Financing Stormwater Retrofits in Philadelphia and Beyond

FEBRUARY 2012

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Acknowledgments

NRDC would like to thank the William Penn Foundation for making this report possible.

NRDC wishes to gratefully acknowledge the peer reviewers who took time to provide their expert comments on the overall report:

Merrian Goggio Borgeson, Lawrence Berkeley National Laboratory
Jeff Hooke, Focus Investment Banking
Jennifer Molloy, USEPA
Ed Osann, Natural Resources Defense Council
Mark Zimring, Lawrence Berkeley National Laboratory

Thanks also to the following people for their advice and insight during the preparation of this report: Jon Devine, NRDC; David Beckman, NRDC; Becky Hammer, NRDC;Karen Hobbs, NRDC; Noah Garrison, NRDC; Peter Malik, NRDC; Douglass Sims, NRDC; Greg Hale, NRDC; Mark Buckley, ECONorthwest; Tom Souhlas, ECONorthwest; Michele Adams, Meliora Design; Roger Clark, The Reinvestment Fund; Jennifer Crowther, Philadelphia Industrial Development Corporation; Alexander Gelber, The Wharton School; Brian Glass, Citizens for Pennsylvania's Future (PennFuture) Kate Houstoun, Sustainable Business Network of Greater Philadelphia; Chris Kloss, Environmental Protection Agency; Jeff Moeller, Water Environmental Research Foundation; Jonathan F.P. Rose, Jonathan Rose Companies; Diane Schrauth, William Penn Foundation; Tyler VanGundy, Forsyth Street Advisors; Dan Vizzini, City of Portland; Erin Williams and the staff of the Philadelphia Water Department.

Special thanks to Ricardo Bayon, Otho Kerr, Andrew Gisselquist, Jason Scott, and Kelly Wachowicz of EKO Asset Management Partners for their expertise provided on portions of Section II and the financial models in Section III, and for their partnership in development of broader, joint projects focused on financing mechanisms for stormwater management. And thanks also to Shandor Szalay and Rodman Ritchie, both of AKRF, for generously sharing their time and expertise on green infrastructure project development.

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EXECUTIVE SUMMARY

Stormwater runoff is a principal cause of urban waterway pollution nationwide, fouling rivers, lakes, beaches, and drinking water supplies. To reduce the environmental and public health threats posed by polluted stormwater and to comply with the Clean Water Act, cities nationwide are making significant investments to reduce stormwater runoff. However, traditional solutions that rely solely on fixing or expanding existing sewer and stormwater infrastructure can be extremely expensive and fail to address the root cause of the problem: impervious spaces in the built environment that generate 10 trillion gallons of untreated runoff per year.

This is why some cities have embraced green alternatives to help solve stormwater problems. Whereas traditional solutions involve expanding and adding to existing cement and pipe systems that convey rainwater away from where it falls, green infrastructure manages stormwater onsite through installation of permeable pavement, green roofs, parks, roadside plantings, rain barrels, and other mechanisms that mimic natural hydrologic functions, such as infiltration into soil and evapotranspiration into the air, or otherwise capture runoff onsite for productive use. These smarter water practices also yield many important co-benefits, such as beautifying neighborhoods, cooling and cleansing the air, reducing asthma and heat-related illnesses, lowering heating and cooling energy costs, and creating jobs.

Green infrastructure techniques, while more cost-effective than traditional gray infrastructure, still require significant financial investment, if they are to be implemented at the scale necessary to protect urban waterways. Fortunately, the use of green infrastructure practices—in combination with stormwater fee and credit systems that reward investment in retrofits—creates tremendous opportunities for private investment to underwrite much of the cost.

More than 400 cities, towns, and utility districts nationwide utilize parcel-based stormwater billing practices that charge property owners stormwater fees based entirely or in part on the amount of impervious area on their property. Those which provide property owners the opportunity to obtain a credit, or discount, on their stormwater fees by installing stormwater management practices can motivate private property owners to manage much of their own stormwater onsite. This reduces stormwater runoff into municipal sewers and local waterways, reducing stormwater management costs for the city or utility district.

Philadelphia has taken the lead among cities nationwide by establishing a parcel-based stormwater billing structure that provides a very significant credit (up to nearly 100 percent) for non-residential owners who can demonstrate onsite management of the first inch of rainfall over their entire parcel. Philadelphia's fee and credit structure and the incentive it creates for private property owners to install stormwater retrofits complements the city's *Green City, Clean Waters* program, which recently received approval from state regulators. That program requires the city, over the next 25 years, to retrofit nearly 10,000 impervious acres of public and private property to manage an inch of stormwater runoff onsite.

The potential market for stormwater retrofit investment is large. Nearly 800 communities, such as Philadelphia, have Clean Water Act obligations to reduce raw sewage overflows from combined sewer systems, which are triggered by excess stormwater runoff. Thousands of municipalities have separate stormwater sewers that are also regulated under the Clean Water Act; an increasing number of these communities are subject to requirements to reduce polluted runoff from existing developed areas, including by retrofitting impervious areas. In Philadelphia alone, we estimate a potential market for third-party investments in stormwater retrofits on the order of $376 million. Given the substantial gaps nationwide between water infrastructure funding needs and available local, state, and federal funds, cities all around the country will increasingly seek to leverage private financing to meet their needs.

In cities like Philadelphia that create incentives to reduce runoff by discounting future stormwater fees, a substantial opportunity exists for private third parties to invest in stormwater retrofits. Similar to how financings for energy efficiency retrofit projects have been structured, a portion of future stormwater fee savings can be utilized for lender or project financier repayment. Indeed, while stormwater retrofits are substantially different from energy efficiency retrofits, challenges in financing both types of projects are similar. In both cases, property owners will often have difficulty finding the upfront cash to self-finance a retrofit and will seek debt or other available project financing. In both cases, installed retrofits have little collateral value and commercial property owners will likely encounter difficulty with traditional lending if their properties are already mortgaged or held, as many commercial properties are, in parent companies with no credit rating.

To meet the financing needs of property owners seeking to install stormwater retrofits, a number of project finance mechanisms may be applicable that have been designed and deployed in the energy efficiency finance sector. These include off-balance sheet "project developer" models, land-secured financing through Property Assessed Clean Energy (PACE) programs, utility-enabled mechanisms including on-bill financing, and elements of Energy Service Company models. In the context of stormwater retrofits, as with energy efficiency retrofits, each of these mechanisms would rely on property owners' savings from reduced utility bills as a type of "cash flow," to facilitate repayment of funds invested up-front for the capital costs of retrofits.

There are also challenges associated with using these mechanisms to create a large and liquid market for private investment in stormwater retrofits. These include the relatively high transaction costs associated with some of these mechanisms, the large number of dispersed stormwater retrofit projects, difficulty lending to mortgaged properties, lack of available collateral, questions that may arise in event of transfer of ownership, and uncertainty regarding long term trends for municipal stormwater fees and credits.

Public policy strategies can help reduce project risk in order to attract commercial lenders and niche financiers to the stormwater retrofit sector, as well as lower the cost of capital for borrowers. These strategies include credit enhancement, facilitating project aggregation, public-private partnerships, offsite mitigation programs, and transparency regarding long-term stormwater fee schedules. Any combination of these policies would help attract private investors to the opportunities presented by a city's stormwater fee structure.

Using cost and financial return data based on a prototypical stormwater retrofit project in Philadelphia, this paper presents cash flow models for three financing scenarios: financing entirely with equity from the property owner, traditional commercial lending, and off-balance sheet "project developer" financing. (The latter two models are also generally representative of cash flows associated with PACE and on-bill financing.) These models illustrate how a property owner financing her own retrofit would realize a relatively unattractive return as compared with other financing alternatives. Traditional debt improves the rate of return for the property owner, but the best rate of return is demonstrated by the third-party project developer model, where the building owner is cash flow positive from day one and the project developer realizes a return of 20.5 percent on its investment.

To date, the authors are aware of firms that can perform the "project developer" role in the energy efficiency sphere, but are not aware of any firms that currently do so for stormwater retrofits. Similarly, while there are existing PACE and on-bill financing programs in operation for energy efficiency retrofits, there are no such existing programs for stormwater retrofits.

Accordingly, this paper concludes by offering recommendations for how a range of public and private actors—including municipalities and stormwater utilities, private firms, and state governments—can actively promote private investment in stormwater retrofits.

Successful examples of private sector investment in stormwater retrofits are critically needed, as cities nationwide are seeking cost-effective alternatives that leverage private dollars to complement necessary public investments in stormwater infrastructure. Philadelphia is a prime candidate to be an early adopter city. By doing so, it could catalyze a broader, perhaps national, market for private third-party investment in stormwater retrofits.

INTRODUCTION: THE PROBLEM OF URBAN STORMWATER RUNOFF AND THE PROMISE OF GREEN INFRASTRUCTURE

As long as there have been cities, there has been polluted stormwater run-off. In building our cities, we have paved over the earth, inhibiting the natural process by which rainwater and snowmelt are absorbed into the ground and filtered. Instead of filtering into the ground, most rain that falls in cities pours on to roofs, sidewalks, and streets, and is channeled into gutters and storm drains, collecting along the way everything from trash to pet waste to antifreeze, motor oil, and other highly toxic pollutants. Once in the storm drains and sewer systems, the polluted stormwater flows directly into our rivers, streams, lakes, and coasts or mixes with human sewage and then overflows, untreated, into our water bodies.[1]

Historically, stormwater management in urban areas has consisted primarily of collecting and conveying runoff from impervious areas, rather than reducing its volume. Two types of systems are used to collect and convey stormwater: separate stormwater sewer systems and combined sewer systems.

Separate storm sewer systems collect only stormwater and release it, usually untreated, together with the pollutants it has accumulated, to a receiving body of water. More than 10 trillion gallons per year of this untreated runoff are dumped into our waterways,[2] leading the Environmental Protection Agency (EPA) to label this pollution source as, "one of the most significant reasons that water quality standards are not being met nationwide."[3]

In combined sewer systems, which are more prevalent in older cities on the East Coast and in the Midwest and Pacific Northwest, stormwater runoff is mixed into the same sewer lines as sewage from the toilets and other indoor plumbing in residential and commercial buildings. During dry weather and small storms, this kind of system sends the combined flows to the wastewater treatment plant. But larger rain events (sometimes less than one-tenth of an inch, depending on which city) trigger overflows, dumping the combined sewage and stormwater, untreated, into a receiving body of water. These combined sewer overflows (CSOs) dump an estimated 850 billion gallons of untreated sewage mixed with polluted urban runoff into U.S. waterways each year, as of 2004.[4] Moreover, many of the nation's 770 combined sewer systems are more than 100 years old and existing water infrastructure is, in some parts of the country, literally falling apart. Washington, D.C., for example, averages one pipe break per day.[5]

Since 1987, the prevention, control, and treatment of stormwater discharges have primarily been regulated through the Clean Water Act's National Pollutant Discharge Elimination System (NPDES) program. Under the Act, communities are required to implement infrastructure upgrades that reduce pollution from both combined and separate storm sewer systems. TheEPA is currently developing more specific nationwide requirements, which will drive additional investments in stormwater infrastructure; moreover, many states and cities have already adopted increasingly robust plans and standards, at the local and regional levels.[6]

The costs to fix aging infrastructure inboth separate and combined sewer systemsand to expand existing systems are enormous. The EPA has estimated the cost at well over $100 billion over the next 20 years, nationwide.[7] Despite the urgent need for investment in stormwater management, under currently constrained fiscal conditions, many municipalities are struggling to fund necessary investments solely with public financing.

In the face of these challenges, flexible, more cost-effective, and comprehensive urban stormwater strategies are gradually being adopted in North American cities. Often referred to as green infrastructure, these techniques that are highlighted in NRDC's November 2011 report, *Rooftops to Rivers II: Green strategies for controlling stormwater and combined sewer overflows*, refer to practices that address stormwater problems "at the source." These approaches place greater emphasis on restoring natural hydrologic processes, such as infiltration, evapotranspiration, and reuse in order to both filter out pollutants and minimize the amount of runoff generated.[8]

In many cases, integrating green infrastructure into the existing built environment is a more cost-effective way to manage stormwater than upgrading antiquated existing infrastructure. For example, Philadelphia's 25-year *Green City, Clean Waters* plan, recently approved by state regulators to satisfy Clean Water Act mandates, requires the city to retrofit nearly 10,000 impervious acres (at least one-third of the impervious area served by Philadelphia's combined sewer system) to manage an inch of runoff onsite, relying on green infrastructure for billions of gallons of required sewage overflow reductions. The plan calls for the investment of at least $1.67 billion of public funds in green infrastructure, while seeking to leverage substantial investments from the private sector. Philadelphia expects to save billions of dollars using this approach as compared to relying exclusively on traditional gray infrastructure solutions that merely expand existing cement and pipe systems. The city also expects these green infrastructure investments to accrue billions of dollars worth of public benefits, such as additional recreational use of the city's waterways; reduction of premature deaths and asthma attacks caused by air pollution and excessive heat; increased property values in greened neighborhoods; the ecosystem values of restored or created wetlands; poverty reduction from the creation of local green jobs; and energy savings from the shading, cooling, and insulating effects of vegetation.[9]

As this paper outlines, policy frameworks can play a crucial role in attracting private investors to greener stormwater management efforts that focus on restoring hydrologic function in urbanized areas. Using Philadelphia's stormwater fee and credit system for commercial properties as a sample case, this paper explores potential financing strategies that leverage private capital to finance urban stormwater retrofits. Drawing from concepts developed in the energy efficiency finance sector, this paper evaluates a number of stormwater retrofit financing options that could be developed to suit the needs of property owners interested in installing stormwater retrofits on their properties to reduce their monthly stormwater bill.

Section I of this paper presents background on Philadelphia's stormwater fee and credit system and an overview of the significant opportunities for private investment in stormwater retrofits in that city. Section II presents the challenges and opportunities in financing energy efficiency retrofits on private property, explains a number of financing mechanisms that have arisen in that context, and explores their potential application to the stormwater context. Section II also identifies a number of challenges that may arise and potential government interventions that can help catalyze a private third-party investment market in stormwater retrofits. Section III models returns to investors based on a prototypical stormwater retrofit project, under three different financing scenarios, and highlights the key implications of the results. Finally, Section IV summarizes the conclusions of the paper and presents policy recommendations for municipalities and stormwater utilities, state governments, and private firms.

SECTION I: BACKGROUND ON PHILADELPHIA'S STORMWATER FEE SYSTEM AND THE POTENTIAL SIZE OF THE STORMWATER RETROFIT MARKET

This section explains Philadelphia's parcel-based billing system and the credit feature that can not only facilitate investment by the property owner in such retrofits, but also provide the basis for private third-party investment in stormwater retrofits. Part A of this section describes the structure and policy rationale for Philadelphia's parcel-based stormwater fee. Part B discusses the credit available under the new fee structure and the process for obtaining the credit. Part C briefly demonstrates the impact of the parcel-based fee on sectors of the commercial property market in Philadelphia and estimates the potential size of the Philadelphia stormwater retrofit market. Finally, part D provides a brief overview of cities with similar stormwater fee systems.

A. PHILDELPHIA'S PARCEL-BASED STORMWATER FEE

Philadelphia is one of the nearly 800 communities nationwide that manages much or all of its stormwater through a combined sewer system, which handles both stormwater and sewage through the same pipes. Sixty percent of the sewered area of the city (about 40,000 acres or 64 square miles) is served by combined sewers, some of which were first installed in the 19th century. When it rains, stormwater runoff from the city's impervious areas overwhelms the system and triggers sewage overflows—in some locations up to 85 times per year. The overflows inundate local waterways with pathogens, debris, and other pollutants that impair water quality and make area waters unsafe for recreational use following storms. Additionally, the volume of polluted runoff carries high sediment loads and contributes to elevated water temperatures, low dissolved oxygen levels, and streambank erosion, degrading riparian and aquatic habitats.[10]

In July 2010, the Philadelphia Water Department (the PWD) began phasing in a new stormwater rate structure that applies to all parcels, both publicly- and privately-owned, except residential buildings of four units or fewer.[11] Together, these properties cover more than 14,000 acres of impervious area—about 50 percent more than the total amount of impervious area that the PWD is required to retrofit under its 25-year *Green City, Clean Waters* plan.[12] We refer in this paper to such properties, collectively, as commercial properties.[13]

Prior to July 2010, a commercial property owner's stormwater fee was based on the parcel's potable water usage, as measured by the size of the water meter on the parcel. Under that meter-based fee structure, there was little or no correlation between the stormwater fee and the volume of runoff generated by a given parcel—i.e., between the stormwater management fees charged to the property-owner and the magnitude of the burden his or her property imposed on municipal stormwater infrastructure.

