Developing an Approach for Communities to Assess Stormwater Application and Detention Requirements for Overall Watershed Health

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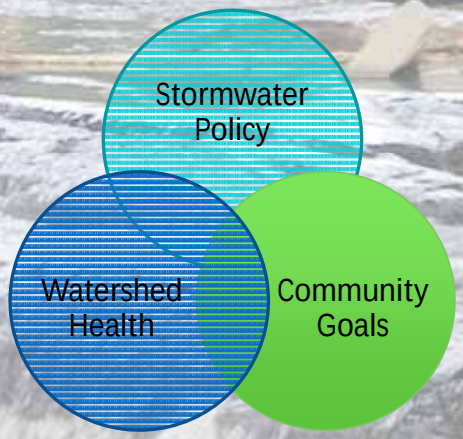
Introduction

- Communities face many issues when trying to protect their local watershed through the use of stormwater policies
- Lack of experience and background in environmental protection and watershed management.
- Stormwater policies often only relate to large sites and require large detention facilities and disregard smaller sites and smaller rain events altogether - does not reflect the end goal of sustainable stormwater design of mimicking natural hydrologic processes

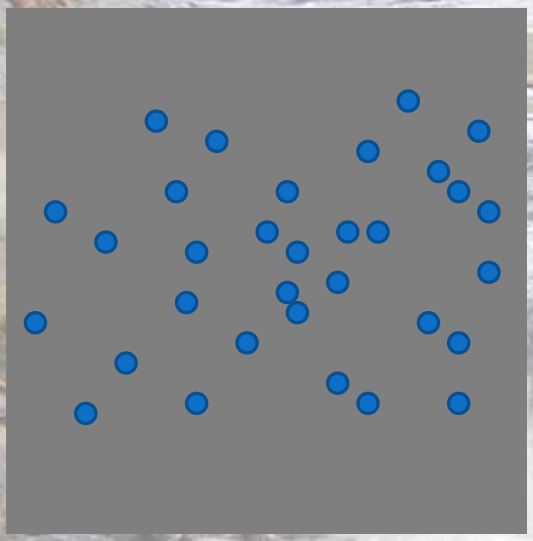


Introduction: Goal

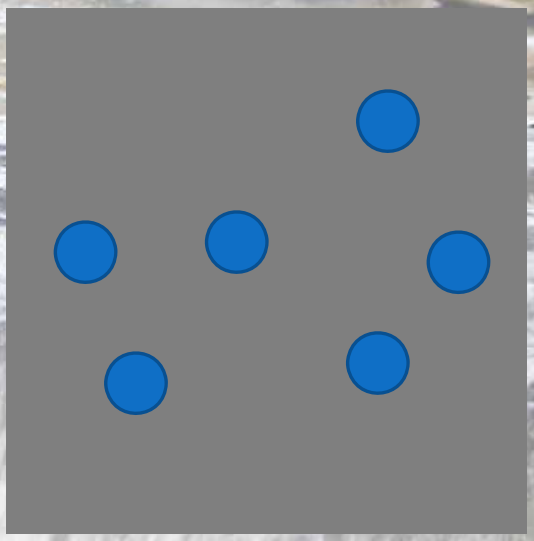
- The purpose of this study is **to test a range of on-site stormwater management policies against a selection of new development projects** from a specific small city of the Southeast United States in order **to determine what combination of policies works best in a particular urban environment**.
- Hypothesis – the policy with the smallest trigger requirement and the smallest detention requirement would manage the greatest amount of stormwater runoff and thus be most beneficial to the community and watershed.

Introduction: Sustainable vs. Traditional

Sustainable Approach:



Traditional Approach:



Introduction: Large vs. Small

Sustainable Approach:
500 sq. ft trigger/2 or 10-year
Every project does less

On-site stormwater management Courtesy of: Cory Gallo

Traditional Approach:
1 ac. trigger/25 or 100-year
Few projects do more

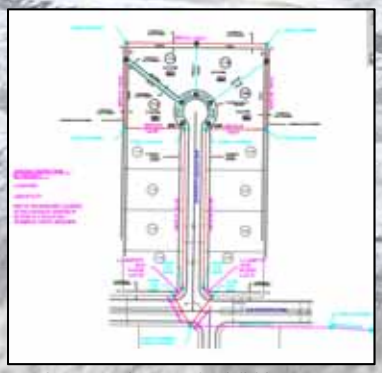
Large detention facility Courtesy of: Cory Gallo

