

WANTED: GREEN ACRES

How Philadelphia's Greened Acre Retrofit Program is catalyzing low-cost green infrastructure retrofits on private property

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EXECUTIVE SUMMARY

In July 2014, the Philadelphia Water Department (PWD) launched an innovative competitive grant program to encourage the development of green infrastructure on private property. Green infrastructure practices—which include trees, rain gardens, green roofs, and porous pavement—restore the landscape's ability to retain stormwater on or near where it falls, keeping polluted runoff out of municipal systems and out of waterways, rivers, and oceans. Philadelphia's program, called the Greened Acre Retrofit Program (GARP) encourages contractors or design/construction firms to bundle green infrastructure projects and compete for limited public grant funding by bringing forward the lowest-cost retrofit opportunities available on private land. The availability of public dollars through GARP creates a competitive green infrastructure market that is able to produce benefits for all parties involved in local green infrastructure development, namely:

- **The local water utility** obtains installed stormwater infrastructure at a fraction of the cost of public right-of-way projects with similar environmental impact;

- **Local green infrastructure contractors** benefit from a program that rewards project aggregation and provides long-term green infrastructure maintenance opportunities; and
- **Property owners** benefit from aggregators identifying cost-effective green infrastructure opportunities that can result in reduced stormwater fees and improved property value.

INTRODUCTION

This Issue Brief details why the Philadelphia Water Department (PWD) developed the innovative performance-based GARP, as well as how this initiative is motivating the private sector to take an active role in creating cost-effective green infrastructure opportunities on private land. The aim of this paper is to highlight how creative incentive programs can encourage public-private collaborations that provide an avenue for cities to meet their water quality objectives in a cost-effective way while creating social benefit and economic growth opportunities.

The Urban Stormwater Problem

Managing stormwater runoff is an issue of rising concern for U.S. municipalities. Urban and suburban development transforms natural landscapes into impervious surfaces such as streets, rooftops, and parking lots. These hard surfaces prevent rainwater from soaking into underlying soils. During rainstorms, impervious surfaces produce stormwater runoff surges that mobilize a wide range of pollutants including fertilizers, pesticides, oils, metals, trash, and bacteria. An estimated 10 trillion gallons per year of this polluted mix flows uninhibited and untreated into local waterways.¹ Two systems are currently used in cities to convey stormwater, both which fail to protect water quality under ordinary conditions. “Separate” stormwater sewer systems collect only stormwater and transmit it with little or no treatment to a receiving body of water, where stormwater and accumulated pollutants are released. In more than 700 U.S. cities with older stormwater infrastructure—like Philadelphia—stormwater and wastewater flow into a single piping system, known as a “combined” sewer system. During a rainstorm, combined sewer systems mix stormwater runoff with wastewater from sinks, toilets, and showers. The resulting volume overwhelms the combined sewer system, leading to overflows of raw sewage, polluting waterways, and presenting a public health threat. Whether a city uses a primarily separate or combined sewer system, or uses some mix of both systems, finding a cost-effective way to manage stormwater runoff volume is a critical issue for any city seeking to protect the quality and health of their communities’ local waterways.

Rise of Municipal Green Infrastructure and Incentive Programs

To reduce the impacts of urban stormwater runoff and meet regulatory compliance obligations under the Clean Water Act, many cities have begun to invest in green infrastructure. These practices—which include trees, rain gardens, green roofs, and porous pavement—restore the landscape’s ability to retain stormwater on or near where it falls, keeping rainwater out of municipal sewer systems and waterways. Through the development of green infrastructure assets in urban environments, cities across the country are finding that they can effectively manage stormwater runoff and improve local water quality in a way that is more cost-effective and generates more community benefits than traditional “pipe and cement” based approaches alone.⁸

With a large proportion of paved urban land in the hands of private property owners, cities are realizing that private landowner involvement is critical to meeting their green infrastructure development and stormwater runoff reduction

goals in a cost-effective manner. Strategic public policies are key to encouraging private property participation in reducing stormwater runoff. For example, many cities now require that new development or redevelopment projects above a specific square footage build the infrastructure to manage stormwater runoff from their project site as a condition of permit approval.⁹ While such development guidelines ensure better water management from future construction, urban waterways are substantially impacted by polluted runoff from existing development. As a result, stormwater utilities have attempted to accelerate installation of green infrastructure on existing commercial and residential properties by offering incentives such as construction cost subsidies and reduced stormwater fees to property owners who voluntarily retrofit existing properties with green infrastructure.¹⁰ A list of example subsidy programs can be found in Table 1.

