Overview
UNRBA Modeling and Regulatory Support, Year 2

Forrest Westall - UNRBA

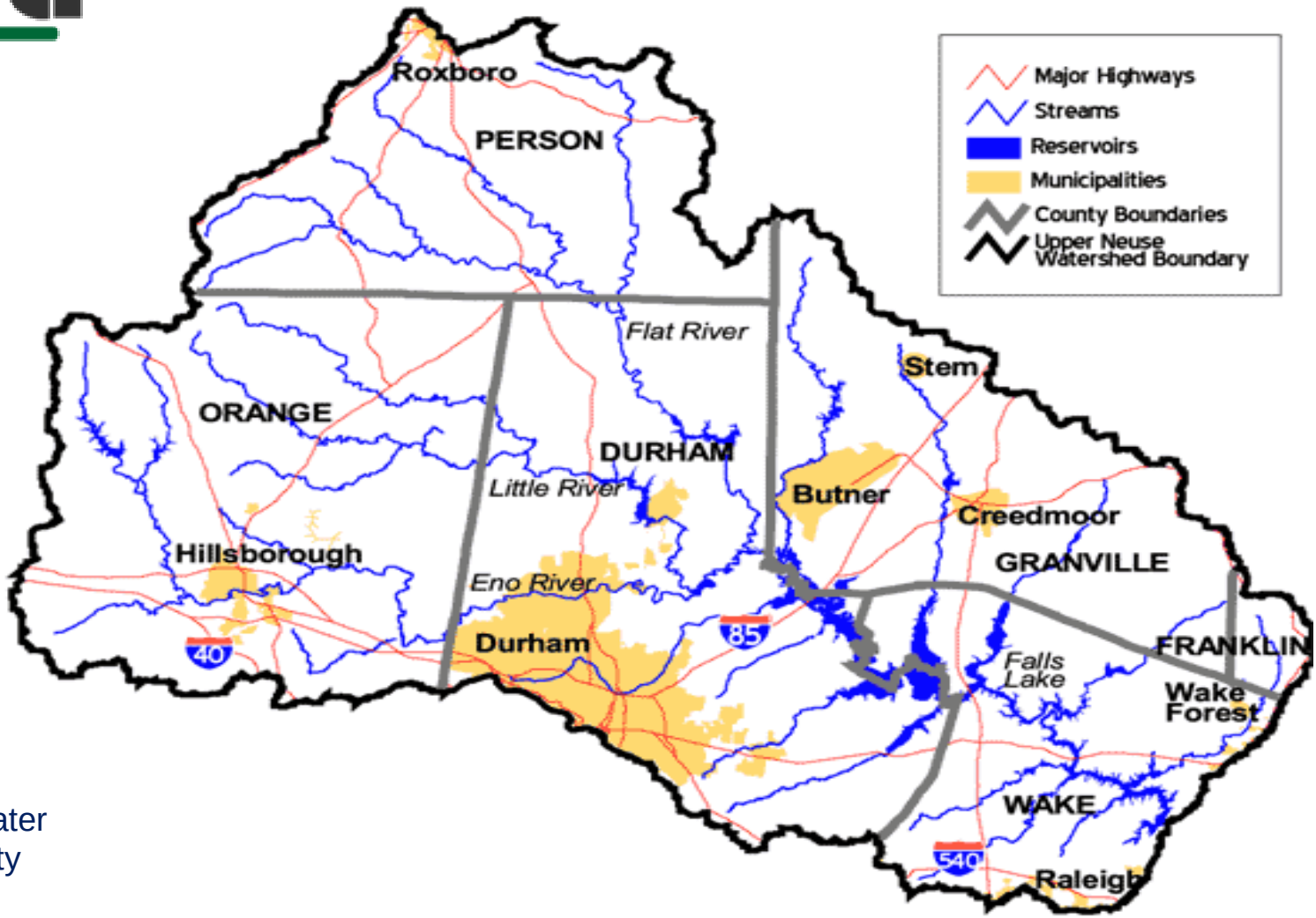
Modeling and Regulatory Support
Year 2 Kick-Off Meeting
October 25, 2017

Municipalities
Butner
Creedmoor
Durham
Hillsborough
Raleigh
Stem
Wake Forest

Counties
Durham
Franklin
Granville
Orange
Person
Wake

South Granville Water and Sewer Authority (SGWASA)

Soil and Water Conservation Districts (Ex Officio)



Project Background

Falls Lake Challenges and Realities

- Primary source of water for one jurisdiction
- Water quality concerns – chlorophyll *a* impairment
- Legislative action required nutrient management
- Falls Lake adopted rules
  - Very restrictive nutrient requirements
  - Stage I requirements for nutrient reductions are expensive
  - Extremely costly Stage II requirements
  - Rules allow for reexamination
- Consensus Principles

Falls Lake at I-85 in October 2007
Source: City of Durham

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

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 PLAN FOR THE REEXAMINATION

Coordination with agencies and stakeholders

2010

Falls Lake Strategy is passed

Consensus Principles adopted

2011

UNRBA decides to initiate a reexamination of Stage II

2012-2013

UNRBA contracted work to develop a strategy for the Reexamination process

2013-2014

Develop monitoring plan to support Reexamination and obtain DWR approval

2014-2018/19

Collect monitoring data for at least 4 years

2018-2021

Revise watershed and lake models; evaluate nutrient management strategies

2022-2023

Develop the UNRBA Reexamination package

Overview of the UNRBA Strategy for Reexamination

- Use a measured, science-based approach to
  - Review monitoring and modeling conducted by DWR
  - Evaluate data gaps and uncertainties
  - Develop a strategy for the reexamination
    - Monitoring
    - Modeling
    - Management alternatives
  - Implement an adaptive monitoring program to support
    - Revised watershed and lake response models
    - Load allocations to sources and jurisdictions
    - Regulatory options as needed

