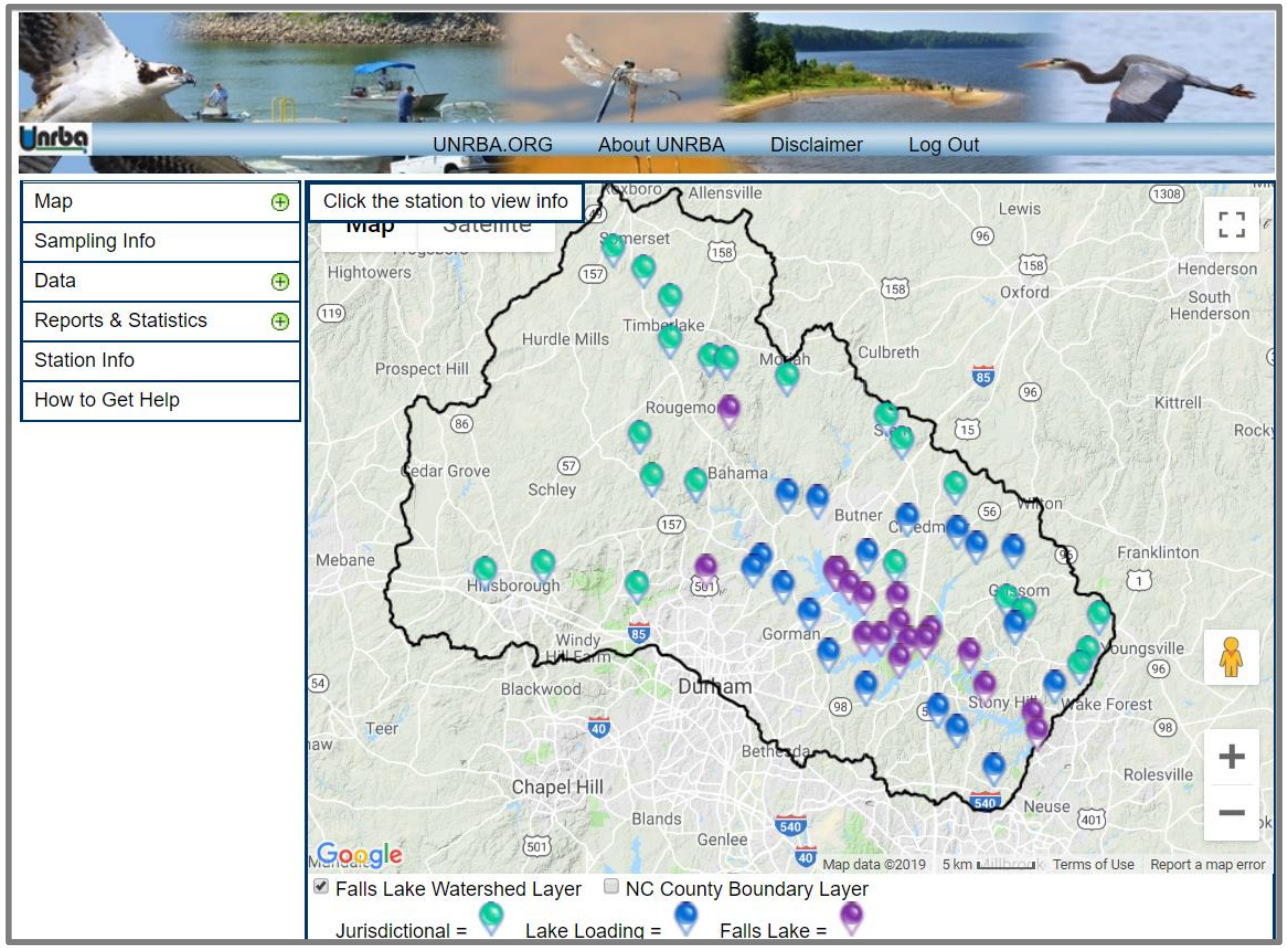
NSAB Meeting
November 1, 2019



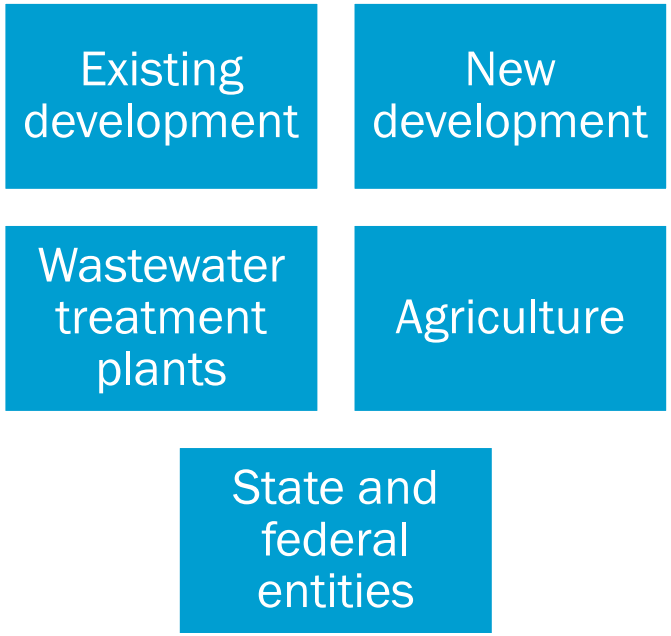
Overview of the Falls Lake Nutrient Management Strategy and the UNRBA Re-examination

Falls Lake Challenges and the UNRBA

- Falls Lake is a valuable, regional resource
  - Provides drinking water for 550,000 customers
  - Regional recreational facility
  - Provides habitat to aquatic and terrestrial wildlife
  - Protects water quality downstream
- Exceedances of the 40 µg/L chlorophyll-a standard resulted in the lake being listed as impaired
- The State developed a nutrient management strategy with two stages of implementation

Falls Lake Nutrient Management Strategy

- Assigns load reduction targets for individual sectors
- Includes the highest nutrient reductions ever passed in NC
- Stage 1 nutrient load reductions
  - 20% N, 40% P; or return to baseline for existing development
- Stage II nutrient load reductions
  - 40% N, 77% P
- Required reductions are technically infeasible
- Uncertain that chlorophyll-a standard could be achieved



The Falls Lake Nutrient Management Strategy developed by the State includes two stages of implementation and is estimated to cost over $1.5 billion.

UNRBA Consensus Principles

- Consensus Principles were established by UNRBA members
  - Resulted in language in the Rules that allowed for re-examination if certain steps were taken
  - Provided the framework for the UNRBA re-examination process
  - Parties agreed to the protection of Falls Lake as a drinking water supply

Re-examination of Stage II

Re-examination of Stage II

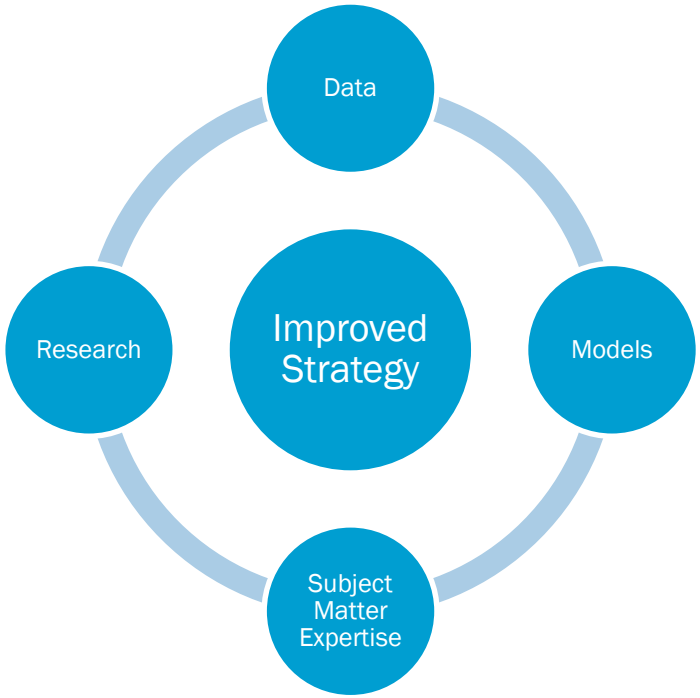
- The UNRBA began planning for the re-examination of Stage II in 2011
- DWR approved the following UNRBA documents as required by the Falls Lake Rules
  - UNRBA Monitoring Plan
  - UNRBA Monitoring Quality Assurance Project Plan
  - UNRBA Description of the Modeling Framework
  - UNRBA Modeling Quality Assurance Project Plan (the detailed Modeling Framework)

The UNRBA is following the re-examination process described by the Falls Lake Nutrient Management Strategy.

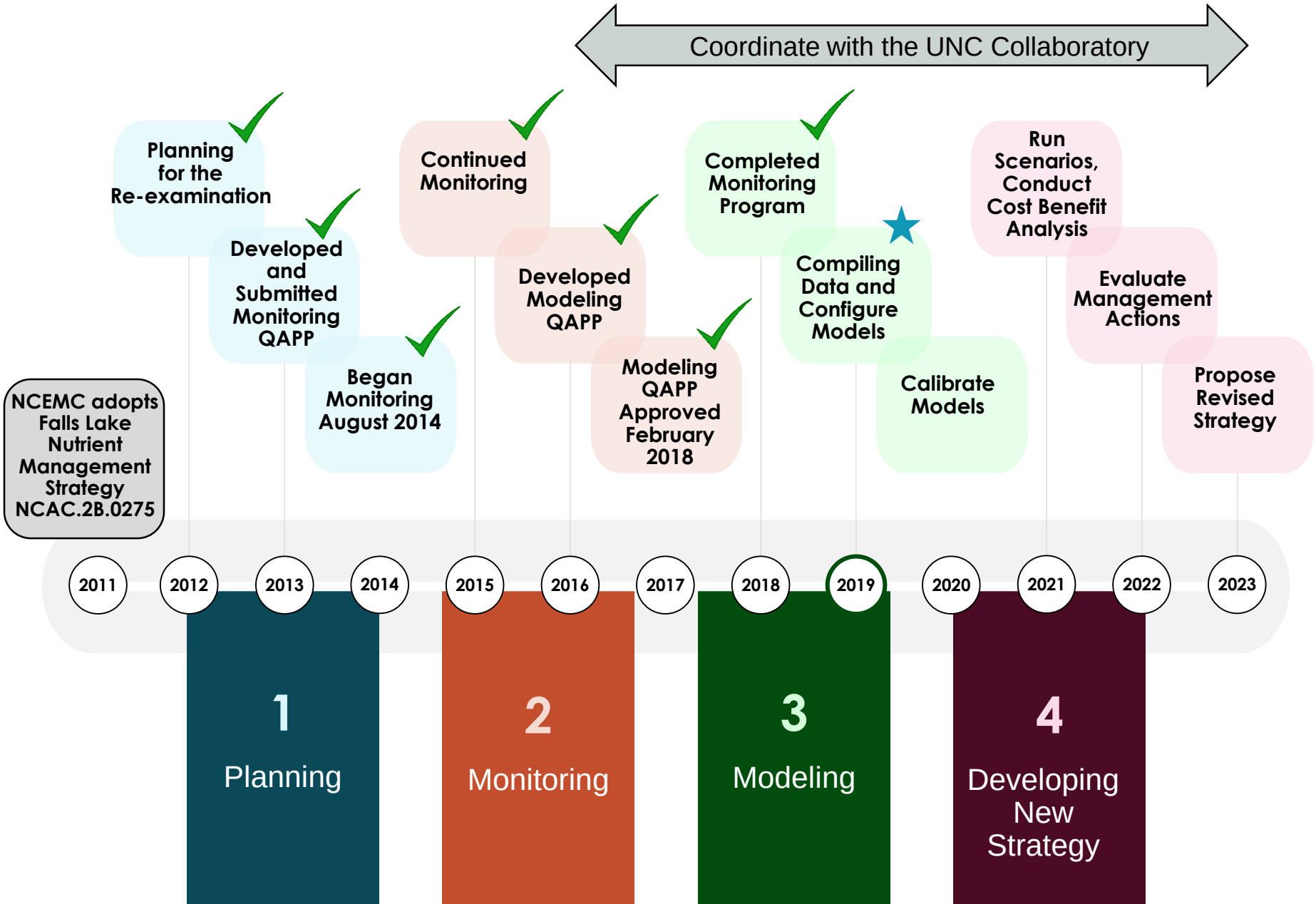
Monitoring is complete and modeling is underway.

