Obstacles to Stormwater Volume Management in North Carolina

Report prepared for
the Nicholas Institute for Environmental Policy Solutions

Terry Sanford Institute of Public Policy
Duke University

By: Sarah Cassanego, Anton Favorini-Csorba,
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May 1, 2009

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May 1, 2009

Dear Mr. Holman,

Enclosed please find our final report on stormwater volume management in North Carolina. We would like to thank Professor Jim Johnson, Boyd DeVane, Rex Bost, Nick Tennyson, David Brown, and Bill Hunt, who aided us with resources, contacts, and insights into stormwater management in North Carolina. Thank you for the opportunity to work with the Nicholas Institute for Environmental Policy Solutions on this project.

Sincerely,

Sarah Cassanego

Anthony Oddo

Anton Favorini-Csorba

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EXECUTIVE SUMMARY[1]

Policy Question

Why are stormwater runoff reduction practices underutilized in North Carolina?

Recommendations (page 18)

To address the underutilization of stormwater runoff reduction practices in North Carolina, we recommend five policy options.

In the short term:

(1) Amend the Best Management Practices (BMP) Manual to include all existing stormwater runoff reduction technologies and to streamline the permitting process for new designs;

(2) Conduct a needs assessment of runoff reduction education opportunities;

(3) Establish focus groups and conduct a survey of developers to guide stormwater policy.

In the long term:

(4) Incorporate solutions for stormwater capture and reuse into building regulations;

(5) Investigate potential policies to provide incentives for stormwater runoff reduction.

Problem Statement (page 1)

The current North Carolina BMP Manual focuses on water quality concerns and generally does not address issues of stormwater volume. It includes few runoff reduction options and fails to specify the level of reduction achieved by those included. The BMP Manual also discourages developers from employing innovative stormwater management techniques by introducing a delay into the permitting

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[1] *This student paper was prepared in 2009 in partial completion of the requirements for PPS 304, a course in the Masters of Public Policy Program at the Terry Sanford Institute of Public Policy at Duke University. The research, analysis, and policy alternatives and recommendations contained in this paper are the work of the student team who authored the document, and do not represent the official or unofficial views of the Terry Sanford Institute of Public Policy or of Duke University. Without the specific permission of its authors, this paper may not be used or cited for any purpose other than to inform the client organization about the subject matter. The authors relied in many instances on data provided to them by the client and related organizations and make no independent representations as to the accuracy of the data.*

process. Additionally, building regulations at the state and local levels in North Carolina conflict with regard to incorporating reuse technologies, creating a barrier to capturing and reusing stormwater in buildings.

There are many misconceptions among the development and regulatory communities about the costs of and maintenance difficulties associated with stormwater runoff reduction technologies. Many developers do not recognize the potential benefits and cost-savings of runoff reduction, despite available educational information on the subject. Public agencies also have yet to realize the potential savings in water treatment costs from decreasing runoff. In addition, North Carolina lacks incentives to encourage volume reduction, despite many incentive programs for other green technologies.

Criteria and Alternatives (page 7)

We use the following criteria to analyze each alternative:

1. Reduce the volume of stormwater runoff coming from North Carolina's developed areas.
2. Encourage stormwater capture and reuse in all types of real estate development.
3. Minimize the costs of implementation, including financial, opportunity, and political costs.
4. Maximize stakeholder acceptability.

The five policy alternatives we evaluate are:

1. Amend the Best Management Practices (BMP) Manual to include all existing stormwater runoff reduction technologies and to streamline the permitting process for new designs.
2. Incorporate solutions for stormwater capture and reuse into building regulations.
3. Investigate potential policies to provide incentives for stormwater runoff reduction.
4. Conduct a needs assessment of runoff reduction education opportunities
5. Establish focus groups and conduct a survey of developers to guide stormwater policy.

Table of Contents

Policy Question

Why are stormwater runoff reduction practices underutilized in North Carolina?[2]

Problem Statement

Background

Our policy question is important at the most basic level because of the numerous ways in which development alters natural hydrological systems for rainwater storage. Stormwater runoff from developed sites results in both water quality and water volume problems, which lead to erosion, flooding, sedimentation, and pollution. The regulatory and technological approach to stormwater management in the United States over the past three decades has been primarily focused on addressing water quality, with little attention paid to either problems caused by volume or the potential to use stormwater as a resource to meet growing demand for water.

The issue of stormwater management in the United States and in North Carolina is a highly political one. The United States Environmental Protection Agency (EPA) and state governments are trying to get developers and local governments to do a better job in stormwater retention. Overall, the state of North Carolina is not currently approaching stormwater as a resource, in spite of the potential for future water scarcity in the region. There is little federal or state funding, so most of the burden of funding and regulation is on local governments. At the local level, there are permitting and financial barriers to better water management. In addition, the local response to stormwater management is not coordinated or unified; each city has its own policies and practices.

Many of these regulatory, technical, political, and financial barriers to better stormwater management apply to both quality and volume issues. In this report, we have chosen to focus on challenges that are specific to stormwater volume management. These include the inflexibility of the State's Best Management Practices (BMP) Manual, the divergent building regulations regarding capture and reuse, the misconceptions among developers and regulators regarding the potential benefits of runoff reduction, and the lack of market incentives for developers and property owners to implement runoff reduction practices.

Given the political nature of stormwater issues, there are numerous stakeholders interested in stormwater volume management problems and potential solutions. In our report we focus on the following stakeholders, which we encountered frequently in our research and interviews:

[2] "Stormwater runoff" in this report refers to runoff from urban, suburban, and commercial areas. It does not include agricultural runoff.

- *Developers/development community* – When referred to in this report, "developers" and "the development community" include not only residential and commercial developers, but also engineers, land planners, irrigation contractors, and others involved with designing and implementing real estate development;
- *State and local agencies* – North Carolina Department of Environment and Natural Resources (NCDENR), the North Carolina Division of Water Quality (DWQ), municipalities, local Departments of Public Works, and others;
- *Residential and commercial property owners* (e.g. Wal-Mart);
- *State legislators and City Council members*.

Other stakeholders that we encountered less frequently in our research and interviews are not directly addressed in this report. It is important, however, for the Nicholas Institute to consider these stakeholders in future research and policy efforts. These include:

- *Governor of North Carolina;*
- *North Carolina Retail Merchants Association;*
- *U.S. Army Corps of Engineers;*
- *Government entities that are also landowners & builders, such as school districts and community colleges*;
- *Environmental advocacy, law, and research organizations* (e.g. Southern Environmental Law Center, Clean Water Education Partnership, North Carolina State University);
- *Councils of Local Governments* (e.g. Triangle J Council of Governments).

Inflexible BMP Manual

The current North Carolina Best Management Practices (BMP) Manual is inflexible, unspecific, and does not include many runoff reduction technologies. The Manual thus hinders implementation of those technologies and reduces the potential mitigation effect they could have on stormwater volume. Developers are de facto limited to implementing stormwater control measures that are enumerated in the BMP Manual. Stormwater control methods outside of those listed in the BMP Manual are accepted only after the design professional in charge of the project (engineer, architect, etc.) demonstrates that a new method matches or exceeds the protection afforded by existing BMPs.[3] The technical justification offered by the design professional must be reviewed by the regulating authority, and this review inevitably delays the overall permitting process. In a time-sensitive industry like construction, that delay effectively penalizes developers for attempting to improve on current stormwater management practices by devising less expensive and more effective treatments.

