UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 4
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DEC 8 2016

Mr. Jay Zimmerman
Director
Division of Water Resources
North Carolina Department of Environmental Quality
1617 Mail Service Center
Raleigh, North Carolina 27699-1617

Subject: The EPA's Partial Approval of the State of North Carolina's 2016 303(d) List Submittal

Dear Mr. Zimmerman:

The North Carolina Department of Environmental Quality submitted a final 2016 Clean Water Act (CWA) Section 303(d) list of water quality limited segments and response to public comments on June 3, 2016. The U.S. Environmental Protection Agency, Region 4 has completed its review and determined that the list partially meets the requirements of CWA Section 303(d) and associated regulations and is partially approving that submission. The EPA is approving North Carolina's listing of 1,231 water quality limited segments and delisting of 44 segments.

The EPA is approving the delisting of Little Alamance Creek from the 303(d) list to the state's Integrated Reporting Category 4b (Total Maximum Daily Load (TMDL) Alternative), which is a tribute to the proactive work of the Division of Water Resources (DWR) in encouraging municipalities to voluntarily address impaired waters. Placement of waters in Category 4b requires a comprehensive demonstration that pollution controls target a particular water quality problem, are expected to result in standards attainment in the near future and include some legal or financial assurance that they will be implemented. In approving this delisting, the EPA recognizes that the watershed plan developed by the Little Alamance partners with DWR is the result of many years of effort, research and cooperation.

The EPA's review of North Carolina's submittal concluded that the state's assessment approach was acceptable for most, but not all, listing decisions. The EPA again found that the state's methodology was not defensible for assessment of toxic pollutants. In addition, the state's methodology did not contain reasonable, statistically-sound delisting procedures for most numeric water quality standards. This led to a failure to demonstrate good cause to delist impaired waters. Also, provisions in the state's methodology related to age of data and minimum sample size were not consistent with federal requirements, resulting in a failure to properly evaluate all existing and readily available data. Therefore, the EPA conducted an independent assessment of water quality data to determine if additional impairments should be added to the 303(d) list.

Based on the EPA's independent review, 72 waterbody-pollutant combinations will be included on the EPA's approved Section 303(d) list for North Carolina. The EPA will be accepting public comments concerning its decision to add these impairments to the list. The decision document for this partial approval action is enclosed. The EPA would like to continue to work closely with DWR to successfully implement the CWA and achieve improvements in water quality.

If you have questions, please contact Mr. Jim Giattina at (404) 562-9345 or Ms. Joanne Benante at (404) 562-9125.

Sincerely,

Heather McTeer Toney

Heather McTeer Toney
Regional Administrator

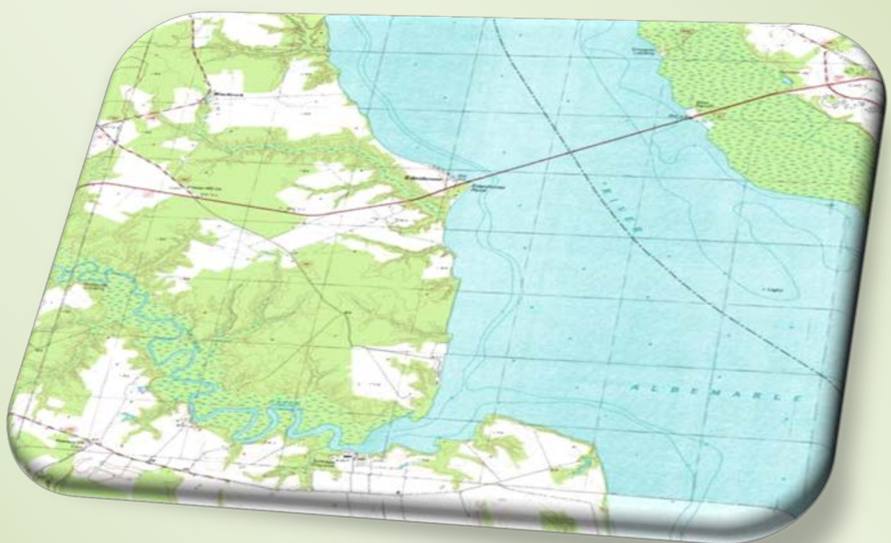
Enclosure

DECISION DOCUMENT

for the Partial Approval of the

North Carolina Department of Environmental Quality

2016 Section 303(d) List submitted on April 1, 2016



Prepared by

U.S. Environmental Protection Agency, Region 4

Water Protection Division

December 8, 2016

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I. Executive Summary

On April 1, 2016, North Carolina Department of Environmental Quality (DEQ), Division of Water Resources (DWR), submitted a final 2016 Section 303(d) list of impaired waters to the U.S. Environmental Protection Agency for review. After a thorough review of North Carolina's submittal, the EPA is partially approving the state's Section 303(d) list. This Decision Document summarizes the EPA's review and the basis for the Agency's decision.

Section 303(d)(1) of the Clean Water Act (CWA or Act) directs states to identify those waters within their jurisdictions for which effluent limitations required by Section 301(b)(1)(A) and (B) are not stringent enough to implement any applicable water quality standard [referred to as water quality limited segments, defined in Title 40 of the *Code of Federal Regulations* (CFR) Section 130.7] and to establish a priority ranking for such waters, taking into account the severity of the pollution and the uses to be made of such waters. The Section 303(d) listing requirement applies to water quality limited segments impaired by pollutant loadings from both point and/or nonpoint sources. After a state submits its Section 303(d) list to the EPA, the Agency is required to approve or disapprove that list.

This report updates the state's most recently approved Section 303(d) list, approved by the EPA on December 19, 2014 (the 2014 list). North Carolina's initial Public Review Draft of the 2016 section 303(d) list was issued on February 29, 2016. The state submitted the final Section 303(d) list to the EPA on April 1, 2016. DEQ submitted responses to comments received on the draft 303(d) list on June 3, 2016. The EPA has consistently expressed concerns about the state's 303(d) listing procedures. The EPA provided comments on September 30, 2014 on the state's 2016 303(d) Listing Methodology during a public review period, again on September 28, 2015 prior to the public review period for the 2016 303(d) list, and during the public review period for the 2016 303(d) list, on March 29, 2016.

The EPA's review of North Carolina's submittal concluded that the state's assessment approach was acceptable for most listing decisions, but not all listing decisions. The EPA determined that DWR's methodology does not reasonably assess toxic or non-conventional pollutants consistent with the State's applicable and EPA-approved water quality standards (WQS). In addition, the EPA determined that the state's methodology did not contain defensible, statistically-sound delisting procedures for most numeric WQS. This lead to a failure to demonstrate good cause to delist impaired waters. Also, the EPA determined that provisions in the state's methodology related to age of data and minimum sample size were not consistent with federal requirements, resulting in a failure to properly evaluate all existing and readily available data. The EPA has conducted an independent assessment of water quality data to determine if additional impairments should be added to the 303(d) list.

Based on the EPA's independent review and the recent state legislation, 72 additional waterbody-pollutant combinations will be included on the EPA's approved Section 303(d) list for North Carolina. The EPA will open a public comment period to receive comments concerning its decision to add these impairments to the list.

II. Statutory and Regulatory Background

A. Identification of Water Quality Limited Segments for Inclusion on the Section 303(d) List

Section 303(d)(1) of the CWA directs states to identify those waters within its jurisdictions for which effluent limitations required by Sections 301(b)(1)(A) and (B) are not stringent enough to implement any applicable water quality standard and to establish a priority ranking for such waters, taking into account the severity of the pollution and the uses to be made of such waters. The Section 303(d) listing requirement applies to waters impaired by point and/or nonpoint sources, pursuant to the EPA's long-standing interpretation of Section 303(d).

The EPA regulations at 40 CFR 130.7(b)(1) state, "Each State shall identify those water quality-limited segments still requiring TMDLs within its boundaries for which: (i) Technology-based effluent limitations required by Sections 301(b), 306, 307, or other sections of the Act; (ii) More stringent effluent limitations (including prohibitions) required by either State or local authority preserved by Section 510 of the Act, or Federal authority (law, regulation, or treaty); and (iii) Other pollution control requirements (e.g., best management practices) required by local, State, or Federal authority are not stringent enough to implement any WQS applicable to such waters." The EPA regulations define water quality limited segment as "[a]ny segment where it is known that water quality does not meet applicable WQS and/or is not expected to meet applicable WQS, even after the application of the technology-based effluent limitations required by Section 301(b) and Section 306 of the Act." See 40 CFR 130.2(j). Note: The term "water quality limited segment" as defined by federal regulations may also be referred to as "impaired waterbodies" or "impairments" throughout this decision document. TMDL is the acronym for Total Maximum Daily Load. A TMDL is a calculation of the maximum amount of a pollutant that a waterbody can receive and still meet WQS and an allocation of that load among the various sources of that pollutant.

The EPA's Integrated Report (IR) guidance[1], recommends the use of five categories, described below, to classify the water quality standard attainment status for each waterbody segment, or assessment unit. The guidance includes three sub-categories for Category 4. North Carolina currently uses the five categories recommended by the EPA plus additional sub-categories within those categories. A description of the State's sub-categories is provided in Appendix A.

Category 1: All designated uses are supported, no use is threatened;

Category 2: Available data and/or information indicate that some, but not all of the designated uses are supported;

Category 3: There is insufficient available data and/or information to make a use support determination;

Category 4: Available data and/or information indicate that at least one designated use is not being supported or is threatened, but a TMDL is not needed because:

[1] *EPA Guidance for 2006 Assessment, Listing and Reporting Requirements Pursuant to Sections 303(d), 305(b) and 314 of the Clean Water Act* (https://www.epa.gov/sites/production/files/2015-10/documents/2006irg-report.pdf) (July 29, 2005)

4a - A TMDL to address a specific segment/pollutant combination has been approved or established by the EPA.
4b - A use impairment caused by a pollutant is being addressed by the state through other pollution control requirements.
4c - A use is impaired, but the impairment is not caused by a pollutant.

Category 5: Available data and/or information indicate that at least one designated use is not being supported or is threatened and a TMDL is needed.

B. Consideration of Existing and Readily Available Water Quality Related Data and Information (40 CFR Part 130.7(b)(5)(i-iv))

In developing Section 303(d) lists, states are required to assemble and evaluate all existing and readily available water quality-related data and information, including, at a minimum, consideration of existing and readily available data and information about the following categories of waters: (1) waters identified as partially meeting or not meeting designated uses, or as threatened, in the State's most recent Section 305(b) report; (2) waters for which dilution calculations or predictive modeling indicate non-attainment of applicable standards; (3) waters for which water quality problems have been reported by governmental agencies, members of the public, or academic institutions; and (4) waters identified as impaired or threatened in any Section 319 nonpoint assessment submitted to the EPA. See 40 CFR 130.7(b)(5).

In addition to these minimum categories, states are required to consider any other water quality-related data and information that is existing and readily available. The EPA's 1991 Guidance for Water Quality-Based Decisions describes categories of water quality-related data and information that may be existing and readily available[2]. While states are required to evaluate all existing and readily available water quality-related data and information, states may decide to rely or not rely on particular data or information in determining whether to list particular waters.

In addition to requiring states to assemble and evaluate all existing and readily available water quality-related data and information, the EPA regulations at 40 CFR 130.7(b)(6) require states to include, as part of its submissions to the EPA, documentation to support decisions to list or not list waters. Such documentation needs to include, at a minimum, the following information: (1) a description of the methodology used to develop the list, (2) a description of the data and information used to identify waters, (3) a rationale for any decision to not use any existing and readily available data and information and (4) any other reasonable information requested by the Region.

C. Priority Ranking

The EPA regulations also codify and interpret the requirement in Section 303(d)(1)(A) of the Act that states establish a priority ranking for listed waters. The regulations at 40 CFR 130.7(b)(4) require states to prioritize waters on their Section 303(d) lists for TMDL development and also to identify those impaired waterbodies targeted for TMDL development in the next two years. In prioritizing and targeting waters, states must, at a minimum, take into account the severity of the pollution and the uses

[2] *EPA Guidance for Water Quality-Based Decisions: The TMDL Process*, EPA/440/4-91-001 (http://www.waterboards.ca.gov/water_issues/programs/tmdl/docs/303d_policydocs/334.pdf) (April, 1991)

to be made of such waters. See CWA Section 303(d)(1)(A). As long as these factors are taken into account, the Act provides that states establish priorities. States may consider other factors relevant to prioritizing waters for TMDL development, including immediate programmatic needs; vulnerability of particular waters as aquatic habitats; recreational, economic and aesthetic importance of particular waters; degree of public interest and support; and state or national policies and priorities.

On December 5, 2013, the EPA announced a new collaborative framework for implementing the Clean Water Act (CWA) Section 303(d) program with states — A Long-Term Vision for Assessment, Restoration and Protection under the Clean Water Act Section 303(d) Program ("Vision").[1] Under the Vision, states are expected to develop tailored strategies to implement their CWA 303(d) Program responsibilities in the context of their overall water quality goals and individual state priorities. The EPA Guidance for 2016 Assessment, List and Reporting Requirements, page 2, says the following:

> "Consistent with the new Vision, the Integrated Report submitted by States for the 2016 Integrated Reporting cycle should include, or reference, the rationale used to set long-term priorities. The rationale should explain how the State arrived at the long-term priorities; and, to the extent feasible, it should discuss where the State plans to develop future TMDLs, alternative restoration approaches, or protection plans, as well as the extent to which they already exist in priority watersheds or waters. States with priorities extending beyond FY 2022 are encouraged to also include, or reference, such information."

Although states' long-term priorities should be included, or referenced, in the 2016 Integrated Report, EPA's formal decision on the state's CWA 303(d) list will not include action on the state's long-term priorities identified under the Vision.

III. Analysis of the North Carolina Submittal

A. Review of North Carolina's Identification of Waters (40 CFR 130.7(b)(6)(i - iv))

In reviewing North Carolina's submittal, the EPA first reviewed the Listing Methodology used by the State to develop the list update in light of the State's approved WQS and then reviewed the actual list of waters. This section describes the State's Listing Methodology and outlines the EPA's evaluation of both that Methodology and the actual list of impaired waterbodies included in the submittal. In cases where the EPA could not determine if the State's Listing Methodology identified all impaired waterbodies for a given designated use or water quality criteria, the EPA conducted a review of water quality data to determine whether any waterbodies should be added to the Section 303(d) list.

Each part of the Listing Methodology was compared against the North Carolina WQS as found in the North Carolina Division of Water Resources (DWR) "Redbook" (*Surface Waters and Wetlands Standards, North Carolina Administrative Code* 15A NCAC 02B .0100, .0200 & .0300; amended effective May 1, 2007, hereafter "North Carolina Water Quality Standards.") The EPA approved revised Water Quality Standards for the state on April 6, 2016; however, the 2016 Section 303(d) list was based on the previously approved standards.

Information on monitoring procedures and water quality assessment was obtained from the DWR Monitoring Program Strategy (Version 2.6, October 29, 2014), as well as DWR's Basinwide Assessment Reports (http://deq.nc.gov/about/divisions/water-resources/water-resources-data/water-sciences-home-page/reports-publications-data) and Basinwide Water Quality Plans (http://deq.nc.gov/about/divisions/water-resources/planning/basin-planning).

1. **North Carolina's Water Quality Standards and Section 303(d) List Development**

The CWA requires each State to identify and prioritize those waters where technology-based controls are inadequate to implement WQS:

> *Each State shall identify those waters within its boundaries for which the effluent limitations required by section 1311(b)(1)(A) and section 1311(b)(1)(B) of this title are not stringent enough to implement any water quality standards applicable to such waters.* 33 U.S.C. 1313(d)(1)(A); see also 40 CFR 130.7(b) (EPA Section 303(d) listing regulations)

The EPA regulations expressly provide that "[f]or purposes of listing waters under 130.7(b), the term 'water quality standard applicable to such waters' and 'applicable water quality standards' refer to those WQS established under Section 303 of the Act, including numeric criteria, narrative criteria, water body uses and antidegradation requirements." See 40 CFR 130.7(b)(3). The EPA's review of the North Carolina Section 303(d) list ensures that the list identifies water quality limited segments consistent with existing State standards.

Water quality criteria can be expressed either as narrative or numeric criteria. Numeric criteria typically establish either a maximum level or a range of levels of a pollutant which can be present in the waterbody while still attaining WQS. Narrative criteria typically describe a condition (e.g., waters shall be suitable for aquatic life propagation and maintenance of biological integrity) which must be met for the waterbody to meet WQS. Determining whether a waterbody is meeting WQS for narrative criteria requires the identification of reference points against which the waterbody can be evaluated. The EPA defers to a State's interpretation of its WQS, including how narrative criteria should be interpreted, when that interpretation is consistent with the underlying narrative criteria and is a reasonable translation of those criteria.

Narrative Water Quality Criteria

The following is a list of the primary narrative criteria considered in North Carolina's water quality assessment. The sections below summarize the EPA's review of the State's methodology against these narrative criteria.

- North Carolina Administrative Code (NCAC) 15A 02B .0208 (Narrative for toxics and temperature).
- NCAC 15A 02B .0211 (Several narratives related to making all fresh waters suitable for aquatic life propagation and maintenance of biological integrity, wildlife, secondary recreation and agriculture).
- NCAC 15A 02B .0220 (Several narratives related to making all salt waters suitable for aquatic life propagation and maintenance of biological integrity, wildlife, and secondary recreation).
- NCAC 02B 15A .0231 (Narratives related to wetlands).

Numeric Water Quality Criteria

The primary numeric criteria related to water quality assessment in North Carolina are detailed in 15A NCAC 02B .0100, .0200 & .0300 (amended effective date May 1, 2007). The State expresses its numeric water quality criteria in a variety of ways, which are delineated for each parameter in the following sections. In general, numeric criteria are written as "maximum permissible levels" or values which "shall not be exceeded."

North Carolina's 2016 303d Listing Methodology

The state uses five different general assessment methods for WQS assessment. Each are described in Sections 4-8 below. However, the EPA has determined that the Methodology used for most numeric WQS is not being used correctly for delisting decisions.

The state uses a nonparametric hypothesis testing approach based on the binomial distribution to assess conventional pollutants and nutrients (chlorophyll-*a*). From the 2016 303(d) Listing Methodology: "The binomial method allows a quantifiable level of statistical confidence (90%) for listing decisions, which provides a 10% probability of listing an assessment unit when it should not be listed." The Methodology does not address removal of waters from the 303(d) or provide for statistical confidence to protect against delisting a waterbody when it should not be delisted.

In its 2014 303(d) list, the state submitted a "Justification for Changes to the 10% Listing Method" that indicated this approach is similar to the one outlined in *A Nonparametric Procedure for Listing and Delisting Impaired Waters Based on Criterion Exceedances*.[3] However, the state's approach is dissimilar to the referenced *Procedure* in that North Carolina does not differentiate between listing and delisting. This is a critical omission from North Carolina's methodology as "[t]he problem of deciding by a statistical procedure whether or not to delist a body of water that has already been designated as 'impaired' is not the same thing as deciding to list an impaired water." (Section 4, Delisting Procedure, of the Lin, et al., paper.)

With the introduction of the binomial approach, the state has the opportunity to recognize and manage uncertainties. The EPA agrees that the binomial approach can help manage uncertainties in making assessment decisions and, as North Carolina's Listing Methodology says, that "the degree of uncertainty depends on the sample size." The uncertainties also depend on the decision rules (or null hypotheses) chosen.

The null hypothesis "is what is assumed to be true about the system under study prior to data collection, until indicated otherwise."[4] According to the state's 2016 Listing Methodology, the "null hypothesis is that the overall exceedance probability is less than or equal to the 10% exceedance allowance." That is, the null hypotheses is that the waterbody is not impaired. Once a waterbody is determined to be impaired, however, the null hypothesis should be reversed to be consistent with a delisting decision. Assuming the same level of confidence (90%) is desired, a different statistical analysis must be employed in delisting decisions.

Confidence and sample size are mathematically linked. There is less chance of making either type of error as the amount of monitoring data increases. As Lin, et al., describe: "… the same sample size could be used for listing and delisting at the expense of a lesser confidence level for delisting. As already

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[3] Lin, Pi-Erh, Duane Meeter and Xu-Feng Niu. 2000. *A Nonparametric Procedure for Listing and Delisting Impaired Waters Based on Criterion Exceedances*. Technical Report. Department of Statistics, Florida State University, Tallahassee, FL.
[4] Helsel, D.R. and R. M. Hirsch, 2002. *Statistical Methods in Water Resources*, Techniques of Water Resources Investigations, Book 4, chapter A3. U.S. Geological Survey. See page 104.

demonstrated, we may use n = 10 samples for both listing and delisting. With three exceedances, the water body reach is listed as impaired with 92.98% confidence … while with no exceedance observed, out of the ten sample measurements, the water body is removed from the impaired water list with only 65.13% confidence… However, any statistical conclusion that has a confidence level of less than 90% is considered not acceptable by most statistics practitioners."

The EPA has determined that the state's Methodology is not being used correctly for delisting decisions and has conducted an independent assessment of water quality data to determine if additional impairments should be added to the Section 303(d) list. Our review found 17 waterbody-pollutant combinations that should be included on the 2016 list as impairments to aquatic life, based on failure to demonstrate good cause to delist. These waters are discussed further in section III.A.4.b and section III.A.4.c. The EPA's analysis and a list of all 17 waters can be found in Appendix C.

The state also uses this approach for toxics, however, the EPA has determined that the state's methodology is not a reasonable method to assess toxics consistent with the State's currently applicable, the EPA-approved WQS. See section III.A.4.e for more discussion on this.

2. Consideration of Existing and Readily Available Water Quality-Related Data and Information

Federal regulations provide that each state "shall assemble and evaluate all existing and readily available water quality-related data and information to develop the list required by Sections 130.7(b)(1) and 130.7(b)(2)." See 40 CFR 130.7(b)(5). The North Carolina DWR collects a variety of biological, chemical and physical data from six primary programs, including benthic macroinvertebrates, fish community, fish tissue, lake assessment, ambient monitoring and aquatic toxicity monitoring.

Sources of data and information include the following: previous Section 303(d) lists; waterbodies where specific fishing or shellfish bans and/or advisories are currently in effect; and data, information and water quality problems reported from local, State, or Federal agencies, Tribal governments, members of the public and academic institutions. DWR maintains a standing solicitation for data on their website http://portal.ncdenr.org/web/wq/ps/mtu/assessment. For data to be used for impairment determinations, data must meet specific submission criteria, including quality assurance and quality control of the collection and analysis of the data.

Use support is assessed for all basins statewide. The 2016 list is based on all data collected in calendar years 2010 through 2014. In some cases, older biological data is used for waters that have not been re-sampled during this data window or where the current impairment is based on that sample.

According to DWR's Use Assessment Methodology, greater than nine samples are needed to be considered for use support assessments (other than biological data). DWR's monitoring program routinely collects more than nine samples at each monitoring site for most parameters, with the exception of some lakes. There has been an understanding that lakes were to be targeted for adequate sampling to ensure that there would be enough data to assess according to the Assessment Methodology required minimum sample size. However, within the data window for the 2016 assessment, state resources were directed to large reservoir projects, leaving several lake data sets with nine or fewer samples.

EPA Conclusion

North Carolina's assessment methodology contains provisions for limiting the use of data based on the age of data (five year window) and sample size (greater than nine samples). The EPA recommends that older data not be automatically excluded, particularly when its inclusion could be used to augment small sets of more current data. The assessment methodology could include a list of circumstances that would explain why the data is no longer reliable or representative. As to minimum sample size provisions in the State assessment methodology, the EPA has two significant concerns.

First, the methodology should allow listing where data demonstrates sufficient exceedances of a criterion, even though the minimum sample size (>9 samples) has not yet been collected. For example, North Carolina's methodology specifies 3 exceedances out of 10 samples are necessary to determine that a waterbody is impaired. Where a waterbody has at least 3 exceedances, regardless of the total number of samples, there is no need to collect the full 10 samples to pass the assessment methodology's exceedance threshold. Such waterbodies should be identified as impaired. As an example, for a given waterbody where four out of five samples exceed the water quality criteria, we note that if five additional non-exceeding samples were collected (to meet the minimum sample size of ten), it would still be considered impaired because four out of ten samples would exceed the criteria. There is no need to wait on the collection of the additional five samples to determine impairment.

Second, many states make the decision of whether a small number of data points can adequately support a conclusion of impairment or non-impairment based on whether the evidence for the small number of samples is "overwhelming." An overwhelming evidence test could consider such factors as the magnitude of exceedance over WQS, or the frequency at which standards were exceeded, or other lines of evidence (e.g., biological, physical, tissue, or sediment data) could be consulted in making an impairment decision on small data sets. North Carolina's methodology does not include an overwhelming evidence test.

Because the EPA identified the State's provisions as being overly restrictive, a data review was conducted to determine if waters, which should be considered impaired, may have been omitted from the list due to these provisions. As has been done in previous listing cycles, the EPA conducted the review by analyzing all data used by DWR in the assessment for the applicable data window. Supporting information was found in the DWR Basin Assessment Reports[5] and Basin Water Quality Plan Reports[6], available online.

For most parameters, several data sets contained fewer than ten data points, but within those small sets there were mostly less than three exceedances. The exception was primarily in the small sets of data available for lakes/reservoirs where there were three or more exceedances of chlorophyll *a* and, in one case, turbidity. While past data reviews have shown no potential issues, in this listing cycle, the EPA has identified 11 impaired assessment units. These waters are discussed in section III.A.4.b and section III.A.4.c and are listed in Appendix B. See Appendix D for a discussion of the EPA's independent review of small sample sets of data.

In order for the EPA to conclude that the State's process is consistent with federal requirements for consideration of data and information, the State should revise its methodology to allow consideration of older data and data contained within smaller data sets for future Section 303(d) lists.

[5] http://deq.nc.gov/about/divisions/water-resources/water-resources-data/water-sciences-home-page/reports-publications-data

[6] http://deq.nc.gov/about/divisions/water-resources/planning/basin-planning

3. Assessment Unit Delineation Approach / Geo-referencing

North Carolina maintains a water quality assessment database, which for each assessment unit provides a description, use support ratings, parameters of interest, as well as the capability to track changes through time. This database is linked with other North Carolina water quality databases including ambient, benthic and fish community data as well as 1:24,000 hydrography. Assessment units are delineated to the 1:24,000 statewide hydrography and can be easily located using a Geographic Information System (GIS). The State has completed georeferencing statewide including indexing assessment units to the high resolution National Hydrography Dataset (NHD).

EPA Conclusion

The State provided a GIS dataset of the State's assessment units at NHD 1:24,000 scale. For the 2016 303(d) list, DWR posted draft GIS data on its website and will finalize the data after the EPA approval[7].

4. Aquatic Life Use Support

The State considers biological and ambient monitoring data in assessing the aquatic life use support category. The EPA separated its review of North Carolina's assessment of aquatic life use support into five categories: waterbodies not listed due to natural conditions; assessment based on physical (naturally variable) parameters, nutrient enrichment, biological indicators; and toxic/non-conventional pollutants.

a. Waterbodies not listed due to natural conditions

North Carolina does not list waterbodies where it is determined that measured concentrations of pH (potential of Hydrogen ions, a measure of acidity or alkalinity) or dissolved oxygen (DO) do not meet the numeric criteria due to natural conditions. North Carolina's WQS address natural conditions, providing that "natural waters may on occasion, or temporarily, have characteristics outside of the normal range established by the standards. The adopted WQS relate to the condition of waters as affected by the discharge of sewage, industrial wastes or other wastes including those from nonpoint sources and other sources of water pollution. WQS will not be considered violated when values outside the normal range are caused by natural conditions. Where wastes are discharged to such waters, the discharger will not be considered a contributor to substandard conditions provided maximum treatment in compliance with permit requirements is maintained and therefore, meeting the established limits is beyond the discharger's control." (15A NCAC 02B .0205)

North Carolina has assigned a supplemental classification category for Swamp Waters (Sw) which is intended to recognize those waters that generally have naturally occurring very low velocities, low pH and low DO. State WQS acknowledge that DO and pH may be natural conditions that are outside the required standard range. For DO, 15A NCAC 02B .0211(3) (b) states, "swamp water, lake coves or backwaters, and the lake bottom waters may have lower values if caused by natural conditions." For pH, 15A NCAC 02B .0211(3) (g) states, "...swamp waters may have a pH as low as 4.3 if it is the result of natural conditions."

