

# Shark River Slough Water Quality Compliance Evaluation

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# Main take away for WY2021

## • Regional drivers

- Miami and L67A canals continue to deliver elevated total phosphorus levels towards the Park
- TP flow-weighted mean concentrations are increasing at S9A and along the western boundary of WCA3A
- Flow vectors from RSM modeling indicate:
  - eastern WCA3A inputs terminate at the S333 complex and S12D
  - Northwestern WCA3A inputs terminate at S12B and S12C
  - Western WCA3A inputs terminate at S12A
- Na:Ca ratios indicate EAA water continues to influence water quality along the WCA3A eastern boundary down to the S333s and eastern S12s

## • Local drivers

- When S333\_H stage was below 9.2 ft
  - S333s, S12C, and S12D TP concentration  $\geq 12$  ppb
  - 53% of S333N flow
  - 42% of S333+S333N flow
  - 42% of  $S12s+S333s+S355s+(\min(S356, S335))$  combined flow
- Further below 9.2 ft the higher the TP concentration

# Regional Drivers

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Hydrodynamic

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Conservative tracer: Na:Ca ratios

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WY2021 spatial flow-weighted mean total phosphorus concentrations

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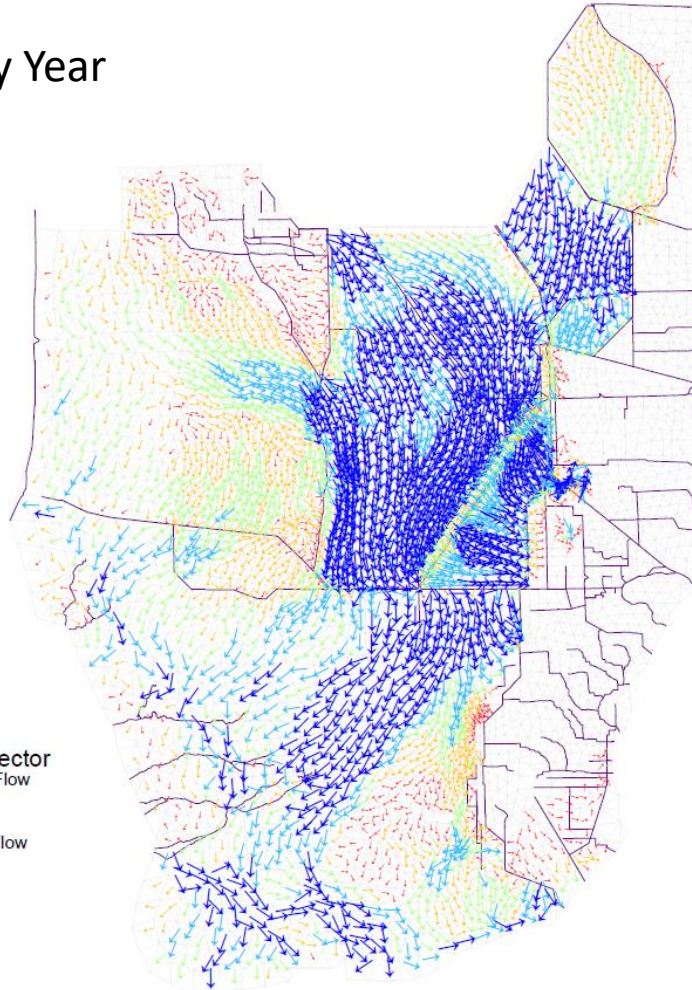
Trends: WY2010 – WY2021; WY = October – September

# Regional drivers

## Dominant flow patterns based on COP AltQ in dry, normal, and wet years

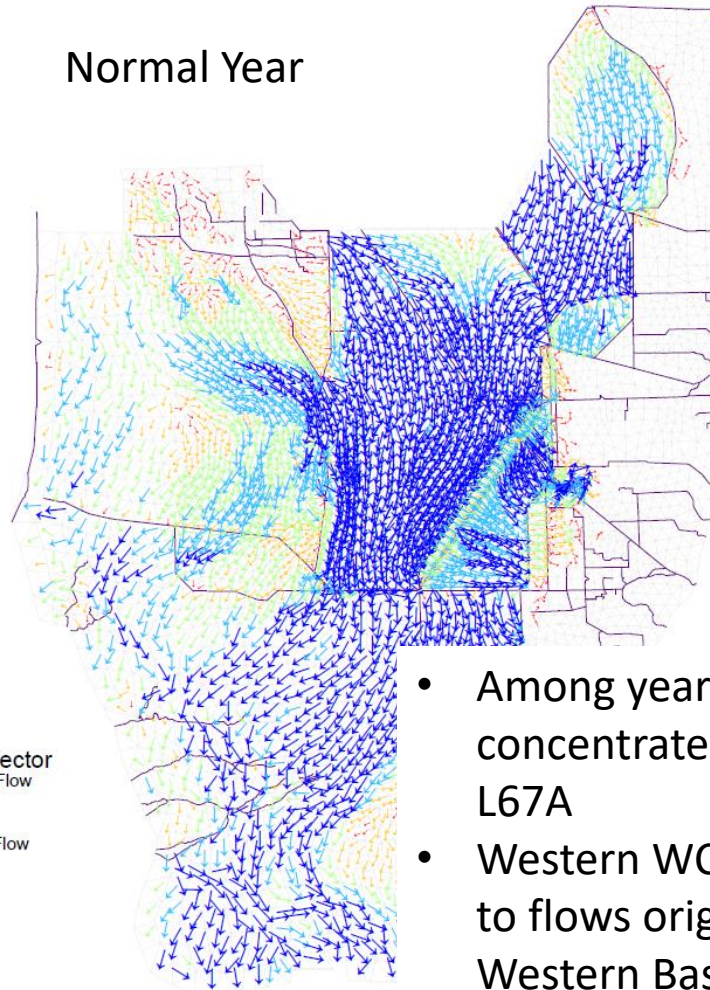
Annual Average Overland Vector  
1993

Dry Year



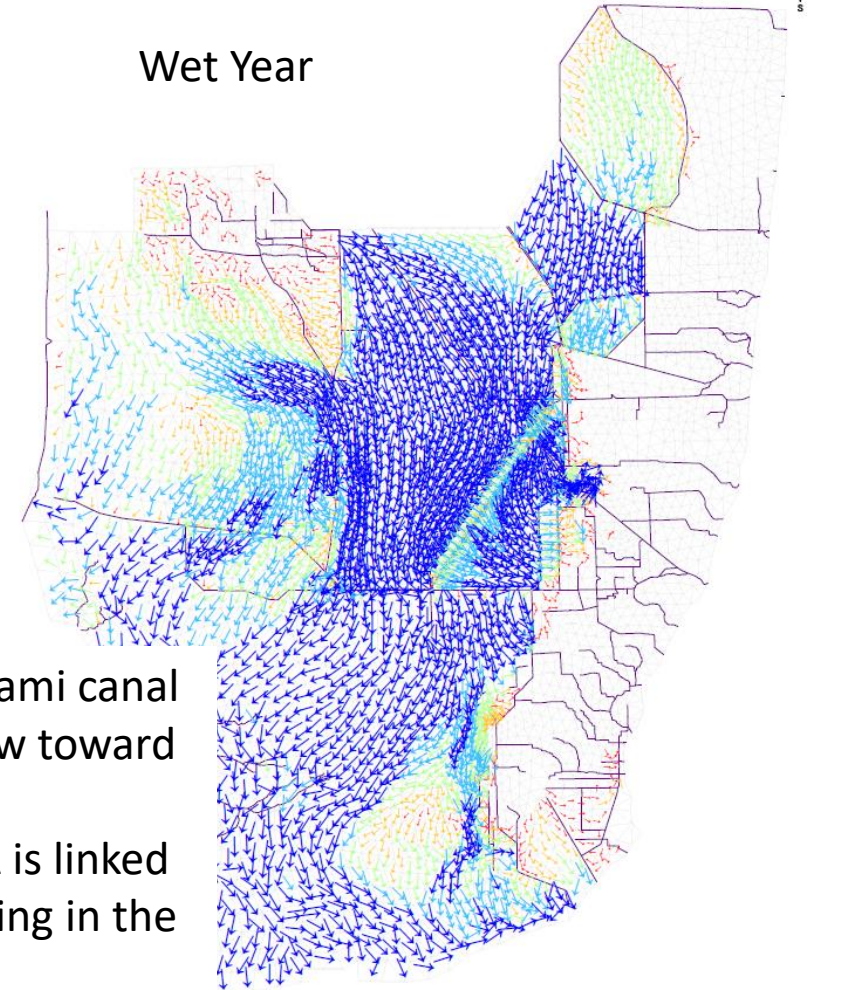
Annual Average Overland Vector  
1994

Normal Year



Annual Average Overland Vector  
1995

Wet Year



- Among years Miami canal concentrates flow toward L67A
- Western WCA3A is linked to flows originating in the Western Basins

