Water Resources Research Institute News
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# Jennings named Associate Director of WRRI

Gregory D. Jennings has been named Associate Director of the Water Resources Research Institute of The University of North Carolina. Jennings is Professor and Extension Specialist in the Department of Biological and Agricultural Engineering in the College of Agriculture and Life Sciences at NC State University. He will retain his academic and extension position and will divide his time between departmental and WRRI responsibilities.

As Associate Director of WRRI, Jennings will work with the Institute's Board and Advisory Committee to set research priorities, oversee administration of research activities, coordinate activities of the N.C. Urban Water Consortium, and develop initiatives to leverage State and Federal funding to build the Institute's research and technology transfer capacity.

Jennings earned the PhD in agricultural engineering from the University of Nebraska and is a licensed Professional Engineer in North Carolina. He joined the NCSU faculty in 1990 and has developed and led many cooperative outreach programs addressing statewide water quality and environmental management issues. Under a special appropriation from the N.C. General Assembly, he helped initiate the Neuse Education Team, which provides education for agricultural and urban audiences on water quality protection in the Neuse River Basin.

Jennings has also been active in undergraduate and graduate education and has provided leadership for many watershed restoration projects emphasizing natural stream channel design in North Carolina. He also serves on the N.C. Environmental Management Commission, the N.C. Sedimentation Control Commission, the N.C. Water Quality Workgroup, and the N.C. Nonpoint Source Workgroup.

Stuart Schwartz, former associate director, has assumed a position as senior research scientist with WRRI.

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## Director's Forum

# Water Quality in North Carolina: How is the picture assessed?

*Kenneth H. Reckhow, Director, Water Resources Research Institute*

In this issue of *WRRI NEWS*, we summarize some of the findings of the draft North Carolina integrated 305(b)/303(d) report on the status of surface water quality in North Carolina. Water quality monitoring in support of these federal requirements raises some interesting scientific questions.

Ideally, a statewide ambient water quality monitoring program should include a range of water quality parameters sampled broadly in space and time, such that the data would provide useful information for any future need. In practice, this is virtually impossible, sometimes because the wrong water quality parameters are sampled but more often because spatial/temporal coverage in statewide monitoring programs is rarely dense enough to provide background on specific, local problems.

The implication of these comments is that water quality data can be more useful if future applications of the data can be anticipated and the monitoring program designed explicitly for those purposes. For example, the biennial 305(b) report is intended to be a summary of the state of a state's water quality. The biennial 303(d) report is intended to provide a list of a state's impaired waters (those waters not meeting state water quality standards). In each case, reporting requirements are sufficiently specific so that a reasonably effective monitoring program can be designed.

Thus, if our objective is to report on the status of North Carolina's waters (for the 305(b) report), and yet we have limited resources for a limited number of samples, the best monitoring program design is probability sampling (perhaps using a random sample). This design is best because statistical inference allows us to make inferences from a probability sample of waterbodies to the "population" of all waterbodies of North Carolina (including those not sampled). Other monitoring programs commonly conducted by states, such as sampling at convenient locations, or sampling at locations of historic interest, do not support inferences to all of the state's waters. Since many states, including North Carolina, do not use probability sampling, 305(b) reports are now carefully worded to express conclusions based on the "percent of waterbodies assessed" rather than the "percent of all of the state's waterbodies."

In a similar manner, since the 303(d) objective is clearly stated—identify impaired waters—a suitable monitoring program can be designed. In this case, the best design builds on existing knowledge. With numeric data on the water quality criterion, sampling should be focused on those waterbodies for which the designation of "impairment" is most uncertain. With "evaluated data" (e.g., indirect assessments based on land use—water quality modeling, visual observations,…) monitoring may be focused on those waterbodies for which the evaluated data suggest impairment; this design would be appropriate if

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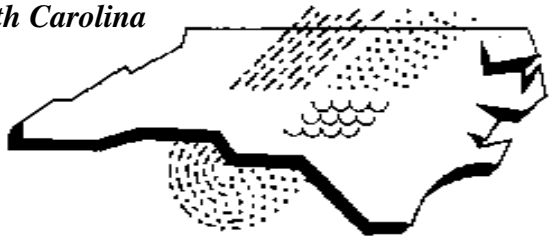

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numeric criterion data are needed for hypothesis testing to confirm impairment.

Regardless of the nature of the monitoring program, a "region of validity" should be specified (rather than simply implied) for each water quality sample. What does this mean? If water quality is unchanging during an entire month and constant throughout an entire stream segment (or reservoir, estuary…), then a single water quality sample per month in each stream segment would fully characterize conditions. However, we know that water quality varies continuously in space and time. Thus, given this variability, what is the space – time region represented by a single sample? Or, in other words, what is the region of validity for a sample?

This is a difficult question, but the likely consequence of the answer, given monthly sampling and a spatially sparse distribution of sampling stations statewide, is that the implied region of validity for most statewide monitoring programs is considerably larger than would be scientifically justified. For example, on any given river network in North Carolina, between sampling stations there are likely to be pollutant inputs and pollutant transformations occurring due to land use and stream hydrology. The "model" of constant water quality leading to a large region of validity simply does not hold water.

A better approach is to change the model for region of validity. Instead of constant water quality within stream segments and months, consider a model that allows water quality to vary continuously. For example, the USGS SPARROW model is used to predict water quality in rivers based on spatially-explicit watershed features and stream characteristics. A model like SPARROW could be fitted for a state's surface waters, yielding predictions of water quality that may vary continuously in space and time. Data from the state water quality monitoring program could then be statistically combined with the model predictions to periodically update and improve assessments of impairment.

In general, the 305(b) and 303(d) programs are sufficiently specific in their requirements that efficient monitoring programs can be designed (leaving open the region of validity question). However, state water quality monitoring is also undertaken for assessing trends, for examining impacts of changing land use, and for other objectives. It would be an interesting and useful exercise to compare North Carolina's water quality monitoring program with a program design that might result from prioritizing and optimizing for current objectives and uses of the data. Changing management issues and objectives, changing land use, and changing public expectations all suggest that periodic review of environmental monitoring programs is a prudent strategy.

## Director's Forum *continued*

# September action of the N.C. Environmental Management Commission

At its regular meeting on September 12, 2002, the N.C. Environmental Management Commission took the following action:

- Approved reappointment of Robert Dodson, superintendent of wastewater treatment plants for the City of Durham, and appointment of Manhar Patel, a private wastewater treatment plant supervisor, to the Water Pollution Control Systems Operators Certification Commission.

- Approved reclassification of a section of the Little Tennessee River in Swain and Macon counties for primary recreation (swimming).

- Approved holding public hearings on reclassifying a portion of Richland Creek in Haywood County from Class B to Class B Trout to protect existing trout populations and reclassifying He creek, Jerry Branch, and Henry Fork in Burke County from Water Supply I-Outstanding Resource Waters to Water Supply V-Outstanding Resource Waters. The City of Morganton no longer uses these waters as sources of drinking water.

- Approved a new schedule of fees for the N.C. Wetlands Restoration Program. The new fees are effective April 1, 2003. For information on the new fee schedule, visit the NCWRP website at http://h2o.enr.state.nc.us/wrp/rules/rules.htm.

- Upheld an Administrative Law Judge's recommended decision in the case of Clyde Harkey, Sr. v. DENR, in which Harkey was assessed a civil penalty and investigation costs for failure to assess the excavation zone of a previously closed underground storage tank to determine if there was a threat to human health and the environment.