[3] North Carolina Division of Water Quality, *Stormwater Best Management Practices Manual*: Revised December 2007, § 1.4, available at http://h2o.ehnr.state.nc.us/su/documents/BMPManual_WholeDocument_CoverRevisedDec2007.pdf (accessed April 20, 2009).

The disincentive to innovate created by the BMP Manual is particularly problematic because the requirements that the Manual is designed to meet are focused on water quality, without regard for the problem posed by large volumes of uncontaminated water. In order to receive a stormwater permit, a project must present plans that remove 85% of the Total Suspended Solids (TSS) flowing from the site.[4] The only requirements concerning volume relate to the ability of a site to treat and contain the rainfall from a one-year storm event (storms that deposit 1" of rainfall over 24 hours).[5] North Carolina does in fact rank BMPs according to "Peak Runoff Reduction" and "Runoff Volume Reduction," but this ranking system only includes the values "Yes," "No," and "Possible." Without commensurable percentages of runoff mitigated, even a developer who is concerned with reducing stormwater volume is hard pressed to determine the most effective suite of technologies for achieving that goal. Many effective volume reduction or runoff reduction technologies are thus overlooked when developers select from the menu of BMP practices to meet regulatory requirements.

Furthermore, there is no mention of "reuse" in the entire Manual. The BMP Manual is intended to aid developers in implementing stormwater management practices by listing the approved practices, and if reuse is not listed as an appropriate management technique, it is unlikely that reuse will register as an acceptable practice in the minds of developers.

The current method of giving credit for volume reduction technologies also lessens the likelihood that a developer will employ those practices. Currently, the permitting authorities give credit for these technologies by reducing the amount of impervious surface from which developers must treat runoff. However, this does not move developers any closer towards meeting TSS reduction requirements, despite the fact that these technologies do reduce TSS. As a matter of practice, developers are less likely to use technologies that do not directly meet the legal requirements.

Permeable pavement provides an illustrative example of the problems with the current BMP Manual. The table below captures the costs and benefits of permeable pavement according to the BMP Manual (each BMP listed in the Manual is summarized in this manner).

[4] *Total Suspended Solids* is a broad measure of the contaminants suspended in water. TSS may include organic and inorganic materials such as pollutants, waste, silt, and decaying organic matter.
[5] North Carolina General Assembly, Raleigh, NC, Session Law 2006-246, Senate Bill 1566, § 9.c.2 *done* 16 August 2006, available at http://h2o.ehnr.state.nc.us/su/documents/SL2006-246.pdf (accessed April 19, 2009).

Permeable Pavement, as described by the NC BMP Manual[6]

Regulatory Credits		Feasibility Considerations	
Pollutant Removal			
0%	Total Suspended Solids	NA	Land Requirement
0%	Total Nitrogen	Med-High	Cost of Construction
0%	Total Phosphorus	High	Maintenance Burden
Water Quantity		NA	Treatable Basin Size
possible	Peak Attenuation*	High	Possible Site Constraints
possible	Volume Capture*	High	Community Acceptance

The table implies that permeable pavement achieves no pollutant reduction and is difficult to construct and maintain. Therefore, it is not surprising that permeable pavement is uncommon in North Carolina. However, the Maryland-based Center for Watershed Protection states that permeable pavement reduces runoff by 45-75% and removes 25% of total phosphorus and total nitrogen. [7] By this standard, the NC BMP Manual is at best non-specific and at worst inaccurate.

Divergent Building Regulations Concerning Stormwater

Capturing stormwater and using it for landscape irrigation and waste removal is a reasonable and realistic method for reducing the demand for potable water in North Carolina. The option has, until recently, not been given much consideration across the country. However, water conservation and reuse have become critical issues for North Carolina due to increased demand associated with the growing population and more severe droughts as a result of climatic changes.

In the United States, outdoor water use is, on average, approximately 30% of total residential potable water use.[8] The greatest demand for outdoor water use occurs during the hottest, driest months of summer, adding significantly to municipal peak water use periods. Moreover, water scarcity is an increasingly large concern for North Carolina as the state grows rapidly and as communities anticipate future growth. The symptoms of scarcity, including increased competition and lawsuits, water rationing, empty reservoirs, and diminished stream flows, can no longer be thought of as problems that only affect the western United States.[9] For example, in

[6] North Carolina Division of Water Quality, *Stormwater Best Management Practices Manual*: Revised December 2007, § 1.4, available at http://h2o.ehnr.state.nc.us/su/documents/BMPManual_WholeDocument_CoverRevisedDec2007.pdf (accessed April 20, 2009).
[7] Center for Watershed Protection, *Technical Memorandum: The Runoff Reduction Method*, p. 11, available at http://www.cwp.org/Resource_Library/Center_Docs/SW/RRTechMemo.pdf (accessed April 17, 2009).
[8] Amy Vickers. 2001. *Handbook of Water Use and Conservation*. WaterPlow Press, Amy Vickers & Associates, Inc.
[9] Tammy Shaw, *Sharing Water in Alabama, Georgia and Florida: An Update on the Tri-State Water Wars*, Mississippi-Alabama Sea Grant Legal Program, available at http://www.olemiss.edu/orgs/SGLC/MS-AL/Water%20Log/21.2waterwar.htm (accessed April 20, 2009).

2007, 2.2 million North Carolina residents were notified of voluntary conservation measures, and 600,000 were notified of mandatory conservation measures.[10] The use of such conservation measures in North Carolina indicates the extent to which water scarcity is already affecting the state.

Current and projected figures for total water use in North Carolina suggest that there are currently no statewide plans to increase water use efficiency in and out of the home.[11] If current water use per capita levels stay constant as the state population grows, demand for water will inevitably increase. Yet in the face of this probable increase in demand, proposed techniques to reduce water demand have been met with resistance. For example, the reuse of stormwater for irrigation purposes has been and continues to be a controversial topic.

Landscape irrigation and waste removal do not require potable water, and thus they are ideal candidates for stormwater reuse. Under NC building codes, however, captured rainwater is of suitable quality to be used for irrigation and toilet flushing only if the rainwater falls on relatively clean, impermeable areas or other landscaped areas.[12] Nutrients and other pollutants mix with stormwater runoff, which has led state officials to declare that all stormwater runoff is unfit for reuse.[13]

In addition, present building codes in North Carolina are neither consistent nor well integrated with respect to the application of policies and procedures for reusing stormwater for irrigation and waste removal.[14] The lack of standards and general guidance from the state are key obstacles to implementing stormwater reuse practices of irrigation and waste removal across the state.

Stakeholder Misconceptions

Runoff reduction technologies are also underutilized in North Carolina because members of the development and regulatory communities have several misconceptions about them, in spite of the educational efforts already being implemented on the subject of stormwater. Interviews with real estate developers

[10] Eben Polk *et al.*, "The Future of Water in North Carolina: Strategies for Sustaining Clean and Abundant Water" (Report accompanying *The Future of Water* Conference, Raleigh, NC, March 1, 2007).