Introduction: Scope

- Starkville MS
  - representation of a small southern city of the U.S.
  - proximity to Mississippi State University
  - recent and current data availability
- Results of this study provide the city with the information to better refine its current stormwater ordinance
- Precedent of this study provided by the stormwater management manuals of
  - NPDES Phase II
  - Philadelphia, PA
  - Detroit, MI
  - Portland, OR
  - Atlanta, GA

Methodology

- Data from City of Starkville – 2009 - 2011
- A project list of 35 projects – 32 with sufficient data
  - Name
  - Date of approval
  - Location
  - Total area
  - Impervious area
  - Disturbed area



Project #4 Huntington Park Subdivision

Methodology: Data Set

- Land-use - varied from commercial to residential, with the majority being commercial
- The project types varied - condos, subdivisions, restaurants, etc.

	Total Area sq. ft	Total Area ac.	Impervious Area sq. ft.	Impervious Area ac.	Disturbed Area sq. ft.	Disturbed Area ac.
Sum	6,875,216	158	3,226,253	73	3,230,216	74
Mean	214,851	4.93	100,820	2.29	100,944	2.30
Median	95,832	2.20	48,096	0.87	40,075	0.87

Methodology: Policy Development

- Each policy has three measurable variables:
  - A **trigger** describes which projects have to meet the requirement
    - In Disturbed or Impervious Area
  - The **detention requirement** determines how much detention each site must provide
    - By Storm Event
  - The **water quality requirement** determines the total volume of water that needs to be cleaned
    - In percentage of Stormwater Runoff

EVENT	Inches
25-year	7”
10-year	6.1”
2-year	4.2”

Starkville’s 24-hour Rainfall events

Methodology: Policy 1 – 1Acre – 25-year

- More Traditional approach
- 1-acre disturbed area trigger (large)
- 25-year event detention requirement (large)
- 85% of Site Runoff to be managed for Water Quality
- NPDES Phase II precedent

NPDES phase II Stormwater detention pond in Seattle, Washington. Courtesy of: City of Seattle

Methodology: **Policy 2 – 10,000 sq ft – 10-year**

- "Middle of the Road"
- 10,000 sq. ft. impervious area trigger (medium)
- 10-year event detention requirement (medium)
- 85% of Site Runoff to be managed for Water Quality
- Philadelphia, PA precedent

Philadelphia stormwater bumpout
Photo Courtesy of: phillywatersheds.org

Methodology: **Policy 3 – 500 sq ft – 2-year**

- More sustainable approach
- 500 sq. ft. impervious area trigger (small)
- 2-year event detention requirement (small)
- 85% of Site Runoff to be managed for Water Quality
- Portland, OR precedent

Portland on-site stormwater management
Photo Courtesy of: dutchdialogues.com

Methodology: Policy Analysis

- Three elements being tested by each policy:
  - The **total impervious area** managed by each policy
  - The **total increased volume** of runoff managed by each policy over preexisting site development
  - The **percent of annual rainfall** managed by each policy for quality

Methodology: Example

Project #20 –The Waffle House

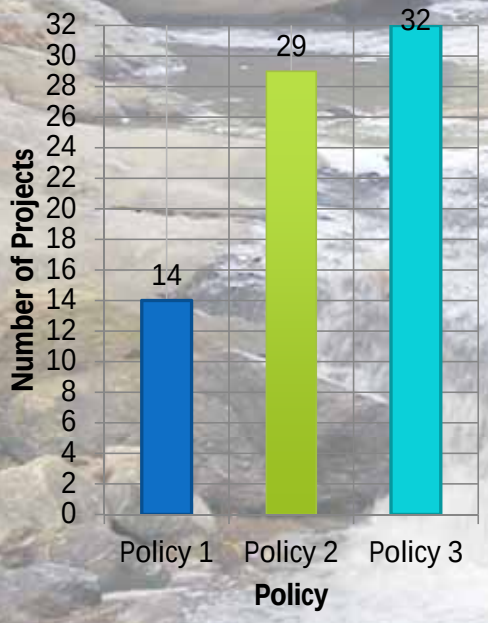
- Total area
  - .63 acres
- Impervious area
  - 19,137 sq. ft.
- Disturbed area
  - .63 acres
- Weighted Runoff Coefficient
  - .73
- Total Annual Runoff
  - 90,682.75 cu. ft.
- Increased Runoff 10-year
  - 7,112.33
- Increased Runoff 2-year
  - 4,897.02