- Learned that attorneys for Tate Terrace Realty Investors, Inc, d/b/a/ Arland Community Development were in discussion with DENR regarding a possible settlement of an administrative case scheduled to be heard by the EMC involving civil penalties and investigation costs for violations of the NPDES General Permit to discharge stormwater from construction sites. Tate Terrace had appealed penalties and costs totaling $61,666.61 assessed for violations at its Westmont Village development in west Raleigh during 1999 and 2000. Penalties were assessed for failure to comply with the approved sedimentation and erosion control plan, failure to conduct/record inspections of sedimentation and erosion control facilities, violations of the state's turbidity standard, and other violations.

- Heard from Chairman David Moreau that the EMC Steering Committee has met with Department of Environment and Natural Resources (DENR) Secretary Bill Ross regarding the structure of civil penalties. The meeting grew out of EMC concern that civil penalties are being assessed against

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# Water Quality in North Carolina: What's the picture?

For many years the N.C. Division of Water Quality has published "Water Quality Progress in North Carolina," also known as the "305(b) Report." The report was required every other year by Section 305(b) of the Clean Water Act and was supposed to give the U.S. EPA and citizens of North Carolina an overall assessment of water quality across the state. However, since the N.C. Division of Water Quality (DWQ) instituted basinwide water quality planning in the early 1990s, the consolidated "Water Quality Progress in North Carolina" report has been eclipsed by the basinwide plans and has been published in a somewhat modified format to be consistent with the basinwide planning schedule. Beginning this year, the traditional 305(b) report will cease to exist.

Under Section 303(d) of the Clean Water Act, states are also required to submit to EPA on a biennial basis a list of impaired waterbodies and total maximum daily loads (TMDLs) for the pollutants causing impairment. For 2002, EPA issued new guidance to the states delaying the deadline for the 303(d) list and allowing states to integrate the 303(d) list of impaired waterbodies with the 305(b) assessment report. North Carolina chose to submit the integrated report, "Water Quality Assessment and Impaired Waters List," and released a public review draft of the report in June. Public comment was taken until August 16, and the final report is due to EPA in October.

The N.C. 2002 Integrated 305(b) and 303(d) Report includes very detailed explanations of how use support ratings are determined and includes extensive lists of supporting and impaired stream segments in categories specified by EPA and customized for the North Carolina program (see explanation under TMDL table on page 7). However, to get an overall picture of water quality by basin or on a statewide basis, it is necessary to read the basinwide plans.

Basinwide water quality planning was hailed as the strategy that would allow DWQ to get the big picture of water quality in each basin, estimate each river's assimilative capacity, estimate total maximum daily loads (TMDLs) of pollutants, and control pollution to support designated uses (*WRRI News* March/April 1991). With ten years and two full cycles of basinwide water quality planning now completed, a statewide look at water quality and TMDL development in North Carolina may be in order. To get a broad picture of water quality statewide, the 2002 integrated 305(b)/303(d) report, previous 305(b) reports, and the most recent basinwide plans were used to put together the tables and water quality highlights in this report.

## How water quality is assessed and reported

DWQ evaluates water quality by determining how well waterbodies meet the water quality standards associated with their designated uses (see table below). DWQ currently assigns a "fully supporting,"or "impaired" use support rating.

In addition to using monitoring data to directly assess water quality, DWQ indirectly "evaluates" water quality in streams. If DWQ has monitoring data that is more than 5 years old, or if an unmonitored stream is a direct or indirect tributary to a monitored stream segment and shares similar land use, then DWQ assigns a use support rating on an "evaluated" basis. If DWQ has no data or insufficient data to determine use support for a stream segment or if an unmonitored stream is a direct or indirect tributary to stream segments rated unpaired, then the stream or stream segment is listed as "not rated." If a waterbody does not fully support its designated uses, it is considered impaired and placed on the 303(d) list.

As the basinwide planning effort has evolved, the way use support is reported has changed. At one time, DWQ used a "support threatened" rating to call attention to streams that were fully supporting but had some notable water quality concerns. Because the way that DWQ used the term "support threatened" was very different from the way EPA used the term, it was dropped. Subsequently, waters that had been reported as "support threatened" were moved to the "fully supporting" rating, unless actual degradation occurred, in which case they were reported as impaired. Also, until very recently, DWQ reported impaired waters as either "partially supporting" or "not supporting." Now, impaired waters are reported as simply "impaired."

| Water classification | Uses that apply to the classification | | | | | |
|---|---|---|---|---|---|---|
| | Aquatic Life/ Secondary | Fish Consumption | Primary Recreation | Water Supply | Shellfish Harvesting | Other |
| C *(basic freshwater classification)* | X | X | N/A | N/A | N/A | X |
| SC *(basic saltwater classification)* | X | X | NA | NA | NA | X |
| B *(freshwater primary recreation, meaning full body contact)* | X | X | X | N/A | N/A | X |
| SB *(saltwater primary recreation, meaning full body contact)* | X | X | X | N/A | N/A | X |
| SA *(Shellfish waters)* | X | X | X | N/A | X | X |
| WS I-WS IV *(Water supply)* | X | X | N/A | X | N/A | X |

In addition, at one time DWQ assigned only one overall use support rating. Beginning in 2000, however, the basinwide program began assigning a support rating for each individual use (see table page 4).

Because all these changes have occurred over the last five years and basinwide plans are updated on a five-year basis, there are inconsistencies in the way support use is reported in current basinwide plans. These inconsistencies are evident in the table "Stream Miles/ Uses Impaired" on page 6.

## Monitoring

A primary reason for adopting basinwide planning was to allow DWQ to focus resources on a few river basins at a time and collect more and better data on water quality conditions. The table on the right compares percent of streams monitored before basinwide planning and after it was fully implemented.

**Ambient monitoring**. To monitor the state's 38,000 miles of freshwater streams, 311,071 acres of freshwater lakes, and 1,997,375 acres of tidal saltwaters, DWQ has a network of about 400 ambient monitoring stations that collect physical and chemical water quality data (up from 340 stations reported in the 1989-99 305(b) report). Each station is visited on a monthly basis, as resources allow. Data from the ambient monitoring network is supplemented in the Cape Fear, Neuse and Yadkin-Pee Dee basins by data collected by wastewater discharger coalitions.

**Biological monitoring**. As part of the rotating basinwide planning process, DWQ's Environmental Sciences Branch (ESB) focuses biological monitoring in several river basins each year. ESB samples benthic macroinvertebrates (organisms that live in and on the bottom of rivers and streams) and assigns bioclassifications ranging from poor to excellent. ESB also evaluates the fish community and assigns a rating according to the N.C. Index of Biotic Integrity. Previously, ESB performed fish tissue surveys as part of the basinwide assessment program. However, the fish tissue surveys are currently targeted to areas of existing or suspected contamination.

## Stream Miles Monitored

| Basin | 1990-91 stream miles monitored (% of total in basin) | 1998-99 stream miles monitored (% of total in basin) |
|---|---|---|
| Broad | 194.7 (13%) | 435 (29%) |
| Cape Fear | 94.7 (15%) | 2037 (33%) |
| Catawba | 425.6 (14%) | 1073 (36%) |
| Chowan | 125 (15%) | 130 (16%) |
| French Broad | 429.4 (10%) | 900 (21%) |
| Hiwassee | 33.8 (3%) | 179 (18%) |
| Little Tennessee | 197.8 (7%) | 514 (19%) |
| Lumber | 458.1 (20%) | 382 (16%) |
| Neuse | 1,110.2 (32%) | 1336 (38%) |
| New | 292.8 (36%) | 418 (52%) |
| Pasquotank | 27 (5%) | 116 (24%) |
| Roanoke | 412.9 (17%) | 681 (28%) |
| Savannah | 29 (13%) | 56 (26%) |
| Tar-Pamlico | 315.1 (13%) | 608 (26%) |
| Watauga | 33.2 (11%) | 101 (33%) |
| White Oak | 34.5 (12%) | 80 (27%) |
| Yadkin-Pee Dee | 897.2 (15%) | 1818 (30%) |

## Highlights gleaned from the 2002 integrated report

■ The report says that all of North Carolina's surface drinking water supplies are currently rated "fully supporting," for their water supply use. However, there are 243.2 miles of streams and 12,203 acres of lakes within water supply watersheds listed as "impaired" by pollutants including chlorophyll a, turbidity, fecal coliform, and mercury. According to the report, DWQ has not yet developed criteria for determining impairment of water supply use.