# Regional drivers

WY2021 Na:Ca molar ratios based on flow-weighted mean concentrations

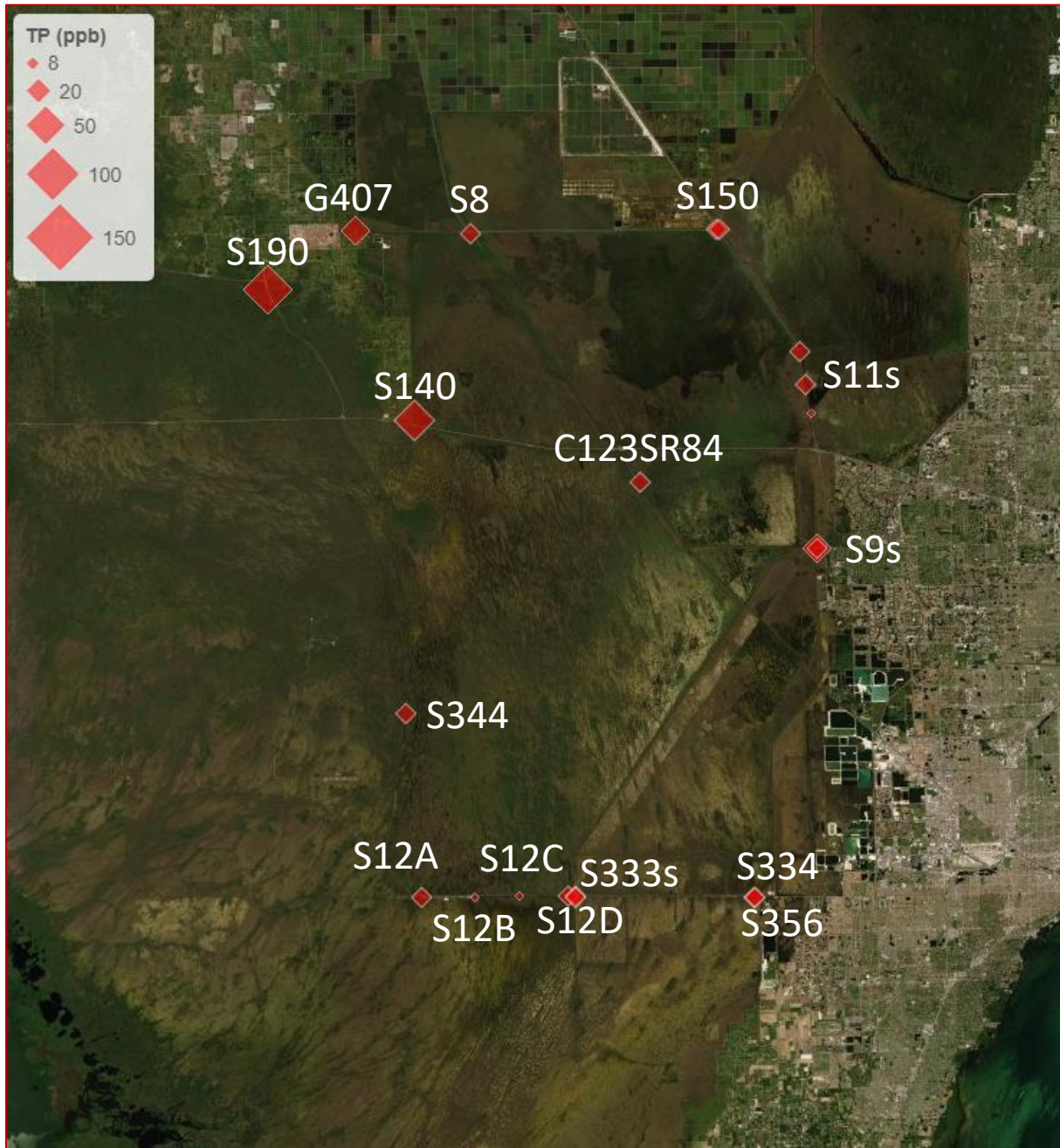
## Assumptions

- Na:Ca ratios have been used to distinguish sources of water to Everglades National Park (Surratt et al 2014; Flora and Rosendahl 1981 and 1982)
- Ratios in the EAA were identified at 0.8 or higher (Chen et al 2006)
- EAA is major source of Na to the Everglades (Naja et al. 2010)
- Rain contribution to Na:Ca ratios is trivial
- Ratios in sheetflow from WCA3A were identified at  $\leq 0.34$

## Results

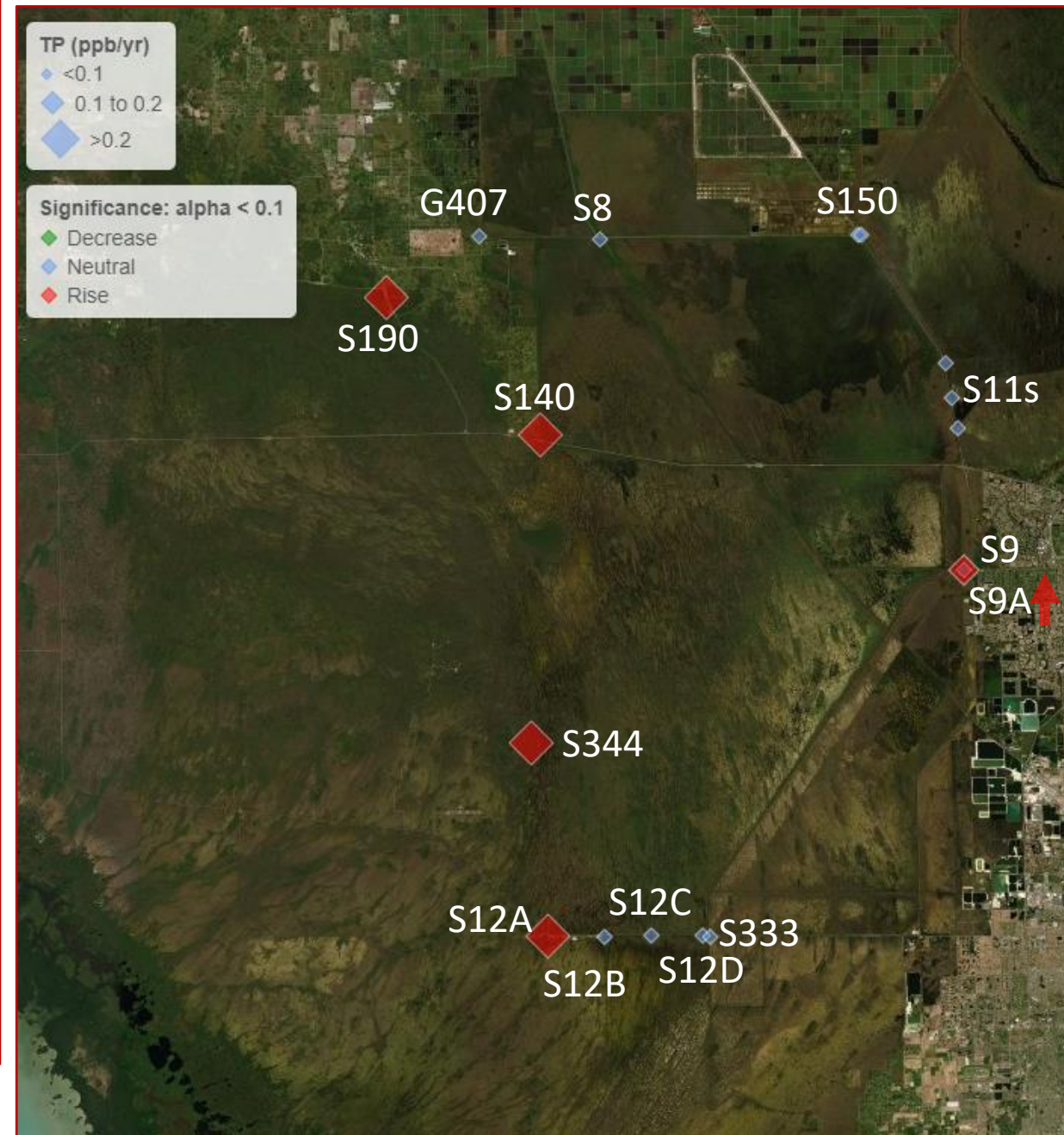
- WY2021 Na:Ca ratios suggest:
  - eastern boundary of WCA3A influenced by EAA
  - S333s and S12C influenced by L67A and WCA3A





WY2021 – TP FWM concentrations

## Seasonal Kendall Trends – WY2010-WY2021



# Local Drivers

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Water levels - duration and magnitude below 9.2 ft

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Flow conditions – flow rates and volumes under 9.2 ft stage

