

Support of Long-Term  
Planning and Regulatory  
Nutrient Activities in the Falls  
Lake Watershed



Prepared for:  
Upper Neuse River Basin Association

Prepared by:



**Shaping the Future**  
Cardno ENTRIX  
5400 Glenwood Ave, Suite G03, Raleigh, NC, 27612

---

# Project Overview

---

## 1.1 Introduction

In 2011, the Upper Neuse River Basin Association (UNRBA) began a project to evaluate the regulatory framework of the Falls Lake Nutrient Management Strategy which is costly and requires actions on the part of UNRBA member governments and other regulated parties that are unprecedented in the State. In light of the potential financial impact of these rules and importance of Falls Lake as a resource, the UNRBA began evaluating the technical bases and regulatory framework for the Falls Rules, particularly Stage II. Local governments agree that protecting the use of Falls Lake as a water supply is paramount, and they want to ensure that the standards applied to the watershed sufficiently and efficiently protect this resource.

In January 2012, the UNRBA contracted Cardno ENTRIX to conduct the technical and regulatory review of the Falls Lake Nutrient Management Strategy. During the 18 month contract, four project tasks were completed to provide the UNRBA with the information needed to make informed decisions regarding the next steps to implementation of the re-examination and to develop jurisdictional loads for regulatory and program implementation purposes:

- > Task 1. Develop a Framework for a Reexamination of Stage II of the Falls Lake Nutrient Management Strategy (Cardno ENTRIX 2013a)
- > Task 2. Review Existing Data and Reports to Summarize Knowledge of Falls Lake and the Falls Lake Watershed (Cardno ENTRIX 2012)
- > Task 3. Review Methods for Delivered and Jurisdictional Nutrient Loads (Cardno ENTRIX 2013b)
- > Task 4. Recommend Future Monitoring and Modeling Approaches (Cardno ENTRIX 2013c)

This Project Overview provides background information about the project as well as a brief summary of each of the Cardno ENTRIX reports. Each report may be found on the UNRBA website at <http://unrba.org/>.

## 1.2 Background

Falls Lake was constructed by the US Army Corps of Engineers in the late 1970s. The Congressionally authorized uses of the project were flood control, water supply, recreation, fish and wildlife enhancement, and augmentation of low flows for purposes of pollution abatement and water-quality control in the Neuse River Basin. P.L. 89-298 (Oct. 27, 1965). The North Carolina Division of Water Quality (NCDWQ) specified designated uses of Falls Lake under the Clean Water Act are drinking water supply, recreation, fishing, aquatic life including propagation and survival, and wildlife.

The North Carolina General Assembly's 2005 "Clean Lakes Act" (S.L. 2005-190) generated intensive data collection in water supply reservoirs across the State, including Falls Lake. Based on water quality monitoring conducted primarily in 2006, a portion of Falls Lake, from the confluence of the Eno and Flat River arms to the Interstate 85 Bridge (I-85), was identified as impaired due to exceedances of the turbidity and chlorophyll *a* water quality criteria. Another portion of Falls Lake, from the I-85 Bridge downstream to the dam also exceeds the chlorophyll *a* water quality criterion. The water quality criteria for chlorophyll *a* and turbidity are 40 µg/L and 25 nephelometric turbidity units (NTU), respectively. Under the Use Support guidance employed for the referenced review period, NCDWQ identified waterbodies as impaired if ten percent or more of the data (minimum of ten samples) exceeded the water quality criteria. The impairment determinations were based on data collected between 2002 and 2006. Based on feedback from the Upper Neuse River Basin Association (UNRBA), the Association is, in addition to the

specific re-examination process for Falls Lake, evaluating the State's chlorophyll *a* standard and is planning on entering into discussions with the Division of Water Quality (NCDWQ) and the Environmental Management Commission (EMC) to review the State's interpretation and application of the chlorophyll *a* standard. As reflected in UNRBA discussions, there are a number of alternatives relative to the standard including the standard value itself, application of the standard over the growing season as an average, and the use of several trophic measurements rather than one to define eutrophication level.