[11] In 2000, North Carolina's per capita daily urban water use, according to the United States Geological Survey (USGS), was 177 gallons per day. Unofficial estimates for 2005 provided by the North Carolina Rural Economic Development Center (NCREDC) and the USGS indicate per capita daily urban water use of approximately 166 gallons. If North Carolina's population grows, as projected, to 12.2 million residents by 2030, and NCREDC projections for total water use are accurate, the per capita daily water use in 2030 would be 163 gallons, essentially no more efficient than today's water use

[12] Eben Polk *et al.*, *op. cit.*

[13] Mandy Locke and Anne Blythe, "State Says Use of 'Gray Water' OK," RALEIGH NEWS & OBSERVER, March 12, 2008.

[14] Nick Tennyson, Personal Interview with Authors, February 13, 2009.

Nick Tennyson[15] and Rex Bost,[16] and NC DWQ Stormwater Engineer Boyd DeVane, revealed a consensus that the needed technology is available but is not being used due to misconceptions about cost and maintenance, combined with a general lack of knowledge about stormwater volume problems.

Environmental regulations are well-known land-cost accelerators for developers.[17] Water quality requirements over the past twenty years have required developers and property owners to spend more money and devote more land to water quality improvement practices. Practices allowing the capture of stormwater, not to mention its reuse, are much newer. As a result, developers and property owners fear that these practices will result in even greater costs.

Yet there is evidence that runoff reduction practices have cost-saving potential, which many developers do not recognize.[18] For example, Watershed Education for Communities and Officials (WECO) reports that "replacing curb, gutter and storm sewers with roadside swales saved one developer $70,000 per mile, or $800 per residence."[19] Other noted benefits include increased number of buildable lots (due to a reduced need for stormwater retention ponds), increased property values, and initial savings from fewer infrastructure requirements, less paving, and lower site preparation costs.[20] Our interviewees also suggested that there is a common fear of high maintenance costs, but argued that these newer technologies require less maintenance and are less likely to fail than traditional technologies such as bioretention ponds. Government agencies also may not fully understand that residential and commercial capture and reuse of stormwater could reduce government water purification costs and help postpone or slow down the need for new water sources in response to increased water demand.[21]

In addition to misconceptions about costs and maintenance is a general lack of knowledge among developers, regulators, and property owners about runoff reduction practices, and more generally about the reasons stormwater volume is a problem.[22] This is combined with skepticism about change, given the constantly shifting regulatory landscape and the aforementioned uncertainties. This lack of knowledge exists in spite of number of stormwater education efforts by a variety of

[15] Tennyson is President of the Home Builders Association of Durham, Orange, and Chatham Counties (HBA-DOC).
[16] Rex Bost is President of Bost Custom Homes.
[17] Nick Tennyson, Personal Interview with Authors, February 13, 2009.
[18] Rex Bost, Personal Interview with Authors, February 27, 2009.
[19] North Carolina State University Cooperative Extension, "Low Impact Development – An Economic Fact Sheet," NC Cooperative Extension – Watershed Education for Communities and Officials, available at http://www.ces.ncsu.edu/depts/agecon/WECO/transylvania/WECO_LID_econ_factsheet.pdf (accessed April 19, 2009).
[20] *Ibid.*
[21] Rex Bost, Personal Interview with Authors, February 27, 2009.
[22] This is at least the perception of those we interviewed. While Bost, Tennyson, and DeVane are all very familiar with these issues, they reported a perception that others in their communities are not well-informed. Our recommendations for the Nicholas Institute, on p. 16 of this report, include methods for further researching and confirming the veracity of this perception.

organizations. One problem may be that these education efforts, like most stormwater regulation and control efforts, focus heavily on water quality. Many education efforts also target the general public, rather than development or regulatory professionals. Those organizations that do educate about volume control or target professionals like the North Carolina Low Impact Development (LID) Center, still may not focus enough on delineating the difference between quality and volume.

Lack of Incentives

No statewide incentive structure exists in North Carolina to encourage developers to embrace volume reduction technologies. Rex Bost is one of the more environmentally progressive developers in North Carolina and regularly installs volume reduction technologies in luxury homes. He asserts that most developers need an incentive structure to start adding these technologies. Mr. Bost serves wealthy clients who demand and can easily afford green improvements, but the majority of clients will not provide developers such incentives or encouragement. "With all the green incentives right now, why aren't there incentives for stormwater conservation?" Mr. Bost asked. Downtown Durham, Inc. also "believes it would be advantageous to create incentives, not disincentives, for [...] green building design/construction in the downtown and the compact neighborhoods."

Since the BMP Manual does not require any reduction technologies, developers that do implement them feel that they are at a cost-disadvantage compared to those who do not. Even if there are no added costs to the new technologies, Bost and Tennyson suggest that developers are likely to resist change.

Criteria

1. Reduce the volume of stormwater runoff coming from North Carolina's developed areas.
2. Encourage stormwater capture and reuse in all types of real estate development.
3. Minimize the costs of implementation, including financial, opportunity, and political costs.
4. Maximize stakeholder acceptability.
   We consider a number of stakeholders, as identified in the background section of the problem statement (page 1). Acceptability, including financial and political acceptability, may have a different meaning for each stakeholder. In analyzing our alternatives against this criterion, we try to consider these different meanings for all stakeholders.

Alternatives

1. Amend the Best Management Practices (BMP) Manual to include all existing stormwater runoff reduction technologies and to streamline the permitting process for new designs.
2. Incorporate solutions for stormwater capture and reuse into building regulations.
3. Investigate potential incentive programs for reducing runoff.
4. Conduct a needs assessment of runoff reduction education opportunities.
5. Establish focus groups and conduct a survey of developers to guide stormwater policy.

Decision Matrix

The following matrix summarizes our analysis, in which we weigh each alternative against each criterion. Alternatives are given a score from 1 to 5 based on how well they meet a criterion (1 indicates that an alternative meets a criterion to a low degree, 5 a high degree). The detailed analysis of each alternative begins on page 9 of the report.

	Reduces Runoff	Capture and Reuse	Implementation	Acceptability	**Total**
Amend BMP Manual	4	4	4	5	**17**
Amend Regulations	3	4	3	4	**14**
Investigate Incentives	2	3	2	3	**10**
Education Needs Assessment	2	3	5	5	**15**
Developer Focus Group	1	1	5	5	**12**

Alternatives and Analysis

Alternative 1: Amend the Best Management Practices (BMP) Manual

Any non-proprietary stormwater runoff reduction technologies that are not included in the BMP Manual, such as vertical storage tanks, could be added. All technologies included in the Manual could be ranked according to the percentage of runoff reduction that each provides. The method of accounting for TSS removed could also be altered to incentivize the use of runoff reduction technologies. Although this is an issue for further research, credit could be given for TSS mitigation via volume reduction as opposed to a reduction in impervious surface as is currently done.

Analysis

Providing clear information on the runoff reduction potential of all technologies in the BMP Manual will immediately reduce the amount of urban stormwater runoff by facilitating the use of those practices by developers (Criterion 1). Providing developers with standardized information on the runoff reduction potential allows developers to compare technologies on how much runoff they mitigate, which they are currently unable to do. Moreover, including all non-proprietary runoff reduction technologies in the manual eliminates the need to apply for permits for those practices, avoiding the costly delays to developers that stem from the permitting. Without that delay, developers are much more likely to implement runoff reduction practices. Both of these changes to the BMP Manual would also encourage the reuse and conservation of urban stormwater runoff by making it easier for developers to implement the technologies that capture stormwater (Criterion 2).

