Appendix I

American Street Corridor Status Update

American Street Corridor

Proposed
Gateway and Corridor Signature Project
Status Update and Project Summary
(August 2011)

Introduction

The American Street corridor is a historically industrial center in the West Kensington neighborhood of Lower North Philadelphia. The district is being gradually redeveloped as a center for smaller fabrication and distribution-type businesses however current property owners feel that streetscape and infrastructure improvements are needed to attract new tenants and businesses. The overly-wide street and lack of vegetation or safe pedestrian passageways make American Street a physical and psychological barrier for area workers and residents of the surrounding neighborhoods that are emerging from the post-industrial landscape.

Opportunity abounds as a 2005 study indicated that there is enough vacant land in the American Street Corridor to double employment in the district if the vacant lands were fully built-out.[1] There has been no major opposition to proposed streetscape and stormwater management improvements because the community recognizes that these improvements could help create a more distinctive and identifiable district and also provide stormwater credit and trading opportunities for property owners.

Partners

Active Partners

- Philadelphia Water Department — www.phila.gov/water/
- Philadelphia Commerce Department — www.phila.gov/commerce/comm/
- Philadelphia Streets Department — streetsweb.phila.gov
- AKRF (Consultants to PWD) — www.akrf.com/

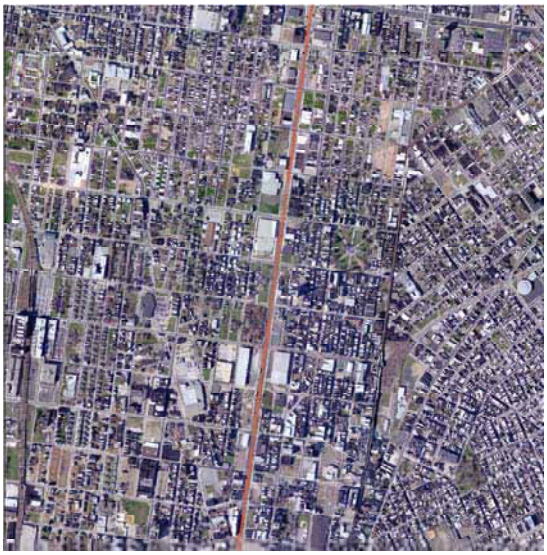
Potential Additional Partners

- Philadelphia Industrial Development Corporation — www.pidc-pa.org/
- Philadelphia Empowerment Zone — www.phila.gov/ohcd/ez.htm
- Mayor's Office of Sustainability — www.phila.gov/green/
- Office of Housing and Neighborhood Preservation — www.phila.gov/ohcd/
- Philadelphia Department of Licenses and Inspections — www.phila.gov/li/
- Philadelphia City Planning Commission — www.philaplanning.org
- Philadelphia Redevelopment Authority — www.phila.gov/rda/
- New Kensington Community Development Corporation — www.nkcdc.org
- Pennsylvania Horticultural Society — www.pennsylvaniahorticulturalsociety.org
- American Street/Erie Avenue Business Association — www.impactservices.org/
- Local Initiatives Support Corporation — www.lisc.org/

[1] http://www.bkurbandesign.com/pdf/reports/American_St_Public_Space.pdf

History of the Site

The North American Street corridor was the center of Philadelphia's thriving textile industry in the beginning of the 20th century. The overly-wide road was originally meant to allow both trucks and rail to access each industrial site. Today the rail line down the center of the road is unused and the vacancy rate along the corridor is high. A series of transportation infrastructure investments, tax incentives, community programs and funding opportunities over the last thirty years have created the conditions today that encourage mixed-use, environmentally sustainable and infill development in this district



Timeline of Important Events

Early 1900s – North American Street is the heart of Philadelphia's textile industry

1977-1981 – The Federal government spent $20 million to convert a 1.7 mile stretch of the corridor into a 90 foot-wide, 8-lane highway[2]

1983 – The American Street Empowerment Zone is created[3]

- Low-interest financing, tax credits and other inducements to companies moving into American Street

1980s-1990s – Illegal dumping, drug use and abandoned buildings earn the corridor a bad reputation

1994 – American Street selected as one of Philadelphia's three Empowerment Zones under the Community Empowerment Initiative (1993)[4]

- 10-year federal commitment to community revitalization
- Additional tax credits and business incentives
- In December 2000, the tax incentives were extended through 2009

1995 – ABC News, "Badlands Part 1 and 2: The Death of an American Neighborhood" – about the poor conditions of the American Street corridor[5]

1996 – American Street Financial Services Center established

- Assists interested businesses and developers find financial resources to make their relocation to American Street possible

1999 – Keystone Opportunity Zone established for some sections of American Street[6]

- Provides a 10-year exemption from most state and local taxes

2000 – Pennsylvania Horticultural Society begins a vacant land greening program on North American Street through the "Philadelphia Green" program[7]

1990s-2000s – Land assemblage and condemnation program fails to attract new businesses to the district while also creating community resentment towards the City and their inability to deliver on redevelopment promises[8]

2005 – BK Urban Design completed a streetscape design plan for the American Street Empowerment Zone[9]

2010 – Neighborhood clean-up program established

2011 – A redevelopment study for a largely vacant lot on North American Street is conducted and published through a partnership between the Urban Land Institute, Infill Philadelphia, the PIDC and the Community Design Collaborative[10]

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[2] http://www.finanta.org/news/long-blighted_area_lures_business_with_tax_breaks
[3] http://www.finanta.org/news/long-blighted_area_lures_business_with_tax_breaks
[4] http://www.finanta.org/news/long-blighted_area_lures_business_with_tax_breaks
[5] http://sociology.barnard.edu/sites/default/files/inline/becher_uncertaintyplanning_0.pdf
[6] http://www.finanta.org/news/long-blighted_area_lures_business_with_tax_breaks
[7] http://www.landvisions.org/reclaimingPage2.html
[8] http://sociology.barnard.edu/sites/default/files/inline/becher_uncertaintyplanning_0.pdf
[9] http://www.bkurbandesign.com/pdf/reports/American_St_Public_Space.pdf
[10] http://philadelphia.uli.org/Community%20Outreach/~/media/DC/Philadephia/Philadelphia%20Docs/ULI%20report_American%20Street%20%202.ashx

The most recent activities include clean and green vacant land management strategies and distinctive streetscape plans. Both of these strategies are meant to make the district more attractive to businesses and developers by demonstrating the community's investment in the health of their community. Recent infill development concept designs and proposals also show an interest in bringing this community as a whole into the 21st century. All of these conditions combined create a promising opportunity for green stormwater infrastructure to be incorporated in any future infill development, streetscape improvements or street reconstruction projects.

History of the Green Infrastructure Project

PWD has been working with consultants to create concept plans for green street and stormwater management features on American Street and to understand the feasibility of implementing this project including understanding the community's desires and concerns regarding the project.

American Street Regional Stormwater Management Concept Summary[11]

Background Information

Through initial studies, PWD found that most properties along the American Street corridor are constrained in terms of green infrastructure implementation due to high impervious cover and lack of available open space. SMPs for highly-constrained sites typically include subsurface systems, porous asphalt and/or green roofs with costs of implementation beyond an attractive payback period for the land owners.

Therefore, PWD decided to investigate a regional stormwater management solution using the wide American Street right-of-way as a possible site for stormwater management. If designed properly, SMPs in the American Street right-of-way could manage both runoff from the street and from adjacent private property. The adjacent property owners could receive stormwater credits for the on-site stormwater management by paying a flat rate, providing in-kind maintenance services, or through another equitable public-private cost-share model.

Description of Existing Conditions

The study area includes the area ½ block east and ½ block west of American Street from West Thompson Street (southern boundary) to West Lehigh Avenue (northern boundary). Therefore, the total study area is approximately 14 blocks or 7,500 feet long. The land use of this area is primarily older light industrial and commercial properties with several vacant lots and limited new redevelopment activity. The right-of-way is very wide (approximately 120 feet) which presents a good opportunity to reconfigure the drive aisles and parking areas to accommodate green infrastructure.

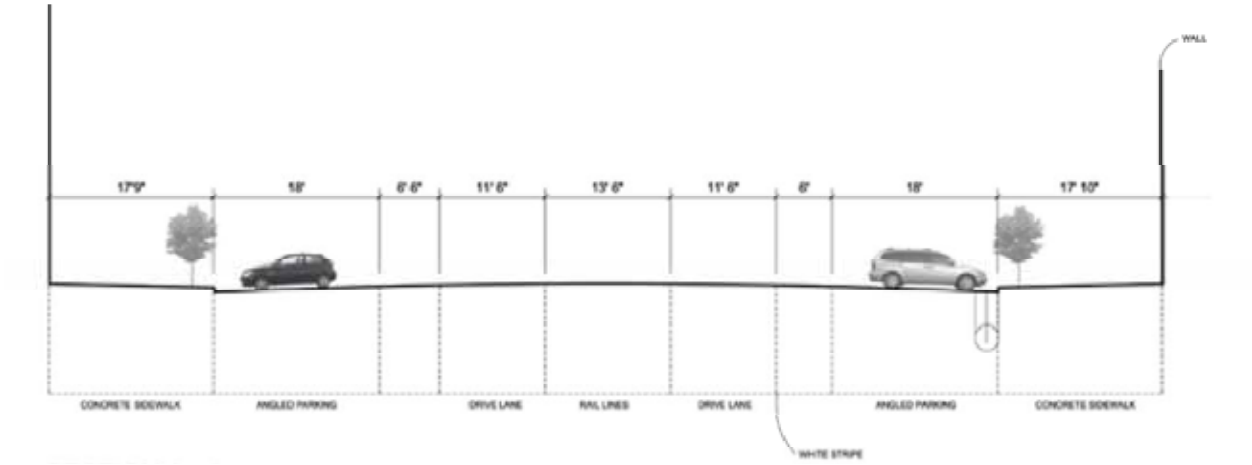
Table 1: Summary of Impervious Area and Runoff Volume Calculations

Description	Impervious Area (Acres)	Runoff Volume from the 1" Storm (cu. ft.)
Private Property (buildings)	14	51,000
Public Property (roadway, parking areas, sidewalks)	32	129,600
Total	46	180,600

Source: American Street Regional Stormwater Management Concept Summary (AKRF, 2010)

[11] From a report to PWDentitled "American Street Regional Stormwater Management Concept Summary" (AKRF, November 2010).

Figure 1: Existing Conditions: Typical Street Cross-Section



Source: Existing Conditions Diagram (AKRF, 2010)

Figure 2: Existing Conditions: Typical Street View

Source: Google Maps

Summary of Public/Private Relationship

Due to the corridor's prominence as a light-industrial and commercial corridor with a current redevelopment focus, the American Street project creates an opportunity for a high-profile green streets program, implemented through a public-private partnership which both decreases CSOs and decreases the individual property owner's stormwater bill. This will likely become a model for similar green commercial corridor retrofits throughout the City.

Summary of Recommended Interagency and Public-Private Relationships

- PWD could charge infill developers a fee to utilize the Regional SMP in the ROW as an alternative to expensive on-site stormwater management.
- PWD could provide the initial capital for SMP implementation and charge customers a pro-rata share of the incremental cost to oversize the system for private runoff. This could be an up-front lump sum payment or a zero-interest loan payable over 10 to 20 years.
- Private property owners who pay to connect to the Regional SMP would then receive a stormwater credit
- PWD, the American Street Business Association and individual property owners would need to determine who would be responsible for long-term maintenance of the SMPs – the development of a formal Business Improvement District, already under evaluation by the business association, could provide this service.
- This presents an opportunity for PWD to work with several other City departments to showcase the economic benefits of green stormwater management while also implementing the recommendations that will be outlined in the upcoming Green Streets Design Manual.

Status

As early as 2006, the Philadelphia Streets Department began initial design work for a road diet of American Street including curb bump-outs and re-striping to decrease the number of travel lanes.

The American Street Business Association has contacted PWD because they are interested in methods to mitigate their increased stormwater bills as a result of the parcel-based stormwater billing system which charges a higher stormwater fee for a higher percentage of impervious cover. This new fee structure will be phased in between 2010 and 2014, so the affected businesses are interested in implementing mitigation options as soon as possible.

In November of 2010, design consultants met with PWD to present the American Street Regional Stormwater Management Concept Summary and results of their initial research into the financial feasibility of a regional SMP. PWD representatives responded with specific questions for consultants to review and begin detailed conceptual designs for selected blocks.

In December of 2010, PWD met with the Commerce Department about this project. The Commerce Department helped by identifying constraints to SMP implementation and benefits of SMP implementation. The Commerce Department volunteered to manage the community outreach component of the project.

In January of 2011, PWD met with the Streets Department about this project. The Streets Department is willing to support the redesign of this corridor and will work with the Traffic Department on their criteria and will research preferences for bike lane locations within the corridor.

In February of 2011, design consultants submitted an updated American Street corridor concept diagram and design considerations to PWD.

Project Description

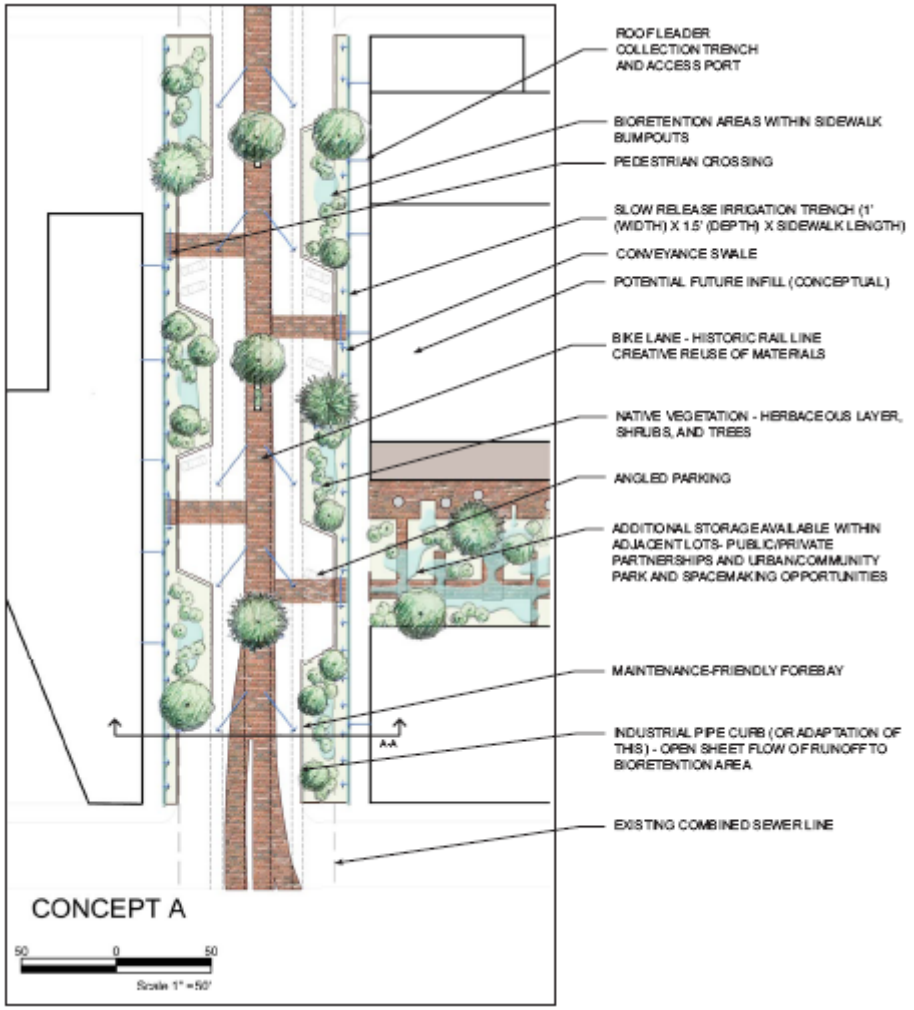
Concept Design Summary

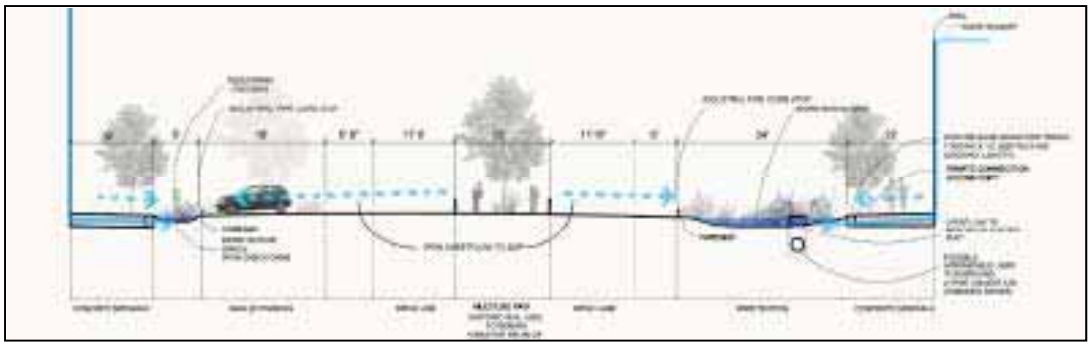
Both of the concepts described below call for a shallow, linear bioretention SMP that controls surface runoff and connects to the roof leaders of the adjacent buildings. Overall, both designs, when fully built-out could **create 46 new Greened Acres.** Both designs incorporate safe pedestrian access, attractive sidewalk materials and general streetscaping as well as a 4 foot-wide bike path on both sides of the road. A modular approach to the implementation of the SMP would allow for sections of the SMP to be constructed as funding becomes available. These initial concepts also incorporate the ability to connect the SMP to future, larger urban plaza-style SMPs on vacant lots which could provide public amenities and additional water quality and quantity control, as needed.