In contrast, Philadelphia's parcel-based stormwater billing system is based on a parcel's gross area and impervious surface area, a figure that is directly correlated to the volume of stormwater runoff that the parcel generates.

The conversion to parcel-based billing began in 1994 when the PWD convened a stormwater Citizens Advisory Council to "resolve perceived deficiencies" in the existing method of stormwater charges.[14] Under the meter-based billing system, which had been in place since 1968, properties with small water meter diameter (low potable water usage) but large impervious areas paid low stormwater fees, even though they generated relatively large amounts of stormwater. In contrast, owners with little impervious area but large amounts of water usage were overpaying for their stormwater management.[15] The advisory council concluded that stormwater rates should no longer be based on the size of a property's water meter but instead should be based on the impervious and gross area of a parcel.[16] In 2002, the PWD began transitioning to parcel-based fee structures by moving all residential customers to the parcel-based charge system, although the fee was set as a flat-rate, based on the mean residential parcel size.[17] Finally, in 2008, the PWD committed to phasing in parcel-specific charges for non-residential customers.[18]

As the parcel-based fee is phased in, commercial properties with small meters but large amounts of impervious surface area on their parcel, such as parking lots and big box stores, are seeing a significant increase in stormwater fees. Conversely, properties with large meters but low levels of impervious cover are generally seeing a reduction in their stormwater fees. For example, under the new parcel-based billing structure, the Philadelphia airport, which uses very little water but is almost entirely paved, will see its monthly stormwater fee raised by $126,000 per month, while the relatively unpaved University of Pennsylvania campus, which uses a large amount of water owing to its hospital and other campus facilities, will save approximately $11,000 per month on stormwater fees, as compared to the meter-based fee structure.[19]

As shown in Table I: Projected Phase-in Schedule for Parcel-based Stormwater Fee, the new parcel-based stormwater fee is being phased in over a four-year period, replacing the meter-based fee in 25 percent increments from 2010 through 2014.[20] The phase-in is meant to ease the transition to parcel-based billing for Philadelphia property owners and provide an opportunity for owners to retrofit their properties to qualify for credit against their fees.

Table 1: Projected phase-in schedule for parcel-based stormwater fee

Year	Percentage of fee that is meter-based	Percentage of fee that is parcel-based
7/1/10 to 6/30/11	75%	25%
7/1/11 to 6/30/12	50%	50%
7/1/12 to 6/30/13	25%	75%
7/1/13 and beyond	0%	100%

The monthly parcel-based fee for non-residential properties is the sum of an impervious area (IA) charge and a gross area (GA) charge, according to the following formula:[21]

Gross Area charge: $0.528 / 500 square feet

Impervious Area charge: $4.169 / 500 square feet

For each commercial parcel at least 5,000 square feet in size, the PWD determines the amount of IA and GA on the site by using Geographic Information Systems tools. For smaller properties, the IA is estimated as 85 percent of the total area of the property, if the site is developed, and as 25 percent, if the site is undeveloped.[22]

B. PHILADELPHIA'S STORMWATER FEE CREDIT

The rationale for the transition to parcel-based billing is not only to make the stormwater fee system fairer to Philadelphia's property owners, as described, but also to provide an incentive for owners to reduce the stormwater generated on their property. The incentive comes in the form of a credit against future stormwater fees for properties that install stormwater retrofits. Under the credit structure, the property owner receives a reduction in the IA portion of the monthly stormwater fee proportional to the amount of impervious area from which the entire first inch of runoff is managed onsite.[23] (Partial credit is not available if the retrofits manage less than an inch of runoff over a given area.) A credit valued at nearly 100 percent of that fee is available to property owners who demonstrate management or retention of the first inch of stormwater over 100 percent of their IA; a monthly minimum charge of approximately $13 prevents stormwater fees from being reduced 100 percent. Once a stormwater fee credit is approved by the PWD, the fee reduction is fixed for a four-year period, at which point the property owner may re-apply for the credit, based on a showing that the retrofit has been properly inspected and maintained and remains fully functional.[24]

The typical costs of specific stormwater management practices are illustrated in Table 2: Example Stormwater Retrofits and Approximate Costs.

Table 2: Example Stormwater Retrofits and Approximate Costs[26]

Stormwater Management Practice	Cost Ranges (per square foot of impervious area managed)
Basins or Ponds	$0.17 – $0.37
Created Wetlands	$0.25 – $0.50
Reducing impervious (hard) surfaces	$0.62
Swales (broad, shallow vegetated channels designed to convey, filter, and infiltrate stormwater runoff)	$1.08
Trees planted near pavement	$1.09
Rain gardens	$1.42 – $1.45
Underground projects (subsurface infiltration)	$1.16 – $2.24
Rainwater harvest & reuse	$2.95
Flow-through planters	$5.30
Porous pavements	$2.10 – $20.96
Green roofs	$31.43

The above costs include materials, installation, design and engineering, but can vary depending on site constraints or unforeseen issues.

Source: Adapted from the PWD Green Guide for Property Management, p. 20, accessed at www.phila.gov/water/Stormwater/pdfs/PWD_GreenGuide.pdf. The unit costs reflect the cost to manage 1 inch of runoff from 1 square foot of impervious area. Personal communication with author of the PWD Green Guide, Jan. 12, 2012.

Generally, the cost of stormwater retrofits on a property property will vary depending on the existing conditions on the property, which affects the selection and sizing of appropriate stormwater management practices. A number of site-specific factors can affect the cost and payback period of retrofits:[25]

- overall size of the property
- size and number of available open spaces or already green areas for stormwater projects
- amount of impervious surface and its proximity to the green areas
- elevation of the green areas, which determines whether stormwater will flow to the green areas naturally or will require piping/pumping
- amount of water the soil in the green areas can absorb

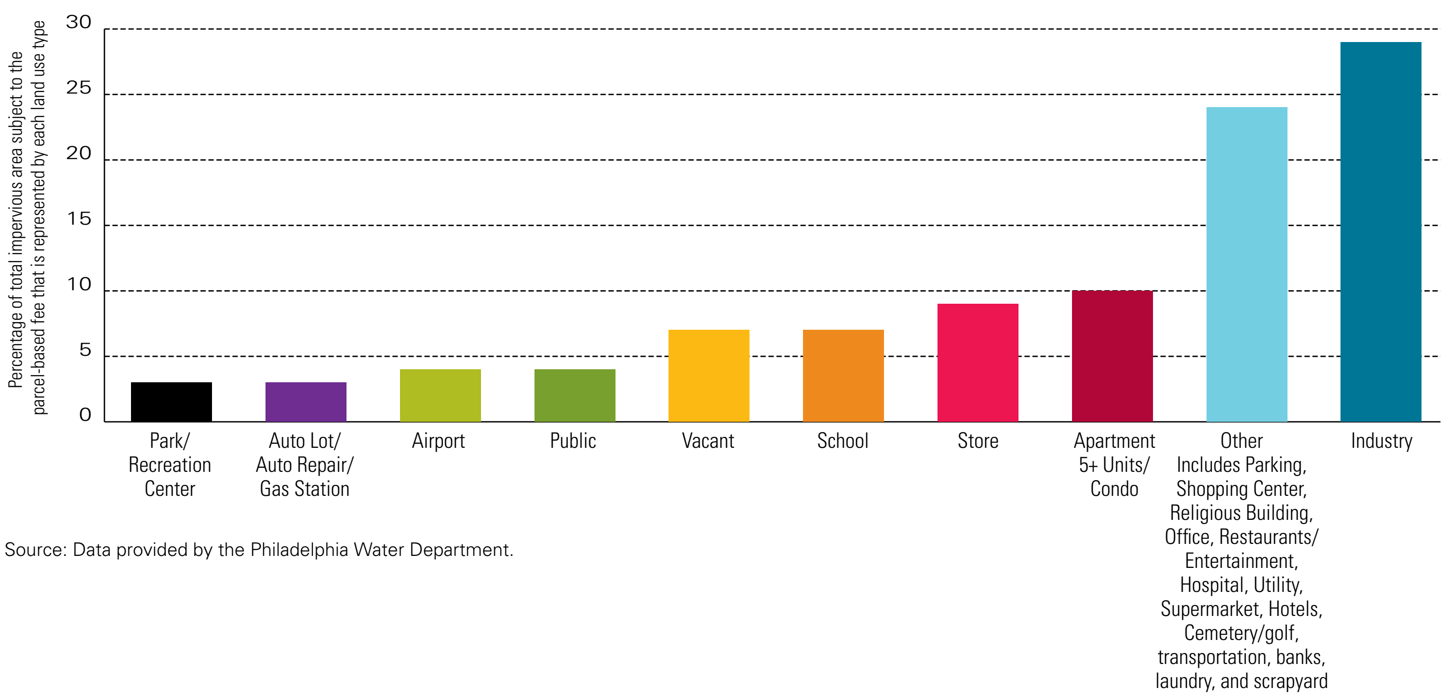
For properties that have no available green areas, projects such as porous paving and green roofs can be constructed.

C. ESTIMATED STORMWATER RETROFIT MARKET SIZE IN PHILADELPHIA

Within Philadelphia, there are approximately 90,000 commercial properties subject to the new parcel-based fee. As indicated in Figure 1: Aggregate Impervious Area by Property Type, industry, apartments, and stores represent the largest proportions of impervious square footage.

In order to provide a sense of the size of the potential market for stormwater retrofit investment in Philadelphia, two groupings of parcels were analyzed for this report: (i) the "top 100" parcels ranked by monthly stormwater fee under the new billing system; and (ii) all parcels with monthly stormwater fees of $1,000 or more. These groupings were selected based on the premise that they will have the greatest incentive to retrofit once parcel-based billing is fully phased in.[26] Although the estimates provided suggest that there is potential for large private investments in stormwaterretrofits, it bears emphasizing that these estimates are to be considered illustrative due to the limitations of available data.[27]

Figure 1: Aggregate impervious area by property type



Source: Data provided by the Philadelphia Water Department.

Top 100 properties

Collectively, the 100 commercial properties with the highest parcel-based fee contain approximately 3,178 acres of impervious area. This is equivalent to approximately one-third of the city's *Green City, Clean Waters* mandate to green at least 9,564 acres over the next 25 years.

Based on a statistical analysis of stormwater retrofit case studies of specific properties in Philadelphia, and assuming that owners of the 100 properties with the highest parcel-based fees would choose to retrofit to manage one inch of runoff from a substantial portion of their aggregate impervious area, we estimate total construction costs in the range of $115 million to retrofit these properties. Further explanation of the statistical methodology and the underlying data is provided in Appendix III.[28]

Following the industry standard for commercial real estate finance, if 80 percent of the retrofit cost were financed and 20 percent of the costs were covered by cash from the property owner, these 100 properties would require as much as $92 million in third-party investment.

Properties with monthly stormwater fees of $1,000 or greater

A broader summary of the market opportunity would consider private properties that will incur stormwater management fees above $1,000 per month under the parcel-based fee structure. There are 1,288 parcels that will have monthly stormwater fees of at least $1,000 once the parcel-based fee is fully phased in. Collectively, these properties contain approximately 9,148 acres of impervious area, equivalent to 96 percent of the city's *Green City, Clean Waters* retrofit mandate. Using the same statistical methodology and assumptions described above, approximately $470 million in construction costs would be needed to retrofit these parcels. Under the same 80 percent financing assumption described above, these projects would require about $376 million in financing.

D. PREVALENCE OF PARCEL-BASED STORMWATER FEES AND CREDITS

Many hundreds of cities, towns, and utility districts nationwide utilize some form of parcel-based billing for stormwater management.[29] Many of those jurisdictions allow, or are developing programs to allow, property owners to obtain credit against their fees if they reduce their stormwater runoff by reducing the impervious area of their property or otherwise retrofitting to manage runoff onsite. A 2010 survey of 70 utilities in 20 states found that a majority offered credit against stormwater fees to property owners who installed stormwater management practices onsite.[30] For descriptions of stormwater fee and credit systems in selected major cities, see Appendix I.

Among cities where stormwater fee credits are available, Philadelphia's billing system provides one of the strongest financial incentives for property owners to retrofit. For a property owner contemplating an investment in stormwater retrofits, the availability of a nearly 100 percent credit against stormwater fees, coupled with the level of the per-square-foot stormwater charge, greatly accelerates payback on stormwater investments as compared to other cities, where similar investment in stormwater retrofits would often result in a maximum of 35 percent or 50 percent reduction in stormwater fees.

Although Philadelphia's new stormwater billing system provides one of the most compelling stormwater fee credits available nationally, the upfront costs of installing retrofits on a parcel will often remain prohibitively high for many of Philadelphia's non-residential property owners. The remainder of this paper describes these barriers to investment and evaluates potential financing options that utilize the avoided stormwater fees (i.e., the effective value of the credits) as a measure of projected return on stormwater retrofit investments. Note that the analyses in this paper do not account for other financial benefits of stormwater retrofits that may accrue to a property owner, independent of any reduction in the stormwater fee. These include, for example, increased property value and energy savings that are associated with vegetated spaces, which are described in the Introduction.

SECTION II: FINANCING CHALLENGES AND OPPORTUNITIES

Part A of this section highlights the challenges of financing stormwater retrofits for commercial buildings, drawing parallels to the challenges of financing energy efficiency retrofits. Part B of this section reviews several of the financing models that the private and public sectors have developed in the context of energy efficiency retrofit finance and analyzes their viability in the context of stormwater retrofits. This analysis applies specifically, and exclusively, to cities or jurisdictions where a parcel-based fee and credit system is in place, providing an opportunity for stormwater retrofits to yield cost-savings on stormwater utility bills, analogous to the cost-saving opportunities provided by energy efficiency retrofits. Part C describes strategies that government entities can pursue to further enhance the financeability of stormwater retrofit projects.

A. CHALLENGES TO FINANCING STORMWATER RETROFITS FOR COMMERCIAL PROPERTIES AND COMPARISON WITH ENERGY EFFICIENCY RETROFITS

In cities that offer substantial fee reductions for property owners who reduce their stormwater runoff, the business case for making stormwater retrofits to commercial buildings looks much like the business case for making energy efficiency retrofits to commercial buildings. Just as property owners who invest in energy-saving improvements for their buildings can re-coup their investment through savings on monthly energy bills, property owners who install stormwater retrofits on their parcels can substantially reduce their monthly stormwater bills. In both the energy efficiency and stormwater retrofit cases, substantial cost savings are available for property owners who retrofit their property. And in both cases, even where these retrofits can pay for themselves through future stormwater fee savings in a few years, the upfront costs of retrofits can be prohibitively high.[31] From the perspective of a commercial property owner interested in undertaking a stormwater retrofit, a number of financial challenges must be overcome. In cities such as Philadelphia, where the parcel-based billing and credit structure is still relatively new, the absence of known case studies of completed investments in stormwater retrofits and absence of a long-term track-record implementing a stormwater credit program entail some non-negligible project risk to both the property owner and potential lenders or third-party project financiers, particularly because investment returns are linked to anticipated stormwater fee savings. These risks would be further increased by any uncertainty regarding the future, long-term stability of the fee and credit structure, which may be associated with local procedures for stormwater utility rate-setting.

If the property owner is seeking third-party financing for the project, the prevalence of existing mortgages on commercial properties can also be a barrier or deterrent to traditional asset-based debt financing of retrofits, as nearly all commercial real estate mortgage contracts include covenants that would be violated if a borrower encumbers the property with senior debt, and many commercial mortgages require existing lender consent if the property owner would like to take on subordinate debt.

Further, lending under traditional asset-backed terms can be challenging owing to the lack of clear collateral. Most commercial real estate properties are held in limited liability companies with no credit ratings. Stormwater retrofits themselves, once installed, are unlikely to be useful as recoverable collateral for lenders, in case of default on debt payments. Moreover, there is no available history of stormwater retrofit loan performance or the value that stormwater retrofits can add to existing property valuations.

In sum, under the traditional asset-backed lending model, stormwater retrofit financing likely will be available only at a high cost, detracting substantially from the value to property owners of pursuing stormwater retrofits.