Amending the BMP manual faces minimal costs of implementation (Criterion 3). It is simple to pursue and is unlikely to face opposition within public agencies. Amending the BMP manual is a matter of making changes within the Division of Water Quality (DWQ), a relatively simple bureaucratic operation according to Boyd DuVane (Stormwater Engineer with DWQ) and Bill Hunt (Urban Stormwater Management specialist at NC State).[23] The chief obstacle to amending the BMP from within the DWQ is the lack of knowledge about the consequences of volume on the part of DWQ staff members. Stormwater volume as a problem distinct from stormwater quality has only recently emerged as an issue. The National Research Council of the National Academies only just released a report in 2008 that was designed to draw the attention of the EPA to the damages caused by stormwater volume. Some DWQ staff who have not yet recognized volume as a concern may not see the point of the BMP changes.[24]

[23] Boyd DeVane, E-mail Message to Authors, February 11, 2009.

[24] It should be noted that Amy Pickle, Senior Attorney for State Policy at the Nicholas Institute for Environmental Policy Solutions, offered a differing opinion on the ease of implementing changes to the BMP manual. Follow-up calls to Ken Pickle and Bradley Bennett in the DWQ Stormwater

The process of updating the manual is time consuming. Rainwater harvesting was added to the manual in December; that process took one and a half years.[25] However, this process moves more quickly in North Carolina than it does in other states, and should be less time intensive than amending regulations or investigating and implementing incentive programs.

Updating the BMP Manual will be politically acceptable to business associations, developers, and property owners (Criterion 4). Changing the Manual will not add any additional legal requirements that developers might protest; it will merely provide building professionals with more information about better ways of managing stormwater. Moreover, because changing the BMP Manual does not involve altering laws, the legislature is not involved and therefore has little impact on the process, effectively removing one of the channels through which groups opposed to changes in stormwater regulation might act.

Changes to the Manual are a first step in introducing considerations of runoff volume reduction into stormwater management programs. Pennsylvania's BMP Manual already considers volume**,** and the Maryland-based Center for Watershed Protection has developed a "Runoff Reduction Method" that the organization is attempting to include in the Virginia BMP Manual. [26] The Runoff Reduction Method shifts the target of BMPs to reducing runoff volume (or Treatment Volume) from reducing Total Suspended Solids as is currently the case in the vast majority of stormwater regulations, including in North Carolina.

The underlying law determines the requirements that have to be met in a site's stormwater management plan. The legal requirements for development plans to receive a permit are laid out in Environmental Management Commission Rule *T15A: 02H .1000* and follow directly from EPA guidelines.[27] In order to *mandate* volume reduction, it would be necessary to change the text of North Carolina laws to include those considerations, which would be a more politically challenging and costly process.

NCDENR is currently developing a Low Impact Development (LID) Manual, due summer 2009, which will serve as a complement to the BMP Manual by aiding developers in implementation of LID. The LID Manual may include many of the runoff reduction technologies that are not listed in the BMP Manual, potentially obviating the need to add those practices to the BMP Manual. However, including specific percentages on runoff reduction potential for the practices in the BMP

Permitting Unit were unanswered, so no definitive conclusion could be reached. However, given the authority of DeVane and Hunt within the stormwater community, their statements should be regarded as accurate.

[25] Bill Hunt, Personal Interview with Authors, April 6, 2009.

[26] Pennsylvania Department of Environmental Protection, "Stormwater Best Management Practices Manual," Blair County Conservation District, available at http://www.blairconservationdistrict.org/SWBMP.htm#pa%20manual (accessed April 21, 2009).

[27] Rule T15a:02H.1000 is authorized by NC Statute *G.S. 143-214.1; 143-214.7; 143-215.3(a)(1)*.

Manual will still be necessary, as will amending the stormwater quality accounting practices as described above. Furthermore, LID will not be required: the Manual is intended as a resource, without the force of law.[28]

Alternative 2: Incorporate solutions for stormwater capture and reuse into building regulations

The state could encourage the use of techniques that capture and reuse stormwater through a standardization of state building codes and regulations. The state government could provide assistance to local governments to develop and implement feasible solutions for reducing potable water withdrawals from local water sources while developing alternative sources of water for use in irrigation, waste removal, and heating and cooling systems.

First, the state could ensure adequate funding and support through legislation and direct grants for municipalities that add dual-delivery (potable and non-potable) systems when expanding utilities to new areas of development. Next, the state could identify the regulatory and legal barriers, and inconsistencies, at state and local levels to adoption of capture-and-reuse systems.

The state could target water harvesting and reuse systems strategically for applications where non-potable water can be a substitute and substantially reduce demand for potable water. Finally, through new state regulations and directives for localities, the state could incorporate general language that does not restrict innovative or newly acquired technologies. Although the state may restrict those capture-and-reuse systems that do not meet established requirements for human health and safety, the use of general language could be utilized so as not to inhibit the implementation and installation of new and innovative technologies.

Analysis

This alternative will have an immediate impact on the amount of stormwater runoff in North Carolina because it provides for the establishment of building codes and regulations that allow for the use of rainwater harvesting and storage systems (Criterion 1). An irrigation system that is combined with a rain harvest system provides a source of irrigation water for all but the longest dry periods in the state, and effectively reduces the amount of stormwater that flows offsite. Capturing stormwater during a storm and holding it on site to be used later for irrigation has many advantages. In North Carolina, enough stormwater can be captured to significantly reduce or eliminate the need for potable water use in landscapes and other places where irrigation is needed.

[28] Bill Hunt, Personal Interview with Authors, April 6, 2009.

In addition, this alternative provides both options and guidance for developers and homeowners who wish to utilize stormwater for waste removal and heating and cooling systems. By establishing a clear directive to local municipalities, the state will demonstrate its support for stormwater capture and reuse, and lead the way towards innovative techniques and technologies.

Alternative two encourages reuse and conservation of stormwater because the storage systems are usually integrated into existing building projects and require relatively little upkeep following installation (Criterion 2). Most importantly, Mitchell, Mein and McMahon evaluated the integrated reuse of stormwater and treated wastewater in Colorado and found that consumption decreased by half with the installation of an integrated stormwater reuse system.[29] In addition, Courtney modeled the operating policy of the University of Colorado's automatic irrigation systems and used the simulation model to estimate the amount of stormwater runoff that could be used for irrigation.[30] The campus is comprised of approximately 60% impervious surfaces, yet the author found that over 80% of the runoff was suitable for irrigation use across the entire campus.

A third study was conducted in Atlanta, Georgia, which developed a model for an individual residential property utilizing harvested rainwater for landscape irrigation. [31] The authors described a method for evaluating the efficacy of onsite capture of stormwater for landscape irrigation use and found even small (~936 cubic feet) water cisterns would collect enough water to serve the irrigation needs of a home on a 10,000 square foot parcel.

