

## **WQC Agenda Item 3, July 13, 2011**

### **Request for Approval of Accounting Methods under the Jordan Agriculture Rule**

#### **Summary**

The Jordan agriculture rule, 15A NCAC 02B .0264, effective August 2009, requires the agriculture community to collectively comply with the strategy percent reduction goals within six to nine years. The reduction goals are the following: 35% nitrogen (N) and 5% phosphorus (P) in the Upper New Hope Arm, 8% N and 5% P in the Haw Arm, and no net increase in N or P in the Lower New Hope Arm. These reductions are relative to a 1997-2001 baseline period. Success in meeting this Rule's goals will be gauged by estimating percentage changes in nitrogen loss and by evaluating broader trends in indicators of phosphorus loss from agricultural lands in the Jordan watershed.

The rule requires a Watershed Oversight Committee (WOC), formed by the Director of Division of Water Quality, to develop tracking and accounting methods for nitrogen and phosphorus loss and to submit them to the Water Quality Committee of the Environmental Management Commission for approval within two years of the rule's effective date, or by August 2011.

The rule sets requirements for the WOC to develop separate accounting methods for cropland nitrogen, pasture nitrogen, and overall phosphorus driven by fundamental differences in accounting needs across these categories. This report summarizes the accounting methods proposed for each of these purposes and requests Committee approval of each.

#### **Nitrogen Accounting Method**

The rule requires the WOC to develop a nitrogen accounting method that shall:

1. quantify baseline and annual total nitrogen losses from agricultural operations in each county, each subwatershed, and for the entire Jordan watershed;
2. include a means of tracking implementation of BMPs, including number, type, and area affected;
3. include a means of estimating incremental nitrogen loss reductions from actual BMP implementation and of evaluating progress toward and maintenance of the nutrient goals from changes in BMP implementation, fertilization, individual crop acres, and agricultural land use acres;
4. be refined as research and technical advances allow.

The Jordan watershed is the beneficiary of a great amount of effort by a range of agency, university, and other participants over a number of years that resulted in a cropland nitrogen accounting method first for the Neuse Basin, and then the Tar-Pamlico Basin that has been wholly transferrable to the Jordan agricultural rule. Through a contract with the North Carolina State University Soil Science Department, the Nitrogen Loss Estimation Worksheet, or NLEW, has been customized for the Jordan watershed. It incorporates 2001 land cover data

## WQC Agenda Item 3, July 13, 2011

representative of the baseline period. The tool is now being revised to address significant changes to Piedmont soil series groupings made more recently by USDA.

A separate contract with the Soil and Water Conservation Districts in the watershed will use NLEW to quantify nitrogen losses for the baseline period and the most recent crop year to form the first estimates of agriculture's progress under the rule. For each period, district staff will collect crop acreage data, estimate aggregate N application rates for each crop, tabulate cost-shared BMP acres, and enter these data into NLEW for each county. The resulting county N loss reductions will then be aggregated to produce N loss reduction estimates to date for each of the three subwatersheds. The process will be repeated each year with the most recent crop, BMP and N rate data.

As a check on the accuracy of NLEW baseline determinations, and to improve confidence in the accounting method, a statistical field sampling procedure was conducted. Using Section 319 grant funds, researchers and statisticians at NCSU designed a statistically valid sampling regime for evaluating individual farm data and surveying individual farmers to determine the extent of baseline fertilization rates and BMP coverage and practices. Results from this analysis will be used to verify and, if needed, adjust baseline survey results.

### **Phosphorus Accounting Method**

The rule requires the WOC to develop a phosphorus accounting method that:

1. Includes a means of tracking implementation of BMPs, including number, type and area affected;
2. Quantifies baseline values for and annual changes in factors affecting agricultural phosphorus loss as identified by the phosphorus technical advisory committee established under 15A NCAC 02B .0256(f)(2)(C). The method shall provide for periodic qualitative assessment of likely trends in agricultural phosphorus loss from the Jordan watershed relative to baseline conditions;
3. May also include a scientifically valid, survey-based sampling of farms in the Jordan watershed for the purpose of conducting field-scale phosphorus loss assessments and extrapolating phosphorus losses for the Jordan watershed for the baseline period and at periodic intervals;
4. Shall be refined as research and technical advances allow.

