Wake County Stormwater and Green Stormwater Infrastructure Best Practice Summary

Introduction

The purpose of this document is to summarize best practices for stormwater management and Green Stormwater Infrastructure (GSI) based upon expertise of stormwater practitioners represented on the Wake County Water Partnership. This document is intended to be used as a resource for jurisdictions seeking to advance stormwater management programs, with a particular focus on integrating GSI. Information covers a range of topics including policies, modeling, maintenance as well as GSI incentive programs and project examples. This document is not intended to be all inclusive but is a living document that will continue to evolve as science and stormwater policies evolve.

The GSI Subcommittee will reevaluate this document on an annual basis to update information based upon the current state of knowledge and local practice applications.

Policies

Existing

- Holly Springs: Drainage Policy requires developers to update basin Hydrology and Hydraulic (H&H) model as new development projects are proposed upstream or downstream of known drainage concerns.
- Cary: Peak flow attenuation rules moved to floodplain ordinance rather than water quality/stormwater ordinance so that peak flow attenuation will not be impacted by changing state regulations. Stormwater Policies updated in 2022 to form basis for incorporating additional GSI. The Land Development Ordinance (LDO) Environmental Regulation chapter encompasses: Tree Clearing Certificate, Urban Transition Buffers, Illegal Discharges to the Storm Sewer System, Soil Erosion and Sedimentation Control, Nuisance and Hazard Control Standards, and the Flood Damage Prevention Ordinance which is aligned with the Community Rating System (CRS) program. GSI is incorporated into 2040 Community Plan.
- Raleigh: Lead by Example GSI Evaluation Policy requires evaluation of GSI on City-led development. Raleigh's updated Stormwater Design Manual (2024) includes more on GSI.

- Asheville, NC policy: Permeable pavement whenever above minimum parking lot requirement.
- Garner: Garner Forward Comprehensive Plan stipulates that natural stormwater management strategies will be incorporated in new developments or stormwater restoration projects and that green streets for stormwater management will be considered in areas of the community. These measures are evaluated as staff makes recommendations to Town Council on a proposal's conformity to the comprehensive plan during a rezoning request.
- Apex: Peak flow attenuation rules are set Town-wide and are these regulations are stricter in certain basins with known flooding issues (Upper Beaver Creek basin and Upper Northwest Tributary to Williams Creek basin). UDO and Town code regulations include riparian buffer protection, prevention of illegal discharges to the stormwater system, soil erosion and sedimentation control, and the flood damage prevention overlay district. In Fall 2025, Apex started requiring GSI to be implemented and at the very least, evaluated for all Town projects.

In Development

- Knightdale: Stormwater as focal features; stormwater features serve as amenity and bring to forefront.
- Charlotte, NC: Looking at removing wet ponds, incentivizing GSI.
- Cary: Pursues Public/Private Partnerships with developers to address legacy stormwater issues with new development. Basin models provide shovel ready projects that compliment new development, easing the burden rezoned cases can manifest, allowing a comprehensive approach to stormwater in a cost-effective manner.
- Raleigh: GSI Master Plan in development in 2026.
- Garner: Staff is working on a GSI toolbox to aid in selection of appropriate measures to recommend on a site-by-site basis as Town Council seeks stormwater controls above and beyond regulatory requirements as a condition of rezoning requests.

Incentives

- Raleigh Rainwater Rewards: Program provides cost-share funding for GSI projects. Applicants may receive up to 90% cost-share funding depending on location in watershed. A subsidy program added in April 2023 also provides 100% funding for GSI projects on private property for eligible community members that fall within disproportionately impacted areas and meet income/rental thresholds.
- Cary GSI Grant Program: Program encourages the use of GSI on new development and redevelopment projects and aims to lead by example by incorporating GSI measures for projects on Cary-owned properties and within the public right-of-way. The GSI grant program launched in April 2024 and is designed for property owners who wish to install GSI on their property. The

program provides reimbursement of up to $5,000 for eligible GSI measures that are installed on privately owned properties or lots within subdivisions that don't have an existing stormwater control measure.
- Holly Springs Street Tree Grant Program: Program assists Holly Springs residents, HOAs, and property owners with planting and replacing dead or dying street trees along Town streets.

