

Costs of Maintaining Stormwater Control Measures in North Carolina



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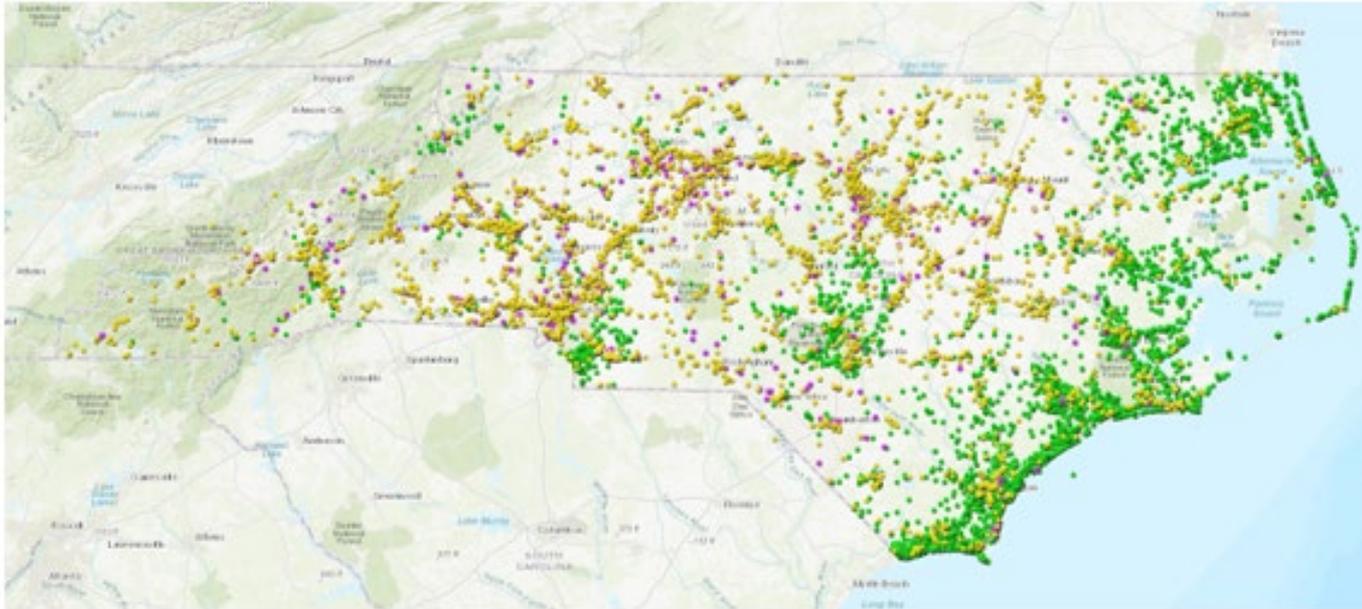
William Lord

North Carolina Regulations

- North Carolina Department of Environmental Quality (NC DEQ) requires signed and notarized maintenance plan for permitted stormwater control measures (SCMs)
- Permitted SCMs inspected on annual basis by Professional Engineer (P.E.) or Registered Landscape Architect (R.L.A.)

North Carolina Regulations

Active Stormwater Permits Map



North Carolina Regulations

Wet Pond



Wet ponds improve stormwater quality by holding stormwater over a two to five day period. A wet pond includes a forebay, a permanent pool, and a temporary

pool. A forebay is a separate smaller pond that is placed upstream of the main portion of the pond to trap suspended solids. A permanent pool is water that stays in the pond between storms to slow down stormwater and allow pollutants to settle out. A temporary pool is additional depth of water that is held and released over slowly after a storm.

[Wet Pond Inspection Form](#)

[Wet Pond Operation & Maintenance Webinar](#)



Impacts of SCM Maintenance

- Maintenance affects SCM performance:
 - Johnson and Hunt (2019) discovered bioretention cell performance in NC improved 17 years later
 - Willard et al. (2017) found bioretention cell performance in VA improved 7 years later
 - Bean et al. (2007) determined permeable pavement infiltration improved from 2 in/hr to 3.5 in/hr after maintenance

The “Mow, Blow, and Go” Method will NOT work!



Nor Will the “Spray and Pray Method”



SCM Maintenance vs. Landscaping

- Landscapers observe plant material and use soil and tissue analyses to fertilize for good plant nutrition
- SCMs built to **remove** nutrients (TN and TP); plant growth secondary concern
- Adding fertilizer to SCMs causes nutrient export



SCM Maintenance vs. Landscaping

- Using SCM maintenance companies ensures:
 - Issues identified and corrected before annual inspection
 - SCMs meet permit requirements while aesthetically pleasing
 - More cost effective to routinely maintain SCMs



Bioretention Cell/Rain Garden Maintenance

- Routine maintenance includes:
 - Removing trash
 - Inspecting components (inlet(s), outlet, cleanouts)
 - Pruning and replacing woody vegetation
 - Mowing
 - Removing sediment from surface