Concept A

The first concept incorporates variable width bioretention areas within sidewalk bumpouts leaving space for angled parking and bus lanes. Concept A provides more variation in SMP shape which would create a more interesting streetscape and allows for pedestrian and vehicular crossings that are easier to construct.

Source of diagrams: American Street Regional SWM Concept Design (AKRF, 2010)

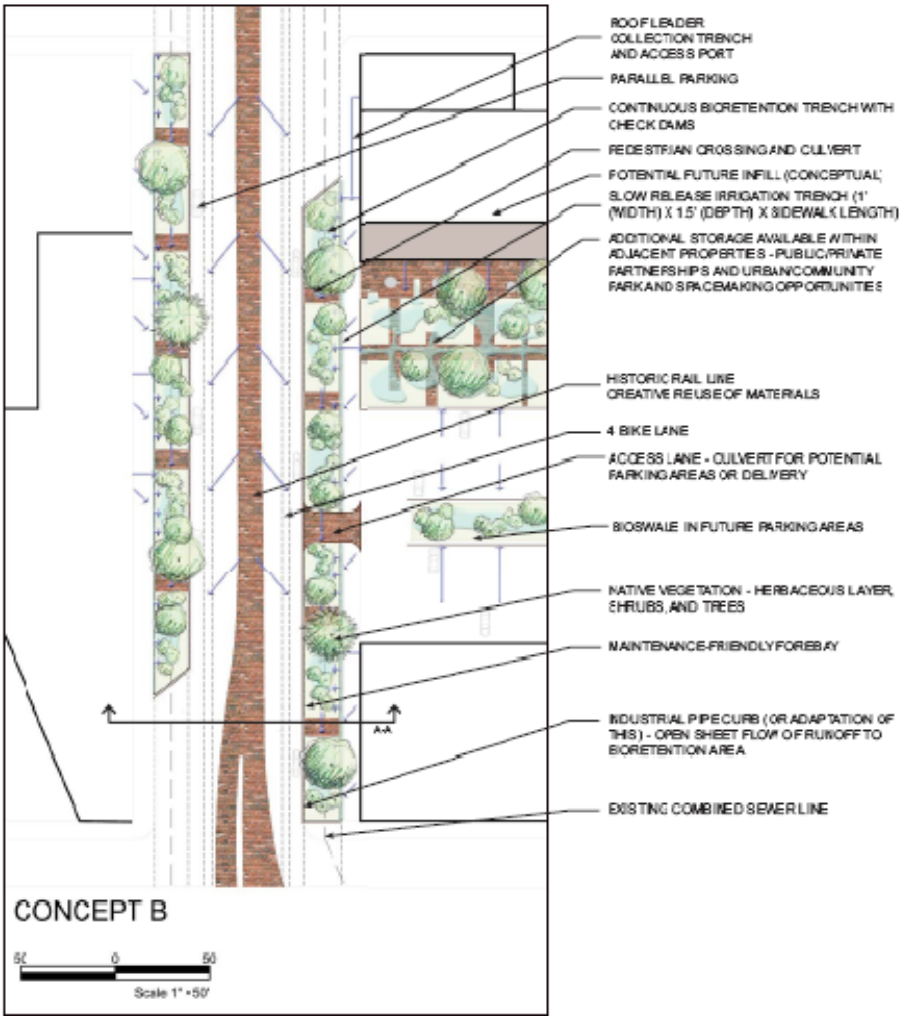




Concept B

The second concept calls for a streamlined bioretention basin along the sidewalk ending 65 feet prior to the end of the block at two corners to provide for a bus lane. This concept design would require parallel parking. Concept B provides for a more uniform overland flow path. This concept also allows for easier modular implementation and easier street maintenance because of a consistent SMP width and design.

Source of diagrams: American Street Regional SWM Concept Design (AKRF, 2010)



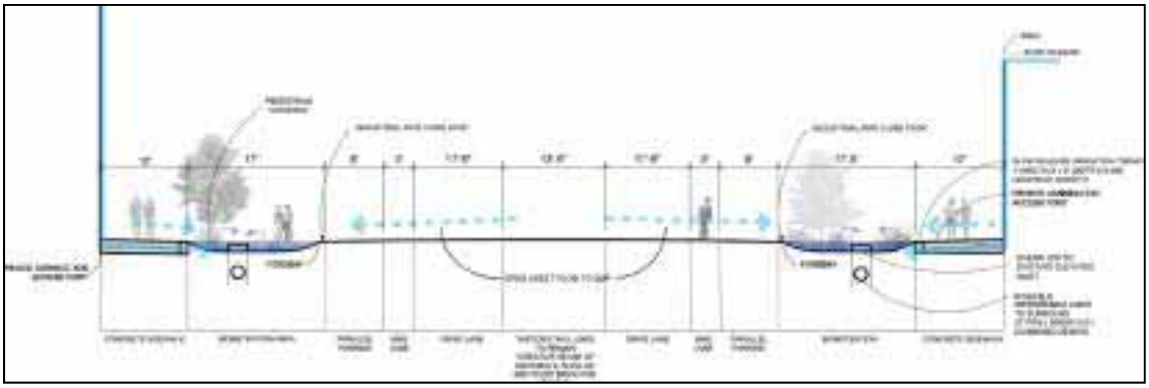


Table 2: SMP Summary Table for Two Concept Plans

Description	Concept A	Concept B
Total SMP length along corridor (including both sides of the street)	6,430 linear feet	5,600 linear feet
Total storage volume along the corridor	174,000 cubic feet	172,000 cubic feet
Unit storage volume (including both sides of the street)	Approximately 27 cubic feet per linear foot of SMP	Approximately 31 cubic feet per linear foot of SMP
Initial Capital Cost	**Approximately $10 million**	**Approximately $10 million**
Unit initial capital cost (including both sides of the street)	$1,600 per linear foot of SMP	$1,800 per linear foot of SMP
Unit initial capital cost	$217,000 per acre of impervious area	$217,000 per acre of impervious area
Annual Operation and Maintenance Costs	**Approximately $500,000 per year**	**Approximately $500,000 per year**
Unit annual O&M costs (including both sides of the street)	Approximately $160 per linear foot per year	Approximately $180 per linear foot per year

Source: American Street Regional Stormwater Management Concept Summary (AKRF, 2010)

Concept Development

Concept B was developed further through a more detailed diagram of how this SMP concept could be implemented on three study blocks. This more detailed design analysis allowed for a quantification of parking created and an in-depth look at where and how safe pedestrian access points and bump outs could be created. Additionally, a more detailed analysis of current drainage inlets, light poles, sewer pipes, etc. was conducted, which allows for a more realistic understanding of actual drainage and flow patterns within each study block.

Potential Greened Acres

Both of the preliminary conceptual designs would create a total of 46 new Greened Acres when fully constructed. This area includes 32 acres of public property impervious area such as roadway, parking areas and sidewalks and 14 acres of private property impervious area such as buildings. Preliminary calculations estimate that this area represents a total of 180,600 cubic feet of runoff from the one-inch storm would be captured and treated by the proposed SMP.

Next Steps

PWD plans to transfer this project to the new SMEDs contract to finalize the conceptual design, create a phasing plan and then construction documents. At this time, PWD estimates it will be 2-3 years before this project is ready to be constructed. The Streets Department is supportive of this project. In a preliminary meeting, the Streets Department mentioned that there might be funding to support construction in 2017 according to their current TIP. PWD will seek to leverage potential partner investments to realize construction of this project.

Connections to Other City Plans and Other Organizations

Greenworks Philadelphia

This proposed green street project would support multiple targets identified in *Greenworks Philadelphia*, Mayor Nutter's sustainability plan released in 2009.[12]

Target 8: Mange Stormwater to Meet Federal Standards

This project will help manage stormwater by creating bioinfiltration swales along the length of the road to treat and filter runoff from the street as well as roof runoff from the adjacent buildings. This green streets project could also serve as a pilot program to evaluate green streets ideas and technologies within a commercial corridor setting; a program identified as PWD's responsibility in *Greenworks*.

Target 11: Increase Tree Coverage Toward 30% in All Neighborhoods by 2025

The bioinfiltration swales proposed for this site would include significant vegetation including trees which would help increase the tree coverage in the Lower North Philadelphia district where tree cover is currently extremely low (5.7%).

Green2015: An Action Plan for the First 500 Acres

Green2015[13], the Philadelphia Parks and Recreation Department's open space plan released in 2010, includes transforming public underused or vacant land, including vacant lots along North American Street, as a key strategy for public open space creation. The plan also identifies North American Street as an opportunity to create on-street connection between Delaware River and Cohocksink Creek trails and the North Philadelphia trail network. Implementing sidewalk and streetscape improvements would create the green connection on N. American Street that this plan recommends.

GreenPlan Philadelphia

GreenPlan Philadelphia, released in 2010, identifies vacant land management and green streets as two important strategies for creating vibrant and sustainable urban places. These strategies are also the driving themes behind PWD's American Street corridor project. *GreenPlan* calls for the creation of a citywide network of 1,400 miles of green streets and identifies North American Street as a key opportunity site for the construction of a green street. When fully completed, this project would create 1.4 miles of green streets and likely spur further redevelopment of vacant lots and buildings along the corridor.

Mayor's Complete Streets Executive Order

In June of 2009, Mayor Nutter signed Executive Order No. 5-09[14], the first city-level policy in Pennsylvania related to complete streets. The executive order encourages City agencies to consider the safety and needs of *all* users when designing or retrofitting streets and sidewalks. The American Street green streets project would turn an overly-wide, unsafe and largely underutilized roadway into a complete and safe street. Sidewalks buffered from the travel lane by a marked parking lane and vegetation would protect pedestrians. A marked bike lane would provide safe passage for bicycle users along this corridor as well. When complete, the American Street green street project would exemplify how green and complete streets can be successfully integrated into commercial/industrial corridors.

Philadelphia2035

Phase 1: City-Wide Vision Planning Process

The first phase of Philadelphia2035, a City-Wide Vision[15], was completed in June of 2011. The 25-year comprehensive plan for the City includes several recommendations that would be achieved by the American Street project.

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[12] http://www.phila.gov/green/greenworks/
[13] http://planphilly.com/green2015-action-plan-first-500-acres
[14] http://www.phila.gov/executive_orders/pdfs/executive%20orders/10.%20Mayor%20Nutter/2009/EO_509_Complete_Streets.PDF
[15] http://phila2035.org/pdfs/final2035vision.pdf

Philadelphia2035 recommends the creation of a city-wide network of green streets and sidewalks and to coordinate utility and streets improvements projects with green streets retrofits. This project would create a 1.4-mile stretch of "green" street and would serve as a model for implementation of the principles elsewhere in the City. PWD's extensive coordination with the Streets Department, Commerce Department, and community organizations is also a model for how green streets retrofits can be integrated with other infrastructure improvements.

Phase 2: Neighborhood Planning Process

The second phase of *Philadelphia2035* involves 18 individual neighborhood plans[16]. Each completed district plan will include a healthy community analysis, a city facilities analysis, an analysis of vacant and underutilized land, multiple urban design studies and a proposed land use map which will help guide a city-wide zoning re-mapping process. The North American Street corridor lies within the Lower North District which is scheduled to be completed in the 2013 planning process[17]. PWD could move ahead with the project now so that it could be highlighted in the plan as a model project or they could wait until 2013 so that the PCPC may assist with the project's design and implementation.

Philadelphia Pedestrian and Bicycle Plan

The Philadelphia City Planning Commission completed a Pedestrian and Bicycle Plan for the City of Philadelphia[18] in the fall of 2010. This project's enhancement of pedestrian safety and construction of a marked bike lane would support the goals of this plan. Intersection geometry, road width and sidewalk surface conditions are issues identified in the bike/ped plan which are also issues in the American Street Corridor. The redesign of this corridor as proposed in this green streets project would incorporate all of these recommendations. Improved pedestrian and bicycle facilities along this corridor will also serve to attract new development to the corridor.

The bike/ped plan labels American Street as an "auto-oriented commercial/industrial street type" with low pedestrian significance. The plan establishes sidewalk width standards for this street type. The plan calls for a twelve-foot minimum total width, a six-foot minimum walking zone width and a five-foot minimum furnishing zone width. The sidewalks in PWD's conceptual green street designs should comply with these standards.

The plan also proposes a bicycle lane be established on N. American Street from Cecil B. Moore Avenue to Lehigh Avenue, a stretch of the corridor which lies within PWD's study area. This new bike lane would connect to an existing bike lane on Lehigh Avenue to the north. This bike lane is identified as a priority to be completed in Phase 1 of the plan's implementation.

The plan also identified funding opportunities and implementation priorities. PennDOT manages all federal and state transportation funding but the Department of Community and Economic Development and the Department of Conservation and Natural Resources may also offer applicable funding programs, such as Rails to Trail funding. The City's capital program allocates some funding for bike/ped improvements, especially street resurfacing. Additionally, some funding for commercial corridor streetscape projects may be available through the Commerce Department.

American Street Empowerment Zone

The American Street Empowerment Zone was established by the Community Empowerment Initiative in 1994 to provide federal grants for community revitalization projects. The Empowerment Zone was criticized for being slow to produce tangible results. In 2005 they commissioned BK Urban Design to develop a streetscape design study to strengthen several commercial corridors within the American Street Empowerment Zone including American Street itself. The final report presented a future American Street corridor that is a "recognizable, distinctive, urban district; responsibly integrated into the life of the criss-crossing streets and the surrounding blocks of houses, shops, schools and churches."[19]

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[16] http://phila2035.org/home-page/district/
[17] http://phila2035.org/home-page/district/lower-north/
[18] http://tooledesign.com/philadelphia/
[19] http://www.bkurbandesign.com/pdf/reports/American_St_Public_Space.pdf

Specific improvements recommended for the American Street commercial corridor include:[20]

- Extend sidewalks at intersection crossings
- "Create a linear green landscape that buffers residential blocks from industrial activities"
- "Improve landscaping at entrances and important cross-street connections and at bus stops to provide pervious areas in the vicinity of stormwater inlets resulting in a reduction of stormwater volume at inlets. It will create a signature landscape for the district while establishing a more hospitable environment for resident transit users."

Although funding was not available to implement these recommendations at the time, the American Street Empowerment Zone's endorsement of these recommendations shows that they are truly invested in integrating "green" street and stormwater management concepts into a redesign of the corridor.

American Street Business Association

As of May 2007, business owners in the American Street corridor were considering creating a Business Improvement District (BID).[21] The creation of a BID would allow for the assessment of an additional tax on commercial property owners. Revenues from this additional tax could then be used to pay for special services as designated by the property owners. A BID Steering Committee was established to create a BID proposal which includes an assessment equal to 15% of annual real estate taxes. Committee members identified sidewalk cleaning and nighttime security as the most important services that a BID could provide.

Pennsylvania Horticultural Society

The Pennsylvania Horticultural Society (PHS) has been working on vacant land stabilization in the American Street Empowerment Zone, through their Philadelphia Green program, since 1999.[22] PHS has combined basic vacant land stabilization strategies such as greening, fencing and art work, with contracting local community groups for maintenance, to stabilize almost 100 sites along the North American Street corridor.

Infill Philadelphia and the Urban Land Institute

In 2010, Infill Philadelphia, a program of the Community Design Collaborative, completed an initial study of a lot on the 2600 block of North American Street[23]. The study looked at the possibility of using the largely vacant industrial site to create small-scale artisan spaces and a community anchor site. The designers and the client wanted to bridge the gap between the industrialized American Street corridor and the adjacent rowhouse neighborhood through transitional uses and spaces. The plan called for the eventual redevelopment of an adjacent underutilized city parking lot into a better use including a community garden and urban orchard.

In 2011, the Urban Land Institute built upon the 2010 study to look at the actual feasibility of implementation and funding opportunities[24]. This report recommends some sustainable design opportunities be utilized including green roofs, stormwater control practices and on-site materials re-use. The report also identifies the PWD/PIDC Stormwater Management Incentives Program (SMIP) as a funding opportunity and incentive to incorporate the recommended stormwater management techniques.

[20] http://www.bkurbandesign.com/pdf/reports/American_St_Public_Space.pdf
[21] http://www.impactservices.org/econ_dev/downloads/aseaba_newsletter_may07.pdf
[22] http://www.pennsylvaniahorticulturalsociety.org/phlgreen/ui_launchinggreencity.htm
[23] http://infillphiladelphia.org/documents/CDCInfill_IS_Spreads.pdf
[24] http://philadelphia.uli.org/Community%20Outreach/~/media/DC/Philadephia/Philadelphia%20Docs/ULI%20report_American%20Street%20%202.ashx

Appendix II

Green Streets Manual Scope of Work

INTRODUCTION

The Scope of Work proposed for the preparation of the Design Manual for Green Stormwater Infrastructure in Philadelphia Streets consists of four phases and 24 discrete tasks requiring 11 months to complete. Note that the phases and tasks in this proposal incorporate all of the tasks delineated in the RFP; the organization herein is intended to provide a logical progression of activities by the McCormick Taylor team, the Task Force, and other stakeholders over the course of the study.

Task Force and Stakeholder Communication

Throughout the duration of the project, the McCormick Taylor team will meet regularly with the Mayor's Office of Transportation and Utilities (MOTU), including representatives from three agencies under the MOTU's jurisdiction: the Philadelphia Water Department (PWD), the Department of Streets (Streets) and the Department of Parks and Recreation (PP&R). These Task Force meetings will be held at critical points during the project process where there is new information to discuss and input and direction is needed from MOTU. Task Force meetings offer the opportunity to discuss the project both in preparation for, and following, larger meetings with the project stakeholders—the Stakeholder Committee meetings. The Task Force members, meeting outlines and role is described under Task 1.