■ Sediment or turbidity is listed as a cause of impairment for about 911 miles of streams or 32% of impaired stream miles. Agriculture is identified as a potential source of impairment for 56% of the stream miles impaired by sediment or turbidity, and land development or urban runoff/storm sewers are thought to be the cause in 58% of stream miles impaired by sediment or turbidity. (In some cases, both agriculture and urban nonpoint sources are cited.)

■ Fecal coliform is listed as the cause of impairment for about 318 stream miles (11% of impaired stream miles) and 47,806 acres. In the White Oak Basin, approximately 28,059 acres (23% of the basin's salt or estuarine acres) are listed as impaired by fecal coliform. Waters impaired by bacteria have been prioritized for development of TMDLs over the next two years (see table on page 7). TMDLs will be developed in coordination with basinwide plans.

■ Thirty-two miles and 38,790 acres are impaired by chlorophyll a or nutrients.

■ The most frequently impaired use is shellfish harvesting (33,914.07 acres), followed by fish consumption (410.6 mi and 23,046 acres) aquatic life (187.6 mi and 4,893 acres), and primary recreation (301.4 acres). It should be noted that many basins are not yet rated for multiple uses and, therefore, these totals are not inclusive.

■ Many miles of streams on the 303(d) list (about 800 or 28% of impaired stream miles) are said to be "biologically impaired" with the cause of impairment listed as unknown.

*Report continued page 6*

# Stream Miles/Uses Impaired by Basin

*Monitored and Evaluated*

| Basin | Stream miles | Stream miles impaired | Uses impaired | Primary cause(s) of impairment | Primary potential source of impairment |
|---|---|---|---|---|---|
| Broad | 1,473 | 37.1 | Overall | sediment, unknown | agriculture, point sources |
| | *93% supporting or support threatened, 3% supporting or not supporting, and 4% not rated. Basinwide plan currently being updated.* | | | | |
| Cape Fear | 6,049 | 563.8 | Overall | sediment/turbidity, fecal coliform, mercury, unknown | urban runoff, point sources, agriculture |
| | *71% supporting, 5% partially supporting, 2% not supporting, 22% not rated* | | | | |
| Catawba | 3,004 | 203.4 | Overall | fecal coliform, sediment/turbidity, unknown | point sources, land development, urban runoff |
| | *79% supporting or support threatened; 6% partially supporting or not supporting, 15% not rated* | | | | |
| Chowan | 788 | 136.4 | Fish consumption, Aquatic life/ secondary recreation | mercury, low DO, nutrients | point sources, atmospheric deposition |
| | *Fish consumption: 13.3% supporting, 2.8% partially supporting, 84% not rated. Aquatic life/secondary recreation: 100% partially supporting* | | | | |
| French Broad | 4,136 | 102.3 | Overall | fecal coliform, sediment/turbidity, habitat degradation, unknown | livestock, aquaculture, urban runoff, agriculture |
| | *77% supporting, 1% partially supporting, 1% not supporting, 21% not rated* | | | | |
| Hiwassee | 989 | None | None | N/A | N/A |
| Little Tennessee | 2,703 | 10.1 | Aquatic life/ secondary recreation | hydromodification, nutrients | dams, urban stormwater, aquaculture |
| | *Aquatic life/secondary recreation: 79.1% supporting, 0.5% partially supporting, 20.4% not rated. Primary recreation: 57.6% supporting, 1.7% partially supporting, 42.4% not rated.* | | | | |
| Lumber | 2,283 | 252.4 | Overall | mercury, fecal coliform | atmospheric deposition?, urban runoff, marinas |
| | *49.2% fully supporting, 48.5% support threatened, and 2% not rated.* | | | | |
| Neuse | 3,440 | 488.5 | Aquatic life/ secondary recreation, Fish consumption, Shellfish harvesting | low DO, chlorophyll a, sediment/turbidity, mercury, unknown | agriculture, land development, urban runoff |
| | *Aquatic life/ secondary recreation: 27.4% supporting, 6.2% impaired, 5.9% not rated, 60.6% no data. Fish consumption: 100% impaired. Shellfish harvesting: 98.7% supporting, 1.3% impaired.* | | | | |
| New | 801 | 12 | Overall | copper, pH, nutrients, sediment | abandoned mines, point sources, urban runoff |
| | *95% fully supporting, 2% impaired, 3% not rated* | | | | |
| Pasquotank | 478 | 153.7 | Aquatic life/ secondary recreation, Fish consumption | low DO, pH, mercury, fecal coliform | point sources, agriculture, unknown |
| | *Aquatic life/secondary recreation: 40.2 mi. Fish consumption: 100% partially supporting.* | | | | |

| Basin | Stream miles | Stream miles impaired | Uses impaired | Primary cause(s) of impairment | Primary potential source of impairment |
|---|---|---|---|---|---|
| Roanoke | 2,389 | 263.2 | Aquatic life/ secondary recreation, Fish consumption | dioxins, mercury, selenium, unknown | point sources, atmospheric deposition agriculture, urban runoff |
| | *Aquatic life/secondary recreation: 50.3% supporting, 2.2% partially supporting, 0.4% not supporting, 47.1% not rated. Fish consumption: 94.4% partially supporting, 0.6% not supporting.* | | | | |
| Savannah | 210 | None | None | N/A | N/A |
| Tar-Pamlico | 2,335 | 79.9 | Overall | chlorophyll a, fecal coliform, low DO, mercury, | point sources, urban runoff, sediment agriculture, septic systems |
| | *Fully supporting 38%, support threatened 38%, partially supporting 3%, not supporting <1%, not rated 20%* | | | | |
| Watauga | 303 | None | None | N/A | N/A |
| White Oak | 292 | 124.4 | Fish consumption | fecal coliform, chlorophyll a, mercury | urban runoff, unknown |
| | *Fish consumption: 100% partially supporting – bowfin advisory.* | | | | |
| Yadkin- Pee Dee | 5,989 | 403.2 | Overall | sediment/turbidity, fecal coliform, low DO, pH, mercury | point sources, urban runoff, construction, agriculture |
| | *41% supporting, 41% support threatened, 7% partially supporting, 2% not supporting, 9% not evaluated.* | | | | |
| **TOTAL** | **38,000** | **2,830.4 (7%)** | | | |

# Waters Targeted for TMDL Development within the Next Two Years

| Basin | Stream (segment of) | Cause of impairment |
|---|---|---|
| Cape Fear | North Buffalo Creek | Fecal coliform |
| | East Fork Deep River | Fecal coliform |
| | Haw River | Fecal coliform |
| | Town Branch | Fecal coliform |
| | Northeast Creek | Fecal coliform |
| | Robeson Creek | Chlorophyll-a |
| Catawba | Clark Creek | Fecal coliform, copper |
| | Crowders Creek | Fecal coliform |
| French Broad | Hurricane Creek | Sediment, fecal coliform |
| Neuse | Pigeon House Branch | Fecal coliform, copper low DO |
| Roanoke | Marlowe Creek | Copper |
| Yadkin | Grants Creek | Fecal coliform |
| | Rich Fork | Fecal coliform |
| | Hamby Creek | Fecal coliform |
| | McKee Creek | Fecal coliform |
| | Clear Creek | Fecal coliform |
| | Rocky River | Fecal coliform |
| | Faulkner Creek | Sediment |
| | Goose Creek | Fecal coliform |
| | Salem Creek | Fecal coliform |
| | Hitchcock Creek | Fecal coliform |

