Insight into Cannabis-Related Water Use and Associated Impacts on Instream Flow

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North Coast Regional
Water Quality Control Board

Monthly Board Meeting
Agenda Item No. 11
February 21, 2019

CALIFORNIA
Water Boards
STATE WATER RESOURCES CONTROL BOARD
REGIONAL WATER QUALITY CONTROL BOARDS

Water Boards

Presentation Overview

- Purpose: to highlight new analyses and empirical work conducted by the NCRWQCB, providing a preliminary understanding of water use by cannabis and its potential impacts on instream flow

- Estimates of cannabis water use (Christopher Dillis)
  - ✓ Based on self-reported data from 2017 Annual Reports, received March 2018
  - ✓ New findings on water sources, storage, and use by cannabis cultivation in the North Coast Region

- Cannabis impacts to instream flow (Bryan McFadin)
  - ✓ Empirical streamflow measurements conducted in 2016-2017
  - ✓ Estimates of streamflow impacts, based on expected water demand of cannabis and other irrigation in Trinity County watersheds

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Cannabis Cultivation in Sensitive Watersheds

- Importance of summer base flow
  (Grantham et al 2012, Harvey et al 2006)
- Cumulative impacts of small diversions are difficult to assess
  (Grantham et al 2010, Merenlender et al 2008)
- Substantial impacts of cannabis
  (Bauer et al 2015, Butsic and Brenner 2016,Carah et al 2015)
- New forbearance period (April through October) for diversion from surface water and springs, instituted by SWRCB Division of Water Rights

Photo credit: Cal Dept of Fish and Wildlife

Water Boards

Fundamental Questions

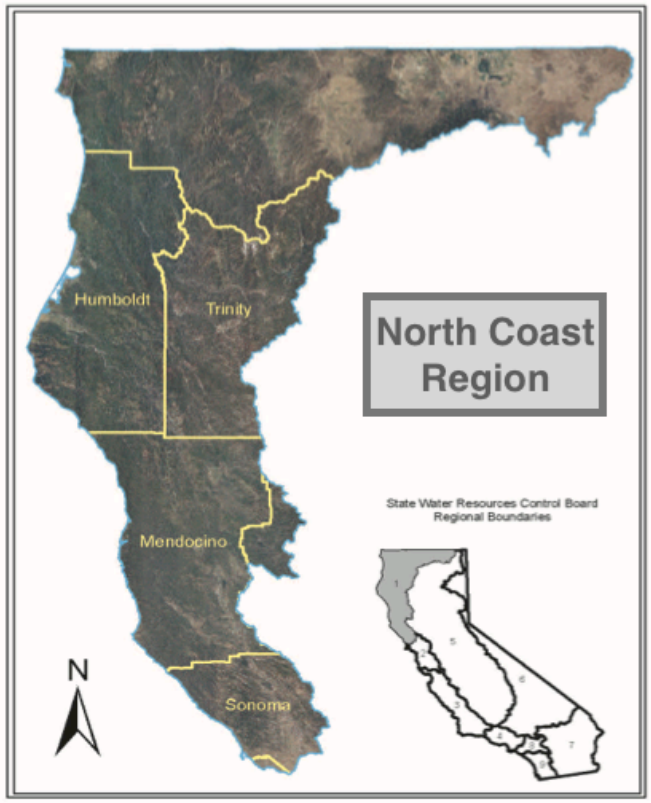
Where do cannabis farms source their water?

How much water is used?

What are the potential impacts to instream flow?

Water Boards

New Data



- Annual reporting: self-reported data on 2017 cultivation year
- First full cultivation season in the program for most enrollees
- Data include:
  - ✓ Size of Cultivation Area
  - ✓ Water input to storage (source and amount)
  - ✓ Water applied to plants (source and amount)
  - ✓ Storage capacity and type
  - ✓ Self-reported compliance with Water Storage and Use Standards

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Fundamental Questions

Where do cannabis farms source their water?

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Water Sources: Seasonal

Surface water

Spring diversion

Water Boards

Water Sources: Seasonal

Rainwater catchment systems

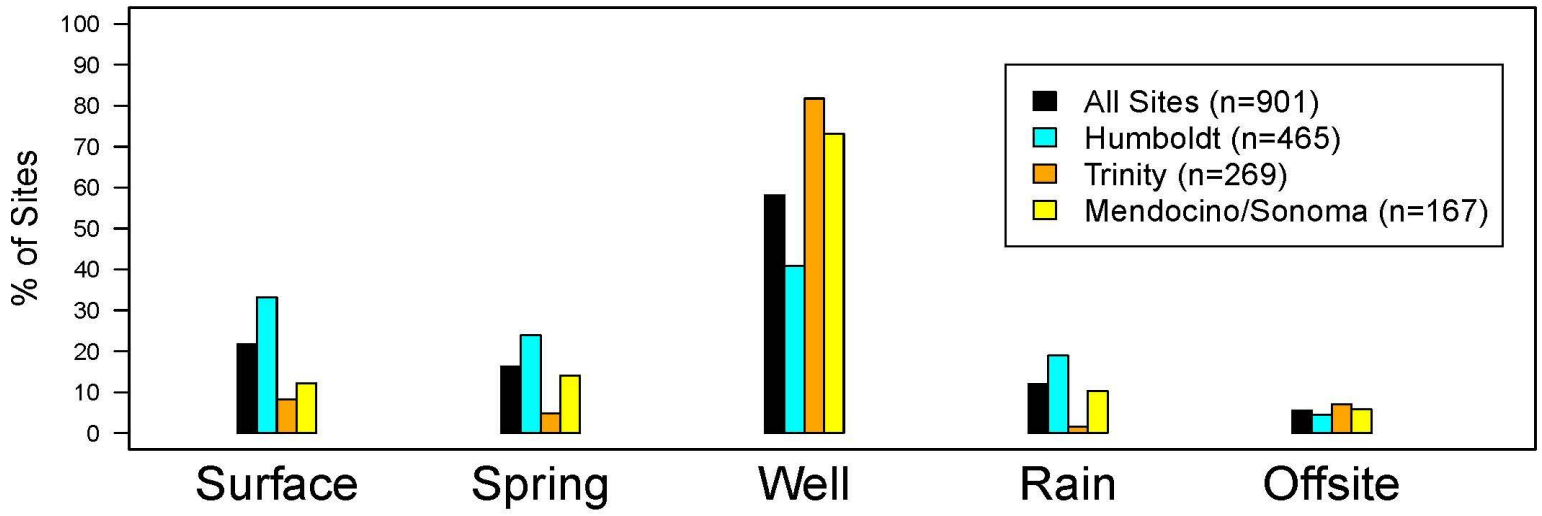
Water Boards

Water Sources: Year-round

Groundwater wells

Not pictured: Water delivery, Municipal tap

Water Sources: Results



-Wells were the most common water source reported by farms (58%), followed by surface diversions (22%) and spring diversions (16%)

-Rainwater catchment not a common source of water, especially as an exclusive source

-Differences in surface water use (following availability) between counties

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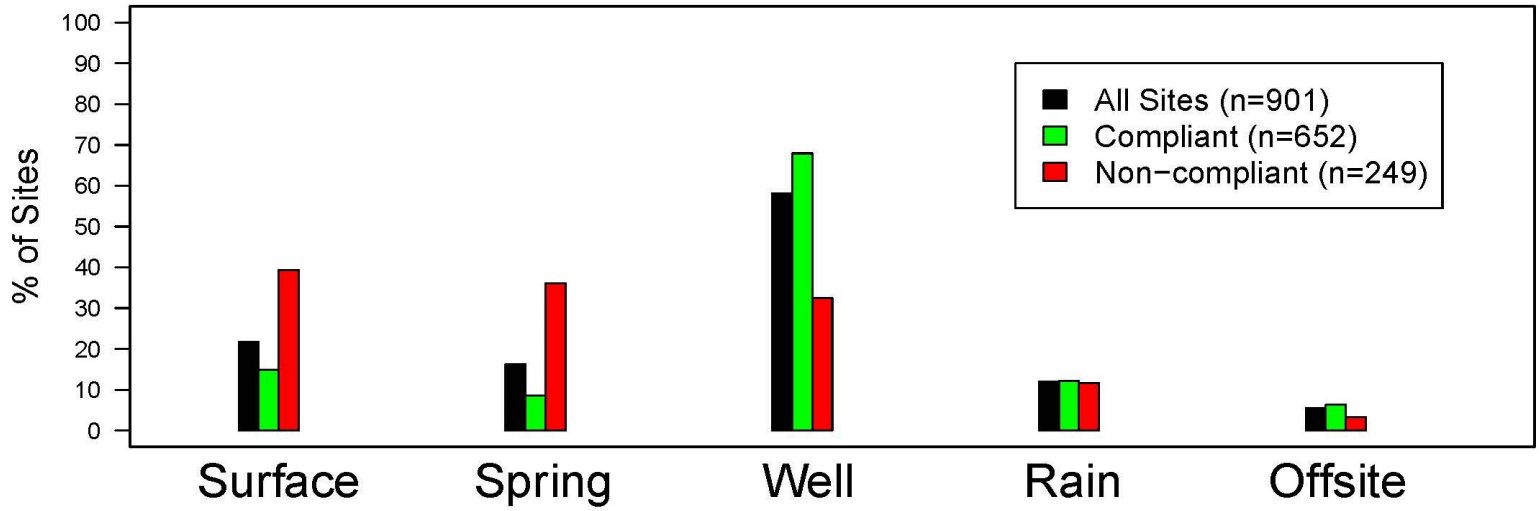
Water Sources: Results



-Self-reported compliance with water storage and use standards

-Forbearance requirements (April-October) in 2019 for surface/spring water

-Sites with wells are more likely to meet Water Storage and Use Standards

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Water Sources: Results

- Key findings:
  - ✓ Widespread use of subsurface water in the North Coast
  - ✓ 38% rely on surface and spring water, which are subject to forbearance restrictions in 2019
  - ✓ Next question: How much water does a farm need and do farms relying on seasonal sources have enough storage for forbearance?

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Fundamental Questions

Where do cannabis farms source their water?

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Water Use

- Previous methods for estimating cannabis water use:
  - ✓ Based on expected water demand by a mature cannabis plant during the growing season (Jun-Oct)
  - ✓ Six gallons per plant, per day

Photo credit: www.cannabis-insight.com

Water use = (# plants) X (6 gallons) X (150 days)

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Water Use

- Limitations of plant-based estimates
  - ✓ Seasonality of water demand
  - ✓ Variability of plant size (outdoor vs. mixed-light operations)
  - ✓ Use of stored water

Water Boards

Water Use

- Limitations of plant-based estimates
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Water Boards

Water Use: importance of storage

Water Use

- ✓ Sum of **water applied from storage** and water directly applied from original source
- ✓ Reflects water applied to meet plant demand
- ✓ Previous paradigm

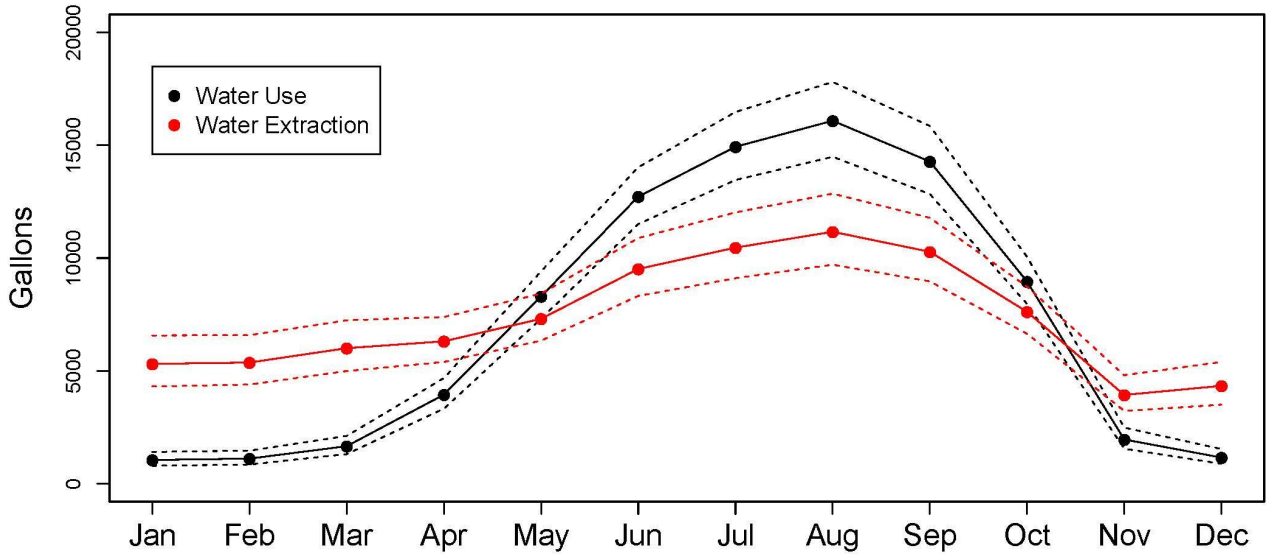
Vs.

Water Extraction

- ✓ Sum of **water input to storage** and water directly applied from original source
- ✓ Reflects water withdrawn from the watershed
- ✓ More ecologically relevant

Water Boards

Water Use vs. Water Extraction

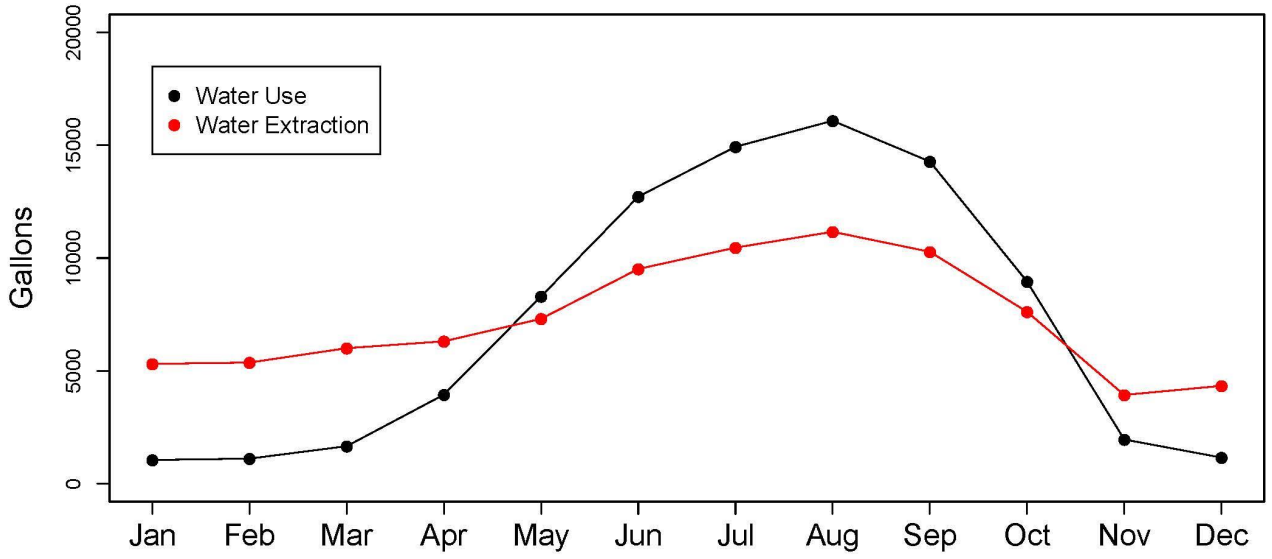


*Model predictions made for median size of cultivation area (11,815.5 ft^2)

- Different seasonal patterns of **Water Use** and **Water Extraction**
- Water input to storage reduces extraction during summer months

Water Boards

Water Use vs. Water Extraction



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- Different seasonal patterns of **Water Use** and **Water Extraction**
- Water input to storage reduces extraction during summer months

