhancement

- Bringing together local, state, federal and private partners
  - Proof-of-concept Barrier remediation
    - 6 barriers to remediate ASAP
  - Watershed wide fish passage barrier assessment
  - Scale up monitoring efforts
    - Fish and flows

Stream Watch

Community Science Streamflow Monitoring Program
Napa River Watershed

- Flow is the most fundamental factor to the health of a stream
- Natural drying of certain reaches is a characteristic of Mediterranean climates and the Napa River system
- Climate change, land development, groundwater pumping, flow diversion increase the degree, extent, and duration of drying resulting in loss of habitat
- Anecdotal evidence of widespread and substantial reductions of dry-season flow
- Need better understanding of location and severity of drying channels and changes through time



Stream Watch

Community Science Streamflow Monitoring Program
Napa River Watershed

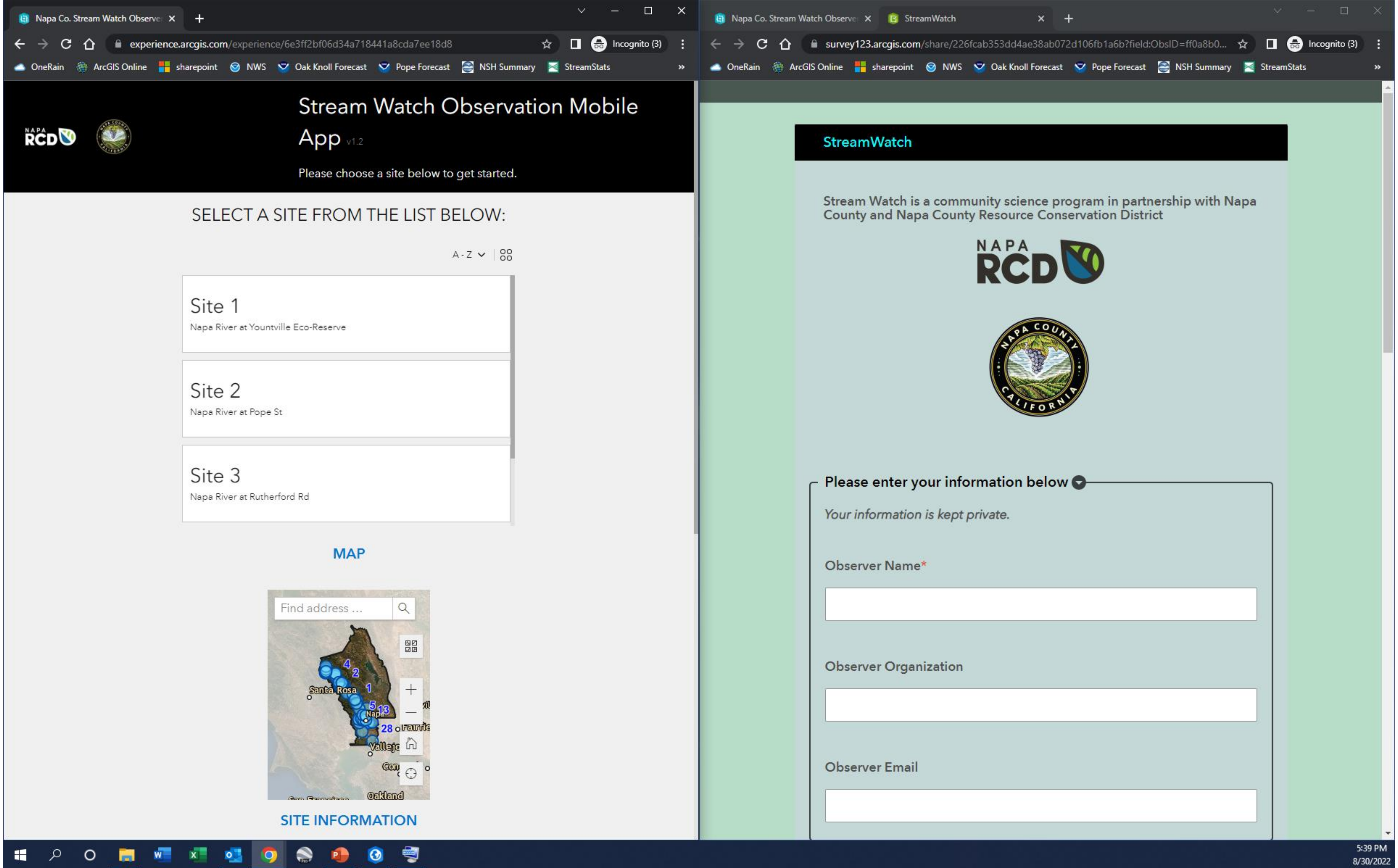
- Napa County and Napa RCD collaboration
- Cost-effective collection of simple high-quality wetted channel information by volunteer observers
- 39 active stations, 3 retired, covering approx. 50 miles of stream channel

Dry

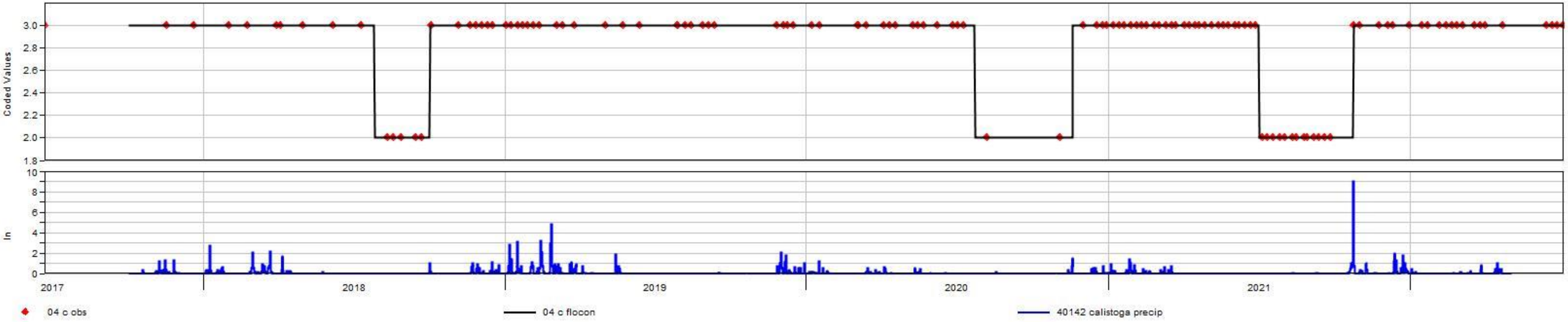
Isolated Pools

Flowing

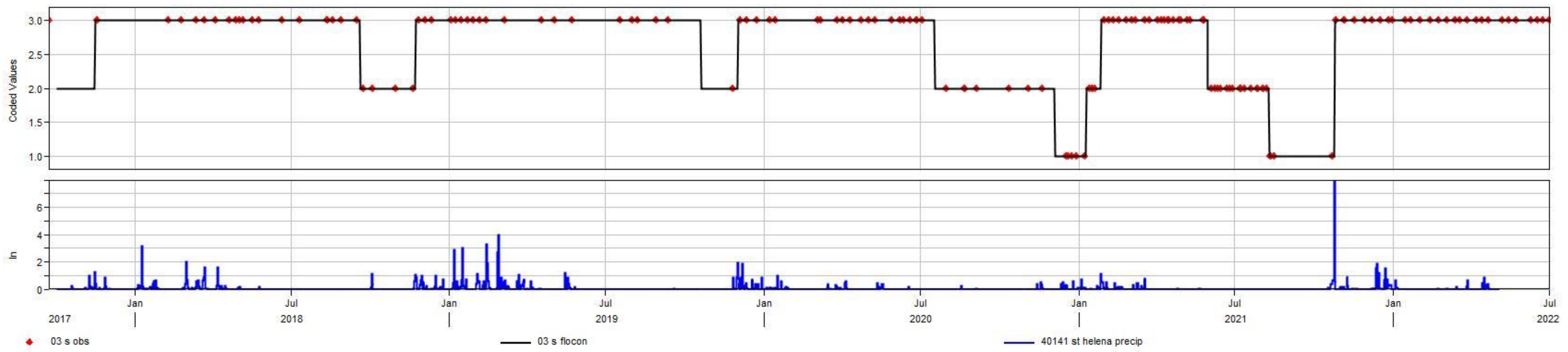
NAPA RCD

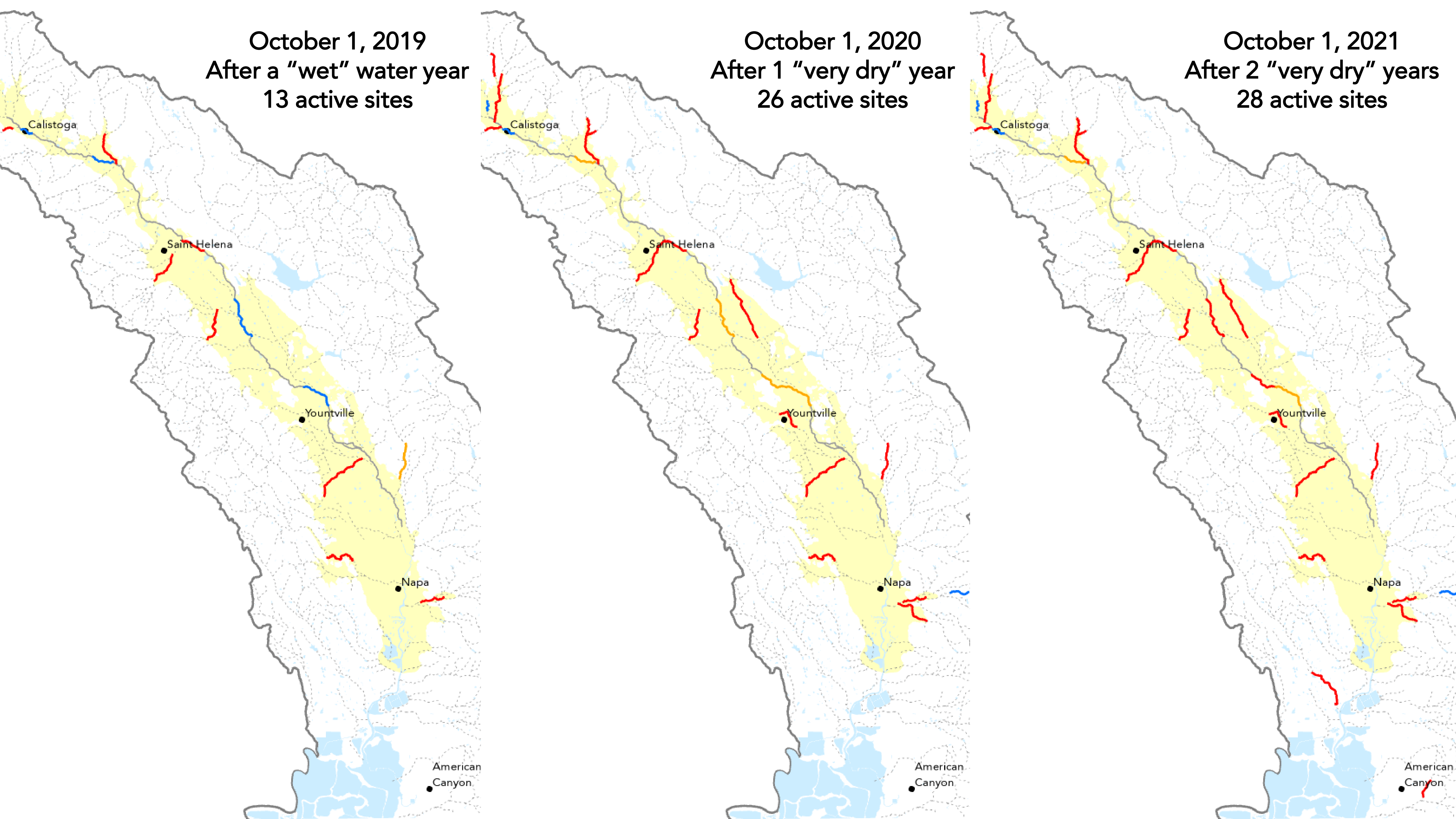

Napa Co. Stream Watch Observe
experience.arcgis.com/experience/6e3ff2bf06d34a718441a8cda7ee18d8
Incognito (3)
OneRain
ArcGIS Online
sharepoint
NWS
Oak Knoll Forecast
Pope Forecast
NSH Summary
StreamStats
Stream Watch Observation Mobile App v1.2
Please choose a site below to get started.
SELECT A SITE FROM THE LIST BELOW:
A-Z
Site 1
Napa River at Yountville Eco-Reserve
Site 2
Napa River at Pope St
Site 3
Napa River at Rutherford Rd
MAP
Find address ...
Santa Rosa
Napa
Vallejo
Oakland
SITE INFORMATION
Napa Co. Stream Watch Observe
StreamWatch
survey123.arcgis.com/share/226fcab353dd4ae38ab072d106fb1a6b?field:ObsID=ff0a8b0...
Incognito (3)
OneRain
ArcGIS Online
sharepoint
NWS
Oak Knoll Forecast
Pope Forecast
NSH Summary
StreamStats
StreamWatch
Stream Watch is a community science program in partnership with Napa County and Napa County Resource Conservation District
NAPA RCD
NAPA COUNTY CALIFORNIA
Please enter your information below
Your information is kept private.
Observer Name*
Observer Organization
Observer Email
5:39 PM
8/30/2022

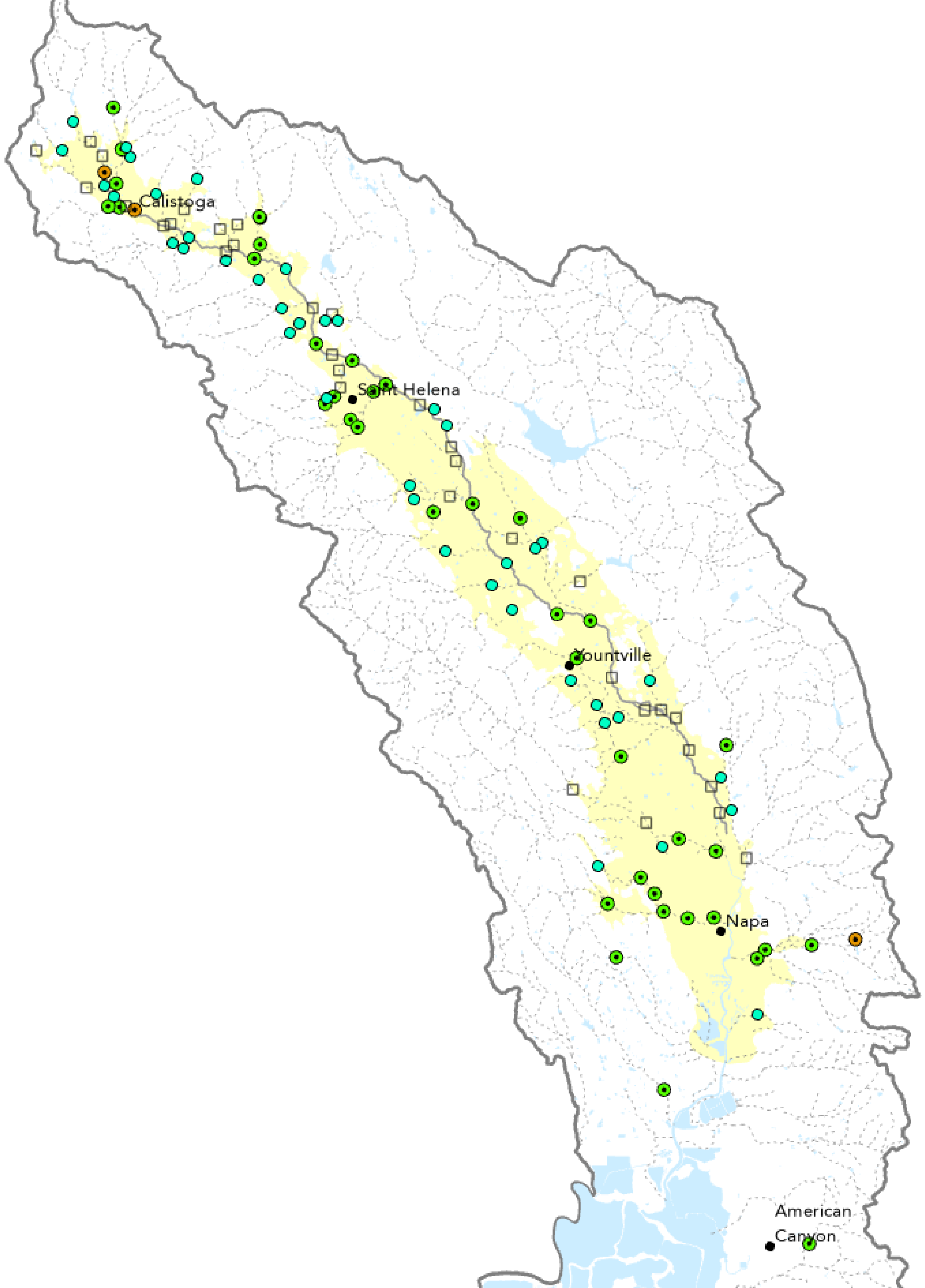
Site 04 – Napa River at Larkmead Ln



Site 03 – Napa River at Rutherford Rd




October 1, 2019
After a "wet" water year
13 active sites
Calistoga
Saint Helena
Yountville
Napa
American
Canyon
October 1, 2020
After 1 "very dry" year
26 active sites
Calistoga
Saint Helena
Yountville
Napa
American
Canyon
October 1, 2021
After 2 "very dry" years
28 active sites
Calistoga
Saint Helena
Yountville
Napa
American
Canyon



Stream Watch

Community Science Streamflow Monitoring Program
Napa River Watershed

- Network can be expanded with up to 40 additional volunteer stations
- Up to 30 camera stations
- Sep/Oct wetted channel mapping of select reaches
- Expand network to upland areas
- Water quality monitoring at select stations

NAPA RCD

Napa Valley Groundwater Dependent Ecosystems and Interconnected Surface Water

Christian Braudrick
Stillwater Sciences

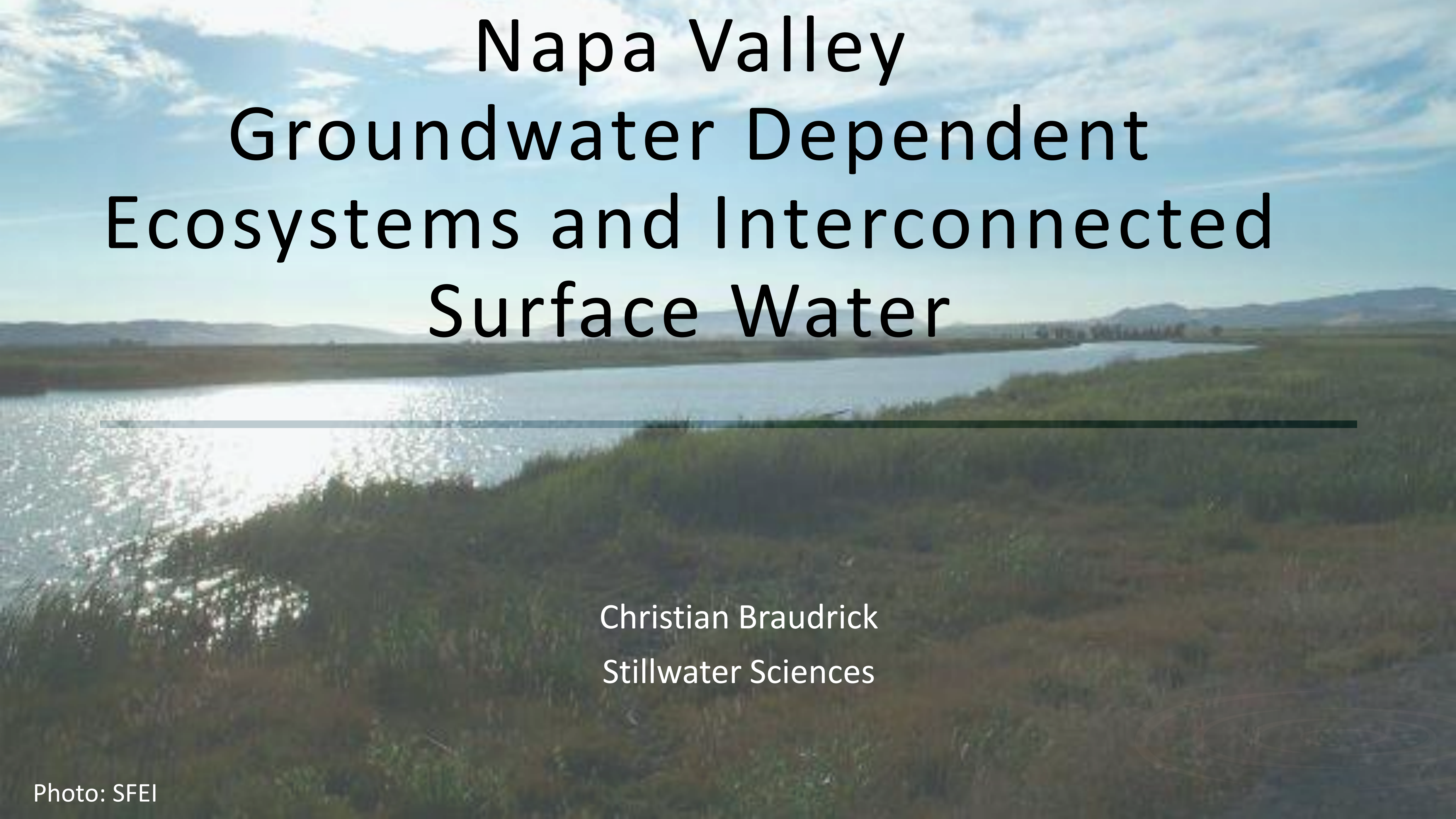


Photo: SFEI

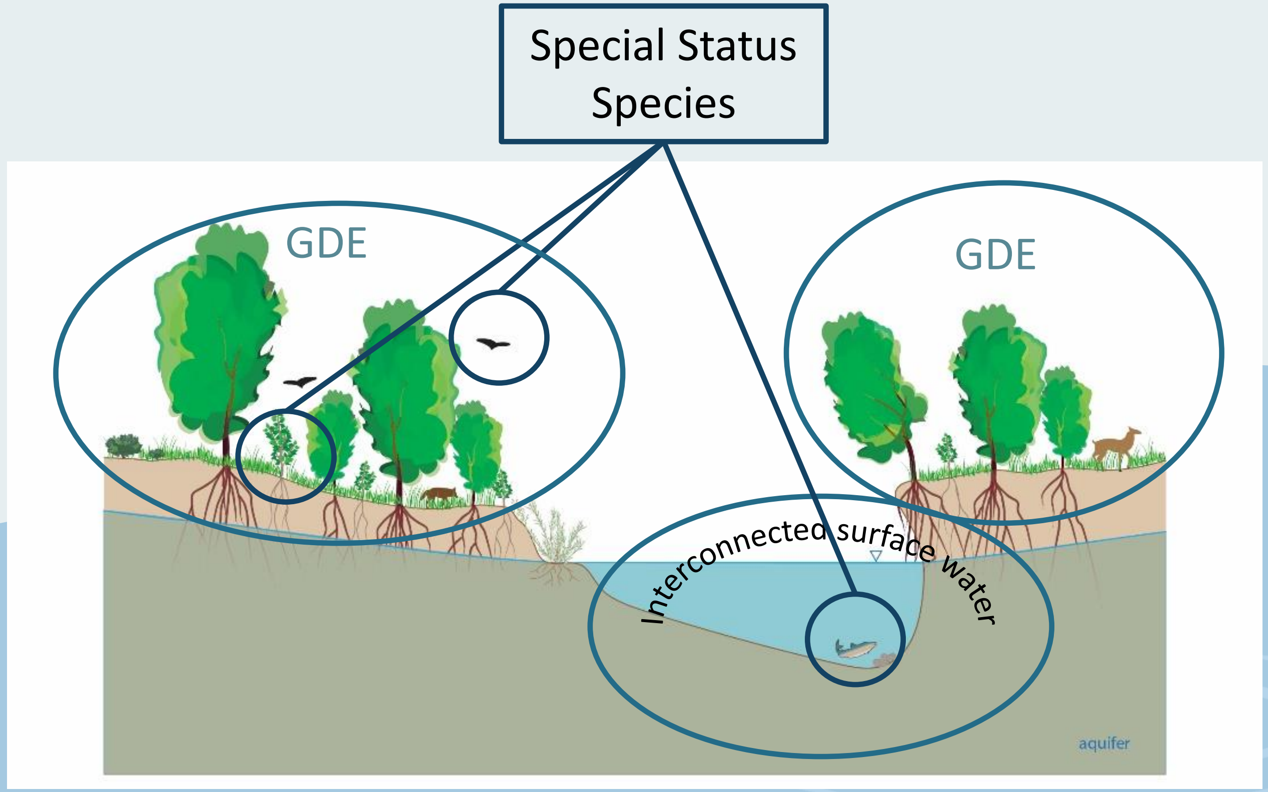
Outline

- GDE overview
- Stillwater Sciences studies in the Napa Basin
- Lifecycle of fish and interconnected surface water (ISW) reliance
- Examples of ISW and groundwater from other basins
- Assessing other aquatic species flow needs

Groundwater Dependent Ecosystems (GDEs)

DWR defines GDEs as ecological communities or species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface for some of their water needs.

GDEs occur in a variety of different environments ranging from seeps and springs, to groundwater-dependent wetlands, to aquatic and riparian ecosystems associated with rivers that partially or entirely rely on groundwater.



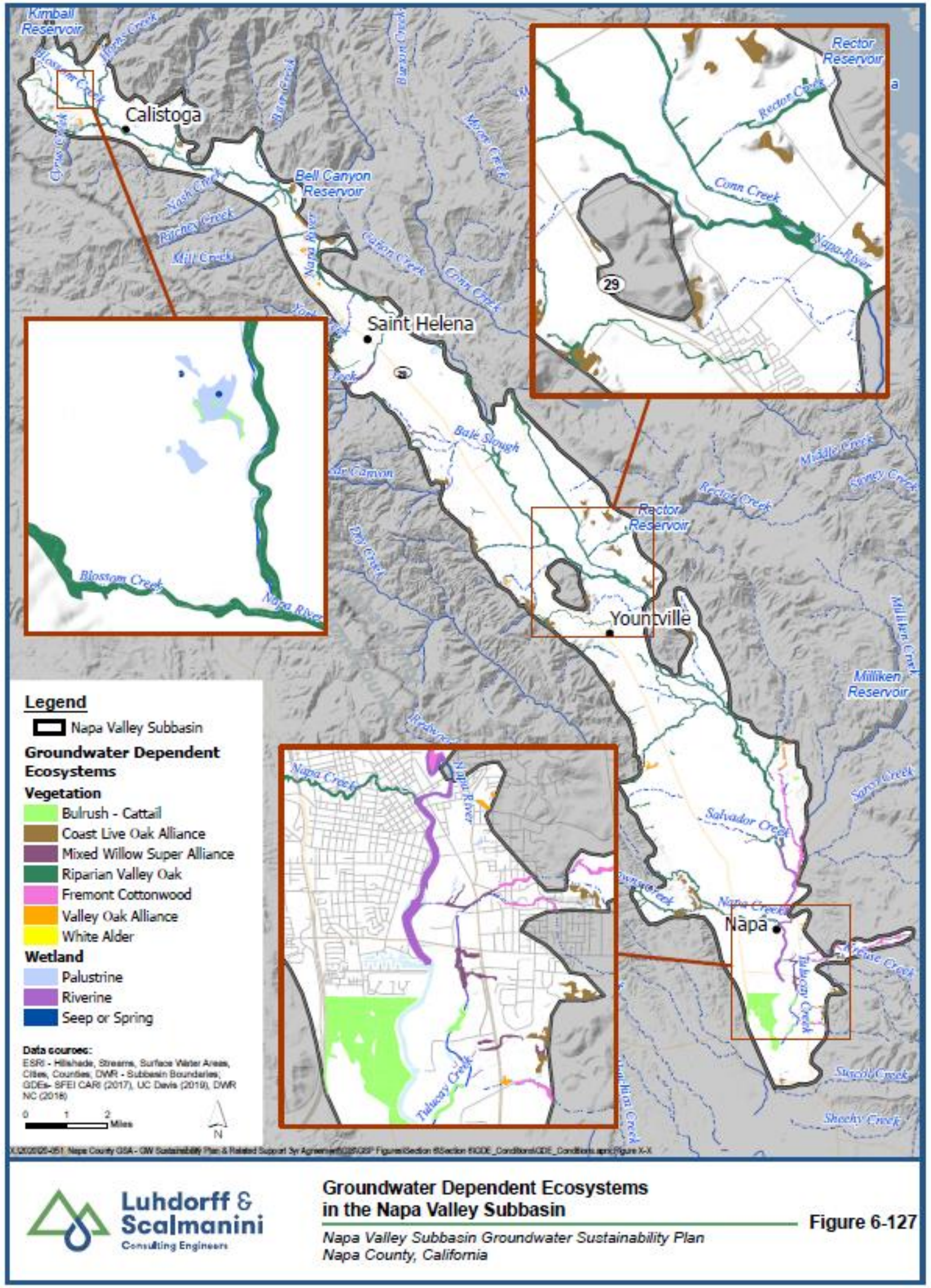
Braudrick et al., 2018 (figure by K. Rodriguez and A. Merrill)

GDEs

- Most of the GDEs were valley oak with bullrush cattail GDEs in the Napa and Napa River marshes subareas

Critical habitat in the basin

- 23 miles of critical habitat for central coast steelhead
- 230 acres of critical habitat for Contra Costa goldfields

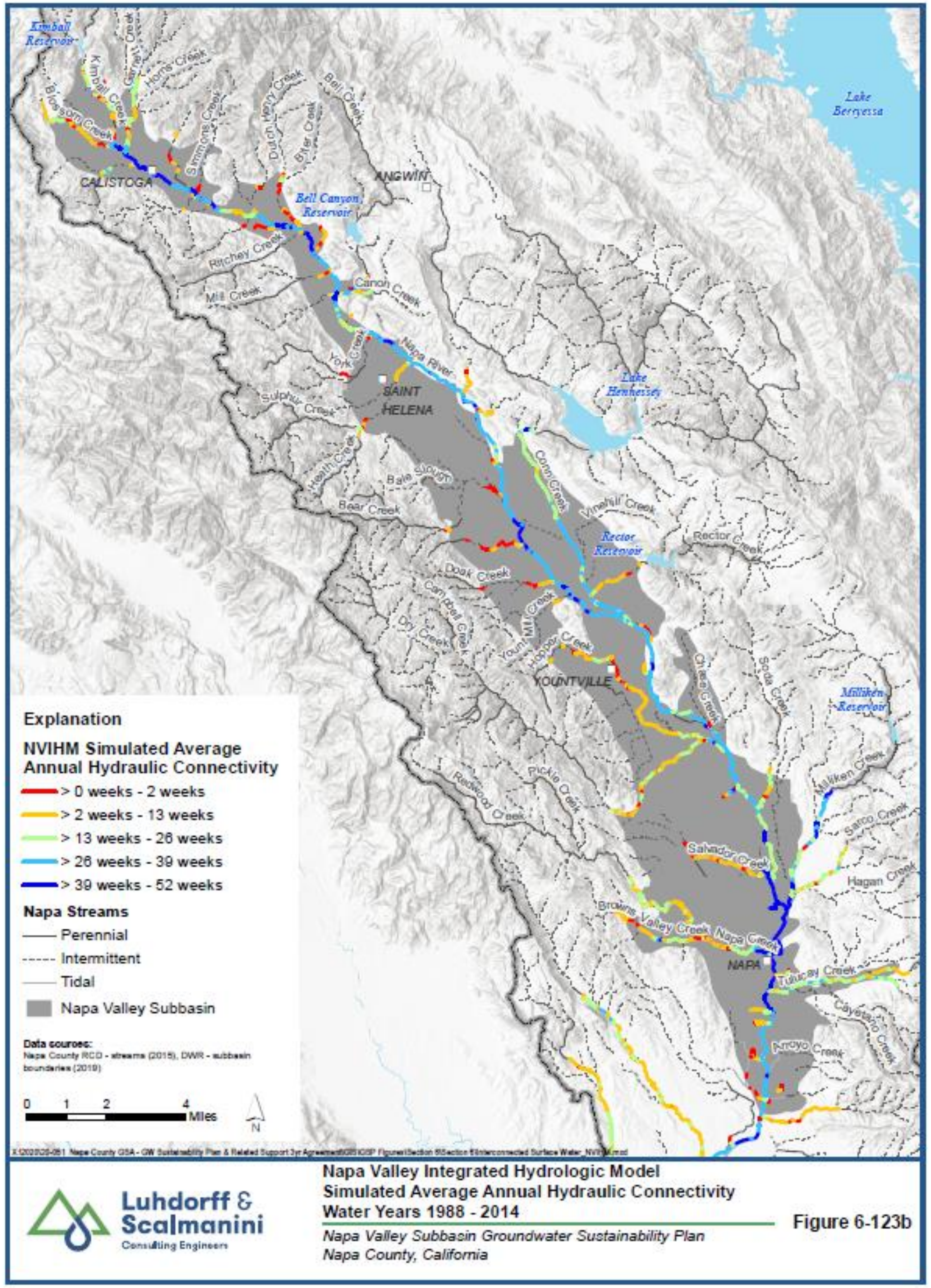


Interconnected surface water (ISW)

Limited surface water data

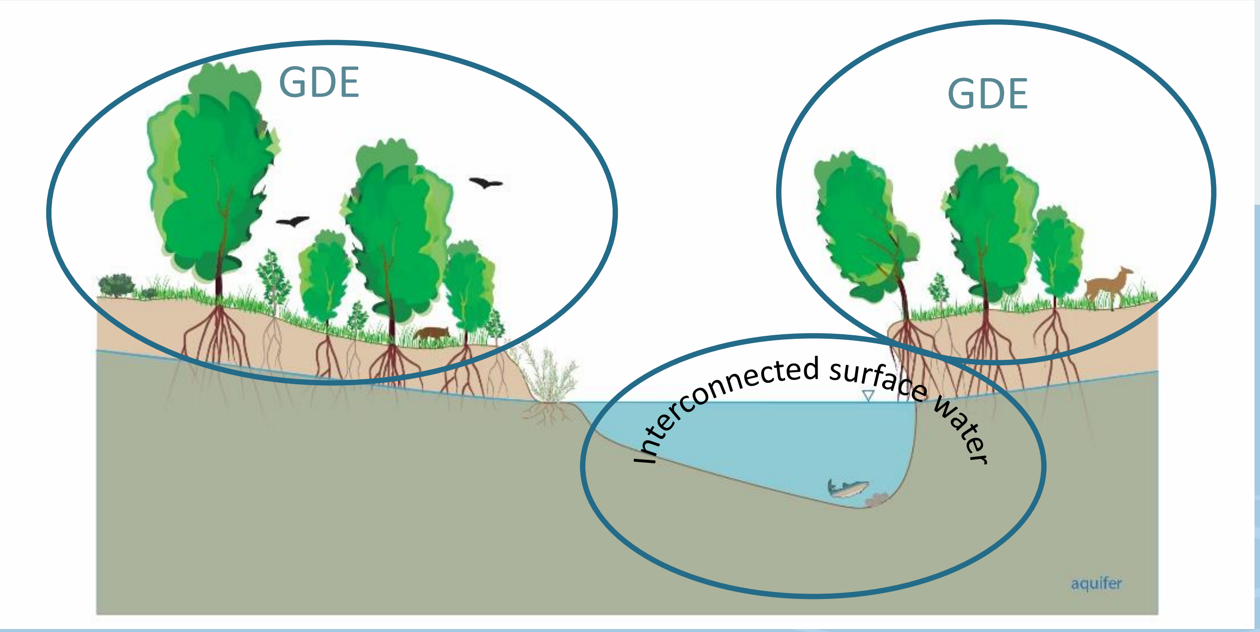
Data includes

- Modeling results from the GSP
- Wet dry mapping from Stillwater (2002)
- Planned wet dry mapping from the RCD



GDEs

1. How does managed groundwater levels affect GDEs
2. Are the plant species likely to be connected to groundwater ?
   - How deep are their roots?
   - How deep is the groundwater?
3. What is the extent of interconnected surface water?



