

Shark River Slough Water Quality Compliance Evaluation WY2022

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Main take away for WY2022

• Regional drivers

- Miami and L67A canals continue to deliver elevated total phosphorus levels towards the Park
- TP flow-weighted mean concentrations are increasing as inputs to 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

• Local drivers

- When S333_H stage was below 9.2 ft
 - 53% of S333 flow – 175 kacft
 - 55% of S333N flow – 150 kacft
 - 54% of S333+S333N flow – 325 kacft
- Further below 9.2 ft the higher the TP concentration

A stylized graphic on the left side of the slide. It features a white, textured, wavy background that resembles a topographic map or a water flow pattern. Overlaid on this background are dark silhouettes of a mountain range and a forest of evergreen trees. The text 'Regional Drivers' is written in a bold, black, sans-serif font, centered vertically within the graphic area.

Regional Drivers

Hydrodynamic

WY2022 spatial flow-weighted mean total phosphorus concentrations

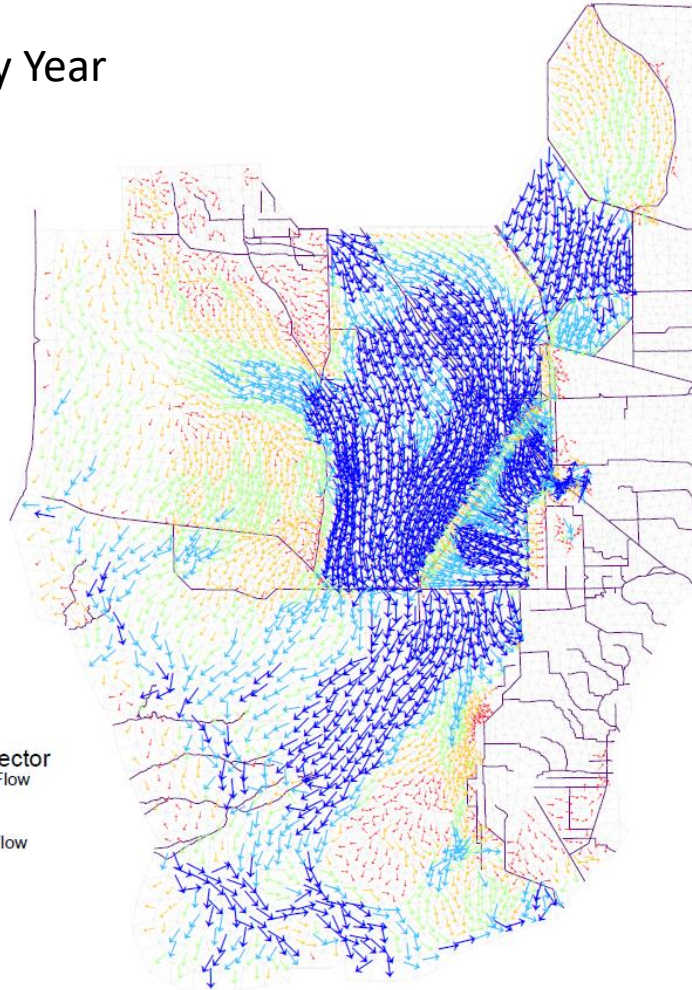
Trends: WY2010 – WY2022;
WY = October – September