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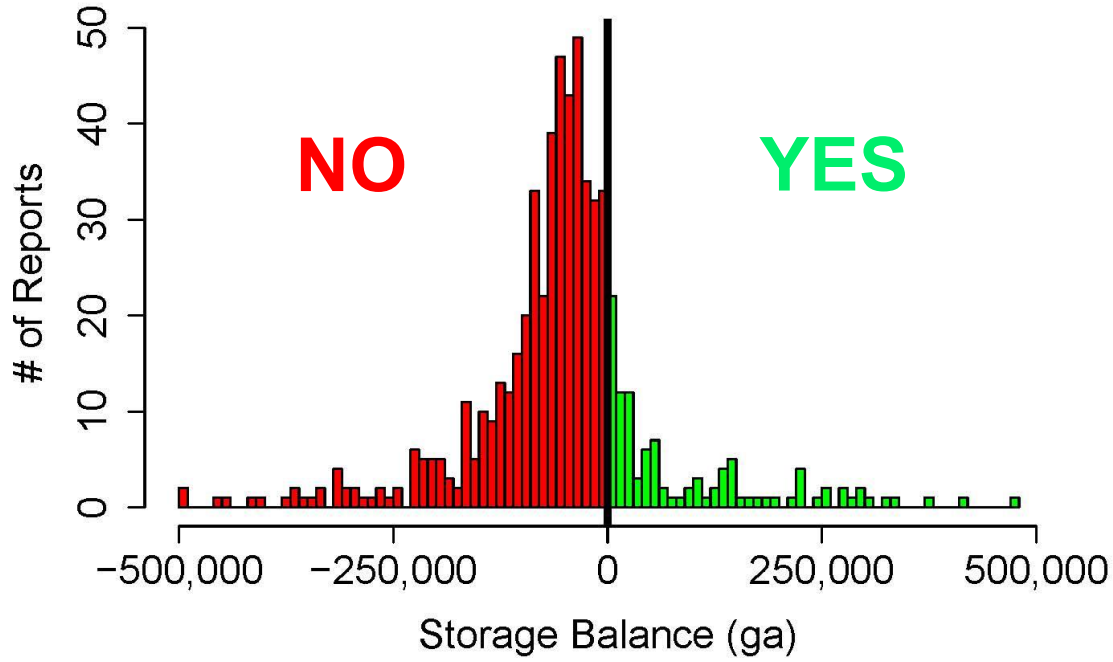
Water Storage

- Storage reduces summer water extraction, *but do farms have enough capacity to forbear Apr-Oct?*



- Storage balance calculated as reported storage capacity minus reported **Water Use** April-October
- In general, farms did not have the storage capacity they would need if required to store water April - October

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Water Storage

What factors influence whether farms have sufficient water storage?

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Water Storage

What factors influence whether farms have sufficient water storage?

Type of Water Source

Year-round (at least one)

Offsite sources

Seasonal (exclusive use)

Water Storage

What factors influence whether farms have sufficient water storage?

Type of Water Storage

Pond

Other (Tank/Bladder)

Water Storage

What factors influence whether farms have sufficient water storage?

- As expected, farms with perennial water sources did not have sufficient storage, given that they are able to use these sources year-round

- However, even farms relying exclusively on seasonal water sources generally did not have sufficient storage, unless they had a pond

- Ponds are rare: Although 40% of farms relied exclusively on seasonal water sources, only 10% of farms reported ponds

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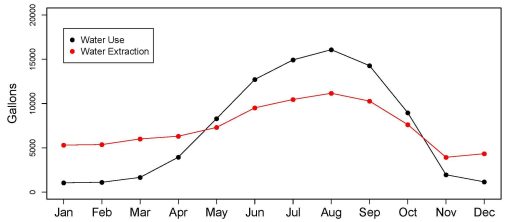
Water Extraction Patterns

- Given that:
  - ✓ The *water source type* and *storage type* influence storage sufficiency, and

  - ✓ Water storage itself distinguishes **Water Extraction** from **Water Use**



- *How do water source type and storage type predict patterns of water extraction?*

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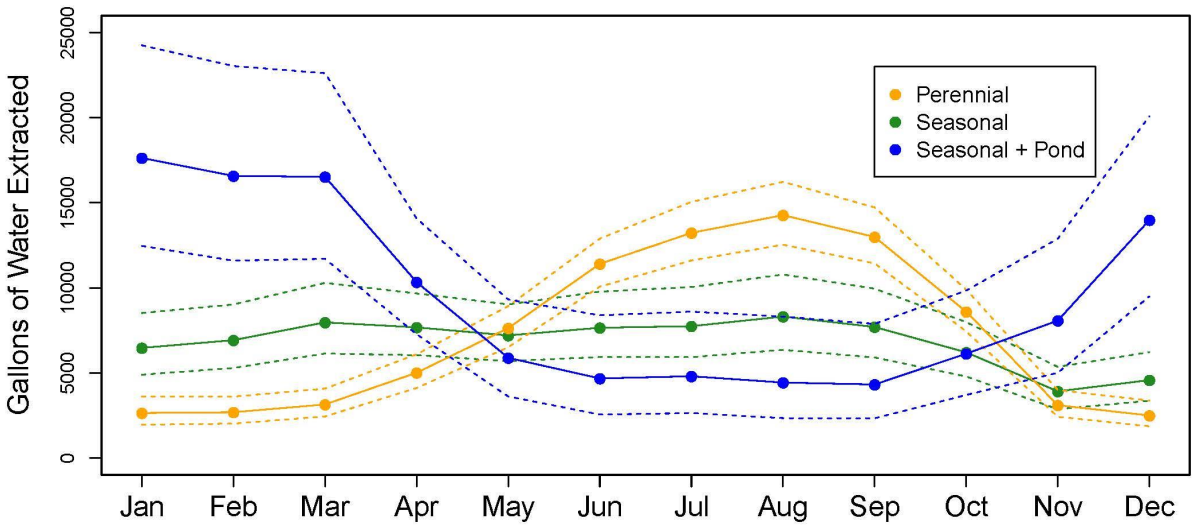
Water Extraction Patterns

- Farms with a **perennial water source** do not store much water and therefore extraction follows plant demand
- Farms relying on **seasonal water sources** show a flat curve reflecting both offseason input to storage, yet insufficient storage, resulting in summer extraction
- Farms with **ponds** generally extract most of their water in offseason months



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Water Boards

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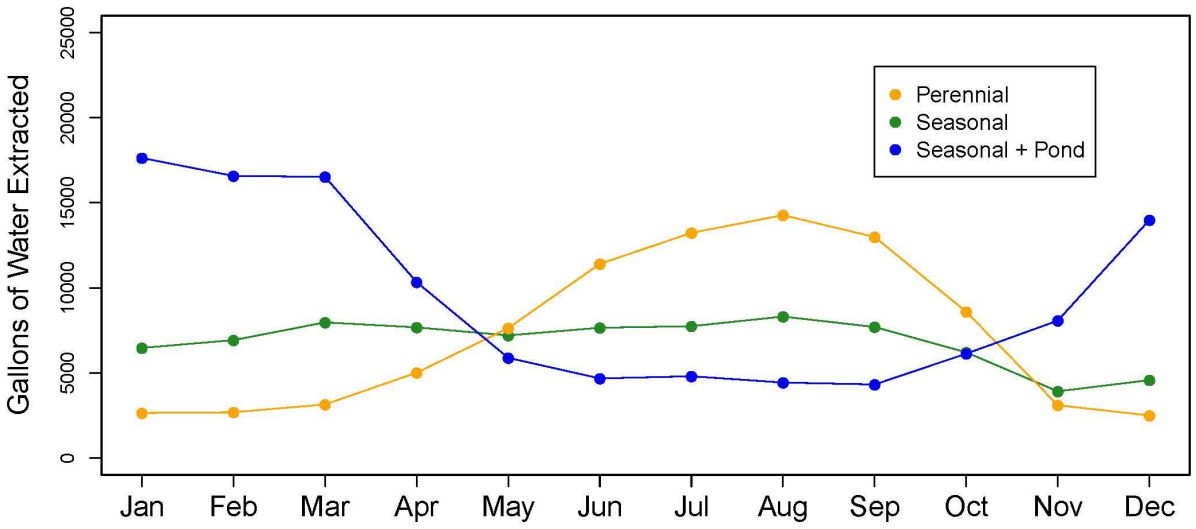

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Fundamental Questions

Where do cannabis farms source their water?

How much water is used?

What are the potential impacts to instream flow?

Water Boards

Fundamental Questions

Where do cannabis farms source their water?

The majority of reported water used for cannabis cultivation came from wells, with surface water and spring water representing the next most common sources

How much water is used?

What are the potential impacts to instream flow?

Water Boards

Fundamental Questions

Where do cannabis farms source their water?

The majority of reported water used for cannabis cultivation came from wells, with surface water and spring water representing the next most common sources

How much water is ~~used~~ **extracted and when**?

The timing and amount of water extracted for cannabis cultivation depends on where farms source their water and what type (i.e. amount) of water storage is used

What are the potential impacts to instream flow?

Water Boards

Fundamental Questions

Where do cannabis farms source their water?

The majority of reported water used for cannabis cultivation came from wells, with surface water and spring water representing the next most common sources

How much water is ~~used~~ ***extracted and when****?*

The timing and amount of water extracted for cannabis cultivation depends on where farms source their water and what type (i.e. amount) of water storage is used

What are the potential impacts to instream flow?

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Potential impacts

- Potential impacts to instream flow are influenced by the timing and amount of water extracted
- Timing of extraction differs dramatically depending on the source of water and whether sites have ponds
- Most farms relying on seasonal water sources typically did not have enough storage in 2017 to forbear Apr-Oct
- What will be the most common solution for insufficient storage?

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Potential impacts

- What will be the most common solution for insufficient storage?

All three options have unique environmental impacts and implications for water extraction from the watershed

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Potential impacts

- What will be the most common solution for insufficient storage?

- Site development for installing many water tanks or large water bladders

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Potential impacts

- What will be the most common solution for insufficient storage?

- Site development, onstream ponds, potential habitat for invasive species

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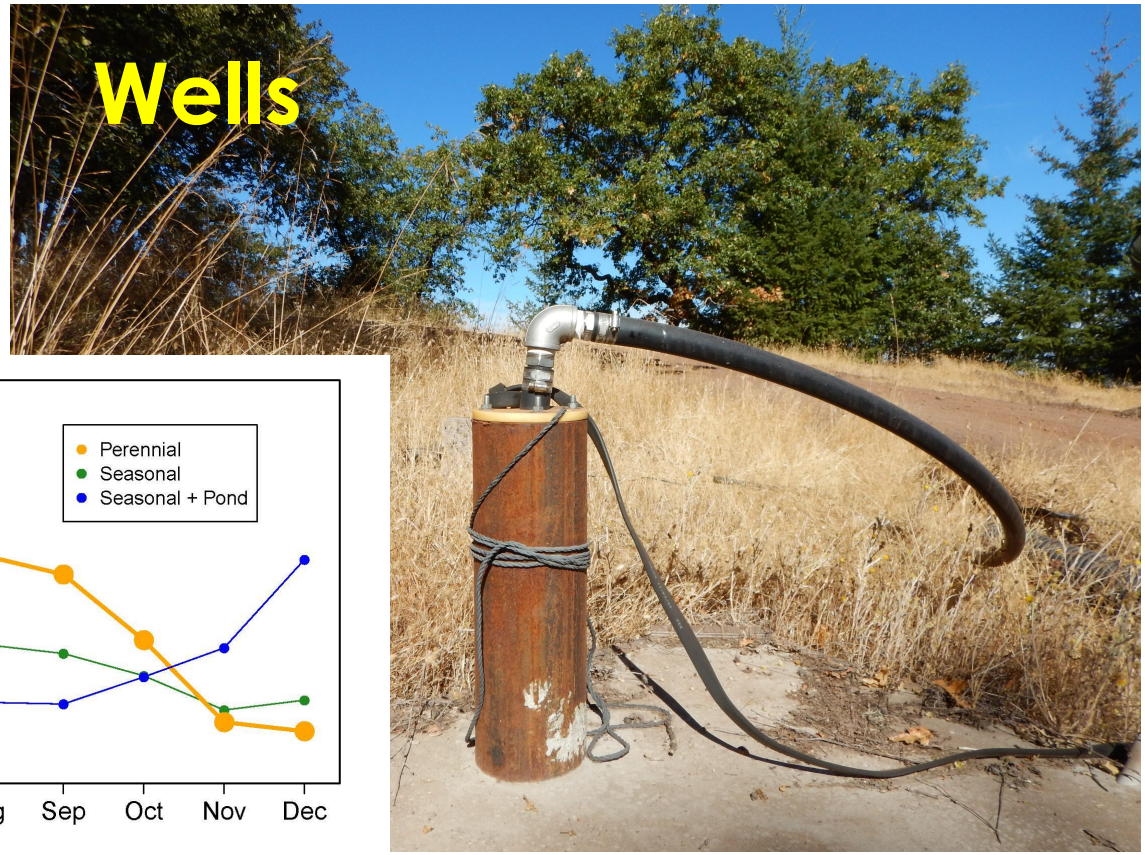
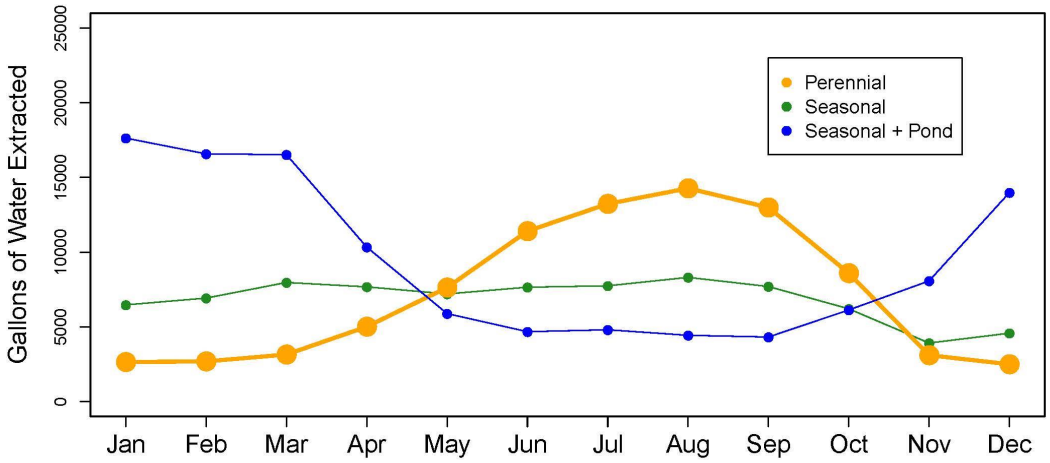
Potential impacts

- What will be the most common solution for insufficient storage?



- Summer extraction



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Additional Considerations

Potential benefits vs. threats of increased well frequency

Vs.

