

Case Study: Philadelphia



Green Stormwater Infrastructure in the Right-of-Way

QUICK PHILADELPHIA STATISTICS

- Population: 1.58M in 2018
- 3.65% population increase since 2010
- Area: 134 sq. mi.
- 48% combined, 52% separated sewer system
- Consent decree: Yes
- NPDES permit: Yes
- Stormwater fee credit program: Yes
- Post-construction stormwater ordinance: Yes
- Snow climate: Yes


A wide-angle photograph of a Philadelphia street, likely Center City, showing a mix of modern skyscrapers and historic architecture, including the prominent Independence Hall. The street is lined with trees and has cars and pedestrians. The image is partially obscured by a large white circular graphic on the left side of the page.

Photo by
Catherine D. Kerr

MOTIVATIONS FOR ADVANCING GSI IN THE ROW

Regulation. The City of Philadelphia is motivated to improve their water infrastructure system by regulatory obligation to the Pennsylvania Department of Environmental Protection (PA DEP) and the U.S. EPA, which requires them to manage stormwater to reduce combined sewer overflows and meet the water quality standards of the Clean Water Act.

Leadership and Community Impact. While most cities invest in gray infrastructure improvements to meet their water quality goals, the City of Philadelphia has prioritized the use of green stormwater infrastructure (GSI), a tool which the Philadelphia Water Department (PWD) had been piloting through demonstration projects since the 1990s. City leadership sees GSI as a tool to maximize the community impact of the billions of dollars that are required to be spent over a 25-year period by bringing stormwater infrastructure investment to the surface of Philadelphia's neighborhoods.

Economic. The massive cost and disturbance entailed by large-scale subsurface stormwater management diversion projects was unappealing to Philadelphia. A decentralized green approach allows for water quality improvements to be accrued on an ongoing basis, rather than only at the completion of a large storage tank or tunnel. This creates space for local firms to be involved in the planning, design, construction, and maintenance of the stormwater systems, whereas a large tank or tunnel project would provide business only for large, highly-specialized engineering and construction firms, which would result in much smaller numbers of local hires.

Publicly Owned Land. The City invests heavily in street systems because they comprise 30% of the impervious area of the city and are easily accessible for the installation of public utilities. The City is motivated to install GSI on any and all City-owned property where it is feasible and amenable to the users of that space, in order to meet the goal of managing 10,000 acres of impervious surface by 2036.

Safety and Accessibility. The prioritization of the safety and convenience of all road users traveling in the public right-of-way (ROW), particularly children, the elderly, and persons with disabilities, was a motivating factor which primarily informed the issuance of the 2009 Complete Streets Executive Order. The resulting Complete Streets Design Handbook provides guidance for engineers to prioritize stormwater management during the development of streetscapes.

Photo courtesy of
Philadelphia Water Department

PROJECT HIGHLIGHT

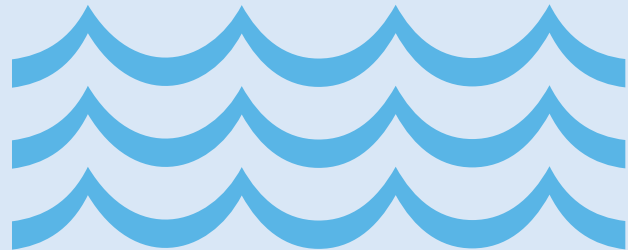
The Windrim Avenue Green Street is a multi-modal project located adjacent to a key train station in SEPTA's regional rail network, featuring bumpouts that were modified to support intermodal bus operations as well as sharrows leading to the train station. Partners included SEPTA, Nicetown Community Development Corporation, PennDOT, and the Philadelphia City Planning Commission.