Regional drivers

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

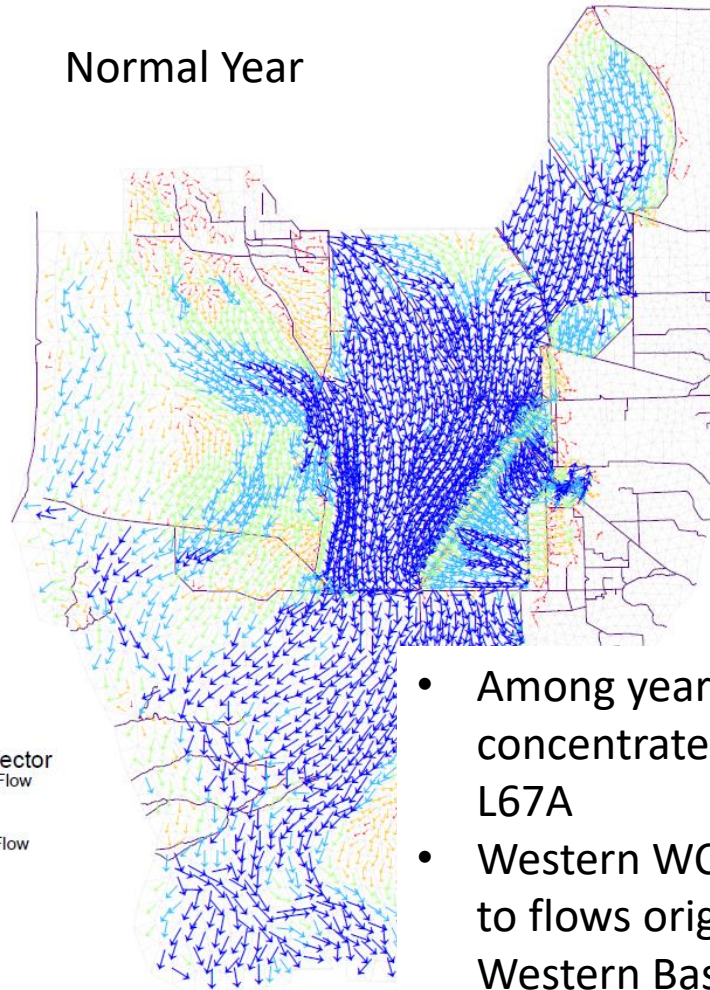
Annual Average Overland Vector
1993

Dry Year



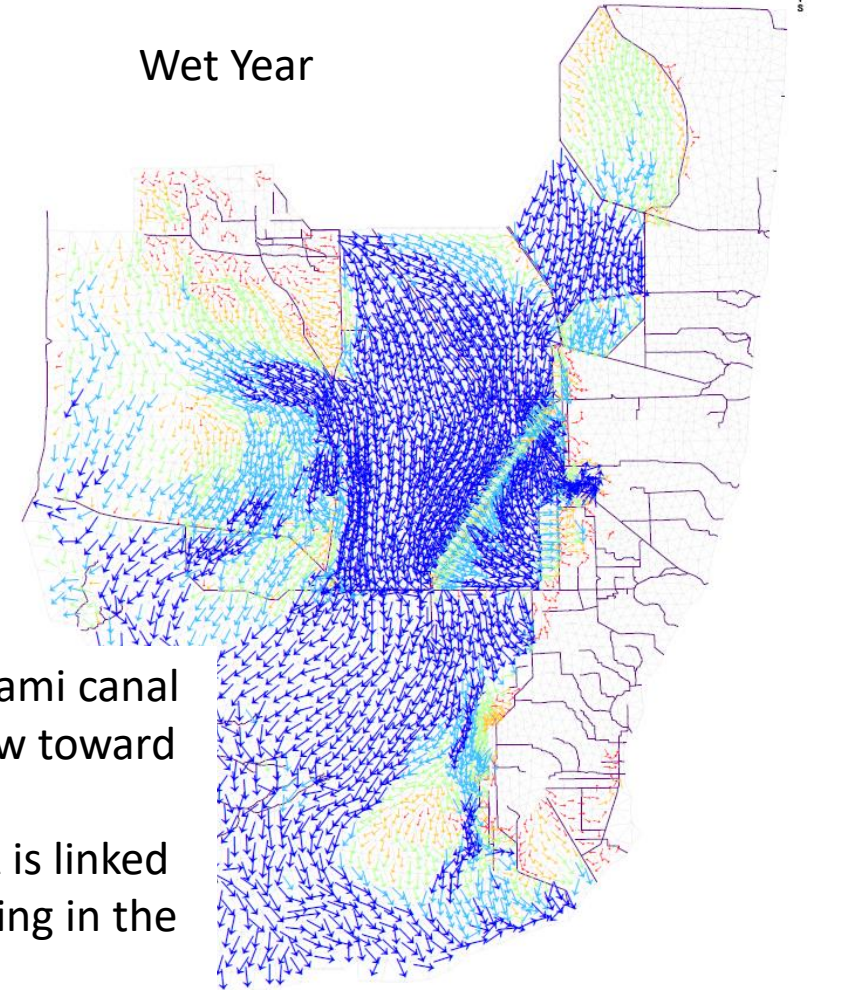
Annual Average Overland Vector
1994

Normal Year

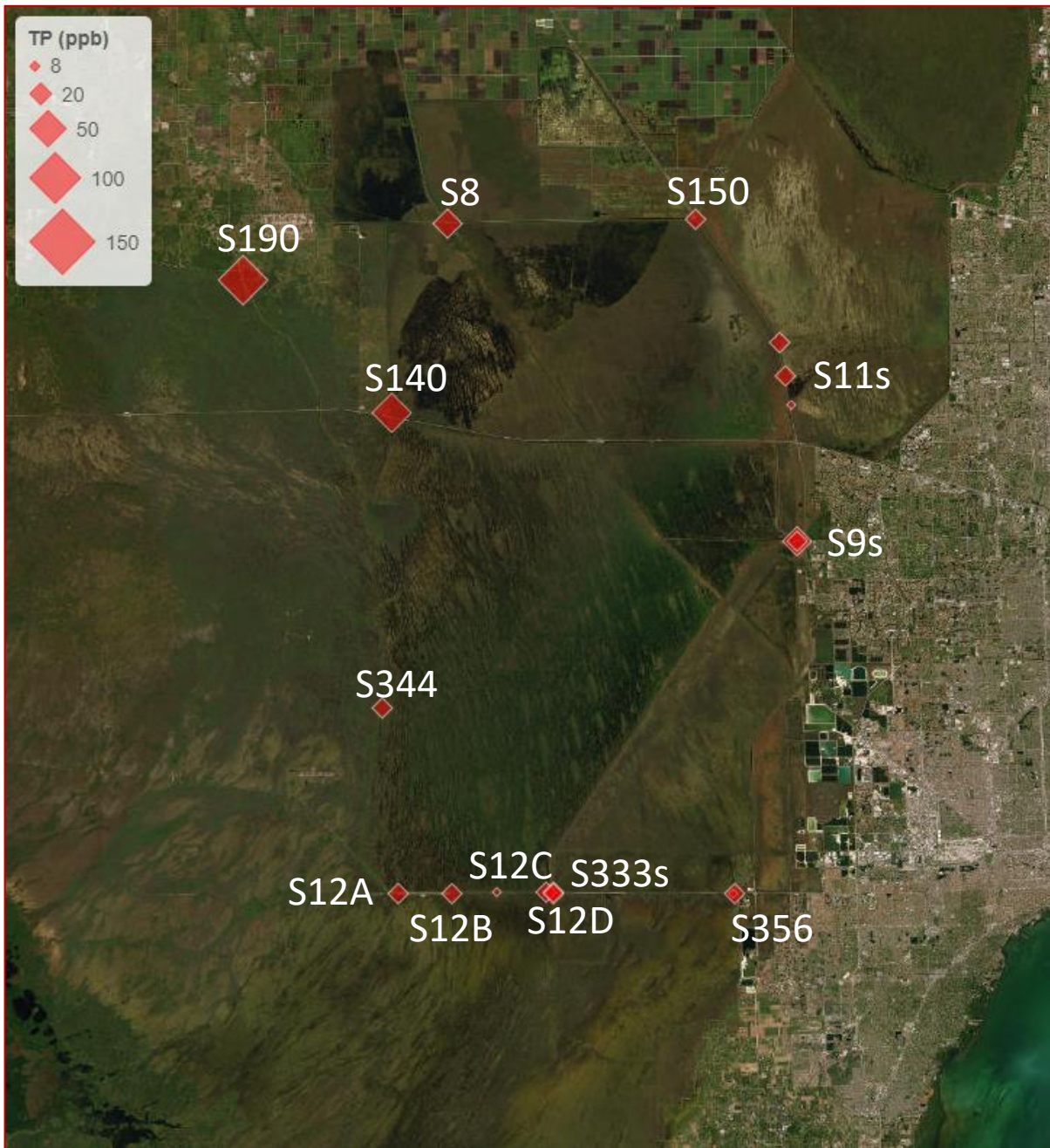


Annual Average Overland Vector
1995

Wet Year



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



Station	DBKey	Flow (ac-ft)	Load (kg)	FWM (ppb)
S190	91428	64,441.8	9,439.3	118.8
S140	91384	60,375.3	6,046.8	81.1
S344	91504	8,683.5	147.5	13.8
S8	15040	213,507.1	6,051.7	23.0
S150	15041	21,842.9	376.9	14.0
S11C	15260	222,573.2	2,766.1	10.1
S11B	15259	126,109.1	1,914.4	12.3
S11A	15258	143,363.3	1,274.3	7.2
S9	K5483	205,563.3	5,262.6	20.8
S9A	91692	32,107.8	661.0	16.7
S12A	01313	9,728.9	181.4	15.1
S12B	00610	12,557.2	127.6	8.2
S12C	00621	125,485.7	1,215.4	7.9
S12D	01310	299,285.3	3,467.8	9.4
S333	91487	331,131.6	6,540.1	16.0
S333N	40371	273,868.4	4,776.3	14.1
S356	64136	243,304.1	2,454.5	8.2