Policy 1			Policy 2			Policy 3		
1 Acre Disturbed	25-year event	Quality 85%	10,000 sq. ft. Impervious	10-year event	Quality 85%	500 sq. ft. Impervious	2-year event	Quality 85%
0.0	0.0	0.0	19,137.00	7,112.33	77,080.33	19,137.00	4,897.02	77080.33

Results

- Results help clarify which range of stormwater policies best meet a community's watershed needs
  - Total projects triggered
  - Impervious area managed
  - Policy detention percentage
  - Percentage of water quality managed

Results: Projects Triggered



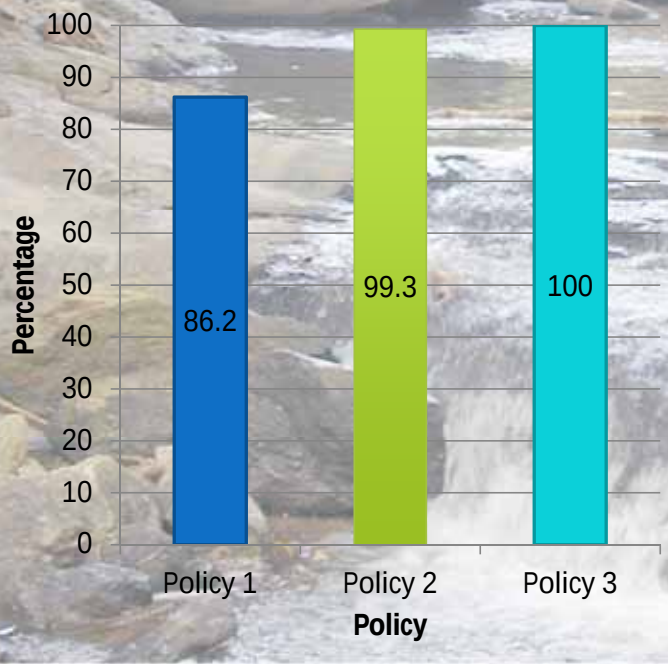
- Policy 1 triggered less then half of the new construction from 2009 -2011
  - The median project disturbed area being .87
- Policy 2 triggered the second highest amount of projects
  - The trigger was the most reflective of the median project size
- Policy 3 triggered the greatest amount of projects into the calculation