These requirements reflect the process developed to address phosphorus accounting under the Tar-Pamlico agriculture rule, 15A NCAC 02B .0256. The Tar-Pamlico rule required the formation of a Phosphorus Technical Advisory Committee (PTAC). The research and work done by that Committee, presented in "Accounting Method for Tracking Relative Changes in Agricultural Phosphorus Loading to the Tar Pamlico River" dated October 21, 2005, was utilized to develop the Phosphorus Accounting Method for the Jordan agriculture rule. The Tar-Pamlico accounting method uses a set of phosphorus loss indicators identified by the PTAC. For each of

## WQC Agenda Item 3, July 13, 2011

these indicators, annual values are compared to baseline values to provide indication of increase, decrease, or no change. These indicators are then reviewed collectively for a qualitative assessment of change. The indicators identified for the Tar-Pamlico Basin were the following:

- Total agricultural land acres
- Total agricultural land acres that have been converted to grass or trees
- Conservation Reserve Program and Wetland Reserve Program acres
- Conservation Tillage
- Acres affected by buffers
- Acres affected by water control structures
- Total scavenger crop acres
- Animal waste P produced, lbs P/Year
- Soil test P, weighted average, mg kg
- Soil test P, median, mg kg

The PTAC was reconvened in April 2010 to review and update the phosphorus tracking methodology for the Jordan Lake Agricultural Rule requirements. The committee recommended the following changes to the set of indicators for use in the Jordan watershed:

- Add tobacco acres, and
- Remove water control structures.

The Jordan WOC also initially recommended adding tracking of the annual application of human biosolids, but ultimately removed this element from the tracking methodology due to lack of readily accessible biosolids data. Currently, biosolids applicators submit paper copy annual reports containing application and site information; however, due to limited resources NC DENR is not keying the information into a database. To include this information would require new resources to mine the historical and enter new hard copy data. To date, resources have not been obtained for this purpose. When digital biosolids information becomes available the human biosolids component will be tracked as a separate component of the phosphorus accounting.

The Jordan WOC recommends that phosphorus reporting be conducted annually and follow the method established in the above-referenced PTAC report, and that it incorporate the two indicator changes recommended by the PTAC as noted above.

### **Pasture Accounting**

The rule also requires the WOC to develop accounting for pasture-based livestock operations:

- Account for aspects of pasture-based livestock operations that potentially affect nutrient loss and are not captured by the accounting methods described above in annual reporting by quantifying changes in the extent of livestock-related nutrient controlling BMPs. Progress may be judged based on percent change in

## WQC Agenda Item 3, July 13, 2011

the extent of implementation relative to subwatershed percentage goals identified in rule .0262 of this Section.

The WOC formed a pasture point system subcommittee in 2010 to revisit the accounting method developed through session law for the Tar-Pamlico agriculture rule. The subcommittee consisted of individuals representing North Carolina State University (NCSU), United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS), NC Division of Soil and Water Conservation (DSWC), NC Division of Water Quality (DWQ), NC Department of Agriculture and Consumer Services (NCDA&CS), and Alamance Soil and Water Conservation District. After reviewing available data sources and existing research findings the sub-committee made certain observations and recommendations, which the WOC has accepted. They found that:

- While the Tar-Pamlico point system was of sound design, it was not practically implementable because it required field-scale assessment, for which human resources were not available. For the purposes of this rule, given the same resources limitations, a county-scale approach to nitrogen loss accounting will be necessary as done with cropland NLEW accounting.
- Unlike state-based cropland statistics that are developed annually, pasture activities are tracked only by the federal Census of Agriculture conducted by USDA-National Agricultural Statistical Service every five years. This will necessarily limit pasture accounting under this rule to a 5-year cycle.
- The point system developed for the Tar-Pamlico is fundamentally sound. It assigned nitrogen “point” credit values for BMPs in lieu of percent reductions based on recognition that research data are insufficient to provide the level of confidence required for attributing percent reductions in load. Point values reflect best estimates of percent load reduction but instead bear the “point” label to connote this greater uncertainty. Research has advanced since the Tar-Pamlico system was developed but not sufficiently to depart from this approach.
- Certain refinements are needed to point assignments for specific BMPs based on additional research findings.