Braudrick et al., 2018 (figure by K. Rodriguez and A. Merrill)

Stillwater Studies in the Napa Basin

Napa River Basin
Limiting Factors Analysis

FINAL TECHNICAL REPORT

Prepared for
San Francisco Bay Water Quality Control Board
1515 Clay St, Suite 1400
Oakland, CA 94612

and

California State Coastal Conservancy
1330 Broadway Ave, Suite 1100
Oakland, CA 94612

Prepared by
Stillwater Sciences
2532 Durant Avenue
Berkeley, CA 94704

and

Professor William Dietrich
Department of Earth and Planetary Science
University of California, Berkeley 94720

14 June 2002

Stillwater Sciences

Napa River Tributary Steelhead Growth Analysis

Final Report

Prepared for
U.S. Army Corps of Engineers
San Francisco Division

Prepared by
Stillwater Sciences
Berkeley, California

June 2007

Stillwater Sciences

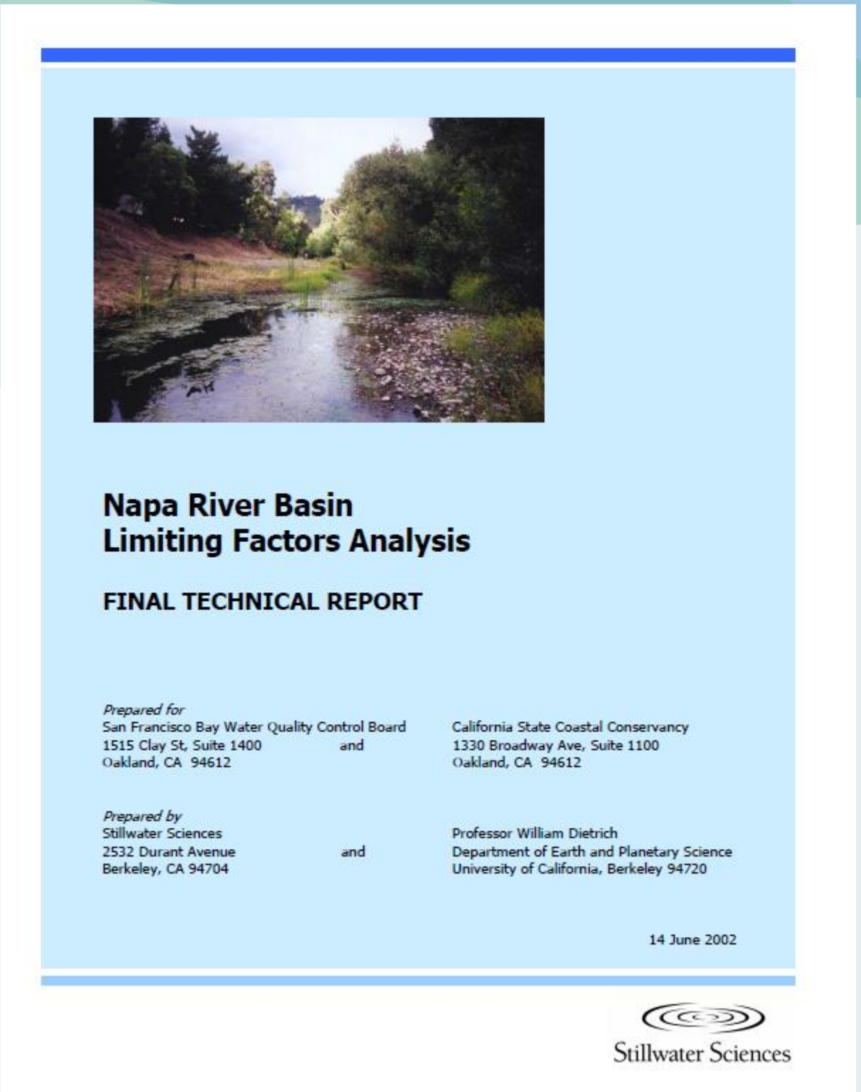
TECHNICAL MEMORANDUM • MAY 2021

Rector Creek Water Year Type and Watershed Model Technical Memorandum

PREPARED FOR
California Department of Veteran Affairs
1227 O Street
Sacramento CA, 95814

PREPARED BY
Stillwater Sciences
279 Cousteau Place, Suite 400
Davis, CA 95618

Napa River Basin Limiting Factors Analysis



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14 June 2002

Stillwater Sciences

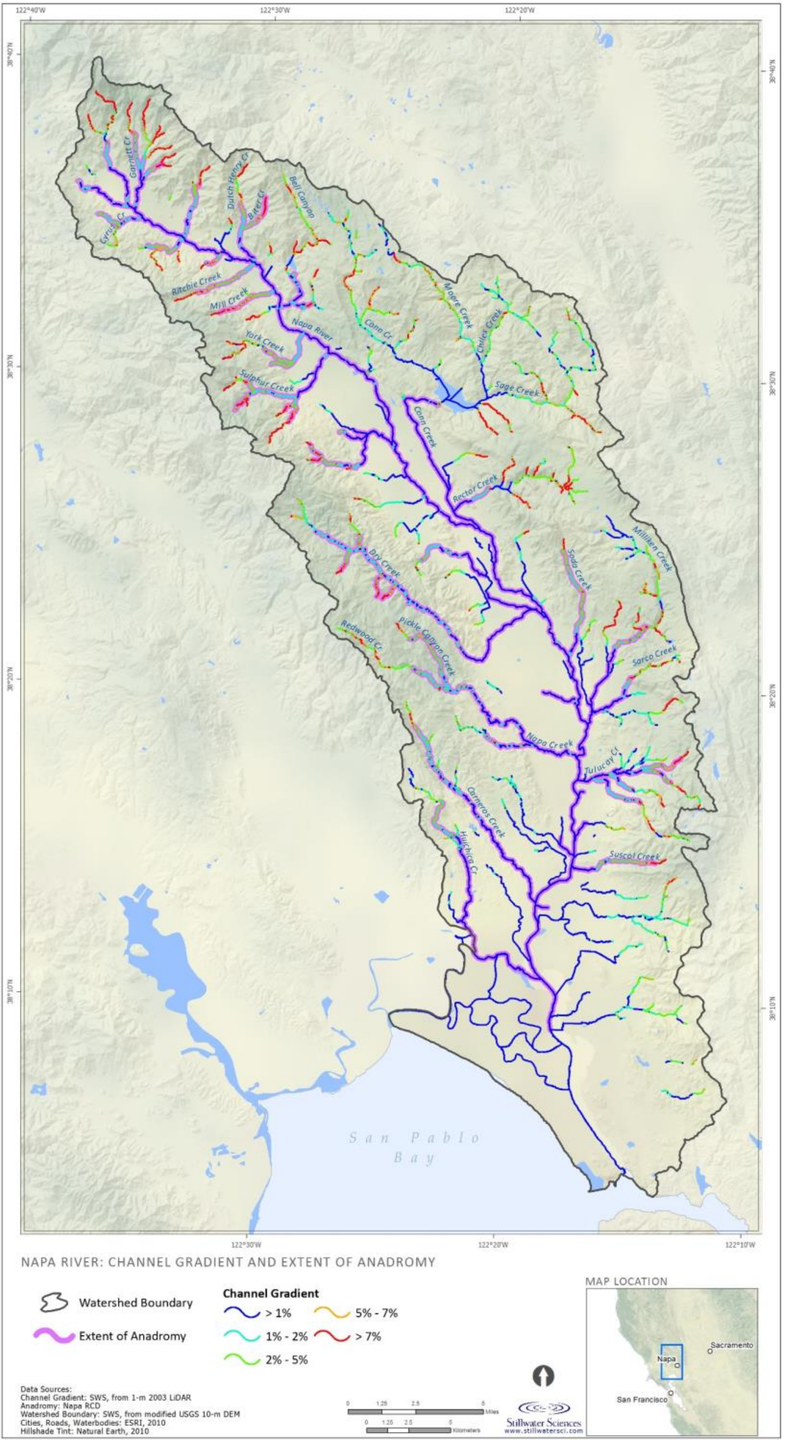
Stillwater Sciences and Dietrich (2002)

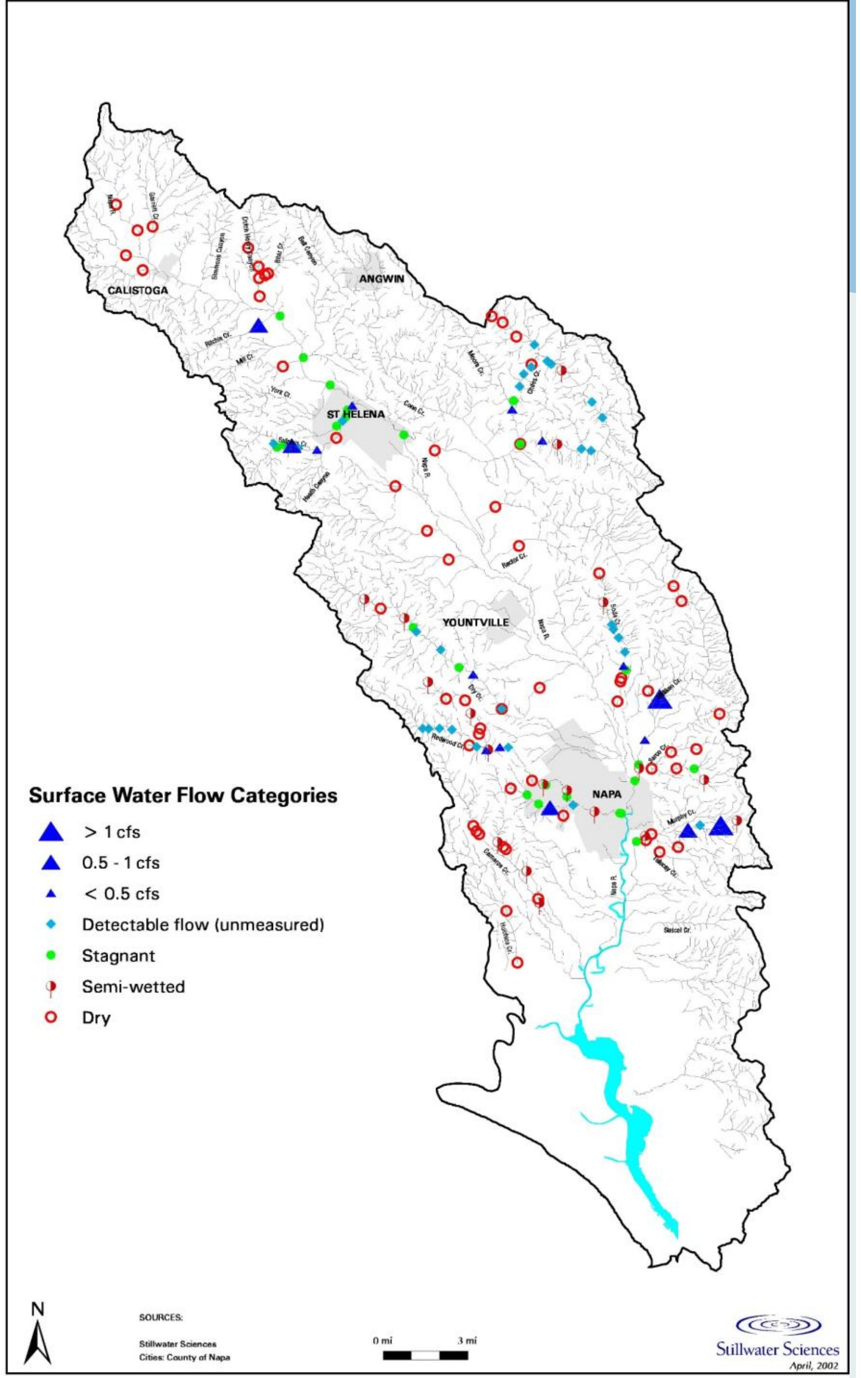
Measurements

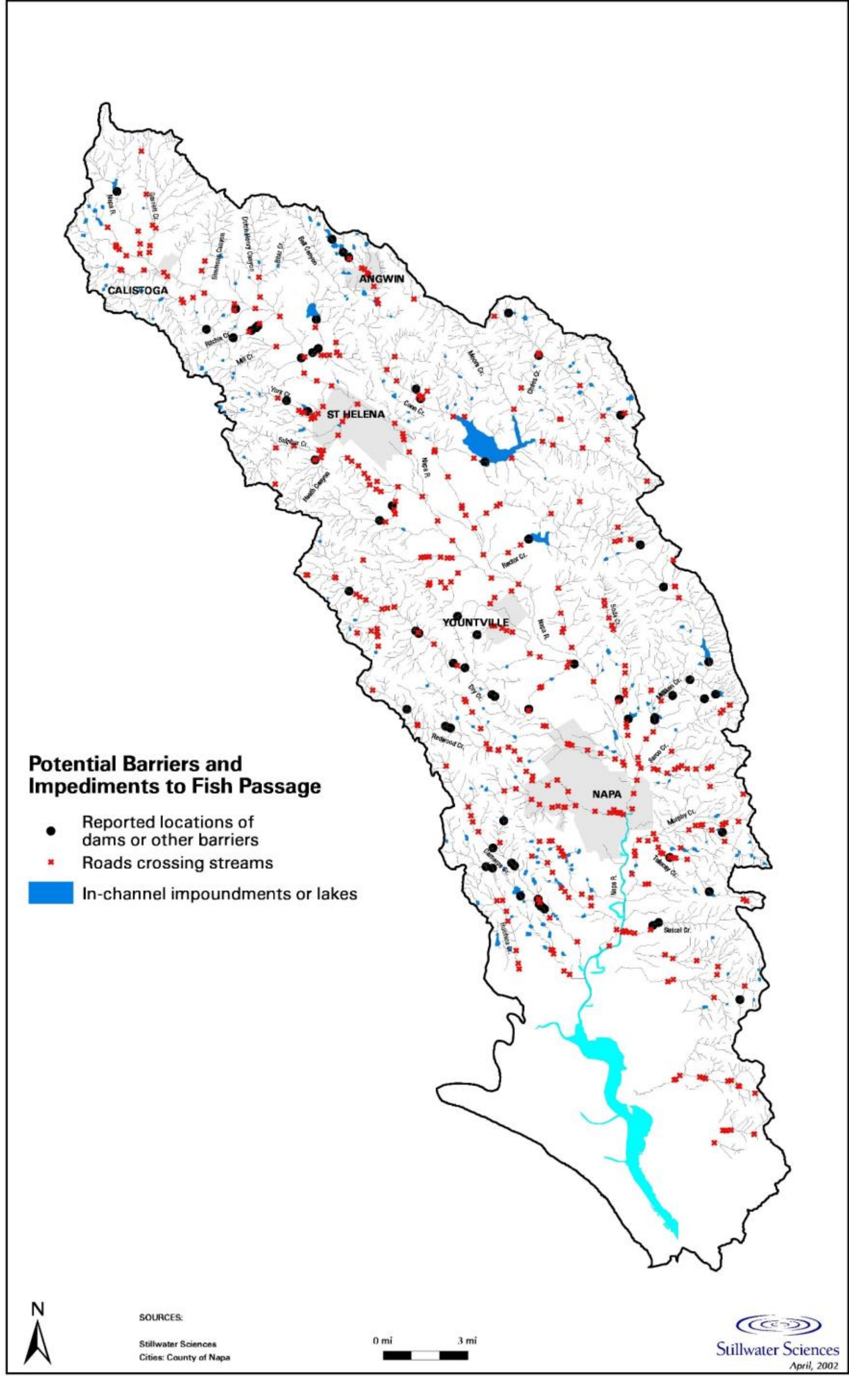
- Stream temperature (22 sites)
- Pool filling with fine sediment (136 sites)
- Spawning gravel permeability (59 sites)
- Turbidity following storms (18 sites)
- Qualitative summer surface flow (148 sites)

Findings

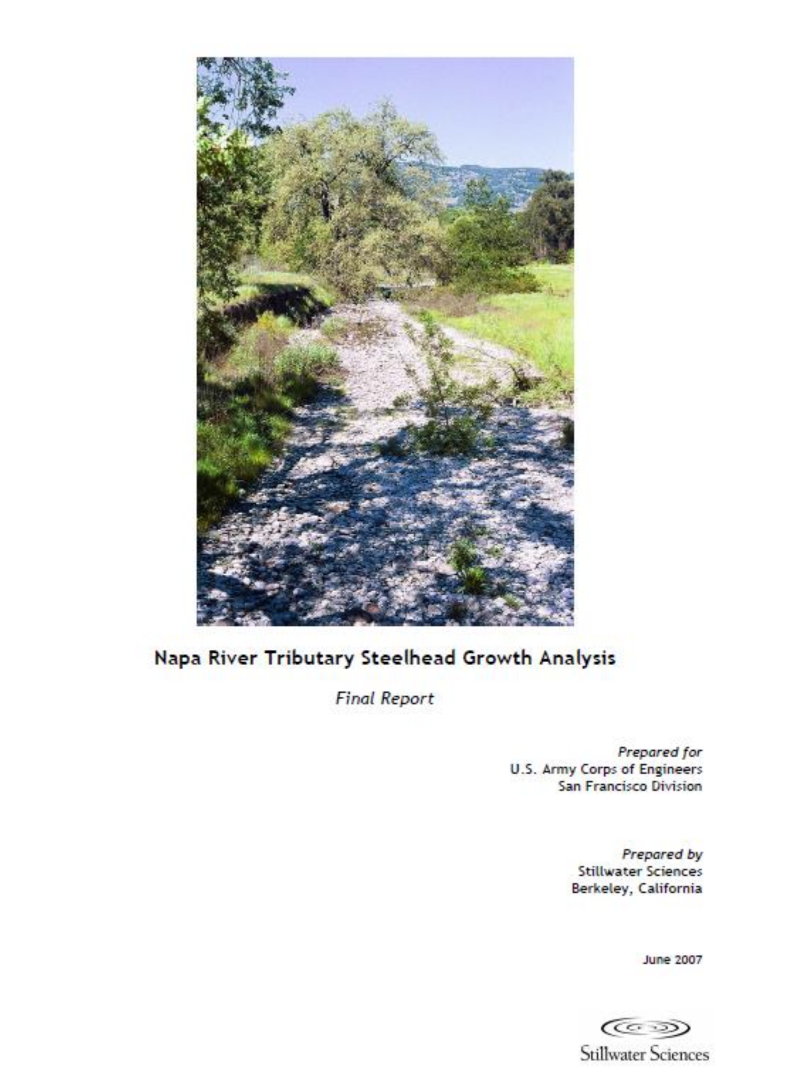
- Fine sediment deposition in salmonid redds may reduce the number of juveniles (high sediment loading)-likely not limiting steelhead population
- High stream temperatures limit summer growth
- Little LWD in the channels
- Extensive barriers to migration
- Simplified channel form limits habitat diversity and cover


NAPA RIVER: CHANNEL GRADIENT AND EXTENT OF ANADROMY
Watershed Boundary
Extent of Anadromy
Channel Gradient
> 1%
1% - 2%
2% - 5%
5% - 7%
> 7%
MAP LOCATION
Sacramento
Napa
San Francisco
San Pablo Bay
Ritchie Creek
Mill Creek
York Creek
Sulphur Creek
Napa River
Conn Cr.
Sage Creek
Moore Creek
Canyon Creek
Rector Creek
Dry Creek
Redwood Cr.
Pickle Canyon Creek
Soda Creek
Milliken Creek
Sarco Creek
Napa Creek
Tulucay Cr.
Carneros Creek
Suscol Creek
Data Sources:
Channel Gradient: SWS, from 1-m 2003 LiDAR
Anadromy: Napa RCD
Watershed Boundary: SWS, from modified USGS 10-m DEM
Cities, Roads, Waterbodies: ESRI, 2010
Hillshade Tint: Natural Earth, 2010
Stillwater Sciences
www.stillwatersci.com


Surface Water Flow Categories
> 1 cfs
0.5 - 1 cfs
< 0.5 cfs
Detectable flow (unmeasured)
Stagnant
Semi-wetted
Dry
CALISTOGA
ANGWIN
ST HELENA
YOUNTVILLE
NAPA
N
SOURCES:
Stillwater Sciences
Cities: County of Napa
0 mi
3 mi
Stillwater Sciences
April, 2002


Potential Barriers and Impediments to Fish Passage
Reported locations of dams or other barriers
Roads crossing streams
In-channel impoundments or lakes
CALISTOGA
ANGWIN
ST HELENA
YOUNTVILLE
NAPA
N
SOURCES:
Stillwater Sciences
Cities: County of Napa
0 mi
3 mi
Stillwater Sciences
April, 2002

Napa River Tributary Growth Analysis (Phase 2 report)


Napa River Tributary Steelhead Growth Analysis

Final Report

Prepared for
U.S. Army Corps of Engineers
San Francisco Division

Prepared by
Stillwater Sciences
Berkeley, California

June 2007

Stillwater Sciences

Measurements

- 12 study reaches in 5 tributaries
- Measured juvenile growth in summer/fall, winter, and spring
- Food availability
- Channel morphology
- Water temperature

Findings

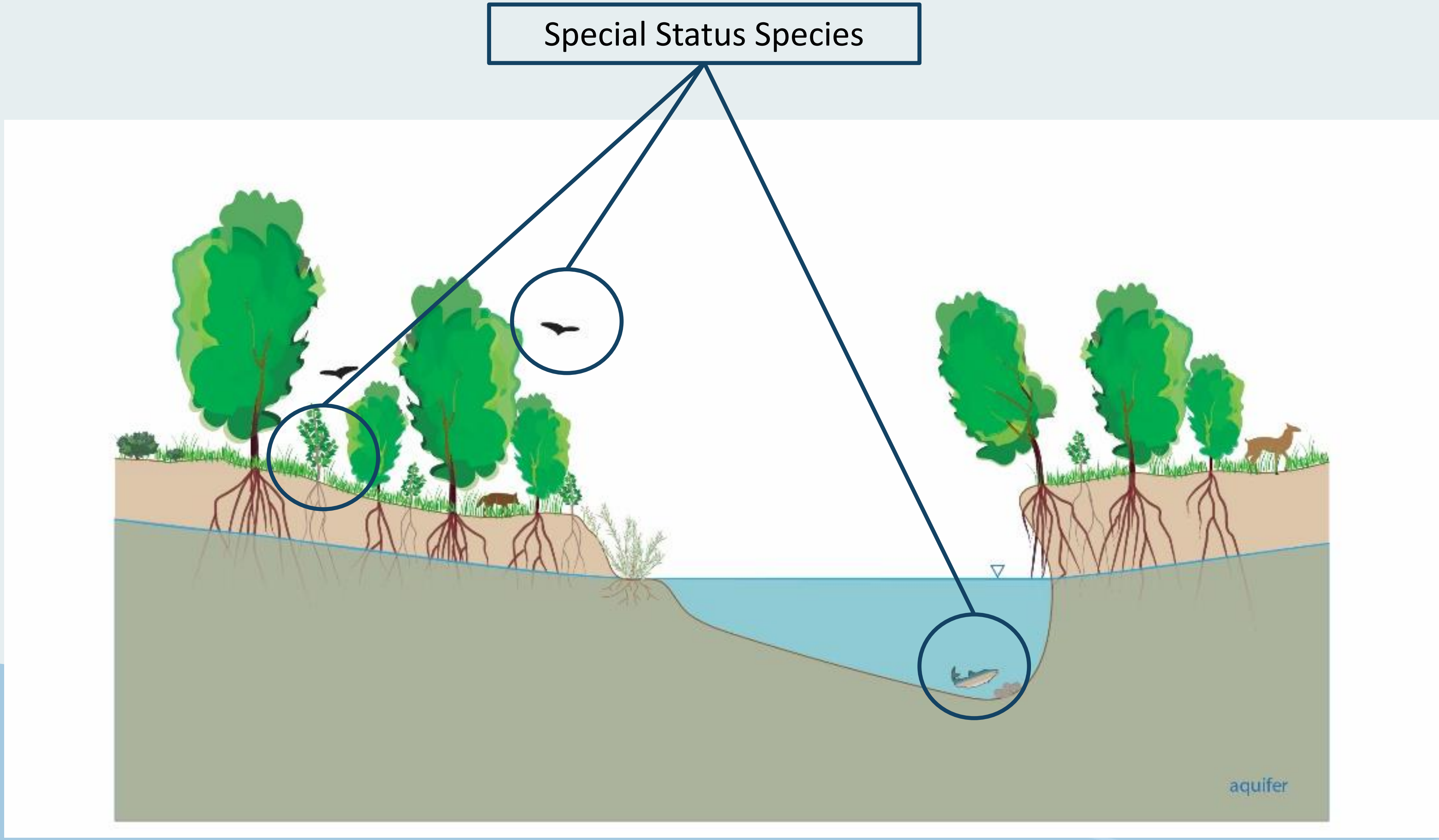
- High stream temperatures and low food availability limited summer juvenile steelhead growth
- This was somewhat balanced by growth in the subsequent spring when food was more available (during a wet year)

Stillwater Sciences (2007)

Rector Creek

- Stillwater Sciences has been studying the hydrology, fish occurrence, and connectivity of Rector Creek downstream of Rector Dam since 2018.
- Generally connected in the winter
- Supports disconnected isolated pools at its downstream end in the summer
- Native fish present with few exotics
- No observed steelhead spawning habitat but some rearing habitat was identified

Sensitive Species



Braudrick et al., 2018 (figure by K. Rodriguez and A. Merrill)

Fish and Wildlife-Special Status species

(Source: Napa GSP)

Foothill yellow-legged frog

Ryan Peek

Central California Coast steelhead

Peter LaTourrette

Saltmarsh common yellowthroat

California freshwater shrimp

Photo by Harry McGrath

Longfin smelt

Tricolored blackbird

Plants –Special Status
(Source: Napa GSP)

Contra Costa Goldfields

CDFW photo by Jeb Bjerke

Napa Blue grass

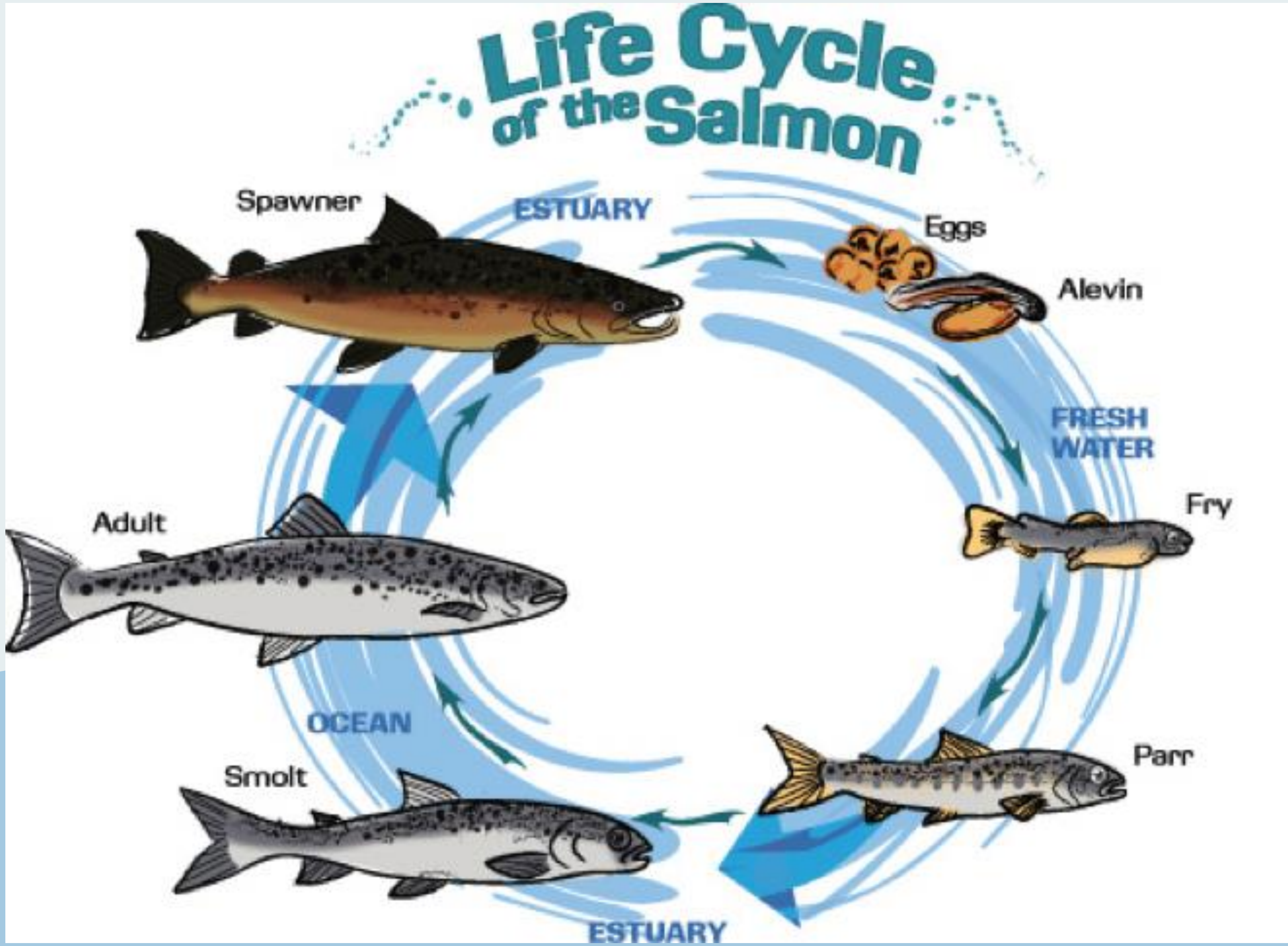
CDFW photo by Marianne McDermon

Focus on steelhead

- Source: Napa County RCD

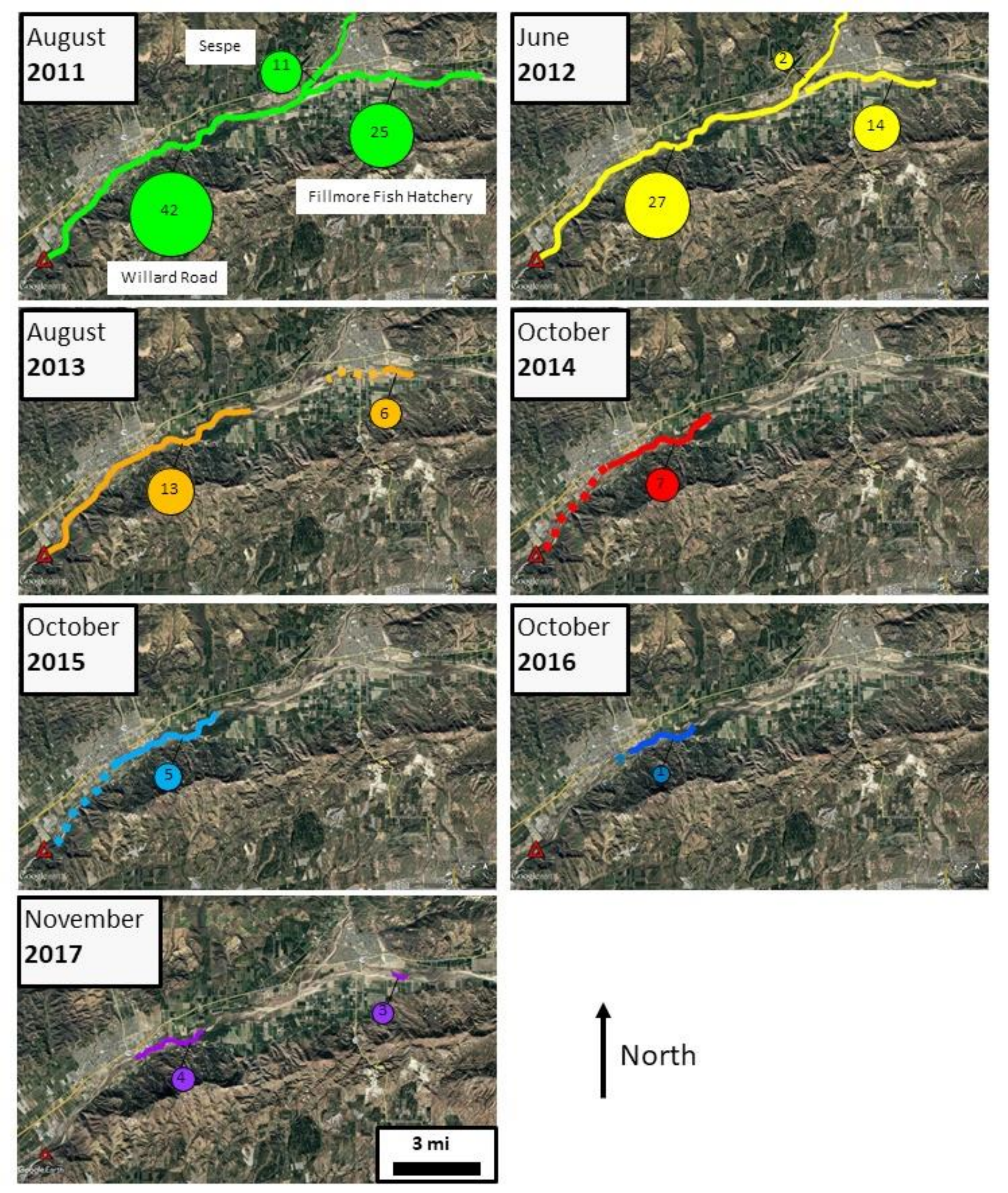
Assess flow requirements for each lifestage

- Assess the spatial distribution of fish usage for each life stage (e.g., spawning, rearing, passage, etc.)
- Assess the role of surface flows and interconnected water on each lifestage.
- Can use the groundwater model to assess the effects of groundwater management on surface discharge…then need to use a different model to assess the effects of fish passage.



