Stormwater Stories: Communicating Triple Bottom Line Benefits of Green Infrastructure

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Highlights

- Finding a client's key connection to stormwater
- Using a variety of media as tools for communicating stormwater ideas
- Communicating the triple bottom line benefits of green stormwater infrastructure

Introduction

In designing stormwater systems to meet the goals of private and public clients, engineers must employ persuasive strategies to promote green infrastructure-based approaches by identifying each client's unique connection to stormwater management. Communication between engineers versed in the technical aspects of design and clients who may not be familiar with regulations and physical constraints can inhibit effective partnerships. This paper highlights different case studies in identifying partner needs and utilizing a variety of tools to communicate with partners and realize their goals.

Background

Identify Partners' Connection to Stormwater

The partnership between engineers and clients attempting to implement stormwater strategies begins with understanding the client's connection to stormwater. Why are they interested in constructing a stormwater system? What are their stormwater management needs? Several case studies reflect the variety of responses engineers may encounter. For instance, in approaching the City of Hoboken's Northwest Resiliency Park, the design team researched and discussed the localized flooding issues the City needed the park's infrastructure to manage. The goal of stormwater management for this project is to prepare for increased flood events due to climate change and protect social and physical infrastructure. In discussing stormwater needs with Allentown Borough for Sgt. George Ashby Memorial Park, the community sought to incorporate sustainable elements within their park through the use of stormwater gardens. Flood management was less of a concern for this client and community members were attracted to stormwater as a tool for habitat creation. The perspective of private developers was highlighted through the process of updating the New Jersey Developers Green Infrastructure Guide for New Jersey Future. The developers present at stakeholder meetings made it clear that stormwater was often a regulatory obstacle to development. They needed stormwater systems that would best serve a development in terms of cost, marketability, and long-term maintenance constraints.

Communication Tools for Stormwater Strategies and Opportunities

Once needs are identified, the engineer must effectively communicate with partners regarding potential solutions. Several case studies demonstrate the effectiveness of deploying a variety of communication tools depending on the particular project and partner. Tools may include written documents, as in the case of the New Jersey Developers Green Infrastructure Guide. This guide provides concise explanations of regulatory requirements, strategies for meeting regulations, benefits of implementing green infrastructure, and case studies. The stakeholder group involved in this project was less interested in reading regulations directly and found the format of the guide more consumable. Providing digital access to the guide on mobile devices was also important to this group. Other strategies may include graphic renderings, as in the case of New Jersey Future's online Municipal Toolkit. Before and after renderings of a street transformed into a complete street with green stormwater infrastructure provides municipalities with an appealing vision for future streetscapes. The science of stormwater systems and regulatory requirements can also be conveyed through the use of videos. A stormwater video series developed by Engineering & Land Planning Associates in partnership with Landau Design + Technology explains updated New Jersey stormwater regulations, the benefits of green infrastructure for both private and public developers, and how to leverage the triple bottom line of green infrastructure. Different videos within the series target different audiences and how to meet that audience's stormwater management goals. The animation style and short-form content make the topic accessible for those less likely to connect to written explanations. When communicating directly with large community groups, charette diagrams can serve as a two-way communication strategy, in which the engineer can identify stakeholder stormwater goals and the community can engage with stormwater as a public amenity. In the case of the Northwest Resiliency Park, a unique profile charette diagram allowed participants to imagine stormwater as it functions above and below grade. In Sgt. George Ashby Memorial Parks' visioning sessions, rain garden cut outs of various sizes assisted community members in thinking about stormwater from the inception of park design, rather than as an engineering element.

Figure 1. This animation still is taken from a video entitled "Leveraging the New Stormwater Rule for New Benefits" The animation demonstrates how a traditional shopping mall can be rearranged to incorporate attractive green infrastructure while also minimizing stormwater system footprints to allow for expanded development.

Key Findings

The case studies identified above reveal the ways in which communication tools may vary based on a particular partnership between engineer and client. The partnership should begin with a discussion of how the client understands stormwater management. Overcoming the perception of stormwater management as an engineering control is key to engaging nontechnical audiences. If talking to a developer who sees stormwater management as a constraint or obstacle in realizing their vision, engineers may need to communicate strategies to leverage stormwater management for greater profit. For partners with no connection to stormwater management, communicating the triple bottom line benefits of green infrastructure may lead to a design with more integrated stormwater components that provide environmental resources and social programming opportunities. In order to effectively communicate these ideas, engineers may find a multimedia approach beneficial.

Recommendations

Approach conversations regarding investment in green stormwater infrastructure as a persuasive endeavor and employ resources to make that endeavor effective. Demonstrate to partners how they can more successfully implement stormwater management strategies and approach future projects with a sustainable and resilient plan. Demonstrate the triple bottom line benefits this approach yields. Communication begins with understanding a partner's stormwater connection. Stormwater management and green infrastructure act as more than engineering controls; they create a sense of place. Engineers should consistently communicate the project's potential with partners to ensure that stormwater approaches are comprehensive and designed to meet specific project goals.

