

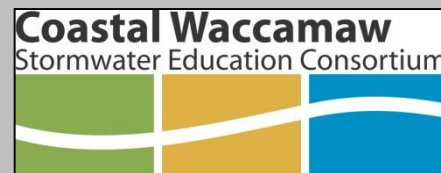
Volunteer Water Quality Monitoring Waccamaw River: 12th Annual Volunteer Meeting Nov 16, 2017

Recent Results: Events and Trends

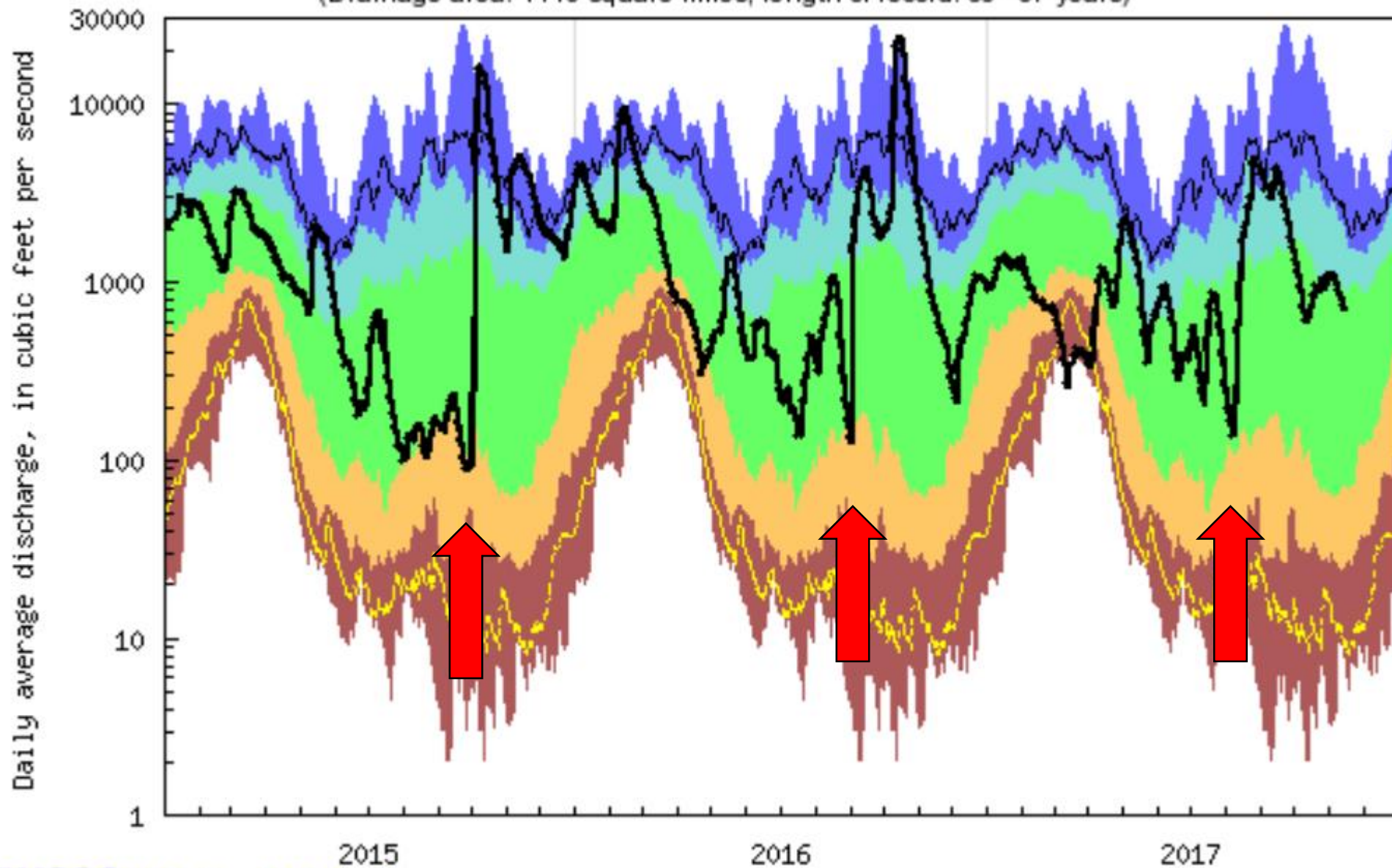
Susan Libes

Waccamaw Watershed Academy

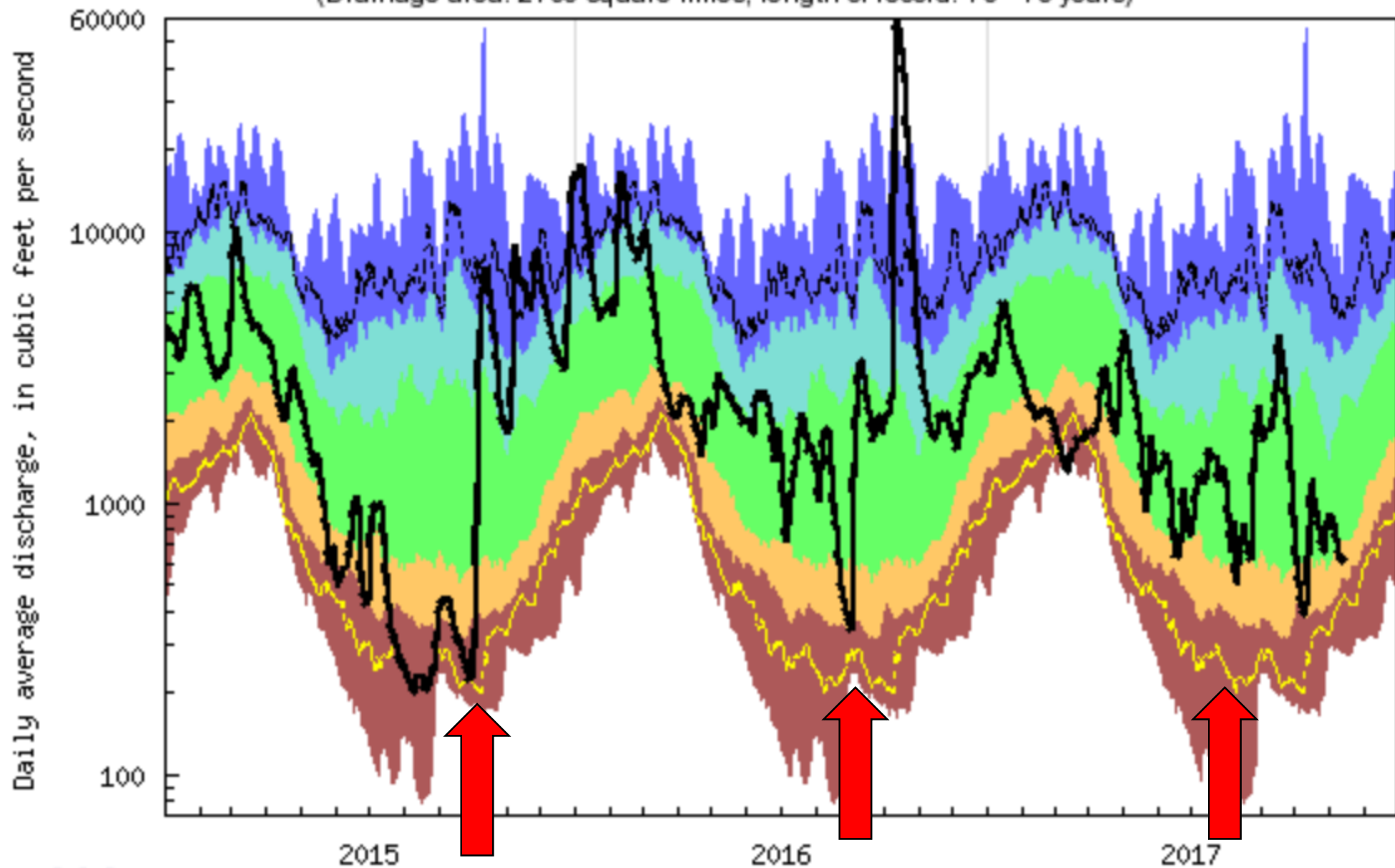
Coastal Carolina University