The subcommittee then made the following recommendations, which the WOC endorses for Committee approval:

1. Pasture accounting will be county-scale and conducted on a 5-year cycle.
2. For each county, the Census of Agriculture will be used for pasture acres and pasture livestock numbers. We will use pasture acres to determine the percentage of pasture land to which BMPs will be applied. In addition, pasture acres and livestock numbers will allow the calculation of livestock stocking density (animal units per acre), which will allow livestock intensity to be tracked.
3. The 2002 Census will be used to represent the baseline period. The first accounting will use the 2007 Census for comparison (since the release date for each Census trails the title date by approximately 2 years, the 2012 Census will not be available for the first accounting).

## WQC Agenda Item 3, July 13, 2011

4. For each county, pasture BMPs funded by state and federal cost share programs will be tracked annually and compiled every 5 years. Individual contracts will be reviewed to compile pasture acres affected by each BMP.
5. For each county for each implementation period, acreage-weighted BMP point assignments will be aggregated and compared to baseline values to yield a county point reduction estimate. These county point values will then be acreage-weighted aggregated for each Jordan subwatershed and compared to subwatershed reduction goals.
6. Pasture point values will not be combined with cropland NLEW reduction estimates given differences in the nature of these estimates. Progress for cropland and pasture will instead be tracked independently.
7. The following pasture BMPs will be used:
  - Exclusion Fencing: Exclusion fencing with a 10' stream setback will receive 30 points.
  - Exclusion Fencing with a buffer:
    - Exclusion + 20' buffer will receive 50 points
    - Exclusion + 30' buffer will receive 55 points
    - Exclusion + 50' buffer will receive 60 points
    - Exclusion + 100' buffer will receive 65 points

These buffer credits incorporate the most recent adjustments made to NLEW cropland accounting, which reflect current research estimating restored buffer net efficiency improvements.

- Other valuable pasture BMPs approved under the Tar-Pamlico system were found to be unsupported relative to nitrogen accounting either from a practical implementation standpoint (prorated cattle exclusion) or from a current research perspective (alternative watering systems).
- Additional BMPs may be added as supported by research and found to be accountable within this system.

### Recommendations

The Jordan Watershed Oversight Committee requests the Committee's approval of the following methods as detailed in this report for use in fulfillment of the requirements of the Jordan Agriculture rule:

1. Aggregate version of the Nitrogen Loss Estimation Worksheet (NLEW) for cropland nitrogen reporting.
2. Qualitative phosphorus loss accounting method.
3. Pastureland point system accounting method.

## WQC Agenda Item 3, July 13, 2011

### Next Steps

Upcoming implementation steps in compliance with the rule are as follows: over the next year, soil and water conservation district employees will collect data needed to conduct initial nitrogen and phosphorus loss accounting for cropland and pastureland for the baseline period and the most current year feasible, perform this accounting, and determine the extent to which agricultural operations have achieved the nitrogen loss goal and phosphorus loss trend indicator goal for each subwatershed, and present these findings to the Water Quality Committee by August 2012. Should the Committee determine at that time that a subwatershed nitrogen or phosphorus loss goal has not been achieved, then Local Advisory Committees shall be formed in that subwatershed to further progress toward the goal by developing local strategies to guide implementation for the following three years, or until August 2015. Independent of the 2012 determination of achievement, the WOC shall subsequently provide annual NLEW and phosphorus reports to the Division. As proposed here, the WOC would provide pasture reporting every five years, with the next report following the 2014 release of the 2012 Census of Agriculture.

