

## Making Our Mark

With this issue of the *WRRI News*, we introduce our new Institute logo and newsletter banner. Our previous logo was designed and adopted twelve years ago, and we thought it was time to update our appearance. Our new logo communicates in a bolder manner who we are.

Sandy Smith—a graphic designer in the Department of Communication Services, College of Agriculture and Life Sciences, at NCSU—created the new look for us.

Concurrently, we are updating the appearance of the WRRI web site. Terri Appleboom, web designer, also in Communication Services, created our new look.

We acknowledge and thank Sandy and Terri for their hard work.

We also have a shorter web address: <http://www.ncsu.edu/wrri/>. This will make it easier for you to find us. The old address will still

take you to our current web site. As you browse through our web site, you will notice that some pages have the new look and others have the old. Please be patient as we put the new look over our whole web site.

As time goes on, you will see more items with our new logo—

letterhead, business cards, report covers, folders, writing tablets, etc.

If you have any comments or questions about our new look or web site please contact Kelly Porter at 515-2815 or [kelly\\_porter@ncsu.edu](mailto:kelly_porter@ncsu.edu).

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**The WRRI Annual Conference and Pre-conference Symposium are coming up March 30-31.**

**Early registration (with reduced fee) ends March 15.**

**See page 15 for workshop and conference schedule and registration form.**

## Director's Forum

# Can we effectively control erosion and sedimentation in North Carolina?

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

After eight years as WRRRI Director, I thought the time was appropriate for reflection on a few of the many interesting experiences I've had during this time. Since I have recently stepped aside as Chair of the North Carolina Sedimentation Control Commission (SCC), I want to focus on some observations on sedimentation and erosion control.

From a regulatory standpoint, sediment and turbidity are essentially unique as water pollutants. Why? In brief, regulatory control of most pollutants is focused on point sources under the jurisdiction of the NC Division of Water Quality (and the Environmental Management Commission) whereas sediments and turbidity are regulated nonpoint source pollutants based largely on controls established by the NC Division of Land Resources (and the SCC).

The source of these pollutants is land disturbance activity, such as land/vegetation clearing for construction and agriculture. This occurs at literally thousands of locations across the state, from large agricultural areas cleared for spring planting, to highway construction zones, to new housing developments. Among the most constant reminders of sediment pollution are those that may slip under the regulatory screen because they are individually small (although they may be collectively large). Probably the best examples of these numerous small sources are the individual new home lot clearing activities, with careless practices leading to trails/clumps of sediment on roads surrounding the site, ultimately to be washed into the nearest watercourse during the next rain.

While I may be frustrated by the fact that regulations do not cover the small home construction sites in my neighborhood, these sources are essentially reminders of the larger issue. At present,

the most urgent problem is North Carolina's inability to adequately enforce its existing regulations. We often hear the comment about proposed legislation (gun control, for example), "if only we enforced the existing regulations, we wouldn't need to consider new legislation." In the case of NC sedimentation and erosion control, I agree with that point; the critical problem at present is

that North Carolina is not providing the resources for rigorous and thorough enforcement of its existing regulations.

Why is North Carolina's enforcement inadequate? The major impediment is lack of resources at the state level. To partially counter this shortcoming, the State's regulatory responsibility is gradually dropping because the NC Sedimentation Control Commission

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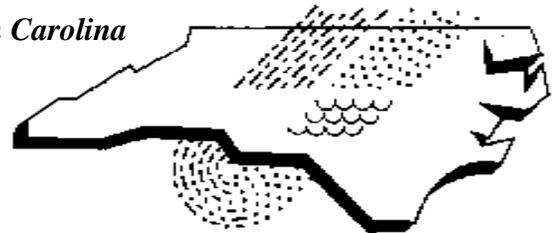
## **Water Resources Research Institute News** of The University of North Carolina

ISSN 0549-799X

Number 345

January/February 2004

Published bimonthly



*This newsletter is financed in part by the Department of the Interior, U.S. Geological Survey, as authorized by the Water Resources Research Act of 1984. Forty-three hundred copies of this newsletter were printed at a cost of \$1,624 or 38 cents per copy.*

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encourages the development of local sedimentation and erosion control programs. These local programs can become self-sustaining with a user fee (see the January/February 2003 Director's Forum) that supports a thorough plan approval and effective inspection process at the local level. However even with this local relief, there are still too many active land-disturbing sites requiring state-level inspection and enforcement for the program to be effective, given the limited number of state staff.

For the past few years, I have supported efforts to substantially increase the cap on fees the State program can charge; however, others have successfully fought these efforts to raise the cap to a level that reflects the costs to maintain an effective program. As a result, we are forced to draw on general state funds, and given the recent tight budgets, the state is unable to support an effective inspection and enforcement program. In my view, all of us lose, even those who oppose the increase in the user fee as a necessary cost of doing business in order to reduce soil erosion and protect our State's water quality.

Why should we care about ineffective sedimentation and erosion control? Loss of soil, long-term ecological damage, economic costs due to diminished capacity of reservoirs, and diminished aesthetic appearance of surface waters are among the consequences. Unlike some environmental damage, certain of these impacts are long-term and not easily reversed.

So, posing the question in the title, "Can we effectively control erosion and sedimentation in North Carolina?" Yes, if we have the resolve to allocate the resources toward an effective program. Unfortunately, while this resolve has been demonstrated by many local programs, it currently is absent at the state level.

## Status of NPDES Stormwater Phase II rules unknown

by Jeri Gray

On January 15, the N.C. Rules Review Commission (RRC) met to consider revisions made by the Environmental Management Commission (EMC) to the NPDES Stormwater Phase II rules in response to earlier RRC objections. The RRC must approve rules before they can be implemented. After listening to a number of special interest groups that opposed or supported the rules, the RRC passed a motion to—in some way—disapprove the stormwater program. However, specifically which rules the motion applied to, the basis for disapproval, and the action that is to be taken as a result of the motion were not stated in the motion, and the meeting ended without clarification. At the end of January, the RRC had not completed written comments on the stormwater rules.

### Background

The Division of Water Quality, as staff to the EMC, began developing rules to implement the federal NPDES Stormwater Phase II program by issuing a "concept" document and holding public workshops in 2001. It immediately became evident that language of the stormwater rules promulgated by the U.S. EPA created a unique problem for North Carolina.

EPA's rules require that owners of all small municipal separate storm sewer systems (called MS4s) located in urban areas obtain an NPDES permit to discharge stormwater to surface waters and implement six minimum measures to control and manage stormwater runoff. In most states, counties own and maintain the drainage systems in unincorporated areas. However, in North Carolina, drainage systems along roadways in unincorporated areas are owned and operated by the N.C. Department of Transportation. On the basis of language in the federal rules, the N.C. Association of County Commissioners made it known

early in the process of developing state rules that counties did not consider themselves subject to the rules.

DWQ and the EMC struggled through stakeholder meetings for months to devise a stormwater control program that would not require a mandate to counties but did not leave a gap in coverage of urbanized areas. When proposed rules were floated first in April 2002, counties with urbanized areas were given three options: (1) they could voluntarily implement the full stormwater program, (2) they could implement the stormwater requirements for the facilities they owned (like fleet maintenance facilities) and a post-construction stormwater control program throughout their jurisdictions and have the state implement the other four required measures through existing programs, or (3) they could implement the full stormwater program only at the facilities they owned and have the state implement the required six measures (including the post-construction stormwater control measure.) throughout their jurisdictions. The rules spelled out how the state would implement the post-construction runoff control measure (See May/June 2002 *WRRR News*).