Coordination Between the UNRBA and the UNC Collaboratory

- Data and information sharing
- Coordination on potential Collaboratory studies
  - 3rd party review
  - Model inputs and parameters, e.g., onsite wastewater treatment systems
  - Site specific criteria for chlorophyll-a
- Routine working meetings
  - Research status
  - Modeling updates
  - Future studies
- Collaboratory research status updates at UNRBA meetings



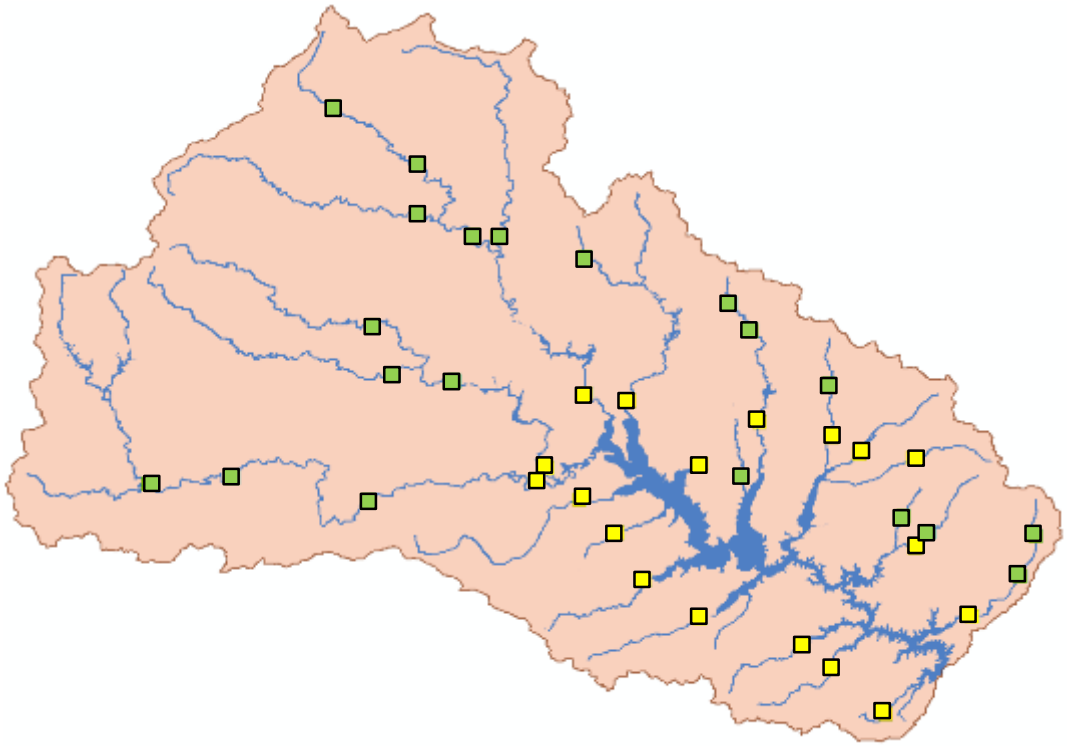
Multi-year UNRBA Stage II Re-examination Timeline



UNRBA Monitoring and Data Analysis to Support Re-examination of Stage II

UNRBA Routine Monitoring Program

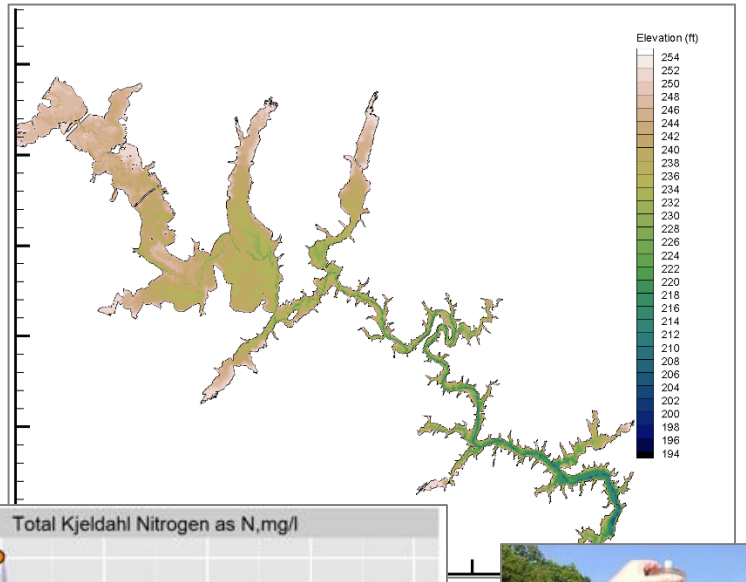
- Routine data collection began in August 2014
- 38 watershed stations
  - Field parameters
  - Nutrients
  - Carbon
  - Chlorophyll *a*
- 12 inlake stations to collect supplemental lake data

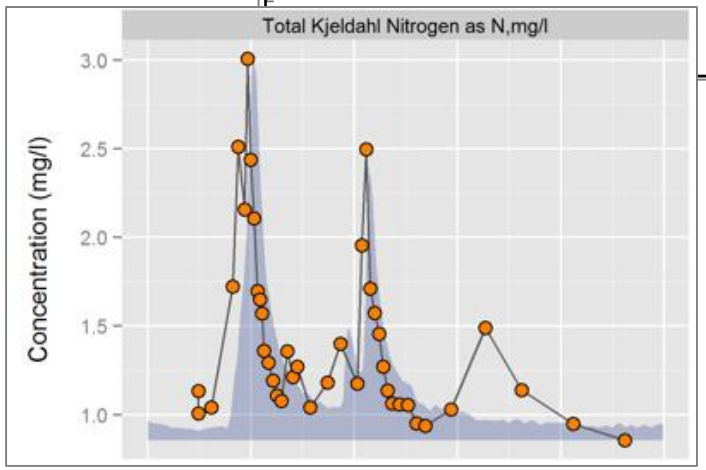


Over 30,000 additional data points from the Routine Monitoring Program

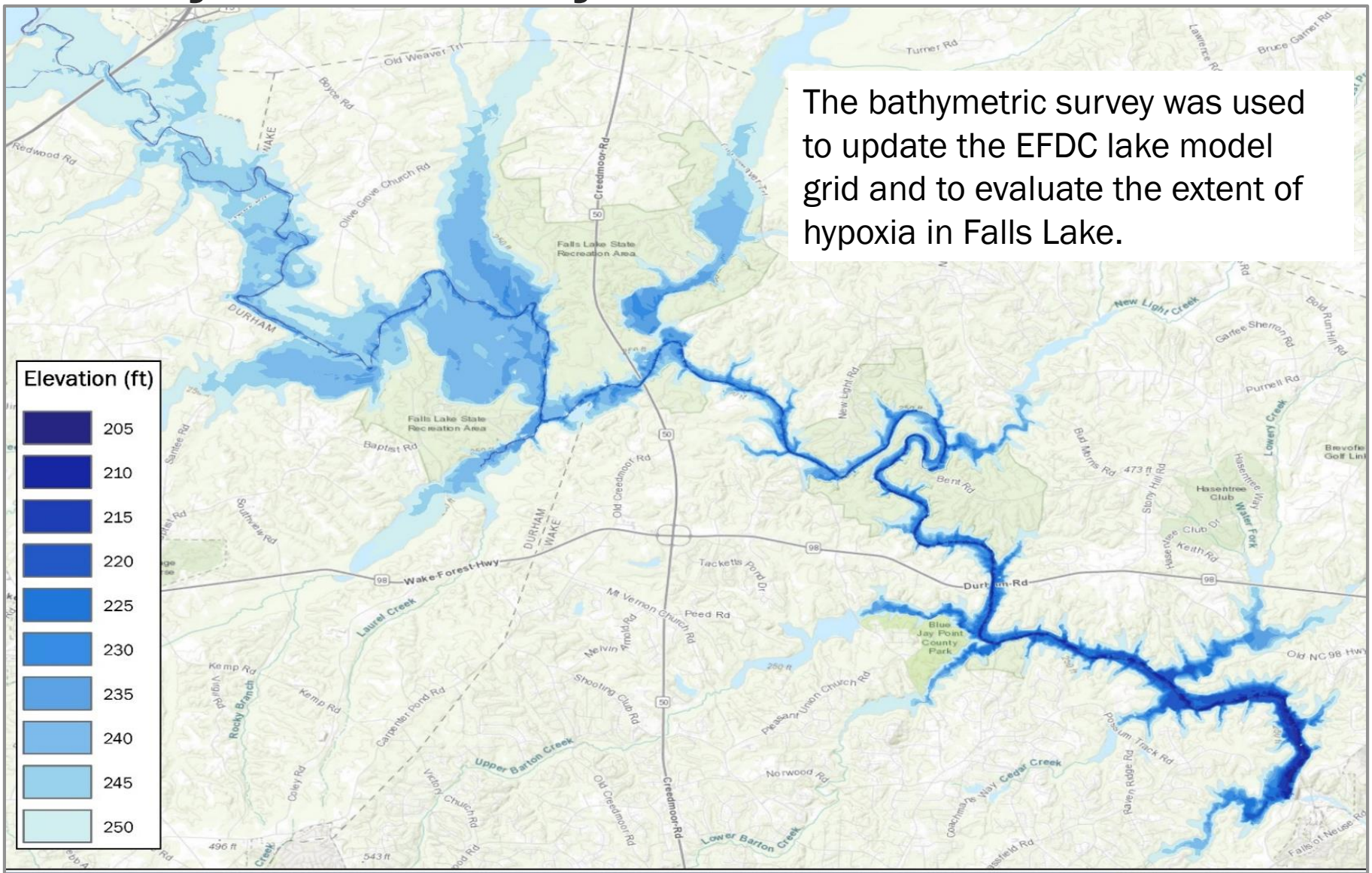
UNRBA Special Studies

- Watershed
  - High flow grab sampling
  - Storm event sampling
- Lake
  - Light extinction data
  - Sediment quality
  - Bathymetry and sediment mapping
  - Constriction point study
    - Velocity
    - Water Quality

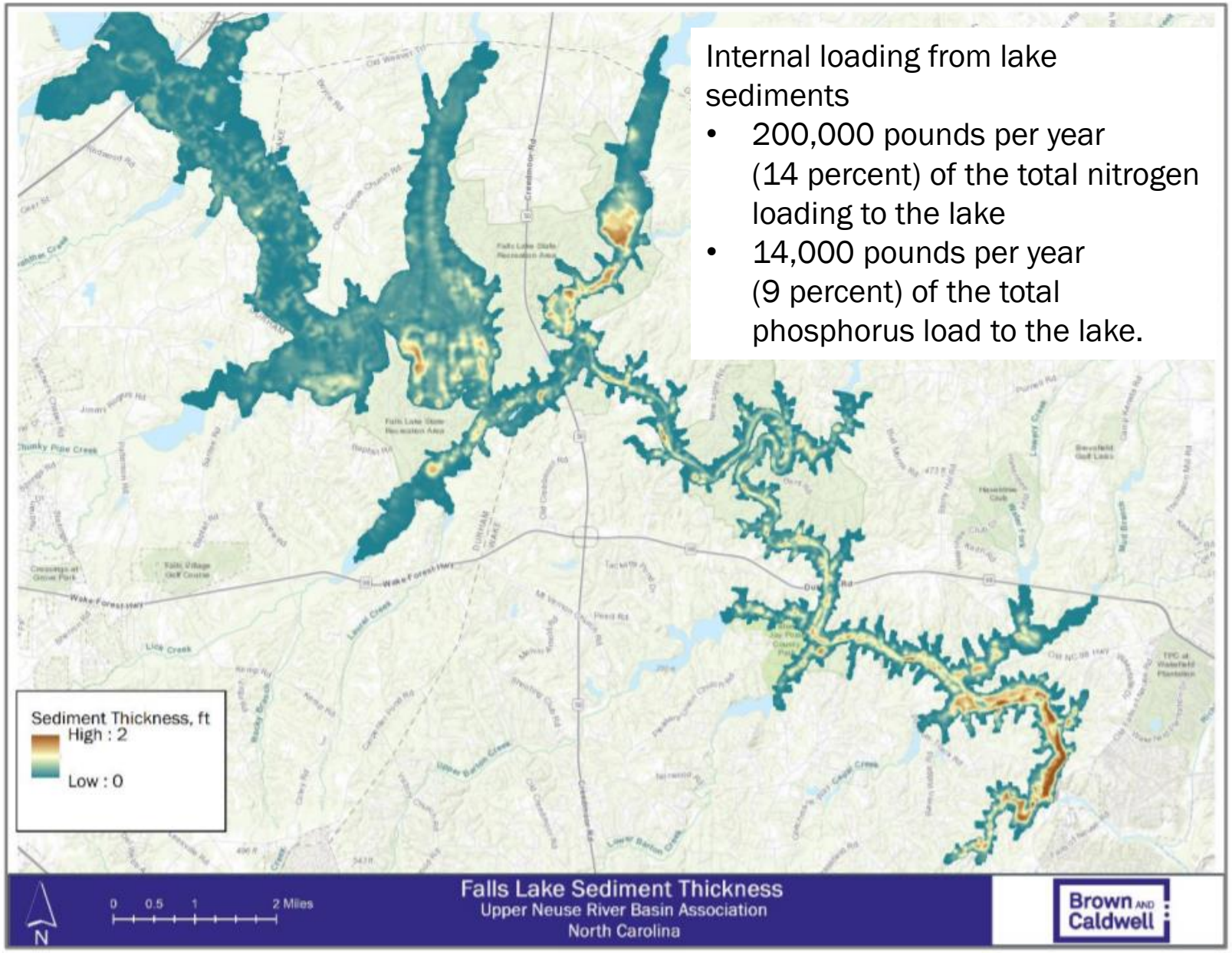




Bathymetric Survey



Sediment Mapping and Sediment Quality



Monitoring Program Data Portal and Comprehensive Monitoring Report

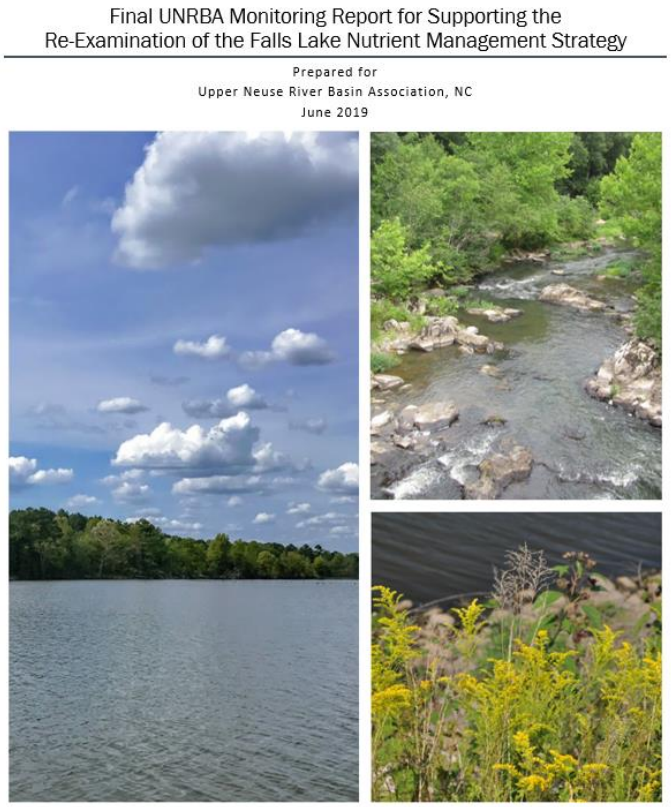
http://monitor.unrba.org/

- Create an account
- See User's Guide (monitoring page)
- Query and download data

