

**NC Division of Water Quality
Planning Section – Modeling & TMDL Unit
Technical Memorandum**

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RE: Modeling Scoping Study for High Rock Lake (Yadkin-Pee Dee River Basin)

This study will not be the official modeling field study, but is designed to fill two purposes.

- ✓ This study will provide additional information for parameters not normally collected as part of the lake ambient monitoring program. These are parameters utilized heavily in the model applications and for which modelers need to have some knowledge prior to designing the formal TMDL field study.
- ✓ This study may also be utilized as a validation year for the modeling since a wealth of additional data will be available for the scoping study period. As such, the modeling staff can plan to have 2 years of calibration and 1 year of validation of the water quality model. Although the model validation will suffer somewhat from having less data in 2005, this study will provide a reasonable third condition to compare model predictions to actual data.

This scoping study is less intensive than the full TMDL field study and is included in the systematic planning for the High Rock Lake Chlorophyll-a and Turbidity TMDL. The full TMDL field study will be conducted after the systematic plan is developed and additional funding is obtained for both the monitoring and the modeling. The earliest the full TMDL field study may begin is January 2007 based on the 104(b)(3) grant cycle. Modeling could potentially begin one year after monitoring has begun, but it is more likely that modeling will begin after monitoring is complete.

The High Rock Lake Chlorophyll-a and Turbidity TMDL will include the development of three different types of physically-based water quality models, a hydrodynamic model to simulate water circulation and movement, a water quality model capable of simulating the nutrient, algal growth, and sediment cycles, and a watershed loading model for both nutrients and sediment. The hydrodynamic and water quality models will be developed for High Rock Lake, and the watershed loading model for the entire watershed to High Rock Lake (i.e., 3,973 square miles). Each of these models requires different types of input and calibration

data. In some cases, we have some historical data from which to design the TMDL field study. In other cases, the historical data is lacking. In these cases some information is needed before designing the TMDL field study, hence this scoping study. Please let me know immediately if some aspect of the scoping study will be difficult or impossible to obtain.

Lake monitoring

This special study should begin in March 2005 and continue through December 2005. Monthly sampling events should be conducted during this period, for a total of 10 sampling events. All special study data should be provided to the Modeling & TMDL Unit, with a transmittal memorandum, at the completion of the study. Data should also be provided in an electronic format (MS Access or MS Excel).

- ✓ **Spatial coverage.** Sample all existing monitoring stations (i.e., YAD1391A, YAD152A, YAD152C, YAD156A, YAD169A, YAD169B, YAD169E, YAD169F). If resources allow, also sample two additional stations: 1) the Yadkin River arm, downstream of YAD1391A and upstream of Swearing Creek and 2) the Abbotts Creek arm, at 0212160350 (Q5990000). Sampling at Q599 should be upstream of the bridge. Coordinates (i.e., latitude and longitude) should be obtained for all sampling stations prior to beginning sampling in March to allow verification of station accessibility and latitude/longitude information. Latitude/longitude is required for all sampling stations. Total number of locations: 10
- ✓ **Parameters:** In addition to physicals, depth profiles, chlorophyll-a, nitrogen series, phosphorus, Secchi depth, total solids, total suspended solids, and turbidity, include analyses for orthophosphate, total dissolved solids, total organic carbon, and BOD5. Stations receiving algal analyses are identified below. Left and right cross-section stations will not be sampled for these parameters, as described below. Since several of these parameters will require field filtering, one filtered field blank should be collected during each sampling trip. This is in addition to any other standard QA/QC sampling performed by Intensive Survey.
- ✓ **Cross-section.** If resources allow, sample a cross-section at YAD152A in order to test the lateral averaging assumption. This should include right, middle, and left sample stations with YAD152A located in the middle. Right and left stations, which do not have to be equidistant from YAD152A, should include physicals (i.e., temperature, DO, pH, and conductivity) as well as chlorophyll-a. Chlorophyll-a can be evaluated using the in-situ fluorometer since laboratory analysis of this parameter is not needed at right and left stations. If resources are not available to perform in-situ measurements of chlorophyll-a, do not perform this analysis. Nutrient series (i.e., nitrogen and phosphorus) are not necessary at the right and left stations and are at your discretion. The cross-section should be sampled during each sampling trip. Total number of additional samples to be analyzed by chemistry lab: 0
- ✓ **Algae data.** A subset of samples should also be analyzed for algal density and dominant species. Algae samples should be analyzed every other month during the 2005 scoping study, for a total of five sample events. The four sites selected for this analysis include YAD1391A, YAD152C, YAD169F, and 0202160350/Q5990000. Total number of samples to be analyzed by ESB in 2005: 20