The full Commission shall review compliance with the nitrogen and phosphorus goals within six years of the effective date of the rule, or by August 2015, based on annual reporting. If it is determined that the goals have not been met, the Commission shall require additional BMP implementation within any subwatershed as needed to achieve its goal by August 2018. In any case, annual NLEW and phosphorus reporting, and 5-year pasture reporting shall continue until the Commission determines that such reporting is no longer needed to fulfill the purposes of the rule.

## WQC Agenda Item 3, July 13, 2011

### Appendix A – Historical Development of the Nitrogen Loss Estimation Worksheet

Nitrogen Loss Estimation Worksheet, or NLEW, was initially developed in 1995 by the USDA - Natural Resource Conservation Service (NRCS) as a field-based procedure to estimate and report nitrogen loading from agricultural fields. State NRCS staff developed the procedure in consultation with NC State University faculty and southern regional NRCS staff. In this initial application, the tool was referred to as the Conservation Effects Program.

In 1996, the NC Division of Soil and Water Conservation (DSWC) initiated statewide use of this early version of NLEW to document beneficial nutrient and soil effects of BMP systems implemented through the NC Agriculture Cost Share Program for nonpoint source pollution control. DSWC also utilized the early NLEW in 1997 under the Tar-Pamlico nutrient strategy to prepare the agricultural portion of the first annual report on implementation of the voluntary NPS strategy.

Since field-by-field evaluation and aggregation for all counties in the basins were not considered an option given time and resource constraints, a more robust and versatile nitrogen accounting tool was needed, particularly for the Neuse and Tar-Pamlico nutrient strategies. In 1996, a multi-agency team began a critical reevaluation of NLEW. This group included representatives from DWQ, NCSU, DSWC, NRCS, and NCDA&CS. A central issue was the adaptability of the field-scale tool for operation at the watershed or county scale.

Scaling up to a county level presented a number of challenges. These included determining the baseline level against which to measure progress towards the reduction goal. County-scale soil and crop information was readily available. However, accurate historic fertilization rates on a large scale would be challenging, as would extent of existing BMPs, such as buffers.

The NLEW Committee developed the current tool under Neuse and Tar-Pamlico agriculture rules over the course of several years. That tool, referred to as NLEW Aggregate, treats each county in an aggregated fashion. All fields in a county are combined and considered as one field with a combination of different soil types, crops and fertilization rates. To accomplish this, Soil and Water Conservation Districts (SWCDs) were contracted to complete surveys wherein they would aggregate certain information at the county level. The local advisory committees (LACs) were asked to verify crops and crop acreage within the basin in their counties, and to determine fertilization rates and extent of BMP coverage. This approach relies in part on information and best professional judgement from local technical agencies (SWCDs, NCSU Cooperative Extension Service, NRCS, NCDA&CS, and the Farm Service Agency). As an additional check, county information is reviewed by DSWC staff and basin oversight committees prior to use in baseline development and preparation of annual reports. While relying in part on local agency best professional judgment may introduce some error into the procedure, the Jordan Lake WOC is confident that using NLEW at the county level provides the best available estimation of nutrient dynamics.

## WQC Agenda Item 3, July 13, 2011

### Appendix B: Detailed Flow of NLEW

The essence of the Nitrogen Loss Estimation Worksheet is a field-scale, empirically derived spreadsheet model that estimates nitrogen export from agricultural management units through surface water and groundwater partitioning of nitrogen movement. Moreover, the primary goal of field-scale NLEW is to estimate relative reduction in that nitrogen export through a pre- and post-BMP implementation calculation. A step-wise description of NLEW is provided here. The output of the worksheet is an estimate of nitrogen export from the cropped area and reduction in that export, not an estimate of delivery to surface water.