Examples from other projects

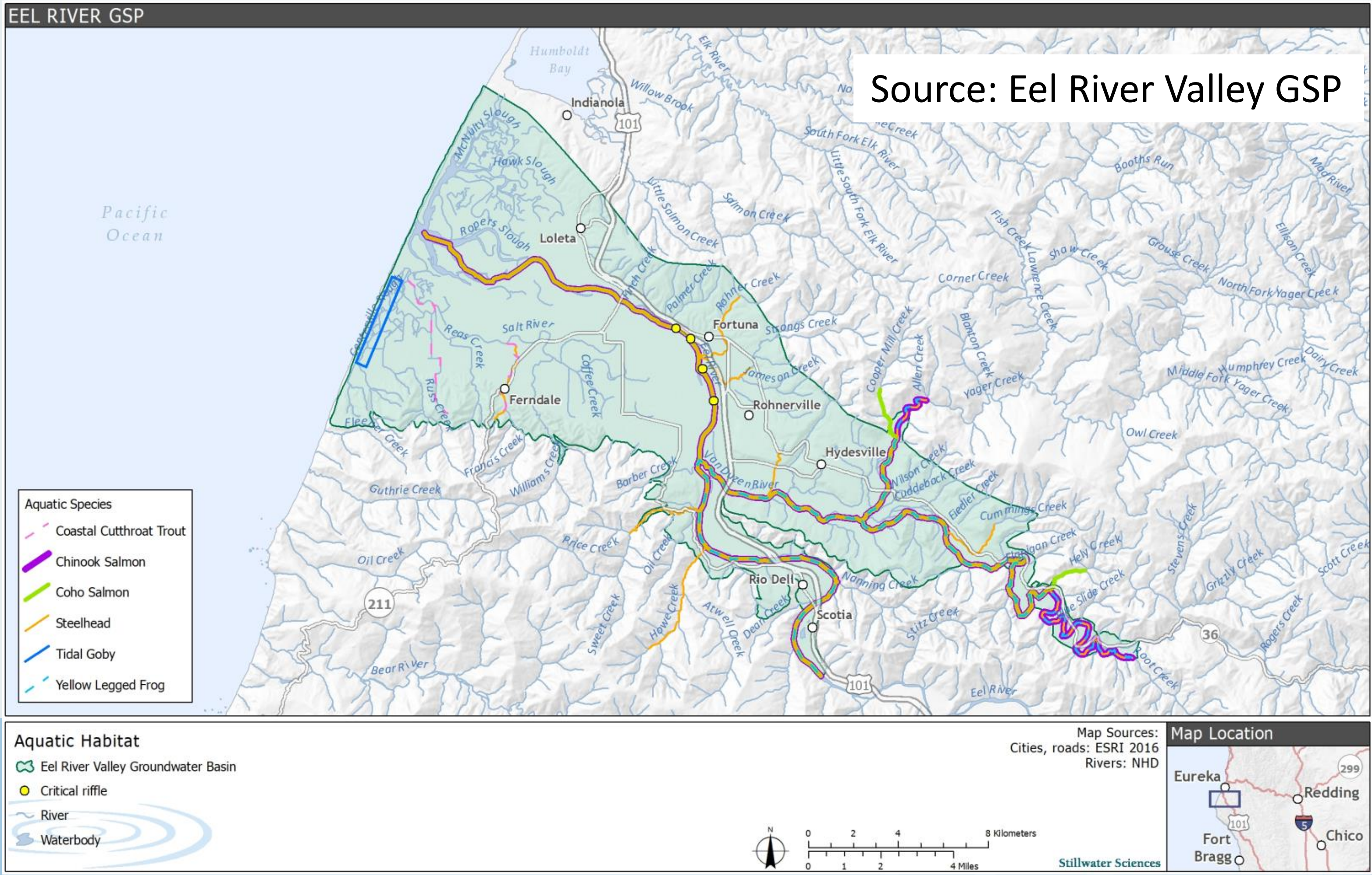
1. Fillmore and Piru groundwater basins (Santa Clara River, CA). Approach used the groundwater model to assess the effect of pumping on fish passage. The maximum pumping effect was a small fraction of the 800 cfs required to get fish into the reach.
2. Groundwater models and passage models occur at different temporal scales (in this case it ended up not mattering)



Source: Fillmore and Piru Basins GSP

Examples from other projects-Eel River

1. Eel River groundwater subbasin. Used a groundwater model to assess pumping effects of flow (and stage), to assess known fish passage discharge. Annual changes to channel morphology had a profound effect on flow requirements at critical riffles



What about other species?

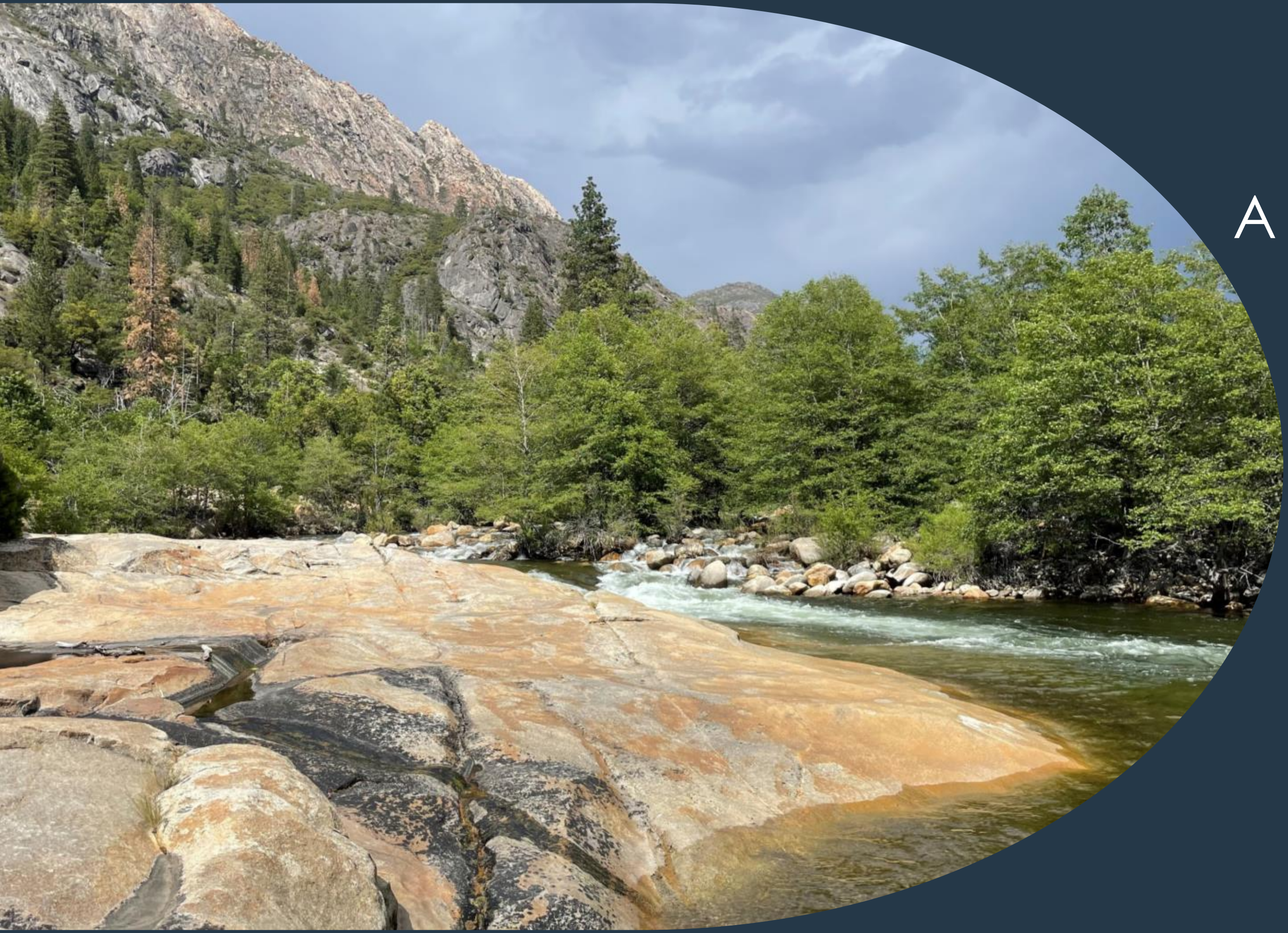
- Need to develop maps of species occurrence (if not already completed)
- Assess water sources and role of groundwater for different lifestages
- Use literature to develop any thresholds (flow, temperature, timing, etc.) for either species or habitats they depend on (e.g., wetlands)
- Assess effect of groundwater pumping


Ryan Peek

Summary

- The Napa Valley groundwater basin supports aquatic and terrestrial GDEs
- Limiting factors for steelhead in the Napa Basin related to ISW include water temperature and food availability (due to connectivity) among other factors
- Models can be used to assess habitat availability for different life stages of steelhead depending on usage in the basin
- A similar approach can be used to assess other species, depending on information about habitat needs

CEFF Applications: Instream Flows & CDFW



Alyssa Obester & Alex Milward
CDFW Water Branch
Instream Flow Program

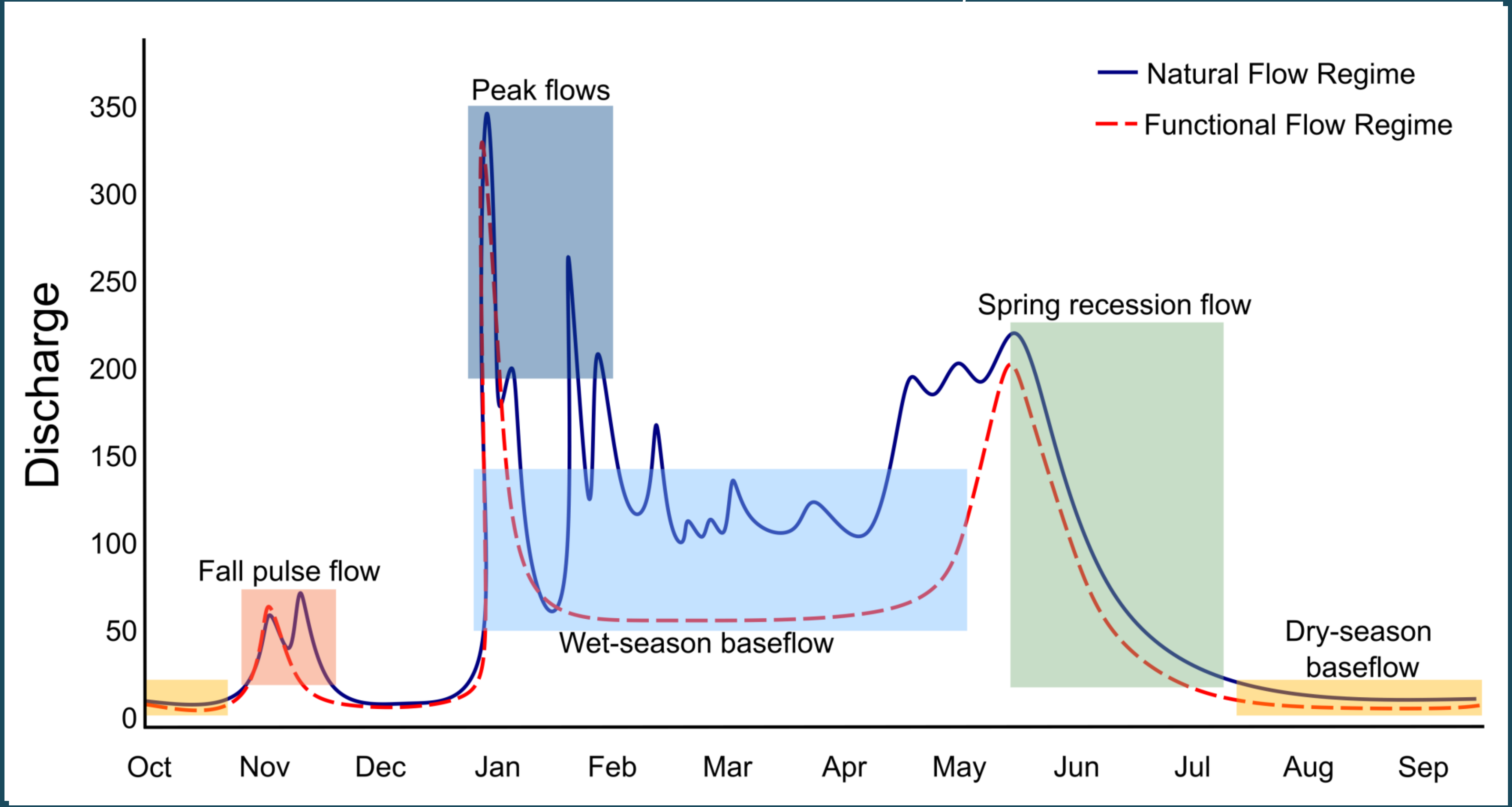
September 8, 2022

WATER BRANCH

CALIFORNIA DEPARTMENT OF FISH & WILDLIFE

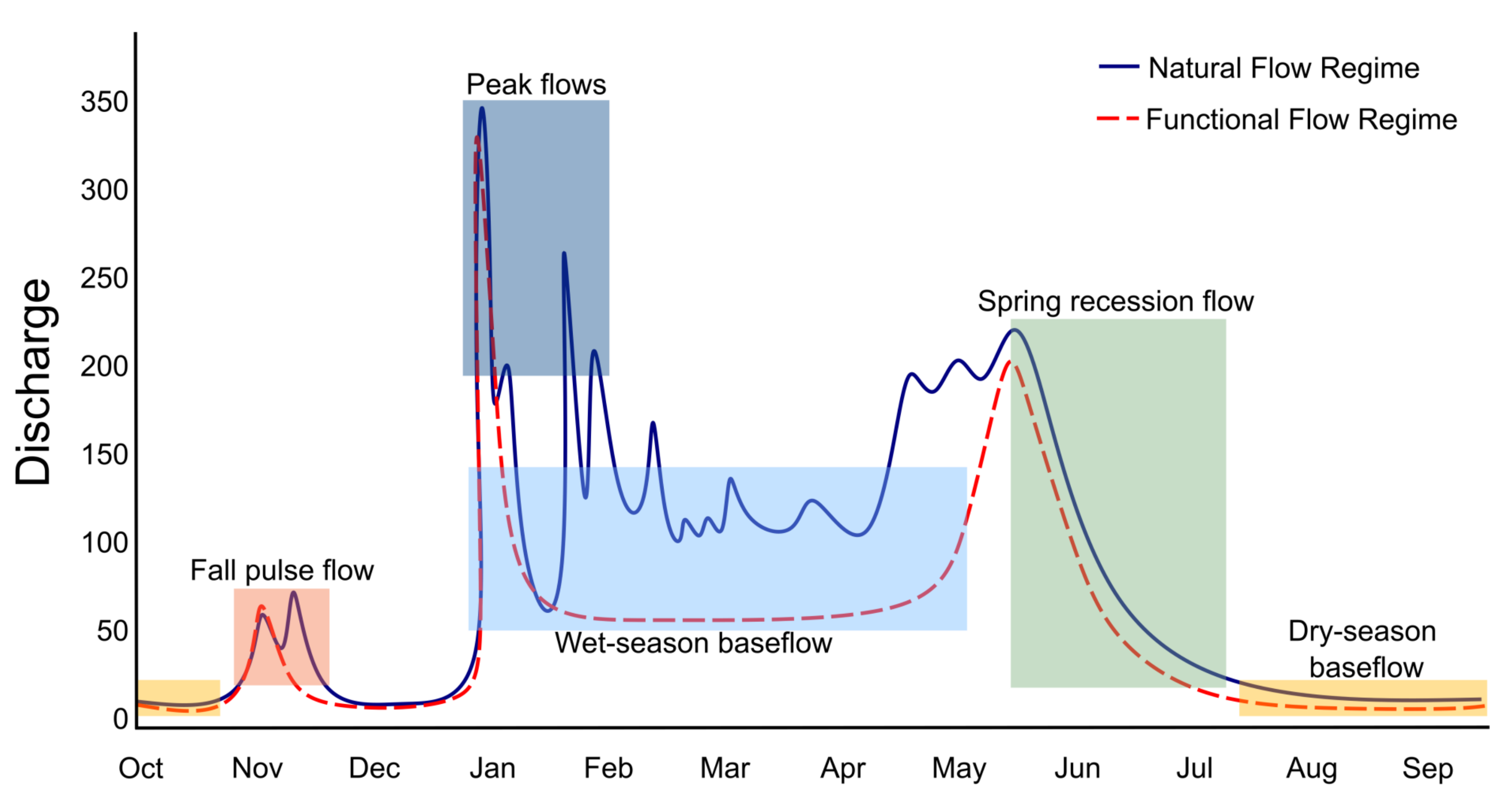
Functional Flows

Adapted from Yarnell et al. 2020



*Key functions and flows that would exist under **natural conditions***

Functional Flows



Functional flow metrics available at rivers.codefornature.org

Flow Component	Flow Metric
Fall pulse flow	Magnitude (cfs)
	Timing (date)
	Duration (days)
Wet-season base flow	Magnitude (cfs)
	Timing (date)
	Duration (days)
Wet-season peak flow	Magnitude (cfs)
	Duration (days)
	Frequency (# of occurrences)
Spring recession flow	Magnitude (cfs)
	Timing (date)
	Duration (days)
	Rate of change (%)
Dry-season base flow	Magnitude (cfs)
	Timing (date)
	Duration (days)

Metrics quantify flow components

Functional Flows

Metric	Wet Years	Moderate Years	Dry Years
Fall pulse flow magnitude (cfs)	534 (150–3,600)	490 (423–948)	402 (269–609)
Fall pulse flow duration (total days per year, when present)	3 (2–6)	4 (2–6)	5 (3–6)
Fall pulse flow start timing	Oct 11 (Oct 5–Oct 29)	Oct 23 (Oct 13–Nov 8)	Oct 18 (Oct 7–Nov 15)
Wet-season baseflow magnitude (cfs)	1,004 (604–1,309)	654 (401–916)	414 (331–672)
Median wet-season flow magnitude (cfs)	3,725 (2,394–5,722)	2,290 (1,360–2,650)	1,300 (913–1,804)
Wet-season duration (days)	135 (102–164)	153 (119–187)	131 (113–164)
Wet-season start timing	Nov 16 (Oct 19–Dec 5)	Nov 21 (Oct 15–Dec 23)	Nov 22 (Nov 3–Jan 1)
2-year peak flow magnitude (cfs)	40,300	40,300	40,300
2-year peak flow duration (total days per year, when present)	4 (1–6)	2 (1–2)	1
2-year peak flow frequency (events per year, when present)	2 (1–3)	1 (1–2)	1
5-year peak flow magnitude (cfs)	70,000	70,000	–
5-year peak flow duration (total days per year, when present)	2 (1–3)	1	–
5-year peak flow frequency (events per year, when present)	1 (1–2)	1	–
Spring recession flow magnitude (cfs)	8,430 (4,424–36,690)	4,680 (2,940–12,100)	4,870 (2,602–9,770)
Spring recession flow duration (days)	34 (28–73)	40 (26–49)	39 (30–54)
Spring recession flow start timing	Mar 29 (Mar 3–Apr 22)	Apr 17 (Apr 9–May 26)	Apr 3 (Mar 19–May 13)
Spring recession flow rate of change (%)	6 (5–8)	5 (4–7)	5
Dry-season baseflow magnitude (cfs)	92 (68–122)	93 (63–110)	69 (59–97)
Dry-season duration (days)	218 (183–240)	165 (139–178)	190 (150–226)
Dry-season start timing	May 9 (Apr 21–May 31)	Jun 1 (May 11–Jun 24)	May 14 (Apr 23–Jun 18)

Functional flow metrics available at rivers.codefornature.org

Functional Flows Summary

- Function and process-focused approach
- Based on natural hydrologic patterns
- Broadly *ecologically* protective
  - Not species or life-stage specific
- Does not account for human water use

California Environmental Flows Framework (CEFF)

- Uses functional flows to represent ecological flow needs
- Provides technical guidance and tools for managers to develop environmental flows
- Not regulatory or prescriptive

https://ceff.ucdavis.edu

CA Environmental Flows Framework (CEFF)

↑

Technical Team → CA Environmental Flows Working Group

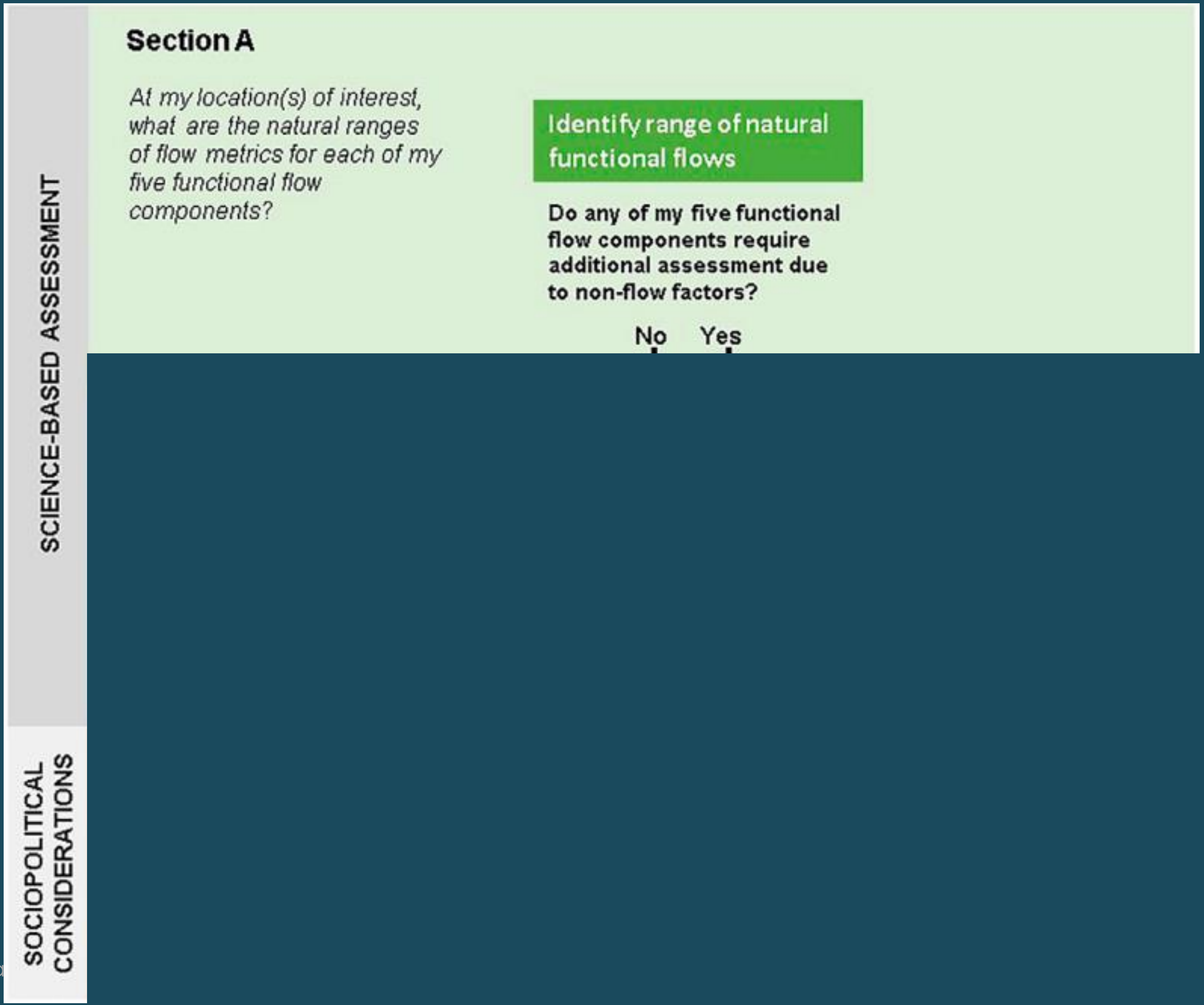
↑

CA Water Quality Council

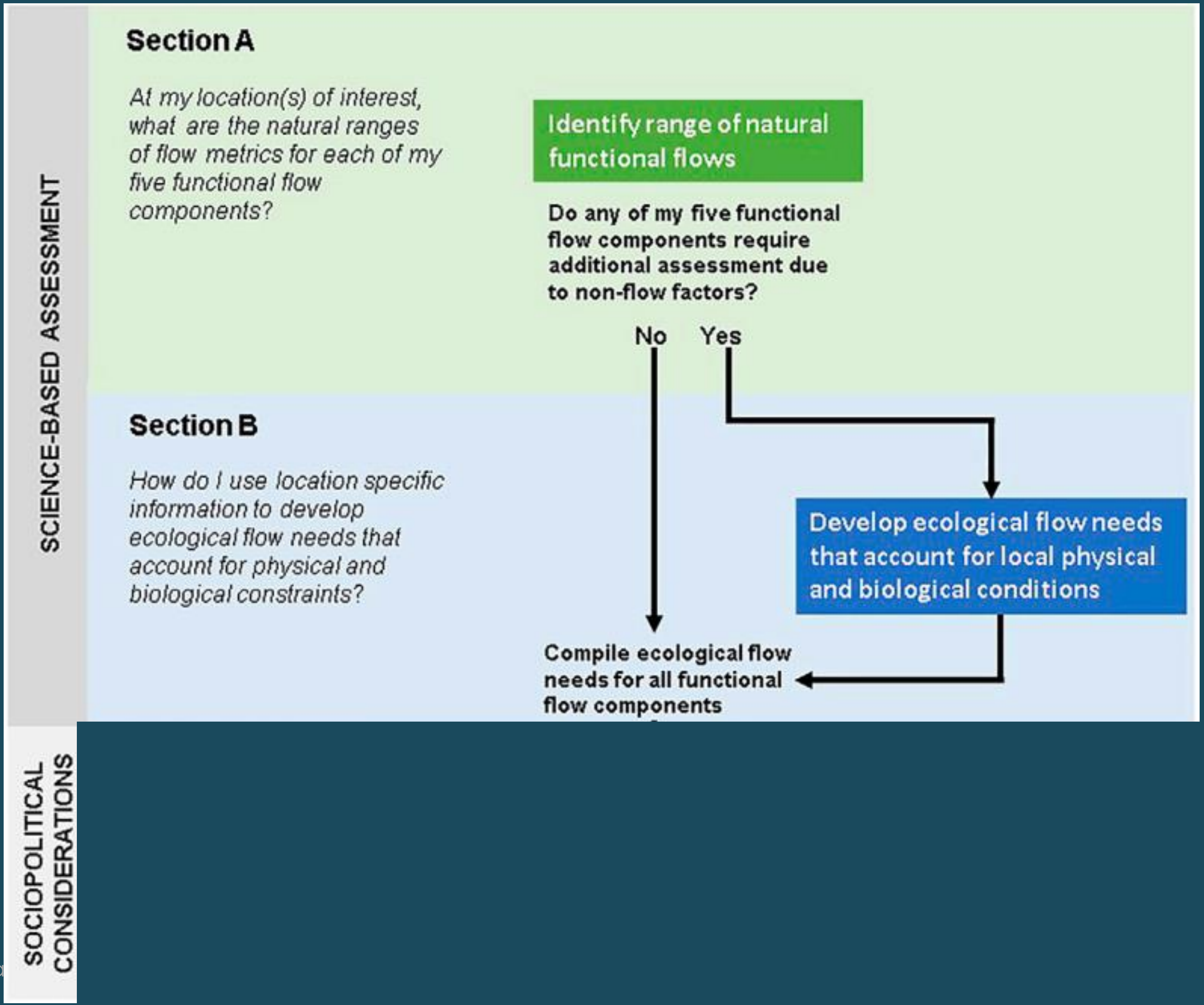
You're welcome to join the CA Environmental Flows Working Group quarterly meetings (open to the public)
https://www.waterboards.ca.gov/resources/email_subscriptions/swrcb_subscribe.html >"General Interests"

See previous meetings
https://mywaterquality.ca.gov/monitoring_council/environmental_flows_workgroup/meetings.html

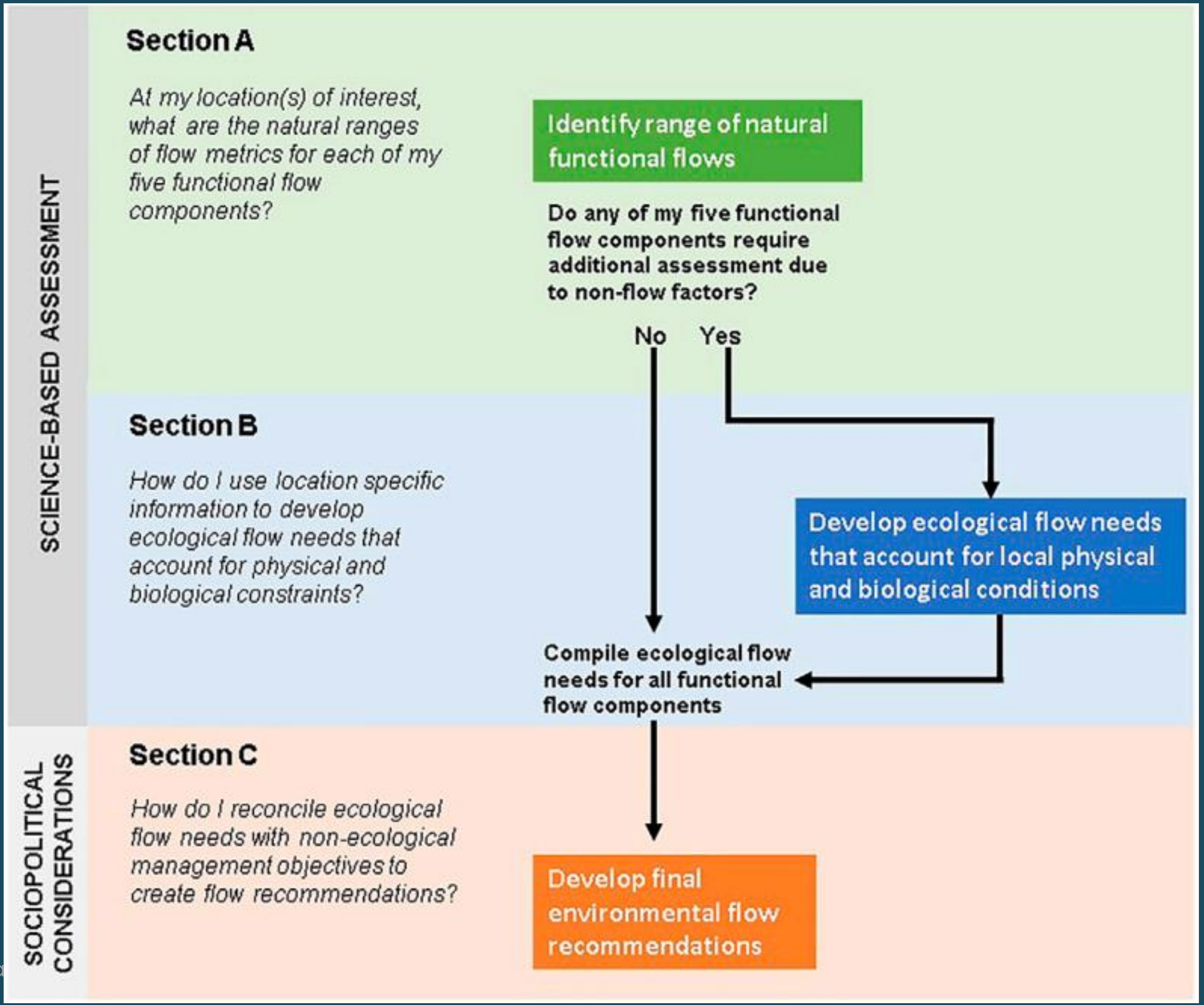
CEFF Overview



CEFF Overview



CEFF Overview



Tools associated with CEFF

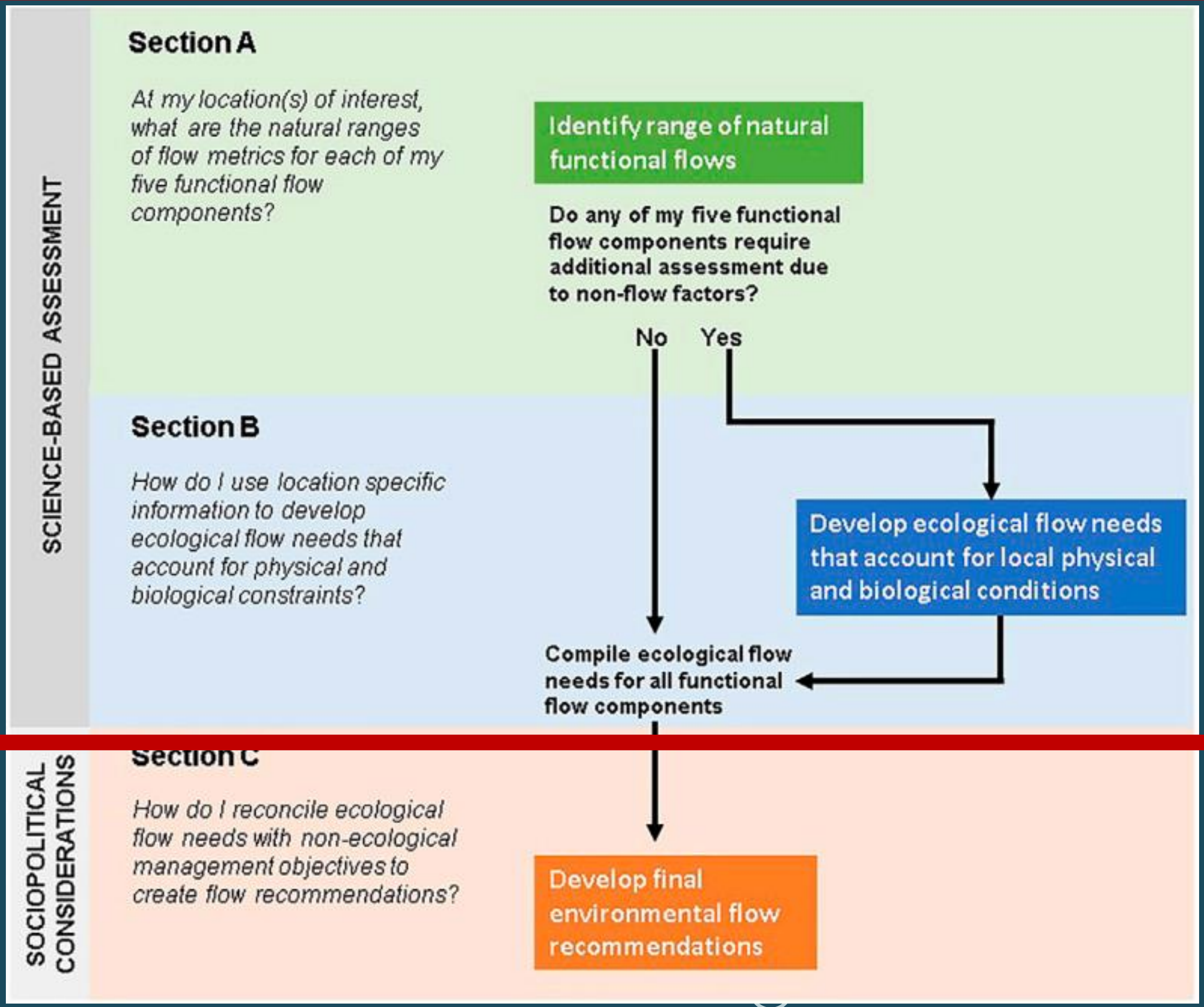
- Hydrologic classification of stream types available at eflows.ucdavis.edu
- Modeled natural functional flow metrics available at rivers.codefornature.org
- Modeled monthly natural flows available at rivers.codefornature.org

