



# SEDIMENTS

Newsletter of the North Carolina Sedimentation Control Commission

## Polyacrylamide Reduces Erosion on Construction Site Slopes

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Soil Science Department, North Carolina State University

**T**HE BENEFITS OF POLYACRYLAMIDE (PAM) to reduce erosion in furrow irrigation systems have been well documented. In fact, the use of PAM is considered a best management practice by the Natural Resources Conservation Service (NRCS), and is included in the NRCS' National Handbook of Conservation Practices (NRCS, 2001). Furrow irrigation rates of PAM as low as 1.00 lb/acre dissolved in furrow irrigation water may be efficient in reducing sediment, phosphorus, and nitrogen losses by 85-99%. The benefits in crop growth have also been documented.

Testing of PAM for erosion control on steep slopes suggests that application rates will need to be higher compared to the rates found to be successful in furrow irrigation. Tests using less than 20 lb PAM per acre have generally had no statistically significant reduction in erosion rates. It should be noted that in these studies there were substantial reductions in sediment losses or runoff turbidity as a result of the PAM treatments, but high variability resulted in few statistical differences.

Substantially higher PAM rates have been shown to be effective, however. Rates of 20 – 80 lb/acre have resulted in reductions in erosion and sometimes runoff volumes. Unfortunately, most studies have been conducted with no mulch, which is not typical of slope stabilization approaches commonly used. Since vegetative cover is usually the objective, a mulch would normally be applied to encourage germination and seedling establishment.

The longevity of PAM benefits in reducing runoff and erosion from the time of application is an important management question. There appears to be no set answer,

but longevity is affected by application rate, slope, and environmental conditions. Lower application rates will usually not last as long, perhaps only for the first several events. Rates of 60-80 lb/acre have been found to last over many storm events. Applications in areas of the country with low rainfall or regular dry periods will last longer than those in the eastern U.S.

There has been little work to determine the effects of PAM on the establishment and growth of vegetation, usually grass, used to stabilize slopes. The two studies available did generally indicate that grass growth was improved, but the results were not very impressive. In theory, if erosion is reduced and infiltration is improved, it should follow that grass growth is better.

It is also important to note that PAM may be applied at rates which can reduce infiltration. One study indicated greatly reduced infiltration rates with PAM applications above 87 lb/acre as a solution or at 58 lb/acre as a powder applied to a wet soil surface. There is even some indication that PAM could be used to reduce infiltration in irrigation ditches and canals.

### Recent Tests in North Carolina

As part of a larger project to evaluate methods to reduce water quality impacts of large transportation projects, we established test plots on different slopes to determine PAM and mulch material effects. The study was initiated in February 2006 and finished in June 2006, during which we established 18 treatment plots in four locations on NC DOT construction projects. One location was just east of Raleigh, NC and the other three were in different locations on a project north of Charlotte, NC. Each site was

prepared by a commercial seeding contractor according to NC DOT specifications, including 4,000 lb/acre lime, 500 lb/acre fertilizer (10-20-20), and a seed mix appropriate for the location, generally fescue, Bermuda, and centipede. The exception was Site 3, where lespedeza was used as is the custom for temporary seeding in the summer.

We tested different combinations of products with or without PAM. These included straw + tackifier, excelsior matting, and a

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State of North Carolina,  
Department of Environment  
and Natural Resources  
William G. Ross, Jr. Secretary

Land Quality Section  
Division of Land Resources  
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bonded fiber matrix hydromulch, Flexterra. The PAM treatment consisted of 33 lb/acre of Applied Polymer Systems 705 powder, applied using a hydroseeder or in the mix for the hydromulches. As an indication of the quality of runoff from the plots, we installed runoff collectors on each plot (Figure 1). These were very simple in design, with barriers



Figure 1. Plots at Site 2 showing runoff collection system.

ers inserted into the soil to divert a portion of the plot runoff into pipes leading to 5 gallon buckets. We did not intend for the results to provide quantitative information about total runoff or sediment loads, but as indicators of runoff quality and erosion losses. After plot establishment, between three and six storm events were monitored at each site and the average is presented here. We also estimated vegetative cover using at least three observers, whose estimates were averaged for each plot.

### Results

The conditions varied but were typical for establishing vegetative cover on construction

projects, with periods of drought and warm temperatures creating difficult conditions for seedling growth. All four sites were cut slopes, but the seedbed materials were highly variable.

