

Green Stormwater Infrastructure Adoption in PA among Small-to-Midsize Communities

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What we will be presenting:

Pennsylvania ranks among the top five states in the U.S. for flood-related disaster declarations since 2000. Yet many communities struggle with effective stormwater management. Green stormwater infrastructure (GSI) helps reduce the amount of water that runs off and improves the quality of that water, but not all communities embrace GSI. Much of what we know about what helps or hinders GSI stems from research on large cities, leaving important gaps in knowledge about smaller communities. Our project examines the state of GSI adoption and drivers and barriers to GSI across small- to medium-sized communities in Pennsylvania.

What the audience will learn:

In this talk, the audience will learn about green stormwater infrastructure, known drivers and barriers or adoption learned mostly from large cities, and preliminary results from our survey of small-to-mid-size municipalities in Pennsylvania. The survey includes information about adoption rates and what helps/hinders adoption. We will include time for discussion and feedback.

Regulation Changes in Water Resources Industry- Challenges and Opportunities

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What I will be presenting:

Sweeping changes in guidance manuals and publications from different government and reviewing agencies across the water resource industry are set to reshape both design practices and what water resource infrastructure will look like in the future. These evolving changes have caused us to rethink our approach to our designs, while also considering inspection and maintenance procedures during and after the construction. This presentation will go over few notable changes in PADEP NPDES submission and PennDOT DM-2 requirements that impact the design. While these changes have introduced challenges, especially on large-scale projects that cannot be submitted for review within 6 months' grandfathering period, they also present an opportunity to utilize novel approaches and tools to our designs. Preliminary screenings will provide opportunity to take proactive action to overcome these challenges which tend to impact projects on cost and time at the last minute. This presentation will highlight JMT's experience on designing stormwater control measures in Tinicum Island Road Relocation Project at Philadelphia International Airport's (PHL) and I-80/81 Bridge Program in PennDOT District 4-0 at Luzerne County, PA. The presentation will review how regulatory changes were navigated for these projects and outline the strategies used to successfully adapt and meet evolving requirements.

What the audience will learn:

Attendees will gain practical insight into tracking and evaluating the impact of these regulation changes on projects. Proactive effort to gauge project timeline and design stages will help designers to evaluate the potential impact on projects due to regulatory changes. This will further allow adequate time to coordinate with clients and agencies to ensure alignment across the project team. The presentation will emphasize the value of constant communication and understanding that are critical to meeting the regulatory goals. The session will outline JMT's lessons from recent experience, while outlining opportunities to implement new approaches to stormwater management to meet regulatory requirements. Participants will learn about the short-term and long-term impact of these changes including but not limited to ROW acquisitions, SCM types and design standards, long-term operation and maintenance. Attendees will leave with practical strategies to navigate these regulatory shifts, leverage opportunities, and successfully deliver projects on schedule and within budget.

Ordinance Auditing as Governance Diagnosis: Identifying Municipal Governance Pathways to Green Stormwater Infrastructure Adoption in Three Pennsylvania Cities

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What I will be presenting:

Green stormwater infrastructure (GSI) delivers cost-effective stormwater management with substantial co-benefits. Local ordinances ultimately determine what GSI can be built, where, and on what terms, but there is scant research on the role of ordinances in GSI implementation. This is especially true for the thousands of small and small-to-medium communities across the U.S. Moreover, we lack tools to help these under resourced communities understand whether (or not) and how their own ordinances help or hinder GSI adoption. The aim of this work is to develop a GSI ordinance audit tool (GOAT) tailored to the needs of under-resourced communities and to explore its diagnostic potential through application. We developed GOAT, an 18-provision instrument across four ordinance types (zoning, subdivision and land development, stormwater management, and street design), informed by practitioner interviews and triangulated with peer-reviewed and grey literature. We applied GOAT to Philadelphia, Lancaster, and Erie operating under Pennsylvania's common regulatory framework. In this exploratory three-city application, the tool unearthed three distinct governance pathways: Parallel Framework Implementation (Philadelphia), Model Ordinance Adoption with Policy Window Coordination (Lancaster), and Model Ordinance Adoption with Limited Horizontal Integration (Erie).

What the audience will learn:

The audience will leave with a better understanding of a GSI ordinance audit tool that small and small-to-medium communities may use as a first-step assessment of where their own ordinances enable or constrain GSI adoption. For researchers, the tool offers a candidate instrument for broader testing across Pennsylvania communities and for cross-state validation, opening empirical questions about whether the three governance pathways identified here are stable at scale; whether additional pathways emerge under different combinations of enforcement pressure and institutional capacity; and what contextual factors predict pathway membership. For state agencies and policymakers, the early takeaway is that the tool may surface a range of governance configurations communities are operating in, each of which may warrant a different intervention. Rather than applying a single uniform reform strategy, state agencies could use the tool to inform how technical assistance, model ordinance guidance, and compliance support are calibrated to the governance pathway each community has adopted, an approach more likely to translate into measurable GSI uptake on the ground.

Differential Impact of the Green Area Ratio and Stormwater Regulation in Washington DC

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What we will be presenting:

This presentation will explore the outcomes and interactions between stormwater regulatory innovations supporting Green Infrastructure in Washington D.C. and consider implications for other cities. Utilizing a dataset of 2,478 Stormwater Best Management Practice Plan approvals between January 2015 and August 2025, we assessed trends in the selection of Green Infrastructure on private properties complying with one or both of two regulations. These are: 1) the Green Area Ratio (GAR), a flexible, performance-based zoning regulation which allows developers to meet environmental targets through a variety of landscape strategies; and 2) stormwater management regulations, which mandate on-site retention of a 0.03 m storm event for major land-disturbing activities and a 0.02 m storm event for major substantial improvements. The smallest 19% of regulatory plan approvals (482 properties) were subject only to GAR. Properties complying with both regulations are significantly more likely to install green roofs, bioretention, permeable pavement, and tree planting than properties complying with SWMP regulations alone. In Washington DC, the GAR functions as a supplement to stormwater regulations shifting compliance towards multibenefit Green Infrastructure practices which contribute to city sustainability goals beyond hydrologic performance.