UNRBA Reexamination Planning and Development Website

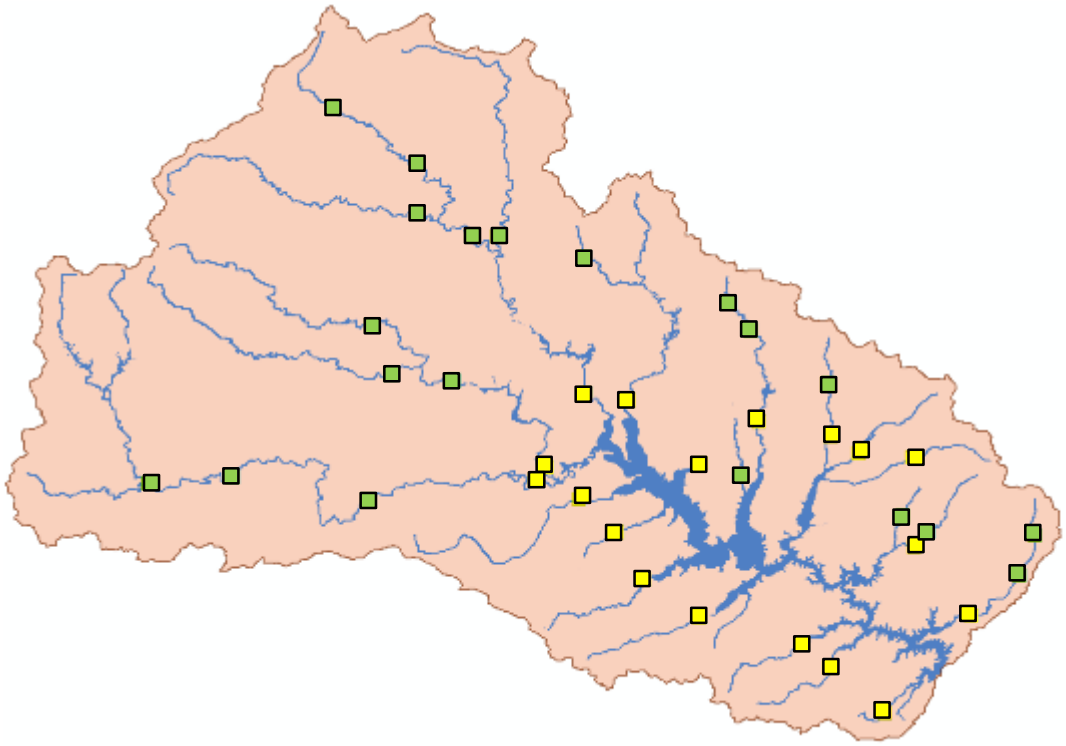
https://www.unrba.org/reexamination

- Organized in reverse order
- Technical memoranda from the planning phase are towards the bottom of the page
- Task 1 – Described the plan for the reexamination
- Task 2 – Summarized the watershed and lake data available at the time
- Task 3 – Discussed available methods and models for determining loads from the watershed
- Task 4 – Recommended monitoring and modeling studies to support the reexamination

Status of the UNRBA Monitoring Program

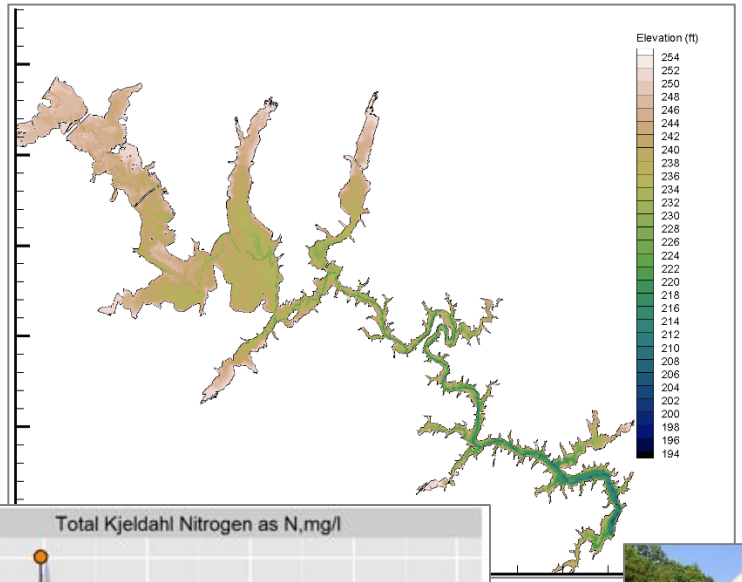
Routine Monitoring (Monthly)

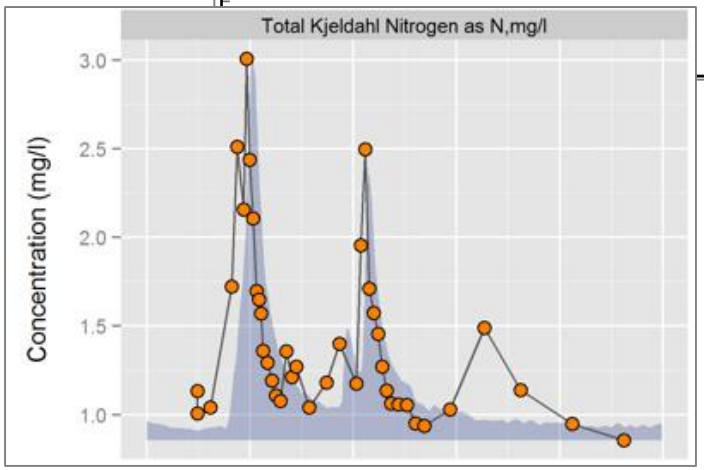
- Began in August 2014
- Stations
  - 18 lake loading
  - 20 jurisdictional
  - 12 inlake (supplemental data)
- Parameters
  - Field parameters
  - Nutrients
  - Carbon
  - Chlorophyll *a*
- Over 25,000 additional data points as of July