References

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GSI: A Tool for Equitable Economic Recovery and Growth in Pennsylvania

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Highlights

- The number of jobs in Pa.'s GSI industry is growing faster than the Commonwealth's overall job growth. From 2011 until 2019, jobs in the state's GSI industry grew at 9.2% compared to Pennsylvania's 6.3%. From 2011, when *Green City, Clean Waters* was fully adopted, to 2019, jobs in Philadelphia's GSI industry grew by 13.3%, more than double the state's 6.3%.
- The GSI industry provides family-supporting jobs and accessible opportunities for career advancement for people with all education and work experience levels. 52% of GSI workers earn at least $15/hour, even without a high school diploma or equivalent.
- The GSI industry spans various sectors including planning, engineering, and design, construction and material supply, inspections, operations, and maintenance. There are upwards of 34,000 GSI workers across PA, greater than the number of middle school teachers, and the largest sector of the GSI industry is Maintenance & Inspection.

Introduction

In May 2021, the Sustainable Business Network of Greater Philadelphia's (SBN) released its new report, Green Stormwater Infrastructure (GSI): A Tool for Economic Recovery and Growth in Pennsylvania, which makes a compelling case for the economic, social, and environmental benefits of green stormwater infrastructure. The report underscores that through local investments, career accessibility, and family-supporting wages, GSI provides an important strategy for equitable economic recovery. Increasing investments in proven growth industries like GSI are critical, because they provide meaningful opportunities for small businesses; family supporting jobs and career advancement opportunities for people with a range of work history, education, and experience with the justice system; equitable community development; and climate resilience.

Methodology

Identifying Sectors & Occupations

GSI occupations were identified using the Standard Occupational Classification (SOC) System codes. All workers are classified into one of more than 800 detailed occupations, each of which is given a unique six-digit code. Information regarding these codes can be found here: http://www.bls.gov/soc/.

Detailed occupational data for Pennsylvania and its metropolitan areas was retrieved from Occupational Employment and Wage Statistics tables provided by the Bureau of Labor Statistics. These statistics can be found here: https://www.bls.gov/oes/tables.htm.

Further identification and refinement of the occupations associated with the GSI workforce was conducted by Fourth Economy through a review of a number of national studies and worked with staff from the Sustainable Business Network of Greater Philadelphia (SBN), interviews with industry leaders as well as members of an advisory group to provide feedback, input, and recommendations. The GSI employment analysis counts employment for workers who are directly employed within planning, design, construction, and ongoing maintenance and inspection occupations.

GSI Jobs & Wages
The green stormwater infrastructure industry supports families and workers from all education and work backgrounds, through accessible career advancement opportunities and livable wages. Many jobs–9 out of 10–in the GSI industry require a high school diploma or equivalent, or no formal educational credential at all. The majority of all GSI-related jobs are accessible to those without a four-year college degree. Just over half of GSI workers in PA earn more than $31,200 ($15/hour). When taking into account that 7 out of 10 PA residents 25 years or older lack a four-year college degree, this career pathway is a strong option for many workers, especially those returning to the workforce.

Table 1. GSI jobs (high-estimate), and salaries and wages according to education level, including entry-level, average, and highest wages. Data sourced from BLS Occupational Employment Statistics.

Entry-Level Education Level	GSI Employment	Typical Entry-Level Wage	Median Wage	High Wage jobs
No formal educational credential	20,062	$21,010	$36,800	$68,730
High school diploma or equivalent	11,476	$25,150	$47,120	$90,700
Associate's degree	600	$32,320	$50,545	$64, 290
Bachelor's degree or higher	1,878	$42,970	$67,890	$113,350

Key Findings
By investing in GSI, Pennsylvanians will receive the return on investment for decades to come. Our report shows that by continuing to spawn further growth of the GSI industry, Pennsylvania will receive billions of dollars of economic activity. This investment creates new opportunities for small businesses and job creation, providing meaningful employment and advancement opportunities for people with a wide range of educational backgrounds and work experience. In addition to these economic drivers, GSI provides equitable access to well-maintained public spaces, improves the health of rivers and streams, and enhances climate-resilience within our communities and our infrastructure systems.

This report recognizes GSI as a proven, ready, and cost-effective solution for water quality, climate resilience, and equity. This stormwater management practice offers an alternative to traditional infrastructure that is cost-effective, while also providing a tool that can adapt to the growing needs and stressors of climate change. GSI can also provide significant community and economic benefits to rural and urban areas across the Commonwealth.

Recommendations
Despite differences between rural and urban areas, environmental justice issues are shared across the state, including flooding, water quality, and the heat island effect, all of which disproportionately impact low-income communities and communities of color. The state's stormwater management efforts must address these environmental, public health, and equity challenges while also meeting the needs of a changing climate. GSI is a proven tool to address these challenges and needs.