PROJECT APPROACH

After Task 1, the next eight tasks, requiring three months to complete, constitute Phase A: Identifying Opportunities, the data collection and analysis phase required as a foundation for the consideration of alternate courses of action and the subsequent preparation of the preparation of the Design Manual.

The next five tasks, requiring two months to complete, constitute Phase B, or the Suitability Analysis Phase, in which the McCormick Taylor team explores various green infrastructure solutions together with their applicability on Philadelphia streets. Also during this phase, streamlining methods for agency coordination and regulatory processes will be explored. The McCormick Taylor team will facilitate discussions with Task Force members to sort out the most viable scenarios for green infrastructure design and permitting processes.

The subsequent four months will be the Draft Design Manual Phase, Phase C, in which the technical content for the Design Manual will be outlined. Topics will include: design standards and specifications, operations and maintenance, performance monitoring, project selection criteria, recommendations for regulatory procedures, and education and communication tools to use both with the general public as well as with other agencies. During this Phase, the Task Force and invited participants will test the Draft Manual in the field at three (3) Manual Field Trial Charettes (described in Task 10).

The final phase, Phase D the Final Manual, will focus on making any modifications to the Draft Design Manual that are desired by the Task Force. Phase D will complete the Scope of Work.

A Work Program Schedule presenting the timing and interrelationship of the 24 proposed tasks has been bound into our proposal and can be found immediately following this Proposed Scope of Work. It can be referred to continuously while reading the detailed descriptions of the individual tasks.

Our team has identified a process that we feel is the best approach to develop a resourceful and paradigm-changing Design Manual for green streets. Each task, while being a necessary component of the Design Manual Process and Manual itself, will have a deliverable that may also act as a useful and versatile stand-alone communications tool for communicating green infrastructure solutions to various agencies, stakeholders and the public. For example, the Roadway Facility Typology Matrix, the Suitability Matrix, and the Project Selection Criteria GIS Mapping will be useful components of the Design Manual but each can also be used by MOTU as a communication tool and in disseminating the Citywide capital program street activities among City agencies, PennDOT and the public. Meeting summaries, handouts, mapping, visualization and other materials related to the ongoing development of the Design Manual will be reviewed for possible inclusion in various coordination and outreach activities.

Task 1: Coordination and meetings

The coordination tasks will occur over 11 months to complete, and will constitute the attendance and facilitation of meetings with a project Task Force and separate Stakeholder Committee.

Task Force

We suggest that the Task Force be in the range of 12 to 16 persons in size and include representatives from the PWD, Streets, PP&R, PennDOT, the Philadelphia City Planning Commission (PCPC), License and Inspection (L&I), the Philadelphia Horticulture Society (PHS), the Southeastern Pennsylvania Transportation Authority (SEPTA), and invited members of the development community. PWD will identify and invite the appropriate agencies and contacts to serve on the Task Force throughout the project.

Our experience has taught us that it is essential to involve key individuals, agencies, and organizations in the process of building a consensus about future direction if the Design Manual is to be effective and successfully implemented.

The diverse makeup of the Task Force is a key part of our strategy to build consensus and develop a common vision that all involved parties can actively support. Representatives on the Task Force provide direct links back to their organizations, keeping their memberships informed of the progress on the Design Manual and providing their Task Force with a built-in form of outreach to the broader community.

We anticipate that the Task Force will meet eight times during the course of the planning and design effort to allow adequate opportunity for discussion of relevant planning, design, and development issues. Task Force meetings will take place at critical stages of the process when review from member agencies would best inform the project.

Stakeholder Committee

Based on clarification with MOTU, we propose that a larger group, representing additional agencies as well as private and public parties serve on a Stakeholder Committee. PWD will identify and invite members to serve as a Stakeholder. Stakeholders will meet with the consultant and Task Force three times during the project study—once in the Suitability Phase, once during the Draft Design Manual Phase, and again during the Final Design Manual Phase.

Special Purpose meetings

We recognize that specific issues will arise requiring meetings that cannot be anticipated at the scoping phase of this project. Therefore, we anticipate as many as five special purpose meetings may be identified over the course of the Design Manual development.

Task 1 Outcomes:

- Summaries of Task Force and Stakeholder Committee meetings
- Print and electronic copies of project information to be used as a communication tool in advance of and at proposed meetings

Phase A: Identifying Opportunities

Task 2: Project Initiation

The purpose of this first task is to ensure that our team's effort will begin on the right foot by providing the Task Force and the McCormick Taylor team an early opportunity to establish an effective communication system and working relationship for the entire study. During this one-month task, the McCormick Taylor team will undertake the following steps:

- Obtain from Client a contact list for both the Task Force and Stakeholder Committee members. Contact list shall include organization name, primary contact, proposed correspondence format, mailing address, e-mail address, and phone number.
- Obtain from MOTU, PWD, Streets, PP&R, PennDOT, L&I, PCPC, PHS, and SEPTA and review all relevant previous planning reports, studies, presentations and data that are relevant to the creation of a Green Streets Policy. Items may include: environmental condition reports, City street classification systems (other than PennDOT's classification system), current development regulations, EPA's National Pollutant Discharge Elimination System (NPDES) stormwater program requirements, floodplain maps and regulations, green infrastructure design details from pilot projects, Green Street project prioritization lists, and any other pertinent studies or plans. PWD will identify, organize and provide all relevant material to McCormick Taylor.

- Obtain digital copies of available city engineering, tax maps, and aerial photography;
- Accompanied by representatives of the Task Force and other relevant individuals, conduct a tour of the green infrastructure pilot projects and areas of the City, as identified by MOTU, PWD and Streets, as potential future green streets; and
- In combination with the above-mentioned tour, hold the first workshop of the Task Force. At this workshop we will review the proposed Work Program, make adjustments as necessary, and establish contacts with key individuals and organizations that the McCormick Taylor team will be meeting with during the course of the planning process.

Task 2 Outcomes:

- Map or maps identifying the City's pilot project locations, large private property green stormwater infrastructure projects, and target green stormwater locations as identified in previous planning reports and data in GIS format
- A Summary report of the relevant background information provided by the Client with key challenges, past successes, lessons learned, , and issues identified for the project to address

Task 3a: Analyze Existing Agency Coordination Methods

During Task 3a, the McCormick Taylor team will begin to identify the existing coordination network between agencies that might play a role in the standardization of green stormwater infrastructure in Philadelphia. Each Agency and/or organization represented in the Task Force will provide the McCormick Taylor team with a summary of their internal and intra-agency coordination methods. We will work closely with Task Force members to identify the existing organizational structure between city, regional, and state agencies involved in the design, construction, permitting, and planning for city streets (including their associated maintenance, traffic control, bicycle advocacy groups, utility providers, and others) as well as for watershed protection. We will also identify the means with which these agencies and organizations coordinate their activities, such as through interagency committees or regulatory conformance. It is anticipated that the project will be informed significantly through the experience and lessons learned from PWD's recent green infrastructure installations.

Task 3a will identify which coordination methods seem to work the best as well as some of the opportunities and means that are deficient and/or absent.

Task 3a Outcomes:

- Narrative description and matrix or chart illustration, if appropriate, of the agencies involved in green stormwater infrastructure in City streets and the means with which they coordinate
- Summary of strengths and weaknesses of the existing process

Task 3b: Analyze Review, Approval & Permitting Processes

Task 3b will consist of the McCormick Taylor team working closely with Task Force members to analyze the existing review, approval and permitting process in the City. Each Agency and/or organization represented in the Task Force will provide the McCormick Taylor team with its protocol for review, approval and permitting process including type of development, submittal process, review type and duration, schedule and special cases. The McCormick Taylor team will actively look for any contradictions, gaps, or ambiguous direction that has the potential to slow down or increase the cost of a green infrastructure project. As with Task 3a, Task 3b will likely be informed by the experience of PWD as green infrastructure pilot projects have been built over the last several years. Strengths and weaknesses of the existing permitting process will be identified.

Task 3b Outcomes:

- Outline of the existing review, approval and permitting process, presented in a short narrative as well as graphically in a chart or matrix format
- Summary of strengths and weaknesses of the existing process

Task 3c: Investigate National Best Practices for Interagency Coordination

Simultaneous with Task 3a, we will research how other cities have reconciled need for a streamlined coordination means between multiple agencies to establish such multidisciplinary topics as green stormwater infrastructure.

Our team has experience working nationally for the EPA as well as for municipalities in Pennsylvania, Maryland, New Jersey, Oregon, California, Delaware, Missouri, Virginia, and Kentucky. Each place has to accommodate special means to facilitate communication and design approval across the board of multiple agencies. We'll investigate how they've accomplished this and report back to the Task Force on which have been most successful and which methods might be most applicable in Philadelphia.

Task 3c Outcomes:

- Narrative summary of National Best Practices for Interagency Coordination
- Identification of National Best Practices for Interagency Coordination that are most applicable in Philadelphia, including the assumptions and necessary steps to adapt the policy to the City

Task 4a: Investigate National & International Best Practices for Green Stormwater Infrastructure Design

Philadelphia is already a national leader in implementing green infrastructure and has an extensive array of best practices to serve as a model for future projects. However, innovations in green infrastructure are happening across the Country, and new ideas and methods can be brought to Philadelphia to further improve water quality and stormwater management. In Task 4a, the McCormick Taylor team will research best practices nationwide to identify an array of options that are most suitable for use in the Philadelphia. Assisting McCormick Taylor in this effort will be two national leaders in the design of green infrastructure - Meliora Design and Nevue Ngan. Together, we will identify the best practices, estimate the costs and benefits of each, and analyze the implications for the City of Philadelphia.

Task 4a Outcome:

- Narrative summary of National and International Best Practices for Green Stormwater Infrastructure Design with design details, project photos, and lessons learned, when documented/available

Task 4b: Review Philadelphia Best Practices for Green Stormwater Infrastructure Design

The purpose of this task is to capitalize on the extensive green stormwater infrastructure solutions that the PWD, Streets, and large property owners have piloted in the Philadelphia area. In recent years these groups have identified failing infrastructure and areas that most contribute to Philadelphia's CSO problem and have begun to pilot innovative solutions throughout the City. The number of innovative solutions will likely grow over the coming years as large property owners install mitigation solutions to the PWD's new Parcel-Based fee, which makes property owners pay for the amount of impervious cover contributing to challenges and some of the reasons behind a project's successes and/or failures. Of first concern will be identifying some of the technical details of design solutions – what worked or didn't work and why. We will also consider other aspects of green stormwater infrastructure planning like: building consensus among stakeholders of green stormwater infrastructure by working together from the planning to construction phases, incorporating input from multiple disciplines in each detail, identifying as many of the potential project contingencies that may have an effect on the function or cost of a project, and understanding the role of maintenance in the upkeep of proposed solutions early on.

The McCormick Taylor team will contact PWD and Streets staff directly to discuss the lessons learned during the design, construction and monitoring of their demonstration projects. In addition, we will make e-mail and/or phone contacts with some of the larger private property owners who have incorporated green stormwater infrastructure solutions on their properties to assess and document their lessons learned.

Task 4b Outcome:

- Narrative summary of Philadelphia Best Practices for Green Stormwater Infrastructure Design with design details, project photos, and lessons learned, when documented/available

Task 4c: Review and Integrate Roadway Facility Typology from the Complete Streets Design Manual Efforts

McCormick Taylor, along with Hunt Engineering and Meliora Design, will coordinate with the McCormick Taylor team for the Complete Streets Design Manual to identify typical street patterns within the various land use types in Philadelphia. These can be used as a menu to assist planners and designers in selecting appropriate facilities for a targeted area. We will utilize the typical street cross sections including the number of through lanes, existence of on-street parking, bike lanes and sidewalks, and the setbacks of buildings fronting the street identified for the Complete Streets project to include physical characteristics relevant to green infrastructure such as potential utilities, drainage patterns, circulation patterns, soil permeability and contamination levels, and traffic volumes that could affect any green infrastructure design.

It is anticipated that the Complete Streets Design Manual outcomes will identify roadway typologies that include the transportation function of the roadway as well as the adjacent land uses along each roadway. For instance, the PennDOT functional classification of an Urban Arterial is more indicative of the type of roadway it is if it also were called an Urban Commercial Arterial or an Urban High Density Residential Arterial. This information should be provided to the Green Stormwater Infrastructure Design Manual McCormick Taylor team in both narrative, cross-section, and mapped format.

The classification of roadways by function, land use, and green infrastructure suitability now will assist the design team and Task Force in identifying the appropriate green stormwater infrastructure solutions in the Suitability Matrix to be completed in Phase B, Task 8.

The roadway facility typology will be documented in a matrix that is easy to read and illustrated with plans, sketches and/or cross sections.

Task 4c Outcome:

- Roadway Facility Typology Matrix with narrative and illustrative description of the function, land use context, and physical condition of typical roadways

Task 5: Goals and Objectives

The purpose of this task is to articulate a vision and accompanying preliminary set of goals and objectives for the creation of a Design Manual for Green Stormwater Infrastructure in Philadelphia Streets. The McCormick Taylor team will work with Task Force members to identify an overarching vision for the Design Manual for Green Stormwater Infrastructure in Philadelphia Streets that meets the needs and vision of each participating agency and/or organization. Once a unified Vision has been determined, the McCormick Taylor team and Task Force members will identify the many goals and objectives related to realizing that Vision. The Goals and Objectives will reflect the description and analysis of the current state of Philadelphia streets and stormwater; the identification of future opportunities; and the local, regional, and state government and construction industry perspectives. The Task Force will consider important concepts such as who the Design Manual will serve, how will they use it, how flexible or rigid a manual will it be, how will it relate to other existing stormwater manuals, and what's most important to include in the Design Manual. Some agencies have given this considerable thought, while others likely have not. This task will enable members of the Task Force to consider the needs and desires of all key stakeholders.

The goals identified in this task will provide guidance to the McCormick Taylor team and the Task Force during Phase B, the Suitability Analysis Phase.

Task 5 Outcomes:

- Documentation of a project vision.
- List of the Goals and Objectives for the creation of a Design Manual for Green Stormwater Infrastructure in Philadelphia Streets.

Phase B: Suitability Analysis

Task 6: Explore and Develop Process and Coordination Streamlining Alternatives

During Task 6 the McCormick Taylor team will identify appropriate alternatives to streamline the permitting process and interagency coordination methods from which the client, together with the Task Force members, can agree upon the most valuable. We anticipate that a maximum of three process alternatives will be developed to improve and streamline the existing permitting/coordination process. Streamlining alternatives could include the following considerations:

- Create an interagency group to facilitate swift review of atypical situations related to the design and process of utilizing green stormwater infrastructure solutions, (i.e.: alternatives to a design standard, a contingency that slows the design and/or process of approval or threatens the budget for a planned capital project). The team would include members of stakeholder agencies experienced in green stormwater infrastructure and could meet on an as-needed or regular basis and make immediate recommendations to ameliorate potential stalemates.
- Continuing pilot projects so that innovative solutions continue to be tested and alternative solutions are honed. Also, so that the general public and stakeholder agencies have a better frame of reference and knowledge of green stormwater infrastructure solutions.

The preferred coordination methods will be outlined, including any input from the Task Force discussion, later in Task 9.

Task 6 Outcome:

- Narrative summary and matrix or chart, if applicable, of alternatives to streamline the permitting process and coordination methods

Task 7: Develop Green Stormwater Infrastructure Toolkit

Once the best practices have been identified and analyzed in Phase A, McCormick Taylor will prepare a user-friendly matrix to summarize the design and key issues related to each facility type. This matrix will provide photos and illustrative plans and sections, and visualizations showing what the facility looks like and how it operates, describing costs and benefits, addressing climate and seasonal issues related to installation and operations, and noting where the facilities are most applicable. In addition, the matrix will include a summary of how the facilities should be maintained to keep them attractive and operational. The identification of green stormwater solutions now will assist the team and Task Force in identifying the appropriate green stormwater infrastructure solutions according to roadway typology in the Suitability Matrix to be completed in Phase B, Task 8.

This task will integrate design requirements reflected in and consistent with the performance requirements of the City Long Term Control Plan Update. We will also integrate the preliminary design guidelines of the City's Green Infrastructure Group of PWD. Where possible, the design criteria will address the appropriate "drain-down" rates for combined sewer areas of the City.

Task 7 Outcome:

- Green Stormwater Infrastructure Toolkit with narrative and illustrative description of the function, benefits, limitations, routine maintenance requirements, and cost of magnitude for each facility

Task 8a: Develop a Suitability Matrix

Developing a Suitability Matrix that carefully considers the context of Philadelphia streets is a critical part in the creation of the Design Manual. The Suitability Matrix is what will ultimately give project designers clear direction on which green stormwater infrastructure solution is most applicable to their projects.

To accomplish this, Task 8 will build upon Task 4c: Review and Integrate Roadway Facility Typology from the Complete Streets Design Manual Efforts and Task 7: Develop Green Stormwater Infrastructure Toolkit. The McCormick Taylor team will organize Philadelphia street typologies based on both its transportation function, as well as its land use context. For example there may be categories such as an Urban Residential Arterial, a category that describes both PennDOT's or the City's, if applicable, transportation function, as well as the type of character of the land uses along the

street. Within each category there will be physical and environmental parameters that will further describe the condition of the street. A partial list of these parameters includes:

- Width of right-of-way;
- Number of lanes;
- Design speed;
- Access controls;
- Presence and width of sidewalks and/or bike lanes;
- Presence of a parking lane;
- Elevation of road relative to the adjacent land (is at grade or in a cut/fill condition);
- Utility placement; and
- Existing trees and vegetation.

