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INTEGRATING STORMWATER RUNOFF QUANTITY AND QUALITY REQUIREMENTS

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ABSTRACT

Beaufort County adopted water quality control requirements in their Best Management Practices (BMP) manual in 1998, and the county saw a 30 percent increase in population without any additional water quality impairments, through 2009. The original version of the manual was based on an anti-degradation target, limiting post-development surface runoff loads of total phosphorus to a level representative of a development with 10% impervious cover. This target could be achieved by limiting impervious cover and/or treating runoff with a stormwater BMP.

Further control requirements were considered in 2009 when the State restricted shellfish harvesting in a section of the May River. Monitoring and studies suggested that stormwater runoff volume, rather than water quality, was contributing to the increasing fecal coliform bacteria levels in this State Outstanding Resource Water. Consequently, the BMP manual and development regulations have been modified to add stormwater runoff quantity control requirements that result in mimicking of the predevelopment hydrology.

This presentation examines the modifications to the BMP manual and development regulations to incorporate runoff volume control requirements. Key considerations in the modifications include the establishment of runoff control goals, determination of runoff reduction associated with various BMPs, and development of tools to evaluate compliance with the requirements.

The County has also modified the development requirements to control the runoff volume from undeveloped lots that are located in developments with an approved BMP plan, based on prior versions of the manual which did not include runoff volume control. For these so-called “Step 2” controls, the County has developed a spreadsheet to enter lot features such as disconnected impervious area and cisterns, and calculates a rain garden size required to meet volume control requirements after the other site features mentioned earlier. This allows for evaluation of low impact development (LID) benefits on an on-lot basis.

KEYWORDS

Runoff volume control, equivalent impervious cover, effective imperviousness, water quantity; water quality, low impact development (LID), integrating quantity and quality requirements.

INTRODUCTION

Beaufort County, SC is located between Charleston, SC and Savannah, GA. Due to the prime coastal location, the County has long been an attractive location for resorts and other types of development. The County's stormwater program has been challenged by its citizens and leaders to be a progressive coastal program that has recently incorporated volume control into its stormwater management criteria. This progressive attitude has kept 85% of our most sensitive water use (Shellfish Harvesting) waters open since water quality controls were first adopted in 1998 (see figure 1). This was maintained while the county increased in population by over 30 percent.

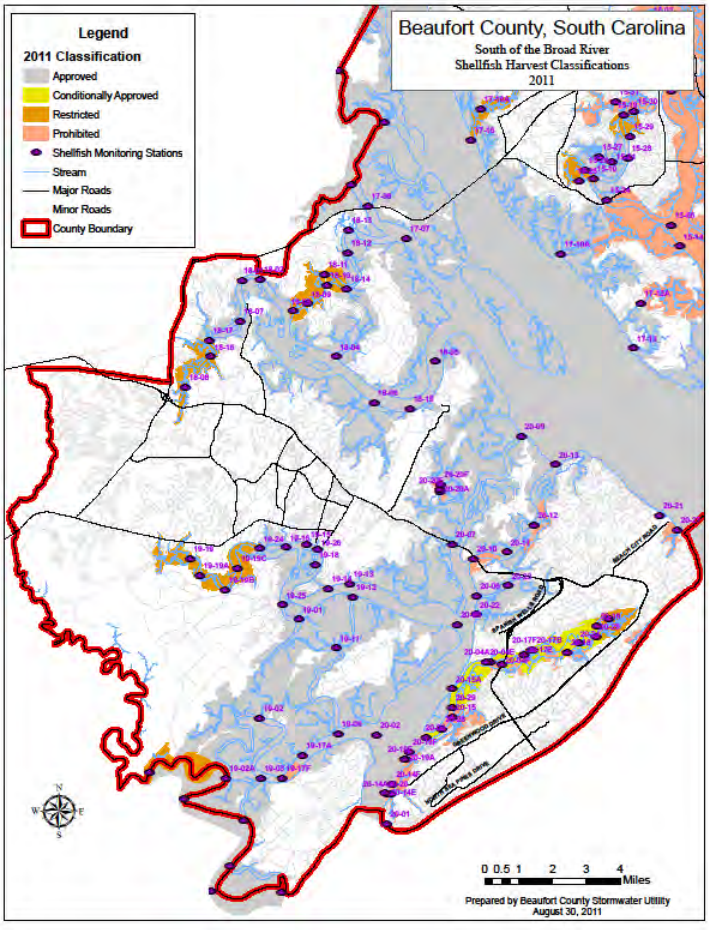

Figure 1- Shellfish Harvest Classification

The County has several unique coastal characteristics: fifty percent of the County consists of open areas and salt marshes, little upstream freshwater input, shellfish harvesting and fishing are major economic and recreational activities, and population growth has been rapid in recent decades.