Generate statistics and figures

https://www.unrba.org/monitoring-program

- Final UNRBA Monitoring Report for Supporting Re-Examination of the Falls Lake Nutrient Strategy

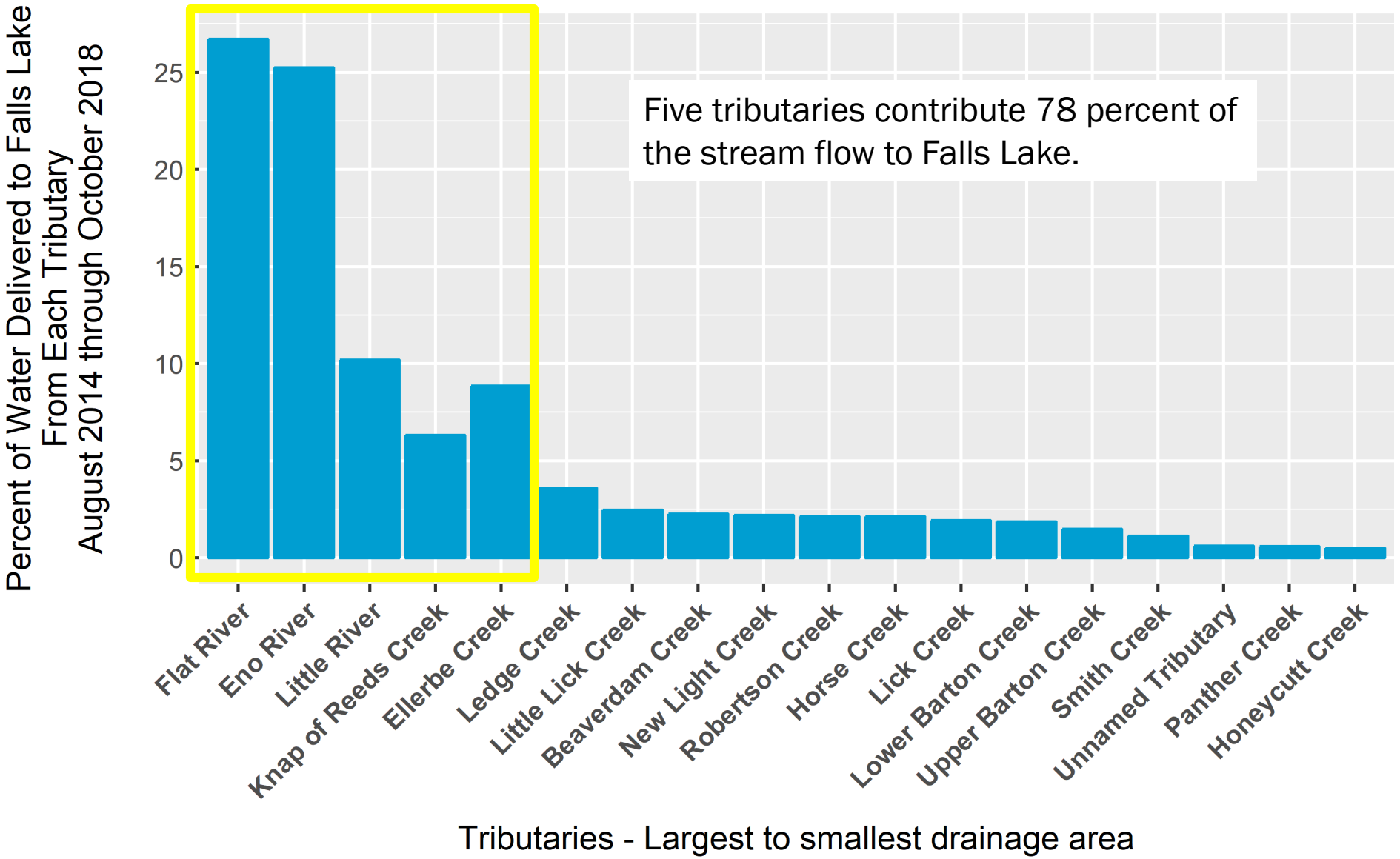


Comparison of Hydrologic Conditions

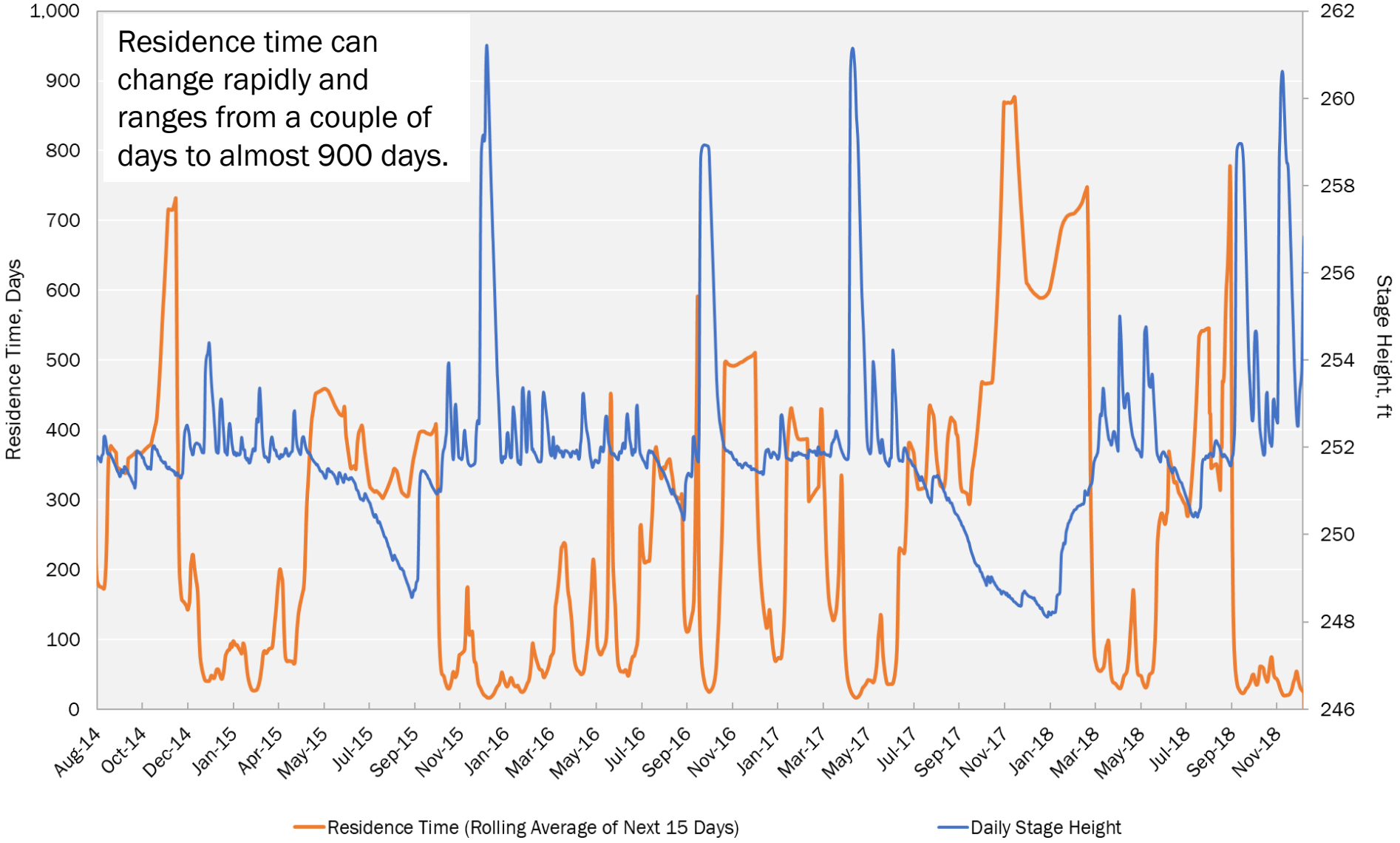
- The 2019 Annual Report compares hydrologic conditions for two monitoring periods
  - Baseline for Falls (DWR): 2005 to 2007
  - Recent (UNRBA and DWR): 2014 to 2018
- The 30-year average rainfall amount is **43 in/yr**
- For the **baseline** monitoring period
  - Annual rainfall totals were **13 to 57 percent lower** than the 30-year average
  - Included a record drought
  - 10 major storms affected the area
- For the **recent** monitoring period
  - Annual rainfall totals were **4 to 11 percent higher** than the 30-year average
  - 36 major storms affected the area

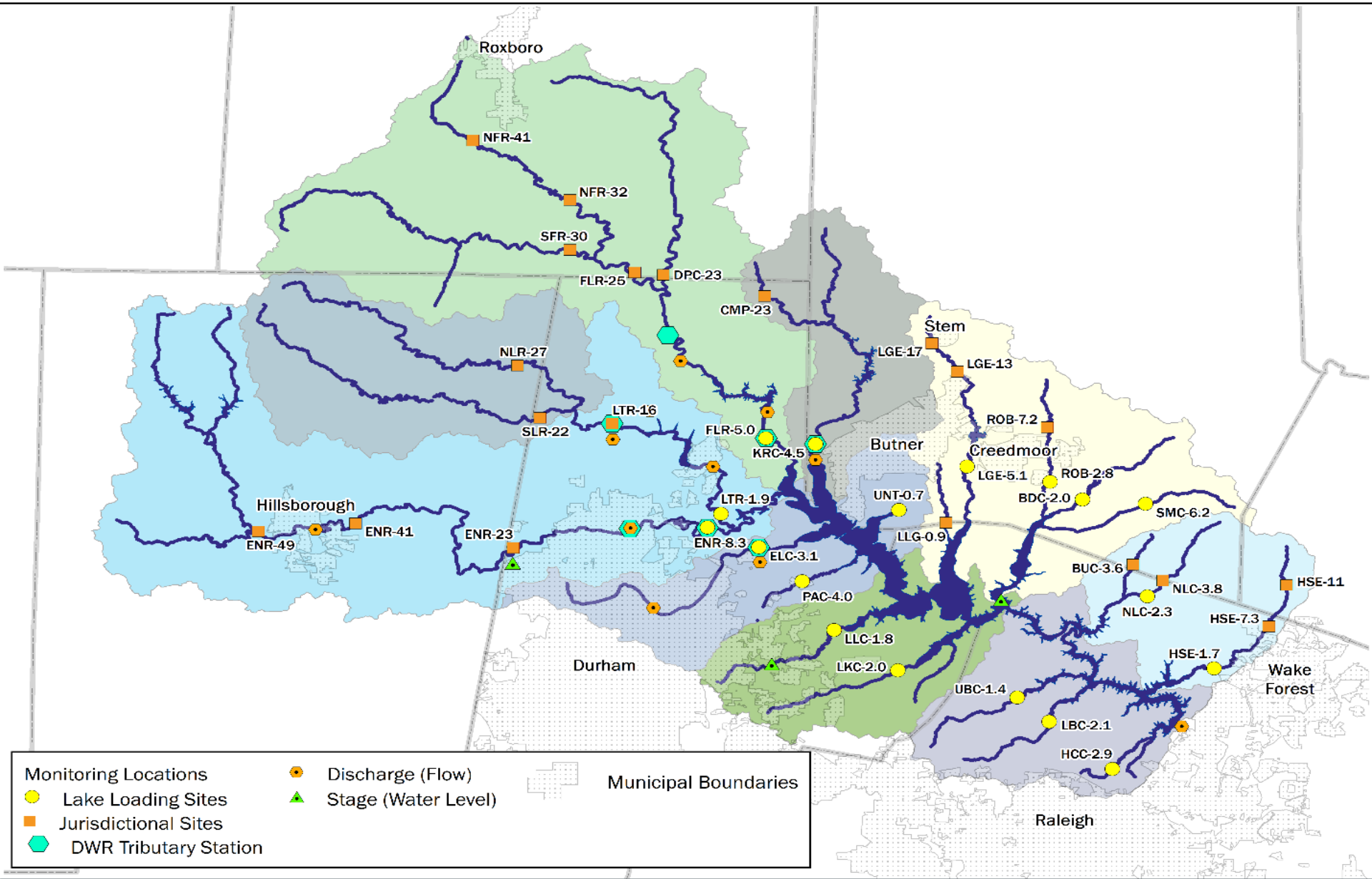
Falls Lake at I-85 in November 2007
Source: Southeast Regional Climate Center