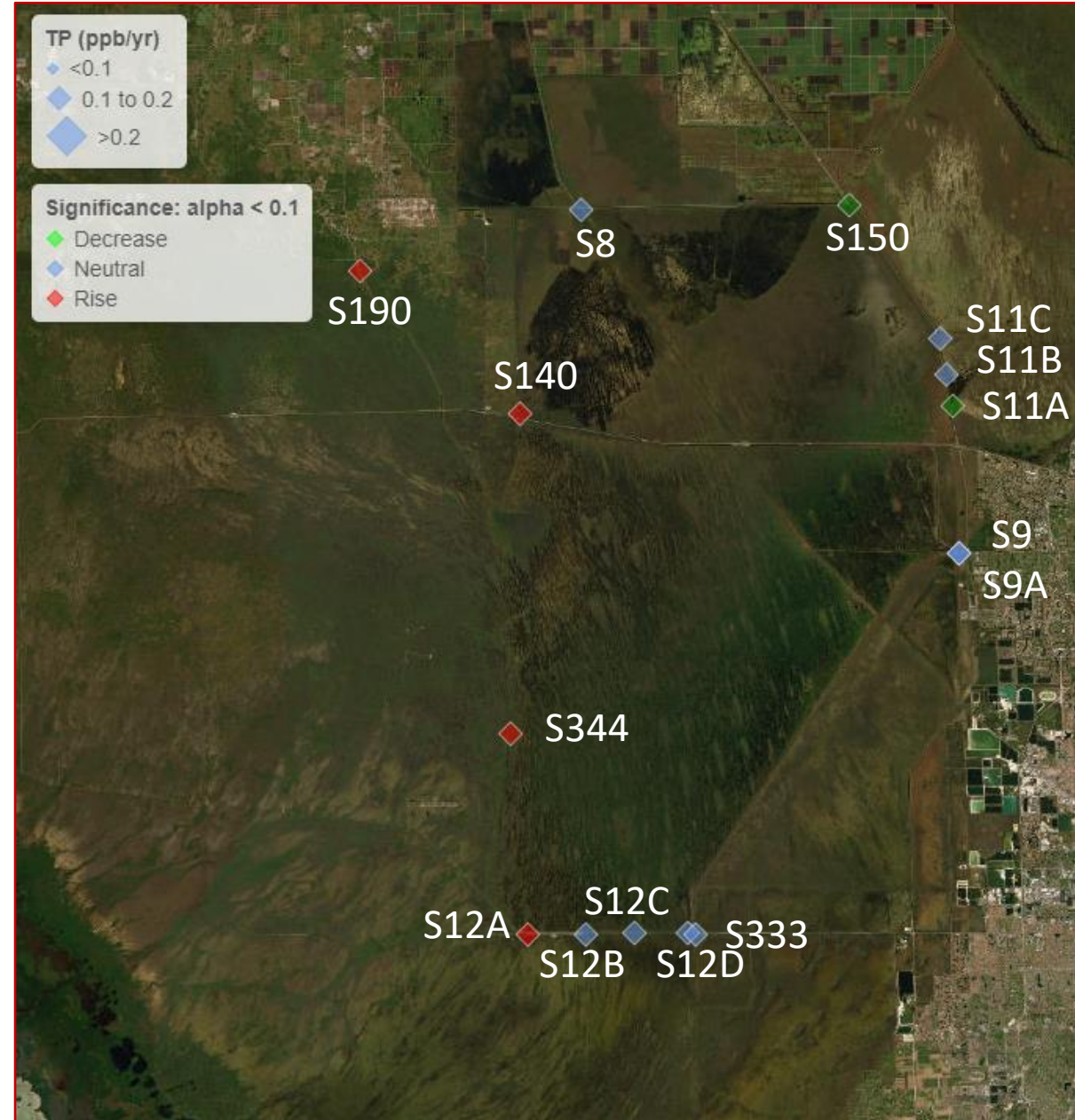
- Daily grab samples when flowing interpolated; auto samples extend max 10 days; auto samples primary
- Daily loads calculated
- Loads and flows summed to WY
- FWM calculated from WY loads and flows

WY2022 – TP FWM concentrations

Station	Tau Trend Strength	Slope (ppb/yr)	p-value
S11A	-3.527	-0.2814	0.0306
S11B	-0.386	-0.0399	0.7728
S11C	-0.177	-0.0121	0.8764
S12A	2.736	0.3410	0.0136
S12B	-0.411	-0.0252	0.6814
S12C	-0.260	-0.0177	0.8605
S12D	0.169	0.0091	0.9131
S140	4.064	1.6680	0.0081
S150	-3.851	-0.2643	0.064
S190	3.827	1.9250	0.0594
S333	1.614	0.1413	0.2244
S344	2.389	0.2152	0.0753
S8	-1.964	-0.1981	0.2394
S9	1.655	0.0969	0.1842
S9A	3.153	0.1491	0.1139

- WY2010-WY2022
- Based on monthly flow-weighted mean concentration for available data across the period of record
- Some records are imperfect, but the test is robust for missing data
- S11B, S11C, S150, S344 begin after Oct 2009, but include more than 10 years of data (limiting test assumption)
- Evaluated with USGS Kendall.exe Seasonal Kendall package

Seasonal Kendall Trends





Local Drivers & Responses

Flow conditions – flow rates and volumes under 9.2 ft stage

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

Water levels - magnitude below 9.2 ft

Appendix A compliance

• Shark River Slough Compliance since WY2006

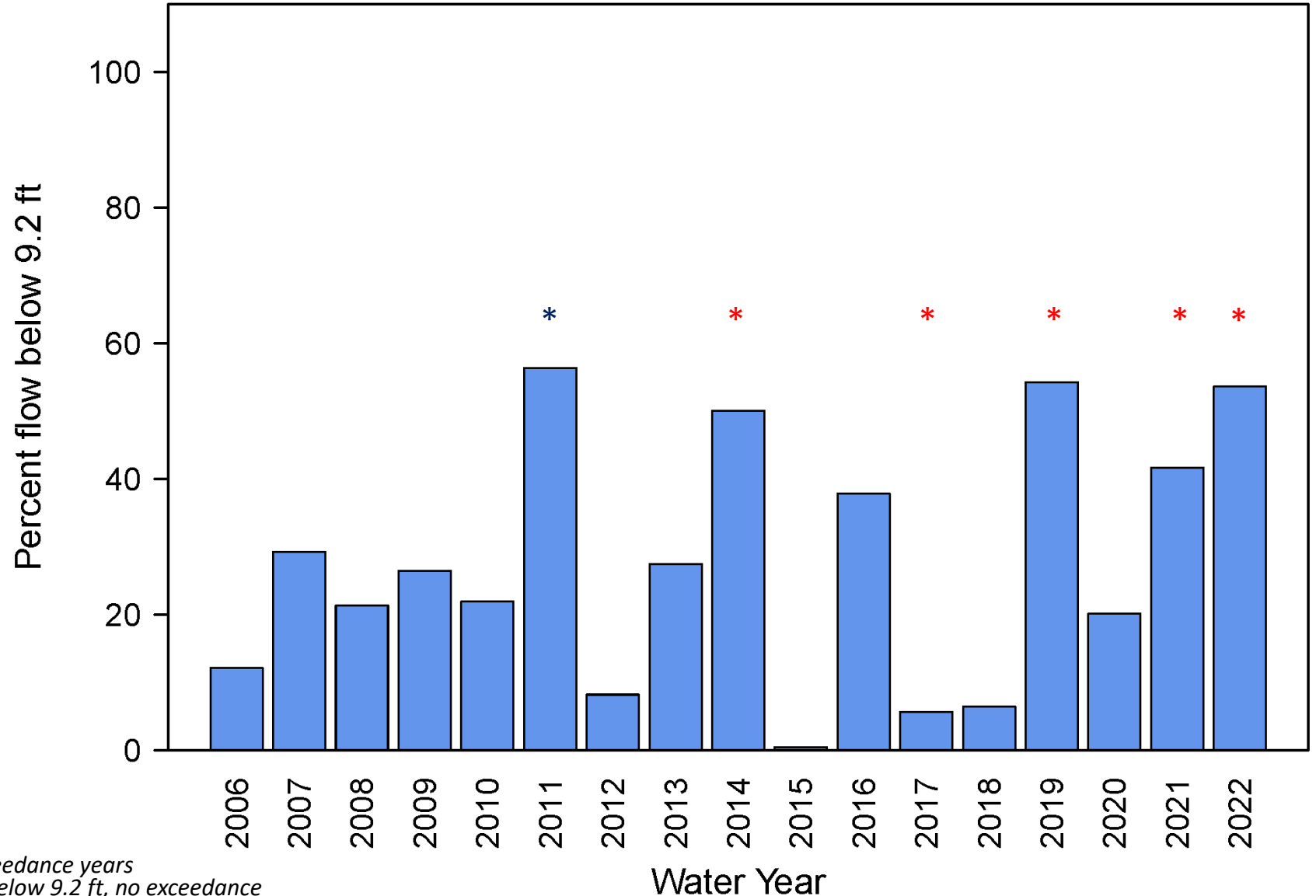
Percent S333s water delivered below 9.2 ft at S333 headwater

Compliant:

- WY2013: 27%
- WY2015: 1%
- WY2016: 38%
- WY2018: 6%
- WY2011: 56% - S333 routed around SRS

Failed compliance:

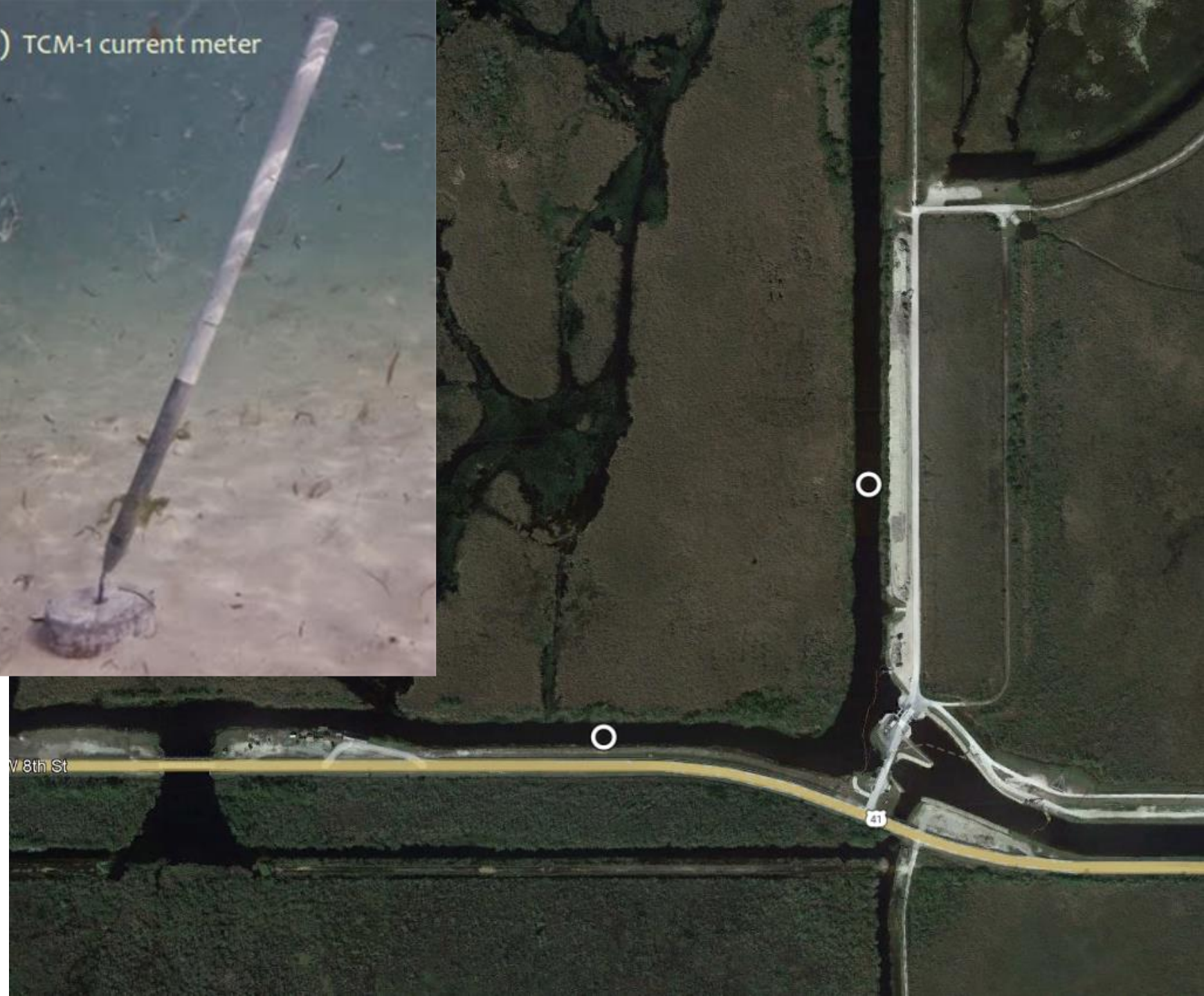
- WY2014: 51%
- WY2017: 6%; drought
- WY2019: 54%
- WY2021: 42%
- WY2022: 54%



* Recent exceedance years
* High flow below 9.2 ft, no exceedance

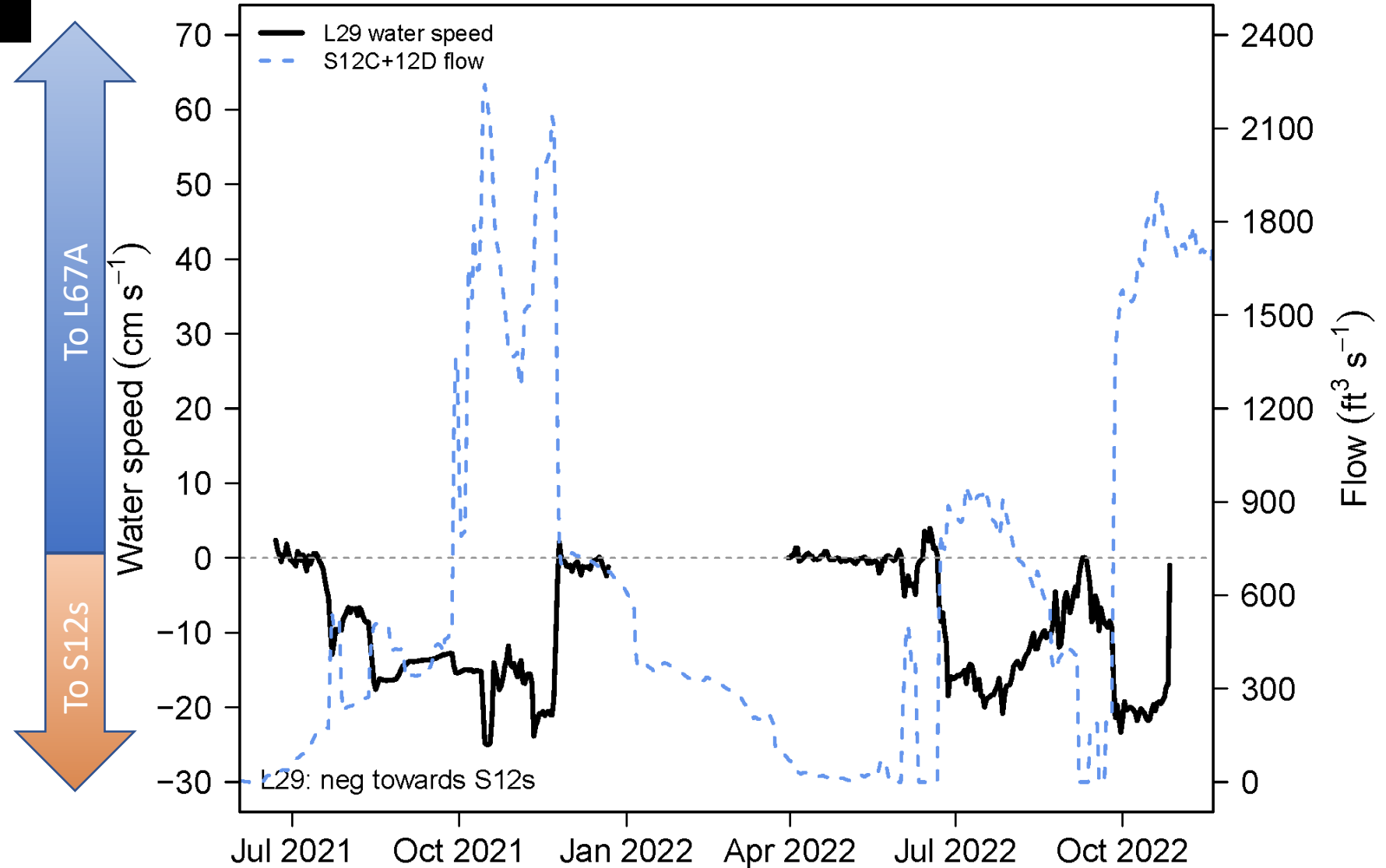
Flow dynamics

- Tilt Current Meter situated 1000 ft upstream of S333 on L67A and L29 canals
- Collected data from Jun 22 – Dec 22, 2021 and Apr 1 – Oct 27, 2022