*The "Integrated List" places all waterbodies into one of 7 categories: 1. Attaining water quality standards and no use threatened. 2. Attaining some uses but there is insufficient data to determine if remaining uses are attained or threatened. 3. Insufficient data to determine if any use is attained. 4. Impaired or threatened for one or more uses but does not require a TMDL because either (a) a TMDL has been completed, (b) other controls are expected to bring about attainment of water quality in near future, or (c) impairment is not caused by a pollutant but by pollution. 5: Impaired and requires a TMDL. 6. Biologically impaired with no identified cause of impairment. 7. Impaired but the proper technical conditions do no yet exist to develop a TMDL.*

*Report continued page 8.*

# Lake/Estuarine Acres Impaired

| Basin | Acres impaired | Cause of Impairment | Uses impaired |
|---|---|---|---|
| Broad | None | N/A | N/A |
| Cape Fear | 147,798 (includes freshwater lakes and estuarine waters) | aquatic weeds, nutrients, mercury, chlorophyll a, fecal coliform | Overall |
| | *For estuarine waters, 76% supporting, 22% partially supporting, 2% not rated.* | | |
| Catawba | None | N/A | N/A |
| Chowan | None | N/A | N/A |
| French Broad | 340 (Waterville Lake in Haywood County) | dioxins | Overall |
| Hiwassee | None | N/A | N/A |
| Little Tennessee | 280 (West Buffalo Creek Arm of Santeetlah Lake) | nutrients | Primary recreation |
| Lumber | 59,623 (includes waters of Atlantic Ocean contiguous to Waccamaw drainage) | mercury, fecal coliform | Overall |
| Neuse | 77,675 (includes waters of Atlantic Ocean contiguous to Ocracoke Island and Drum Inlet) | chlorophyll a, aquatic weeds, mercury, fecal coliform | Overall |
| New | None | N/A | N/A |
| Pasquotank | 21,709.7 (includes waters in Roanoke Sound) | fecal coliform, mercury, low DO | Fish consumption, shellfish harvesting, primary recreation |
| Roanoke | 11,229 | mercury, selenium, aquatic weeds | Fish consumption, aquatic life |
| Savannah | None | N/A | N/A |
| Tar-Pamlico | 38,360 | chlorophyll a, mercury, fecal coliform | Overall |
| Watauga | None | N/A | N/A |
| White Oak | 30,303.4 (includes waters around Bear Island ORW) | fecal coliform | Shellfish harvesting |
| Yadkin | 301 | drained lakes, mercury, aquatic weeds | Overall |

## EMC action *continued*

wastewater treatment facilities without regard to size or the nature of violations. Moreau said that the Secretary has proposed to scale fines to take size into account but that the Steering Committee is still concerned that small facilities are disadvantaged by regulations governing monitoring that make them guilty of continuing violations before they have results of sampling. Moreau also said that the Steering Committee is considering a revision in the civil penalty remission procedure to screen out cases in which no new information is presented before oral hearings are held. Moreau said that rulemaking will not be required for the change.

■ Heard from Tom Fransen of the N.C. Division of Water Resources that the EMC has very little authority to take actions to head off or deal with problems brought on by drought. Fransen said the Emergency Management Act gives the governor authority to take action to deal with drought emergencies and that the Safe Drinking Water Act gives the secretary of DENR authority to take actions such as granting waivers for emergency interconnections. However, any authority the EMC has requires rulemaking, which takes about two years to complete and would be useless in an emergency. [Senate bill 1260, Conserve Water/Promote Green Energy introduced in the General Assembly in June would direct the EMC to adopt rules governing water conservation and reuse and mandate other actions to encourage water conservation by local governments. The bill has passed the senate and as of 9/18/02 was in the House Environment and Natural Resources Committee.]

# Press reports prompt op-ed by head of NRC sludge study panel

Land application of sewage sludge (what the wastewater industry calls biosolids) has long been the subject of negative reporting (see for instance *Toxic Sludge is Good for You: Lies, Damn Lies and the Public Relations Industry*, Common Courage Press, 1995). Now, because of negative press coverage of its recently released report, the chairman of a National Research Council committee charged with examining the scientific basis of EPA's regulations for biosolids application has issued an editorial to clarify the committee's findings.

Thomas A. Burke, professor at the Bloomberg School of Public Health at Johns Hopkins, issued an op-ed in September because "some press accounts focused only on criticisms of EPA's past efforts, and do not fully reflect the findings and recommendations of our report."

The NRC committee was appointed at the request of EPA to respond to requirements of the Clean Water Act to periodically reassess the scientific basis for the "Part 503" rule and to address public health concerns on which a number of community protests against land application have been based.

Burke emphasized that the committee found no evidence of an urgent public health risk from exposure to land-applied biosolids. He said that even though land application has been practiced for decades there are no studies documenting adverse health effects. Because there have been anecdotal reports of illness, however, the committee recommended that EPA support studies of populations exposed to biosolids, such as workers or communities near application sites.

The committee also recommended that, in light of changes over time in chemical uses, wastewater treatments, and technology, EPA should update the understanding of components of biosolids through a new national sewage sludge survey.

Because EPA has not reassessed the chemical and pathogen standards for biosolids since it established them in 1993, the committee recommended that EPA reassess whether the existing regulatory standards are supported by the latest scientific data, improved technology, and methods for estimating risk.

# September action of the EMC's Water Quality Committee

At its regular meeting on September 11, 2002, the Environmental Management Commission's Water Quality Committee took the following action:

■ Approved revised Water Supply Watershed Protection ordinances for Pasquotank County and Camden County.

■ Approved a major variance from the Neuse riparian buffer rules for the Yates Mill Pond county park in Wake County.

■ Approved holding public meetings on the draft Broad River Basinwide Water Quality Management Plan. For information visit the Basinwide Planning website: http://h2o.enr.state.nc.us/basinwide/meetings_by_month.htm

■ Reviewed a proposed schedule for development of a Jordan Lake Nutrient Management Strategy and asked the staff of DWQ to "harden" the schedule so that the EMC receives the draft strategy in 2003.

# Action on environmental legislation in the N.C. General Assembly

*You can follow action on legislation on the General Assembly's website: http://www.ncga.state.nc.us/BillInfo/BillInfo.html*

## Legislation passed

*In addition to environmental legislation reported in the July/August 2002 WRRI News, the 2001-2002 session of the General Assembly has passed the following environment-related legislation:*

S 1253 AN ACT TO PROVIDE THAT CERTAIN ANIMAL WASTE MANAGEMENT SYSTEMS SHALL NOT QUALIFY FOR SPECIAL PROPERTY CLASSIFICATION AND EXCLUSION FROM THE TAX BASE PURSUANT TO G.S. 105-275(8) AND TO DIRECT THE REVENUE LAWS STUDY COMMITTEE TO STUDY ISSUES RELATED TO THE TAX EXCLUSION, AS RECOMMENDED BY THE ENVIRONMENTAL REVIEW COMMISSION. Provides that tax exclusion shall not apply to an animal waste management system unless the Environmental Management Commission determines that it will (1) eliminate discharge of waste to surface waters and groundwater, (2) substantially eliminate atmospheric emissions of ammonia, (3) substantially eliminate emission of odor detectable beyond boundaries of farm, (4) substantially eliminate release of disease-transmitting vectors and airborne pathogens, and (5) substantially eliminate nutrient and heavy metal contamination of soil and groundwater.