Hydraulic Loading from Tributaries



Reservoir Residence Time



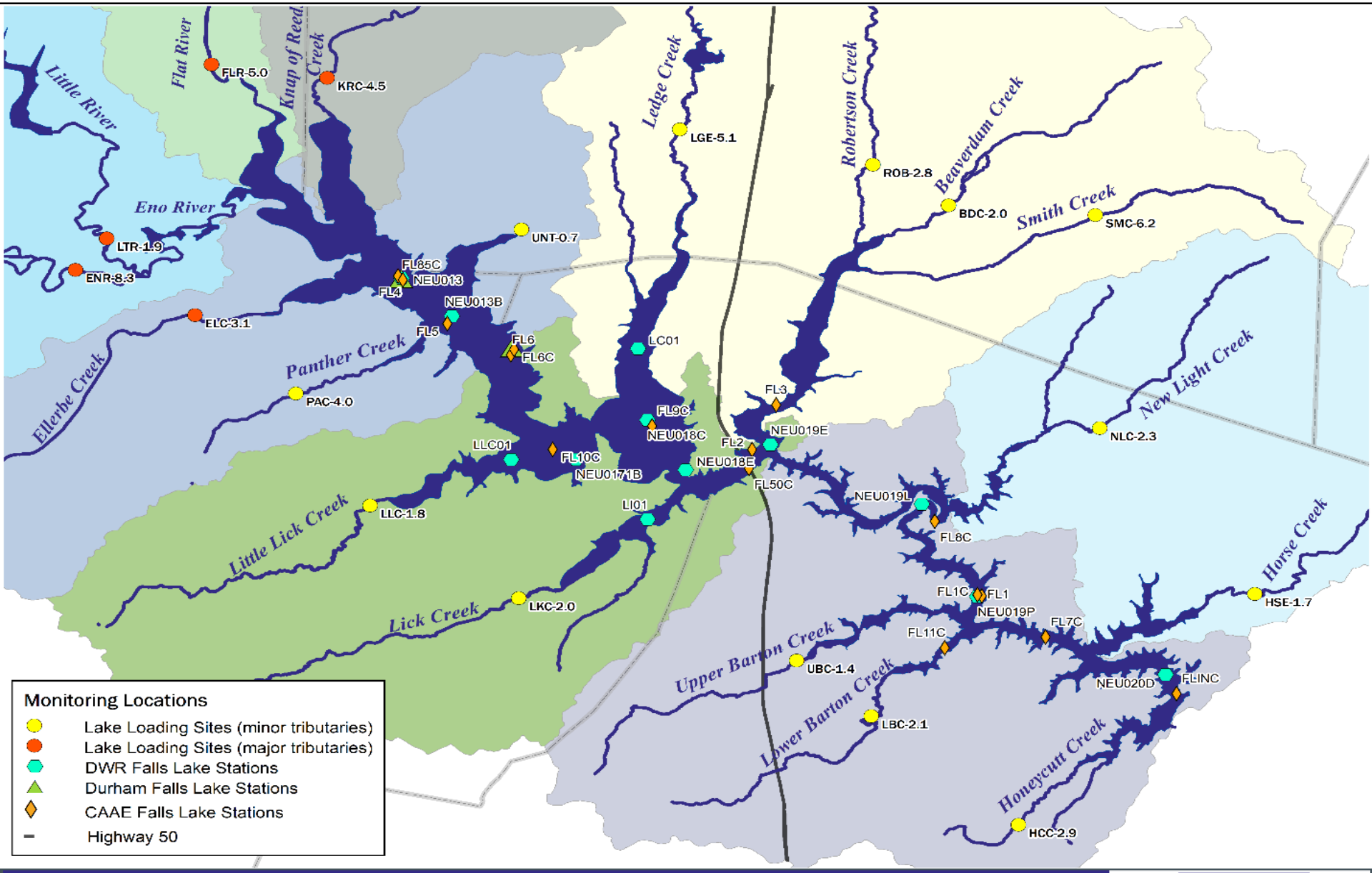


Tributary Monitoring Locations

Upper Neuse River Basin Association

North Carolina

Brown AND Caldwell

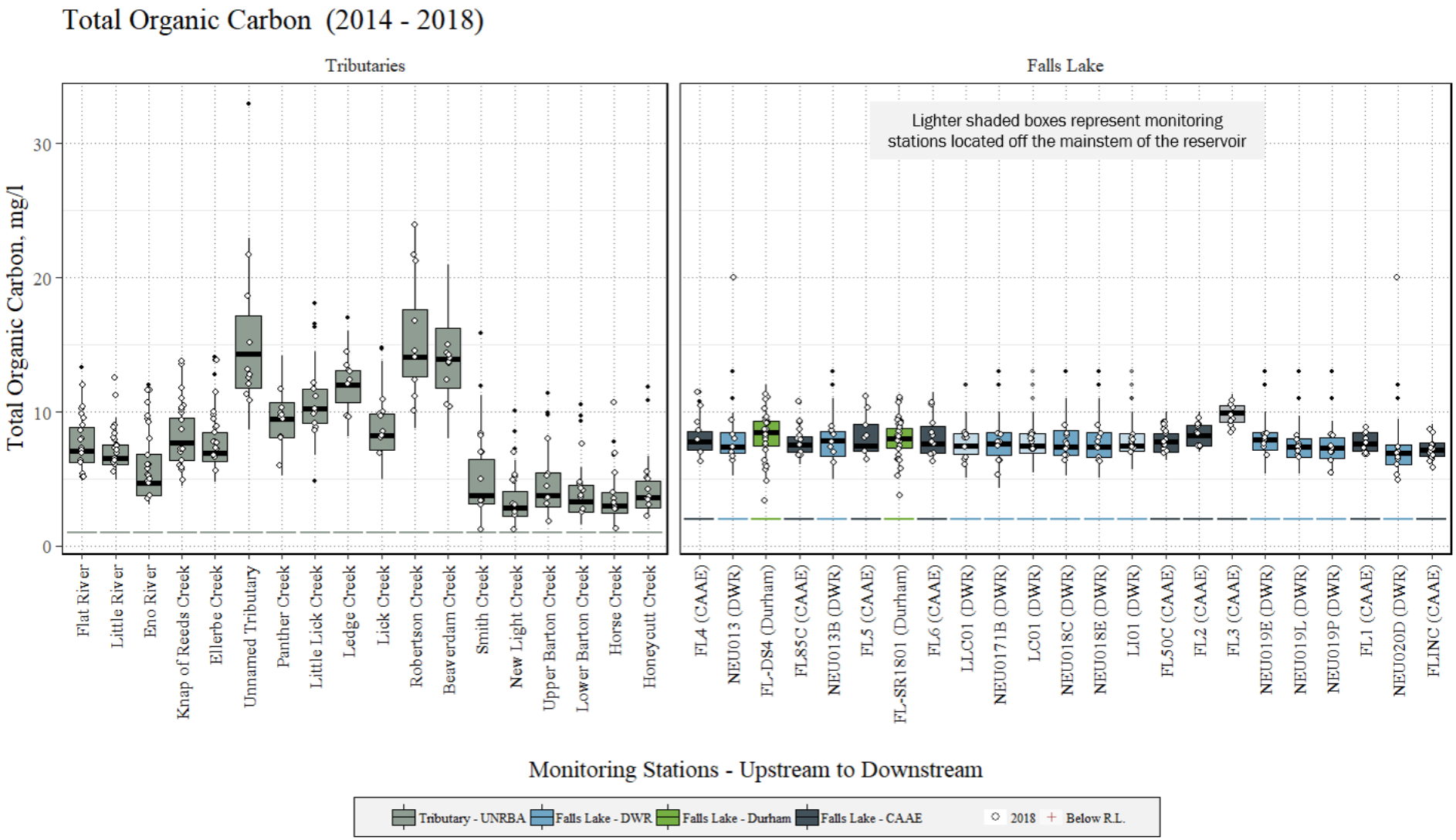


Monitoring Locations

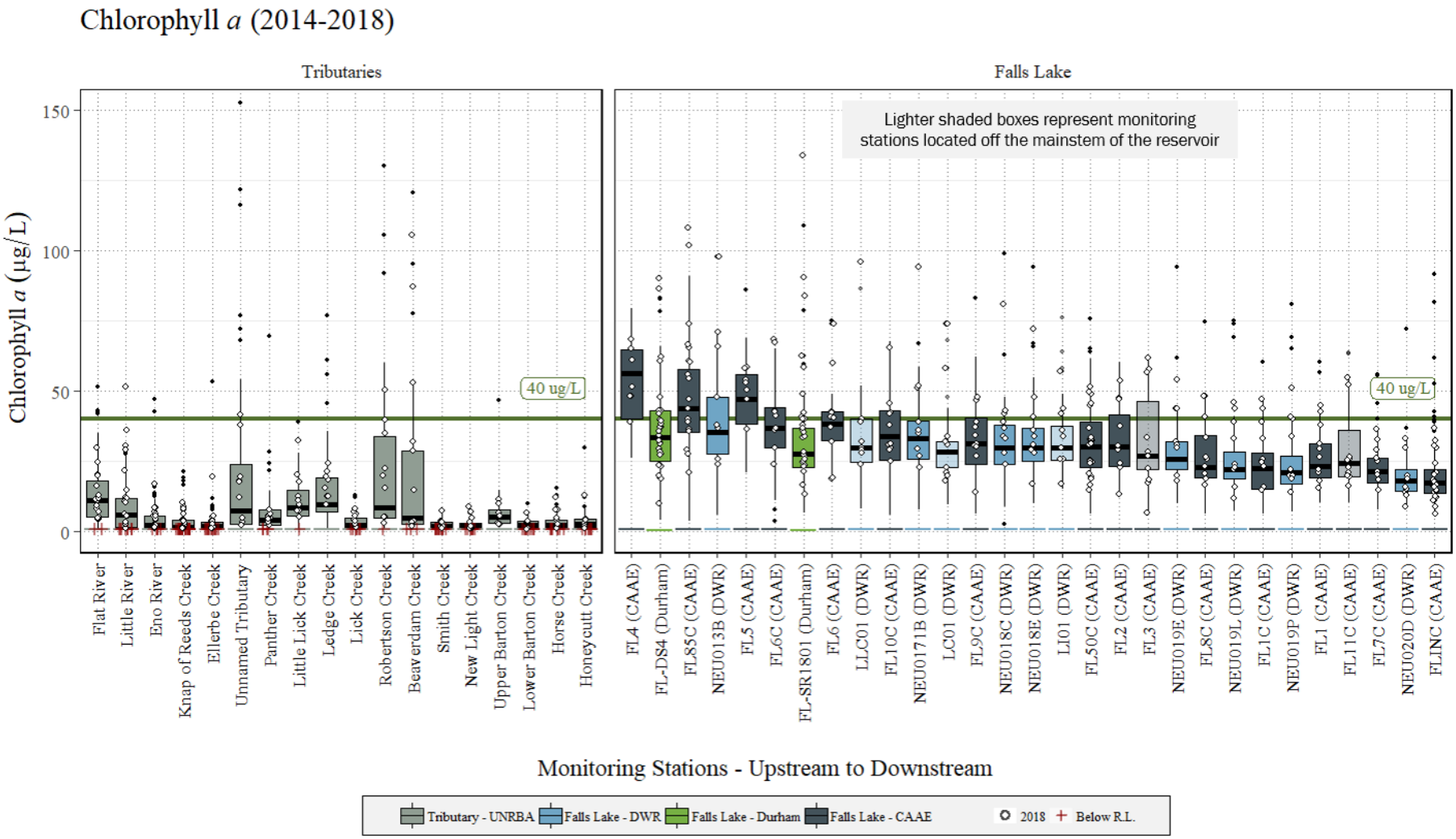
Upper Neuse River Basin Association

North Carolina

Brown AND Caldwell

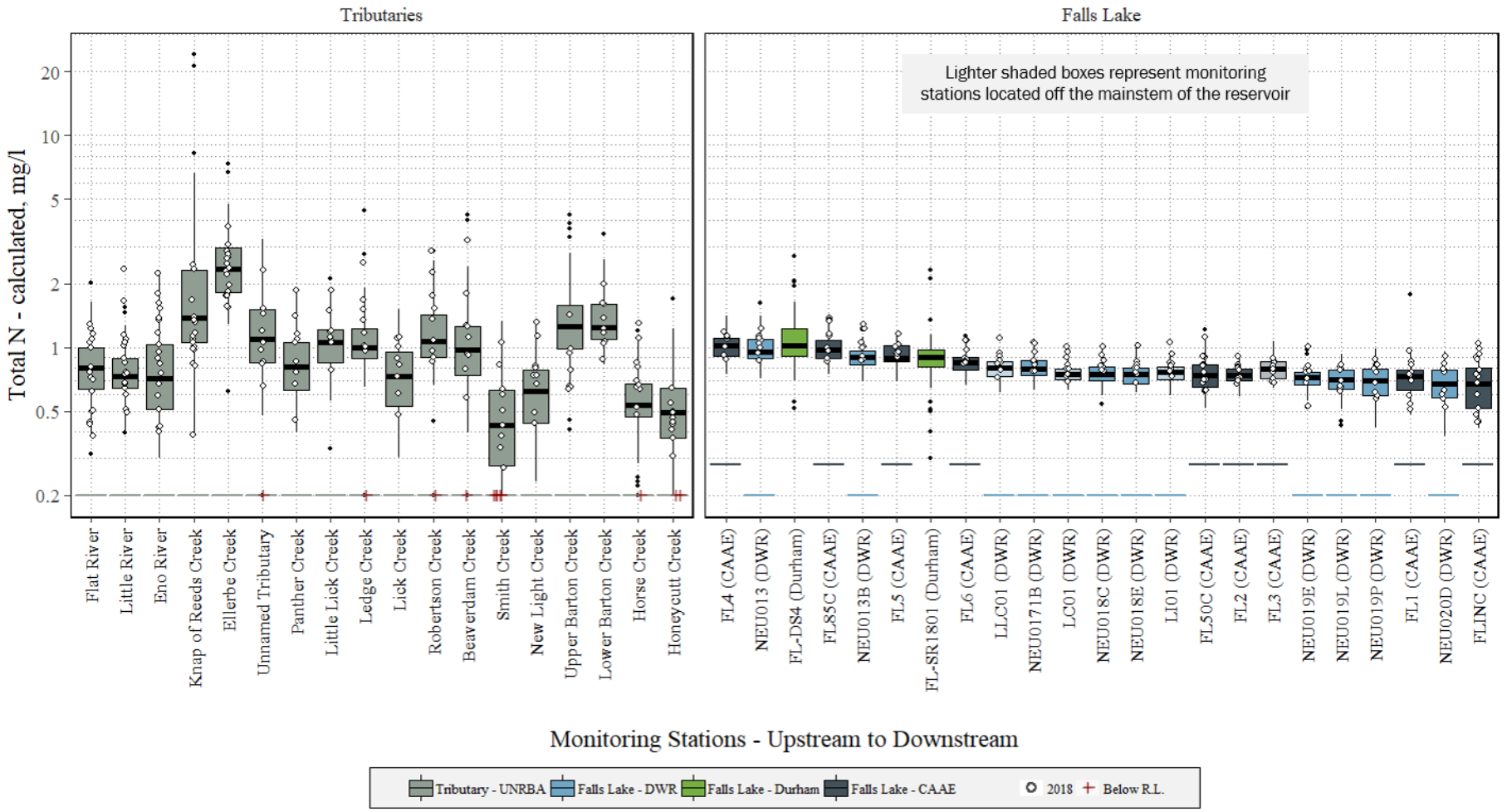