When the EMC adopted temporary rules to implement the stormwater program in October 2002, counties were given only two options: (1) voluntarily implement a program that includes all the six minimum measures, or (2) implement only post-construction runoff control measures and good housekeeping/pollution prevention measures at their own facilities. The rules were adopted as temporary rules so that municipalities could meet the federal deadline for applying for NPDES stormwater permits, but the EMC made it clear that in developing permanent rules, they would turn to authority given them under the N.C. Clean Water Responsibility Act to

*continued page 4*

## Stormwater rules *continued*

develop a program that would bring counties fully into the stormwater control program. (See November/December 2002 *WRRI News*.)

In February 2003, the EMC sent to public hearing proposed permanent rules that essentially established two stormwater control programs: (1) the federal NPDES Stormwater Phase II program that would apply to owners of MS4s, and (2) a state stormwater program that would apply essentially the same requirements to counties, requiring them to adopt by ordinance a post construction stormwater control program that would apply to all new development and re-development over one acre. A series of public hearings was held across the state in April 2003, and in July 2003 the EMC adopted permanent rules implementing the two separate programs.

In August 2003 the N.C. Rules Review Commission extended their review period for the proposed permanent stormwater rules but sent a clear message that they considered the rules to be cumbersome and in need of reformatting and that they would question the authority of the EMC to require counties to adopt an ordinance requiring others to comply with a post-construction stormwater program. At its September meeting the EMC adopted some changes to the rules related to vested rights, which RRC staff said had been changed from the rules that went to public hearing in violation of the Administrative Procedure Act (APA).

In October, the RRC considered the full package of stormwater rules and voted to object to both rules, saying that both were ambiguous, both went beyond the authority given to the EMC by the legislature, and that it was not clear that the rule implementing the state program was meant to apply to counties that do not own MS4s. The RRC also noted that there were other problems with the rules, which it would take up when the revised rules were considered.

Once again DWQ staff and EMC members went to work to try to craft

rules that would, in the words of Commissioner Charles Peterson, be fair and would avoid pushing development out of municipalities into counties.

In December, the EMC approved a reformatting of both rules and a change in requirements for counties. Counties would not be required to obtain an NPDES stormwater permit or pass a post-construction stormwater control ordinance, but could do so voluntarily. In counties that did not choose to be permitted and implement a post-construction control ordinance, developers of projects large than one acre would be required to apply to the state for an NPDES stormwater permit and implement all six minimum measures called for by the federal program, including post-construction stormwater BMPs.

### January 15, 2004, RRC meeting

When the RRC took up the third revision of the stormwater rules on January 15, Department of Environment and Natural Resources (DENR) legal counsel from the Attorney General's Office, Mary Penny Thompson, asked for an extension of the period of review to enable DWQ staff to respond more fully to RRC requests for technical corrections and to give RRC staff more time to review the revised rules.

Representatives of special interest groups opposed DENR's request and registered opposition to the rules. Paul Wilms of the N.C. Home Builders Association said that the requirement for developers in urban counties to obtain stormwater permits was significantly different from the rules that went to public hearing and therefore violated the APA.

Commissioner Jim Jeffrey P. Gray agreed, saying that the rules now cover people who were not covered before (specifically mentioning forestry) and that the rules should, therefore, go back to public hearing.

RRC staff attorney Joseph DeLuca advised the commission that under APA provisions in effect when the stormwater rules were proposed, the EMC does not

have to hold public hearings on rule changes that were made in response to RRC objections, even if they are substantial changes. He noted that if the commission extended the period of review, DENR could perhaps narrow the coverage of the rule.

Commissioner John Tart moved to extend the period of review but received no second, so the motion died and discussion continued.

Commissioner Gray asked if the stormwater rules are "forever under the old APA" or if the RRC could require the EMC to "start all over."

DeLuca responded that the RRC must continue to act on the rules initiated in 2002. "At some point this may become a legislative issue," he said.

DeLuca said that the staff (his) recommendation was to approve the rule reformatting and that the staff (his) opinion on legal authority is that the EMC has been responsive to RRC objections and that there is no basis for sending the rules back.

Nevertheless, Gray moved to return the rules to the EMC for failure to comply with the APA. Reminded of staff opinion that the EMC has complied with the applicable APA procedures, Gray then charged that the rules are ambiguous because "groups are now included that were not included before."

Asked by the RRC chair to clarify his motion, Gray said that the EMC had "exceeded the spirit of the old APA," and that he objected to the rules on the grounds of ambiguity and lack of statutory authority.

On the basis of that clarification, the RRC (with two members recused and the chair voting nay) passed Gray's motion.

Asked by DeLuca to write down his specific objections, Gray responded, "I don't think I have to explain my motion."

Representatives of special interest groups again weighed in, disagreeing with DeLuca's interpretation of the APA and urging that public hearings be held on the rule changes.

DENR legal counsel Mary Penny Thompson countered that developers

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

At its December 11, 2003, meeting, the N.C. Environmental Management Commission (EMC) took the following action:

- Adopted revisions to rules implementing section 112 (j) of the Federal Clean Air Act. According to Commissioner Daniel Besse, who served as hearing officer, the revisions were necessary to maintain consistency with federal MACT (maximum achievable control technology) standards for hazardous air pollutants.
- Approved the fiscal year 2004 priority and funding list for the Clean Water State Revolving Fund supported by federal funds through the U.S. EPA and matching state funds. According to Construction Loans and Grants Section Chief Bobby Blowe, about \$50 million is available in this fund for loans to municipalities for construction or modification of wastewater treatment facilities to protect water quality. A public hearing was held on the proposed funding list, and no comments were received. Information about State financial assistance programs for municipal wastewater treatment works can be found at <http://www.nccgl.net/fap/>.
- Approved loans from the North Carolina Revolving Loan and Grant Fund for the cities of Southport and Rocky Mount.
- Approved the final Lumber River Basinwide Water Quality Plan. According to Division of Water Quality planner Jennifer Everett, there is a fish consumption advisory for all waters in the Lumber Basin because of mercury contamination. In addition, 84 percent of the estuarine acres in the Lumber Basin are impaired for shellfish harvesting. The Lumber plan can be found on the Basinwide Planning web

site at <http://h2o.enr.state.nc.us/basinwide/index.htm>.

- Approved changes to rules developed to implement the federal NPDES Stormwater Phase II program made in response to the Rules Review Commission comments. (See article page 3.)

- Approved changes to the Catawba River Basin riparian buffer rules made in response to comments from the Rules Review Commission. Changes involved clarification of measurement of buffers and authority to approve local buffer ordinances. **JG**

### N.C. Environmental Management Commission gets four new members

Four new members have been appointed and five current members have been reappointed to the commission that develops rules to implement most environmental legislation in North Carolina.

**Tom Ellis**, a 28-year veteran of the N.C. Department of Agriculture, was named by Governor Mike Easley to replace Greg Jennings of Raleigh as a representative of the agricultural community. Ellis has spent the last 14 years promoting aquaculture in North Carolina.

**Craig Frazier** of Sophia was named by the governor to replace Don Abernethy of Hickory as a representative of the public at large. Frazier is a dairy farmer who serves on the Randolph County Soil and Water Conservation District board.

**John R. Gessaman** of Rocky Mount was named by the N.C. Senate to replace Maurice Lasher of Weaverville. Gessaman is president of an economic development organization, Carolinas Gateway Partnership, and is a professional planner in urban and economic development.

**Freddie Harrell** of Shelby was named by the N.C. Senate to replace Robert G. Ray of Cullowhee. Harrell owns and operates an environmental consulting business specializing in removal and remediation of underground storage tanks.

**Thomas Jenkins** of Franklin was reappointed by the N.C. Senate. **Anne Barnes** of Chapel Hill was reappointed by the N.C. House. **Marion Deerhake** of Raleigh, **Leo Green** of Wilson, and **Larry Jordan** of Apex were reappointed by the governor.