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Water quality response – Total suspended solids and total phosphorus under 9.2 ft stage

# Appendix A compliance

• Shark River Slough Compliance since WY2006

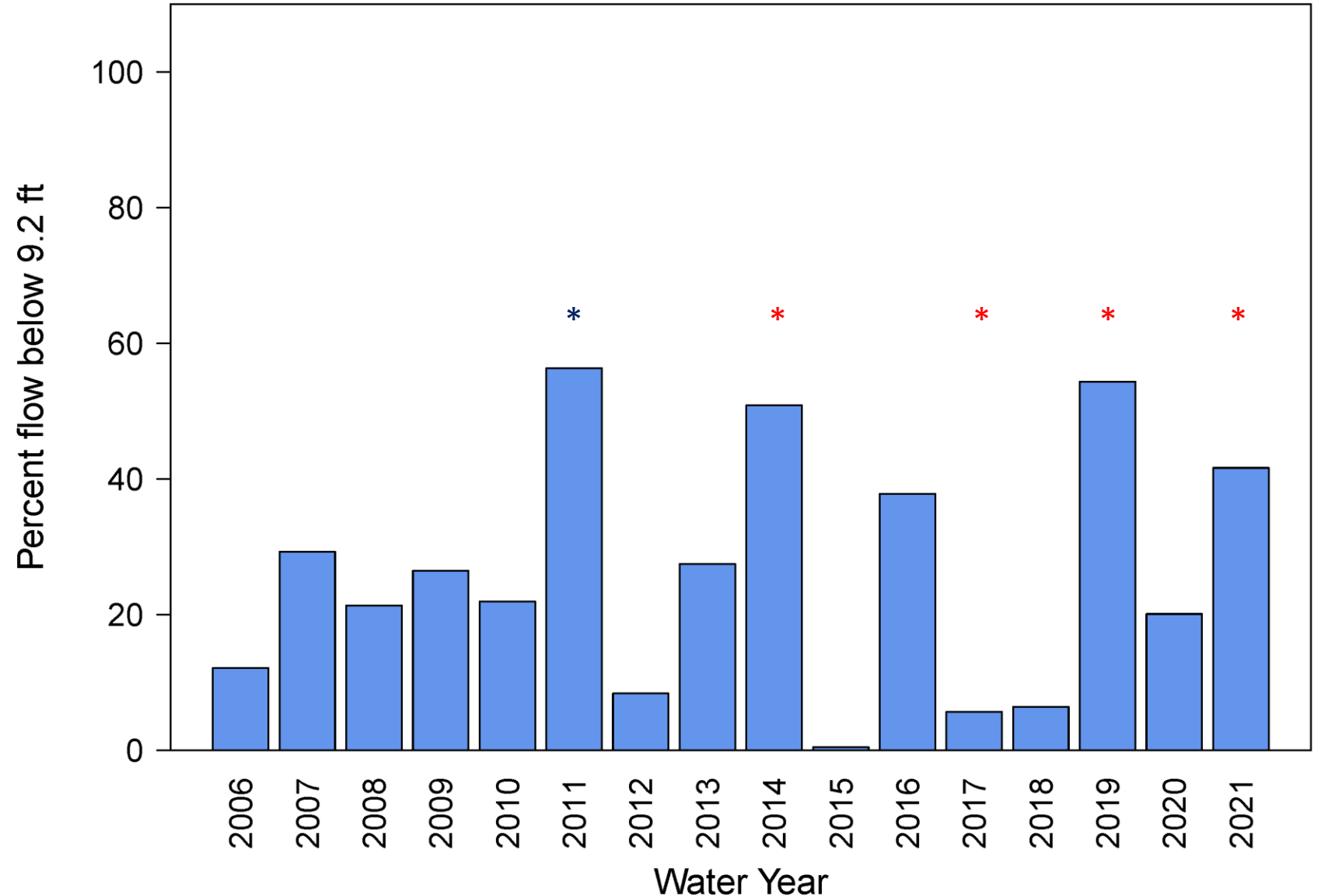
Percent S333s water delivered below 9.2 ft at S333 headwater

Compliant:

- WY2013: 27%
- WY2015: 1%
- WY2016: 48%
- WY2018: 6%
- WY2011: 56% - S333 routed around SRS

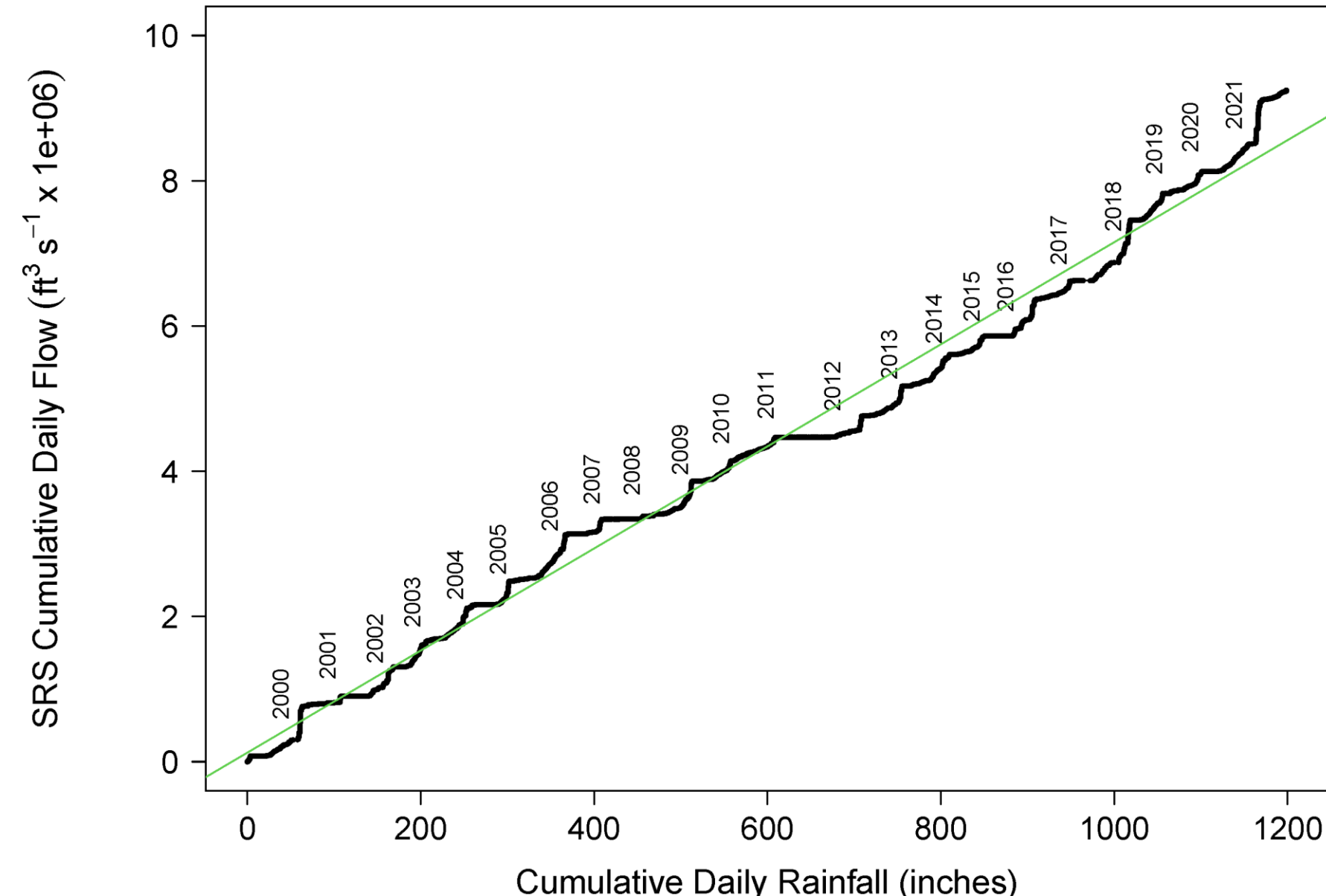
Failed compliance:

- WY2014: 51%
- WY2017: 6%; drought
- WY2019: 54%
- WY2021: 42%



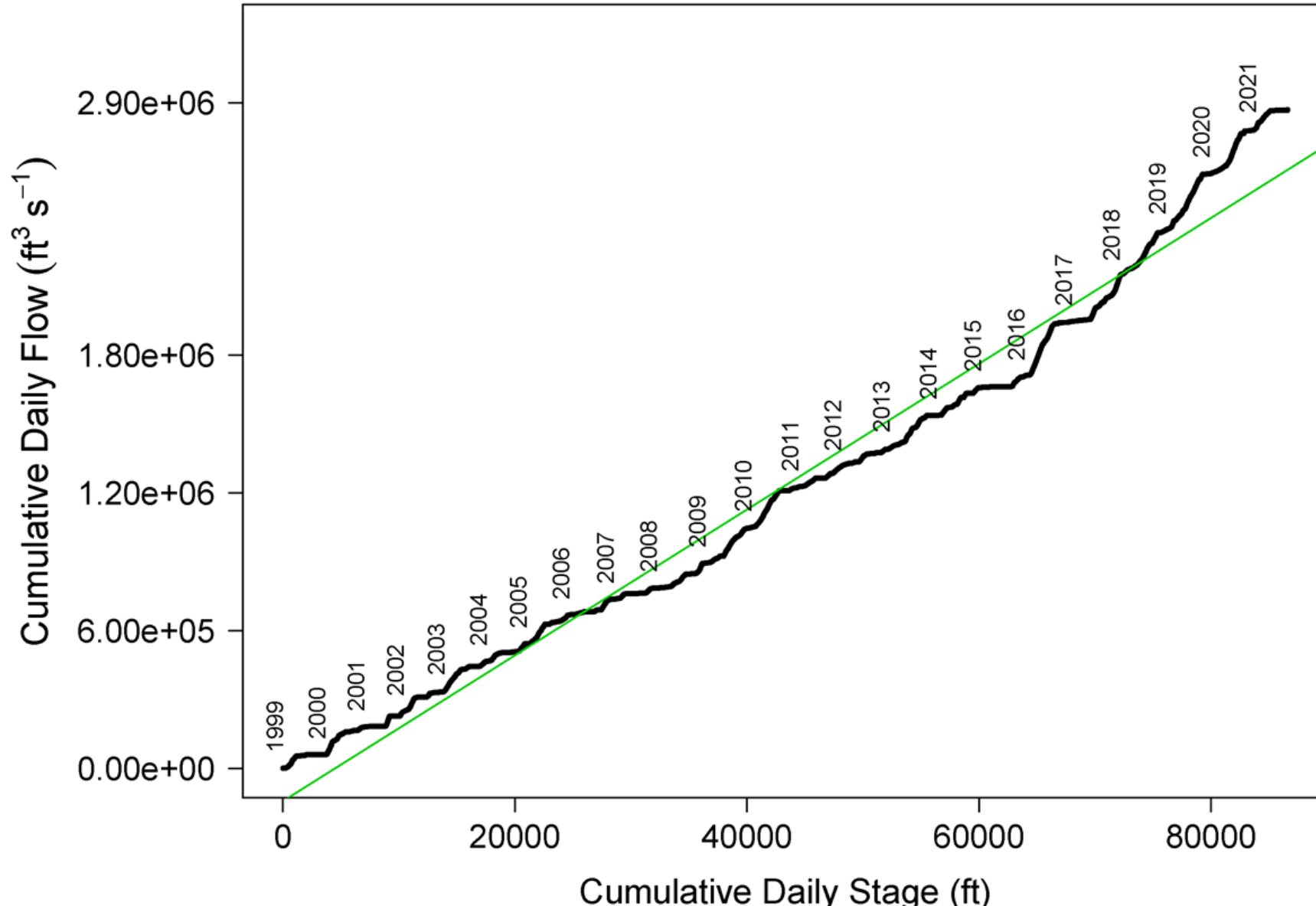


# Hydrologic conditions



- Daily rain to WCA3A outpaced SRS daily flows in drought periods:
  - WY2007 – WY2008;  
WY2011 - WY2012
- Daily flows to SRS outpaced rainfall in WY2021

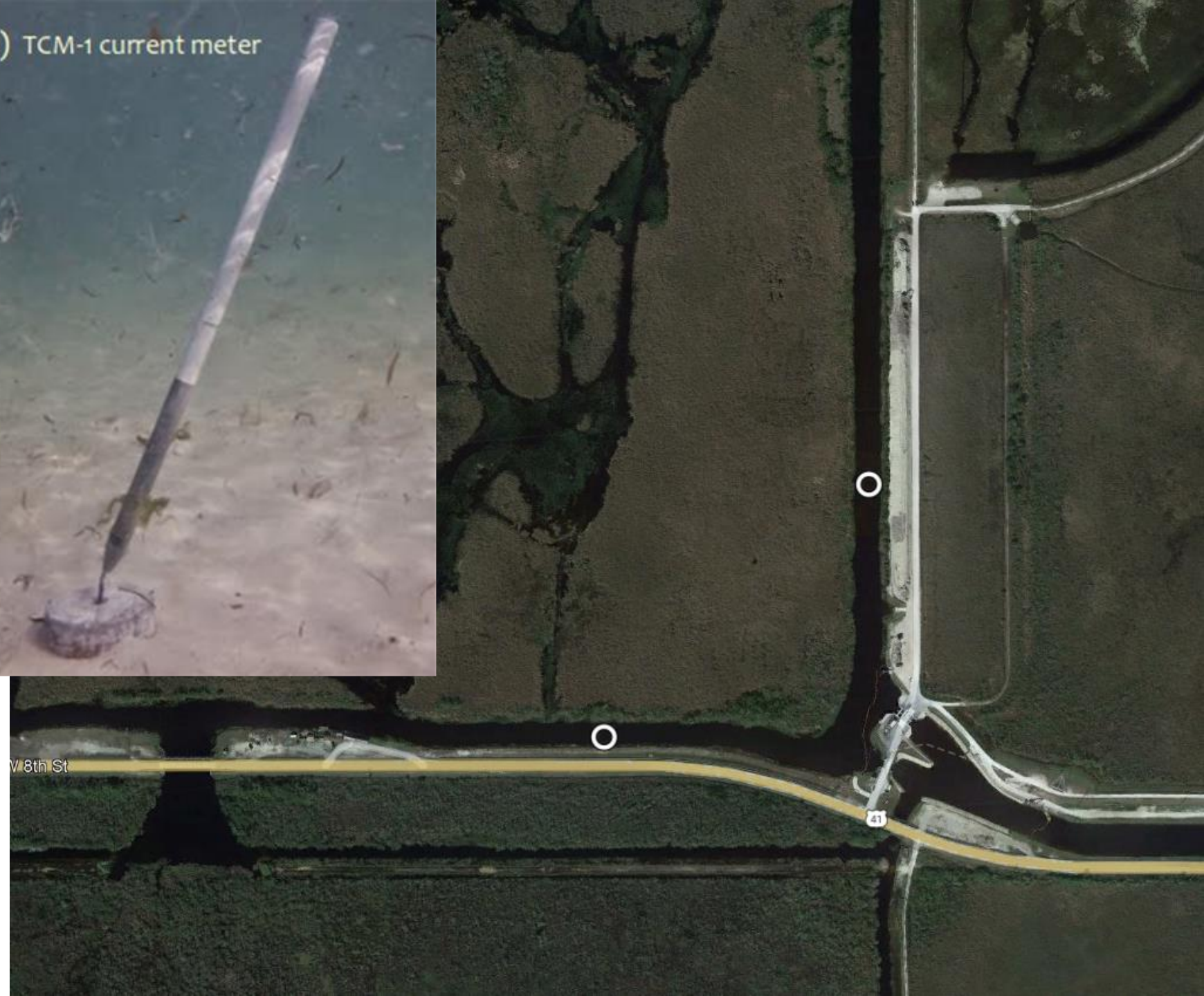
# Hydrologic conditions



- Daily flows to SRS out paced daily stage at S333 in WY2021
- Coupled with increased flows relative to rain management operations had a strong influence on water delivered to SRS in WY2021