Though these circumstances are challenging, they will sound familiar to those working in the commercial energy efficiency retrofit finance sector, where alternatives to asset-backed lending have also been necessary. The financing needs for energy efficiency retrofits are similar to the needs for stormwater retrofits, and there are strong parallels as well in the risks (lack of known track record, lack of collateral)[32] and rewards (repayment based on projections of retrofit performance). In the energy efficiency sector, high-profile retrofits of buildings such as the Empire State Building stand as examples of ambitious and profitable energy efficiency retrofit investments (see Empire State Building Energy Efficiency Retrofit text box). However, absent specialized financing vehicles, the vast majority of building owners are unable or unwilling to pursue energy efficiency retrofits, as they lack available capital and traditional asset-backed debt financing is unlikely to be available at reasonable cost.

Given these challenges, the remainder of this section highlights a number of project financing strategies that utilize future savings on utility bills as an anticipated cash flow stream from which project financiers can source repayment. Although these strategies have been developed and applied, to date, in the context of energy efficiency financing for commercial buildings, they are likely to be instructive for commercial stormwater retrofit financings, in cities where parcel-based stormwater fee and credit structures are in place.

B. ENERGY EFFICIENCY RETROFIT FINANCE MODELS AND THEIR VIABILITY IN THE CONTEXT OF STORMWATER RETROFITS

A number of financing mechanisms have been developed for efficiency retrofit projects to circumvent the challenges of traditional asset-backed financing (i.e., financing secured by some asset, typically the building that is being improved). Instead of being secured by an asset, most of the models described in this section are premised on the characterization of future savings resulting from an energy efficiency retrofit as a source of cash that can either be channeled directly to the project financier or enhance the building owner's ability to repay the project financier. Likewise, in cities with stormwater billing structures that provide a reduction in stormwater fees to property owners who install stormwater retrofits, avoided stormwater fees can be characterized as a future cash flow and source of repayment for project financiers.

Although the models designed for the energy efficiency retrofit sector can be instructive for financiers interested in stormwater retrofits, certain differences should be recognized in terms of project performance and regulatory risk. These differences can guide how energy efficiency financing models need to be refined if they are to be applied to the stormwater context.

Project risks, including technical performance of installed retrofits as well as user behavioral risks, are likely to be lower for stormwater retrofit projects than for energy retrofit projects. Stormwater retrofit plans can be submitted to the stormwater utility, in advance of project implementation, to ascertain the precise stormwater credit that will result. Once the plans are approved and the stormwater fee credit is applied, the parcel's monthly bill is reduced, subject to periodic re-certification that the retrofit is properly functioning; n the case of Philadelphia, once every four years. In contrast, in the energy efficiency retrofit context, a drop in occupancy, substantial change in building user behavior, or technical failure of building management systems can alter realized energy savings. Although behavioral and technical risks associated with stormwater retrofits may be much lower, it should be noted that, just as in the energy efficiency context, stormwater retrofits require ongoing inspection and maintenance in order to ensure that they perform as designed and remain eligible for a credit.

In the energy efficiency context, project financiers must take into account the risk of utility price fluctuation, which affects the differential between pre- and post-retrofit energy bills. In the stormwater retrofit context, the cash flow stream from stormwater fee credits is based on local regulations that put a price on impervious area and set incentives for reduction in stormwater runoff. In the absence of long-term stormwater fee and credit assurances from the relevant authority, reliance on a payback stream that stems from specific stormwater billing policies can be perceived as risky. This risk is particularly salient for retrofit projects with longer payback periods in cities with recently-adopted parcel-based fee and credit systems, where it may be unclear whether the stormwater retrofit credit regulations will remain consistent over time.

Energy efficiency has proven itself a low-hanging fruit in principle that is difficult to harvest in practice. As a number of reports written over the past several years have indicated, a national market in energy efficiency financing is possible, though third-party financings for commercial energy efficiency retrofits remain rare.[33] Nevertheless, each of the still-evolving energy efficiency retrofit financing mechanisms described in the following subsections are relevant as a potential model for stormwater retrofit financing, as each of them has proven effective in at least some of cases in circumventing the challenges of lending to commercial owners in reliance on future avoided costs.

Empire State Building Energy Efficiency Retrofit

While undertaking a broader renovation of the entire property, the owner of the Empire State Building (ESB) allocated $20 million toward energy efficiency upgrades for the building.

Sample efficiency improvements from the ESB retrofit include:

- Rebuilding the electric chiller plant, increasing available cooling capacity and reducing capital expenditures and operating expense.
- Upgrading the Building Management System (BMS) (building automation and controls) and installing sub-meters on each floor.
- Retrofitting all 6,514 windows to increase their insulating value from R2 to R7, reducing overall cooling and heating expenses.
- Installing multi-channel, state-of-the-art electric meters in every electrical distribution closet, allowing floor-by-floor, quadrant-by-quadrant, monitoring of electrical energy consumption available for common spaces as well as individual tenant spaces.
- Installation of reflective insulation behind each of the 6,514 radiators. This redirected heat inward, reducing the project's use of steam and, thus, lowering operating costs.

Once completed, the energy efficiency retrofit is projected to save 38 percent - or $4.4 million annually- on the ESB's energy costs. This provides a very attractive payback period of fewer than four years and the owner will enjoy significantly lower operating expenses during the remainder of the useful life of the improvements. Because the ESB project was self-financed, the owner will retain the full benefits of the energy savings.

For more details on the Empire State Building's energy efficiency retrofit, see http://www.esbnyc.com/sustainability_energy_efficiency.asp.

1. OFF-BALANCE SHEET "PROJECT DEVELOPER" FINANCING

Deployment in the energy efficiency sector

Because commercial building owners are typically either unwilling or unable to encumber their balance sheets with additional debt to finance an efficiency retrofit, a class of energy efficiency investment firms has arisen which provide "off-balance sheet" financing for efficiency retrofits. These firms do not loan capital to the building owner in the traditional sense, but instead act as energy efficiency "project developers."[34] With variations in precise structure, these firms cover all upfront retrofit costs, often installing the retrofit measures as well as providing multi-year maintenance, monitoring and verification of performance following installation. In exchange, the building owner pays the project developer in installments, based on a portion of the energy savings resulting from the retrofit.[35] To enhance security of repayment, project developer firms may retain ownership of the efficiency improvements for the duration of the contract.[36]

Project developers can use external debt, external equity, or their own cash to finance the retrofit and the project remains on the project developer's balance sheet rather than the property owner's balance sheet. These models are attractive because they do not encumber the building owner's balance sheet and they also shift project performance risk away from the building owner. The primary benefits of project developer financing are that the building owner does not need to cover any expenses upfront and, where the project developer shares a portion of the savings with the building owner, the building owner can be net cash flow positive from day one.

Project developer financing mechanisms, as applied in the energy efficiency retrofit sector, are relatively new and most projects using this model, to date, have been developed and deployed in the industrial/campus/healthcare sector. Although these projects vary in terms of interest rates, generally the costs of capital and transaction costs are high for project developer financing, primarily owing to the extensive contractual arrangements and costs of ongoing monitoring and verification. These financings, therefore, make stronger economic sense for larger retrofit projects (e.g., those with costs greater than $500,000).

Application of "project developer" financing to stormwater retrofits

The "project developer" model would likely have slightly different features in the stormwater context to match the different risk/reward calculation presented by stormwater retrofits, in comparison to energy efficiency retrofits. For example, the cost of the specialized third-party off-balance sheet models for energy efficiency retrofits stems in part from the desire, on the part of the building owner, to shift project performance risk to the project developer, as well as to compensate the project developer for costs of ongoing monitoring and verification of energy conservation performance. Because Philadelphia's stormwater credit is fixed, once initially approved, for a four-year period, there is more certainty in stormwater retrofit project payback than in energy retrofit performance, and this increased certainty could result in lower project performance risk for stormwater retrofit financing. On the other hand, stormwater retrofits may be subject to a higher level of regulatory risk than energy retrofits. For example, the risk of change in the parcel-based fee and credit structure, introduces an element of uncertainty into forward repayment cash flow opportunities; this could, in turn, add to the cost of capital for stormwater financing. If stormwater utilities made long-term stormwater rate schedules (10 year to 15 year projections) available, some perception of regulatory risk could be mitigated.

The high cost of capital will likely remain a challenge for application of this model in the stormwater context, just as it has been in the energy context. Just as in the energy efficiency sector, stormwater retrofits will still require extensive contractual arrangements, ongoing maintenance and general financial risk when 100 percent of the upfront costs are covered, and these features will continue to keep the cost of capital high.

There are no firms currently performing this type of project developer function in the stormwater sector at the time of publication. However, this financing structure could be particularly attractive for stormwater retrofits to large industrial or shopping mall properties, which face some of the largest fee increases under Philadelphia's new parcel-based stormwater fee and would likely require capital-intensive retrofits to substantially reduce those fees. More details on the specific investment returns from a prototypical stormwater retrofit project financed through an off-balance sheet project developer approach are provided in Section III.

2. LAND-SECURED FINANCING THROUGH COMMERCIAL PACE (PROPERTY ASSESSED CLEAN ENERGY) PROGRAMS

Deployment in the energy efficiency sector

PACE is a finance program that was developed to help residential and commercial building owners afford renewable energy, energy efficiency, and water efficiency improvements. Currently, 27 states and the District of Columbia have passed enabling legislation that provides legal authority for municipalities within their states to implement PACE programs.[37]

Under a typical PACE model, a municipality issues special revenue bonds, the proceeds of which are utilized by participating property owners to pay for energy or water efficiency improvements to their property. Property owners who receive PACE financing for improvements agree to repay the costs of the retrofit in the form of an assessment on their property taxes for up to 20 years. (See Figure2: How PACE Works.)

Because the assessment is part of the property tax, the PACE assessments are attached to the property, not the individual owner. PACE thereby addresses two of the primary challenges in financing energy-related retrofits: the up-front cost and the risk that the owner will not be able to recover the retrofit costs through energy savings by the time the property changes hands.

Importantly, existing municipal debt limitations or credit concerns have no bearing on the viability of PACE programs. PACE bonds are backed not by the balance sheet or credit rating of the city; PACE bonds are backed only by the property tax liens on the properties that use PACE funds for retrofits.

Many PACE programs require PACE-financed improvements to achieve a savings-to-investment ratio (SIR) of 1 or more (SIR≥1). This means that the annual energy savings to the property owner resulting from the retrofit needs to be greater than the annual amount in PACE-related assessments the owner must pay. This requirement aims to ensure that PACE financings are used toward projects that will generate significant savings and helps ensure that the projects are cash-flow positive on an annual basis, improving property owners' ability pay down existing mortgage debt.

PACE financing came under fire in July 2010 when the Federal Housing Finance Agency (FHFA) and the Office of the Comptroller of the Currency (OCC) issued statements that effectively shut down PACE program development in the residential market, on the basis that the PACE tax lien was an infringement on existing lenders' senior mortgage rights.[38] As a result of FHFA's directives, most states and cities have suspended existing or planned residential PACE programs.

However, PACE programs aimed at the commercial sector were not precluded by theregulators' 2010 statements.[39] Because most commercial PACE programs require existing lender consent as a prerequisite to extending PACE financing, by definition most commercial PACE programs would not infringe on the rights of existing mortgage holders. Commercial PACE programs have recently been launched in South Florida, Sacramento, and San Francisco.[40]

As the time of publication, legislation is pending in Congress that would prohibit the FHFA and its regulated entities (Fannie Mae and Freddie Mac) from discriminating against communities with PACE programs, or residential properties with PACE financings.[41] The legislation would also protect existing residential mortgage lenders by establishing specific underwriting requirements for PACE. It also includes a requirement that PACE programs utilize a SIR≥1 threshold for PACE-financed improvements.

Application of PACE to stormwater retrofits

The benefits of PACE are as salient in the stormwater management context as they are in the energy efficiency, water efficiency, and renewable energy context. For stormwater retrofit investments, property owners will need assistance in covering up-front retrofit project costs and will benefit from the fact that PACE liens are attached to, and travel with, the property. In municipalities that provide a credit for commercial owners who reduce stormwater runoff from their parcels, some (but likely not all) stormwater retrofits can yield stormwater fee savings that could be a viable basis for the SIR≥1 requirement and repayment schedules. Stormwater retrofits can also meet the SIR≥1 requirement when they are bundled with other cost-saving measures, such as energy and water conservation improvements.

Moreover, the idea of utilizing tax lien financing for stormwater retrofits is not new. As early as 2009, the Environmental Protection Agency's Environmental Finance Advisory Board (EFAB) sent a report to EPA Administrator Lisa Jackson encouraging the agency to consider tax-lien mechanisms to finance a range of environmentally beneficial improvements to private property. The report highlighted specifically the role that the EPA could play in encouraging states to enact PACE enabling legislation that includes mechanisms not only to finance energy efficiency and renewable energy installations, but also to finance stormwater retrofits such as green roofs, rainwater catchment

Figure 2: How PACE works

PACE enabling legislation passed at the state level	Local gov't creates assessment district and issues special revenue bonds	Property owners sign up for PACE financing and use bond sale proceeds to pay for retrofits	Assessments added to participating property owners' property tax bills	Bond funds repaid from assessments over useful life of the improvements (up to 20 years)

Source: www.pacenow.org.

basins, and permeable pavement.[42] As recently as May 2011, EFAB sent a letter to Administrator Jackson to address concerns raised by the FHFA and urging the EPA to support tax-lien financed mechanisms, "because they provide an important source of financial support to for crucial community-wide environmental programs."[43]

In practice, a number of policy measures will be required before PACE or variations on the tax-lien financing mechanism are a viable option for financing stormwater retrofits. For commercial PACE financing to apply to stormwater retrofits on a stand-alone basis (i.e., not bundled with other retrofits) and still conform to the SIR≥1 requirement, there will need to be some apparent financial benefit from installing stormwater retrofits. Billing systems that provide a credit against stormwater fees for property owners who retrofit are one example, but utilities should bear in mind that, in order to meet the SIR≥1 requirement for a stand-alone stormwater retrofit, the credit may need to be more significant than the currently available fee discounts in many cities that offer such discounts.

In addition, legislative changes will likely be needed before PACE can apply to a broad range of stormwater retrofits. PACE-financeable improvements included in most existing state PACE enabling legislation include only energy efficiency, renewable energy, and water efficiency improvements. Depending on the language of specific state enabling legislation, some states may be able to characterize stormwater retrofits as an element of water efficiency, since some stormwater retrofit projects include rainwater harvesting for use in landscape irrigation or interior building applications, which would reduce water consumption. However, most existing PACE state enabling statutes would likely need to be amended to specifically provide for inclusion of stormwater retrofits. (In Pennsylvania, proposed PACE enabling legislation (H.B. 2525), which includes financing for stormwater retrofits, was introduced in 2010 but has not yet been adopted.[44])

With at least one major commercial PACE financing closed in the second half of 2011 and more are likely to follow, commercial PACE is an increasingly viable mechanism to finance improvements on private property that have a public benefit, such as energy efficiency or stormwater management.[45] Although any rollout of PACE for stormwater retrofits may be delayed by the needs to amend state authorizing legislation, PACE provides the upfront capital to owners, assures that the lien will remain with the property in event of transfer of ownership, and does so at virtually no cost to the public sector. Assuming the policy prerequisites can be met, commercial PACE could be extremely relevant to stormwater retrofit financing needs.