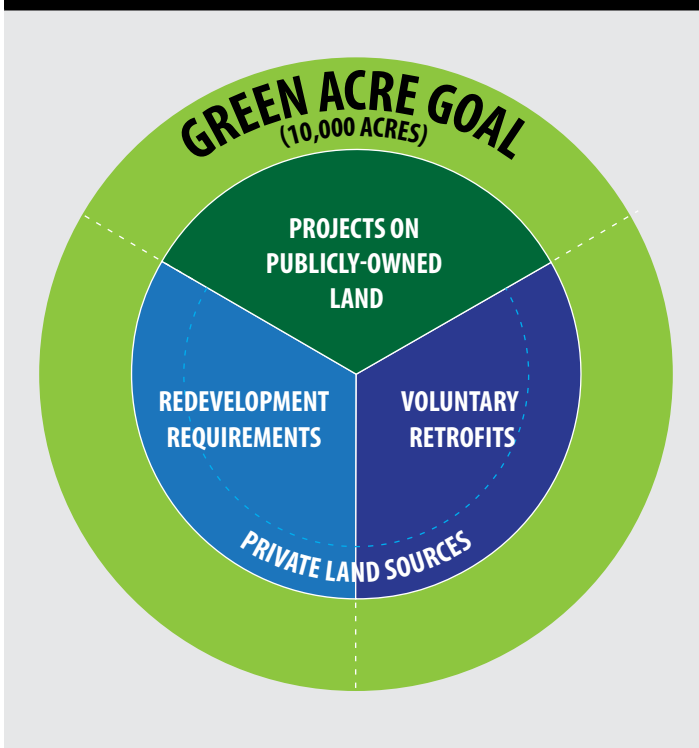
Table 1. Examples of Municipal Green Infrastructure Subsidy Programs

City	Subsidy Program
Seattle, WA	Seattle Public Utilities’ Rainwise Program provides rebates to property owners who install rain gardens or cisterns on their property. Rebates can be as high as \$3.50 per square foot of impervious area managed. ²
Louisville, KY	Louisville Metropolitan Sewer District offers a Capital Recovery Stipend, which provides customers rebates up to \$1.50 per square foot of impervious area managed. ³
Palo Alto, CA	City of Palo Alto Storm Drain Utility offers rebates to residents, businesses, and city departments for the installation of qualifying green infrastructure measures. ⁴
Montgomery County, MD	The Water Department’s Rainscapes Rewards Rebate program provides rebates to both residential (up to \$2,500) and commercial property owners (up to \$10,000) for installation of green infrastructure measures. ⁵
Milwaukee, WI	Milwaukee Metropolitan Sewerage District (MMSD) offers reduced stormwater fees for property owners who manage stormwater on-site. MMSD’s Green Infrastructure Partnership Program will pay up to 50 percent of the cost of capturing stormwater on-site. ⁶
Washington, D.C.	D.C.’s District Department of Environment’s RiverSmart Homes, RiverSmart Communities and Green Roofs programs offer capital cost-share incentives to private property owners for installing green infrastructure projects. ⁷

PHILADELPHIA'S GREEN INFRASTRUCTURE GOALS AND MOTIVATING PRIVATE PROPERTY PARTICIPATION

In 2011, Philadelphia adopted one of the most ambitious green stormwater infrastructure programs in the country.¹¹ To address the city's obligations under the Clean Water Act to reduce its extensive and regular sewer overflows, PWD received state and federal approval to use an approach that deploys green infrastructure to manage the first inch of stormwater runoff from approximately 10,000 acres of impervious land, effectively "greening" a third of the existing impervious landscape within the city's combined sewer service area.