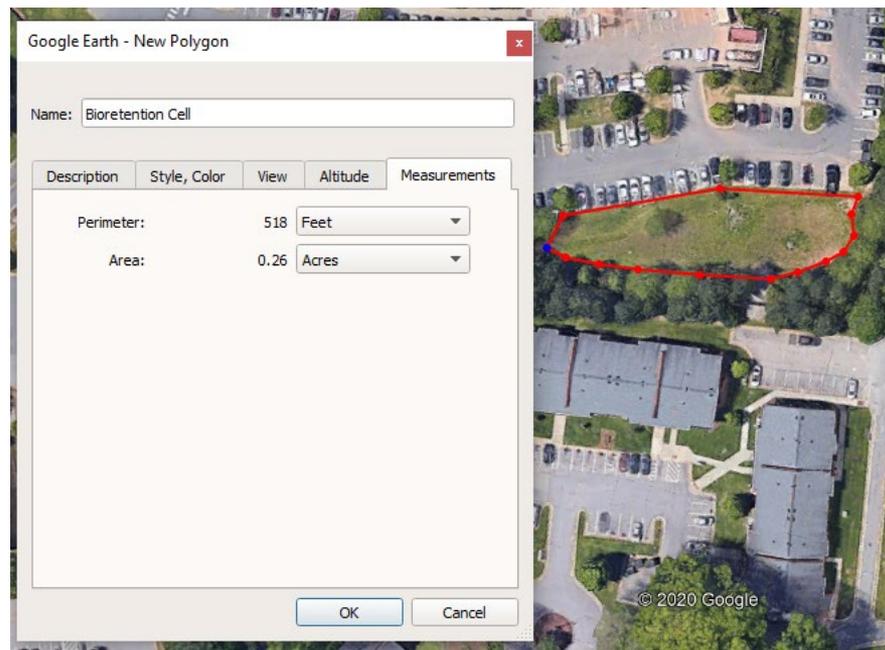


Bioretention Cell/Rain Garden Maintenance

- Anticipated routine maintenance costs:
 - Mulched: \$14,052 to \$16,682 per ac of bioretention cell per year
 - Grassed: \$12,646 to \$28,103 per ac of bioretention cell per year
- Expected inspection cost:
 - \$585 to \$1,464 per SCM

Bioretention Cell/Rain Garden Maintenance

- Need to know surface area of bioretention cell to project routine maintenance costs
 - Review design/as-built plans
 - Estimate using Google Earth

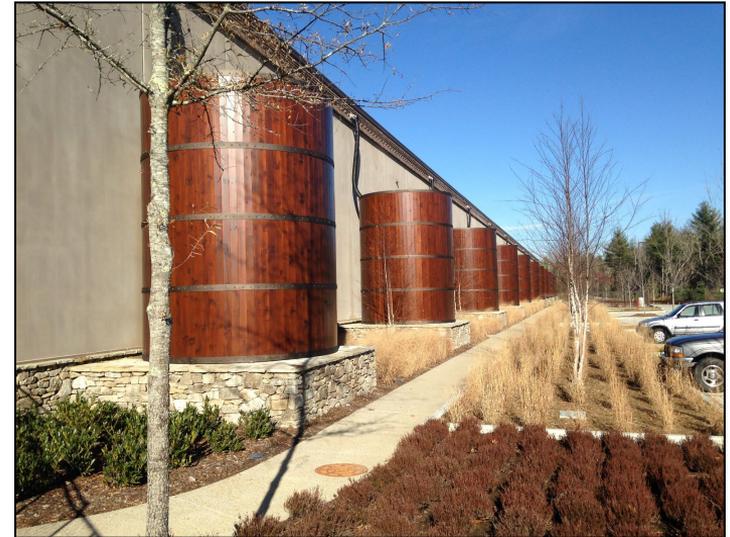


Bioretention Cell/Rain Garden Maintenance

- Typical bioretention cell surface area is 0.13 ac
- Estimated O&M costs for mulched bioretention cell:
 - 0.13 ac * \$14,052/ac-yr → \$1,756 per yr
 - 0.13 ac * \$16,682/ac-yr → \$2,108 per yr
- Anticipated annual inspection cost:
 - \$585 to \$1,464 per SCM
- **Expected annual costs: \$2,342 to \$3,571**

Cistern/Rain Barrel Maintenance

- Typical maintenance includes:
 - Inspecting and repairing all leaks
 - Cleaning gutters
 - Unclogging screens and filters
 - Inspecting distribution system (e.g., pump)
 - Flushing out cistern



Cistern/Rain Barrel Maintenance

- Anticipated routine maintenance costs:
 - \$1,756 to \$2,108 per cistern per year
- **Expected annual costs: \$2,342 to \$3,571**



Permeable Pavement Maintenance

- Typical maintenance includes:
 - Stabilizing surrounding area
 - Vacuuming or sweeping surface
 - Inspecting observation well(s)
 - Annually testing infiltration
- Anticipated routine maintenance costs:
 - **\$0.75 to \$1.16 per sf of permeable pavement**



Downspout Disconnection/Swale Maintenance

- Typical maintenance includes:
 - Removing any trees/shrubs in designated vegetated area
 - Unclogging gutters
 - Removing excess sediment or debris from drainage area
 - Maintaining non-clumping vegetation at height of 3 to 4 inches
 - Swale vegetation should be between 4 to 6 inches