Despite the wide body of literature indicating the success of stormwater capture-and-reuse systems for irrigation and waste removal, a directive from the state legislature to local cities and municipalities in North Carolina is likely to face significant resistance. North Carolina's local governments establish their own building codes, which often take into consideration environmental factors that are unique to the municipality's watershed or hydrologic area.

Nevertheless, the state must indicate that it is simply coordinating and standardizing building regulations so that stormwater capture-and-reuse technologies are not excluded from new and existing projects due to unclear guidance. The input from local government officials will help assuage fears that the state government is dictating building policy to localities, and will ensure passage of clear and

[29] V.G. Mitchell, R.G. Mein, and T.A. McMahon, "Evaluating the Resource Potential of Stormwater and Wastewater: An Australian Perspective," *Australian Journal of Water Resources*, IEAust, vol. 2, no. 1, 1997.
[30] B.A. Courtney, "An Integrated Approach to Urban Irrigation: The Role of Shading, Scheduling, and Directly Connected Imperviousness," MS Thesis, Department of Civil, Environmental, & Architecture, University of Colorado, Boulder, Colorado, 1997.
[31] J.P. Heaney, L. Wright, and D. Sample, "Stormwater Storage-Treatment-Reuse Systems," in *Innovative Urban Wet-Weather Flow Management Systems*, eds. R. Field, J.P. Heaney (Lancaster, Pennsylvania: Technomic Publishing Co., Inc., 2000).

progressive building regulations for the capture and reuse of stormwater in North Carolina buildings and homes (Criterion 3).

Finally, the second alternative will be acceptable to all stakeholders involved, except local governments and municipalities, because it incorporates money-saving technologies into new and existing construction and encourages a reduction in the use of potable water (Criterion 4). Moreover, by standardizing building codes across the state with respect to capture-and-reuse technologies, the legislature sends a clear message that the State is committed to addressing water scarcity.

Alternative 3: Investigate potential policies to provide incentives for stormwater runoff reduction

This alternative is designed to fill the gap between cost-conscious developers and environment-conscious government agencies. Under this alternative, the Nicholas Institute could undertake a research project to determine which, if any, incentive program to propose to legislators and regulators. This research could also include an analysis of the pertinent legal restraints.

Various market incentives are being eagerly researched in both universities and public agencies, such as the EPA, as volume- and pollution-reduction solutions.[32] Some of the most promising and commonly discussed include water pricing, tax credits, and priority permitting, although this is not an exhaustive list. A brief description of each program follows:

Water Pricing. Economic principles and natural evidence suggest that increasing the price of water (which is ubiquitously and artificially low at present)[33] could result in a reduction in potable water use.[34] If price increases are combined with information on stormwater capture options, it may have the effect of replacing municipal water use with stormwater *re*use. Nick Tennyson explained that residents of the Hills of Rosemont development near Research Triangle Park are indeed utilizing stormwater capture in response to the higher prices they face by being on a private utility. Increasing municipal water prices may provide a consumer-based solution to runoff volume, but may also provide an incentive for developers, if property owners demand reduction technologies in order to reduce future costs.

[32] Bo Cutter *et al*., "Financial Incentives for Control of Storm Water Runoff," University of California – Riverside, available at http://www.envisci.ucr.edu/about/rproj02.html (accessed April 18, 2009); Hale Thurston *et al*., "Using Economic Incentives to Manage Stormwater Runoff in the Shepherd Creek Watershed," United States Environmental Protection Agency, October 2008, available at http://www.epa.gov/nrmrl/pubs/600r08129/600r08129.pdf (accessed April 20, 2009).
[33] *Progressive Investor*, "Special Report: Investing in Water," Issue 43, February – March 2007.
[34] Sheila Olmstead and Robert N. Stavins, "Comparing Price and Non-Price Approaches to Urban Water Conservation," *National Bureau of Economic Research* Working Paper 14147, available at http://www.nber.org/papers/w14147.pdf (accessed April 20, 2009).

Tax Credits. This program directly targets developers by rewarding the installation of volume reduction technologies with tax credits. Alternatively, tax credits could be given to property owners who adopt these technologies. Implementation could occur at the state or local level, depending on the specific tax credited.

Priority Permitting. Developers are required to obtain permits before work on a project can begin. This can be a tedious and time-consuming process that leads to opportunity costs for the firm. State and/or municipal agencies could reward the inclusion of volume reduction technologies in the proposed development plan by placing the developer on a fast-track permitting course.

Analysis

If this research ultimately leads to implementation of one or more programs, we expect it to reduce stormwater runoff volume (Criterion 1) and more certainly encourage capture and reuse (Criterion 2). Olmstead and Stavins found that a 10% increase in the price of urban water in the U.S. leads to a 3-4% decrease in water use in the short run and a 6% decrease in the long run.[35] The effect of the price increase grows over time because consumers can adapt in order to avoid the higher price (by adopting stormwater capture-and-reuse technologies, for example). Engaging in research of incentives is only a preliminary step, however, and has no direct effect on stormwater runoff reduction or reuse.

Implementation and acceptability will also depend on the specific incentive program chosen (Criteria 3 and 4). Water prices, for example, are set at either a municipal or state level. Implementation will thus require multiple campaigns to municipalities as well as the North Carolina Utilities Commission instead of just one campaign to the State. In addition, water-pricing policies have been criticized for being regressive and thus may face public resistance beyond expected ire at price increases.[36] Tax credits will likely receive a good deal of support from developers and be relatively easy to carry out. For example, Downtown Durham Incorporated, an urban revitalization organization, has already said that tax credits are an appealing offer.[37] On the other hand, taxpayers may oppose bearing the costs of this program and thus there may be some political friction when the proposal is presented to the state legislature or city councils. This resistance might be avoided if tax credits are given to property owners, rather than developers, but property owners are less likely to be aware of the opportunity or take advantage of it. Priority permitting, like water pricing, will also require lobbying multiple municipal governments, but will otherwise

[35] Sheila Olmstead and Robert N. Stavins, "Comparing Price and Non-Price Approaches to Urban Water Conservation," *National Bureau of Economic Research* Working Paper 14147, available at http://www.nber.org/papers/w14147.pdf (accessed April 20, 2009).
[36] Donald E. Agthe and R. Bruce Billings, "Equity, Price Elasticity, and Household Income under Increasing Block Rates for Water," *American Journal of Economics and Sociology*, vol. 46, no 3, July 1987, 273-286.
[37] Bill Kalkhof, President DDI, and Melissa Norton, Government Relation Director DDI, comment on "Stormwater Ordinance Follow-up," Bull City Rising Blog.

cause little difficulty in implementation and face no resistance. Research by the Nicholas Institute will be easy to carry out (although time-consuming) and will not meet resistance from any stakeholders.

Alternative 4: Conduct a needs assessment of runoff reduction education opportunities

In order to determine how to best address the current misconceptions about runoff reduction practices, there must be a more comprehensive understanding of what the current education efforts are and what problems exist. We therefore recommend that the Nicholas Institute complete a formal needs assessment of stormwater runoff reduction education, involving the steps outlined below.