Straw and tackifier is the standard mulch system used on many construction sites. At all four sites, the turbidity from the straw plots was reduced substantially with the addition of PAM (Table 1). Runoff turbidity was generally highest in the straw plots compared to the other mulches, and the addition of PAM often brought turbidity down within the range of the best treatments. This suggests that in many cases adding PAM to a good straw cover could result in performance similar to much more expensive systems. Excelsior matting was tested for PAM response at three of the four locations and it had a less dramatic reduction in runoff turbidity, but still measurable. The two sites where wood hydromulch was tested had very different results, with a large turbidity reduction with PAM at Site 1 and a slight increase in turbidity at Site 4.

The bonded fiber matrix (BFM) hydro-mulch was only tested at one site in this study, but it had a 77% overall reduction in turbidity. It should be noted that the turbidity from this mulch treatment was much less than any other, with or without PAM.

The estimated erosion rates for the plots had patterns very similar to the turbidity responses to PAM applications (Table 2). However, in several instances the PAM effects were more dramatic due to a lower volume of water coming from the treated plots. We have not been able to document this consistently, but PAM can have the effect of increasing infiltration by maintaining soil structure during storm events.

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Cover Type	Number of Sites	Erosion Rate Reduction
Straw	4	19-79%
Excelsior	3	16-75%
Wood Hydromulch	2	-3-79%
Flexterra	1	20%

Table 1. Effects of PAM on runoff turbidity for different cover types.

Cover Type	Number of Sites	Erosion Rate Reduction
Straw	4	45-78%
Excelsior	3	25-69%
Wood Hydromulch	2	23-98%
Flexterra	1	20%

Table 2. Effects of PAM on erosion rates for different cover types.



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Send comments to Ashley Rodgers, NCDENR-Land Quality, 1612 Mail Service Center, Raleigh, NC 27699-1612. Email: Ashley.Rodgers@ncmail.net. Send change of address and subscription information to Soil Science Dept., Campus Box 7619, North Carolina State University, Raleigh, NC 27695-7619 (919) 513-1678; joni\_tanner@ncsu.edu). Fifty-five hundred copies of this newsletter were printed at a cost of \$1,448 or 26 cents per copy.

Personnel of the Land Quality Section of the NC Department of Environment and Natural Resources provide information and assistance for implementation of the NC Erosion and Sedimentation Control Program. For assistance, please contact the Regional Engineer or the Raleigh headquarters listed below:

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Swannanoa, NC 28778  
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# The North Carolina Sedimentation Control Commission

The Sedimentation Control Commission (SCC) was created to administer the Sedimentation Control Program pursuant to the NC Sedimentation Pollution Control Act of 1973 (SPCA). It is charged with adopting rules, setting standards, and providing guidance for implementation of the Act. The composition of the Commission is set by statute to encompass a broad range of perspectives and expertise in areas related to construction, industry, government, and natural resource conservation and quality. All members are appointed by the Governor and serve three-year terms, except for the Director of the Water Resources Research Institute of The University of North Carolina, who serves as long as he remains Director. The chairman of the SCC is named by the Governor. The following is a list of current members with the organizations they represent:

## Chairman:

Kyle Sonnenberg  
Fayetteville  
NC League of Municipalities

## Vice Chairman:

Donnie W. Brewer  
Greenville  
NC Environmental Management Commission

## Commissioners:

W. T. "Buzz" Bryson  
Raleigh  
NC Public Utilities

Elaine C. Chiosso  
Bynum  
Non-governmental Conservation

John William Miller, Jr.  
Burnsville  
NC Mining Commission

Joseph H. Kleiss  
Raleigh  
NC State University, Dept. of Soil Science

Grover McPherson  
Winston-Salem  
NC Soil and Water Conservation Commission

David H. Moreau  
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Water Resources Research Institute of  
The University of North Carolina

Joseph Rudek  
Raleigh  
Non-governmental Conservation

Mark A. Taylor  
Greensboro  
Professional Engineers of NC

Richard Vick  
Wilson  
Carolinas Associated General Contractors

F. Roger Watson  
Asheville  
NC Home Builders Association

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There were no obvious responses to PAM in grass growth on the plots (data not presented). We will continue to look for measurable improvements since less erosion and more infiltration should favor grass growth, but thus far we have not observed significant effects.

