UNRBA Monitoring, Modeling, and Regulatory Support

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Modeling and Regulatory Kick-Off Meeting
September 28, 2016

Falls Lake Monitoring and Modeling

- Past efforts
  - DWR
  - UNRBA
- Current work
  - Monitoring
  - Planning for modeling
- Future activities
  - Continued monitoring
  - Modeling

Background Information on the Original Establishment of the Rules

Issues with Original Modeling Period

- Legislative mandate required that DWR collect monitoring data, develop and calibrate watershed and lake models, and draft rules within 3 years
- Most of the chorophyll *a* data from 2005 had to be rejected due to laboratory analysis issues
- Given time constraints, DWR proposed that the Nutrient Management Strategy would be based largely on 2006 data
- Technical Advisory Committee had concerns with 2006 as the baseline year, but no alternative available
- Overall the monitoring period (2005 through 2007) occurred in a severe drought when lake levels were often extremely low

Pictures of Falls Lake at I-85 Taken in 2007

Photo courtesy of City of Durham (October)

Photo courtesy of Southeast Regional Climate Center (November)

Rule Language Regarding Reexamination

- "**Recognizing the uncertainty** associated with model-based load reduction targets…a person may at any time during implementation of the Falls nutrient strategy develop and submit for Commission approval **supplemental nutrient response modeling**" requiring
  - Division review and approval of any monitoring study plan and description of the modeling framework
  - A minimum of three years of lake water quality data
  - Supplemental modeling is conducted in accordance with the quality assurance requirements of the Division

UNRBA Monitoring and Modeling and Regulatory Support to Support Reexamination

UNRBA Strategy for Reexamination (Past Work)

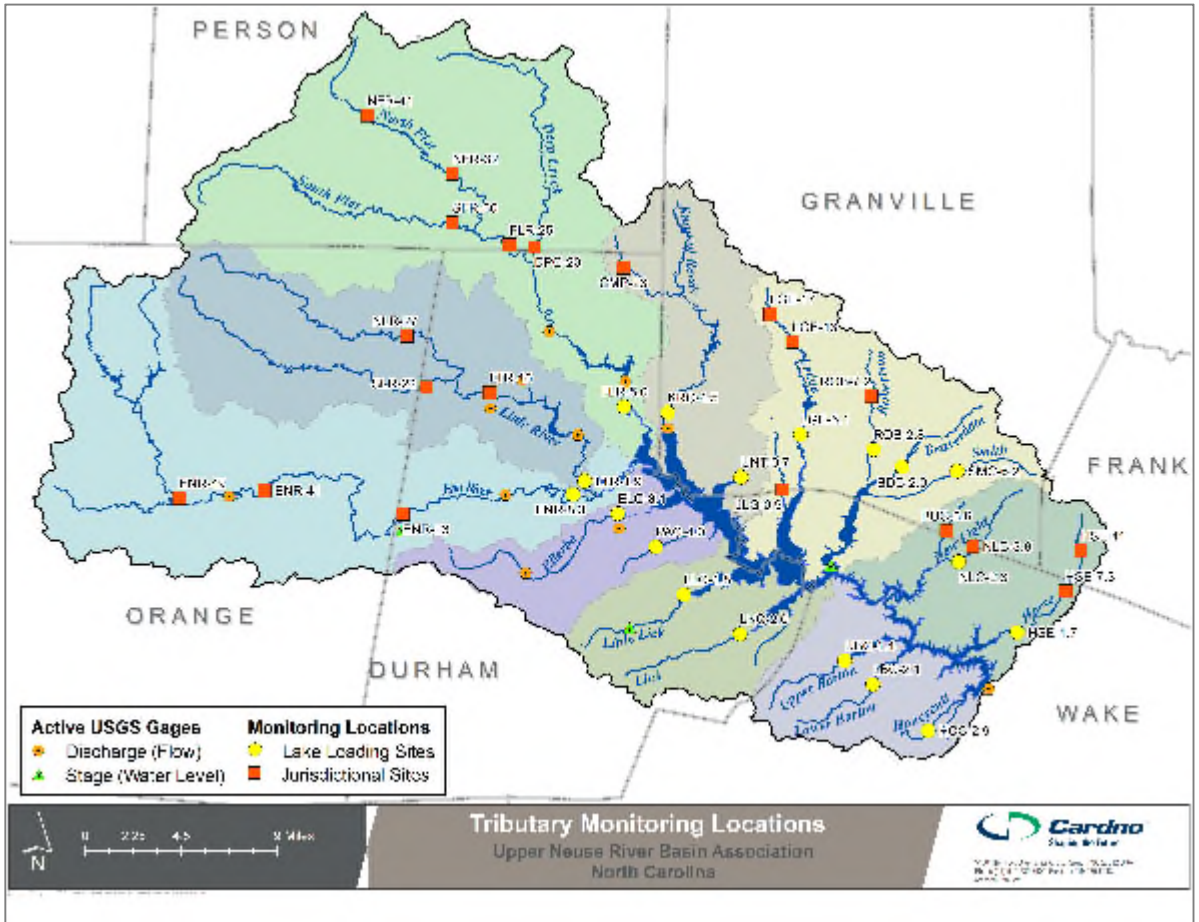
- In 2011, the UNRBA began planning for the reexamination using a measured, science-based approach and hired Cardno to
  - Review monitoring and modeling conducted by DWR
  - Evaluate data gaps and uncertainties
  - Develop a strategy for the reexamination (monitoring, modeling, and regulatory alternatives)
  - Develop and conduct an adaptive monitoring program to support
    - Revised lake response modeling
    - Load allocations to sources and jurisdictions
    - Regulatory options as needed

Examples of Data Gaps and Modeling Uncertainties

- Chlorophyll *a* and TOC were not sampled in tributaries
- Linear interpolation between grab samples was used to extrapolate tributary concentrations on days not sampled
- Lake processes such as nutrient flux were constant over the lake bottom (i.e., no spatial variability)
- Simulated nutrient loading to the lake was inconsistent between the watershed and lake response model
- Lake constrictions (bridge crossings are not represented) by the model grid

UNRBA Monitoring Program – Routine Monitoring

- 4-5 year program
- Began in August 2014
- Stations
  - 18 lake loading
  - 20 jurisdictional
  - 12 inlake (supplemental data)
- Sampled monthly