A roster of EMC members with addresses and phone numbers can be downloaded in Microsoft Word at <http://h2o.enr.state.nc.us/admin/emc/>.

# December action of the EMC Water Quality Committee

At its regular meeting on December 10, 2003, the N.C. Environmental Management Commission's Water Quality Committee took the following action:

- Approved a revised Water Supply Watershed Protection Ordinance for the Village of Alamance.
- Approved sending to the full EMC a draft rule for "exceptions" to water quality rules (15A NCAC 2B .0111). This rule started life as the "vested rights" rule but the reference was changed because statutory processes already exist for determining a vested right. The "exceptions" rule establishes conditions under which water quality rules will not apply—that is where an exception to the water quality rules can be granted. The exceptions rule will provide relief from stormwater control requirements, buffers, setbacks, density limitations, and other requirements established by rules that specifically refer to it. It will apply only to rules adopted in the future. The draft includes three options for providing authority to grant exceptions, including one under which local governments may ask for delegated authority. The rule will be presented to the EMC in February. If the EMC approves, public hearings will be held in the spring, and the rule will be adopted in the summer. If it meets with Rules Review Commis-

sion and General Assembly approval, it will become effective in the fall. For details of the rule, contact Tom Reeder with the Division of Water Quality (DWQ) at (919) 733-5083 Extension 557.

- Approved language for a letter to be sent to the Town of Cary to clarify the Water Quality Committee's (WQC) intent in approving the town's stormwater program under the Neuse River rules. The clarification was requested by staff of DWQ as part of mediated settlement in a contested case lodged in the Office of Administrative Hearings (OAH). A property owner in Cary requested variances from buffer requirements to allow financially viable development on a site. DWQ granted a minor variance from the Neuse buffer rules, but the Town of Cary had not granted a variance from the town's own 100 foot buffer rules. The property owner filed a contested case in OAH, apparently contending that the WQC's approval of the town's stormwater requirements provided authority for the town's 100-foot buffer. The WQC approved a statement for a letter to Cary clarifying that the committee did not grant the town authority to establish riparian buffers greater than those established by the EMC. Commissioner Dan Besse asked that the WQC minutes reflect that "as a whole the statement

does not reflect the committee's affirmative conclusion that Cary lacks authority to adopt buffer rules."

- Heard an update on development and implementation of the Unique Wetland (UWL) classification (15A NCAC 2B .0101 (e) (7)). This is a special classification similar to the High Quality Waters and Outstanding Resource Waters classifications that focuses on preserving habitat for threatened and endangered species and will be applied on a site by site basis. According to Ed Schwartzman with the 401/Wetlands Unit, a preliminary analysis indicates that about 4% or 200,000 acres of the state's wetlands meet the criteria established for Unique Wetlands. Eighty percent of UWLs are on public lands. Schwartzman said that no UWL classifications will be made on private land without the landowner's agreement. He said that DWQ expects to identify and delineate an initial set of UWLs on public lands and land trusts for reclassification by September 2004. The proposed reclassifications will be noticed and public hearings will be held. Then, the reclassifications will be presented to the WQC and the EMC for approval.

- Heard an update on the nutrient response model and watershed loading model for the B. Everett Jordan Reservoir. The reservoir and surrounding watershed have been designated Nutrient Sensitive, and a nutrient management strategy is being developed for the watershed. In addition, the upper New Hope arm of the reservoir is considered impaired, and a TMDL must be developed for this portion of the reservoir and submitted to EPA by April 2005. Model analysis indicates that to achieve a less than 10% excursion from the state chlorophyll a standard (40 µg/L), there must be a 35% reduction in nitrogen loading and a 2-5% reduction in phosphorus loading to the upper New Hope arm. **JG**

## Stormwater rules *continued*

were always going to be regulated. Under the original rule, counties would have regulated them, she said, and under the current version, the state will regulate them.

"The forestry inclusion may be new," she admitted. "This was intended to track the Sedimentation Pollution Control Act. We can work on that, but if you return this rule, there will be big problems."

Asked by Thompson for clarification as to which rule the objection applied to, the commission was silent. Staff attorney

DeLuca then told her, "We'll get with you to work this out."

The meeting ended with no understanding of the substance of the motion passed by the RRC. Did the motion apply only to the state rule (15A NCAC 2H. 1014) or to both rules? Did the RRC object to the rules or does the body intend to return the rules to the EMC, essentially killing them and leaving North Carolina in noncompliance with a federal Clean Water Act requirement? What is the specific basis for the RRC's action, whatever it was? At press time, these questions still had not been answered.

## EPA proposal on wastewater “blending:” What are the implications?

As North Carolina clamps down on sanitary sewer overflows by requiring removal of overflow pipes and other measures (see *WRR I News* Nov/Dec 2003), some wastewater systems may see higher flows reaching treatment plants during periods of wet weather. Systems that have significant infiltration from groundwater or inflow from illegally connected storm drains into sewer pipes could find themselves dealing with higher peak flows than their easily-upset biological treatment units were designed to handle. What are they supposed to do when all that extra wastewater comes rushing into treatment plants?

That is a question now under debate by EPA, the wastewater community, states and environmental groups. The debate is intense in states where—by design—the same sewers carry wastewater and stormwater directly to wastewater treatment plants and any significant rainfall can threaten to overwhelm treatment capacity. In North Carolina, where sanitary sewers are separate from sewers that carry stormwater, the debate is low key because only extreme rainfall events (such as hurricanes) might threaten treatment capacity. But, the same question applies: How should a wastewater system deal with wastewater flows above its peak treatment capacity?

For many years, many wastewater systems have—by design—dealt with the problem by using a practice called “blending.” In this practice, all wastewater receives both primary and secondary (biological) treatment up to the capacity of the biological treatment unit. Then, additional flows receive primary treatment (screening and clarifying, which can handle significant variation in flow and pollutant concentration) and are routed around the finicky biological treatment unit, “blended” with effluent from the biological treatment unit, disinfected, and discharged. Under EPA policy and policy in many states, blending was allowed as long as wastewater discharge met all pollutant limits set in the system’s NPDES permit.

However, in 1999-2000, some EPA regions began telling states that blending was not legal under the Clean Water Act and that language must be written into state-issued NPDES permits to prohibit it. The new language was to redefine the term “bypass” (which is forbidden by federal regulations) to mean routing wastewater flows around any part of the treatment process.

Municipal organizations in Tennessee, Pennsylvania and Arkansas challenged EPA Region 4’s interpretation of the Clean Water Act and asked EPA national headquarters for clarification of policy. According to these organizations the only alternative to blending is building facilities to store additional wastewater flows until they can receive full treatment. According to the Tennessee Municipal League, EPA, itself, estimated the cost nationwide to build such facilities at \$100 billion.

Receiving no clarification on blending from EPA, the organizations then sued. The U.S. District Court for the District of Columbia, where the suit was filed, decided it had no jurisdiction because regional policy does not constitute final agency action.

In the meantime, EPA issued a proposed policy on blending which, the agency says, will provide “clear, nationally consistent guidance to the interpretation of the NPDES regulations as they related to the practice of blending and ensure that if blending is used by a municipal sewage treatment facility it is used in a way that is fully protective of human health and the environment.” The proposed policy essentially allows blending as long as permit limits are met.

The proposed policy was hailed by the Water Environment Federation (which represents the wastewater community) as “supporting local governments in planning and operating wastewater facilities which provide environmentally sound and cost effective treatment during a variety of conditions, leading to improvements in water quality.” The Association of Metropoli-

tan Sewerage Agencies (AMSA) also welcomed the proposed policy.