## Conclusions

The benefits of PAM applications in agricultural settings has been very well documented, but typical construction site settings are much more challenging and require dif-

ferent recommendations. A review of PAM application rates on slopes from 5 – 45% suggests that at least 20 lb/acre is needed for a consistent reduction in erosion rates, and that higher rates are needed on steeper slopes. Significant reductions in erosion rates and runoff volumes are usually reported. Most previous studies have been performed on bare soil, but recent results of our studies have suggested that PAM is beneficial when combined with typical mulch materials. We have found that this is true for the common ground cover types used on construction sites. The performance of straw with PAM at 33 lb/acre sometimes met or exceeded that of matting and wood fiber hydromulch. Improvements in vegetation establishment have not been as evident as reductions in erosion and runoff turbidity.

## Three Counties Approved as New Local Erosion and Sediment Control Programs

**T**HE SEDIMENTATION CONTROL Commission (SCC) met most recently on February 15, 2007, in the Ground Floor Hearing Room of the Archdale Building in Raleigh, NC. At this meeting, the Commission delegated implementation of the Sedimentation Pollution Control Act (SPCA) to three new local programs: Caldwell County, Henderson County, and Lincoln County. Local program staff will perform plan reviews and enforce compliance of plans within their jurisdictions. Each of these three programs was also awarded start-up funds of \$33,785 from the Sedimentation Control Commission. Funds will be used for a variety of needs, including salary, equipment, and vehicles.

In order to be awarded delegation, each local program must adopt a local erosion and sedimentation control ordinance, which is evaluated and found to be at least as restrictive as the model ordinance of the State and in compliance with all requirements of the Sedimentation Pollution Control Act. If you are involved in erosion and sediment control work in any of these three counties, or any other local government with delegated authority under the SCC, then you should be familiar with the approved local ordinance. While these ordinances must be at least as restrictive as the state requirements, they may be more restrictive.

To reach any of the new local programs, please contact the appropriate person below:

**Caldwell County** (estimated to begin October 1, 2007)  
Bill Duquette, P.E.  
County Environmental Engineer  
1051 Harper Avenue SW  
Lenoir, NC 28645  
Phone: (828) 757-6860  
Fax: (828) 757-6864  
billd@caldwellcountync.org

**Henderson County** (estimated to begin October 1, 2007)  
Samuel Laughter, CZO  
Director of Building Services  
101 East Allen Street  
Hendersonville, NC 28792  
Phone: (828) 697-4525  
Fax: (828) 698-6185  
saml@hendersoncountync.org

**Lincoln County** (estimated to begin May 1, 2007)  
Rick McSwain  
Natural Resources Conservationist  
115 West Main Street  
Lincolnton, NC 28092  
Phone: (704) 736-8501  
Fax: (704) 736-8504  
rmcswain@lincolncounty.org

Current contact information for other delegated local programs may be found at the link below. Also available at that location is the most recent Model Ordinance approved by the SCC, as well as information about the procedure for starting your own local program. <http://dlr.enr.state.nc.us/pages/sedimentlocalprograms.html>

# Sediment and Erosion Control Workshop in Western North Carolina

Sarah Carter  
Americorps  
North Carolina Arboretum

**N**ORTH CAROLINA STATE University (NCSU) Water Quality Group in coordination with the NCSU Soil and Water Environmental Technology Center held a “Sediment and Erosion Control Workshop for Contractors” on February 20, 2007, at the North Carolina Arboretum in Asheville. Funding for this workshop was provided by the U.S. Environmental Protection Agency Clean Water Act Section 319 program. The workshop was tailored to address the specific issues contractors face concerning sediment and erosion in the mountains. Seventy-six attendees, mostly contractors, surveyors, professional engineers, and landscapers, learned the basics of how to appropriately control onsite erosion.

As the lead instructor, Dr. Richard McLaughlin compared the uses and effectiveness of a wide range of erosion control technologies, ranging from different types of ground cover to the use of polyacrylamide (PAM) in silt bags. He also highlighted changes to the Erosion and Sediment Control Manual, and what that means for contractors. In addition to Dr. McLaughlin, Jason Zink and Steve Foster from NCSU

Water Quality Group spoke about how land use changes affect water quality and why sediment and erosion control is important. Representing NC Department of Environment and Natural Resources (NC DENR), Laurie Moorhead expounded upon the role of the regulator and the regulator’s perspective.