Special Studies

- High flow grab sampling
- Storm event sampling
- Light extinction data
- Lake sediment quality
- Lake bathymetry
- Lake constriction point study
  - Velocity
  - Water Quality





UNRBA Monitoring Program Website

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

- DWR-Approved documents as required by the Falls Lake Rules
  - UNRBA Monitoring Plan
  - UNRBA Monitoring Quality Assurance Project Plan
  - UNRBA Description of the Modeling Framework
- Interim and annual reports that summarize the data collected and provide preliminary analyses
- Link to the UNRBA Monitoring Database and User Documentation
- Study Plans for the Special Studies
- Additional analyses
  - Flow estimation methods
  - Model performance and sensitivity

Status of the UNRBA Modeling and Regulatory Support Project

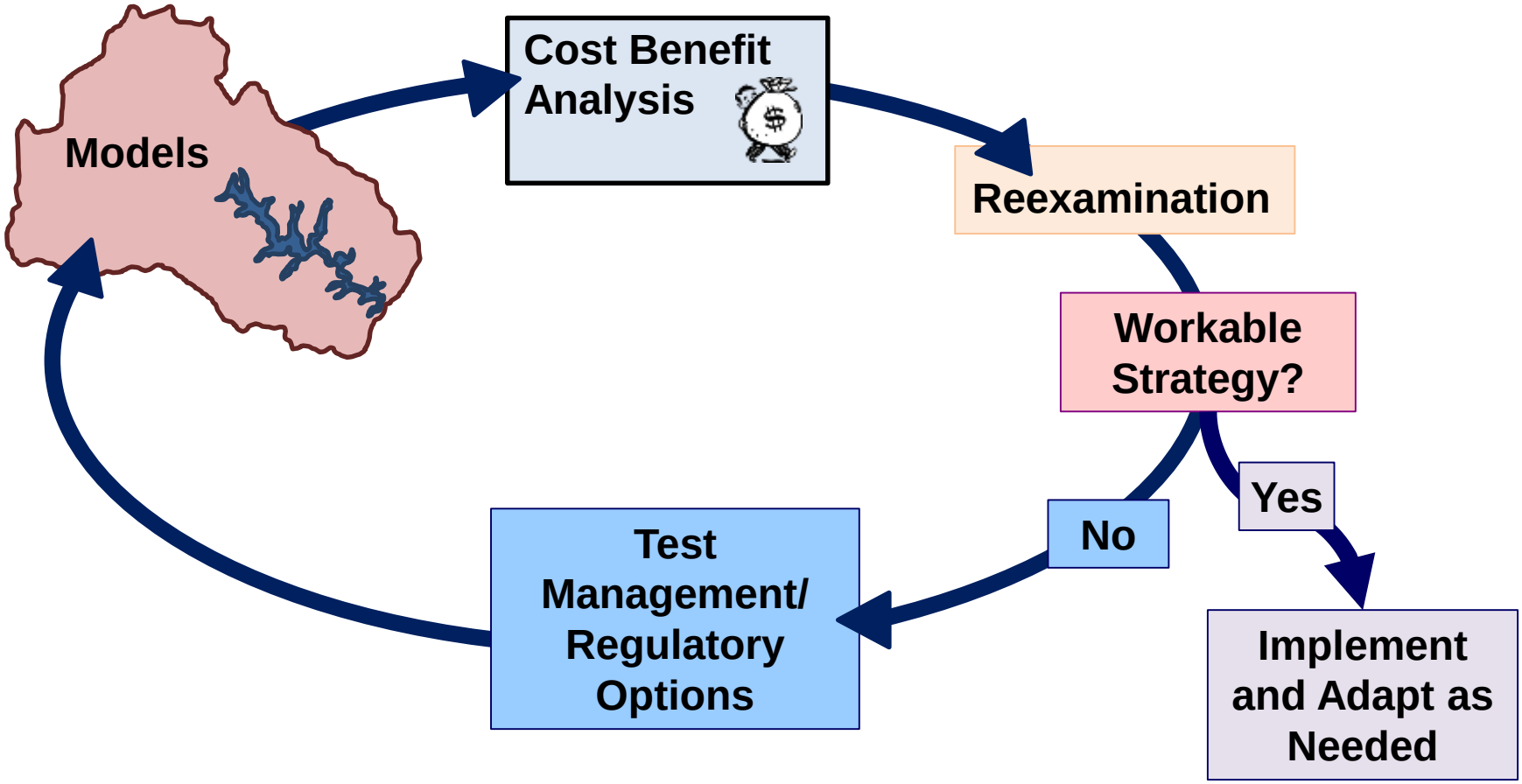
Work Completed During Year 1

- Stakeholder meetings in September 2016 and March 2017
- Selection of watershed and lake models for the reexamination
  - Development of criteria
  - Model ranking and evaluation
  - Model selection by the Modeling and Regulatory Support Workgroup
- Conceptual modeling plan to describe how the models work together
- Development of the multi-year work plan
- Memorandum are available at https://www.unrba.org/reexamination