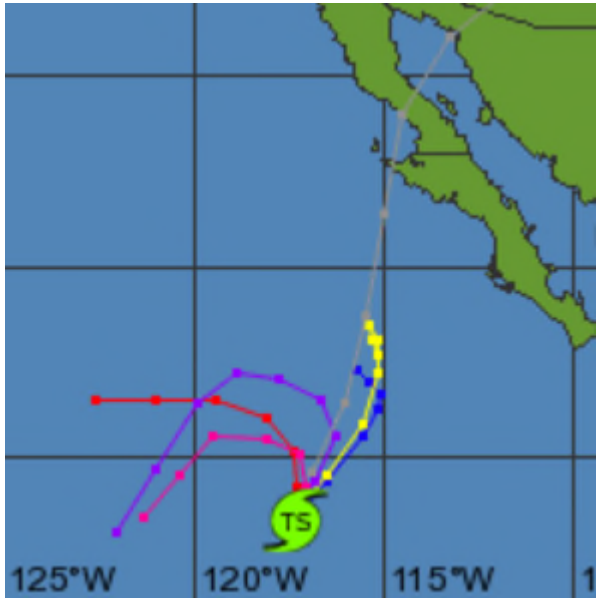


UNRBA Monitoring Program – Special Studies

- Special studies address specific questions
  - Storm event sampling (automated samplers)
  - High flow event sampling (grab samples)
  - Lake bathymetry study
  - Lake constriction point monitoring (velocities and water quality)
  - Lake sediment evaluations (cores, mapping depths of sediment)

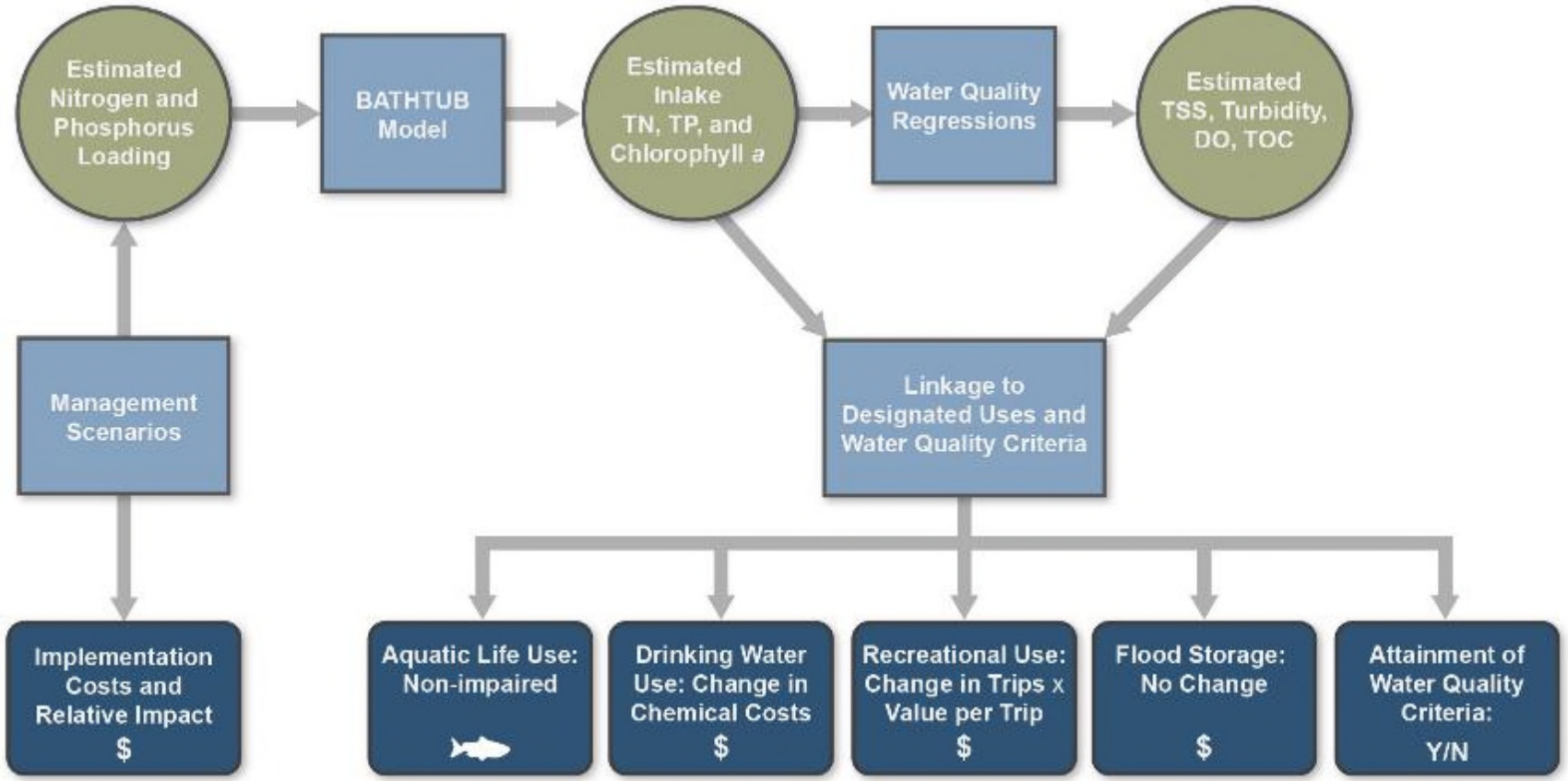
UNRBA Modeling Approach

- Use multiple models to corroborate results
- Test and optimize management strategies
- Make future predictions
- Test “What ifs”



UNRBA Modeling Approach, Continued

> Link water quality in the lake to designated uses



UNRBA Modeling Approach, Continued

- Follows required approval process described in the Falls Lake Nutrient Management Strategy (FLNMS)
  - UNRBA Description of the Modeling Framework was approved by the Division in June 2014
  - UNRBA Monitoring Plan and Monitoring QAPP were approved by the Division in July 2014
  - UNRBA Monitoring Program exceeds minimum 3-yr required
  - Supplemental modeling to be conducted in accordance with the quality assurance requirements of the Division

Linking the Components of the Reexamination

Collect Monitoring Data

Develop Models

Watershed / Loading

Lake Response

Empirical / Bayesian

Adaptive Management

Recalculate Loading Targets,
Evaluate Feasibility
(Cost-Benefit Analysis)
and Regulatory Alternatives