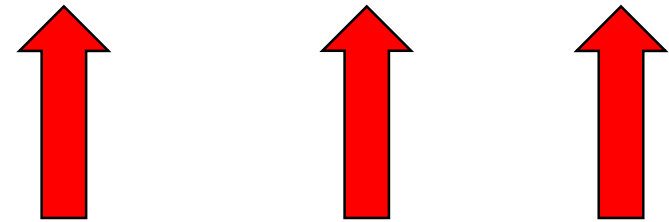
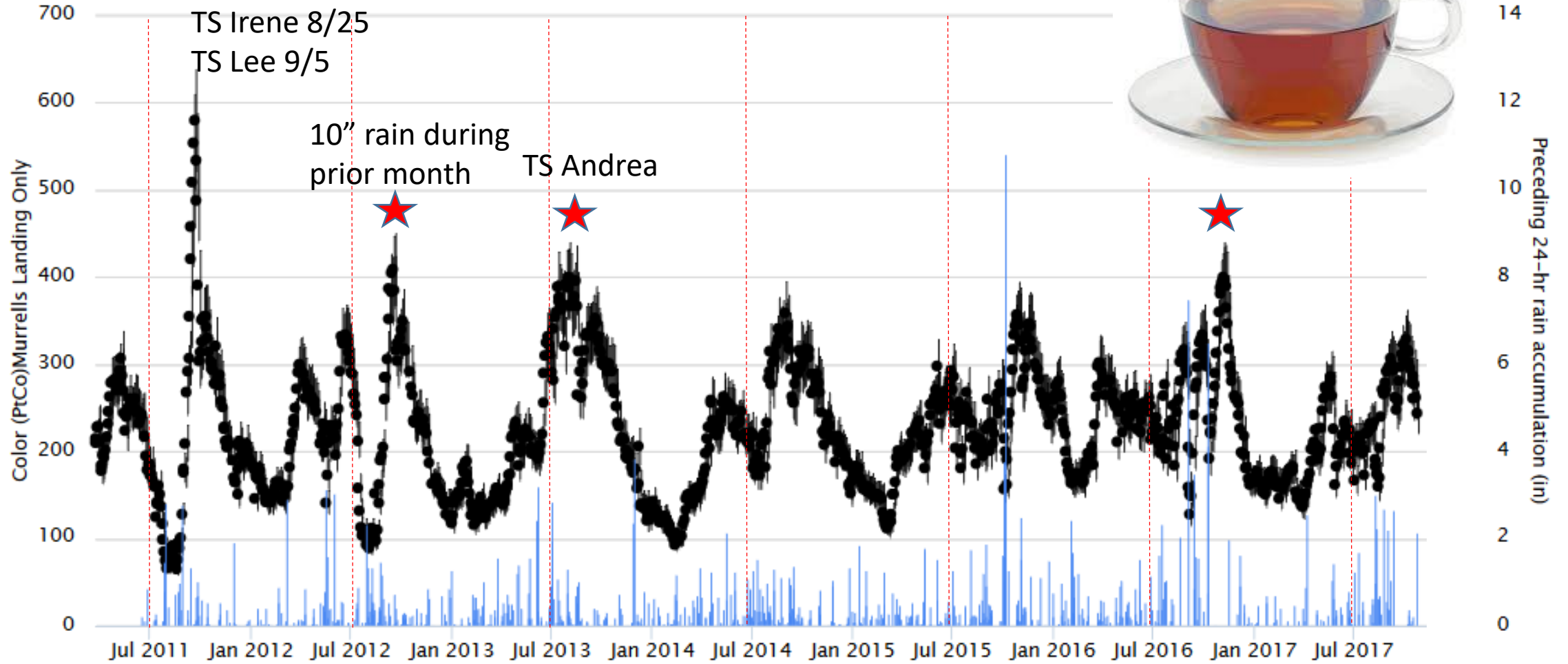
USGS 02110500 WACCAMAW RIVER NEAR LONGS, SC
(Drainage area: 1110 square miles, length of record: 66 - 67 years)



USGS 02135000 LITTLE PEE DEE R. AT GALIVANTS FERRY, SC
(Drainage area: 2790 square miles, length of record: 73 - 75 years)