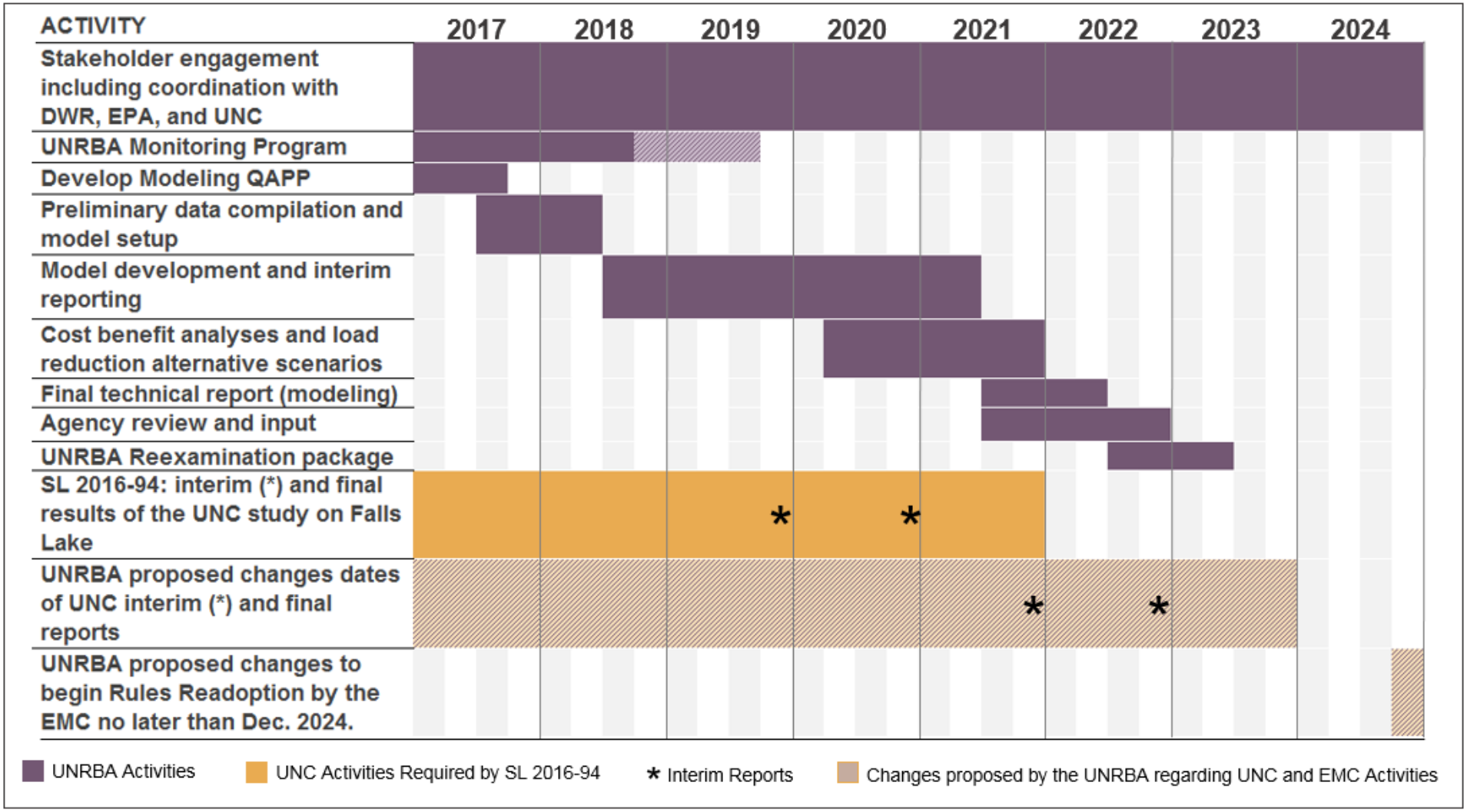
Models Selected for the Reexamination

- Watershed Analysis Risk Management Framework (WARMF)
  - Watershed model
  - Lake model – 1 dimensional with lake segments
- Environmental Fluid Dynamics Code (EFDC)
  - Lake model – 3 dimensional, hydrodynamic, grid based
- Statistical Modeling
  - Lake model – empirical model developed for lake segments