Figure 1: Reaching Philadelphia's Green Acre Goals



To meet the city's ambitious green infrastructure goals, PWD developed the following three-pronged strategy:

1. Invest in greening public property and rights-of-way.

PWD committed to work with other city departments to integrate green infrastructure into public space improvements, including street, sidewalk, and park projects. Installing green infrastructure assets on public property or in the public right-of-way should theoretically be easy projects for the city to plan, implement, and maintain, because these projects are located on land controlled by the city. Yet despite the ease of access, public

property retrofits can be cumbersome and costly due to street closure requirements, utility conflicts in the public right-of-way, limited retrofit options, competing needs for limited space, and the need for coordination among multiple public agencies. Based on experience to date, PWD estimates that it costs approximately \$250,000-\$300,000 for each greened acre constructed on city-owned land.

2. Require green infrastructure investments for new development and redevelopment on private property.

To ensure more sustainable development patterns in new construction, Philadelphia's land use and permit regulations require new development and redevelopment projects that disturb more than 15,000 square feet of land to install (and maintain) green infrastructure sufficient to manage the first inch of stormwater that falls on the site.¹² These projects have the advantage of requiring no upfront investment by the city, but the number of green acres the city can obtain in this way is limited by the rate of new and redevelopment.

3. Encouraging voluntary retrofits by existing private parcel owners.

Aerial land cover surveys of Philadelphia found that while 38 percent of existing impervious area is comprised of public roadways, the second and third largest contributors to the city's impervious area are residential (20 percent), and commercial/industrial properties (16 percent).¹³ As discussed in further detail below, through a combination of incentive programs and cost-share subsidies, PWD may be able to access relatively low-cost stormwater management opportunities on private property.

However, because the city does not control private land and regulations do not require any on-site capture for existing development, for PWD to benefit from low-cost green infrastructure opportunities on private land, PWD must find private property owners who are willing to build as well as maintain green infrastructure assets on their property. The remainder of this document explores the steps that Philadelphia has taken to catalyze voluntary green infrastructure retrofits on private property through a new competitive grant program that positions local contractors as marketers, champions, and partners in the execution of the program.

ENCOURAGING OWNERS TO VOLUNTARILY RETROFIT: GREEN INFRASTRUCTURE PROJECT ECONOMICS

Given the high cost and constraints inherent in public right-of-way green infrastructure projects, and the limits to developing green acres through redevelopment, PWD had to identify ways to encourage private property owners to voluntarily invest in retrofitting existing properties with green infrastructure. In response to this need, Philadelphia implemented a two-step strategy: modifying its stormwater billing system and launching green infrastructure grant programs.

Philadelphia began the process of incentivizing private parcel retrofits by modifying commercial property owners' monthly stormwater fees to reflect each property's relative contribution to stormwater runoff.¹⁴ Under the new fee structure, properties with large impervious areas that produce significant volumes of stormwater runoff would pay the highest monthly stormwater fees. The new billing system also provided property owners with an important incentive: owners who installed green infrastructure practices sufficient to manage the first inch of stormwater runoff from their property were eligible to save up to 80 percent on their monthly stormwater fees.¹⁵

Even with PWD's offer of an 80 percent reduction in monthly stormwater fees for property owners who managed their stormwater on-site, the city did not experience a substantial increase in the number of private property owners seeking to voluntarily install green infrastructure. The low rate of green infrastructure retrofits appeared to be the result of unfavorable project economics. Even though Philadelphia's property owners pay some of the nation's highest stormwater fees, and available fee reductions were generous, the potential stormwater fee savings generated by green infrastructure installations were dwarfed by the upfront capital costs of green infrastructure retrofit projects. In short, retrofits were not expected to produce reasonable payback periods for property owners based on decreased stormwater fees alone.¹⁶

Potential for Win-Wins on Private Property

A green infrastructure project finance analysis conducted by the Natural Infrastructure Financing Laboratory (NatLab) and PWD in 2012 supported the thesis that green practices could be delivered at a lower cost per acre on private property than on public property.^{17,18}

The analysis conducted by NatLab and PWD further suggested that programs which encouraged the aggregation of retrofit projects (to drive down permitting, labor, staging, and material costs), combined with substantial subsidies to reduce property owners' design and construction costs, would help PWD generate thousands of private-parcel green acres at a lower cost than was possible for green infrastructure projects in the public right-of-way.¹⁹