Modeling

- Holly Springs: See Drainage Policy above. Developers update existing models and provide data to Town as new developments initiated.
- Cary: Development of basin models support infrastructure and SCM maintenance and open space initiatives for flood mitigation. Completed models for both Walnut Creek and Swift Creek basin. Leverage modeling data to fix known infrastructure and SCM issues as redevelopment occurs. Promotes cost-efficient solutions without slowing the permitting process, fosters partnerships with developers. Installation of sensors and rain gauges in the basins supports model calibration and helps identify GSI opportunities within basins.
- Morrisville: Stormwater Drainage System Inventory Map used to help build town-wide model and develop capital project list.
- Durham: Watershed Stormwater Management Models (SWMM/PCSWMM) models as part of Watershed Improvement Plans to evaluate areas of pollutant loading and perform scenario analysis. Models developed for: Eno River, Little Lick Creek, New Hope Creek and Little Creek, Ellerbe Creek, Northeast and Crooked, Third Fork Creek watersheds.
- UNC Chapel Hill: Campus-wide SWMM model to support stormwater management for existing and future development.
- Raleigh: Developing nutrient and sediment models citywide in Watershed Improvement Plan (WIP) Tools, a planning level, GIS-based model that calculates annual upland and stream loads. Developing PCSWMM models for each watershed to evaluate conveyance infrastructure and storage capacity of GSI for larger scale features through watershed studies, and models are available to develop site scale models for local GSI once the study is complete.

Planting

- Raleigh: Coordinated with gardeners and maintenance staff to identify plants for City-led projects in parks and right-of-way; developed design charette and supporting resources. Eliminated the use of all invasive plants as listed in both the Extension Gardener Plant Toolbox and the Invasive Plant Council of NC; developing a City-wide policy to eliminate the use of invasive species.
- Cary: Developed table of plant species and best placement.

Maintenance

- Cary: Maintenance shifted to the Stormwater Division allowing greater flexibility in expanding the GSI initiative. Cary promotes and maintains new development non-regulatory GSI in right-of-way as part of public-private partnership.
- Raleigh: Centralized stormwater maintenance for City projects under Stormwater Department. Dedicated staff for GSI Maintenance located with Parks Dept. and funded with Stormwater Fees.
- Apex: Contracted SCM Maintenance company for all Town-owned SCMs and any new GSI.
- All Jurisdictions follow NCDEQ Stormwater Control (SCM) Design Manual: NCDEQ Stormwater Control Measure (SCM) Design Manual used for design and maintenance

Data Mapping

- Morrisville: Stormwater Drainage and System Inventory Map
- Holly Springs: Stormwater Complaint Map
- Cary: Storm drainage system mapped in ESRI ArcMap, AGOL, and ArcPRO. Mapped SCMs support post-construction management of over 1,400 SCMs. Work has begun to incorporate GSI data management and mapping.
- Garner: Stormwater infrastructure, drainage complaints, illicit discharge investigations, and outfall screenings are mapped in ArcGIS.
- Raleigh: Developed internal data maps for Raleigh Rainwater Rewards and has an internal SCM layer containing over 2,900 SCMs. Efforts are being made to update the individual SCM device layer with additional details per device and track GSI installations. A data management plan and enhancements to internal dashboards are underway. Developing a citywide Watershed Improvement Plan model, which can be used to identify opportunities for GSI and quantify the benefit. Developed a public-facing GSI StoryMap, which includes a GSI Tour and link to the GSI Visual Monitoring StoryMap(s).
- NCDOT: SCMs are included in NCDOT Highway Stormwater Environmental Sensitivity Map
- Apex: Watershed Protection Overlay Map searchable by address. Stormwater Utility Fee Map that is searchable by address and includes information on residential and non-residential monthly stormwater fees.

Partnerships

- Cary: Cary promotes partnerships early in the planning phase using basin modeling and developer agreements. New developments incorporate regulatory and non-regulatory GSI (through developer agreements).
- NC Department of Transportation (NCDOT): NCDOT partners with Wake County

and municipalities to construct SCM retrofits. Projects currently underway with Cary, Holly Springs, Wake Tech Southern Campus, and Morrisville.