Framework for the Reexamination

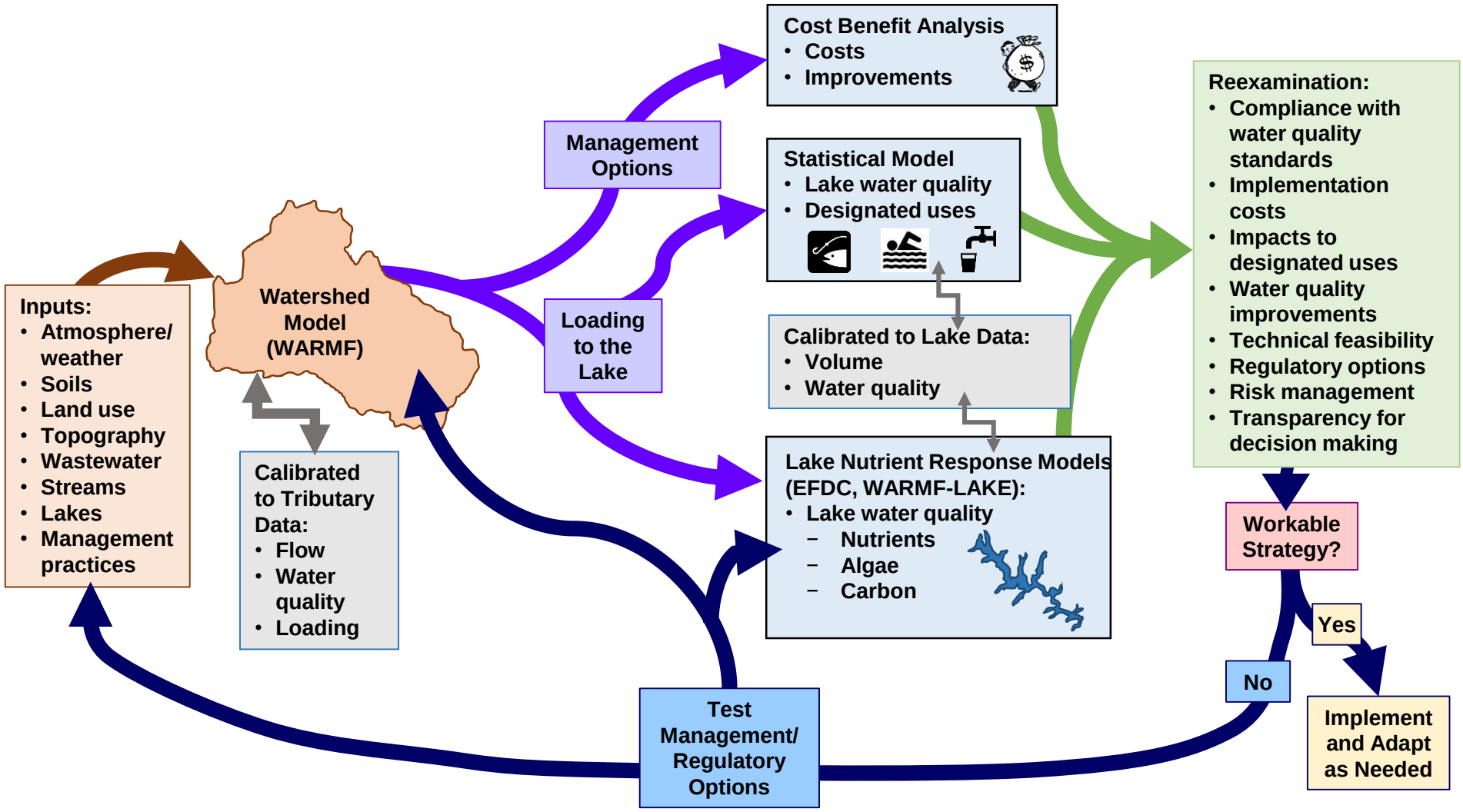


Schedule for the Reexamination



Goals for Year 2

- Stakeholder meetings in October 2017 and spring 2018
- Finalize Modeling Quality Assurance Project Plan
- Preliminary model development
  - EFDC lake model grid
  - WARMF watershed model subwatersheds and stream network
  - Evaluation of lake water quality data to inform segmentation for the statistical modeling
- Compilation of public and private data to support modeling
  - Work with stakeholders to obtain available data sets
  - Today's stakeholder meeting focuses on watershed data
  - Next presentation today will describe the data needed for WARMF


Inputs:
• Atmosphere/ weather
• Soils
• Land use
• Topography
• Wastewater
• Streams
• Lakes
• Management practices
Watershed Model (WARMF)
Calibrated to Tributary Data:
• Flow
• Water quality
• Loading
Management Options
Loading to the Lake
Cost Benefit Analysis
• Costs
• Improvements
Statistical Model
• Lake water quality
• Designated uses
Calibrated to Lake Data:
• Volume
• Water quality
Lake Nutrient Response Models (EFDC, WARMF-LAKE):
• Lake water quality
– Nutrients
– Algae
– Carbon
Reexamination:
• Compliance with water quality standards
• Implementation costs
• Impacts to designated uses
• Water quality improvements
• Technical feasibility
• Regulatory options
• Risk management
• Transparency for decision making
Workable Strategy?
Yes
No
Implement and Adapt as Needed
Test Management/ Regulatory Options

A Brief History of the UNRBA

- Formed in 1996 due to concerns about the future water quality of Falls Lake
- Following the adoption of Falls Lake Nutrient Management Strategy and the Falls Lake Rules in 2010, the organization shifted focus
- Updated goals and objectives
  - Assist member jurisdictions with Strategy implementation
  - Reexamine the Stage II Rules

Primary UNRBA Driving Forces

- Protect lake water quality for the purpose of water supply
- Stage II feasibility
  - Costs greater than $1 billion
  - Requirements are not technically feasible
- Reexamination
  - Enhanced monitoring program - $800,000 per year
  - Remodeling/updated data analysis – recalculate nutrient targets & loads
- Nutrient credits development project
  - Expansion of BMP Toolbox
- Development of alternative regulatory options

Nutrient Reduction Requirements

- Stage I (2011- 2021)
  - Achieve standards in lower lake by 2021
  - Initial reductions watershed wide
  - Reduce loading by 20% for TN and 40% for TP
  - New development requirements implemented in 2012
- Stage II (2021 – 2036)
  - Achieve standards in entire lake by 2041
  - Additional reduction in upper watershed
  - Reduce loading by 40% for TN and 77% for TP
  - Continue new development requirements

Major Components of the Rules as Developed Through the Consensus Principles

- Adaptive Management
- Provision for Reexamination of the Strategy/Rules

The Path Forward: Increasing the Effectiveness of the UNRBA in the Era of the Falls Lake Rules

Collaboration in the Era of the Falls Lake Rules

- Providing a public forum to review and discuss innovative approaches to restore, protect & maintain water quality
- A robust and innovative trading program with a transparent and accessible system for recording and maintaining nutrient offsets and credits. [*Consensus Principles #11, Session Law 2010-115]*
- Technical assistance for all jurisdictions. Service needs will vary based on the jurisdiction size and existing programs.
- A re-examination of the nutrient management strategy that answers key questions about the impacts of reductions and the feasibility of Stage II. [*Consensus Principles #9, 15A NCAC 02B.0275(5)]*