3. UTILITY-ENABLED FINANCING AND REPAYMENT

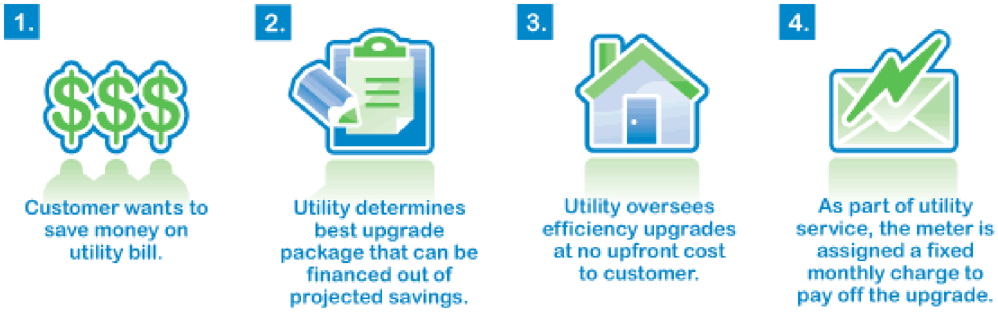
Deployment in the energy efficiency sector

A local utility's existing relationship with ratepayers provides an opportunity to utilize known channels for disbursement of retrofit funds and collection of retrofit financing repayment. If an electric utility is offering an on-bill financing program, this typically means that the utility will lend capital to ratepayers, who will use those funds to install energy efficiency retrofits, and the utility will collect repayment through a monthly line item listed on participating ratepayers' utility bills. The funds provided for the on-bill financing typically come from ratepayer funds or other state or local funds. An on-bill program could also be administered by a local community development financial institution (CDFI), as existing on-bill programs are in Oregon and Kentucky.[46]

With California and New York passing legislation that makes on-bill efficiency financing mandatory for electric utilities operating within the state, the availability of on-bill financing for energy efficiency retrofits is sure to rise in the coming years.[47] However, in the absence of legislative mandates such as those in California and New York, electric utilities have been reluctant to adopt on-bill programs, as they consider it one step removed from their core business (providing energy) and are also concerned about the administrative burden of running on-bill programs and exposure to banking regulations if they charge interest on the loans. From the perspective of the building owner, the primary risk with on-bill financing is that some programs require that the loan be non-transferable; if there is a change in ownership, the loan amount must be paid in full.

One way that utilities have, in some cases, overcome concerns about banking regulations is by structuring the on-bill program as a tariff rather than a loan, which characterizes the funding as a service provided by the utility.[47] Although specific prerequisites and implications of structuring the program as a tariff rather than a loan will vary by state, the benefits include reduction in regulatory hurdles for the utility and, because tariffs are linked to the utility meter, the ability of property owners to pass the tariff on to subsequent owners in event of sale or transfer of the property.

Figure 3: Kentucky's Mountain Association for Community Economic Development "$MART KY" On-bill Program



Source: See $MART KY program details at http://www.maced.org/howsmart-about.htm.

On-bill financing applied to stormwater retrofits

The on-bill mechanism could provide benefits to borrowers and lenders in the stormwater context, just as it does in the energy efficiency context. Similar to the extant on-bill programs in the energy sector, a small charge applied to utility ratepayers could form a pool of capital sufficient to lend to property owners for stormwater retrofits. If the water or stormwater utility were to offer on-bill financing for stormwater retrofits—particularly if the stormwater retrofit loan were fixed to the property and transferable to future owners—this would likely stimulate demand by building owners for stormwater retrofit financing.

While most on-bill programs in the energy efficiency sector have, to date, been funded directly by utilities, on-bill program funds could also be sourced, in whole or in part, from private investors and/or CDFIs. Such investors could rely on the track record of ratepayer utility default rates as a yardstick for repayment default. In cities where stormwater utilities can demonstrate relatively low delinquency rates on utility bills, this approach, coupled with a repayment obligation running with the property, may entice private investment.

For one example of how such a financing could be structured, see Utility-enabled "Project Developer" Financing text box. In this scenario, which we have termed a "utility-enabled project developer model," if a private investor provides the capital for an on-bill program and enters a contractual agreement with the utility to receive a pre-determined amount from each participating property owner's utility bill, as a means to recover its capital outlay. At least one report has documented that lenders perceive a lower level of risk with on-bill programs than through stand-alone energy efficiency financing.[49] The program structure would need to compensate the private investor for the cost of the upfront capital lent to ratepayers and compensate the utility for the administration of the payments and the marginal increase in risk of default associated with a higher utility bill.

Similar to the electric utilities, which have been slow to embrace on-bill financing in the absence of regulatory incentives or directives, it is likely that stormwater utilities would be reluctant to take on the burden of administering an on-bill financing program in the absence of regulatory pressure. In Philadelphia, it has been suggested that the administration of an on-bill program could be outsourced through a partnership between the PWD and a bank or local CDFI, enabling entities that are actually in the business of making and managing loans to manage the underwriting and lending processes for the utility.[50] Stormwater utilities would also likely share electric utilities' concern regarding regulatory and accounting treatment if they were to charge any interest on the loans and may want to consider structuring the program as a tariff rather than a loan.

In sum, whether through traditional on-bill financing or an alternative "utility-enabled project developer" model, utility participation in stormwater retrofits can be an effective catalyst for private third-party investment in stormwater retrofits.

4. PERFORMANCE CONTRACTING (ESCO) MODEL

Deployment in the energy efficiency context

Energy Services Companies (ESCOs) are not a financing mechanism but, rather, are specialized firms that contract with building owners to analyze pre-retrofit energy usage, install energy-saving measures, and conduct post-installation monitoring and verification of energy savings and maintenance of installed equipment. ESCOs are attractive in part because they can use their own balance sheet capacity to offer building owners a guarantee of energy-savings performance (termed an "energy savings performance contract" or "ESPC") for installed measures, which contractually binds the ESCO to compensate the building owner for any shortfall in projected savings for the life of the energy savings performance contract. ESCOs typically charge a premium for this transfer of project performance risk from the building owner for a charge of approximately 15 percent

Utility-enabled "project developer" financing

Jurisdictions where a parcel-based fee and credit policy are in place can incorporate elements from the "on-bill" and "project developer" models. A project developer would provide the upfront capital for installation of a stormwater retrofit and commit to conducting ongoing monitoring and verification of the project performance. The utility would contractually agree with the property owner and the project developer that, rather than apply a "credit" against property owner's stormwater bill, the utility will send an equivalent check to the project developer and continue to bill the ratepayer at the pre-retrofit rate. In order to provide the property owner some financial benefit from the start, the project developer would agree to make a monthly payment to the property owner, derived from a portion of the "credit" payment that the project developer receives from the utility.

Under this model, the underwriting responsibilities and project risk accrue to the project developer. Property owners are incentivized to participate by the monthly checks they will get from the project developer, and the project developers have a secure repayment stream. Although the specific terms of such contracts are outside the scope of this paper, in event of change of property ownership, a buyout option could be written into the project developer's contract with the property owner. To lower transaction costs and facilitate these contractual arrangements, the utility could provide boilerplate contractual language for use by local property owners and project developers.

of the total project costs. The ESCO model has primarily flourished in municipal, university, school, and hospital (MUSH) building energy efficiency retrofit projects and is appealing to large investment-grade commercial campus and industrial owners who have the balance sheet capacity to borrow or self-finance. The primary benefit the ESCO offers is the risk transfer of the energy savings performance contract, which guarantees a threshold amount of energy savings resulting from the project.

Application of the ESCO model to stormwater retrofits

Although Water Efficiency Service Companies have operated in apartment buildings to undertake retrofits of plumbing fixtures to reduce potable water usage,[51] no firms known to the authors operate in the context specifically of stormwater management. In the case of stormwater retrofits, the ESCO model may be less applicable, for several reasons. First, the costs of ongoing verification of project performance are likely to be far lower, since reduced stormwater charges are not based on actual, measured reductions in runoff volumes, but rather on the proper design, installation, and maintenance of a stormwater retrofit. Second, because the reduction in stormwater fees is fixed for a four-year period once a credit is approved, the need for a "guarantee" in the form of a performance contract is greatly reduced. Application of the ESCO model to the stand-alone stormwater retrofit context will likely be limited because the ESCO model (similar to the project developer model) is generally more cost-effective for larger projects, though stormwater retrofits could conceivably be integrated into larger retrofit projects that encompass energy and water-related improvemets. However, the application of ESCO-type contracts to the stormwater context may merit further investigation, as at least one prior report has suggested the possibility of developing mini-ESCO-type firms to support implementation of stormwater retrofits, suggesting that initial startup costs for the firms could be subsidized by local CDFIs.[52]

C. ADDITIONAL STRATEGIES TO SUPPORT PRIVATE INVESTMENT IN ENERGY EFFICIENCY AND STORMWATER RETROFITS: CREDIT ENHANCEMENT, PROJECT AGGREGATION, AND OFFSITE MITIGATION PROGRAMS

When stormwater fee structures are designed strategically, investments in stormwater retrofits can have attractive payback schedules. However, the large number of dispersed projects, relatively high transaction costs, difficulty lending to mortgaged properties, risks that arise in event of transfer of ownership, and potential uncertainty regarding long-term trends in a given utility's stormwater fee and credit program, may still present challenges to financing the initial costs of stormwater retrofits—even if the property owner seeks third-party capital for the project under any of the mechanisms.

The strategies outlined below aim to mitigate repayment risk, lower stormwater retrofit transaction costs by aggregating projects, and enhance liquidity in the stormwater retrofit market. Each of the strategies described in this section can be applied to the financing mechanisms described in Part B, individually or in conjunction with one another.

1. CREDIT ENHANCEMENT

Credit enhancement refers to mechanisms that provide a financial backstop for a percentage of a total portfolio of financed projects. Typically, a credit-enhancing entity provides a pool of capital, or commits to utilizing its own balance sheet, to cover losses on a certain percentage of defaults (often 5 percent to 10 percent but percentages can vary). A properly designed credit enhancement facility can improve financing terms and extend repayment periods beyond what they might be in the absence of credit enhancement. Credit enhancement facilities can be set up by either private or public entities, or by public-private partnerships (see New York City Energy Efficiency

Corporation text box). If these facilities are private funds or publicly-subsidized entities that seek to become self-sustaining, revenue can be generated from charging origination fees, fees for credit enhancement, and interest income. Credit enhancement facilities make particular sense for public entities seeking to support investment in a sector that provides important community benefits, such as energy efficiency or improved stormwater management, because it enables a limited pool of public funds to be leveraged with private capital to generate a far larger pool of available funds to lend.[53]

A credit enhancement facility shifts default risk away from financiers and onto the source of the credit enhancement. Whether structured as a component of a stand-alone entity or incorporated into existing city-administered structures, a credit enhancement mechanism would be extremely beneficial to drawing initial lenders to stormwater retrofit investments on private property.

Credit enhancement can help jumpstart "project developer" stormwater retrofit financing, by insulating project developers from a portion of the risks of owner non-payment or bankruptcy, and can also be applied in the context of on-bill programs, where credit enhancement can backstop potential losses from defaults by ratepayers, which would otherwise be borne by the utility. Credit enhancement can also be instrumental in the PACE context; a pool of capital can be made available to compensate existing mortgage lenders who are at risk because in the event of property owner default or bankruptcy, they are paid out only after any PACE assessments in arrears are paid, owing to the super-senior nature of PACE tax liens.

2. PROJECT AGGREGATION AND PUBLIC-PRIVATE PARTNERSHIPS

High transaction costs for both energy efficiency and stormwater retrofits make financing small projects extremely difficult. From an investor's point of view, because the transaction costs (including outreach, set up, and legal costs for separate financing agreements) for a small project are substantially similar to the transaction costs for a large project, it is far more efficient to undertake a small number of large projects than a large number of small projects. One strategy to help overcome the challenges of high transaction costs is to identify additional sources of financing that are prepared to bear the costs of aggregating many smaller projects into one or several large portfolios that can be sold to private capital providers. Aggregation can be carried out by public or private entities, such as non-profit organizations, local utilities, or a public-private partnerships (PPPs).

New York City Energy Efficiency Corporation

In the energy efficiency context, New York City will be administering a credit enhancement facility through the newly-created New York City Energy Efficiency Corporation (NYCEEC.) NYCEEC, a public-private partnership, is an independent non-profit corporation seeded with $37.5 million of federal stimulus money granted to New York under the Department of Energy's 'Energy Efficiency and Conservation Block Grant' (EECBG) program. NYCEEC's goal is to substantially leverage the EECBG seed funding with philanthropic and private sector capital in order to harness market forces to deliver energy retrofits to properties in various New York City real estate sectors.

By utilizing a portion of the EECBG funds as a loan loss reserve or other type of credit enhancement, NYCEEC aims to leverage a portion of the $37.5 million in EECBG funds to raise several hundred million dollars in debt and equity financing for energy efficiency retrofits in New York City.

The credit enhancement approach is the simplest strategy to draw investment from commercial lenders, which have been reluctant to provide capital for efficiency retrofits with payback based solely on future energy savings as collateral. With a credit enhancement function in place, NYCEEC can reduce the risk and cost of capital associated with unsecured lending to commercial real estate owners. NYCEEC's credit enhancement mechanism(s) will provide lenders with the comfort they need to begin financing energy efficiency retrofits. In turn, this will create a track record of project performance in terms of energy savings and financial returns, laying the groundwork for increased future lending in the energy efficiency sector.

Many cities and municipalities already enter into PPPs to finance a wide range of infrastructure investments, from the building of roads and ports, to the management of water systems and the construction and management of hospitals. These public-private partnerships can aggregate a diverse range of projects and seek to capitalize on the fundraising and project management capabilities of the private sector, sometimes allowing cities to accomplish their goals in a more cost-effective manner.

A project aggregation approach could be a successful catalyst for any of the third-party, private investment mechanisms described earlier. Cities may be able to access state, federal, or philanthropic funding for a PPP or other entity whose mission would be to deliver financing and help complete stormwater retrofit projects on private property. This entity could then use this funding to cover the transaction costs involved in reaching out to smaller property owners and possibly even providing financing for these projects, in return for some of the savings in stormwater costs (similar to the off-balance sheet financing model discussed above). The entity could then put together a portfolio of stormwater retrofit projects generating returns, which it could "sell" to a source of private finance, who would share in the returns from these investments. This approach would allow private investors to overcome the transaction cost barrier that they would face if the projects remained dispersed. PPPs also allow the government to outsource some

New York Port Authority PPP

In 1999, the Port Authority of NY and NJ put out a Request for Proposals for the creation of a PPP to build and operate the International Terminal (Terminal 4) of JFK airport. The contract was awarded to a consortium made up of the Schiphol Group (the Dutch company that manages and operates the largest airport in the Netherlands) and a number of financing partners. By the time the Terminal opened for business in 2001, it had cost around $1.4 billion dollars and was the largest airport privatization project in the U.S.

In order to select the consortium to build and manage the terminal, the Port Authority of NY and NJ conducted a competitive solicitation involving several international consortia of private developers, operators and financiers. In return for financing, operating, and managing the terminal, the winning consortium entered into a 28 year concession lease with the Port Authority and helped issue one of the largest airport revenue bonds to the private financial markets.

This was an attractive arrangement because the Port Authority had limited capacity to assume more debt on its own. Additionally, the reconstruction of the terminal during on-going airport operations was seen to pose significant construction and operational risks and challenges. It was felt that a dedicated private consortium might be better able to surmount the challenges and assume the risks.

Source: See Ten Principles for Successful Private-Public Partnerships, Urban Land Institute at page 22 (2005). Available at http://www.uli.org/ResearchAndPublications/Reports/~/media/Documents/ResearchAndPublications/Reports/TenPrinciples/TP_Partnerships.ashx

of the financial, technical, and operational risks associated with given project.

A variation on this theme borrows from the PPPs model utilized to finance traditional public infrastructure. A PPPs can be established when the government contracts with a consortium of private entities to deliver a public service. In typical PPPs, the government sets the goals for the project and maintains ownership of the assets. The consortium raises the up-front capital needed for construction, designs and manages the construction (to standards set by the government and to meet the goals set during the bidding process), maintains the asset for a certain time period, and takes on the financial and operational risks associated with the project. In return for this work, the consortium either gets paid via a portion of the revenues from the operation of the asset (e.g., tolls from a toll road), or via regular and contracted government payments (e.g., from tax revenues). For an example from a typical infrastructure PPPs, see New York Port Authority PPP text box.

3. OFFSITE MITIGATION WITH TRADABLE CREDITS

Programs that utilize offsite (or off-system) mitigation have been deployed for ecosystem services around the world to create incentives for conservation and restoration, while steering investments to wherever the most environmental benefits and highest returns to investors can be obtained at the lowest cost. This section provides a brief overview of how offsite mitigation concepts might be applicable to stormwater retrofits on private property.

As discussed in Section I of this paper, the cost of stormwater retrofits can vary greatly depending on a given parcel's location and features. Opportunities for offsite management hold promise to increase deployment of private capital toward stormwater retrofits in a given city, where some impervious areas (for example commercial buildings located in dense city centers) will face higher upfront costs to manage runoff than others (e.g., a property abutting an open field). With an offsite mitigation option, a participant facing higher onsite stormwater management costs can source reductions or purchase credits from less expensive locations.