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[7] http://ncdenr.maps.arcgis.com/apps/webappviewer/index.html?id=87870e4480c54b8abf6bd7ee97ebc26b

If DWR identifies natural condition waters with point source discharges, DWR conducts an analysis of the likely impact of the discharges. The waters will be listed if the discharges may be contributing to the low DO or pH.

EPA Conclusion

DWR has identified waterbodies containing low pH and DO which are believed due to natural conditions. These are generally slow-moving blackwater streams, low-lying swamps and productive estuarine waters in the Coastal Plain. Based on the available data and information, North Carolina's decision that these waterbodies should be included in Category 3 rather than on the State's Section 303(d) list is reasonable. However, these segments should be considered high priority for follow-up monitoring in order to confirm that the low pH and DO found in these waterbodies is due solely to natural conditions.

In addition, the State should continue to include in its IR submission a rationale for either removing or not including these water/pollutant combinations on the State's Section 303(d) list. The EPA's *Information Concerning 2014 Clean Water Act Sections 303(d), 305(b), and 314 Integrated Reporting and Listing Decisions* http://water.epa.gov/lawsregs/lawsguidance/cwa/tmdl/2014-memo.cfm provides this guidance:

> *The rationale should identify the geologic or other conditions that cause the natural loading of the pollutant to exceed otherwise applicable water quality standards. In addition, the rationale should document why anthropogenic sources of pollutant loading, such as municipal, industrial, agricultural, contaminated groundwater, or anthropogenic airborne deposition, were determined not to be sources of pollutant loading. The rationale should also cite the approved, applicable natural conditions provision upon which the State is relying.*

b. Impairments Indicated by Physical Parameters

Naturally variable physical parameters are those that fluctuate in a waterbody due to non-anthropogenic influences such as rainfall/flow, depth, time of day, salinity, etc. Naturally variable parameters assessed by DWR during this listing cycle include DO, pH, temperature and turbidity. Comparison against the North Carolina WQS is as follows.

Water Quality Standard (note: mg/l is milligrams per liter)	**State Assessment Methodology**
Freshwater Dissolved Oxygen **NCAC 15A 02B .0211(3)(b)** DO not less than 6.0 mg/l for trout water, not less than a daily average of 5.0 mg/l with a minimum instantaneous value of not less than 4.0 mg/l; swamp waters, lake coves or backwaters and lake bottom waters may have lower values if caused by natural conditions (see section 4a, above).	**Exceeding Criteria- Category 5** - Greater than 10% exceedance with greater than or equal to 90% confidence - Sample size is greater than nine - AU is not a class Sw or swamp-like

Saltwater Dissolved Oxygen **NCAC 15A 02B .0220(3)(b)** DO not less than 5.0 mg/l, except that swamp waters, poorly flushed tidally influenced streams or embayments, or estuarine bottom waters may have lower values if caused by natural conditions.	**Exceeding Criteria-Category 5** - Greater than 10% exceedance with greater than or equal to 90% confidence - Sample size is greater than nine - AU is not a class Sw or swamp-like
Freshwater pH **NCAC 15A 02B .0211 (3)(g)** pH shall be normal for the waters in the area, which generally shall range between 6.0 and 9.0 except that swamp waters may have a pH as low as 4.3 if it is the result of natural conditions **Saltwater pH** **NCAC 15A 02B .0220(3)(g)** pH shall be normal for the waters in the area, which generally shall range between 6.8 and 8.5.	**Exceeding Criteria- Category 5** - Greater than 10% exceedance with greater than or equal to 90% confidence - Sample size is greater than nine - AU is not a class Sw or swamp-like
Freshwater Temperature **NCAC 15A 02B .0211 (3)(j)** Temperature not to exceed 2.8^{o} C above the natural water temperatures, and in no case to exceed 29^{o} C for mountain and upper piedmont waters and 32^{o} C for lower piedmont and coastal plain waters. The temperature for trout waters shall not be increased by more than 0.5^{o} C due to the discharge of heated liquids but in no case to exceed 20^{o} C. **Saltwater Temperature** **NCAC 15A 02B .0220(3)(k)** Temperature shall not be increased above the natural water temperature by more than 0.8^{o} C during June, July and August nor more than 2.2^{o} C during other months and in no cases to exceed 32^{o} C due to the discharge of heated liquids.	**Exceeding Criteria- Category 5** - Greater than 10% exceedance with greater than or equal to 90% confidence - Sample size is greater than nine
Turbidity NCAC 15A 02B .0211 (3)(k) and 15A NCAC 02B .0220 Turbidity in the receiving water shall not exceed 50 Nephelometric Turbidity Units (NTU) in streams not designated as trout waters and 10 NTU in streams, lakes or reservoirs designated as trout waters; for lakes and reservoirs not designated as trout waters the turbidity shall not exceed 25 NTU; if turbidity exceeds these levels due to natural conditions the existing turbidity level cannot be increased. 25 NTU – salt waters	**Exceeding Criteria- Category 5** - Greater than 10% exceedance with greater than or equal to 90% confidence - Sample size is greater than nine

The EPA's 2002 *Consolidated Assessment and Listing Methodology* (CALM) guidance[8] recommends that the "state's assessment and listing methodology should describe how chemical data are collected and how they are used to determine the attainment of water quality standards." The web page for DWR's Ambient Monitoring System references standard operating procedures and quality assurance documents that provide additional information on the collection of samples which satisfies that provision.[9,10]

EPA conclusion

The state's WQS for DO, pH, temperature and turbidity do not specify an allowable percent of samples outside of the criteria. North Carolina's use of a ten percent threshold (plus 90% confidence) for determining use support for naturally variable parameters is generally consistent with North Carolina's existing, the EPA-approved WQS and with the EPA regulations for 303(d) listing purposes.

However, the EPA has determined that the state's methodology, as currently presented, did not contain defensible, statistically-sound delisting procedures for most numeric WQS (see Section III.A.1). Use of a nonparametric procedure for delisting requires stronger evidence and a larger sample size than for listing but this provision is not included in the state's methodology. The lack of appropriate delisting provisions resulted in DWR failing to identify 13 waterbody pollutant combinations as not attaining the WQS for DO, pH and turbidity.

Also, the EPA determined that provisions in the state's methodology related to age of data and minimum sample size are not consistent with federal requirements (see Section III.A.2). The provisions of the state's methodology related to minimum sample size resulted in DWR failing to identify one waterbody as not attaining the turbidity standard (see Appendix D). In order for EPA to conclude that the state's process is consistent with federal requirements for consideration of data and information, the state should revise its methodology to allow consideration of older data and data contained within smaller data sets for future Section 303(d) lists.

Based on the EPA's independent review of the existing and readily available data, the EPA is approving all except 14 of DWR's listing decisions for DO, pH, temperature and turbidity. These waterbody-pollutant combinations, listed in Appendix B, will be included on the EPA's approved Section 303(d) list for North Carolina.

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[8] *EPA's Consolidated Assessment and Listing Methodology*: *Toward a Compendium of Best Practices* (https://www.epa.gov/sites/production/files/2015-09/documents/consolidated_assessment_and_listing_methodology_calm.pdf) (July 2002)

[9] NC DWR's *Intensive Survey Unit Standard Operating Procedures* (https://ncdenr.s3.amazonaws.com/s3fs-public/Water%20Quality/Environmental%20Sciences/ISU/ISB%20SOP%20Version2.1%20%20FINAL.pdf) (December 2013)

[10] NC DWR's *Ambient Lakes Monitoring Program Quality Assurance Project Plan* (https://ncdenr.s3.amazonaws.com/s3fs-public/Water%20Quality/Environmental%20Sciences/ISU/Final%20LakesQAPP%20v1.1%20Approved%207-2012.pdf) (July 2012)

c. Impairments Indicated by Nutrient Enrichment

North Carolina's WQS include a numeric criterion for chlorophyll *a*, which is used as an indicator of nutrient enrichment in waters of the State.

Water Quality Standard	**State Assessment Methodology**
NCAC 15A 2B .0211 (3) (a) "Chlorophyll *a*: not greater than 40 ug/l for lakes, reservoirs, and other waters subject to growths of macroscopic or microscopic vegetation not designated as trout waters and not greater than 15 ug/l for lakes, reservoirs, and other waters subject to growths of macroscopic or microscopic vegetation designated as trout waters (n/a to lakes and reservoirs less than 10 acres in surface area)."	**Exceeding Criteria- Category 5** - Greater than 10% exceedance with greater than or equal to 90% confidence - Sample size is greater than nine

EPA conclusion

The state's water quality standard for chlorophyll *a* does not specify an allowable percent of samples outside of the criteria. North Carolina's use of a ten percent threshold (plus 90% confidence) for determining use support for chlorophyll *a* is generally consistent with North Carolina's existing, the EPA-approved WQS and with the EPA regulations for 303(d) listing purposes.

However, the EPA has determined that the state's methodology, as currently presented, did not contain defensible, statistically-sound delisting procedures for most numeric WQS (see Section III.A.1). Use of a nonparametric procedure for delisting requires stronger evidence and a larger sample size than for listing but this provision is not included in the state's methodology. The lack of appropriate delisting provisions resulted in DWR failing to identify 4 assessment units as not attaining the WQS for chlorophyll *a*. These assessment units are part of High Rock Lake in the Yadkin River basin.

Also, the EPA has determined that provisions in the state's methodology related to age of data and minimum sample size are not consistent with federal requirements (see Section III.A.2). The provisions of the state's methodology related to minimum sample size resulted in DWR failing to identify 10 assessment units as not attaining the chlorophyll *a* standard (see Appendix D). In order for the EPA to conclude that the State's process is consistent with federal requirements for consideration of data and information, the State should revise its methodology to allow consideration of older data and data contained within smaller data sets for future Section 303(d) lists.

Based on the EPA's independent review of the existing and readily available data, the EPA is approving all except 14 of DWR's listing decisions for chlorophyll *a*. These waterbody-pollutant combinations, listed in Appendix B, will be included on the EPA's approved Section 303(d) list for North Carolina.

d. Impairments Indicated by Biological Information

The EPA reviewed North Carolina's listing methodology for assessment of Aquatic Life designated use support indicated by biological monitoring. North Carolina's WQS include a narrative for biological integrity applicable to all Class C waters, as follows.

Water Quality Standard	State Assessment Methodology
NCAC 15A 2B .0211 (2) "The waters shall be suitable for aquatic life propagation and maintenance of biological integrity, wildlife, secondary recreation and agriculture; sources of water pollution which preclude any of these uses on either a short-term or long-term basis shall be considered to be violating a water quality standard." **NCAC 15 A 2B .0202 (11)** Biological integrity is defined as "...the ability of an aquatic ecosystem to support and maintain a balanced and indigenous community of organisms having species composition, diversity, population densities and functional organization similar to that of reference conditions."	**Exceeding Criteria-Category 5** - Poor, Fair, and Severe biological ratings

Benthic macroinvertebrate and fish community assessments are completed by the DWR Biological Assessment Unit.[11] The most recent Standard Operating Procedures for macroinvertebrate (February 2016) and fish community assessment (December 2013), data and scores and ratings are available on the DWR website.[12,13] If both macroinvertebrate and fish community data are available, both are used to evaluate use support. The State's use of multiple assemblages is in conformance with the EPA's recommendation in the 2002 CALM guidance that the use of more than one biological index enhances "confidence in the assessment finding."

EPA Conclusion

The DWR Listing Methodology for biological data is consistent with North Carolina's existing, EPA-approved WQS and EPA regulations. The EPA is approving DWR's listing decisions based on biological data.

[11] NC DWR Biological Assessment Unit website: http://deq.nc.gov/about/divisions/water-resources/water-resources-data/water-sciences-home-page/biological-assessment-branch.

[12] NC DWR Standard Operating Procedures for Macroinvertebrates: https://ncdenr.s3.amazonaws.com/s3fs-public/Water%20Quality/Environmental%20Sciences/BAU/NCDWRMacroinvertebrate-SOP-February%202016_final.pdf

[13] NC DWR Standard Operating Procedures for Fish Communities https://ncdenr.s3.amazonaws.com/s3fs-public/document-library/IBI%20Methods.2013.Final.pdf

e. Impairments Indicated by Toxic and Non-Conventional Pollutants

Many pollutants which exert a toxic effect in water react and behave differently in the environment than the naturally variable pollutants discussed above. Unlike the naturally variable pollutants described above, toxic and non-conventional pollutants do not generally have wide variability in concentration under natural conditions that would still be protective of the designated use. Therefore, the EPA carefully considered waterbodies with data related to toxic and non-conventional pollutants when reviewing North Carolina's Section 303(d) list. In considering this data, the EPA paid particular attention to the magnitude and duration of any exceedances and also considered any compensating periods of time when no exceedances were observed. See the EPA Technical Support Document for Water Quality-based Toxics Control.[14]

Parameter	**Water Quality Standard** (µg/l is micrograms per liter.)	**State Assessment Methodology**
Arsenic	50 µg/l (fresh and salt waters)	**Exceeding Criteria - Category 5** - Greater than 10% exceedance with greater than or equal to 90% confidence - Sample size is greater than nine
Chromium	50 µg/l fresh water 20 µg/l salt water	
Lead	25 µg/l (fresh and salt waters)	
Cadmium	0.4 µg/l for trout waters, 2.0 µg/l for non-trout waters and 5.0 µg/l for salt waters	
Nickel	88 µg/l fresh water 8.3 µg/l salt water	
Cyanide	5 µg/l fresh water	
Fluoride	1.8 milligram/l	
Copper	7 µg/l fresh water 3 µg/l salt water	
Zinc	50 µg/l fresh water 86 µg/l salt water	
Iron	1 milligram/l	Iron was not assessed in this cycle. Previous iron data that was assessed showed elevated levels to be a natural condition statewide.

[14] Technical Support Document for Water Quality-based Toxics Control, Appendix D - Duration and Frequency, U.S. Environmental Protection Agency, EPA/505/2-90-001 (https://www3.epa.gov/npdes/pubs/owm0264.pdf) (March 1991)

North Carolina's WQSs for toxics, as documented in the State's *Redbook* (Amended Effective May 1, 2007), are specified as "maximum permissible levels." Because the State's WQSs do not define the conditions of toxicity (acceptable duration and frequency), one interpretation of the WQSs could be that no exceedances are permissible in the waters of the state; i.e., one sample value over the applicable criterion is cause for listing the water as impaired. The DWR has assessed its waters for toxics by assigning impairment to waters with a greater than ten percent exceedance frequency of the criteria, with at least 90% statistical confidence level and the sample size exceeds nine.

Use of the ten percent "rule of thumb" for interpreting water quality data is usually considered appropriate for conventional or naturally variable pollutants. However, it is not consistent with toxics criteria expressed as "maximum permissible levels." The EPA's 2006 IR guidance, Part IV *(Issues Concerning the Development and Use of an Assessment Methodology*), Section G, states:

> **How should statistical approaches be used in attainment determinations?**
>
> Past EPA guidance (1997 305(b) and 2002 CALM) recommended making non-attainment decisions, for "conventional pollutants" — TSS, pH, BOD, fecal coliform bacteria grease [There are a variety of definitions for the term "conventional pollutants." Wherever this term is referred to in this guidance, it means "a pollutant other than a toxic pollutant."] — when more than "10% of measurements exceed the water quality criterion." (However, EPA guidance has not encouraged use of the "10% rule" with other pollutants, including toxics.) Use of this rule when addressing conventional pollutants, is appropriate if its application is consistent with the manner in which applicable WQC (Water Quality Criteria) are expressed. …
>
> On the other hand, use of the ten percent rule for interpreting water quality data is usually not consistent with WQC expressed either as: 1) instantaneous maxima not to be surpassed at any time, or 2) average concentrations over specified times. In the case of "instantaneous maxima (or minima) never to occur" criteria use of the ten percent rule typically leads to the belief that segment conditions are equal or better than specified by the WQC, when they in fact are considerably worse. (That is, pollutant concentrations are above the criterion-concentration a far greater proportion of the time than specified by the WQC.) Conversely, use of this decision rule in concert with WQC expressed as average concentrations over specific times can lead to concluding that segment conditions are worse than WQC, when in fact they are not. If the state applies different decision rules for different types of pollutants (e.g., toxic, conventional and non-conventional pollutants) and types of standards (e.g., acute vs. chronic criteria for aquatic life or human health), the state should provide a reasonable rationale supporting the choice of a particular statistical approach to each of its different sets of pollutants and types of standards.

The State may use an alternative scientifically defensible methodology if it can show that the methodology is no less stringent than the WQS (40 CFR 131.11(b)) and can demonstrate that the alternative frequency component fully protects aquatic life. In the State's Section 303(d) list submittal of March 31, 2014, DWR provided a "*Justification for Changes to the 10% Listing Method*" which states:

> In 2013 the Environmental Management Commission approved changes to the assessment methods. These methods were used to develop the 2014 303(d) list. The new method uses the 10% exceedance approach and adds a 90% statistical confidence component. This approach is a nonparametric procedure [similar to Lin *et al.* 2000: Lin, Pi-Erh, Duane Meeter and Xu-Feng Niu. 2000. *A Nonparametric Procedure for Listing and Delisting Impaired Waters Based on*

Criterion Exceedances. Technical Report. Department of Statistics, Florida State University, Tallahassee, FL. (http://www.dep.state.fl.us/water/tmdl/docs/Supdocument.PDF)].

The EMC adopted the statistical confidence approach to provide more statistical confidence that standards were exceeded in at least 10 percent of samples by taking sample size into account. This reduces the chance of listing a parameter as exceeding criteria when it may be meeting criteria.

Florida Department of Environmental Protection used the Technical Report referenced above to support "Florida's Methodology for Identifying Surface Water Impairment Due to Metals" as part of the State's Impaired Waters Rule (IWR). Florida applies this methodology, in part, to water quality parameters such as metals to account for uncertainty in data quality. A large proportion of FDEP's sizable data set is from third party sources, including volunteer groups, and its validity is uncertain. These factors weighed heavily in the EPA's evaluation of the use of the nonparametric statistical test for use support determinations for that State. Appendix E of this Decision Document includes the EPA's detailed evaluation of FDEP's methodology. This "Detailed Review of the IWR Binomial Statistical Test" is an appendix to the EPA's *Determination Upon Review of Amended Florida Administrative Code Chapter 62-303 Identification of Impaired Surface Waters*, dated February 19, 2008.

In North Carolina, data validity is ensured through consistent use of standard operating procedures and rigorous quality assurance and quality control processes (refer to the DWR monitoring *Standard Operating Procedures*[15] and the DWR *Ambient Monitoring System Quality Assurance Project Plan*[16]). In addition, only high quality data is accepted for use support decisions (see criteria for submitting data for regulatory use on the DWR website[17]. The majority of third party data in North Carolina, in contrast to Florida, comes from the State's monitoring coalitions which operate under mutually agreed upon Memoranda of Agreement that ensure that the data collected by the coalitions are of comparable quality to the data collected by DWR[18].

Thus, in North Carolina, statistical confidence is not necessary to account for uncertainty in data quality. The EPA's evaluation of and qualified agreement with, the nonparametric procedure in the case of FDEP 303(d) listing decisions for metals was based on the large size and uncertain quality of the data set. Given the different circumstances in North Carolina, the EPA does not agree with the use of a ten percent exceedance approach with ninety percent confidence for metals use support assessment.

The State's justification does not address how a ten percent exceedance rate with a confidence level supports the WQS. Nor does it demonstrate protection of aquatic life.

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[15] NC DWR's *Intensive Survey Unit Standard Operating Procedures* (https://ncdenr.s3.amazonaws.com/s3fs-public/Water%20Quality/Environmental%20Sciences/ISU/ISB%20SOP%20Version2.1%20%20FINAL.pdf) (December 2013)

[16] NC DWR's Ambient Monitoring System Quality Assurance Project Plan (https://ncdenr.s3.amazonaws.com/s3fs-public/document-library/AMS%20QAPP%20v1.2%20Approved%203.28.2014_All.pdf) (March 2014)

[17] http://deq.nc.gov/about/divisions/water-resources/planning/modeling-assessment/water-quality-data-assessment

[18] http://deq.nc.gov/about/divisions/water-resources/water-resources-data/water-sciences-home-page/ecosystems-branch/monitoring-coalition-program

For toxics criteria, the EPA CWA Section 304(a) guidance recommends an average frequency for criteria excursions not to exceed once in three years. The EPA selected this frequency of criteria exceedance based on derivation of the nationally-recommended criteria. Section 3.1.2 of the EPA WQS Handbook[19] states:

> Frequency for Aquatic Life Criteria
>
> To predict or ascertain the attainment of criteria, it is necessary to specify the allowable frequency for exceeding the criteria. This is because it is statistically impossible to project that criteria will never be exceeded. As ecological communities are naturally subjected to a series of stresses, the allowable frequency of pollutant stress may be set at a value that does not significantly increase the frequency or severity of all stresses combined.
>
> The EPA recommends an average frequency for excursions of both acute and chronic criteria not to exceed once in 3 years. In all cases, the recommended frequency applies to actual ambient concentrations and excludes the influence of measurement imprecision. The EPA established its recommended frequency as part of its guidelines for deriving criteria (Appendix H). The EPA selected the 3-year average frequency of criteria exceedance with the intent of providing for ecological recovery from a variety of severe stresses.

DWR is not required to use the EPA-recommended one-in-three method. However, North Carolina has not provided a scientifically defensible rationale to support their Listing Methodology for toxics. In the state's Section 303(d) list submittal of April 1, 2016, DWR provided a "White paper" entitled *Water Quality Assessment Methods for Toxics* to provide "a scientific basis, rationale and justification for not relying on exceptionally small datasets for making a 303(d) listing decision." While this document provides a "Retrospection of the '>1-in-3' Assessment Method," it does not provide a rationale to support a ten percent exceedance rate with a confidence level.

Whenever the EPA cannot conclude that an assessment methodology is appropriate, an independent review of data is done to determine whether all waterbody impairments are properly identified. Prior to the 2008 303d list cycle, North Carolina was not consistently assessing for impairments of metals, particularly "action level" metals, i.e., copper and zinc. The EPA's independent assessment of metals data identified numerous impaired waterbodies. The State subsequently added 82 copper and/or zinc impairments to waterbodies to the 2008 and 2010 Section 303(d) lists.

Given the amount of data then available for metals in the assessment data windows (2002-2006 and 2004-2008, respectively), the ten percent exceedance methodology resulted in the same (or more) listings as the EPA recommended one-in-three exceedance frequency. Within the five-year data window for each listing cycle, DWR conducted metals monitoring quarterly for most sampling stations, resulting in twenty samples, sometimes fewer. In most cases, just two exceedances triggered an impaired designation.

In 2007, DWR suspended most ambient monitoring for all metals as they began a process to update metals WQS. Limited metals monitoring was resumed in 2010. Therefore, for the 2012 and 2014 cycles,

[19] EPA Water Quality Standards Handbook: Second Edition; EPA-823-B-12-002 (http://water.epa.gov/scitech/swguidance/standards/handbook/)

there was very little new metals data within the assessment data windows (2006-2010 and 2008-2012, respectively).

In the 2012 cycle, DWR proposed to delist the copper impairment from part of the North Toe River based on a 9.5 percent exceedance frequency. The EPA's independent assessment determined that the State had failed to adequately demonstrate good cause for delisting. In the state's 2014 303(d) list, over fifty waterbody-pollutant combinations (metals) were proposed for delisting based solely on a change in assessment methodology (the addition of a confidence level). The EPA subsequently included these waterbody-pollutant combinations on the EPA's approved 2014 Section 303(d) list for North Carolina. The EPA's final action document on the 2014 list is provided in Appendix F.[20]

In the state's submittal of the 2016 303(d) list, the same waterbody-pollutant combinations (metals) were proposed for delisting, most based solely on the change in assessment methodology (the addition of a confidence level). Five waters were delisted based on the assessment of new data. Though the state used their ten percent exceedance (plus confidence) methodology to assess this new data, the EPA's independent assessment indicated no impairment using the EPA recommended one-in-three exceedance frequency.

EPA Conclusion

The EPA has determined that the State's methodology for toxics does not properly implement the applicable WQS and has conducted an independent assessment of water quality data to determine if additional metals impairments should be added to the 303(d) list. Our review found forty-one waterbody-pollutant combinations (metals) that should be included on the 2014 list as impairments to aquatic life, based on greater than one exceedance in three years. Three waterbody-pollutant combinations (arsenic) also found in this review are discussed in the section on Human Health protection, below (section III.A.8). Appendix B contains an entire list of waterbody-pollutant combinations to be included on the 2016 list.

A thorough review of the State's data during the 2014 303d list cycle also revealed an additional 153 waterbody-pollutant combinations with potential metals impairments. See Appendix G for a list of these waterbodies. Data for these waters shows more than one exceedance in three years. However, much of the data is qualified. The two most common data qualifiers associated with metals data were "U": *Analyzed for but not detected above the Practical Quantitation Limit (PQL), which is defined as the lowest level achievable among laboratories within specified limits during routine laboratory operation (The PQL is about three to five times the method detection limit and represents a practical and routinely achievable detection level with a relatively good certainty that any reported value is reliable.)*; and "P": *Elevated PQL due to matrix interference and/or sample dilution.* Data flags are defined in the DWR's Ambient Monitoring Systems Data Explanations (http://portal.ncdenr.org/web/wq/ess/eco/ams).

The EPA recommends that these waterbodies remain or be placed in Category 3 and be given high priority for follow-up monitoring. Monitoring and assessment of those and all waterbodies must be based on North Carolina's WQS as revised and approved by the EPA.

[20] *Responsiveness Summary to Comments Regarding the EPA's July 31,2014 Action to Add Waters to North Carolina's 2014 Section 303(d) List*. (December 19, 2014)

The EPA's independent assessment of metals data for the 2008 and 2010 lists, described above, resulted in a list of additional waterbody-pollutant combinations requiring further investigation for potential impairments of copper and/or zinc. These waters were placed in Integrated Reporting Category "3a." The EPA's 2006 IR guidance defines Category 3: **"**No data, or insufficient information to determine if any designated use is attained. Supplementary data and information, or future monitoring, will be required to assess the attainment status." In an internal memo dated April 9, 2010, the State indicated its intention to conduct metals sampling at "assessment units identified for 303(d) additional metals sampling." EPA anticipated that these waterbodies would be treated as high priority for additional assessment monitoring during future listing cycles. DWR has monitored several of these waterbodies, some as part of the special study that assisted in the new WQS development. Appendix H contains the list of waterbodies that require further investigation for potential impairments of copper and/or zinc.

5. Fish Consumption Use Support

Class C waters are freshwaters protected for several uses, including fishing. Class SC represents saltwater protected for several uses, including fishing. All waters in the state are protected at a minimum at the Class C or SC level. The fish consumption use support category is based on protecting human health, so these waters are assessed to determine whether humans can safely consume fish from a particular waterbody.