PHILADELPHIA'S FIRST "STORMWATER MANAGEMENT INCENTIVE" PROGRAM

In an effort to spur the development of green infrastructure on private property, PWD launched its first green infrastructure capital rebate program, the Stormwater Management Incentive Program (SMIP), in 2012.²⁰ Philadelphia's SMIP is a traditional green infrastructure subsidy program. Similar to a variety of green infrastructure subsidy programs in other cities (see Table 1 above), Philadelphia's SMIP offered private property owners rebates to defray a portion of the up-front capital costs of installing green infrastructure.

During its first three years, PWD approved 36 SMIP applications for funding and produced a number of successes—including the implementation of green infrastructure retrofits at Greene Street Friends School and Cardone Industries' corporate headquarters (see Figure 2). Just as important as the creation of more green infrastructure however was the growing conversation and innovation around green infrastructure development that began to unfold among PWD, local property owners, and contractors within the region.

However, the total number of projects under SMIP was smaller than PWD expected, given the city's approximately 80,000 non-residential properties.²¹ The low application rates for SMIP dollars prompted PWD to gather feedback from property owners and contractors regarding barriers to program involvement. SMIP requires that interested property owners sign and submit grant applications for one property at a time, tending to require heavy involvement by the property owner. PWD learned that they needed to develop a program structure that would reduce the personal initiative required of property owners to participate in the program and also make it easier for property owners to assess the benefits of participating in the SMIP.

Despite a program structure that required owners to submit applications, enterprising contractors were actively working to aggregate multiple green infrastructure projects, then advancing the projects through the SMIP process through the property owners as independent applications. In addition, PWD began receiving calls from green infrastructure project developers inquiring about the opportunity to submit proposals that aggregated stormwater retrofit projects across multiple properties. These contractors noted that project aggregation could help drive down both the soft costs (marketing, application review, and permitting) and hard costs (materials and project/equipment staging) of project implementation. It was becoming clear to PWD that changes to the SMIP structure could yield more private market participation in green infrastructure development and lower project implementation costs.

Moreover, SMIP's early years reinforced PWD's belief that there were indeed significant cost-effective green stormwater infrastructure opportunities available on private property.

Under SMIP, PWD was paying approximately \$100,000 for an acre of “greened” impervious area on private property—in contrast to the \$250,000- \$300,000 that PWD was paying

for green infrastructure projects on publicly-owned land, providing tremendous cost savings to the utility, and thus ratepayers.

Figure 2: Green Infrastructure Project Successes under SMIP

Greene Street Friends Playground Retrofit



Before



After

Greene Street Friends School, a private charter school, had a roughly one-acre parking lot that served as the students’ playground. Seen as a subpar recreational area, the school worked with PWD to replace half of the blacktop with a grass field, and installed a rain garden at the edge of the field to manage the remaining parking/play area runoff. This project illustrates the opportunity to produce multiple benefits with green infrastructure (enhanced play area for children, reduced stormwater runoff, and lower monthly fees), and also how creative project design can reduce runoff from the remaining impervious area.

By the Numbers

- TOTAL GREENED ACRES: 0.92 acres
- RUNOFF MANAGED:
Designed to manage runoff from 1.2 in. storm.
- SMIP REBATE: \$91,080
- COST TO PWD PER GREENED ACRE: \$99,000

Cardone Industries



Before



After

Cardone Industries is the largest private-public partnership stormwater project in Philadelphia, as well as a model for a cost-effective retrofit project. The retrofit consists of a series of underground and above ground detention basins as well as a vegetated swale. Soil excavated on-site for the retrofit was mixed with topsoil in vegetated areas, saving on disposal costs.

By the Numbers

- TOTAL GREENED ACRES: 68.7
- RUNOFF MANAGED:
Designed to manage runoff from 1.33 in. storm.
- SMIP REBATE: \$3.4 million
- COST TO PWD PER GREENED ACRE: ~ \$49,000

THE GREENED ACRE RETROFIT PROGRAM (GARP)

In 2014, PWD sought to leverage the lessons learned during SMIP's first two years to design a program that would focus on contractor-led project aggregation and a competitive grant process. In July 2014, PWD launched and aggressively funded a new grant program called the Greened Acre Retrofit Program (GARP). This program would exist in addition to SMIP, though it would differ in design from SMIP in several fundamental ways: application requirements, proposal size threshold requirements, and the introduction of a competitive award process. The following sections discuss each of the innovative characteristics of GARP.