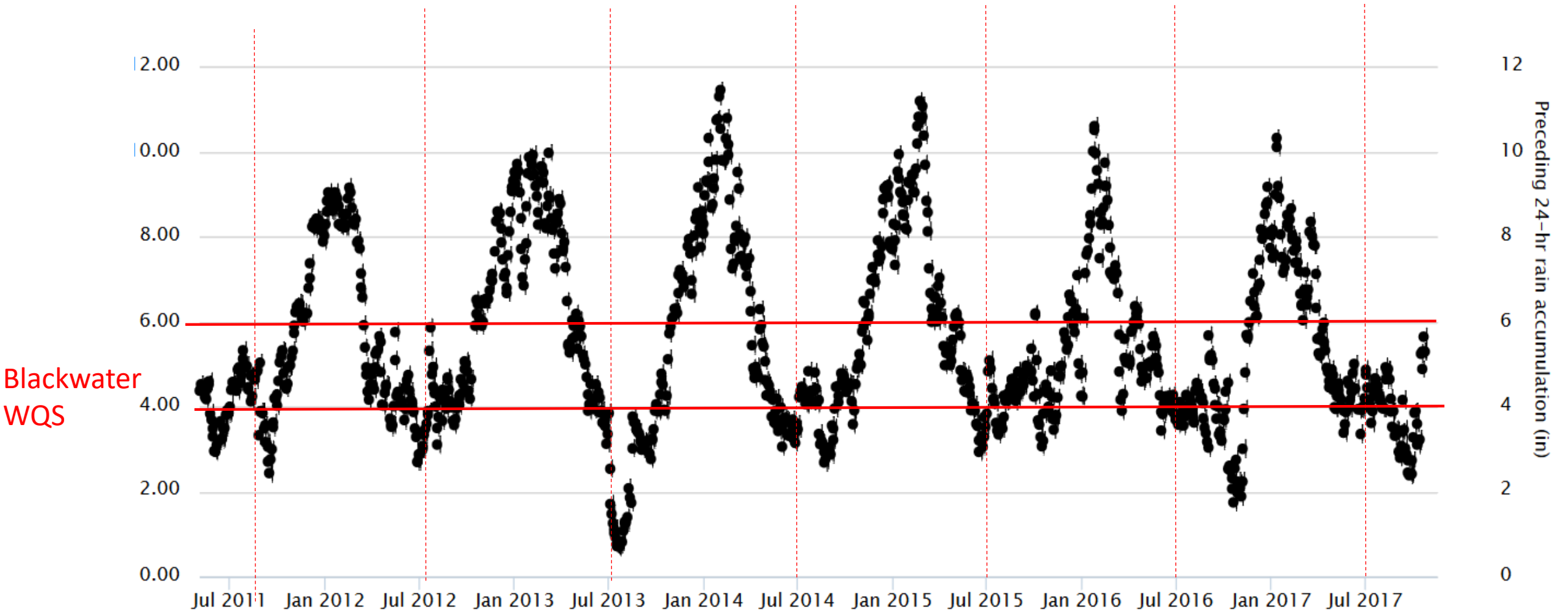


True Color at Murrells Landing



Typical Flood ranges from 350 to 400 PtCo

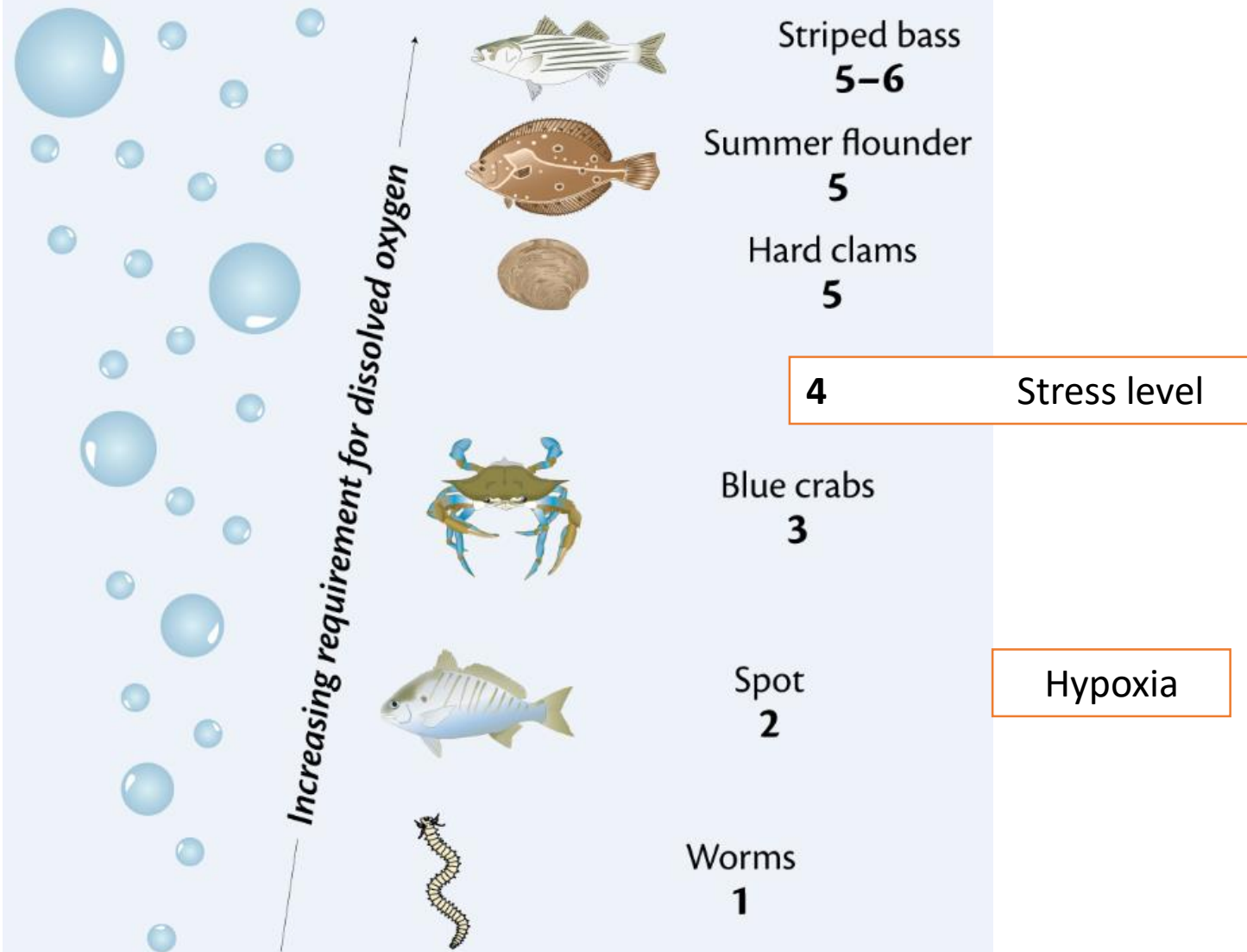
Dissolved Oxygen at Murrells Landing



DO is often below the Blackwater WQS
Might be normal? Associated with high flows – floods. Climate change associated?
Fish and other animals seem to be acclimated since we don't see kills.

Dissolved oxygen criteria

Minimum amount of dissolved oxygen needed to survive
(milligrams of dissolved oxygen per liter of water [mg L⁻¹])