Develop Management Scenarios and Regulatory Approach

Implement Approved Plan

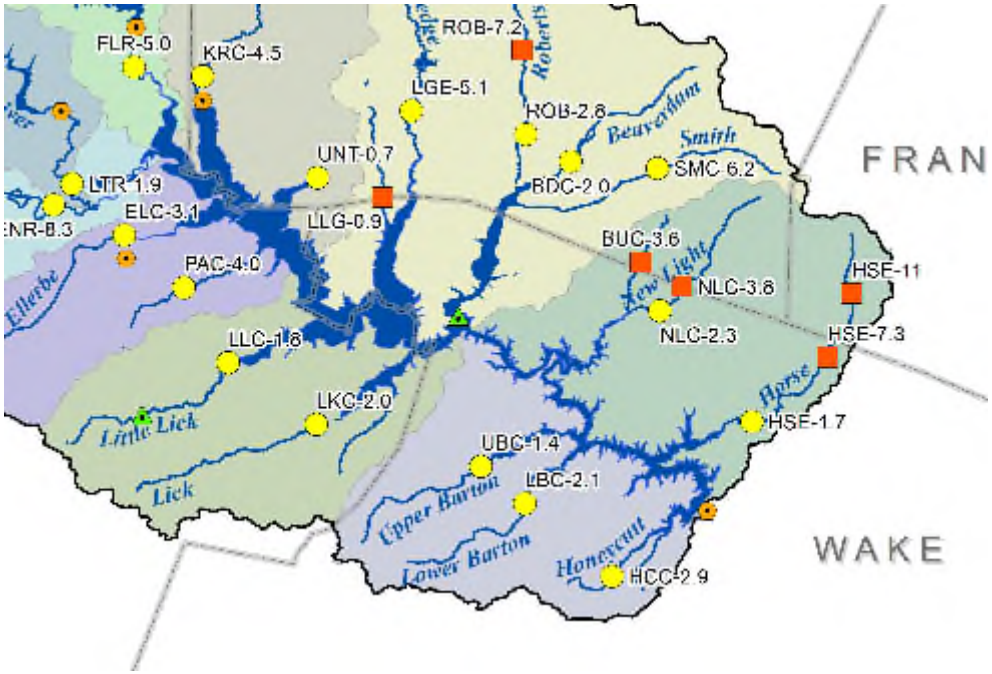
Year 1 Effort for the UNRBA Modeling and Regulatory Support

- Stakeholder kickoff meeting today to hear concerns and questions
- Evaluate and select watershed and lake models that best address modeling objectives
- Develop the conceptual plan for the multi-modeling approach
- Develop and obtain DEQ approval of the Modeling QAPP
- Develop of the two year work plan
  (October 2017 to September 2019)

Examples of how modeling goals link to the monitoring and modeling plans

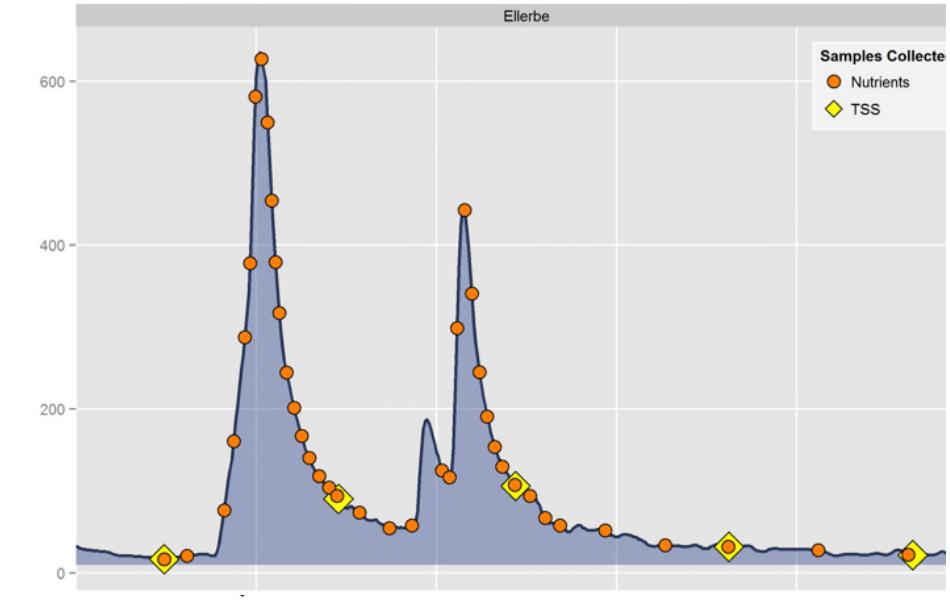
“What is entering the lake”? (chlorophyll a, nitrogen, phosphorus)

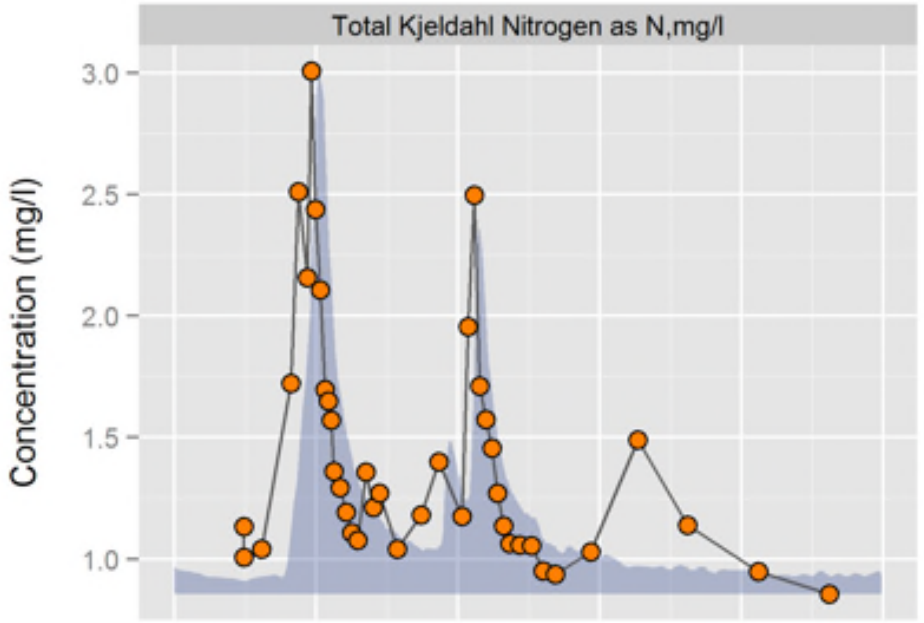
- UNRBA routine monitoring includes sampling these parameters at each lake loading station



“What is entering the lake”? (chlorophyll a, nitrogen, phosphorus)