Once the Philadelphia street typologies are cataloged, the Green Stormwater Infrastructure Toolkit will be itemized. The Suitability Matrix will clearly illustrate which green stormwater infrastructure strategies should be considered for each street typology. In the same matrix, or referenced therein, some of the advantages and considerations for each strategy within that street typology will be described. Considerations that may effect the facility type chosen include:

- Size of drainage area;
- Location and depth of utility lines;
- Slope of roadway and adjacent areas;
- Soil permeability;
- Presence of hazardous materials;
- Depth of water table; or
- Existing property features such as signs, bus shelters, planters, etc.

Furthermore, the Suitability Matrix will also summarize maintenance considerations both short- and long-term to ensure all parties have a full understanding of how to keep these facilities sustainably functional. The maintenance considerations will identify the routine activities necessary on an annual basis, any expected long-term maintenance activities, as well as a cost estimate or manhour estimate if volunteers will used.

We recognize that this Suitability Matrix should be easy to comprehend and have a strong visual element to enable its legibility. For example, street typologies may be listed on the X-axis of the matrix and the Green Stormwater Infrastructure Toolkit may be listed on the Y-axis of the matrix with check marks in the applicable cross entries. Diagrams or illustrative drawings may be incorporated as well if it would improve its legibility.

Task 8a Outcome:

- A matrix identifying which green stormwater infrastructure solution is applicable to typical Philadelphia street typologies

Task 8b:Summary of Design Criteria, Calculations and Methods

The practical application of specific stormwater designs and design requirements will require considerable details for the Design Manual user. Since the purpose of the manual is to maximize the designer's understanding of what is required for a range of conditions and situations, we will develop applicability guidance materials. The applicability of requirements could easily be summarized in a table similar to Table 2.2 in the City's Stormwater Management Guidance Manual. The applicability table will summarize design criteria, calculation methods, permit requirements and other variables for the user.

Task 8c: Innovative Designs

As Green Infrastructure strategies continue to be tested throughout Philadelphia and the rest of the world, our understanding of stormwater solutions in urban settings will grow. Through lessons learned, experts in this field will have increased data on why and where some strategies work and other strategies fail, both in terms of their function, as well as in terms of the solution's community quality of life value. To continue to improve the function of green stormwater infrastructure, standards will need to continually evolve to be more effective and new strategies that are, as of yet, unknown will need to be adopted. New innovative strategies that may prove to be effective and test current procedures so that the amount and effectiveness of green infrastructure strategies expand will need to be piloted.

To enhance the relationship between green stormwater solutions and their context, solutions can and should be designed in ways that utilize materials and rainwater as an amenity. For example, the conveyance of water from one place to another can be done artfully either by creating small, naturalized rivulets or by using an artfully cut, trench drain arranged in a signature pattern on the ground plane. Large boulders intended to be used as a protective barrier or to direct or slow water can also double as seating in a community context. Opportunities to implement green stormwater solutions in ways that surprise, educate, relax, perplex, and tantalize the senses should be encouraged.

We will identify ways in which stormwater designers can use the standards outlined in the Manual in ways that fit in with, and enhance, the community context. We will also document the strategies that are, at the time of the preparation of the manual, considered to be innovative strategies for the City and its agencies and outline how they can begin to pilot them through demonstration projects.

Task 8c Outcomes:

- Narrative and graphic summary of artful stormwater solutions locally and nationally
- List of contextual setting questions for designers to consider ways in which green stormwater solutions can enhance and serve community quality of life
- Outline of innovate design approaches to consider exploring and the ways in which they can begin to be piloted

Phase C: Draft Design Manual

Task 9a: Project Selection Criteria

Removed from scope as requested

Task 9b: Regulatory Process Procedures

This task will define and document specific changes to streamline the review, permitting and approval process. Recommendations will address actions of multiple agencies and relate to City regulations such as zoning, licensing, subdivision and land development ordinances, as well as state agencies such as PennDOT's manuals and standards. A goal will be to cross-reference some of the regulatory processes and avoid countering existing, or future regulations.

Task 9b Outcome:

- Narrative summary and matrix or table including specific recommendations to improve and streamline the permitting process and coordination methods.

Task 9c: Design Standards and Specifications

We recognize a great need to implement green street policy and implementation to set reproducible design and construction standards. However, doing this successfully has proven to be difficult for many other cities that have already established green infrastructure policies because the standards often imply too much rigidity.

Implementing successful green street design standards involves several key factors: 1) provide design details to reflect the street type (residential, commercial, arterial, etc.) and a variety of design tools (pervious paving, swales, planters, rain gardens, curb extensions, green gutters, etc.); 2) coordinate the green street design standards to foster innovation in design solutions; 3) provide the ability to update design standards; 4) identify design elements or design situations that need to be rigid and which need to be more flexible; 5) allow for collaboration between engineers and landscape architects in the formulation of the design standards; and 6) keep the design standards simple and easy to interpret.

During Task 9c, the McCormick Taylor team will prepare design standards and specifications that apply green infrastructure solutions and adapt them as needed to particular Philadelphia street typologies. Utilizing the Roadway Facility Typology Matrix, Green Infrastructure Toolkit, and Suitability Matrix Developed in Phases A and B will ensure that the design standards and specifications respond to the specific street type and utilize a variety of green stormwater infrastructure design strategies. As part of Task 9c, the design standards will be detailed by an interdisciplinary design team, and will be easy to interpret.

Our team engineers are experienced in preparing design specifications for both PennDOT and the City. We are familiar with the present standards related to both roadway and stormwater management and will utilize that experience to create design specifications for the Task Force.

The specifications will be in a familiar format and design language so that the associated agencies feel comfortable utilizing the new standards.

The new green stormwater design standards and specifications will build on and/or reference local, City, state and Federal guidelines such as:

- The City of Philadelphia Stormwater Management Guidance Manual Version 2.0
- The Pennsylvania Stormwater Best Management Practices Manual
- National Pollutant Discharge Elimination System
- A Triple Bottom Line Assessment of Traditional and Green Infrastructure Options for Controlling CSO Events in Philadelphia's Watersheds
- EPA's Guidance Manual for Implementing Municipal Stormwater Management
- EPA stormwater manual
- Philadelphia's/PWD's pilot project details
- National Best Practices)

Pre-final design specifications will be developed for the facilities contained in the Green Stormwater Infrastructure toolkit and categorized in the Suitability Matrix. For the purposes of this proposal it is assumed that specifications will be provided for twenty (20) individual types of green infrastructure facilities.

The design standards will be developed to provide general guidance and applicability to all the selected facility types. The design standards will serve as a reference supplement to the facility details and specifications in order to provide minimum criteria for design and construction and to describe the global intent and spirit for the implementation of green stormwater facilities. For the purposes of the proposal it is assumed that the design standards will be incorporated into the pre-final specifications document under its own heading.

Task 9c Outcomes:

- Design standards in printed and MicroStation and/or PDF format
- Design specifications in printed and electronic Microsoft Word format

Task 9d: Operations and Maintenance Issues

It is our understanding that a new manual for maintenance and operations of City stormwater facilities is currently under development with PWD. To avoid any duplication of effort, our role will focus on review and coordination activities. If directed, we will conduct a review of the prescribed maintenance procedures and specifications in the Draft M and O Manual. This review will allow us to incorporate our experience regarding proper maintenance and operation practices and protocols. We will identify any issues and offer suggestions to maximize the success and minimize costs associated with maintaining green stormwater infrastructure. We will meet and coordinate as directed with the City staff and their consultants to provide helpful and constructive input.

Task 9d Outcome:

- Review comments regarding the short-, medium-, and long-term practices and procedures outlined in the Draft M and O Manual.

Task 9e: Development of Online Tool for Agency Coordination and Project Data Sharing

In coordination with the Task Force, we will develop an on-line database/tool to house pertinent green streets program and project related data. This tool will allow agency users to share project designs, specifications, performance data, current status and other information to facilitate projects from concept development to construction. This tool could facilitate project selection, prioritization, review, and approval status and allow the review and monitoring of projects in place. The database could also have the ability to rank potential projects based on variable performance criteria considering factors such as: cost, need, benefit, feasibility, and community support. Those projects most consistent with the criteria could then be prioritized for implementation.

This electronic, web-based coordination tool can be developed with a password protected access for easy, real-time coordination by multiple parties. This will help facilitate open communication and information sharing among MOTU, Streets Department, PWD and other agencies and stakeholders. McCormick Taylor has experience in developing similar databases, including the Environmental Monitors Toolkit and the McCormick Taylor Project Portal.

Task 9e Outcome:

- Online, password-protected database/tool containing program and project related data

Task 10a: Preliminary Draft Design Manual

Task 10a: Preliminary Draft Design Manual will consist of incorporating the outcomes from Tasks 1 through 9e, as well as any additional information needed to complete the Design Manual in a format that is logically presented and user-friendly. The Manual will define, up front, the definition of projects to which the Manual applies. Our experience shows that graphic representation of what is being described enriches the content and provides clarity where words may not—a picture is worth a thousand words. The Draft Manual will include many illustrative plans, cross-sections and sketches that will illustrate what is being recommended. Photos of real life examples will be used throughout the document to convey what is being described.

Task 10a Outcome:

- Printed and electronic PDF files of the Draft Design Manual. Editable design files, in Adobe InDesign, or other agreed upon format, may also be provided to the client as desired.

Task 10b: Green Streets Design Charettes

During the development of the Draft Manual the McCormick Taylor team will conduct up to three design charettes. These charettes offer the opportunity to "put the Design Manual to the test" before it is released as a draft. These design charettes are anticipated to include staff of City agencies, their consultants and appropriate stakeholders and could also include regulatory agencies, engineers and contractors. It is anticipated that one charette will be conducted with PWD leadership, one with Streets leadership and one yet to be determined.

After a brief overview of the Design Manual, participants will be asked to work through the design of green stormwater infrastructure projects by using the Design Manual. Participants will identify the Roadway Facility Typology, utilize the Suitability Matrix to identify appropriate green infrastructure solutions, discuss the Design Standards and Specifications that may be utilized, prioritize the relative significance of the project, consider the Maintenance and Operations Requirements, determine the Performance Measures, and discuss the project's permitting process and agency involvement. The McCormick Taylor team will facilitate this hands-on, inclusionary discussion, while sketching out design alternatives.

The process of using the Design Manual in such a practical application with the Task Force will reveal whether the Design Manual meets the stated Goals and Objectives, if the design criteria and information is presented in a logical and clear manner, and if the content is complete and accurate.

Task 10b Outcome:

- A summary of the Manual Field Trial Charette discussions, including suggested revisions to the Preliminary Draft Design Manual and all associated graphics produced at the Charettes

Task 11: Final Draft Design Manual

Following the Task Force meeting to review the Preliminary Draft Manual, the McCormick Taylor team will make any necessary revisions determined by the Task Force members to develop and submit the Final Draft Design Manual.

Task 11 Outcome:

- Printed and electronic PDF files of the Final Draft Design Manual. Editable design files, in Adobe InDesign or other agreed upon format, may also be provided to the client as desired.

Phase D: Final Design Manual

Task 12: Final Design Manual

Following the completion of the review period at the end of Phase C, the McCormick Taylor team will revise the Draft Design Manual as directed by the Task Force and prepare a Final Design Manual. The delivery of the Final documents to the PWD Project Manager will complete the proposed Scope of Work for the McCormick Taylor team.

Task 12 Outcome:

- Printed and electronic PDF files of the Final Design Manual. Editable design files, in Adobe InDesign or other agreed upon format, may also be provided to the client as desired.

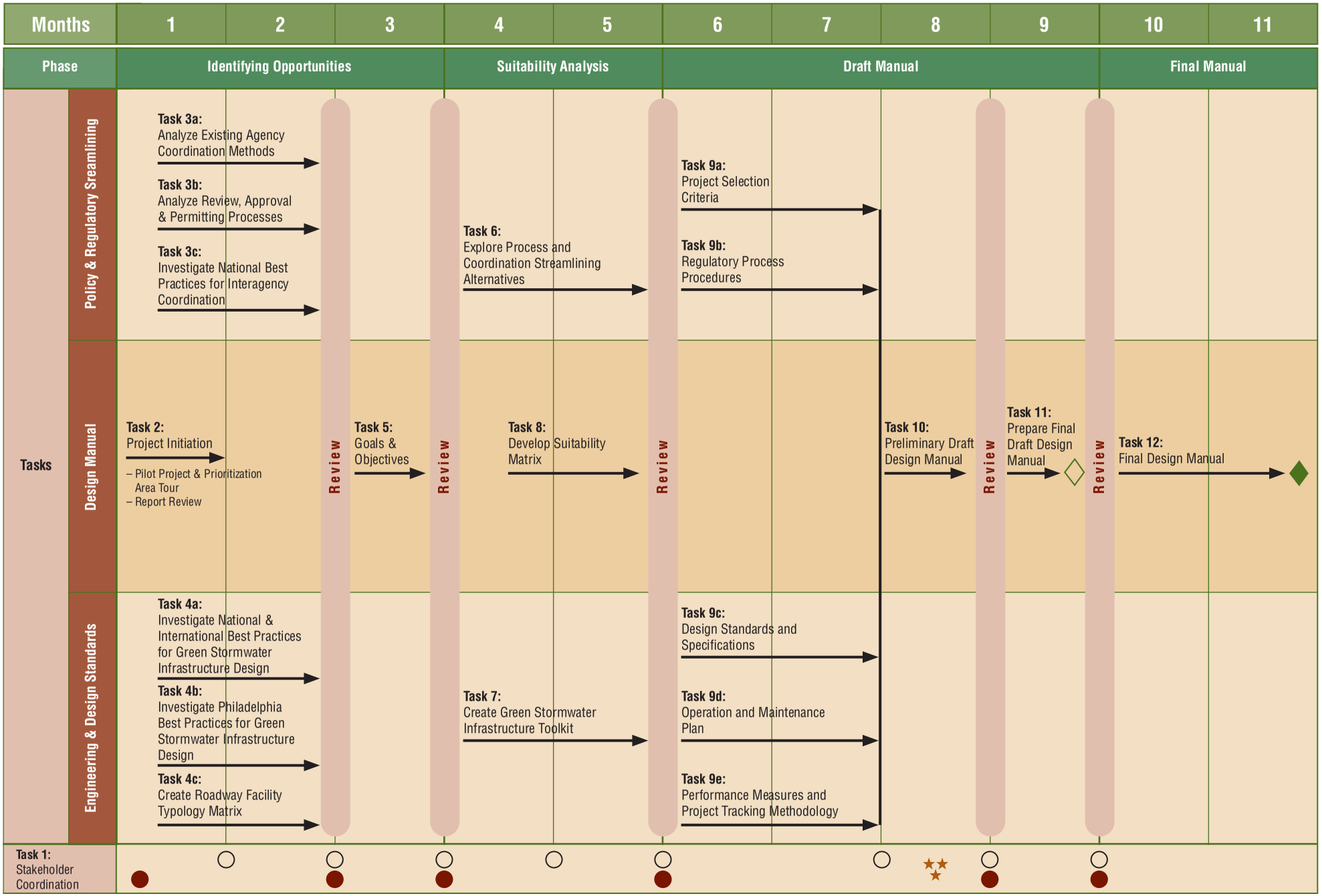
Task 13: Project Management

This task includes the team management and coordination activities over the duration of the contract. It also includes management communications such as telephone and e-mail contacts with the PWD and City partner agencies. Coordination meetings described in Task 1 are not part of the Management Task. Other project management tasks are related to on-going project schedule and budget management efforts as well as review of products and deliverables. Monthly progress reports will be prepared and submitted with invoices.

McCormick Taylor
Engineers & Planners Since 1946

Work Program Schedule

Design Manual for Green Stormwater Infrastructure in Philadelphia Streets



Appendix III

Interagency Opportunities and Analysis

Interagency Opportunities and Analysis:

Recommendations for Streamlining Implementation of *Green City, Clean Waters*

Table of Contents

INVENTORY OF *GREEN CITY, CLEAN WATERS* COMPLEMENTARY INITIATIVES

What follows is a compendium of initiatives assembled in the summer of 2011 and evaluated by the Philadelphia Water Department for applicability, potential leveragability, coordination, collaboration and implementation opportunity as the *Green City, Clean Waters* program is implemented. Each initiative includes a summary of the time frame, lead organization, connection to *Green City, Clean Waters,* and recommendations for the Water Department role in seeking potential opportunities.

CITY OF PHILADELPHIA INITIATIVES

Philadelphia Department of Parks and Recreation

Green2015: An Action Plan for the First 500 Acres www.phila.gov/green/greenworks/

Time Frame: 2010-2015
Led by: Philadelphia Parks and Recreation
Connection to *Green City, Clean Waters*: This plan outlines how PPR could meet the *Greenworks* goal of increasing public park and recreation resources and includes green stormwater infrastructure recommendations.
The Water Department's Role: The Water Department will continue to be involved to ensure that proper stormwater management and environmental education opportunities are maximized during park and school greening. The responsibilities of design and construction will be clarified in a MOU.