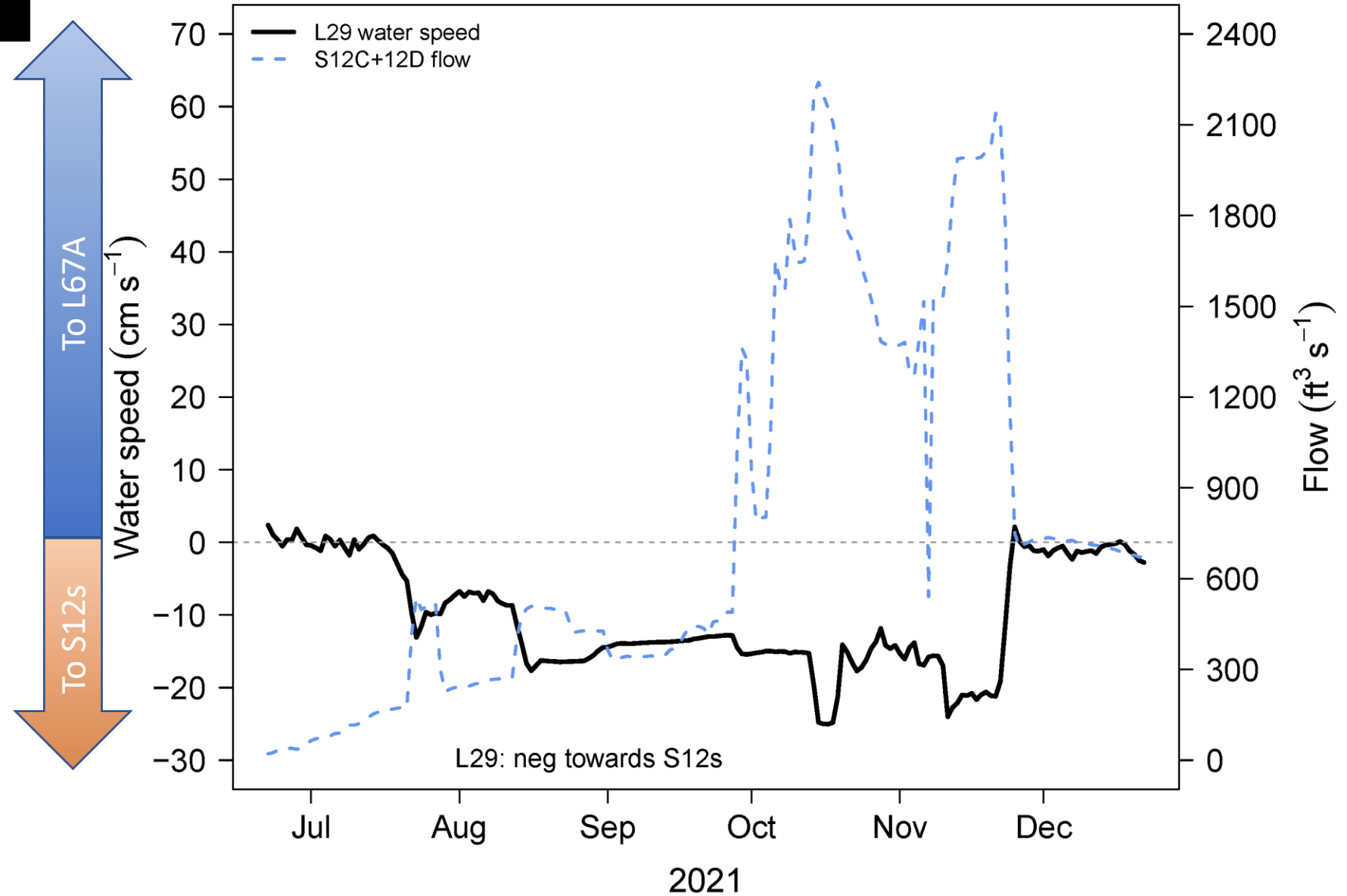
# Flow dynamics

- Tilt Current Meter situated 1000 ft upstream of S333 on L67A and L29 canals
- Collected data from Jun 22 – Dec 22, 2021



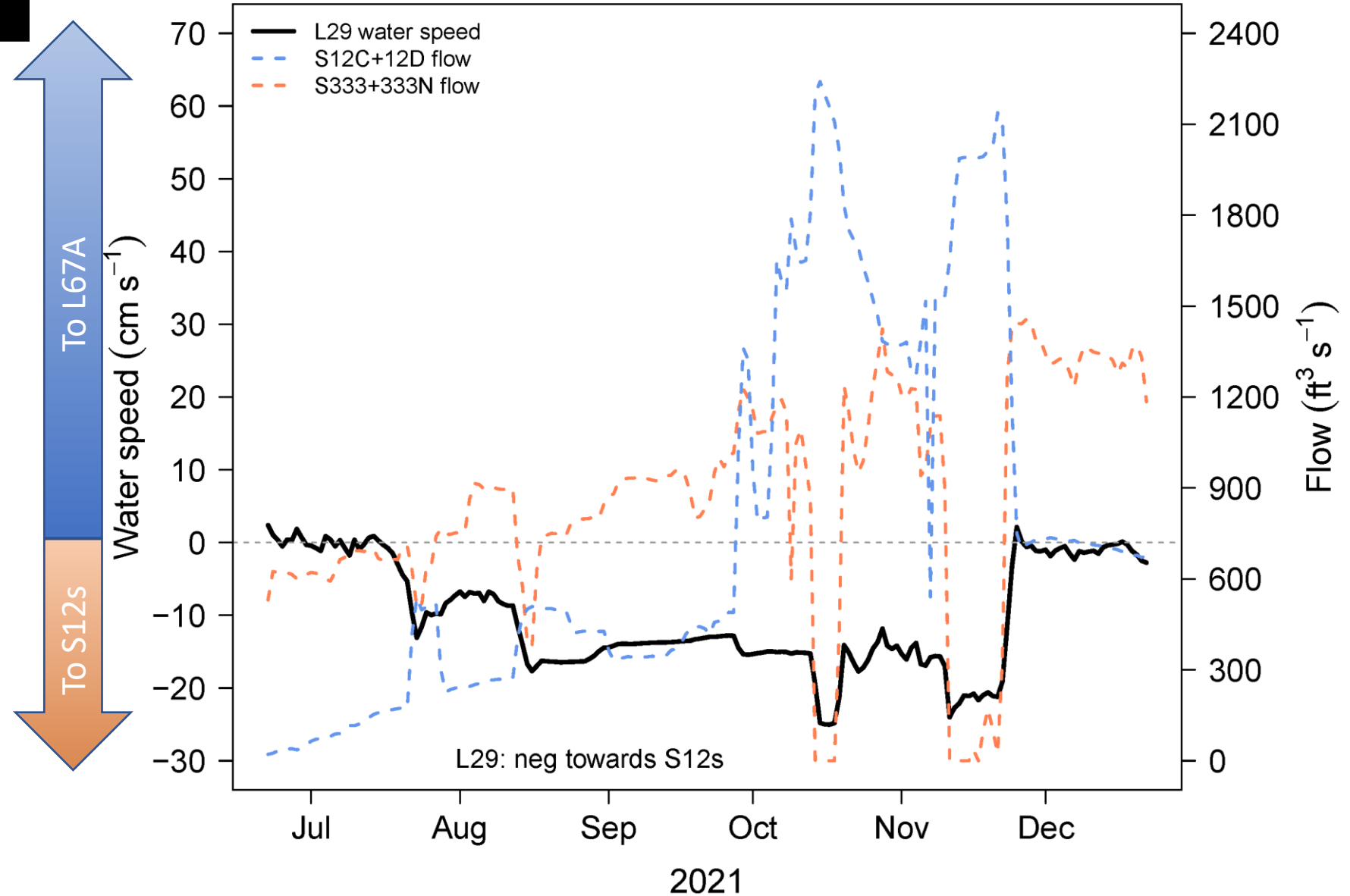
# Flow dynamics

- Tilt Current Meter readings (L29) indicates that for most available period flows moved from L67A towards the S12s even when the S333 complex was open
- TCM readings show correlation with S12D and S12C flows