Water Quality Standard	State Assessment Methodology
15A NCAC 02B.0211(l)(ix) (l) Toxic substances: numerical WQS (maximum permissible levels) for the protection of human health applicable to all fresh surface waters are in Rule .0208 of this Section. Numerical WQS (maximum permissible levels) to protect aquatic life applicable to all fresh surface waters: (ix) Mercury (water column criteria): 0.012 µg/l	Fish consumption was assessed based on site-specific fish consumption advisories developed using fish tissue data. Advisories and advice are developed by the NC Department of Health and Human Services using fish tissue data collected by DWR and others. See http://epi.publichealth.nc.gov/fish/current.html for all advice and advisories.
NCAC 15A 02B .0208(a)(2) Standards for Toxic Substances and Temperature Human Health Standards: The concentration of toxic substances will not exceed the level necessary to protect human health through exposure routes of fish (or shellfish) tissue consumption, water consumption, or other route identified as appropriate for the water body. (A) For non-carcinogens, WQS or criteria used to calculate water quality based effluent limitations to protect human health for fish consumption. (See regulation for details on calculation.)	**Exceeding Criteria - Category 5** o Fish consumption advisory in place for AU o AU has site specific fish tissue data Additional Mercury Assessment Criteria An assessment unit was assessed as Impaired for fish consumption when greater than 10% (with greater than or equal to 90% confidence) of samples (sample size greater than 9) were greater than 0.012 µg/l.

(B) For carcinogens: WQS applicable to protect human health from carcinogens through the consumption of fish are: (i) Aldrin: 0.05 ng/l; (ii) Arsenic: 10 ug/l; (iii) Benzene: 51 ug/l; (iv) Carbon tetrachloride: 1.6 ug/l; (v) Chlordane: 0.8 ng/l; (vi) DDT: 0.2 ng/l; (vii) Dieldrin: 0.05 ng/l; (viii) Dioxin: 0.000005 ng/l; (ix) Heptachlor: 0.08 ng/l; (x) Hexachlorobutadiene: 18 ug/l; (xi) Polychlorinated biphenyls (total of all identified PCBs and congeners): 0.064 ng/l; (xii) Polynuclear aromatic hydrocarbons (total of all PAHs): 31.1 ng/l; (xiii) Tetrachloroethane (1,1,2,2): 4 ug/l; (xiv) Tetrachloroethylene: 3.3 ug/L; (xv) Trichloroethylene: 30 ug/l; (xvi) Vinyl chloride: 2.4 ug/l.	

The Monitoring Program Strategy states that DWR conducts fish tissue testing for mercury, selenium, cadmium, PCBs and pesticides (including dioxins). Data are provided to the North Carolina Department of Health and Human Services (DHHS) for that agency to make fish consumption advisories.

<u>Dioxins in Waterville Reservoir</u>

In 2012, the EPA's independent analysis of fish tissue data from Waterville Reservoir indicated a probable standard exceedance of dioxin in the water column. DWR's assessment methodology for dioxin is based on fish consumption advisories issued by the DHHS, not an evaluation of compliance with the water quality standard. DWR has listed the Pigeon River and Waterville Reservoir in the past based on fish advisories. However, levels in fish tissue (monitored annually) have been declining and, when the fish advisories were dropped, these waterbodies were removed from the State's section 303(d) list. The presence of an advisory indicates impairment, however, lack of an advisory does not necessarily indicate lack of impairment.

The North Carolina water quality standard for dioxin is given as a water column number (0.005 parts per quadrillion, or ppq). Levels in the water column are below detection limits with normal sampling methods. Because dioxin bioaccumulates in aquatic organisms, fish tissue data is used to determine use support. However, the level of dioxin in fish tissue which triggers a fish consumption advisory in the state (3.0 parts per trillion, or ppt) is less stringent than the level (0.025 ppt) that would indicate the water is not attaining the standard for dioxin.

Since the time that Blue Ridge Paper Products, a facility upstream of the Reservoir, stopped releasing detectable levels of dioxin in the early 1990s, levels in fish tissue have been declining. The EPA's review of the Blue Ridge Paper Products NPDES permit renewal in 2009 led to review of recent fish tissue data in Pigeon River and Waterville Reservoir (no probable exceedances were found in the Pigeon

River). Though the fish tissue data for Waterville Reservoir did not trigger a fish advisory, the EPA conducted back calculations of this fish tissue data to determine the level of dioxin in the water column, and these calculations indicated that the water column levels might be elevated.

Based on the data analysis, the EPA determined that it was likely that Waterville Reservoir continued to be impaired for dioxin. In order to further confirm the dioxin levels that currently exist in the water column of Waterville Reservoir, and make a determination about whether WQS are currently being met, the EPA, in conjunction with DWR, completed field work in May, 2014, using high volume sampling. This high volume sampling, a technique developed by the EPA Region 4's Science and Ecosystems Support Division, can achieve a much lower detection limit, allowing direct comparison of the water column monitoring data with the state water column standard.

<u>Statewide Fish Consumption Advisory for Mercury</u>

In North Carolina, a statewide fish consumption advisory exists for mercury in Largemouth Bass. Due to this advisory, the designated uses of all water bodies statewide are impaired by mercury. DWR developed a TMDL which the EPA approved on October 12, 2012. Therefore, all named water bodies in North Carolina were included in the 2014 and 2016 IR in Category 4a for mercury impairment.

<u>EPA Conclusion</u>

The EPA has determined that, in general, North Carolina's use of fish tissue data and fish consumption advisories is consistent with North Carolina's existing, EPA-approved WQS. However, the methodology should allow flexibility to address site specific data as in the case of Waterville Reservoir. The EPA's 2002 CALM guidance advises "…for fish and shellfish advisories for 'dioxin and dioxin-like compounds,' the EPA recommends that because of the unique risk characterization issues, listing decisions should be made on a case-by-case basis."

The final report on dioxin sampling in Waterville Reservoir was released in July, 2016. The EPA and the state are now working to determine the impairment status of this water for the 2018 listing cycle.

The EPA does not agree that provisions in the State's methodology related to age of data and minimum sample size are consistent with federal requirements. Also, for the reasons set out in the section addressing assessment of toxics in section III.A.4.e above, the EPA has determined that use of the greater than ten percent exceedance with greater than or equal to 90% confidence test is not a reasonable method for DWR to assess toxic or non-conventional pollutants such as mercury. However, based on the EPA's independent review, the provisions of the State's methodology related to age of data, minimum sample size and toxic or non-conventional pollutants did not result in DWR failing to identify any waters based on fish consumption use. Therefore, the EPA is approving DWR's listing decisions for fish consumption use support.

6. Shellfish Consumption Use Support

The methodology for Shellfish Harvesting Use Support is applicable only to Class SA waters: tidal salt water bodies used for shellfish harvesting for market purposes.

Water Quality Standard	State Assessment Methodology
15A NCAC 02B .0221 Waters shall meet the current sanitary and bacteriological standards as adopted by the Commission for Health Services and shall be suitable for shellfish cultures...Quality standards applicable: (a) Floating solids; settleable solids; sludge deposits: none attributable to sewage, industrial or other wastes. (b) Sewage: None (c) Industrial Wastes or other wastes: none which are not effectively treated...in accordance with the requirements of the Division of Health Services. (d) Organisms of the coliform group: fecal coliform group not to exceed a median MF of 14/100 ml and not more than 10 percent of the samples shall exceed an MF count of 43/100 ml in those areas most probably exposed to fecal contamination during the most unfavorable hydrographic and pollution conditions. (Note: MF is an abbreviation for the membrane filter procedure for bacteriological analysis)	An assessment unit was assessed as Impaired when the geometric mean was greater than 14 colonies/100ml or greater than 10% of the samples were higher than 43 colonies/100ml. **Exceeding Criteria- Category 5** o Class SA water o Growing area classification is Not Approved

The North Carolina Division of Environmental Health (DEH) operates its monitoring program under guidelines outlined in the National Shellfish Sanitation Program's Guide for the Control of Molluscan Shellfish. When a condition or event occurs that impacts the open status of waters, DEH closes those waters to protect public health.

According to the DEH website (http://portal.ncdenr.org/web/mf/shellfish-sanitation), conditionally approved "areas are generally open to shellfishing, but can be closed after a significant rainfall event due to the resultant runoff. The area will then remain closed until water sampling indicates a return to acceptable bacteria levels." By definition, conditionally approved areas do not meet the water quality criteria based on a sanitary survey involving detailed water quality assessments conducted under the national protocols. Consequently, EPA's guidance advises and DWR's Listing Methodology appears to agree, that all conditionally approved areas be listed on the Section 303(d) list.

According to the 2016 303(d) Listing Methodology, an assessment unit was assessed as Impaired when the North Carolina DEH growing area classification was Prohibited or Conditionally Approved. It appears that these classifications are considered "Not approved" in the state's Listing Methodology.

EPA Conclusion

The EPA agrees that North Carolina's listing methodology provides for DWR to make listing decisions based on bacteriological data and shellfish harvesting classification information and in a manner consistent with the state's currently applicable WQS and EPA regulations.

The EPA does not agree that provisions in the state's methodology related to age of data and minimum sample size are consistent with federal requirements. However, based on the EPA's independent review of the existing and readily available data, the provisions of the state's methodology related to age of data and minimum sample size did not result in DWR failing to identify any waters not attaining shellfish use. Therefore, the EPA is approving DWR's listing decisions for shellfish use support based on that methodology.

7. Recreational Use Support

In addition to all Class C requirements, Primary Recreation Use Support (e.g., swimming, water-skiing, skin diving) is assessed for all Class B, SA and SB waters. Secondary Recreation Use Support (e.g., wading, boating) is assessed for all Class C and SC waters. WQS applicable to Class C waters also apply to all waters classified as water supply.

North Carolina bases its determination of use support on (1) the fecal coliform bacteria water quality standard for fresh water (applicable to all Class C, B and SA waters), (2) the enterococcus water quality standard for coastal waters (applicable to all Class SA, SB and SC waters) and (3) the duration of swimming advisories issued by state and local health departments.

Water Quality Standard	State Assessment Methodology
15A NCAC 2B .0211 (3)(e) (Class C) **15A NCAC 2B .0219 (3)(b) (Class B)** **15A NCAC .0220 (3)(e) Class SC** **15A NCAC .0222 (3)(c) Class SB** Fresh Waters Organisms of the coliform group: fecal coliforms shall not exceed (1) a geometric mean of 200/100 ml (MF count) based upon at least five consecutive samples examined during any 30 day period, nor exceed (2) 400/100 ml in more than 20 percent of the samples examined during such period. Coastal Waters Enterococcus, including *Enterococcus faecalis*, *Enterococcus faecium*, *Enterococcus avium* and *Enterococcus gallinarium*: not to exceed a geometric mean of 35 enterococci per 100 ml based upon a minimum of five samples within any consecutive 30 days.	**Recreation Use Support** Fresh Waters Exceeding Criteria- Category 5 o There are at least five samples collected within a 30- day period and o Geometric mean is greater than 200 colonies/100ml of water or o Greater than 20% of the samples exceed 400 colonies/100ml Coastal Waters Exceeding Criteria- Category 5 o There are at least five samples collected within a 30- day period and o Geometric mean of 35 enterococci per 100 ml **Advisory Posting Assessment** An AU was assessed as Impaired when a swimming advisory was posted for greater than 61 days in any 5 year period (includes permanent postings).

The North Carolina Division of Marine Fisheries Recreational Water Quality Monitoring program tests coastal recreation waters, including the ocean beaches, sounds, bays and estuarine rivers, for Enterococcus levels. According to their website (http://portal.ncdenr.org/web/mf/recreational-water-quality) "[t]he program tests 240 swimming sites, most of them on a weekly basis during the swimming season, which runs from April 1 to Oct. 31. All ocean beaches and high-use sound-side beaches are tested weekly from April through September; lower-use beaches are tested twice a month. All sites are tested twice a month in October and monthly from November through March." There are 14 assessment units (AUs) impaired by enterococci on the state's 303(d) list.

DWR conducts *monthly* fecal coliform bacteria (FCB) testing as part of its ambient monitoring program for fresh waters. This means that the data typically collected is not directly used to assess against the water quality standard which requires at least five samples collected within a 30 day period. According to recent discussions with DWR staff and as stated in North Carolina's 2006 IR, "Locations with annual geometric means greater than 200 colonies per 100 ml, or when more than 20 percent of the samples are greater than 400 colonies per 100 ml, are identified for potential follow-up monitoring conducted five times within 30 days as specified by the state fecal coliform bacteria standard." Resource limitations may hinder immediate follow-up monitoring in locations not identified as Primary Recreation Use. When the 5 samples in 30 days requirement is not met but monthly data indicates possibility of impairment (annual geometric mean is > 200/100ml or > 20% exceed 400/100ml), waters are placed in IR Category 3.

In March 2014, the Cape Fear River Watch and Waterkeeper Alliance requested that DWR place Stocking Head Creek (Assessment Unit #18-74-24, from source to Northeast Cape Fear River) on the 2014 303(d) list for FCB based on recent (2013) monitoring results. The state responded that the results were outside of the 2014 303(d) data window (2008-2012) and requested the commenters to resubmit the data for consideration in the 2016 303(d) listing cycle. This waterbody is not on North Carolina's Ambient Monitoring network and has never been sampled by the state for FCB. Biological monitoring at Stocking Head Creek in 2003 resulted in a "Good-Fair" rating and so it has been considered as meeting aquatic life uses for many listing cycles.

The commenters resubmitted their request in March 2016, however not in the format required by the state nor in time to place the water on the draft 303(d) list to receive public comments. The EPA and the state received and reviewed the raw monitoring results from the commenters in July, 2016. The state has committed to follow up and perform FCB sampling in the waterbody in the near future.

EPA Conclusion

Based on the EPA's review of DWR's assessment submittals, DWR's assessment methodology for recreational use is consistent with North Carolina's existing, EPA-approved WQS.

The EPA does not agree that provisions in the state's methodology related to age of data and minimum sample size are consistent with federal requirements. However, based on the EPA's independent review of the existing and readily available data, the provisions of the state's methodology related to age of data and minimum sample size did not result in DWR failing to identify any waters not attaining recreational use. Therefore, the EPA is approving DWR's listing decisions for bacteria related to recreational use based on that methodology.

8. Drinking Water Use Support and Protection of Human Health

Water supply watersheds are classified as WS-I through WS-V waters. WQS applicable to Class C waters also apply to Class WS-I through WS-V waters. The following WQS apply to surface waters within water supply watersheds.

Water Quality Standard	State Assessment Methodology
NCAC 15A 02B .0212, .0214, .0215, .0216, .0218 Waters of this class are protected by numerous management strategies including significantly limiting the point and non-point sources and imposing development management practices. Arsenic: 10 ug/l Chloride: 250 mg/l Manganese: 200 ug/l Nickel: 25 ug/l Nitrate nitrogen: 10 mg/l MBAS (Methylene-Blue Active Substances): not greater than 0.5 mg/l to protect the aesthetic qualities of water supplies and to prevent foaming;	**Exceeding Criteria- Category 5** -Greater than 10% exceedance with greater than or equal to 90% confidence - Sample size is greater than nine.
Aldrin: 0.05 ng/L Coliforms: total not to exceed 50/100ml (MF count) as monthly geomean value in watersheds serving as unfiltered water supplies in WS-I only Barium: 1.0 mg/l Benzene: 1.19 ug/l Carbon Tetrachloride: 0.254 ug/l Chlordane: 0.8 ng/L Chlorinated benzenes: 488 ug/l 2,4-D: 100 ug/l DDT: 0.2 ng/L Dieldrin: 0.05 ng/L Dioxin: 0.000005 ng/L Total hardness: not > 100 mg/l as $CaCO_3$ Heptachlor: 0.08 ng/l Hexachlorobutadiene: 0.44 ug/l Phenolic compounds: not greater than 1.0 ug/l Polynuclear aromatic hydrocarbons: 2.8 ng/l 2,4,5-TP (Silvex): 10 ug/l Sulfates: 250 mg/l TDS: not greater than 500 mg/l Tetrachloroethane: 0.17 ug/l Tetrachloroethylene: 0.7 ug/l Trichloroethylene: 2.5 ug/l Vinyl Chloride: 0.025 ug/l	The Use Support Methodology does not discuss an assessment methodology for these parameters. A number of indicators with associated standards are not monitored or infrequently monitored by the DWR Ambient Monitoring Program, primarily due to expense of analysis or current analytical methods have reporting limits above the applicable standard. Since 2007, DWR has conducted a Random Ambient Monitoring System (RAMS) on freshwater streams statewide which collects many of these parameters. [See Probabilistic Monitoring of North Carolina Freshwater Streams - 2007-2010 (DWR, 2012; page 6) and North Carolina Monitoring Program Strategy (DWR, 2012)]

All Toxics are Maximum Permissible Concentrations to protect human health through water consumption and fish tissue consumption for carcinogens and non-carcinogens.

EPA Conclusion

DWR's Listing Methodology to assess attainment of drinking water and human health uses for conventional pollutants is generally consistent with North Carolina's existing, the EPA-approved WQS and with the EPA regulations. The EPA has determined that provisions in the state's methodology related to age of data and minimum sample size are not consistent with federal requirements. Based on the EPA's independent review of the existing and readily available data, the provisions of the state's methodology related to age of data and minimum sample size, did not result in DWR failing to identify any waters not attaining drinking water and human health uses.

The EPA has determined that use of the 10% exceedance frequency test (plus a confidence level) is not a reasonable method for DWR to assess toxic or non-conventional pollutants. Section III.A.4.e, *Impairments Indicated by Toxic and Non-Conventional Pollutants*, contains a detailed description of this determination.

Our review found three waterbody-pollutant combinations (arsenic) that should be included on the 2016 list as impairments to human health, based on greater than one exceedance in three years. Therefore, the EPA is approving all but three of DWR's listing decisions for drinking water and human health uses. See Appendix B for the list of all waterbody-pollutant combinations included on the North Carolina 2016 Section 303(d) list.

9. Other Pollution Control Requirements (40 CFR 130.7(b)(1))

The EPA's regulations provide that Total Maximum Daily Loads (TMDLs) are not required for waterbodies where "[o]ther pollution control requirements (e.g., best management practices) required by local, State, or Federal authority are stringent enough to implement any WQS [WQS] applicable to such waters." 40 C.F.R. Section 130.7(b)(1)(iii). The EPA's IR Guidance acknowledges that the most effective method for achieving WQS for some water quality impaired segments may be through controls developed and implemented without TMDLs (referred to as a "4b alternative"). The EPA expects the state to demonstrate that these controls are specifically applicable to the particular water quality problem and are expected to result in standards attainment in the near future.

The EPA evaluates on a case-by-case basis a State's decision to exclude certain segment/pollutant combinations from Category 5 (the Section 303(d) list) based on the 4b alternative. In this 2016 Section 303(d) list, the state has proposed one new Category 4b listing for Little Alamance Creek, located in Alamance County, North Carolina. In addition, because recent legislation may affect its 4b status, a discussion of Falls Lake is included below.

Little Alamance Creek TMDL Alternative

Little Alamance Creek is impaired for biological integrity, based on a narrative standard that pertains to the aquatic life use designation. This Creek (Assessment Unit# 16-19-11) was listed in 2005 as impaired due to a "Poor" bioclassification rating of the benthic macroinvertebrate community. There is no single pollutant responsible for the biological integrity impairment, rather a suite of factors. This is a predominantly urban watershed with a considerable percentage of impervious surfaces (roughly 30%). Hydro-modification, insufficient riparian buffer, streambank erosion, pollutants in stormwater runoff and degradation of instream habitat are some of the factors responsible for impairment. For these reasons, pollutant loads were not allocated; rather, a suite of best management practices (BMPs) will be implemented that will provide control of discharges that that could alter natural hydrology, reduce stormwater pollutants and mitigate other stressors that contribute to the impairment.

The project partners who developed the *Category 4b Demonstration Plan* (final version, dated December 2014, http://burlingtonnc.gov/DocumentCenter/View/7307) are the City of Burlington, City of Graham and North Carolina Department of Transportation in conjunction with the DWR. The Little Alamance Creek watershed is located within the Jordan Reservoir watershed of the Cape Fear River Basin. Jordan Reservoir and all waters draining to it have also been classified as Nutrient Sensitive Waters (NSW) pursuant to Rules 15A NCAC 2B .0101(e)(3) and 15A NCAC 2B .0223 (commonly known as the Jordan Lake Rules).

In January, 2015, after reviewing the *Category 4b Demonstration Plan*, the EPA concurred with the state's proposal to move the biological impairment on Little Alamance Creek from the 303(d) list to Category 4b (Appendix I). The EPA concurrence with this Category 4b determination was based primarily on the intent of the project partners to implement a wide variety of pollution control measures, and partly on their commitment to adopt the Jordan Lake Rules into local ordinance.

For all waterbodies identified in Category 4b, the State expects that other required regulatory controls (e.g., NPDES permit limits, Stormwater Program Rules, Nutrient Management Rules, etc.) will result in compliance with standards within a reasonable period of time. It is understood that improvement of the benthic macroinvertebrate community will take time to achieve. The Little Alamance Plan states that WQS are projected to be achieved by 2030. North Carolina has also confirmed that future monitoring will be used to verify standards achievement. The City of Burlington has set up a public website to "allow citizens the opportunity to follow the progress associated with this effort" at http://www.littlealamancecreek.com/.

EPA Conclusion

The EPA is approving the delisting of Little Alamance Creek to Category 4b. The Little Alamance Category 4b Demonstration Plan includes many implementation activities that are currently underway and ongoing. Before the next 303(d) listing cycle in 2018, the EPA has requested that the state and the Little Alamance partners document progress of the Plan as well as provide an explanation of the extent to which any changes in the Jordan Lake Rules (or other statewide legislative changes) may impact progress toward meeting WQS.

Falls Lake TMDL Alternative

In the 2012 303(d) listing cycle, EPA approved a TMDL alternative (Category 4b) for nutrient impairment in Falls Lake based on expected implementation of the state's Falls Lake Nutrient Rules. The Rules were developed over many years by the State and many stakeholders to ensure sharing of nutrient reductions between point (wastewater treatment plants) and nonpoint sources (agriculture and development activities) in a fair, reasonable and proportionate manner. Implementation of the pollution controls to achieve water quality standards was to be staged, with full implementation of the first stage set to occur no later than January 15, 2021. The North Carolina 2016 Appropriations Act, signed into law on July 14, 2016, calls for further data review and study of implementation options, potentially delaying implementation efforts.

EPA Conclusion

The TMDL alternative path is intended for waters where control requirements will lead to attaining water quality standards within a reasonable period of time. Continued delays in implementation will likely prolong the standards attainment date – already projected to extend out to the year 2041. EPA interpretation of the new legislation is that the Falls Lake Nutrient Rules are still in effect but could be rendered ineffective in the future. The EPA expects the state to continue to evaluate the effectiveness of the Falls Lake Nutrient Rules to determine whether the state can continue to support its original 4b demonstration. Any significant change in the basis for approval of a TMDL alternative could result in the return of that waterbody to the 303(d) list.

B. North Carolina's 2016 Section 303(d) List of Impaired Waters (40 CFR 130.7(b)(4))

1. North Carolina's Addition of Water Quality Limited Segments

North Carolina identified additional water quality limited segments (WQLS) in its 2016 Section 303(d) list submittal, consistent with Section 303(d) and EPA's implementing regulations. The EPA is approving the addition of those WQLSs to North Carolina's Section 303(d) list. (See Appendix K.)

2. Delistings from North Carolina's 2014 Section 303(d) list (40 CFR 130.7(b)(6)(iv))

North Carolina proposed to remove specific WQLSs from its 2014 Section 303(d) final list, consistent with Section 303(d) and EPA's implementing regulations. The EPA has reviewed the good cause justification for those delisting requests and is approving the delisting of all but 62 of those WQLSs from North Carolina's Section 303(d) list. All waterbodies approved for delisting are identified in Appendix L. The delistings not approved by the EPA are discussed in section III.A.4.b (*Impairments Indicated by Physical Parameters*), section III.A.4c (*Impairments Indicated by Nutrient Enrichment*), section III.A.4e (*Impairments Indicated by Toxic and Non-Conventional Pollutants*) and section III.A.8 (*Drinking Water Use Support and Protection of Human Health*). A list of all WQLSs the EPA proposes to add to the Section 303(d) list is provided in Appendix B.

3. Water Quality Limited Segments added by the EPA to the North Carolina 2016 Section 303(d) list

Based on the EPA's independent review, 72 waterbody-pollutant combinations will be included on the EPA's approved Section 303(d) list for North Carolina. These WQLS are listed in Appendix B.

The EPA has determined that the state's methodology does not contain acceptable delisting procedures for most numeric WQS. The methodology uses faulty statistical logic in that it does not differentiate between listing and delisting. Use of a nonparametric procedure for delisting requires stronger evidence and a larger sample size than for listing but this provision is not included in the state's methodology (see section III.A.1, *North Carolina's Water Quality Standards and Section 303(d) List Development*). The EPA has conducted an independent assessment of water quality data to determine if additional impairments should be added to the Section 303(d) list. Our review found 17 WQLSs that should be included on the 2016 list as impairments to aquatic life, based on failure to demonstrate good cause to delist.

The EPA has determined that provisions in the state's methodology related to age of data and minimum sample size are not consistent with federal requirements (see section III.A.2, *Consideration of Existing and Readily Available Water Quality-Related Data and Information*). The EPA has conducted an independent assessment of water quality data to determine if additional impairments should be added to the 303(d) list. Our review found 11 WQLSs that should be included on the 2016 list as impairments to aquatic life, based on failure to properly evaluate all existing and readily available data.

The EPA has determined that the State's methodology for toxics does not properly implement the applicable WQS and conducted an independent assessment of water quality data to determine if additional impairments should be added to the 303(d) list. Our review found forty-one WQLSs that should be included on the 2016 list as metals impairments to aquatic life, based on greater than one exceedance in three years (see section III.A.4.e, *Impairments Indicated by Toxic and Non-Conventional Pollutants*). An additional three WQLSs found in this review involved exceedances of the human health criteria for arsenic (see section III.A.8, *Drinking Water Use Support and Protection of Human Health*).

C. Priority Ranking and Targeting (40 CFR 130.7(b)(4))

Priority Ranking and Targeting for Total Maximum Daily Loads (TMDL) and individual water quality-based effluent limitations is described in 40 C.F.R. Section 130.7(b)(4): "The list required under [Sections] 130.7(b)(1) and 130.7(b)(2) of this section shall include a priority ranking for all listed water quality-limited segments still requiring TMDLs, taking into account the severity of the pollution and the uses to be made of such waters and shall identify the pollutants causing or expected to cause violations of the applicable WQS. The priority ranking shall specifically include the identification of waters targeted for TMDL development in the next two years."

DWR's description of how WQLSs are prioritized for TMDL development was included in the state Section 303(d) submittal. The prioritization follows *EPA's Long-Term Vision for Assessment, Restoration, and Protection under the Clean Water Act Section 303(d) Program.*[21] The EPA has determined that the state's priority ranking adequately considers the severity of pollution and the designated uses of waterbodies.

D. Schedule for Development of TMDLs for Listed Waters and Pollutants

Pursuant to 40 CFR Section 130.7(b)(4), the State's submittal "shall specifically include the identification of waters targeted for TMDL development in the next two years." The EPA has determined that the state has appropriately established a schedule for development of TMDLs to address impaired waters in its 2016 Section 303(d) list.

[21] *EPA's Long-Term Vision for Assessment, Restoration, and Protection under the Clean Water Act Section 303(d) Program* https://www.epa.gov/sites/production/files/2015-07/documents/vision_303d_program_dec_2013.pdf) (December 2013)

E. Government to Government Consultation

The EPA recognizes its unique legal relationship with Tribal Governments as set forth in the United States Constitution, treaties, statutes, executive orders and court decisions. Government wide and the EPA specific policies call for regular and meaningful consultation with Indian Tribal Governments when developing policies and regulatory decisions on matters affecting their communities and resources. The *EPA Policy on Consultation and Coordination with Indian Tribes* (Policy) was finalized on May 4, 2011, in accordance with the Presidential Memorandum issued November 5, 2009, directing agencies to develop a plan to implement fully Executive Order 13175. This Policy reflects the principles expressed in the *1984 EPA Policy for the Administration of Environmental Programs on Indian Reservations* (1984 Policy).The 1984 Policy remains the cornerstone for the EPA's Indian program and "assure[s] that tribal concerns and interests are considered whenever the EPA's actions and/or decisions may affect" tribes (1984 Policy, p.3, principle no.5).