- **Who Can Apply.** The SMIP program limits applicants to individual property owners.²² GARP, in contrast, allows contractors or other third parties to submit project applications. This shifts the burden of project development from the property owner to the contractor, and encourages contractors to initiate and develop project portfolios on behalf of multiple private property clients. With the ability to bundle and submit projects on behalf of owners, contractors are motivated by the potential profit margins from construction as well as the possibility of signing long-term green infrastructure maintenance contracts with property owners.
- **Scale of Proposals.** Whereas SMIP has no project size requirements for rebate proposals, GARP requires that grant proposals be at least 10 acres in size. Given that very few individual private parcels in the grant-eligible watershed meet the 10-acre threshold, GARP effectively requires that applications consist of an aggregation of green infrastructure projects spread across multiple properties.²³ This potentially creates a market opportunity for contractors to seek out and aggregate low-cost green acre opportunities throughout the city. In addition, by submitting bundled applications, contractors are expected to realize lower costs in application time and permitting per project. Aggregated proposals may also reduce the contractor's risk of cost overruns from any given project by spreading risk over the aggregated project portfolio. For example, excess excavation costs from one project could be mitigated by lower than expected costs on another project in the same contractor's GARP portfolio.
- **Competitive Subsidy Program.** Under SMIP, as under many analogous green infrastructure grant or subsidy programs across the country, the amount PWD offers is fixed and is based on estimates of average green infrastructure construction costs. Under GARP, the utility has opted out of setting a price per greened acre, but welcomes bids for green infrastructure at a price *not to exceed* a given cost per green acre (PWD can change the cost ceiling each year). By not setting a fixed subsidy rate and prioritizing grant awards based on

cost-competitiveness, PWD is encouraging contractors to compete for public dollars—which should lead to lower-cost green infrastructure projects over time.

To ensure better outreach and increase application numbers, GARP is structured to change the “who” and “how” of a traditional subsidy program. By allowing third-party providers to submit grant applications and requiring that each application be at least 10 acres in size, GARP creates a market incentive for green infrastructure project developers and contractors to seek out and “sell” the GARP program to property owners who have cost-effective green infrastructure opportunities on their properties. This may include explaining any out-of-pocket costs owners are likely to incur, as well as the reductions in stormwater fees that will result from the project. Motivated contractors are also well-positioned to educate property owners on the ancillary economic benefits created by investments in green space—including lower tenant vacancy rates, decreased heating and cooling costs, higher rents and re-sale values, cleaner air, and reduced crime.²⁴

While property owners essentially break even when it comes to the up-front costs of green infrastructure projects and will benefit primarily from avoiding future stormwater fees, contractors have a profit-making opportunity in bundling low-cost green infrastructure projects into a competitive grant portfolio, obtaining the grant to do the work, and entering into long-term maintenance agreements with property owners (additional information on GARP's maintenance requirements is provided below). As a result, these contractors lead the way in cost-effective green infrastructure project identification, customer acquisition, and implementation—all serving to reduce the time and financial investment needed from property owners and PWD.

Finally, GARP's competitive structure emphasizes the city's goal of continuing to find and deliver cost-effective green acres to reduce runoff into the city's combined sewer system.