On the other hand, the proposed policy is being condemned by environmental groups and recreational organizations. They point out that there are no limits in discharge permits for certain pathogens, including giardia and cryptosporidium, and that primary treatment is not effective in removing them from wastewater. They point out that most serious outbreaks of water-borne disease have occurred following heavy rainfalls and charge that allowing treatment facilities to bypass biological treatment endangers public health. They contend that if the only alternative to blending is for municipal wastewater systems to build more storage capacity, then build they must.

In January, 64 members of the U.S. House of Representatives sent a letter to EPA criticizing the proposed blending policy.

### Policy in North Carolina

According to Mark McIntire, an environmental engineer with the NPDES Unit of the N.C. Division of Water Quality (DWQ), North Carolina does not currently have a blending policy.

“We haven’t historically permitted bypass lines,” said McIntire, “so treatment plants generally aren’t designed to blend. However, some bypass lines have been permitted under unique circumstances. The only time blending might be going on in this state is when a treatment plant is under water or excessive inflow/infiltration could cause an upset at a treatment facility”

However, McIntire admits, that’s not to say that an operator can’t drop in a submersible pump and attach a flexible hose to bypass for maintenance or in extreme situations. Such operation has likely occurred. If such bypasses do occur, they must be reported to DWQ and are handled on a case by case basis. Without justification, a bypass could result in enforcement. DWQ wants to keep it this way rather than issuing a blanket policy on blending, recognizing the varying circumstances statewide, McIntire says.

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## WRR I report available

Single copies of WRR I 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 WRR I, Box 7912, North Carolina State University, Raleigh, NC 27695-7912 or call (919) 515-2815.

### ***Land Use Patterns and Pollution in the Upper Neuse River (Report 348 December 2003)***

*Mary Atasoy and Raymond B. Palmquist, Dept of Economics, College of Management; and Daniel J. Phaneuf, Dept of Agricultural and Resource Economics, College of Agriculture and Life Sciences; NC State University*

Water pollution is among the most important issues in North Carolina today, with the problems in the Neuse River being of particular prominence in the minds of policy makers and the public. Pollutants entering the river come from a variety of sources, including agricultural operations, sewage treatment plants, and urban runoff among others. The relative importance of various sources differs in the upper and lower stretches of the river. In the Neuse Basin in Wake County and upstream, the rapid urban development likely accounts for much of the pollution that winds up in the upper stretches of the river and its tributaries. In North Carolina, a substantial component of the debate and research on the Neuse has centered on land-use regulations (in the form of best management practices and animal waste management) for agricultural operations in the lower stretches of the river. There has been less research on the relationship between the growth-driven changes in land use in the upper part of the Neuse and water quality. In this project, the investigators studied the land use/water quality relationship. The specific goals for the research were twofold: (1) understand the factors that influence the location and timing of

residential development in Wake County, and (2) examine the impact that aggregate decisions on land development have on water quality in the county.

The investigators studied where and when urban development takes place using an optimal stopping model involving a series of discrete binary choices and alternatively using a proportional hazard model. Each model identified a number of factors that significantly influence when a parcel is developed. The investigators found that the surrounding residential activity, particularly contemporaneous development activity, is important in explaining why an individual parcel is developed in a given year. Related to this, incorporation into a municipality signals that development of a parcel is more likely, due in part to the increased availability of sewer and other services. Interpolating from these findings, the investigators conclude that, all else being equal, development follows development as a critical mass of existing residential density and development activity increases the attractiveness of vacant plots for residential use. The development likelihood is further augmented if the parcel has good access to employment centers such as Research Triangle Park. From this, they speculate that improved infrastructure for commuting to employment (and perhaps amenity and service) areas increases the attractiveness of a parcel for residential use. Thus, they say, they would expect greater future development in areas with improved transportation infrastructure.

The investigators studied the effects of this development on water quality using a unique data set and spatial econometric techniques. The upper Neuse River basin in Wake County, NC,

was delineated into drainage zones such that water quality in each zone was consistently monitored for total phosphorous, total nitrogen, and total suspended solids between 1995 and 1999. Data on when each residential parcel was developed were used to develop measures of the residential development and change in development for each zone. Measures of discharges from wastewater treatment plants above each monitor were developed. In-stream transport of pollutants was measured, as well as other variables. These data were then used in a spatially autoregressive model. The results indicate that both total residential development and changes in that development have statistically significant positive effects on total phosphorus and total nitrogen, while only new construction affects total suspended solids. The other variables perform as expected. The impacts of changes in the residential variables have proportionally much larger effects than changes in point-source discharges.

The authors conclude that urban water quality regulation needs to consider the impact of the location and timing of residential land use and land development, although they caution that residential land use is far from the only factor influencing urban water quality. They recommend further research using other pollutants and other measures of river basin health (e.g., benthic macroinvertebrates). They also suggest research on a reduced geographic scale, allowing investigation of water quality impacts at the neighborhood rather than hydrological unit level and studying the effects of development on water quality in areas with different soil types. They point out that such research would depend on more extensive water quality monitoring, particularly in areas predicted by their development model to see increasing development activity.

# Studies

## New tool uses genetic algorithm to minimize environmental impacts and maximize profit of development in urbanizing watersheds

With the example of TMDL requirements for impaired streams before them, decision makers in urban areas are beginning to see the wisdom of preventing rather than responding to the environmental effects of urban development. In order to understand and control the environmental effects of urbanization, planners and stakeholders need tools to identify land use patterns that optimize both environmental and economic objectives. Working in the recently revitalized field of genetic algorithms, researchers at Southern Illinois University at Carbondale are developing such a tool.

The combination of sophisticated hydrologic simulation models and geographic information systems has become the standard watershed planning tool. This combination is useful for predicting the changes in runoff quantity and stream quality that will result from specific development. However, simulation and GIS models alone cannot directly reveal development patterns that optimize specified objectives. Under a grant from the Illinois Water Resources Center, John Nicklow, a civil engineer, and Leslie Duram, a geographer, and others are working to overcome the limitations of the standard watershed planning tool. They are developing a multi-objective Spatial Decision Support System (SDSS) that integrates a genetic algorithm for identifying weighted, optimal land use patterns with the USDA's Soil and Water Assessment Tool (SWAT) for hydrologic simulation and a GIS for generating input and visualizing output.

Genetic algorithms (GAs) use the mechanics of natural selection and natural genetics. First developed in the 1960s and currently enjoying a renaissance, genetic algorithms are search

procedures that use evolutionary techniques, based on function optimization and artificial intelligence, to develop a solution. Genetic algorithms operate by, first, developing a population of possible solutions to a problem (coded as artificial chromosomes); next recombining (the chromosomes of) the better solutions to form some new solutions; and finally, replacing the poorer of the original solutions with the new solutions and repeating the process.

In application of the SDSS, the GA is used to specify various land use patterns corresponding to levels of urbanization. SWAT then simulates the behavior of the watershed in response to the land use patterns. The GA evaluates the fitness of original land use patterns and specifies new patterns, based on the feedback from the simulation model. This loop is repeated until specified convergence criteria are obtained. The fitness of a solution is defined by a function that is the weighted sum of the environmental and economic objectives.

The researchers have applied their model to the Lower Kaskaskia watershed located in southwest Illinois near St. Louis, in an area called Metro East. In this initial application, only the control of sediment yield was considered as an environmental objective. Economic profit was evaluated based on proximity of the center of each sub-basin to St. Louis and the distance from each basin center to the nearest interstate. This aggregate function implies that development of subbasins closer to St. Louis and major interstates will produce a larger profit than those that are not. The convergence, or stopping, criterion utilized in the study was a user-specified maximum number of iterations. At termination of model execution, the fittest solution was taken as the optimal

land management decision. The application tested only the operation of the SDSS, as SWAT had not been calibrated for the study watershed. However, results demonstrated the capability of the SDSS to identify optimal land use patterns that limit sediment yield while promoting profit to be earned from development.