On April 1, 2016, the State of North Carolina submitted its final Section 2016 303(d) list to the EPA for review. The state subsequently submitted a responsiveness summary to address comments submitted during public review of the list on June 3, 2016. This submittal triggered the EPA's mandatory duty under Section 303(d) of the CWA to review the State's Section 303(d) list for consistency with the requirements of the CWA and to take action to approve or disapprove the 303(d) list.

The State of North Carolina's Section 303(d) list and the EPA's decision on this list will apply to waters in the State of North Carolina and will not apply to waters in Indian Country. Nonetheless, because some of the State waters are adjacent to or upstream of Tribal waters, Tribal resources could be impacted by this action. As such, the EPA identified and offered government to government consultation to two federally recognized tribal governments to ensure that tribal input was considered prior to a final Agency action on the North Carolina 2016 Section 303(d) list.

By letter on April 28, 2016, the EPA formally offered consultation to the Eastern Band of Cherokee Indians and the Catawba Indian Nation. The consultation process was conducted in accordance with the EPA Policy www.epa.gov/tribal/consultation/consult-policy.htm. The process ended on May 20, 2016. Neither tribal government choose to consult on the 2016 Section 303(d) list.

As discussed above, the EPA conducted an independent assessment of water quality data and determined that several waterbody-pollutant combinations should be included on the 2016 list as impairments. The EPA will open a comment period to solicit comments on the proposed addition of these impairments to the North Carolina 2016 Section 303(d) list. The EPA's proposed additions to the list will not trigger an offer of tribal consultation and coordination.

IV. Final Recommendation on North Carolina's 2016 Section 303(d) List Submittal

After careful review of the final Section 303(d) list submittal package, the EPA Region 4 Water Protection Division recommends that the EPA partially approve the State of North Carolina's 2016 Section 303(d) list. The Water Protection Division's review concluded that DWR's approach was acceptable for most, but not all, use support listing decisions. The EPA is approving North Carolina's listing of 1,231 water quality limited segments and delisting of 44 segments.

The EPA has determined that the state's methodology did not contain acceptable, statistically-sound delisting procedures for most numeric WQS. This lead to a failure to demonstrate good cause to delist.

Also, the EPA does not agree that provisions in the state's methodology related to age of data and minimum sample size are consistent with federal requirements resulting in failure to properly evaluate all existing and readily available data. And lastly, the EPA has determined that DWR’s methodology is not a reasonable method for DWR to assess toxic or non-conventional pollutants consistent with the State’s currently applicable, EPA-approved WQS. The EPA has conducted an independent assessment of water quality data to determine if additional impairments should be added to the 303(d) list.

Based on the EPA’s independent review and the recent state legislation, 72 waterbody-pollutant combinations will be added on the EPA’s approved Section 303(d) list for North Carolina. (See Appendix B.) The EPA will open a comment period to solicit comments on the proposed addition of these waterbody-pollutant combinations to the North Carolina 2016 Section 303(d) list. The EPA’s proposed additions to the list will not trigger an offer of tribal consultation and coordination.

The final report on the high volume dioxin sampling study in Waterville Reservoir, described above in section III.A.5, was released in July, 2016. The EPA and the state are now working to determine the impairment status of this water for the 2018 listing cycle.

The EPA's approval of North Carolina’s Section 303(d) list extends to all other waterbodies on the list with the exception of those waters that are within Indian Country, as defined in 18 U.S.C. Section 1151. The EPA is taking no action to approve or disapprove the State's list with respect to those waters at this time. The EPA, or eligible Indian Tribes, as appropriate, will retain responsibilities under Section 303(d) for those waters.

NC 2016 303(d) List

APPENDICES

Appendix A	**North Carolina 2016 Integrated Report Categories**
Appendix B	**Water quality limited segments added to the North Carolina 2016 Section 303(d) List by the EPA**
Appendix C	**EPA's Analysis of the State's Use of a Nonparametric Procedure for Delisting**
Appendix D	**EPA's Analysis of the State's Small Sample Sets Which Indicate Impairment**
Appendix E	**EPA's Detailed Evaluation of Florida's Assessment Methodology**
Appendix F	**"*Responsiveness Summary to Comments Regarding the EPA's July 3, 2014 Action to Add Waters to North Carolina's 2014 Section 303(d) List*"**
Appendix G	**Assessment Units where metals data shows greater than one exceedance in 3 years but data is flagged**
Appendix H	**Assessment Units where further investigation is required for potential impairments of copper and zinc**
Appendix I	**Little Alamance Creek 4b Demonstration**
Appendix J	**Water quality limited segments added to the North Carolina 2016 Section 303(d) List**
Appendix K	**Water quality limited segments removed from the North Carolina 2014 Section 303(d) list – Approved by EPA, 2016**

2016 NC Integrated Report Category	2016 NC Integrated Report Category Description	Cores-ponding EPA category
1	Parameter assessed was meeting criteria	1
1b	Parameter assessed was meeting criteria and there is a management strategy in place for the assessed parameter	1
1f	Fish tissue collected in Assessment Unit with no advisories other than statewide Mercury advice	1
1nc	Parameter assessed was exceeding some criteria but it was determined that the exceedances were due to natural conditions (documentation required)	1
1r	Parameter assessed was meeting criteria and there are ongoing restoration activities	1
1t	Parameter assessed was meeting criteria and there is an approved TMDL in place for the assessed parameter	1
3a	Data are inconclusive	3
3b	Data are inconclusive, management strategy in place for parameter	3
3c	Data are inconclusive, non-pollutant is reason for exceedance	3
3e	Metals exceeding standard greater than one time in lastest three year. Criterion not used for category 5 assessments in NC	3
3r	Data are inconclusive, ongoing restoration activities in place to address parameter	3
3t	Data are inconclusive, approved TMDL in place for parameter	3
3v	Data are inconclusive, exceedance due to permitted facility with a variance	3
3z1	Data not assessed against a NC water quality standard	3
3z2	No data or information to make assessment	3
4b	Exceeding Criteria, with 4b demonstration for the parameter	4b
4c	Exceeding Criteria, non-pollutant is reason for exceedance	4c
4cs	Shellfish growing area- not approved. AU has an approved fecal coliform bacteria TMDL assessed in category 4t	4c
4i	Parameter assessed is addressed by a TMDL for a different parameter	4a
4r	Exceeding criteria for assessed parameter, ongoing restoration activities in place to address parameter. This is also used for fast 4r Measures of Intersest	4c
4s	Biological data exceeding criteria, another aquatic life parameter is assessed in category 4 or 5	4c
4t	Exceeding Criteria, approved TMDL for parameter	4a
4v	Exceeding Criteria, exceedance due to permitted facility with a variance	4c
5	Exceeding Criteria, no approved TMDL in place for assessed parameter	5
5-alt	An alternative to TMDL approach has been planned for the parameter assessment unit combination	5
5e	Greater than 10% criterion exceeded, 90% statistical confidence criterion not met. EPA listed the assessment based on EPA guidance	5
5r	Exceeding Criteria, no approved TMDL in place for assessed parameter, ongoing restoration activities in place to address parameter	5

APPENDIX B - NC 2016 303(d) List Decision Document

Water Quality Limited Segments Added by the EPA to the NC 2016 303(d) List Based on Failure to Demonstrate Good Cause to Delist

2016 Assessment Unit#	Waterbody Name	NC Basin	Parameter of Interest
16-18-(1.5)b	Back Creek (Graham-Mebane Reservoir)	Cape Fear	Turbidity
18-16-1-(2)	Kenneth Creek	Cape Fear	pH
18-4-(2)	Lick Creek	Cape Fear	pH
11-129-2-(4)	Jacob Fork	Catawba	pH
6-54-(1)b	Mills River	French Broad	pH
7-2-(21.5)	North Toe River	French Broad	Turbidity
15-(1)d	WACCAMAW RIVER	Lumber	pH
15-25-13	Calabash River	Lumber	Turbidity
27-52-(1)b	Mill Creek (Moorewood Pond)	Neuse	Dissolved Oxygen
27-86-3-(1)a2	Turkey Creek	Neuse	Dissolved Oxygen
29-34-35	Pungo Creek	Tar Pamlico	Chlorophyll *a*
21-35-1b4	North River	White Oak	Turbidity
12-(108.5)b2	YADKIN RIVER (including upper portion of High Rock Lake)	Yadkin PeeDee	Chlorophyll *a*
12-(114)a	YADKIN RIVER (including lower portion of High Rock Lake)	Yadkin PeeDee	Turbidity
12-(114)b2	YADKIN RIVER (including lower portion of High Rock Lake)	Yadkin PeeDee	Chlorophyll *a*
12-(124.5)a	YADKIN RIVER (including lower portion of High Rock Lake)	Yadkin PeeDee	Chlorophyll *a*
30-3-(12)	Pasquotank River	Pasquotank	pH

APPENDIX B - NC 2016 303(d) List Decision Document

Water Quality Limited Segments Added by the EPA to the NC 2016 303(d) List
Based on failure to properly evaluate all existing and readily available data
Refer to Appendix D for more information

2016 Assessment Unit#	Waterbody Name	NC Basin	Parameter of Interest
16-14-(5.5)	Stony Creek (Stony Creek Reservoir)	Cape Fear	Chlorophyll *a*
17-43-(5.5)b	Rocky River	Cape Fear	Chlorophyll *a*
17-43-6-(2)	Mud Lick Creek	Cape Fear	Chlorophyll *a*
27-10-(1)	Ledge Creek (Lake Rogers)	Neuse	Chlorophyll *a*
27-10-(1)	Ledge Creek (Lake Rogers)	Neuse	Turbidity
27-33-(1)	Crabtree Creek	Neuse	Chlorophyll *a*
27-33-(3.5)a	Crabtree Creek (Crabtree Lake)	Neuse	Chlorophyll *a*
27-43-(5.5)b	Swift Creek (Lake Benson)	Neuse	Chlorophyll *a*
27-43-15-3	Basal Creek [(Bass Lake, (Mills Pond)]	Neuse	Chlorophyll *a*
27-86-11-(1)	Toisnot Swamp (Silver Lake, Lake Wilson)	Neuse	Chlorophyll *a*
13-17-9-4-(1)	Cold Water Creek (Lake Fisher)	Yadkin PeeDee	Chlorophyll *a*

APPENDIX B - NC 2016 303(d) List Decision Document

Water Quality Limited Segments Added by the EPA to the NC 2016 303(d) List
Based on failure to provide a reasonable method to assess toxic pollutants

2016 Assessment Unit#	Waterbody Name	NC Basin	Parameter of Interest
16-(1)c1	HAW RIVER	Cape Fear	Copper
16-11-(9)b	Reedy Fork (Hardys Mill Pond)	Cape Fear	Zinc
16-41-1-12-(1)	Third Fork Creek	Cape Fear	Copper
16-41-1-12-(2)	Third Fork Creek	Cape Fear	Copper
16-41-1-17-(0.7)b2	Northeast Creek	Cape Fear	Copper
17-(10.5)d2	DEEP RIVER	Cape Fear	Copper
18-(16.7)	CAPE FEAR RIVER	Cape Fear	Copper
18-(71)b	CAPE FEAR RIVER	Cape Fear	Arsenic
			Nickel
18-(87.5)a	CAPE FEAR RIVER	Cape Fear	Arsenic
18-74-(61)	Northeast Cape Fear River	Cape Fear	Copper
18-28ut3	Ut to Locks Creek	Cape Fear	Arsenic
			Zinc
11-129-5-(9.5)	Clark Creek	Catawba	Copper
11-137-1	Irwin Creek	Catawba	Lead
			Zinc
11-138	Twelvemile Creek	Catawba	Copper
7	NOLICHUCKY RIVER	French Broad	Copper
7-2-(21.5)	North Toe River	French Broad	Copper
27-(22.5)c	NEUSE RIVER	Neuse	Copper
27-(36)	NEUSE RIVER	Neuse	Copper
			Zinc

Water Quality Limited Segments Added by the EPA to the NC 2016 303(d) List
Based on failure to provide a reasonable method to assess toxic pollutants (cont.)

2016 Assessment Unit#	Waterbody Name	NC Basin	Parameter of Interest
27-(49.75)	NEUSE RIVER	Neuse	Copper
27-(96)b2	NEUSE RIVER Estuary	Neuse	Copper
27-34-(4)b	Walnut Creek	Neuse	Copper
22-58-12-6b	Marlowe Creek	Roanoke	Copper
29-(27)	PAMLICO RIVER	Tar Pamlico	Copper
29-6-(5)	Chocowinity Bay	Tar Pamlico	Copper
19-14	Wilson Bay	White Oak	Copper
21-32b	Calico Creek	White Oak	Copper
12-(38)b	YADKIN RIVER	Yadkin PeeDee	Copper
12-(47.5)	YADKIN RIVER	Yadkin PeeDee	Zinc
12-108-18-(3)	Bear Creek	Yadkin PeeDee	Copper
12-94-(0.5)b2b	Muddy Creek	Yadkin PeeDee	Copper
12-94-12-(4)b	Salem Creek (Middle Fork Muddy Creek)	Yadkin PeeDee	Zinc
			Copper
12-94-12-(4)c	Salem Creek (Middle Fork Muddy Creek)	Yadkin PeeDee	Copper
13-17-36-(5)a2	Richardson Creek	Yadkin PeeDee	Copper
13-17-40-11	Beaverdam Creek	Yadkin PeeDee	Copper
13-17-5a	Mallard Creek	Yadkin PeeDee	Copper
13-17-9-(2)	Irish Buffalo Creek	Yadkin PeeDee	Copper
13-17c2	Rocky River	Yadkin PeeDee	Copper
13-17c3	Rocky River	Yadkin PeeDee	Zinc
			Copper

APPENDIX C - NC 2016 303(d) List Decision Document

The EPA's Analysis of the State's Use of a Nonparametric Procedure for Delisting

The EPA has determined that the North Carolina's Listing Methodology used for most numeric water quality standards is not being used correctly for delisting decisions. The state uses a nonparametric hypothesis testing approach based on the binomial distribution to assess conventional pollutants and nutrients (chlorophyll-*a*). From the 2016 303(d) Listing Methodology: "The binomial method allows a quantifiable level of statistical confidence (90%) for listing decisions, which provides a 10% probability of listing an assessment unit when it should not be listed." The Methodology does not address removal of waters from the 303(d) or provide for statistical confidence to protect against delisting a waterbody when it should not be delisted.

In its 2014 303(d) list, the state submitted a "Justification for Changes to the 10% Listing Method" that indicated this approach is similar to the one outlined in *A Nonparametric Procedure for Listing and Delisting Impaired Waters Based on Criterion Exceedances*.[1] However, the state's approach is dissimilar to the referenced *Procedure* in that North Carolina does not differentiate between listing and delisting. This is a critical omission from North Carolina's methodology as "[t]he problem of deciding by a statistical procedure whether or not to delist a body of water that has already been designated as 'impaired' is not the same thing as deciding to list an impaired water." (Section 4, Delisting Procedure, of the Lin, et al., paper.)

With the introduction of the binomial approach, the state has the opportunity to recognize and manage uncertainties. The EPA agrees that the binomial approach can help manage uncertainties in making assessment decisions and, as North Carolina's Listing Methodology says, that "the degree of uncertainty depends on the sample size." The uncertainties also depend on the decision rules (or null hypotheses) chosen.

The null hypothesis "is what is assumed to be true about the system under study prior to data collection, until indicated otherwise."[2] The State's Listing Methodology "provides a 10% probability of listing an assessment unit when it should not be listed"; in other words, a "false" listing. When picking the decision rules and statistical methods in use support assessment for listing, one can attempt to minimize the chances of making either of the two following errors:

1. Concluding the segment is impaired, when it is not (a "false" listing), and
2. Deciding not to declare a segment impaired, when it is impaired.

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[1] Lin, Pi-Erh, Duane Meeter and Xu-Feng Niu. 2000. *A Nonparametric Procedure for Listing and Delisting Impaired Waters Based on Criterion Exceedances*. Technical Report. Department of Statistics, Florida State University, Tallahassee, FL.

[2] Helsel, D.R. and R. M. Hirsch, 2002. *Statistical Methods in Water Resources*, Techniques of Water Resources Investigations, Book 4, chapter A3. U.S. Geological Survey. See page 104.

In statistical hypothesis testing, errors are the incorrect rejection of a true null hypothesis (a Type I error as described in #1 above) and incorrect failure to reject a false null hypothesis (a Type II error in #2 above).

If the null hypothesis is that the waterbody is not impaired, a Type I error is detecting an impairment that is not present ("false" listing), while a Type II error is failing to detect an impairment that is present. According to the State's 2016 Listing Methodology, the "null hypothesis is that the overall exceedance probability is less than or equal to the 10% exceedance allowance." That is, the null hypotheses is that the waterbody is not impaired.

Once a waterbody is 303(d) listed, however, the null hypothesis should be reversed to be consistent with a delisting decision. If the null hypothesis is that the waterbody is impaired, then the Type I error is concluding a waterbody meets standards when it is not, while the Type II error is failing to delist when it should be. In that instance, the errors, listed above, would be swapped:

1. Deciding not to declare a segment impaired, when it is in fact impaired (a "false" delisting), and
2. Concluding the segment is impaired, when in fact it is not.

Error rates and sample size are mathematically linked. There is less chance of making either type of error as the amount of monitoring data increases. As Lin, et al., describe: "… the same sample size could be used for listing and delisting at the expense of a lesser confidence level for delisting. As already demonstrated, we may use n = 10 samples for both listing and delisting. With three exceedances, the water body reach is listed as impaired with 92.98% confidence … while with no exceedance observed, out of the ten sample measurements, the water body is removed from the impaired water list with only 65.13% confidence… However, any statistical conclusion that has a confidence level of less than 90% is considered not acceptable by most statistics practitioners."

For assessments made based on a binomial distribution method, the procedure for delisting requires stronger evidence and a larger sample size than for listing, if the same level of confidence is required. By using the same procedure for delisting as listing, the state has selected a lower confidence level for delisting decisions. The following table, based on statistical methods in the Lin et al. paper referenced above, demonstrates that for a delisting method of 10% exceedance where a 90% confidence level is desired, a minimum of 22 samples with no exceedances observed is required.

Sample size	# of Exceedances	For a DELISTING decision, the level of confidence would be:
10	0	**65%**
15	0	**79%**
20	0	**88%**
21	0	**89%**
22	**0**	**90%**
23	0	**91%**

For comparison, using the same statistical formula[3], the following table presents examples sample set size from some of the state's delisted waters. The resulting confidence levels show how certain one can be that these waterbodies are truly not impaired.

Sample size	# of Exceedances	For a DELISTING decision, the level of confidence would be:
10	1	**26%**
15	3	**6%**
20	3	**13%**
50	8	**6%**
59	7	**23%**
59	9	**7%**
85	10	**23%**

The EPA has conducted an independent assessment of water quality data to determine if additional impairments should be added to the section 303(d) list. The state removed 17 waterbody-pollutant combinations from the 303(d) list based on data that showed a greater than 10% exceedance rate, but with less than 90% confidence. However, this confidence level was calculated as if these were non-impaired waters.

The State of Alabama uses a delisting procedure[4] that is similar to that described in Lin et al., and which does reverse the null hypothesis to be consistent with a delisting decision as described above. The EPA has concluded that Alabama's approach is an acceptable method for demonstrating good cause for delisting. The table below compares sample size and number of exceedances that North Carolina used to delist the 17 waters with Alabama's "Maximum Number of Samples Exceeding the Numeric Criterion Necessary for Delisting at the 90 Percent Confidence Level." We note that Alabama requires a minimum sample size of 22 to delist. It is clear that in all 17 waters, assuming that a 90% confidence level is desired, that North Carolina's sample sizes are too small to delist or too many exceedances were allowed.

Our analysis found these 17 waterbody-pollutant combinations should be included on the 2016 list, based on failure to demonstrate good cause to delist. These waters are listed below and discussed in Section III.A.4.b, Section III.A.4.c.

[3] Delisting "level of confidence" was calculated using the Excel BINOM.DIST function: 1-[BINOM.DIST(#exceedances, #samples, 10% exceedance rate, TRUE)]

[4] Alabama's Water Quality Assessment and Listing Methodology January 2016; Alabama Department of Environmental Management, http://adem.alabama.gov/programs/water/wquality/2016WAM.pdf

Water Quality Limited Segments Added by the EPA to the NC 2016 303(d) List
Based on Failure to Demonstrate Good Cause to Delist

This table compares sample size and number of exceedances that North Carolina used to delist with Alabama's allowable exceedances. (The EPA has concluded that Alabama's approach is an acceptable method for demonstrating good cause for delisting.)

AU#	AU Name	Parameter of Interest	Sample size	# of Exceedances used to delist	Maximum # exceedances allowable for delisting with 90% confidence
11-129-2-(4)	Jacob Fork	pH	15	3	N/A - sample size too small *
12-(108.5)b2	YADKIN RIVER (including upper portion of High Rock Lake)	Chlorophyll *a*	10	1	N/A - sample size too small *
12-(114)a	YADKIN RIVER (including upper portion of High Rock Lake)	Turbidity	10	2	N/A - sample size too small *
12-(114)b2	YADKIN RIVER (including upper portion of High Rock Lake)	Chlorophyll *a*	10	2	N/A - sample size too small *
12-(124.5)a	YADKIN RIVER (including upper portion of High Rock Lake)	Chlorophyll *a*	10	2	N/A - sample size too small *
15-(1)d	WACCAMAW RIVER	pH	59	7	3
15-25-13	Calabash River	Turbidity	59	9	3
16-18-(1.5)b	Back Creek (Graham-Mebane Reservoir)	Turbidity	12	2	N/A - sample size too small *
18-16-1-(2)	Kenneth Creek	pH	48	8	2
18-4-(2)	Lick Creek	pH	48	6	2
21-35-1b4	North River	Turbidity	56	9	3
27-52-(1)b	Mill Creek (Moorewood Pond)	Dissolved Oxygen	84	10	5
27-86-3-(1)a2	Turkey Creek	Dissolved Oxygen	85	10	5
29-34-35	Pungo Creek	Chlorophyll *a*	50	8	2
30-3-(12)	Pasquotank River	pH	43	5	2
6-54-(1)b	Mills River	pH	20	3	N/A - sample size too small *
7-2-(21.5)	North Toe River	Turbidity	55	8	3

Alabama requires a minimum sample size of 22 to delist.

APPENDIX D - NC 2016 303(d) List Decision Document

EPA ANALYSIS OF THE STATE'S SMALL SAMPLE SETS WHICH INDICATE IMPAIRMENT

The EPA has determined that provisions in the State's Assessment Methodology related to age of data and minimum sample size are not consistent with federal requirements. Based on the EPA's independent review of the existing and readily available data, the provisions of the State's Methodology related to minimum sample size resulted in DWR failing to identify the following waters as not attaining the state water quality standards. Within the data window for this listing cycle (2010 through 2014), between 3 and 5 out of 5 samples in eight waterbodies exceeded the state water quality criteria for chlorophyll *a*, and in one of those waterbodies, turbidity.

North Carolina's Methodology specifies 3 exceedances out of 10 samples are necessary to determine that a waterbody is impaired. Where a waterbody has at least 3 exceedances, regardless of the total number of samples, there is no need to collect the full 10 samples to pass the exceedance threshold. For the waterbodies identified below, if an additional five samples were collected (to meet the minimum sample size of ten), and even if all five did not exceed the criteria, it would still be considered impaired because four out of ten samples would exceed the criteria. There is no need to wait on the collection of the additional five samples to determine impairment.

LAKE ROGERS

Four out of five samples in Lake Rogers exceeded the state water quality criteria for both turbidity and chlorophyll *a*. Lake Rogers, a 140 acre reservoir at Creedmoor, NC, upstream of Falls Lake, is classified as a high quality, nutrient-sensitive, water supply reservoir. This Assessment Unit [#27-10-(1)] in the Neuse River Basin has been listed on the state's Integrated Report in Category 3 (a determination of insufficient available data to make a use support determination) since 2012. According to the NC DWR Neuse River Basin Lakes and Reservoir Assessments, last updated in 2011: "Turbidity values at the upper end of the lake were consistently greater than the state water quality standard of 25 NTUs." The report also states: "Lake Rogers was determined to exhibit extreme biological productivity (hypereutrophic conditions). The trophic state of this lake has ranged from hypereutrophic in 1991 to eutrophic in 1992 and 1995." We note that the U.S. Army Corps of Engineers and the U.S. Geological Survey, agencies who have assisted in studies of water quality in the area, have recommended "implementation of the Neuse River Basin Rules, development of zoning ordinances, sediment trap implementation, a potential Section 206 study, and implementation and enforcement of Best Management Practices" to help alleviate the problems.

LAKE BENSON

Three out of five samples in Lake Benson exceeded the state water quality criteria for chlorophyll *a*. Lake Benson, a 472 acre reservoir at Garner, NC, is classified as a nutrient-sensitive, water supply reservoir. This Assessment Unit [#27-43-(5.5)b] in the Neuse River Basin has been listed on the state's Integrated Report in Category 3 (a determination of insufficient available data to make a use support determination) for chlorophyll *a* and high water temperature since 2012. According to the NC DWR Neuse River Basin Lakes and Reservoir Assessments, last updated in 2011: "In response to the availability of nutrients, chlorophyll *a* values were frequently greater than the state water quality standard of 40 µg/L. The greatest chlorophyll a values occurred in July (71 µg/L and 72 µg/L). The water level in the lake had dropped by three to four feet, increasing the concentration of nutrients in the lake. An analysis of phytoplankton samples taken from Lake Benson on July 14th and 15th indicated the presence of extreme blooms (> 100,000 units/ml) of the filamentous blue-green alga Cylindrospermopsis sp. Blue-green algae are associated with taste and odor problems in drinking water and additional treatment of raw water sources is frequently required to alleviate this problem." The report also states that "[t]his lake has been consistently eutrophic since it was first monitored in 1981."

BASS LAKE

Five out of five samples in Bass Lake exceeded the state water quality criteria for chlorophyll *a*. Bass Lake, a small reservoir also known as Basal Creek or Mills Pond, at Holly Springs, NC, is classified as a nutrient-sensitive reservoir. This Assessment Unit [#27-43-15-3] in the Neuse River Basin has been listed on the state's Integrated Report in Category 3 for chlorophyll *a* as well as turbidity and pH since 2012 (Category 3 means a determination was made that there was insufficient available data to make a use support determination). According to the NC DWR Neuse River Basin Lakes and Reservoir Assessments, last updated in 2011: "The greatest individual chlorophyll a values (72 µg/L and 74 µg/L) occurred on July 15th. Algal blooms were mild during May, severe during June, July and September, and extreme during August. Algal assemblages were dominated by golden-brown algae in May and by filamentous blue-greens June to September. Blue-green algae are associated with lakes experiencing nutrient enrichment. The report also states that "Bass Lake has been determined to be eutrophic since it was first monitored in 1987."

LAKE WILSON

Three out of five samples in Lake Wilson exceeded the state water quality criteria for chlorophyll *a*. Lake Wilson, a small reservoir also known as Toisnot Swamp or Silver Lake, is classified as a nutrient-sensitive, water supply reservoir. This Assessment Unit [#27-86-11-(1)] in the Neuse River Basin has been listed on the state's Integrated Report in Category 3 (a determination of insufficient available data to make a use support determination) since 2012. According to the NC DWR Neuse River Basin Lakes and Reservoir Assessments, last updated in 2011: "In response to the availability of nutrients in Lake Wilson, chlorophyll a values in June (48 µg/L), July (46 µg/L) and September (47 µg/L) were greater than the state water quality standard of 40 µg/L." The report also states that "Lake Wilson was determined to be hypereutrophic (exhibiting extremely high biological productivity) in 2010 based on the calculated NCTSI scores. Lake Wilson was previously determined to be eutrophic (having elevated biological productivity) in 1991 and 1995 when it was previously monitored."