The plan promotes several stormwater management practices that are complementary to the Water Department's green stormwater infrastructure goals:

- Some of the priorities for new green space are located in a CSO sewershed and have high impervious cover and low tree cover
- The plan recognizes that new park development can incorporate environmental benefits by using green stormwater infrastructure
- The plan provides recommendations for green stormwater infrastructure design principles that can also simplify park maintenance

Philadelphia Parks & Recreation Master Planning www.phila.gov/recreation/

Time Frame: Ongoing, varies by project
Connection to *Green City, Clean Waters*: The PPR manages all park space and park and street trees in the City of Philadelphia. PPR also engages in park planning and often includes stormwater management measures in these plans.
The Water Department's Role: The Water Department will work with PPR on waterfront and park development projects to ensure that stormwater management and Greened Acre creation opportunities are maximized.

PPR is actively engaging in master planning and renovations of several major parks around the City, many with sustainable water management aspects. One component of their strategic direction and mission is "to value and enhance our resources."[2]

Centennial District Master Plan

This 2005 plan looks at how to link the West Philadelphia community to the park and revitalize the underused section named after the original grounds of the Centennial Exhibition. The goal of the plan is to create a guidance planning document to create a unified destination. A second goal is "restoration and enhancement of the natural and man-made water elements throughout the park." The plan also calls for improved parking, fewer roads and increased

[2] http://www.phila.gov/recreation/Mission_Statement.html

connections between neighborhoods and parks.[4] One of the first neighborhood districts to be analyzed in the second phase of the Philadelphia2035 Comprehensive Plan process is Park West which includes this neighborhood. A flyer advertising the first community meeting indicated that they will consider any current or proposed improvements to the Centennial District in their planning analysis.[5]

Penn Treaty Park Master Plan

Time Frame: Master Plan and designs published in 2009
Led by: Philadelphia Department of Parks and Recreation
Connection to *Green City, Clean Waters*: The Master Plan for this seven-acre waterfront park incorporates green stormwater infrastructure systems that could potentially manage adjacent road runoff and ultimately allow the park area to be disconnected from the storm sewer system.
The Water Department's Role: Support the implementation of the plan and provide design and monitoring assistance as needed.

PPR and the Friends of Penn Treaty Park group commissioned the creation of a master plan for the site which was completed in 2009. The master plan is meant to represent an early-action project to develop community support and input for the waterfront development process.

The Master Plan ultimately presented three schemes for public evaluation. All three schemes incorporated green stormwater infrastructure systems which could potentially manage adjacent road runoff and ultimately allow the park area to be disconnected from the storm sewer system. Some of the elements used include stormwater treatment rain gardens, cap and seal roadside catch basins, trench drains allowing stormwater to enter planted medians and flow-through planters, and a swale with check dams to promote infiltration.[6] The impementaiton of this Master Plan for Penn Treaty Park is supported by both the "Action Plan for the Central Delaware" and the "Master Plan for the Central Delaware."

Master Plan for Philadelphia Skateboarding

Time Frame: First phase complete in 2011; Second phase ongoing
Led by: PPR and the Franklin's Paine Skate Park Fund
Connection to *Green City, Clean Waters*: Opportunities include the ability to incorporate stormwater management into skate park designs that adaptively reuse vacant or underutilized properties.
The Water Department's Role: The Water Department could evaluate the potential to leverage opportunities to garner greened acres and provide design and monitoring assistance as needed.

Franklin's Paine Skate Park Fund announced in May 2011 that they have been commissioned by the PPR to create a Master Plan for Philadelphia Skateboarding.[7] The first phase, evaluating possible skate park locations in West and Southwest Philadelphia, has already been completed. Franklin's Paine has completed several skate park projects around the city and has shown a strong interest in adaptive reuse of underutilized urban spaces and on-site stormwater management within their designs (see Nicetown Skate Park for a good example).

[4] http://www.eastparkside.org/centennial_district.pdf
[5] http://phila2035.org/wp-content/uploads/2011/06/flyerWP2.pdf
[6] http://planphilly.com/sites/planphilly.com/files/Public%20presentation2%20.pdf
[7] http://www.franklinspaine.com/blog/master-plan-philadelphia-skateboarding-press-release

Philadelphia Planning Commission

Philadelphia2035 Comprehensive Plan
www.phila2035.org

Time Frame: 2011-2035

Connection to *Green City, Clean Waters*: Recommends establishing "greening" as a vacant land management strategy, creating and sustaining a city-wide network of green streets and sidewalks and establishing a standardized process and model for schoolyard greening.

The Water Department's Role: The Water Department is participating in the planning processes for the district plans initiated through the Phila2035 process seeking to leverage partner opportunities.

Figure 1: Philadelphia 2035 District Planning source: phila2035.org/home-page/district/

Phase 1: City-Wide Vision Planning Process

The first phase of Philadelphia2035, a City-Wide Vision, was completed in June of 2011. All three themes developed by the PCPC to guide the planning process for the *Philadelphia2035 Comprehensive Plan* are in line with *Green City, Clean Waters*. In particular the "Renew" theme with a focus on stream valleys, parks, waterfronts, trails, tree cover and stormwater management will help to further the goals of *Green City, Clean Waters*.

Some of the *Philadelphia2035* recommendations relevant to the Water Department's *Green City, Clean Waters* program include:

- Establish "greening" as a vacant land management strategy
- Create and sustain a city-wide network of green streets and sidewalks
- Establish a standardized process and model for schoolyard greening
- Coordinate utility and streets improvement projects with green streets retrofits
- Create neighborhood paths of historic stream corridors
- Increase overall tree canopy to 30%
- Beautify alleyways with green stormwater infrastructure
- Implement water conservation measures

Phase 2: Neighborhood Planning Process

The second phase of *Philadelphia2035* involves 18 individual neighborhood plans. Four district plans will be completed each year until all 18 plans are completed (Figure 1). Each completed district plan will include a healthy community analysis, a city facilities analysis, an analysis of vacant and underutilized land, multiple urban design studies and a proposed land use map which will help guide a city-wide zoning re-mapping process.

A preliminary analysis of the key issues identified by the Planning Commission for each neighborhood district shows that they recognize bike and pedestrian needs and open space and waterfront access needs. PCPC is also interested in promoting green business and adaptive reuse of vacant or underutilized industrial sites.

2012-2017 Recommended Capital Program Budget

www.philaplanning.org/plans/rcpgm12.pdf

Time Frame: 2012-2017
Led by: Philadelphia City Planning Commission
Connection to *Green City, Clean Waters*: The City's Capital Program Budget establishes the list of projects and priorities for capital funding. The 2012-2017 Budget lists an overall goal of making Philadelphia the greenest city by 2015, and provides funding for street trees, open space and greening projects, and waterfront development.
The Water Department's Role: Coordinate capital project implementation priorities with fellow City agencies in order to prioritize them within the Capital Program Budget

The recommended capital program budget drafted by PCPC incorporates funding for several different green stormwater infrastructure programs and initiatives including those outlined in both *Green2015* and *GreenPlan*.

- $3.5 million in new city funding is recommended for PPR and the Managing Director's Office to plant park and street trees (goal of planting 6,000 street trees is mentioned elsewhere in the budget) and to implement other projects to advance *Green2015 reco*mmendations
- Funding to implement *GreenPlan* initiatives including open space and greening projects
- Funding to advance waterfront development, play area improvements and Ben Franklin Parkway pedestrian improvements which all present opportunities for incorporation of green stormwater infrastructure
- Funding for the design and construction of a new public green at Dilworth Plaza is recommended in the budget. The most recent plan for the Dilworth Plaza redevelopment includes measures to manage stormwater on-site and decrease the total impervious area of the plaza.

Philadelphia Zoning Code Commission

City of Philadelphia Zoning Code Update www.zoningmatters.org

Time Frame: Initially projected to be signed into law by the end of 2011, however the schedule may be delayed.
Led by: Philadelphia Zoning Code Commission
Connection to *Green City, Clean Waters*: Recommendations follow an overall goal of promoting sustainability based on the *Greenworks Philadelphia* framework that has been established.
The Water Department's Role: The Water Department should continue to monitor the progress as the ZCC presents its recommendations to the City Council and make sure any concerns are addressed in a timely manner.

This update represents the first major update to Philadelphia's Comprehensive Plan since 1962 and will modernize and streamline the zoning code. Years of ad hoc changes have resulted in a lengthy (640+ pages) and complex code. As approved by voters in the May 2007 Primary, the Zoning Code Commission (ZCC) was created to reform and modernize Philadelphia's Zoning Code. A guideline to promote sustainability based on the *Greenworks Philadelphia* framework has been established.

Proposed changes that encourage green stormwater infrastructure include:[8]

§14-101 (2) (b): The purpose of the zoning code is to "promote sustainable and environmentally responsible practices" including to "encourage water conservation" in support of the City's sustainability goals as laid out in Greenworks Philadelphia.

§14-203 Definitions: The new definition for (.97) Directly Connected Impervious Surface is: "An impervious or impermeable surface, which is directly connected to the City's drainage system, as defined by the Philadelphia Water Department."

§14-301 (10): The Water Department's scope of review was expanded from "stormwater impacts" to "stormwater runoff, erosion and sedimentation impacts." Rather than explicitly stating which districts the Water Department can help review, it is implied that PCPC will reach out to the Water Department as appropriate when master plans are under review for special purpose districts.

§14-306 Enforcement: There is new language that better-enables the Water Department to inspect stormwater systems to determine compliance.

§14-506 /CDO, Central Delaware Riverfront Overlay District: This section is reserved for anticipated zoning standards that will be adopted as part of the Master Plan for the Central Delaware once it is adopted by PCPC. The final Master Plan for the Central Delaware has many elements supporting the incorporation of green stormwater management into new development along the riverfront.

§14-507 /DRC, Delaware River Conservation Overlay District: This is a new overlay district created to promote and protect a system of parks and trails along the North Delaware River called the 'Delaware River Greenway." One of the permitted uses in this district is "recreation trails, which must conform to any design regulations adopted by the Commission." This presents an opportunity for the Water Department to work with the Commission to ensure recreational trail standards incorporate green stormwater management.

§14-606 (4): States that vegetation (including trees) is required on 10% of new parking lots over 5,000 sq. ft. with additional recommendations and allowances for bioretention systems and curb cuts or curb elimination.

§14-705 Open Space and Natural Resources:

(2) Steep Slope Protection: Protection criteria was expanded to slopes greater than 15% city-wide, following PCPC's new "Philadelphia Steep Slopes Map".

(3) Stormwater Management: This section refers to stormwater regulations rather than listing individual triggers.

(5) Stream Buffers: The buffer width was increased from 25 to 50 feet. The stream buffer applicability requirements are expanded to include lots located along watercourses listed on the Water Department's Hydrology Map, rather than listing individual streams. New text prohibits "any other directly connected impervious surface", allowing for the development of riverfront trail systems and other forms of public access to Philadelphia's water resources.

§14-706 Landscape and Trees: Certification of the landscape plan is now required. Text requiring landscaped areas to include plants from Philadelphia Parks and Recreation's low-water species list is added.

[8] http://zoningmatters.org/files/Preliminary%20Report.PUBLIC.pdf

§14-803 Motor Vehicle Parking Standards: New standards allow for use of pervious paving material and required use of pervious paving material if more than 20 spaces beyond the minimum off-street parking requirement are provided along with a cross-reference to the Philadelphia Stormwater Management Guidance Manual. The new code reduces the number of required parking spaces for certain land classes, such as shopping centers, and places a maximum on the number of spaces for all parking lots. The code also requires parking lots to be included in landscape area plans, which incorporate stormwater management design.

Many of these proposed zoning changes could have the potential to promote the creation of Greened Acres by local private interests and developments.

The creation of the zoning code proposed changes has taken many years but legislation and hearings in the summer of 2011 are moving the process towards implementation. On May 11, 2011, the ZCC adopted its *Preliminary Report*. Then on June 2 the City Council passed Resolution No. 110459 authorizing the Committee of the Whole to review the ZCC's *Zoning Code Proposals*. The City Council then began its hearings on the Zoning Code Commissions proposals on June 15, 2011.[9]

Philadelphia Streets Department www.phila.gov/streets

The Water Department is working on several initiatives with the Streets Department to align standards and specifications with the Philadelphia Streets Department to make Green Streets an accepted widespread practice throughout the City of Philadelphia.

Connection to *Green City, Clean Waters*: Alignment with a city-wide goal of creating a network of green streets and sidewalks.

The Water Department's Role: Coordination with participation in partnerships that will work towards clarifying maintenance responsibilities, evaluate street sweeping policy to reduce trash, debris and sediments, and to maximize greened acres in the public streets.

Green Streets Design Manual www.phila.gov/green/greenworks/equity_Stormwater

Time Frame: To be completed in 2012

Led by: Philadelphia Water Department and Streets Department

Connection to *Green City, Clean Waters*: Will create consensus on design specifications and details for green streets to ensure efficient application of green streets principles to any new street infrastructure projects.

The Water Department's Role: Continue to work with the Streets Department to complete this manual in a timely manner.

Streets and sidewalks are by far the single largest category of public impervious cover, accounting for roughly 38% of the impervious cover within the combined sewer service area of Philadelphia.[10] The goal of this manual is to develop a consensus on design specifications and standard details for green streets, to create a design manual for green stormwater infrastructure in Philadelphia streets and to identify opportunities to optimize and streamline interagency coordination for the inclusion of green stormwater infrastructure into the city's capital projects for street work.

Street Improvements for Stormwater Management Ordinance legislation.phila.gov/attachments/9724.pdf

In December of 2009, the City Council passed Bill No. 090749 to revise the method by which the Board of Surveyors may approve supplemental plans relocating the curb lines and changing the roadway widths of streets. The revisions allow for improved stormwater management to be a valid reason to relocate curb lines and decrease roadway width provided that the changes will maintain traffic safety, provide sufficient sidewalk widths for pedestrian usage.

[9] http://zoningmatters.org

[10] Note: impervious cover associated with streets and sidewalks in front of parks was not included in this percentage; these areas are included in the Green Public Open Space program.

Complete Streets Policy
www.phila.gov/executive_orders/pdfs/executive%20orders/10.%20Mayor%20Nutter/2009/EO_509_Complete_Streets.PDF

In June of 2009, Mayor Nutter signed Executive Order No. 5-09, the first city-level policy in Pennsylvania related to complete streets. The executive order calls for Philadelphia's streets to balance the needs of all users by encouraging City agencies to consider safety and needs of *all* users when designing or retrofitting streets and sidewalks. A related plan, the Philadelphia Pedestrian and Bike Plan, acknowledges the synergies between increased street landscaping and increased pedestrian and bicycle safety. The plan encourages that implementation of bicycle and pedestrian safety measures and new bike trails be aligned with the implementation of the Water Department's *Green City, Clean Waters*.

Mayor's office of Sustainability Initiatives

Mayor's Office of Sustainability Initiatives and City Council Ordinances
www.phila.gov/green

Connection to *Green City, Clean Waters*: Many MOS initiatives are supportive of *Green City, Clean Waters*, especially the Green Roof Tax Credit and the Green Streets Design Manual.
The Water Department's Role: The Water Department should continue to collaborate with the existing MOS programs and the creation of new initiatives that may encourage program implementation.

Greenworks Philadelphia — www.phila.gov/green/greenworks/

Time Frame: 2009-2015
Led by: the Mayor's Office of Sustainability
Connection to *Green City, Clean Waters*: Sets targets for stormwater management to meet Federal standards and sets a citywide priority for increasing tree coverage and parks resources.
The Water Department's Role: The Water Department's main role and responsibility is to achieve Target 8: Manage Stormwater to Meet Federal Standards through its *Green City, Clean Waters* program but it may be able to support other *Greenworks* programs such as green streets, parks creation and tree planting, as needed.

In April 2009, the City launched *Greenworks Philadelphia*, an action plan focused on Energy, Environment, Equity, Economy, and Engagement with ambitious targets to be addressed within the next few years to make Philadelphia the greenest city in the country by 2015. Commitments from the *Greenworks* plan will contribute to a wide range of city programs with an emphasis on greening that support energy efficiency, stormwater management and increase triple bottom line benefits. The *2011 Greenworks Progress Report* states that 135 of 151 *Greenworks* initiatives are in progress or complete[11] including initiatives within the relevant targets:

- **Target 8: Manage Stormwater to Meet Federal Standards** supported by the *Green City, Clean Waters* program
- **Target 11: Increase Tree Coverage Toward 30% in All Neighborhoods by 2025** due to the City-commissioned report on existing and possible tree canopy and support PPR and PHS tree stewardship programs and tree give-a-ways.

Retrofit Ramp-up — energyworksnow.com

The Mayor's Retrofit Ramp-Up program has created a new initiative "Energy Works." A $12 million grant has gone to the Greenworks Loan Fund which provides low-interest loans to commercial projects that incorporate significant energy efficiency measures. Efficient water systems are considered with these criteria, aligning with the Water Department's goal of maximizing combined sewer system capacity.

[11] http://www.phila.gov/green/PDFs/Greenworks_PrgrssRprt_2011.pdf

Cool Roof Bill — legislation.phila.gov/attachments/10096.pdf

On April 22, 2011, City Council passed Bill No. 090023 requiring all new commercial and residential construction with low or no slope roofs to use highly reflective roofing materials that meet or exceed Energy Star cool roof standards. Vegetated roofs, roofs used for recreation, roofs used for solar power production or roofs with an area of less than 3% of the gross floor area are exempt from this rule. Therefore, there is an indirect incentive to create vegetated roofs, especially when combined with the green roof tax credit.

Green Philly, Grow Philly — www.phila.gov/green/greenworks

Time Frame: 2010-2015
Led by: Mayor's Office of Sustainability
Connection to *Green City, Clean Waters*: This program supports tree planting along public streets, in riparian zones and on public lands near municipal and neighborhood parks.
The Water Department's Role: The Water Department should partner with MOS to ensure that any new street trees planted maximize both tree survival and stormwater benefits.