H 1308 AN ACT TO CONFIRM THE DATE ON WHICH STATE REQUIREMENTS GOVERNING THE CONCENTRATION OF SULFUR IN GASOLINE BECOMES EFFECTIVE AND TO PROVIDE THAT GASOLINE THAT MEETS FEDERAL REQUIREMENTS GOVERNING THE CONCENTRATION OF SULFUR IN GASOLINE SHALL BE DEEMED TO COMPLY WITH STATE REQUIREMENTS GOVERNING THE CONCENTRATION OF SULFUR IN GASOLINE DURING THE TWO-YEAR PERIOD ALLOWED FOR THE TRANSITION TO LOW-SULFUR GASOLINE BY FEDERAL REGULATIONS.

H 1540 AN ACT TO DISAPPROVE AN AMENDMENT TO THE ADMINISTRATIVE RULE "USE STANDARDS FOR OCEAN HAZARD AREAS" ADOPTED BY THE COASTAL RESOURCES COMMISSION AND TO AUTHORIZE COUNTIES AND CITIES TO ORDER THE REMOVAL OF A SWIMMING POOL UPON A FINDING THAT THE SWIMMING POOL IS DANGEROUS OR PREJUDICIAL TO PUBLIC HEALTH OR SAFETY.

H 1545 AN ACT TO AUTHORIZE THE ADDITION OF ELK KNOB STATE NATURAL AREA AND BEECH CREEK BOG STATE NATURAL AREA TO THE STATE PARKS SYSTEM, AS RECOMMENDED BY THE ENVIRONMENTAL REVIEW COMMISSION.

H 1557 AN ACT TO EXTEND THE MORATORIUM ON ISSUING NEW SHELLFISH CULTIVATION LEASES IN CORE SOUND AND TO DIRECT THE JOINT LEGISLATIVE COMMISSION ON SEAFOOD AND AQUACULTURE TO STUDY VARIOUS MARINE FISHERIES ISSUES, AS RECOMMENDED BY THE JOINT LEGISLATIVE COMMISSION ON SEAFOOD AND AQUACULTURE.

H 1575 AN ACT TO CLARIFY CERTAIN STATUTES RELATED TO LAND-USE RESTRICTIONS AND RECORDATION OF THOSE RESTRICTIONS IN CONNECTION WITH THE CLEANUP OF RELEASES FROM PETROLEUM UNDERGROUND STORAGE TANKS, AS RECOMMENDED BY THE ENVIRONMENTAL REVIEW COMMISSION.

H 1584 AN ACT TO MAKE THE STATE DEADLINE FOR APPROVAL OF HAZARD MITIGATION PLANS CONSISTENT WITH THE FEDERAL DEADLINE FOR APPROVAL OF THESE PLANS, AS RECOMMENDED BY THE ENVIRONMENTAL REVIEW COMMISSION, AND TO EXTEND THE DATE BY WHICH CERTAIN SMALL MUNICIPAL WASTE COMBUSTION UNITS MUST ACHIEVE COMPLIANCE WITH CERTAIN REQUIREMENTS RELATED TO THE EMISSION OF AIR POLLUTANTS.

## Legislation awaiting concurrence

S 1037 AN ACT TO PROVIDE THAT ANY PROSPECTIVE APPLICANT FOR AN AIR QUALITY PERMIT FOR A NEW FACILITY MAY COMMENCE CONSTRUCTION PRIOR TO OBTAINING THE AIR QUALITY PERMIT TO OPERATE THAT FACILITY IF THE PROSPECTIVE APPLICANT SUBMITS A NOTICE OF THE CONSTRUCTION AND THAT ANY CURRENT HOLDER OF AN AIR QUALITY PERMIT MAY COMPLETE NEW CONSTRUCTION AT AN EXISTING PERMITTED FACILITY PRIOR TO OBTAINING THE AIR QUALITY PERMIT TO OPERATE THAT FACILITY IF THE PROSPECTIVE APPLICANT SUBMITS A NOTICE OF THE CONSTRUCTION. Versions have passed third reading in both House and Senate. As of 9-18-02 remained in Conference Committee.

S 1161 AN ACT TO AMEND THE PRESENT-USE VALUE STATUTES, TO CREATE A PROPERTY TAX SUBCOMMITTEE OF THE REVENUE LAWS STUDY COMMITTEE, TO CLARIFY THE SALES AND USE TAX EXEMPTION REGARDING CERTAIN AGRICULTURAL SUBSTANCES, AND TO MAKE VARIOUS ADMINISTRATIVE CHANGES IN THE TAX LAWS. Clarifies that land remains eligible for present use taxation after a conservation easement is acquired and that rollback taxes are not owed when forest or farmland is acquired for conservation. Senate calendared for 9/20/02 for concurrence on house amendment.

# WRRI reports available

*WRRI has recently published peer-reviewed technical completion reports on research projects for which it provided funding. Single copies of WRRI reports are available free to federal/state water resource agencies, state water resources research institutes, and other water research institutions with which exchange agreements have been made. Single copies of publications are available to North Carolina residents at a cost of $4 per copy prepaid ($6 per copy if billed) and to nonresidents at a cost of $8 per copy prepaid ($10 per copy if billed). Send requests to WRRI, Box 7912, North Carolina State University, Raleigh, NC 27695-7912 or call (919) 515-2815 or email: water_resources@ncsu.edu.*

***Neuse River Estuary Modeling and Monitoring Project Stage 1: Evaluating Historical Nutrient and Chlorophyll Patterns in the Neuse River Basin Report* No. 325-H May 2002**

*Martin E. Lebo, Weyerhaeuser Company and Adjunct Professor, UNC-Chapel Hill, and David G. McHenry and James H.Fromm, Weyerhaeuser Company*

This report summarizes nutrient and chlorophyll a (Chl *a*) patterns for the Neuse River Basin at three locations and for the Neuse Estuary based on data compiled from monitoring efforts from the 1940s to 2000. It presents a set of analysis approaches that yield consistent temporal patterns in nutrient and Chl *a* concentrations in the lower portion of the Neuse River Basin.

Nutrient and Chl *a* data were obtained from research groups and agencies having surface layer (i.e. photic zone) monitoring programs with stations located along a longitudinal transect from Streets Ferry Bridge to the confluence with Pamlico Sound. Additional data from the Neuse River at Kinston, Contentnea Creek at Hookerton, and the Trent River at Trenton were also included.

The analysis of watershed nutrient patterns focused on selected locations in the lower portion of the Neuse Basin. For the Neuse River at Kinston, mean nitrate ($NO_3$-N) and total nitrogen (TN) increased significantly during the mid-1970s to the early 1990s, and then decreased after 1994. This increasing pattern for the 1970s and 1980s was more pronounced for $NO_3$-N than TN due to a concurrent decreasing pattern for organic N (Org-N). Annual mean concentrations of ammonium ($NH_4$-N) were low (range 0.04 – 0.09 mg/L) and accounted for 3 – 9% of mean annual TN. Variations in inorganic phosphorus ($PO_4$-P) and total phosphorus (TP) concentration at Kinston showed a significant decrease as P control measures were implemented in 1998.

Patterns in nutrient and Chl *a* concentrations at the headwater to the Neuse Estuary generally reflected the pattern at Kinston. The Neuse River at Streets Ferry Bridge showed peak $NO_3$-N concentrations in the late 1980s and 1990s. The temporal pattern in TKN concentrations at Streets Ferry exhibited peaks in the early part of the data record (1979-82) and relatively constant mean values after 1983. For TN, variation in concentrations over time reflected changes in both the $NO_3$-N and TKN fractions, with the lowest concentrations during 1994-00. The dominant temporal pattern in P concentrations over the past two decades at Streets Ferry was a large reduction after 1987, with a concomitant decrease in average Chl *a* concentrations. For samples collected near New Bern, temporal patterns were limited to decreased $PO_4$-P and TP after 1987 and lower $NH_4$-N concentrations in the 1990s.