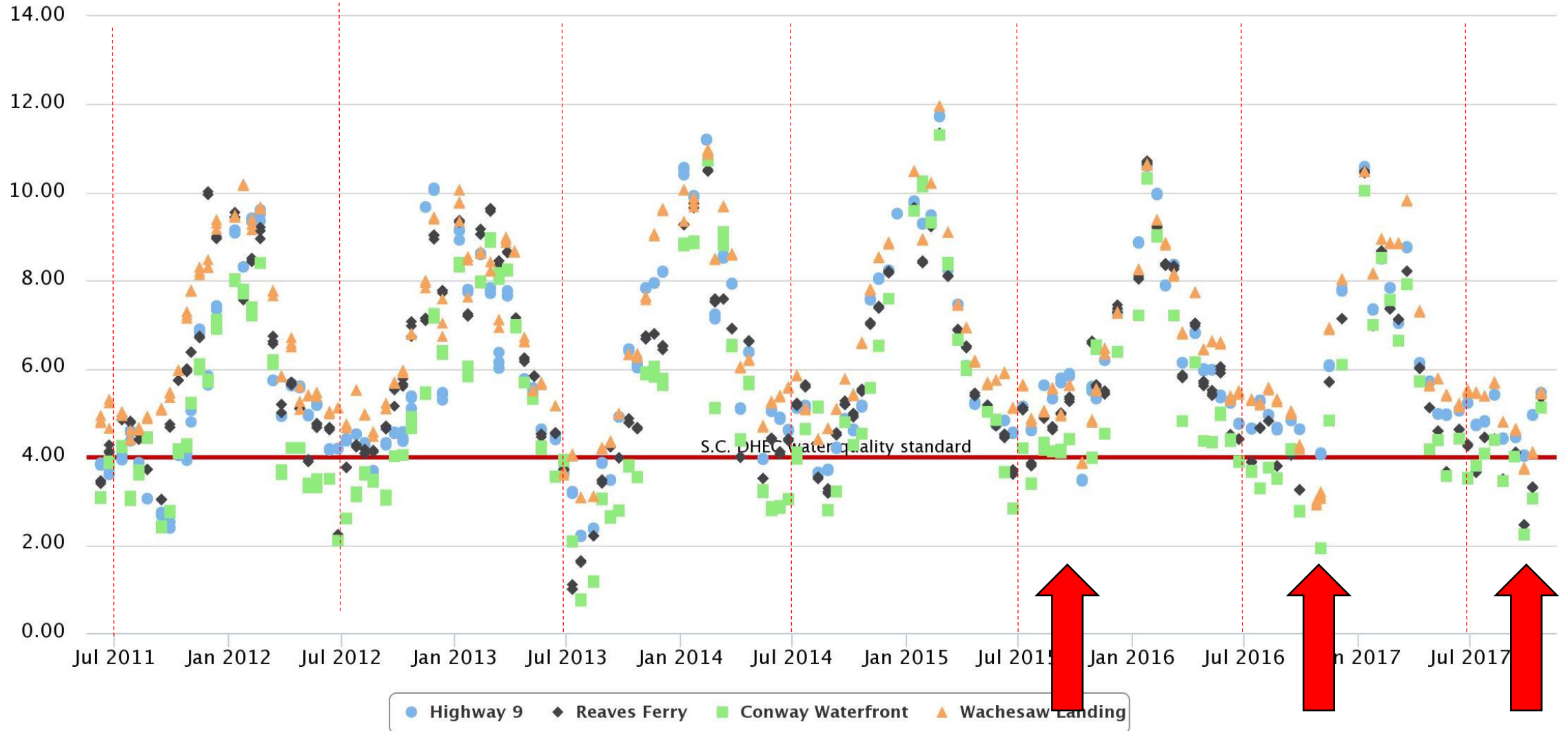


Dissolved Oxygen

TS Irene 8/25
TS Lee 9/5

Dissolved Oxygen (mg/L)

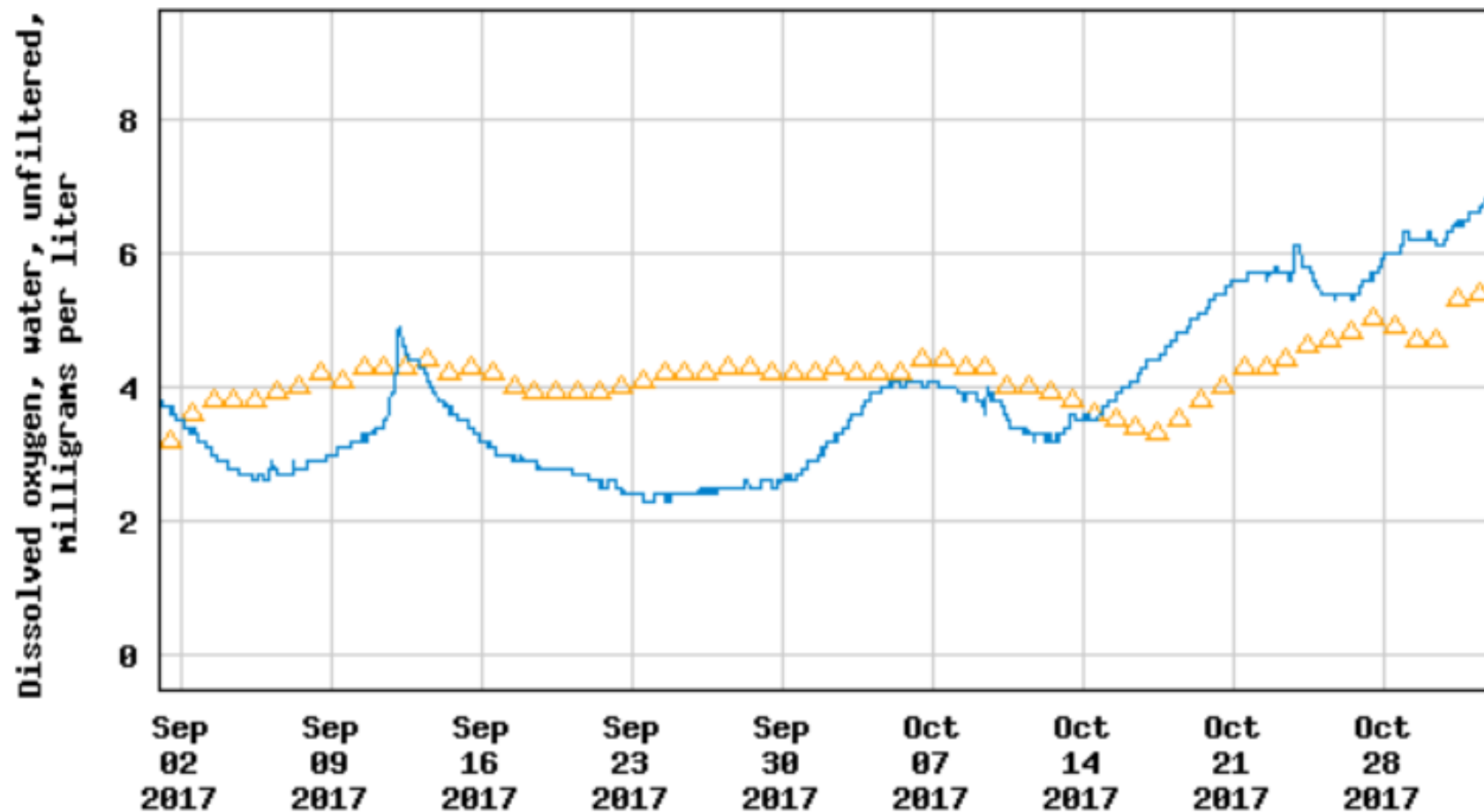
Data collected between Jun 01, 2011 and Oct 25, 2017



Dissolved oxygen, water, unfiltered, milligrams per liter

Most recent instantaneous value: 6.0 11-06-2017 15:30 EST

USGS 02110550 WACCAMAW RIVER ABOVE CONWAY, SC



---- Provisional Data Subject to Revision ----

△ Median daily statistic (3 years) — Dissolved oxygen

Recent Impacts from Rain

- 10/25/17: A significant amount of rain fell the day prior to sampling. Rainfall ranged from 1" at Buck Creek and Reaves Ferry to 3" at Conasauga. Conductivity was "normal".

Due to the recent rainfall, turbidity and E. coli were elevated at several sites in the main stem of the river and in the lake as described below. This was a bit surprising as conductivity was only somewhat low at these sites.

- 11/1/17: About 1" of rain had fallen three days prior to sampling. River discharge was at the high end of normal.