The impetus for the County's stormwater regulations came from shellfish closures in the mid-1990s (Hilton Head Island – Figure 1 lower right). These closures led to heightened public awareness and political will on the part of the County Council. The first round of the regulations was adopted in 1998. The innovative approach used at the time was based on an anti-degradation target for phosphorus of 10% "Equivalent Impervious Cover" (EIC). EIC is a metric that measures how effectively impervious surface runoff is reduced relative to pre-development pervious surface runoff. In other words, degradation could be halted if land development projects limited their EIC to 10%. EIC limits can be reached either by reducing impervious cover or treating impervious cover with a stormwater BMP that has credits based on its size assigned in the BMP Manual. In subsequent years, the EIC concept was extended to anti-degradation goals for bacteria and nitrogen. The County also established a stormwater utility in 2001 in response to a recommendation from citizen action in response to the 1990s shellfish bed harvesting closings. This utility is a dedicated funding source for stormwater releated initiatives.

After another shellfish closure in the May River in 2009, (station 19-19 in figure 1) the County investigated possible causes, and the volume of stormwater came under increased scrutiny. Increased stormwater volume from development projects was implicated in salinity changes, increased discharges into wetlands with observed increases in fecal coliform bacteria concentration at wetland outlets, and impacts to fisheries. With direction from the County Council, the County Stormwater Utility developed a volume-based criterion based on the 95th percentile storm event (derived from the federal facilities standard in the 2007 Energy Independence and Security Act). This storm in Beaufort County is 1.95 inches of rainfall in 24 hours.

In 2009, the County amended its stormwater ordinance to include volume controls, and in 2010, updated its BMP Manual. The revised manual details volume reduction and EIC credits for six stormwater practices that infiltrate, evapotranspire, and/or reuse runoff:

1. Rooftop practices (green roofs, evaporative cooling on flat roofs)
2. Pervious pavement
3. Runoff capture and use for irrigation
4. Disconnection of impervious areas
5. Rain gardens and other devices
6. Swales for runoff from highways and roadways

The updated manual outlines EIC credits for various combinations of practices, soils, and ponding depth/storage. The manual also contains a compliance worksheet to calculate EIC resulting from using a combination of practices.