In the stormwater context, offsite mitigation could make sense in scenarios where an owner of a constrained site A would like to reduce her stormwater fee, but the cost to retrofit on her particular parcel (owing to its location or other characteristics) is so high that she will not see a return on her investment within a reasonable time. For the same reason, the retrofit to site A would also be nearly impossible to finance utilizing any of the other mechanisms described in Section II above. On the other hand, owner of site B is relatively unconstrained and can not only retrofit his own parcel to manage the volume of runoff needed to qualify for a maximum credit against his stormwater fee, but can also cost-effectively manage additional stormwater runoff from his own property, an adjacent parcel, or the adjacent public right-of-way (i.e., streets or sidewalks.)

Under an offsite mitigation program, the owner of site B could retrofit the property to reduce stormwater fees while also generating additional credits. Owner B could go beyond the level of investment needed to obtain the maximum reduction available in his stormwater fees, by installing retrofits in conjunction with his project that are large enough to accept additional runoff—either a greater amount of runoff from site B than is required for the maximum fee reduction,[54] or runoff from impervious surfaces on adjacent parcels or the adjacent right-of-way. For providing this excess stormwater management capacity, the stormwater utility could grant owner B credits, which another ratepayer, such as owner A, who otherwise would have no cost-effective way to reduce the stormwater fee, can purchase and apply towards a reduction in the stormwater fee for her own property. If the cost to owner B to build the excess stormwater management capacity that generates the credit is less than the cost to owner A to retrofit her own property to obtain a fee reduction, such a credit system would encourage owners like A to invest in such "offsite mitigation," carried out by owners like B.[55]

The opportunity to invest in such credit-generating projects need not be limited to property owners. Private investors could also invest in these retrofits and generate credits to sell to constrained owners. It is worth noting that stormwater regulations in Southern California, specifically in Ventura and Orange Counties, already allow forms of offsite mitigation where onsite compliance with mandatory stormwater performance standards for development projects is "technically infeasible," which can include projects where infeasibility is determined based on space constraints on densely developed properties.

Before a municipality devotes substantial resources to developing an offsite program with tradable credits, a number of threshold issues should be addressed including:

- Estimating the potential supply and demand for credits, to determine whether it is sufficient to justify developing of a program
- Determining the locational value of mitigation, i.e., is the value of reducing runoff in one part of the city of equivalent value to reducing the same amount of runoff in another part of the city?
- Setting the value of the credit (i.e., how much reduction in the stormwater fee will be offered for a given level of excess onsite stormwater management capacity in a given area) at a level commensurate with the avoided costs to the stormwater utility, and determining whether such credits would be valuable enough to provide an incentive for investment in off-site mitigation projects
- Identifying costs to administer and audit the offsite program and ways to reduce transaction costs for participants, for example by creating boilerplate contractual language and making contracts available to participants in offsite projects

In the case of property owners with limited or cost prohibitive options to implement green infrastructure, an offsite mitigation option can be an attractive alternative. Determining the applicability of an offsite mitigation program in a given city, and how such a program could be structured, would require further investigation and research.

D. CONCLUSIONS

As with more traditional project financings, there is no single approach to drawing private capital into stormwater retrofit projects. Project size and borrower credit quality will be central to determinations of which financing mechanisms make sense on a given project. For larger campus, industrial and commercial parcels with a high proportion of impervious area, third-party project developer models and, potentially, aspects of ESCO-style performance contracting are viable options. For projects under $500,000 where the third-party project developer and ESCO elements will be costly relative to project size, mechanisms that leverage the ability of existing local intermediaries with proven collection capability, such as PACE and utility-based financing programs, will be far more attractive to stormwater investors than project-based financing or lending.

For the full range of project sizes and project types, reducing investor risk for stormwater retrofits will be critical to keeping the cost of capital low enough to entice property owners to move forward with retrofits. Credit enhancement facilities, project aggregation, and innovative public-private partnerships will likely be needed to reduce risk in initial projects and channel private capital funds into those projects at reasonable interest rates. For some jurisdictions an offsite mitigation program may help direct additional private investment to the projects that provide the highest environmental return per dollar invested.

Once a track record of performance is established in the stormwater retrofit financing space across a range of cities, national commercial lenders will be more likely to enter the market for direct loans at a reasonable rate.

SECTION III: INTERNAL RATE OF RETURN FOR STORMWATER RETROFIT PROJECTS AND ILLUSTRATIVE MODELS

This section aims to illustrate rates of return to investors in stormwater retrofits. It describes internal rate of return estimates generated from 27 local Philadelphia stormwater retrofit case studies.[56] This section also presents illustrative investment return models for a typical retrofit project under three financing scenarios: (i) retrofits financed fully through equity from the property owner, (ii) retrofits financed with 80 percent debt, and (iii) retrofits financed by a third-party "project developer" as described in Section II. The project developer and 80 percent debt models could also be generally representative examples of cash flows associated with PACE and on-bill financing. The data used to perform the analyses described in this section were provided by the PWD.[57] It is important to note that the analyses below are based on an assumption that stormwater fee and credit policies are held constant over the course of project payback.[58]

A. IRRS FROM CASE STUDIES

In 27 case studies of potential stormwater retrofits on commercial properties in Philadelphia, which the PWD provided to the authors, it was assumed that the property owners would finance 80 percent of their retrofit costs and returns were calculated over a 20-year repayment period, with loans at market rate interest of 6 percent.[59] The case studies concluded that property owners could enjoy average savings on the monthly stormwater fee of 72 percent, ranging between 13 percent and 99 percent over the 20-year life of the loan.[60] The debt service on the loan to finance the custom retrofit installation was in most cases lower than the amount of stormwater fee savings resulting from the retrofit. Many of the case studies offer compelling IRRs: Of the 27 properties featured in the case studies, all but two generated an IRR for the property owner that exceeded 13 percent. One case study showed a projected IRR as high as 132 percent.

For most of the case studies, three different stormwater management investment options were modeled (high, medium, and low investment). The high investment option reduced the stormwater fee by the greatest amount, but also incurred the highest retrofit costs. Similarly, the medium and low investment options represented incrementally lower investments, with lower associated monthly stormwater fee savings. The IRRs for the "high investment" case study scenarios, which aimed to manage runoff from as much impervious area as possible on each parcel, were generally the most financially promising: for 18 of 27 properties, a high investment in stormwater retrofits yielded projected IRRs of at least 11 percent, including 10 that were above 20 percent and 4 above 50 percent. (For additional explanation of the retrofit case studies, see Appendix III.)

B. STORMWATER RETROFIT FINANCING MODELS

This section uses a case study of an industrial property in Philadelphia to illustrate potential returns on investment in stormwater retrofits for property owners under three financing models: (1) property owner financed, where the owner of the property pays for the retrofit out-of-pocket and without debt; (2) debt financed, where the property owner contributes an equity investment but largely borrows debt from a bank or other financier; and (3) off-balance sheet financed, where a third-party project developer provides 100 percent of the costs for the retrofit and shares in the stormwater fee savings, by charging the property owner a service fee once the retrofit is complete. The project developer and debt financed models are also generally representative examples of cash flows associated with PACE and on-bill financing, two financing possibilities described in Section II above that will not be explicitly illustrated here.[61]

The following models are intended to provide insights into the types of financing structures that might incentivize property owners to move forward with investments in stormwater retrofits. The assumptions and returns presented are intended to be illustrative of the needs of a medium-sized industrial property owner, but are not necessarily indicative of all properties. The models assume the following:

- The retrofit project consists of three stormwater detention basins, sized to manage runoff from 439,088 square feet (or 10 acres) of impervious area.
- The total cost of the retrofit investment is $200,000.
- The retrofit is completed in 2014, simultaneous with full phase-in of the PWD's parcel-based stormwater fee, such that it generates a stormwater fee savings of $36,000 per year over the a four-year period.
- The annual stormwater fee savings is assumed to increase by 7 percent every four years thereafter, to reflect hypothetical 7 percent stormwater fee increases in future credit renewal periods.
- The retrofit carries annual operating and maintenance expenses of $2,000, which are tax deductible.
- The models reflect a 12-year investment horizon, which was selected because it represents two four-year renewals of the parcel-based stormwater fee credit.
- The cost of the stormwater retrofit is depreciated for tax purposes over 39 years.[62]

- The effect on tax deductions from the investment reflects the foregone opportunity for the property owner to claim a tax deduction on the stormwater fees prior to the retrofit. This tax effect does not impact actual cash flows, but is represented in the models to better fully understand the economic implications of the investment. A 40.59 percent corporate income tax rate is assumed, representing an estimate of the federal and state tax corporate tax treatment, where an entity of comparable size would likely be subject to a 9.99 percent Pennsylvania tax rate and a marginal 34 percent federal tax rate (with the state tax being deductive from federal tax).

1. PROPERTY OWNER FINANCED MODEL

The property owner-financed scenario considers a retrofit where the property owner makes an equity investment to cover 100 percent of the retrofit cost. While easy to implement—only requiring a decision by the property owner—this approach is relatively expensive when compared to the other models because the retrofit ties up the property owner's capital to finance the entire cost of the project.

As shown in Table 3: Property Owner Financed Model, assuming an original investment of $200,000 in the retrofit, the property owner realizes a modest internal rate of return (IRR) on that investment of 5.8 percent over the 12-year investment period. However, the investment carries a negative net present value (NPV) and becomes cash flow positive for the property owner only in year nine. With these marginal returns and long payback period it is unlikely that a property owner would choose to make the retrofit investment in the absence of other incentives or financing options.

In general, given the level of the PWD's per-square-foot stormwater charge when the parcel-based billing is fully phased-in (i.e., at the end of year-four under the new rate structure), property owner financing represents a relatively unattractive investment option, even with the availability of a near 100 percent credit. This suggests that if property owners are to pursue stormwater retrofit investments they are likely to seek alternative financing mechanisms including debt or off-balance sheet structures.

2. DEBT FINANCED MODEL

As discussed earlier, the majority of commercial property owners may have difficulty securing asset-backed debt to finance a stormwater retrofit. Nevertheless, the debt financed model is instructive in that it shows the higher returns provided by debt financing, as compared to self-financing. The debt financed model assumes that the property owner invests 20 percent of the cost of the retrofit out-of-pocket, and is able to finance 80 percent of the retrofit through a traditional loan,[63] likely provided by a bank or other debt provider, at an interest rate of 6 percent. The benefit of debt financing is that it ties up significantly less of the property owner's capital, and as a result has a materially positive impact on the return. Further, many property owners may not have cash on hand to invest in a retrofit, requiring access to financing that allows for a smaller upfront investment.

The model in Table 4: Debt Financed Model assumes the following:

- The cost of the retrofit is financed in one lump sum, 20 percent ($40,000) by the property owner and 80 percent ($160,000) by a loan.
- The $160,000 loan has a 12-year term and an interest rate of 6 percent.
- The interest on the loan is deductible for tax purposes and the cost of the stormwater retrofit can be depreciated for tax purposes over 39 years. However, this tax benefit is offset by the fact that the property owner no longer receives the benefit of deducting the cost of the previous (higher) stormwater fees.

When debt financing is utilized the property owner realizes a post-tax IRR of 13.8 percent, a positive NPV and a payback period of six years. The inclusion of debt financing in this example creates a compelling justification for investing and is likely to incentivize property owners to implement retrofits. This higher return on the property owner's equity investment, as compared to the property owner financed model, indicates the significant role that access to debt financing can have in lifting investment prospects for property owners.

3. OFF-BALANCE SHEET FINANCING

The off-balance sheet financing structure assumes that a third-party project developer will finance, install, and maintain the retrofit. In this scenario, a specialized firm or "project developer" covers the total cost to retrofit the property, in exchange for a service fee payment from the property owner equal to a share of the stormwater fee savings. The project developer may also use debt to finance the retrofit, as assumed in the model below, or use its own balance sheet capital. It is possible that a credit-worthy project development firm could borrow debt at more attractive terms than a property owner and therefore may achieve superior financial returns. An attractive feature of this scenario for property owners is that they would not incur any upfront costs and would still benefit from the stormwater fee savings generated by the retrofit.

Table 3: Property Owner Financed Model

	Assumptions in Property Owner Financing Scenario	
	Discount rate	6%
	Annual stormwater fee savings (first 4-yr period)	$36,000
	Operations & Maintenance (O&M)	$2,000
	Tax rate	40.59%
	Depreciation term (years)	39
	Increase in annual stormwater fee savings (per 4-yr period)	7%

Step	Steps in Property Owner Financing Scenario
1	Retrofit generates a stormwater fee savings.
2	Cashflow is adjusted by income tax and tax deductions.
3	Cashflow relative to equity investment generates a return.

Step		YEARS												
		0	1	2	3	4	5	6	7	8	9	10	11	12
1	**RETROFIT**													
	Total cost of retrofit	($200,000)												
	Equity investment from property owner	($200,000)												
	Stormwater fee savings		$36,000	$36,000	$36,000	$36,000	$38,520	$38,520	$38,520	$38,520	$41,216	$41,216	$41,216	$41,216
	Operations & Maintenance (O&M)		($2,000)	($2,000)	($2,000)	($2,000)	($2,000)	($2,000)	($2,000)	($2,000)	($2,000)	($2,000)	($2,000)	($2,000)
	Pre-tax cash flow	($200,000)	$34,000	$34,000	$34,000	$34,000	$36,520	$36,520	$36,520	$36,520	$39,216	$39,216	$39,216	$39,216
2	**TAX CONSEQUENCES**													
	Depreciation deduction	$0	$2,082	$2,082	$2,082	$2,082	$2,082	$2,082	$2,082	$2,082	$2,082	$2,082	$2,082	$2,082
	Effect on tax deductions of investment and reduced stormwater fees	$0	($13,801)	($13,801)	($13,801)	($13,801)	($14,823)	($14,823)	($14,823)	($14,823)	($15,918)	($15,918)	($15,918)	($15,918)
	Total tax consequences	$0	($11,719)	($11,719)	($11,719)	($11,719)	($12,742)	($12,742)	($12,742)	($12,742)	($13,836)	($13,836)	($13,836)	($13,836)
	CASH FLOW													
	Total Cash Flow to Property Owner	($200,000)	$22,281	$22,281	$22,281	$22,281	$23,778	$23,778	$23,778	$23,778	$25,380	$25,380	$25,380	$25,380
3	**RETURNS (pre-tax)**													
	NPV before tax consequences	$97,460												
	IRR before tax consequences	14.2%												
	RETURNS (post-tax)													
	NPV post tax consequences	($2,220)												
	IRR post tax consequences	5.8%												

12 year payback assumes two fee renewals and three periods

Table 4: Debt Financed Model

Assumptions in Debt Financing Scenario	
Discount rate	6%
Loan Rate	6%
Financing	80%
Annual stormwater fee savings (first 4-yr period)	$36,000
Operations & Maintenance (O&M)	$2,000
Tax rate	40.59%
Depreciation term (years)	39
Loan term (years)	12
Increase in annual stormwater fee savings (per 4-yr period)	7%

Step	Steps in Debt Financing Scenario
1	Retrofit generates a stormwater fee savings.
2	Property owner borrows to pay for retrofit.
3	Property owner pays Financier interest and loan paydown.
4	Cashflow is adjusted by income tax and tax deductions.
5	Cashflow relative to equity investment generates a return.