Table 1-1 summarizes the impairments for Falls Lake segments. The impairment status is specified by assessment unit number, which is a unique identifier that the North Carolina Department of Environment and Natural Resources (NCDENR) uses to define specific waterbody segments. The designated use associated with these water quality standards violations is the Aquatic Life use. However, there is no existing biological evidence to support an impaired status for this use; i.e., the lake does not have issues with fish kills due to eutrophication or low DO and supports a healthy sports fishery, etc. Although a fish kill occurred in 2008 near Highway 50, it was limited primarily to one species, channel catfish, and water quality measurements, total algal counts, and algal speciation during the event were within normal ranges (NCDWQ 2008). A North Carolina Wildlife Resources commission representative considered it a natural event likely "caused by a combination of spawning activities and high water temperature which may have allowed a bacterial infection to sicken weakened fish" (NCDWQ 2008). However, the lake is considered impaired because it does not meet all of the applicable water quality criteria assigned to the aquatic life use. Other designated uses of the lake include municipal drinking water supply and recreation.

**Table 1-1 Falls Lake Water Quality Attainment and Impairment Status**

Listing Year	Water Body	Assessment Unit Number	Cause of Impairment	Use Support Category	Use Support Rating
2008	Flat River (incl. Flat R. Arm of Falls Lake)	27-3-(9)	Low Dissolved Oxygen	Aquatic Life	Impaired
	Neuse River (From Source to I-85 Bridge)	27-(1)	Turbidity; Chlorophyll <i>a</i>	Aquatic Life	Impaired
	Neuse River (From I-85 Bridge to Dam)	27-(5.5)	Chlorophyll <i>a</i>	Aquatic Life	Impaired
2010	Flat River (incl. Flat R. Arm of Falls Lake)	27-3-(9)	Low Dissolved Oxygen	Aquatic Life	Impaired
	Neuse River (From Source to I-85 Bridge)	27-(1)	Turbidity; Chlorophyll <i>a</i>	Aquatic Life	Impaired
	Neuse River (From I-85 Bridge to Panther Creek)	27-(5.5)a	Turbidity; Chlorophyll <i>a</i>	Aquatic Life	Impaired
	Neuse River (From Panther Creek to Falls Dam)	27-(5.5)b	Chlorophyll <i>a</i>	Aquatic Life	Impaired
2012	Flat River (incl. Flat R. Arm of Falls Lake)	27-3-(9)	Low Dissolved Oxygen	Aquatic Life	Impaired
	Neuse River (From Source to I-85 Bridge)	27-(1)	Turbidity <sup>1</sup>	Aquatic Life	Impaired
	Neuse River (From I-85 Bridge to Panther Creek)	27-(5.5)a	Turbidity <sup>1</sup>	Aquatic Life	Impaired

In 2010 the Environmental Management Commission (EMC) passed the Falls Lake Nutrient Management Strategy, requiring two stages of nutrient reductions (N.C. Rules Review Commission 2010). The Rules establish a Nutrient Management Strategy for Falls of the Neuse Reservoir aimed at attaining:

"...the classified uses of Falls of the Neuse Reservoir set out in 15A NCAC 02B .0211 from current impaired conditions related to excess nutrient inputs; protect its classified uses as set out in 15A NCAC 02B .0216, including use as a source of water supply for drinking water; and maintain and enhance protections currently implemented by local governments in existing water supply watersheds encompassed by the watershed of Falls of the Neuse Reservoir." (15NCAC 02B .0275)

Stage I of the Nutrient Management Strategy requires "intermediate or currently achievable controls throughout the Falls watershed with the objective of reducing nitrogen and phosphorus loading, and attaining nutrient-related water quality standards in the Lower Falls Reservoir as soon as possible but no later than January 15, 2021, while also improving water quality in the Upper Falls Reservoir..." (15NCAC 02B .0275 (4) (a)). Based on modeling and evaluation by the NC Division of Water Quality (NCDWQ), Stage I will require a 20 percent and 40 percent reduction in total nitrogen and total phosphorus loading, respectively, for point sources and agriculture. For development based sources, the rules require that loading be reduced to the levels of the baseline year (2006) established by NCDWQ. Stage I requires local jurisdictions to establish requirements to control nutrient input from new development sources.