- **Practice type:** Stormwater bumpout, infiltration/storage trench
- **Annual stormwater capture:** 4.69 million gallons
- **Greened Acres managed:** 2.73
- **Drainage area:** 65,000 sq. ft.
- **GSI design & construction cost:** \$1.17 million
- **Funded by:** Multimodal Transportation Fund, through the Department of Community and Economic Development



IMPACT OF CLEAN WATER ACT REGULATION

The City of Philadelphia has several regulatory obligations to improve the quality of water that is discharged from its sewer outfalls into local waterways. The City has taken a bold approach to meeting their water quality goals by heavily investing in green stormwater infrastructure, particularly within the public right-of-way.



Combined Sewer Overflow Reduction. A Consent Order and Agreement (COA) was initiated in 2011 between the Pennsylvania Department of Environmental Protection (PA DEP) and the Philadelphia Water Department (PWD). The COA stipulates that PWD is required to meet the Water Quality Requirements as established by the Clean Water Act, the Federal Combined Sewer Overflow (CSO) Control Policy, and the Pennsylvania CSO Policy, as well as comply with the City's National Pollutant Discharge Elimination System (NPDES) permits for combined sewer system discharge. A requirement of the COA was submission of a Long Term Control Plan Update to the PA DEP to explain how PWD would achieve CSO control goals.

Green City, Clean Waters (GCCW). Adopted in 2011 as a requirement of the consent order, GCCW is the City of Philadelphia's 25-year plan for CSO control and serves as an update to its Long Term Control Plan, which was first adopted in 1997. Foregoing the colossal expense of expanding the city's gray infrastructure capacity, the program focuses on using GSI to restore ecological systems

and reap the many environmental, social, and economic benefits of this type of investment. GCCW commits \$1.67 billion to GSI projects that will manage impervious surface runoff across the city's combined sewer area, which includes projects on public property as well as grants for stormwater management practices on private property.

Administrative Order for Compliance on Consent. Issued by the U.S. EPA to the City of Philadelphia in 2012, this order requires the City's compliance with the Clean Water Act while also reinforcing the City's agreement with the PA DEP to reduce the volume of CSOs through a commitment to implement GSI as a component of the Green City, Clean Waters program.

Restoring Water Quality. The City of Philadelphia has a partial (about 52%) separated storm sewer system. It is regulated by a Municipal Separate Storm Sewer System (MS4) NPDES permit, which requires municipalities to use best management practices to reduce pollutants in stormwater runoff to the maximum extent possible and meet the water quality standards of the Clean Water Act.

POLICIES & PROGRAMS THAT PROMOTE GSI IN THE ROW

Complete Streets Policy. An executive order was issued by Mayor Michael Nutter in 2009 to establish a Complete Streets Policy for the City of Philadelphia. It specifies the use of streetscape elements such as medians and curb extensions to improve user safety.

Complete Streets Bill. Passed by the city council in 2012, the legislation amended the Traffic Code, implementing an enforceable Complete Streets Policy for the City of Philadelphia. It authorizes the Streets Department to publish and update the policy through the Complete Streets Handbook.

Development Right-of-Way Incentive. This stormwater grant opportunity can provide funding for private developers who build practices that manage runoff from the public right-of-way on their private property at a rate of \$100,000 per impervious drainage acre.

Green Street Incentive. PWD developed this program to encourage private developers to construct green stormwater infrastructure in the public right-of-way adjacent to new development projects. PWD only offers this incentive at locations that have been identified as opportunities for significant stormwater management. Developers must design and build the green infrastructure to PWD standards. Upon completion, PWD accepts ownership and maintenance of the infrastructure.

GUIDING PLANS & STRATEGIES FOR GSI

The Implementation and Adaptive Management Plan guides PWD through the implementation of Green City, Clean Waters, establishing frameworks for identifying GSI-related capital projects, addressing policy and coordination needs, developing a Maintenance Manual and Comprehensive Monitoring Plan, and continuing public outreach efforts. It is a requirement of the Consent Order and

Agreement, and is reassessed every five years in the form of an Evaluation and Adaptation Plan which evaluates compliance with Water Quality Based Effluent Limits (WQBEL) Performance Standards and describes any changes in program elements for the next five-year period to ensure program goals are met.