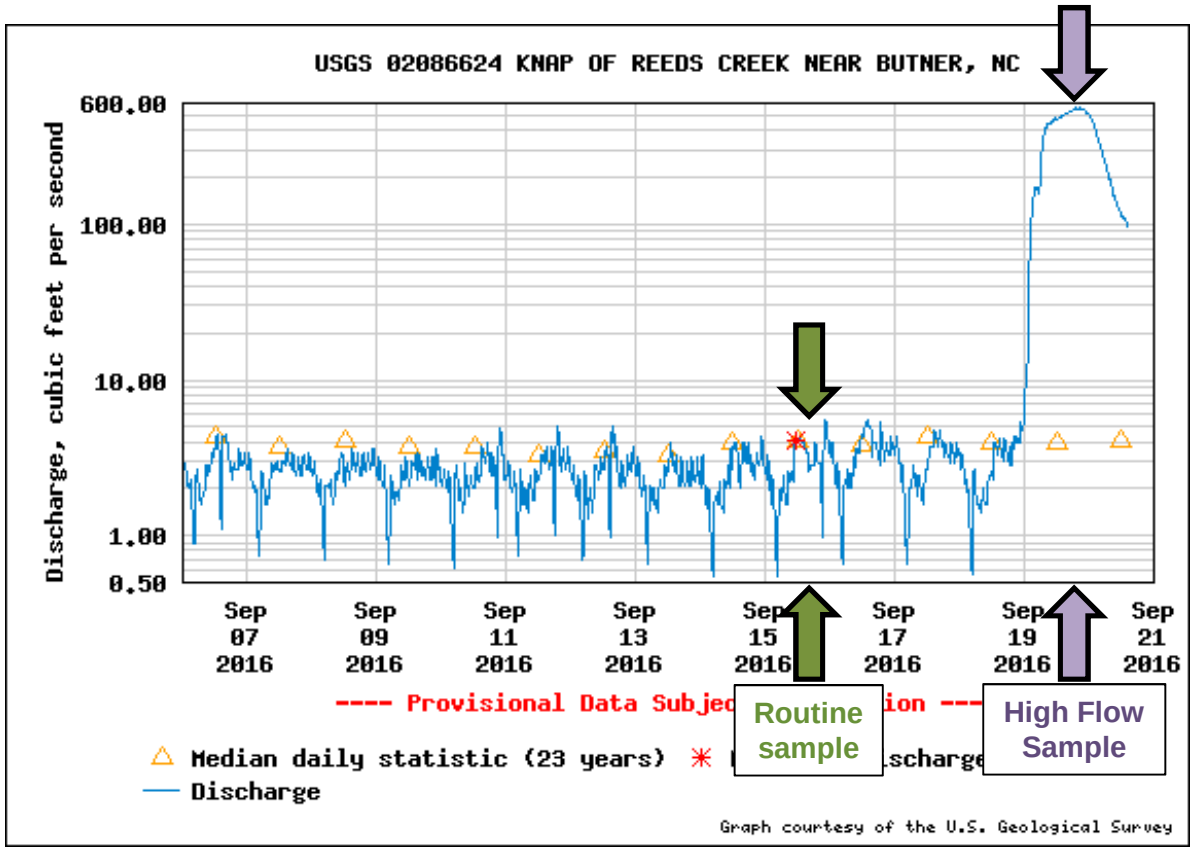
- Storm event sampling occurred during four storms on two tributaries to obtain “measured” loads entering the lake
- Auto samplers collect approximately 20 samples per storm to be paired with USGS 15-min flow data





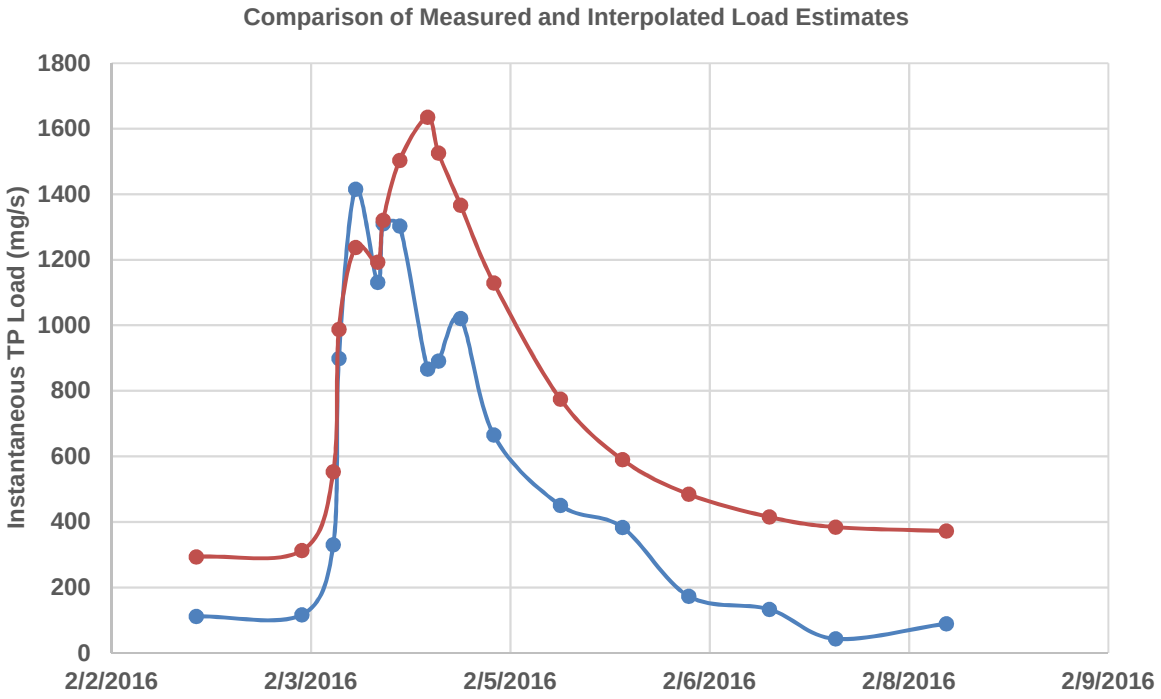
“What is entering the lake”? (chlorophyll a, nitrogen, phosphorus)

- High flow sampling to target conditions when loading to the lake is high



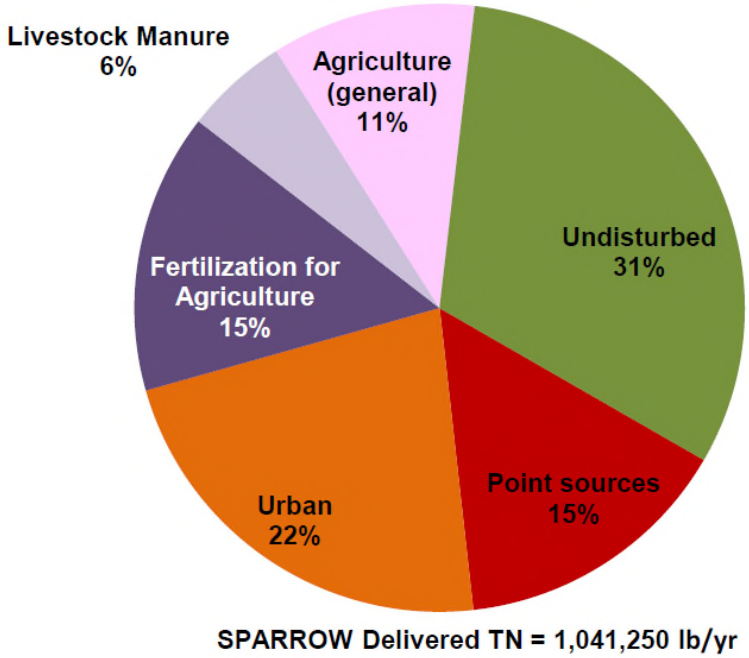
“What is entering the lake”? (chlorophyll a, nitrogen, phosphorus)