Early runs of the SDSS were presented to watershed stakeholder groups whose feedback was integrated into later runs, demonstrating how the tool can involve stakeholders. Stakeholders wished to disallow development of primarily forested watersheds and wetland areas and supplied the idea of using distance to interstates as part of the economic-objective function.

The researchers are now calibrating SWAT for the Lower Kaskaskia watershed, expanding the environmental objective to include other water quantity/quality factors, and developing an artificial life algorithm to verify optimal results specified by the GA.

Allred, K.O., J.W. Nicklow, M.K. Muleta, and L.A. Duram. 2003. "A multiobjective SDSS for management of urbanizing watersheds: The case of the lower Kaskaskia Basin, Illinois." *Proceedings of the 2003 Conference of the Environmental and Water Resources Institute, ASCE*. Philadelphia, PA, June 23-26.

*Conference proceedings are not peer-reviewed. The authors are in the process of submitting journal articles. Corresponding author: John W. Nicklow, Southern Illinois University at Carbondale (nicklow@engr.siu.edu).*

*Those interested in learning more about application of genetic algorithms can visit the Illinois Genetic Algorithms Laboratory at <http://www-illigal.ge.uiuc.edu/index.php3>.*

## Studies *continued*

### Study of Prince William Sound reveals chronic effects of petroleum contamination

Fourteen years worth of evidence gathered following the Exxon Valdez oil spill refutes the assumption that negative effects of petroleum contamination on wildlife are acute and short-term, say the authors of an article published in the December 19, 2003, issue of *Science*\*. Dr. Charles Peterson of the UNC-Chapel Hill Institute of Marine Sciences and co-authors say their evaluation of the long-term ecosystem impacts of the Exxon Valdez oil spill provides evidence of a link between declines in estuarine-dependent fish and petroleum degradation products and suggests that standards for stormwater control and chronic low-level oil releases need to be strengthened to reverse the decline of estuarine-dependent fisheries.

The release of 42 million liters of crude oil in Northern Prince William Sound on March 24, 1989, prompted an ecological monitoring program of unprecedented scope and duration that has provided new understanding of oil ecotoxicity and the long-term impacts to a coastal ecosystem and its marine life. The authors say that rejecting the old paradigm in oil ecotoxicology based on acute-toxicity to one species and bringing an ecosystem perspective to the study of petroleum contamination illuminates the mechanisms through which long-term impacts are induced: (1) chronic persistence of oil in sediments and population impacts to species associated with sediments; (2) delayed population impacts from sublethal exposure that compromises health, growth and reproduction; and (3) indirect effects of food-chain, habitat, and social interactions.

The immediate effects of the Exxon Valdez release were the death of as many as 2,800 sea otters, 250,000 seabirds, and 302 harbor seals as well as mass mortal-

ity of macroalgae and benthic invertebrates. These acute effects were predicted. The long-term effects were not.

At the time of the Exxon Valdez spill, predictions of risk to fish were based on laboratory tests of short-term acute toxicity of the water-soluble fraction of oil dominated by 1- and 2-ringed aromatic hydrocarbons. Subsequent laboratory studies exposed fish to partially weathered oil dominated by 3-, 4- and 5-ringed polycyclic aromatic hydrocarbons (PAHs). These studies showed that exposure to PAHs from partially weathered oil at concentrations as low as 1 part per billion induces high mortality rates among pink salmon and herring. When pink salmon eggs were exposed for the months of development and herring eggs were exposed for 16 days there was a dramatic reduction in fitness so that eggs and larvae succumbed at high rates to a range of normal environmental stressors. These studies partly explain why mortality among pink salmon eggs in oiled streams of Prince Edward Sound was elevated for at least 4 years after the oil spill.

Another part of the explanation of prolonged elevated mortality of salmon eggs is the discovery that the rate of dispersion and degradation of petroleum hydrocarbons contaminating the shorelines slowed significantly over time. Monitoring revealed that significant amounts of oil were sequestered in coarse-grained gravel shores armored by boulders and cobbles that inhibited wave disturbance and, as a result, suppressed degradation through oxygenation and photolysis. Exposure to this bio-available oil killed pink salmon embryos through at least 1993. Oil was similarly trapped under mussel beds providing a route for hydrocarbon entry into many food chains. At current degradation rates, recovery of oiled mussel beds to background conditions will take 30 years. Chronic exposures of species that lay eggs or forage among sediments was evident for years after the spill in biomarkers in fish, sea otters, and seaducks.

Monitoring of other species in Prince William Sound also showed substantial population effects of chronic exposure to oil contamination over the long term: Suspension-feeding clams, which are prominent prey of sea otters, concentrate hydrocarbons in their tissue, and high levels of the detoxification enzyme CYP1A confirmed persistent exposure of sea otters to hydrocarbons. At one highly oiled location, the number of sea otters in 2000 remained at half the pre-spill number. In 1998, sampling of harlequin ducks, which prey on intertidal benthic invertebrates, revealed the CYP1A detoxification enzyme and showed that body mass was negatively related to CYP1A levels. Radio tracking of adult female harlequins overwintering on heavily oiled island shores showed elevated mortality when compared to those on unoiled shores. As a result of the loss of females, fall densities of harlequins on oiled shores declined about 5 percent per year during 1995-97, while populations on unoiled shores were stable.

Study of the black oystercatcher in Prince William Sound also showed that chronic sublethal exposure can lead to population impacts through compromised health, growth or reproduction. Black oystercatchers that consumed mussels from oiled shores bred less and produced smaller eggs than those that bred elsewhere. These shorebirds fed their chicks more oiled mussels to achieve less growth than those on unoiled shores. Smaller chicks have reduced odds of surviving.

Studies also showed that cascades of indirect effects lengthened the recovery process on rocky shorelines for a decade or more. As an immediate result of the oil spill, there was a dramatic loss of the rockweed *Fucus gardneri*, which had provided important cover for invertebrates. An opportunistic barnacle moved into the freed rock space, inhibiting recovery of the rockweed. The loss of grazers formerly associated with the rockweed led to blooms of green algae. After an apparent recovery of the

*continued*

rockweed, another die-off occurred in 1994 as the single-aged stand reached senility, indicating establishment of a cyclic instability of this habitat.

The authors say that their synthesis of 14 years of Exxon Valdez oil spill studies provides evidence of delayed, chronic, and indirect effects of petroleum contamination in the marine environment. Suggesting broader implications of their synthesis, they conclude: "Vague concerns about the role of poor water quality in the steady declines of estuarine-dependent fisheries may now find renewed focus on a specific class of contaminants, the multi-ringed PAHs, in physically protected sedimentary spawning and nursery habitats."

\*Peterson, Charles H., Stanley D. Rice, Jeffrey W. Short, Daniel Esler, James L. Bodkin, Brenda E. Ballachey, and David B. Irons. Long-Term Ecosystem Response to the Exxon Valdez Oil Spill. *Science* 302: 2082- 2085

## Study shows PAHs in lake sediments increase in proportion to vehicle miles traveled

Polycyclic aromatic hydrocarbons (PAHs)—a product of incomplete combustion of petroleum, oil, coal and wood—compose the largest class of suspected carcinogens and have been shown to be toxic to aquatic life in high concentrations. Studies in the 1970s and 1980s indicated that PAHs concentrations in the environment were declining as a result of reduced use of coal for home heating, industrial emissions controls, and increased efficiency of power plants. However, authors of a study published in *Environmental Science and Technology*\*, say that not only are concentrations of PAHs increasing in urban and suburban environments but they are now composed of the more toxic 4- and 5-ring species.