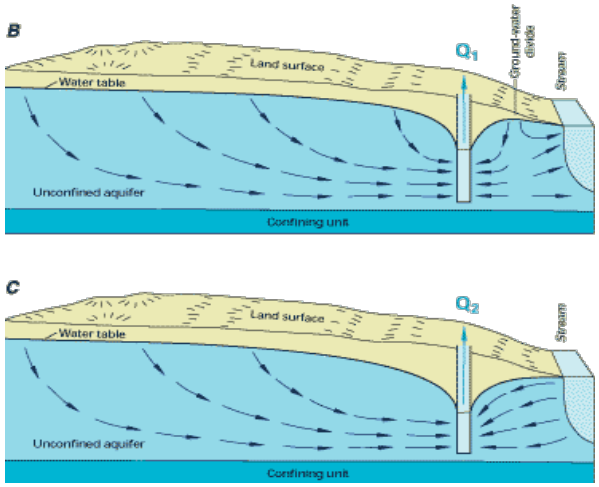

Photo credit: US Geological Survey

- Lagged effect of groundwater extraction (from properly sited wells) on instream flow could move the impacts out of the crucial summer dry season
- More research needed on groundwater/surface water interaction in the North Coast

- Wells in close proximity to streams are essentially surface water diversions
- Typical patterns of well extraction would thus amount to summer surface water diversions

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Instream Flows in Select Trinity River Tributaries and Comparison to Water Use Estimates

Item No. 11

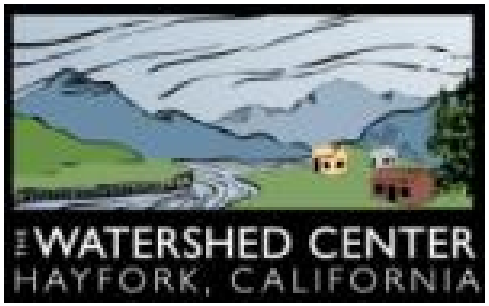
February 21, 2019

Presented by Bryan McFadin

CALIFORNIA Water Boards

Acknowledgements

- Josh Smith and Cindy Buxton, WRTC
- Nick Cusick, Callie Grant, Emily McClintock, Cameron Heyvaert, and Katy Abbott, Americorps WSP
- Andy Hill and crew, CDFW
- Galen Andersen, Kyle Hopkins, and Justin Pabich, USFS
- Carrieann Lopez, Connor McIntee, Justin Fitt, Rich Fadness, Stormer Feiler, Shin-Roei Lee

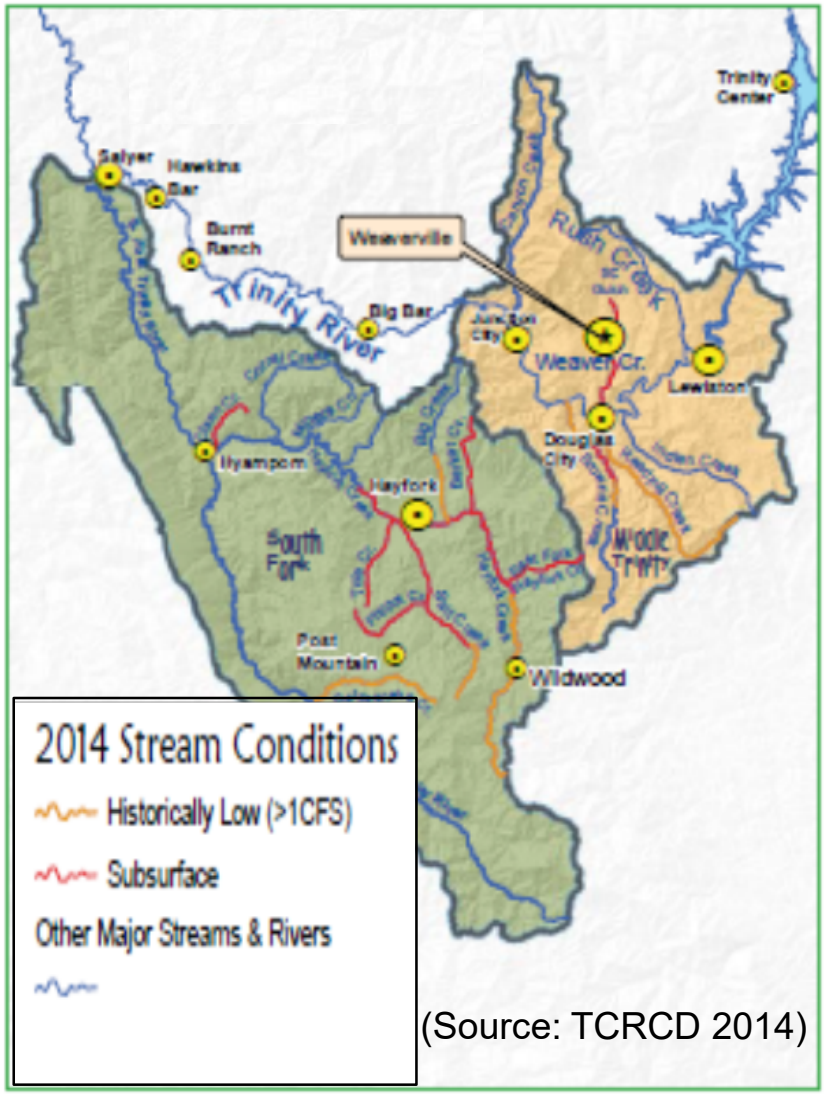


Outline

- Background
- Objectives of Study
- What we did
- Results
- What we learned

Water Boards

Background



(Source: TCRCD 2014)

- Alarming low flow conditions in drought
- Increased water demands: mostly cannabis
- Request for assistance

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Study Objectives

- Characterize the hydrology of the basins (Weaver, Indian, Reading, Browns, Hayfork, & Rattlesnake Creeks)
- Understand water extraction and impacts
- Establish historical context
- Provide the basis for evaluating the effectiveness of regulations

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What we did…

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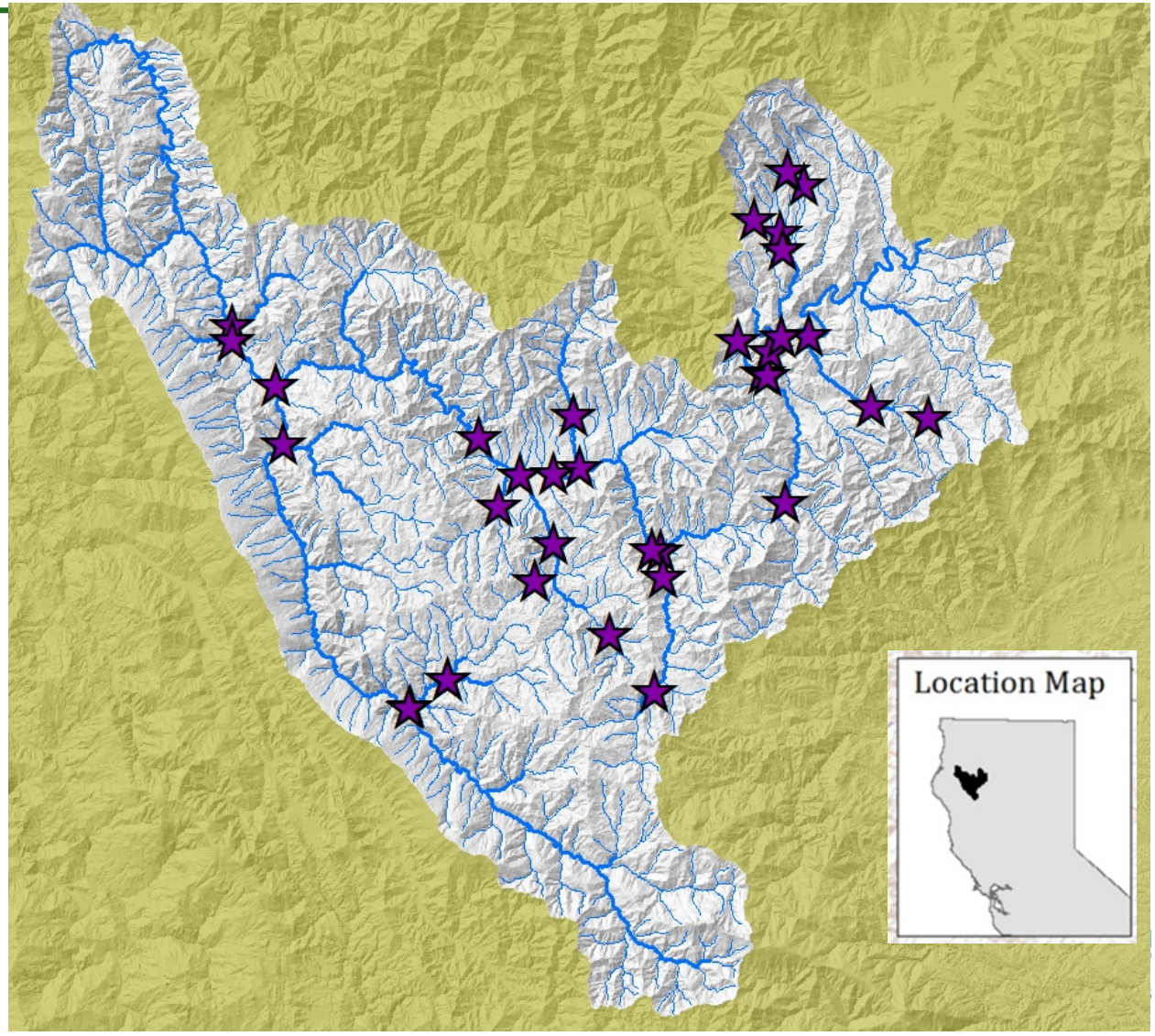
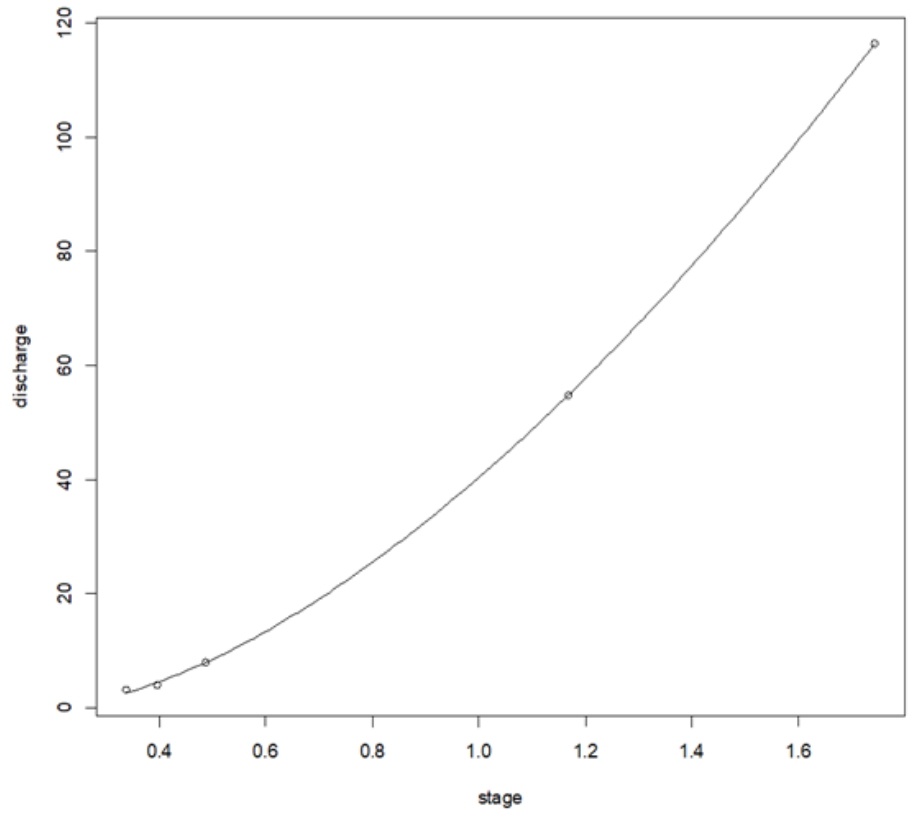
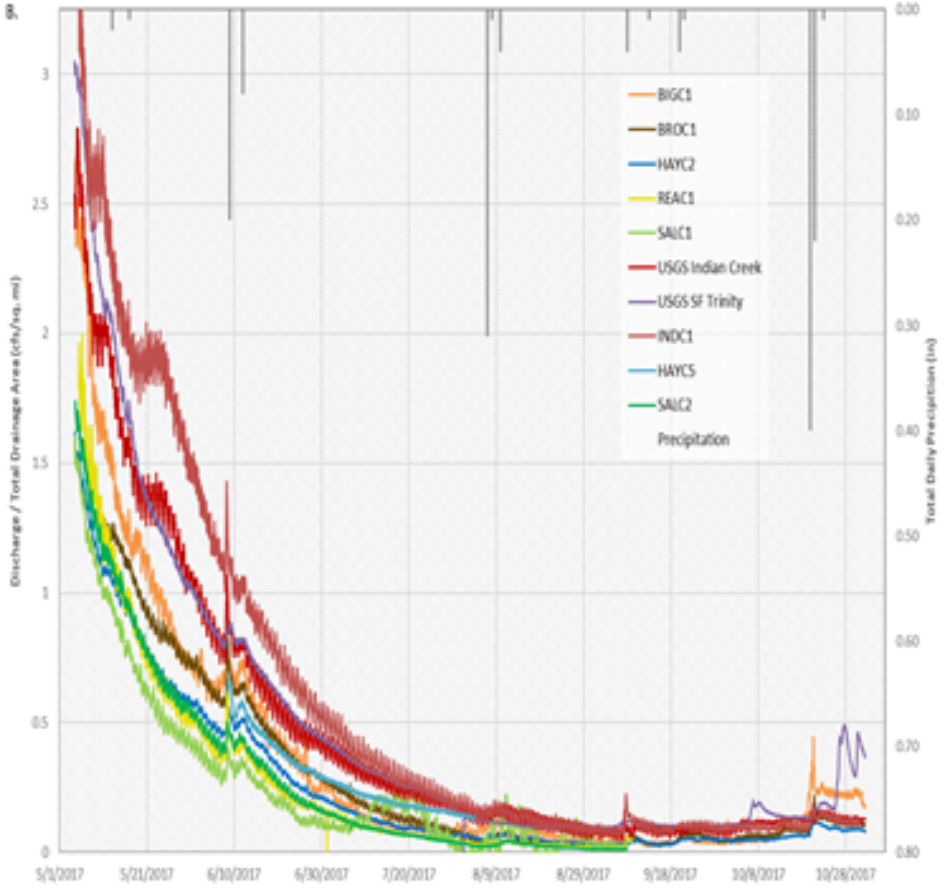
Measured Instream Flows Monthly at 33 locations