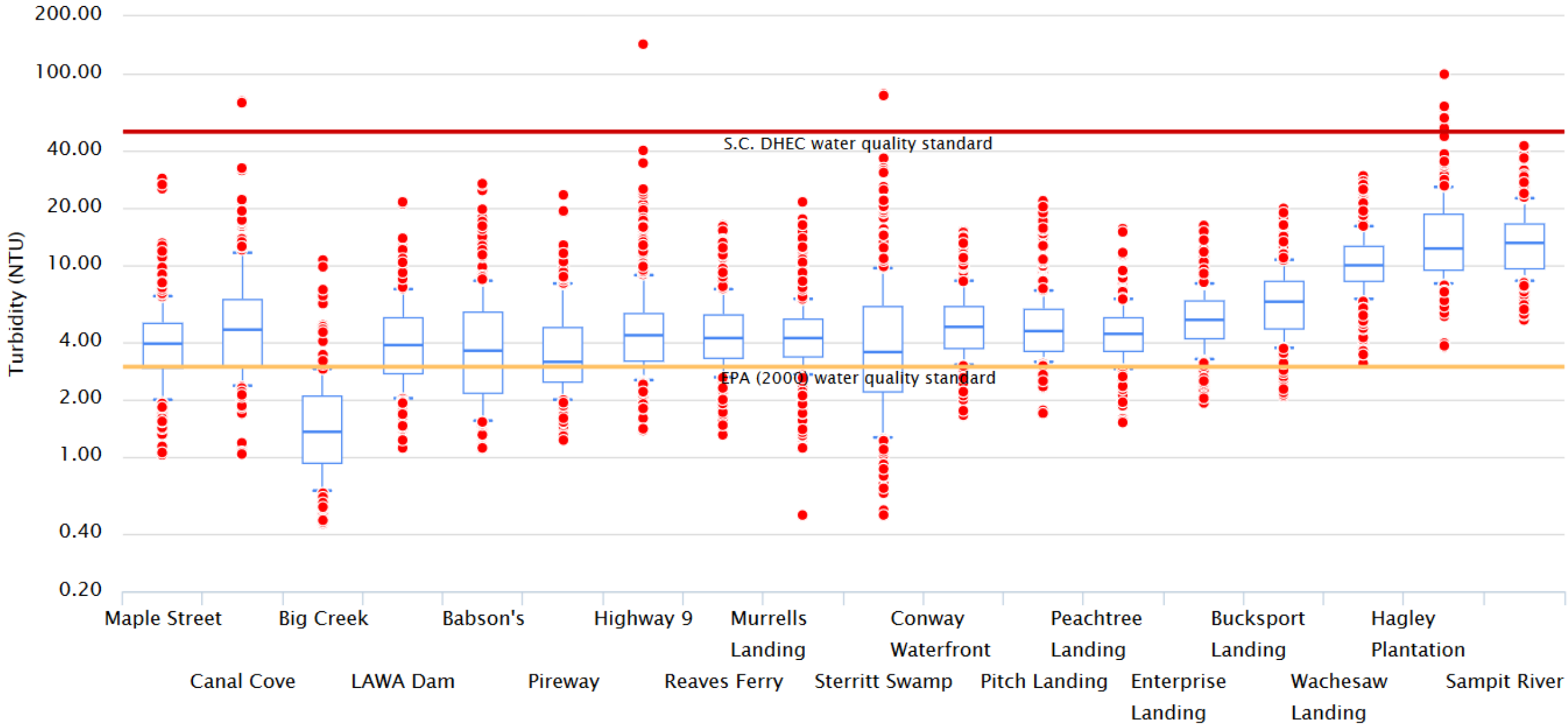
Due to continuing rainfall, turbidity and E. coli were still somewhat elevated from the last sampling on 10/25/17 at a few sites as described below. Conductivity was still somewhat low at these sites.

Similar results in
Surfside and
Murrells Inlet

How we know what unusually high is

Turbidity (NTU)

Data collected between Jun 06, 2006 and Oct 25, 2017



October 25, 2017

| Sampling Sites | DO (mg/L) > 20 C | DO (mg/L) < 20 C | %DO > 20 C | %DO < 20 C | Temp (C) > 20 C | Temp (C) < 20 C | *Turbidity (NTU) | Nitrate (ppm N) | Nitrite (ppm N) | *Ammonia (ppm N) | E. coli (CFU/100 mL) | Total coliform (CFU/100 mL) |
|--------------------|------------------|------------------|-------------|-------------|-----------------|-----------------|------------------|-----------------|-----------------|------------------|----------------------|-----------------------------|
| LAWA Dam | | <10th | | Site Normal | | > 90th | Site Normal | Site Normal | Site Normal | Site Normal | Site Normal | Site Normal |
| Canal Cove | | Site Normal | | Site Normal | | > 90th | > 90th | > 90th | Site Normal | Site Normal | > 90th | > 90th |
| Maple Street | >75th | | Site Normal | | <10th | | > 90th | Site Normal | Site Normal | Site Normal | > 90th | >75th |
| Big Creek | | <10th | | <10th | | > 90th | >75th | Site Normal | Site Normal | Site Normal | > 90th | > 90th |
| Babson's Landing | | <25th | | <25th | | > 90th | >75th | Site Normal | Site Normal | Site Normal | > 90th | > 90th |
| Pireway Landing | | <10th | | <25th | | > 90th | > 90th | Site Normal | Site Normal | Site Normal | > 90th | > 90th |
| Highway #9 | | <25th | | Site Normal | | > 90th | > 90th | Site Normal | Site Normal | Site Normal | > 90th | > 90th |
| Reaves Ferry | > 90th | | >75th | | <10th | | > 90th | Site Normal | Site Normal | Site Normal | > 90th | > 90th |
| Murrells Landing | > 90th | | >75th | | <10th | | > 90th | Site Normal | Site Normal | Site Normal | > 90th | > 90th |
| Sterritt Swamp | | Site Normal | | Site Normal | | >75th | Site Normal | Site Normal | Site Normal | Site Normal | >75th | Site Normal |
| Conway Waterfront | > 90th | | >75th | | <10th | | > 90th | Site Normal | Site Normal | Site Normal | > 90th | > 90th |
| Pitch Landing | > 90th | | >75th | | <10th | | >75th | Site Normal | Site Normal | Site Normal | >75th | >75th |
| Bucksport Landing | >75th | | Site Normal | | <10th | | <25th | Site Normal | Site Normal | Site Normal | > 90th | Site Normal |
| Peachtree Landing, | | <25th | | <25th | | > 90th | >75th | Site Normal | Site Normal | >75th | > 90th | Site Normal |
| Enterprise Landing | > 90th | | >75th | | <10th | | Site Normal | > 90th | Site Normal | Site Normal | Site Normal | Site Normal |
| Wachesaw Landing | >75th | | Site Normal | | <10th | | Site Normal | Site Normal | Site Normal | Site Normal | > 90th | >75th |
| Hagley Landing | > 90th | | >75th | | <10th | | <25th | Site Normal | Site Normal | Site Normal | Site Normal | <25th |
| Sampit River | > 90th | | >75th | | <10th | | Site Normal | Site Normal | Site Normal | Site Normal | >75th | >75th |

10/25/17

Notes: A significant amount of rain fell the day prior to sampling, ranging from 1" at Buck Creek and Reaves Ferry to 3" at Crabtree. River discharge was "normal".