Modeled natural flows and functional flow metrics available at rivers.codefornature.org

CDFW's Instream Flow Program

- Develop instream flows required to maintain healthy conditions for aquatic and riparian species
- Provide technical, flow-related support to CDFW regional staff
  - Site-specific, technical instream flow studies
  - Desktop-based flow criteria
  - Flow information to support drought, other regulatory processes

CDFW's Instream Flow Program



CDFW involvement

Flow study

Flow criteria

Flow recommendations

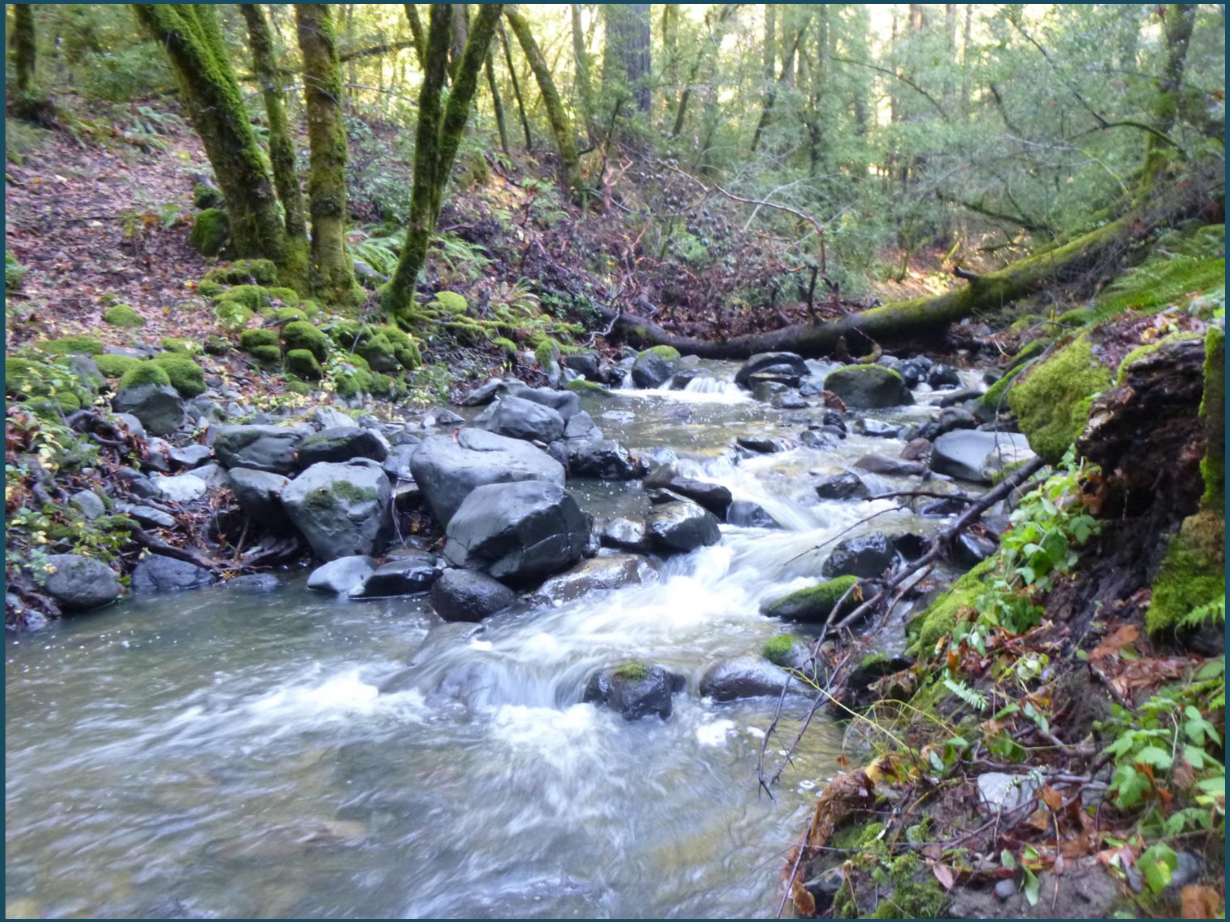
Flow objectives & other water allocation decisions

CDFW CEFF Involvement

- Member of Technical Team
  - Assist in Framework development, provide feedback, test tools
- Participate in Eflows Workgroup Meetings
- Serve as CDFW's "CEFF resource"
  - Provide CEFF trainings to staff

CEFF Applications: Watershed Criteria Reports

- Rapid approach for developing watershed-wide flow criteria
- Developed using hydrologic and modeling tools – no data collection required
- Can be combined with site-specific data, when available



CEFF Applications: Watershed Criteria Reports

Functional Flows

What are the flows that preserve the ecological and physical processes throughout the year and across years?

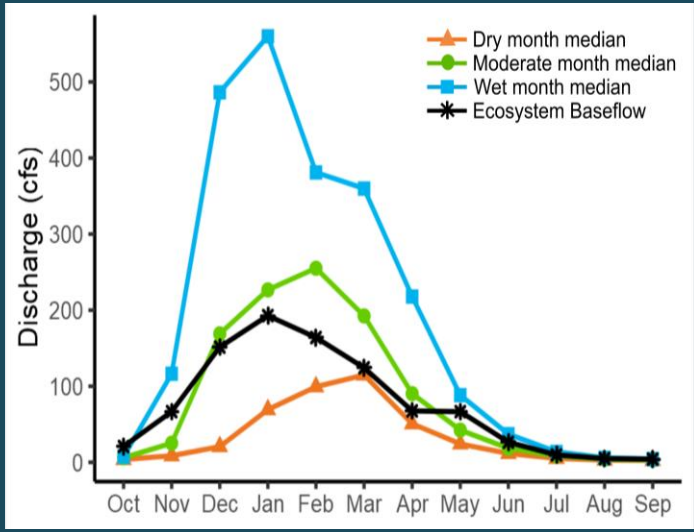
Metric	Wet Years	Moderate Years	Dry Years
Fall pulse flow magnitude (cfs)	400 (180–1,400)	300(185–1,400)	150 (75–450)
Fall pulse flow duration (total days per year, when present)	3 (2–6)	3 (2–5)	6 (3–9)
Fall pulse flow start timing	Oct 20 (Oct 11–Oct 31)	Oct 15 (Oct 3–Nov 13)	Oct 16 (Oct 9–Nov 11)
Wet-season baseflow magnitude (cfs)	1500 (1,096–2,502)	900 (605–1,217)	500 (300–700)
Median wet-season flow magnitude (cfs)	400 (250–700)	300 (200–450)	130 (75–230)
Wet-season duration (days)	150 (97–175)	140 (118–176)	120 (70–163)
Wet-season start timing	Nov 15 (Oct 20–Dec 15)	Nov 20 (Nov 6–Dec 28)	Dec 15 (Nov 13–Jan 3)

+

Additional Analyses

What are specific ecosystem and species-specific flow targets?

Stream	Drainage Area (mi^2)	Juvenile Steelhead Optimum Flows (cfs)
6) Mark West Creek 3	36.2	30
5) Mark West Creek 2	52.1	34
1) Mark West Creek 1	254.4	73



CEFF Applications: Watershed Criteria Reports

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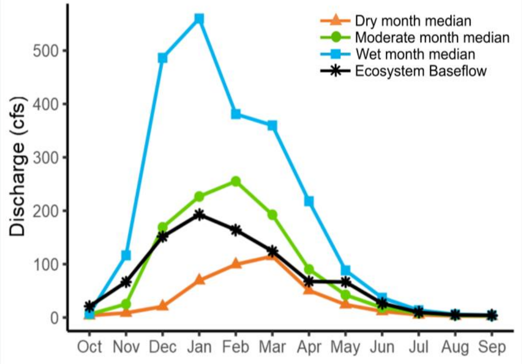
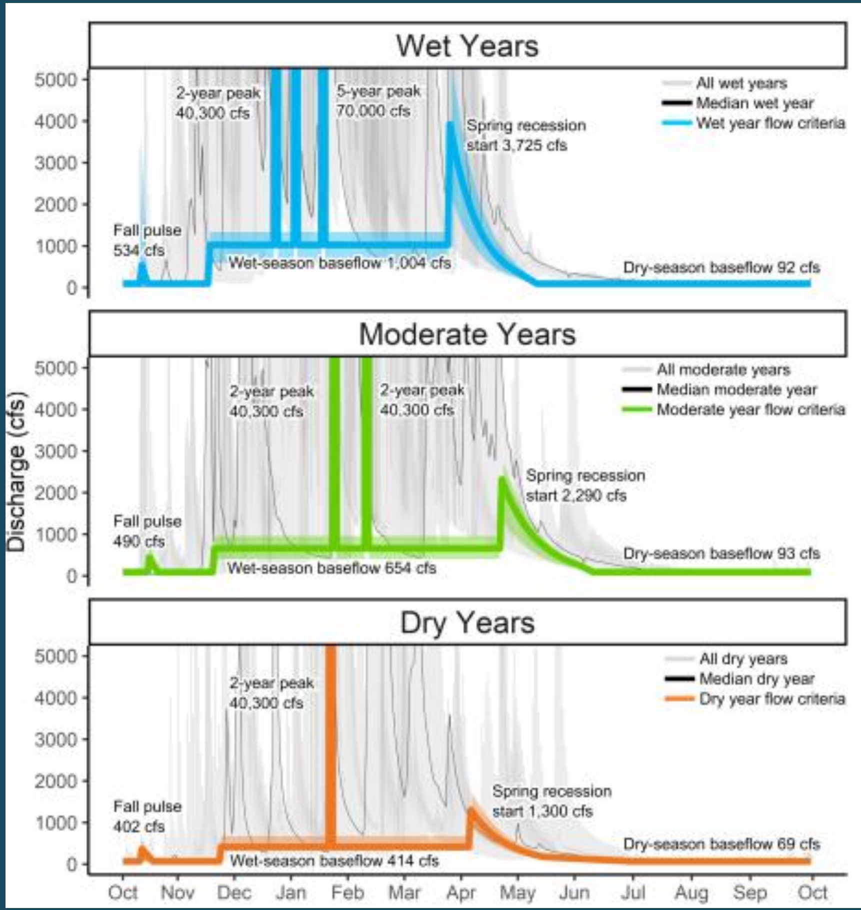
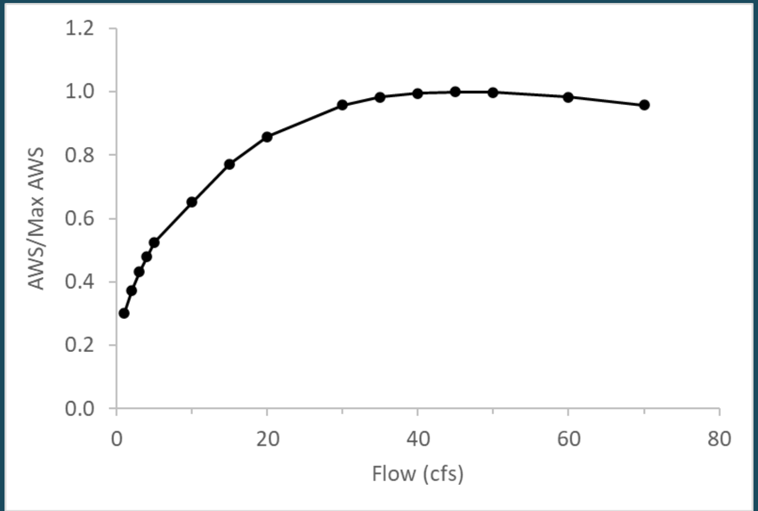


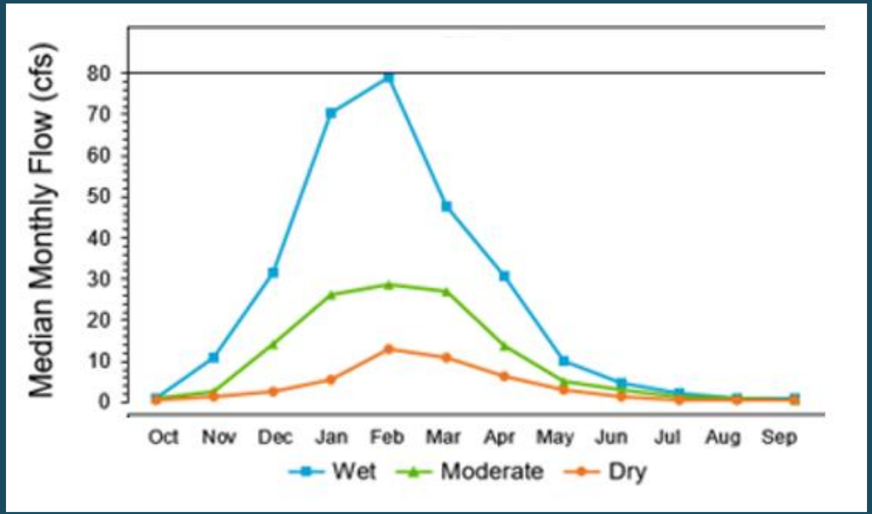


Water Year Type	Wet Season Nov-Mar	Spring Recession Week 1	Spring Recession Week 2	Spring Recession Week 3	Spring Recession Week 4	Spring Recession Week 5	Spring Recession Week 6	Spring Recession Week 7	Spring Recession Week 8	Spring Recession Week 9	Spring Recession Week 10	Dry Season May-Oct
Wet	1,004[†]	3,118	2,022	1,311	850	551	358	232	150	97	-	92[‡]
Moderate	654[†]	1,974	1,378	963	672	469	328	229	160	112	78	93[‡]
Dry	414[†]	1,120	782	546	382	266	186	130	91	-	-	69[‡]

CEFF Applications: Refining Field-Based Habitat-Flow Relationships



Streamflow - habitat suitability relationship



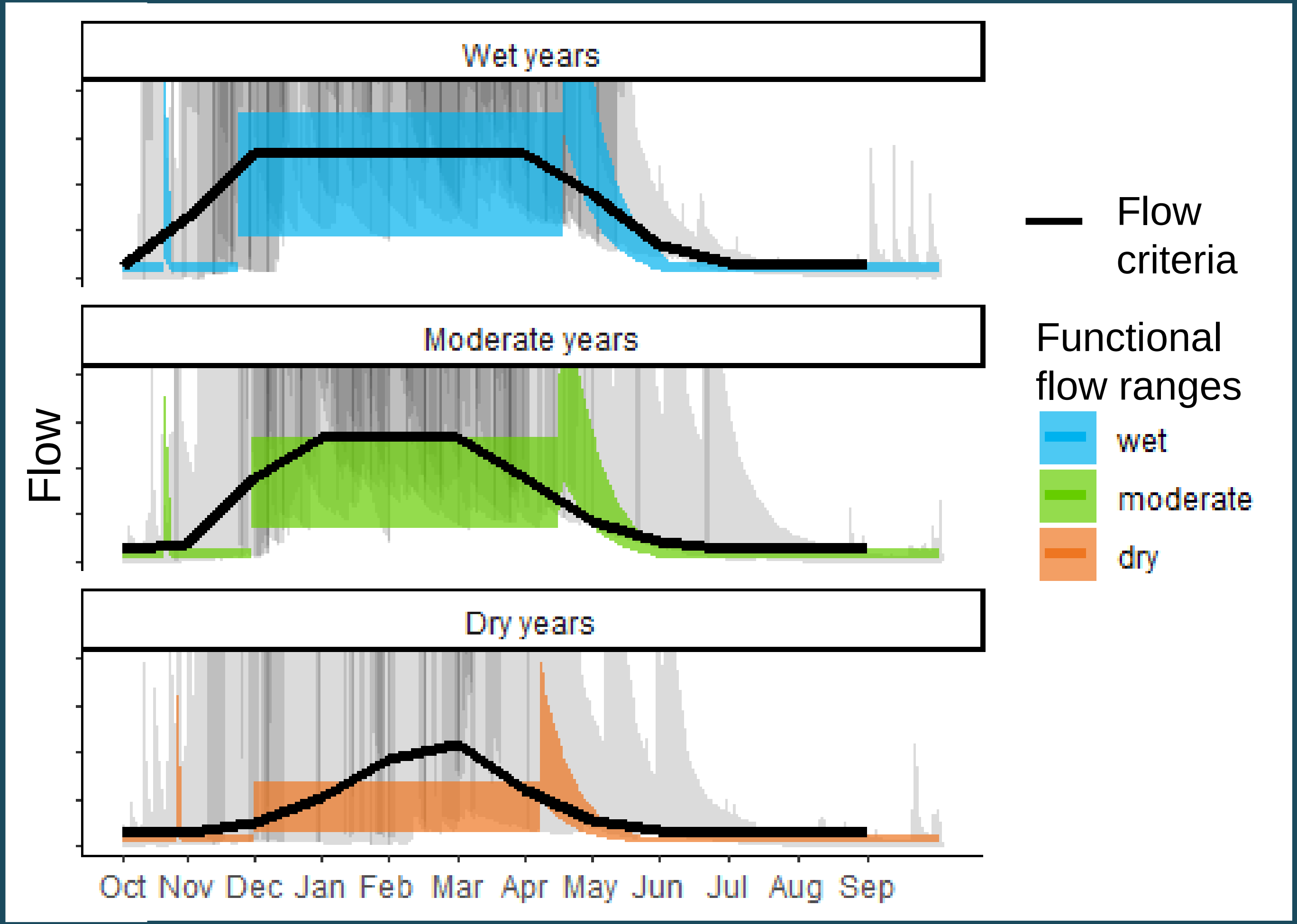
Estimated natural hydrology from Natural Flows Database

Month	Moderate Water Month Type
January	26
February	29
March	27
April	14
May	5
June	3
July	1
August	1
September	1
October	1
November	3
December	14

Green Line
Results table

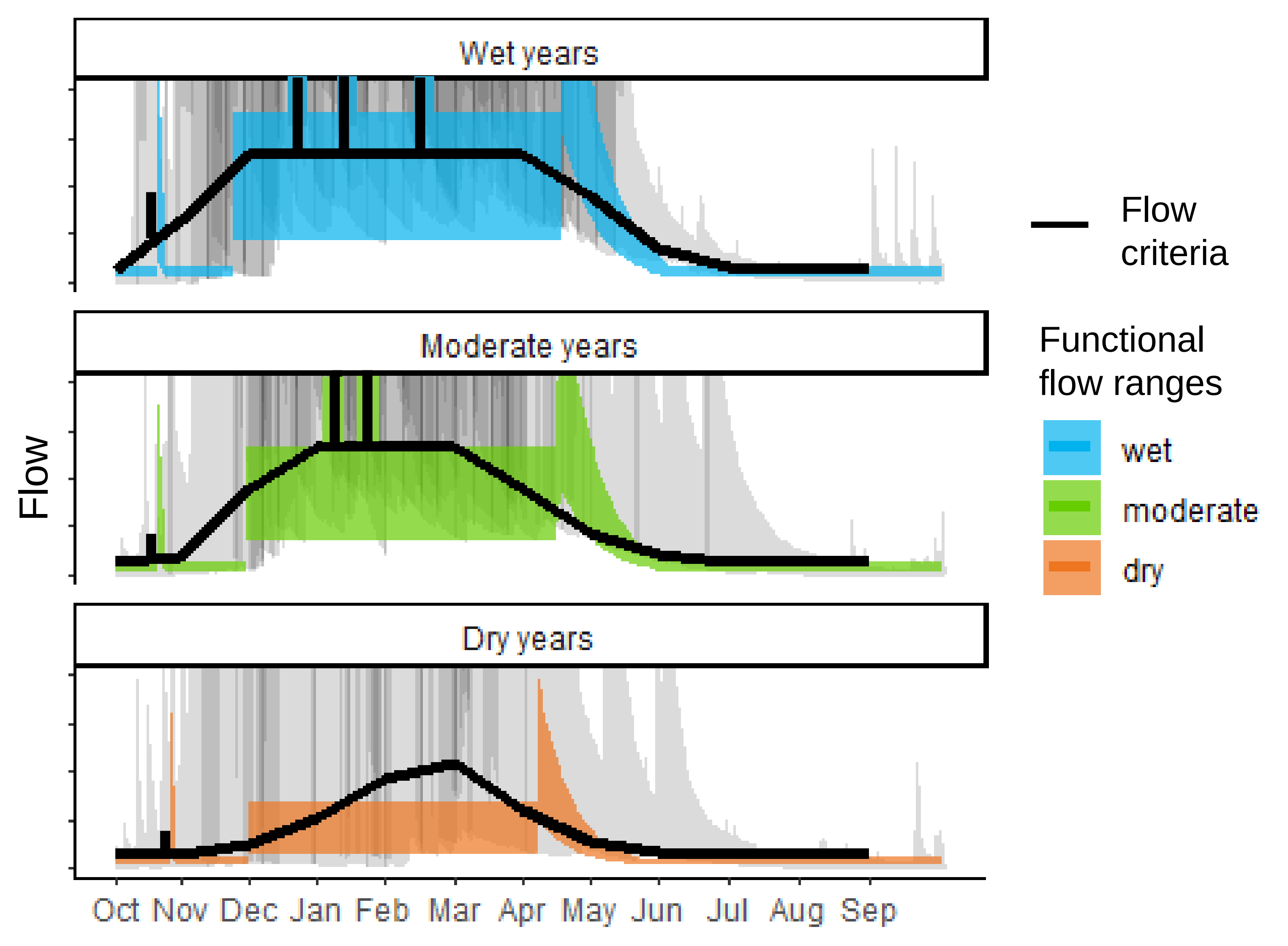
CEFF Applications: Refining Field-Based Flow Criteria

- Assessing whether field-based flow criteria match natural hydrology



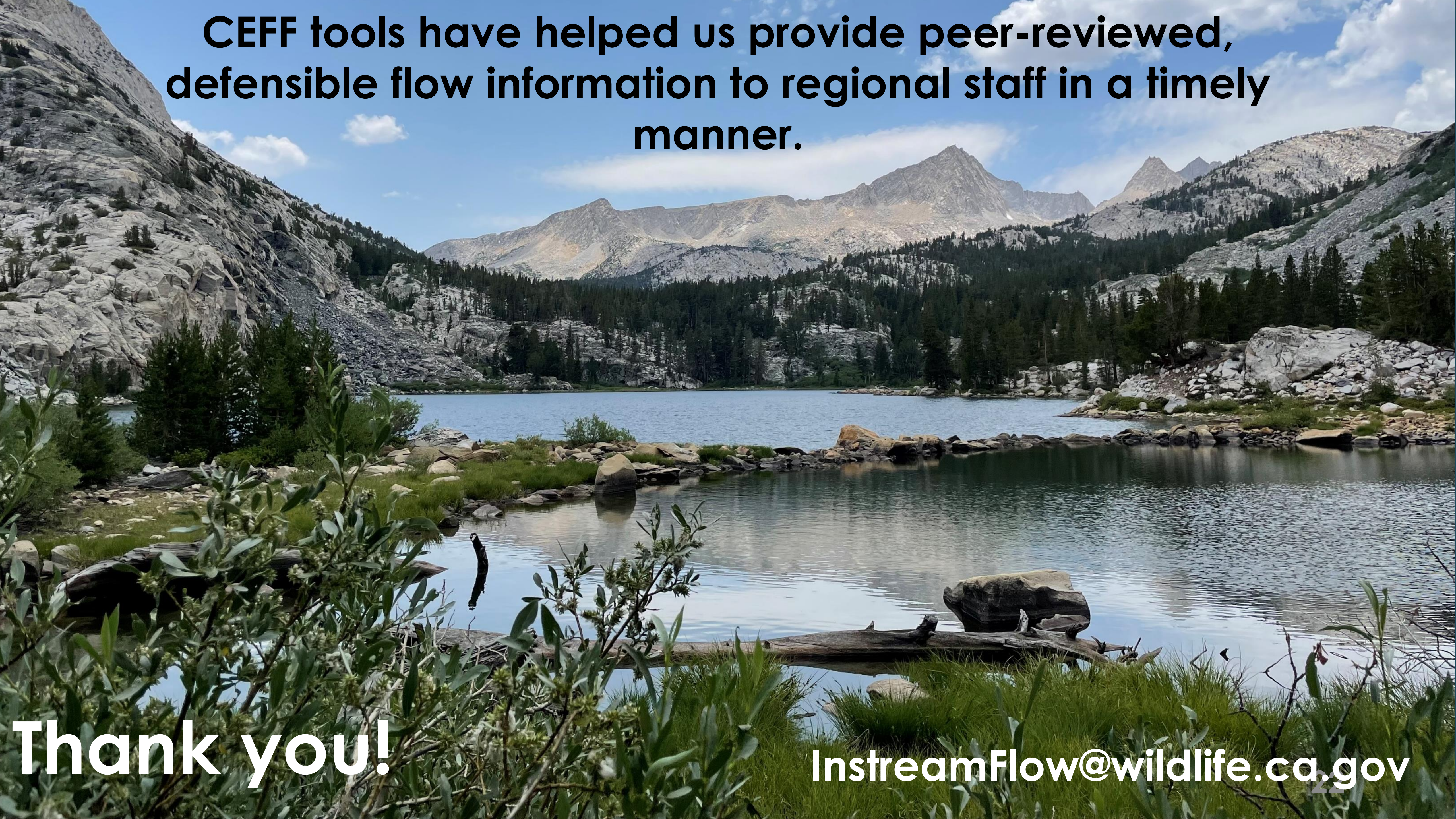
CEFF Applications: Refining Field-Based Flow Criteria

- Incorporating variability (pulse and peak flows) to baseflow-focused criteria



ADDITIONAL APPLICATIONS

- Assisting regions in drafting conditions for FERC licenses
- Providing flow information for water management
- Providing flow information support to regions during drought to assist with water management discussions



CEFF tools have helped us provide peer-reviewed, defensible flow information to regional staff in a timely manner.

Thank you!

InstreamFlow@wildlife.ca.gov

South Orange County Flow Ecology Study

South Orange County Watershed Management Area

California Environmental Flows Framework (CEFF) Application

Napa County GSA Technical Advisory Group Meeting

September 8, 2022

CEFF Application Highlights

- Highly modified watershed where establishing reference-based flows may be challenging
- Flow modifications are from diffuse non-point sources
- Groundwater may be a significant contributor to summer baseflows

Study Objectives

Develop tools and datasets to inform decisions regarding flow management activities

- Identify when and where flows are altered
- Evaluate degree to which alteration is impacting ecology
- Prioritize areas for flow management

Incorporate input from local stakeholders and technical experts

Provide ready access to data, tools, and products

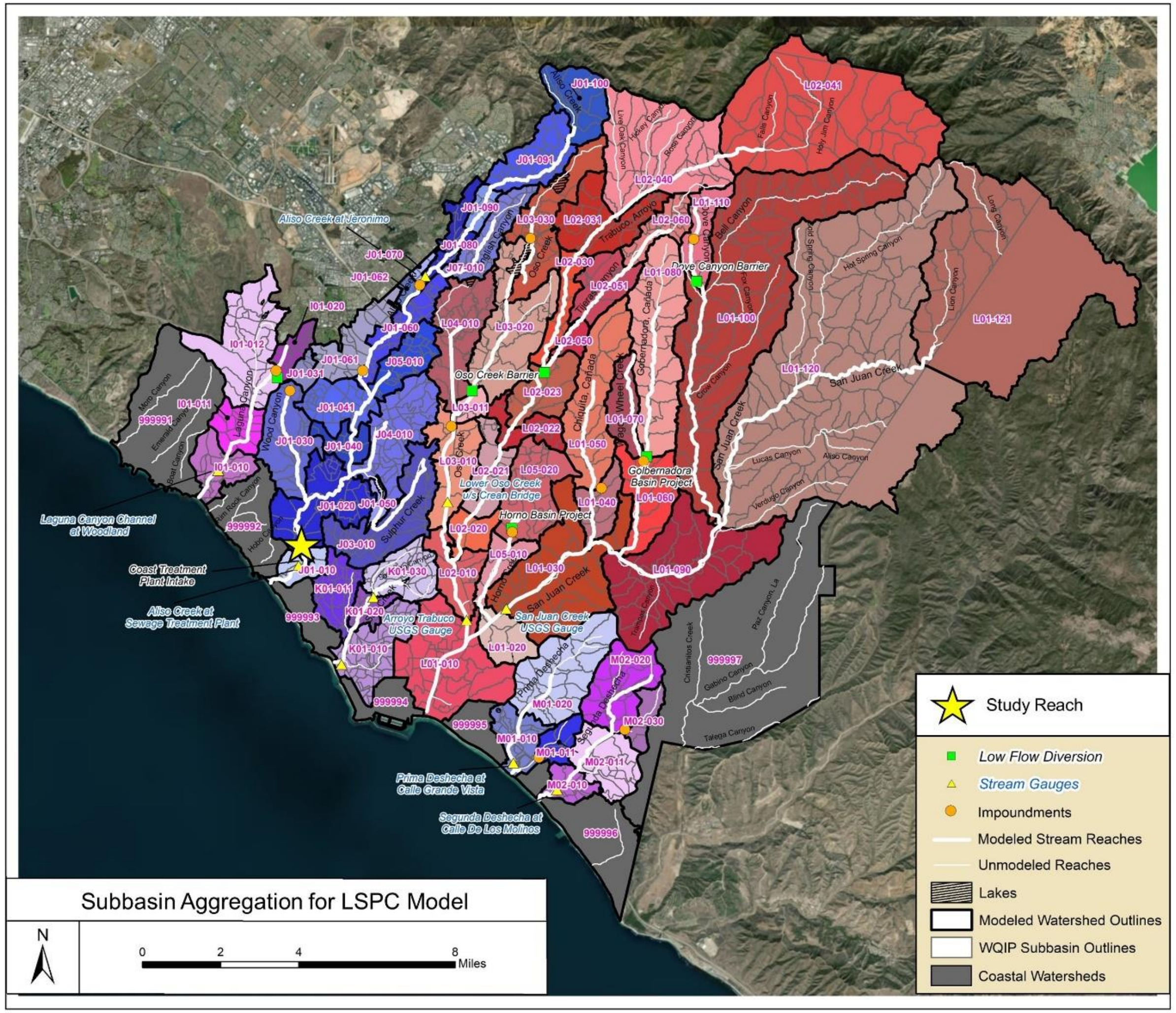
Stakeholder Engagement

- **Online Webinar: July 17, 2019**
  - Overview of the study and context
- **Stakeholder Advisory Group (SAG) Meeting: August 5, 2019**
  - Webinar Q&A summary and discussion
- **Technical Advisory Group (TAG) Meeting: October 22, 2019**
  - Project overview, roles and expectations of TAG
  - Technical approach, including hydrologic model development and calibration
- **TAG/SAG Meeting: January 8, 2020**
  - Tiered approach for ecological assessment
  - Update on hydrologic model development
- **TAG Meeting: June 3, 2020**
  - Hydrologic model calibration
- **SAG Meeting: June 16, 2020**
  - Tier 1 and 2 example outputs
  - Focal species discussion
- **TAG/SAG Meeting: November 12, 2020**
  - Hydrologic model recalibration
- **TAG/SAG Meeting: December 3, 2020**
  - Tiers 1-3 development and interpretation
  - Synthesis of data and key decisions