GOALS & OUTCOMES

CSO Reduction:

- **5-year outcome (2016):** Managed 1.5 billion gallons of stormwater annually using green infrastructure, keeping that volume out of the combined sewer system and exceeding the goal of managing 600 million gallons.
- **Next 5-year goal (2021):** Manage a cumulative 2.044 billion gallons per year.
- **Overall goal (2036):** Reduce the volume of combined sewer overflows by 85% by the end of the 25-year GCCW implementation period (equivalent to removing 7.96 billion gallons of volume from the system annually).

Greened Acres:

- **5-year outcome (2016):** Completed 837.7 Greened Acres of stormwater management, exceeding the goal of 744 Greened Acres.
- **Next 5-year goal (2021):** Reach a cumulative 2,148 Greened Acres.
- **Overall goal (2036):** Convert 34% of the combined sewer system drainage area into Greened Acres (equivalent to 9,564 Greened Acres) to manage the first inch of rainfall runoff from impervious areas.

Economic Outcomes (as of 2016):

- Leveraged \$51 million of public and private investment in streets, parks, schools, and public housing as a result of GSI projects.
- Created 430 new jobs in the GSI industry, equivalent to 14% growth.
- Increased property values by an estimated 10.3%, creating an additional \$18 million in annual property tax revenue.

ASSOCIATED BENEFITS OF GSI IN THE ROW IN PHILADELPHIA

As identified by Philadelphia's Green City, Clean Waters plan,
Green Streets Design Manual, and program staff.



Ecology

- Restore ecosystems
- Recharge groundwater
- Increase biodiversity and habitat
- Improve water quality
- Mitigate climate change
- Sequester carbon dioxide



Public Health

- Provide recreation space
- Reduce heat island effect
- Improve air quality
- Improve health outcomes
- Improve quality of life



Urban Vitality

- Lower traffic speeds
- Reduce crashes
- Increase property values
- Improve aesthetics



Economy

- Create green jobs
- Save on energy costs
 - Reduced treatment system operation
 - Buildings shaded and insulated
- Make cost-efficient improvement to water infrastructure system

GUIDELINES FOR DESIGNING GSI IN THE ROW

The Complete Streets Design Handbook.

Issued in 2013 and updated in 2017 by the Mayor's Office of Transportation and Utilities, it provides the design guidance necessary to implement the Complete Streets policy and promotes more efficient project implementation by serving as a comprehensive resource to guide the Streets Department's review of all projects within the public right-of-way. It includes treatment standards for incorporating stormwater management in the right-of-way and references the Green Streets Design Manual for more details.

The Green Streets Design Manual. Issued in 2014 by PWD in partnership with the Philadelphia Streets Department, it includes design standards and guidance for public and private developers building green stormwater infrastructure within the public right-of-way. The manual also provides information on effectively siting GSI systems

and how to navigate implementation policies and procedures. It complements the Complete Streets Design Handbook.

The Green Stormwater Infrastructure Planning and Design Manual.

First issued in 2015 by PWD, it includes design standards and guidance for public projects building GSI. The manual provides even more information on effectively designing GSI systems on parcels and within the ROW than the Green Streets Design Manual. It serves as the primary resource for consultants and PWD staff on all aspects of planning and design of GSI within the combined sewer service area.

Streets Design Guidance. This internal memo, developed and edited on a rolling basis, is a series of recommendations by the Streets Department for PWD design engineers relating to a series of design considerations helpful in the design of the cartway. Topics include but are not limited to turning radius, grading priorities, area protection, and the design of systems at signalized intersections.

Photo by InSapphoWeTrust



Benjamin Franklin Parkway

COLLABORATION & PARTNERSHIPS

LEAD AGENCY

Philadelphia Water Department (PWD). Role: administers the Green City, Clean Waters program and leads all Green Streets and GSI work in the city.