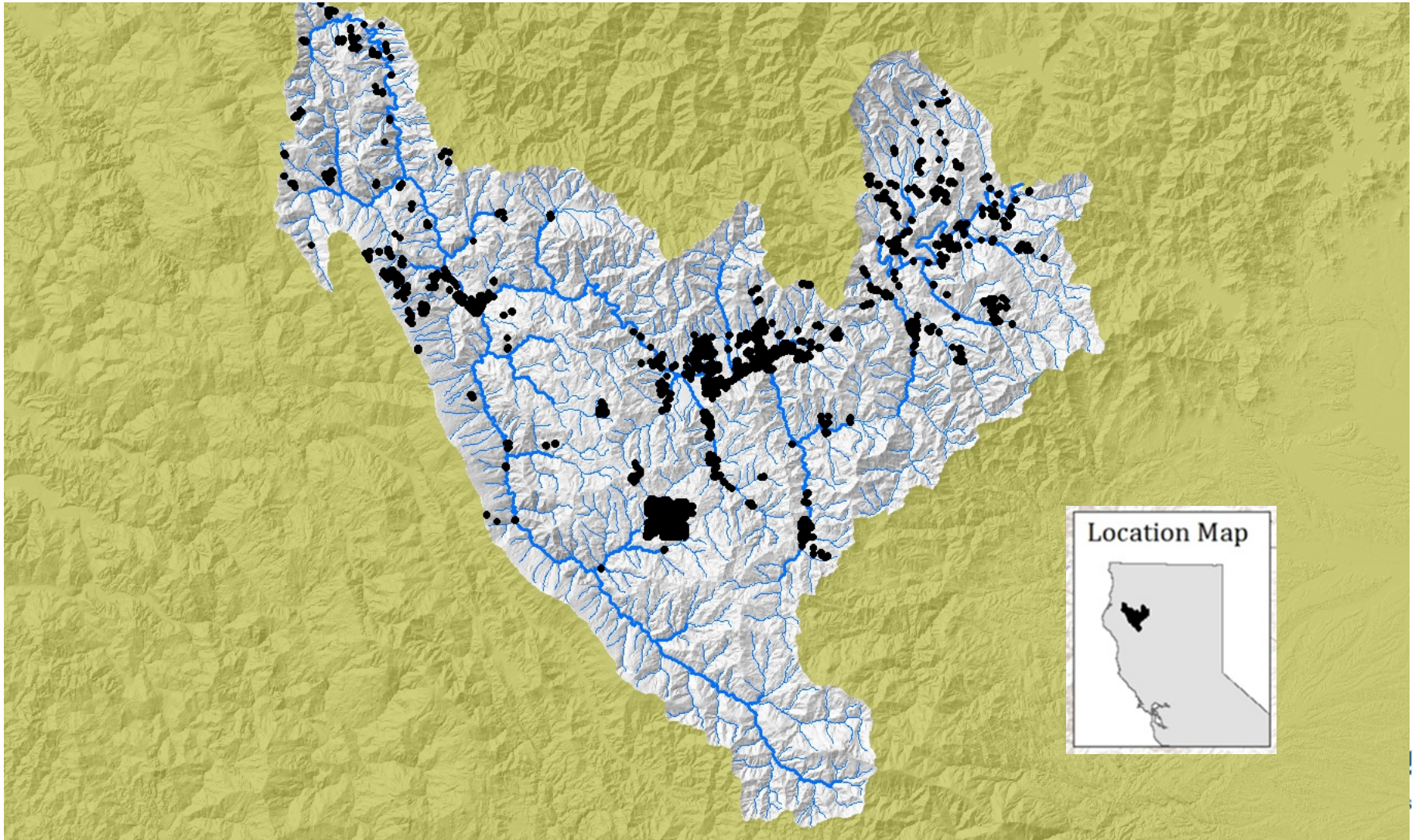
Established Seasonal Gages

- 5 sites in 2016
- 9 sites in 2017

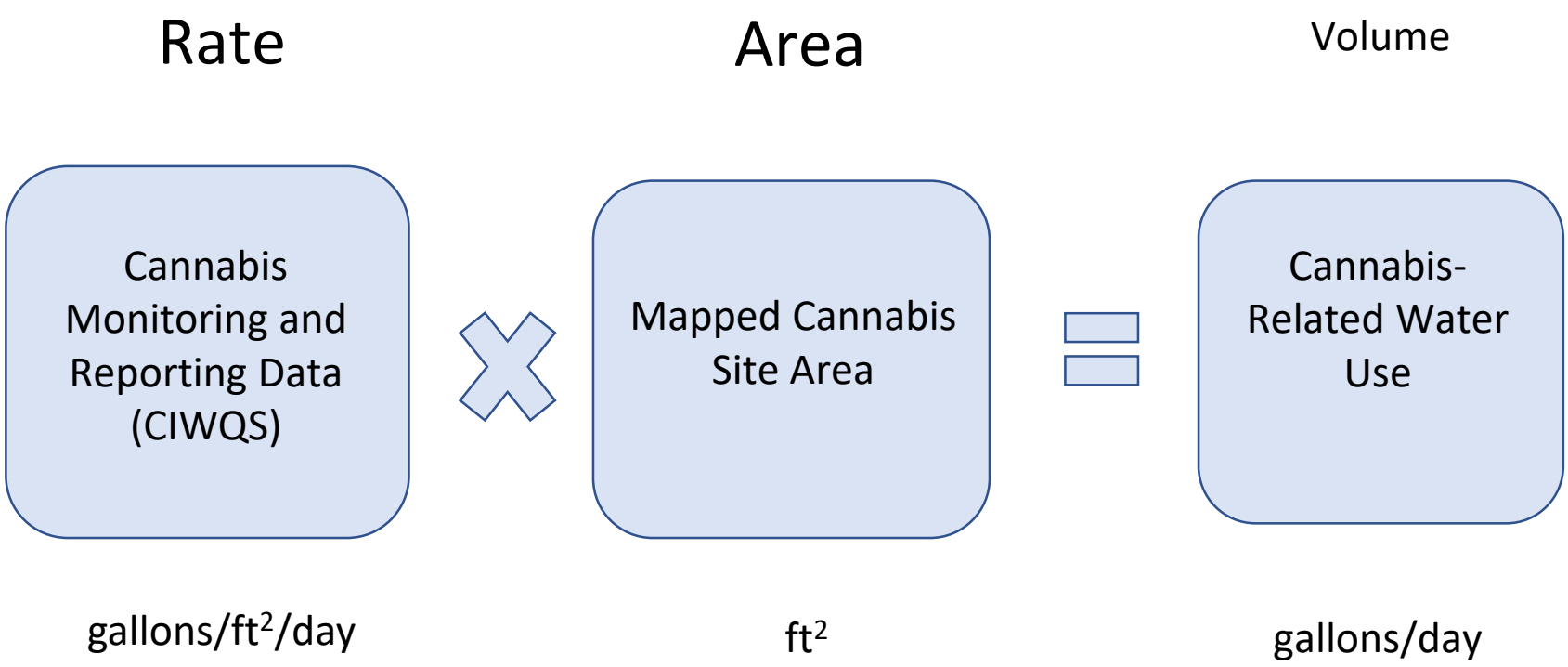




Mapped Cannabis Grows



Estimated Cannabis Water Use



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Cannabis Water Use Estimates:

- All cannabis-related water use is assumed to be serviced by direct diversion
- We did not account for storage, groundwater, municipal, and delivered water
- Resulting estimates over-estimate actual flow impacts

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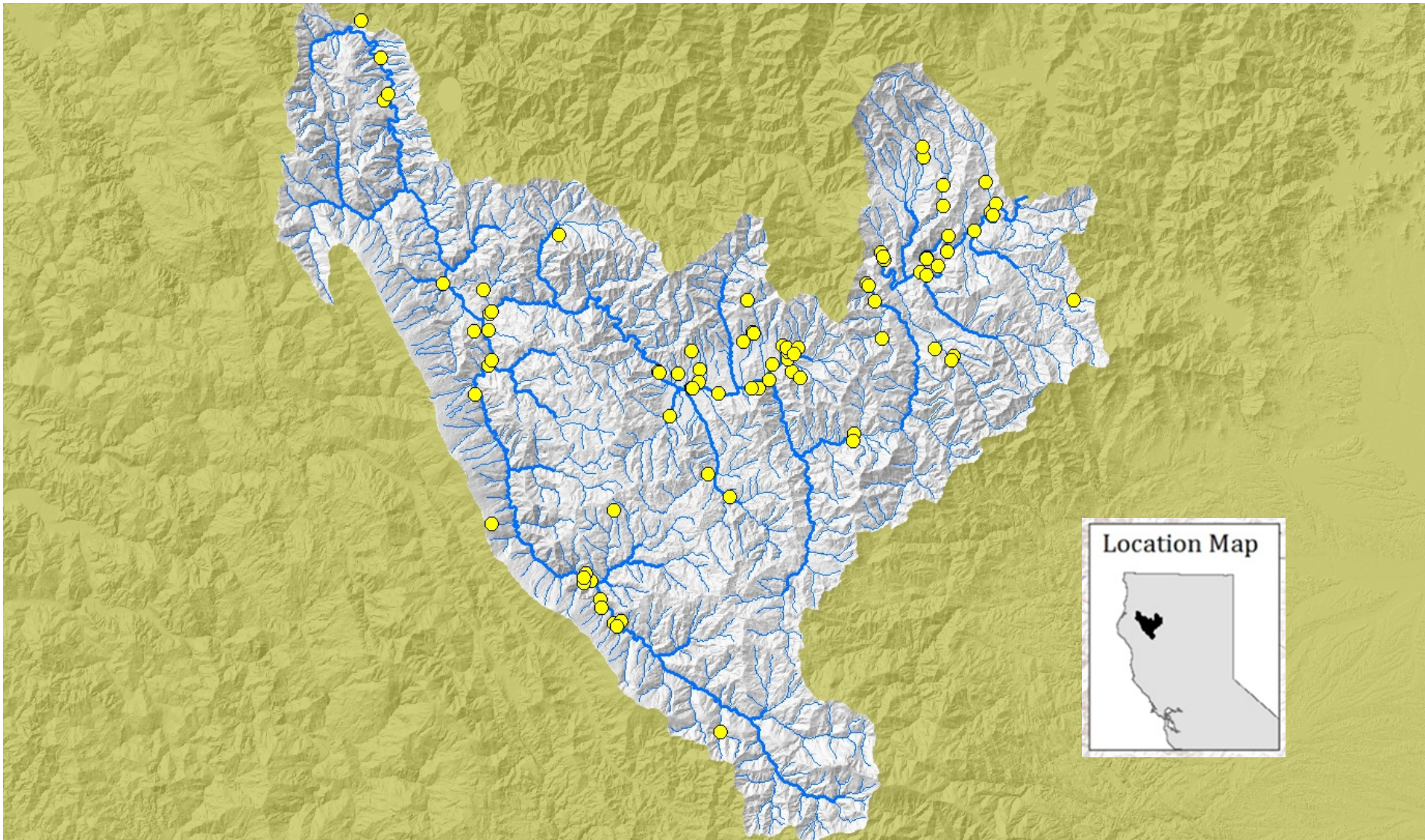
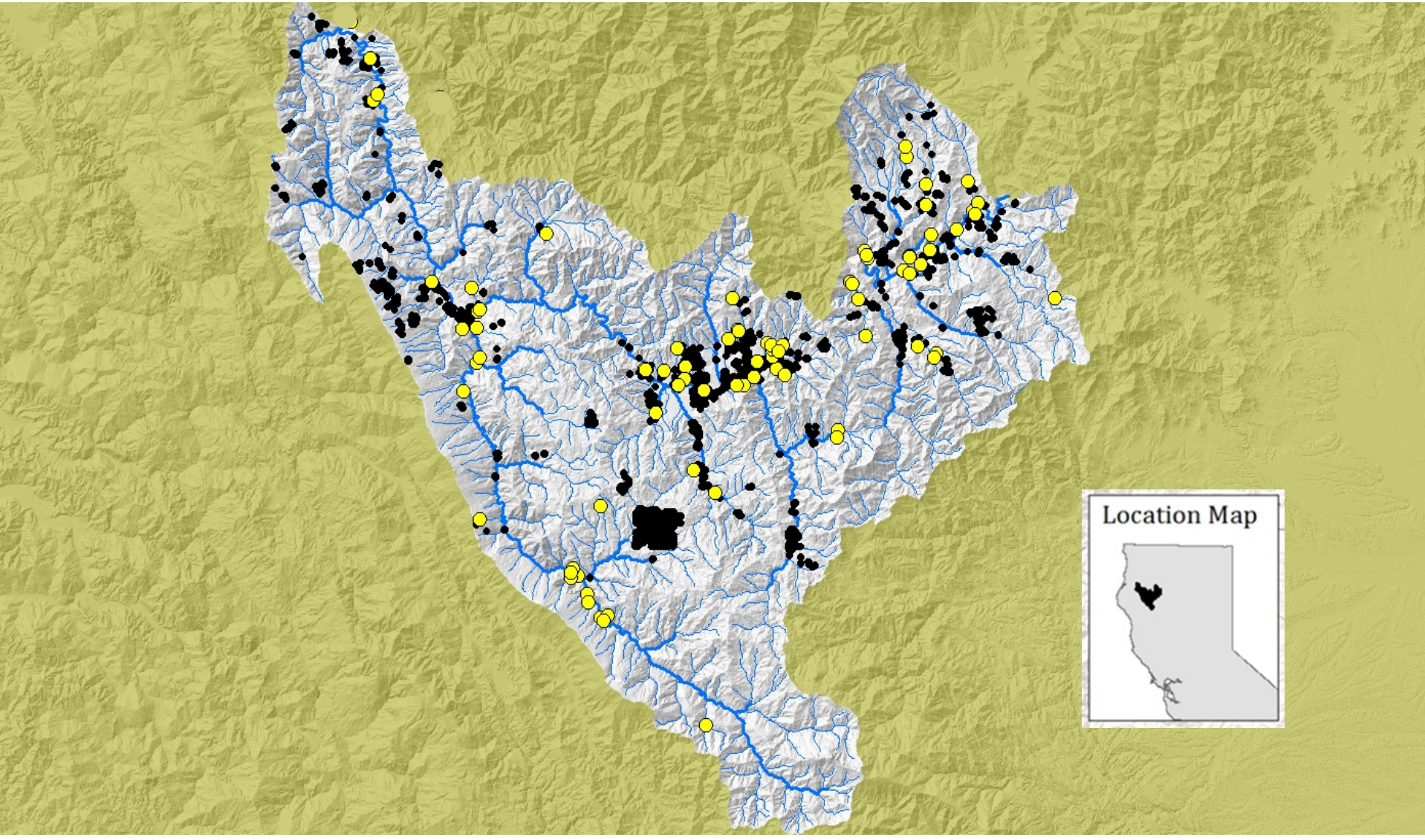
Mapped and Quantified Water Rights



Water Rights and Cannabis



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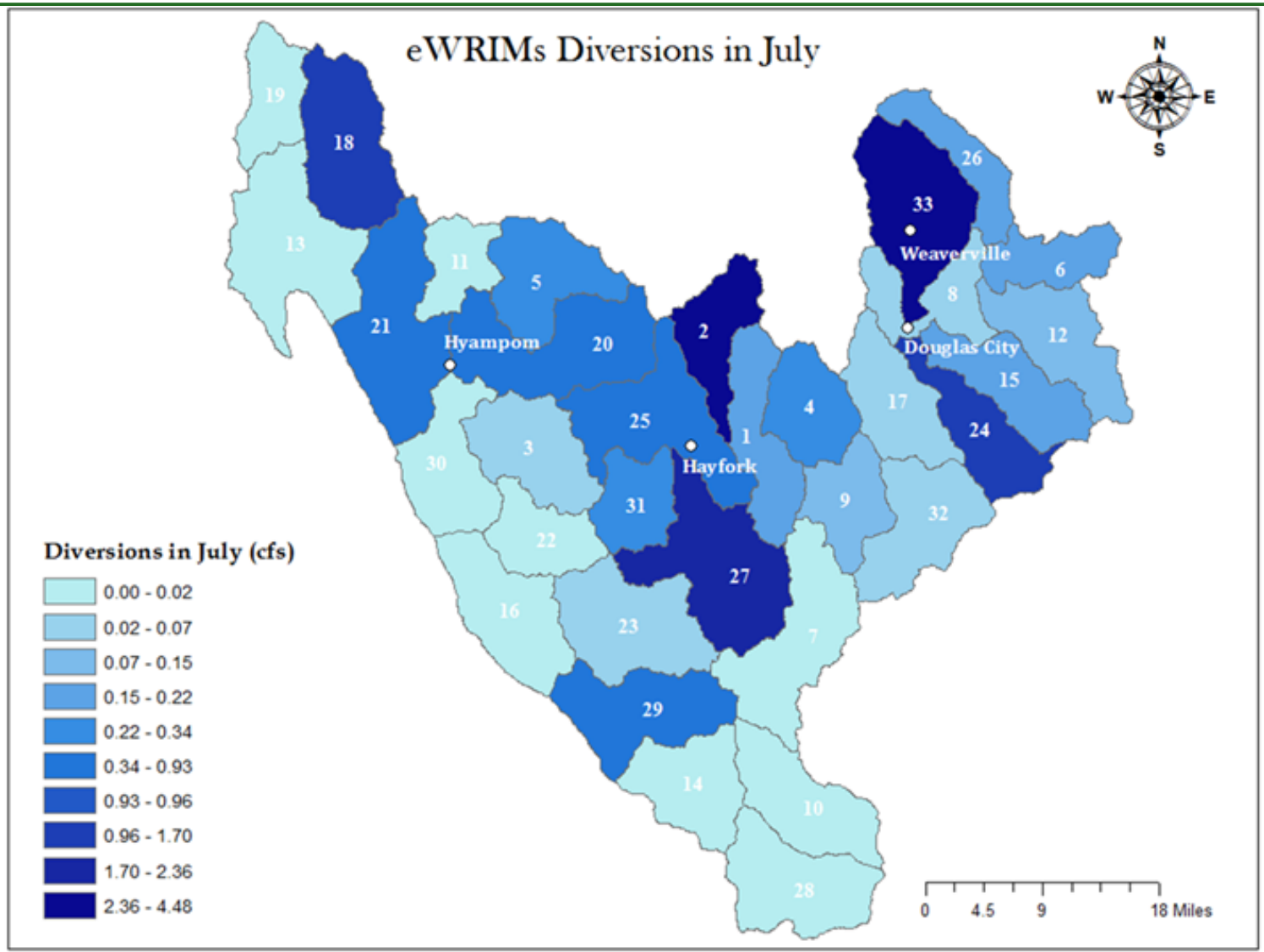