FL3 is on Beaverdam Impoundment; Robertson Creek and Beaverdam Creek drain into this impoundment.

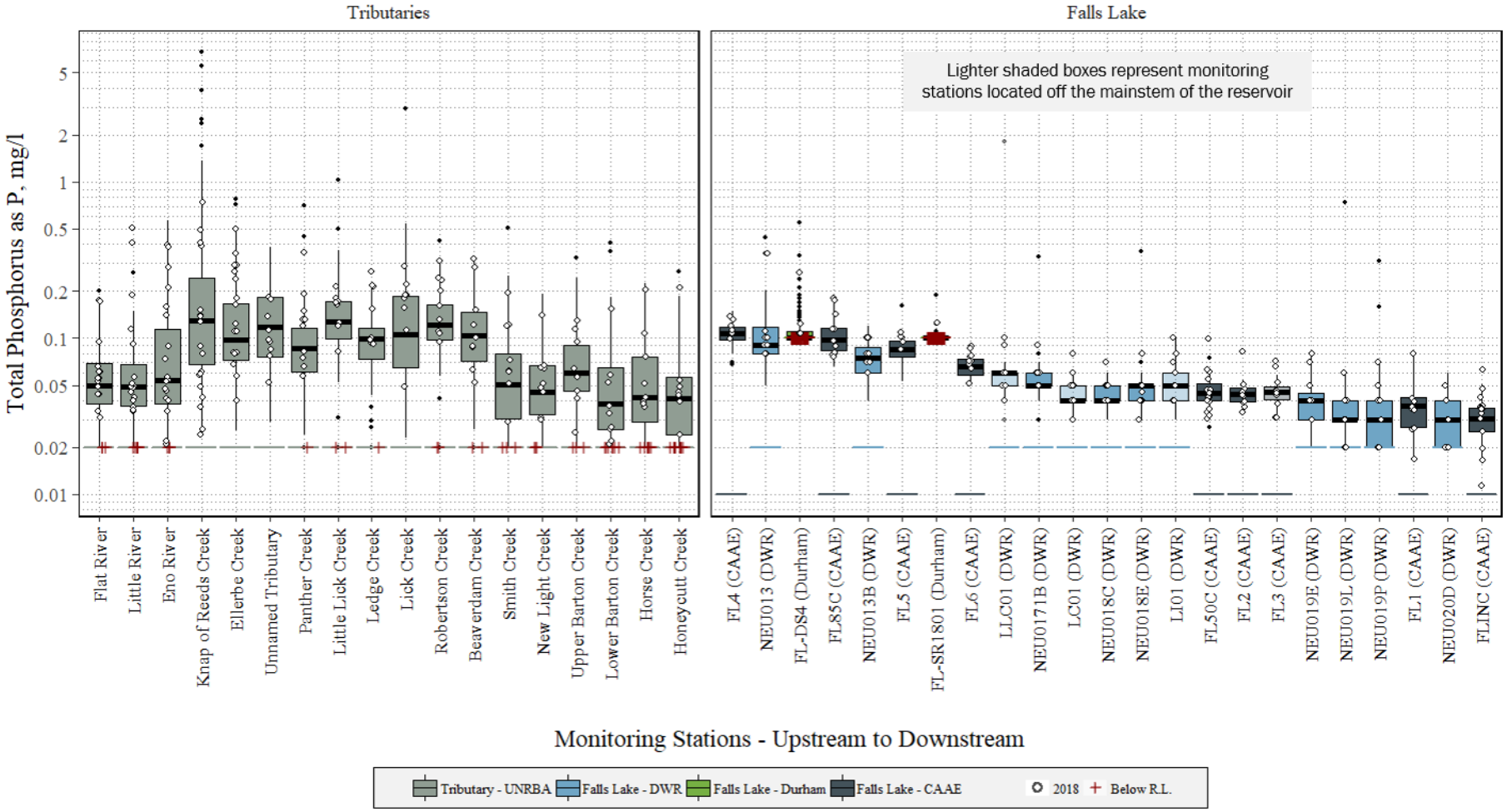


CAAE began collecting photic zone composites at some stations in April 2016, so the period of record is different for different stations. Stations with C in the name have the photic zone composites for the entire UNRBA monitoring period.

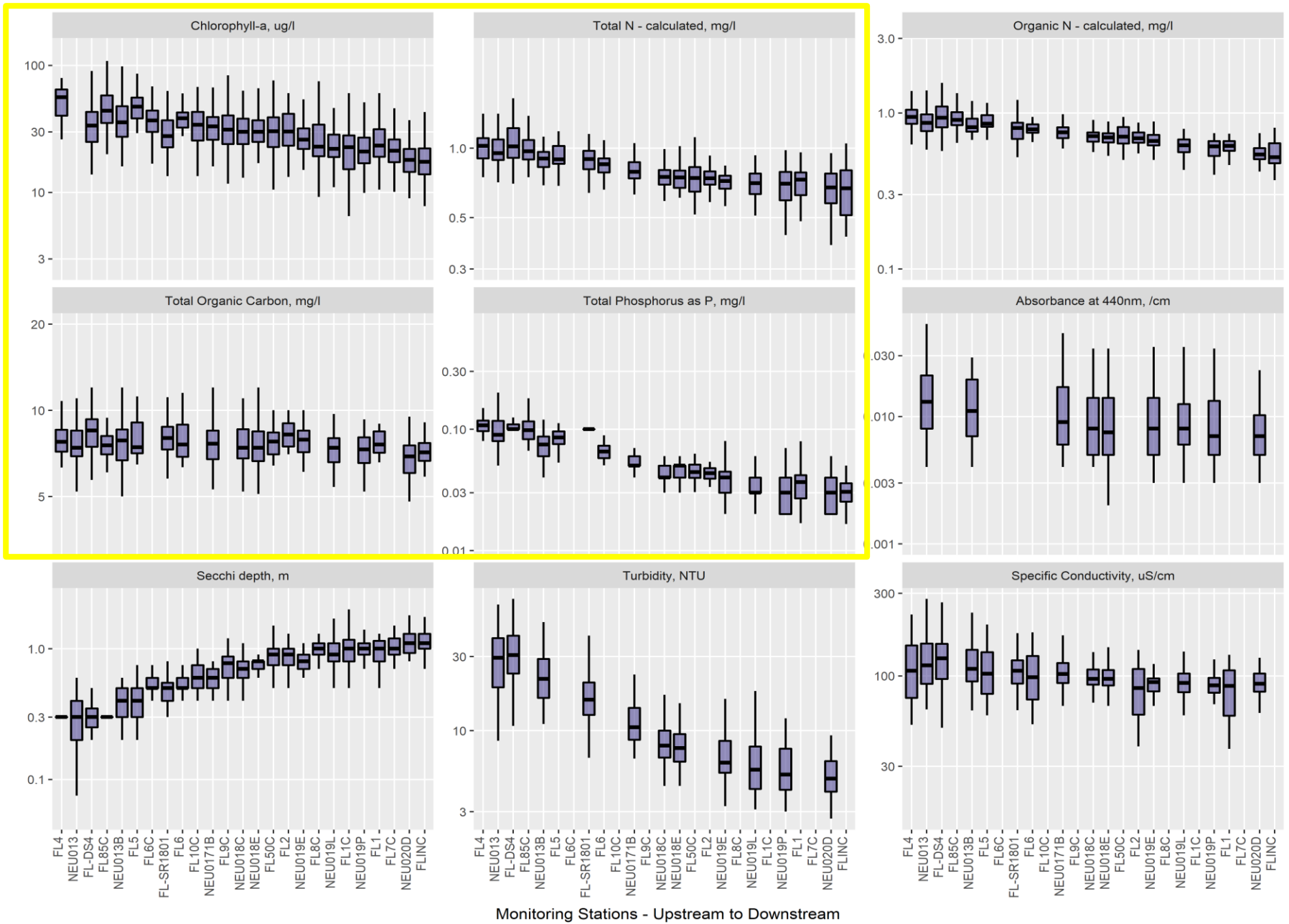
Total Nitrogen (2014 - 2018)

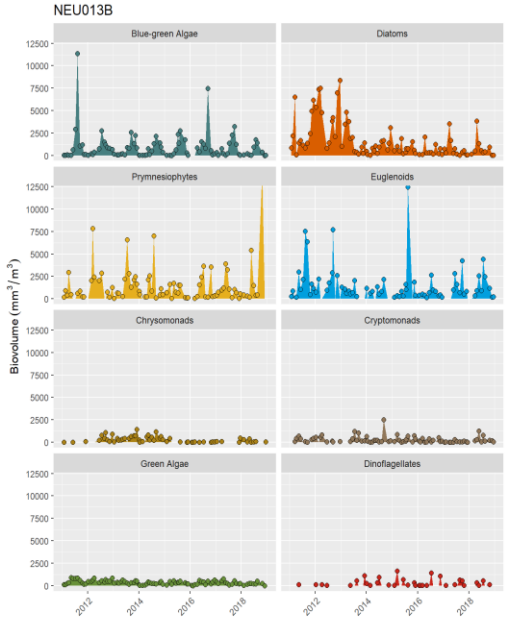


Total Phosphorus (2014 - 2018)