Study Area

South Orange County, CA
Watershed Management Area

Altered hydrology and channel erosion identified as the highest priority water quality conditions[1]



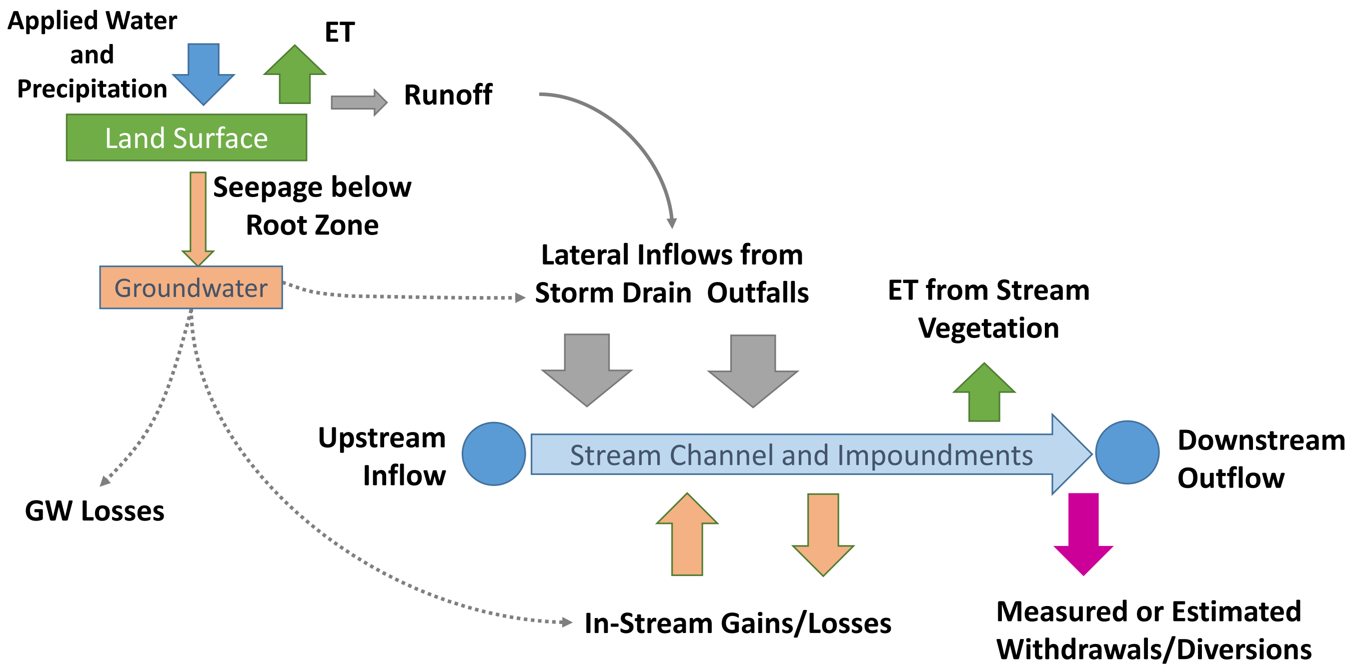
[1]*South OC Watershed Management Area Water Quality Improvement Plan, 2018*

Ecological Management Objectives

- Improve stream flow conditions to benefit overall stream ecosystem health
- Reduce unnatural flows that favor invasive species
- Provide habitat to support federally endangered least Bell's vireo
- Restore habitat for native fish populations

Hydrologic Modeling

- Provided finer temporal and spatial resolution
- Allowed for evaluation of future scenarios
- Utilized isotope analysis to quantify natural versus unnatural water contributions



Used Loading Simulation Program in C++

Current condition

- Current land use and flow management measures
- Recent climate: 1990-2019; Recent irrigation patterns: 2010-2019
- Calibrated to streamflow gages, outfall monitoring, and water isotope data

Reference condition

- Remove urban land, irrigated agriculture, diversions, and impoundments
- Same time period

Future scenarios

- Climate change at mid-century
- Increased water conservation progress

Tiered Flow Ecology Analysis

1 - Hydrologic alteration based on deviation from reference condition

2 - Biologic alteration based on Bioassessment Indices (CSCI and ASCI)

3 - Biologic alteration based on higher trophic level species

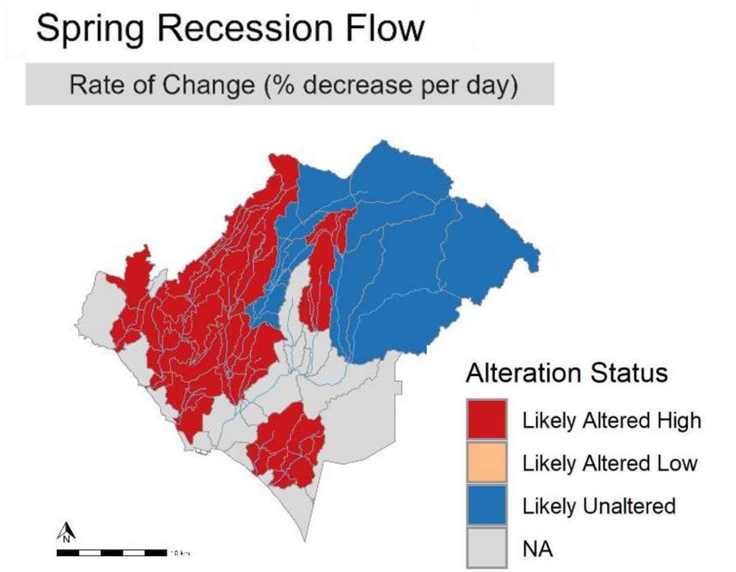
Flow Component	Flow Metric	Natural Range of Flow Metrics median (10th - 90th)	Ecological Flow Criteria: Black Willow	Ecological Flow Criteria: Arroyo Chub
Fall pulse flow	Fall pulse magnitude	2.4 (1.7 - 5) cfs	Same as natural range	Same as natural range
	Fall pulse timing	Nov 29 (Oct 24 - Dec 3)	Same as natural range	Same as natural range
	Fall pulse duration	11 (3 - 16) days	Same as natural range	Same as natural range
Wet-season baseflow	Wet-season baseflow magnitude	3 (2 – 5) cfs	**0.1 – 12 cfs**	**> 120 cfs[a]**
	Wet-season timing	Dec 15 (Oct 10 – Jan 25)	Same as natural range	Same as natural range
	Wet-season duration	67 (30 - 133) days	Same as natural range	Same as natural range
Peak flows	2-year peak flow magnitude	31 cfs	Same as natural range	Same as natural range
	2-year peak flow duration	4 (1 – 25) days	Same as natural range	Same as natural range
	2-year peak flow frequency	2 (1 – 8)	Same as natural range	Same as natural range
	5-year peak flow magnitude	423 cfs	Same as natural range	Same as natural range
	5-year peak flow duration	3 (1 - 6) days	Same as natural range	Same as natural range
	5-year peak flow frequency	3 (1 - 4) event(s)	Same as natural range	Same as natural range
Spring recession flows	Spring recession start magnitude	15 (3 - 528) cfs	**33** - 528 cfs	Same as natural range
	Spring timing	Mar 3 (Feb 22 - Mar 18)	Same as natural range	Same as natural range
	Spring duration	109 (76 - 125) days	Same as natural range	Same as natural range
	Spring rate of change	1.4 (0.9 – 1.9) % decline per day	Same as natural range	Same as natural range
Dry-season baseflow	Dry-season baseflow magnitude	2 (0.5 – 4) cfs	**0.1 – 12 cfs**	**> 120 cfs[a]**
	Dry-season timing	June 20 (May 9 - Jul 10)	Same as natural range	Same as natural range
	Dry-season duration	198 (116 - 220) days	Same as natural range	Same as natural range

Ecological Flow Criteria for Species of Concern

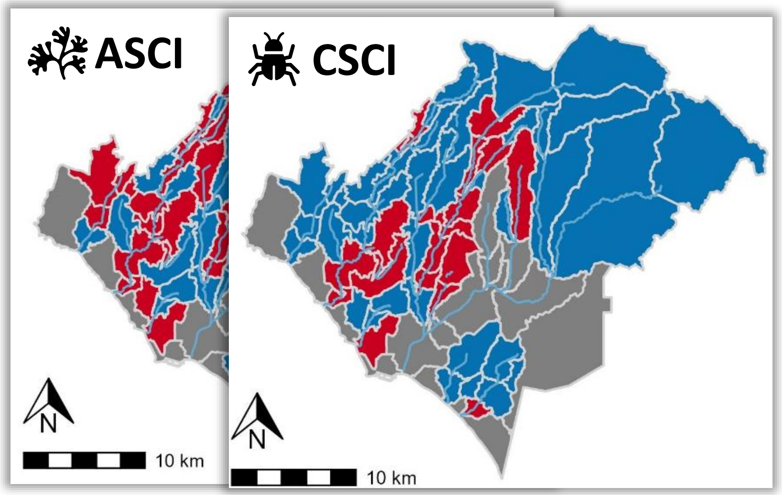
[a] High baseflow criteria due to widened channel morphology. Channel modifications needed for suitable baseflow depths

Data Products

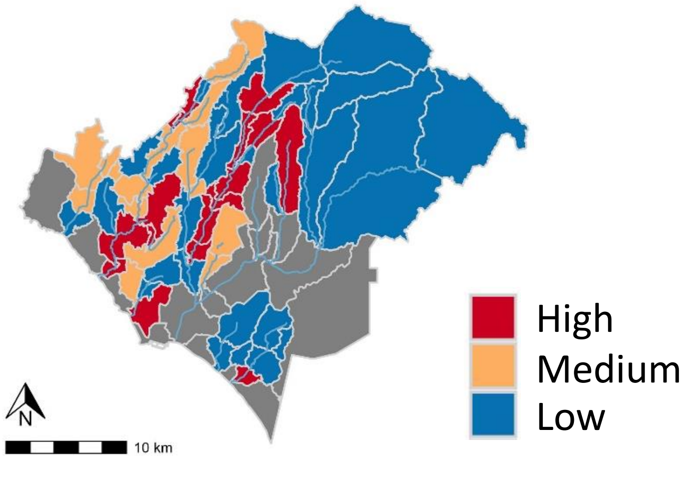
Where are flows altered?



Where is alteration impacting biology?

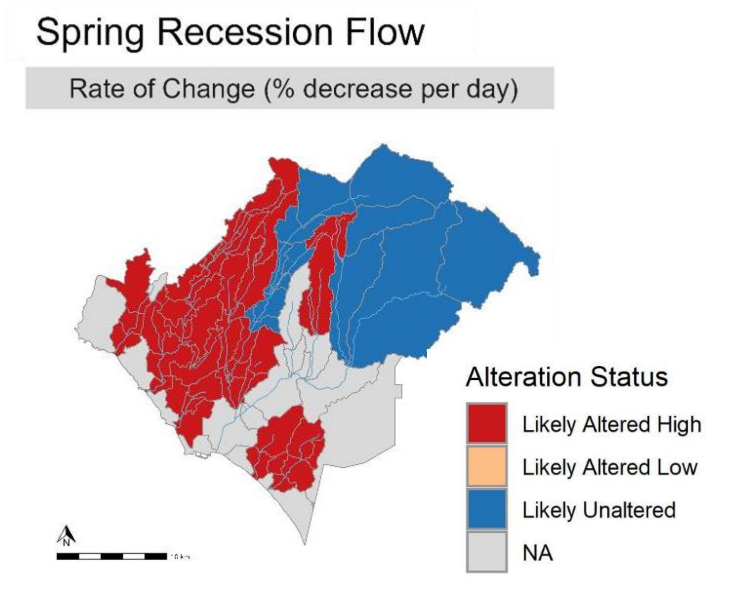


Where are priority areas for flow management?



Data Products Inform Management Decisions

Where are flows altered?



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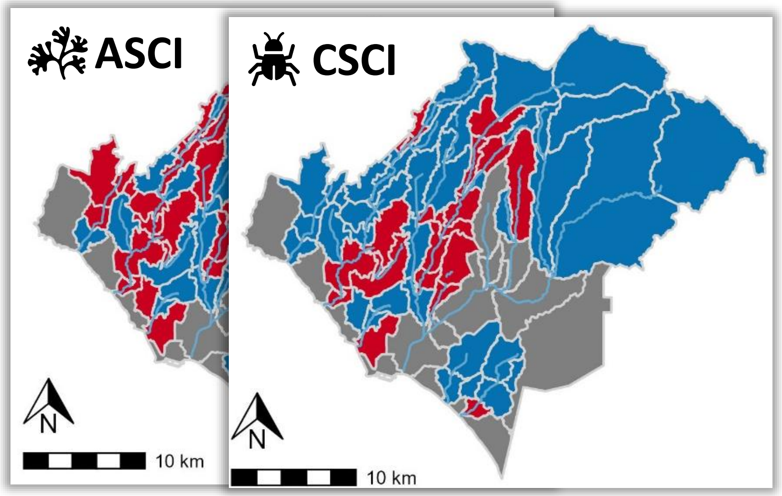

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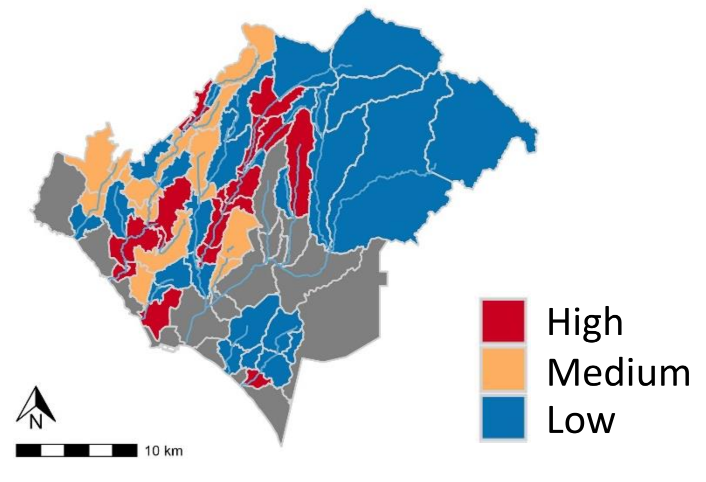


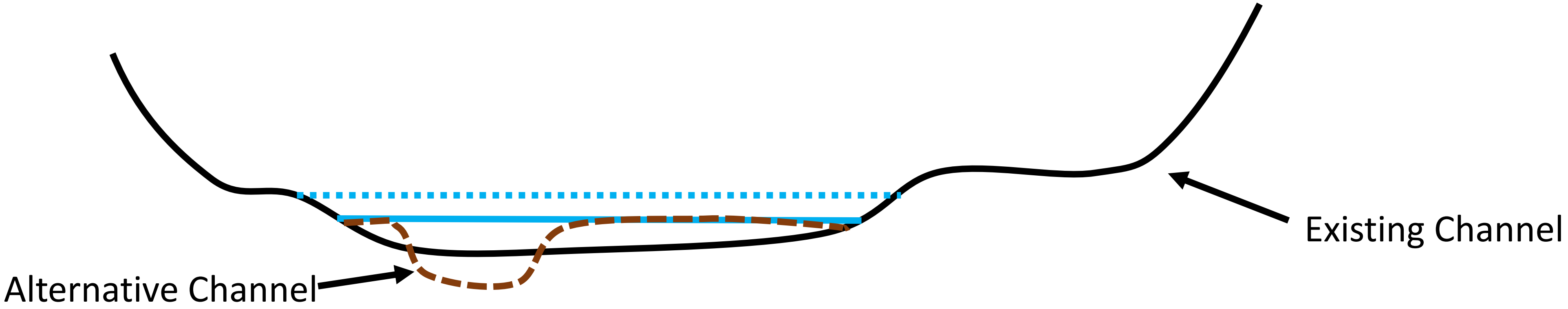
Where should flow management be prioritized?

Where should channel restoration be prioritized?

How should flows and morphology be in restored stream reaches?

Can we get more out of the water we have?

- Existing channel too wide to provide suitable depths for arroyo chub

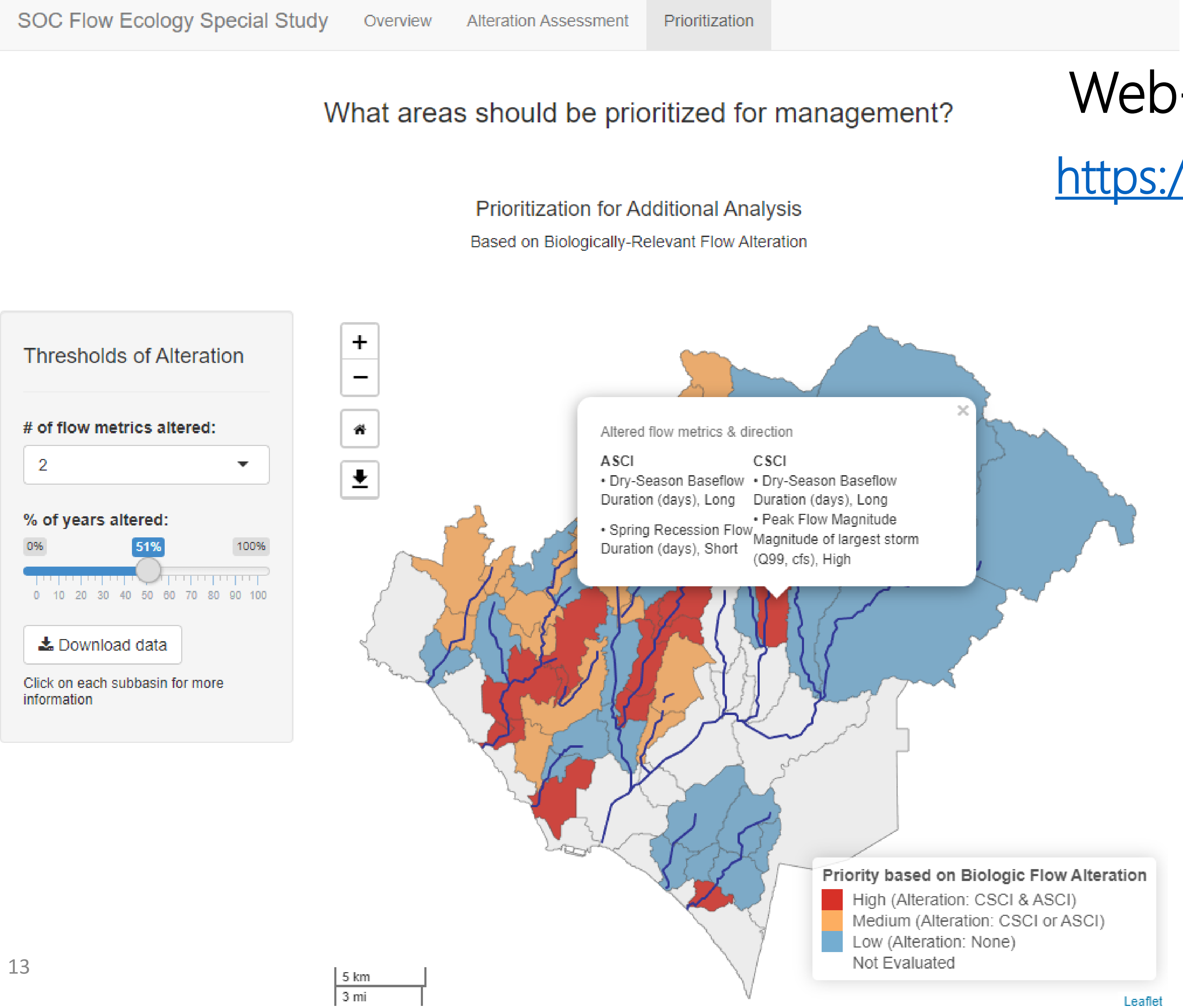


Can changes to the channel morphology be made to provide more suitable habitat conditions?

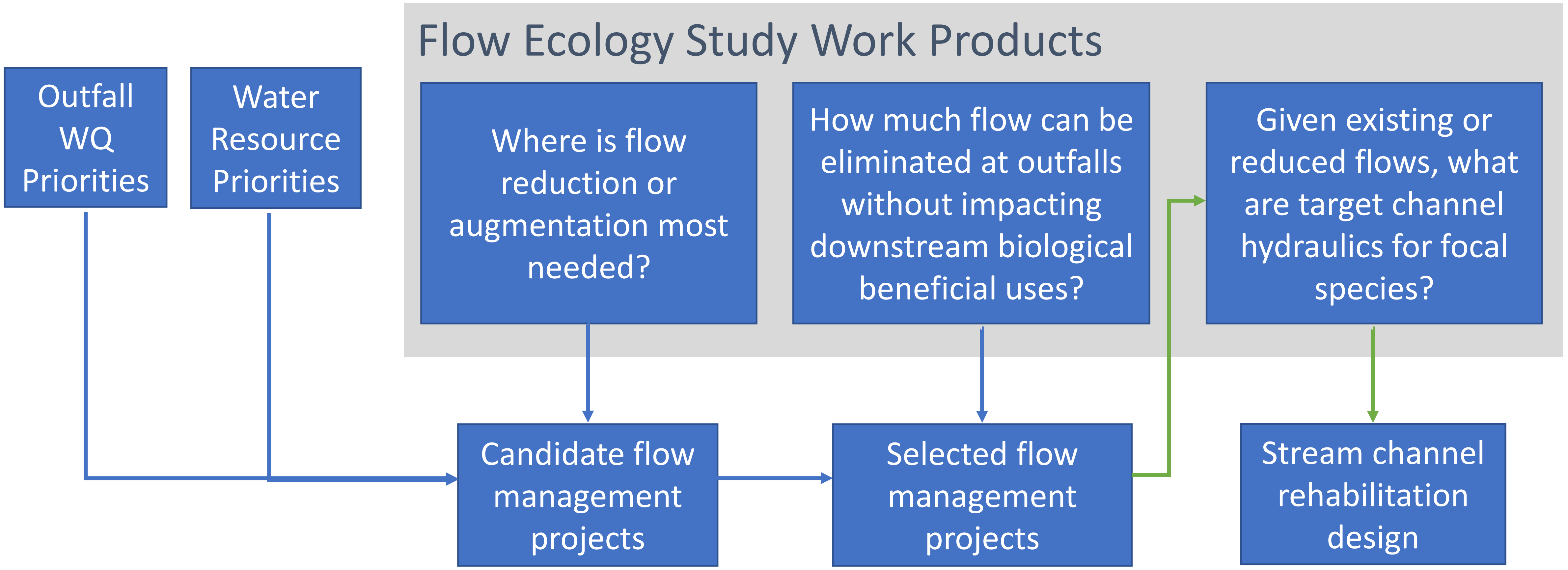
➢ Example design with narrower channel and inset floodplain

Web-based Application

https://sccwrp.shinyapps.io/socfess_shinyapp/



How can the products be used locally?



What did we learn?

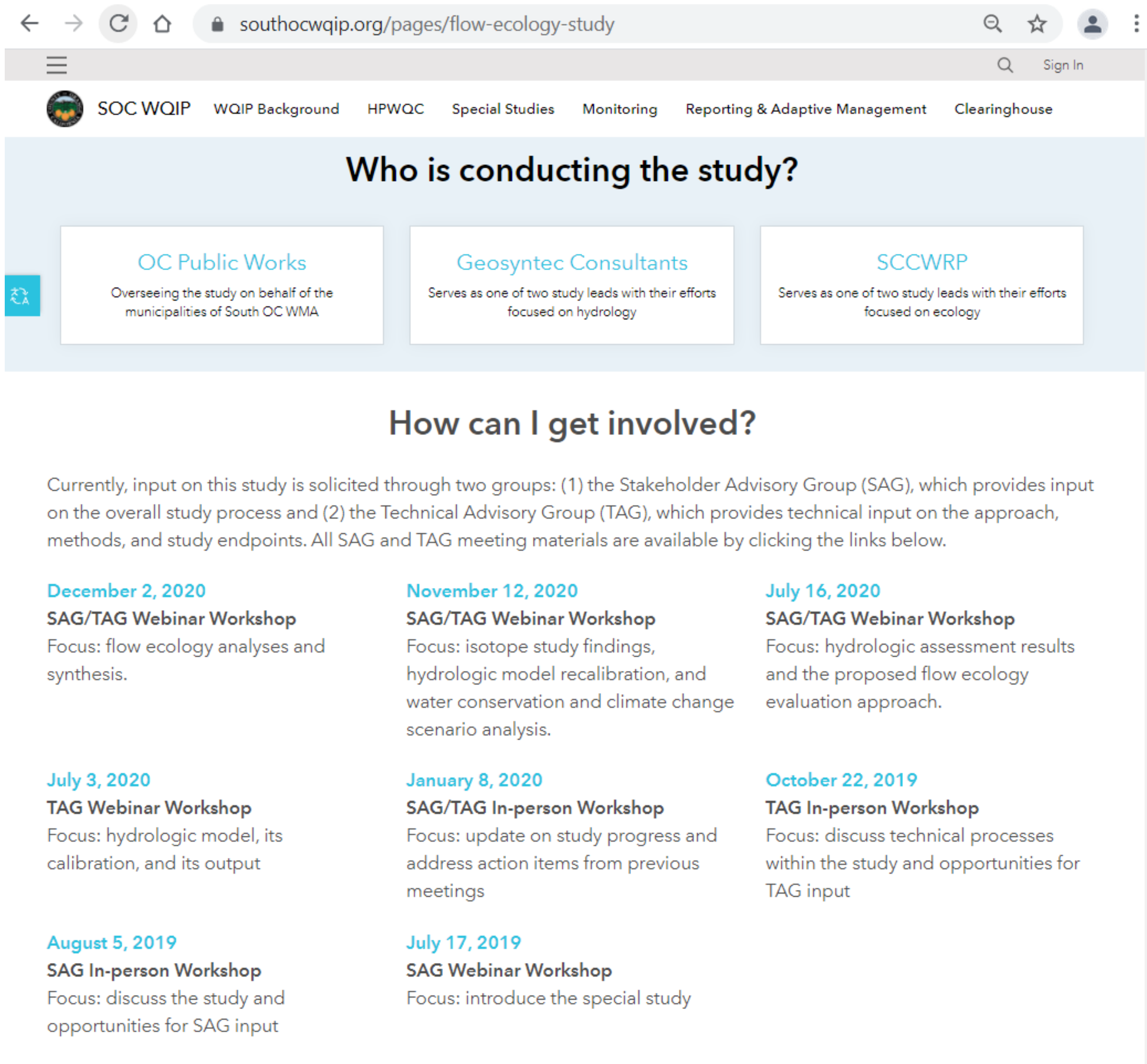
- Hydrologic alteration affects biological condition to varying degrees

- Flow ecology tools can be used to prioritize subbasins for management
  - Approximately 40% of subbasins prioritized for flow management

- CEFF provides flexible guidance that can be applied in highly altered systems
  - ➢ More detailed local hydrologic modeling may be necessary
  - ➢ Consideration of mediating factors (i.e., channel alteration) is important
  - ➢ Non-flow management actions may be necessary to achieve ecological flow criteria

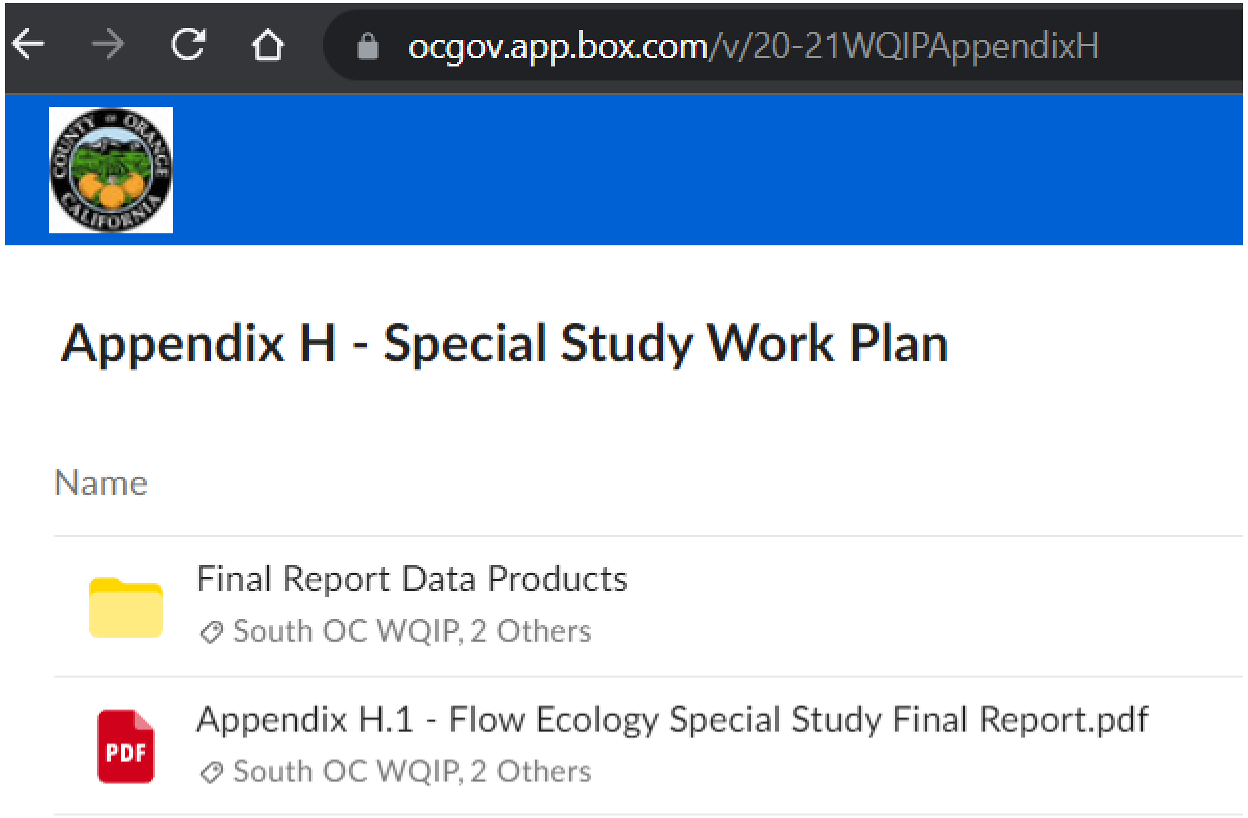
More Information

https://www.southocwqip.org/pages/flow-ecology-study



Open Data Portal:

https://ocgov.app.box.com/v/20-21WQIPAppendixH



Additional Resources

Taniguchi-Quan, K. T., Irving, K., Stein, E. D., Poresky, A., Wildman Jr, R. A., Aprahamian, A., Rivers, C., Sharp, G., Yarnell, S. M., & Feldman, J. R. (2022). Developing Ecological Flow Needs in a Highly Altered Region: Application of California Environmental Flows Framework in Southern California, USA. *Frontiers in Environmental Science*, 1–18. https://doi.org/10.3389/fenvs.2022.787631

Irving, K., Taniguchi-Quan, K. T., Aprahamian, A., Rivers, C., Sharp, G., Mazor, R. D., Theroux, S., Holt, A., Peek, R., & Stein, E. D. (2022). Application of Flow-Ecology Analysis to Inform Prioritization for Stream Restoration and Management Actions. *Frontiers in Environmental Science*, 1–18. https://doi.org/10.3389/fenvs.2021.787462

Questions?