A confounding factor in the evaluation of temporal patterns in nutrient and Chl *a* concentrations in the Neuse Estuary from New Bern to Pamlico Sound is irregular flow-related changes in the location of salt water. In general, salt water in the Neuse Estuary is located further downstream when flow is high and progressively moves upstream during periods of lower flow. Associated with this flow-driven downstream movement of fresh water is higher concentrations of $NO_3$-N in the lower estuary and spatial migration of peak Chl *a* concentrations typically observed at a salinity of about 2 – 5 psu. Nutrient and Chl *a* data for samples with measured salinities between 0.5 and 15 psu were extracted from the larger data set for the Neuse Estuary and grouped into eight salinity intervals. Organizing inorganic N data by salinity interval revealed temporal patterns consistent with headwaters to the Neuse Estuary; the $NH_4$-N concentration decreased over time while $NO_3$-N for the low salinity intervals peaked during 1985-93. Temporal variations in $PO_4$-P, TP, Org-N, and TN in average property-salinity diagrams also were consistent with the headwater pattern. Further, Chl *a*-salinity diagrams indicate a general increase in average concentrations in the 1980s through the 1990s but a possible decrease in recent years (1997-00).

Evaluation of the effectiveness of implemented management actions in the Neuse River Basin is confounded by natural climatic fluctuations, including the series of hurricanes that occurred during 1996-99. An analysis approach is presented, based on rating curves developed for 1-3 year periods, that reduces the effect of variable rainfall among years on the assessment of load reductions.

Short-term feedback on the effectiveness of management actions implemented in the Neuse River Basin to reduce N inputs to the estuary is essential. Predicted flow-normalized $NO_3$-N, TN, and TP annual loads for 1995-00 were recalculated by year to illustrate how the analysis approach can provide short-term feedback on changes in nutrient levels in the Neuse River over time for stations with extensive data collection programs.

*WRRI did not provide funding for this analysis but published the report as part of the Neuse ModMon report series.*

***Seeking Science-based Nutrient Standards for Coastal Blackwater Stream Systems***
**Report No. 341 August 2002**

*Michael A. Mallin, Lawrence B. Cahoon, Matthew R. McIver, and Scott H. Ensign, Center for Marine Science, UNC-Wilmington*

Blackwater streams are the most common lotic systems on the North Carolina Coastal Plain. Despite their abundance, these streams are rarely considered to be sensitive to nutrient loading and are usually not afforded the nutrient protection that estuaries and Piedmont water bodies receive.

Blackwater systems normally contain somewhat reduced dissolved oxygen relative to clearwater streams because they have contact with organic sediments in floodplain swamps and are high in bacteria, and because high concentrations of dissolved organic carbon are available as substrates for bacterial respiration. Thus, blackwater streams are particularly at risk for pollution-caused hypoxia and anoxia. The authors' hypothesis for this research was that hypoxia in the lower Cape Fear River Basin is exacerbated by inputs of organic and inorganic nutrients.

The investigators concentrated their research in the Black River basin, a major subwatershed of the lower Cape Fear River. They conducted experiments on water from a near-pristine stream (Colly Creek) and a stream draining an area of heavy animal production (Great Coharie Creek). Colly Creek is a wetlands-rich system with few concentrated animal feeding operations (CAFOs) while Great Coharie Creek has much less wetland coverage and many CAFOs. These differences are reflected in the water quality. The pH values of Colly Creek were low, indicating large contributions of organic-acid rich swamp water, while the higher pH of Great Coharie Creek likely results from less wetland inputs combined with anthropogenic loading.

Total nitrogen concentration was similar between creeks but Great Coharie Creek had 37% of total nitrogen in the inorganic form (primarily nitrate) while only 11% of total nitrogen in Colly Creek was inorganic. Total phosphorus concentrations were about 4 times higher in Great Coharie Creek than in Colly Creek, as were orthophosphate concentrations. Mean total and inorganic N/P ratios were well above the Redfield ratio for phytoplankton (16) in both creeks for the 24-month research period. However, inorganic N/P ratios were at or below the Redfield ratio during the growing season when experiments were conducted. Chlorophyll *a* was low in both creeks.

The investigators used nutrient addition bioassays to assess the susceptibility of these blackwater streams to nutrient loading, with chlorophyll *a*, biochemical oxygen demand (BOD), and bacterial abundance as response variables. Nutrient additions were nitrate, urea + nitrate (TN), orthophosphate, and orthophosphate + glycerophosphate (TP), with treatment concentrations of 0, 0.2, 0.5, 1.0, 2.0, and 5.0 mg of N (nitrogen) or P (phosphorus)/L.

Nitrogen, either as nitrate or TN proved to be the nutrient that limited the growth of phytoplankton. In several of the nitrogen treatments, BOD was significantly stimulated over control through the photosynthetic pathway of algal production followed by algal death and decay leading to subsequent BOD increase. Phosphorus did not stimulate the growth of phytoplankton in these experiments. However, significant BOD increases occurred in combined orthophosphate + glycerophosphate addition experiments, through stimulation of heterotrophs (mainly bacteria). Orthophosphate alone did not significantly stimulate BOD. In most cases, chlorophyll *a* was stimulated to a greater degree in the water from the anthropogenically impacted creek than water from the pristine creek, and there was stronger coupling between chlorophyll *a* and BOD. This possibly indicates a microbial community adapted to take advantage of periodic nutrient pulses from rainfall-driven runoff from swine waste sprayfields, poultry litterfields, or fertilized agricultural areas. Significant stimulation of chlorophyll *a* and BOD occurred with additions of 0.2 – 0.5 mg nitrate-N/L, and significant stimulation of chlorophyll and BOD also occurred in Great Coharie Creek with inputs of TN as low as 0.2 mg-N/L. Significant stimulation of BOD occurred with additions of either 0.5 or 1.0 mg-P/L as TP. Previous experiments conducted on water from the Black and Northeast Cape Fear Rivers using additions of 1.0 mg/L of N or P also showed significant stimulation of chlorophyll *a* (by N) and adenosine triphosphate (ATP) by P or N.

The authors say that because waters of the lower Cape Fear basin are not considered to be nutrient-sensitive, limited data is available on nutrient discharges from permitted point source dischargers. They recommend that dischargers over 0.1 MGD in the lower basin be required to report weekly TN and TP data to the N.C. Division of Water Quality. They also suggest that, in order to prevent biological degradation of blackwater streams, standards be developed to prevent anthropogenic loading that would increase blackwater stream inorganic nitrogen concentrations above 0.5 mg-N/L and total phosphorus concentrations above 0.5 mg-P/L.

## EPA reports on research needs for TMDL program

The U.S.EPA has released *The Twenty Needs Report: How Research Can Improve the TMDL Program* to guide EPA research managers and scientists to help improve the scientific basis for restoring and protecting impaired waters. Among the needs identified are information to improve the consideration of atmospheric deposition in development TMDLs and development of adaptive management approaches.

The report is available at website: http://www.epa.gov/owow/tmdl/20needsreport_8-02.pdf.

# Studies

## Report on emissions from animal operations raises possibility of air quality nonattainment in rural areas

An interim report released in July by the National Research Council (NRC) says that with a recent change in EPA regulation for ozone (0.08 parts per million, 8-hour average) more rural areas will violate the ozone standard and be designated as ozone nonattainment areas, necessitating implementation of emission controls under the Clean Air Act. In rural areas containing large numbers of animal feeding operations (AFOs), nitric oxide emissions from soils receiving animal manures will be an important source of ozone precursors to be controlled.