Results: Policy 1

Results: Policy 2

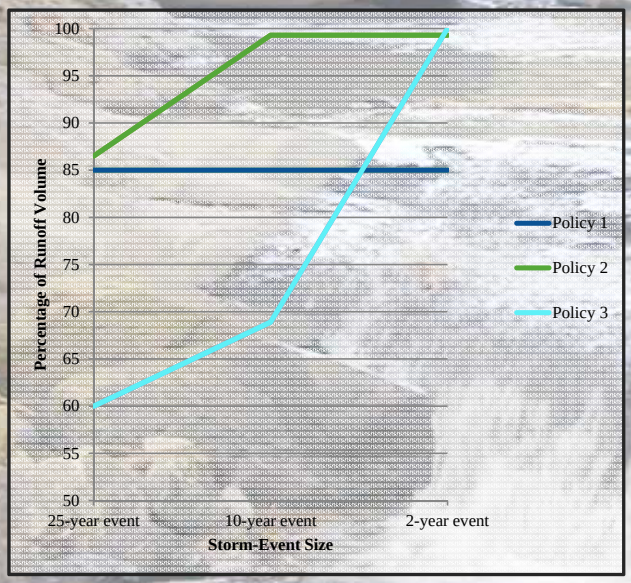
Results: Policy 3

Results: Impervious Area Managed



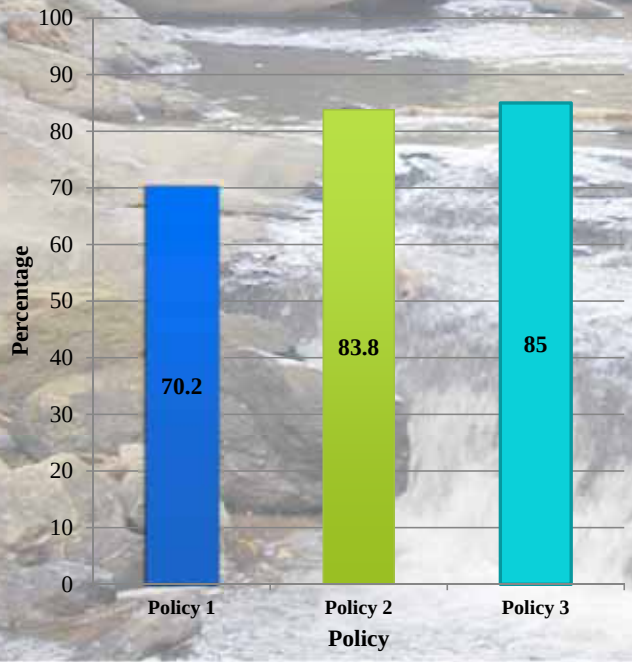
- Policy 1 required the lowest amount of impervious area to be managed of all three policies due to the largest trigger requirement - thus excluding a majority of the smaller projects.
- Policy 2 provided the second largest impervious area to be managed due to having a trigger that was most representative of the median project size.
- Policy 3 allotted the greatest amount of impervious area to be managed for due to the fact that no project had an area that was less than the trigger size of 500 sq. ft.

Results: Policy Detention Percentage



- Policy 1 provided a relatively low amount of detention for the 25, 10, and 2-year storm events
  - Due to the limited number of projects that were triggered into the calculation
- Policy 2 provided the greatest amount of detention according to all three requirements
- Policy 3 maintained the most detention for the 2-year storm-event, it provided the least detention for the 25 and 10-year storm-events even though it triggered the greatest number of projects