Pennsylvania can lead on GSI through making necessary cost-effective investments in stormwater management, when combined with the urgency for economic recovery, equity, and climate action. This creates an opportunity to leverage GSI as an adaptable solution that provides many economic, social, and environmental benefits to communities across the Commonwealth. To ensure these investments are made, SBN recommends that:

1. State and the Federal Administration direct substantive funding and incentives for public and private investments in GSI.
2. Ensure that state stormwater regulations incorporate climate resilience to address the challenges that municipalities across the Commonwealth face, and ensure public and private investments advance water quality goals and long-term resilience.
3. Streamline processes and procedures to support private investments in GSI, by removing administrative barriers, aligning codes, and fast-tracking approval processes for GSI best practices.

Reshaping the Regulatory Framework: **An Avant Garde Clasic Equitable Fully Distributed Integrated Approach for Optimal Green Infrastructure Selection**

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Highlights

- Involves use of the US EPA Clasic tool and the Inter-Connected Pond Routing (ICPR) model
- Decision support method that allows for direct inclusion of economic, environmental, and social benefits
- Identifies the differences in top ranked green infrastructure types and locations for different sets of criteria

Introduction

Though it has evolved over time the metrics used in the traditional regulatory framework that has driven implementation of stormwater management practices referred to herein as green infrastructure (GI) has been limited to volume and peak rate reduction, infiltration, and water quality. Implementation of GI at the site scale is done typically as a part of land development ordinances or planning efforts with targeted implementation, and at the water/sewershed scale as part of a long term combined sewer overflow control plan or watershed restoration plan. In recent years there has been a shift to include economic, social, and environmental impacts, and environmental equity in the selection of optimal locations and types of GI practices. However, associated requirements are non-existent, may be loosely defined, and/or are accounted for after an optimal set has been chosen based on the aforementioned criteria. A paradigm shift in the regulatory framework, and way GI is viewed is essential in allowing for attainment of the full spectrum of benefits that GI can provide. The first step in this process is to not just focus on the impacts these measures can have as it relates to stormwater which is why these practices are redefined in this work from stormwater control measures to green infrastructure. To facilitate this shift there is a growing need to develop non-heuristic integrated water resources management decision support tools and associated modeling approaches to aid in the selection of GI that directly include all criteria and account for both site and system scale dynamics. Additionally, the impacts and distribution of local flooding are often unaccounted for in determining optimal locations and types of GI to place, and the impacts of surface-water groundwater interactions are often not considered.

Methodology

The USEPA Community-Enabled Life Cycle Analysis of Stormwater Infrastructure Costs (Clasic) tool was integrated along with the fully distributed model Inter-Connected Pond Routing (ICPR), and the Green Infrastructure Ranking Tool (GIRT) as part of an avant-garde decision support tool that determines both the pareto optimal surface and ranking values. This tool was used for a case study area in Minneapolis for a 3,210 acre sewershed with five different types of GI. A 1D/2D integrated ICPR model was used to assess the surface water, open channel, storm sewer pipe, and groundwater interactions, and to determine the severity and frequency of local flooding. A novel approach to evaluate environmental equity for each location was applied that accounted for racial minority, low income, and disabled community members. The changes in the spatial distribution optimal rankings were assessed through variations in the direct inclusion of various combinations of assessment criteria. The optimal rankings were determined using runoff volume only, peak flow and runoff volume, and then a new criterion was subsequently added for each scenario. Metrics were developed to assess the overall system impacts with the attainment of target objectives for certain specified criteria for three different hydrologic scenarios.

Key Findings

The spatial distribution of top ranked optimal locations and types had some variability with the addition of hydrologic based criteria, but varied the most upon addition of environmental equity, and economic, social, and environmental criteria (triple bottom line criteria). Without considerations to the triple bottom line criteria there was a less diverse selection of GI types amongst the top ranked solutions. The more criteria that was included with equal weights of importance the higher the number of GI necessary to achieve the proposed target objectives which included; a 20% runoff volume and peak flow decrease, a 20% infiltration volume increase, 20% reduction in pollutant loading, and 20% inclusion of environmental justice communities. However, results from the use of a reverse optimization approach to attain target objectives whilst lowering costs, and higher relative importance values assigned to certain triple bottom line criteria showed that the benefits of accounting for these criteria resulted in lower costs then if they had not been included.

Conclusions and Recommendations

The variability in the spatial distribution of optimal locations when environmental equity was included highlights the importance of identifying metrics and methodologies that integrate environmental equity directly into the regulatory framework. Direct inclusion of triple bottom line criteria allows for identification and optimization of various social, economic, and environmental benefits that are important to the community along with the hydrologic criteria. These findings are also helpful in providing insight to identify ways in which metrics could be defined and integrated within the regulatory framework.