What the audience will learn:

- Recognize the structure of two regulatory innovations in Washington DC: stormwater regulations and the Green Area Ratio.
- Understand the differential impact of these complementary yet divergent regulations on Green Infrastructure implementation on private property.
- Consider applications of these regulatory innovations in other communities seeking to increase Green Infrastructure construction to address urban resilience and environmental sustainability.

From Assessment to Implementation: A Replicable Model for Green Stormwater Infrastructure in the Brandywine–Christina and Chesapeake Bay Watersheds

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Highlights

- Watershed-based pipeline advances GSI projects from assessment through implementation
- Replicable model expanded from Brandywine–Christina to Chesapeake Bay watershed
- Adaptive design and partnerships improve project success and scalability

Introduction

Stormwater runoff remains a leading source of nonpoint source pollution, contributing to degraded water quality, increased flooding, and loss of ecological function across both urban, suburban, and rural landscapes. Green Stormwater Infrastructure (GSI) has been established as a practical, cost-effective approach that mimics natural hydrology to manage runoff at its source while providing environmental and community benefits (Brandywine Conservancy, Brandywine Red Clay Alliance 2025).

The Brandywine Conservancy has developed a comprehensive, watershed-based GSI program that advances projects from initial assessment through design and implementation, first within the Brandywine–Christina Watershed and now expanding into the Chesapeake Bay Watershed. This partnership-driven model integrates planning, funding, and community engagement to achieve measurable improvements in water quality and quantity while advancing long-term watershed resilience.

Background

The Brandywine Conservancy's approach to GSI is grounded in a watershed-based, replicable methodology that advances projects from identification through implementation while maintaining flexibility to adapt to site-specific conditions. This process integrates GIS screening, field validation, stakeholder engagement, and strategic funding to create a replicable project pipeline.

The methodology begins with watershed-scale screening to identify priority areas based on land use, impervious cover, hydrology, and proximity to impaired streams. Windshield surveys and outreach to municipalities and landowners ground-truth these findings and refine a targeted list of candidate sites, with emphasis on high-visibility, public, commercial, and institutional properties. Field-based assessments evaluate drainage patterns, infrastructure, soils, and constraints to inform preliminary concepts using a treatment train approach that captures and infiltrates stormwater at its source. Projects are advanced into conceptual designs, including mapping and preliminary BMP cost estimates to support funding applications. Next, construction-ready designs are created through collaboration with landscape architecture and/or engineering firms. Designs incorporate feedback throughout the process from partners and site conditions, with adaptive problem-solving addressing challenges such as infiltration limitations.

Funding strategies are developed in parallel, leveraging federal, state, municipal, and private sources to support projects at different stages. Implementation is conducted with contractor oversight, followed by post-construction monitoring and modifications as needed.

Community engagement is integrated throughout, with projects located at highly visible sites, supported by educational signage, outreach materials, and site tours. Partnerships with organizations such as White Clay Wild & Scenic and Wissahickon Trails as well as other local partners have informed program development and ensured alignment with regulatory frameworks, including MS4 requirements. Additionally, generous support from the William Penn Foundation was instrumental in helping advance and strengthen this program.

Key Findings

The Conservancy's work demonstrates that a structured pipeline, from assessment through implementation, is an effective and replicable model for advancing GSI projects. Early investment in GIS screening, field validation, and relationship-building improves project feasibility and accelerates implementation by reducing uncertainty and strengthening landowner buy-in. Prioritizing visible, community-centered sites increases engagement and long-term stewardship, allowing projects to function as both infrastructure and educational assets. This highlights the importance of pairing GSI with outreach and education.

Adaptive design emerged as a critical factor in project success. At one municipal site, a rain garden experienced poor infiltration following installation. The system was retrofitted, restoring functionality and demonstrating the importance of flexibility and post-construction evaluation.

Innovative practices such as biochar-amended basins enhanced pollutant removal while remaining adaptable to site constraints. Leveraging multiple funding sources across project phases has also been essential for maintaining momentum and expanding implementation capacity. Strong partnerships were critical as they supported implementation, outreach, and regulatory alignment through coordination with peer organizations, municipalities, and conservation districts. Additional partnerships are also being explored with programs such as the Penn State Master Watershed Steward Program.

Finally, the program's expansion into the Chesapeake Bay watershed demonstrates that this structured, yet flexible model can be successfully replicated across geographies. Core components remain consistent while allowing adaptation to local conditions, providing a practical framework for watershed-scale GSI implementation.

Recommendations

Future GSI programs should prioritize watershed-scale screening, field validation, adaptive design, post-construction evaluation, and proactive maintenance planning to strengthen implementation pipelines and long-term project performance. Continued leveraging of funding and partnerships remain critical to expanding watershed-scale restoration efforts. Upcoming work will focus on developing stewardship guidelines and maintenance timelines for commonly implemented GSI practices, recognizing that long-term maintenance is critical to the success and sustainability of GSI projects.

Lessons Learned

- Adaptive management and post-construction evaluation are essential, as site-specific challenges may require modifications after installation.
- Long-term project success depends not only on implementation, but also on proactive maintenance planning, education, and sustained partnerships.

References

Brandywine Conservancy, Brandywine Red Clay Alliance. (2025). Guide to Green Stormwater Infrastructure.