As part of the U.S. Geological Survey National Water Quality Assessment (NAWQA) Reconstructed Trends program, researchers tracked trends in PAHs over several decades to the mid-to-late 1990s by analyzing sediment cores taken from 10 lakes and reservoirs in six U.S. metropolitan areas. PAHs attach to particulates and are deposited in water bodies from the atmosphere, sewage discharges, and stormwater runoff. In lakes and reservoirs, they accumulate in sediments making it possible to reconstruct trends in their concentrations.

For this study, sediment cores were taken from lakes and reservoirs whose watersheds represent a range in degree and age of urbanization. Date of deposition of sediment intervals was based on several date-depth markers: construction date of reservoir, lead-210, cesium-137, DDT and/or PCB profiles, and total lead peak. Samples were also analyzed for total and individual PAHs, major and minor elements, and chlorinated organic pesticides.

The results showed modest to dramatic increases in PAH concentrations in all 10 watersheds over the last 20 to 40 years. In rapidly urbanizing sites, PAH concentrations increased sharply from pre-development levels—one to two orders of magnitude above pre-development concentrations. In reservoirs where watershed development started after 1960, PAH concentrations increased steadily from the date of reservoir construction to the present. In reservoirs whose watersheds underwent pre-1960s urbanization, PAH concentrations peaked in the 1950s, then decreased, then increased again after the 1960s. Core analysis also revealed a shift in PAH source over the last 40 years from uncombusted (oil seeps, petroleum spills) to combusted (vehicle exhaust, domestic heating with coal).

Researchers compared the change in PAH concentration from the mid-1970s to the mid 1990s to the concurrent change in the amount of urban land use for the watersheds. In nine of the 10 sites, the increase in PAH concentration was faster than the increase in urbaniza-

tion. At two sites there was essentially no increase in the amount of urban land use, but a doubling of PAH concentration.

To investigate the possible effect of traffic on PAH concentration trends, the researchers plotted trends in vehicle use (vehicle miles traveled) for six metropolitan areas against the trends in PAH concentrations. They found similar increases for the 1970s through the 1990s. The researchers point out that in addition to vehicle exhaust, tire wear, crankcase oil, and roadway wear contribute PAHs to the environment.

To put the concentrations of PAHs found in their study into an ecological perspective, the researchers compared their findings for three of the most prevalent PAHs to the Canadian Sediment Quality Guidelines for the Protection of Aquatic Life. They found that concentrations in all 10 waterbodies exceeded the levels below which adverse effects are unlikely to occur. Concentrations in six of the lakes exceeded the concentration above which adverse biological effects are expected to occur.

The authors say their study suggests that urban growth or sprawl outside a watershed may adversely affect water quality within the watershed. They also say the study suggests that without reductions in vehicle-related PAH releases, concentrations of PAHs will continue to increase at rates comparable to those projected for automobile use.

\* Van Metre, Peter C., Barbara J. Mahler, and Edward T. Furlong. 2000. Urban Sprawl Leaves Its PAH Signature. *Environmental Science and Technology* 2000 (34) 4064-4070.

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## Wastewater "blending" continued

"Pump stations, sewer lines, and the hydraulic capacity of treatment plants must be designed to handle peak flow, which may be as much as two-and-a-half to four times normal flow. Equalization (storage) capacity is required. Systems are required to correct infiltration and inflow. If systems are doing what they should be, there should be little need for blending.

"Even during Hurricane Fran, the City of Raleigh's wastewater treatment plant didn't need to bypass and blend because the collection system is well maintained. And, Raleigh is now building a 30-million-gallon equalization facility which will assure they won't need this practice in the future."

McIntire said that DWQ would submit comments to EPA on blending, but that blending is not a big issue in North Carolina and he does not expect it to become a major issue.

"Blending is a big issue where cities have combined sanitary and stormwater sewers, like Washington, DC, for example. But there are no combined sewers in North Carolina so the only way 'clean' water would be getting into sewer lines is likely through poor collection system condition," said McIntire.

DWQ encourages municipalities to properly operate and maintain collection systems to reduce inflow and infiltration.

"We've not had a lot of municipalities coming to us saying they need to be able to blend—to my knowledge only one has approached us about this issue."

Regardless of what the EPA policy turns out to be, it is unlikely that North Carolina will change its position on blending. The state does not have to adopt an EPA rule or policy that is less stringent than a state regulation.

"The bottom line for DWQ is that blending may not necessarily be bad, but it is bad to institute a policy that might encourage municipalities to neglect their collection systems." **JG**

## Conferences and workshops

The North Carolina Cooperative Extension Service in cooperation with NC State Biological and Agricultural Engineering, Pitt County, NCDENR, and the City of Greenville are co-sponsoring a 1-day workshop March 23 in Greenville, North Carolina entitled "**Stormwater BMPs in the Tar-Pamlico Basin.**" Details and registration information can be found at: <http://www.bae.ncsu.edu/workshops/greenville/index.html>

Restore America's Estuaries will present the **2nd National Conference on Coastal and Estuarine Habitat Restoration**, September 12-15, 2004, at the Washington State Convention & Trade Center and the Grand Hyatt Seattle, Seattle, Washington. For information go to web address: <http://www.estuaries.org/2ndnationalconference.php>

The North American Lake Management Society will present the **13th Annual Southeastern Lake Management Conference "Working Together, Sharing Resources"** March 7-9, 2004, at the Wild Dunes Resort, Charleston, South Carolina. The conference will be held over 2 1/2 days from March 7th through the 9th. The conference program will consist of a plenary session and four concurrent breakout sessions. A stream restoration workshop will be held during the conference. Networking opportunities will be provided in the exhibit area and during a reception on the evening of March 8th. The technical sessions will address issues of interest to lake management professionals as well as private citizens and public organizations. For information go to web address: <http://www.nalms.org>

WRRI, the International Erosion Control Association, the N.C. Land Quality Section and others will present **Sediment and Erosion Control Solutions for the Southeast**, March 17-19, 2004, in Charlotte, NC. Information and registration at: <http://www.soil.ncsu.edu/swetc/ieca/main.htm>.

WRRI and others will present **Stormwater: Emerging Issues for**

**Local Communities**, April 19-22, 2004, at the Grove Park Inn, Asheville, NC. Information and registration at <http://www.soil.ncsu.edu/swetc/stormwaterconf/main.htm>.

The NCSU Forestry Education and Outreach Program will present **Delineation of Piedmont and Coastal Plain Jurisdictional Wetlands**, May 24-28, 2004, Raleigh and New Bern, NC. Information at <http://www.ces.ncsu.edu/nreos/forest/feop/programs.html>.

The Metropolitan Washington Council of Governments will present **Putting the LID on Stormwater Management**, September 21-23, 2004, in College Park, Maryland. The 2-1/2-day conference will highlight innovative low impact design/development techniques designed to mitigate the effects of urbanization and development at the watershed level. Information at: <http://www.mwco.org/environment/lidconference/>

The North Carolina Stream Restoration Institute and others will present **Southeastern Regional Conference on Stream Restoration**, June 21-24, 2004, Winston-Salem, NC. This conference will showcase stream and wetland restoration efforts from Maryland to Florida. Professionals from the southeastern United States and beyond will have an opportunity to present and discuss topics related to the field of restoration. Research and results will be the primary focus of this four-day event, including topics such as sediment transport, in-stream structures, and monitoring and evaluation. Habitat issues, ecosystem assessments, mitigation, funding sources as well as other topics associated with restoration will also be highlighted. For information go to: [http://www.bae.ncsu.edu/programs/extension/wqg/sri/2004\\_conference/index.html](http://www.bae.ncsu.edu/programs/extension/wqg/sri/2004_conference/index.html)

## Other resources

**WATERSHEDSS (WATER, Soil, and Hydrologic Decision Support System)**, a watershed-level, web-based decision support system, has been updated (<http://www.water.ncsu.edu/watershedss/>) and now includes numerous graphics. This web site provides: (1) Educational information covering diverse topics on water quality, water quality monitoring, land treatment, watershed management, and watershed projects (Educational Component). Subject areas range from pollutants to wetlands. (2) A searchable database of over 6,000 annotated articles on NPS pollution control (NPS Bibliography) developed by the NCSU Water Quality Group (<http://www.bae.ncsu.edu/bae/programs/extension/wqg/>) over the past 20 years. (3) A decision support system that allows users to conduct a preliminary watershed evaluation (Decision Support). This option was designed to help users determine the appropriate best management practices (BMPs) and landscape features.