The first step is to define the problem – why developers and regulators are not getting the education and information they need. One part of this would be a comprehensive review of the education programs currently being offered (see Appendix I for an initial list). The goal would be to fully understand the range of training events being held, materials being made available, and the types of organizations involved in stormwater education. A second part would be to gather information on problems with the current education efforts from people in the development and regulatory communities. We recommend the use of focus groups, surveys, and interviews with key informants. Focus groups of both developers and regulators would allow for interactive dialogue, which would be useful in uncovering generally agreed upon conceptions of the problems with and needs for stormwater education. Surveys would be helpful in identifying differences within these groups; e.g. variations in attitudes among developers towards runoff reduction practices and the need for education. The third method would be interviews with key informants (individuals with certain types of expertise), such as developers like Rex Bost or regulators like Boyd DeVane, who are particularly interested in and knowledgeable about runoff reduction and capture and reuse. These interviews would complement the information received in focus groups and surveys.

The second step of the needs assessment would be to determine the target of any new stormwater education intervention. Our initial research targets developers and regulators, but there are likely to be different needs between and within these communities. Different stakeholders will have different definitions of who the programs should be targeting, but the methods used in step one may help identify some consensus.

The final step would be to identify possible solutions to the problem, which would include how new or revised education programs might address the problems identified in the first step.

Although implementation of this alternative would be an involved process (particularly step one), it would be useful due to the political nature of stormwater

issues in North Carolina and the number of stakeholders interested in the issue. Conducting focus groups, surveys, and interviews will help build the community buy-in necessary to make future educational efforts effective.

Analysis

If this research leads to the implementation of more effective education programs, we expect it to indirectly result in a reduction in the amount of stormwater runoff by encouraging better stormwater volume management (Criterion 1). This would be a future, long-term effect, as education efforts will take time to be implemented and have influence. Conducting the needs assessment is a preliminary step and will not itself meet the first criterion.

More effective education programs would more directly encourage the reuse and conservation of stormwater runoff (Criterion 2). One main goal of such programs will be to encourage an increase in the implementation of runoff reduction practices by demonstrating the benefits of using such practices (both to developers and municipalities) and making the necessary technical knowledge more accessible. Again, the research phase itself will not directly meet this criterion.

The costs of implementing a needs assessment should be relatively low for the Nicholas Institute (Criterion 3). Some staff and financial resources would be needed to organize and conduct the focus groups, survey, and interviews, but we assume the overall financial, opportunity, and political costs of this effort would be comparatively low. The costs of implementing new or revised education programs may be much greater. One goal of the needs assessment would be to determine how an education effort would be implemented. Given budget challenges faced by local and state governments, partnership with private organizations and universities seems likely. The fact that stormwater education efforts already exist in these sectors contributes to the likelihood of implementation.

Another important step would be to determine what government agency should be involved. An education effort is likely to be more successful if stormwater management is better integrated (the current division of responsibilities among various agencies is a problem for both water quality and volume management). Ease of implementation depends on public agency capability, funding and willingness to expand/develop education programs; and on the ability to find a capable and willing private partner/university to participate.

In regard to this alternative, the issue of stakeholder acceptability applies in a number of different ways (Criterion 4). First is the acceptability of the needs assessment itself, to which we believe there would be little to no opposition from any stakeholder. However, stakeholder acceptability also applies to the likelihood that developers and regulators will participate in education and training, and the ability to affect attitudes enough to build a willingness to participate in this kind of education. This stage may require involving progressive developers and regulators and leaders

in each field to encourage education among these communities. One possible method for increasing participation among developers in stormwater runoff reduction education is to allow or require developers to meet continuing education requirements with these training opportunities. This is already possible, for example, through workshops being offered by the North Carolina Low Impact Development Center.[38]

Alternative 5: Establish Focus Groups and Conduct a Survey of Developers to Guide Policy

Because developers may have varied opinions that differ from those of our key informants (Bost and Tennyson) and because developers are key stakeholders, Alternative 5 proposes that the Nicholas Institute set up focus groups of developers from across the state. These focus groups would have six goals:

- Obtain more specific estimates of costs that developers face
- Evaluate developers' technological knowledge
- Evaluate developers' resistance to change
- Evaluate developers' response to potential incentive programs
- Evaluate developers' need for and interest in stormwater education
- Analyze potential differences in developer opinion according to:
- Type of development (residential or commercial) and
- Locale (region, urbanization level, etc.)

Analysis

Organizing focus groups will not reduce stormwater runoff (Criterion 1) or encourage capture/reuse (Criterion 2), but could provide information that will allow the state to make more informed policy decisions towards these goals in the future. It may also send signals to participating developers that stormwater volume management is becoming a priority for public agencies. Implementing focus groups will be time-consuming for the Nicholas Institute, but would be inexpensive and relatively easy to set up (Criterion 3). The two stakeholders affected by this alternative should both find it acceptable (Criterion 4). To developers, a focus group allows them a voice in the policy design process; to the Nicholas Institute, a focus group provides guidance for prioritizing research initiatives.

[38] North Carolina Low Impact Development Center. "Upcoming Workshops/Short Courses" North Carolina State University, available at http://www.bae.ncsu.edu/topic/lid/workshops.html (accessed April 20, 2009).

Recommendations

We believe that the Nicholas Institute should pursue all five alternatives, as they will all result in a better understanding of and provide solutions to the problem of stormwater volume management. We have provided a priority list of what alternatives can be implemented in the short versus the long term (based on feasibility and ease of implementation), and the order in which they should be implemented given how well they meet our established criteria.

In the short term, we recommend that the Nicholas Institute consider the following alternatives in the order given:

(1) Amend the Best Management Practices (BMP) Manual to include all existing stormwater runoff reduction technologies and to streamline the permitting process for new designs;

(2) Conduct a needs assessment of runoff reduction education opportunities;

(3) Establish focus groups and conduct a survey of developers to guide stormwater policy;

In the long run, we recommend that the Nicholas Institute consider the following alternatives in the order given:

(4) Incorporate solutions for stormwater capture and reuse into building regulations;

(5) Investigate potential policies to provide incentives for stormwater runoff reduction.

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Appendix I: List of Stormwater Educational Programs and Resources

Organization	Website	Mission
Clean Water Education Partnership	http://www.nccwep.org/index.php	The Clean Water Education Partnership aims to protect North Carolina's waterways from stormwater pollution through public education and outreach. The Clean Water Education Partnership (CWEP) is a cooperative effort between local governments, state agencies, and nonprofit organizations to protect water quality in the Tar-Pamlico, Neuse, and Cape Fear River Basins.
Durham Public Works Department	http://www.durhamnc.gov/departments/works/stormwater_public.cfm#10	
Environmental Protection Agency (EPA) National Stormwater Best Management Practices	http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm	
NC State University - Biological and Agricultural Engineering Stormwater Engineering Group at NC State University	http://www.bae.ncsu.edu/stormwater/	The BAE Stormwater Engineering Group is a team consisting of tenure and non-tenure track faculty, graduate students, part-time associates, and off-campus Extension Faculty. Our mission is to "learn and teach" stormwater management and cover the three main aspects of a land-grant university: (1) applied research, (2) extension and engagement, and (3) on- and off-campus teaching.
NC State University - Department of Soil Science at NC State University	http://www.soil.ncsu.edu/programs/stormwater/	The Soil Science Department has an active program in erosion and sediment control research and education for the construction industry.
NC State University - NC LID Center at NC State University	http://www.bae.ncsu.edu/topic/lid/index.html	North Carolina is developing at a rapid rate. As such, it is not practical to halt development nor is it practical to assume that resources are quickly and easily replenishable. Although there are many entities in the State that use principles of low impact development, it is often difficult and laborious to access this information in a single place. The NC Low Impact Development Center was created to help remedy this problem… The NC LID Center serves as a depository of information on low impact development research and projects across North Carolina.