SUPPORTING MUNICIPAL AGENCIES

Streets Department (Streets). Role: permits and engineers road projects, implements and enforces the Complete Streets Policy, partners to align funding.

Philadelphia City Planning Commission (PCPC). Role: coordinates with PWD and other agencies regarding major street reconstruction projects.

Department of Commerce. Role: partners with PWD to incorporate GSI into commercial corridor redesign.

Office of Transportation, Infrastructure, and Sustainability (oTIS). Role: manages pedestrian enhancement programs and Vision Zero activities and sets bicycle lane priorities; supports Streets and PWD in seeking grant funds for street improvement projects.

Office of Complete Streets (OCS). Role: stewards the City's Vision Zero initiatives and collaborates with PWD and Streets on Safe Routes to School projects.

EXTERNAL PARTNERS

Pennsylvania Department of Transportation (PennDOT). Role: partners on GSI projects on streets under PennDOT jurisdiction; provides state and federal transportation funds for street improvement projects, portions of which are occasionally used to fund GSI integrated into those projects.

Southeast Pennsylvania Transportation Authority (SEPTA). Role: provides review and feedback on Green Streets projects; partners with PWD to integrate GSI into major transportation network improvements.

Representatives from SEPTA and oTIS meet on a monthly basis, together with PWD and Streets, to review projects in design and resolve concerns with project management.

FUNDING & FINANCING

The City of Philadelphia uses a combination of sources to fund GSI and Green Streets projects:

- PWD's green infrastructure programs and maintenance program are funded by the department's capital budget from water ratepayer revenues.
- Federal transportation funds and grants pursued by the City occasionally cover stormwater infrastructure design and/or construction included in street improvement projects.

- Private foundation and public grant funds help supplement GSI projects by providing funds for the non-stormwater elements of capital projects such as park or streetscape improvements.

GSI MAINTENANCE RESPONSIBILITIES

The Green Stormwater Infrastructure Maintenance Manual was published by PWD in 2016 and provides specifications for surface and subsurface green stormwater infrastructure maintenance.

Subsurface maintenance: PWD does preliminary inspections and hires contractors to maintain systems.

Surface maintenance: PWD holds an MOU with the Streets Department that affirms PWD's maintenance of GSI systems. Both Streets and PennDOT maintain their roads, curbs, and traffic medians.

Vegetation maintenance: PWD oversees contractors for maintenance of landscaping and street trees associated with GSI.

LESSONS LEARNED & KEYS TO SUCCESS

Lessons Learned:

- Establish design and construction expectations and responsibilities for critical partners such as traffic engineers and stormwater engineers early in project development.
- Rights-of-way with fewer utilities and space constraints such as near parks and industrial areas are easier spaces to design and implement GSI.

- Monitoring and evaluation of system performance is essential for the success of ongoing project design.
- Ongoing communication across agencies and levels is key.
- Package projects together on a neighborhood scale to bring down costs and sustain work with contractors whose operations are better suited for large projects.
- Major changes to the curblines may raise turning and parking concerns, and therefore are perceived as prompting more coordination with transportation agencies to implement.

Keys to Success:

- GSI liaisons between agencies can help advance the work and resolve inter-agency conflicts and concerns.
- Expand opportunities for funding and alignment of priorities through partnerships.
- Leverage PWD's GSI investments for grant funding of partnership projects that go beyond GSI.
- Convene an inter-agency group regularly to maintain open communication and help advance the work across agencies.
- Involve civic groups and non-governmental organizations to increase early buy-in and acceptance of projects.

SPECIAL THANKS

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PROTECTING WATER, SUSTAINING LIFE

The Alliance for the Great Lakes is a nonpartisan nonprofit working across the region to protect our most precious resource: the fresh, clean, and natural waters of the Great Lakes. Learn more at greatlakes.org.