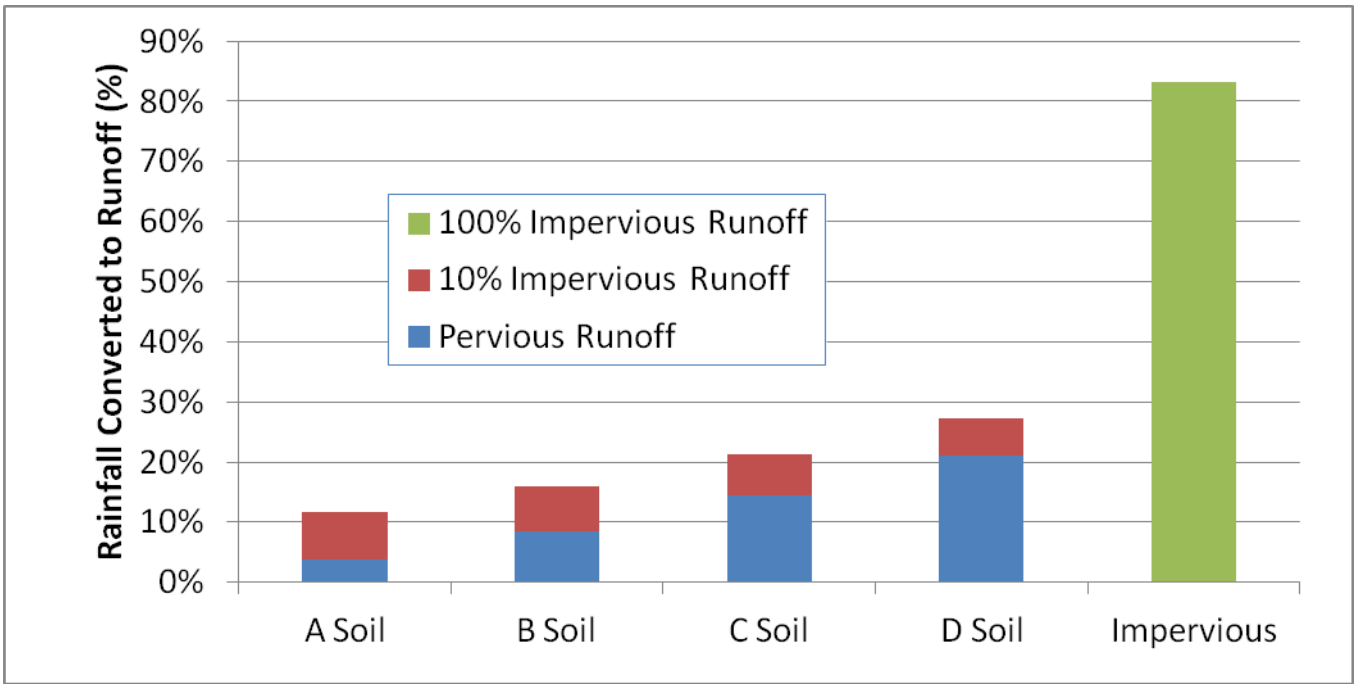

Figure 2- Runoff Annual Goals

Figure 2 shows how the County's 10 percent EIC anti-degradation target relates to allowed rainfall percentage to runoff by soil type on an annual average. Practices selected in manual will allow the runoff from the impervious area to be reduced to meet the allowed runoff percentages.

With the adoption of new development controls, there were questions raised about developments that had been approved before runoff volume controls, but had not been built out. An analysis was conducted to determine the extent of this un-built universe. The analysis indicated that there were over 22,000 residential lots of record that could be built without volume controls. Over 15,000 of these vacant lots were in previously approved Subdivisions (SD) and Planned Urban Developments (PUD). This was significant since the built universe of improved single family residential structures was 39,000 units. It was determined that the additional stormwater runoff from this permitted future building could make the volume problems worse and could lead to further water use impairments.

Ordinance changes were developed to require on-lot volume reduction BMPs for individual new homes and modifications of existing homes that are more than 50% of assessed value. This was only required if the volume of the lot was not being treated by a development plan or other method. This allowed the voluntary option of subdivisions and PUDs to opt for a neighborhood

retrofit in lieu of only on-lot controls. These controls were adopted in June 2011 after some workshops with a new stakeholder in the stormwater control arena, the local home builders. As part on this process the County developed a web-based program to assist in compliance with these on-lot controls. This web-based program was developed to allow homebuilders and homeowners to develop solutions without resorting to technical support. Over 50 homes received permits utilizing this web-base approach. Additionally a number of developments have analyzed their existing controls and have documented their compliance with the 2009 volume controls on a development-wide basis.

INTEGRATING STORMWATER RUNOFF QUANTITY AND QUALITY

The Center for Watershed Protection pondered "The Computation Conundrum" on how to account for small storm runoff reductions in larger storm hydrology. This highlighted the traditional stormwater approaches where quantity and quality decisions were kept in separate silos and impacts in one area did not get recognized in the other area. The computational methods were further partitioned by state and regulatory programs. Quantity controls were designed on an event basis and water quality controls were developed on an annual average basis.

The one thing driving both the quantity and quality designs has been impervious surface. Development in Beaufort County has increased impervious surfaces. Researchers have linked increased percentage of impervious surface in watersheds with deceases in stream health and increased water use impairments. Increased impervious surface causes three impacts:

- Increase in rate of runoff (peak controls)
- Increased loads of pollutants to receiving waters (water quality controls)
- Increase in total volume of runoff (runoff volume controls)

When the County adopted controls for the third impact in 2009 many questions were being raised with these volume controls concerning the benefits of volume controls on peak shaving and their impact on existing water quality controls.

The County discovered that the EIC concept historically used for water quality compliance could be adapted for the new volume control criterion. It was determined that the LID features designed to meet the 95th percentile storm (1.95 inch) control requirement would also reduce long-term runoff to a level that would be expected from a site with 10 percent equivalent impervious cover. This was similar to the goals set for many of the targeted pollutants. This led to a realization that runoff volume controls were a different way to handle stormwater runoff and not an additional set of controls. This led to a reformatting of the County's BMP manual to recognize the water quality benefits of volume reduction before going on to address the water

quality controls themselves. This BMP manual reformatting was finalized in 2012 after seeking additional formatting input from local stakeholders and users.

Impacts of runoff volume control were carried over into peak shaving requirements. Analysis indicated that by applying volume controls and maintaining the same peak shaving volume requirements in the County's current 25 year event shaving requirement, we could control to the 100 year event requirement. While there was some benefit to going to the higher level controls it was decided to maintain the current peak shaving volume requirement. This was because the local engineering community had already started to explicitly incorporate the runoff volume control features into their peak shaving calculations. Therefore by utilizing volume controls, most water quality and some of the peak shaving requirements are also addressed.

SUMMARY

Beaufort County found in addressing a runoff volume requirement that volume quantity and quality requirements can be integrated by utilization of Equivalent Impervious Cover (EIC). Quantity requirements, computed on an event basis, can be related to runoff volume controls sizes, and evaluation of the EIC percentage. This percentage can then be related to water quality requirements that have historically been developed on an annual average basis. Using EIC allows for a systematic linkage of all three impacts of impervious surface increase and links well to research that has related biological and hydraulic health of streams to the impervious surface in the watershed.

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