- Comparison of load estimation techniques to develop most accurate tributary input files for the lake response model



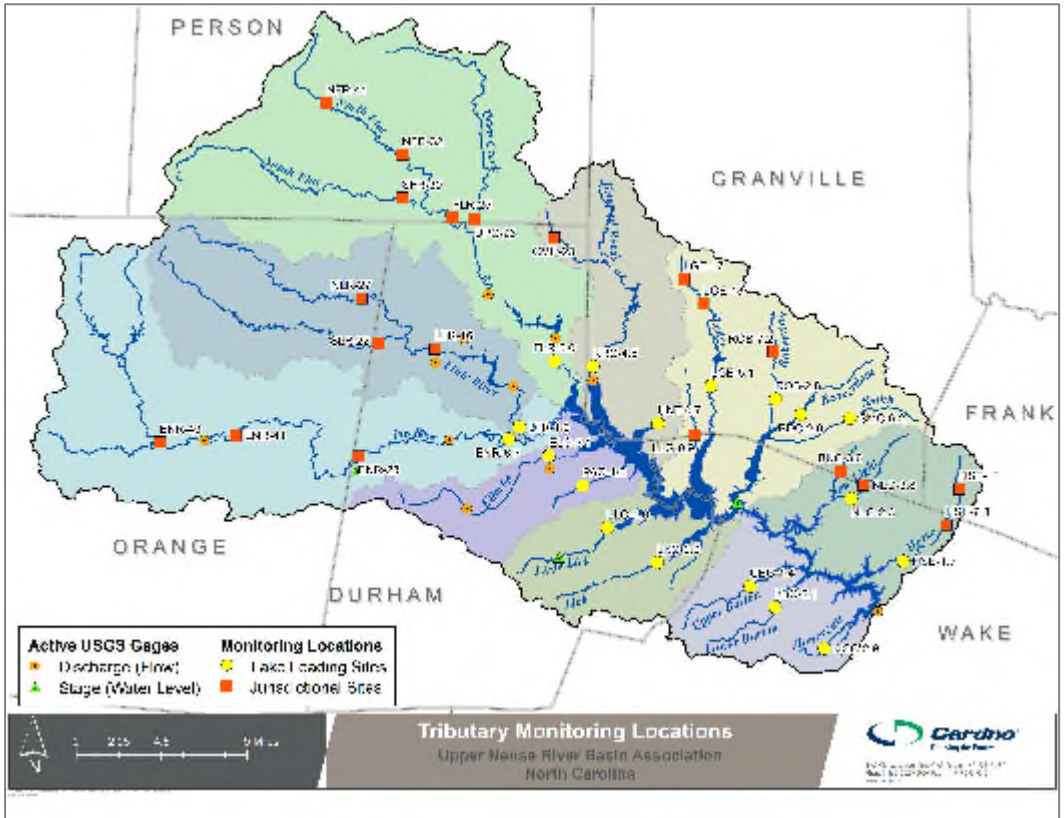
“What is entering the lake”? (chlorophyll a, nitrogen, phosphorus)

- Future development of a watershed model will help identify sources of nutrient and carbon loading



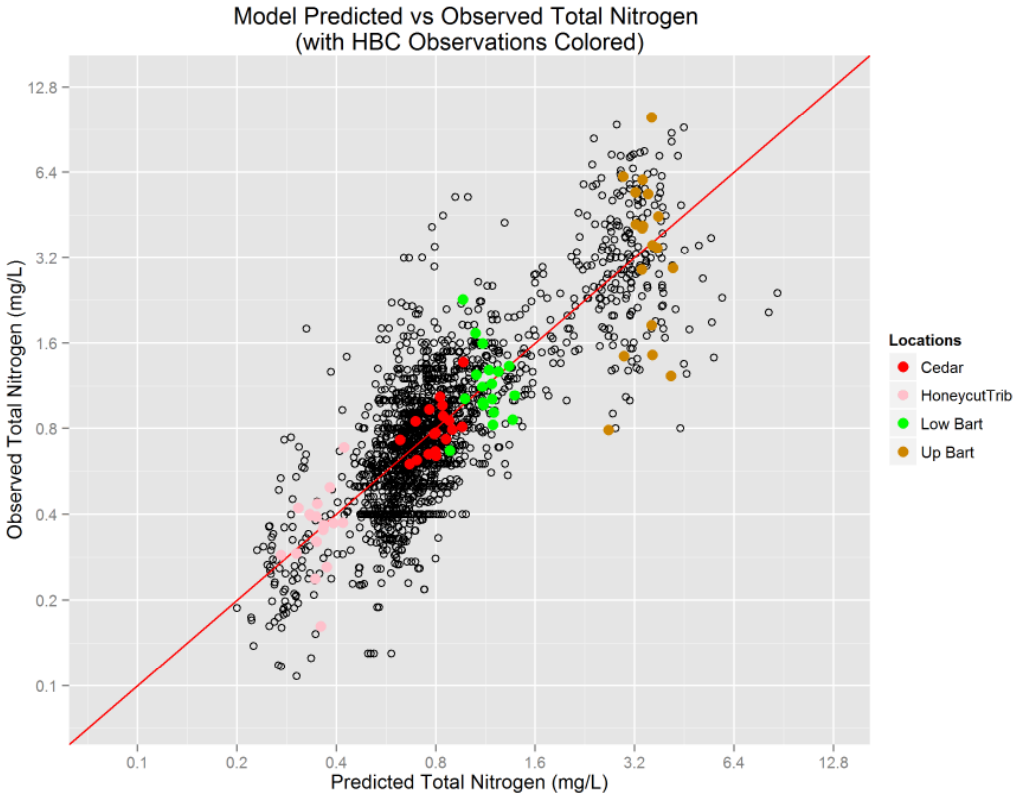
“What is the load distribution from subwatersheds and jurisdictions”?