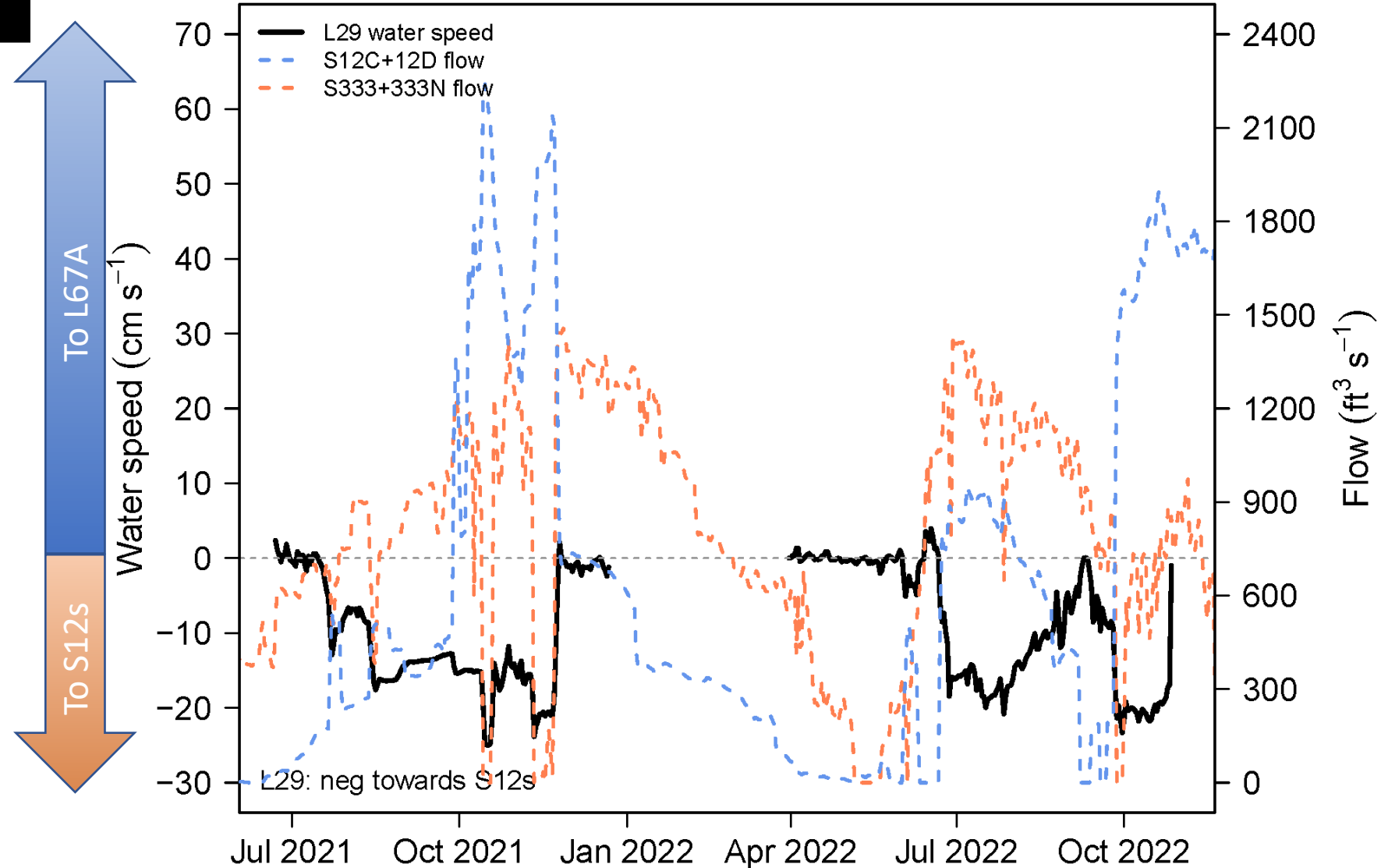
Flow dynamics

- 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



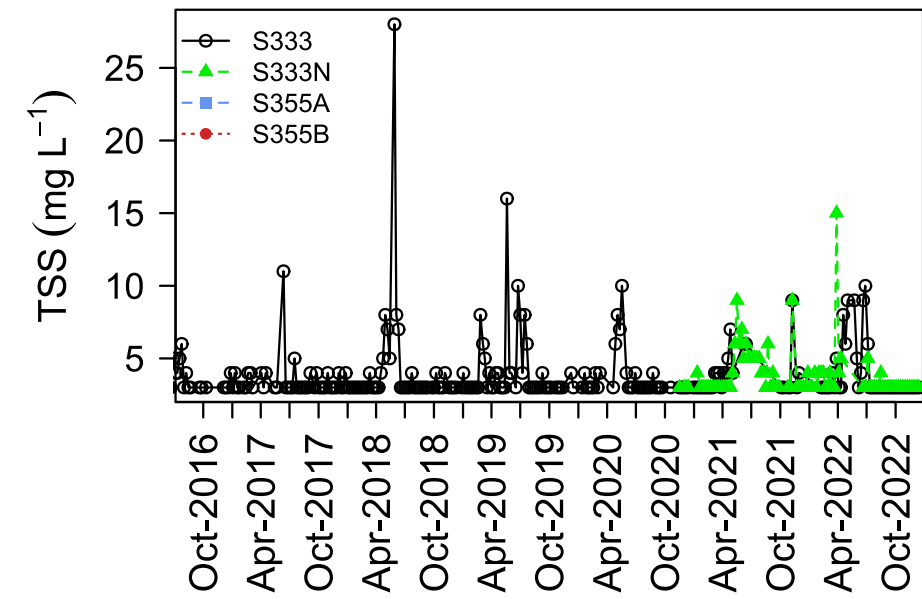
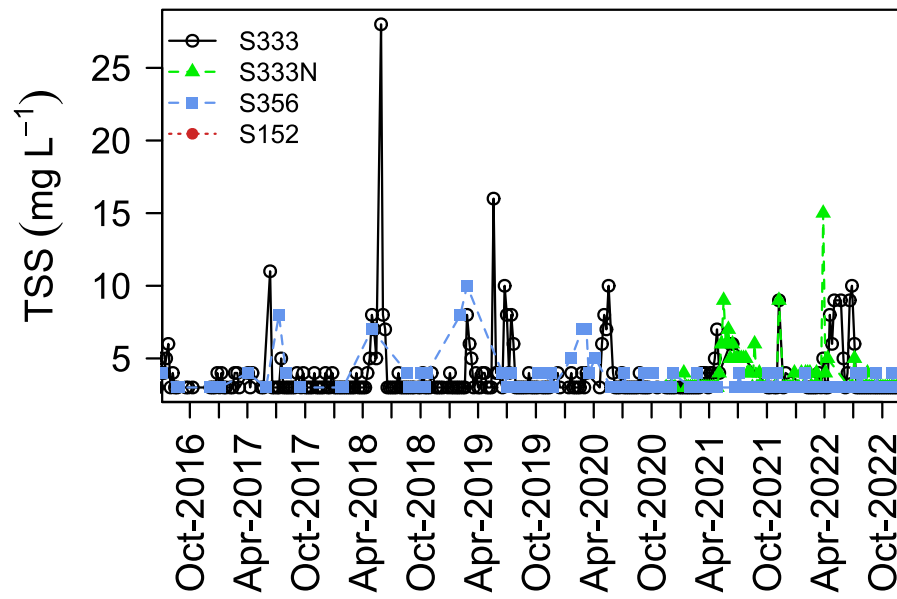
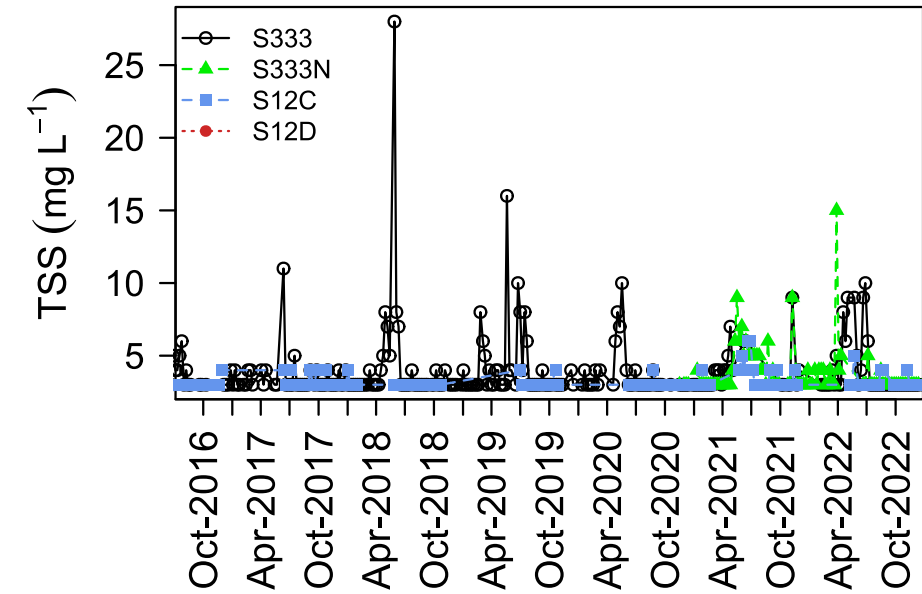
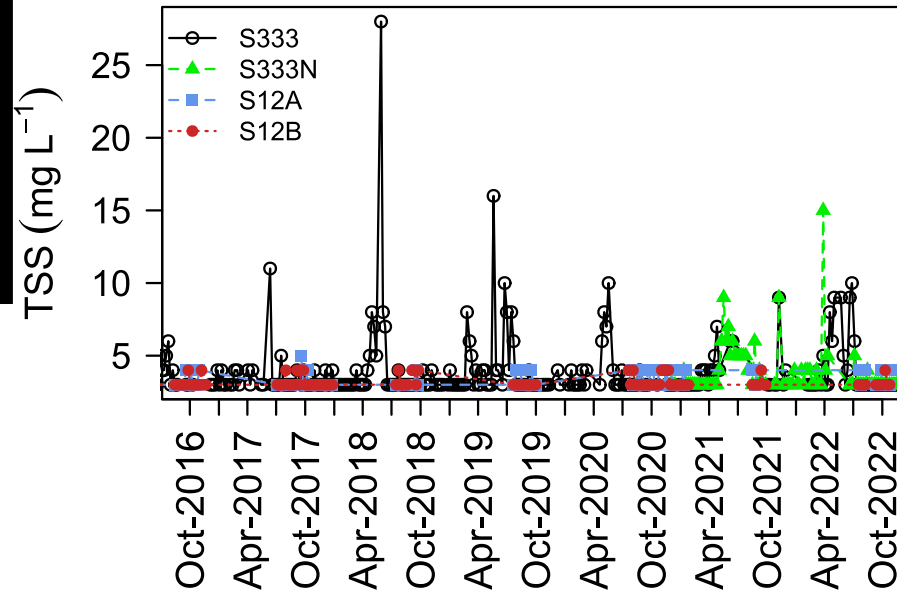