"Green Philly, Grow Philly" is a comprehensive tree planting campaign that serves as a model for tree planting and stewardship in support of achieving the 300,000 trees by 2015 goal of *Greenworks*. Trees will be planted along public streets, in riparian buffer zones, and on public lands near municipal and neighborhood parks.

The Mayor's Office of Sustainability (MOS) offers free Tree Planting Request Forms and Tree Maintenance Service Request Forms[12]. The forms must be submitted by the adjacent property owner and PPR would do the actual planting and maintenance work. The MOS website highlights the fact that §14-2104 (13) of the Philadelphia Code requires that street trees be planted in all residential and apartment house subdivisions and offers guidelines for builders.

Green Roof Tax Credit — dvgbc.org/files/Green_Roof_Tax_Credit.pdf

On March 29, 2007, City Council passed Bill No. 070072 which provides for a 25% tax credit (up to $100,000) of all costs actually incurred in the construction of a green roof.

LEED Certification of Public Buildings — legislation.phila.gov/attachments/9704.pdf

In December of 2009, Mayor Nutter signed Bill No. 080025 requiring that all city-owned new construction and major rehabilitation projects over 10,000 square feet meet the criteria for the LEED silver rating.

Philadelphia Department of Licenses & Inspections

Green Building Guide — http://www.phila.gov/green/greenBuilding.html

In 2009, the Philadelphia Department of Licenses and Inspections began the process of developing a "guide for green construction projects", listing special processes for things like solar panels and green roofs. The guide has not yet been published as of July 2011.

Green Program Manager

In 2009, the Philadelphia Department of Licenses and Inspections created a position to serve as the City's green building program manager to serve as a resource to developers and residents who are interested in green building, conduct outreach to outside stakeholders - such as the local chapter of the USGBC and a number of private developers. The actual components of the program are focused on improving the permitting and development process for entities that want to build green in the city. This staff position and the Green Building Guide will seek to streamline some permitting procedures for things like solar panels, solar hot water heaters, and other types of Green Infrastructure.

[12] http://www.phila.gov/green/

Real Estate Tax Exemption for LEED Certified Buildings
legislation.phila.gov/attachments/6098.pdf

This bill, which is currently in the Committee on Finance, proposes an amendment to Chapter 19-1300 of the Philadelphia Code to allow for real estate tax exemptions for certain improvement to, or construction of, residential, commercial or other business properties that meet or exceed the high-performance building criteria of the LEED system, including energy and water efficiency standards.

Philadelphia Industrial Development Corporation

An Industrial Land & Market Strategy for the City of Philadelphia
www.pidc-pa.org/userfiles/file/PIMLUS_Report_September_2010.pdf

Time Frame: 20 years

Connection to *Green City, Clean Waters*: Outlines a strategy for conscientious industry and industrial land development in Philadelphia including green industry and adaptive reuse of waterfront properties.

The Water Department's Role: The Water Department should work with PIDC to monitor any new businesses that wish to follow these guidelines. The Water Department's Green Businesses program could partner with any businesses or industries that develop in accordance with the recommendations outlined in this report to ensure on-site stormwater management and waterfront protection is incorporated into the sties and businesses plans.

This report, released by the Philadelphia Industrial Development Corporation (PIDC) in September of 2010, is meant to communicate a strategy for advancing conscientious industry and industrial land development in Philadelphia, especially in light of recent and proposed changes to Philadelphia's zoning code and master plan.

The report includes recommendations for zoning for modern industry, positioning industrial land for investment and strategies for green industry and workforce development.[13] The report's potential development design for the Port Richmond Rail Yard site includes stormwater infiltration, a 100-foot waterfront setback, a waterfront trail and public access to fishing and boating piers. The concept also includes reducing the need for surface parking on the site by ensuring adequate access to mass transit resources. Their analysis of the industrial areas around the lower Schuylkill River includes consideration of the location and future development of the Schuylkill Banks River Trail. These concepts show how industrial areas can incorporate sustainable water management practices and waterfront recreation opportunities. A section of the report was devoted to green industry including sustainable building, sustainable product development, and relating future industrial development to *Greenworks* goals and the Water Department's stormwater management incentives for industrial sites. The report also promotes infill development and adaptive reuse of historic industrial buildings.

www.pidc-pa.org/userfiles/file/PIMLUS_Report_September_2010.pdf

[13] http://www.pidc-pa.org/userfiles/file/PIMLUS_Report_September_2010.pdf

Stormwater Management Incentives Program (SMIP) www.pidc-pa.org/financing/

Time Frame: Ongoing program established in 2011
Led by: Philadelphia Industrial Development Corporation
Connection to *Green City, Clean Waters*: Provides financial tools and incentives for non-residential customers to construct on-site stormwater mitigation measures.
The Water Department's Role: Continue to work with PIDC to administer this and other stormwater management incentives and credits.

This program, which is managed by PIDC for the Water Department, provides financial tools to incentivize the implementation of green stormwater infrastructure. Funds are used to support the design and construction of stormwater mitigation measures on non-residential property. Loans shall be consistent with the payback period of the stormwater mitigation measure (up to 15 years).

As of June 2011, there have been three applicants to this program whose applications have either been accepted or are in the approval process. The Water Department predicts that the success of this program will continue to grow and will continue to track the use of this loan program. A grant program is also under development by PIDC and the Water Department, which will be used in combination with the loan program.

School District of Philadelphia

Time Frame: Ongoing, varies by project
Connection to *Green City, Clean Waters*: Many of the school greening projects completed so far under the District's "Campus Parks Initiative" include water efficiency and stormwater management measures such as rainwater harvesting and green roofs.
The Water Department's Role: This initiative and its success so far, reflect the City's commitment to greening its schoolyards and therefore a major opportunity for the Water Department to partner with the School District on future Green Schools projects.


www.gilmore-assoc.com/kensingtonhsmayornuttervisit/

Campus Parks Initiative

The Campus Parks Initiative was established in 2002 by then School District of Philadelphia CEO Paul Vallas to fund improvements to the exterior environments of Philadelphia's schools.[14] This initiative represents the City's strong commitment to greening its schoolyards and therefore a major opportunity for the Water Department to partner with the School District on future Green Schools programs.

- #### West Philadelphia High School
  The groundbreaking for the new high school was in November 2009 and the school is set to be completed and ready for students by September 2011. The new high school has been designed to meet LEED silver criteria including rainwater collection system to be used for non-potable uses, restoration of trees along Chestnut & 49th Streets and other sustainable landscape features.[15]

- #### MLK High School
  MLK High School was one of the first schools to be completed within the Campus Parks Initiative. Some of the green features of the site include an ecology study area, Mathematics and Sciences Garden, hydraulic pools, drainage interceptor swales and a horticultural garden.[16]

[14] http://cdesignc.org/p_2410_philadelphia.htm
[15] http://ucreview.com/school-district-of-philadelphia-celebrates-groundbreaking-for-new-west-phil-p1758-87.htm
[16] http://www.agcinfo.com/civil_site.htm

- ### Kensington Creative and Performing Arts School
  The Kensington Creative and Performing Arts School was featured in Mayor Nutter's *Greenworks Philadelphia 2011 Progress Report* in June 2011. The Water Department, in partnership with the School District of Philadelphia, was able to install green infrastructure elements such as porous pavement, underground detention and infiltration facilities, rain gardens, rain cisterns and green roofs covering 50% of the total roof area. The building earned a LEED Platinum certification.[17]

- ### Albert M. Greenfield School
  The sustainable transformation of the Albert M. Greenfield Elementary School schoolyard in Rittenhouse Square neighborhood is led by the community group "Greening Greenfield." Their design for the site to become a pilot project of schoolyard greening has been split into five phases. Ultimately, they would like to see the site naturally manage stormwater and offer other environmental education opportunities for the school's students. Sustainable water management features planned for the site include pervious pavement, rain gardens, tree planting and a green roof.[18]

Other Initiatives

Philadelphia Zoo — philadelphiazoo.org

Time Frame: ongoing
Led by: Philadelphia Zoo
Connection to *Green City, Clean Waters*: The Zoo's interest in sustainability may be used to develop a stormwater management plan for this 42 acres public site would create a great precedent for other City facilities.
The Water Department's Role: The Water Department should monitor the progress of this program and provide assistance as needed in both the planning and implementation stages.

The Philadelphia Zoo has committed to a sustainable future through "Footprints: On-Site Sustainability Initiatives" such as renewable energy certificates and water conservation goals. The Zoo's water conservation goals include the creation of a stormwater management plan, reuse of graywater through a rain barrel system, planting of native plants and installation of green roofs to help mitigate the urban heat island effect.

GreenPlan Philadelphia

Time Frame: N/A
Led by: N/A
Connection to *Green City, Clean Waters*: This plan identifies "green infrastructure" as the best approach to open space creation and management.
The Water Department's Role: Utilize data, insights and recommendations of this plan to help feed green infrastructure opportunities analysis.

This plan is meant to provide a long-term, sustainable roadmap for using, acquiring, developing, funding, and managing open space in our city's neighborhoods. *GreenPlan* identifies the "green infrastructure" approach to open space creation and management as complementary to multiple City initiatives. Additional open space provides opportunities to manage stormwater and potential for adding greened acres within the City.

GreenPlan Philadelphia was completed in 2009, but was not publicly released due to the release of *Greenworks Philadelphia* and the subsequent *Green2015* plan. However, the data collected and the recommendations outlined are included in the 2012-2017 Recommended Capital Program[19] and other city planning initiatives.

[17] http://www.phila.gov/green/PDFs/Greenworks_PrgrssRprt_2011.pdf
[18] http://www.greeninggreenfield.net/plan/17-planning-articles/37-article-nextsteps

PHILADELPHIA AREA WATERFRONT PLANNING INITIATIVES

Tidal Schuylkill River Master Plan — www.schuylkillbanks.org

Time Frame: Published in 2003
Led by: Schuylkill River Development Corporation (SRDC)
Connection to *Green City, Clean Waters*: The SRDC has been successful in implementing incremental projects to create a connected greenway along the banks of the Schuylkill River including landscaping and water quality studies.
The Water Department's Role: The Water Department should seek to collaborate with SRDC to identify potential stormwater management projects and track the greened acres accrued by new park projects. Design support, technical assistance, and other tools may be offered by the Water Department.

The Schuylkill River Development Corporation released a master plan for the Tidal Schuylkill River area in 2003.[20] Since then they have been very successful in implementing incremental projects to create a connected greenway along both the east and west banks of the lower Schuylkill River. The group works closely with the Navy Yard and the University City District to synthesize other development and gateway plans. In 2010, they implemented a composting restroom with a Coastal Zone Management (CZM) grant and additional support from the Rails-to-Trails Conservancy. This project is estimated to save more than 100,000 gallons of water each year.[21]

Grays Ferry Crescent Greenway

Previously a DuPont research facility, this park opened in May of 2011 providing a catalyst for the development of a greenway along the extent of the east bank of the Schuylkill. This park will eventually connect to a larger greenway but for now it is an important juncture and a model project of successful private development of open space. The park provides a 3,700 foot-long bicycle and pedestrian trail plus an additional 1,600 feet of walking trails. Lawns and other vegetation provide for multiple other recreational opportunities on the site.[22]

Connecting this small park/greenway to a larger proposed greenway may be delayed because some waterfront sections are under private ownership and will take time to resolve.

Philadelphia Navy Yard Master Plan — navyyard.org/userfiles/file/FinalReport.pdf

Time Frame: Published in 2004
Led by: Philadelphia Industrial Development Corporation
Connection to *Green City, Clean Waters*: This plan outlines how to reuse the formerly industrial site by creating more public space, adaptively reusing facilities and land and better integrating the site with the 2.5 miles of frontage along the Delaware River.
The Water Department's Role: Innovative stormwater projects on this high-profile, mixed-use development would serve as an important precedent for private development throughout the region and to raise the profile of green stormwater infrastructure in the context of green building.

The 2004 Navy Yard Master Plan is an update and extension of the 1994 Community Reuse Plan for the site. It builds on the principles already established for how to reuse the large formerly industrial site, create more public space and integrate the site better with the 2.5 miles of frontage along the Delaware River. Overall, the 2004 Master Plan outlines the desired development of 522 acres of the 1,000 acre site.[23]

This Master Plan incorporates and promotes stormwater best management practices including narrower streets to reduce runoff and a policy to size parking lots to include bioswales for stormwater retention and filtering. The Plan also recognizes that there are opportunities for stormwater management to be combined with passive recreation water amenities. The open space plan section includes a proposal for pervious open space that will allow for natural water infiltration.

[20] http://www.schuylkillbanks.org/sites/72.27.230.230/files/SRDC%20Master%20Plan.pdf
[21] http://www.schuylkillbanks.org/projects/composting-restroom
[22] http://www.schuylkillbanks.org/projects/grays-ferry-crescent
[23] http://www.ramsa.com/projects-search/planning/philadelphia.html

Recent Updates

- 2007: Broad Street Line Extension Feasibility Study to extend the Broad Street Line to service the Navy Yard
- 2008: PIDC announced the development of a solar energy center
- PIDC recommends that new construction meet LEED certification
- Many large businesses are implementing adaptive reuse principles when creating their office and manufacturing spaces in the Navy Yard (e.g. Urban Outfitters).

Diagonal Boulevard

The Master Plan included the creation of "a new landscaped boulevard placed at a diagonal to the existing street grid connecting the Navy Yard's historic entrance at Broad Street to a new 250 slip marina, a centrally located focal point on the Delaware River. Along the diagonal boulevard is a 1.4 million square foot corporate center development with nine buildings from three to five stories high."[24] Construction of this site has commenced and includes streetscape improvements that will manage stormwater runoff from the road and the adjacent (current and planned) buildings. The green street elements incorporated in the design include stormwater tree trenches, curb cuts and rain gardens.[25] The Broad Street Line extension will some day run underneath the Diagonal Boulevard. Overall this is an example of a successful, privately-developed green street system.

Civic Vision and Action Plan for the Central Delaware www.planphilly.com

Time Frame: Published in 2006
Led by: Central Delaware Advocacy Group and PennPraxis
Connection to *Green City, Clean Waters*: This community based vision for waterfront development laid the groundwork for DRWC's Master Plan for the Central Delaware. The plan encourages waterfront owners to dedicate land for parks, create green space and a waterfront setback.
The Water Department's Role: The Water Department will seek opportunities to leverage project implementation.

Starting in 2006, Penn Praxis was commissioned by Mayor Street to lead a community-based visioning and planning process for the Central Delaware waterfront. The plan encourages waterfront owners to dedicate land for parks, creating green spaces and paths under I-95 and implementing overlay zoning to limit development within 100 feet of the river. The Plan calls for the Water Department to work with others to define the best use of vacant and underutilized public spaces and other opportunities for greening.

In April of 2009, the Philadelphia City Planning Commission adopted the *Civic Vision for the Central Delaware* as the framework for future development for the area along the Delaware River between Allegheny and Oregon Avenues and I-95.[26]

Master Plan for the Central Delaware www.delawareriverwaterfrontcorp.com

Time Frame: 2011-2035
Led by: Delaware River Waterfront Corporation
Connection to *Green City, Clean Waters*: The plan sets the goal of creating vibrant public parks every ½-mile along the six-mile stretch of river, which if properly planned, could become Greened Acres.
The Water Department's Role: Conceptual plans and redevelopment guidelines include stormwater management. The Water Department should help identify where greening is needed and where flooding is an issue, paving the way for partnerships to implement Green Streets and Green Public open Space projects.

[24] http://www.ramsa.com/projects-search/planning/philadelphia.html
[25] http://www.navyyard.org/uploads/files/newsletters/v7.NYNews%20Spring-2010.pdf
[26] http://www.nextgreatcity.com/actions/river/update

The goal of this 25-year plan, released in June 2011, is to transform the six-mile length of Philadelphia's Central Delaware River waterfront into an authentic extension of the City. The integration of historic and cultural resources identifying the waterfront with its industrial past will be carefully integrated with natural ecological systems. Only 10% of the Central Delaware waterfront is publicly-owned, of that only 7 acres, or 1% is public park space. Therefore, this plan focuses on leveraging development on these sites to encourage continued private development of mixed-use and ecologically-sound sites. Availability of land is not an issue as currently almost 40% (386 acres) of the waterfront is vacant.

The Plan sets a goal of creating vibrant public parks every ½-mile along the six-mile stretch which, if properly planned, could become Greened Acres. The Plan also includes a focus on sustainability as defined in "Development Principle #4: Incorporate Best Practices in Sustainability."[27]

- Encourage energy conservation by promoting innovative, high performance development goals for all new development, using publicly owned land to achieve gold and platinum LEED certification
- Work with the Philadelphia Water Department to incorporate best practices in watershed management including restoration of wetlands and improved stormwater management
- Demonstrate best practices and innovation in sustainable landscape design

All of these goals align with the *Green City, Clean Waters* program. Any large re-development of waterfront areas will create greened acres through compliance with the stormwater regulations.

An element of the transportation plan includes connector streets that are "green" and pedestrian-friendly. Improved streetscapes include greening and trees. The plan also promotes light industrial "flex buildings" that incorporate sustainable design elements.