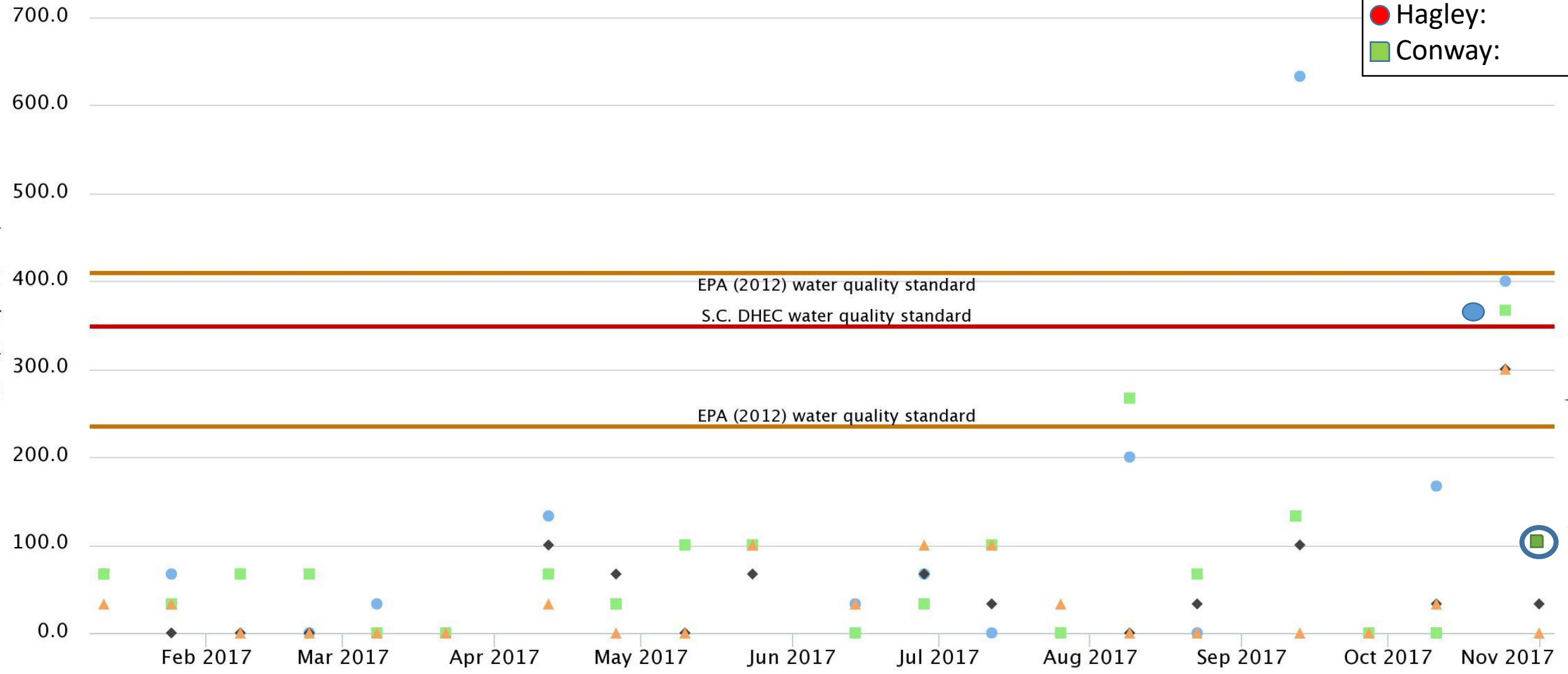
- On the river, E. coli was unusually high from Babson's Lndg to Wachesaw Lndg with the exception of Enterprise (normal), and Pitch Lndg (somewhat elevated). **Concentrations exceeded EPA's recommended water quality criteria at Highway 9 (400 CFU/100 mL), Reaves Ferry (300 CFU/100 mL), Conway Waterfront (367 CFU/100 mL) and Wachesaw Landing (300 CFU/100 mL)**, where E. coli comprised 24%, 36%, 26%, and 35% of the total coliforms, respectively. This was the 4th highest report for Highway 9 and Reaves Ferry, the 6th highest report for Conway Waterfront and the 2nd highest for Wachesaw Lndg.
- Turbidity was somewhat-to-unusually high at 8 sites on the main stem of the river, from Babson's to Peachtree Lndg, and at three sites in Lake Waccamaw. At Canal Cove, turbidity (32 NTU) was the 2nd highest out of 134 reports.
- At Hagley, pH was unusually high, along with DO. Surface water DO concentrations was 1.3 ppm higher than the deep water (USGS), suggesting an algal bloom was present.
- Dissolved oxygen (DO) was below the water quality criteria at Sterritt Swamp (SC), Big Creek (NC) and Canal Cove (NC). The concentration at Big Creek was hypoxic and unusually low. The levels at the other two sites were normal.

E. Coli (CFU/100 mL)

Data collected between Jan 01, 2017 and Nov 2, 2017

11/2/17

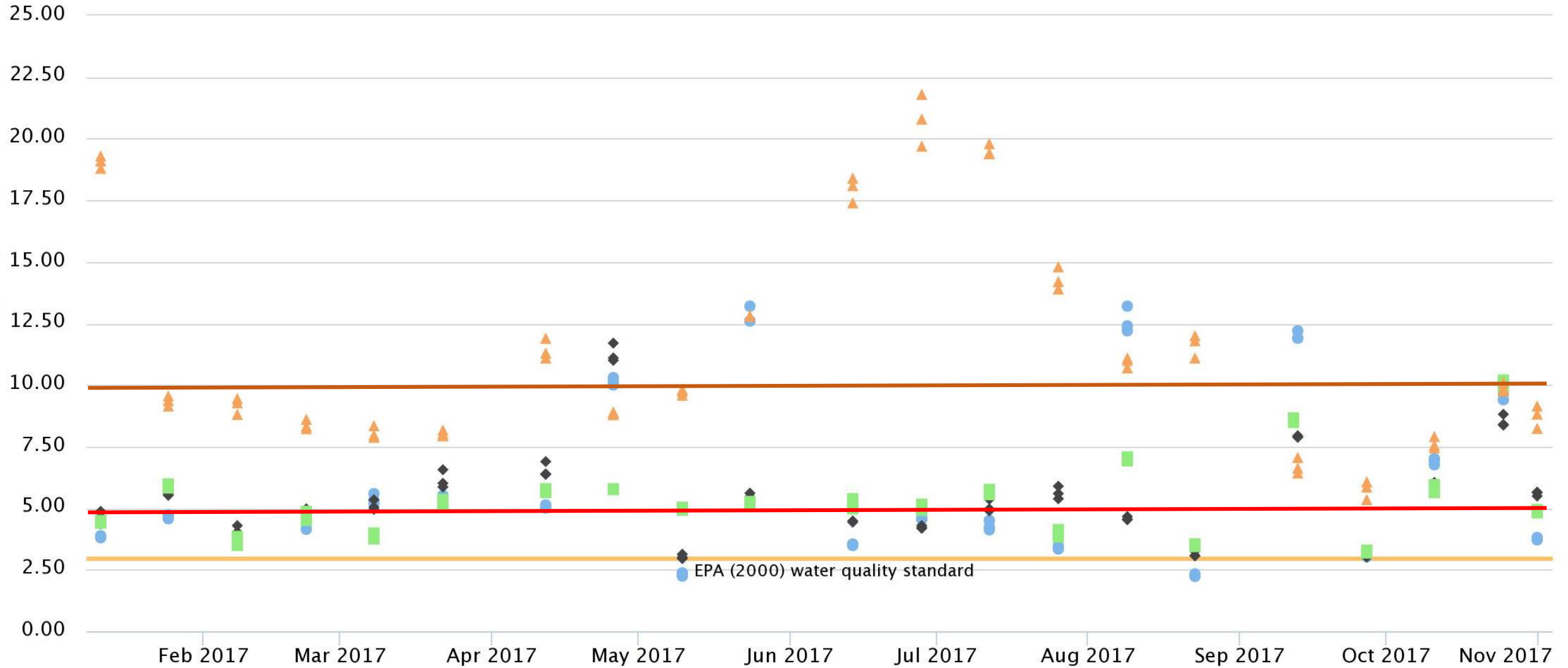
| | |
|-----------------|-----|
| ◆ Buck Creek | 236 |
| ● Highway 9: | 150 |
| ◆ Reaves Ferry: | 93 |
| ● Hagley: | 86 |
| ■ Conway: | 42 |