Moreover, the report points out, EPA's National Ambient Air Quality Standards also regulate particulate matter, which is an emission of growing concern in regard to AFOs.

However the report also says that developing state air quality implementation plans for regions that contain AFOs will require quantitative estimates of their air emissions and that getting reasonably accurate estimates is difficult because the operating environment for AFOs is complex.

The interim report *The Scientific Basis for Estimating Emissions from Animal Feeding Operations* was issued by an NRC committee charged with conducting a rigorous review of air emissions factors related to animal feeding and production systems in the United States, identifying critical short- and long-term research needs, and providing recommendations on the most promising science-based methodologic and modeling approaches for estimating and measuring emissions. The committee considered all relevant literature and data, and critically reviewed *Air Emissions from Animal Feeding Operations* in which the EPA Office of Air and Radiation proposed a method for estimating AFO emissions. Two NC State University faculty members, Dr. Wayne P. Robarge, and Dr. Kelly D. Zering, served on the committee.

### Emissions from animal operations

The report lists a broad range of compounds and particulates known to be emitted by AFOs and describes their environmental and health-related effects:

- **Ammonia ($NH_3$)**. The nitrogen in animal manure can be converted to ammonia and emitted to the atmosphere. Once emitted, the $NH_3$ can be converted rapidly to ammonium ($NH_4^+$) aerosol which can stay in the atmosphere for days and can be transported hundreds of miles. As an aerosol, $NH_4^+$ contributes directly to the formation of fine particulate matter (PM2.5), which can reach and be deposited in the smallest airways in the lungs. Ammonium may be a major component of fine particulate matter over much of North America. Once removed from the atmosphere, $NH_3$ contributes to ecosystem fertilization, acidification, and eutrophication.

- **Nitric Oxide (NO).** Nitrification in aerobic soils is the dominant pathway for agricultural NO release, with only minor emissions directly from livestock or manure. NO is a precursor to photochemical smog and ozone ($O_3$), and is oxidized along with $NH_3$ in the atmosphere to nitrate, which contributes to both fine particulate matter and excess nitrate deposition.

- **Hydrogen Sulfide ($H_2S$).** $H_2S$ is emitted during manure decomposition and by the reduction of sulfate in feeds and water. Most $H_2S$ in the atmosphere is oxidized to sulfur dioxide ($SO_2$), which is then either dry deposited or oxidized to aerosol sulfate and removed from the atmosphere by rain. $SO_2$ emissions from AFOs may be important on a local and regional basis and can have health impacts on workers in AFOs. (EPA does not regulate $H_2S$, but North Carolina does under its air toxics regulations.)

- **Nitrous Oxide ($N_2O$).** $N_2O$ is emitted to the atmosphere from soils receiving animal manure via nitrification and denitrification. Once emitted, $N_2O$ is globally distributed because of its long residence time (about 10 years) and contributes to both tropospheric warming and stratospheric ozone depletion.

- **Methane ($CH_4$).** $CH_4$ is produced by microbial degradation or organic matter under anaerobic conditions. About 65% of the $CH_4$ emissions from livestock production can be traced to enteric fermentation in ruminant animals, with the remainder attributable to anaerobic decomposition of livestock manure. Liquid waste handling systems produce significant quantities of $CH_4$, while solid waste management systems may produce little or none. Because of the long residence time in the atmosphere (about 8.4 years), $CH_4$ becomes distributed globally. It is a greenhouse gas and contributes to global warming.

- **Particulate matter.** PM10 is airborne particles with aerodynamic diameters less than 10 micrometers. PM2.5 is particles with aerodynamic diameters less than 2.5 micrometers. AFOs contribute directly to particulate matter through production of dust and indirectly through emission of NO and $NH_3$ that can be converted to aerosols. Both PM2.5 and PM10 can be deposited in the respiratory tract.

- **Volatile Organic Compounds (VOCs).** VOCs are organic compounds that vaporize easily at room temperature. The majority of these compounds participate in atmospheric photochemical reactions, while others play an important role as heat-trapping gases.

*continued page 15*

# Report says sprawl exacerbates drought problems

Urban and suburban development is making the nation's drought even more painful by impairing the landscape's ability to recharge aquifers and surface waters, says a report released in August by American Rivers, the Natural Resources Defense Council, and Smart Growth America. Nationwide, paved-over land sends billions of gallons of water into streams and rivers as runoff, rather than into the soil to replenish groundwater. The report, *Paving the Way to Water Shortages: How Sprawl Aggravates the Effects of Drought*, estimates the extent of this phenomenon in 18 rapidly growing cities.

The authors estimate that in Atlanta, the nation's most rapidly sprawling metropolitan area, recent sprawl development sends an additional 57 billion to 133 billion gallons of polluted runoff into streams and rivers each year. This water would have otherwise filtered through the soil to recharge aquifers and provide underground flows to rivers, streams and lakes. The report gives the first estimates of groundwater losses due to sprawl development in the 1980s and 1990s.

The authors conclude that the link between sprawl and drought needs to be examined more closely. The report suggests that policies to promote "smart growth" and low-impact development techniques are needed to ensure adequate water supplies and to protect aquatic resources into the future.

The three organizations called for more money for scientific study to determine more precisely the extent of sprawl's impact on water resources and watersheds.

The full report is available online at http://www.smartgrowthamerica.com/waterandsprawl.html.

# Websites

The U.S. Geological Survey (USGS) has unveiled its new, online **WaterWatch** website which gives visitors an instantaneous picture of water conditions nationwide in near real time. Through the use of USGS WaterWatch maps, the entire Nation's current streamflow conditions, including high flood-flows and low drought-flows are depicted on maps with color-coded dots which represent conditions at about 3,000 streamgages. The WaterWatch website is available at http://water.usgs.gov/waterwatch/.

**WaterWiser**, a program of the American Water Works Association and the U.S. Bureau of Reclamation, is an online clearinghouse for water efficiency and water conservation information. Included is information on education, case studies, products, and services. Postings are accepted for papers and conferences. Go to URL http://www.waterwiser.org/.

## North Carolina Precipitation/Water Resources

| | July | August |
|---|---|---|
| **Rainfall (+/- average)** | | |
| Asheville | 1.99" (-1.88") | 2.09" (-2.21") |
| Charlotte | 1.20" (-2.59") | 4.32" (+0.60") |
| Elizabeth City | 5.90" (+0.95") | 7.51" (+2.91") |
| Greensboro | 3.26" (-1.18") | 4.42" (+0.71") |
| Raleigh | 4.76" (+0.47") | 4.73" (+0.95") |
| Wilmington | 7.80" (+0.18") | 12.09" (+4.78") |