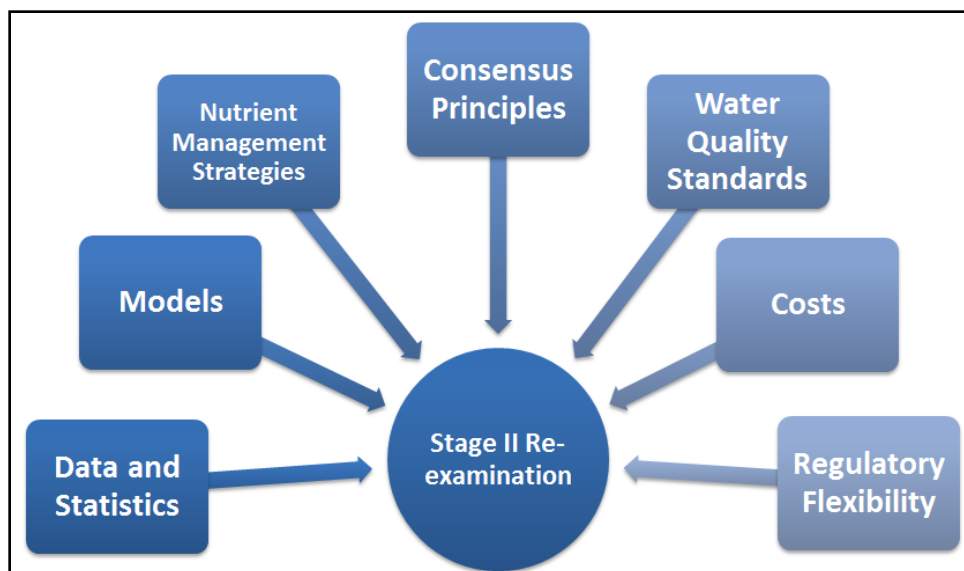
Stage II requires that all areas of Falls Lake achieve the nutrient-related water quality standards. Based on NCDWQ modeling and evaluation, the additional loading reductions required to achieve this goal are 40 percent and 77 percent for total nitrogen and total phosphorus, respectively, relative to the baseline year. NCDWQ reservoir monitoring data will be used to assess compliance with the goals of the Strategy and determine if additional load reductions to a particular lake segment are needed. As stated in the Rules:

"Stage II requires implementation of additional controls in the Upper Falls Watershed beginning no later than January 15, 2021 to achieve nutrient-related water quality standards throughout Falls Reservoir by 2041 to the maximum extent technically and economically feasible..." (15NCAC 02B .0275 (4) (b))

The NCDWQ believes that the Stage II nutrient reductions are needed for all of Falls Reservoir to achieve compliance with water quality standards. The rules identify the parties (municipalities, counties, agriculture, and state and federal entities) responsible for implementing the nutrient reductions. The nutrient reductions are to be achieved by requiring stormwater controls and implementation of best management practices (BMPs) for new and existing development, point source discharges, and agricultural non-point sources.

The Consensus Principles were adopted in February 2010 to guide the Falls Lake Nutrient Management Strategy. The Consensus Principles call for a review of the attainability of the designated uses for the Upper Lake, and the feasibility of achieving Stage II reduction goals and meeting the water quality standard for chlorophyll *a*. The principles also propose an examination of whether existing uses of the Upper Lake can be protected with alternative water quality standards.

Cardno ENTRIX is assisting the Upper Neuse River Basin Association (UNRBA) in determining the best approach to address the nutrient management rule requirements and the Consensus Principles regarding the re-examination of Stage II of the Falls Lake Nutrient Management Strategy. The re-examination should consider existing data, models, nutrient management strategies, the Consensus Principles, water quality standards (including designated uses and water quality criteria), implementation costs, and regulatory flexibility (Figure 1-1).



**Figure 1-1 Stage II Re-examination Components**

### 1.3 Organization of Work Products

Four project tasks were designed to provide the UNRBA with the information needed to make informed decisions regarding the next steps for possible implementation of the re-examination and to develop jurisdictional loads for regulatory and program implementation purposes. Each task has a corresponding report that includes the following:

#### 1.3.1 **Task 1. Develop a Framework for a Re-examination of Stage II of the Falls Lake Nutrient Management Strategy**

Cardno ENTRIX (2013a) integrates the findings from Tasks 2, 3, and 4 into a recommended path forward for the re-examination of the Stage II rules. The Task 1 executive summary serves as the executive summary for the entire project and includes an overview of the major findings of the other tasks as well as a description of the re-examination process. Cardno ENTRIX (2013a) summarizes the existing physical, chemical, and biological conditions of Falls Lake and reviews the existing lake nutrient response model. A discussion of the feasibility of Stage II of the Falls Lake Nutrient Management Strategy is also provided based on the NCDWQ fiscal analysis of the rules (NCDWQ 2010). Using existing information, Cardno ENTRIX also describes the linkage between lake water quality and uses. Task 1 also includes a discussion of the various regulatory options that may be pursued as part of the re-examination process including sub-classification use attainability analyses, site specific criteria, and variances. Cardno ENTRIX recommends that the re-examination process include additional water quality and flow monitoring studies, revised watershed and lake response modeling, and more detailed analyses to support the regulatory options being considered under the plan.