LAKE CRABTREE

Three out of five samples in Lake Crabtree exceeded the state water quality criteria for chlorophyll *a*. Lake Crabtree, a small reservoir on Crabtree Creek in Raleigh, is classified as nutrient-sensitive. Two Assessment Units of Lake Crabtree [#27-33-(1) and 27-33-(3.5)a] in the

Neuse River Basin have been listed on the state's Integrated Report in Category 3 (a determination of insufficient available data to make a use support determination) since 2012. The Lake is also on the 303(d) list for impaired biology and PCB contamination. According to the NC DWR (then DWQ – the Division of Water Quality) Neuse River Basin Lakes and Reservoir Assessments, last updated in 2011: "The greatest chlorophyll a value, 69 µg/L, occurred at the sampling site near the dam (NEUCL3) in July. Analysis of phytoplankton samples collected from Lake Crabtree in 2010 indicated that algal blooms were mild during June, moderate during July, and severe during August to September. Algal assemblages were dominated by the colonial green Coelastrum sp. during spring and by the filamentous blue-green Cylindrospermopsis sp. throughout the summer. The euglenoid Trachelomona sp. was also prevalent during July. Blue-green algae are common indicators of nutrient enriched water and may form unsightly water discoloration, surface films, flecks, mats as well as producing taste and odor problems in drinking water. Euglenoids are also indicators of nutrient enriched water and blooms may create the appearance of spilled green paint on the surface of a lake. Based on the calculated NCTSI scores for 2010. Lake Crabtree was determine to exhibit extreme biological productivity (hypereutrophic). The trophic state of Lake Crabtree has alternated between eutrophic to hypereutrophic conditions since it was first monitored by DWQ in 1990."

LAKE BURLINGTON

Four out of nine samples in Lake Burlington exceeded the state water quality criteria for chlorophyll *a*. Lake Burlington, also known as Stony Creek Reservoir, is a small reservoir north of Burlington, NC, classified as a nutrient-sensitive water supply reservoir. This Assessment Unit [#16-14-(5.5)] in the Cape Fear River Basin has been listed on the state's Integrated Report in Category 3 (a determination of insufficient available data to make a use support determination) since 2010. According to the NC DWR Cape Fear River Basin Lakes and Reservoir Assessments, last updated in 2014: "Based on the calculated NCTSI scores, Lake Burlington was determined to exhibit elevated biological productivity (eutrophic conditions) in 2013. This reservoir has exhibited eutrophic conditions since it was first monitored by DWR in 1990."

CHARLES L. TURNER RESERVOIR

Five out of five samples at 4 different monitoring stations on the Charles L. Turner Reservoir exceeded the state water quality criteria for chlorophyll *a* of 40 µg/L. According to the NC DWR Cape Fear River Basin Lakes and Reservoir Assessments, last updated in 2014: "Charles L. Turner Reservoir is an impoundment located on the Rocky River in Chatham County downstream of Rocky River Reservoir. This reservoir, which serves as a water supply for the Town of Siler City, was created in 2009 by the construction of a new dam downstream of an existing 24 acre reservoir. The Charles L. Turner Reservoir encompasses 162 acres and increases available drinking water for Siler City. The watershed is primarily agricultural with some pasture land immediately adjacent to the lake. DWR monitored this reservoir for the first time in 2013." The upstream 24-acre reservoir [Assessment Unit #17-43-(5.5)a] has been on the NC 303d list since 2010 for chlorophyll *a*. The Assessment Unit for the Charles L. Turner Reservoir [#17-43-(5.5)b] and a tributary, Mud Lick Creek [#17-43-6-(2)] are classified as a critical area of this water supply watershed and both are now listed on the state's Integrated Report in Category 3 (a determination of insufficient available data to make a use support determination) for chlorophyll *a*. Four out of five samples on Mud Lick Creek in the arm of the reservoir exceeded the state water quality criteria for chlorophyll *a* of 40 µg/L.

LAKE FISHER

Three out of five samples in Lake Fisher exceeded the state water quality criteria for chlorophyll *a*. Lake Fisher is the primary water supply source for the city of Concord, NC, and is classified as a critical area of this water supply reservoir. This Assessment Unit [#13-17-9-4-(1)] in the Yadkin River Basin has been listed on the state's Integrated Report in Category 3 (a determination of insufficient available data to make a use support determination) for chlorophyll *a* and turbidity since 2008. According to the NC DWR Yadkin River Basin Lakes and Reservoir Assessments, last updated in 2012: "Chlorophyll a values ranged from 20 to 56 µg/L." The report also states that "Lake Fisher was determined to have elevated biological productivity (eutrophic conditions) based on calculated NCTSI scores for all of the sampling dates with the exception of September 28th when the trophic state of this lake was determined to be exceptionally productive (hypereutrophic)."

Appendix A "Detailed Review of the IWR Binomial Statistical Test" is part of the United States Environmental Protection Agency's Determination Upon Review of Amended Florida Administrative Code Chapter 62-303 Identification of Impaired Surface Waters, February 19, 2008

APPENDIX A: Detailed Review of the IWR Binomial Statistical Test

APPLICATION OF THE STATISTICAL TEST

A primary feature of the Florida Impaired Waters Rule (IWR) is the use of a statistical test based on the binomial distribution to evaluate data sets of water quality parameter measurements prior to relying on such data sets in listing a waterbody as "impaired." Statistical tests are useful when making decisions based on limited information (samples) about a general condition (population). While samples generally represent a population, they may have limited power to accurately and precisely represent specific characteristics of that population with great confidence. For example, it can be difficult to determine whether a particular data set of water quality sample measurements accurately represents actual conditions in ambient waters.

The binomial distribution is a nonparametric test based on a yes/no or pass/fail outcome. Such tests can be used, for example, to determine how many defective parts are allowed to come off an assembly line run without rejecting the entire lot (the example given in Microsoft Excel software). Nonparametric tests are useful, in general, when data are sampled from a population that is not normally distributed (i.e., a "bell" shaped curve) or where some data are "off the scale" (i.e., too high or too low to measure because of limitations of measuring devices or detection limits). The latter condition is typical of many water quality data sets. Going back to the assembly line example, the binomial test as applied to water quality is used to determine how many "defective" water quality measurements can occur before the waterbody as a whole is determined to be impaired (rejection of the entire lot).

The binomial statistical test has two key components, a probability value and a confidence value (or alpha). The probability value represents the proportion of samples that do not meet applicable water quality criteria (or the proportion of "defective" samples) associated with determining impairment in the waterbody as a whole. In the IWR, the probability value is 10%. In other words, "I believe that a rate of 10% or more of samples not meeting water quality criteria is enough to determine that the waterbody as a whole is impaired". The confidence value represents the desired certainty that small sample sizes are truly representative of the entire population. The confidence value is also expressed as a percentage value. In the IWR, the confidence value is 90% (80% for the planning list). In other words, "I want to be 90% certain that I have the right answer." For small sample sets, application of the confidence value results in the proportion of samples not meeting criteria to be greater than 10% before determining impairment, because of the relatively low certainty that small sample sets adequately represent the waterbody as a whole. As the size of the sample set increases, the proportion of samples not meeting criteria that are necessary to determine impairment approaches 10% because of the increased certainty, afforded by more data, that the sample set adequately represents the waterbody as a whole. The choice of probability value is not affected by sample size: the same acceptable proportion of "defective" measurements is applied to large and small data sets. Likewise, the choice of confidence value is not related to the acceptable proportion of "defective" measurements: it is a separate expression of desired certainty when considering the reliability of limited information. The probability value and the confidence value work together in the statistical test: "I want to be 90% sure that 10% or more of the samples do not meet water quality criteria in order to determine that the waterbody as a whole is impaired."

INTERPRETATION OF THE PROBABILITY VALUE OF 10%

In 2005, EPA determined that changes to criteria were those that affected magnitude (i.e., "how much"; usually expressed as a concentration such as "milligrams per liter"), duration (i.e., "how long"; usually expressed as an averaging period in hours or days), and frequency (i.e., "how often"; usually expressed as a return interval such as "no more than once every three years" or as a percent of time), as these features establish the level of protection or underlying expectation for ambient water quality. EPA further determined that provisions related to data reliability or sufficiency were not changes to water quality standards. In 2005, and now, EPA has determined the confidence value is not a change to standards because it relates to data reliability rather than to magnitude, duration, or frequency. In 2005, however, EPA determined the probability value was a new or revised water quality standard as a change to the frequency component of criteria. As explained more fully below, EPA is changing that determination because, based on additional information submitted by FDEP, we believe the probability value is a data reliability component of the IWR rather than a modification to the frequency component of the criteria.

In evaluating the IWR, both the 2001 version examined in EPA's 2005 Determination and the amended 2007 version which is the subject of this review, EPA's question with respect to the binomial test is "what is meant by the probability value?", or in other words, "what does it mean to be a 'defective' water quality measurement?" Is it defective in the sense that it is in error, inaccurate, biased, or an unreliable measure, or is it defective in the sense that it represents a pollutant or water quality parameter that exceeds its criterion? Based on the analytical framework laid out in EPA's 2005 Determination, if it is the latter then the probability value represents a new or revised water quality standard as a frequency component of water quality criteria. Florida's currently applicable water quality standards say that, "unless otherwise stated, all criteria express the maximum not be exceeded at any time." However, if the probability value represents the former (data reliability), then it does not represent a new or revised water quality standard. Under this interpretation, the underlying expectations for the ambient water are unchanged: the criteria are not to be exceeded. The probability value establishes the strength of the signal from data that may include a proportion of unreliable measures that is necessary to conclude that the criteria have in fact been exceeded. In the absence of documented clarification, EPA acted expansively with respect to what is a new or revised standard and concluded that the probability value constituted a new or revised water quality standard in its review of the of the 2001 IWR (2005 Determination).

EPA now understands that the probability value operates differently than we determined it did in 2005. In 2005, EPA reasoned that application of the 10% probability value would result in a 10% exceedance of a criterion magnitude value <u>in ambient water.</u>

Under this earlier understanding, a "defective" measurement actually would represent a pollutant or water quality parameter that, in fact, would exceed the criterion in the ambient water. Requiring a 10% exceedance rate in the ambient water would be different than what is expressed in Florida's water quality standards in terms of frequency. Based on consideration of additional information submitted by the State, however, EPA now understands that the purpose of the 10% probability value is to exclude data that are likely to be unrepresentative of actual ambient water conditions. Unless the number of samples ostensibly showing exceedance of the relevant water quality criterion is 10% or more, then FDEP will not list the receiving waters as having exceeded the criterion. The 10% probability value reflects the fact that the universe of samples assessed by FDEP are likely to include many unreliable and thus unrepresentative measurements, which do not accurately reflect the condition of the ambient water. Therefore, the State's binomial statistical test requires 10% or more of such samples to exceed criterion magnitude values before it will determine the waterbody itself does not meet water quality standards.

MODIFICATIONS TO THE 2007 AMENDED IWR

The 2007 amended IWR differs from the 2001 IWR with respect to the binomial statistical test in both the wording of the rule language and the supporting rationale that the State submitted in 2007.

In the 2001 IWR, it was unclear whether the probability value component of the binomial statistical test revised the expectations for ambient water set out in Florida's existing water quality standards. The binomial test provisions appeared in Florida Administrative Code (F.A.C.) rule 62-303.320(1), for the planning list, and rule 62-303.420(2), for the verified list, and the test was cross referenced in a number of other sections of the IWR.[1] The 2001 IWR described the probability value as "the number of exceedances of an applicable water quality criterion" necessary to determine impairment. EPA understood this language to revise the frequency component set out Florida's existing water quality standards and, in its 2005 Determination, identified the provisions implementing the binomial as new or revised water quality standards.

The 2007 amended IWR addresses the binomial test in the same provisions of the Rule as did the 2001 IWR However, the description of the probability value in the 2007 IWR refers to "the number of samples that do not meet an applicable water quality criterion" necessary to determine impairment for the waterbody as a whole. The consistent use of the term "samples" throughout these provisions describes the objective of the provisions as data reliability rather than ambient expectation. This interpretation is further clarified in the written materials submitted by FDEP in 2007.

The binomial statistical test first appears in the 2007 IWR in rule 62-303.320, related to the planning list. This provision has been renamed "Aquatic Life-Based Water Quality Assessment" in the 2007 IWR. The provision had been titled "Exceedances of

[1] Unless otherwise stated, all Rule and subsection citations are to provisions in the Florida Administrative Code.

Aquatic Life-Based Water Quality Criteria" in the 2001 Rule. The changes to the text in paragraph (1) are as follows:

> Water segments shall be placed on the planning list if, using objective and credible data, as defined by the requirements specified in this section, the number of samples that do not meet ~~exceedances of~~ an applicable water quality criterion due to pollutant discharges is greater than or equal to the number listed in Table 1 for the given sample size. For sample sizes up to 500, waters are placed on the planning list when ~~This table provides the number of exceedances that indicate a minimum of a~~ 10% or more of the samples do not meet the applicable criteria ~~exceedance frequency~~ with a minimum of an 80% confidence level using a binomial distribution. For sample sizes greater than 500, the Department shall calculate the number of samples not meeting the criterion that are needed to list the waterbody with an 80% confidence level for the given sample size using the binomial distribution.

References to "number of exceedances" and "exceedance frequency" have been replaced with "number of samples". Likewise, the changes in the text heading of Table 1 are as follows:

> **Minimum number of samples not meeting an applicable water quality criterion ~~measured exceedances~~ needed to put a water on the ~~P~~planning list with at least 80% confidence ~~that the actual exceedance rate is greater than or equal to ten percent~~.**

The term "measured exceedances" and the phrase "that the actual exceedance rate is greater than or equal to ten percent" have been removed and replaced with "samples not meeting an applicable water quality criterion".

The binomial statistical test appears in the 2007 IWR provisions related to the verified list at rule 62-303.420(2). This provision includes a 90% confidence limit, rather than the 80% confidence limit applied to the planning list. However, the probability value remains the same in this provision. Language changes similar to those made in rule 62-303.320(1) and Table 1 are also made for this provision and Table 3:

> …Once these additional data are collected, the Department shall re-evaluate the data using the approach outlined in rule 62-303.320(1), F.A.C., but using Table 3~~2~~, and place waters on the verified list when ~~which provides the number of exceedances that indicate a minimum of a~~ 10% or more of the samples do not meet the applicable criteria, ~~exceedance frequency~~ with a minimum of a 90% confidence level using a binomial distribution.

As with the changes to rule 62-303.320, the changes to rule 62-303.420 represent a clear change in meaning from the 2001 IWR. These changes in language clarify that the probability value of 10% is intended to be a data reliability provision related to the number of samples necessary to conclude that criteria have been exceeded in a waterbody rather than a new allowable frequency of exceedance. EPA acknowledges that the assessment result is the same as in 2001. However, the amended language clarifies that the probability value of 10% serves as a data reliability provision related to the number of samples necessary to conclude that criteria have been exceeded in the waterbody as a whole rather than a new frequency component allowing ambient waters to exceed criteria 10% of the time. This clarification is fully explained in the FDEP supporting materials accompanying the submission of the IWR for review.

RELATED PROVISIONS IN THE 2007 AMENDED IWR

There are two important provisions within 62-303.320 that merit further discussion to understand the context of the application of the binomial statistical test. The first is paragraph (4)(a) which establishes a procedure for grouping data collected within a 4 day period and using the median as the representative value for the entire period. This provision clearly represents a new or revised water quality standard as it adds a duration component to the criteria. EPA reached the same conclusion in its 2005 Determination of the 2001 IWR, when the duration period was 7 days. The same duration period is established specifically for the marine dissolved oxygen daily average criterion in paragraph (5). The second note-worthy provision is paragraph (6)(b), which calls off the duration period in paragraph (4)(a) and the binomial statistical test for acute toxicity-based water criteria (as did the 2001 IWR) and for synthetic organic compounds and synthetic pesticides (which is new for the 2007 IWR), opting for a no more than once in three year period frequency of exceedance for any measurement above the criteria for any of these parameters. For practical purposes, these provisions limit the applicability of the binomial statistical test to metals, dissolved oxygen, and bacteria measurements.

Although they appear in planning list provisions, the duration and frequency criteria components described in 62-303.320(4)(a), (5), and (6)(b) constitute new or revised water quality standards based upon their cross reference in 62-303.420(1) and (6) and 62-303.720(m), which execute attainment decisions for purposes of meeting the requirements of Clean Water Act section 303(d).

The binomial statistical test described in 62-303.320, excluding the 4 day duration period, is cross referenced in 62-303.360(1)(a) and 62-303.370(1) for evaluating samples with respect to bacteria criteria and 62-303.380(1)(a) and (3)(a) with respect to drinking water and human health criteria (excluding synthetic organics and synthetic pesticides via 62-303.320(6)(b)). The binomial statistical test described in 62-303.420, excluding the 4 day duration period, is also cross referenced in 62-303.460(3)(a), 62-303.470(3)(a), and 62-303.480(3)(a) for evaluating samples with respect to bacteria criteria.

An important feature of the amended 2007 IWR is the so-called "overwhelming evidence clause" at 62-303.420(7):

> …water segments shall also be included on the verified list if, based on representative data…scientifically credible and compelling information regarding

> the magnitude, frequency, or duration of samples that do not meet an applicable water quality criterion provides overwhelming evidence of impairment.

This provision allows FDEP to consider data of known high quality and reliability, as well as data having other characteristics that make a credible and compelling case for non-attainment, and execute an attainment decision with respect the 303(d) list. While this provision does not constitute a new or revised water quality standard, because the standards for evaluating the credible and compelling information are not changed, it does help provide needed flexibility for considering all relevant information pursuant to the regulatory requirements of 40 C.F.R. Part 130 for preparing an appropriate and complete list of impaired waters. There are also other provisions of the 2007 IWR that provide FDEP the legal authority to exercise discretion in identifying waters as impaired.

EVALUATION OF SUPPORTING RATIONALE

FDEP submitted a 40 page document entitled "Florida's Methodology for Identifying Surface Water Impairment Due to Metals" (metals methodology) among the package of supporting material accompanying the submittal of the 2007 IWR for EPA review. In the Introduction section of this document, FDEP summarizes:

> The IWR, which was adopted in 2001, establishes procedures for evaluating data sufficiency and data quality to ensure that a number of sample exceedances of a water quality criterion do, in fact, represent impairment of a waterbody. The statistical approach and thresholds selected are intended to provide greater confidence that the outcome of the water quality assessment is correct.
>
> While the IWR uses EPA's long-standing 10% exceedance rate as the threshold for impairment when evaluating aquatic life-based numeric water quality criteria, it differs from EPA's Integrated Report guidance in two principal ways. First, it applies the threshold to both conventional pollutants and metals, while EPA recommends it only for conventionals. <u>Florida applies this methodology to water quality parameters such as metals to account for uncertainty in data quality.</u> Second, it establishes a minimum confidence level for the assessment (an 80% confidence level for the Planning List of potentially impaired waters and a 90% confidence level for the Verified List of impaired waters) that is calculated using a non-parametric statistical approach called the binomial method. (emphasis added)

Chapter 3 of FDEP's metals methodology describes in detail the factors supporting the need to address uncertainty in data quality based on accounting for sampling and analytical error, with a particular concern for "false positive" (bias at the high end of measurement). The document states "erroneously high metal concentrations have routinely been reported in natural waters because of contamination artifacts introduced during sampling and analysis" (scientific literature citations provided). The document also states that "[i]t is the Department's experience that much of the data reported for metals in natural waters are biased erroneously high and need to be verified if reported to exceed water quality standards," adding that "[s]ampling errors can sometimes be detected through metadata (for instance, if field blanks are contaminated)." Specific experiences related to working with Florida's data set are recounted, as in:

> The Department's Bureau of Laboratories has referred a number of cases in which exceedances of water quality standards were alleged for metals; however further investigation (split sample studies, etc.) using analytical techniques designed to remove interfering substances (e.g., chelation extraction techniques for metals) nearly always demonstrated that measurement artifacts were the likely culprit, as few chronically reported water quality exceedances for metals could be substantiated in the laboratory or in properly designed field studies.

A detailed evaluation of phosphorus data from the Everglades provides some quantification of error rates from reports from lab analysis of field data, and the implications are summarized as:

> While the previous example clearly illustrates the importance of metadata, the vast majority (>80%) of the state's data providers still did not meet the metadata requirements of the original IWR due to data management constraints. FDEP has nonetheless accepted the data and has, in fact, revised the IWR to allow use of data without metadata because we do not want to overly limit the amount of data available for impaired water assessments[2]. However, it should be noted that most of the water quality data collected for ambient waters come from laboratories with less incentive and less oversight than in the Everglades Program. Analysis of exceedances suggests that many are the result of data that were improperly qualified and that should not have been submitted without proper qualifiers identifying them as below the MDL or PQL. As a result, FDEP remains convinced that data lacking supporting QA/QC metadata (e.g., Legacy STORET data) should be used very cautiously in deciding whether a waterbody should be listed as impaired, and that the assessment methodology needs to acknowledge some level of false positives in the dataset. EPA's TSD Response Summary states that "**the allowable frequency for criteria excursions should refer to true excursions of the criteria, not to spurious excursions caused by analytical variability or error**."
>
> When deciding on an appropriate assessment methodology, FDEP recognized that there would be some unknown number of false positives (given the potential for error combined with the limited ability to identify and exclude bad data). Because of the large water quality dataset (some 45 million records in the IWR database) it is not possible to do a QA analysis of each data point. As such, the only alternatives are to either exclude all data of unknown quality (the majority of currently available data), or to acknowledge this error in designing an assessment methodology. Florida's methodology attempts to use as many data as possible to

[2] In cases where metadata show the data to be unreliable (i.e., do not meet the minimum QA/QC standards), the data are of course not used.

> include as many waterbodies as possible in assessing waters for the TMDL Program. (emphasis theirs)

FDEP has assembled a large amount of data, a large proportion of which is from third party sources. This large database factors heavily in EPA's evaluation of the use of the binomial statistical test and FDEP's supporting material. Going back to the statistical background provided at the beginning of this analysis, the need for a method to determine the "greatest number of defective parts allowed to come off an assembly line run without rejecting the entire lot," or in this case "how many 'defective' water quality measurements need to occur to gain confidence that the water is impaired," is evident. FDEP's metals methodology provides an extensive list of outside data providers, along with the number of records provided by each. FDEP summarizes the challenges of working with large volumes of data from multiple sources:

> Given the vast amount of ambient data available in Florida and the uncertainties associated with this data as far as its quality, accuracy and representativeness, FDEP needed to either limit the data that could be used to only that which could be rigorously evaluated for data quality and representativeness, or develop an assessment methodology that allowed for computerized, statistical evaluation of the data. Rather than limit the data that could be used, FDEP opted to use the vast combined monitoring capacity of multiple entities within Florida that collect data and promote documentation of collection, handling, and analysis, and reporting procedures.
>
> However, from a practical management point, FDEP recognized that, even with improved sampling procedures, a significant fraction of the data will continue to represent erroneously high values because of errors introduced in sampling and analysis and bias from non-representative sampling. When examining data, it is not possible to identify (or program a computer to identify) which particular data points are valid or invalid because of the large range of possible results. However, certainty is increased greatly when multiple values are found to be exceeding a threshold. The extreme tail end of a distribution may be most likely to contain the most erroneous data, but as a greater proportion of the data lie above a threshold of interest, certainty increases greatly that the value has in fact been exceeded. The use of a 10% exceedance frequency in the IWR represents a threshold where the frequency of poor quality data suggests it is not likely that all the data above this point would be erroneously high, as a general rule. Thus, this serves as a practical adjustment for uncertainty from known data quality impacts, while ensuring confidence that waters that are impaired will be captured.

FDEP's methodology also documents and supports the selection of 10% as the probability value:

> FDEP selected EPA's recommended 10% exceedance frequency as the listing threshold for the assessment of aquatic life use support in acknowledgement that some percentage of the available data are unreliable and/or represent natural

variation. The FDEP included the binomial method as a mechanism to establish the confidence associated with the assessment and applied the method to both conventional pollutants and toxics. FDEP has subsequently revised the IWR so that the binomial method does not apply to synthetic organics or pesticides because data for these pollutants are typically negatively biased. However, FDEP has concluded that the binomial method is appropriate for metals… The following points summarize FDEP's alternative approach for metals:

- The confidence limit aspect of the alternative approach using the binomial reflects FDEP's management of statistical uncertainty of sampling (grab sample monitoring) from an overall population (ambient water conditions)
- The 10% exceedance rate is a **sample** exceedance rate for the assessment data, not an inherent allowable rate of criteria exceedance in the ambient water. Florida must process over 45 million data records to conduct its assessment program, and nearly 75% of Florida's data are from other agencies. These non-FDEP data have greater uncertainty with respect to accuracy and representativeness, and it is not possible to thoroughly review the QA/QC associated with all these data. However, these data also provide a wealth of information about the status of Florida's waters. To most fully utilize these data resources, FDEP developed a statistical approach that is amenable to computerized data processing and that allows FDEP to achieve the objectives of using data most likely to be reliable, while ensuring that waters not expected to meet applicable water quality standards are indeed placed on the state's 303(d) list
- The 10% exceedance rate quantitatively represents an accounting for sampling and analytical error associated with factors such as collection and handling errors, reporting errors, blank contamination, reversals, and matrix interference. The extent and effect of these types of data quality factors have been quantified for specific data sets in Florida to provide further support for the selection of 10% as a reasonable and appropriate target value. For example, the USGS audit identified that 10% of the samples in Florida's data were unreliable. [*Note: this USGS audit was conducted using all of Florida's data, not just USGS collected data.*] The best quantification of potential error rates comes from Everglades data records, which indicate a range of between 2-60% for various water quality parameters. Excluding the extremes (a low overall error rate for calcium and a very high rate of blank contamination from one lab for orthophosphate), this range narrows to 7-33% with all but one remaining value above 10%. Recognizing that the majority of error is reflected on the high end of reported data, a selection of 10% is reasonable and appropriate for this accounting.

EPA finds this rationale reasonable and concludes that the 10% probability value does not constitute a new or revised water quality standard. EPA acknowledges that this conclusion differs from the 2005 Determination associated with the 2001 IWR with respect to the comparable provisions. However, EPA rigorously applied the identical analytical approach for evaluating what constitutes new or revised water quality standards as it employed in the 2005 Determination. With the benefit of FDEP's supporting rationale and the changes in the regulatory language itself, the documentation of the 10% probability value functioning as a data reliability provision is clear and convincing. EPA believes that the characteristics of Florida's assessment data base in terms of volume of records and proportion generated from sources outside the state regulatory agency's control may be unique in the nation. While Florida has successfully made a State-specific case that use a 10% probability value in a statistical binomial test is appropriate and acceptable for use in Florida at this time, the documentation does not support this use as a general matter in other places or with an assessment data base that differs from Florida's current one in terms of documentation, quality, volume and underlying sources.

In its metals methodology, FDEP also makes an assertion concerning a minimal number of valid samples that exceed criteria, outside the context of data reliability:

> The 10% exceedance rate also reflects that a minimal number of valid samples may exceed the criteria, but would not result in impairment of designated uses. No significant damage to the biological community is expected to occur from intermittent, low-level exceedances of chronic criteria because the exceedances are typically very short in duration (shorter than 96-hours) and, for metals, typically include non-bioavailable particulate forms. The results from FDEP stream bioassessments include many cases of waters that have had intermittent exceedances of chronic criteria for toxics and still have excellent bioassessment scores. Florida's well-developed bioassessment tools are an integral part of the assessment process, and FDEP believes that these tools are useful at identifying impairment of aquatic life use support.

This assertion no doubt expresses the belief of the authors of the report, but nonetheless does not have a relationship to the intended function of the 10% probability value, which is clearly identified as a "sample exceedance rate for the assessment data, not an inherent allowable rate of criteria exceedance in the ambient water" a few sentences above this assertion in the same Methodology document, nor did this assertion have any bearing on EPA's evaluation. However, as a factual matter EPA does not disagree with the general point, as evidenced by EPA's own criteria recommendation published pursuant to Clean Water Act section 304(a), which are the basis for the magnitude value in Florida's underlying water quality criteria for metals, and for which EPA has recommended associated duration and frequency components whereby the magnitude may be exceeded for short periods of time at infrequent intervals and still be fully protective of aquatic life uses. Florida could have elected to produce a methodology with an alternative allowable frequency component for their criteria, but they did not choose to do so.