| **Streamflow** **Index Station** (County, Basin) | **July mean flow (CFS)** (% of long-term median) | **August mean flow (CFS)** (% of long-term median) |
|---|---|---|
| Valley River at Tomotla (Cherokee, Hiwassee) | 121 (98%) | 76.9 (67%) |
| Oconaluftee River at Birdtown (Swain, Tenn) | 225 (68%) | 152 (50%) |
| French Broad River at Asheville (Buncombe, FB) | 652 (48%) | 416 (29%) |
| South Fork New near Jefferson (Ashe, New) | 165 (48%) | 110 (37%) |
| Elk Creek at Elkville (Wilkes, Yadkin/Pee-Dee) | 26.4 (39%) | 15.9 (29%) Rcrd Mnth Low |
| Fisher River near Copeland (Surry, Yadkin/Pee-Dee) | 68 (48%) | 22 (20%) Rcrd Mnth Low |
| South Yadkin River near Mocksville (Rowan, Yadkin/PD) | 27.7 (12%) Rcrd Mnth Low | 15.4 (8%) Rcrd Mnth Low |
| Rocky River near Norwood (Stanly, Yadkin/Pee-Dee) | 169 (45%) | 156 (50%) |
| Deep River near Moncure (Lee, Cape Fear) | 91.1 (27%) | 46.6 (12%) Rcrd Mnth Low |
| Black River near Tomahawk (Sampson, Cape Fear) | 136 (38%) | 95.3 (26%) |
| Trent River near Trenton (Jones, Neuse) | 5.85 (7%) | 5.96 (9%) |
| Lumber River near Boardman (Robeson, Lumber) | 50.8 (10%) Rcrd Mnth Low | 81.4 (13%) Rcrd Mnth Low |
| Little Fishing Creek near White Oak (Halifax, Pamlico) | 3.25 (7%) Rcrd Mnth Low | 83.6 (260%) |
| Potecasi Creek near Union (Hertford, Chowan) | 6.52 (17%) | 3.79 (8%) |

| **Groundwater** **Index well (Province)** | **July depth below surface (ft)** (departure from average for month) | **August depth below surface (ft)** (departure from average for month) |
|---|---|---|
| Blantyre (Blue Ridge) | 36.09 (-4.93) Rcrd Mnth Low | 37.80 (-5.63) Rcrd Mnth Low |
| Mocksville (Piedmont) | 23.07 (-4.86) Rcrd Mnth Low | 23.08 (-5.35) Rcrd Mnth Low |
| Simpson (Coastal Plain) | 7.97 (-2.49) Rcrd Mnth Low | 7.79 (-2.54) |

Source: U.S. Geological Survey's *Water Resources Conditions in North Carolina http://nc.water.usgs.gov/monthly/*

# Emissions from AFOs *continued*

In addition, some may irritate the skin, eyes, nose, and throat on contact and the mucous membranes if inhaled. VOCs can also be precursors to ozone and fine particulate matter.

## The challenge of regulating animal operations

According to the report, EPA's Office of Air and Radiation and Office of Water face a tough challenge in regulating AFOs because of cross-media effects. AFO regulations proposed by EPA and due for finalization in December may very well have the effect of increasing air emissions. Regulations aimed at protecting water quality will probably affect manure management at the farm level by limiting the amount of manure nitrogen and phosphorus that can be applied to cropland. This will create an incentive to use practices that volatilize ammonia to decrease the nitrogen remaining after storage or create the need to spread manure over additional acres.

At the same time the EPA Office of Water is under pressure to regulate AFOs for water quality protection, the Office of Air and Radiation is under growing pressure to take actions to mitigate the impacts of AFOs on air quality. To select the best regulatory alternatives, EPA needs to understand how management practices influence air emissions from AFOs and needs to be able to make reasonably accurate estimates of air emissions at the individual farm level, according to the report.

In its consensus findings, the committee says that measuring air emissions at all AFOs is not feasible and that requiring monitoring of air quality at all AFOs would not be useful. However, the committee agreed that it will be necessary to take measurements on a statistically representative subset of AFOs. To define subsets of AFOs, they will have to be characterized in terms of their components: animal types, nutrient inputs, manure handling practices, output of animal products, management of feeding operations, confinement conditions, physical characteristics of sites, and climate and weather conditions. Relationships between these various factors and air emissions will have to be established. Regulators will also have to collect information on the spatial relationships among individual farms and the dispersion of air emissions from them. Obtaining all this information will require a commitment of new resources.

The committee agreed that they cannot support use of the model farm approach to estimating air emissions from AFOs that was suggested by the EPA Office of Air and Radiation in its 2001 report. In this study, EPA developed a set of 23 model farms intended to represent the majority of commercial-scale AFOs. Each model farm had three variable elements: a confinement area, manure management system, and land application method. Emissions rates from each element would be combined to produce an estimate of emissions from each type of model farm. However, the report says that AFOs are complicated biological systems with daily, seasonal, and probably yearly cycles and have inherent variability because of differences in physical design. The committee concluded that the way EPA had characterized feeding operations is inadequate and that the data used to support the model farm approach is weak.

According to the report, a process-based model farm approach that incorporates "mass balance" constraints for some of the emitted substances of concern, in conjunction with estimated emission factors for other substances, may be a useful alternative to EPA's model farm construct. Such an approach would start with defining feeding operations in terms of major activities. However it would focus on activities that determine the movement of nutrients and other substances into, through, and out of the system. Modeling would be used to simulate the system and the movement of reactants and products through each component so that emission of elements, such as nitrogen, could not exceed their flows into the system.

The interim report was released to provide the committee's findings regarding the scientific criteria needed to ensure that estimates of air emission rates are accurate, the basis for these criteria in the scientific literature, and the uncertainties associated with them. It also identifies economic criteria needed to evaluate emission mitigation techniques and best management practices. The committee is now working on the final report with the goal of determining scientifically valid ways to estimate air emissions from AFOs before EPA finalizes the NPDES rules for AFOs in December. The final report will also identify critical short- and long-term research needs and will provide recommendations on potential mitigation technologies.

The interim report *The Scientific Basis for Estimating Emissions from Animal Feeding Operations* can be read online or ordered from the National Academy Press at http://www.nap.edu/catalog/10391.html.

# People

**Greg Thorpe**, formerly deputy director of the N.C. Division of Water Quality has taken a position as Environmental Management Director for the N.C. Department of Transportation.

**Pat Davis**, formerly water resources programs manager with the Triangle J Council of Governments, has rejoined the Orange Water and Sewer Authority.

**Paula Thomas**, formerly environmental policy specialist with the N.C. League of Municipalities, has joined AMEC Earth and Environmental as Senior Consultant.

**Sonya Avant**, formerly with the N.C. Division of Water Resources, has joined the N.C. Division of Land Resources as Assistant State Sediment Specialist.

# Applications invited for 2003 Natural Resources Leadership Institute

The Natural Resources Leadership Institute administered through the NC Cooperative Extension Service at NC State University is recruiting for the 2003 Natural Resources Leadership Institute.

The institute teaches natural resource professionals leadership skills, emphasizing conflict resolution, critical thinking, and collaborative problem solving. The goal is to improve collaborative leadership in environmental management and policy development, leadership that will influence workable solutions within complex, and often contentious, environmental issues.

The program, structured around six three-day workshop sessions, includes a Washington DC session, two one-day review sessions, graduation and a leadership project. Participants attend each session at various locations in North Carolina and Washington DC.

Institute tuition is $900 (covers workshop instruction, educational materials, refreshments, and Raleigh rail transportation to DC). Costs for prearranged workshop meals and/or accommodations are participants' responsibility, including travel expenses to/from each session. Limited funds are also available to applicants requiring financial support for tuition and/or travel expenses. Applications for NRLI 2003**, accepted until October 3, 2002,** are available by email request to Mary_Addor @ncsu.edu,or online at: **www.ces.ncsu.edu/PIE/nrli/Leader/applicat.htm**

NCWRA
North Carolina Water Resources Association

## 2002 - 2003 Luncheon and Forum Schedule

December 2, 2002
Stormwater Regulations: Phase II and Beyond

February 3, 2003
Post-Construction Stormwater BMPs: Good, Bad, and Ugly

April 7, 2003
Airborne Water Pollutants

September 8, 2003
Land Use & Water Quality Interactions Using GIS

December 1, 2002
Water Reuse

All luncheon/forums take place at 11:30 am
at the Jane S. McKimmon Center on
the N.C. State University campus.
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