Organization	Website	Mission
NC State University - Watershed Education for Communities and Local Officials (WECO) at NC State University	http://www.ces.ncsu.edu/depts/agecon/WECO/index.html	WECO is dedicated to developing local capacity for sustainable watershed management and facilitating watershed partnerships in North Carolina. WECO joins watershed stakeholders to accomplish collaborative solutions to water resource issues.
North Carolina Department of Environment and Natural Resources, Stormwater & Runoff Pollution Toolkit	http://www.ncstormwater.org/pages/toolkit.html	
Stormwater Training Resource Locator	http://www.envcap.org/statetools/swt/swt.cfm?st=NC	
Southeast Stormwater Association	http://www.seswa.org/index.asp	The Southeast Stormwater Association was created in response to the ever-increasing demand for information on stormwater management and funding questions so you won't have to "reinvent the wheel" each time you undertake a new project! Our boundaries are co-terminus with those of EPA Region IV and include the states of Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina and Tennessee. With a primary focus on services to stormwater professionals in city and county governments, membership is available to those in state, regional and local governments, the private sector, non-profit organizations and academia.
Upper Neuse Site Evaluation Tool	http://www.unrba.org/set/index.shtml	The Upper Neuse Site Evaluation Tool (SET), a tool that can help you assess the environmental impacts and costs of a site's stormwater design… The SET is designed primarily for local government site review planners, professional developers, and stormwater engineers, but it is useful for anyone with a little knowledge of stormwater.

Appendix II: Stormwater Contacts List

Last Name, First Name	Title	Organization	Phone	Email Address	Date/Method of Contact	Response?	Date of Meeting(s)	Referred to By
Bennett, Bradley	-	NC Division of Water Quality	807-6378	bradley_bennett@h2o.enr.state.nc.us	4/20/2009	No	-	Bill Holman
Bost, Rex	President	Bost Custom Homes, FreeRain Rain Harvesting Solutions	460-1983	rex@bosthomes.com	2/16/2009 (phone)	Yes	2/27/2009	Nick Tennyson
Brown, David	Stormwater Engineer	Stormwater Services Section, City of Durham	724-7935	David.Brown@durhamnc.gov	3/23/2009 (email)	Yes	3/30/2009 (phone)	None
Bruce, Sarah	Senior Water Resources Planner at Triangle J Council of Governments	Clean Water Education PartnernshipPartnership	-	cwep@tjcog.org	3/22/2009 (e-mail)	Yes	Email only	None
Cox, John	Water Quality Manager	Stormwater Services, City of Durham	560-1230 ext. 224	john.cox@durhamnc.gov	1/29/2009, 3/22/2009 (email)	No		Bill Holman
DeVane, Boyd	Stormwater Engineer	Division of Water Quality	807-6373	boyd.devane@ncmail.net	1/29/2009 (email)	Yes	2/5/2009	Bill Holman
Durso, Francine	Senior Project Manager	CH2M HILL	760-1754	Francine.durso@ch2m.com	-	-	-	Bill Holman
Goetz, Lou	President/ CEO	Park City Development, Inc.	-	-	-	-	-	Nick Tennyson
Hunt, Bill	Professor of Urban Stormwater Management	NCSU	515-6751	bill_hunt@ncsu.edu	4/1/2009 (e-mail)	Yes	4/7/2009	Bill Holman
Morrison, Craig	Owner	Cimarron Homes	382-2888, ext 109	-	-	-	-	Nick Tennyson
Peirce, Jane	CWA Section 319 Program Coordinator	Massachusetts Department of Environmental Protection, Division of Municipal Services	(508) 767-2792	jane.peirce@state.ma.us	3/2009	No	-	None

Pickle, Ken	Stormwater Engineer	NC Division of Water Quality Permitting Unit	807-6376		4/20/2009	No		Amy Pickle
Raabe, Peter	Southeast Director of Government Relations and Policy Director for Budget and Appropriations	American Rivers	682-3500	praabe@americanrivers.org	1/29/2009 (email)	No	-	Bill Holman
Reimer, Lynn	Liaison to NC/SC	Center for Watershed Protection	-	-	-	-	-	Bill Holman
Richardson, Curtis	Director	Duke University Wetland Center	613-8006	curtr@duke.edu	-	-	-	Bill Holman
Senior, Mark	Senior Project Engineer	City of Raleigh Stormwater Administration	-	seniorm@raleigh-nc.org	3/2009	No	-	Bill Holman
Smith, Laura	Stormwater Public Education Coordinator	Durham Public Works	-	laura.smith@durhamnc.gov	3/22/2009 (e-mail)	Yes, referred us to David Brown	-	None
Tennyson, Nick	Executive Vice President	Home Builders Association of Durham, Orange and Chatham Counties	493-8899	nick@hbadoc.com	Phone	Yes	2/13/2009	Bill Holman
Webster, Henry	Chief Plumbing Engineer	North Carolina Department of Insurance	661-5880 x23	hwebster@ncdoi.net	2/4/2009 (e-mail)	no	-	Boyd DeVane

Appendix III: Interview Summaries

A. Rex Bost

The authors conducted an interview with Rex Bost, of Bost Custom Homes, on 27 February 2009. The major points expressed by Mr. Bost were:

1) Instead of building technologies to clean water, we should build technologies to capture and reuse water
- See East Medical Center in Webster, TX as an example of the implementation of capture-and-reuse technologies

2) Mr. Bost had sent a memo to the NC Code Council about rainwater codes for NC
- The Council was supposed to approve a revised code in January 2009, but newly appointed members of the Council tabled the proposition
- A new code should allow North Carolinians to use untreated rainwater for use in flushing toilets
    - Current building codes treat rainwater as "grey water"
    - Such codes would probably only allow water from roofs to be reused, but not water from parking lots

3) A new DWQ ruling allows property owners to collect stormwater in cisterns and get stormwater credits for doing so

4) Technologies for improving water quality are expensive and maintenance is not monitored or enforced. In contrast, the maintenance of underground containment systems directed at water capture is relatively easy. Underground systems do not require excavation to conduct maintenance either.