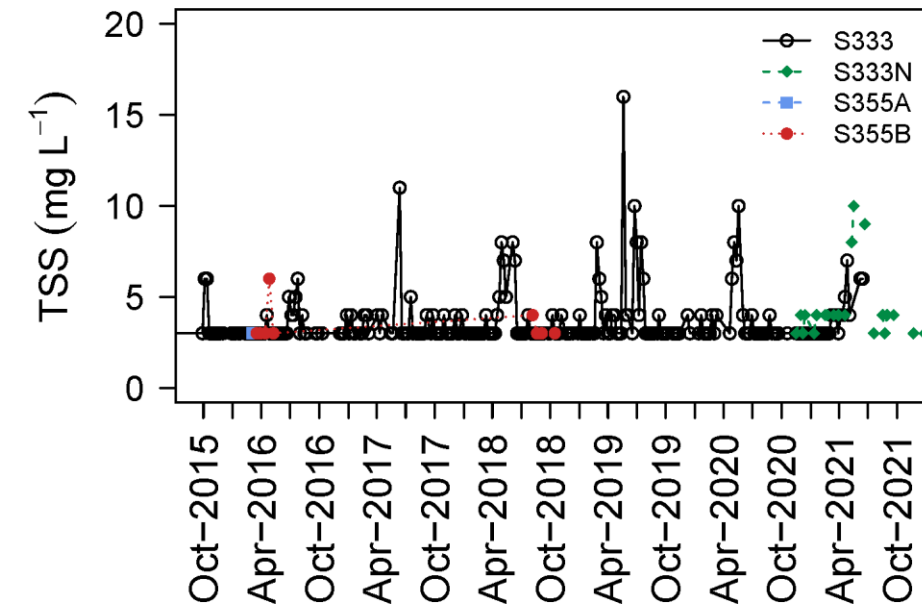
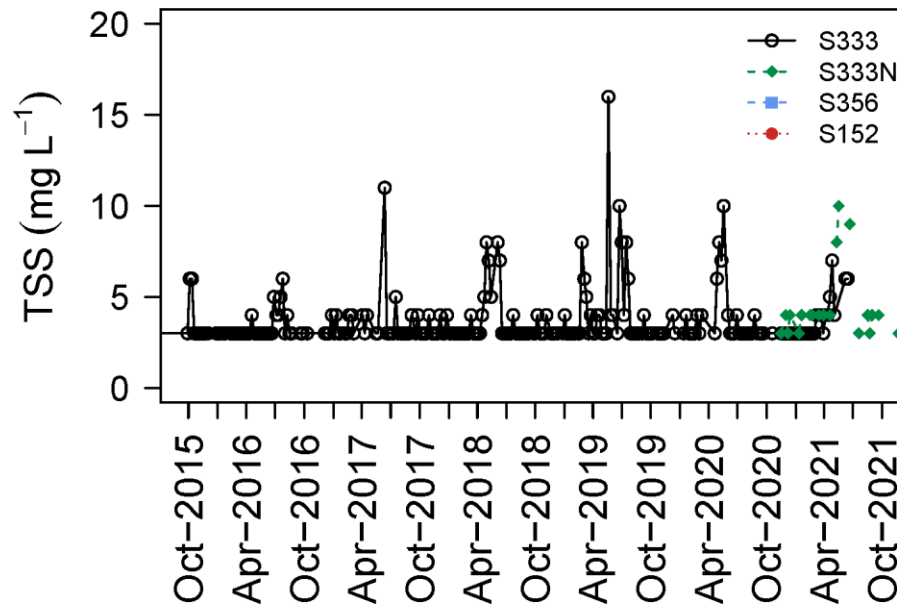
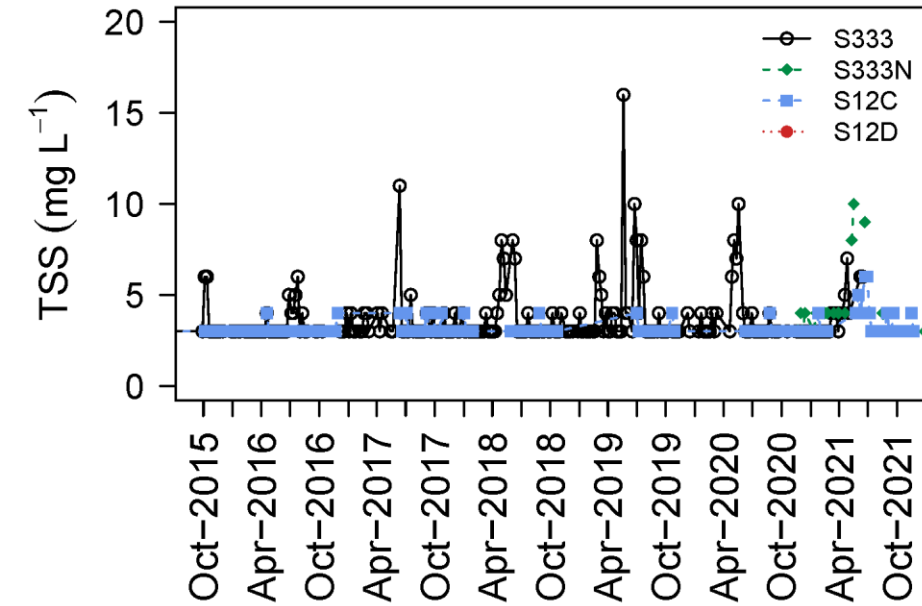
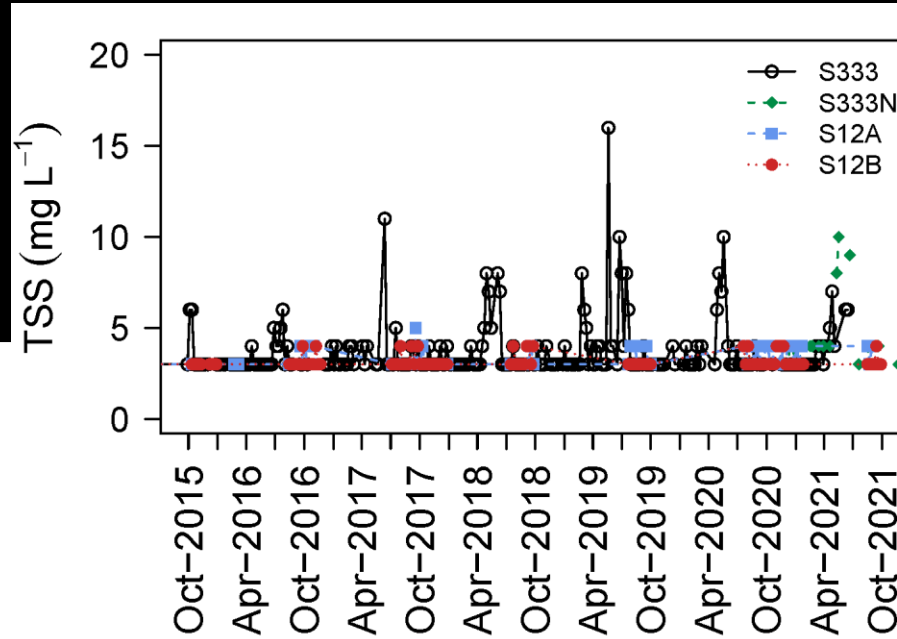
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