PAY-FOR-PERFORMANCE: ENSURING LONG-TERM PERFORMANCE OF GREEN INFRASTRUCTURE ASSETS ON PRIVATE PROPERTY

A critical question facing utilities looking to implement green infrastructure on private property is how to manage a growing network of stormwater assets scattered across a city. Subsidizing green infrastructure projects on private land will only help meet water quality goals cost-effectively if those assets are properly designed, constructed, and maintained. Thus, green infrastructure projects funded by grant or subsidy programs must conform to design standards as well as be governed by agreements that ensure ongoing project performance.²⁵

To protect their green infrastructure investments, PWD requires that property owners receiving GARP funding execute an Operations and Maintenance (O&M) Agreement with the utility, agreeing to maintain the green infrastructure asset for at least 45 years.²⁶ An example of PWD's O&M Agreement can be found at http://docs.nrdc.org/water/wat_15012701.asp. Under this agreement, the property owner agrees to maintain the asset according to the standards in PWD's O&M manual. Moreover, the agreement's maintenance commitment is officially recorded with the property deed. As a result, if the property changes hands, the obligation to maintain the green infrastructure asset transfers to the new owner. If, for any reason, the green infrastructure assets paid for by PWD are removed, the property owner must construct another green infrastructure facility of equal or greater value, or the city is entitled to restore the original green infrastructure facility at the property owner's expense.

The operations and maintenance obligations required by the GARP agreement will likely lead to increases in property maintenance costs for program participants—in terms of labor and (at times) materials such as compost, new plants, etc. However, because PWD's stormwater fee structure offers significant monthly stormwater bill discounts (up to 80 percent reductions, as described in Section 3 above) for property owners who install green infrastructure, Philadelphia property owners who retrofit their property are able to use a portion of their avoided stormwater fees to pay for the ongoing maintenance of green infrastructure assets subsidized by PWD under GARP. Initial anecdotal project information suggests that the avoided fees are more than enough to pay for ongoing maintenance while still providing monthly cost-savings to the property owner relative to their pre-retrofit stormwater fees. The stormwater fee reduction component of PWD's billing system therefore serves an important “pay-for-performance” role, providing an ongoing “payment” (in the form of reduced stormwater fees) in exchange for maintenance of the green infrastructure asset over time.

In short, the GARP O&M Agreement ensures protection of the city's infrastructure investment, while the ongoing stormwater fee reductions serve as a monthly “payment-for-performance” from the city to property owners for maintaining the asset.

GARP ROLL-OUT

PWD currently envisions a \$10 million annual budget for GARP, spending a maximum of \$90,000 per acre for a total of at least 100 acres in the first year. Over time, PWD hopes that the competitive nature of the program, coupled with advances in contractor expertise in executing aggregated projects, will lead to reductions in per-acre costs. By using public dollars to create an entrepreneurial and competitive green infrastructure market, GARP is aiming to provide benefits for all parties to the transactions, including:

- **PWD, the local stormwater utility**, obtains installed stormwater retention infrastructure at a fraction of the cost of public right-of-way projects with similar environmental impact;
- **Local green infrastructure contractors** benefit from a program that rewards project aggregation and provides long-term green infrastructure maintenance opportunities; and
- **Property owners** benefit from aggregators identifying cost-effective green infrastructure opportunities that can result in reduced stormwater fees and improved property value.

While the GARP program is still in its infancy, PWD is already beginning to see contractors' aggregate projects into economically attractive bid packages. The first bid—which was submitted within a few weeks of the program's launch—includes over 90 green acres spread across eight properties at a cost under the \$90,000 per acre program maximum.²⁷

Figure 3: Step-by-Step GARP Overview^a

- 1. Grant Program Announced.** Call for proposals announced on PWD website. Green infrastructure project aggregator identifies projects and obtains agreement from property owner for specific green infrastructure project designs.
- 2. PWD Ranks Proposals submitted.** PWD evaluates proposals submitted based on cost per acre and number of green acres delivered. Other criteria such as public access may also be considered.
- 3. Grants Awarded.** PWD awards grants to the most cost-effective proposals.
- 4. Grant Agreement and Funding.** GARP property aggregator enters into a grant agreement with the city that stipulates performance-based funding milestones and acknowledgement of PWD's Operations & Maintenance Agreement that each property owner must execute.
- 5. Construction.** After permits are issued, contractors and PWD hold preconstruction meetings and construction begins.
- 6. Construction Completion.** PWD conducts a final inspection. If the project meets the design specification, the remaining 10 percent of the grant is awarded and reduced stormwater bill credits are issued to the property owner.
- 7. Ongoing Maintenance.** Property owners, or their designated contractors, are required to maintain infrastructure, with PWD inspecting each green infrastructure project once a year.