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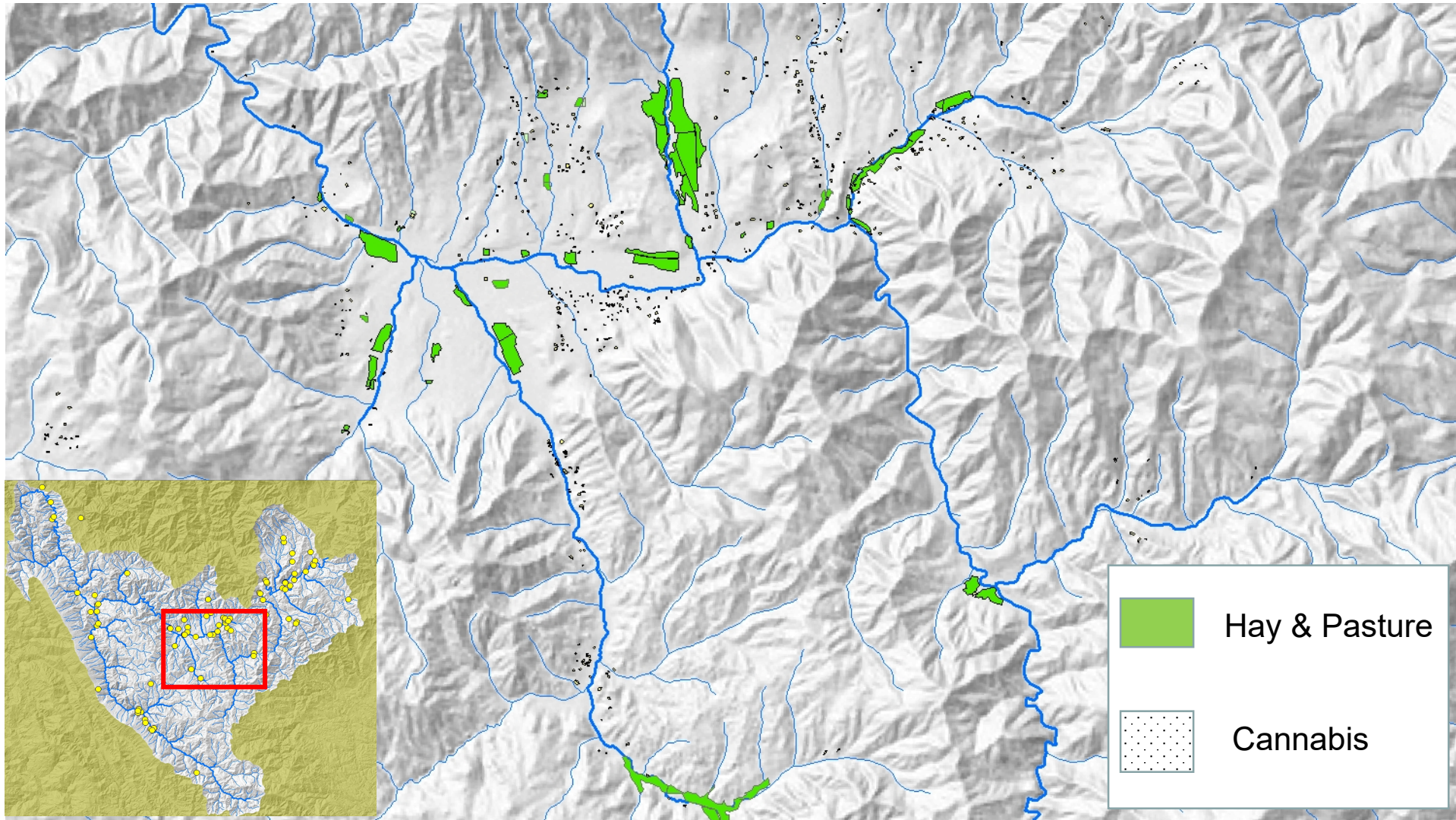
Irrigated Agriculture



Compared Measured Flows to Long-Term Gage Records

- We developed equations relating our seasonal gage records to established USGS gages with longer records

- We used the equations to estimate the historical distribution of flow conditions at our sites, expressed as percentiles

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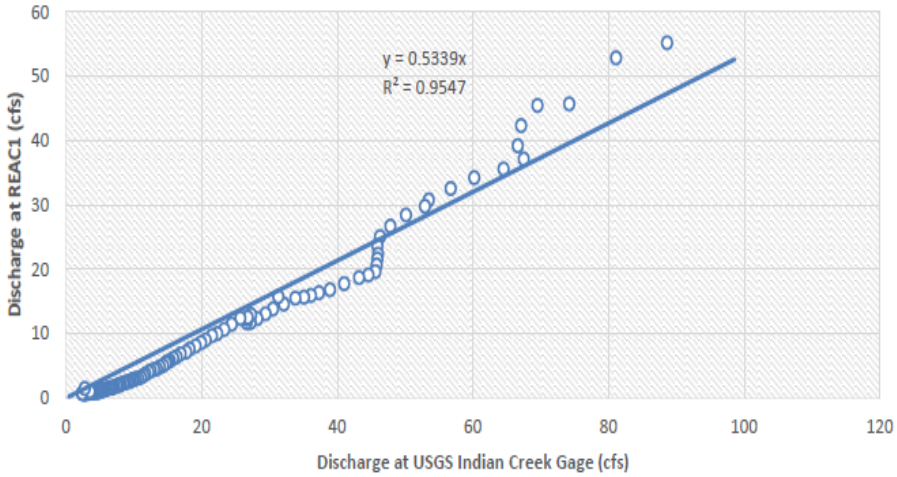
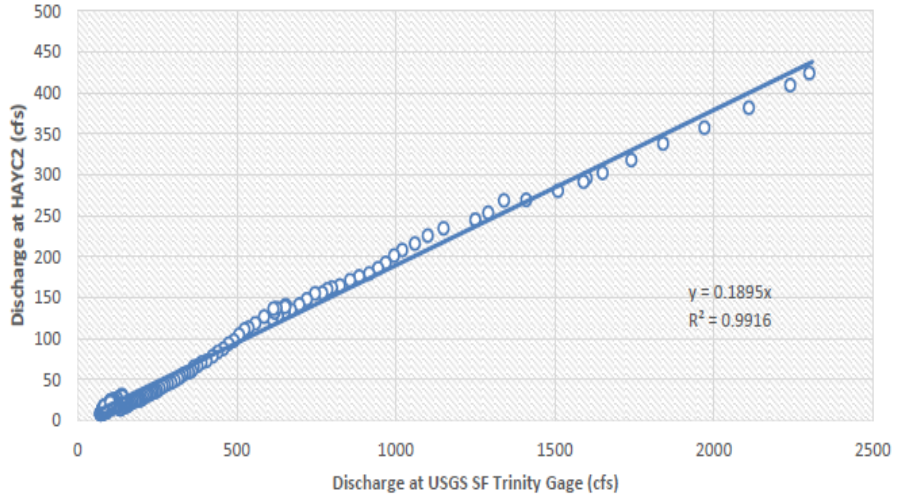
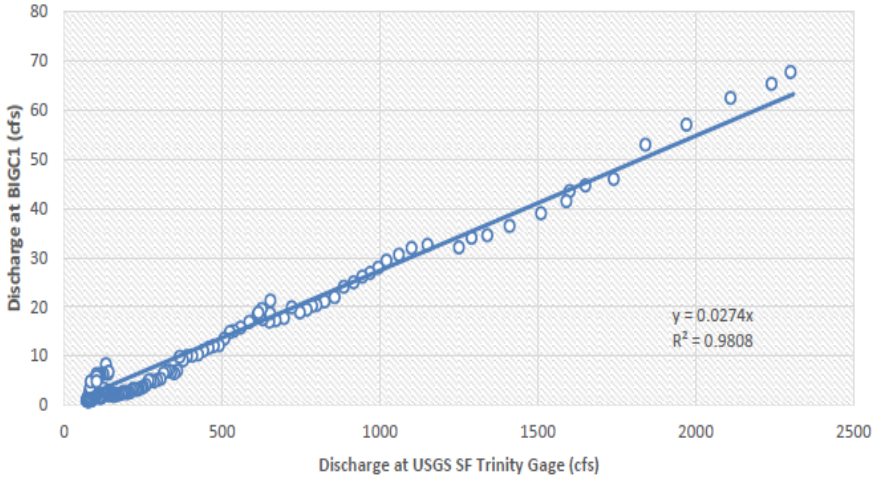
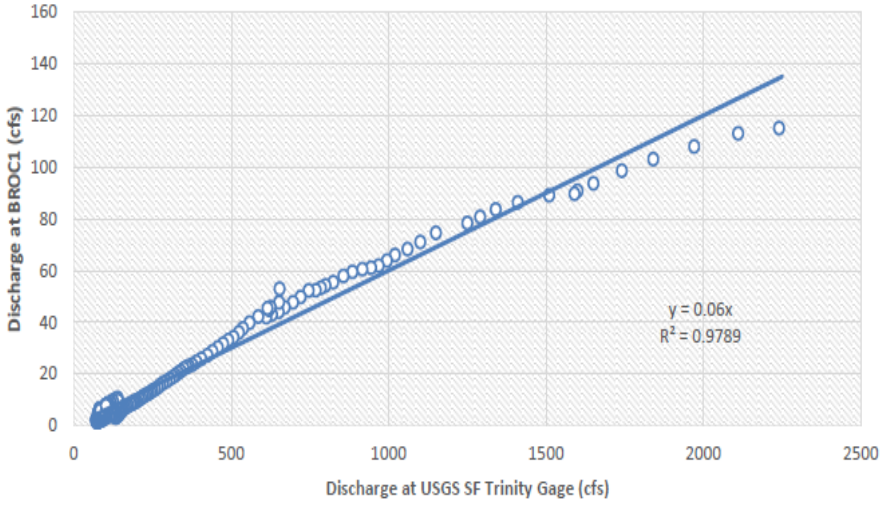
Compared Measured Flows to Long-term Gage Records









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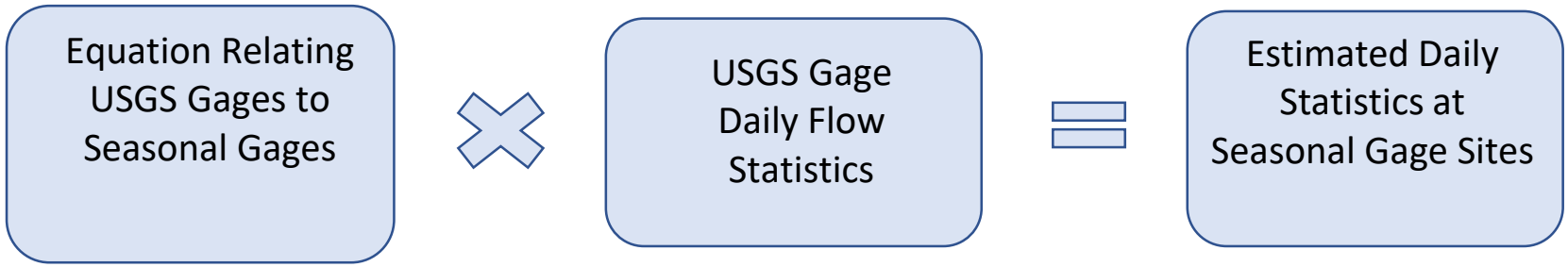

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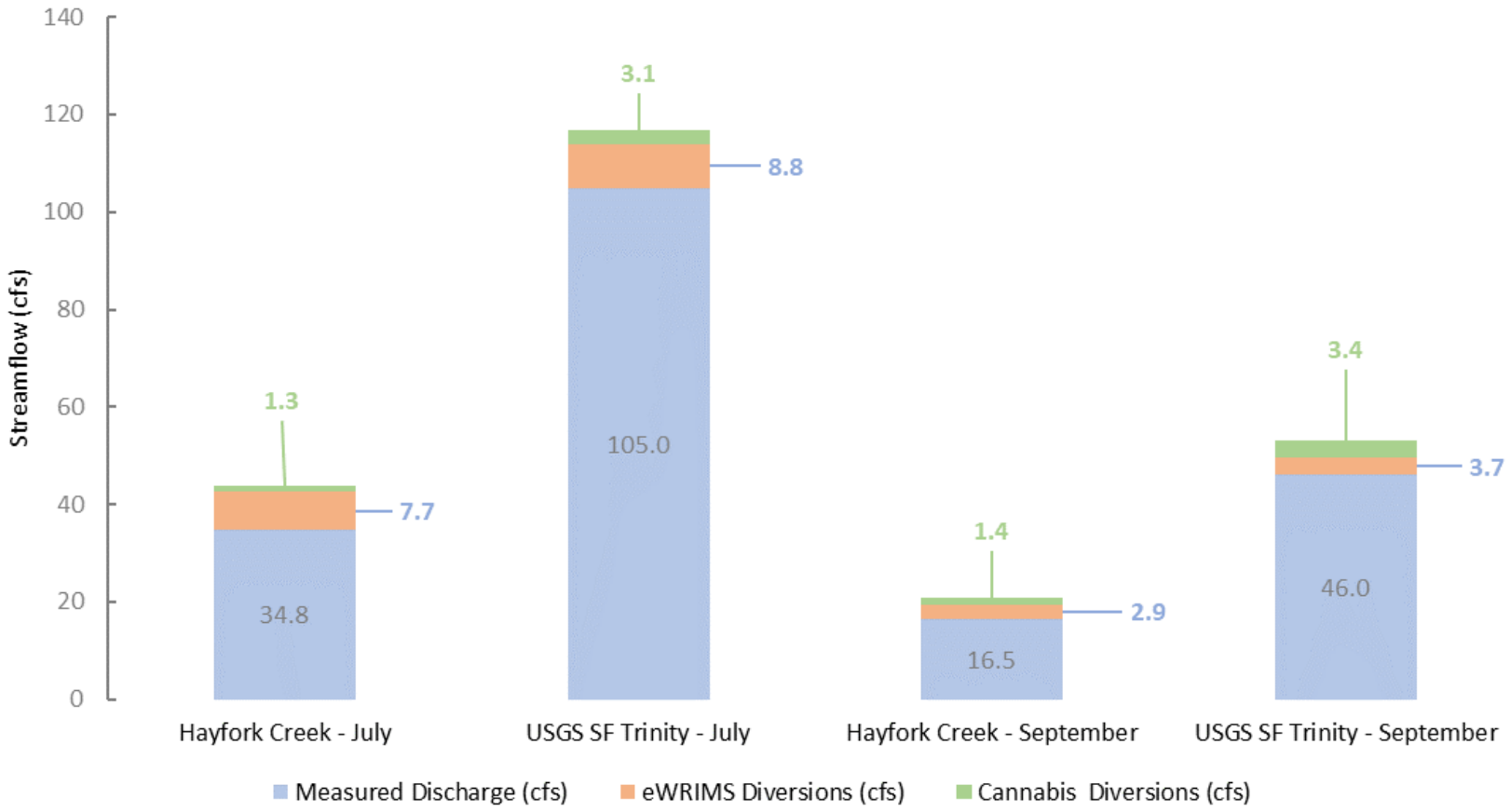
Compared Water Use to Streamflow