- Walnut Creek Watershed Action Team (WAT): Federal, state and local partners participate in WAT to promote floodplain/stormwater and water quality improvement in the Walnut Creek watershed. Participants include Cary, Raleigh, Wake County, NC State University, NC Water Resources Research Institute (WRRI), NC Dept. of Environmental Quality, NCDOT, United States Geological Survey (USGS), Partners for Environmental Justice (PEJ) and Carolina Wetlands Association.
- Walnut Creek Community Partnership: Collaborative effort that supports community engagement and watershed improvement. The Conservation Fund is supporting through Parks with Purpose initiative. Online Watershed Action Plan identifies and tracks project opportunities.
- Raleigh: Partnering with Urban Sustainability Solutions, LLC on the high school rain garden apprenticeship program with Wake County Public School teachers and students. The GSI maintenance crew is also partnering with Partners for Environmental Justice on volunteer maintenance events.

Example Projects

- Morrisville: Large, constructed wetland SCM across from Town Hall to support future priorities. Stormwater wetland serves as amenity and aesthetic; incentive for developers coming into downtown so developers don't have to build SCM directly with development.
- Wake County: Beech Bluff County Park designed to meet Sustainable SITES Initiative certification which considers landscape in site plan and design; project includes integrated stormwater management-grass swales, bioretention, permeable pavers, rainwater harvesting and education.
- Downtown South Project: Establishment of Riparian Corridor Fund as part of rezoning conditions. Fund used as matching grant funds for water quality improvement/flood mitigation projects in larger watershed. Local stakeholders key to establishment of fund.
- Garner: Incorporating GSI into Yeargan Park design.
- City of Durham: Pursuing Equitable Green Infrastructure Project.
- Cary: Regional stormwater wetland in Swift Creek watershed near downtown will help mitigate existing flooding issue. Permanent drainage associated with stormwater wetland helps address runoff associated with new development. Raingarden, permeable pavers, and Silva Cells installed at Historic Ivey Ellington home that was relocated to the former library site on Academy St. Cary has five additional GSI projects in downtown installed through Public/Private partnerships and several others currently under construction.
- NC Water Resources Research Institute (WRRI): WRRI is partnering with NCSU Bio & Ag and local hotel in Cary to install Low Impact Development (LID) with support from NCDWR 319(h) grant. An underground infiltration device will be studied as part of grant.

- Cary: Awarded a $1.9 million grant to improve stormwater management and water quality in the Walnut Creek corridor from the downtown park to Cary Towne Boulevard by incorporating open space, riparian buffer, stormwater management, floodplain management, tree canopy, GSI, linear park and greenway trail integration. Cary is pursuing purchasing floodplain and riparian buffer corridor for the entire reach. Cary is also on the final list for approval for $1.1M grant for stream stabilization and stormwater management along the Walnut Creek corridor from Cary Towne Blvd to I-40.
- Raleigh: Raleigh is advancing various GSI initiatives. Recently completed GSI projects are included in the Dix Park Gipson Play Plaza. GSI will be incorporated into Raleigh's new City Hall/ Civic Campus and Smoky Hollow Park, as well. For additional information and to see our GSI online tour, visit: Green Stormwater Infrastructure Initiatives.

Funding

- Stormwater Utility fees fund projects in Raleigh, Holly Springs, Apex, Morrisville, and Wake Forest
- Debt financing
- Raleigh plans to issue revenue bonds for stormwater FY 25
- Budget allocation- Cary has recurring appropriation from Utility Fund balance that is roughly equivalent to 15 cents per 1,000 gallons water consumed by Cary Customers that will be applied to Jordan Lake One Water
- Public-Private Partnerships
- Grants:
    - NCDEQ Financial Resources for Watersheds Water Quality, Cost-Share, Grants and Loans
    - USEPA: Green Infrastructure Funding and Technical Assistance Opportunities
    - Watershed Stewardship Network Funding Site: Sustainable Funding Resources
    - State and Tribal Assistance Grant (STAG) funding: Cary received $900,000 to support Swift Creek sensors and modeling.
    - Land and Water Fund
    - NCDEQ Water Resources Development Grant