^a PWD staff interview, 6/6/14 and PWD GARP presentation

Endnotes

- 1 Noah Garrison and Karen Hobbs, *Rooftops to Rivers II: Green Strategies for Controlling Stormwater and Combined Sewer Overflows*, Natural Resources Defense Council, 2011.
- 2 Seattle Public Utilities, "Rainwise Detail Sheet 1," www.seattle.gov/util/groups/public/@spu/@usm/documents/webcontent/02_008087.pdf (accessed October 22, 2014).
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- 6 Milwaukee Metropolitan Sewer District, "Green Infrastructure Partnership Program," www.freshcoast740.com/Learn/Funding-Programs/GI-Partnership-Program (accessed October 22, 2014).
- 7 District of Columbia Department of the Environment, "Stormwater Management," green.dc.gov/node/10372 (accessed October 22, 2014).
- 8 Garrison and Hobbs, *Rooftops to Rivers II*.
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- 10 Hale W. Thurston, "Applying a Reverse Auction to Reduce Stormwater Runoff," *Ambio: A Journal of the Human Environment*, 37, 4 (2008): 326-327.
- 11 Philadelphia Water Department, *Amended Green City Clean Waters: The City Of Philadelphia's Program for Combined Sewer Overflow Control Program Summary*, June 2011, 3.
- 12 Planning and Research Department, Philadelphia Water Department, *Stormwater Management Guidance Manual: City of Philadelphia, Version 2.1*, February 2014, 2-1.
- 13 Philadelphia Water Department, *Amended Green City Clean Waters*, 21.
- 14 Alisa Valderrama and Larry Levine, *Financing Stormwater Retrofits in Philadelphia and Beyond*, Natural Resources Defense Council, February 2012. Prior to 2010, property-based stormwater charges were based on the property's freshwater usage, measured by the size of the water meter. Although this is a common practice, potable water usage bears little relevance to the amount of stormwater generated by a given property. Total stormwater runoff from a property is correlated largely with the impervious area on the property. See the above source for more details about the phase-in of Philadelphia's parcel-based stormwater billing system.
- 15 Philadelphia Water Department, *Stormwater Management Guidance Manual*.
- 16 Alisa Valderrama, et al., *Creating Clean Water Cash Flows: Developing Private Markets for Green Stormwater Infrastructure in Philadelphia*, Natural Infrastructure Finance Laboratory, January 2013, 17.
- 17 Philadelphia Water Department, personal communication.
- 18 Philadelphia Water Department, personal communication.
- 19 Valderrama, *Creating Clean Water Cash Flows*. See this source for a more detailed explanation of the economics of green infrastructure retrofits on private property in Philadelphia.
- 20 Philadelphia Water Department, personal communication with the author, June 6, 2014.
- 21 "Non-residential properties typically include commercial and industrial uses and residential properties with more than four dwelling units." From <http://www.phila.gov/water/wu/stormwater/Pages/NonResidentialStormwaterBilling.aspx>. In addition to only receiving fifty applications in the programs first year, application volumes stayed steady or dropped in 2012 and 2013.
- 22 Philadelphia Water Department, personal communication.
- 23 Philadelphia Water Department, "Greened Acre Retrofit Program Grant Fact Sheet," <http://www.phila.gov/water/wu/Stormwater%20Grant%20Resources/GARPFactSheet.pdf>.
- 24 Janet Clements and Alexis St. Juliana, *The Green Edge: How Commercial Property Investment in Green Infrastructure Creates Value*, Natural Resources Defense Council, December 2013. Academic and practitioner research has found that property owners, who invest in increasing their property's green space, can realize a variety of non-stormwater benefits including increased rent potential, lower unit vacancies, and higher retail sales. See the above source for a comprehensive review and summary of the latest research illustrating the ancillary benefits produced by Green Infrastructure.
- 25 New York City Department of Environmental Protection, "Green Infrastructure Grant Program: 2013 Grant Workshops," www.nyc.gov/html/dep/pdf/green_infrastructure/2013-green-infrastructure-grant-program-grant-workshop.pdf. New York City's Green Infrastructure Grant program requires a 20-year maintenance agreement by the property owner. See the above source for more information.
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