UNRBA Re-examination Strategy for Stage II

Assess existing information

Link water quality to designated uses

Assess feasibility of Stage II

- Explore regulatory options
- Implement monitoring program
- Expand the toolbox

Reexamination Effort Status

- Monitoring began August 2014
- Special studies are underway
- Interim report released November 13, 2015
- Annual monitoring report issued May 18, 2016
- RFQ for modeling and data analysis released April 8, 2016
- Modeling and Regulatory Support (MRS) Kick-Off Meeting, September 28, 2016
- Year 2 MRS Kick-Off Meeting, October 25, 2017

Falls Lake Monitoring and Modeling

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

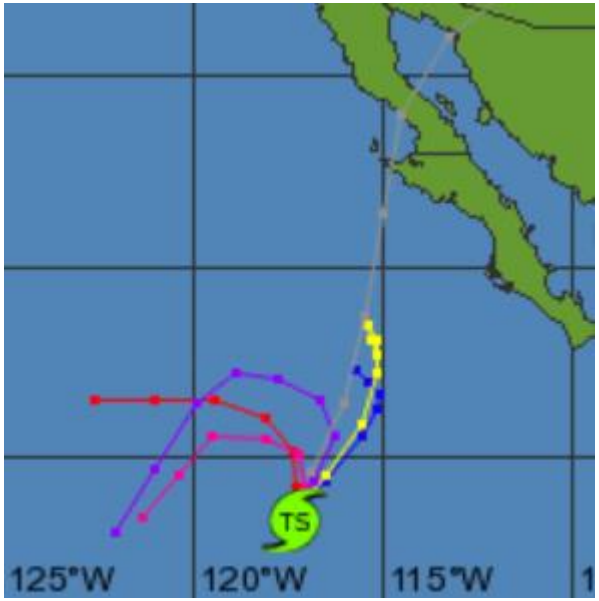
UNRBA Monitoring and Modeling to Support Reexamination

Special Studies

- 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

UNRBA Modeling Approach

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



Linking the Components of the Reexamination

Collect Monitoring Data

Develop Models

Watershed / Loading

Lake Response

Empirical / Bayesian

Adaptive Management

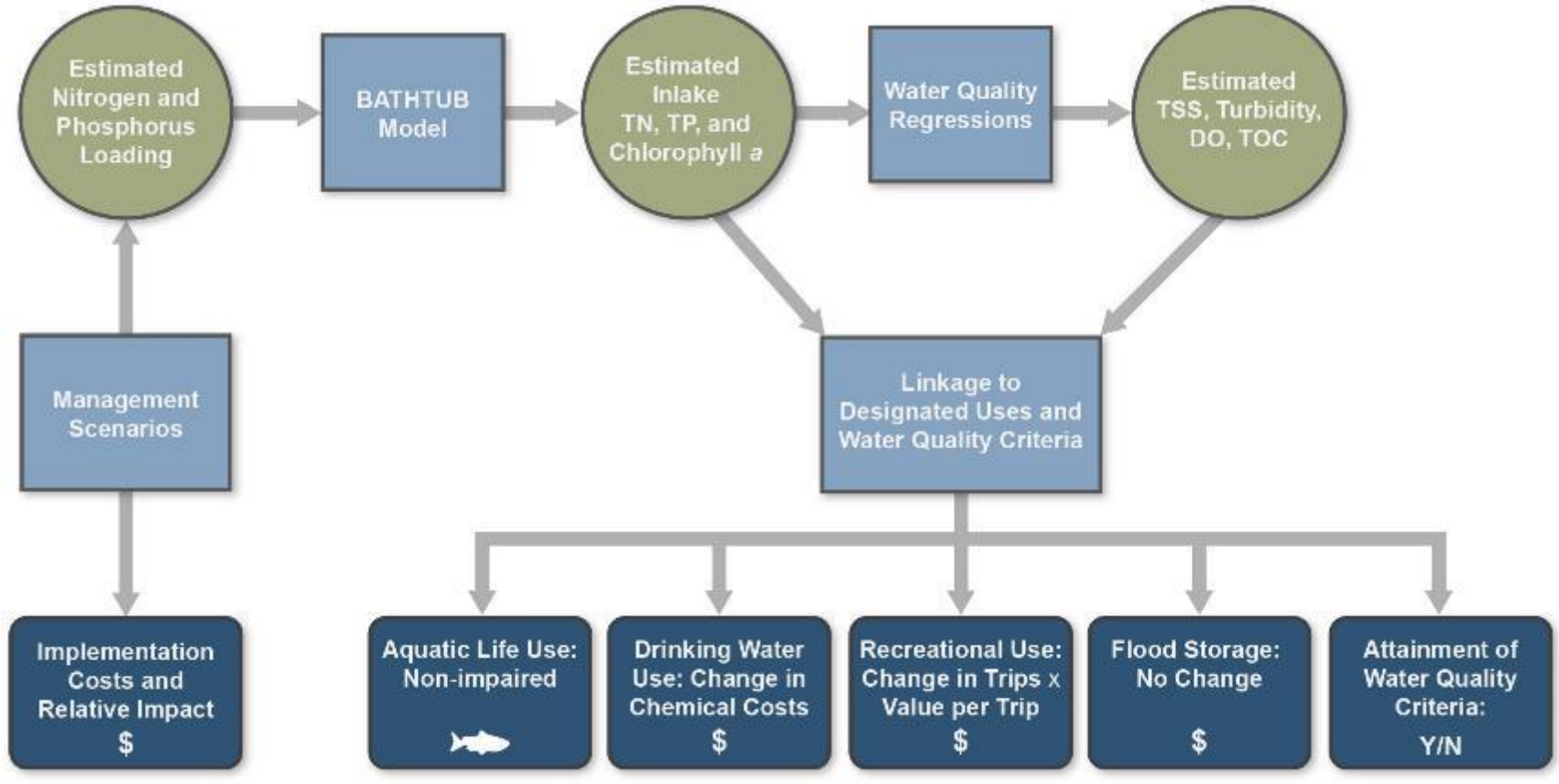
Recalculate Loading Targets,
Evaluate Feasibility
(Cost-Benefit Analysis)
and Regulatory Alternatives