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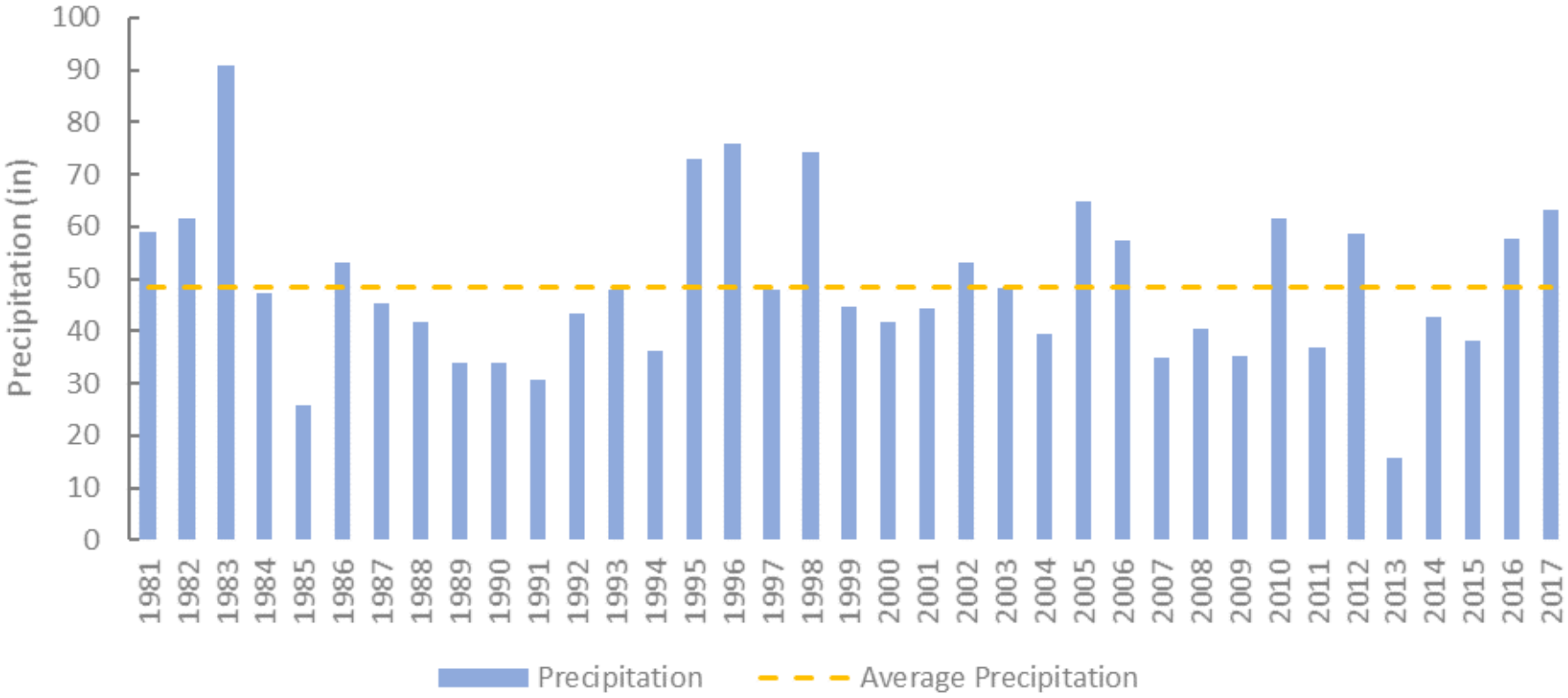
Context: Hydrologic Years 2016 & 2017



Mean annual precipitation (inches), Hyampom CA.

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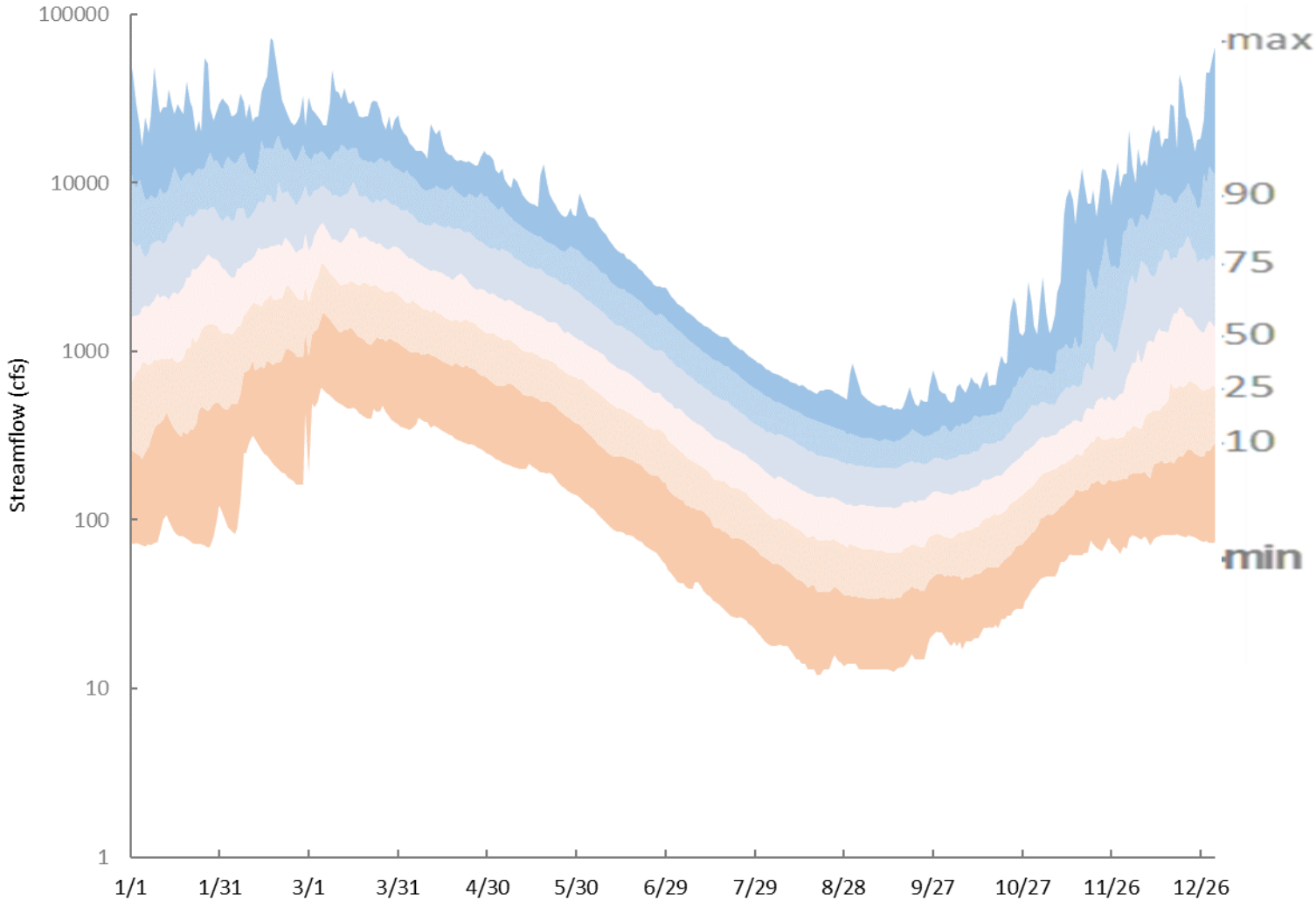
Context: Long-term Streamflow Records



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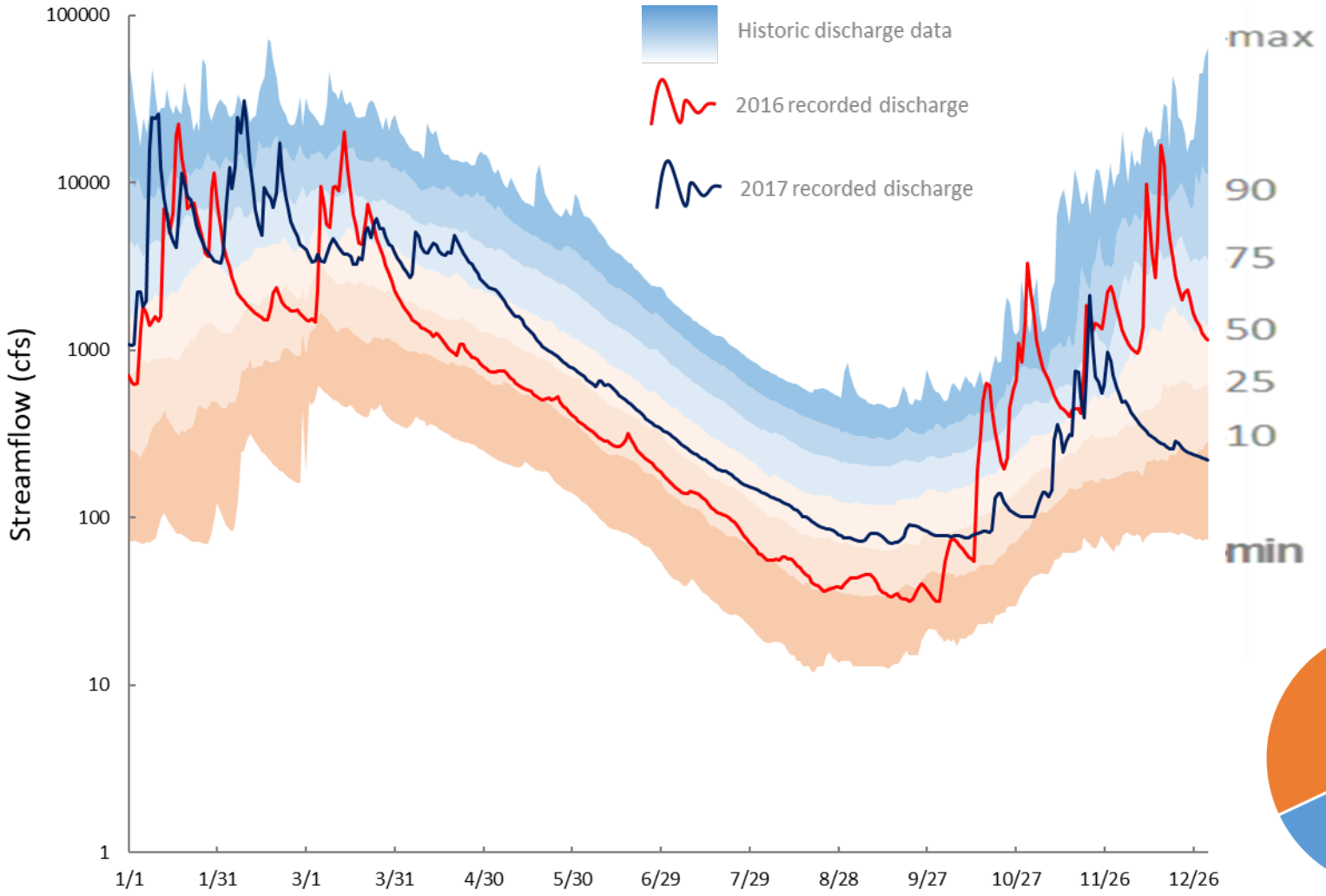
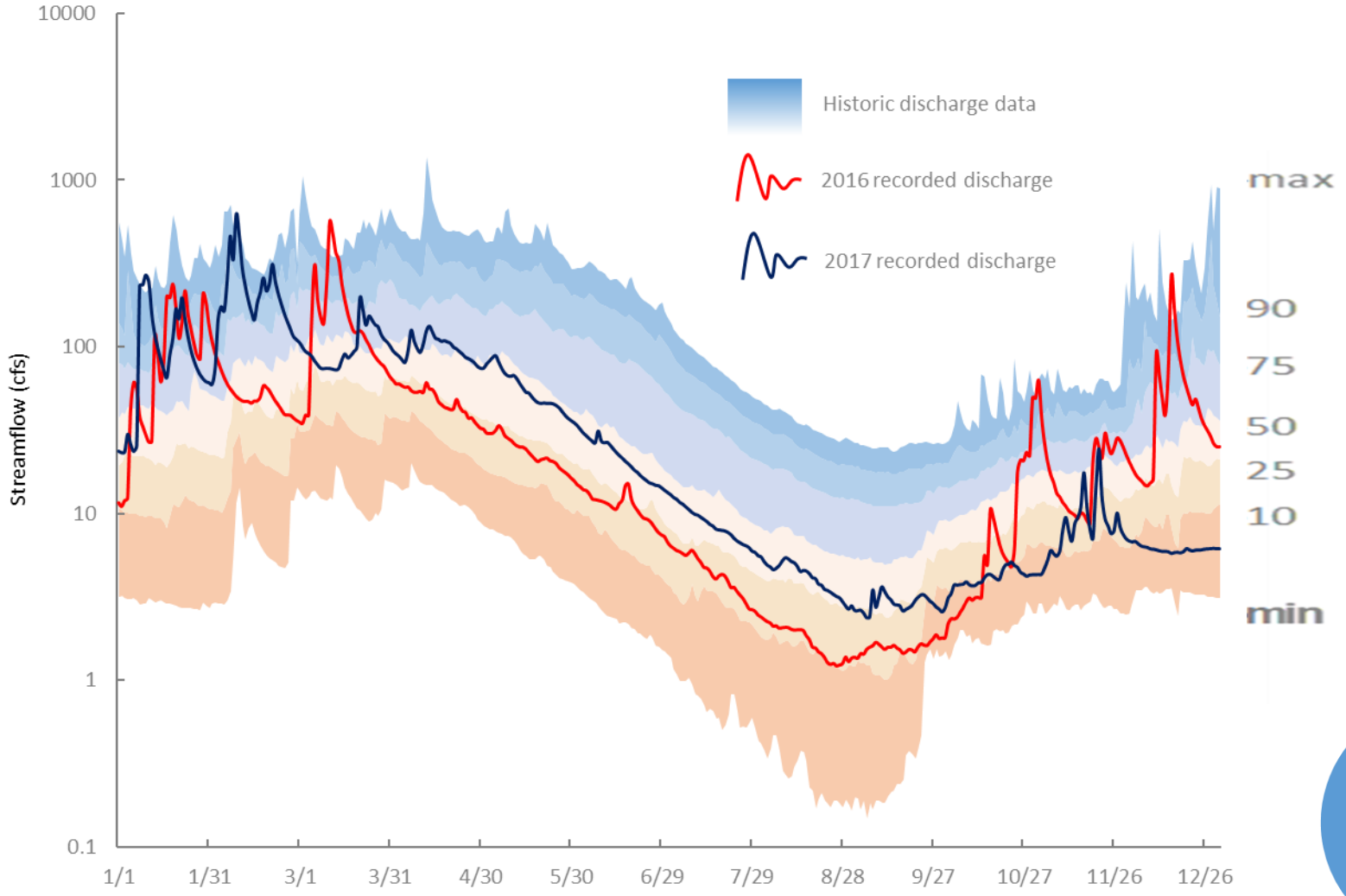
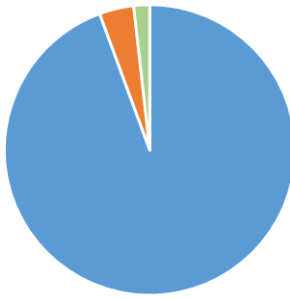
SF Trinity at Hyampom (USGS)



Indian Creek (USGS)