The Low Impact Development Center has received an Assistance Agreement from the US EPA Office of Water to post a **LID research clearinghouse on the internet**. The purpose of this assistance agreement is to create a dialogue between researchers and to update the design community and stormwater managers on what state-of-the-art projects are being done throughout the country. The LID Center will post downloadable forms on the internet that they ask researchers to fill in about their projects and how interested parties can track the progress or find out more information from the researchers. They will try to get this up and running so it is available for the National LID Conference in September. For more information on the conference go to <http://www.mwco.org/environment/LIDconference/>.

The National Cooperative Highway Research Program (NCHRP) Synthesis 272 **“Best Management Practices for**

**Environmental Issues Related to Highway and Street Maintenance,”** is now available via the internet. The synthesis, which is appropriate for state, county, city and local agencies, is a compilation of practices likely to increase the environmental sensitivity of road maintenance work, including many practices that have become widely adopted and adapted. A full-text electronic copy is available in the National Transportation Library digital collection at the following url: <http://ntl.bts.gov/lib/21000/21800/21818/PB99143489.pdf>

EPA's Office of Research and Development has recently established a **Watershed and Water Quality Modeling Technical Support Center**. The mission of the Center is to provide assistance to EPA Regions, State and Local Governments, and their contractors in the implementation of the Clean Water Act. The Center which is part of EPA's Office of Research and Development (ORD) is committed to providing access to technically defensible tools and approaches that can be used in the development of Total Maximum Daily Loads (TMDL), waste load allocations, and watershed protection plans. For more information on this center, go to: [www.epa.gov/athens/wwqtsc](http://www.epa.gov/athens/wwqtsc)

**Technical and Regulatory Guidelines Document for Constructed Treatment Wetlands (WTLND-1)** This document was prepared by The Interstate Technology & Regulatory Council Wetlands Team. It describes the fundamental mechanisms of wetland contaminant removal and overall wetland functions and provides detailed descriptions of the various contaminant treatment objectives, treatment efficiencies, and goals of different constructed wetland applications. Detailed, site-specific predesign criteria and conceptual designs are outlined, followed by final design, post-construction activities, operation and maintenance, monitoring, and implementation costs. The document provides decision trees for each of the major constructed treatment wetland applica-

tions, designed to enable users to take basic information from a specific site and, through a flow chart, decide whether a particular wetland system is appropriate for the site (November 2003, 212 pages). View or download at <http://www.itrcweb.org/WTLND-1.pdf>.

To help those seeking funding opportunities, information, and links to programs that assist in environmental technology development and commercialization, EPA launched the **Environmental Technology Opportunities Portal (ETOP)** on December 31, 2003. ETOP links to governmental and non-governmental programs that foster the use and acceptance of innovative technologies through collaborative recognition and incentives or advocacy and information programs. ETOP was established as a result of a Congressional mandate through the FY 2003 House Appropriations Conference Report that directed EPA to develop a “one-stop-shop” office to coordinate similar programs that foster private and public sector development of new, cost-effective environmental technologies. For more information, see the website at: <http://www.epa.gov/etop>.

**Reusing Cleaned Up Superfund Sites: Golf Facilities Where Waste is Left On Site** (EPA 540-R-03-003). This document was published by the U.S. EPA Office of Superfund Remediation and Technology Innovation. It provides technical information useful in planning, designing, and building golf facilities on sites where the remedy calls for on-site containment of contaminated material or post-construction monitoring or treatment. The report draws from experiences at completed redevelopment projects, EPA technical guidance, and other sources to describe remedy approaches and golf facility design features that have been used to accommodate golf courses at remediated Superfund sites where waste has been left on site (October 2003, 73 pages). View or download at <http://www.epa.gov/superfund/programs/recycle/golf-103103-c.pdf>

## People

**Steve Wall**, formerly with the Conservation Council of North Carolina, has joined the N.C. Department of Environment and Natural Resources as policy analyst in the office of the secretary.

**Jennie (Hill) Smith**, long-time administrative assistant to the N.C. Environmental Management Commission, has retired. She was honored at the Dec 11, 2003, EMC meeting by Chairman David Moreau, who thanked her for "cajoling her co-workers to get material ready for meetings and for countless hours of deciphering meeting tapes and efforts to make us look good on paper."

**Terry L. Pierce**, Transylvania County health director, is the new director of the N.C. Division of Environmental Health. He replaces Linda Sewall, who retired from state government in 2003 and became the health director for Greene County.

**Dr. Fred Gould**, William Neal Reynolds professor of entomology at NC State University, has been named a national associate by the National Academies, a group comprising the National Academy of Science, the National Academy of Engineering, the Institute of Medicine, and the National Research Council. The honor recognizes Gould's extraordinary contribution to the National Academies through pro bono services. Gould has contributed to several projects related to the ecological and evolutionary aspects of agricultural pest management. Gould was among the first to show that insects could adapt to *Bacillus thuringiensis* (Bt) crops. Findings reached in his lab have been instrumental in convincing the U.S. EPA and industry that there are ways to get long-term benefits from Bt toxin-producing crops, including planting of "refuges" of non-Bt crops that are susceptible to insect attack, and ensure that an insect population continues to contain individuals susceptible to the Bt toxin.

## Web site provides case studies of the impact of urban design on water resources

<http://newurbanismwatershed.unc.edu/index.htm>

UNC-Chapel Hill Professor Philip R. Berke and co-investigators have developed a web site to make available materials developed under their WRRRI project *Water Quality and Quantity Impacts of Urban Form: A Comparative Analysis of Compact and Low-Density Developments*.

The investigators completed six case studies of new urban and low density

development to assess how well each integrates stormwater impact mitigation techniques involving the built and natural environment. They have also modeled development scenarios and applied each to a demonstration sub-basin and compared the water quality impacts.

The case studies are now on the web site and a modeling paper will be available soon.