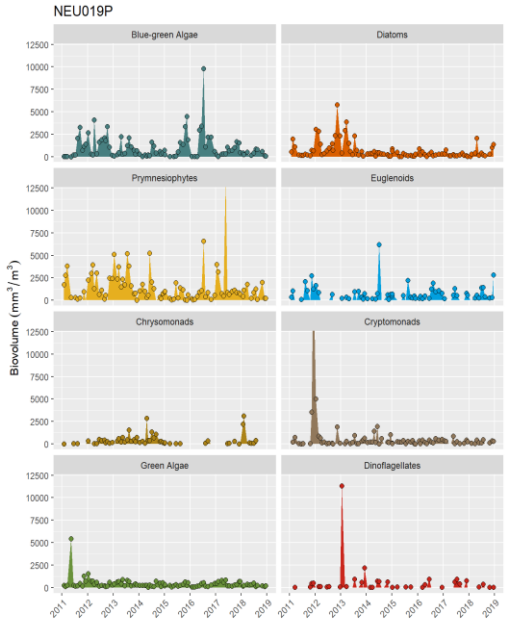


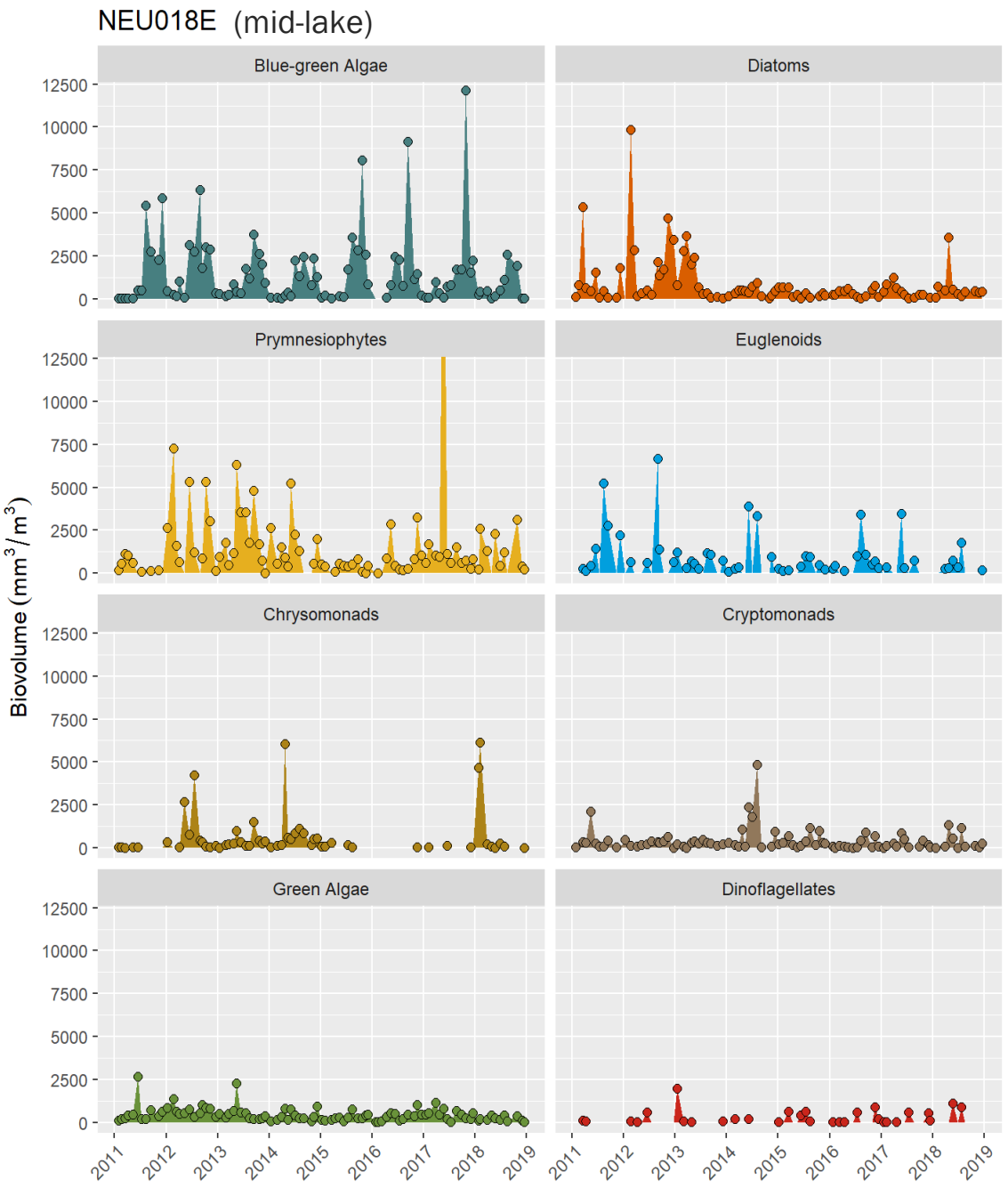
Upstream to Downstream Lake Water Quality Patterns



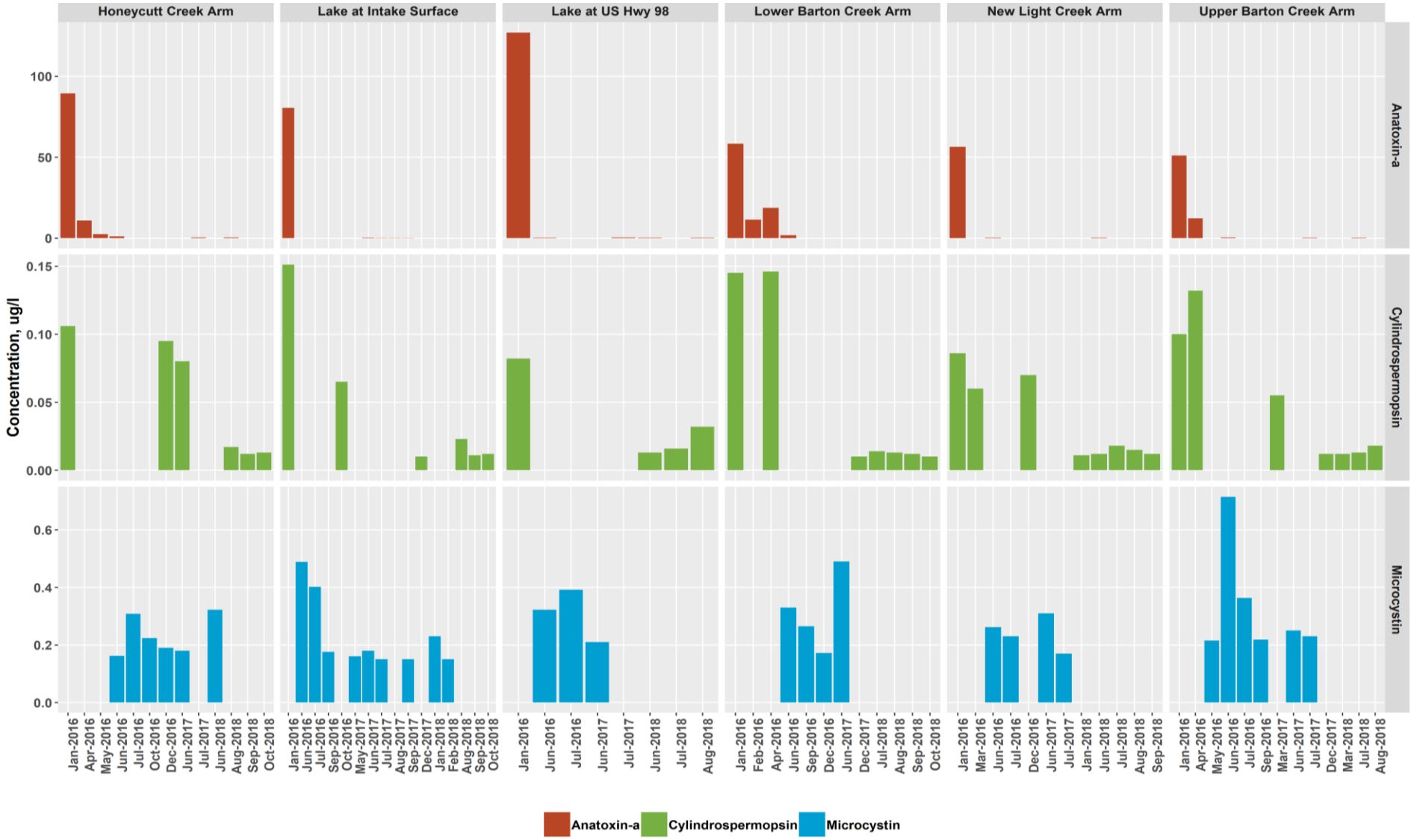


Algal Groups



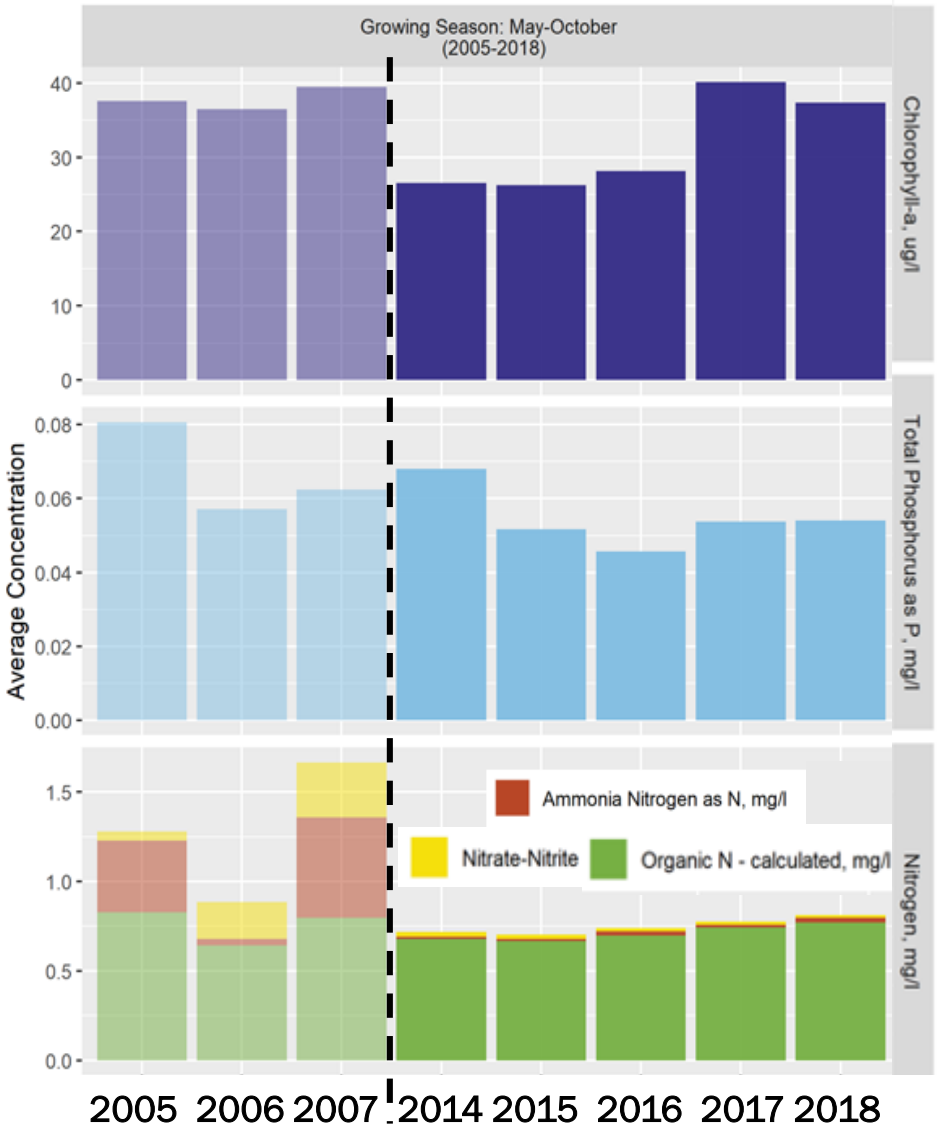


Algal Toxin Data from City of Raleigh



No NC criteria for these toxins. For microcystin, the WHO drinking water guideline is 1 ug/L and the EPA draft recreational guideline is 4 ug/L. No samples exceeded these guidelines.

Comparison of Water Quality in Falls Lake to the Baseline Period (2005-2007)

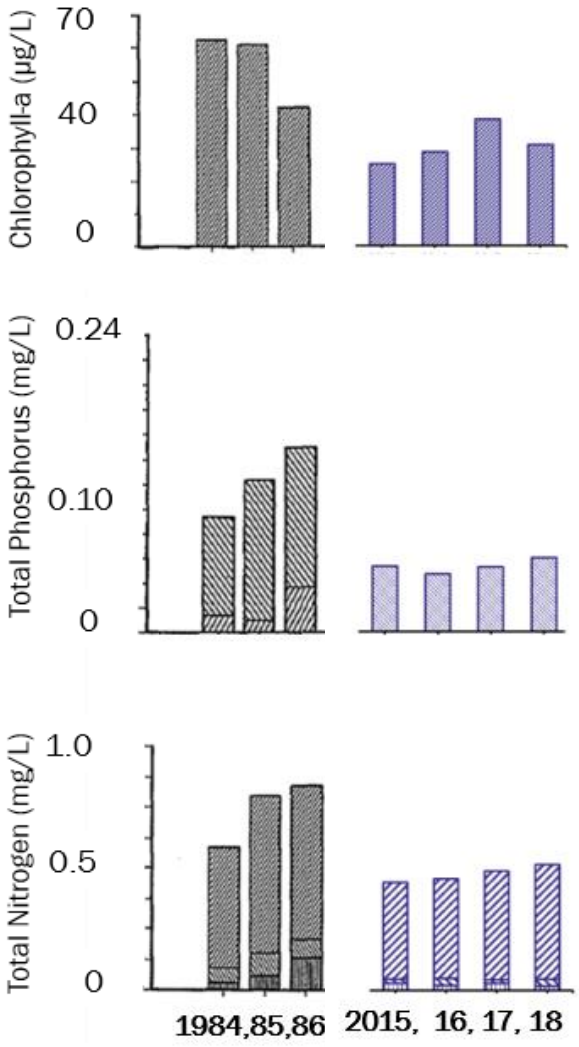


- Growing season averages for all stations in the lake
- Baseline years are lighter
- Chlorophyll-a concentrations (top panel)
  - Similar to or lower than baseline period
  - 2017 was the highest for the recent period
- Total phosphorus concentrations (middle panel)
  - Similar to or lower than baseline period
- Total nitrogen concentrations (lower panel)
  - Consistently lower than baseline

Comparison of Recent Water Quality in Falls Lake to the early 1980s (Post Filling)