- UNRBA routine monitoring includes sampling at 20 jurisdictional monitoring locations



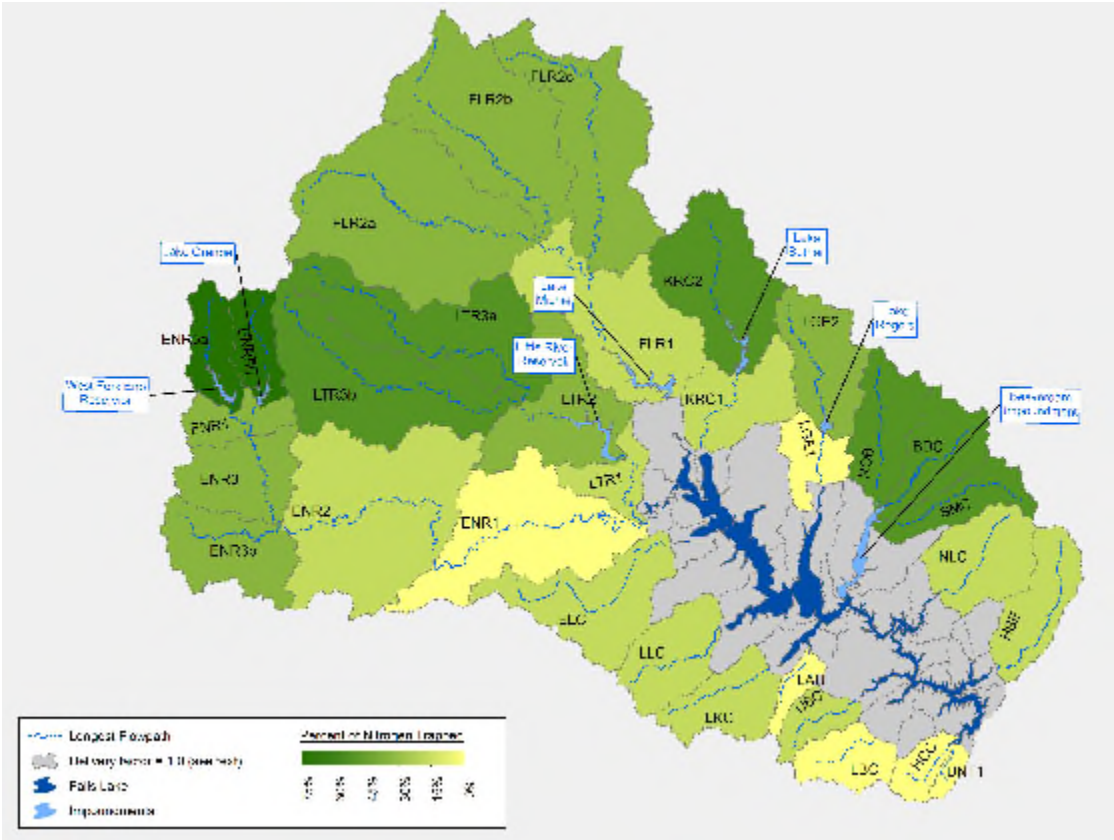
“What is the load distribution from subwatersheds and jurisdictions”?

- Previously developed statistical models test our ability to predict concentrations



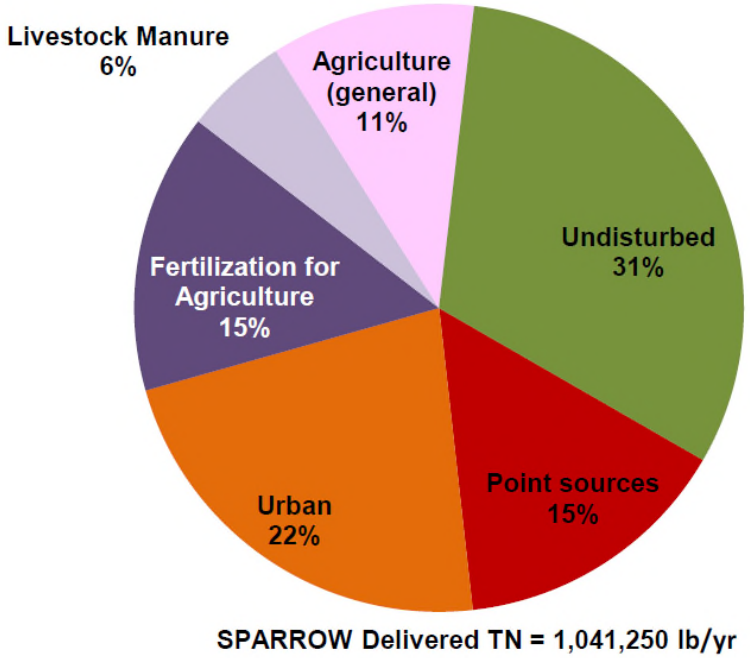
“What is the load distribution from subwatersheds and jurisdictions”?

- Developed watershed trapping factors as part of the UNRBA Nutrient Credits Project



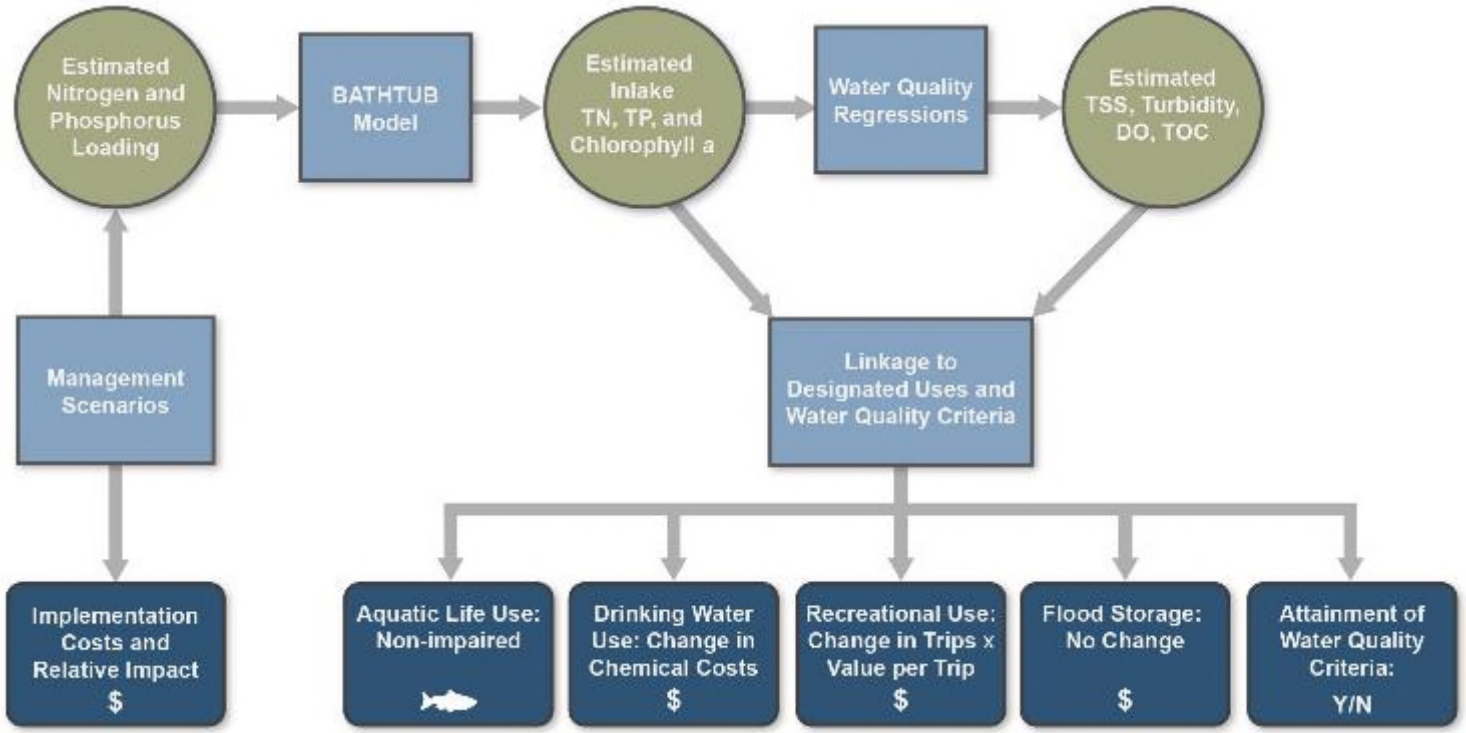
“What is the load distribution from subwatersheds and jurisdictions”?