5) There is not enough knowledge among developers about stormwater capture and reuse

6) Some technologies are already used to reduce runoff (by letting water seep into the ground), but the next step is reusing water for plumbing and irrigation

7) Stormwater concern in the development community is money-driven
- Developers could be spending the same amount or less to capture and reuse water as they do to install traditional runoff technologies such as bio-retention ponds
    - Developers do not recognize the cost-saving potential
    - Public agencies do not understand how much capture and reuse can save them in terms of the energy and financial costs of water purification

8) Engineers, land planners, and contractors need more education so that they are aware of all the options

- Developers do not usually know that capture and reuse is possible

8) There are proven devices available that are very easy to use ("plug and play") but that are not included in the BMP Manual

9) Developers are skeptical of change

10) We need to establish incentives
- With all the green incentives available these days, why are there no incentives for stormwater conservation?
- Some homeowners want to be green, but this is not a big source of incentives for developers

B. Nick Tennyson

On 13 February 2009 the authors conducted an interview with Nick Tennyson, former mayor of Durham and current President of the Home Builders Association of Durham, Orange, and Chatham Counties. The major points expressed by Mr. Tennyson were:

1) He stated several times that all the information he was giving us was opinion, not necessarily fact

2) Stormwater regulations are a "moving target"
- There is a lack of confidence among developers that what is being done actually helps
- Standards keep changing as the science progresses
- Regulations can appear to be a NIMBY (not in my neighborhood) tool that makes development too expensive

3) The BMPs feel like a series of arbitrary demands
- It is hard for developers to see the real value of the BMPs

4) Regulations are inconsistently enforced
- Legislators legislate, regulators regulate, but no one enforces
- Laws do not get translated well into enforceable regulations
- The only incidents that do get regulated are the egregious violations
- We need the regulations and enforcers to be working together to better train the development community

5) The developers who are ultimately bearing the costs of the regulations are those that obey the law. There are enough developers who do not follow the law ("bad actors") and make more profits as a result, that they out-compete the developers who obey the regulations

6) Regulations are a land-cost accelerator for developers
    - To be profitable, a lot's price must be no more than 20% of the cost of the home

7) There should be incentives that make it worthwhile to address strormwater concerns in developments
    - If a development provides a solution to the stormwater problem that is above and beyond the standard, the extra benefit should accrue to the developer or landowner
    - The price of water is too low. People would change their behavior and reduce water usage if prices were raised.
        - Ex: Hills of Rosemont, a Triangle-area residential development that runs on a private water system, which is more expensive than public water. Residents have responded by reclaiming stormwater.

8) Stormwater should be operated as a utility
    - One problem with this might be the generation of revenue that elected officials would then be eager to appropriate for other needs when the budget falls short
    - Look at Chapel Hill as an example of what not to do: the city imposes the same regulations for single-family homes as for large commercial developments

9) Stormwater runoff from development is currently an aggregate problem that is approached and regulated at the individual level

C. Boyd DeVane

On 5 February 2009, the authors interviewed Boyd DeVane, Stormwater Engineer at the NC Division of Water Quality. The major points expressed by Mr. DeVane were:

1) Developers have maintenance fears
- What happens when permeable pavement fills up?
- What happens if a cistern breaks?
- What if an underground structure breaks and we have to dig everything up?
- A public information campaign could be helpful

2) Neither developers nor state officials understand the effects of large runoff volumes

3) Developers need specific types of soil to install permeable pavement
- Clay (like that found in the Piedmont region) does not infiltrate well

- It could still work though if the infiltration is slowed down enough
- Developers do not have technical expertise because volume control is a new concept (about six years old)

4) Regulations
- Focused on suspended solids (must remove 85%)
- Ignore volume issues even though reducing volume also reduces the solids that must be removed
- Do not have Runoff Reduction Ratios of BMPs
- Are excessive regarding the reuse of water (cannot even use stormwater for toilet flushing without treating the water first)
- EPA has no authority over non-point sources

5) Alternative: Selling stormwater back to the grid
- Mr. DeVane liked the idea, but would want to see some quantifiable data
- One problem is getting water back to the treatment center
- Might be able to use fire water lines
- Another problem is measurement—stormwater is not metered
- Some places have very low water fees (Raleigh = $4.20/1,000 gal; Cary = $14/1,000 gal) so does it make sense to sell stormwater back?
- It probably only makes sense for large businesses like Walmart to sell back stormwater or build cisterns

6) Water is too cheap
- Raleigh provides water at below cost

7) Some good places to look for examples of stormwater volume management are:
- Australia
- New Jersey
- Maryland
- Massachusetts
- Arizona: water conservation incentive program
- Chesapeake Bay Network
- Huntersville, NC: study about what happens if they do not stop runoff

8) Rain gardens
- An alternative for individual homes where it is not cost-efficient to use cisterns
    - The cost of cisterns is about $1/gallon capacity
- Questions of maintenance:
    - Will homeowners keep it up?
    - Could the city provide maintenance services through increased property taxes?
- May be an alternative to bio-retention ponds
- Reduce the amount of stormwater going into storm drains by 90%

9) Can quarries be used for storing water and allowing infiltration rather than dumping stormwater directly into rivers and streams?

10) Some other possible development incentives include:

- Revise the BMP Manual and give more "credits" for infiltration and harvesting
- Remove requirement to build a retention pond if rain gardens cisterns, etc. are used
    - Frees up land that would have gone towards the retention pond
    - Retention ponds are just “lump it and dump it” techniques
- Priority permitting
- Reduce treatment requirements

11) An externality exists wherein producers of runoff don't have to worry about it while people downstream do. We therefore need more accountability

12) Advocacy needs to occur at the state level

D. Bill Hunt

On 7 April 2009, the authors interviewed Bill Hunt, Assistant Professor and Extension Specialist, Biological and Agricultural Engineering and Urban Stormwater Management, North Carolina State University. The major points expressed by Dr. Hunt were:

1) Engineers stick to ponds because they have always worked. Why fix what is not broken?

2) Prospective changes

- Best incentive to provide would be speeding up permitting process
    - Two-way problem: current system does not give benefit to developers trying something new and it also takes longer to get innovative things approved
    - Couple LID (Low-Impact Development) with fast-track: if you use LID, we will fast-track your permitting
- Tiered water pricing: low rate for showers, etc. but high rate for washing car

NC 401 unit

- Development mitigation for streams and lakes
- LID is first choice
- Potential Alternative: must prove that LID is not feasible in order to do something else

3) LID is still somewhat new

- Maintenance issue: pond maintenance well defined, but LID maintenance is not yet well-defined.
    - With LID, developers have to worry about things they cannot see; although this does not mean the maintenance is any harder to conduct
- Ponds require more frequent maintenance, but you only have one pond for 30 acres, whereas LID requires the maintenance of more devices but less frequently

4) North Carolina LID design manual is probably coming out this summer
- It is predicated on annual volumetric runoff reduction
- Published by DWQ but written by CM2H Hill, NC State, etc.
- Written with the intention of complimenting the BMP manual

5) Raleigh recently changed building codes to allow reuse of stormwater
- This will encourage capture and reuse

6) The average Raleigh homeowner would save $100-$200 per year if they could replace outdoor water uses (lawn, vehicles) with stormwater (based on current rates)
- This is not enough to incent investment in cisterns, etc.
- If homeowners saved $400-$800 per year, cisterns could be paid for in 3 to 4 years and the incentive would be greater to use capture and reuse technologies

7) The BMP Amendment Process
- Category 1: Non-proprietary systems
    - DENR has a mechanism where NCSU reports improvements in existing practices and then DENR updates the BMP Manual
        - This takes time, but is faster than in any other state he knows
    - Changes do not require any developer financial or time expense
    - Example: water harvesting took about 1.5 years to be added to the manual, most practices take 1.5-2 years
- Category 2: Proprietary systems (individual manufacturer makes it)
    - Long, costly process