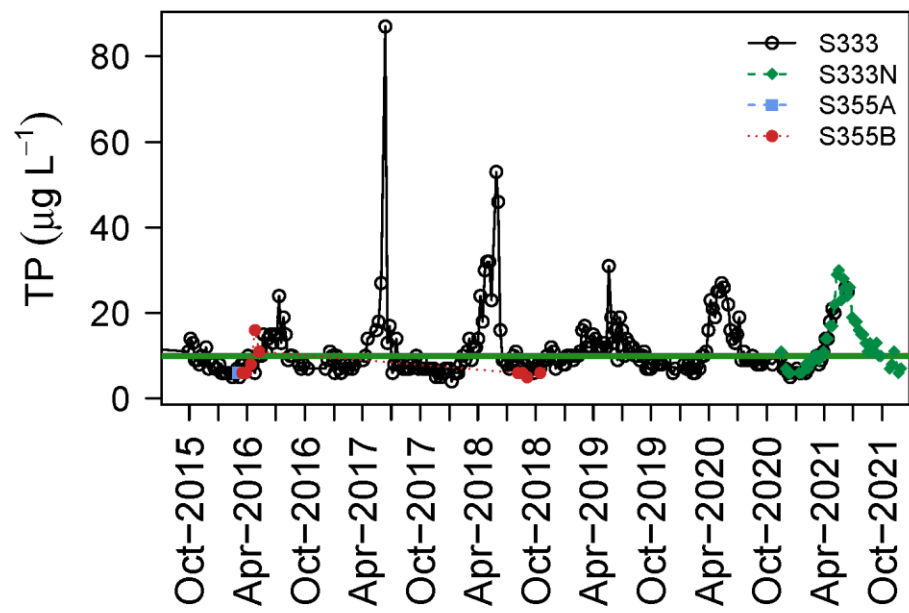
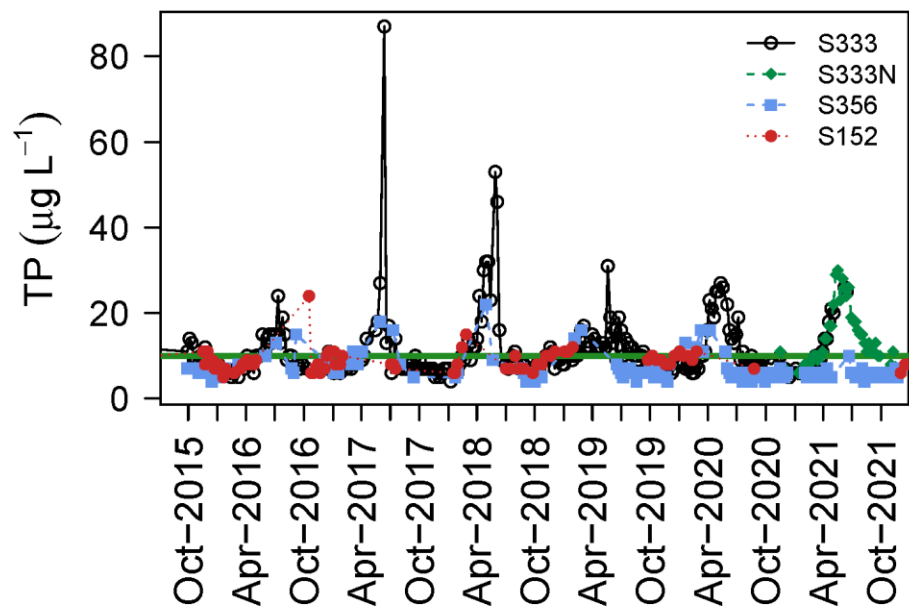
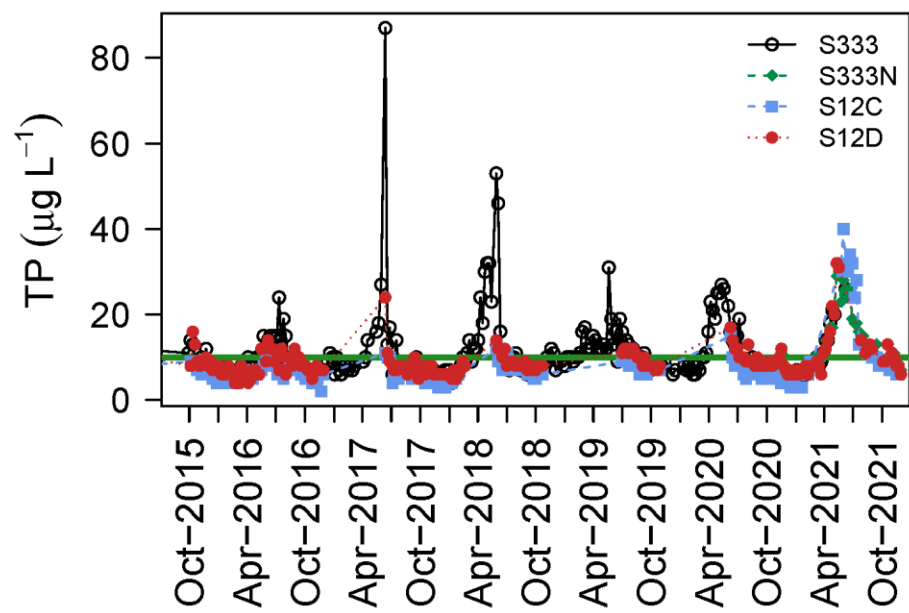
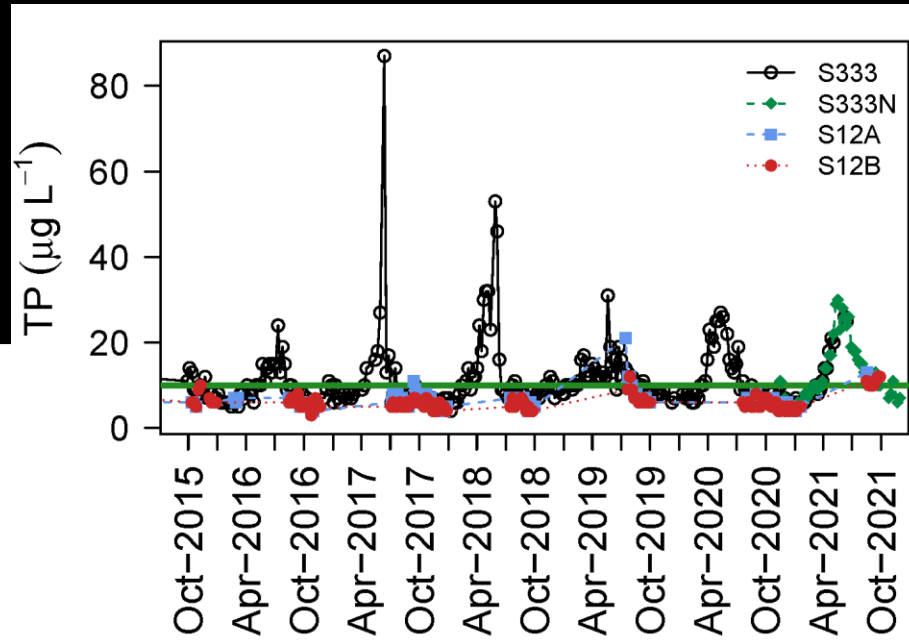
# TSS and hydrologic nexus