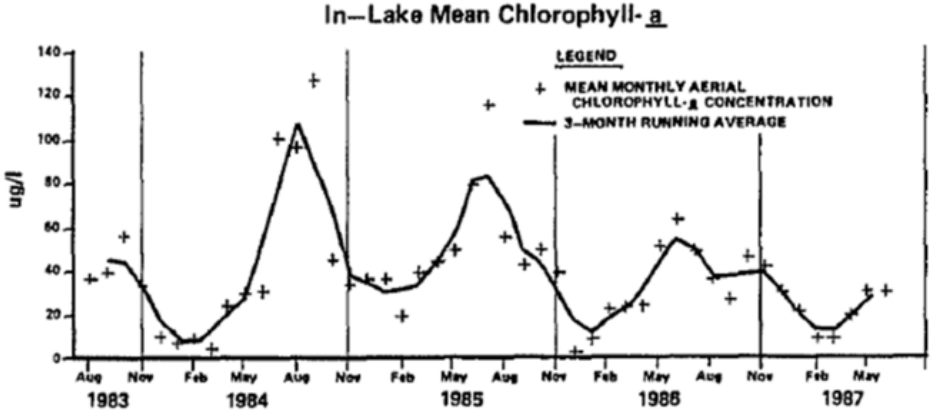
- Similar comparisons can be made using USACE data from the 1980s
- Water quality in the lake has improved

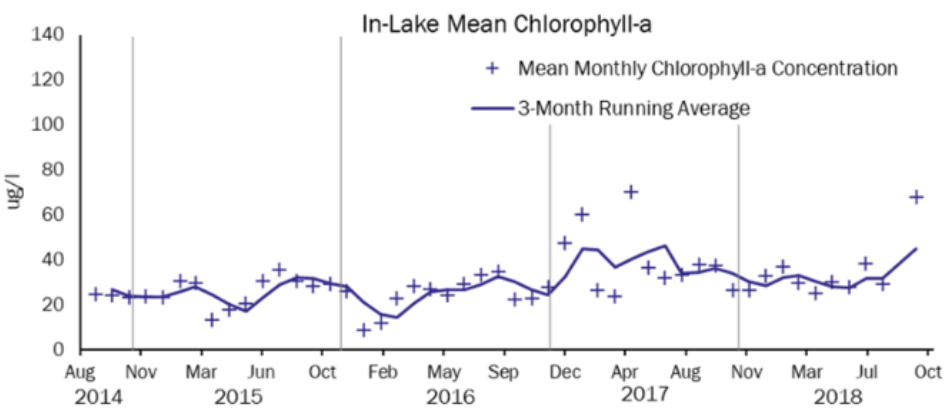
- Nutrient loads to the lake from three tributaries have decreased
  - Total nitrogen loads decreased by ~60 percent
  - Total phosphorus loads decreased by ~90 percent
  - The total discharge from these three tributaries was approximately 50 percent higher in 2018 compared to 1983



Comparison of Mean Chlorophyll-a

- Time series of lake average chlorophyll-a
- Chlorophyll-a concentrations are less variable compared to the 1980s
- Water quality in the lake has improved

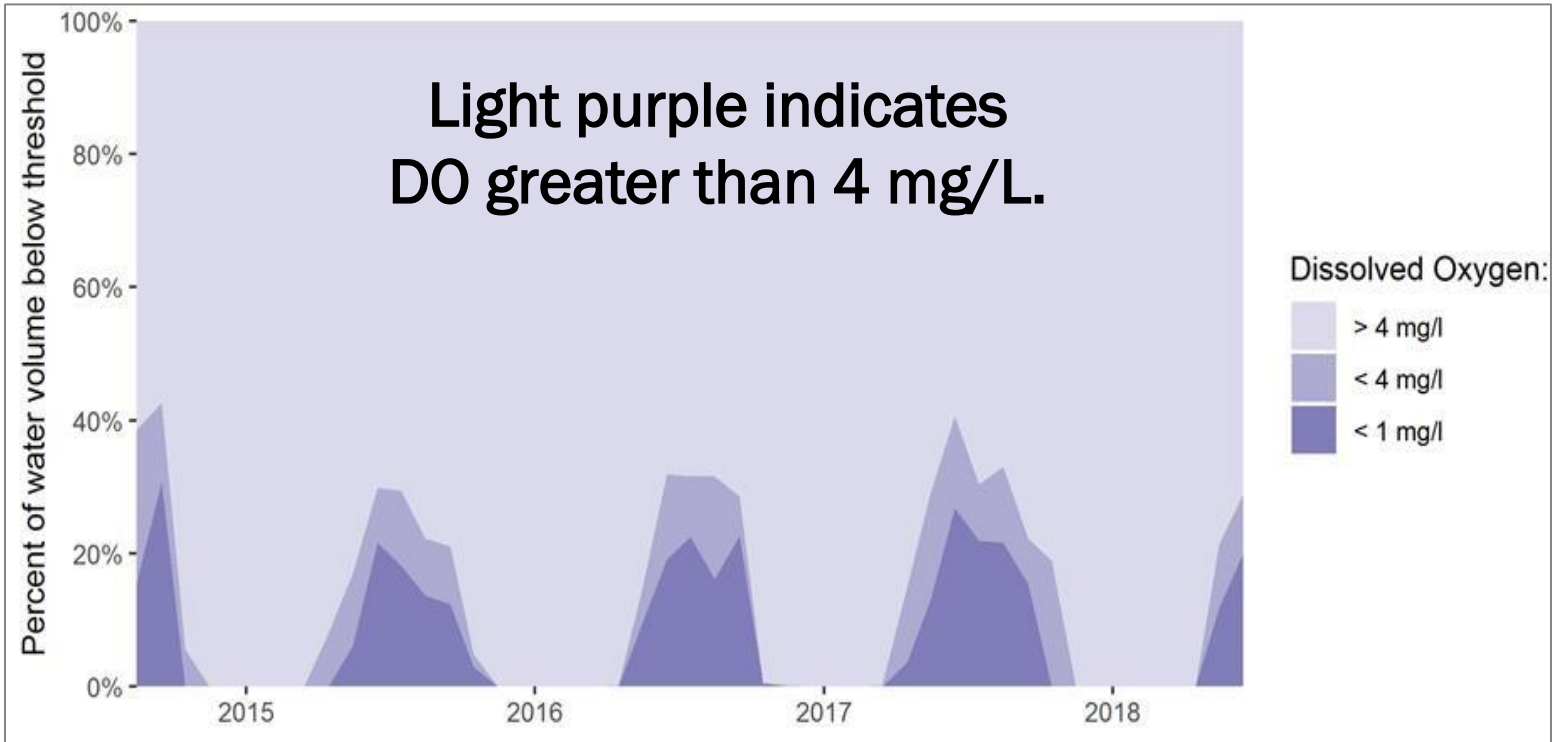




Average chlorophyll-a concentrations in the lake were higher during the 1980s (left) compared to the more recent monitoring period (right).

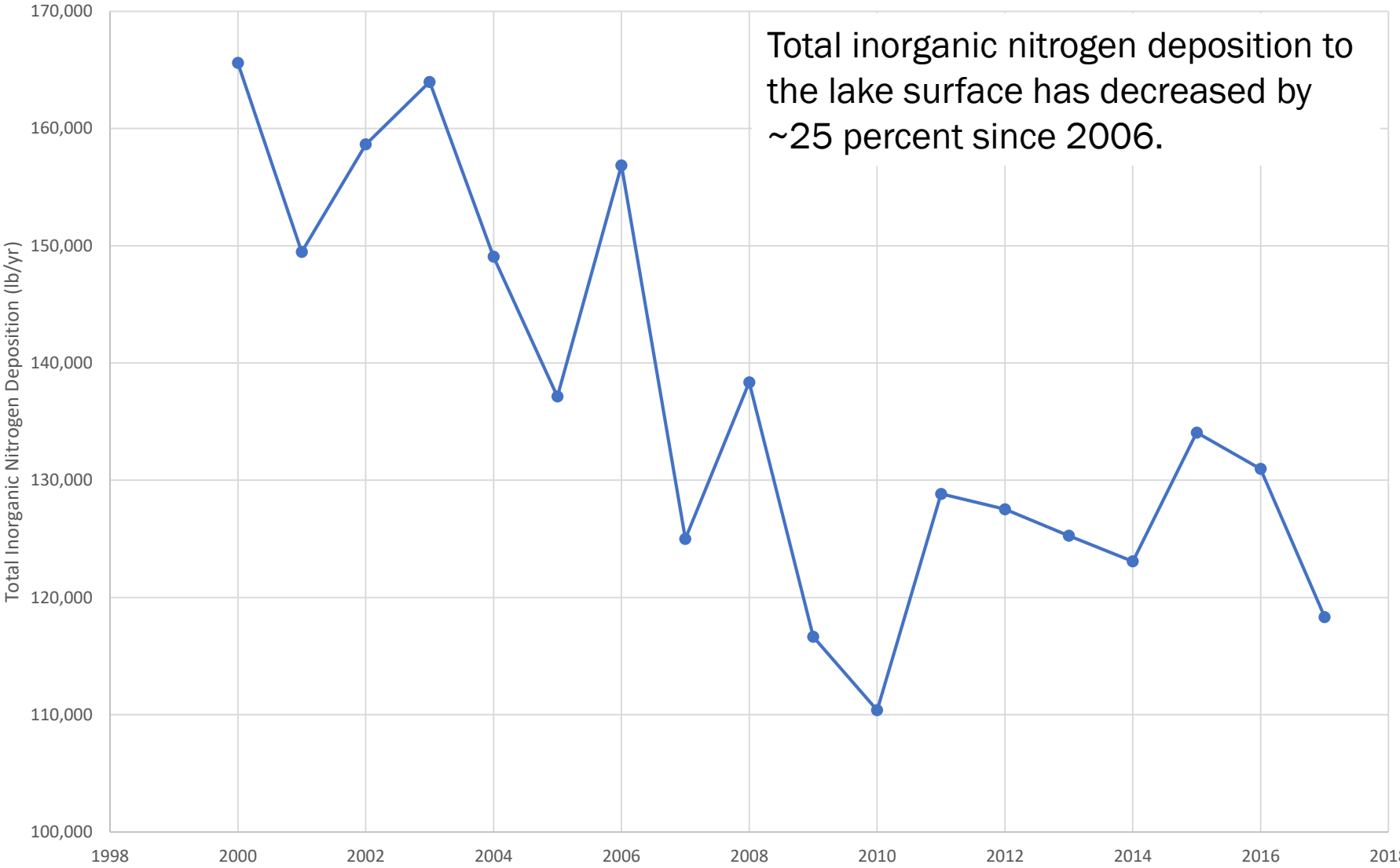
Evaluation of Oxygen Data in Falls Lake

- Dissolved oxygen (DO) is needed to sustain aquatic life
- Low levels can cause aquatic stress
- During the winter months, DO is greater than 4 mg/L throughout the water column
- In the summer months, the deepest parts of the lake in the historic river channel can experience low DO
- This is a common observations for lakes and reservoirs