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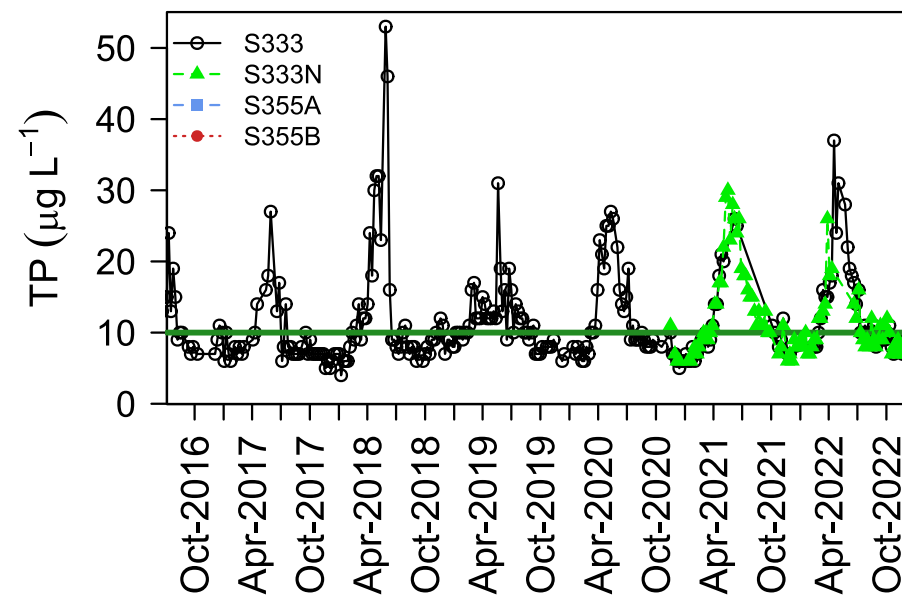
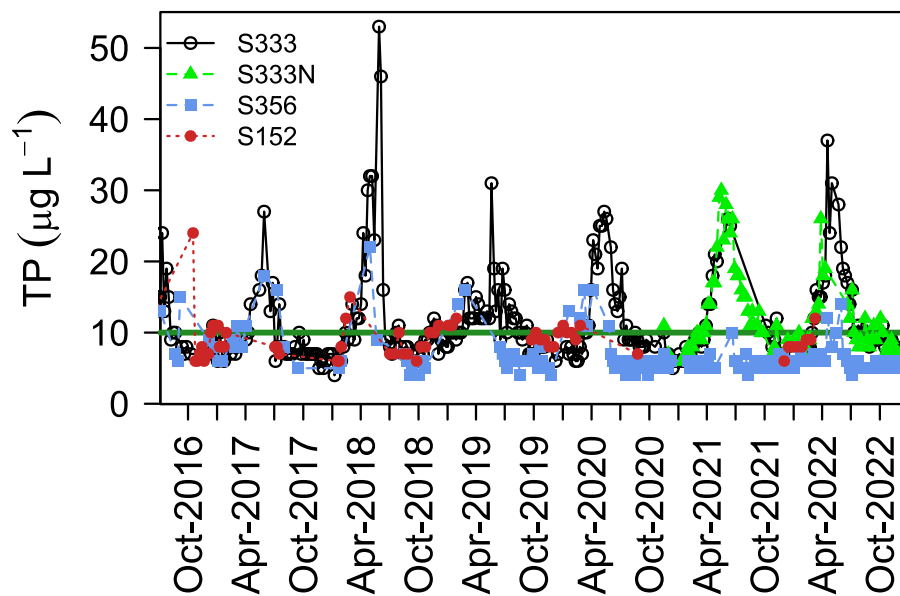
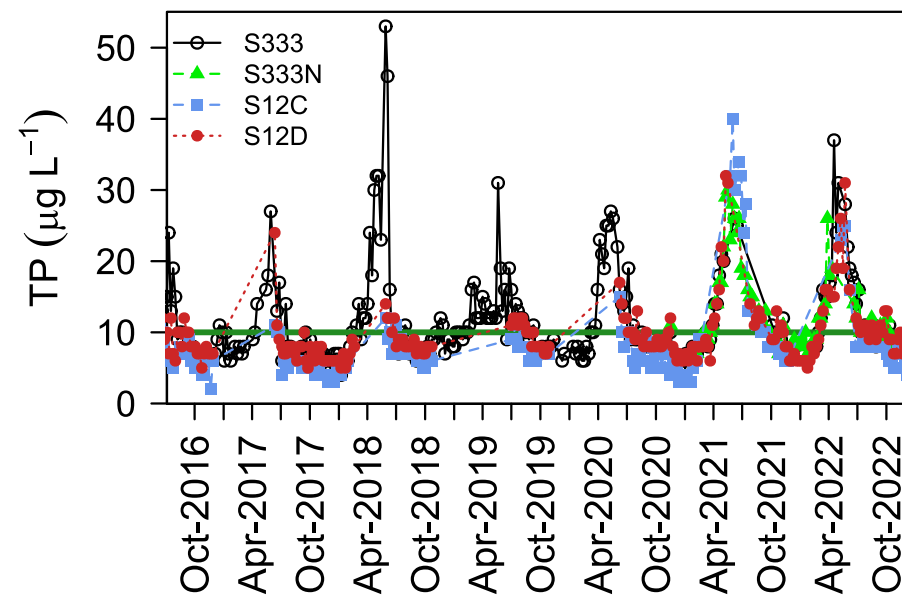
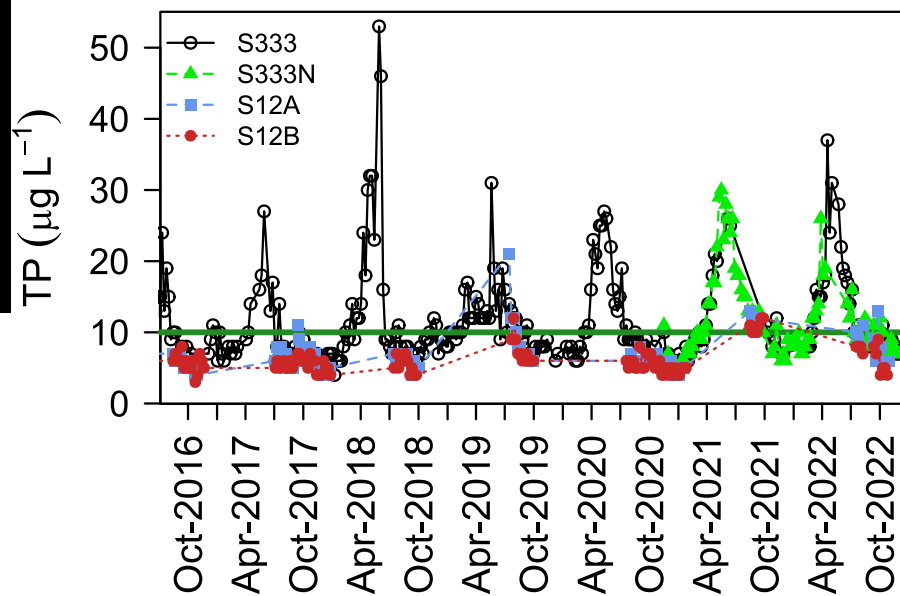
TSS and hydrologic nexus