- Future watershed modeling to provide estimates of loading from various sources and locations in the watershed



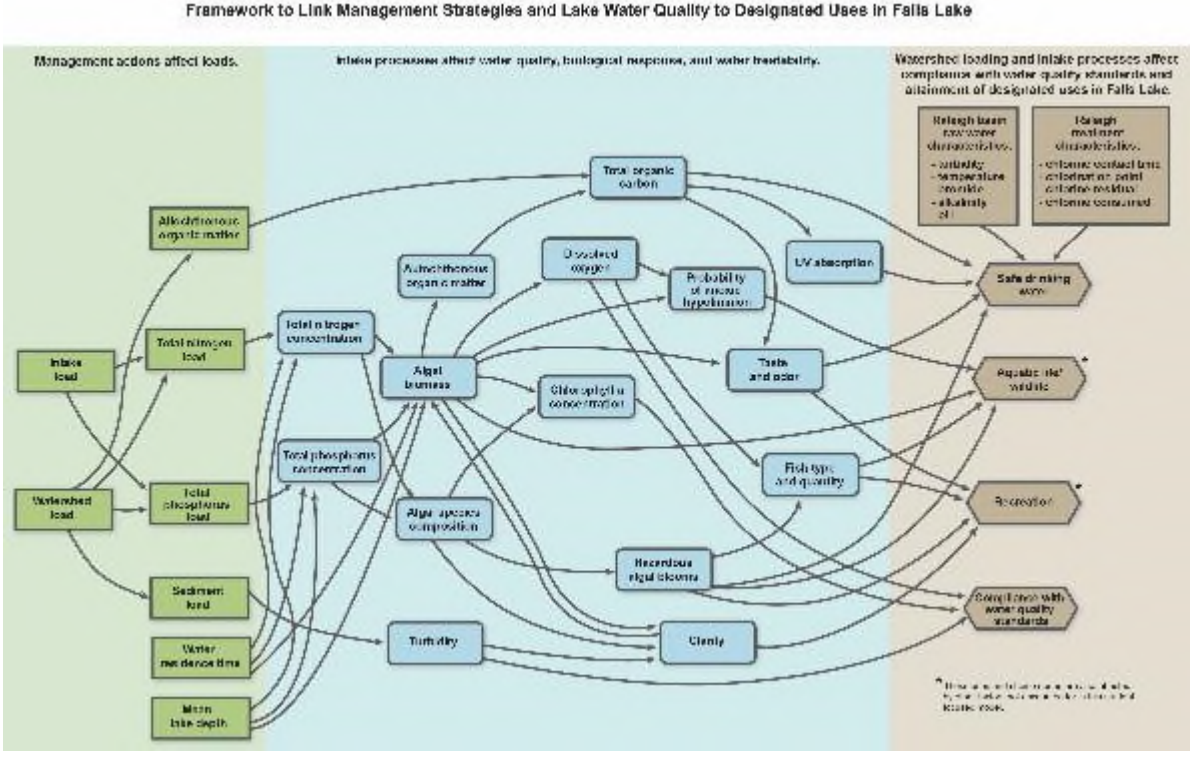
“Evaluate how well the lake meets existing uses”

- UNRBA developed the Falls Lake Framework Tool as a preliminary empirical model to link water quality to designated uses