● Highway 9 ◆ Reaves Ferry ■ Conway Waterfront ▲ Wachesaw Landing

Turbidity (NTU)

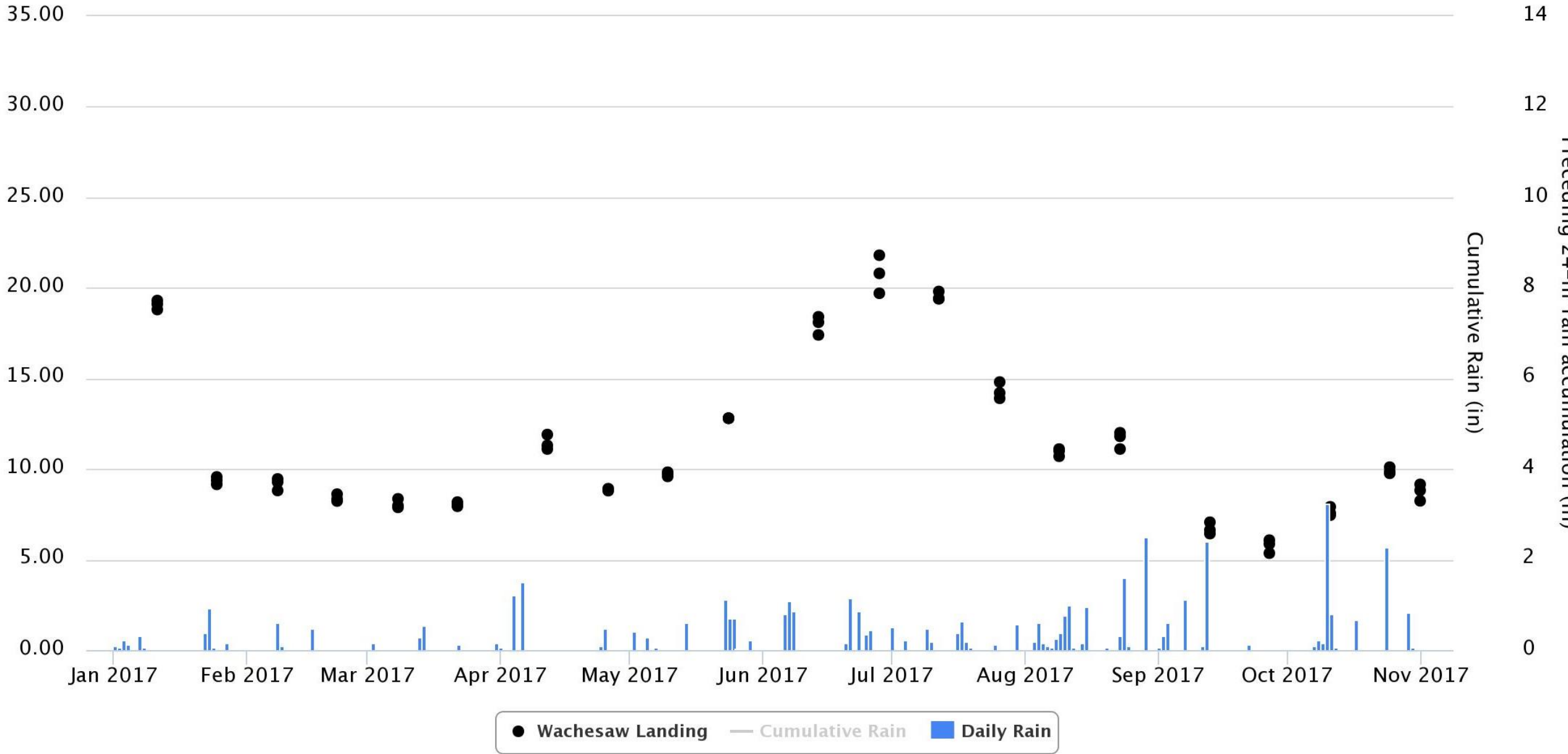
Data collected between Jan 01, 2017 and Nov 2, 2017