CONTINUED EPA OVERSIGHT

While not identified as a new or revised water quality standard, EPA continues to have a responsibility for regulatory oversight of use of the 10% probability value in conjunction with its review of lists of impaired waters submitted to EPA pursuant to

Clean Water Act section 303(d). EPA recognizes that the 10% probability value represents a reasonable choice based on data quality as documented at this time. However, EPA also recognizes the improvement in data quality that Florida seeks in their underlying data moving forward, and that several provisions of the IWR encourage and mandate documentation of monitoring data used for water quality assessment purposes. EPA will continue to monitor and evaluate waters in all assessment categories with respect to the underlying data and the relevant aspects of the binomial statistical test as part of the Agency's oversight responsibilities under the Clean Water Act. EPA retains the discretionary authority to add waters to Florida's list of impaired waters if circumstances warrant. Furthermore, EPA will advise Florida accordingly if at some time in the future, continued use of the 10% probability value as a data reliability provision becomes inappropriate and counter-productive to Florida's program goals and responsibilities.

NATURALLY VARIABLE POLLUTANTS

As mentioned previously, the binomial statistical test applies to parameters other than metals, most notably to dissolved oxygen and bacteria criteria. EPA has addressed Florida's assessment methodology with respect to "naturally variable" pollutants or pollutant parameters in previous determinations and actions associated with Florida's 303(d) list. As explained above, EPA has determined that the bionomial probability value is a "sample exceedance rate for the assessment data, not an inherent allowable rate of criteria exceedance in the ambient water." As to naturally variable parameters, like dissolved oxygen and bacteria, however, even if EPA determined the probability value were an allowable rate of criteria exceedance in a waterbody, that allowable exceedance rate would not constitute a new or revised water quality standard. As explained more fully below, applying a 10% exceedance rate to naturally variable parameters would be consistent with Florida's currently approved water quality standards and would not represent a change in magnitude, frequency, or duration.

Natural variability relates to the degree that conditions in nature vary as a function of time and space based on physical, chemical, biological, hydrological, and geomorphological factors. Pollutants and pollutant parameters can be placed into three distinct groups for considering the effects of natural variability. Some pollutants, such as chlorine and pesticides, are introduced solely as a function of anthropogenic activity and, although natural factors can mitigate or augment their effects, their presence cannot be attributed to natural conditions. The second group of pollutants usually occurs naturally in the environment at low levels, such as copper and cadmium, but protective water quality criteria for these pollutants usually lie well above the typical range of solely natural occurrence. For this group, the natural contribution is likely negligible at measured levels above or near the water quality criterion. Natural variability is generally not a factor for consideration in evaluating ambient measurement samples that exceed water quality criterion magnitude values for these first two groups of pollutants. By contrast, a third group of pollutants or pollutant parameters has protective water quality criteria that lie within or near the range of naturally occurring conditions. This "naturally variable" group includes pollutants or pollutant parameters such as dissolved oxygen, turbidity, bacteria, conductivity, and alkalinity. Natural variability is an appropriate and reasonable factor to consider in evaluating ambient data for this group of pollutants or pollutant parameters.

Dissolved oxygen (DO) is perhaps the best example of a naturally variable pollutant parameter. DO refers to the volume of oxygen that is contained in water, and is measured and expressed as a concentration (typically in mg/L). Oxygen may occur in surface water as a by-product of photosynthesis by aquatic plants and/or through physical transfer from the surrounding air. DO solubility and, as a result, the expected ambient measured levels, are affected by temperature (colder water holds more oxygen), salinity (fresher water holds more oxygen), and altitude (lower pressure reduces oxygen's solubility). DO levels are also affected by flow and stream channel or lake morphology (more turbulent or well-mixed water transfers more oxygen from the air at the water surface), degree of biological activity (plant and animal respiration deplete oxygen, especially at night), and the amount of naturally occurring organic matter (aerobic decomposition depletes oxygen). As a result, DO can change and vary in a single water body according to time of day, season, weather, temperature, depth and location of sampling, and flow. The variability across different waters is augmented by many of the factors described above. DO can range from 0-18 mg/L in natural water systems, with long-term levels set generally within 5-6 mg/L to support a diverse aquatic community in most warmwater systems, as reflected by Florida's water quality standards.

An allowable exceedance rate of 10% for naturally variable pollutants would be consistent with EPA's general recommendations for such pollutants and would represent a reasonable choice for attainment decisions. In 2003, EPA approved, as consistent with Florida's existing water quality standards, FDEP's use of a 10% exceedance rate for naturally variable pollutants when compiling the State's Group 1 update to its section 303(d) list.[3] The Eleventh Circuit Court of Appeals recently ruled in a challenge to that approval in Sierra Club et al. v. Leavitt, 488 F.3d 904 (11th Cir. 2007). One issue addressed by the Court was EPA's recognition that while some of Florida's water quality criteria are "not to be exceeded at any time," it was reasonable for Florida to interpret that regulatory phrase in concert with legislation authorizing the creation of Florida's water quality standards. That legislation provided that FDEP was to take into account the variability occurring in nature when applying the State's water quality standards. Id. at 919. The Eleventh Circuit held:

> The EPA noted that because Florida does not have a monitoring program that continuously measures all points in its waterbodies (and thus the FDEP could never determine that a waterbody had not exceeded water quality criteria "at any time"), Florida must use statistical sampling to estimate a waterbody's compliance

[3] See Decision Document Regarding Department of Environmental Protection's § 303(d) List Amendment Submitted on October 1, 2002 and Subsequently Amended on May 12, 2003. (June 11, 2003), page 25 and Appendix N on naturally variable pollutants.

<www.epa.gov/region4/water/tmdl/florida/documents/EPA303d_decdoc.pdf>

> with water quality standards. Florida's Legislature recognized that sampling introduces variability into the testing process, some due to natural variability and some associated with sample collection and analysis. Thus, the EPA concluded, a single sample does not determine whether a waterbody fails to meet water quality standards. Instead, the EPA "considered a number of factors" in reviewing whether a waterbody was impaired. Decision Document at 21. "These factors included whether more recent data show attainment that renders earlier data suspect (trends); the magnitude of exceedance; the frequency of exceedance; pollutant levels during critical conditions; and any other site-specific data and information such as biological monitoring, whether new controls have been implemented on the water, etc." Id. Like the district court, we find the EPA's "totality" approach reasonable. Id. at 920.Recently, Florida has revised its underlying water quality standards to more clearly incorporate the legislative requirement that FDEP consider natural variability when applying its water quality standards:
>
> In applying the water quality standards, the Department shall take into account the variability occurring in nature and shall recognize the statistical variability inherent in sampling and testing procedures. The Department's assessment methodology, set forth in Chapter 62-303, F.A.C., accounts for such natural and statistical variability when used to assess ambient waters pursuant to sections 305(b) and 303(d) of the Federal Clean Water Act. [Rule 62-302.530, F.A.C]

EPA believes that Florida has correctly interpreted its own statute and regulations to recognize natural and statistical variability when making determinations of impairment. Therefore, even if EPA were to determine that the 10% probability value in the binomial statistical test was a new allowable exceedance rate rather than a data reliability provision, EPA would also determine such an exceedance rate does not constitute a new or revised water quality standard as to naturally variable pollutants.

Bacteria represents a special case in applying the binomial statistical test because the criteria itself includes allowable exceedance rate of 10% in ambient water. In this case, application of the 10% probability value is redundant with the criteria already in place as a practical matter. It is clear there is no intended change in criteria. EPA considers the application of the 10% probability value to provide no additional consideration for data reliability as a listing metholodogy for this component of the bacteria criteria. The binomial statistical test does function to add a confidence value to the assessment procedure. Regardless, however, EPA is neither approving nor disapproving the confidence value because it is not a not a new or revised water quality standard.

USE OF THE CONFIDENCE VALUE

As described in the beginning of this appendix, the confidence value represents the desired certainty that small sample sizes are truly representative of the entire population. In a few places in its 2005 Determination, EPA mistakenly suggested that the application of the confidence value constituted a new or revised water quality standard. For example, on page 14 of Appendix C of the 2005 Determination, EPA stated:

> EPA has determined that as applied to Shellfish Use Consumption Support, this provision changes or further defines the frequency of Florida's currently approved Fecal and Total Coliform criteria found at 62-302.530(6) and (7) from a strict "not more than 10% of the samples exceeding . . ." and replaces it with an evaluation of samples targeting higher than 10% of the samples to gain confidence of an actual exceedance rate of 10%.

On pages 55-56 of that same document, EPA stated:

> EPA does not find the minimum sample size aspect of this provision to be a water quality standard. This provision relates to the exclusion of data for CWA 303(d) listing purposes pursuant to implementing regulations at 40 CFR Part 130.7(b)(5) and 40 CFR Part 130.7(b)(6)(ii) and (iii). This aspect of the provision is not a water quality standard because it does not describe the ambient condition of a water body. This provision contains policy choices about what data is reliable, but it does not describe the condition of the water body that is assessed. Additionally, <u>applying a confidence test to assessing exceedance frequency does not itself change the targeted magnitude, duration, and frequency of criteria that describes the ambient condition of the waterbody as long as the targeted exceedance frequency is equivalent to the underlying frequency of the existing water quality standard. The statistical confidence test relates to the reliability or sufficiency of data rather than to the ambient condition of the waterbody</u>**.** The statistical confidence takes into account the variability of data that derives from sampling error that occurs in any field sampling/water monitoring, and thus whether the data accurately represent the condition of the waterbody, but it does not incorporate a different ambient condition in the waterbody - in other words, a different level of pollutant(s) or pollutant indicators that are acceptable in the waterbody. The frequency of exceedence, however, does relate to the ambient condition and therefore is a part of a water quality criterion. The statistical confidence test may be used to gain assurances of an exceedance of a defined frequency for purposes of identifying water quality limited segments. [emphasis added]

The underlined portion of the second quote above reflects the correct understanding of the confidence value and EPA's current determination with respect to whether the confidence value constitutes a new or revised water quality standard. However, the rationale offered in the next sentence of the 2005 Determination, "statistical confidence takes into account the variability of data that derives from sampling error that occurs in any field sampling/water monitoring, and thus whether the data accurately represent the condition of the waterbody," does not correctly describe how the confidence value works in the IWR. A statistical confidence test does not account for the underlying accuracy of data, rather it accounts for the representativeness of the sample data -- how well a sample set represents a population. The effect of sampling error is accounted for by the probability value in the IWR.

As explained above, FDEP demonstrated that 10% is a reasonable representation of erroneously high values in their overall population of water quality data, without respect to sample size. If one could expect 10% of the data to be in error regardless of sample size (i.e., a 10% error rate for the population of recorded ambient measurements), then a confidence value associated with sample size simply represents the degree to which a small sample set could disproportionately represent erroneously high values (i.e., the sample set may have more than 10% erroneously high values while the population maintains an overall rate of 10% erroneously high values). Thus, the confidence value component of the binomial statistical test does not constitute a new or revised water quality standard in any context that it appears in the IWR.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 4
ATLANTA FEDERAL CENTER
61 FORSYTH STREET
ATLANTA, GEORGIA 30303-8960

DEC 19 2014

Mr. Tom Reeder
Director
Division of Water Resources
North Carolina Department of Environment
and Natural Resources
1617 Mail Service Center
Raleigh, North Carolina 27699-1617

Dear Mr. Reeder:

The purpose of this letter is to transmit to you the final decision of the Environmental Protection Agency Region 4 to add fifty-one waterbody-pollutant combinations to North Carolina Department of Environment and Natural Resources' Final 2014 Clean Water Act (CWA) section 303(d) list of water quality limited segments. The EPA partially approved the state's 2014 section 303(d) list in its July 31, 2014, Decision Document. At the same time, the EPA identified fifty-two additional water quality limited segments to be included on the state's section 303(d) list and initiated a public comment period seeking comment on the additional listings. Due to a counting error, the partial approval document and public notices incorrectly specified fifty-*two* waters; the list itself, in Appendix D of the July 31st document has only fifty-*one* waters.

After considering the comments submitted during the public comment period, the EPA has not revised its decision to list the fifty-one waterbody-pollutant combinations. The Responsiveness Summary of comments received is enclosed.

The EPA would like to continue to work closely with your Division to successfully implement the CWA and achieve improvements in water quality. If you have questions, please contact me at (404) 562-9345 or Ms. Joanne Benante at (404) 562-9125.

Sincerely,

James D. Giattina
Director
Water Protection Division

Enclosure

cc: Mr. Bennie Hutson, Chairman, NC Environmental Management Commission
Mr. Tom Fransen, Chief, Planning Section, NC Division of Water Resources
Ms. Kathy Stecker, Modeling & TMDL Unit Supervisor, NC Division of Water Resources

Responsiveness Summary to Comments
Regarding the EPA's July 31, 2014 Action to Add
Waters to North Carolina's 2014 Section 303(d) List

On July 31, 2014, the EPA partially approved the North Carolina (NC) Clean Water Act (CWA) section 303(d) list submittal for the 2014 listing cycle, approving NC's listing of waters, associated pollutants, and associated priority rankings for the state. The EPA also independently determined that fifty-one additional waterbody-pollutant combinations should be added to the state's list. On August 16, 2014, the EPA issued a public notice of the decision to add these waters to NC's 303(d) list. On September 16, 2014, the EPA issued an extension of the comment period with comments due on October 14, 2014. Due to a counting error, the partial approval document and public notices incorrectly specified fifty-*two* waters; the list itself, in Appendix D of the July 31st document, has only fifty-*one* waters.

During the comment period, we received 1,143 emails in support of the Agency's action to list these waterbodies. We received six detailed comment letters, of which two were in support of, three were opposed to, and one was outside the scope of this action. All comments are archived in the Administrative Record for this Agency action. The state submitted comments jointly from the NC Environmental Management Commission (EMC) and the NC Division of Water Resources (DWR). We commend the EMC and DWR staff for their diligent efforts to improve the water quality assessment process that supports the state's CWA sections 305(b) and 303(d) Integrated Report (IR). We note that the state and the EPA agreed on 230 of the state's delisting determinations, and 1,193 listed waterbody-pollutant combinations, identified in the 2014 303(d) list.

The EPA, after consideration of all comments received, is not changing its partial approval of the NC 303(d) list submittal for the 2014 listing cycle and is listing the fifty-one waterbody-pollutant combinations. Because the EPA received a significant number of similar comments on the proposed action, the comments and responses have been categorized and grouped under the following headings:

A. Comments related to the EPA's legal authority

B. Comments related to the validity of the 1-in-3 method for toxics

C. Comments related to the validity of the 10% / 90% methodology for toxics

D. Other / Miscellaneous comments

A. COMMENTS RELATED TO THE EPA'S LEGAL AUTHORITY

A1 Comment: The EPA's One in Three Policy Must Be Promulgated Through Rulemaking

Response: Section 303(d)(1)(A) of the CWA requires each state to identify those waters within its boundaries for which the effluent limitations required by the CWA are not stringent enough to implement any water quality standard (WQS) applicable to such waters. Section 303(d)(2) requires each state to submit to the EPA Administrator for approval the waters identified under paragraph (1)(A). The Administrator shall either approve or disapprove such identification.

To assist in approval or disapproval of the submitted list, each state shall provide documentation to support the state's determination to list or not to list its waters and shall include at a minimum a description of the methodology used to develop the list, among others. See 40 CFR 130.7(b)(6). The methodology used is not required to be promulgated through rulemaking. In carrying out its CWA 303(d) responsibilities, the EPA reviews the state's assessment methodology to determine if it properly implements applicable WQSs and federal 303(d) regulations for each category of impairment. The state may use any scientifically defensible methodology if it can show that the methodology properly implements the WQS (40 CFR 131.11 (b)). When the EPA cannot conclude that the state's methodology properly implements the WQS, the EPA conducts an independent assessment and reviews water quality data for each relevant category to determine if additional impairments should be added to the 303(d) list. Since the EPA could not conclude that NC's ten percent exceedance frequency methodology was appropriate, the EPA conducted an independent assessment using the EPA recommended guidance.

For toxics, the EPA CWA section 304(a) recommended criteria was established through rulemaking and recommends that acute and chronic aquatic life criteria for toxics not be exceeded more than once every three-year period (l-in-3) on the average (EPA 1992). The scientific basis of this frequency recommendation is discussed in detail in section B, below.

With the concurrence of the EPA, states may adopt site-specific criteria, rather than national criteria, in their state standards. Such site-specific criteria may include not only site-specific concentrations, but also site-specific, and possibly pollutant-specific, durations of averaging periods and average frequencies of allowed excursions. If adequate justification is provided, site-specific and/or pollutant-specific concentrations, durations, and frequencies may be higher or lower than those given in national water quality criteria for aquatic life. (EPA 1991a).

Just as states are not required to promulgate their assessment methodology through rulemaking, there is no CWA requirement that the EPA promulgate its assessment methodology guidance. The 1-in-3 frequency for toxics is the recommended assessment methodology the EPA has shown as consistent with and protective of the CWA 304(a) toxic criteria. The 1-in-3 is protective of NC's criteria in the absence of another explicit, scientifically defensible frequency. NC may demonstrate why a different methodology is protective.

A2 Comment: The EPA Lacks Legal Authority to Impose the >1-in-3 Listing Method

Response: The EPA's statutory authority in CWA section 303(d)(2) includes approval or disapproval of the state's submission of a list of waters for which the effluent limitations required by the CWA are not stringent enough to implement any WQS applicable to such waters. The EPA shall approve a list only if it meets the requirements of 40 CFR 130.7(b), as stated in 40 CFR 130.7(d)(2). The state documentation required in 40 CFR 130.7(b) includes a description of the methodology used to develop the list. The EPA does not approve the state's methodology, but rather considers the methodology as it assesses whether the state conducted an adequate review of all existing and readily available water quality-related information, whether the factors that were used to make listing and removal decisions were reasonable, whether the process for evaluating different kinds of water-quality related data and information is sufficient, and whether the process for resolving jurisdictional disagreements is sufficient. If the EPA finds that the state's methodology is inconsistent with its WQS, as it found NC's methodology for toxics, the EPA conducts an independent review.

In this review, the EPA used its recommended methodology to identify waters not meeting any applicable WQS that are not included in the state's submitted list. The state's methodology was not scientifically defensible as consistent with NC's WQS, therefore the EPA used its scientifically defensible methodology. The EPA has not imposed its recommended methodology on NC, but rather used the methodology when unable to determine that the state's methodology is scientifically defensible as consistent with its WQS. The EPA conducted an independent review using a scientifically defensible methodology within its authority to review the list for consistency with the relevant provisions of the CWA and the regulations. (EPA 2005)

B. COMMENTS REGARDING THE VALIDITY OF THE 1-IN-3 METHOD

B1 Comment: The 1-in-3 method is not appropriate because it ignores importance of sample size; the EPA should endorse statistical approaches, such as those recommended by the National Research Council.

Response: The EPA's recommended 1-in-3 frequency is the Agency's best scientific judgment of the average amount of time it will take an unstressed system to recover from a toxic pollution event and is intended to ensure that aquatic communities are not constantly recovering from effects caused by exceedances of the criteria. Studies showed that even one toxic exceedance can cause damage if the magnitude was very high or the affected area was very large (EPA 1991a). Therefore, a statistical approach based on a percentage of exceedances, no matter the sample size, is not valid and would not protect the designated use.

The National Research Council (NRC) published a report in 2001 titled "Assessing the TMDL Approach to Water Quality Management" that analyzed the total maximum daily load (TMDL) program as well as statistical methods that can reduce uncertainties in water quality assessments. The report concluded with a call for an adaptive process that could balance between caution against listing in error that can trigger unnecessary TMDLs, and concern about unidentified impaired waters that could result in other adverse consequences (NRC 2001). The EPA's IR guidance published subsequent to the NRC report incorporates some of the NRC recommendations and clearly supports the use of appropriate statistical approaches in attainment decisions, including the use of a binomial approach for conventional pollutants and consideration of sample size (EPA 2002, EPA 2003, EPA 2005).

At the heart of the EPA's action to list waters on the NC 2014 303(d) list is determining what an acceptable frequency of exceedance is for non-conventional, or toxic, pollutants. For NC's toxics criteria expressed as "maximum permissible levels," a ten percent exceedance has not been shown to be an acceptable frequency. The NRC report supports our position:

> *The choice of acceptable frequency of violation is also supposed to be related to whether the designated use will be compromised, which is clearly dependent on the pollutant and on waterbody characteristics such as flow rate. A determination of 10 percent cannot be expected to apply to all water quality situations. In fact, it is inconsistent with federal water quality criteria for toxics ...* (NRC 2001)

The EPA has consistently advised the state to include in its methodology a way to consider the importance of sample size. As we stated in the July 31, 2014, Partial Approval Decision Document, "the methodology should allow listing where data demonstrates sufficient exceedances of a criterion, even though the minimum sample size (>9 samples) has not yet been collected... Where a waterbody has 3 exceedances, regardless of the total number of samples, there is no need to collect the full 10 samples..." This holds true especially in the case of toxics assessment where more than one exceedance can indicate impairment. (EPA 2014a)

B2 Comment: The 1-in-3 method is not appropriate because it is not based on rigorous scientific analysis

Response: As described in the July 31, 2014, Partial Approval Decision Document (EPA 2014a), the EPA established the 1-in-3 frequency of criteria exceedance as part of the derivation of the nationally-recommended criteria for toxics. Section 304(a)(1) of the CWA requires the EPA to develop criteria for water quality that accurately reflects the latest scientific knowledge. These criteria are based solely on data and scientific judgments on pollutant concentrations and environmental or human health effects.

The EPA's recommended use of the 1 in 3 year maximum allowable excursion recurrence frequency for toxics was based on extensive scientific analyses, looking at recovery rates of ecosystems from various kinds of natural disturbances and anthropogenic stressors. The concentrations (or magnitudes), durations and frequencies specified in all aquatic life criteria are based on biological, ecological, and toxicological data, and are designed to protect aquatic organisms and their uses from unacceptable effects. This is documented in many places (EPA 1985a; EPA 1985b; EPA 1991a; EPA 1994) including most of the EPA's metals criteria documents (http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm).

B3 Comment: The 1-in-3 method is not appropriate because it is overly conservative and based on studies that do not support the need for a three year recovery period for typical exceedances of toxics WQS which are much more likely to be marginal than large excursions

Response: The EPA's criteria development guidelines are designed to derive criteria that protect aquatic communities by protecting most of the species and their uses most of the time, but not necessarily all of the species all of the time (EPA 1985a). The EPA toxics criteria recommendations for magnitude, duration and frequency were based on toxicity test results in which aquatic organisms were exposed to metals under laboratory conditions. They are conservative estimates that are designed to be protective of aquatic communities in a wide range of water bodies. We agree that the criteria may, in some cases, be overprotective because they do not take into account site-specific characteristics such as water chemistry or the effects of marginal excursions. A state may choose to develop scientifically derived decision rules that address these factors (refer to response to comment C3, below).

The resilience of ecosystems and their ability to recover from toxic criteria exceedances differ greatly. For example, aquatic life typical of small headwater streams have often been found to recover more rapidly than 3 years. However, "recovery periods longer than 3 years may be necessary after multiple minor excursions or after a single major excursion or spill during a low-flow period in medium-to-large rivers, and up to 25 years where long-lived fish species are to be protected." This is described more fully in *Considerations for Proposing Site-Specific Increases or Decreases in the Average Frequency of Allowed Excursions* in Appendix D of the EPA's Technical Support Document for Water Quality Based Toxics Control (EPA 1991a).

The 1-in-3 method is the Agency's assessment of how long it will take an unstressed system to recover from an exceedance. Already stressed systems would be expected to require more time for recovery. We note that most of the NC waters we are listing for metals in this Agency action are, or have been in the past, identified as impaired for other pollutants and could be considered "stressed systems." Also, in our review of the assessment data, we found that over half of the waters we are listing included exceedances that are more than double the WQC.

The EPA responded to comments on the conservative nature of the 1-in-3 frequency in the *Responsiveness Summary* of the 1991 Technical Support Document for Water Quality Based Toxics Control. See that document for a full discussion, but we note here that, "in general, the EPA recommends that ecosystems not spend a substantial portion of time in a state of recovery from pollution stresses, and that pollution stresses not significantly increase the total stress experienced by organisms in the ecosystem. If the criteria are set appropriately, a marginal excursion might be expected to have little or no measurable impact, and little or no time period needed for recovery. The probability of a marginal criteria excursion nevertheless has a calculable relationship with the probabilities of severe criteria excursions. Consequently, a scientifically justified site-specific or state-wide frequency could be developed by considering (a) the probability (estimated by simulation or by statistical calculation) of a range of excursions of differing severity, coupled with (b) the estimated ecological recovery period for the corresponding different degrees of impact. Based on the total period of recovery from a full range of possible events, compared with the sum of return intervals for such events, the allowable frequency for the marginal criteria excursion could be established." (EPA 1991a)

B4 Comment: The 1-in-3 method is not appropriate because samples were not collected using clean techniques

Response: The state's data validity is, and has been, ensured through consistent use of standard operating procedures and rigorous quality assurance and quality control processes which incorporate the appropriate the EPA analytical methods (NC 2004, NC 2011, NC 2012, NC 2013). According to DWR's website, "[g]enerally, analytical data generated by non-DWR parties for regulatory purposes will be required to meet the same data quality requirements as internal activities... In order to be usable by DWR for regulatory purposes, data must meet certain requirements AND undergo detailed review to evaluate the accuracy, precision, and representativeness of the data." (NC 2014a). We understand that the state's monitoring coalitions operate under mutually agreed upon Memoranda of Agreement that ensure that the data collected by the coalitions are of comparable quality to the data collected by DWR.

Field blanks are, and have been, routinely used to identify errors or contamination in sample collection and analysis. Where contamination or other analytical errors have been identified, data is "qualified," or "flagged," and are not used in use support decisions. In our independent review of the state's data, we acknowledged these qualifiers. We noted in our July 31, 2014, Partial Approval Decision Document that "[a] thorough review of the State's data also revealed an additional 153 waterbody-pollutant combinations with potential metals impairments. ... However, much of the data is qualified. ... The EPA recommends that these waterbodies remain or be placed in Category 3 and be given high priority for follow-up monitoring." (EPA 2014a) Therefore, the EPA fully considered data quality when making our final decision.

B5 Comment: The 1-in-3 method is not appropriate to apply against NC WQC because it was designed for chronic and acute criteria and averages over a prescribed time period, and because it is designed for dissolved metals.

Response: In the absence of an explicit averaging period, it is reasonable to assume that NC's WQCs are considered chronic criteria with no averaging period. In the absence of site specific information and decision rules for guidance, the EPA believes that the 1-in-3 method is appropriate based on grab (no averaging period) or composite (e.g., 4 day average) samples. From the EPA's 1997 305(b) guidance for use support determinations for toxicants, a water is "Fully Supporting" when "[f]or any one pollutant, no more than 1 exceedance of acute criteria (EPA's criteria maximum concentration or applicable State/Tribal criteria) within a 3-year period based on grab or composite samples and no more than 1 exceedance of chronic criteria (EPA's criteria continuous concentration or applicable State/Tribal criteria) within a 3-year period based on grab or composite samples." (EPA 1997) Also, see response to comment B6.

Before 1995, national criteria for metals were derived as total metals. In 1995, the EPA altered its national policy on the expression of aquatic life criteria for metals from the total form to the dissolved form. (EPA 1995) The EPA's 1-in-3 method was a recommended approach before and after this change. It applies to both total and dissolved metals data, and for both acute and chronic impacts. This is documented in many places (EPA 1985a; EPA 1985b; EPA 1991a; EPA 1994; EPA 1997; EPA 2007a) including the EPA's metals criteria documents (http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm).