Results

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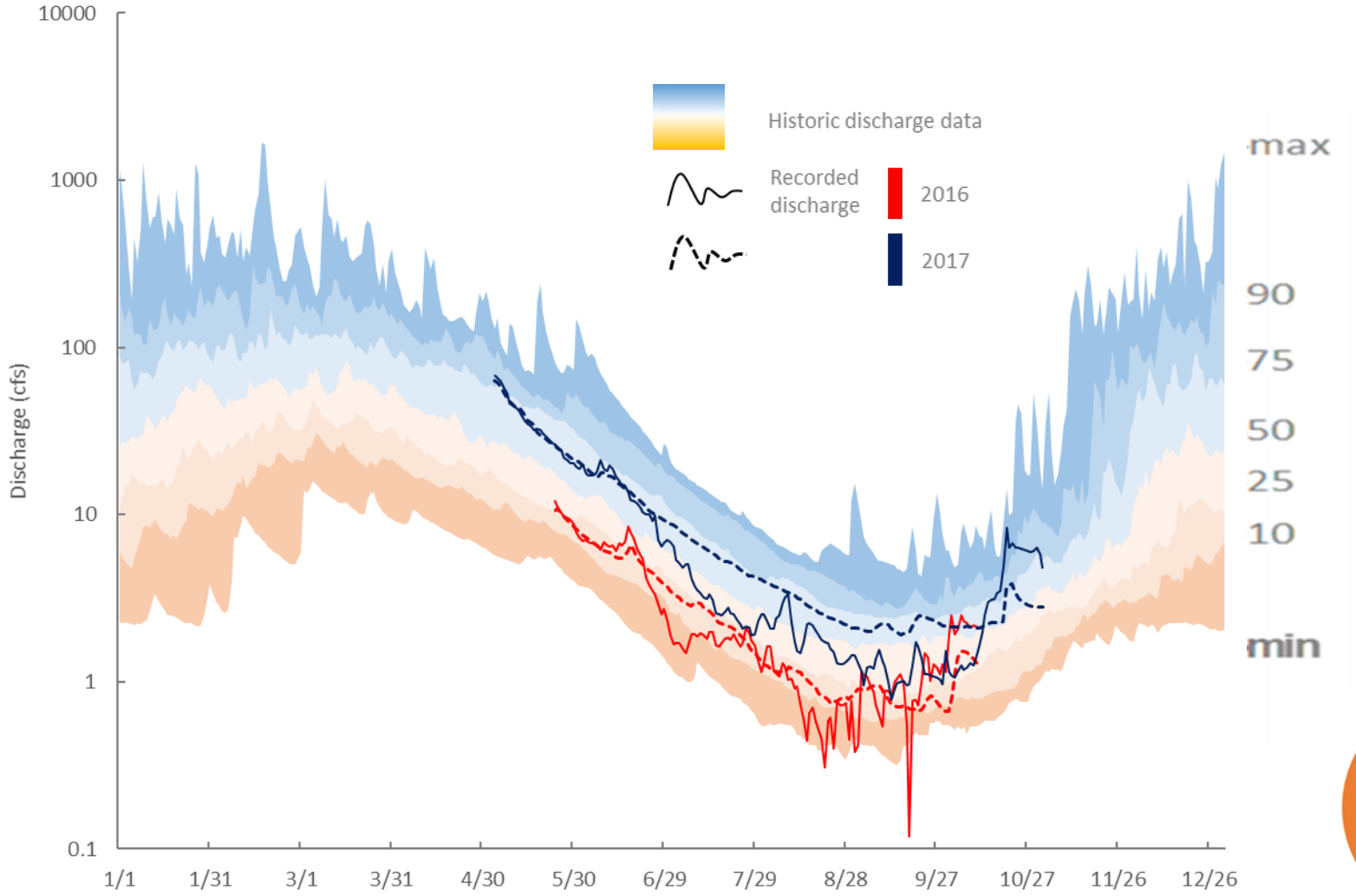
Big Creek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1000
100
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1
0.1
Discharge (cfs)
Historic discharge data
Recorded discharge
2016
2017
max
90
75
50
25
10
min
1/1
1/31
3/1
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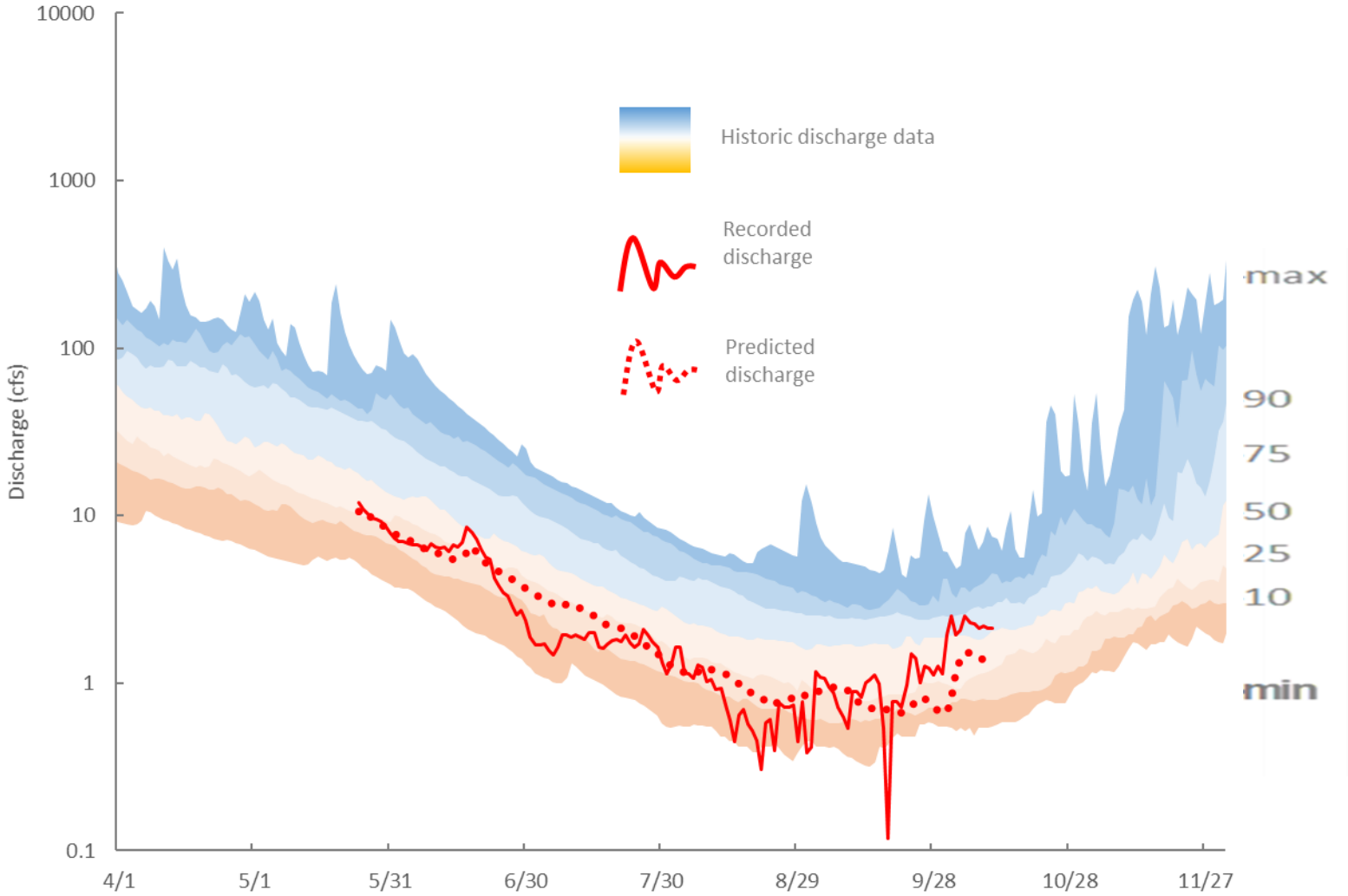
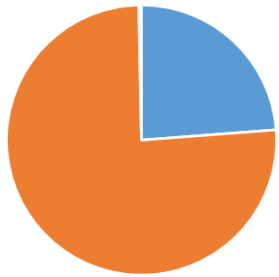
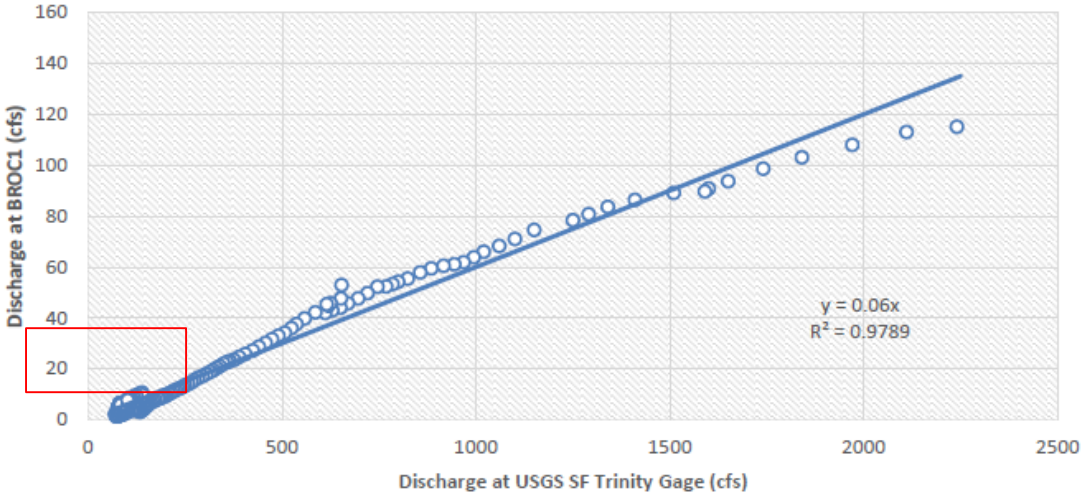
10/27
11/26
12/26