In the afternoon, many of the technologies covered in the lectures were demonstrated at a construction site on the NC Arboretum’s campus. Silt bags, live staking, reinforced matting, and a level spreader were installed and pumped with muddy water so that attendees could see these technologies in action. More information on this workshop can be found at the following website:

[http://www.bae.ncsu.edu/programs/extension/wqg/frenchbroad/sediment\\_workshop.html](http://www.bae.ncsu.edu/programs/extension/wqg/frenchbroad/sediment_workshop.html)



Dr. Rich McLaughlin demonstrates various sediment and erosion techniques.



Alan Johnson demonstrates live staking techniques.

## International Certified Erosion, Sediment and Storm Water Inspector Certification Program (CESSWI)

David Ward, Executive Director  
CPESC, Inc.

**T**HE CERTIFIED PROFESSIONALS in Erosion and Sediment Control (CPESC), Inc. is excited to announce the development of its Certified Erosion, Sediment and Storm Water Inspector Certification Program (CESSWI). This new program will be available to all qualified technicians and inspectors who wish to demonstrate their proficiencies in construction and post construction inspection skills and abilities. This new designation for certified specialists was created by CPESC, Inc., in conjunction with a national oversight committee of erosion and sediment control and storm water management professionals.

This unique program will make it possible for both the regulators and the regulated community to employ qualified inspection

staff to observe and report the adequacy of erosion and sediment controls and storm water management for construction, industrial and municipal operations. Persons with the CESSWI certification will be recognized throughout the United States and Canada as candidates who have demonstrated the minimum proficiencies needed to inspect construction and post construction Best Management Practices. Specific state requirements may be added to the certification process.

To apply, a candidate must provide information on education and applicable work experience. Applicants will be reviewed by a qualifications committee and notified of their eligibility to sit for an examination. An Inspector Study Course will be available for

those who want to sharpen their skills prior to the exam.

### For more information contact:

David Ward  
[www.cpesc.org](http://www.cpesc.org)  
[david@cpesc.org](mailto:david@cpesc.org)  
(828) 655-1600

### For more information on Sediment and Erosion Control, please visit:

NC Dept. of Environment and Natural Resources - Land Quality Section  
[www.dlr.enr.state.nc.us/pages/landqualitysection.html](http://www.dlr.enr.state.nc.us/pages/landqualitysection.html)

International Erosion Control Association  
[www.ieca.org](http://www.ieca.org)

# University Viewpoint

## Low Impact Development, Part II

Dwane Jones  
NC Cooperative Extension

**I**N PART I OF OUR SERIES ON LOW Impact Development (LID), we introduced the concepts and tenets of the practice and contrasted it with conventional development. We also broached the subject of incorporating LID into local ordinances and state codes.

A few years ago, I participated in the first national Low Impact Development Conference in Maryland. The conference was hosted by Prince George's County, Maryland and other progressive LID advocates. Having worked in a local government setting for a number of years, I must say that I had reservations with regard to developers and their desire to design and construct sites using environmentally-friendly practices. I always had in mind that most developers had little or no desire to use low impact development. However, by participating in the LID conference in Maryland, I had my first opportunity to hear the developers' perspective on the issue.

One developer, as a presenter at the conference, noted that developers focus on three major concepts when planning a development – time, value, and money. These three concepts are critical to the success of the project. He said that he desired to use low impact development. However, under the active regulations at that time, it took him about a year to gain approval for the LID-based plan in contrast to the conventional type, which would have taken about 30 days for approval. So, let's see. If time, value, and money were the founding principles of your project, and it took 11 times the amount of time to gain approval for a low impact development than a conventional development for the same project, which approach would you choose? Does this not cause us to question the various perspectives on environmental projects, particularly those pertaining to low impact development?

I have conducted preliminary research on this topic:

### Designer's Perspective

- Minimize Risks
- Satisfy Clients
- Utilize accepted practices
- Gain respect from governing authority

### Developer's Perspective

- Minimize risks
- Maximize profit
- Minimize time (permitting, etc.)
- Maximize value
- Minimize issues of "surprise"
- Satisfy clients/customers

### Local Government's Perspective

- Minimize risks
- Minimize short and long-range expenses
- Enforce environmental regulations
- Performance of integrated management practices
- Protection of landowners

There are various perspectives and several parties involved in the design, construction, and implementation phases of a given project. How can we mesh the various perspectives into a low impact development program? What groups should participate in a process that focuses on these perspectives? What could be the end result of a forum on perspectives? Perhaps the end result will be a statewide catalyst for low impact development. We will discuss this in more detail in a later article.