B6 Comment: It is not appropriate to assume that single sample instantaneous results may be used to represent four-day parameter WQC.

Response: The EPA's 1997 water quality assessment guidance acknowledges "[t]he challenge in establishing assessment methods for chronic criteria lies in demonstrating that a chronic exposure has actually occurred. If at least four days of data are available within a seven-day period, one could use an average to determine whether an exceedance has occurred." However, few states "if any, are obtaining composite data over a 4-day sampling period for comparison to chronic criteria. The EPA believes that 4-day composites are not an absolute requirement for evaluating whether chronic criteria are being met. Grab and composite samples (including 1-day composites) can be used in water quality assessments if taken during stable conditions." (EPA 1997)

For criteria with multiple day averaging periods (such as the chronic criteria in NC's proposed metals WQS), states should develop scientifically derived decision rules for concluding impairment where information indicates a reasonable likelihood that the average was exceeded. For example, if conditions have remained fairly stable over the period of interest, it would be valid to use a grab sample to represent that time period. Some states [e.g., Arizona (AZ 2014), New Mexico (NM 2011)] have developed methods for determining chronic criteria exceedances based on grab samples, for use when multiple days of data are not available. Typically these methods assume that stable conditions were occurring at the time unless there is information to the contrary.

C. COMMENTS REGARDING THE VALIDITY OF THE 10% / 90% METHOD

C1 Comment: The 10% method is more appropriate because it reflects solid science and is statistically sound

Response: The EPA's mission of protecting human health and the environment dictates that the protection of aquatic life through proper assessment of WQC outweigh the desire to use an all-purpose, 'one-size-fits-all,' statistical approach. We have agreed that the state's use of the 10% method is consistent with the EPA's general recommendations for conventional pollutants. However, for toxics, in the absence of site-specific data to the contrary, science shows that aquatic life is likely not protected when subjected to more than one criteria exceedance over a three-year period (EPA 1991a). See Response to Comment B2, above.

The EPA's 2004 IR guidance clearly articulates why it is questionable to apply the 10% method to criteria that are expressed as maximum permissible levels: "The problem is that the 10% rule could be interpreted in such a way to allow the concentration of the pollutant in a water to be greater than the criterion concentration at some very high frequency–perhaps even once every 10 seconds. Such a high frequency of adverse diversions from the magnitude-duration-frequency scenario spelled out in the WQC provides strong evidence that the relevant designated use is impaired. Hence, if a state intends to use the "10%" rule in conjunction with WQC expressed as 'the instantaneous concentration of the pollutant shall not be greater than _ ug/L, at any time,' the state will need to provide a rationale for why such an application of the rule is a reasonable approach to evaluation of data against water quality standards." (EPA 2003) For guidance on developing a rationale, see *Considerations for Proposing Site-Specific Increases or Decreases in the Average Frequency of Allowed Excursions* in Appendix D of the EPA's 1991 Technical Support Document for Water Quality Based Toxics Control (EPA 1991a) See Response to Comment B3, above.

C2 Comment: The 10% method is more appropriate because it accounts for sampling and analytical errors, and addresses data validity

Response: Data validity is ensured through consistent use of standard operating procedures and rigorous quality assurance and quality control processes. See Response to Comment B4, above.

C3 Comment: The 10% method is more appropriate because it helps account for data variability (e.g., concerns with outliers, borderline impairments and to prevent occasional exceedances from the 'first flush" of stormwater)

Response: An appropriate way to account for data variability would be to develop scientifically derived decision rules. The EPA guidance discusses, and many states have included, decision rules that consider site specific issues like the magnitude of exceedance over water quality criteria (including outliers or borderline exceedances) and samples taken in unstable conditions. [e.g., Alabama (AL 2014), Arizona (AZ 2014), New Hampshire (NH 2014), New Mexico (NM 2011); also see EPA 1991a, EPA 2002, EPA 2005]

D. OTHER / MISCELLANEOUS COMMENTS

D1 Comment: Several commenters agreed that the 10% method is not an appropriate way to assess toxic impacts in NC and supported listing of the fifty-one waterbody-pollutant combinations. Many were concerned that "[t]oxic metals are damaging to aquatic life, and can increase treatment costs for downstream drinking water systems."

Response: Thank you for your support. The EPA, after consideration of all comments received, is not changing its decision. We have consistently communicated our reservations about the 10% frequency to the state and provided opportunities to suggest alternatives for many 303(d) listing cycles. (EPA 2006, EPA 2007b, EPA 2007c, EPA 2009a, EPA 2009b, EPA 2010a, EPA 2010b, EPA 2011, EPA 2012a, EPA 2012b, EPA 2012c, EPA 2013, EPA 2014a)

D2 Comment: EPA has accepted listing methodologies in other southeastern states that are similar to that proposed by NC and allowed those jurisdictions to proceed without intervention.

Response: Some states, like NC, include in their listing methodology a 10% exceedance method for toxics. However, whenever the EPA cannot conclude that an assessment methodology is consistent with the state's applicable WQS, an independent review of data is done to determine whether all waterbody impairments are properly identified. The EPA Region 4 allowed the use of a 10% methodology for toxics in Florida because there were scientifically justified reasons for doing so. Please refer to the thorough discussion on this in our July 31, 2014, Partial Approval Decision Document. (EPA 2014a).

D3 Comment: NC has an extensive biological monitoring network and assessment approach that truly identifies areas exhibiting impacts [sic] the additive effects from toxics, sediment, habitat change and other potential causes. The impacted areas are included in the list based on the latest assessments – not a statistical measure related to water quality data.

Response: The state is commended for its robust biological monitoring network. However, we note that the validity of the results of one assessment approach does not depend on confirmation by another method. For more information see the EPA's *Final Policy on the Use of Biological Assessments and Criteria in the Water Quality Program* (EPA 1991b). We also commend DWR for its analysis of metals and biological integrity as part of the Random Ambient Monitoring System (RAMS), as published recently in the report *Total and Dissolved Metals in North Carolina Surface Waters: RAMS Data Exploration* (NC 2014b).

D4 Comment: The League and its members take seriously the responsibility to protect and enhance water quality. Cities and towns in NC are allocating tremendous amounts of resources for water quality management

Response: Comments noted. Thank you for your extremely important work in protecting and enhancing water quality.

D5 Comment: "EPA's decision to add the fifty-two waterbodies to NC's 2014 303(d) list represents an unnecessary action that places an additional burden on NC's water quality management program without any significant beneficial contribution in efforts to address real water quality impairment. ... The actions required to address the waters listed by NC are often significant and can result in the allocation of huge amounts of financial resources."

Response: The EPA notes that the scope of the 303(d) program focuses only on WQS attainment and identifying impaired waters. States are provided flexibility in determining the most appropriate means of addressing water quality impairments. The state may prioritize its resources to address the most severe impairments first.

The CWA requires the EPA to ensure that impaired waters are properly identified. Proper identification of impaired waters supports the EPA's mission to protect human health, support economic and recreational activities, ensure safe drinking water, and provide healthy habitat for fish, plants, and wildlife.

As we note below in the response to comment D7, we are encouraged by the progress made by NC in adopting more up-to-date WQSs for metals. Renewal of the state's water quality monitoring for metals should also help identify the true condition of waters.

D6 Comment: Several commenters requested sampling of the waterbodies listed in this EPA action.

Response: We appreciate that NC has already begun sampling at several of the waters identified as metals-impaired. We note that we approved the delisting of five waterbody-pollutant combinations in the 2014 303(d) list cycle based on new metals data. Also, in their comments on this Agency action, the state committed to continue sampling of the listed waters.

D7 Comment: "The State is in the process of changing metals criteria and will subsequently adopt listing methods to properly assess the metals criteria. Until those standards changes are adopted the use of NC's current approach is more appropriate."

Response: Impaired waters assessment must be based on NC's EPA-approved WQS. Based on the information described above, we do not agree that the 10% approach is appropriate to assess the current WQS. We are encouraged by the progress made by NC in adopting more up-to-date WQSs for metals. Renewal of the state's water quality monitoring for metals should also help identify and address impairments.

D8 Comment: One comment letter received contested the EPA's decision to approve the delisting of six waters in the Neuse Estuary previously listed for impairment from chlorophyll-a. Numerous emails we received included the comment "Nitrogen and phosphorus pollution remain a major threat to our lakes and rivers, and EPA should not allow North Carolina to ignore these problems in the next assessment, in 2016."

Response: These comments are outside the scope of this Agency action. However, we note that the EPA included this comment to DWR on the 2016 303(d) Listing Methodology:

> Because the EPA Region 4 has received comments from numerous North Carolina citizens encouraging a closer look at assessing nutrient impairments, we would like to draw attention to the 2014 IR [Integrated Reporting] guidance *(Information Concerning 2014 Clean Water Act Sections 303(d), 305(b), and 314 Integrated Reporting and Listing Decisions,* September 3, 2013*)*, which includes approaches to consider for identifying nutrient-related impaired waters for the

303(d) list based on narrative nutrient water quality criteria and/or direct evidence of failure to support designated uses. Also note that the EPA's 2016 IR Guidance is expected to be released in early 2015.

The EPA IR guidance is national in scope and, as nutrient over-enrichment is a significant national issue, the 2016 IR Guidance may contain additional information about assessing for nutrient impairments.

D9 Comment: We received several comments that expressed concern about a variety of legislative and regulatory issues in NC.

Response: These comments are outside the scope of this Agency action.

D10 Comment: "...for at least 130 of these impaired waters, the State made the delisting decision without any evidence that existing effluent limitations are sufficiently stringent to implement applicable water quality standards, defying the intent of 33 U.S.C. § 1313(d)(1)(A). The State offered no argument that the conditions that led to the original listing have changed; nor did the State argue that the initial listing decision was in error. The only justification provided for delisting these waters was the adoption of a new listing methodology."

Response: From the EPA 2006 IR guidance, "...if the state evaluates the pre-existing data and information using a new or revised methodology that accurately reflect the applicable WQS, and the results of that evaluation provide a 'good cause' basis for not including the segment on the 2006 section 303(d) list, the segment would no longer need to be included in Category 5. However, the delisting should only occur if it is determined that the basis for the decision is consistent with the state's applicable WQS and is reasonable." (EPA 2005) The EPA has commented consistently since the 2004 listing cycle that the NC assessment methodology for toxics (10% exceedance frequency) is not consistent with the state's WQS. See response to comment D1, above.

Comments on delistings other than the metals-impaired waters addressed above are outside the scope of this Agency action. However, as we noted in our comments to DWR on the 2016 303(d) Listing Methodology, in future assessments the NC approach should differentiate between listing and delisting and should fully describe all policy decisions implicit in the statistical analysis (e.g., the methodology should define null and alternative hypotheses, and Type I and Type II error thresholds for both listing and delisting). (EPA 2014b)

D11 Comment: One commenter asked for an investigation of campground septic systems overflowing in the summer into the head waters of the Catawba River's drinking water supply, Buck Creek, which runs along Highway 80; an engineering inspection was suggested but apparently no action has been taken.

Response: This comment is outside the scope of this Agency action. However, we did notify NC DWR staff who provided contacts at the local Health Department which handles septic inspections. We encourage all citizens who observe sewer overflow events to contact the appropriate officials. We also recommend that the state follow up on this potential water quality issue.

CONCLUSION

The EPA, after consideration of all comments received, is not changing its decision regarding the listing of fifty-one waterbody-pollutant combinations. The EPA has determined that the state's 10% exceedance plus a 90% confidence level methodology for toxics does not properly implement the toxics WQC, as currently specified. DWR is not required to use the EPA-recommended 1-in-3 method. The state may use a scientifically defensible alternative methodology if they can show that it is no less stringent than the WQC (40 CFR 131.11(b)). However, DWR has not provided a scientifically defensible rationale to support the 10% methodology.

The EMC and DWR support NC's new methodology by stating that it was developed "with significant input and ultimate approval by the EMC after months of effort and discussion including the involvement of interested stakeholders." The EPA was aware of the state process whereby a new methodology was developed. The EPA submitted comments on the new methodology (EPA 2012b), and, as we have consistently done since the 2004 303(d) listing cycle, proposed the commonly used 1- in-3 exceedance frequency as a more appropriate way to assess toxics impairment. We appreciate the time and effort put into NC's methodology, however we cannot rely on EMC and stakeholder input as a scientific rationale to demonstrate the methodology properly assesses for impairment against NC's WQC.

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Appendix G - NC 2016 303(d) List Decision Document

Assessment Units where metals data shows >1 exceedance in 3 years but data is flagged.

Assessment Unit #	Waterbody Name	NC Basin	Potential Impairment
9-50-(1)	First Broad River	Broad	Cadmium
18-(71)a	CAPE FEAR RIVER	Cape Fear	Cadmium, Chromium, Nickel
18-(71)b	CAPE FEAR RIVER	Cape Fear	Chromium, Nickel
18-(87.5)a	CAPE FEAR RIVER	Cape Fear	Chromium
18-74-(61)	Northeast Cape Fear River	Cape Fear	Chromium, Nickel
18-88-3.5	Southport Restricted Area	Cape Fear	Chromium
11-38-34	Wilson Creek	Catawba	Cadmium
5-41	Cataloochee Creek	French Broad	Cadmium
5-(6.5)	PIGEON RIVER	French Broad	Cadmium
5-26-(7)	Jonathans Creek	French Broad	Cadmium
6-(1)	FRENCH BROAD RIVER	French Broad	Cadmium
6-34-(15.5)	Davidson River	French Broad	Cadmium
6-38-(1)	Little River (Cascade Lake)	French Broad	Cadmium
6-54-(1)b	Mills River	French Broad	Cadmium
7-2-(21.5)	North Toe River	French Broad	Cadmium
7-2-(27.7)b	North Toe River	French Broad	Cadmium
7-2-52-(1)	South Toe River	French Broad	Cadmium
7-3-(13.7)b	Cane River	French Broad	Cadmium
1-52c	Valley River	Hiwasee	Cadmium
2-190-(3.5)	Cheoah River	Little Tennessee	Cadmium
2-57-(0.5)	Nantahala River	Little Tennessee	Cadmium
15-25-1-(11)	Lockwoods Folly River	Lumber	Chromium, Nickel
15-25-1-(16)a	Lockwoods Folly River	Lumber	Arsenic, Cadmium, Chromium, Nickel, Lead
15-25-1-(16)c	Lockwoods Folly River	Lumber	Arsenic, Cadmium, Chromium, Nickel, Lead
15-25-13	Calabash River	Lumber	Cadmium, Chromium, Nickel
15-25-2-(10)d1	Shallotte River	Lumber	Arsenic, Cadmium, Chromium, Nickel, Lead
15-25-2-(7.5)	Shallotte River	Lumber	Chromium, Nickel
15-25d	Intracoastal Waterway	Lumber	Arsenic, Cadmium, Chromium, Nickel
15-25v	Montgomery Slough	Lumber	Arsenic, Cadmium, Chromium, Nickel
27-(104)a	NEUSE RIVER Estuary	Neuse	Chromium, Nickel
27-(118)a1	NEUSE RIVER Estuary	Neuse	Chromium, Nickel
27-(118)a2	NEUSE RIVER Estuary	Neuse	Cadmium, Chromium, Nickel
27-(96)a	NEUSE RIVER Estuary	Neuse	Chromium, Nickel
27-(96)b1	NEUSE RIVER Estuary	Neuse	Chromium, Nickel
27-(96)b2	NEUSE RIVER Estuary	Neuse	Chromium, Nickel
27-101-(31)b	Trent River	Neuse	Chromium, Nickel
27-128-3a	Back Creek (Black Creek)	Neuse	Chromium, Nickel
27-150-(9.5)a2	Bay River	Neuse	Chromium, Nickel
27-97-(6)	Swift Creek	Neuse	Chromium, Nickel
30-16-(7)	Alligator River	Pasquotank	Chromium, Nickel
30-3-(12)	Pasquotank River	Pasquotank	Chromium, Nickel
30-6-(3)	Perquimans River	Pasquotank	Chromium, Nickel
30-9-(2)	Kendrick Creek (Mackeys Creel	Pasquotank	Chromium
30a	ALBEMARLE SOUND	Pasquotank	Chromium, Nickel
30b	ALBEMARLE SOUND	Pasquotank	Chromium, Nickel

Appendix G - NC 2016 303(d) List Decision Document

Assessment Units where metals data shows >1 exceedance in 3 years but data is flagged.

Assessment Unit #	Waterbody Name	NC Basin	Potential Impairment
30c	ALBEMARLE SOUND	Pasquotank	Chromium, Nickel
22-(1)b	DAN RIVER (North Carolina po	Roanoke	Cadmium
4-13-(0.5)b	Horsepasture River	Savannah	Cadmium
29-(1)	PAMLICO RIVER (Upper Pamlic	Tar Pamlico	Chromium, Nickel
29-(27)	PAMLICO RIVER	Tar Pamlico	Cadmium, Chromium, Nickel
29-(5)a	PAMLICO RIVER (Upper Pamlic	Tar Pamlico	Chromium, Nickel
29-(5)b1	PAMLICO RIVER (Pamlico Blou	Tar Pamlico	Chromium, Nickel
29-(5)b2	PAMLICO RIVER (Pamlico Bath	Tar Pamlico	Chromium, Nickel
29-(5)b3	PAMLICO RIVER(Pamlico Midd	Tar Pamlico	Cadmium, Chromium, Nickel
29-(5)b4	PAMLICO RIVER (Pamlico Sout	Tar Pamlico	Cadmium, Chromium, Nickel
29-10-(3)	Broad Creek	Tar Pamlico	Chromium, Nickel
29-19-(5.5)	Bath Creek	Tar Pamlico	Cadmium, Chromium, Nickel
29-34-(5)	Pungo River	Tar Pamlico	Chromium, Nickel
29-34-34-(2)	Pantego Creek	Tar Pamlico	Chromium, Nickel
29-34-35	Pungo Creek	Tar Pamlico	Chromium, Nickel
29-6-(5)	Chocowinity Bay	Tar Pamlico	Chromium, Nickel
29-9	Blounts Bay (inside a line from	Tar Pamlico	Chromium, Nickel
8-(1)a	WATAUGA RIVER	Watauga	Cadmium
8-(1)b	WATAUGA RIVER	Watauga	Cadmium
19-(10.5)	New River	White Oak	Chromium, Nickel
19-(15.5)	New River	White Oak	Cadmium, Chromium, Nickel
19-12	Brinson Creek	White Oak	Chromium, Nickel
19-14	Wilson Bay	White Oak	Chromium, Nickel
19-16-(3.5)a	Northeast Creek	White Oak	Chromium, Nickel
19-17-(6.5)	Southwest Creek	White Oak	Chromium, Nickel
19-17-(6.5)	Southwest Creek	White Oak	Chromium, Nickel
20-(18)a1	WHITE OAK RIVER	White Oak	Chromium, Nickel
20-(18)a1	WHITE OAK RIVER	White Oak	Chromium, Nickel
21-32	Calico Creek	White Oak	Cadmium, Chromium, Nickel
21-35-1-7a	Ward Creek	White Oak	Arsenic, Cadmium, Chromium, Nickel
21-35-1b4	North River	White Oak	Arsenic, Cadmium, Chromium, Nickel
21-35-7-10-4	Broad Creek (Nelson Bay)	White Oak	Chromium, Nickel

Appendix H - Metals Watch List - NC 2016 303d list Decision Document

Recommend high priority for followup monitoring.

Assessment Unit #	Waterbody Name	NC Basin	Impairment
16-(1)d2	HAW RIVER	Cape Fear	Zinc
16-11-14-2c	South Buffalo Creek	Cape Fear	Copper
17-(4)b	DEEP RIVER	Cape Fear	Zinc
25a2a	Chowan River	Chowan	Cadmium
27-(118)a2	NEUSE RIVER Estuary	Neuse	Copper
27-(49.5)a	NEUSE RIVER	Neuse	Copper
27-(38.5)	NEUSE RIVER	Neuse	Copper
27-23-(2)	Smith Creek	Neuse	Zinc
27-33-(10)c	Crabtree Creek	Neuse	Copper
22-40-(2.5)	Smith River	Roanoke	Copper
22-40-(3)	Smith River	Roanoke	Copper
28-11e	Fishing Creek	Tar-Pamlico	Zinc
28-11e	Fishing Creek	Tar-Pamlico	Copper
21-35-7-10-4ut1	Ditch to Broad Creek	White Oak	Copper
12-(124.5)c	YADKIN RIVER (including Tuckertown Lake, Badin Lake)	Yadkin	Copper
12-108-21c	Second Creek (North Second Creek)	Yadkin	Copper
12-110b	Grants Creek	Yadkin	Copper
12-110b	Grants Creek	Yadkin	Zinc
13-17-36-(5)a1b	Richardson Creek	Yadkin	Copper
13-17-36-9-(4.5)	Stewarts Creek [Lake Twitty (Lake Stewart)]	Yadkin	Copper
13-17-40-(1)	Lanes Creek	Yadkin	Copper
13-17-40-(1)	Lanes Creek	Yadkin	Zinc
13-17-40-10	Barkers Branch	Yadkin	Copper
13-2-3-3-(0.7)	Back Creek (Back Creek Lake)	Yadkin	Copper
13-45-(1)	Marks Creek (Water Lake)	Yadkin	Copper
13-17b1	Rocky River	Yadkin	Copper
13-17b3	Rocky River	Yadkin	Copper
13-17d	Rocky River	Yadkin	Copper

4B Demonstration for Little Alamance Creek

Assessment Unit: 16-19-11

Alamance County, North Carolina

Cape Fear River Basin

Prepared by:

Alya Singh-White

USEPA Region 4

In Cooperation With:

North Carolina Division of Water Resources

January 2015

Overview:

Section 303(d) of the Clean Water Act and the Environmental Protection Agency's regulations in 40 CFR 130.7 require states to develop lists of waters impaired by a pollutant and needing a TMDL and to prepare a TMDL for each waterbody / pollutant combination. EPA regulations also recognize that alternative pollution control requirements that are stringent enough to implement applicable water quality standards within a reasonable period of time may obviate the need for a TMDL. The alternative referenced above is known as Category 4B.

According to EPA's Guidance for *2006 Assessment, Listing and Reporting Requirements Pursuant to Sections 303(d), 305(b) and 314 of the Clean Water Act* [2006 Integrated Reporting Guidance (IRG)] (EPA, 2005), Category 4 waters have available data and / or information indicating that at least one designated use is not being supported or is threatened, but a TMDL is not needed. Under subcategory 4B, a TMDL is not needed because other pollution control requirements are expected to result in attainment of the applicable water quality standard in a reasonable period of time. EPA evaluates on a case-by-case basis a state's decision to exclude certain segment / pollutant combinations from Category 5 (of the 303(d) list) based on the Category 4B alternative. Per the IRG, States should address the following six elements in their 4b demonstration:

1. Identification of segment and statement of problem causing the impairment;
2. Description of pollution controls and how they will achieve water quality standards;
3. An estimate or projection of the time when WQS will be met;
4. Schedule for implementing pollution controls;
5. Monitoring plan to track effectiveness of pollution controls; and
6. Commitment to revise pollution controls, as necessary.

This demonstration summarizes the documentation supporting the 4B classification of Little Alamance Creek, located in Alamance County, North Carolina. The project partners are the City of Burlington, City of Graham and North Carolina Department of Transportation in conjunction with the North Carolina Division of Water Resources. This demonstration is consistent with EPA's new Vision for 303(d) programs, which encourages "alternative approaches adaptively implemented to achieve water quality goals. The Cities of Burlington and Graham and NC DOT have provided a template for biologically impaired waters due to flow alterations that can guide other stakeholders in North Carolina as they address similar impairments within their jurisdictions. EPA is encouraging states and local communities to focus their pollution control efforts on protecting high quality waters and restoring priority waters. This collaborative effort by the Cities and DOT is a good example of how locals can effectively address priority waters and we support development of similar 4b demonstrations as alternatives to TMDLs in North Carolina.

1. Identification of segment and statement of problem causing the impairment.

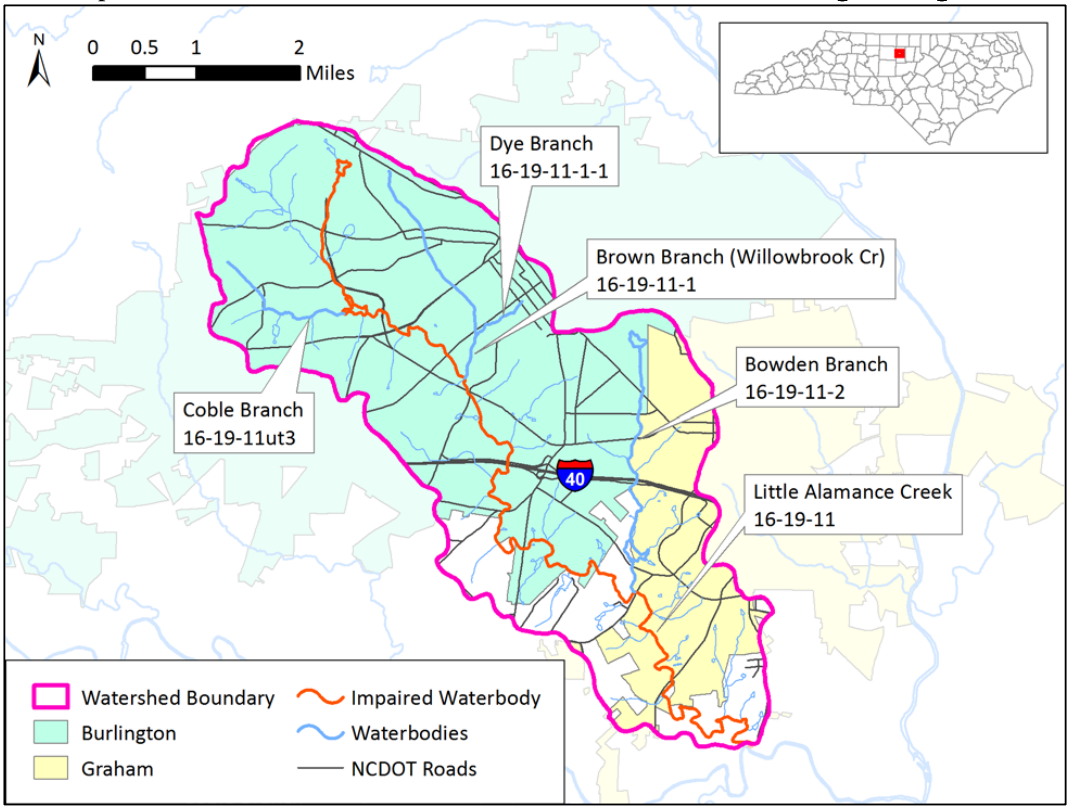
Segment Description

Based on sections 1, 2 and 3 of the Plan, the Little Alamance Creek (assessment unit 16-19-11) watershed is located in Alamance County, North Carolina, within the upper Cape Fear River Basin. The watershed includes portions of the cities of Burlington and Graham, is approximately 15.9 square miles in size and corresponds with the Unites States Geological Survey (USGS) 12 digit hydrologic unit code (HUC-12) 030300020309. In 2005, the Piedmont Triad Council of Governments (PTCOG) estimated a population amount of 29,512 from data utilized from its Regional Data Center. One major highway (I-85/I-40) transects the watershed. This watershed is mostly urbanized with 89.4% of the area developed. Industrial uses make up 12.4% of the area. Impervious surfaces (areas such as roof tops, roads and parking lots that prevent infiltration of precipitation into the soil) cover approximately 30% of this watershed.

Located in the Southern Outer Piedmont region, Little Alamance Creek is drained by its tributaries: Cable Branch, Brown Branch (also referred to as Willowbrook Creek), Dye Branch and Bowden Branch (also known as Boyd Creek). The Creek flows southeast into Big Alamance Creek, three miles upstream of its confluence with the Haw River.