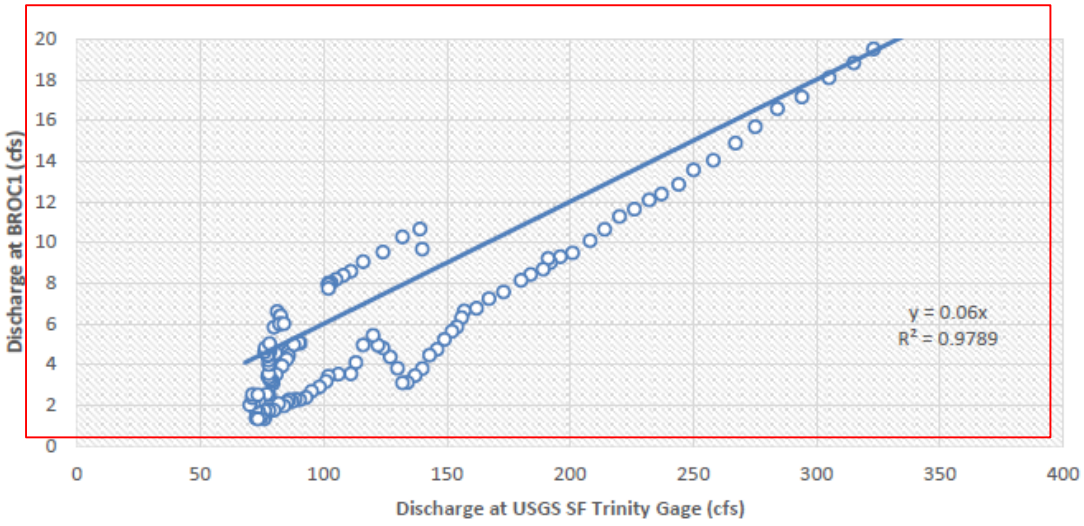
Big Creek 2016





A caution on interpreting results…

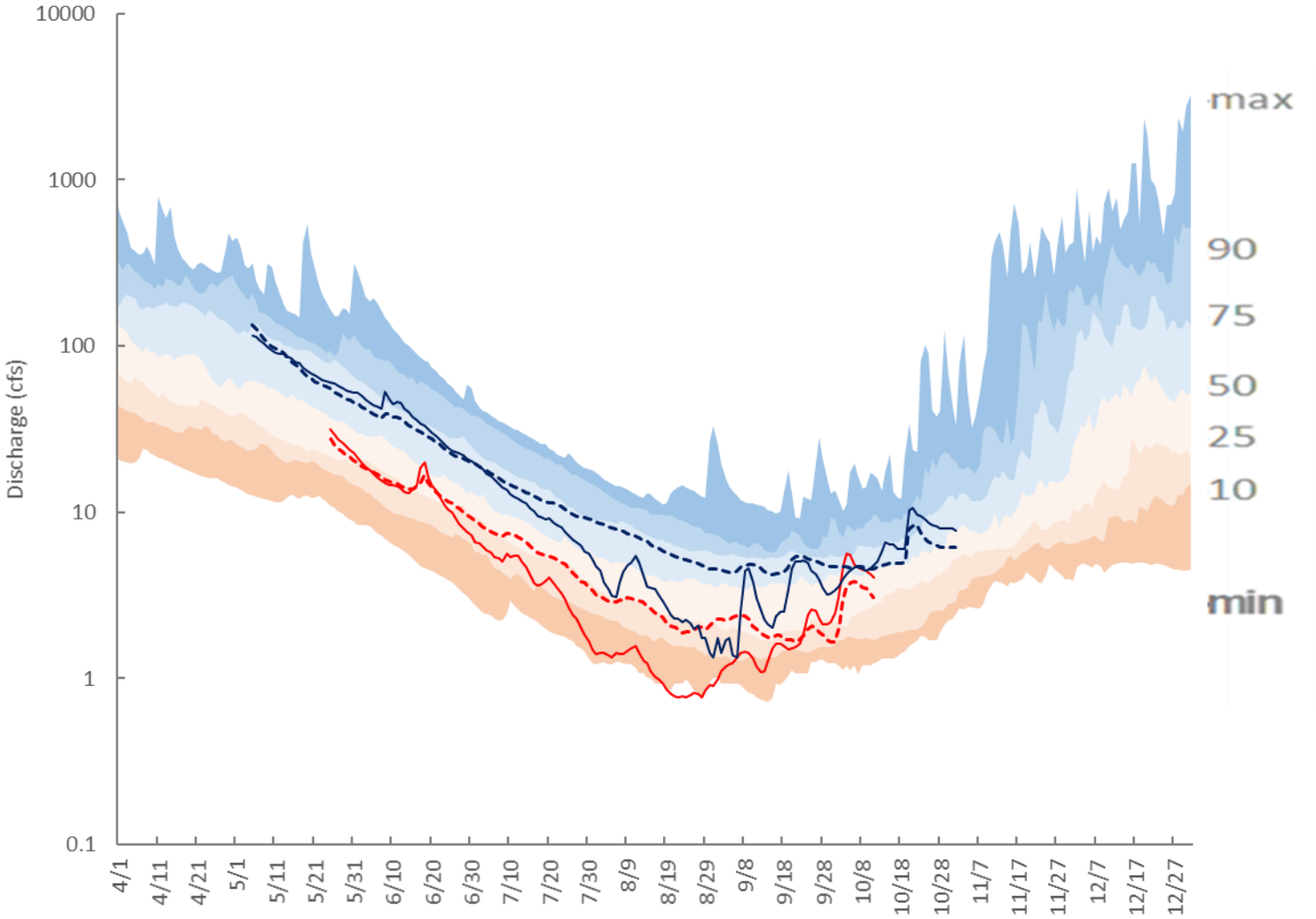


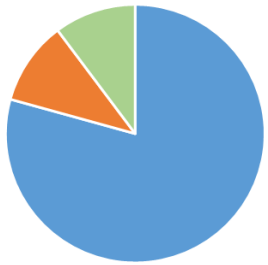


Results reflect the relationship between the USGS and seasonal gages

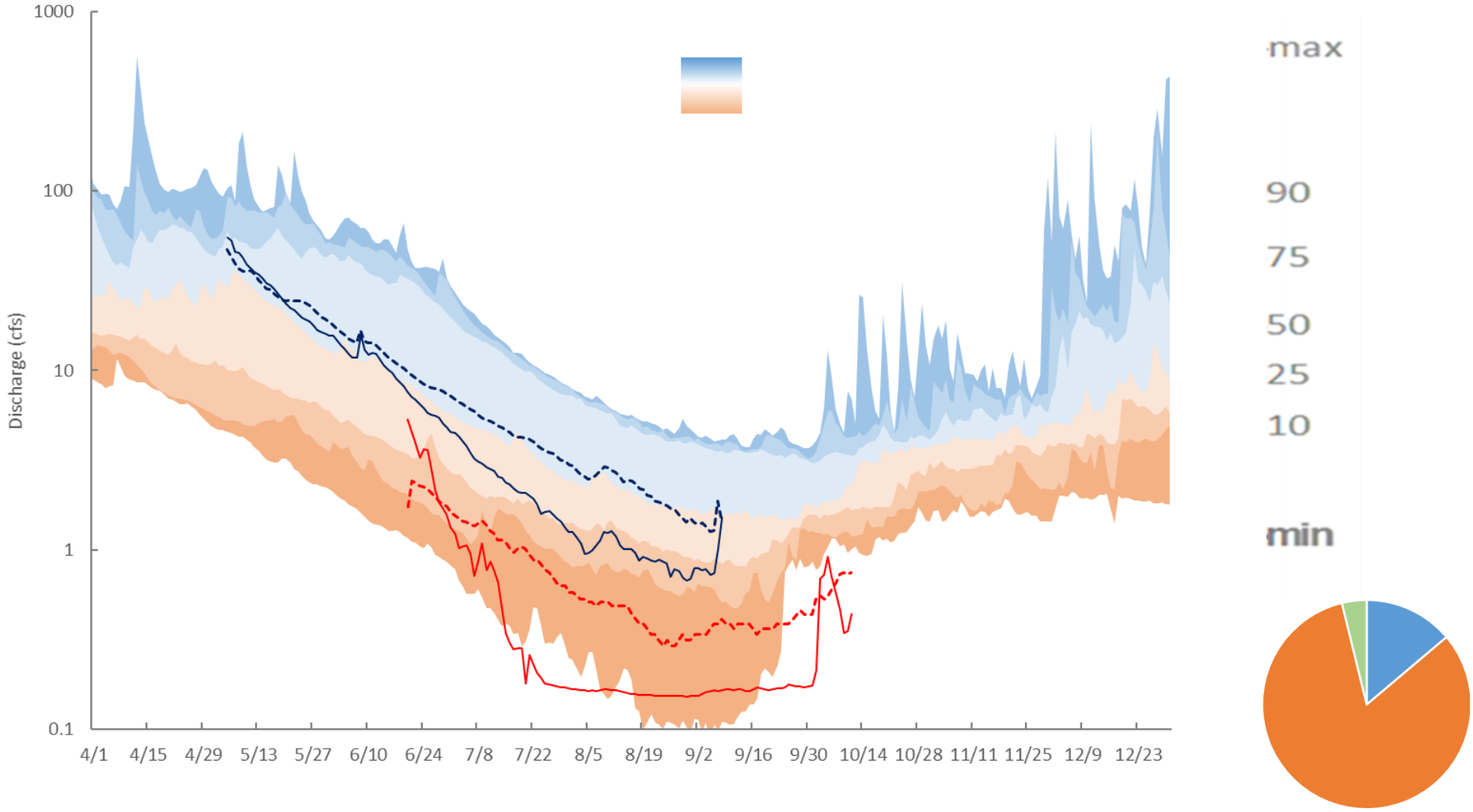
Water Boards

Browns Creek

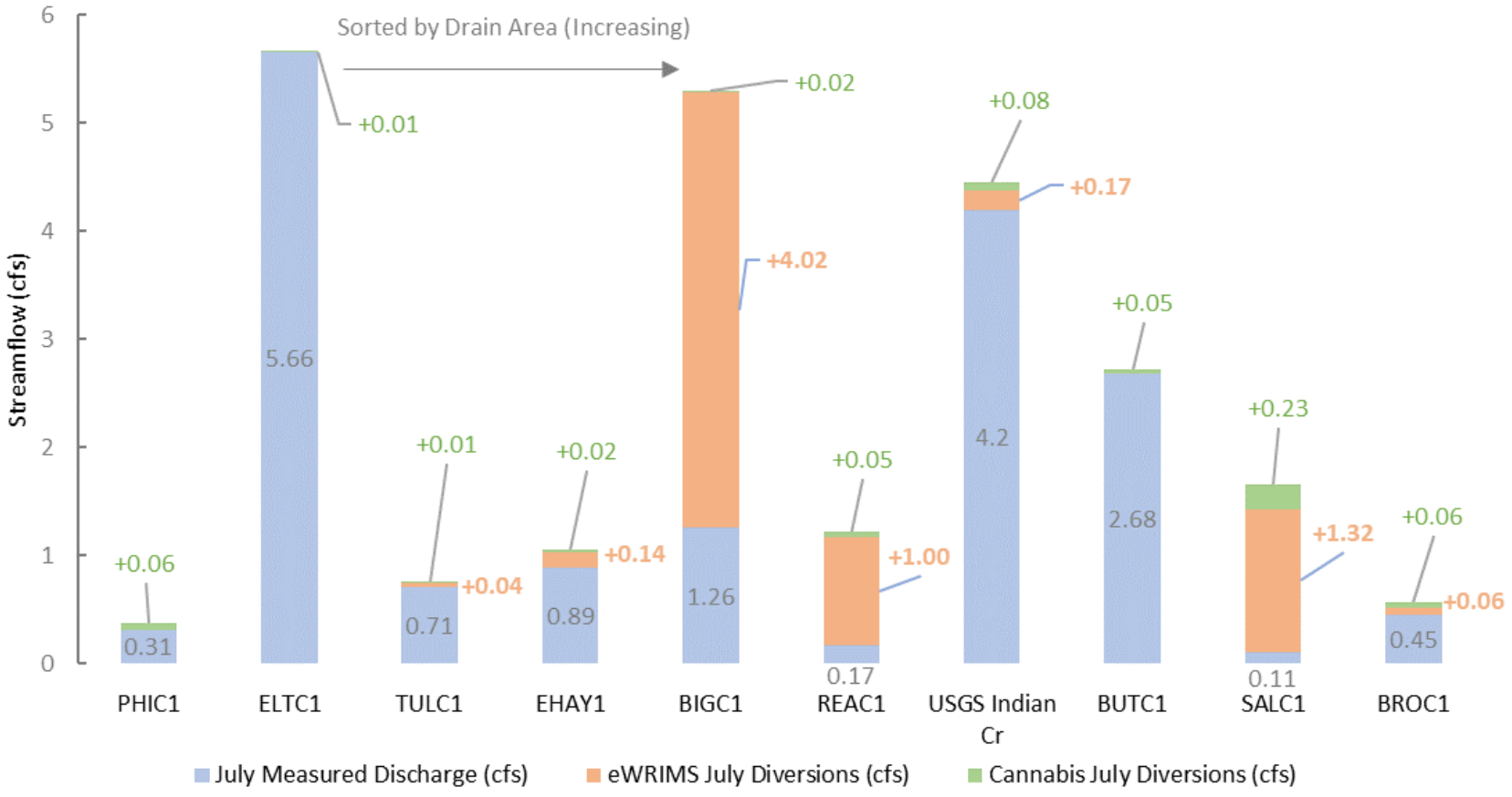




Reading Creek

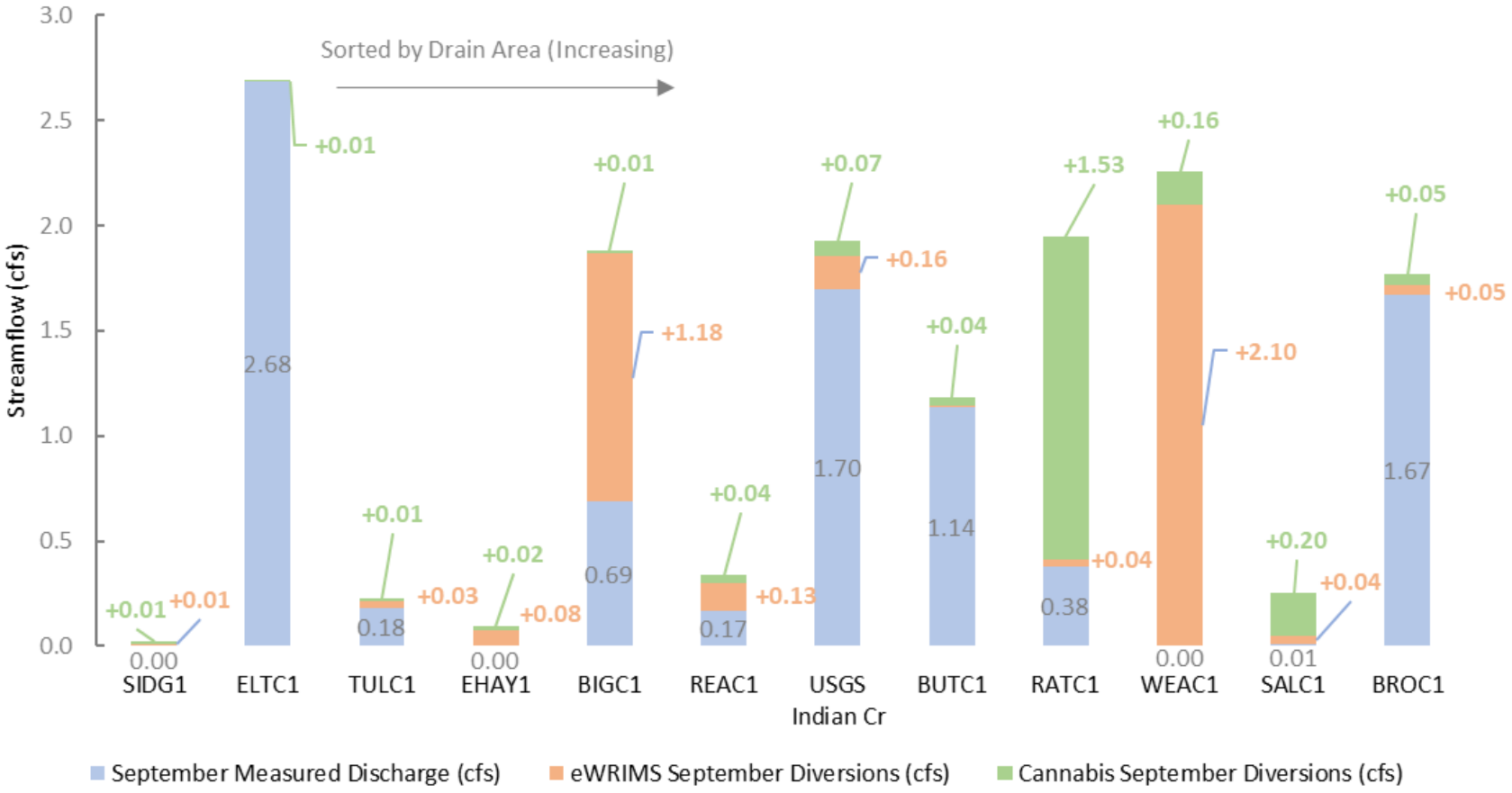


Water Use Compared to Instream Flow: July



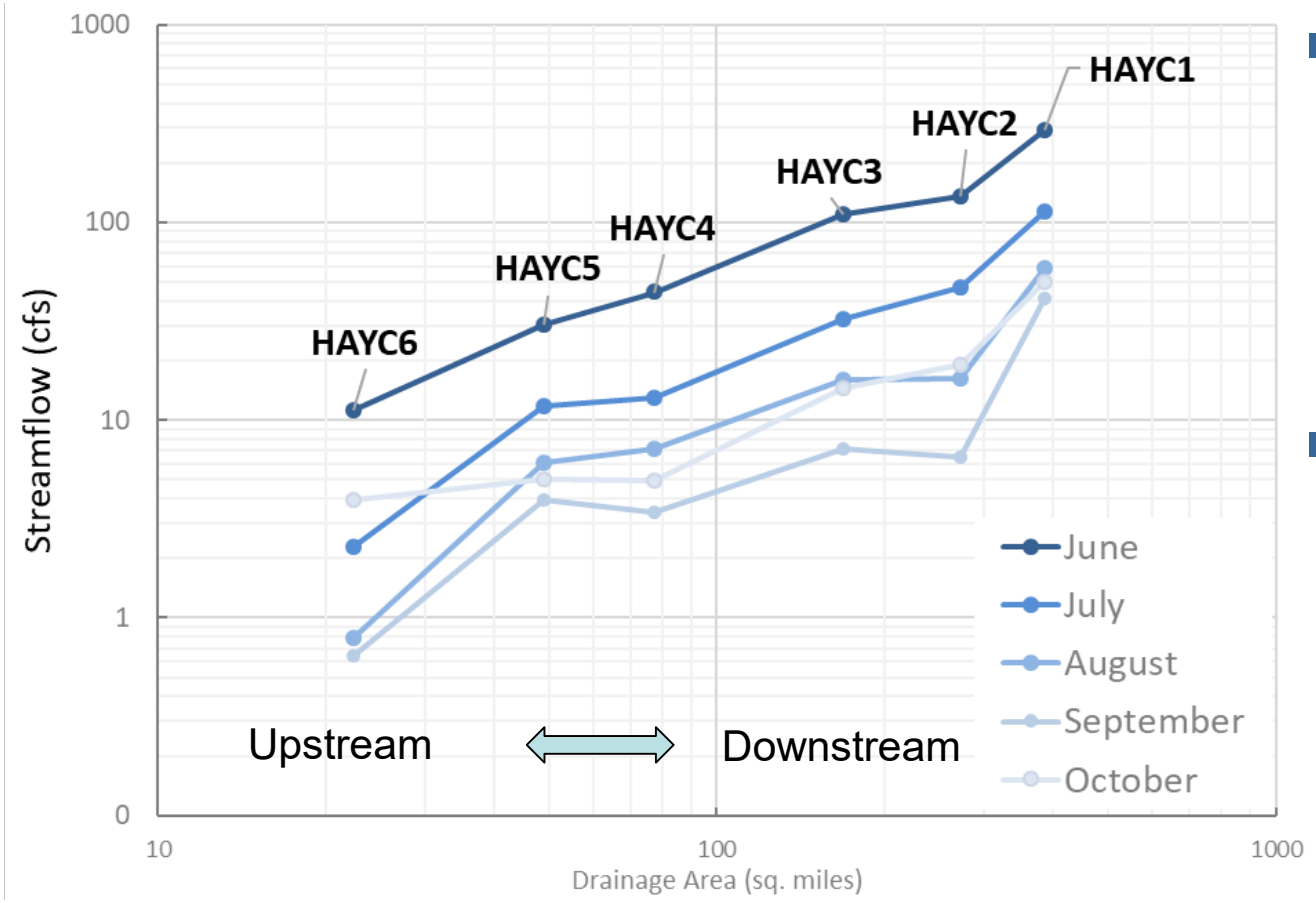
Water Boards

Water Use Compared to Instream Flow: September



Water Boards

Where Does the Water Go?



- Streams generally increase in the downstream direction
- Loss of flow corresponds with areas of concentrated use and valley areas

Water Boards

Near-Stream Wells

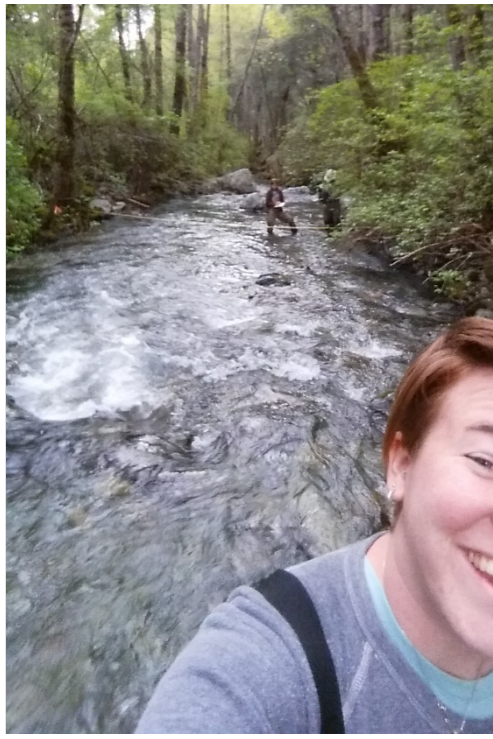
- Near-stream wells are very common
- These wells have similar impacts as riparian diversions, but are basically unregulated

Water Boards

Conclusions

- Streams in study area approached drought condition by the end of the irrigation season, regardless of water year type
- Cannabis water use is relatively small in comparison to traditional water uses in many areas of the study areas
- Diversions for municipal use and flood irrigated pasture have big impacts on the flow of streams in the study area
- Near-stream wells represent a regulatory gap
- Cumulative impacts of combined water uses are significant, and can lead to lethal effects

Water Boards



Questions?

Water Boards