The PCPC Proposed 2012-2017 budget includes the statement "More than $5.8 million in new City, federal, state, and private funding is for plans and improvements along the Central and North Delaware River and Schuylkill River waterfronts."[28]

Four Areas of Redevelopment Identified in the Master Plan

Washington Avenue and the Far South
Plans for this site include three major new parks at the termini of Mifflin, Dickinson and Washington streets, significant wetland restoration, a 50-foot waterfront trail and linear park extending along the new wetlands park and extensions of several connector streets to provide more access to the river's edge.[29] The large-format stores (e.g. Lowe's and IKEA) in this area of the waterfront are also mentioned in the Plan. The Plan assumes that the stores will remain in the short-term but that they will be integrated into mixed-use developments as they are expected to change form in the future.[30]

Penn's Landing
The Delaware River Waterfront Corporation owns this property and proudly operates it as a large-scale venue for a multitude of cultural events and festivals. The Plan calls for a re-visioning of the site as a green space while maintaining the large-scale civic functions that the site is known for. A new large green park will be constructed between Chestnut and Walnut streets from the riverfront to Front Street, covering the remaining un-decked portions of I-95 and Columbus Boulevard in this area. This will create six acres of new green space and also improve the pedestrian and visual connection between Old City and the riverfront.[31]

[27] http://www.plancentraldelaware.com/wp-content/uploads/2011/06/SummaryReport110609.pdf
[28] http://www.philaplanning.org/plans/rcpgm12.pdf
[29] http://www.delawareriverwaterfrontcorp.com/media/summaryreport110609.pdf page 43
[30] http://www.delawareriverwaterfrontcorp.com/media/summaryreport110609.pdf page 47
[31] http://www.delawareriverwaterfrontcorp.com/media/summaryreport110609.pdf page 49

Spring Garden

The Plan proposes that the DRWC-owned "Festival Pier site be redeveloped into a compact mixed-use residential community that would be surrounded on three sides by the Delaware River. The buildings would be organized around a new park and public plaza that would be activated at the street level by restaurants, retail activities, public events and a linear water feature that connects the existing inlet through the plaza to the Spring Garden view corridor."[32] DRWC is interested in implementing streetscape improvements on Spring Garden Street to make the area more attractive to infill development.[33] This creates an opportunity for the Water Department, along with PEC, the East Coast Greenway Alliance, the Streets Department and more, to be involved in implementing green street elements on this major arterial road. In particular, this creates a strong synergy between the development of the Spring Garden Street Greenway and waterfront development/redevelopment at the Festival Pier and surrounding sites.

Penn Treaty and the Far North

The Plan recognizes that this section of the waterfront will likely be reinvigorated with new regional access when the major I-95, Girard Avenue Interchange project is completed within 5-7 years. The Plan proposes exciting new uses for the site including a renovated Penn Treaty Park as outlined in PPR's Penn Treaty Park Master Plan, the adaptive reuse of the historic PECO power plant site, the development of a large-scale, seasonal performance venue and the creation of a new park with waterfront access at the end of Berks Street.[34] To the far north of this section, the Plan also calls for improvements to the existing PPR Pulaski Park, two new parks at Cumberland Street and Lehigh Avenue, the preservation of the Ore Pier structure, general streetscape improvements and a waterfront park and trail.

Development Guidelines Related to Green Infrastructure

The full Master Plan includes detailed recommendations for the development of each key waterfront park including several green stormwater infrastructure recommendations.

- Internal parking lots are discouraged, on-street and shared parking encouraged
- Potential for upland wetland, constructed wetlands, and stormwater collection is identified
- Community gardens, rain gardens

The Master Plan recommends that connector streets that are "green" and pedestrian-friendly be developed to connect neighborhoods to the new waterfront. The Plan suggests that streets improvements to Primary Connector Streets, including Washington and Spring Garden Streets, take place over the next ten years through coordination with the Streets Department and PennDOT. The Plan also states that these streets improvements "will be coordinated with other improvements such as planned storm sewer improvements on Washington avenue and the reconfiguration of intersections as part of the I-95 reconstruction."[35]

Specific Stormwater Management Targets Identified

0-5 years GOAL: all projects in the Master Plan for the Central Delaware district meet the Philadelphia Water Department's best management practices for use and runoff

5-15 years GOAL: all projects in the Master Plan for the Central Delaware district contribute to a 75% reduction in runoff from all directly-connected impervious areas

[32] http://www.delawareriverwaterfrontcorp.com/media/summaryreport110609.pdf page 57
[33] http://www.delawareriverwaterfrontcorp.com/media/summaryreport110609.pdf page 59
[34] http://www.delawareriverwaterfrontcorp.com/media/summaryreport110609.pdf page 63
[35] http://www.plancentraldelaware.com/wp-content/uploads/2011/07/Transportation-FINAL1.pdf

New Kensington Riverfront Plan www.nkcdc.org

Time Frame: Published in 2003
Led by: New Kensington Community Development Corporation (NKCDC)
Connection to *Green City, Clean Waters*: This plan incorporates several green concepts for a gateway transformation of the Girard Interchange site under I-95 including stormwater infiltration.
The Water Department's Role: the Water Department can support the implementation of these green concepts as the I-95 redesign and reconstruction moves forward, through the Sustainable Advisory Council (see Transportation section) or through partnerships with NKCDC.

This plan, released in 2008, is an expansion and update on a neighborhood plan from 2003, largely in reaction to development pressures, state infrastructure investments and opportunities to partner with other planning efforts. The plan also provides a flexible framework focused on implementation.

The plan proposes a gateway transformation of the Girard Interchange site on I-95 to include stormwater runoff infiltration. The plan also promotes an educational rain garden at Penn Treaty Park, green connector streets, a public greenway and green roofs as part of general sustainable building practices. Some of these green concepts have been incorporated into the plans for the redevelopment of this site as of the summer of 2010.

Northern Liberties Waterfront Plan www.nlna.org

Time Frame: Published in 2005
Led by: Northern Liberties Neighbors Association (NLNA)
Connection to *Green City, Clean Waters*: One of the major goals outlined in this plan is the creation of a natural river's edge to improve stormwater management in the neighborhood.
The Water Department's Role: Seek opportunities to work with NLNA to identify mutually beneficial implementation projects.

This 2005 waterfront plan for the Northern Liberties neighborhood was initiated in response to a recognized need for a plan to help assess whether proposed projects would add value to the waterfront while also developing a framework of public improvements that will enhance the use of the waterfront. The goal was to establish a plan which could move forward independent from the larger Central Delaware waterfront planning and development process.

One of the major goals outlined is the creation of a natural river's edge to improve stormwater management. The plan proposes the installation of trees and stormwater swales to insulate the neighborhood from I-95. The Plan also recommends maximizing the use of pervious pavement, bioswales and infiltration beds. The Plan recognizes that all land uses should be within an ecological framework for stormwater management.

RELEVANT TRANSPORTATION-RELATED INITIATIVES

Interstate-95 Improvements www.95revive.com

Time Frame: Design and planning in short-term (5-10 years) and construction in long-term (10-20 years)
Led by: Pennsylvania Department of Transportation (PennDOT)
Connection to *Green City, Clean Waters*: PennDOT is incorporating stormwater management into its designs for long-term infrastructure improvements to I-95 in Philadelphia. PennDOT also plans to construct separate sewer pipes from I-95 to the Delaware River during the highway's expansion which supports the waterfront disconnection described in Section 3 of the IAMP.
The Water Department's Role: The Water Department will continue to coordinate with PennDOT during the expansion of Interstate 95.

PennDOT has started a long-term, multi-phase infrastructure initiative to improve and rebuild I-95 in Philadelphia including replacing or rehabilitating structural components, reconstructing and widening miles of pavement, and reconfiguring most of the interchanges from I-676/Vine Street to Academy Road. Additionally, PennDOT has developed a Sustainable Action Committee (SAC) as a forum for city agencies and key partners to integrate community planning into the design of the interstate and capital projects in the surrounding area with an emphasis on various Delaware River waterfront planning initiatives.

Waterfront Disconnection

The Water Department has been coordinating with PennDOT to over-size the stormwater pipes that will collect stormwater from the highway and discharge it to the Delaware River. The increased capacity should accommodate stormwater from all future riverfront development, disconnecting the area from Philadelphia's combined sewer system.

Green Infrastructure and Community Involvement

The SAC met for the first time in June 2010. Since then they have met occasionally as the design for each segment of the reconstruction progresses. The committee has also facilitated several community design workshops to allow committee members, planners and engineers the opportunity to identify waterfront planning, recreation and environmental improvements that could be incorporated into the design of I-95 – with a focus on the Girard Avenue Interchange. To date, the workshops focused on the reconstruction of Richmond Street from Beach to Ann Streets and improvements to the space beneath the overpasses of I-95 from Frankford Avenue to Ann Street in the City's Fishtown and Port Richmond neighborhoods. The Water Department provided an analysis of stormwater management opportunities on open space parcels that will remain after construction. The Water Department will continue to evaluate open space parcels associated with the I-95 project design for stormwater management opportunities.

Greenway Initiatives

East Coast Greenway — www.greenway.org/pa.aspx

Time Frame: Ongoing projects until greenway is completed
Led by: Pennsylvania Environmental Council (PEC)
Connection to *Green City, Clean Waters*: The Segment of the East Coast Greenway that crosses through the City of Philadelphia presents an opportunity for green stormwater infrastructure implementation and riverfront connections.
The Water Department's Role: Coordinate with PEC and partners to identify opportunities.

The East Coast Greenway is a developing trail system, spanning nearly 3,000 miles as it winds its way between Canada and Key West, linking all the major cities of the eastern seaboard. Nearly 25 percent of the route is already on safe, traffic-free paths.

In February 2010 the East Coast Greenway Alliance received a $23 million TIGER grant from PennDOT for trail construction and connections to the Schuylkill River Trail and the New Jersey trail network. Approximately $16 million from this grant is allotted for projects specifically in the City of Philadelphia.

Spring Garden Street Greenway — www.pecpa.org/eastcoastgreenway

Time Frame: 2-10 years
Led by: PEC
Connection to *Green City, Clean Waters*: PEC would like to make Spring Garden Street a 2.2 mile-long east-west linear park, Green Street and safe bicycle and pedestrian route.
The Water Department's Role: The Water Department should support the green streets elements of this project to ensure stormwater is managed on-site to maximize potential Greened Acres created.

June 2011: "The Pennsylvania Environmental Council has issued an RFP for a design to make [Spring Garden Street] the most bike friendly street in the City of Philadelphia. Spring Garden Street will be a great addition to the East Coast Greenway and will connect the Art Museum and Schuylkill Banks to the Delaware waterfront."

The Spring Garden Street Greenway (SGSG) is an important bicycle and pedestrian connection between the Schuylkill and Delaware Rivers. This corridor is mentioned in both the Northern Liberties Neighborhood Plan (NLNA, 2005) and PEC's plans for the larger greenway network and is also in accordance with Mayor Nutter's Complete Streets Executive Order. PEC's plan is to "transform a 2.2 mile-long east-west artery in Center City into a linear park, Green

Street and a high-quality walking and biking trail separate from traffic lanes."[36] They state that they will follow the Water Department's green street guidelines to ensure that stormwater is managed efficiently on site. In May 2010, NLNA planted 55 trees along the corridor as part of this project.[37] The plan also includes creating a more vibrant experience at the SEPTA station and underpass.

North Delaware River Greenway www.drcc-phila.org

Time Frame: Planned in three phases to be completed by 2019
Led by: PEC
Connection to *Green City, Clean Waters*: The design for the greenway reflects a 50-foot waterfront setback and 10-foot vegetated buffer. The plans and design guidelines recommend green streets techniques such as street trees, vegetated medians and decreasing the number of lanes.
The Water Department's Role: The implementation of all of the elements of this greenway would support both the Water Department's Green Streets and other GSI programs..

The Delaware River City Corporation (DRCC) was established by the City in 2006 to create a "revitalized sustainable riverfront corridor in northeast Philadelphia by reconnecting the people, places, businesses and neighborhoods of the City of Philadelphia and the surrounding region to the Delaware River while simultaneously promoting a diversity of uses through implementation of the North Delaware Riverfront Greenway Plan."[38]

In addition to the DRCC's initial feasibility study, they have also completed a gaps study analyzing the most feasible route for the greenway and design guidelines which include green stormwater management recommendations such as green streets techniques, vegetated buffers for the paths and respect for the overall waterfront setback requirements. According to the DRCC's initial plan the most ambitious green streets projects such as River Road, State Road and other "green" connector streets would not take place until the third phase of construction in 2019.

In April of 2009, the City of Philadelphia Zoning Commission established a new overlay district, the Delaware River Conservation District (DRCD) expressly for the purpose of further enhancing "the quality of life in Philadelphia by promoting and protecting a system of parks and trails along the North Delaware River called the Delaware River Greenway."

Frankford Creek Greenway

Time Frame: Master Plan published in 2007, Land acquisition strategy initiated in 2011
Led by: Philadelphia City Planning Commission, Philadelphia Water Department, Philadelphia Parks and Recreation
Connection to *Green City, Clean Waters*: Provides PWD opportunities to develop green infrastructure projects as part of a new green space development in partnership with PPR and PCPC.
The Water Department's Role: Water Department is providing input on potential green infrastructure projects to be developed as part of the greenway.

The Frankford Creek Master Plan was published by the Philadelphia Water Department in 2007 and prepared by Greenways, Inc. and Biohabitats, Inc. This plan was produced through research and planning exercises throughout the Tookany/Tacony-Frankford Creek watershed, specifically focusing on the 2.7 mile stretch of Frankford Creek, the only open-air creek in the city not surrounded by planned or existing parklands. The goals of the master plan include: improve the stream ecology, develop a greenway system, preserve the history of the corridor, provide riparian buffer, manage stormwater and provide connectivity for surrounding communities.

In July of 2011, The Water Department was approached by the planning commission to help develop a strategy for land acquisition along the creek to be submitted as a request for Neighborhood Transformation Initiative (NTI) funds currently available to city council offices for Qualified Redevelopment Areas, of which Frankford Creek is one. The Water Department conducted analyses of all 10 recommended land parcels along a 1.5 mile portion of the creek between Castor Avenue and Frankford Avenue. Based on these analyses, the Water Department provided a prioritization list of all 10 parcels based on the amount of stormwater management potential of each site.

[36] http://www.pecpa.org/eastcoastgreenway/spring-garden-street-greenway
[37] http://www.accessphilly.com/blog/update-on-spring-garden-greenway-project/
[38] http://www.drcc-phila.org/reports/Gap%20Study/Gap%20Study.pdf

PPR supports the acquisition of as much land as possible along this corridor, and has agreed to be the lead in future green space development. The Water Department will seek to assist through the development of green infrastructure projects wherever feasible.

The Redevelopment Authority had begun to investigate each parcel for ownership status of each parcel and appraisal. The results of this study will be submitted to the Interagency Acquisition Review Team (IART) in 2011 as a funding request. City Council may have funds to support this. Meanwhile, the planning commission is also applying for grant funds for greenway design through the DVRPC Regional Trails Program. The Water Department will continue to track the opportunities related to the Frankford Greenway for green stormwater infrastructure.

Philadelphia Pedestrian and Bike Plan www.tooledesign.com/philadelphia/

Time Frame: 2010-2020
Led by: Philadelphia City Planning Commission
Connection to *Green City, Clean Waters*: The plan recommends creating a collaborative relationship with the implementation of the Water Department's *Green City, Clean Waters* plan in order to achieve some bike/ped improvements.
The Water Department's Role: This plan references drawbacks to promoting the placement of street trees in the pedestrian space. Therefore, the Water Department should work with PCPC to create standards for how to construct green stormwater infrastructure in the pedestrian right-of-way while providing both environmental benefits and a safer and more enjoyable pedestrian experience.

The Philadelphia City Planning Commission, with the assistance of the Toole Design Group, completed a Pedestrian and Bicycle Plan for the City of Philadelphia in the fall of 2010. Improving pedestrian and bicycle safety and mobility is an important aspect of the City's efforts towards sustainability, as well as the open space plan, *GreenPlan Philadelphia*.

Deliverables from The Philadelphia Pedestrian and Bike Plan include recommendations and an actual framework for planning, development and maintenance including a street classification system, a set of policies to enhance facilities and improve safety and education and strategies for implementing bike/ped network recommendations.

The plan recommends creating a collaborative relationship with the implementation of the Water Department's *Green City, Clean Waters* plan in order to achieve some of the plan's recommendations. However the plan also recognizes that there are pros and cons to putting street trees in the pedestrian space. Their goals of "promoting and enhancing the role of sidewalks in the public realm" should include green stormwater infrastructure.

As of June 2011, the Philadelphia Area Pedestrian and Bike Network is working with PEC and the East Coast Greenway to reconstruct and improve 16.3 miles of bike/ped facilities in and around Philadelphia using the TIGER grant funds.

American Street Corridor

Time Frame: Ongoing
Led by: Philadelphia Water Department and Pennsylvania Horticultural Society (PHS)
Connection to *Green City, Clean Waters*: A proposal for the street includes a "linear green landscape" to buffer pedestrians from truck traffic using improved landscaping and pervious areas near stormwater drain inlets.
The Water Department's Role: Continue implementation of proposed stormwater management improvements and promote the stormwater credit benefits of this project to current and potential property owners adjacent to the improvements along American Street. If successful, apply this model to other commercial corridors in need of stormwater management and redevelopment.

PHS has been working on vacant land stabilization in the American Street Empowerment Zone, through their Philadelphia Green program, since 1999[39]. This former heavy-industrial center has been in decline for decades and several studies have been done to understand how to make the area more attractive to infill development. The American Street Empowerment Zone 2005 report[40] proposes a "linear green landscape" to buffer pedestrians from truck traffic. It also proposes improved landscaping and pervious area near stormwater drain inlets. Some of these

[39] http://www.pennsylvaniahorticulturalsociety.org/phlgreen/ui_launchinggreencity.htm
[40] http://www.bkurbandesign.com/pdf/reports/American_St_Public_Space.pdf

green recommendations are being implemented today in a public-private green streets initiative headed up by the Water Department.