The surface water classifications for the Little Alamance Creek watershed include Classes C, Water Supply -V and Nutrient Sensitive Waters. All waters in North Carolina have the base classification of “C.” Class C waters are protected for aquatic life propagation and biological integrity (including fishing and fish), wildlife, secondary recreation, agriculture and other uses suitable for Class C. The Little Alamance Creek watershed is located within the Jordan Reservoir watershed of the Cape Fear River Basin. Jordan Reservoir and all waters draining to it have been supplementally classified as Nutrient Sensitive Waters (NSW) pursuant to Rules 15A NCAC 2B .0101(e)(3) and 15A NCAC 2B .0223. Per the Jordan Water Supply Nutrient Strategy, waters not already designated as WS-II, WSIII, and WS-IV shall be classified WS-V (15A NCAC 02B.0262, 2008).

The map below shows Little Alamance Creek, tributaries and neighboring cities.



Impairment and pollutant causing impairment

In 2005, Little Alamance Creek was listed as impaired by DWR due to a “Poor” bioclassification rating of the benthic macroinvertebrate community. In 2013, Little Alamance Creek was assigned a “Good-Fair” bioclassification for fish, but remained in category 5 [303(d) list] due to a benthos bioclassification of “Poor”. Coble Branch was listed as a category 3a due to inconclusive assessment results. Brown Branch, Dye Branch and Bowden Branch have not yet been assessed by DWR. Impaired, or Category 5, waters are those that do not meet defined water quality standards, i.e., are biologically or otherwise impaired and require a TMDL.

Little Alamance Creek is impaired for biological integrity which is based on a narrative standard that pertains to the aquatic life use designation. Biological integrity has been defined as "the ability of an aquatic ecosystem to support and maintain a balanced and indigenous community of organisms having species composition, diversity, population densities and functional organization similar to that of reference conditions” (15A NCAC 02B.0202). DWR’s criterion for assessing aquatic life as impaired is a biological community at a benthic macroinvertebrate or fish sampling site with a bioclassification of Poor, Fair or Severe Stress. The criterion for assessing aquatic life as supporting is a bioclassification of Good-Fair, Good, Excellent, Not Impaired, Natural or Moderate Stress at a biological community sampling site.

There is no single pollutant responsible for the biological integrity impairment of Little Alamance Creek, rather a suite of factors. This is a predominantly urban watershed with a considerable percentage of impervious surfaces (roughly 30%). Stormwater runoff and pollutants present in stormwater, hydrologic changes and habitat degradation are some of the factors responsible for impairment. Additional factors are explained more in depth in the next section. (Section 1 of the Plan, Page 3)

Sources of pollutant causing impairment

Potential stressors in the Little Alamance watershed were evaluated and identified by reviewing water quality data, benthic data, habitat, riparian conditions, and channel and stream geomorphology. Causes of impairment were characterized using a "strength of evidence" approach which analyzed whether candidate stressors were primary causes of impairment, secondary causes of impairment, part of the cumulative cause of impairment, a contributing stressor, a potential cause or contributor or an unlikely cause or contributor.

Water quality data was collected during December 2006 – August 2007 from seven sites. The analysis included physicochemical parameters, nutrients, metals, and bacteria as well as benthic community samples and habitat assessments. Samples were taken approximately monthly during baseflow and on three occasions during stormflow.

In 2003 DWR (then DWQ) conducted a stressor study in the Little Alamance Creek watershed. This effort assessed benthic macroinvertebrates, habitat characteristics, and chemical and physical data to analyze specific stressors to the aquatic community. Based on this effort, the following were determined to be significant causes of impairment:

- Stormwater runoff due to high levels of impervious surfaces and lack of stormwater control. High conductivity measurements across the watershed are indicative of a mixture of pollutants from urban runoff. The benthic macroinvertebrate data lacked specific indicator taxa but rather exhibited highly pollution tolerant benthic communities, suggesting considerable impacts from urban/suburban pressures. The stream bank erosion and sedimentation associated with these events contribute to habitat degradation associated with biological impairment. The lack of stormwater treatment and control was found to be the most pervasive stressor in the watershed.
- Hydromodification (resulting from riparian vegetation removal). Many of the benthic community sites noted significant lack of riparian vegetation areas. Hydrologic changes, due to channelization and large amounts of impervious surface, have degraded instream habitat. This was identified as a secondary stressor.
- Hydromodification (resulting from channelization). Many of the benthic community sites evidenced previous or historical channelization of the stream. Hydrologic changes, due to channelization and large amounts of impervious surface, degrade instream habitat. This was also identified as a secondary stressor.

There are three MS4 operators in the Little Alamance watershed. The City of Burlington and the City of Graham are both NPDES stormwater Phase II permit holders (NCS000428 and NCS000408, respectively) and NCDOT is a NPDES stormwater Phase I permit holder (NCS000250). A review of the NCDENR's Stormwater Permitting Program list indicates that there are 14 active general NPDES stormwater permittees in or close to the Little Alamance Creek watershed, three individual NPDES stormwater permittees (listed above), and two facilities with No Exposure certifications within the watershed (Section 4 and Appendix C of the Plan).

2. Description of pollution controls and how they will achieve water quality standards

Water quality target

Little Alamance Creek is impaired for biological integrity. Impairment for biological integrity pertains to the aquatic life use designation. Biological integrity means "the ability of an aquatic ecosystem to support and maintain a balanced and indigenous community of organisms having species composition, diversity, population densities and functional organization similar to that of reference conditions" (15A NCAC 02B.0202, 2007).

Based on the Plan (Section 7, page 58), the overall goal of this Category 4b Demonstration Plan is to achieve a benthic macroinvertebrate community bioclassification of "Not Impaired", "Good-Fair", or better for Little Alamance Creek. Numeric values associated with a bioclassification of Good-Fair or better are determined by DWR, and listed in the current *Standard Operating Procedures for Collection and Analysis of Benthic Macroinvertebrates*. For example, a bioclassification of Good-Fair is based on the average of the biotic index and EPT scores = 3 (DWR, 2013). Actual numeric values depend upon stream size, flow regime, season of collection, and collection method. Numeric target levels used to evaluate attainment will be consistent with the SOP in effect at the time of evaluation.

Point and nonpoint source loadings that when implemented will achieve WQS

As previously stated, it is likely that the biological impairment is due to a combination of many complex factors. The existing reports have attributed the impairment to the general conditions typical of an urban watershed, including: hydro-modification, insufficient riparian buffer, streambank erosion, pollutants in stormwater runoff and degradation of instream habitat. There is no single pollutant or single source that is responsible for the biological impairment in this watershed. For these reasons, pollutant loads were not allocated; rather, a suite of BMPs will be implemented that will provide control of discharges that that could alter natural hydrology, reduce stormwater pollutants and mitigate other stressors that contribute to the impairment.

Controls that will achieve WQS

Based on the data and study results, DWR made several recommendations for the watershed: (1) Little Alamance Creek, particularly its tributary Willowbrook Creek, would likely benefit from stormwater controls to help moderate the "flashy" hydrology and to reduce sediment and chemical pollutant inputs. (2) Restoration is recommended in the Willowbrook Creek subwatershed to improve conditions and to reduce downstream impacts on Little Alamance Creek. (3) Particular attention needs to be directed to detecting and correcting the sources of elevated nutrients, heavy metals, and other pollutants in Willowbrook Creek and just downstream of its confluence with Little Alamance Creek.

Sections 5 and 6 of the Plan describe the pollution controls, in detail, that will be implemented and those already in place by the City of Burlington, City of Graham and NCDOT. The project partners all share responsibility in implementing their individual pollution controls within the boundaries of their MS4s as well as at owned and operated facilities. Tables within Sections 5 and 6 outline pollution controls by the type of control and the partner (MS4) responsible for implementation. The controls selected are expected to mitigate urban stormwater runoff and hydrologic changes resulting from channelization and riparian vegetation removal. The end result will be attainment of water quality standards; which in this case, is a benthic macroinvertebrate community bioclassification of Good-Fair or better throughout the Little Alamance Creek watershed.

Description of requirements under which pollution controls will be implemented

The City of Burlington, City of Graham and NCDOT have each submitted letters of commitment to the development of the 4b plan for Little Alamance Creek watershed and the implementation of pollution control measures outlined in the document. The letters of commitment can be found in Appendix A of the Plan.

The Little Alamance Creek watershed is located within the Jordan Reservoir watershed; therefore, the waterbody is subject to the rules in the Jordan water supply nutrient strategy. NC Session Law 2005-190 directed the Environmental Management Commission to adopt permanent rules to establish and implement nutrient management strategies to protect drinking water supply reservoirs. In 2009, permanent rules for the Jordan Water Supply Nutrient Strategy were adopted by the General Assembly. The strategy contains a total of thirteen separate enforceable rules. Several rules require stormwater controls to reduce nutrient loads delivered from new and existing development as wells as protection of existing buffers (15A NCAC 02B .0265-.0267).

As previously mentioned, waterbodies in the Little Alamance Creek watershed are classified as WS-V. Pursuant to G.S. 143-214.5(b), the entire Jordan watershed shall be designated a critical water supply watershed and through the Jordan Water Supply Nutrient Strategy given additional, more stringent requirements than the state minimum water supply watershed management requirements. The best usage of WS-V waters are protected as water supplies which are generally upstream and draining to Class WS-IV waters (15A NCAC 02B.0218, 2007). All of these administrative codes apply in Little Alamance Creek watershed and for the jurisdictions of Burlington, Graham and NCDOT are subject to the Jordan Water Supply Nutrient Strategy (15A NCAC 02B.0262).

3. Estimate or projection of time when WQS will be met

It is understood that improvement of the benthic macroinvertebrate community will take time to achieve a “Not Impaired”, “Good-Fair”, or better bioclassification. Section 8 of the Plan, page 61 states that water quality standards are projected to be achieved by 2030.

4. Schedule for implementing pollution controls

The schedule for implementation can be found in Section 6 of the Plan, Tables 6.1 – 6.10. The project partners all share responsibility in implementing their individual pollution controls within the boundaries of their MS4s as well as at owned and operated facilities.

5. Monitoring plan to track effectiveness

The monitoring plan can be found in Section 7 of the Plan. Since the biological impairment is due to a combination of factors (stressors), a dashboard approach will be used to monitor effectiveness. The dashboard will allow tracking of toolbox item implementation, which correlates progress with available data, and communicates efforts to the public. The toolbox items comprise the various pollution controls that are to be implemented or are already in place. The dashboard approach allows the project partners to maintain a long-term focus on addressing the various stressors, even as refined effectiveness data on toolbox items becomes available and as project partner’s ability to implement or organizational responsibilities evolve. Additionally, the dashboard approach facilitates the communication of technical water quality information to a more public-friendly format in order to communicate progress and encourage public participation in watershed restoration. The organization of the dashboard also provides direct linkages from dashboard group to the toolbox items to the metrics. Metric tracking provides common ground for the project partners to work separately but collectively to a consistent goal. The cumulative tracking of these metrics will be used to reinforce the implementation progress being made with respect to analytical monitoring results.

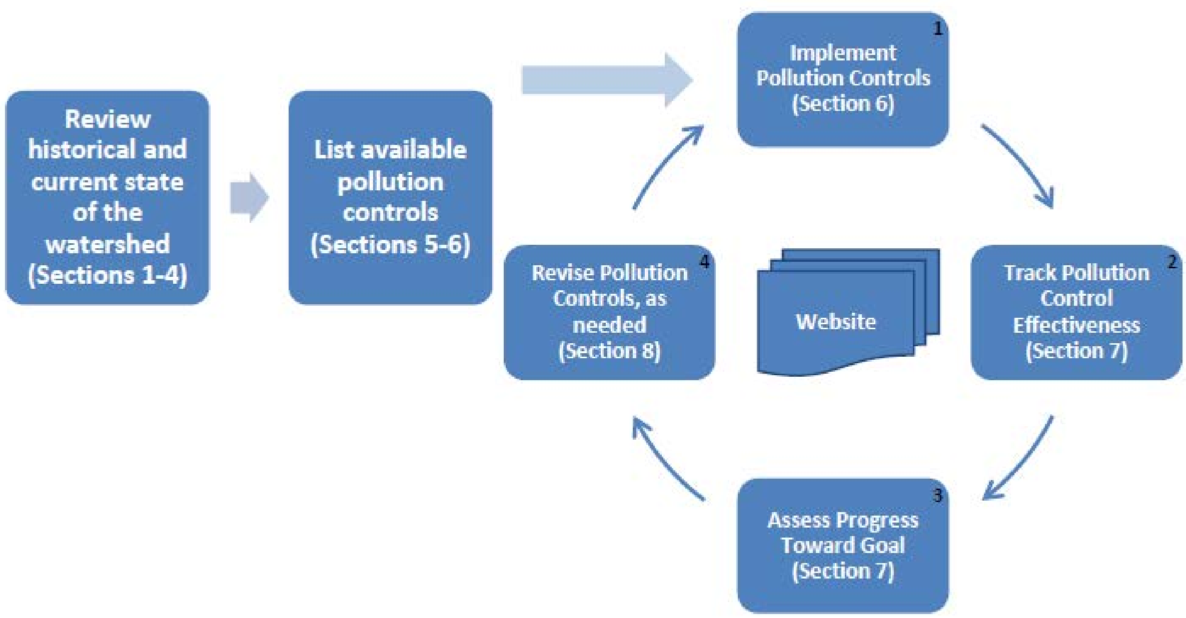
The “Stream Health” dashboard group will be compiled from water quality monitoring sources within and near the watershed. These sources of water quality monitoring principally include NCDENR ambient monitoring programs, municipal ambient monitoring programs for illicit discharge detection and elimination, and special studies being performed by others in the watershed. NCDENR’s ambient monitoring program includes, but is not limited to, temperature, specific conductance, turbidity, total suspended solids, dissolved oxygen, pH, fecal coliform, nutrients, total hardness, chloride, fluoride, sulfate, oil and grease and dissolved metals. The fish community and benthic macroinvertebrate community will also be monitored. Assessment results will be posted to a website that will be regularly updated by the project partners and NCDENR.

In the table below, is the dashboard created by the project partners to track effectiveness of pollution controls in Little Alamance Creek watershed. Section 8 of the Plan, page 62.

Table 7.1 Dashboard groups, toolbox items and examples of associated tracking and metrics

Dashboard Groups	**Toolbox Items (see section 6)**	**Example Metrics for Tracking Effectiveness**
Streamside Enhancement 	Stream Buffers	Linear feet/sq feet protected; # of potential sites assessed/identified
	Stream Restoration	Linear feet of enhancement or restoration; # of potential sites assessed/identified; instream habitat index results; streambank stability index results
Public Involvement and Outreach 	Public Education and Outreach and Public Involvement Programs	# of stream clean-up events; # of volunteers; feet of streams cleaned up; # of bags of trash collected; # of events where information was distributed; individual narratives highlighting specific public initiatives
	Research	Individual narratives on current collaboration efforts
Pollution Prevention & Reduction 	Illicit Discharge Detection and Elimination	# of outfalls screened; # of illicit discharges detected; # of internal training events/participants, related to the IDDE program
	Erosion and Sediment Control Program	# of sites inspected; # of internal training events/participants, related to the Erosion and Sediment Control program
	Post-Construction Runoff Program	# of sites inspected; # of training events/participants, related to the Post-Construction Runoff Program
	Pollution Prevention and Good Housekeeping	# of training events/participants, related to the PPGH program; individual narratives illustrating an improvement or concerted effort in water quality protocols at a municipal maintenance facility
	Collection System Improvements	Feet of lines assessed; # of manholes assessed; feet of lines slip-lined/replaced; # of manholes repaired
	Retrofits	# of potential sites assessed/identified; # of existing sites; total drainage area of all completed BMPs; nitrogen and phosphorus reduction estimates from implemented BMPs; inspection & maintenance results
Stream Health 	Ambient Water Chemistry*	Narrative discussion of physicochemical water quality results
	Fish Community*	North Carolina Index of Biotic Integrity (NCIBI) score and rating results†
	Benthos*	Bioclassification results†
	All monitoring*	Summary of monitoring activities performed

6. **Commitment to revise pollution controls, as necessary**
   Per Section 8.1 of the Plan, an adaptive management process will be used to revise pollution controls within the watershed if progress toward meeting water quality standards is not being shown. Based on Table 8-1 (shown below), the adaptive management process is built upon the overview of the historical and current state of the watershed (Sections 1–4) and the assessment of appropriate pollution controls (section 5–6). The adaptive management process begins with the **implementation** of the toolbox items (Figure 8-1, box 1). Pollution controls and monitoring activities performed by the project partners across the Little Alamance Creek watershed will be **tracked** (box 2). Efforts by the project partners will be **assessed** against available water quality data collected by NCDENR and the project partners (box 3). Results of this analysis will be used to **adjust** future actions performed by the project partners (box 4). A summary of the information gathered during the adaptive management process will be presented in a website that will be updated on a regular basis.



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APPENDIX J - NC 2016 303(d) List Decision Document

Water Quality Limited Segments added to the NC 2016 303(d) List

Assessment Unit Number	Name	NC Basin	Parameter of Interest
16-11-(1)a	Reedy Fork	Cape Fear	Biological Integrity
16-11-(3.5)b1	Reedy Fork	Cape Fear	Chlorophyll *a*
16-11-(3.5)b1	Reedy Fork	Cape Fear	Turbidity
16-11-(9)a2	Reedy Fork (Hardys Mill Pond)	Cape Fear	Biological Integrity
16-11-4-(1)b	Brush Creek	Cape Fear	Chlorophyll *a*
16-11-5-1-(1)	Unnamed Tributary at Guilford College	Cape Fear	Biological Integrity
16-14-(1)b	Stony Creek (Lake Burlington)	Cape Fear	Biological Integrity
16-14-6-(0.5)	Jordan Creek	Cape Fear	Biological Integrity
16-19-8	Stinking Quarter Creek	Cape Fear	Biological Integrity
16-31-(2.5)	Terrells Creek (South Side Haw River)	Cape Fear	Biological Integrity
16-41-2-(5.5)b	Morgan Creek	Cape Fear	Biological Integrity
16-6-(0.3)	Troublesome Creek	Cape Fear	Biological Integrity
17-12b1	Haskett Creek	Cape Fear	Biological Integrity
17-16-(1)b	Sandy Creek	Cape Fear	Chlorophyll *a*
17-2-(0.3)b	East Fork Deep River	Cape Fear	Biological Integrity
17-3-(0.3)	West Fork Deep River	Cape Fear	Biological Integrity
17-32	Big Governors Creek	Cape Fear	Dissolved Oxygen
17-35	Indian Creek	Cape Fear	Biological Integrity
17-8.5-(3)	Hickory Creek	Cape Fear	Biological Integrity
18-(5.5)a	CAPE FEAR RIVER	Cape Fear	Chlorophyll *a*
18-(71)a3	CAPE FEAR RIVER	Cape Fear	pH
18-16-(0.7)b	Neills Creek (Neals Creek)	Cape Fear	Biological Integrity
18-27-(1)c	Cross Creek (Big Cross Creek)	Cape Fear	Biological Integrity
18-27-5	Blounts Creek	Cape Fear	Biological Integrity
18-81-2ut1	UT to Lewis Swamp	Cape Fear	pH
11-135cut7	UT to Crowders Creek	Catawba	Biological Integrity
11-138	Twelvemile Creek	Catawba	Biological Integrity
6-11	Cherryfield Creek	French Broad	pH
6-28	Nicholson Creek	French Broad	Biological Integrity
6-6-8	Upper Creek	French Broad	Biological Integrity
7-2-49	Lilly Branch	French Broad	Turbidity
1-58-6	Rapier Mill Creek	Hiwassee	Biological Integrity
2-(1)a	LITTLE TENNESSEE RIVER	Little Tennessee	Biological Integrity
2-27	Iotla Creek	Little Tennessee	Biological Integrity
2-46	Brush Creek	Little Tennessee	Biological Integrity
2-57-45b	Whiteoak Creek	Little Tennessee	Biological Integrity
27-(104)a2	NEUSE RIVER Estuary	Neuse	pH
27-(49.75)	NEUSE RIVER	Neuse	Turbidity
27-2-3c	East Fork Eno River	Neuse	Biological Integrity
27-86-5.2	Little Swamp	Neuse	Dissolved Oxygen
10-1-32b2	Naked Creek	New	Biological Integrity
10-2-20	Buffalo Creek	New	Turbidity
30-1-15b	Dowdys Bay (Poplar Branch Bay)	Pasquotank	Enterrococcus
30c1	ALBEMARLE SOUND	Pasquotank	pH
22-18	Mill Creek	Roanoke	Biological Integrity

Water Quality Limited Segments added to the NC 2016 303(d) List

22-20	Snow Creek	Roanoke	Biological Integrity
22-52	Rattlesnake Creek	Roanoke	Biological Integrity
22-9	Big Creek	Roanoke	Biological Integrity
28-(1)	TAR RIVER	Tar Pamlico	pH
28-(1)	TAR RIVER	Tar Pamlico	Biological Integrity
28-100a	Grindle Creek	Tar Pamlico	pH
28-100b	Grindle Creek	Tar Pamlico	pH
29-19-(5.5)	Bath Creek	Tar Pamlico	Chlorophyll *a*
29-34-(5)ut6	UT Canal	Tar Pamlico	pH
29-34-11-(1)ut7	UT Canal	Tar Pamlico	pH
29-34-3-2	Lake Canal	Tar Pamlico	pH
29-34-3ut10	UT Canal	Tar Pamlico	pH
29-57-1-1	Lake Mattamuskeet	Tar Pamlico	Chlorophyll *a*
29-57-1-1	Lake Mattamuskeet	Tar Pamlico	pH
18-87-21a1	Middle Sound	White Oak	Shellfish
20-(18)a1	WHITE OAK RIVER	White Oak	Dissolved Oxygen
21-34	Taylor Creek	White Oak	Enterrococcus
21-35-1b7	North River	White Oak	Enterrococcus
99-(4)b	Atlantic Ocean	White Oak	Enterrococcus
12-(108.5)b4	YADKIN RIVER (including upper portion of High Rock Lake below normal operating level)	Yadkin	Turbidity
12-(108.5)b4	YADKIN RIVER (including upper portion of High Rock Lake below normal operating level)	Yadkin	pH
12-(114)b3	YADKIN RIVER (including lower portion of High Rock Lake)	Yadkin	pH
12-108-21a	Second Creek (North Second Creek)	Yadkin	Turbidity
12-108-21c	Second Creek (North Second Creek)	Yadkin	Turbidity
12-117-(3)a	Second Creek Arm of High Rock Lake	Yadkin	Turbidity
12-118.5b	Abbotts Creek Arm of High Rock Lake	Yadkin	Turbidity
12-72-(4.5)a2	Ararat River	Yadkin	Turbidity
12-73	Martin Mill Creek	Yadkin	Biological Integrity
13-17-17b	Clear Creek	Yadkin	Turbidity
13-17b1	Rocky River	Yadkin	Turbidity
13-17b3	Rocky River	Yadkin	Turbidity
13-17c1	Rocky River	Yadkin	Turbidity

APPENDIX K - NC 2016 303(d) List Decision Document

Water Quality Limited Segments Removed from NC 2014 303(d) List - Approved by EPA, 2016

Assessment Unit Number	Name	NC Basin	Parameter of Interest	Justification (more complete descriptions, below table)
25a2a	CHOWAN RIVER	CHO	Cadmium	More Recent/New Data
16-11-14-1a1	North Buffalo Creek	CPF	Biological Integrity	More Recent/New Data
17-7-(4)	Richland Creek	CPF	Biological Integrity	More Recent/New Data
16-19-(4.5)a	Big Alamance Creek (Alamance Cr)(Lk Macintoch)	CPF	Biological Integrity	More Recent/New Data
16-(37.5)b	Haw River (B. Everett Jordan Lake below normal pool	CPF	Turbidity	More Recent/New Data
16-11-14-2c	South Buffalo Creek	CPF	Copper	More Recent/New Data
18-16-1-(2)	Kenneth Creek	CPF	Biological Integrity	Pollutant Identified
16-19-11	Little Alamance Creek (Gant Lake, Mays Lake)(Alamance	CPF	Biological Integrity	Watershed Plan
16-41-2-(9.5)	Morgan Creek (including the Morgan Creek Arm of New Hope River Arm of B. Everett Jordan Lake)	CPF	Turbidity	TMDL Complete
16-41-1-(14)	New Hope Creek (including New Hope Creek Arm of New Hope River Arm of B. Everett Jordan Lake)	CPF	Turbidity	TMDL Complete
11-138-1	West Fork Twelvemile Creek	CTB	Biological Integrity	More Recent/New Data
11-139	Waxhaw Creek	CTB	Biological Integrity	More Recent/New Data
11-29-22	Shooks Creek	CTB	pH	TMDL Complete
11-38-32-9ut3	UT to Frankum Creek	CTB	pH	TMDL Complete
11-38-34-14	Harper Creek	CTB	pH	TMDL Complete
5-16-(16)a	Richland Creek	FBR	Biological Integrity	More Recent/New Data
7-2-52-(1)	South Toe River	FBR	pH	TMDL Complete
6-34-(15.5)	Davidson River	FBR	pH	TMDL Complete
1-49	Martin Creek	HIW	Biological Integrity	More Recent/New Data
2-(1)a	LITTLE TENNESSEE RIVER	LTN	Biological Integrity	More Recent/New Data
27-2-(1)	Eno River	NEU	Biological Integrity	More Recent/New Data
27-(38.5)	NEUSE RIVER	NEU	Copper	More Recent/New Data
27-150-3	South Prong Bay River	NEU	Shellfish	Flaws
27-150-3-1	Neal Creek	NEU	Shellfish	Flaws
10-1-32b1	Naked Creek	NEW	Biological Integrity	More Recent/New Data
10-9-12	Crab Creek	NEW	Biological Integrity	More Recent/New Data
10-1-(3.5)b	South Fork New River	NEW	Biological Integrity	More Recent/New Data
10-1-32b2	Naked Creek	NEW	Biological Integrity	More Recent/New Data
30-1a1	Currituck Sound	PAS	Enterrococcus	More Recent/New Data
23-10c	Smith Creek	ROA	Biological Integrity	More Recent/New Data
22-40-(1)	Smith River	ROA	Copper	More Recent/New Data
29-49a	Swanquarter Bay	TAR	Enterrococcus	More Recent/New Data
29-34-34-(2)	Pantego Creek	TAR	Chlorophyll a	More Recent/New Data
28-68b	Stony Creek (Boddies Millpond)	TAR	Dissolved Oxygen	More Recent/New Data

20-32	White Oak River Restricted Area	WOK	Enterrococcus	More Recent/New Data
19-41-(14.5)a	Intracoastal Waterway	WOK	Enterrococcus	More Recent/New Data
18-87-21c1	Middle Sound	WOK	Shellfish	More Recent/New Data
18-87-10a2a	Topsail Sound	WOK	Shellfish	More Recent/New Data
18-87-25.7c1	Masonboro Sound ORW Area	WOK	Shellfish	More Recent/New Data
21-35-7-10-4	Broad Creek (Nelson Bay)	WOK	Copper	Flaws
12-(108.5)b1	YADKIN RIVER (including upper portion of High Rock Lake below normal operating level)	YAD	Copper	More Recent/New Data
13-17d	Rocky River	YAD	Copper	More Recent/New Data
12-(124.5)c1	YADKIN RIVER (including Tuckertown Lake, Badin Lake)	YAD	pH	More Recent/New Data

Delisting Justifications	
More Recent/New Data	The assessment and interpretation of more recent or more accurate data in the record demonstrate the parameter of interest is meeting criteria
Pollutant Identified	Moved to Category 4s. Pollutant causing impairment identified. TMDL implementation will result in attainment of water quality standards
Flaws	Flaws in the original analysis of data and information led to assessment being incorrectly listed in Category 5
TMDL Complete	TMDL completed and approved by EPA
Watershed Plan	Moved to Category 4b, TMDL Alternative Plan.