- TSS concentrations when flowing
- Concentrations at S333 and S333N increase above MDL during low water events



TP and hydrologic nexus

- TP concentration when flowing
- WY2022 TP pattern followed the pattern observed in WY2021 for S333s and S12D and S12C



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

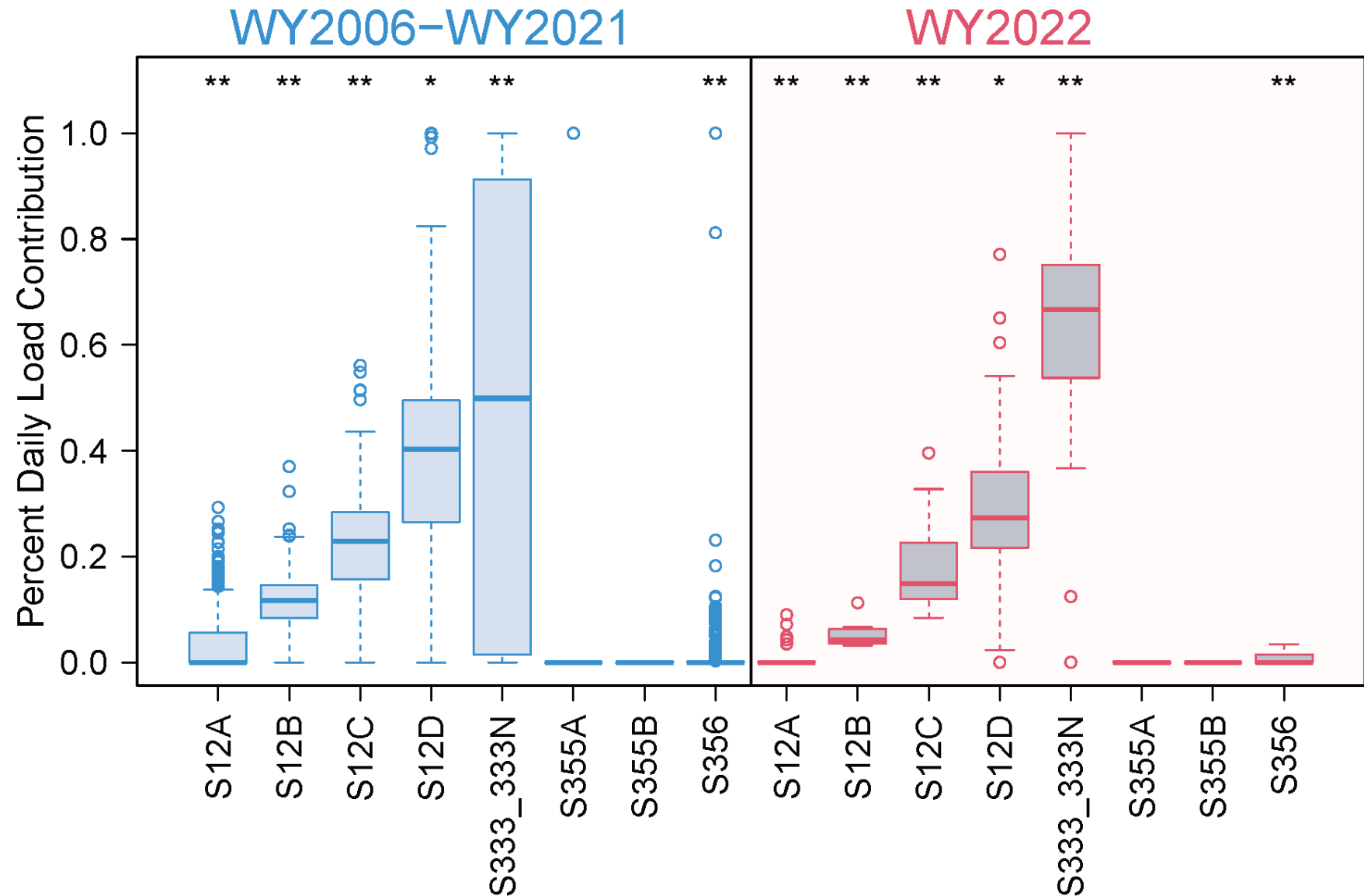
i = day

Daily Contribution =

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

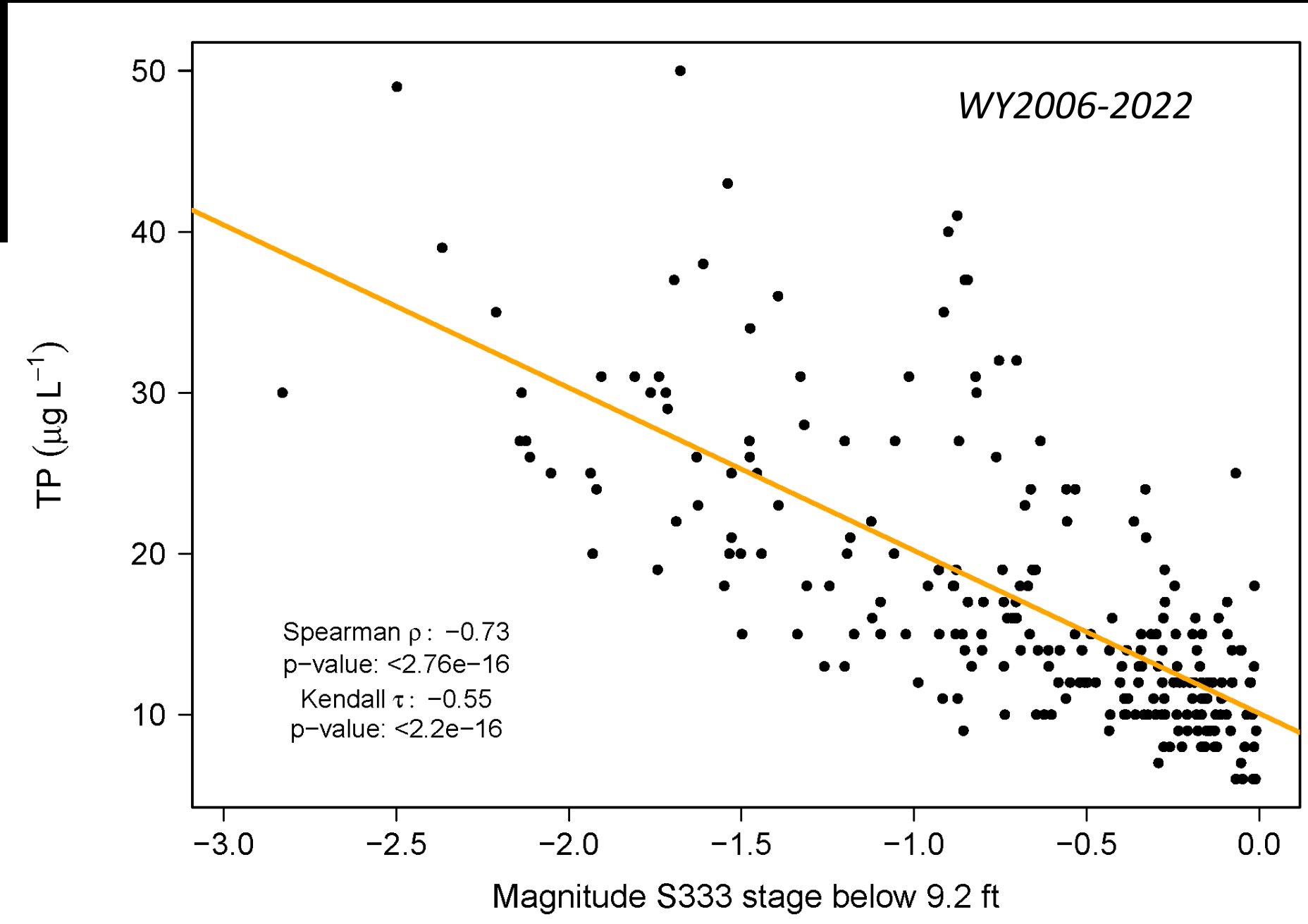
Q = flow

C = concentration



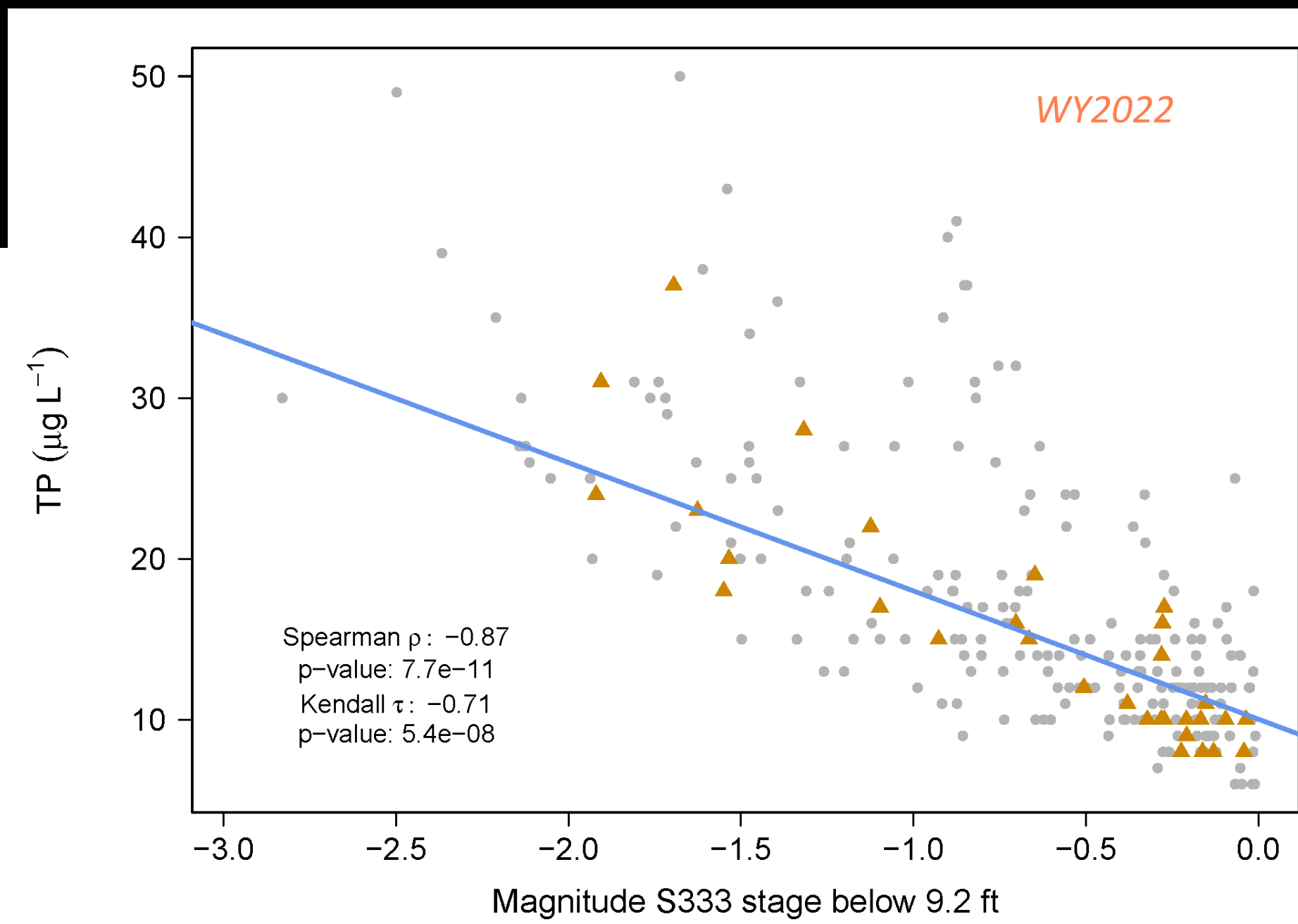
TP and hydrologic nexus

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



TP and hydrologic nexus

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Summary

- WY2022 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 as inputs to the western WCA3A boundary
 - Flow vectors indicate WCA3A input connectivity to Shark River Slough inflows
 - Local
 - More than 50% of the annual flow through the S333s 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
 - WY2022 much of this water was incorporated in compliance determination
 - 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