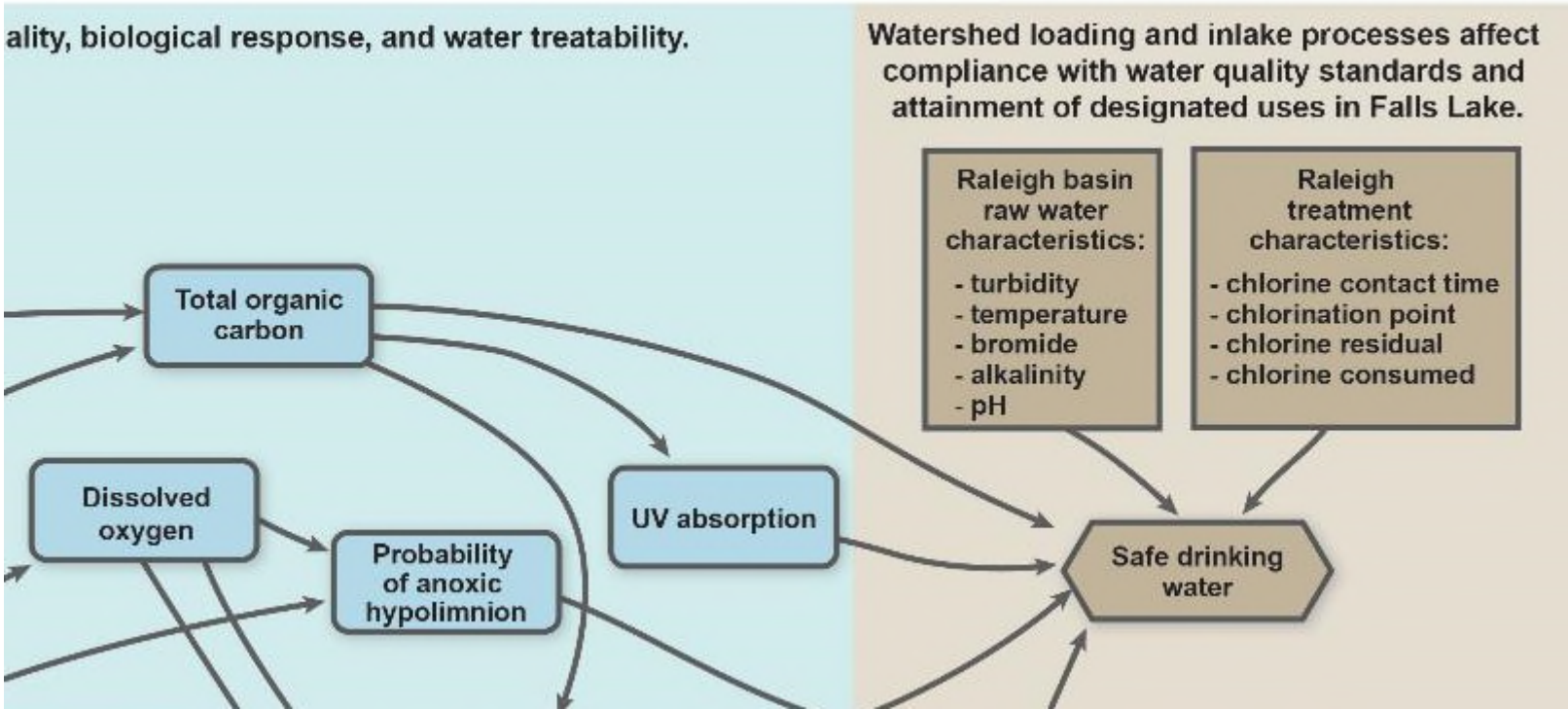
“Evaluate how well the lake meets existing uses”

- Multi-modeling approach includes an empirical model to be developed to link nutrient loading to lake water quality and designated uses (drinking water, aquatic life, and recreation)



“Evaluate how well the lake meets existing uses”

- Monitoring Program includes analysis of additional lake water quality parameters to understand the sources of carbon in the lake and the treatability of drinking water



Goals and Objectives, 2010

Falls Lake Monitoring and Modeling Goals and Objectives

Stakeholder Meeting: September 7, 2010. Facilitator: Vickie Atkinson, City of Durham

What goals and objectives do you or your jurisdiction have for any new monitoring or modeling of Falls Lake or the Falls Lake watershed?

MUST DO

Falls Lake

- Evaluate Past, Present and Future Uses of the Lake
  - Determine if existing water quality standards support existing uses. Are they too restrictive, too loose, or missing?
  - Evaluate how well the lake meets existing uses. Water supply, aquatic life propagation, recreation (boating, swimming, fishing)
  - Evaluate the degree to which the lake has, is, or can support all it's authorized uses.
  - Understand current condition of the lake
  - Supports UAA (Use Attainability Assessment) or change in use (water quality standard) for upper Falls Lake
- Lake Response Timeline
  - Given high internal loading in the lake, how will the lake respond to changes in the load?
  - Data and analysis that can be used to forecast or "backcast" conditions
- Water Treatment Concerns
  - Relationship between TOC and chlorophyll a
- Account for lake operations in model
- Fix short-comings of the existing model
- Capability to develop our own model
- Account for atmospheric deposition
- Lake Boundary Conditions
  - What is entering the lake? Chlorophyll a, other tributaries N, P and chlorophyll a
  - Are loads to the lake declining? (N, P and chlorophyll a)
  - Where is the best location (stable) to monitor inputs to the lake?

Falls Lake Watershed

- Characterize the distribution of loads
  - Load distribution (at jurisdictional boundaries)
  - What loads come from each jurisdiction
  - What are the actual loads distributed from throughout the watershed? Can we better understand sources by having a watershed model that is calibrated to measured loads at multiple locations? At jurisdictional boundaries?
  - Know loads by jurisdiction & tributary
  - Nutrient loading by jurisdiction and by subwatershed (2006 base and ongoing, current as of date certain)
  - Better unit loading rates that may vary by geography and by land use
- Tell us whether management efforts are succeeding (a vigorous effort)
  - Understand how management practices are affecting loads (individual and cumulative)
- Monitor Rainfall
  - Given that the model used rain data from RDU, would local monitoring of rainfall improve hydrologic calibration?
- Nutrient Mapping
- Sources Mapping
- Unknowns: Fertilizer, septic, sediment-attached P, atmospheric deposition
- Know the value of EACH individual management strategy (e.g., septic, ag). Do the BMPs work?
- Watershed Characterization
  - Distinguish sources of different types of nitrogen
  - Understand loads from forest and atmospheric deposition
  - Atmospheric deposition—coordinate with energy & air quality efforts with regard to nutrients
  - Forest is the largest component of the watershed. What are the actual nutrient loads from forests in the Triassic basin?

MUST DO

Goals and Objectives, 2012

Upper Neuse Water Quality Monitoring Plan

Potential Objectives

Table 1. Objectives for a water quality monitoring plan as grouped into headings.

Sources/Dynamics of Nutrient Loading

- What is entering the lake? Chlorophyll a, other tributaries N, P and Chlorophyll *a*
- Are loads to the lake declining? (N, P and chlorophyll a)
- What is entering the lake? (Chlorophyll a, other tributaries (N, P, Chl a)
- Where is the best location (stable) to monitor inputs to the lake?
- Sources Mapping
- Unknowns: Fertilizer, septic, sediment-attached P, atmospheric deposition
- What are the impervious cover characteristics of the watershed? (Where is IC and how is it distributed?)
- Understand (soils for) onsite wastewater attenuation rates
- What are the actual loads distributed from throughout the watershed? Can we better understand sources by having a watershed model that is calibrated to measured loads at multiple locations? At jurisdictional boundaries?
- What loads come from each jurisdiction?
- Characterize internal lake load
- What is approximate nutrient loading into Falls Lake watershed from groundwater?
- Nutrient loads from groundwater discharge
- Lake boundary conditions (are loads to the lake declining (N, P, Chl a))?
- Understand how loads from agriculture (equine) differ from others (flow, composition, urban/suburban)
- Where is the best location (stable N, P, Chlorophyll a) to monitor inputs to the lake?
- Nutrient loading by source type. Base, ongoing, and current as of date

Round Table Discussions for Breakout Session

- What concerns do you have about what you have heard today?
- What advice do you have for the UNRBA and their contractors as they move forward with the project?
- What are we doing right? What are we not considering?
- Is the list of goals provided in the pre-meeting material appropriate? What are we missing?
- What are your concerns about the project? What could we do to address them?