Develop Management Scenarios and Regulatory Approach

Implement Approved Plan

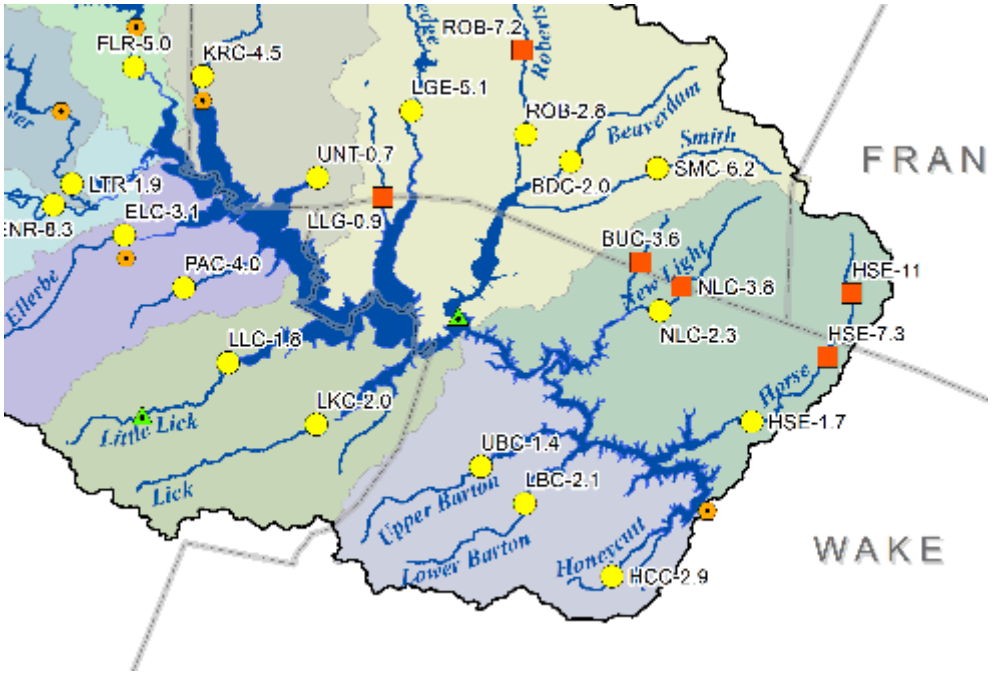
UNRBA Modeling Approach—Designated Use

> Link water quality in the lake to designated uses



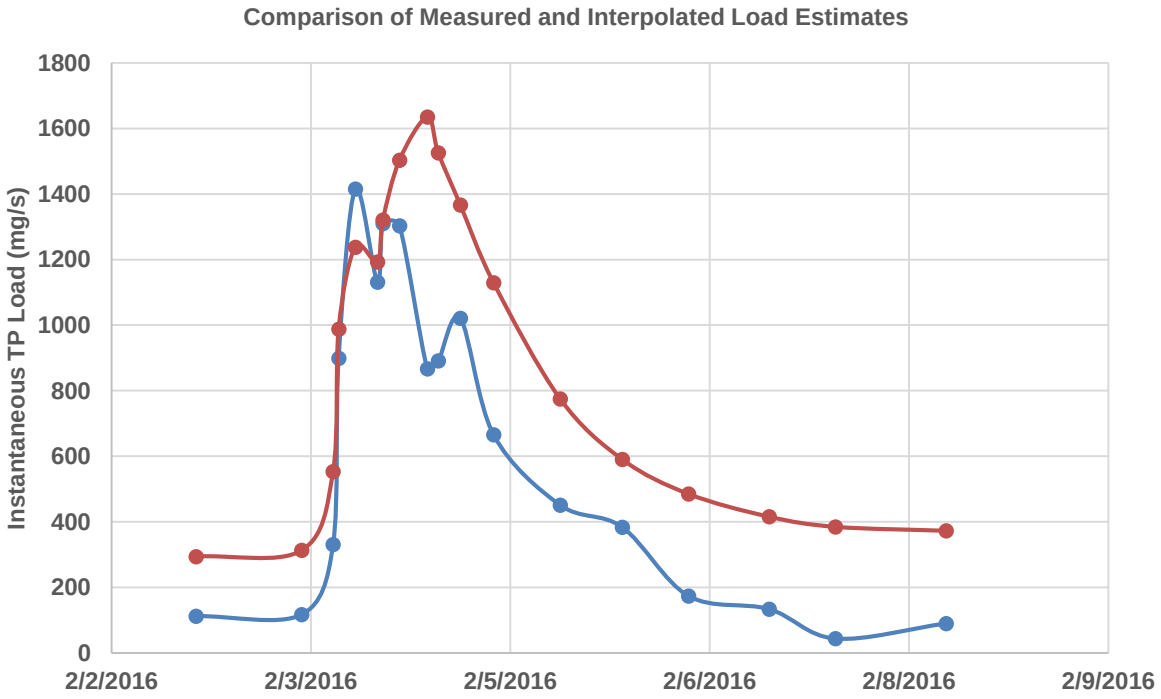
“What is entering the lake”? (chlorophyll a, nitrogen, phosphorus, organic carbon)