Step		YEARS												
		0	1	2	3	4	5	6	7	8	9	10	11	12
1	**RETROFIT**													
	Total cost of retrofit	($200,000)												
	Equity investment from property owner	($40,000)												
	Stormwater fee savings		$36,000	$36,000	$36,000	$36,000	$38,520	$38,520	$38,520	$38,520	$41,216	$41,216	$41,216	$41,216
	Operations & Maintenance (O&M)		($2,000)	($2,000)	($2,000)	($2,000)	($2,000)	($2,000)	($2,000)	($2,000)	($2,000)	($2,000)	($2,000)	($2,000)
2	**LOAN**													
	Loan Beginning of Year (BOY)		$160,000	$150,516	$140,462	$129,806	$118,510	$106,536	$93,844	$80,390	$66,129	$51,013	$34,989	$18,004
	Interest		$9,600	$9,031	$8,428	$7,788	$7,111	$6,392	$5,631	$4,823	$3,968	$3,061	$2,099	$1,080
3	Loan Payment (PMT)		($19,084)	($19,084)	($19,084)	($19,084)	($19,084)	($19,084)	($19,084)	($19,084)	($19,084)	($19,084)	($19,084)	($19,084)
	Loan balance End of Year (EOY)	$160,000	$150,516	$140,462	$129,806	$118,510	$106,536	$93,844	$80,390	$66,129	$51,013	$34,989	$18,004	($0)
	Pre-tax cash flow	($40,000)	$14,916	$14,916	$14,916	$14,916	$17,436	$17,436	$17,436	$17,436	$20,132	$20,132	$20,132	$20,132
4	**TAX CONSEQUENCES**													
	Interest deduction	$0	$3,897	$3,666	$3,421	$3,161	$2,886	$2,595	$2,285	$1,958	$1,611	$1,242	$852	$438
	Depreciation deduction	$0	$2,082	$2,082	$2,082	$2,082	$2,082	$2,082	$2,082	$2,082	$2,082	$2,082	$2,082	$2,082
	Effect on tax deductions of investment and reduced stormwater fees	$0	($13,801)	($13,801)	($13,801)	($13,801)	($14,823)	($14,823)	($14,823)	($14,823)	($15,918)	($15,918)	($15,918)	($15,918)
	Total Tax Consequences	$0	($7,822)	($8,053)	($8,298)	($8,558)	($9,856)	($10,147)	($10,456)	($10,784)	($12,226)	($12,594)	($12,984)	($13,398)
	CASH FLOW **Total Cash Flow to Property Owner**	($40,000)	$7,093	$6,862	$6,617	$6,358	$7,580	$7,288	$6,979	$6,652	$7,906	$7,538	$7,148	$6,734
5	**RETURNS (pre-tax)**													
	NPV before tax consequences	$97,460												
	IRR before tax consequences	38.5%												
	RETURNS (post-tax)													
	NPV post tax consequences	$17,933												
	IRR post tax consequences	13.8%												

Continued on Page 25

Table 5: Off-Balance Sheet Financed Model

Step		YEARS												
		0	1	2	3	4	5	6	7	8	9	10	11	12
1	**Stormwater fee savings**		**$36,000**	**$36,000**	**$36,000**	**$36,000**	**$38,520**	**$38,520**	**$38,520**	**$38,520**	**$41,216**	**$41,216**	**$41,216**	**$41,216**
	IMPACT TO PROJECT DEVELOPER													
2	**RETROFIT**													
	Loan to project developer	$160,000												
	Equity contribution from project developer	($40,000)												
3	**LOAN**													
	Loan Beginning of Year (BOY)		$160,000	$150,516	$140,462	$129,806	$118,510	$106,536	$93,844	$80,390	$66,129	$51,013	$34,989	$18,004
	Interest		$9,600	$9,031	$8,428	$7,788	$7,111	$6,392	$5,631	$4,823	$3,968	$3,061	$2,099	$1,080
	Loan Payments (PMT)		($19,084)	($19,084)	($19,084)	($19,084)	($19,084)	($19,084)	($19,084)	($19,084)	($19,084)	($19,084)	($19,084)	($19,084)
	Loan balance End of Year (EOY)	$160,000	$150,516	$140,462	$129,806	$118,510	$106,536	$93,844	$80,390	$66,129	$51,013	$34,989	$18,004	($0)
4	**PRE-TAX CASH FLOW**													
	Share of stormwater fee savings to project developer (service fee)	75%	$27,000	$27,000	$27,000	$27,000	$28,890	$28,890	$28,890	$28,890	$30,912	$30,912	$30,912	$30,912
	O&M		($2,000)	($2,000)	($2,000)	($2,000)	($2,000)	($2,000)	($2,000)	($2,000)	($2,000)	($2,000)	($2,000)	($2,000)
	Pre-Tax Cashflow	($40,000)	$5,916	$5,916	$5,916	$5,916	$7,806	$7,806	$7,806	$7,806	$9,828	$9,828	$9,828	$9,828
5	**TAX EFFECTS**													
	Income tax on share of SWM fee savings (service fee)		($2,401)	($2,401)	($2,401)	($2,401)	($3,168)	($3,168)	($3,168)	($3,168)	($3,989)	($3,989)	($3,989)	($3,989)
	Interest Deduction	$0	$3,897	$3,666	$3,421	$3,161	$2,886	$2,595	$2,285	$1,958	$1,611	$1,242	$852	$438
	Depreciation Deduction	$0	$2,082	$2,082	$2,082	$2,082	$2,082	$2,082	$2,082	$2,082	$2,082	$2,082	$2,082	$2,082
	Total Tax Consequences		$3,577	$3,346	$3,101	$2,842	$1,799	$1,508	$1,199	$871	($297)	($665)	($1,056)	($1,469)
	CASH FLOWS TO PROJECT DEVELOPER													
	Cash Flow to Project Developer	($40,000)	$9,493	$9,262	$9,017	$8,757	$9,605	$9,313	$9,004	$8,677	$9,531	$9,163	$8,772	$8,359
6	**RETURNS TO PROJECT DEVELOPER (pre-tax)**													
	NPV before tax consequences	$21,971												
	IRR before tax consequences	14.4%												
	RETURNS TO PROJECT DEVELOPER (post-tax)													
	NPV post tax consequences	$34,353												
	IRR post tax consequences	20.5%												
	IMPACT TO PROPERTY OWNER													
7	**RETROFIT**													
	Share of savings to property owner	25%	$9,000	$9,000	$9,000	$9,000	$9,630	$9,630	$9,630	$9,630	$10,304	$10,304	$10,304	$10,304
8	**TAX EFFECTS**													
	Foregone tax deduction on stormwater fee		($3,653)	($3,653)	($3,653)	($3,653)	($3,909)	($3,909)	($3,909)	($3,909)	($4,182)	($4,182)	($4,182)	($4,182)
	Total Tax Consequences	$0	($3,653)	($3,653)	($3,653)	($3,653)	($3,909)	($3,909)	($3,909)	($3,909)	($4,182)	($4,182)	($4,182)	($4,182)
	TOTAL CASH FLOWS TO PROPERTY OWNER													
	Cash Flow to Property Owner		$5,347	$5,347	$5,347	$5,347	$5,721	$5,721	$5,721	$5,721	$6,122	$6,122	$6,122	$6,122
9	**RETURN TO PROPERTY OWNER**													
	NPV (pre-tax)	$80,019												
	NPV (post-tax)	$47,539												

Table 5: Off-Balance Sheet Financed Model

Assumptions in off-balance sheet financing scenario	
Discount rate	6%
Loan rate	6%
Total cost of retrofit	$200,000
Project developer's share of stormwater fee savings	75%
Financing	80%
Loan term (years)	12
Stormwater fee savings (1st period)	$36,000
Operations & Maintenance (O&M)	$2,000
Tax rate	40.59%
Depreciation rerm (years)	39
SWM fee savings increase (per 4-yr period)	7%

Steps in Debt Financing Scenario	
1	Retrofit generates a SWM fee savings.
2	Project developer borrows to finance project.
3	Project developer pays interest and loan paydown.
4	Project developer shares fee savings with property owner.
5	Cashflow is adjusted by income tax and tax deductions.
6	Cashflow generates return for project developer
7	Property owner benefits from its share of fee Savings.
8	Property owner loses fee expense deduction.
9	Cashflow generates return for property owner.

Continued on Page 24

The model in Table 5: Off Balance Sheet Financed Model assumes the following:

- The cost of the retrofit is financed in one lump sum, 20 percent ($40,000) by equity from the project developer and 80 percent ($160,000) through debt taken on by the project developer.
- The loan to the project developer has a 12-year term and an interest rate of 6 percent.[64]
- The project developer charges the property owner a service fee equal to 75 percent of the stormwater fee savings, following completion of the retrofit.
- The interest on the loan to the project developer is deductible for tax purposes. Moreover, because the project developer owns the retrofit, it can depreciate the cost of the stormwater retrofit for tax purposes over 39 years, and deduct the operating and maintenance expense. This tax benefit is slightly offset by the income taxes the project developer will pay on the service fee.

The model in Table 5 illustrates an attractive return for both the project developer and the property owner. Even when providing the property owner with 25 percent of the fee savings, the project developer still realizes a post-tax return of 20.5 percent on its $40,000 equity investment.

The results for the project developer in this model are similar to the results for the property owner under debt financing model. This is especially true as the service fee paid to the project developer approaches close to 100 percent share of the stormwater fee savings. The primary advantage to the property owner of this scenario, as compared to the previous two models, is that the off-balance sheet approach can make the project net cash flow positive for the property owner from day one, since the property owner can avoid making an initial cash outlay for the retrofit.

C. LESSONS FROM THE INTERNAL RATE OF RETURN ANALYSIS

The availability of alternative financing structures would greatly increase the attractiveness of retrofits to property owners, as compared to self-financed retrofits. Returns on retrofit investments begin to look attractive when traditional debt financing becomes available. The most attractive options for property owners, however, will likely be innovative structures, such as project developer models, land-secured financing through PACE, and utility-enabled mechanisms like on-bill financing—whereby the property owner does not have to make an upfront investment and is able to minimize the burden on his or her balance sheet.

In addition, credit enhancement, while not included in the cash flow models, could make retrofit investments even more attractive. Credit enhancement could reduce the cost of borrowing, by providing guarantees that allow for higher credit ratings and lower interest rates for the borrower. Credit enhancement, which could be provided through various mechanisms, would likely provide additional comfort and surety to debt providers and likely attract more lenders into financing stormwater retrofits. Adding a credit enhancement feature to the models presented in this section would increase returns, by reducing the interest rate and/or increasing the financing percentage.

Before project development firms would be willing offer third-party financing services for retrofits, several threshold issues would likely need to be addressed. These include (i) certainty with respect to long-term stormwater fee policy, (ii) availability and cost of financing, and (iii) clarity regarding transaction costs associated with obtaining stormwater fee credits. Finally, it is important to note that the assumptions used to inform these models are based on an illustrative industrial property and may not apply to all properties. As additional projects are completed and more data become available, a more robust analysis will be possible.

SECTION IV: CONCLUSIONS AND RECOMMENDATIONS

Effective stormwater management to protect urban waterways will require tens of billions of dollars in investments nationwide. In the face of these needs, cities can benefit from structuring stormwater policies that provide incentives for private investment in stormwater management. Stormwater fee and credit structures that equitably allocate the costs of managing urban runoff and provide credits for reducing runoff can help private property owners, as well as investors, generate profit from stormwater retrofits. The fee reduction, or credit, component of the parcel-based billing system is critical to making the case for property owners and potential investors that stormwater retrofits produce a steady and distinct cash flow stream. The avoided stormwater fees can be regarded as a source of repayment security for third-party project financiers.

Philadelphia's transition to a parcel-based fee, coupled with the opportunity for near-100 percent fee reduction, makes that city one of the most attractive jurisdictions for structuring third-party financed stormwater retrofits on private property. Philadelphia alone represents a potential market for private investment on the order of $376 million, while hundreds of other cities nationwide are facing similar stormwater challenges and seeking cost-effective solutions.

In many cases, however, traditional asset-backed lending to cover the upfront costs of private stormwater retrofits is unlikely to be a viable financing option, even where the promise of stormwater credits creates an incentive for such retrofits. Off-balance sheet, tax-lien, and utility-enabled financing models borrowed from the energy efficiency finance sector, when coupled with a stormwater fee and credit system, can provide valuable tools to overcome these obstacles.

Furthermore, sample cash flow models, based on a prototypical stormwater retrofit project in Philadelphia, indicate that an off-balance sheet "project developer" model, in particular, can be very attractive in providing returns to both the property owner and the project developer financing the project. Other non-traditional lending approaches described in this paper can be expected to perform similarly.

Even with these innovative approaches, several challenges may still deter large-scale private investment in stormwater retrofits. Local, state, and federal policies that actively encourage—or even directly facilitate—the development and application of innovative financing models can help to overcome these challenges.

For example, off-balance sheet financing structures, such as third-party project developer models, have high transaction costs and, therefore, have been used most successfully for large energy efficiency projects (e.g., municipal and industrial facilities, campuses, etc.). To facilitate application of these models in the stormwater context, cities can take steps such as helping establish a public-private partnership or other nonprofit entity to aggregate projects into a single portfolio, which utilizes economies of scale to reduce transaction costs per project. Additionally, establishment of credit enhancement mechanisms to backstop a portion of losses can substantially reduce the costs of capital for third-party project developer investment.

Tax-lien financing structures such as PACE hold enormous potential, but existing PACE enabling legislation in many states will likely have to be amended to explicitly include stormwater retrofits. Local PACE programs that encompass stormwater retrofits will need to adopt a stormwater fee and credit structure that ensures participating property owners are made cash flow-positive by the PACE financed improvements (which may include stormwater retrofits alone or coupled with energy efficiency retrofits). Credit enhancement can also facilitate private investment in PACE programs, where the financial backstop can serve to compensate existing creditors for any PACE assessments in arrears that would get paid ahead of existing mortgage debts, in event of default or bankruptcy.

Local and regional utilities could also play a crucial role, by helping disburse and collect retrofit funds to provide reliable paybacks to project financiers, in support of a wide variety of financing structures. Utilities can leverage existing relationships with ratepayers to attract private investors for projects that benefit the utility, where such investors might be otherwise deterred by the large number of dispersed projects and lack of project performance track record.

Programs that enable offsite stormwater mitigation could also increase deployment of private capital toward stormwater retrofits, by directing private capital into the most cost-effective stormwater retrofits. As described above, further exploration of this approach is needed to identify key criteria for an effective program, in the context of voluntary retrofits.

Given demographic shifts toward urban living and ballooning costs to maintain and expand gray stormwater infrastructure, many cities will likely be looking to use their stormwater fee system to incentivize private investment in green infrastructure. While specific policies must be tailored to local or regional needs, this report illuminates the potential opportunities for municipalities, property owners, and third-party investors to create business opportunities, provide an essential public good, and reduce stormwater compliance costs to local governments and ratepayers.

A. SUMMARY OF RECOMMENDATIONS

A range of public and private actors, including municipalities and stormwater utilities, state governments, and private firms, can draw lessons from the analysis presented in this paper. We offer the following recommendations for each of these entities to facilitate private investment in stormwater retrofits.

Recommendations for municipal officials and stormwater utilities:

- Implement parcel-based billing in order to distribute stormwater management costs among ratepayers more equitably than alternatives such as meter-based systems.
- In connection with parcel-based billing, provide a "credit" or discount for installing stormwater retrofits, which provides a strong incentive for owners to retrofit their property where doing so would reduce net costs to the utility. To facilitate private third-party financing that would help property owners cover their upfront capital costs, the credit should be generous enough for capital providers to realize a return on their investment when relying on avoided stormwater fees as a "cash flow" stream.
- Publicize information about the costs of retrofits needed to obtain a stormwater fee credit, and about the value of the resulting credits.
- Provide clear projections of long-term stormwater fee schedules to reduce uncertainty for potential investors.
- Establish (or support the establishment of) credit enhancement facilities.
- Use existing ratepayer billing mechanisms to serve as an agent for disbursement of retrofit financing and collection of repayment (i.e., on-bill financing).
- Seek state authorization to use PACE-style tax-lien financing for stormwater retrofits.
- Explore means of facilitating project aggregation, such as through public-private partnershippublic-private partnerships.
- Explore options for offsite mitigation mechanisms, which would enable owners of properties that are less suitable for cost-effective, onsite retrofits to reduce their stormwater fees by contributing to offsite retrofits.

Recommendations for state governments:

- Authorize tax-lien financing, such as Property Assessed Clean Energy, to finance stormwater retrofits. If PACE enabling legislation has already been passed at the state level, amend the text as needed to include stormwater retrofits.
- Authorize and encourage local jurisdictions to use available state grant funds to leverage additional private capital, by using the grant funding to underwrite a credit enhancement facility designed to attract private capital providers to initial stormwater retrofit financings.
- Promote examples of successful public-private partnerships on water infrastructure generally, and stormwater infrastructure specifically (as such examples become available).
- Provide incentives, such as grant financing or revolving fund dollars, to municipalities to implement parcel-based billing practices and/or on-bill financing programs.