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Napa County Groundwater Sustainability Agency

Technical Advisory Group

Groundwater Conditions and Potential Recharge Areas of Interest

September 8, 2022

Luhdorff & Scalmanini
Consulting Engineers

Current Conditions and RMS Templates

SMC for Chronic Lowering of Groundwater Levels

Minimum Threshold

Minimum static October groundwater elevation prior to 2015

Undesirable Result

20% of designated RMS well levels fall below the MT in fall (October) for 3 consecutive years of fall measurements in non-drought years

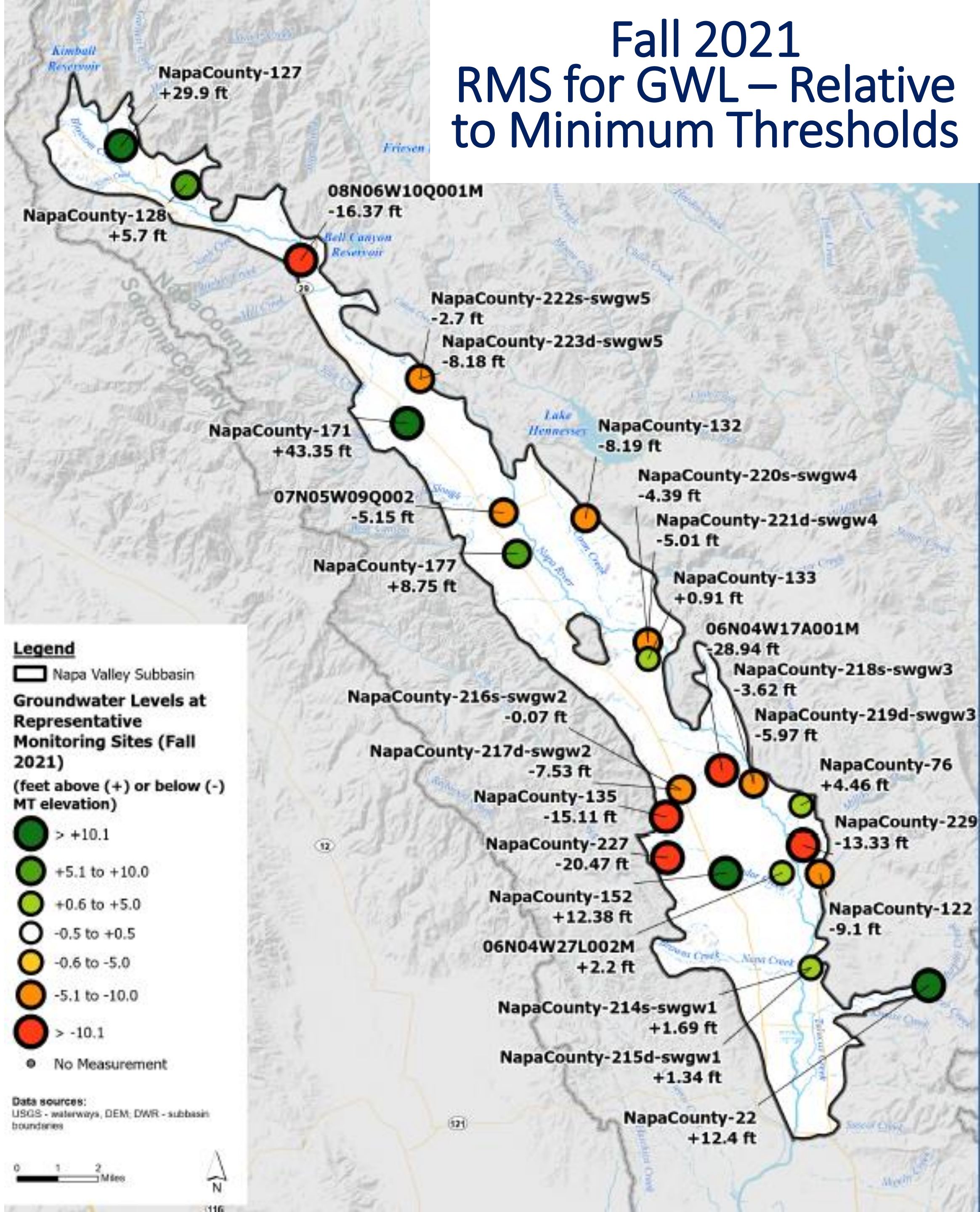
Trigger

20% of designated RMS well levels fall below the MT in fall during a single year

RMS Groundwater Levels- Fall 2021

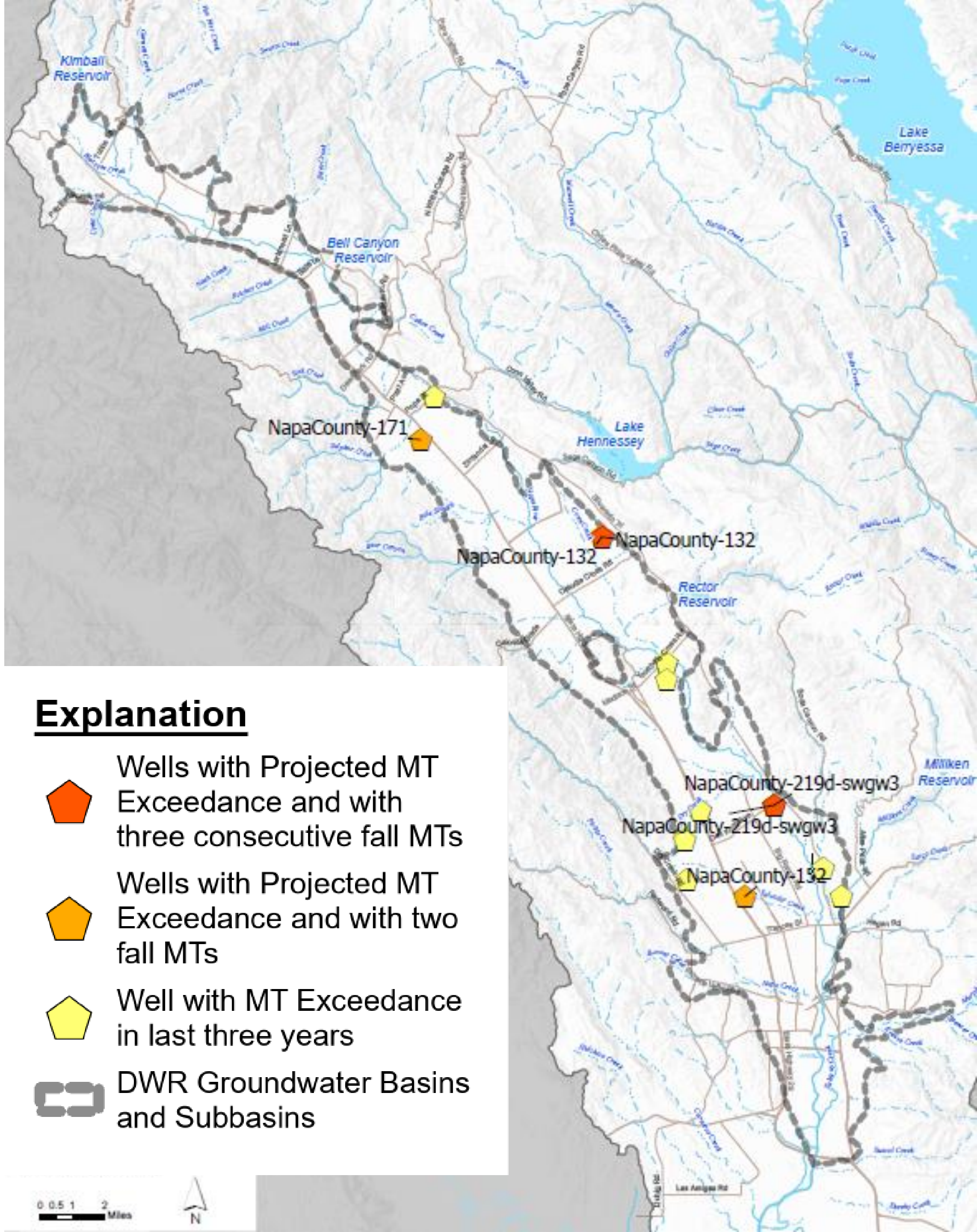
- 27 RMS wells measured
- 16 of the 27 wells (59%) had exceedances
  - 5 well had exceedance of > 10 feet
  - 7 wells had exceedances of 5-10 ft
  - 3 wells had exceedances of 2-5ft
  - 1 well had exceedances of 0-1ft

Fall 2021 RMS for GWL – Relative to Minimum Thresholds



RMS Groundwater Levels-Response Action Required

- Four wells on track to have a Fall MT exceedance
- Two of the wells will have had three consecutive years of MT Exceedance
- Three wells have been dropped from a monitoring network
  - Letters for re-recruitment have been drafted



RMS Template

- Data sheets are provided for all RMS Wells that monitor groundwater levels in Napa Valley.
- Information pertaining to location, Sustainability Indicator(s), construction information, and nearby features are included.
- These are living documents and can be updated and modified based on requests.

Well Name: NapaCounty-127

Monitoring Network
SGMA Representative Monitoring Network

SGMA Sustainability Indicator(s)
Groundwater Levels (GWL)

Supplemental Indicator(s)
NA

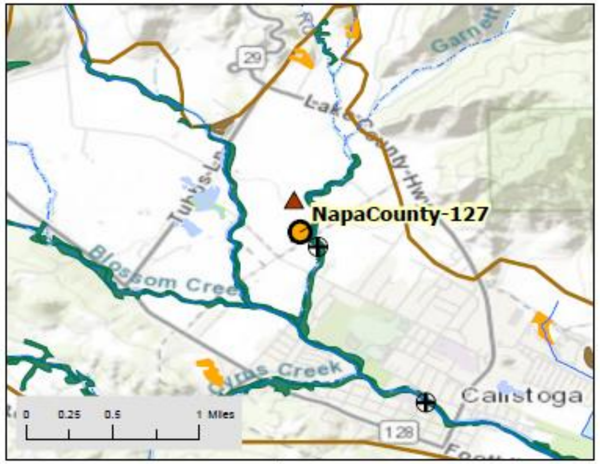
Well Identification
SWN: 009N007W25N001M
MNM: 385926N1225938W001

Well Construction
Well Type: Domestic well
Well Depth (ft bgs): 149
Top of Perforation (ft bgs): NA
Bottom of Perforation (ft bgs): NA
Well Completion Report Available? Yes

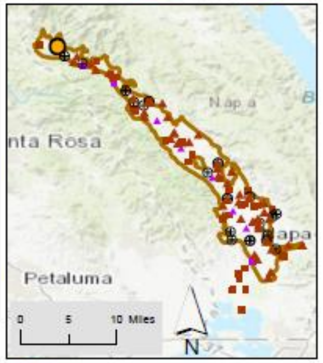
Monitoring Information
Monitoring Frequency: Semi-Annual GWL
Measurable Objectives (MO) and Minimum Thresholds (MT) (ft amsl):
GWL MO = 374.0; MT = 351.0

Groundwater Level Observation
Most Recent Water Level:
Measurement Date: 3/7/2022
Depth below ground surface (ft): 9.33
Elevation (ft amsl): 382.67

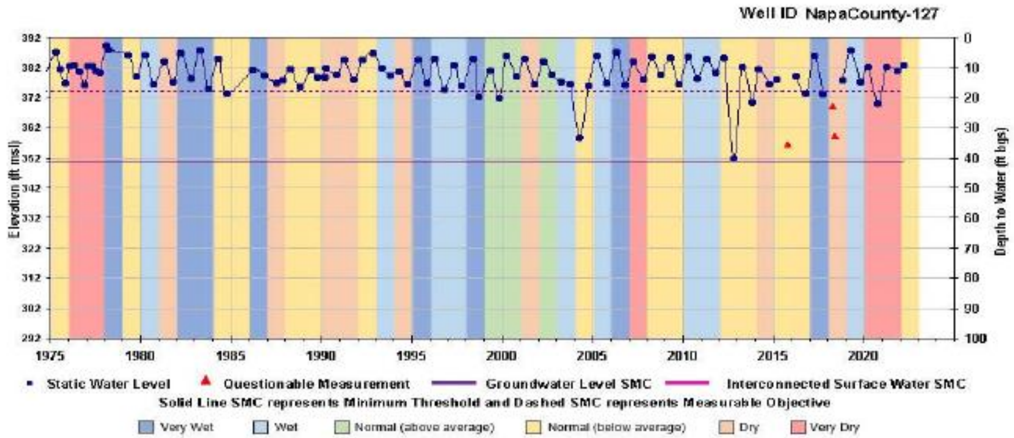
Location Description
Latitude/Longitude: 38.593241/-122.592484
Ground Surface Elevation (ft amsl): 392.00
Distance to Perennial Stream (ft): 300
Alluvial Thickness (ft): 70



Explanation
RMS Sites in Focus
Other RMS Sites
Groundwater Well
Stream Flow/Stage
Benchmark (Land Subsidence)
Non-RMS Monitoring Sites
Groundwater Well
Stream Flow/Stage
Benchmark (Land Subsidence)
Subbasin Boundary



Groundwater Dependent Ecosystems
Bulrush - Cattail
Coast Live Oak Alliance
Riparian Valley Oak
Valley Oak Alliance
Wetlands
River/Creek - Perennial
River/Creek - Intermittent



MT Exceedance Summary

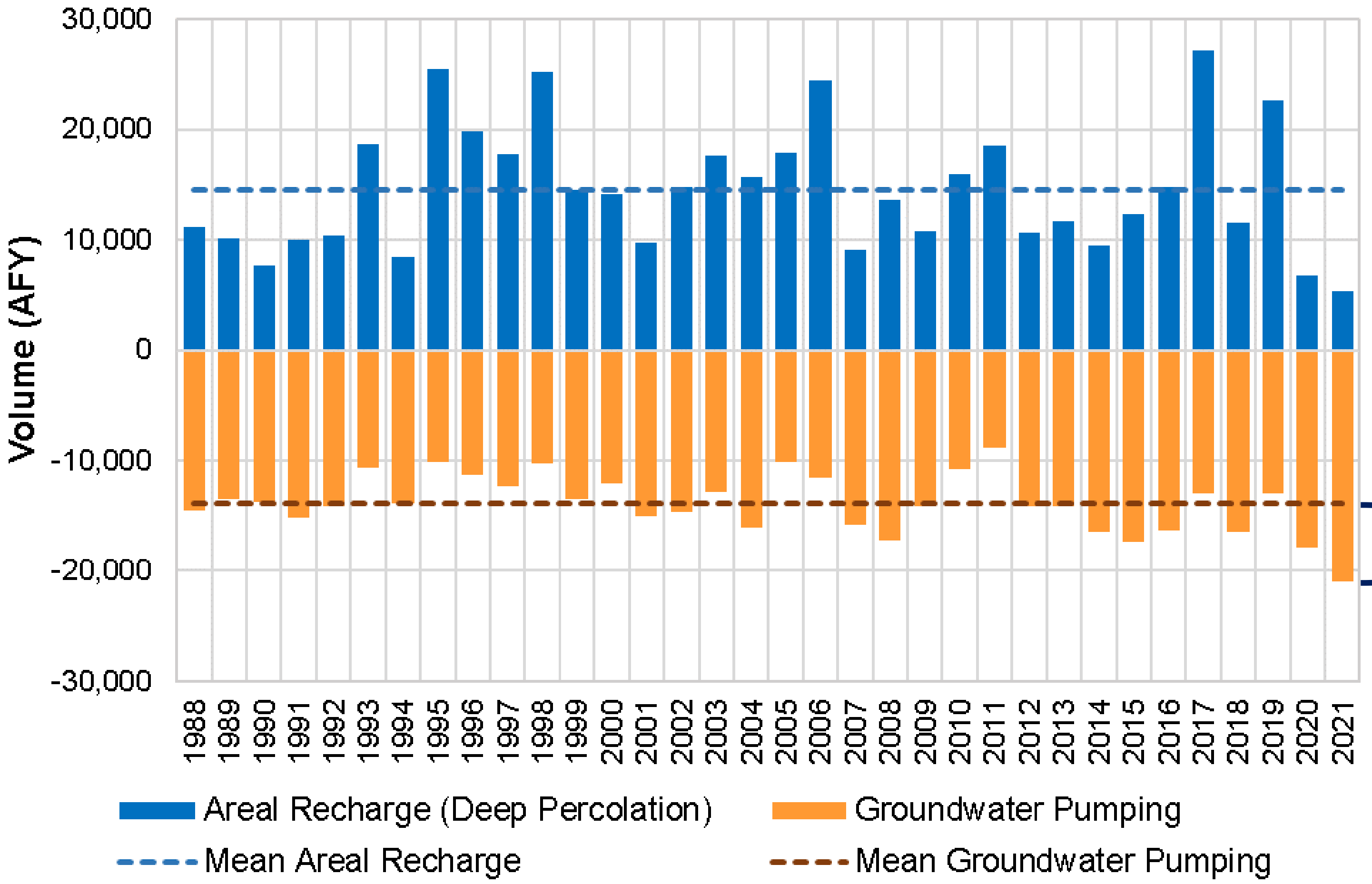
Well ID	MT (ft msl)	Fall 2020 (ft msl)	Fall 2021 (ft msl)	Spring 2022 (ft msl)	Summer 2022 (ft msl)	Response Action
06N04W17A001M	42	-11.44	-28.94			Working to re-recruit
07N05W09Q002M	126	2.34	-5.15			Working to re-recruit
08N06W10Q001M	270	-21.57	-16.37			Working to re-recruit
NapaCounty-122	-45	-7.35	-9.1	9.67		
NapaCounty-132	109	-2.7	-8.19	3.8	-0.65	Yes, on track to have a fall exceedance
NapaCounty-133	73	-1.2	0.91	8.52	1.08	
NapaCounty-135	33	19.68	-15.11	19.73	6.63	
NapaCounty-152	55	5.16	12.38	11.96	-55	Yes, on track to have a fall exceedance
NapaCounty-171	165	-6.73	43.35	38.83	-4.2	Yes, on track to have a fall exceedance
NapaCounty-216s-swgw2	66	4.995	-0.07	20.11	18.51	
NapaCounty-217d-swgw2	60	-0.373	-7.53	12.87	7.97	
NapaCounty-218s-swgw3	29	0.04	-3.62	3.47	-1.38	Yes, on track to have a fall exceedance
NapaCounty-219d-swgw3	29	-0.41	-5.97	3.47	-1.8	Yes, on track to have a fall exceedance
NapaCounty-220s-swgw4	75	-0.129	-4.39	7.49	4.13	
NapaCounty-221d-swgw4	75	-0.795	-5.01	7.83	3.41	
NapaCounty-222s-swgw5	185	0.47	-2.7	7.6	7.16	
NapaCounty-223d-swgw5	164	-7.88	-8.18	15.04	10.11	
NapaCounty-227	59	N/A	-20.47	8.1		
NapaCounty-229	-69	-18.59	-13.33	8.37		

Orange on track to have three consecutive MT exceedances in the Fall

Yellow on track to have MT exceedance in the Fall

Quantifying Existing Recharge and Pumping

Pumping and Recharge in the Current Drought: Napa Subbasin *(Model Results)*

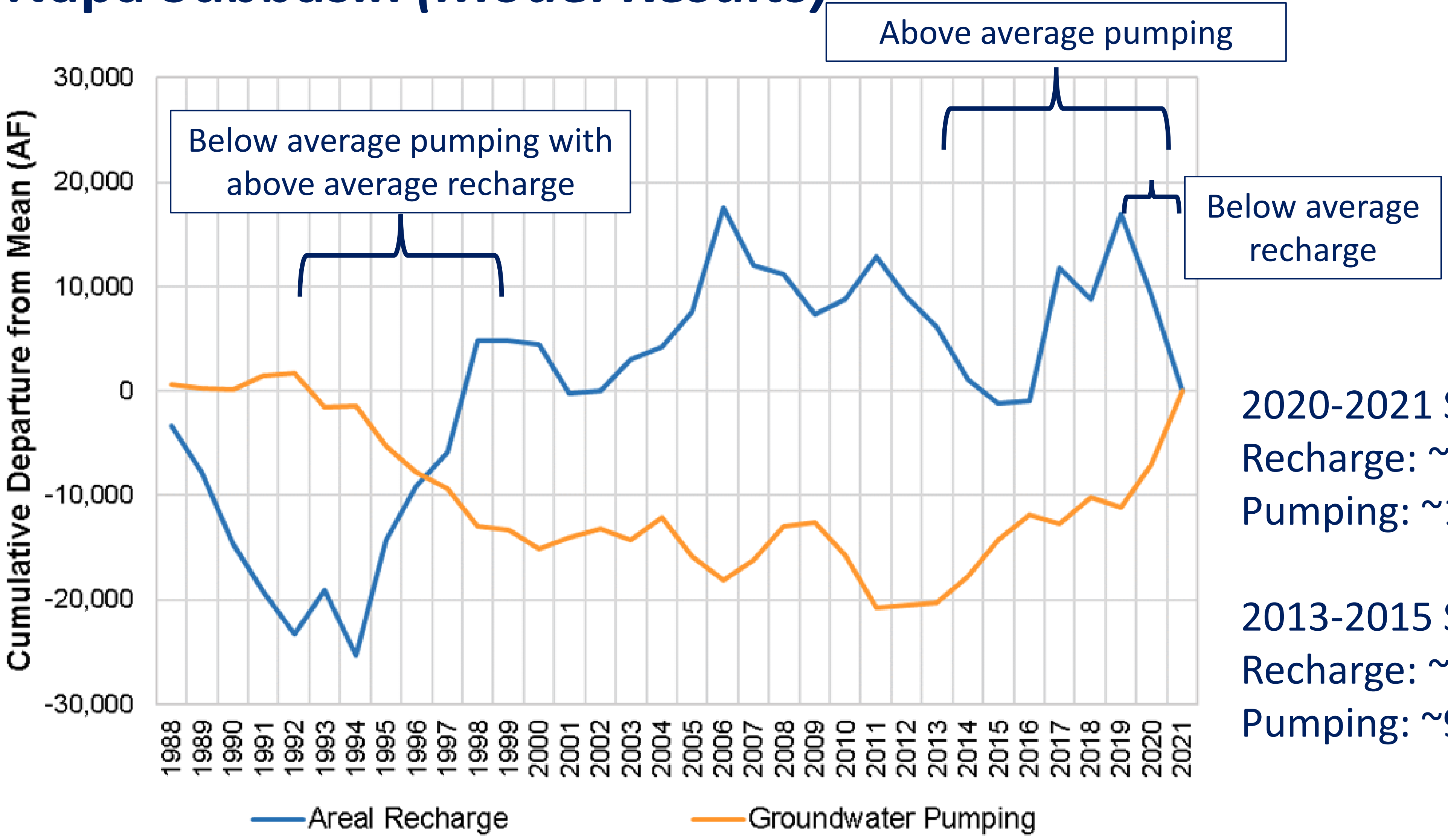


2020-2021 Summary:

Recharge: ~17k AF less

Pumping: ~11k AF more

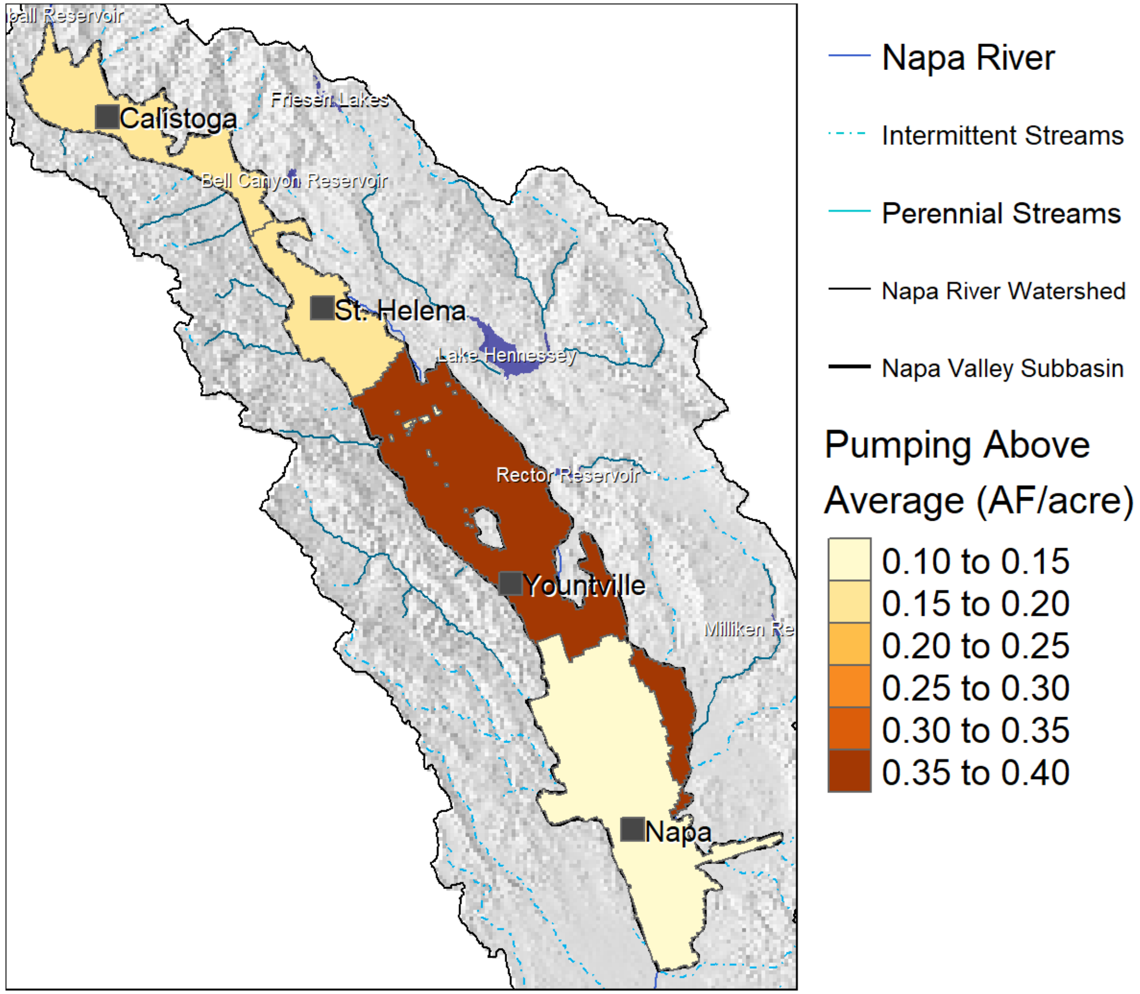
Pumping and Recharge in the Current Drought: Napa Subbasin *(Model Results)*

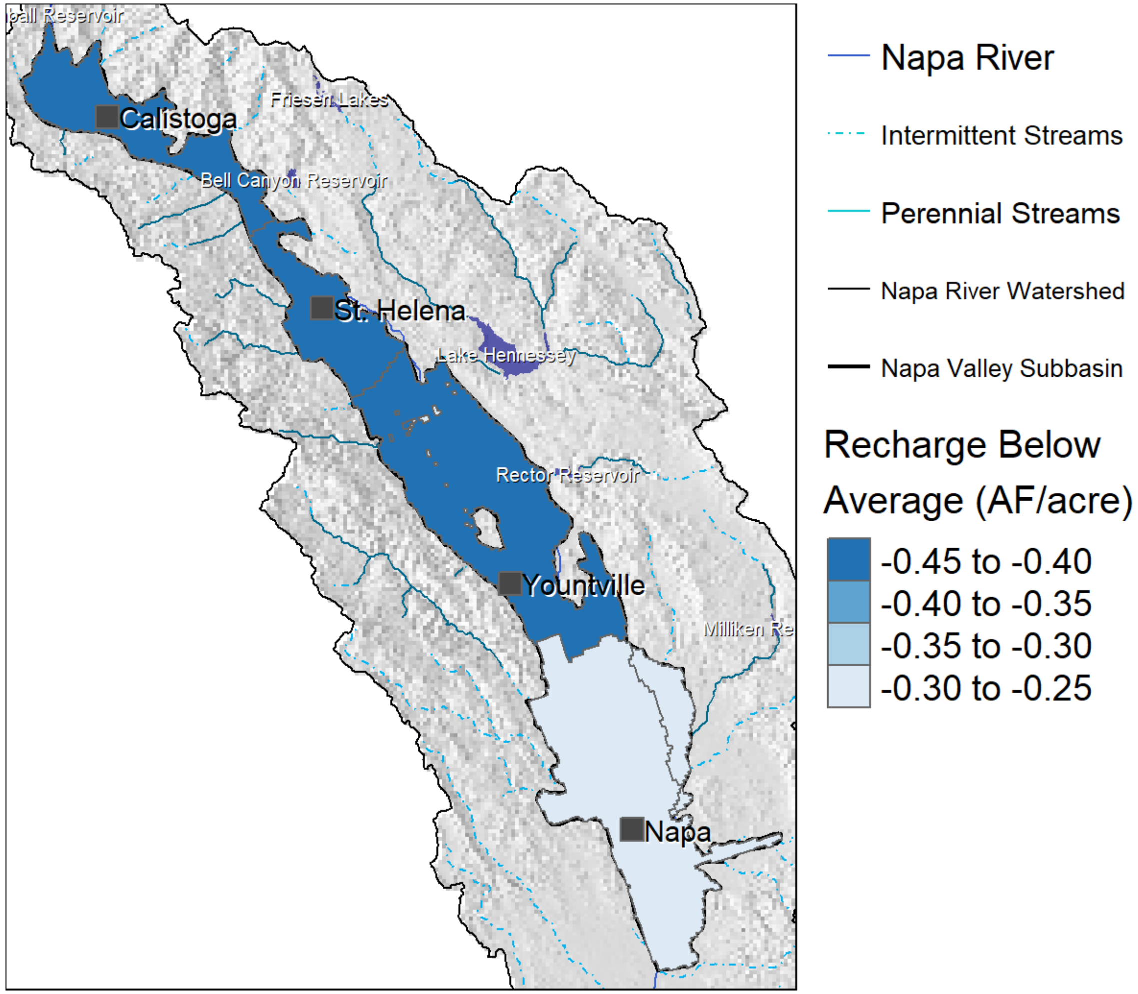


2020-2021 Summary:
Recharge: ~17k AF less
Pumping: ~11k AF more

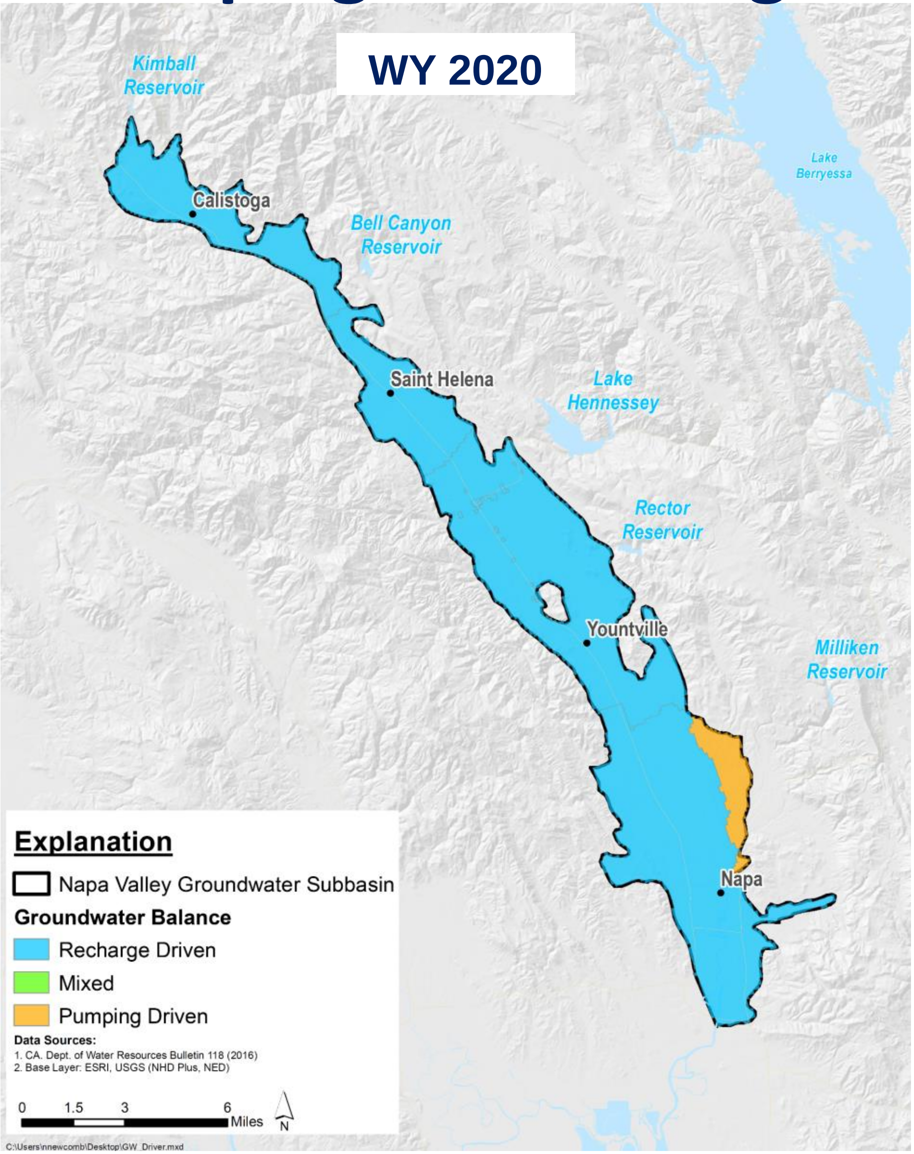
2013-2015 Summary:
Recharge: ~12k AF less
Pumping: ~9k AF more

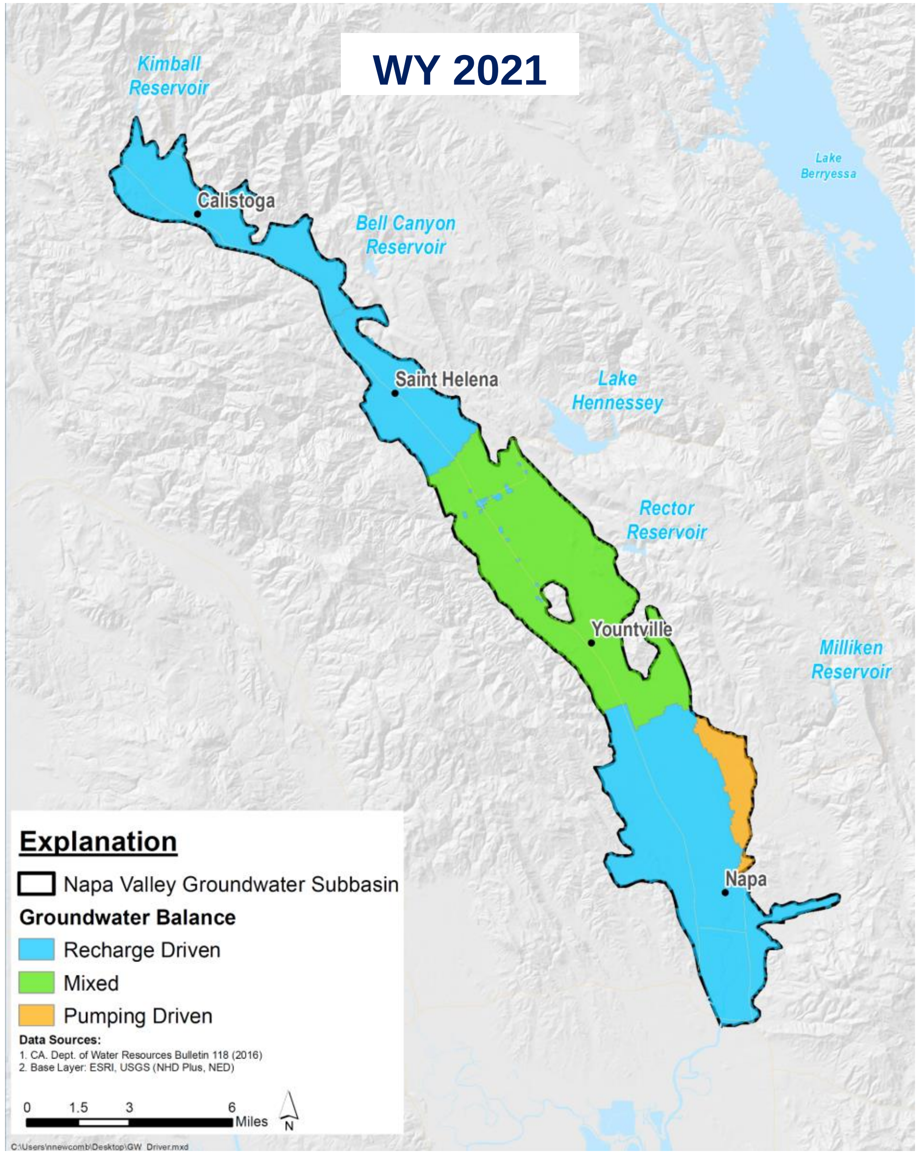
Pumping and Recharge in the Current Drought: Napa Subbasin – Pumping & Recharge (AF/acre)