Results: Water Quality Percentage

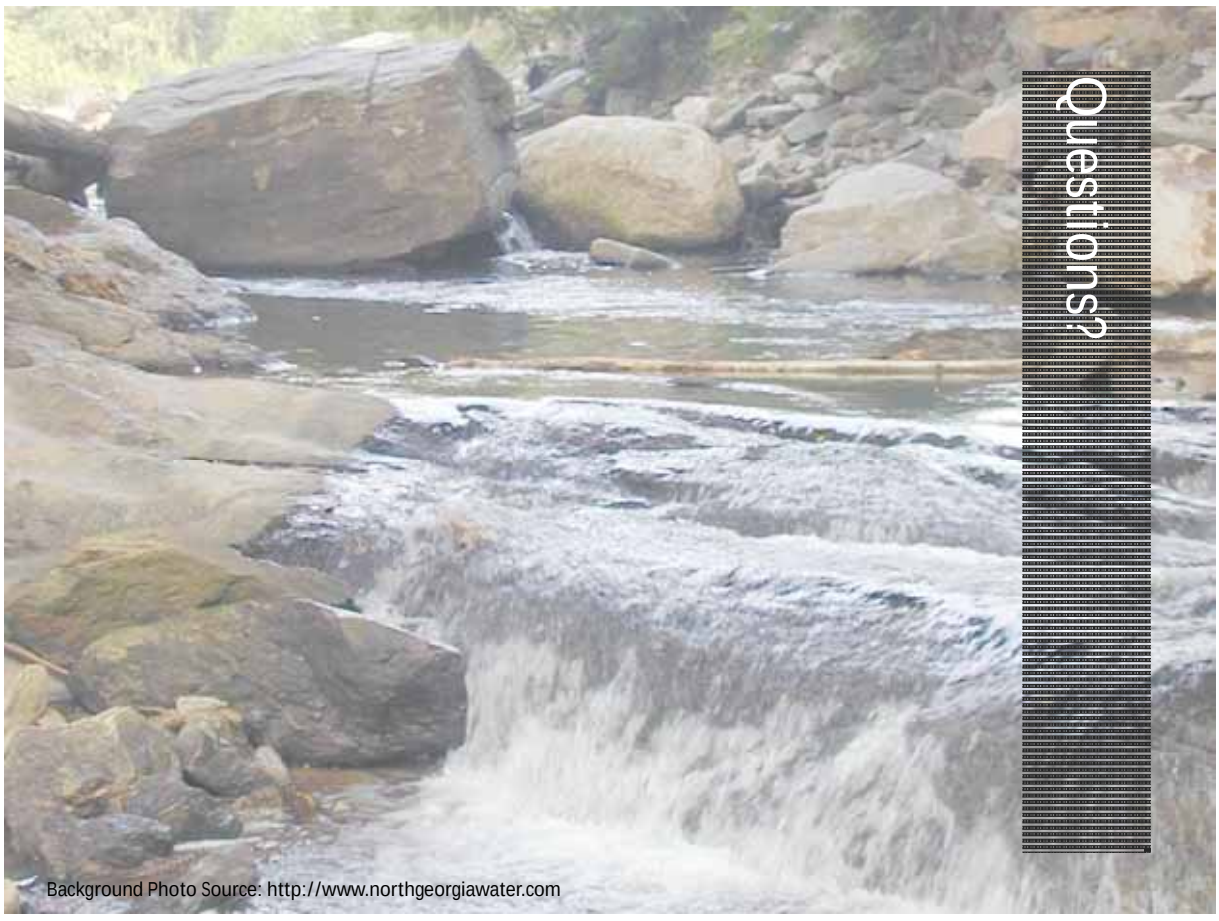


- Policy 1 provided the least amount to be managed for water quality
- Policy 2 required the second highest percentage to be managed for quality
  - it implemented 1.2% less than 85% required
- Policy 3 provided the highest runoff percentage to be managed for water quality and was the only policy to meet the full 85% annual runoff requirement

Discussions and Conclusions: Recommendations

- It is recommended that a municipality follow a similar process to determine what's appropriate for them.
- Every Community is Unique!!!
- The best solution comes from the intersection of:
  - Environment
  - Culture and Values
  - Development Types
  - Administrative Structure

Clean stormwater runoff poster
Photo Courtesy of: calntownship.org



Questions?

Background Photo Source: http://www.northgeorgiawater.com

Discussions and Conclusions

- What policy would manage the greatest amount of stormwater runoff and be the most beneficial to the community of Starkville and its watershed.
- Hypothesis – the policy with the smallest trigger requirement and the smallest detention requirement would manage the greatest amount of runoff.
  - The results = **the policy with a more average requirement, for both trigger and detention, managed the greatest volume of stormwater runoff** (Policy 2)
  - Policy 3 had smallest trigger and detention requirement but its detention requirement was not reflective of Starkville's rainfall volume.
- In order for a policy to manage the greatest volume of stormwater runoff, the trigger must be an accurate representation of the types and sizes of projects being built in an area and the detention requirement must reflect the rainfall volume of the region.
- **Every community is different**; therefore each city will have different project sizes that are being constructed as well as different occurring storm-event sizes.
- A municipality must evaluate their local rainfall volume and intensity, new-development conditions of their community, and recommend a stormwater management policy that is more specific to their unique needs.

Discussions and Conclusions: Limitations

- The data set represented new construction that exceeded 1,000 sq. ft. impervious
  - Minor technical hitch that caused the difference in the total projects triggered
- The runoff coefficient of .22 for pre-existing conditions
  - No way of calculating the preexisting conditions of each site
- Water quality requirement of 85% annual runoff only represents one measurement to water quality
  - Other policies measure three alternatives
- Time frame of the project data was form 2009-2011and occurred directly after an economic recession
  - May have affected the volume of projects constructed as well as the size

Stormwater Quality Design Atlanta, GA
Photo Courtesy of: Hughes, Good, O'Leary & Ryan Landscape Architects

Discussions and Conclusions: Future Research

- Management and maintenance of stormwater facilities
  - If a facility is to function in a sustainable manner, it should also be managed and maintained in a likewise fashion
- Case studies of successful sustainable stormwater management policies for communities to emulate
  - A municipality may have a better grasp on how to deal with their own watershed issues
- A study on the application of multiple policy trigger and detention requirements based on project size
  - Suggesting multiple policies for the different sizes of new construction that may occur within a community
- Financial assessment of stormwater management for large sites with large detention facilities that shoulder the financial burden of stormwater management vs. the smaller ones
  - Also, the prime real-estate used for large detention facilities

Stormwater drainage canal
Photo Courtesy of: Malmo Kommunala Bostadsbolag (MKB)