Downspout Disconnection/Swale Maintenance

- Estimated routine maintenance costs – DIS:
 - **\$148 to \$3,607 per ac of DIS per year**
- Anticipated routine maintenance costs – Swale:
 - **\$40 to \$187 per length of swale per year**



A Little More About Mowing

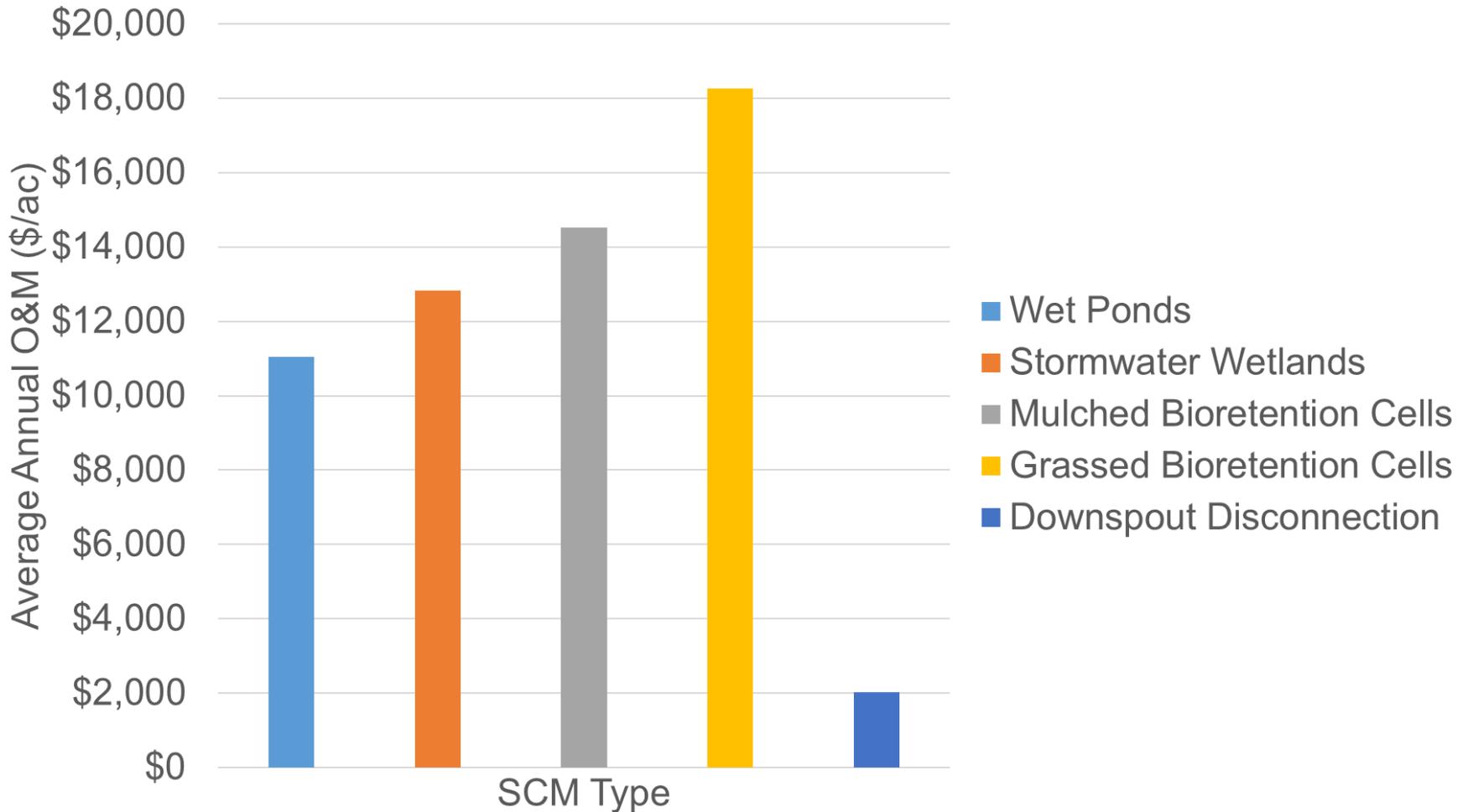
- Don't mow after rain/soggy conditions
 - More water than nature intended
- Be careful with lowering mower
 - Scarring



Wet Pond/Wetland Maintenance

- Typical maintenance includes:
 - Removing trash and invasive vegetation
 - Replanting as needed
 - Inspecting components (inlets, outlet, forebay)
 - Removing vermin (beavers, muskrats) as needed
- Expected routine maintenance costs:
 - **\$6,323 to \$17,799 per ac of wet pond/wetland per year**

Average Annual Routine Maintenance



- Wet Ponds
- Stormwater Wetlands
- Mulched Bioretention Cells
- Grassed Bioretention Cells
- Downspout Disconnection

Questions?

SCM O&M Resources:

- <https://stormwater.bae.ncsu.edu/resources/>

SCM O&M Training:

- <https://www.bae.ncsu.edu/workshops-conferences/>

SCM O&M Costs:

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