Quantifying the Relative Impact of Pumping vs. Recharge





ΔQ Difference in Pumping Relative to 1988-2019 Average

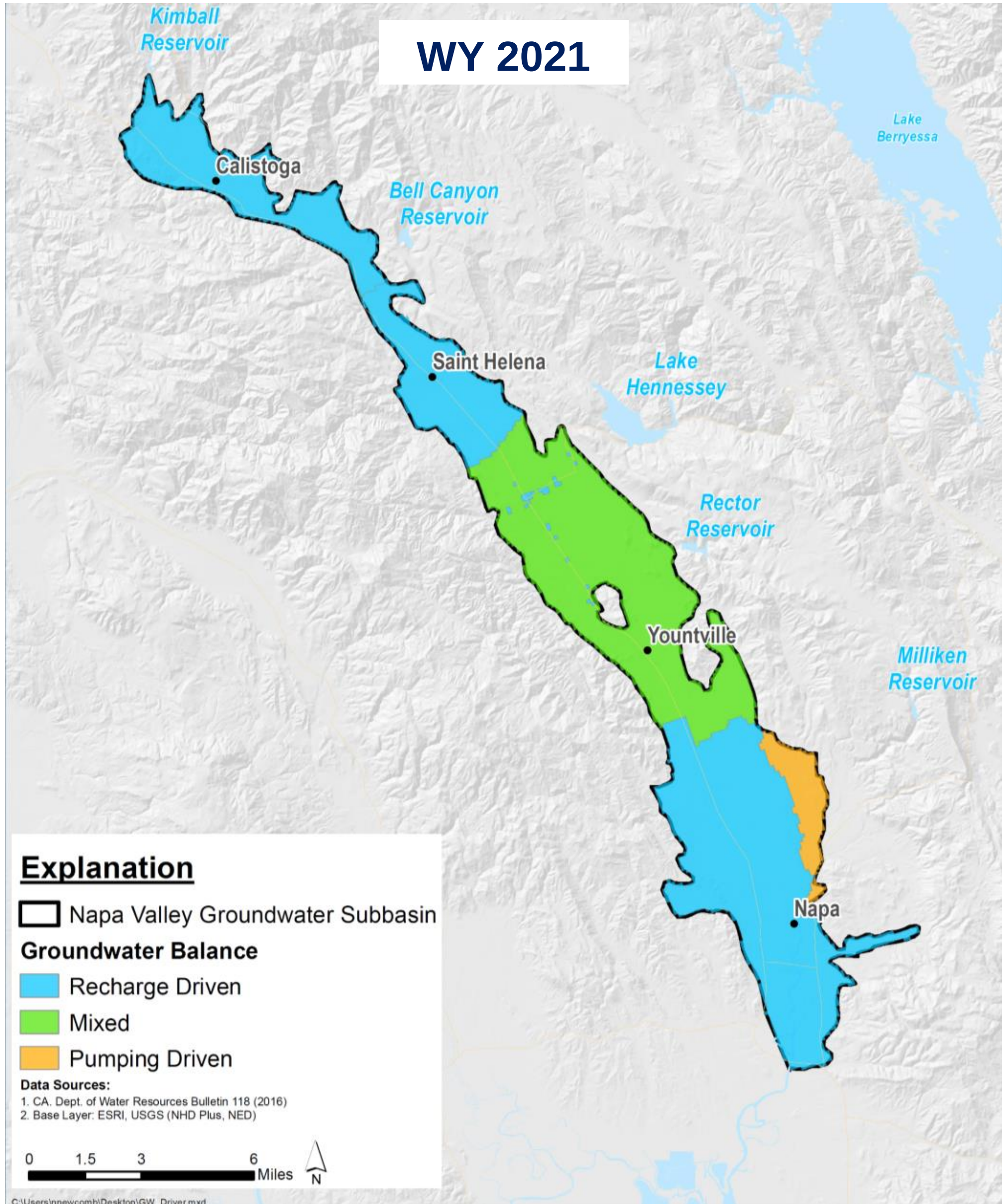
ΔR Difference in Recharge Relative to 1988-2019 Average

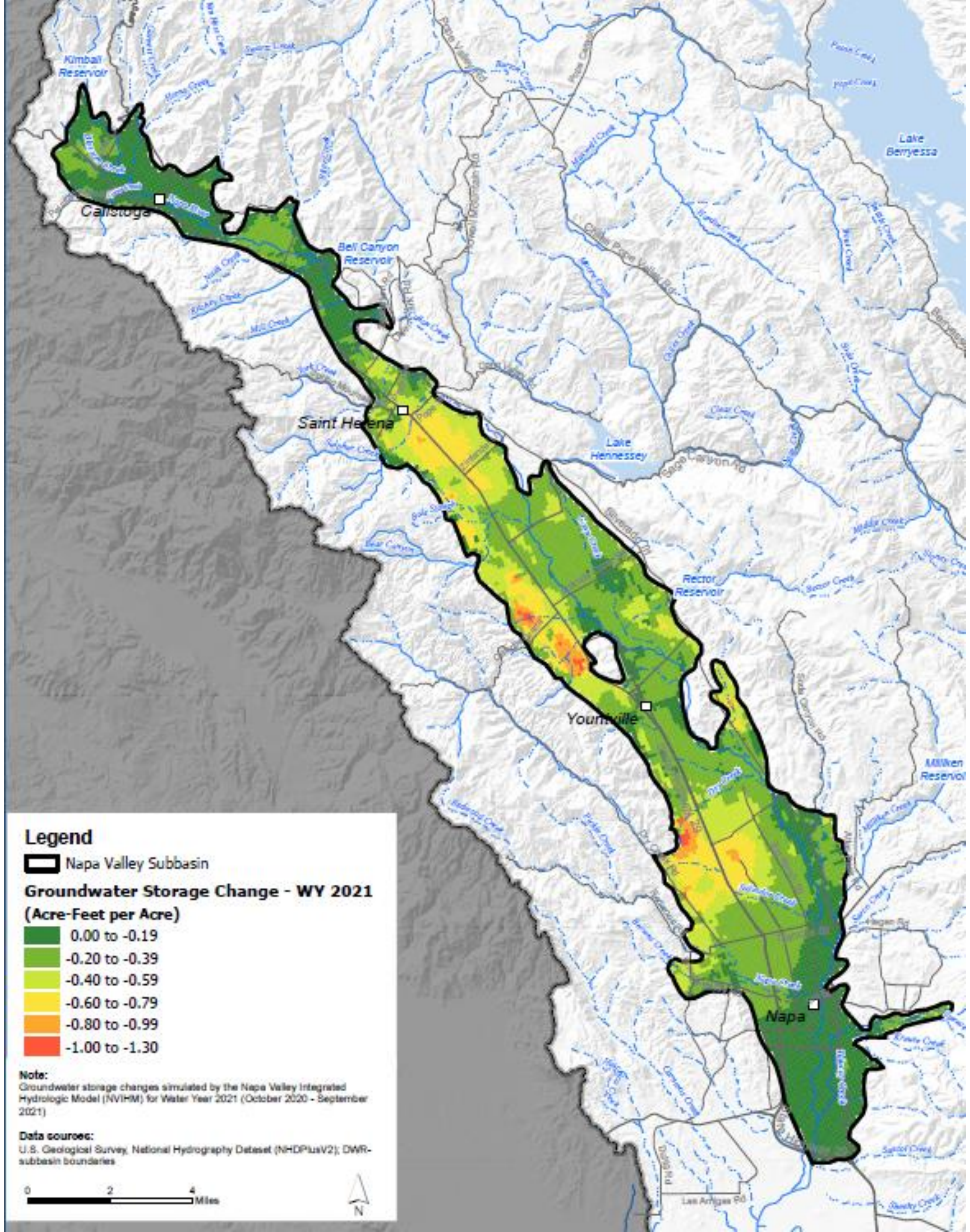
$\frac{\Delta Q}{\Delta R} \leq 0.75$ Recharge Driven

$0.75 < \frac{\Delta Q}{\Delta R} \leq 1.25$ Mixed

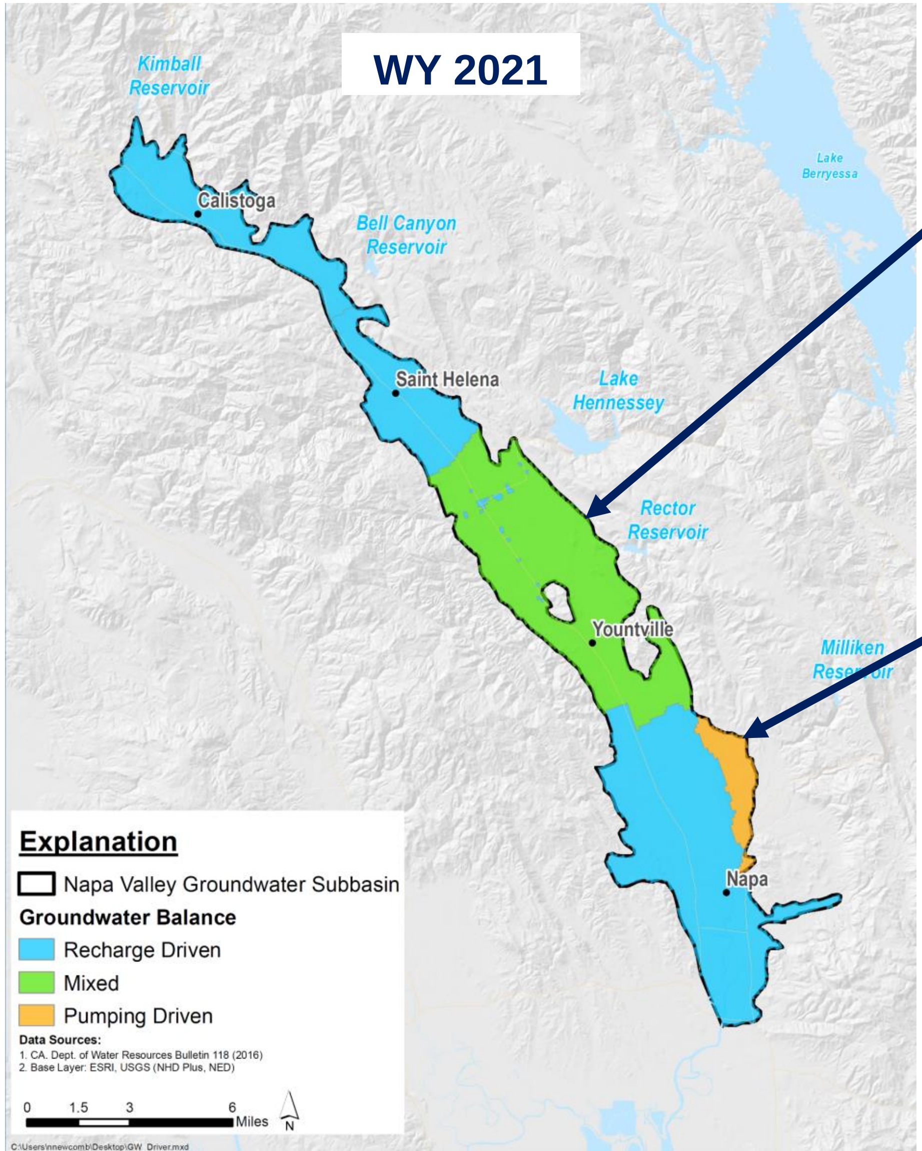
$\frac{\Delta Q}{\Delta R} > 1.25$ Pumping Driven

Pumping and Recharge Changes Compared to Storage Changes



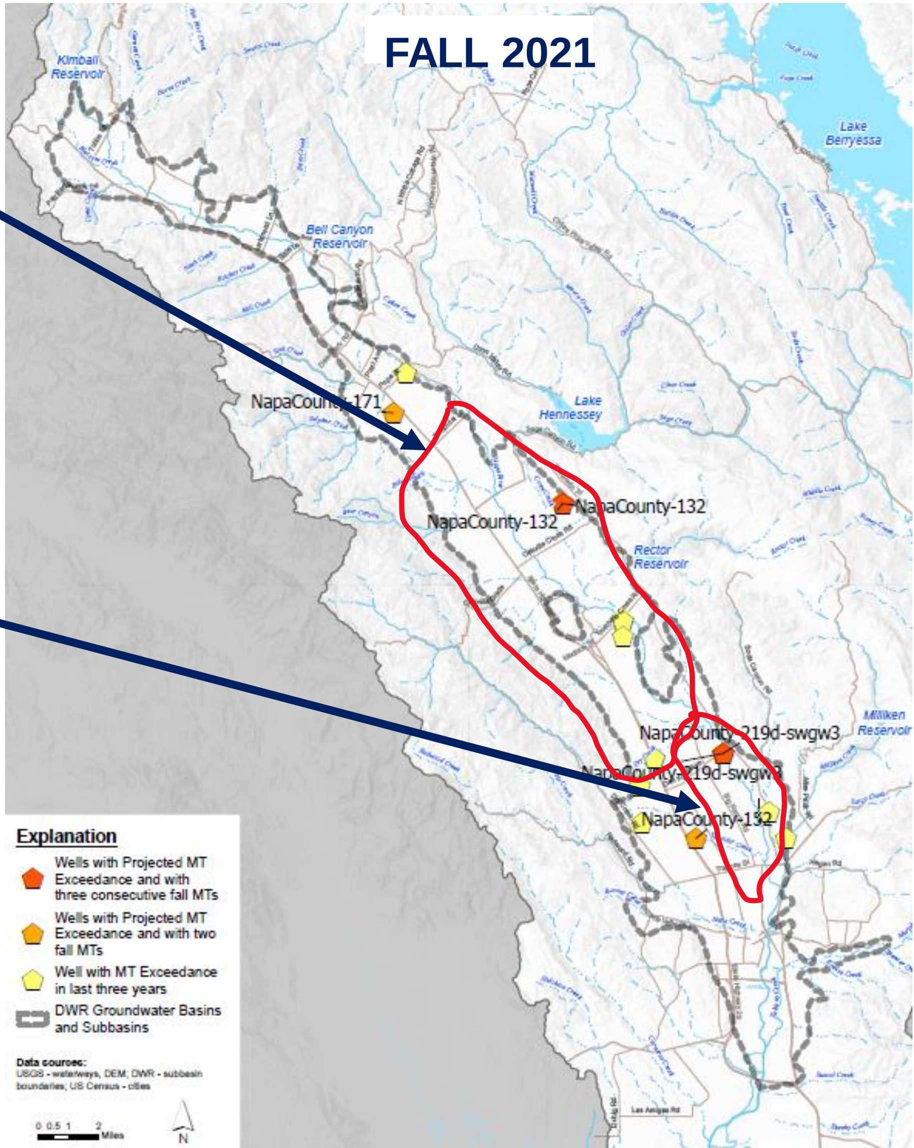


Drought Impacts by Areas



Drought Effects:
Mixed impacts of both diminished recharge and additional pumping. Relative to average.

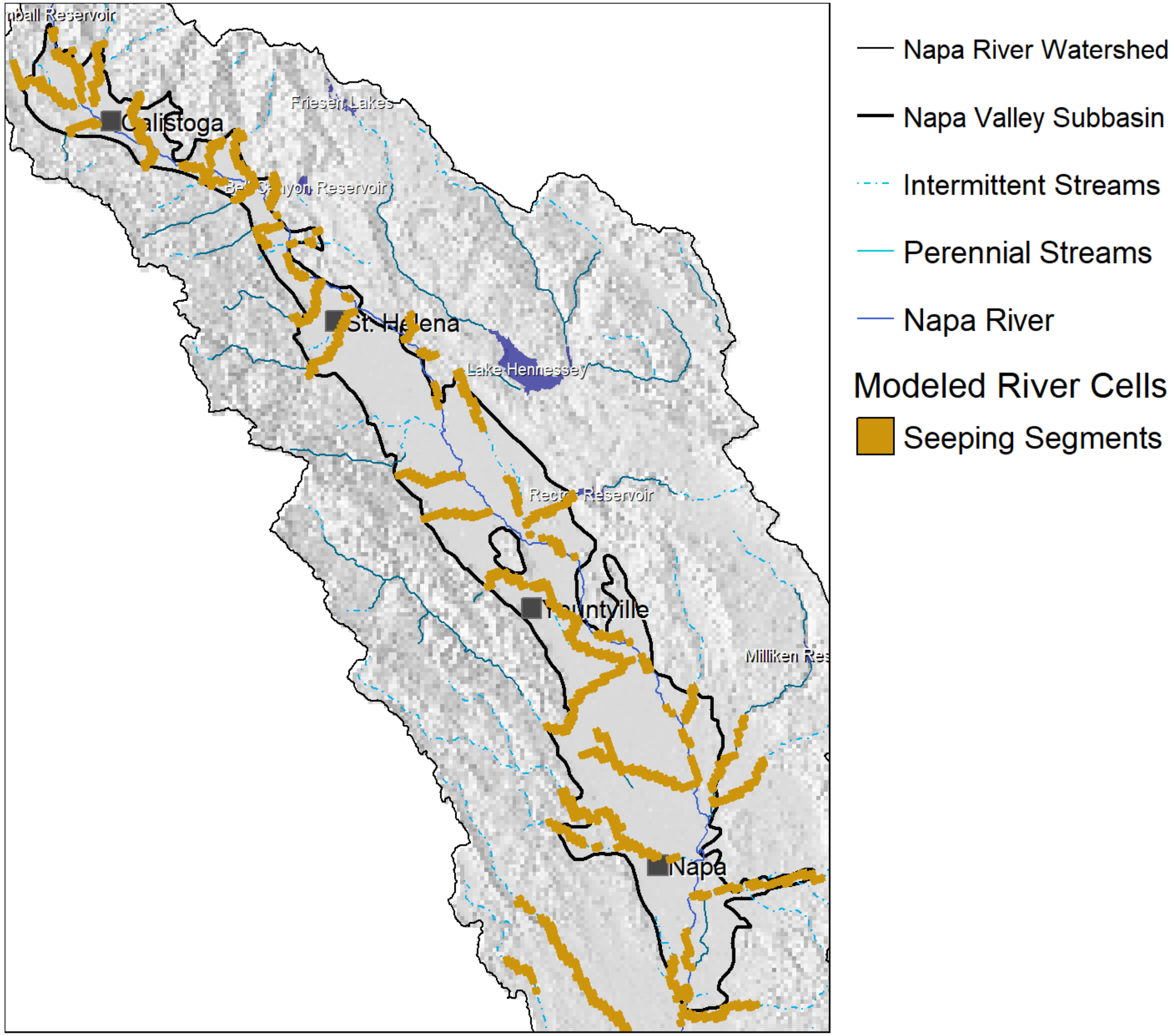
Northeast Napa Management Area:
Predominately pumping driven impacts.



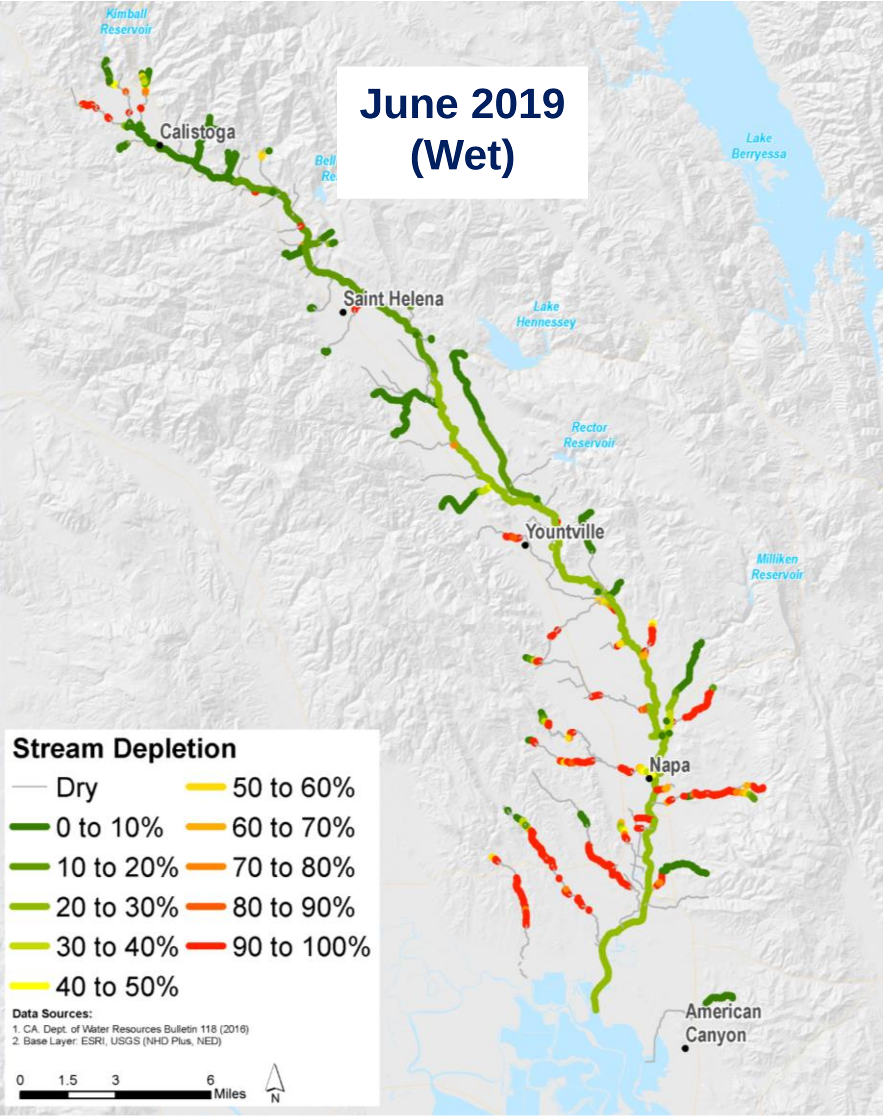
Modeled Stream Reaches with High Seepage

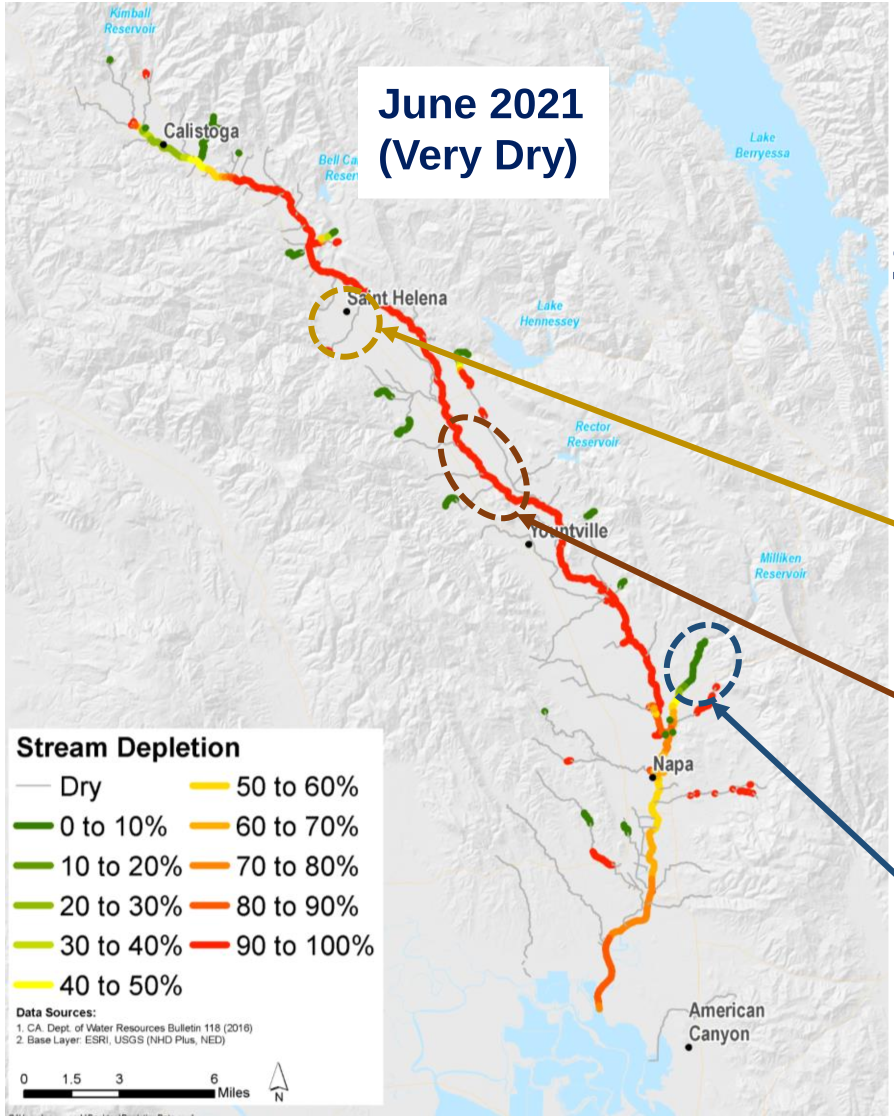
- Infiltration based on historic groundwater model run (NVIHM).
- Infiltration potential based on amount of infiltration (from river to aquifer) when water was in the stream.

- Scenario analysis for pumping is used to explore effects of groundwater pumping on streams.
  - No Pumping Scenario: Pumping never occurred in Napa Valley
  - Pumping: Normal as-is conditions



Climate, Pumping, and Stream Flow - June





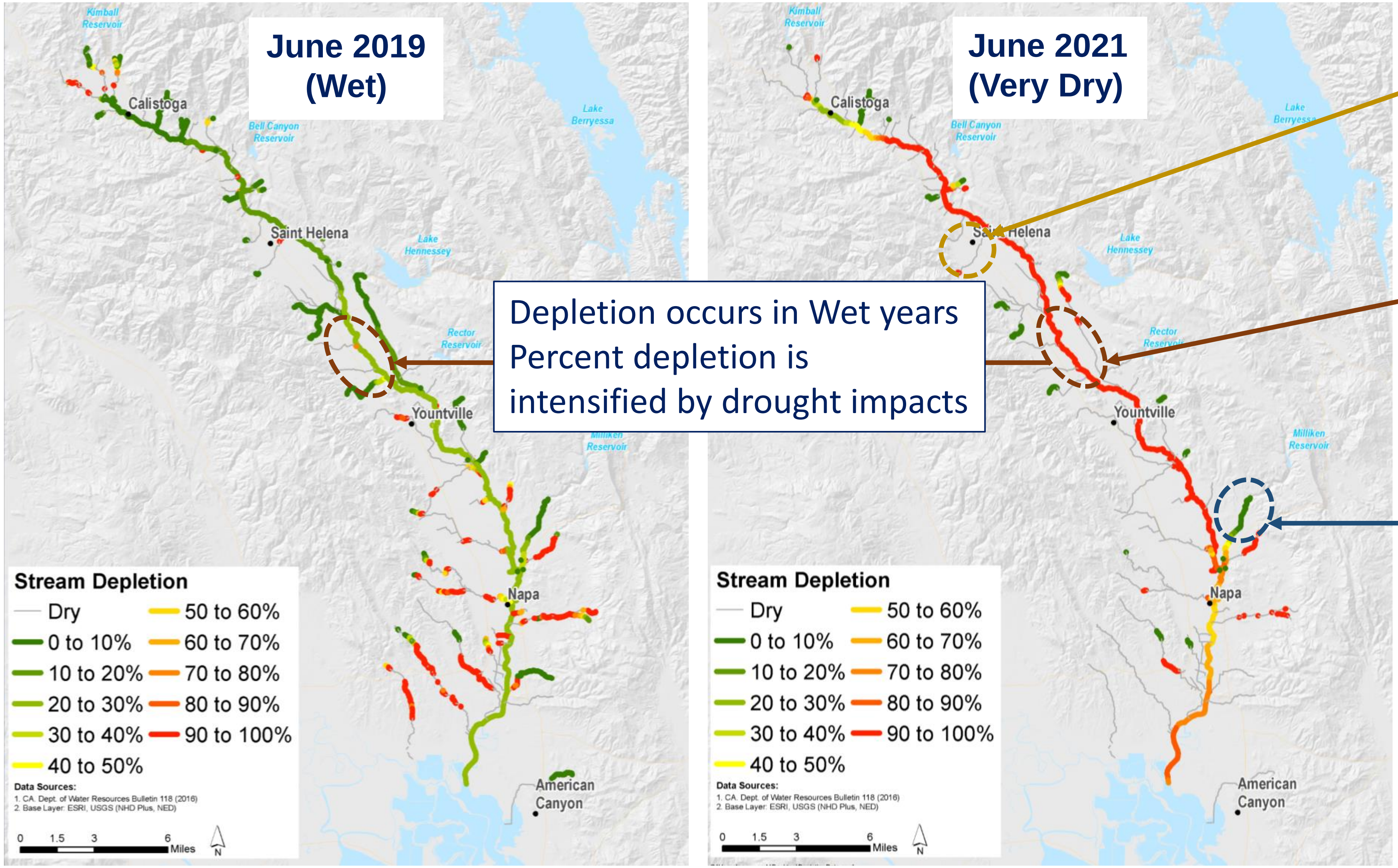
$$\text{Stream Depletion} = \frac{\text{Flow}_{\text{No Pumping}} - \text{Flow}_{\text{Pumping}}}{\text{Flow}_{\text{No Pumping}}}$$

Stream Depletion is ‘Dry’ -
No Pumping scenario flow is 0

Stream Depletion ~100% -
Pumping flow is 0 (dry channel)

Stream Depletion ~0% -
Pumping flow is equal to No Pumping scenario

Climate, Pumping, and Stream Flow - June



Depletion occurs in Wet years
Percent depletion is intensified by drought impacts

Stream Depletion is ‘Dry’: Pumping reductions will not add flow to these reaches.

Stream Depletion ~100% - Pumping reductions will have the greatest impact to increasing flow

Stream Depletion ~0% - Pumping has little to no effect on stream flow

Potential Recharge Areas of Interest

Technical Memo on Potential Recharge Areas

- GIS spatial analysis of currently available information
  - Stream network, including significant streams within the Napa River Watershed
  - Surficial and subsurface geology
  - Fish and other ecological habitat status and/or priority (biological value)
  - Stream Watch network observations
  - Other existing observations/prior studies that inform recharge site prioritization

Recharge Overview

Goals for Recharge

Physical Limitations

Prioritizing Need

Discussion

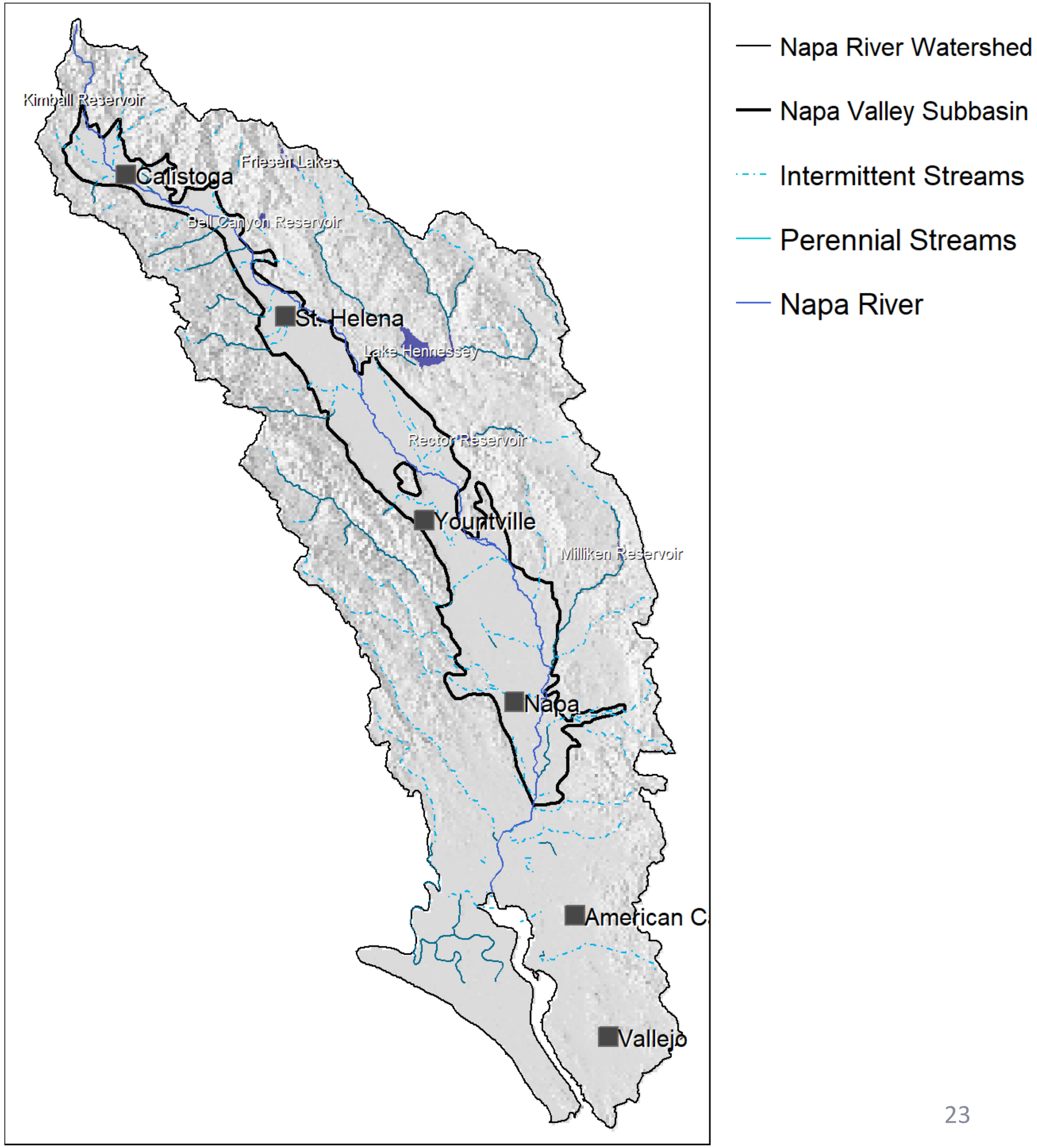
Reasons and Goals for Recharge

- Reasons that an area may benefit from additional recharge:
  - Climate impacts
    - Areas that have diminished recharge due to ongoing drought
  - Areas of high pumping
    - Mitigate groundwater decline due to prolonged pumping
  - Additional ecosystem benefits
    - Increased baseflow to river segments
    - Higher groundwater elevation for phreatophytes or other GDE

Recharge Considerations – Where is it needed?