Recommendations for private firms (for-profit and non-profit):

- Collaborate with Community Development Financial Institutions, utilities, and other relevant organizations to set up structures, such as public-private partnershippublic-private partnerships or credit enhancement capabilities, to get initial projects financed at reasonable rates.
- Share case studies and promote financial and environmental results wherever possible. Stormwater retrofit projects are relatively new and there is little to no track record of successful financings. The novelty of stormwater retrofit financing for commercial property, in addition to difficulty in lending to this sector on an asset backed basis, may drive prohibitively high capital costs for project financing.

APPENDIX I: PARCEL-BASED BILLING IN SELECT CITIES

Below are examples of how a number of cities have structured their stormwater fee and credit policies in the context of parcel-based billing. As described more fully in NRDC's recent report *Rooftops to Rivers*, each of these cities, like Philadelphia, has a consent decree or other obligation to retrofit a certain amount of impervious area to reduce stormwater runoff.

Cleveland, Ohio[65]

In January 2010, the Northeast Ohio Regional Sewer District approved a plan to assess a fee on homeowners and others, including businesses and churches, based on the amount of a property's impervious surfaces, such as driveways and roofs.

Owners of small homes will pay $2.85 per month, a medium house pays $4.75 per month, and a large house pays $8.55 per month. Owners of businesses, parking lots, churches and other commercial property would also be charged based on the amount of hard surface.

Property owners will be eligible for a fee reduction—up to 100 percent for both residential and commercial owners, through a "stormwater quality" credit of up to 25 percent and a "stormwater quantity" credit of up to 75 percent. Although the credit is potentially generous, the full stormwater quantity credit can only be obtained for stormwater management plans that meet the relatively high standard of preventing the developed runoff volume from exceeding the pre-developed runoff volume for up to a "100-year 24-hour design storm."

Kansas City, Missouri[66]

Kansas City stormwater fees are set at $0.50 per month for each 500 square feet ("runoff unit") of runoff surface on a residential, commercial or industrial property. The maximum stormwater fee for a parcel is $4,000.00 per month. Two types of stormwater fee credits are available:

"Ratio" credit: Properties that have a large pervious area to help absorb runoff from the impervious surface will be given a ratio credit, if the ratio of the total property area to the impervious surface area is at least 30:1. Properties that qualify shall be granted a 50 percent stormwater fee credit.

"Detention" credit: Stormwater detention structures are defined as measures that reduce the peak flow of and runoff volume of stormwater from a drainage area, thereby reducing flooding and erosion downstream. Properties served by a privately owned, and properly maintained, detention structure are eligible for a stormwater fee credit. The amount of the credit is based on the reduction of stormwater runoff provided by the detention structures. The minimum credit shall be ten percent and the maximum credit shall be 50 percent.

If a property receives both a ratio credit and a detention credit, the ratio credit will be applied first, and then the detention credit shall be applied to the remaining amount. The combined credit may not exceed 75 percent of the total stormwater fee. Currently, the rather small monthly fee does not appear to provide a strong enough incentive for retrofits, nor does it cover all of the utility's operation, maintenance, and capital costs. Based on the city's own review, covering those costs would require a "significant increase" in the fee.

Portland, Oregon[67]

Portland established an impervious-area based stormwater charge in 1977. 35 percent of Portland's fee is attributable to the city's costs of managing ratepayers' onsite stormwater and 65 percent by offsite stormwater. Onsite refers to stormwater volume created by a given property's impervious surface area and Offsite covers costs for street drainage, combined sewers, and other wastewater disposal infrastructure. Portland's fee covers residential, commercial, and industrial property owners.

In 2006, Portland launched the Clean River Rewards program, which provides discounts to property owners based on the extent of their onsite stormwater management. Because the discount is available only toward the onsite portion of the fee, the maximum discount that a property owner can receive on a monthly stormwater bill is 35 percent. Notably, transaction costs in Portland are quite low; the process for registering can be accomplished online and requires only the property owner's signature as certification.

At one point, Portland offered a larger stormwater fee credit for owners who reduced stormwater runoff. However, property owners obtaining the credit were not paying their fair share of the city's costs of managing offsite stormwater. As a result, the maximum available credit was reduced.

Washington, D.C.[68]

District of Columbia property owners receive two stormwater charges on their utility bills. First, the stormwater fee, which is assessed by the District Department of the Environment (DDOE), covers costs associated with the city-owned separate storm sewer system. That fee was established in 2001; it was originally a flat fee to single-family residences and was based on water consumption for other customer classes. In 2009, legislation was enacted directing DDOE to assess stormwater fees based on impervious cover. Second, DC Water (the regional water and sewer utility) imposes an Impervious Area Charge (IAC), also adopted in 2009, to cover costs of reducing combined sewer overflows.

In August 2011, DC Water, in conjunction with the District Department of the Environment, proposed the implementation of a stormwater fee credit of up to 55 percent for residential and non-residential parcels that retain the equivalent volume of stormwater created by a one and two tenths inch (1.2 in.) storm event. At the time of the writing of this paper, the final details of this credit remain to be determined. DC Water is also working to establish a similar credit for the IAC.

APPENDIX II: PHILADELPHIA STORMWATER FEE DATA AND REGRESSION ANALYSIS METHODOLOGY

The PWD provided the authors with information, including property type, impervious area, gross area, and meter- and parcel-based stormwater fees, on approximately 90,000 commercial and public properties, including apartment and condo buildings, but not individual households. AKRF, Inc., working as a consultant to the PWD, provided the authors with "case study"analyses of 27 commercial properties whose owners are looking for cost-effective ways of overcoming the proposed increase in stormwater charges.[69] For each property, AKRF designed up to three custom scenarios, with low, medium, and high investment levels, to manage runoff from the property's impervious area. Each scenario identified a mix of stormwater management practices that could be installed to reduce the property owner's stormwater fees, given the physical characteristics of the particular property. The high investment level scenarios managed an inch of runoff from, on average, 88 percent of the property's impervious area.[70] Each case study included concept-level design of stormwater management practices (SMPs), accompanied by data on the upfront investment costs,[71] the total impervious area from which runoff would be managed, the resulting reduction in monthly stormwater fees, and the net present value and IRR for each scenario.

Using information about the properties in the case studies, we used simple linear multiple regression analysis[72] to estimate an equation for the construction costs to retrofit properties in Philadelphia to manage the first inch of runoff onsite from nearly all of their impervious area. Based on this analysis, we concluded that the two independent variables, the gross area of the parcel and the ratio of impervious area to gross area, were statistically correlated to total construction costs and that the coefficients in the regression equation are statistically significant. We calculated total construction costs for all of the properties on the list provided by the PWD, using this regression equation. For example, a property of 100,000 square feet with 50,000 square feet of impervious area would have an estimated construction cost of $265,523 to treat all or nearly all of the impervious area on the property. This is a very rough estimate, as the cost of construction varies greatly among properties depending on the land features and types of projects that are most appropriate to that location. However, these data were useful in summarizing construction costs across a broad range of properties, such as estimating the total amount of investment needed, as discussed above in Section I of this paper.

Specifically, we regressed the construction costs for the 27 high investment levels scenarios against those properties' gross area (GA) and ratio of impervious area (IA) to GA. We included the IA:GA ratio in the regression as a proxy for how "constrained" the property is (i.e., how much or how little space may be available to infiltrate stormwater relative to the amount of impervious space), on the hypothesis that properties with impervious area covering most of the parcel may face higher investment costs for having to plan and construct stormwater management practices . The dependent variable in this regression analysis was thus the total construction costs, while the two independent variables were the gross area and the ratio of impervious area to gross area. Additionally, based on the hypothesis that estimated total construction costs for each property would be greater than 0, we imposed the constraint in the regression that the intercept would be equal to 0, or that the outcome would be a positive number. The coefficient outputs of the regression are:

	Coefficients
Intercept	0
Ratio IA:GA	447353.1794
GA	0.41845962

while the equation produced by this regression is:

Estimated Construction Costs=$0.41846 * GA+$447,353*(IA/GA)

The regression statistics are given as:

Regression Statistics	
R^2	0.489663901
Adjusted R^2	0.429250457
Observations	27

R^2, or the coefficient of determination, is the proportion of variability in a data set that is accounted for by the regression model. It provides a measure of how well future outcomes are likely predicted by the model, and can be considered an estimate of the "goodness of fit" of the regression line. An R^2 of 1.0 indicates that the regression line fits the data perfectly. Here, the R^2 is about 49 percent, suggesting that we are capturing around half of the variation in the original data set. The Adjusted R^2, also commonly known as "R bar squared" is a modification of R^2 that adjusts for the number of independent variables in the model, since these variables are rarely statistically independent. The Adjusted R^2 increases only if the new term improves the model more than would be expected by chance. Adjusted R^2 will always be less than or equal to R^2, and is to be interpreted separately from R^2. Though Adjusted R^2 did not feature prominently in this analysis, it is generally used in variable selection processes in building regression models.

To elaborate further on the coefficients that make up the equation of the regression line, we consider the following:

The standard error is an estimate of the standard deviation of the coefficient. It can be thought of as a measure of the precision with which the regression coefficient is measured. In general, the coefficient should be about twice the corresponding standard error before any correlation can be assumed. In this regression, the coefficient for the first variable, the ratio of impervious area to gross area, is slightly more than twice the standard error, suggesting that the ratio of IA to GA and the total construction costs are correlated. Similarly, the standard error for the GA coefficient is 0.190 as compared to the 0.418 coefficient, leading us to conclude that GA is highly correlated with total construction costs. The T-Statistic (t-Stat) is the coefficient divided by the standard error, so a t-Stat greater than 2 suggests a strong correlation. The p-value, or significance level, measures the probability that the coefficient for the corresponding independent variable emerged by chance and does not describe a real relationship. For example, a p-value of 0.05 means that there is a 5 percent chance that the relationship emerged randomly, and a 95 percent chance that the relationship is based on a real correlation. In this analysis, the p-values for coefficients of both variables are less than 5 percent, indicating both coefficients can be considered statistically significant, and the corresponding independent variables exert independent effects on the dependent variable.

ENDNOTES

1 For example, in 2010, 36 percent of all swimming beach advisory and closing days attributed to a known source were caused by polluted runoff and stormwater. See Dorfman, M., and K.S. Rosselot, Testing the Waters: A Guide to Water Quality at Vacation Beaches (21st ed.) (2011). New York: Natural Resources Defense Council, accessed at http://www.nrdc.org/water/oceans/ttw/ttw2011.pdf.

2 EPA, "Report to Congress: Impacts and Control of CSOs and SSOs," April 26, 2004, EPA 833-R-04-001, p. 4-29, accessed at http://cfpub.epa.gov/npdes/cso/cpolicy_report2004.cfm.

3 U.S. General Accounting Office (2001). "Water Quality: Better Data and Evaluation of Urban Runoff Programs Needed to Assess Effectiveness," GAO-01-679, accessed at http://www.gao.gov/new.items/d01679.pdf.

4 U.S. EPA. (2004, August). Report to Congress: Impacts and Control of CSOs and SSOs. Office of Water. EPA-833-R-04-001.

5 Duhigg, C., Saving U.S. Water and Sewer Systems Would Be Costly. NYTimes (Mar. 14 2010).

6 See NRDC, *Rooftops to Rivers II*, pp. 8-10, 33, 35-37, accessed at www.nrdc.org/rooftops

7 *Rooftops to Rivers II*, p, 17.

8 *Rooftops to Rivers II* includes a survey of the legal, policy, technical, and economic issues regarding stormwater pollution and green infrastructure, along with detailed case studies of 14 North American cities adopting green infrastructure solutions to their stormwater problems. The report is available at www.nrdc.org/rooftops.

9 Philadelphia Water Department (June 2011). "Amended Green City, Clean Waters-The City of Philadelphia's Program for Combined Sewer Overflow Control, Program Summary," accessed at http://www.phillywatersheds.org/doc/GCCW_AmendedJune2011_LOWRES-web.pdf11

10 NRDC, *Rooftops to Rivers II* (2011), available at www.nrdc.org/rooftops.

11 The city's 450,000 residential properties are charged a flat rate of approximately $11 per month, based on the mean residential property size (2,090 square feet gross area, 1,060 square feet impervious area). See Philadelphia Water Department (hereinafter The PWD), "Frequently Asked Questions: Stormwater Management Service Charge (Residential)," Nov. 2010, accessed at www.phila.gov/water/Stormwater/pdfs/Res_FAQ.pdf; C. Crockett, PWD, "Parcel-based Billing for Stormwater," March 2010, accessed at http://asce-philly.org/images/archive/2010/2010-03-11-ASCE-ChristopherCrockett.pdf.

12 Although reduced runoff anywhere in the city would benefit water quality, only retrofits within the combined sewer portions of the city would reduce raw sewage overflows and, therefore, count towards meeting the Green City, Clean Waters mandates. If one were to assume that the 14,000 acres of IA on commercial property are evenly distributed between the portion of the city served by a combined sewer system (48%), and the remaining portions of the city that are either served by separate storm sewer sewers or drain directly to adjacent waterways, at least 6,700 acres of IA within combined sewer service areas would be subject to the city's parcel-based billing system. The actual total may be even higher, since The PWD's most recent calculations of citywide IA on commercial property are somewhat higher than the numbers used in this report. Pers. comm. with The PWD staff (Jan. 31, 2011). (For the statistic that 48% of the city is served by a combined sewer system, see Philadelphia Water Department (June 2011). "Amended Green City, Clean Waters—The City of Philadelphia's Program for Combined Sewer Overflow Control, Program Summary," p. 2, accessed at http://www.phillywatersheds.org/doc/GCCW_AmendedJune2011_LOWRES-web.pdf.)

13 Specifically, the term "commercial properties," as used herein, includes commercial and industrial properties, condominiums, residential buildings with more than four units, and most or all city-owned properties. The only types of properties not included are those classified under The PWD regulations as "residential," a category consisting of real estate used exclusively for residential purposes with at least one and no more than four dwelling units." See PWD, Storm Water Management Service Charge Credits and Adjustment Appeals Manual, p. 2, July 2010, accessed at www.phila.gov/water/Stormwater/pdfs/SCAA_Manual.pdf.

14 PWD Stormwater Charge Allocation Citizens Advisory Committee, Final Report, Findings and Recommendations, Executive Summary, 1996, accessed at www.phila.gov/water/Stormwater/pdfs/SCACACFinalReport.pdf.

15 See PWD, "Frequently Asked Questions: Stormwater Management Service Charge (Non-Residential)," Nov. 2010, pp. 6-12, accessed at www.phila.gov/water/Stormwater/pdfs/Non-Res_FAQ.pdf.

16 Philadelphia's meter-based stormwater billing system had been in place since 1968. Prior to 1968, stormwater management costs were borne by the city's General Fund. Id. at 1.

17 PWD, Citizens Advisory Council Committee,Handout #2: Historical Background (April 28, 2011), p. 10, accessed at www.phillywatersheds.org/sites/default/files/PWD%20CAC%20M1%20Handout%202%203MAY11%20V3.pdf.

18 Id at 9.

19 DiStefano, Joseph, "UPenn Wins, Philly Airport Loses in Stormwater Fee Shift," Philadelphia Inquirer, Oct. 2010.

20 See PWD Green Guide for Property Management, p. 4, accessed at www.phila.gov/water/Stormwater/pdfs/PWD_GreenGuide.pdf.

21 "Impervious area" refers to the total square footage of any plane hard surface area, including the roofs of buildings, paved or hardscaped areas, and compacted dirt and gravel that either prevents or restricts the absorption of water into the soil and thereby causes water to run off the surface. "Gross area" refers to the total area contained within the legally described boundaries of a property, excluding portions of sidewalk that are in the public right-of-way. See PWD, "Frequently Asked Questions: Stormwater Management Service Charge (Non-Residential)," Nov. 2010, accessed at www.phila.gov/water/Stormwater/pdfs/Non-Res_FAQ.pdf.

22 PWD, "Frequently Asked Questions, Stormwater Management Service Charge (Non-Residential)" p. 3, accessed at www.phila.gov/water/Stormwater/pdfs/Non-Res_FAQ.pdf.