#### What is it?

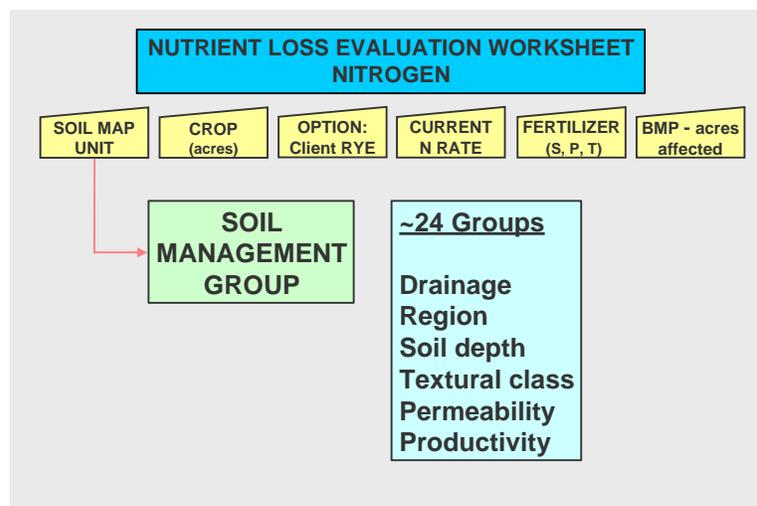
The Nitrogen Loss Estimation Worksheet is a field-based procedure to estimate nitrogen export from agricultural management units. The primary goal is to estimate relative effects of the implementation of best management practice systems on nitrogen export through a pre- and post-BMP implementation calculation.

#### What information is needed?

- Soil series
- Crop
- Crop acreage
- Current nitrogen rate
- Previous yield and fertilizer information
- Fertilizer source, placement, and timing information
- BMPs implemented, and acreage effected by BMPs

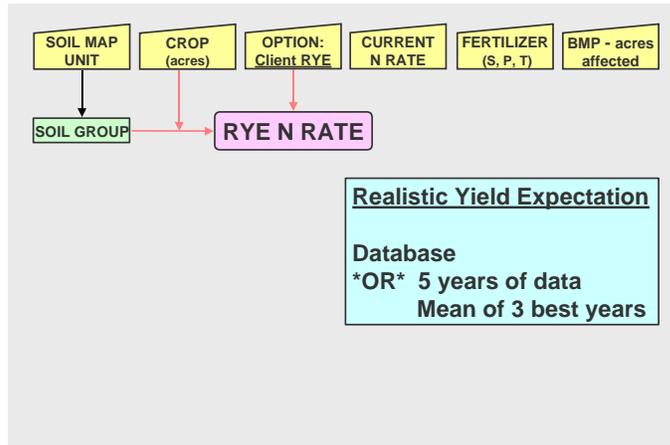
#### How does the program work?

- Soil series and mapping unit information is used to assign the soil series to a soil management group. The soil management groups are based on various soil parameters such as drainage, soil depth, and texture



## WQC Agenda Item 3, July 13, 2011

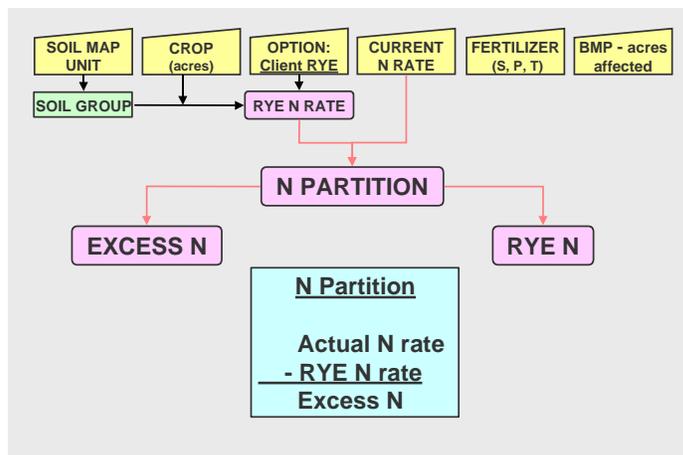
- Based on the soil series/soil management group, a realistic yield expectation (RYE) value and a recommended fertilization rate are specified for the specific crop grown that year. Previous yield records may substitute for the RYE .