- ✓ Continuous temperature data. Using the temperature thermisters (Tidbits), continuous temperature should be measured at three locations and multiple depths. Buoys should be placed near YAD152C, YAD169F, and 0202160350/Q5990000. Thermisters for YAD152C and 0202160350 should be placed at 1, 2, 4, and 6 meters deep, for YAD169F thermisters should be placed at 1, 2, 4, 6, 9, and 12 meters deep. Thermisters should be set to record temperature every two hours and should be deployed for the entire scoping period from March to December 2005. If resources are lacking for this schedule, monitoring should be conducted for a minimum of 5 weeks. It is suggested that the thermisters initially be deployed for a 1-week period after which field staff retrieve the devices and record the data. Field staff can then evaluate the success of the field method prior to obtaining the additional weeks of data.
- ✓ Sediment oxygen demand and nutrient flux. Sediment oxygen demand and nutrient flux data are lacking in this reservoir. Sediment oxygen demand and nutrient flux should be measured once each at YAD152C and YAD169A. Total number of samples: 2

Lake monitoring summary

Media	Type of analyses	No. of sites	No. of monthly sampling events	No. of samples to be processed
Surface water	All chemical parameters listed above	10 + field blank	10	110
	Physicals and <i>in-situ</i> chlorophyll-a (cross-sections)	2	10	N/A
	Algae	4	5	20
	Continuous temperature	3	Continuous, 14 <i>in-situ</i> Tidbits	N/A
Sediment	SOD	2	1	N/A
	Benthic nutrient flux (TN and TP)	2	1	4

Watershed monitoring

Watershed loading is an important component of the High Rock Lake modeling and strategy. The best places to calculate watershed loading of nutrients and TSS is at locations with existing USGS gages. Using 2004 data, DWQ can calculate annual loads at five locations in the watershed, as follows:

- Yadkin River at North Wilkesboro (nutrient loads only)
- Mitchell River at SR1001 (nutrient and TSS loads)
- Fisher River @ NC268 (nutrients and TSS loads)
- Yadkin River at Yadkin College (nutrient and TSS loads)
- Abbotts Creek @ SR1243 (nutrient loads only)

At least monthly nutrient and TSS data are needed to calculate annual loading rates. However, where possible I would like to get semi-monthly (i.e., bi-weekly) data. This will eliminate some of the error in the annual load estimate. Utilizing overlapping DWQ and YRBA stations is one way to get semi-monthly data. Quarterly data is insufficient and can yield unacceptable errors.

The watershed scoping study should occur for a slightly longer period than the intensive lake monitoring, for a total of 12 months. As such, the monitoring should begin no later than March 2005 and continue until February 2006. The monitoring frequency for all stations is monthly for the desired parameters. **The parameters needed include TN (TKN, NO₂/3), TP, TSS, turbidity and physicals (temperature, DO, pH, conductivity).** Total dissolved solids (TDS) are needed at a subset of sites.

Subbasin	Station and Description	DWQ Ambient site? (a)	YRBA site?	Recommendations for study
030701	Q0450000 Yadkin River at Bus US 421 nr N. Wilkesboro	No	Yes (Nutrients, metals, turbidity, bacteria)	DWQ - add site and begin sampling. YRBA-add TSS
	Q0660000 Roaring River @ SR1990 nr Roaring River	Yes (does not currently include nutrients)	No	DWQ – add nutrient sampling
030702	Q0810000 Yadkin River @ US 21 Bus @ Elkin	Yes (does not currently include nutrients)	No	DWQ- add nutrient sampling
030703	Q1780000 Ararat River @ SR2019 nr Ararat	Yes (does not currently include nutrients)	US - Q1725 Ararat R at SR 2119 nr Mt Airy (incl turbidity and bacteria)	DWQ – add nutrient sampling YRBA – continue existing sampling
	Q2040000 Yadkin River at SR1605 at Enon	Yes (does not currently include nutrients)	No	DWQ- add nutrient sampling
030704	Q2810000 Yadkin River at Yadkin College at US 64	Yes (does not currently include nutrients)	Yes (nutrients, metals, turbidity, TSS, bacteria)	DWQ- add nutrient and TDS sampling. YRBA – continue existing sampling
030706	Q3460000 South Yadkin River @ SR1159 nr Mocksville	Yes (does not currently include nutrients)	Far DS – Q397 S. Yadkin River nr Coolemee (nutrients, metals, turbidity, TSS, bacteria)	DWQ- add nutrient and TDS sampling. YRBA – continue existing sampling
030707	Q5930000 Abbotts Creek @ SR1243 at Lexington	Yes (includes nutrients)	DS – Q594 Abbots Cr @ I-85 (nutrients, turbidity, bacteria)	DWQ – add TDS sampling. YRBA - add TSS
(a) All DWQ ambient sites currently monitor TSS on a quarterly basis and turbidity on a monthly basis. The frequency of monitoring for TSS should be increased to monthly at these sites.				

Existing monthly nutrient and TSS monitoring at the following YRBA stations should be continued:

Q1065000 Mitchell River @ SR1001

Q1215000 Fisher River @ NC268 nr Fairview

Watershed monitoring summary:

Number of new DWQ ambient monitoring sites: 1

Number of DWQ ambient monitoring sites with parameter modifications: 7

Number of YRBA sites with parameter modifications: 2

Table 3. Summary of watershed samples for scoping study

Media	Type of analyses	No. of sites	No. of monthly sampling events	No. of samples to be processed
Surface water (DWQ)	All chemical parameters listed above, except TDS	8	12	96
	TDS analyses	3	12	36
(YRBA)	All chemical parameters listed above, except TDS	2	12	24

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