#### 1.3.2 **Task 2. Review Existing Data and Reports to Summarize Knowledge of Falls Lake and the Falls Lake Watershed**

Cardno ENTRIX (2012) compiled existing data and reports on Falls Lake and its watershed from 1999 to 2011. The resulting database was used to summarize spatial and temporal trends in lake water quality and to identify gaps in monitoring data. Summary statistics and box plots were used to assess spatial and temporal trends in water quality data. The main report and appendices summarize field parameters, nutrients, chlorophyll *a*, total organic carbon, and Secchi depth measurements.

### **1.3.3 Task 3. Review Methods for Delivered and Jurisdictional Nutrient Loads**

Cardno ENTRIX (2013b) describes the various methodologies available to calculate Stage I and Stage II load reduction requirements as described by the Falls Lake Nutrient Management Strategy. This report also includes quantification of nutrient loading from sources in the watershed that were not specifically addressed by the existing information. Estimates of nutrient loading from the five upper lake tributaries to Falls Lake are compared to other available estimates. Task 3 relies heavily on the database compiled for Task 2. Cardno ENTRIX (2013b) identified gaps in knowledge related to jurisdictional and tributary load estimation and provided preliminary suggestions for future monitoring and modeling studies which are the focus of Task 4.

### **1.3.4 Task 4. Recommend Future Monitoring and Modeling**

Cardno ENTRIX (2013c) reviewed the existing watershed and lake models developed by NCDWQ which are the basis of the Falls Lake Nutrient Management Strategy and identified future studies that will support reexamination of Stage II of the Falls Lake Nutrient Management Strategy. These studies may include monitoring or modeling studies. Task 4 relies heavily on the database compiled for Task 2 of the project and the load estimation performed under Task 3 to identify gaps in knowledge and data.

## **1.4 Summary of Project Findings**

The Falls Lake Nutrient Management Strategy presents technical and financial challenges to the regulated community in the watershed. The State estimated that Stage II of the Strategy would cost approximately \$945 million to implement (NCDWQ 2010). A review of the NCDWQ fiscal analysis indicates that these expenditures are not likely to achieve the Stage II nitrogen or phosphorus reductions (Cardno ENTRIX 2013a). Achieving the nitrogen reductions from the upper watershed would require 1) treating every acre of existing development (which is not technically feasible) 2) use of a limited set of best management practices (BMPs), and 3) installation of approximately 1,000 BMPs each year (which is not logistically feasible). The Stage II phosphorus reduction goals for existing development are beyond the limits of technology.

Given the high cost of implementing Stage II and the uncertainty with respect to the outcome, Cardno ENTRIX (2013a) recommends a multi-part approach for moving forward with the re-examination process. The overall process relies on collection of additional monitoring and modeling studies to provide a scientific basis for the re-examination. These studies will support revised lake response modeling and support the various regulatory options that comprise the overall plan for the re-examination process.

## **1.5 References**

- Cardno ENTRIX. 2012. Task 2: Review Existing Data and Reports for Falls Lake and the Watershed Support of Long Term Planning and Regulatory Nutrient Activities in the Falls Lake Watershed. Prepared for the Upper Neuse River Basin Association.
- Cardno ENTRIX. 2013a. Task 1: Framework for a Re-examination of Stage II of the Falls Nutrient Strategy Support of Long Term Planning and Regulatory Nutrient Activities in the Falls Lake Watershed. Prepared for the Upper Neuse River Basin Association.
- Cardno ENTRIX. 2013b. Task 3: Estimation of Nutrient Loading to Falls Lake Support of Long Term Planning and Regulatory Nutrient Activities in the Falls Lake Watershed. Prepared for the Upper Neuse River Basin Association.
- Cardno ENTRIX. 2013c. Task 4: Review of Existing Models and Recommendations for Future Studies Support of Long Term Planning and Regulatory Nutrient Activities in the Falls Lake Watershed. Prepared for the Upper Neuse River Basin Association.

NCDWQ. 2008. North Carolina Division of Water Quality Annual Report of Fish Kill Events, 2008.  
Available online: <http://portal.ncdenr.org/web/wq/ess/fishkills>.

NCDWQ. 2010. Fiscal Analysis for Proposed Nutrient Strategy for Falls of Neuse Reservoir.