Integrated Water Management

- Cross-communication between stormwater, planning, general services, parks and recreation departments helps facilitate coordinated stormwater management and support GSI projects that provide co-benefits.
- Cary: Coordinates across departments and is incorporating GSI into the 2040 Community Plan
- Raleigh: Works across the organization through staff in Stormwater Plan Review and Water Quality, including two "GSI Advocates", to implement GSI evaluation

early in design and support above and beyond GSI with supplemental funding. GSI Maintenance is coordinated between Raleigh Stormwater and Raleigh Parks. Service Level Agreements/MOUs are being developed between Stormwater and multiple internal departments, such as Transportation and Parks, to ensure long-term sustainability of GSI. Raleigh is working on developing agreements with the Wake County Public School System for collaboration on project implementation and maintenance on school sites and shared sites.

- Wake County: Coordinates with Housing Affordability and Community Revitalization Dept.to identify potential opportunities to integrate GSI into future affordable housing projects.
- Wake County: Facilitates flood coordination meeting to identify data sharing opportunities/needs, regulatory updates, and pilot project opportunities with municipal partners and the following County departments: Parks, Recreation and Open Space, Emergency Services, GIS, Planning, General Services Administration, Environmental Services, Soil and Water Conservation District.
- Wake County: Completed a fifty-year One Water Plan that integrates all water planning (water supply, wastewater treatment, stormwater and flood management, and groundwater protection) with County and municipal development and transportation planning.

Education

- Walnut Creek Community Partnership: Informed community helps promote GSI in rezoning, development efforts.
- Partners for Environmental Justice (PEJ): PEJ partners with City of Raleigh, Cary and other partners to develop the Walnut Creek Watershed Learning Network, a six-week community engagement and empowerment initiative.
- Cary: Grant funding supported partnership with NCSU Extension to produce Rain It In video series on GSI. Collaboration between Stormwater Division and Environmental Outreach Program Coordinator in Parks & Rec to advertise GSI grant program and develop additional opportunities and events; examples include Creek Week activities and “Creating a Raingarden” classes.
- Wake County Green Schools Partnership: Collaborative group of schoolteachers, administrators, environmental educators, parents, businesses, university and government partners that share a common goal to increase school sustainability and environmental literacy. GSI is one of the focus areas of this group.
- GSI StoryMaps provide visual examples of GSI projects for public:
    - Green Stormwater Infrastructure in Raleigh
    - Green Stormwater Infrastructure in Wake County
- Raleigh is partnering with Urban Sustainability Solutions on a new high school rain garden apprenticeship program. Raleigh also offers the following Stormwater contests and awards: Stormwater Capture It! Art Contest (2025 theme highlights GSI) and new Stormwater Smart educator award.

Resources

- City of Raleigh Menu of GSI-based conditions for rezoning
- NCDEQ Stormwater Control Measure (SCM) Design Manual
- ACTION PLAN FOR NATURE-BASED STORMWATER STRATEGIES: Promoting Natural Designs that Reduce Flooding and Improve Water Quality In North Carolina

Stormwater Research

- NCDOT's Research & Development Office partners with NCDOT units, universities and business partners (including local governments) to fund research projects and solicits new research ideas on an annual basis. Applicants are encouraged to partner with a NCDOT unit on project proposals. Application information is available on NCDOT's Research & Development website. A comprehensive list of past research and ongoing research projects is available: on NCDOT Research Projects page.
- United States Department of Agriculture (USDA) Forest Service publications. 2011 Boggs and Sun publication: Urbanization alters watershed hydrology in the Piedmont of North Carolina.
- Dr. Bill Hunt, Dr. Sarah Waickowski and Bill Lord 2021 publication: Maintenance Costs of Stormwater Control Measures (SCMs) in North Carolina.
- Raleigh is partnering with NCSU to monitor the performance of its subsurface gravel wetland at Walnut Creek Wetland Park.

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