- TSS concentrations when flowing
- S12C consistently above MDL in Jun 2021
- Concentrations at S333 and S333N increase above MDL during low water events



# TP and hydrologic nexus

- TP concentration when flowing
- S12C and S12D increased above S333 and S333N concentration from May 24 – Jul 12 2021
- Some flow during this time was delivered to the S12C and S12D due to hydrologic restriction on flow through the S333s and construction activity (old Tamiami Trail removal)



# Structure contribution to event total phosphorus load

## Daily calculation:

$S_{12s} + [S_{333} + S_{355A} + S_{355B} + \text{minimum}(S_{356}, S_{335}) - S_{334}]$

$$Load_{Qi*Ci} = \sum Q_{S,i} * C_{S,i}$$

S = structure

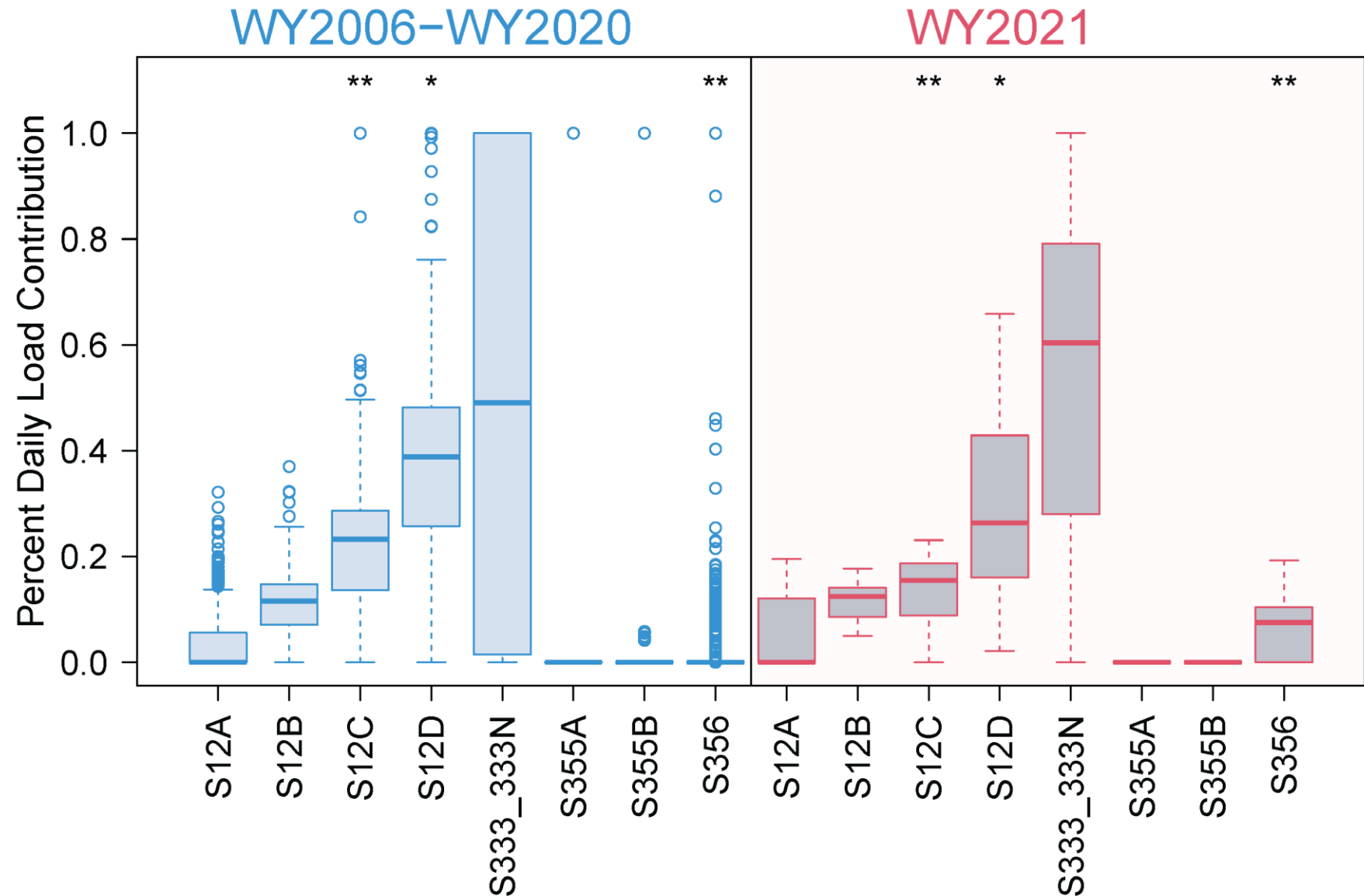
i = day

Daily Contribution =

$$load_{S,i} / Load_{Qi*Ci}$$

Q = flow

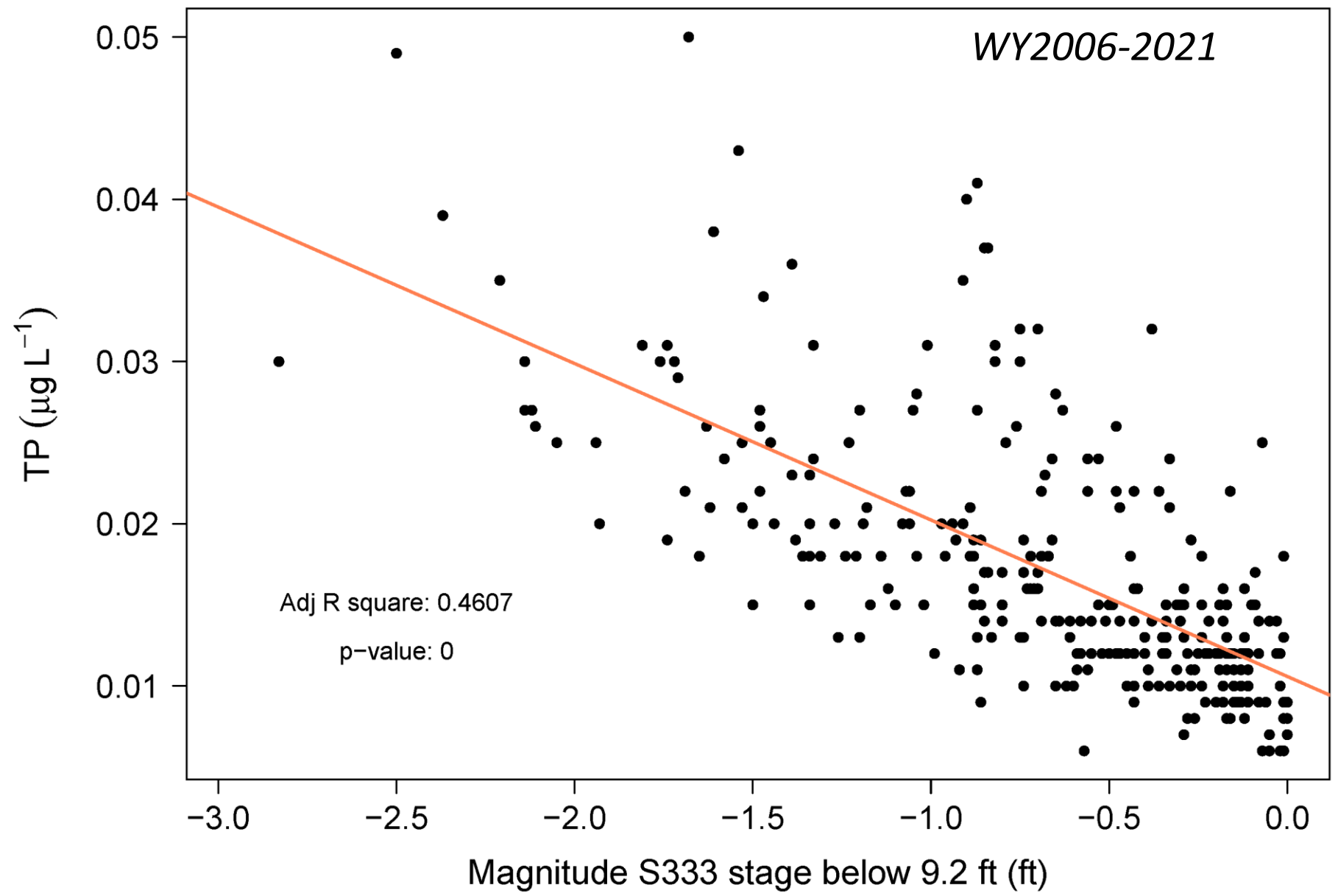
C = concentration





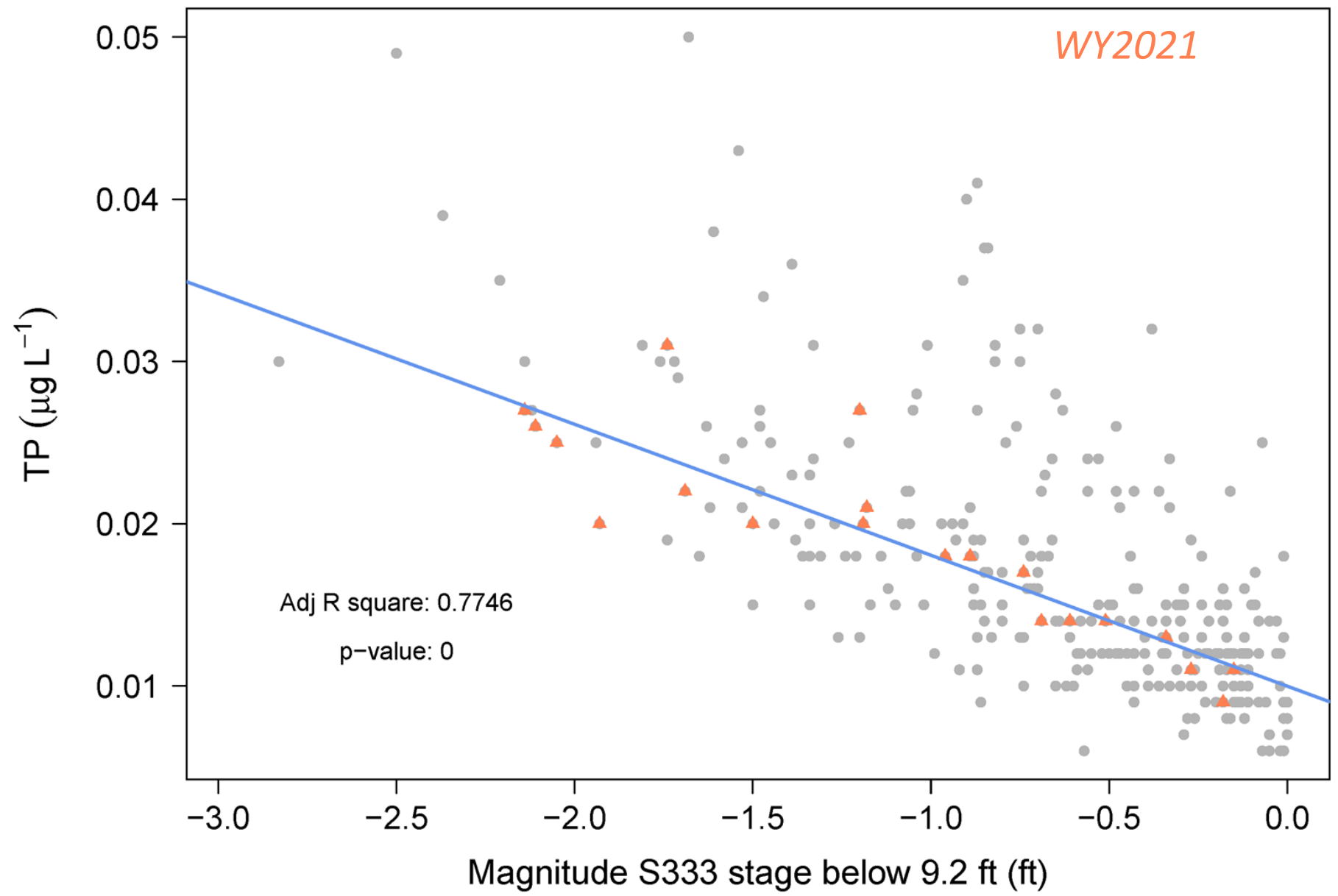
# TP and hydrologic nexus

Magnitude of stage (difference between observed S333 stage and 9.2 ft) below 9.2 ft is related to increasing TP



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# Summary

- WY2021 compliance for Shark River Slough
  - Regional
    - Miami canal and S9 are still delivering elevated levels of TP concentrations to the Shark River Slough
    - TP flow-weighted mean concentrations are increasing at S9A and along the western WCA3A boundary
    - Flow vectors indicate WCA3A input connectivity to Shark River Slough inflows
    - Na:Ca ratios indicate EAA water continues to influence water quality along WCA3A's eastern boundary down to the S333s and eastern S12s
  - Local
    - TP concentration at S12D and S333s began above 8 ppb
    - More than 40% of the annual flow occurred under 9.2 ft at S333 headwater
      - Most past years a larger fraction of this water was routed to South Dade or not delivered
      - WY2021 much of this water was incorporated in compliance determination
      - TP concentrations at S12C, S12D, and S333s were  $\geq 12$  ppb
    - Dominant contributor to Shark River Slough total loads remains S333 complex
      - Related to low water stage operations
      - Relative to long-term record S12C and S12D WY2021 contributions were reduced

# The Ask

- Continue implementing long-term solutions (e.g., Restoration Strategies)
- Continue the Sediment Characterization and Hydrodynamic studies to inform paths forward
- Evaluate water quality Adaptive Management strategies within CEPP 1.0