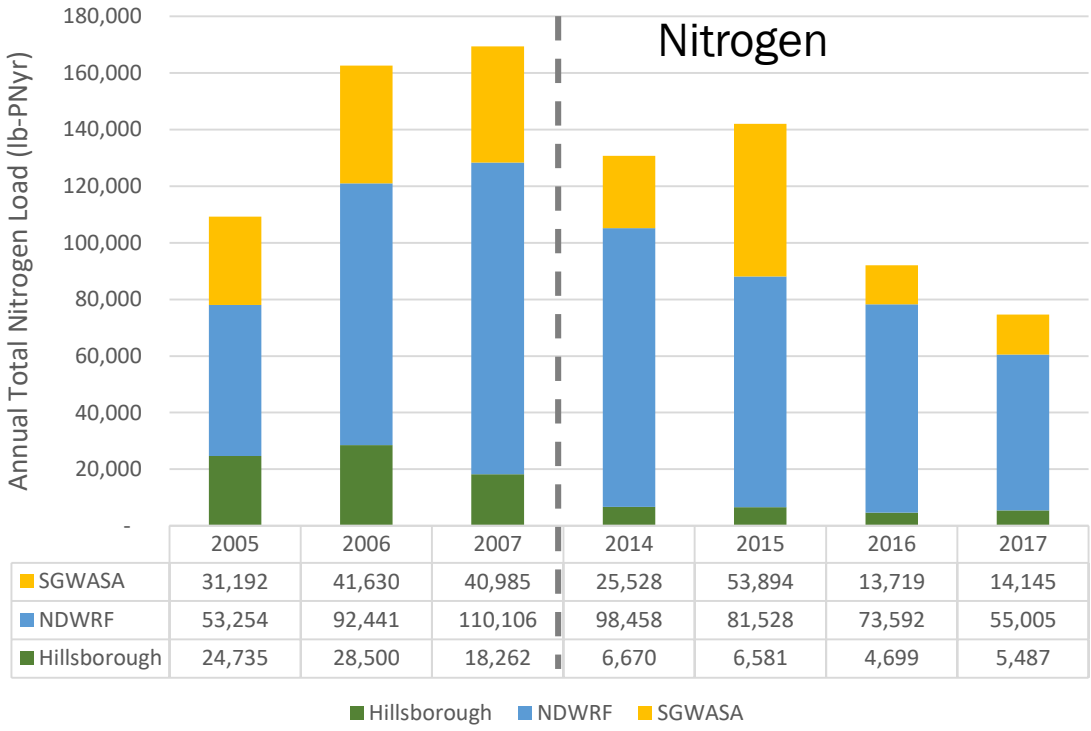
Analysis of Loading to Falls Lake

Atmospheric Deposition onto Falls Lake

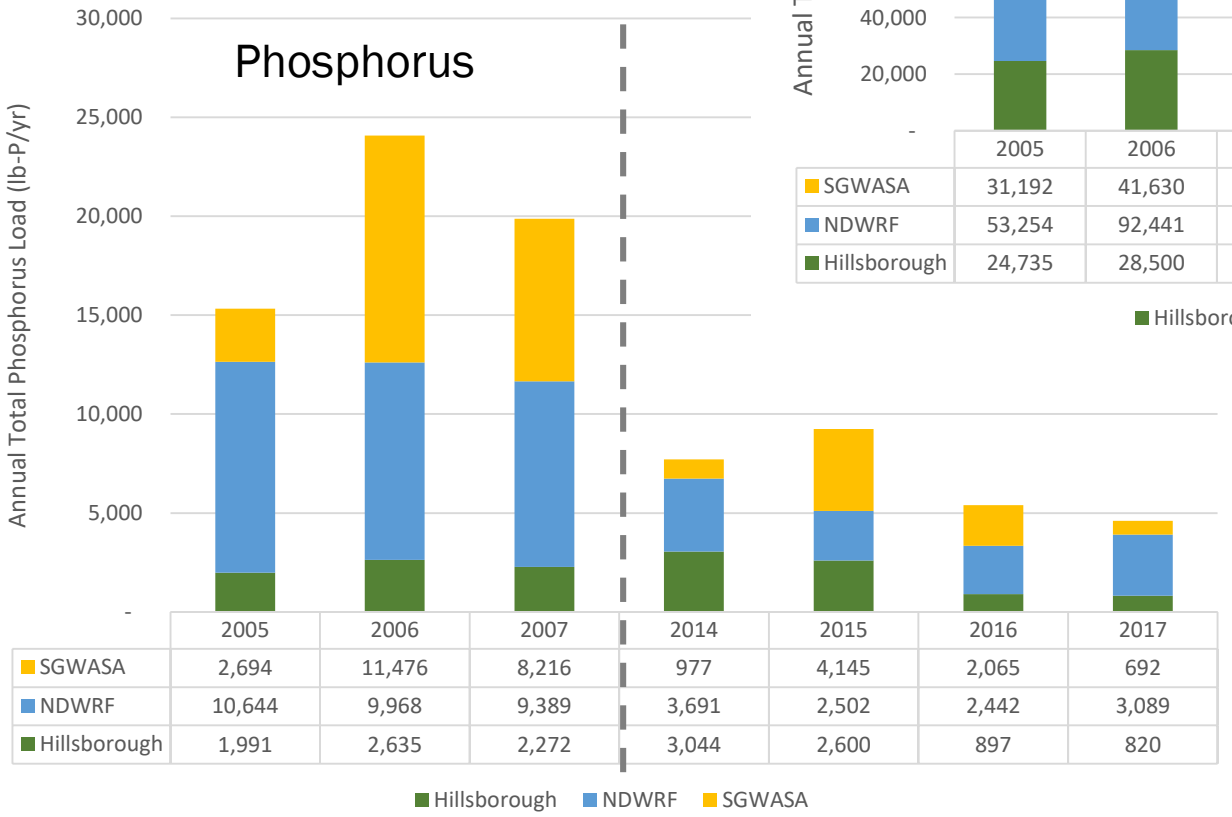


Nutrient Loading from Treatment Facilities

Total nitrogen loads from WWTPs have decreased by 54 percent since 2006.



	2005	2006	2007	2014	2015	2016	2017
SGWASA	31,192	41,630	40,985	25,528	53,894	13,719	14,145
NDWRF	53,254	92,441	110,106	98,458	81,528	73,592	55,005
Hillsborough	24,735	28,500	18,262	6,670	6,581	4,699	5,487



	2005	2006	2007	2014	2015	2016	2017
SGWASA	2,694	11,476	8,216	977	4,145	2,065	692
NDWRF	10,644	9,968	9,389	3,691	2,502	2,442	3,089
Hillsborough	1,991	2,635	2,272	3,044	2,600	897	820

Total phosphorus loads from WWTPs have decreased by 81 percent since 2006.

Loading and Lake Water Quality

- Nutrient loading to Falls Lake has decreased
  - 13-15 percent lower than the baseline period though flows were higher
  - 60-90 percent lower than the post-filling period though flows were higher
- Chlorophyll-a concentrations
  - Improved relative to the post-filling period
  - Improved or similar compared to the baseline period
  - Higher concentrations in the recent monitoring period appear to be driven by lake operations, residence time, and seasonality rather than nutrient loading (i.e., concentrations were higher in years that had lower nutrient loading)

Nutrient loads in 2017 were lower than 2018 (by ½)

Chlorophyll-a concentrations in 2017 were higher than 2018.

2018 had the highest flows and nutrient loading to Falls Lake.

UNRBA Modeling for the Re-examination of Stage II

Two Model Periods

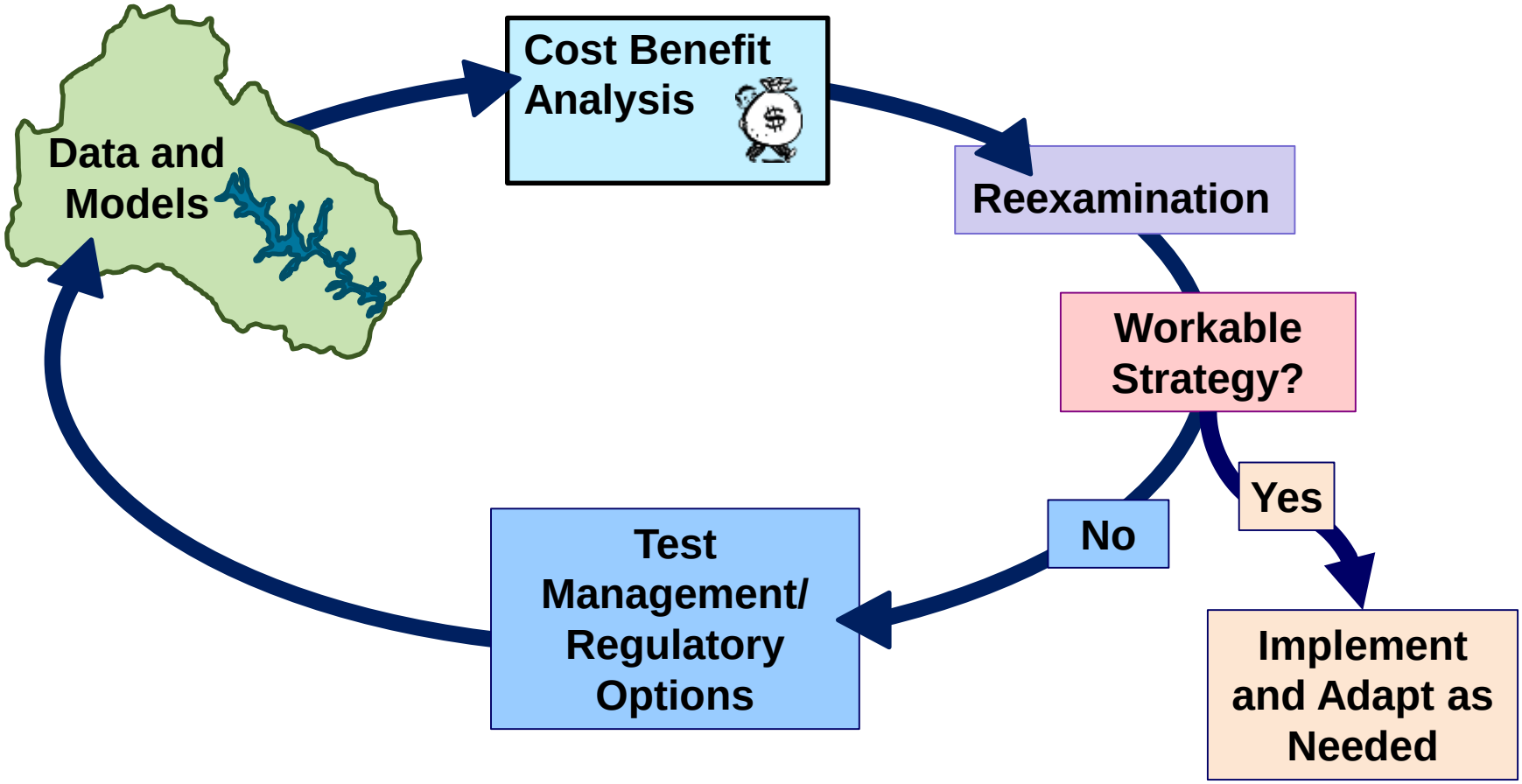
2005 to 2007

- Corresponds to the original modeling period (DWR models)
- Includes the baseline year (2006) that provides the “starting point” for the Stage II load reductions

2015 to 2018

- Corresponds to the UNRBA Monitoring Program
- Incorporates new data and information collected since the original model was developed

Framework for the Reexamination



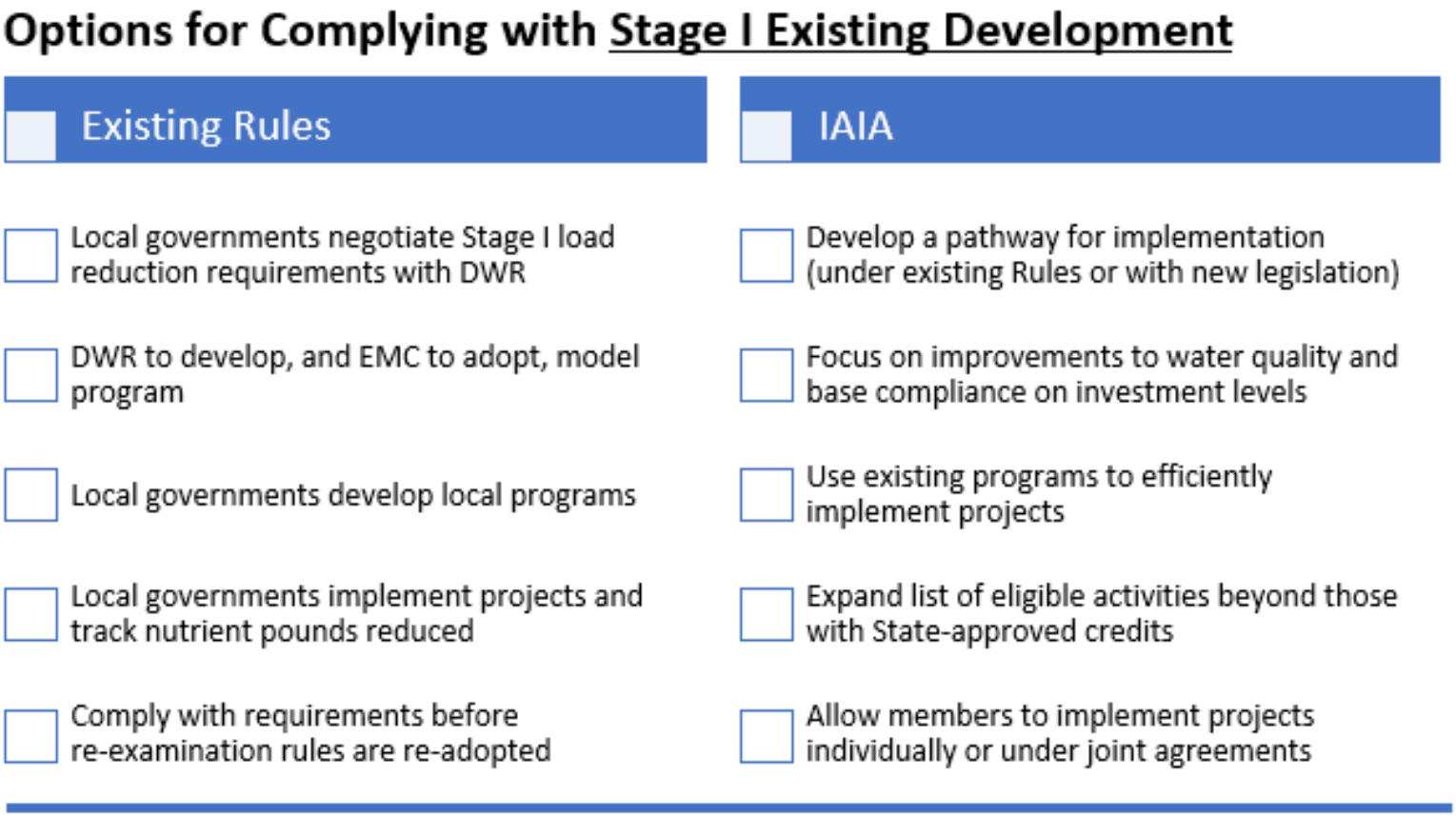
Alternative Implementation Approach for Stage I

Status of Stage I

- The Stage I requirements have been met by the wastewater treatment, agriculture, and State and Federal agency sectors
- The Stage I Existing Development requirements for local governments have not been set by the NC Division of Water Resources.
  - The rules associated with Stage I Existing Development are difficult to implement
  - The load reduction targets for Existing Development have not been set (estimates are available)
- The nitrogen and phosphorus reductions from wastewater treatment facilities under Stage I are an order of magnitude greater than the estimated reductions required for Existing Development
- The Falls Lake Nutrient Management Strategy allows trading among sectors

UNRBA Interim Alternative Implementation Approach (IAIA)

- In 2018, the UNRBA began discussing an interim alternative implementation approach (IAIA)



Status of the IAIA

- UNRBA IAIA Workgroup is continuing to consider an IAIA
  - Eligible practices and activities
  - Funding levels
  - Funding approaches
  - Reporting requirements
  - Authority for the program
    - Under the trading allowed by the Falls Lake Nutrient Management Strategy
    - New legislation to authorize an alternative approach
- DWR and NGO's are participating in the discussions and reviewing working drafts

Questions and Discussion