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



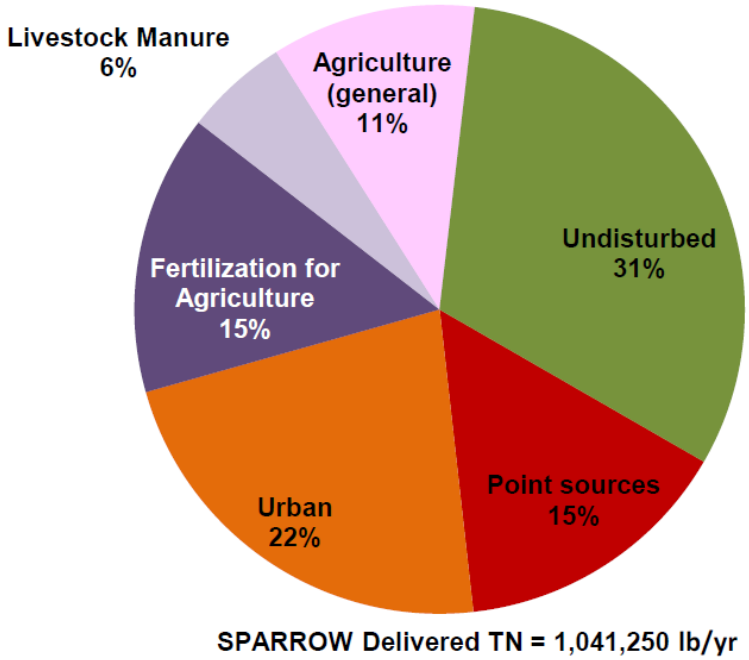
“What is entering the lake”? (chlorophyll a, nitrogen, phosphorus, organic carbon)

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



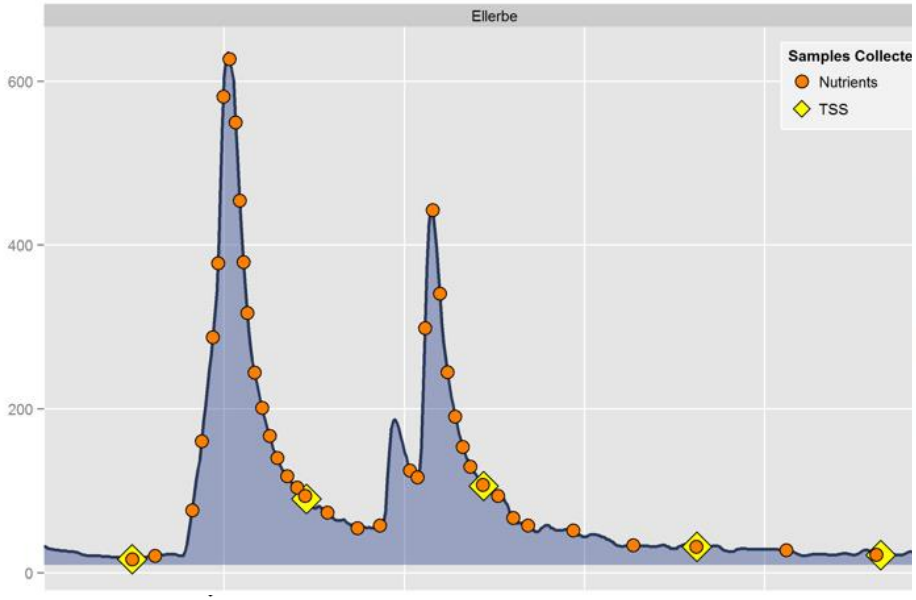
“What is entering the lake”? (chlorophyll a, nitrogen, phosphorus)

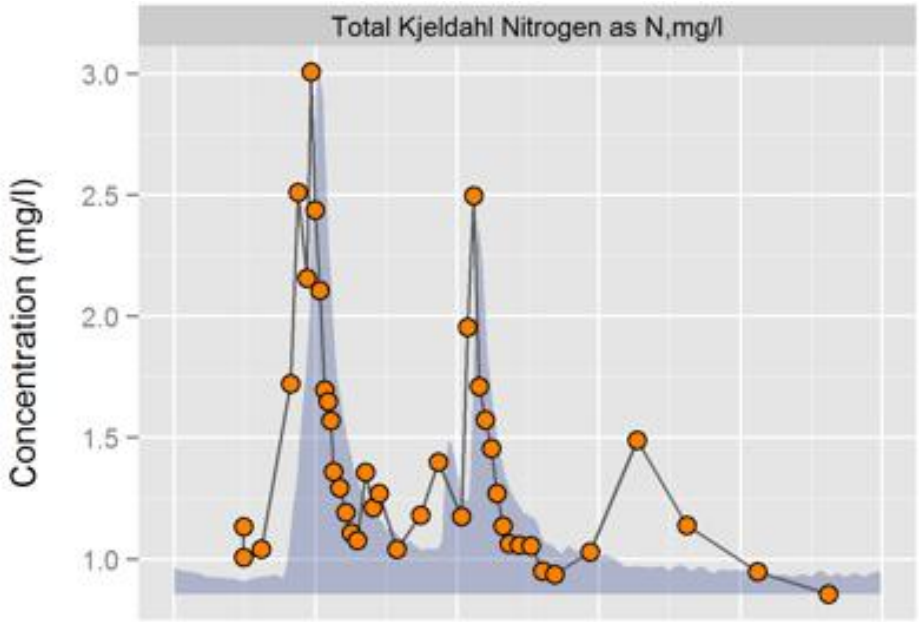
- Future development of a watershed model will help identify sources of nutrient and carbon loading



“What is 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





Issues with Original Modeling Period

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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)

Summary of Falls Reexamination
- a measured, stepwise, reexamination process

- Local governments want to improve water quality
- Local governments' burden is over $1,000,000,000
- Local governments want the best science
- Achieve improved water quality by applying economic, scientifically supportable and reasonable actions

Working to Balance Action With Level Of Problem