23 The credit described here is for the IA portion of the parcel-based fee, which, as illustrated by the formula above, comprises the vast majority of the total charge for a site that is primarily impervious (since the charge per 500 acres of GA is about one-eighth the charge per 500 acres of IA). Further, credits are available for up to 100 percent of the GA charge, and retrofits aimed at obtaining the IA credit may easily be enhanced to become eligible for the GA credit as well. The GA credit is based on meeting performance standards relating to the rate at which runoff is discharged into the sewer system, rather than the volume of runoff, as with the IA charge. However, the same stormwater management practices that reduce the volume of runoff will also tend to reduce the rate of runoff. See PWD, SWMS Charge Credits and Adjustment Appeals Manual, pp. 5-6, July 2010, accessed at www.phila.gov/water/Stormwater/pdfs/SCAA_Manual.pdf.

24 See PWD, SWMS Charge Credits and Adjustment Appeals Manual, July 2010, accessed at www.phila.gov/water/Stormwater/pdfs/SCAA_Manual.pdf.

25 See PWD Green Guide for Property Management, p. 21, accessed at www.phila.gov/water/Stormwater/pdfs/PWD_GreenGuide.pdf.

26 The assumption that larger properties would be more likely to invest in stormwater management is used here to establish a bound for the potential market size. In practice this may not always be the case. One possible contrary scenario, for example, is a small property owner who both has extensive funding available for retrofits would accrue benefits from installing retrofits beyond the reduction in stormwater fees (e.g., improved business).

27 The data used to perform the market size analysis described in this section were provided by the PWD and AKRF, an environmental planning, engineering, and consulting firm with whom the PWD has contracted to advise property owners affected by the parcel-based fee. The data from PWD covered basic information about approximately 90,000 commercial, non-residential, and city-owned properties in Philadelphia. The data provided by AKRF were based on 27 case studies of stormwater management practices that specific property owners could install on their properties to reduce their stormwater fees, and included data on the total impervious area managed and the resulting reduction in monthly stormwater fees.

28 As explained further in Appendix III, the particular retrofit case studies from which we derived this aggregate construction cost estimate were designed to manage runoff from, on average, 88 percent of the impervious area on a site.

29 EPA estimates that, as of 2009, more than 800 communities have established stormwater utilities, and that the three predominant methods for calculating service fees are all based, in whole or in part, on the amount of impervious area on a property. USEPA New England, "Funding Stormwater Programs" (April 2009). Accessed at http://www.epa.gov/region1/npdes/stormwater/assets/pdfs/FundingStormwater.pdf.

30 See Black & Veatch, Stormwater Utility Survey, page 11, 2010, accessed at www.bv.com/Downloads/Resources/Brochures/rsrc_EMS_2010StormwaterUtilitySurvey.pdf.

31 For a review of the financing constraints in the energy efficiency context, see Kapur, Hiller, and Langdon, "Show Me the Money: Energy Efficiency Financing Barriers and Opportunities," Environmental Defense Fund, July 2011, accessed at www.edf.org/sites/default/files/11860_EnergyEfficiencyFinancingBarriersandOpportunities_July%202011.pdf. For a review of the financing constraints in the stormwater context, see Sarah Francis, "Gray to Green: Jumpstarting Private Investment in Stormwater Infrastructure," p. 26, Greater Philadelphia Sustainable Business Network, 2010, accessed at www.sbnphiladelphia.org/images/uploads/02-17-10_EIP_stormwater.pdf.

32 For example, many energy efficiency technologies (e.g., efficient lamps and ballasts, insulation) become "fixtures" that cannot be removed once they are installed and would have low recovery value even if they could be removed. This will also be a consideration for financing green infrastructure, as green infrastructure improvements (e.g., installation of porous pavement, rain gardens, or swales) will similarly become legal fixtures once installed and therefore not serve as effective collateral.

33 See Kapur, Hiller, and Langdon, "Show Me the Money: Energy Efficiency Financing Barriers and Opportunities," July 2011, accessed at www.edf.org/sites/default/files/11860_EnergyEfficiencyFinancingBarriersandOpportunities_July%202011.pdf. See also CALCEF Innovations, "Energy Efficiency: Paying the Way," accessed at www.fypower.org/pdf/CALCEF-WP-EE-2010.pdf.

34 CALCEF Innovations, "Energy Efficiency: Paying the Way," accessed at www.fypower.org/pdf/CALCEF-WP-EE-2010.pdf.

35 These approaches are similar to the "power purchase agreement" model pioneered in the renewable power sector, whereby a third-party developer pays for the installation of a renewable energy system on a property under an agreement that the property owner will purchase the power generated by the system. The property owner pays for the system through these power payments over the life of the contract with the project developer. After installation, the developer owns, operates, and maintains the system for the life of the contract. See www1.eere.energy.gov/femp/financing/power_purchase_agreements.html.

36 Transcend Equity Development Corp., based in Dallas, is an example of an "off-balance sheet" energy solutions firm that assumes responsibility for buildings' utility bills post-retrofit. Transcend's Managed Energy Services Agreement (MESA) is an operating expense that replaces the building owner's current utility expenses and is set equal to historical energy costs. In exchange for these historical costs, Transcend Equity invests its capital into comprehensive improvements in building energy efficiency and earns a return on its investment from the efficiencies generated by the improvements. For more information, see www.transcended.com.

37 PACE Financing Policies Summary Map, U.S. Department of Energy Database for State Incentives for Renewable and Energy Efficiency (DSIRE). Accessed at http://www.dsireusa.org/summarymaps/index.cfm?ee=1&RE=1.

38 Because the PACE assessment has the same "super senior" lien status as property taxes, in the event of bankruptcy or foreclosure the PACE lien becomes senior to any existing mortgage debt. However, PACE financing does not present a material threat to existing lenders because, in event of default, only the PACE lien amount in arrears becomes due.

39 The FHFA directive applied only to PACE for residential properties. The OCC merely indicated that national banks should be mindful of the potential risks to lenders presented by PACE financing: "This lien infringement raises significant safety and soundness concerns that mortgage lenders and investors must consider…" Accessed at www.occ.gov/news-issuances/bulletins/2010/bulletin-2010-25.html.

40 See Justin Gillis, "Tax Plan to Turn Old Buildings 'Green' Finds Favor," New York Times, Sept. 19, 2011, accessed at www.nytimes.com/2011/09/20/business/energy-environment/tax-plan-to-turn-old-buildings-green-finds-favor.html?_r=1&scp=1&sq=ygrene&st=cse. See also "Mayor Lee Announces Launch of Innovative Green Financing Program for Commercial Buildings," Office of the Mayor of San Francisco, press release, October 13, 2011, accessed at http://pacenow.org/blog/wp-content/uploads/10.13.11-GreenFinanceSF-Commercial1.pdf.

41 In July 2011, U.S. Reps. Nan Hayworth, M.D. (R-NY), Mike Thompson (D-CA), and Dan Lungren (R-CA) introduced HR 2599, the *PACE Protection Act* of 2011. If passed, the Act would likely boost municipal support for commercial PACE efforts that are currently under way and would reinvigorate dormant residential PACE programs, by forcing the FHFA to issue new directives reversing their previous directives, which characterized PACE liens as an infringement on existing mortgage-holder priority.

42 See U.S. EPA Financial Advisory Board (hereinafter EFAB) "Report on Voluntary Economic Improvement Bonds: An Innovative Local Concept for Mitigation of Climate Change Risk; Air Pollution Reduction; and Reduction of Non-point Source Water Pollution," June 2009, at Appendix A. Accessed at nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=P100AA92.txt.

43 See EFAB letter to Administrator Jackson (May 2011), accessed at http://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=P100BJI3.txt.

44 More detail on this bill is available at www.pennenvironment.org/legislature/testimony/energy/energy/testimony-on-pace-clean-energy-legislation-hb2525.

45 See "Clean Fund Completes First Private Capital PACE Commercial Financing," accessed at http://pacenow.org/blog/2011/09/clean-fund-completes-1st-private-capital-pace-commercial-financing/; and Justin Gillis, "Tax Plan to Turn Old Buildings 'Green' Finds Favor," New York Times, Sept. 19, 2011, accessed at www.nytimes.com/2011/09/20/business/energy-environment/tax-plan-to-turn-old-buildings-green-finds-favor.html?_r=1&scp=1&sq=ygrene&st=cse.

46 Oregon's MPOWER and Clean Energy Works on-bill programs and Kentucky's MACED program both utilize CDFI funds. For more details on these programs, as well as a survey of 19 existing on-bill energy efficiency financing programs, see Bell, Nadel, and Hayes, "On-Bill Financing for Energy Efficiency Improvement: A Review of Current Challenges, Opportunities, and Best Practices," American Council for an Energy-Efficient Economy, report E118, Dec. 2011, accessed at www.aceee.org/sites/default/files/publications/researchreports/e118.pdf. [I found this not at the URL given in the note but at http://www.aceee.org/research-report/e118]

47 In California, the Public Utilities Commission passed Decision 09-09-047 in September 2009 mandating on-bill financing for all investor-owned utilities. See http://docs.cpuc.ca.gov/PUBLISHED/Graphics/107829.PDF. In New York, the Power New York Act (A. 8510/S. 5844), passed by the state legislature on June 22, 2011, provides a mechanism to allow owners of residential and non-residential buildings to borrow money for energy-efficiency projects and pay it back over a period of years through their electric and gas bills, as a way to provide financing for New York State's existing Green Jobs Green New York program. See "Senate Passes Energy Efficiency Plan to Lower Costs for Homeowners and Businesses," New York State Senate website, www.nysenate.gov/press-release/senate-passes-energy-efficiency-plan-lower-costs-homeowners-businesses.

48 What distinguishes a "loan" from a "tariff" can vary according to state regulatory structure. For more details on on-bill tariff or loan programs, see Bell, Nadel, and Hayes, "On-Bill Financing for Energy Efficiency Improvement: A Review of Current Challenges, Opportunities, and Best Practices," American Council for an Energy-Efficient Economy, report E118, Dec. 2011, accessed at www.aceee.org/sites/default/files/publications/researchreports/e118.pdf.

49 See Bell, Nadel, and Hayes, "On-Bill Financing for Energy Efficiency Improvement: A Review of Current Challenges, Opportunities, and Best Practices," American Council for an Energy-Efficient Economy, report E118, Dec. 2011, accessed at www.aceee.org/sites/default/files/publications/researchreports/e118.pdf.

50 Sarah Francis, "Gray to Green: Jumpstarting Private Investment in Stormwater Infrastructure," p. 28, 2010, accessed at www.sbnphiladelphia.org/images/uploads/02-17-10_EIP_stormwater.pdf.

51 For example, see www.watermgt.com/index.html.

52 Sarah Francis, "Gray to Green: Jumpstarting Private Investment in Stormwater Infrastructure," p. 26, 2010, accessed at www.sbnphiladelphia.org/images/uploads/02-17-10_EIP_stormwater.pdf.

53 When public infrastructure funds, such as the federally financed Clean Water State Revolving Funds, are used to provide direct loans (or grants) for capital projects, the limited pool of funds is spent dollar-for-dollar on specific projects. In contrast, when such funds are used for "credit enhancement," they can support the lending of much larger sums by private financiers, enabling a much greater number of capital projects to be built.

54 It would only be in a stormwater utility's interest to allow credit for managing excess runoff from site B—e.g., in the case of Philadelphia, more than 1 inch of runoff—if the utility determined that the additional increment of stormwater capture would provide a significant additional benefit toward meeting the utility's overall stormwater goals. The extent of the credit granted should be proportional to the amount of benefit; at some point, sizing stormwater retrofits to manage larger storms begins to yield diminishing marginal returns in terms of environmental benefits, because smaller storms occur at a greater frequency than larger ones.

55 It is worth noting that stormwater regulations in Southern California, specifically in Ventura and Orange Counties, already allow forms of offsite mitigation, where onsite compliance with mandatory stormwater performance standards for development projects is "technically infeasible." This can include projects where infeasibility is determined based on space constraints on densely developed properties. California Regional Water Quality Control Board, Los Angeles Region, Order No. R4-2010-0108, NPDES NO. CAS004002 (stormwater discharge permit for municipalities in Ventura County), accessed at www.swrcb.ca.gov/rwqcb4/water_issues/programs/stormwater/municipal/ventura_ms4/AdoptedVenturaCountyms4/Order.pdf; and California Regional Water Quality Control Board, San Diego Region, Order No. R9-2009-0002, NPDES NO. CAS0108740 (stormwater discharge permit for municipalities in Ventura County), accessed at www.swrcb.ca.gov/rwqcb9/water_issues/programs/stormwater/docs/oc_permit/updates_012710/FINAL_R9_2009_0002.pdf.

56 IRR is broadly defined as the rate of return generated by a time series of cash flows. An investment is generally considered worthwhile if the IRR is greater than the return of an average similar investment opportunity, or if the IRR is greater than the cost of capital.

57 Two types of data were used. First, PWD provided basic information about the approximately 90,000 commercial properties in Philadelphia that are subject to the parcel-based stormwater fee, including each property's gross area, impervious area, meter-based fee, and parcel-based fee (once the parcel-based fee structure is fully phased in). Second, PWD provided 27 retrofit case studies generated by an environmental planning, engineering, and consulting firm pursuant to a contract with PWD. Each case study examined an actual commercial property to identify stormwater management practices that could be installed to reduce the property owner's stormwater fees, given the physical characteristics of the particular property. Each case study included concept-level design of stormwater management installations, cost estimates, the total impervious area from which runoff would be managed, the resulting reduction in monthly stormwater fees, and a simplified analysis of return on investment.

58 For example, the analyses do not account for any adjustments to the parcel-based billing phase-in period, to the fundamental rate structure, or to verification methods for obtaining credits, which PWD might consider or adopt in the future.

59 A 20 percent equity investment by the property owner, with the remaining 80 percent financed, is a reasonable assumption of standard financing terms for commercial real estate loans. A 6 percent financing rate, which represents the approximate market rate for a standard commercial property improvement loan, was assumed for the purposes of this analysis. For reasons explained in Section II, many commercial property owners would face higher-than-usual finance costs for—or face difficulty obtaining at all—a standard commercial loan for stormwater retrofits. The next part of Section III explores alternative financing mechanisms that would avoid this problem.

60 The case studies assumed the retrofits would be installed in 2011 and calculated the avoided stormwater fees based on actual PWD rates,

in accordance with the 4-year phase-in of the parcel-based rate structure described above in Section I.

61 On-bill financing could be structured as either partial debt and equity financing or as 100 percent "project developer" financing, depending on how the programs are structured. PACE financing is typically 100 percent financed.

62 This is the federal depreciation rate for non-residential real property.

63 Financing of 80 percent may not be available and will depend on the willingness of lenders to finance stormwater projects.

64 This interest rate reflects a conservative assumption, since a project developer may be able to obtain a lower interest rate than the property owner can, as noted above.

65 See Northeast Ohio Regional Sewer District Stormwater Fee Credit Manual, October 2011, accessed at http://neorsd.org/I_Library.php?a=download_file&LIBRARY_RECORD_ID=4699.

66 Kansas City, Missouri, Code of Ordinances, section 61-4: Collection and Amount of Stormwater Fees, accessed at http://library.municode.com/HTML/10156/level3/PTIICOOR_CH61ST_ARTISTUT.html#PTIICOOR_CH61ST_ARTISTUT_S61-4COAMSTFE. See also NRDC, *Rooftops to Rivers II* (Nov. 2011). Accessed at www.nrdc.org/rooftops.

67 Clean River Rewards Frequently Asked Questions, accessed at www.portlandonline.com/bes/index.cfm?c=43438&.

68 See DC Water, Impervious Area Charge, www.dcwasa.com/customercare/iab.cfm; District Department of the Environment, Notice of Proposed Rulemaking: Stormwater Fee Discount Program, July 29, 2011, accessed at www.dcregs.dc.gov/Gateway/NoticeHome.aspx?NoticeID=1352779; and NRDC, *Rooftops to Rivers II* (Nov. 2011), accessed at www.nrdc.org/rooftops.

69 AKRF has been retained by PWD to aid property owners in evaluating green infrastructure investment options.

70 The median amount of IA managed in the high investment scenario was 95 percent, with a range of 44-100 percent. At sites where the high investment scenario was less than 100 percent, more extensive retrofits were not analyzed due to physical constraints, client preference, planned redevelopment, and/or excessive cost, in the judgment of the case study authors.

71 The retrofit costs were based on a literature review of unit costs for various SMPs, from which the SMP costs shown above in Section I, Table 2, were also derived.

72 Regression analysis is a statistical technique that attempts to explore and model the relationship between a dependent variable and two or more independent variables. A linear regression model attempts to explain the relationship between two or more variables using a straight line.