### North Carolina Precipitation/Water Resources

#### Rainfall (+/- average)

	November	December
Asheville	3.89" (+0.07")	2.78" (-0.61")
Charlotte	0.84" (-2.52")	2.40" (-0.78")
Elizabeth City	1.55" (-1.38")	8.25" (+5.19")
Greensboro	1.64" (-1.32")	2.65" (-0.41")
Raleigh	1.81" (-1.16")	3.52" (+0.48")
Wilmington	1.95" (-1.31")	4.95" (+1.17")

#### Streamflow

Index Station (County, Basin)	November mean flow (CFS) (% of long-term median)	December mean flow (CFS) (% of long-term median)
Valley River at Tomotla (Cherokee, Hiwassee)	202 (136%)	297 (121%)
Oconaluftee River at Birdtown (Swain, Tenn)	521 (143%)	580 (107%)
French Broad River at Asheville (Buncombe, FB)	2,925 (193%)	2,832 (128%)
South Fork New near Jefferson (Ashe, New)	757 (219%)	566 (146%)
Elk Creek at Elkville (Wilkes, Yadkin/Pee-Dee)	152 (243%)	138 (160%)
Fisher River near Copeland (Surry, Yadkin/Pee-Dee)	252 (169%)	280 (188%)
South Yadkin River near Mocksville (Rowan, Yadkin/PD)	281 (121%)	381 (110%)
Rocky River near Norwood (Stanly, Yadkin/Pee-Dee)	263 (45%)	544 (51%)
Deep River near Moncure (Lee, Cape Fear)	528 (95%)	1,406(129%)
Black River near Tomahawk (Sampson, Cape Fear)	773 (201%)	1,262 (188%)
Trent River near Trenton (Jones, Neuse)	424 (696%) Rcd Mnth High	435 (286%)
Lumber River near Boardman (Robeson, Lumber)	1,828 (213%)	1,959 (145%)
Little Fishing Creek near White Oak (Halifax, Pamlico)	153 (209%)	333 (240%)
Potecasi Creek near Union (Hertford, Chowan)	175 (545%)	550 (468%)

#### Groundwater

Index well (Province)	November monthly mean water level (ft) (Percent of long-term median)	December monthly mean water level (ft) (Percent of long-term median)
Blantyre (Blue Ridge)	30.29 (193%)	29.99 (na)
Mocksville (Piedmont)	16.67 (196%)	16.59 (na)
Simpson (Coastal Plain)	3.05 (163%)	2.94 (na)

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

# Water Resources Research Institute of The University of North Carolina

## Preconference Symposium

**“Watershed Management in North Carolina: Successes and Challenges”**

**12:30 - 5:00 pm, Tuesday, March 30, 2004**

**Jane S. McKimmon Center, Raleigh, NC**

**Early Registration Fee: \$40 (Students \$10)**

Three and one-half (3.5) PDH’s available for PEs and Surveyors

12:30 PM Registration. Exhibits open.

1:00 PM Welcome & Introductions, *Greg Jennings, Associate Director, Water Resources Research Institute of UNC*

- Model for Successful Watershed Management, *Suzanne Klimek, Planning Coordinator, Ecosystem Enhancement Program & Greg Jennings*
- Building Local Support & Coordination Capacity, *Christy Perrin, Program Coordinator, Watershed Education for Communities and Local Officials, NCSU*

2:20 PM Case Studies - Local Watershed Management

- Mitchell River, *Dick Everhart, NRCS - Surry County*
- Watauga River, *Wendy Patoprsty, NC CES - Watauga County*
- Lower Catawba River, *Rusty Rozelle, Mecklenburg County*
- Changing Behaviors in Local Watersheds, *Craven Hudson, NC CES - Gaston County*

Check the WRRRI web site for full agenda with titles of papers in concurrent sessions:

[http://www.ncsu.edu/wrri/2004\\_annual\\_conference.html](http://www.ncsu.edu/wrri/2004_annual_conference.html)

## 2004 Annual Conference

**“Watershed Assessment and Restoration: Lessons Learned and Future Directions”**  
**8:00 am - 5:00 pm, Wednesday, March 31, 2004**

**Jane S. McKimmon Center, Raleigh, NC**

**Early Registration Fee: \$60 (Students \$30)**

Six (6) PDH’s available for PEs and Surveyors

7:45 – 8:45 AM Registration

8:45 AM General Session

- Welcome, *Dr. Kenneth H. Reckhow, Director, UNC Water Resources Research Institute*
- Keynote Address:
  - Historical Perspective On Water Resources In North Carolina And Future Directions Of Watershed-Based Management, *David Moreau, Ph.D., Chair, Dept of City & Regional Planning, UNC Chapel Hill, and Chair, NC Environmental Management Commission*
  - Watershed Assessment And Restoration: Vision For North Carolina, *Ron Ferrell, Director of Operations, Ecosystem Enhancement Program*

10:00 AM Break (Posters and exhibits open)

- *Courtesy of N. C. Water Resources Association (NCWRA)*

10:30 PM Three Concurrent Sessions

12:00 PM Lunch (Posters and exhibits open)

- *NCWRA will present graduate student poster awards*

1:15 PM Three Concurrent Sessions

2:45 PM Break (Posters and exhibits open)

- *Courtesy of N. C. Association of Environmental Professionals*

3:15 PM Three Concurrent Sessions

**Register before March 15, 2004 for early registration fee.**

## 2004 Water Resources Research Conference & Preconference Symposium Registration Form

Please print clearly or type.

Name: \_\_\_\_\_ Affiliation: \_\_\_\_\_ Phone: \_\_\_\_\_

Address: \_\_\_\_\_

City: \_\_\_\_\_ State: \_\_\_\_\_ Zip: \_\_\_\_\_ Email: \_\_\_\_\_

Student? Yes No College or University \_\_\_\_\_

I will attend:

Preconference Workshop. Enclosed is my check for \$40 (Students \$10) **After 3/15/2004:** \$60 and Students \$30.

Annual Conference. Enclosed is my check for \$60 (Students \$30) **After 3/15/2004:** \$80 and Students \$50.

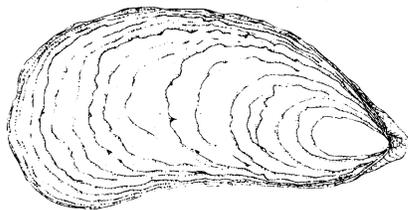
Both the Preconference Symposium and Annual Conference. Enclosed is my check for \$100 (Students \$40) **After 3/15/2004:** \$120 and Students \$60.

I would like to receive PDH credits, and my license number and type are: \_\_\_\_\_

**Make checks payable to WRRRI and mail with registration form to:  
Water Resources Research Institute, Box 7912, NC State University, Raleigh, NC 27695-7912**

Questions? Call WRRRI at (919) 515-2815 or check our website: [http://www.ncsu.edu/wrri/2004\\_annual\\_conference.html](http://www.ncsu.edu/wrri/2004_annual_conference.html)

The North Carolina Coastal Federation, the  
U.S. EPA, the N.C. Shellfish Sanitation  
Section and others will present



***An Encore for Oysters***  
**March 16 and 17, 2004,**  
**Crystal Coast Civic Center,**  
**Morehead City, NC.**

Participants will discuss the status and trends of  
NC's oyster population and water quality,  
habitat, the National Academies' report on  
non-native oysters and ways citizens can help  
to restore oyster habitat and water quality in  
North Carolina's estuaries.

**For a full brochure and registration information  
please contact Lauren Kolodij  
at 252-393-8185  
or by emailing her at [laurenk@nccoast.org](mailto:laurenk@nccoast.org).  
([www.nccoast.org](http://www.nccoast.org))**

**NCWRA**  
North Carolina Water Resources Association

## 2004 Tentative Luncheon and Forum Schedule

March 30-31, 2004.

Jane S. McKimmon Center

The April 2004 meeting of the NCWRA will be held in  
conjunction with the WRRI Annual Conference. NCWRA  
is a co-sponsor of the conference and will present  
awards for the best graduate student posters during the  
conference luncheon.

September 13, 2004

NCSU Centennial Campus, College of Textiles  
Advanced Wastewater Treatment and TMDLs

December 6, 2004

NCSU Centennial Campus, College of Textiles  
The Impact of TMDLs on Stormwater Programs

Updates to this schedule will be posted on web site:  
<http://www.ncsu.edu/wrri/events/ncwra>

All luncheon/forums take place at 11:30 am  
at the College of Textiles Building on Centennial Campus  
N.C. State University. For directions, go to website:  
<http://centennial.ncsu.edu/howtogether/htgh.htm>

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