Returning to the developer at the LID conference in Maryland, his year-long wait for project approval was essentially caused by antiquated ordinances – ordinances that inhibited and discouraged low impact development.

NCSU and Cooperative Extension are currently working on some initiatives to address antiquated ordinances. Some projects in the works include a North Carolina LID Design Manual (contact Laura Spzir at [laura\\_spzir@ncsu.edu](mailto:laura_spzir@ncsu.edu) for information on this subject), an alternative LID ordinance, amending local ordinances to encourage LID, and a developers forum.

To schedule a low impact development training seminar or receive more information on the subject matter contained in this article, please contact Dwane Jones at 252.747.5831 or [dwane\\_jones@ncsu.edu](mailto:dwane_jones@ncsu.edu).

# Resources for Plan Design

**T**HE LAND QUALITY SECTION has worked to create new tools to assist planners and designers in the design of several measures found on erosion and sedimentation control plans submitted throughout the state. These have been created to reflect new guidelines from the Planning and Design Manual.

Tools for the design of various sediment control measures (including basins and traps), plunge pools, rational method (using kinematic wave theory), and open channel design may be found under "Design Calculation Spreadsheets" at: <http://dlr.enr.state.nc.us/pages/links.htm>

Further information regarding stream classification, precipitation data, and links to other downloadable tools, including the Natural Resources Conservation Service (NRCS) Revised Universal Soil Loss Equation, version 2, may also be found at the abovementioned page under "Engineering Design Downloads."

In addition, Erosion and Sedimentation Control Training Packets for Inspectors, Planners, and Designers may also be ordered through the Raleigh Central Office. These packets contain a variety of information which can be used as quick references, although material in them is for informational purposes and is not intended to be a substitute for the current law, rules, and guidelines. Custom packets may also be ordered for specific information. Order forms for these materials may be found under "Educational Materials" at: <http://dlr.enr.state.nc.us/pages/publications.html>

Current information about training opportunities which will also assist you with plan design may be found at: <http://dlr.enr.state.nc.us/pages/events.html>

We strive to provide you with the most accurate and up-to-date tools and information to assist in the design of erosion and sedimentation control plans. Please let us know if you have any suggestions or note any problems. You may send comments to [Ashley.Rodgers@ncmail.net](mailto:Ashley.Rodgers@ncmail.net).



Newsletter of the North Carolina  
Sedimentation Control Commission  
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Raleigh, NC 27695-7619

Nonprofit Org  
US Postage  
PAID  
Raleigh, NC  
Permit No. 2353

## Calendar of Events

5/10/07	<b>Retrofitting and Monitoring Innovative Stormwater Practices</b> Charlotte, NC <a href="http://www.soil.ncsu.edu/swetc/stormtour/tour07.htm">http://www.soil.ncsu.edu/swetc/stormtour/tour07.htm</a>		<b>Stormwater Treatment Practice Inspection &amp; Maintenance Taxonomy and Certification</b> 7/17-18/07 Durham, NC 7/24-25/07 Charlotte, NC 9/17-18/07 Asheville, NC <a href="http://www.bae.ncsu.edu/workshops/2007certification/index.html">http://www.bae.ncsu.edu/workshops/2007certification/index.html</a>
5/15/07	<b>Sediment and Erosion Control Workshop</b> Raleigh, NC <a href="http://www.soil.ncsu.edu/swetc/sediment2/2007/main2.htm">www.soil.ncsu.edu/swetc/sediment2/2007/main2.htm</a>		<b>Erosion &amp; Sediment Control Workshop</b> Wake Forest, NC <a href="http://www.wakeforestnc.gov/residents/engineering_erosionandsedimentcontrol.aspx">http://www.wakeforestnc.gov/residents/engineering_erosionandsedimentcontrol.aspx</a>
	<b>Level II: Erosion &amp; Sediment Control/ Stormwater Certification for NC DOT Projects</b>		
6/13/07	Hickory, NC		
6/20/07	Raleigh, NC <a href="http://www.bae.ncsu.edu/workshops/dot/leveliioverview.html">www.bae.ncsu.edu/workshops/dot/leveliioverview.html</a>		