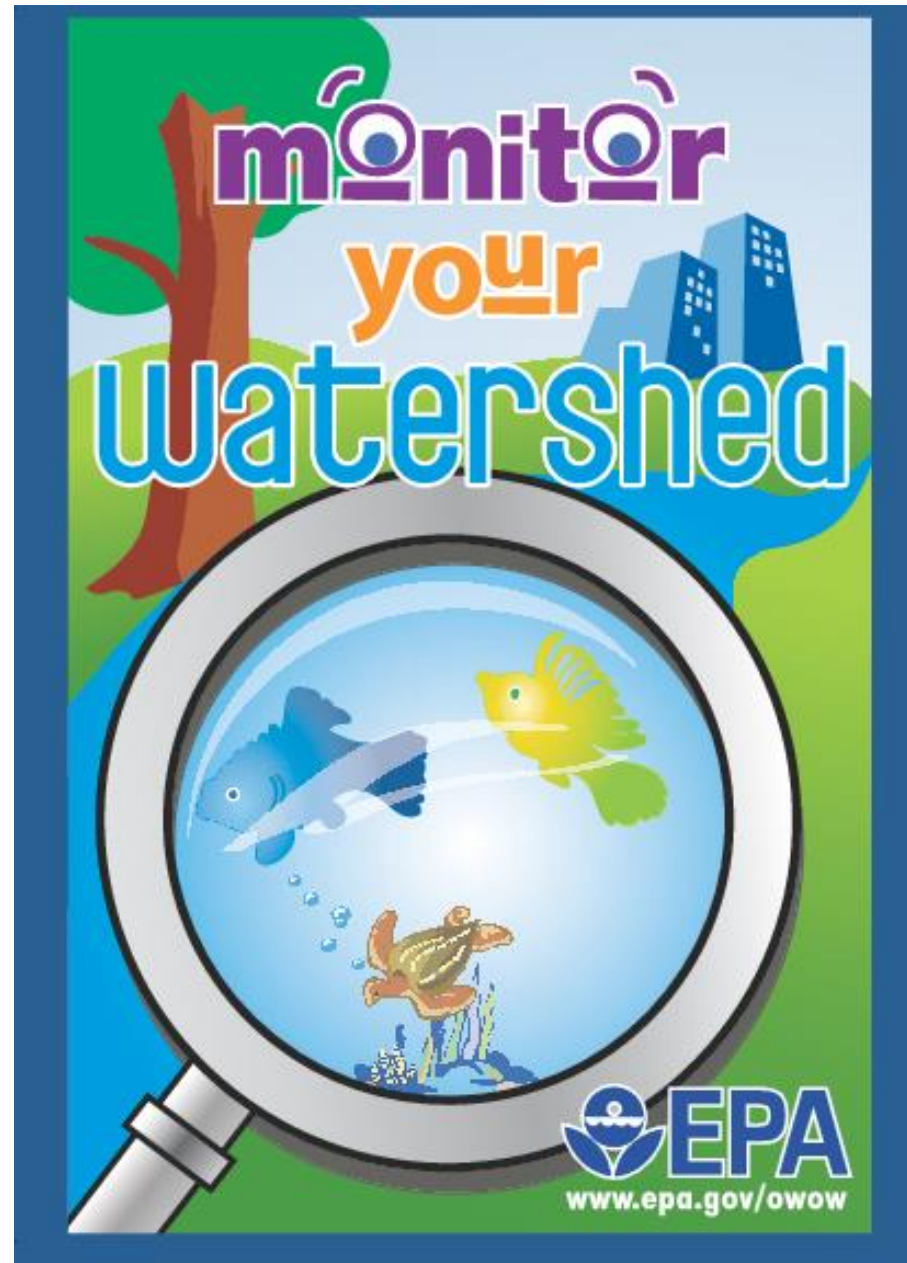
● Highway 9 ◆ Reaves Ferry ■ Conway Waterfront ▲ Wachesaw Landing

Turbidity (NTU) for Wachesaw Landing

Data collected between Jan 01, 2017 and Nov 2, 2017



Why we need to keep at it.



November 1, 2017

| Sampling Sites | Conductivity (μ S/cm) | TDS (ppm) | DO (mg/L) < 20 C | %DO < 20 C | *Turbidity (NTU) | Nitrate (ppm N) | Nitrite (ppm N) | *Ammonia (ppm N) | E. coli (CFU/100 mL) | Total coliform (CFU/100 mL) |
|--------------------|-------------------------------|--------------|------------------------|---------------|---------------------|--------------------|--------------------|---------------------|-------------------------|--------------------------------|
| LAWA Dam | <10th | <10th | Site Normal | Site Normal | >75th | Site Normal | Site Normal | Site Normal | Site Normal | Site Normal |
| Canal Cove | Site Normal | Site Normal | >75th | >75th | >75th | Site Normal | Site Normal | Site Normal | Site Normal | Site Normal |
| Maple Street | <10th | <10th | Site Normal | >75th | >75th | Site Normal | Site Normal | Site Normal | Site Normal | <25th |
| Big Creek | Site Normal | Site Normal | <25th | <25th | Site Normal | Site Normal | Site Normal | > 90th | >75th | Site Normal |
| Babson's Landing | Site Normal | Site Normal | Site Normal | Site Normal | Site Normal | Site Normal | Site Normal | Site Normal | > 90th | > 90th |
| Pireway Landing | Site Normal | Site Normal | Site Normal | Site Normal | >75th | Site Normal | Site Normal | Site Normal | >75th | >75th |
| Highway #9 | <25th | <25th | Site Normal | Site Normal | Site Normal | Site Normal | Site Normal | Site Normal | >75th | Site Normal |
| Reaves Ferry | Site Normal | Site Normal | Site Normal | Site Normal | >75th | Site Normal | Site Normal | Site Normal | Site Normal | <25th |
| Murrells Landing | <25th | Site Normal | Site Normal | Site Normal | >75th | Site Normal | Site Normal | Site Normal | Site Normal | Site Normal |
| Sterritt Swamp | Site Normal | Site Normal | Site Normal | >75th | Site Normal | Site Normal | Site Normal | Site Normal | Site Normal | Site Normal |
| Conway Waterfront | <25th | <25th | Site Normal | Site Normal | Site Normal | Site Normal | Site Normal | Site Normal | >75th | >75th |
| Pitch Landing | <25th | <25th | Site Normal | Site Normal | Site Normal | Site Normal | Site Normal | Site Normal | Site Normal | Site Normal |
| Bucksport Landing | <25th | <25th | Site Normal | Site Normal | <25th | Site Normal | Site Normal | Site Normal | >75th | Site Normal |
| Peachtree Landing | <25th | <25th | Site Normal | Site Normal | Site Normal | Site Normal | Site Normal | Site Normal | Site Normal | Site Normal |
| Enterprise Landing | <25th | Site Normal | Site Normal | Site Normal | Site Normal | Site Normal | Site Normal | Site Normal | Site Normal | Site Normal |
| Wachesaw Landing | Site Normal | Site Normal | Site Normal | Site Normal | Site Normal | Site Normal | Site Normal | >75th | Site Normal | <25th |
| Hagley Landing | Site Normal | Site Normal | Site Normal | Site Normal | Site Normal | Site Normal | Site Normal | Site Normal | Site Normal | <25th |
| Sampit River | Site Normal | Site Normal | <25th | Site Normal | <25th | Site Normal | Site Normal | Site Normal | >75th | Site Normal |

11/1/17

Notes: About 1" of rain had fallen three days prior to sampling. River discharge was at the high end of normal.

- Due to continuing rainfall, turbidity and E. coli were still somewhat elevated from the last sampling on 10/25/17 at a few sites as described below. Conductivity was still somewhat low at these sites.
- Turbidity was somewhat elevated at LAWA Dam, Canal Cove and Maple Street in Lake Waccamaw and at Pireway, Reaves Ferry and Murrells Landing on the Waccamaw River. Concentrations were above EPA recommended levels except at Pireway.
- E. coli did not exceed the water quality criteria, but was unusually high at Babson's Landing in the Waccamaw River and somewhat elevated downstream at Pireway, Highway 9, Conway Waterfront, Bucksport Lndg and Sampit River. In Lake Waccamaw, levels were somewhat elevated at Big Creek.
- Dissolved oxygen (DO) was still below the water quality criteria at Big Creek (NC) and somewhat low.
- At Hagley, pH continues to be unusually high. Surface water DO concentration was 1.0 ppm higher than the deep water (USGS), suggesting an algal bloom was present.
- Ammonia was detected at Big Creek (NC) and Enterprise Landing (SC)