Significant Stream Network

- Streams based on Napa County Stream Network
- Stream Network based on biological habitat as well as perennial rivers

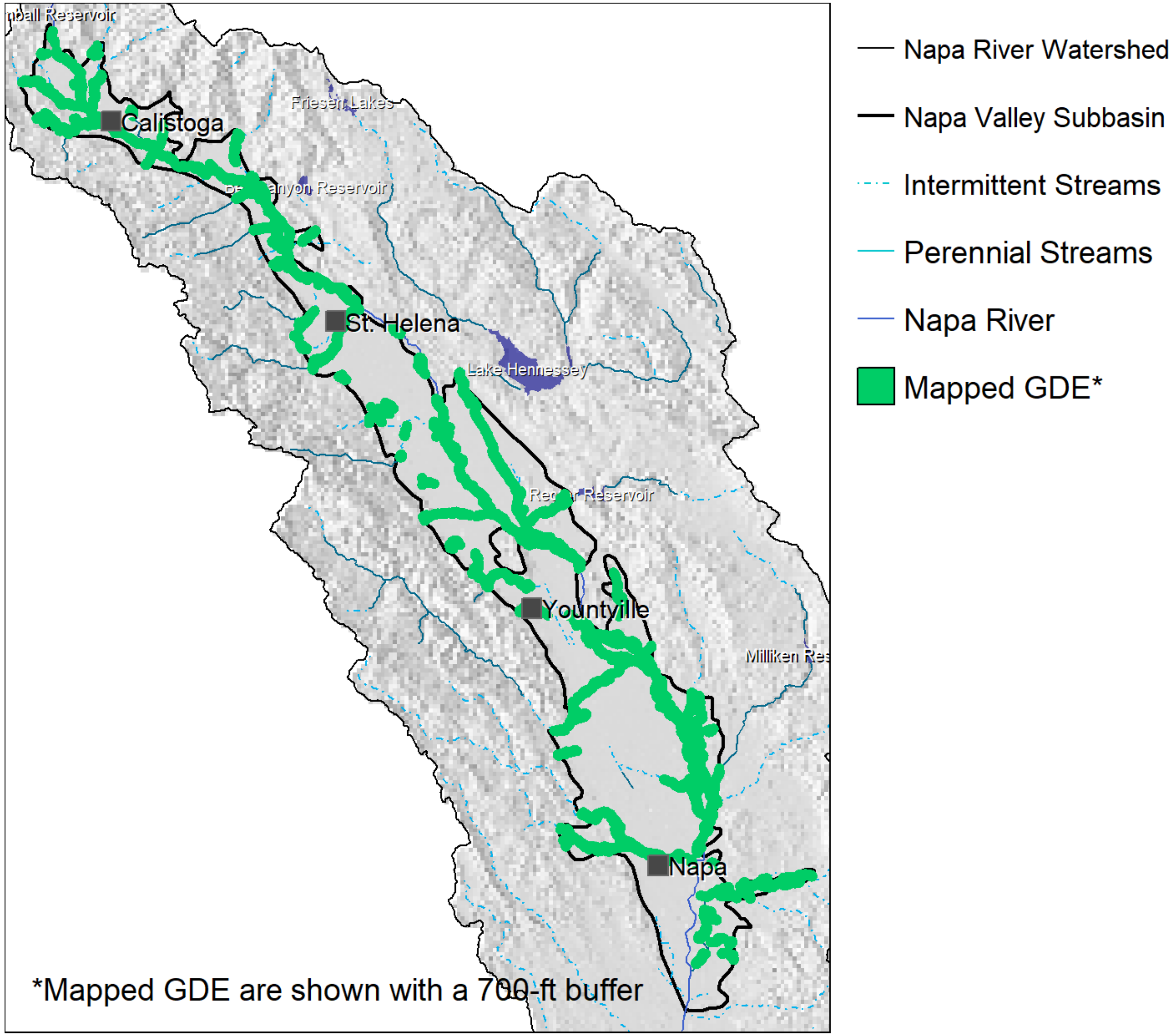


Groundwater Dependent Ecosystems (GDEs)

Identification/Delineation

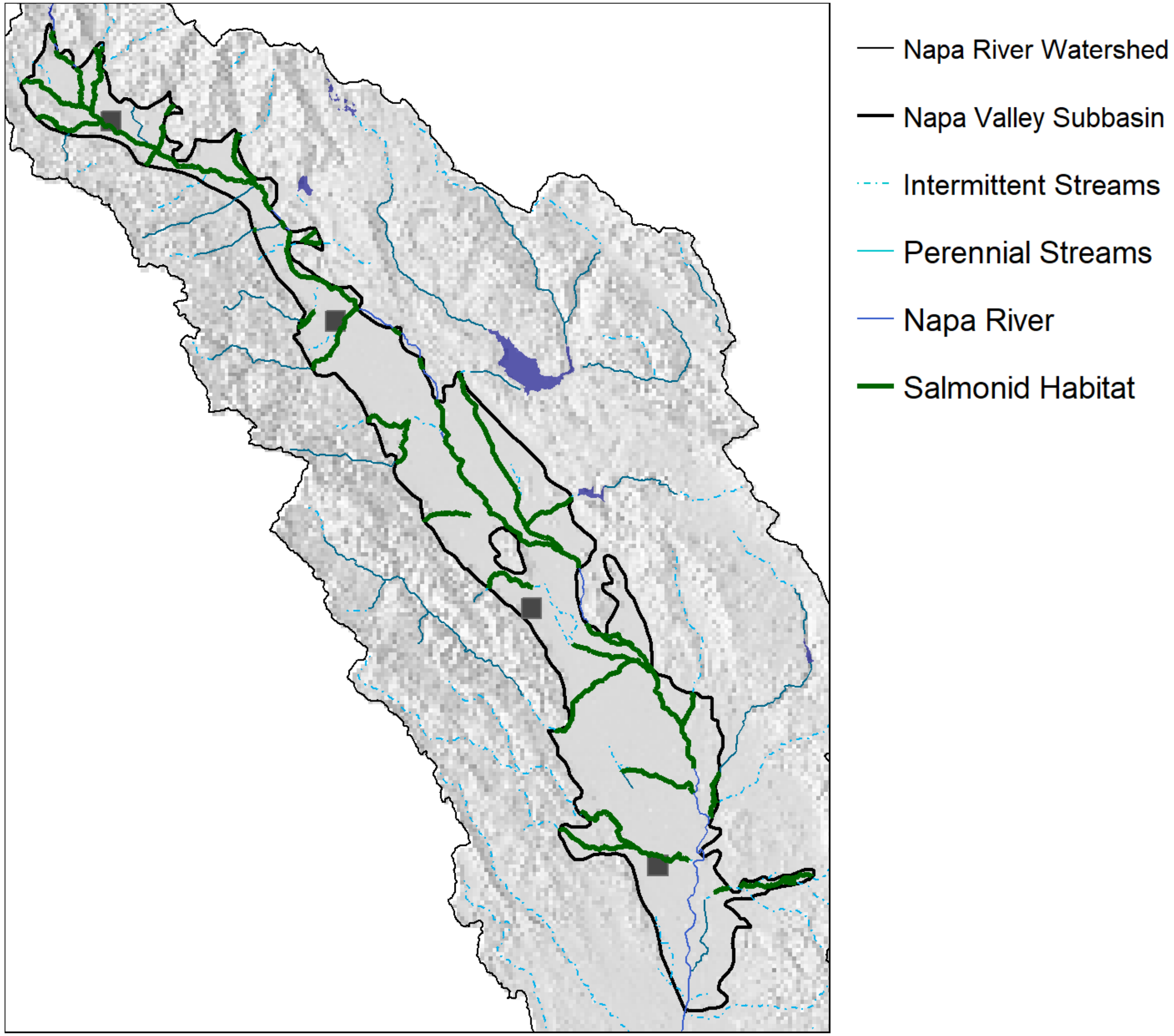
- 2,663 acres delineated in 2019
- 12 freshwater species and 9 other species identified as potentially GW dependent.

- Possible metrics for prioritization:
    - Specific species that are more sensitive to groundwater fluctuations.
    - Changes in remotely sensed health, i.e., NDVI and NDMI
    - Others?



Fish Habitat

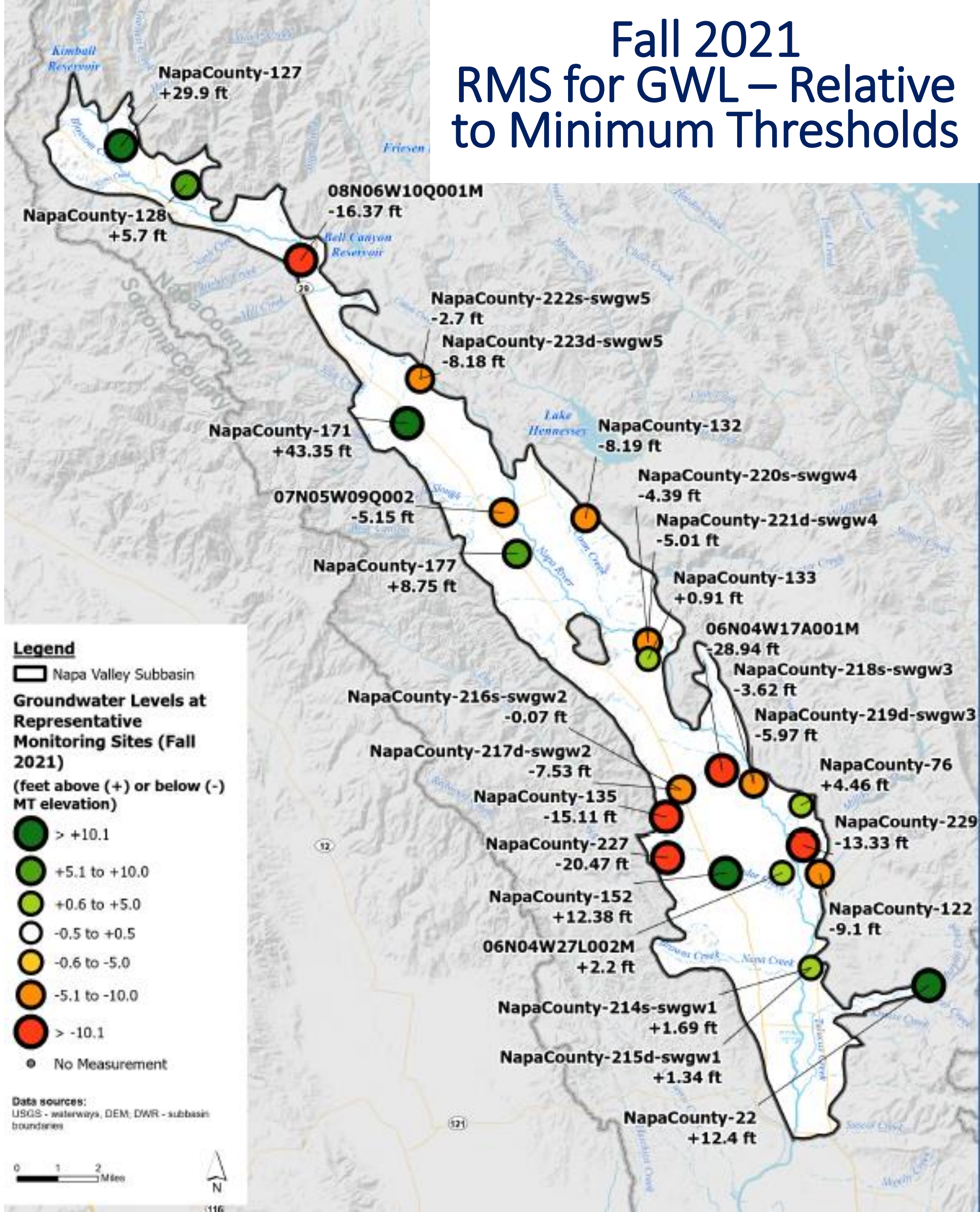
- RCD work to quantify known or potential habitat for salmonids.
- Habitat is for both spawning and rearing.
- Ongoing coordination with RCD is needed to assess which stream reaches may require additional baseflow for better habitat.



Fall 2021 Groundwater Levels

- Representative Monitoring Sites (RMS) are used to measure the sustainability of an area.
- Fall 2021, multiple wells were below the Minimum Threshold (MT).
- RMS below the MT can be used to identify general areas that would benefit from additional recharge.

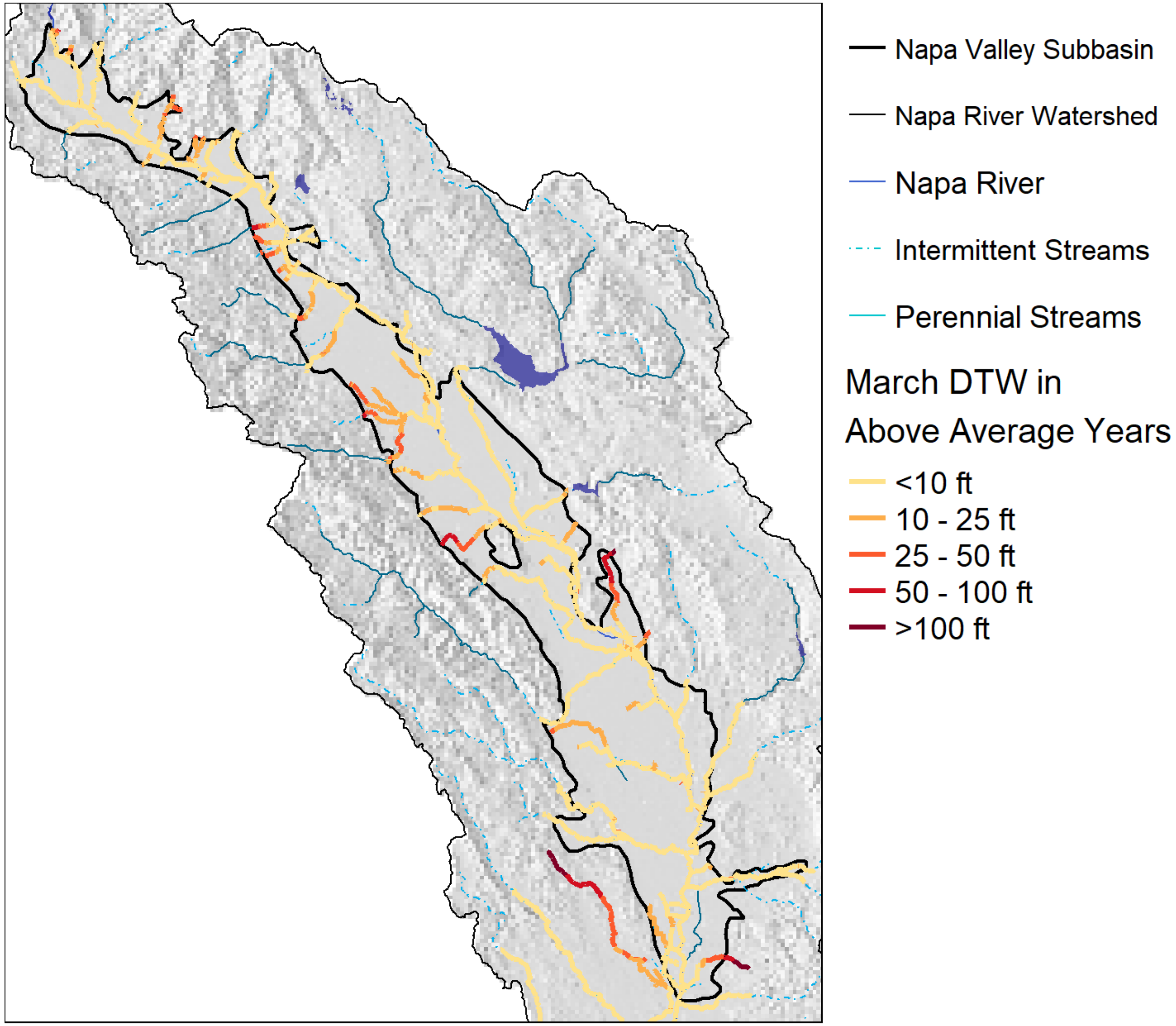
Fall 2021
RMS for GWL – Relative to Minimum Thresholds



Physical Characteristics Related to Recharge

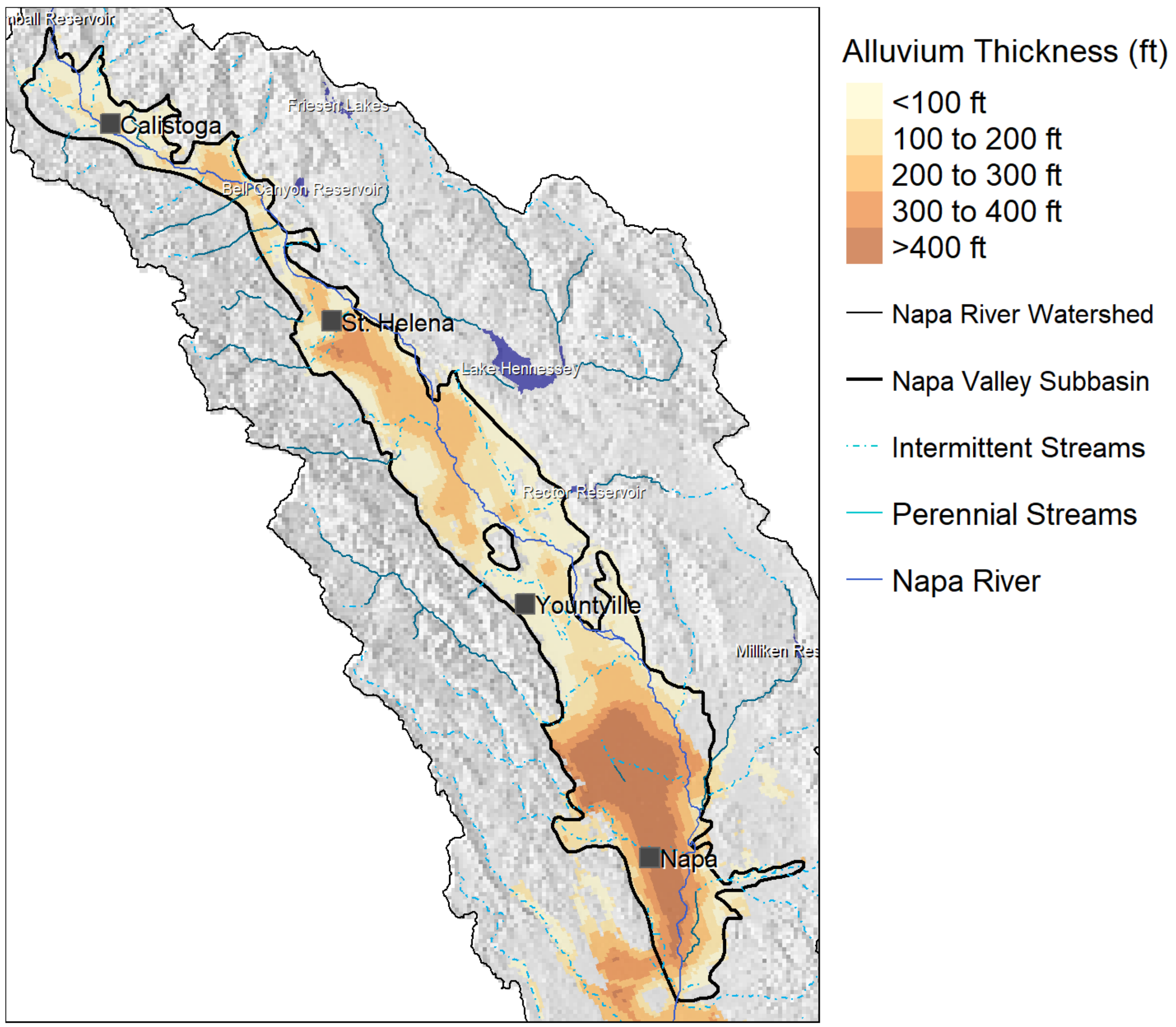
Depth to Water in Aquifer System below the Stream

- Depth to water below stream reaches based on historic groundwater model run (NVIHM).
- Average depth to water in March in climate years that are Above Average shows where there is capacity for recharge when there is water available.



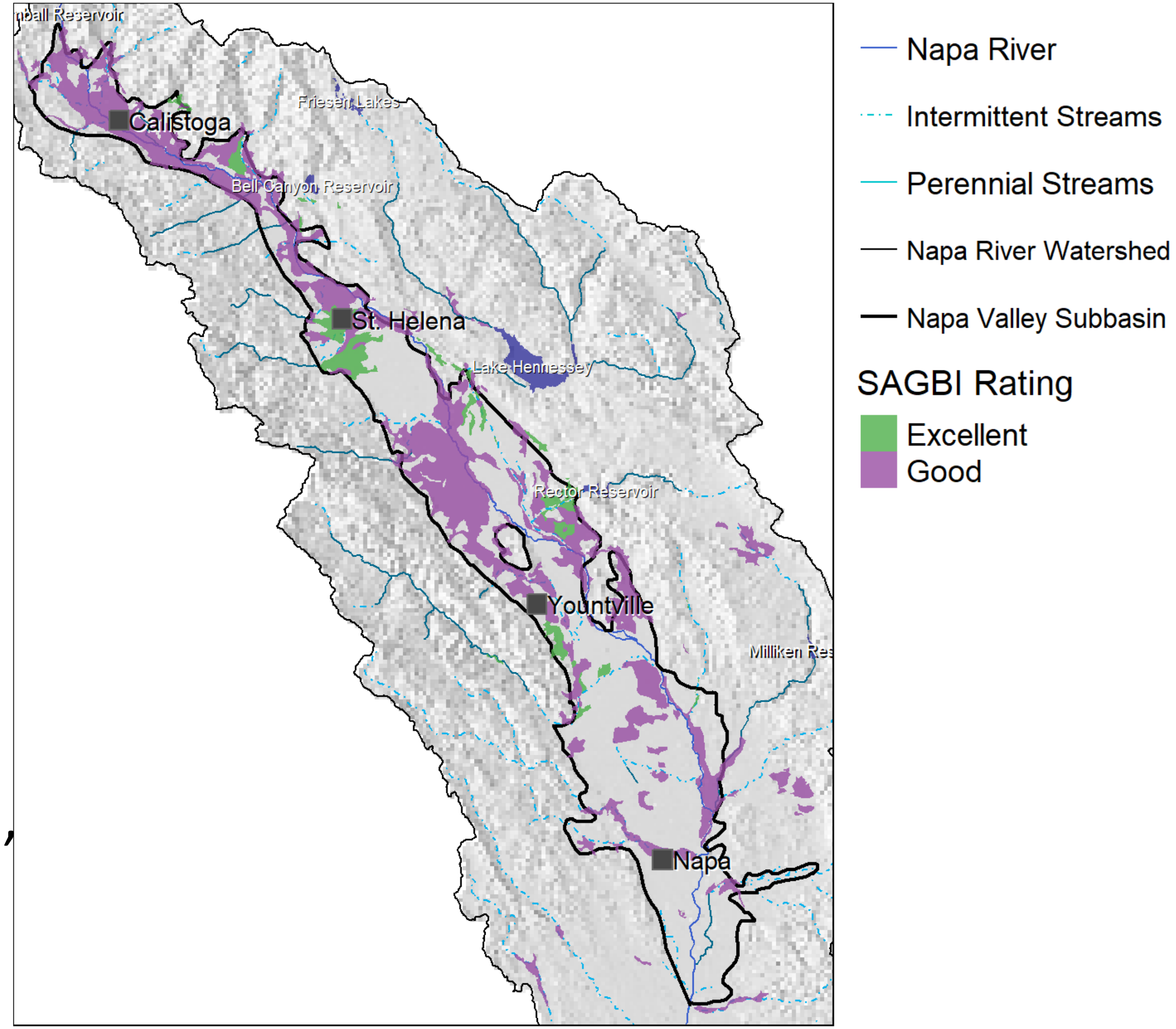
Alluvium Thickness

- Alluvial thickness affects the amount of recharge that can occur in a region.
- Alluvium is the uppermost geologic unit in the Napa Valley, in general, lower conductivity volcanic rocks are under the alluvium.
- If there is not enough storage space in the alluvium, additional recharge may immediately flow out of the alluvium or be rejected.



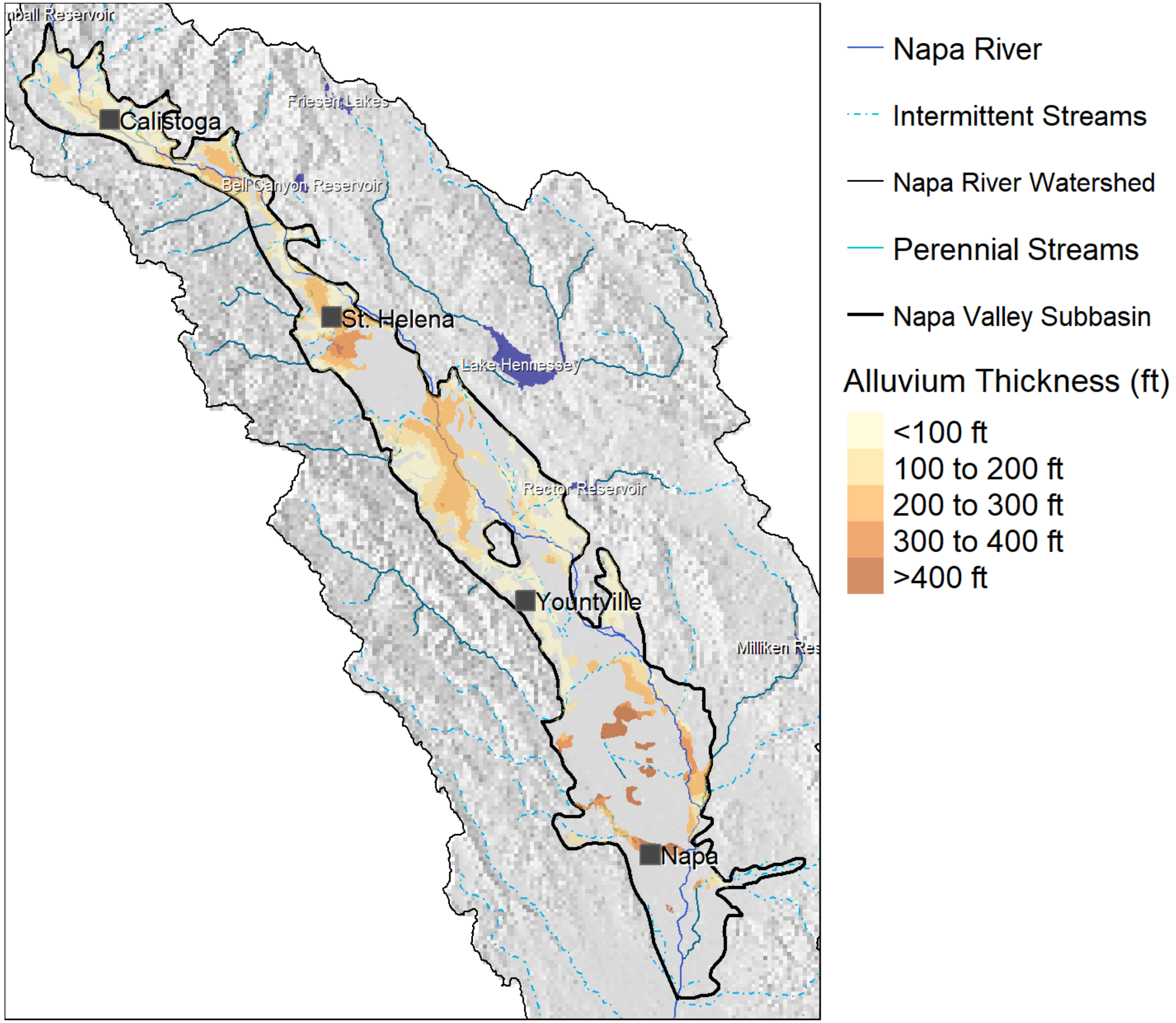
SAGBI Data

- <u>S</u>oil <u>Ag</u>ricultural <u>G</u>roundwater <u>B</u>anking <u>I</u>ndex
- Soil recharge potential characteristics: *permeability*, *topography*, drainage, salinity, crusting/erosion.
- These areas generally have high permeability soil and low topographic relief. Giving water time and ability to infiltrate down.
- Only showing 'Good' and 'Excellent' categories.



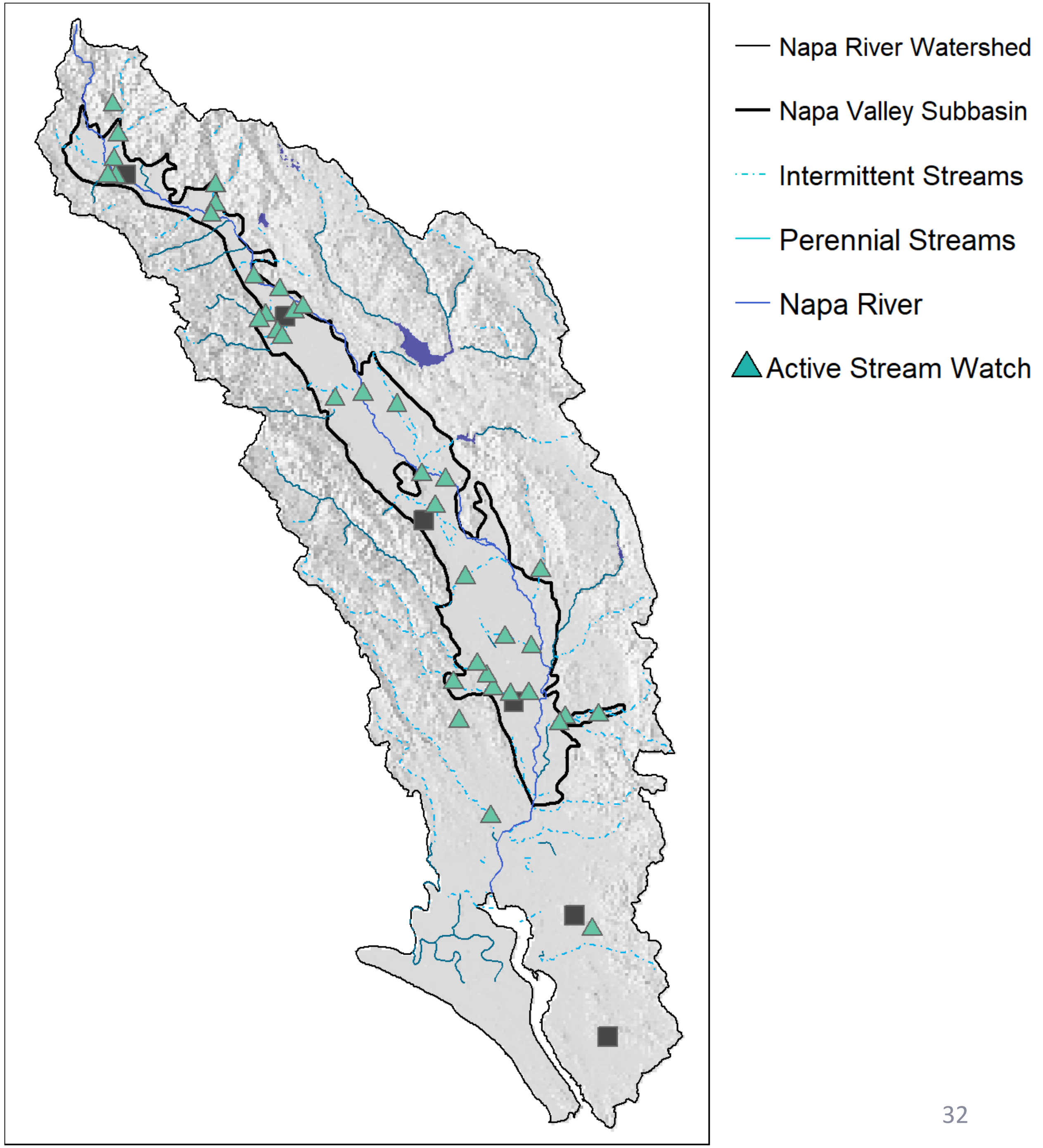
SAGBI Areas with Additional Information

- Total area of ~12,000 acres within Napa Subbasin
- Median alluvial thickness ~150 feet.
- Land use for high priority SAGBI areas (based on DWR/LandIQ 2019 data):
    - 76.4% Vineyards
    - 21.5% Urban
- Additional considerations of groundwater elevations and proximity to stream reaches required.



Additional Data Sources

- Napa RCD
  - Stream Watch
  - Historic Stream Temperatures in Napa Valley
- Pacific Fishery Management Council
- Infrastructure Requirements
- Stormwater Availability
- Land Use



Response Actions: Near-Term and Subsequent

Very Near-Term

Outreach

- Voluntary Drought Measures
- GSA: Subbasin
- County: Watershed/County
- Local: Cities/Communities
- Agricultural/Wineries

Short Term

Workplans

- Storm Water Resource
- Water Conservation
- Groundwater Pumping Reduction
- Interconnected Surface Water & GDEs

Mid-Term

PMAs

- ID Recharge Areas of Interest
- Explore Recharge Opportunities
- Implement Workplans
- GW Pumping Reduction Options

Drought Response Actions: TAG Input

- What drought response measures might be implemented soon to address drought effects on Interconnected Surface Water?
- What kind of outreach might be most effective?
- What additional interim monitoring (available to implement now) might be useful while data gaps are being addressed (takes longer)?

October 2022: Tentative Topics

- Water Conservation Workplan
  - Summary of survey results on water conservation approaches (Napa Valley Grapegrowers)
  - Irrigation system evaluations (RCD and Napa Green)
  - OpenET
  - Tule Technologies: local stations
- Groundwater Pumping Reduction Workplan
  - Well inventory planning
- RMS exceedances and TAG input on potential response actions
- Potential recharge areas of interest (continuing discussion)

Thank You

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