- Each crop has designated nitrogen use efficiency. (see table)

Crop	NUE, %	Reference
Bermudagrass	75	Woodhouse, 1969
Corn: Tidewater, Arenic	40	Chancy, 1982
Coastal Plain, Irrigated	55	Kamprath, 1986
Piedmont, Conv. Till	40	Wagger, 1992
Piedmont, Cons. Till	55	
Soybean, nodulated	25	Israel, 1998
Sweet Potato	40	Ortega, 1996
Tobacco: Burley	40	Mackown, 1996
Flue-cured	50	Sisson, 1991
Wheat, Oat, Rye, Barley	45	Scharf, 1993 Frederick & Camberato, 1995

- Current nitrogen rate as well as fertilizer source, placement, and timing completes the information needed to partition nitrogen between the nitrogen needed to fulfill the RYE and any excess nitrogen.

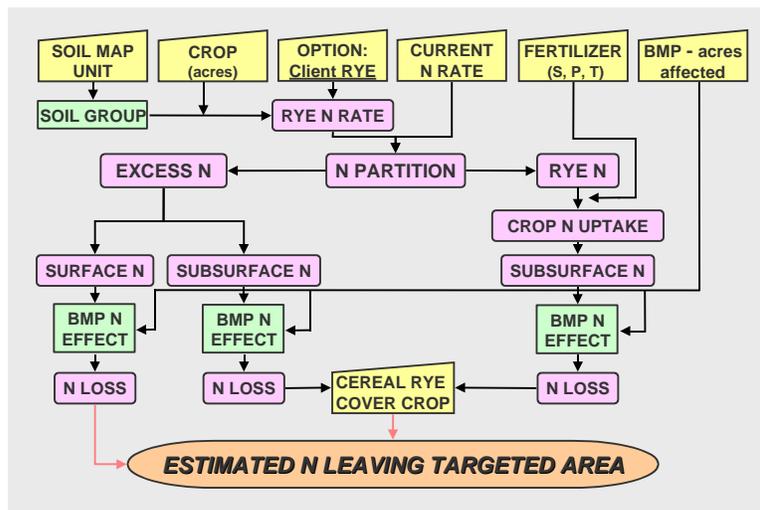


## WQC Agenda Item 3, July 13, 2011

- BMP information generates an interception efficiency that is assigned to the surface and subsurface nitrogen pools.

Best Management Practice	% N Reduction
20' Buffer	20
30' Buffer	25
50' Buffer	30
100'+ Buffer	35
Cover Crop - Wheat	5
Cover Crop - Oats	10
Cover Crop - Rye	15

- After calculating the nitrogen loss from RYE nitrogen and the excess surface and subsurface nitrogen, the values are summed to provide an estimate of nitrogen leaving the targeted area. These values represent fertilizer that was applied and neither used by crops nor intercepted by BMPs in the evaluated area. They may not represent the actual nitrogen loading to streams.



## WQC Agenda Item 3, July 13, 2011

### Appendix C: Membership of Jordan Watershed Oversight Committee

<b>Affiliation</b>	<b>Representative</b>
Division of Soil and Water Conservation	Julie Henshaw
United States Department of Agriculture - Natural Resources Conservation Service	Jill Malton
North Carolina Department of Agriculture and Consumer Services	Robin Watson
North Carolina Cooperative Extension Service	Deanna Osmond
Division of Water Quality	Jason Robinson
Environmental interests (3 representatives of which at least 2 must be residents of the Jordan watershed)	Catherine Deininger, other two positions are currently vacant
General farming interests	Anne Coan
Pasture-based livestock interests	Frank Bell
Equine livestock interests	Sue Gray
Cropland farming interests	Jane Iseley
Scientific community with experience related to water quality problems in the Jordan watershed	Janet MacFall