The American Street Corridor is a potential Green Street initiative that would involve significant public/private collaboration. A July 2011 Stormwater Crediting article on stormh2o.com[41] talks about the Water Department 's desire to link stormwater trenches and curb bump-outs with making North American Street more attractive to infill development. The public-private nature of this project would create an effective stormwater management cost-share system by allowing adjacent private industrial and commercial properties to receive stormwater credits while also decreasing the pressure on the public combined sewer system. This project could provide a good example of implementation of the Mayor's Complete Streets Executive Order as well as a significant pilot and case study of green streets in commercial corridors and public-private cost-share programs.

Southeastern Pennsylvania Transportation Authority www.septa.org/sustain

Time Frame: Ongoing, varies by project
Led by: Southeastern Pennsylvania Transportation Authority (SEPTA)
Connection to *Green City, Clean Waters*: SEPTA released a sustainability plan in January of 2011 which includes a goal to improve water use and pollutant discharge performance. SEPTA is interested in decreasing sources of both non-point source stormwater runoff and excess graywater pumping into the combined sewer system.
The Water Department's Role: The Water Department could support the green stormwater infrastructure on SEPTA's stations and of SEPTA's rail corridors. The Water Department should stay involved with the PCPC's neighborhood planning process over the next five years which will help coordinate the Water Department green stormwater infrastructure projects with SEPTA's long-term infrastructure improvement process.

SEPTA operates an extensive system of rails, subways, trolleys and buses to serve the residents of Bucks, Chester, Delaware, Montgomery and Philadelphia Counties. SEPTA's extensive network of stations, rails and viaducts creates a multitude of opportunities for partnership with stormwater management and open space initiatives. SEPTA currently has water usage metered at over 300 locations resulting in a current annual water cost of $1.9 million. They understand that this cost is likely to increase as the Water Department's parcel-based stormwater billing system is implemented and are interested in using green infrastructure and capture and reuse technologies to reduce their stormwater bill and protect area waterways.

SEP-TAINABLE: The Route to Regional Sustainability

SEPTA's sustainability plan takes a regional perspective in order to include their transit systems that extend into Philadelphia's suburbs. The Water Department's stormwater and watershed management approaches also take a regional perspective as all of the watersheds that drain to Philadelphia include some suburbs. SEPTA has a three-pronged approach to sustainability using economic, social and environmental goals and initiatives. Goal 2 is most relevant to the implementation of the *Green City, Clean Waters* program: "Improve water use and pollutant discharge performance."[42] Their plan proposes several stormwater management-related initiatives to achieve this goal including:

- Install roof rainwater collection systems to decrease stormwater runoff from roof gutters
- Capture and recycle graywater (subway groundwater pumping, vehicle washer systems, etc.) for reuse
- Improve stormwater control and reduce stormwater runoff on properties through innovative landscape design and planning methods to reduce impervious areas
- Expand tree planting by partnering with the Pennsylvania Horticultural Society

[41] http://www.stormh2o.com/july-august-2011/stormwater-crediting-philadelphia-4.aspx
[42] http://www.septa.org/sustain/pdf/sustainplan2011.pdf

- Partner with stakeholders to protect natural habitats (e.g. work with the Water Department on restoration projects adjacent to rail lines and stations)

- Retrofit or construct buildings to accommodate green roofs

Washington Lane Station and Area Improvements

A June 2011 *Newsworks* article[43] gives a description of the work planned for the Washington Lane station: "Station improvements at Washington Lane will include driveway modifications and curbing, new signs, repairing/replacing and painting railings and ornamental fencing, sealing off the under-track tunnel, and painting the bridge over Washington Lane." The proposed "sealing" of the station's under-track tunnel could potentially create a site for centralized stormwater storage. The site is actually a nexus for green development and infrastructure. In 2006, Awbury Arboretum and the Water Department worked together to create an inlet and bioswale system which directs runoff from Washington Lane through the bioswale and into a wetland[44]. In March 2011, Mt. Airy USA received a $100,000 grant from the City to begin the planning stages for a transit oriented development called "Mt. Airy Transit Village" on a 6-acre empty lot at the intersection of Washington Lane and Chew Avenue.[45]

Stormwater Bumpouts in South Philadelphia

SEPTA's Surface Transportation Department recently partnered with the Water Department and the Streets Department on a pilot program to design stormwater "bumpouts" around bus stops in South Philadelphia. This project shows that SEPTA recognizes the ability to incorporate stormwater management retrofits into traditional streets and transit system improvements. Bumpouts improve pedestrian safety and capture surface runoff.

Tree Planting Initiative

A March 2011 article states that SEPTA planted more than 500 trees since 2008, including 127 in Philadelphia.[46] Many of these trees were planted in conjunction with station improvement projects that were funded through the American Recovery and Reinvestment Act of February 2009. SEPTA recognizes the stormwater and other environmental benefits of increased tree canopy and plans to partner with Pennsylvania Horticultural Society to implement standard tree planting practices in conjunction with future capital improvement projects and help move the City and region towards achieving their tree canopy cover goals.

Green Transit Stops Program

Time Frame: Ongoing, first project completed in 2011
Led by: Philadelphia Water Department
Connection to *Green City, Clean Waters*: The Water Department is hoping to spark interest in both residential and commercial green projects through greening of highly-visible transit stops.
The Water Department's Role: The Water Department should continue to manage the installation and promotion of these demonstration projects in conjunction with the Water Department's residential stormwater management and commercial stormwater crediting programs.

The Water Department in partnership with Roofmeadow completed the installation of a pilot green roof bus stop in Center City Philadelphia in June 2011.[47] The unveiling of the green roof bus stop coincided with the Mayor's

[43] http://www.newsworks.org/index.php/neighborhoods/mt-airychestnut-hill-/item/20777-chestnut-hill-east
[44] http://www.awbury.org/pdfs/arbor_fall06.pdf
[45] http://sct.temple.edu/blogs/murl/2011/03/08/mount-airy-group-moves-forward-with-transit-village/
[46] http://www.septa.org/sustain/blog/2011/03-04.html
[47] http://www.phillywatersheds.org/green-roof-bus-shelter

release of the *Greenworks Philadelphia 2011 Progress Report*. It is felt that this installation could lead to the development of more public or private greening projects. By bringing the green roof down to the pedestrian-level, the Water Department is hoping to spark interest in residential green projects such as green roofs, rain gardens or rain barrels.

Railroad Viaduct Parks

Time Frame: Ongoing
Led by: City of Philadelphia and community advocacy groups
Connection to *Green City, Clean Waters*: These areas present significant stormwater management opportunities.

With the recent success of New York City's "High Line" Park[48] on an unused, raised rail corridor, Philadelphians are starting to reevaluate the highest and best use of two large viaducts; Reading Viaduct and Lehigh Avenue Viaduct.

Reading Viaduct readingviaduct.org

The Reading Viaduct extends from Vine Street at 11th Street, to Fairmount Avenue at 9th Street, with an east-west section that extends to North Broad Street. This structure represents what is left of a railway viaduct that operated from the 1890s to 1984. Sections of the viaduct have been demolished to build the Pennsylvania Convention Center and the Vine Street Expressway.

The Reading Viaduct Project formed in December of 2003 to rally around the preservation of this icon and its transformation into an urban park which could also help revitalize the neighborhood.

The group recently commissioned a planning study to evaluate the structure and the possibilities for redevelopment. Demolition of the property including the mile-long, massive stone abutment would cost $50 million while retrofitting the site as an urban park would only cost $36 million. Leaving it the way it is, is costing the city millions in real estate depreciation and lost property tax revenue. The study also found that the increase in real estate values on existing real estate abutting the site would be twice as high from a green renovation as from demolition.

The *Philadelphia2035* Comprehensive Plan, *GreenPlan Philadelphia* and *Green2015* all recognize the potential to create a unique urban green space on the underutilized Reading Viaduct. Additionally, the potential green transformation of the site presents opportunities for the Water Department to become involved in design assistance and incentives to create deliberate stormwater management on the site. The addition of interpretive signage could easily make these features an educational tool for visitors and residents.

Lehigh Avenue Viaduct

The *Action Plan for the Central Delaware* identifies the Lehigh Viaduct as a possible longer-term park opportunity to help revitalize the City's connection to the Delaware riverfront.[49] The viaduct's east-west orientation presents an opportunity to create a unique waterfront connection through green space. *Green2015*, the City's plan to create 500 acres of new park space by 2015, presents the possibility of creating a rails-to-trails type park on the underutilized Lehigh Viaduct. The largest challenge to transforming this site into a public park is that the rails are still infrequently used by one rail customer. The writers of *Green2015* believe that the viaduct would be able to accommodate recreational uses on the section of the viaduct east of Kensington Avenue because there is an at least 100-foot wide buffer available between the rails and the proposed park areas.

The Lehigh Viaduct Coalition, a group formed by the Office of Community Development of the Archdiocese of Philadelphia, met with the Managing Director's committee about the site in May of 2011.[50] The two groups appear to be most concerned with current trespassing and illegal dumping. They are interested in increasing safety and decreasing blight in the surrounding neighborhood but have not mentioned the possible use of the space as a park.

[48] http://thehighline.org/
[49] http://planphilly.com/node/3298#04_ActionsLongerLocations
[50] http://www.officeforcommunitydevelopment.org/news.php?news=Lehigh-Viaduct%3A-New-Success&news_id=4

OPPORTUNITIES WITH DISTRICTS and COMMUNITY ORGANIZATIONS

Philadelphia Special Service Districts (SSDs) & Business Improvement Districts (BIDs)

SSDs and BIDs are designated areas within the City where special revenue streams are set-up to support beautification, livability and development projects. Some SSDs (Table 1) and BIDs (Table 2) already participate in streetscaping and landscaping projects creating opportunities for the Water Department to partner with these districts on stormwater management projects such as Green Public Open Space, Green Streets and Green Parking.

Table 1: Special Service Districts in Philadelphia

Special Service District	Year Founded	Website	Relevant Programs	Relation to Philadelphia2035 Comp. Plan	Relation to *Green City, Clean Waters*
Center City	1991	www.centercityphila.org	• Sidewalk cleaning & Graffiti removal • Landscaping & maintenance • Parkway improvements • Plans and other publications	• West Market Train Station (new) • City Hall Station and Dilworth Plaza improvements • Reading Viaduct Project • Part of Philadelphia's metropolitan center	Street tree program & SW features of Dilworth Plaza redesign
Old City	1997	www.oldcitydistrict.org	• Street cleaning • Graffiti removal Streetscape improvement plan	• Registered historic district • Central Delaware Master Plan • Part of Philadelphia's metropolitan center • I-95 reconstruction	Strategic plan: create physical & environmental connection to the Delaware River
University City	1997	www.universitycity.org	• Sustainability workshops • Vacant properties • Streetscaping and sidewalk cleaning	• Part of Philadelphia's metropolitan center • 30th Street Station Gateway	PWD is working with Drexel University to make JFK Boulevard a "green" street
Sports Complex	2002	www.scssd.org	Working with PHS and contractors to maintain landscape improvements	• One of Philadelphia's metropolitan sub-centers • Industrial legacy area and underutilized land problem • Design study to create TOD	PWD is developing a stormwater master plan for this district
Frankford	2007	www.frankfordssd.org	Sidewalk cleaning	Underutilized land problem & lack of access to food	
Germantown	1996	www.centralGermantowncouncil.com	• Sidewalk cleaning Plans for streetscape improvements		
Manayunk	1997	www.manayunk.com	• Sidewalk cleaning, streetscaping, landscaping • Extension of Cynwyd Heritage Trail over Manayunk Viaduct • Interest in developing store fronts along towpath	• Lack of food access • Steep slope area Philadelphia's first historic district	Not in combined sewer area. Plans to build sewage overflow tank on Lower Venice Island; the community would like to create a park with GSI

Special Service District	Year Founded	Website	Relevant Programs	Relation to Philadelphia2035 Comp. Plan	Relation to *Green City, Clean Waters*
Penn Treaty	2010	www.Penntreatyssd.com	Grant program funded by the Sugar House Corporation	• Industrial legacy area & underutilized land problem • Central Dela. Master Plan • I-95 reconstruction & proposed Delaware Waterfront Light Rail	
South Street and Headhouse Square	unknown	www. southstreet.com	• Oversees zoning issues • Street cleaning		
City Avenue	1999	www.cityave.org	Working with PHS on gateway plan	Regional center	Zoning changes, bonus for public open space
Temple University	Not fully developed yet			• Regional center, Industrial legacy area & underutilized land problem • High poverty and underserved by open space	

Table 2: Business Improvement Districts in Philadelphia

Business Improvement District	Year Founded	Website	Relevant Programs	Relation to Philadelphia2035 Comp. Plan	Relation to *Green City, Clean Waters*
Mt. Airy BID		www.mtairybid.com	• Sidewalk cleaning • Streetscaping and landscaping	• Cluster of public-serving facilities	Not in combined sewer area
Greater Cheltenham Avenue BID	2010	www.Cheltenhamtownship.org	• Plans to improve Streetscaping including trees • Private street cleaning	• Underserved by public open space	Plan for district include landscaping, infill dev. & porous paver parking lanes
Chestnut Hill BID			• Landscaping and sidewalk cleaning		Not in combined sewer area
Aramingo Avenue BID			• Sidewalk cleaning	• I-95 Reconstruction	
East Passyunk Avenue BID	2003	www.visiteastpassyunk.com	• Neighborhood sidewalk cleaning program • Streetscaping and landscaping		
Roxborough Development District	1992	www.roxborough.us	• Sidewalk cleaning • Streetscaping and landscaping (recent $2.2M project)	• Lack of food access • Steep slope area	Not in combined sewer area.

Plant!Philadelphia

Time Frame: 2007-2012
Led by: Center City District
Connection to *Green City, Clean Waters*: Trees planted in stormwater management tree pits further the *Green City, Clean Waters* goals.
The Water Department's Role: Seek opportunity to collaborate with this initiative to maximize stormwater management opportunities.

Partially in response to Mayor Nutter's "greenest city" goal and the *Greenworks Philadelphia* initiative, the Center City District established the Plant!Philadelphia program through which individuals and businesses can donate money to support street tree planting and maintenance in the Center City District.[51] The Water Department could partner with CCD on this program to ensure all street trees planted are accompanied by appropriate stormwater tree trenches and maintenance guidelines.

Center City: Planning for Growth

Time Frame: 2007-2012
Led by: Center City District
Connection to *Green City, Clean Waters*: The plans do not explicitly prescribe stormwater management as redevelopment of Center City moves forward however their focus on "walkable urbanity" and streets that are "safe, clean and attractive" could be interpreted to support the incorporation of green stormwater infrastructure such as street trees and vegetated bump-outs.
The Water Department's Role: Support incorporation of green stormwater management on any project, especially those in the highly visible public realm.

In 2007, the Center City District released their 5-year plan "Center City: Planning for Growth" which outlines a program to improve the Ben Franklin Parkway, West and East Market Street and Broad Street sections with a new focus on "walkable urbanity" and streets that are "safe, clean and attractive."[52] These master plans will help guide consistent design and connection with surrounding landscape and buildings as is appropriate for the heart of the municipal district for the City.

Dilworth Plaza

Time Frame: Designs completed, construction planned for mid-November 2011
Led by: Center City District
Connection to *Green City, Clean Waters*: The proposal includes reducing the impervious cover on the site by 38% and increasing tree canopy on the site by 26%. The plan also includes an ambitious on-site rainwater harvesting and storage system.
The Water Department's Role: The Water Department can provide technical assistance on the stormwater management features.

The 2007 plan "Center City: Planning for Growth" included a call for improvements to Dilworth Plaza adjacent to City Hall. A vision for the Dilworth Plaza published in 2009 incorporates on-site rain water collection and storage. The collected water would then be redistributed for irrigation and fountain uses. The proposal includes reducing the impervious cover of the site by 38% and increasing tree canopy on the site by 26%.[53] There is significant support for these designs. In March 2011, the City of Philadelphia Art Commission unanimously approved the concept drawings for the redesign.[54] Additionally, CCD received a $15 million federal Transportation Investment Generating Economic Recovery (TIGER) grant in 2010[55] but construction has not started yet. The Water Department has concerns about the feasibility and code/zoning issues of such a large rain water collection and storage facility. This plaza as well as the surrounding areas is extremely visible locations for the implementation of innovative stormwater and public outreach opportunities.

[51] http://www.centercityphila.org/about/plantphila.php
[52] http://www.centercityphila.org/about/Publications.php
[53] http://www.centercityphila.org/docs/CCRDilworthPlaza2011.pdf
[54] http://www.centercityphila.org/pressroom/prelease030311.php
[55] http://www.centercityphila.org/docs/CCRDilworthPlaza2010.pdf

University City District *universitycity.org*

The University City Special Service District organization established in 1997 has a renewed interest in place-based community development.

University City District Gateway Study[56]

Time Frame: 2007-2012
Led by: University City District
Connection to *Green City, Clean Waters*: Some of this study's recommendations such as raised planters and street trees could provide stormwater management benefits when designed and implemented properly.
The Water Department's Role: The Water Department should align planning efforts to collaborate on projects before the design process begins in order to maximize stormwater and community benefits.

This study, published in fall 2007, recognizes the benefits of vegetation in improving the appearance of streetscapes. Their streetscape guidelines for the district include tree species and spacing. The plan also places a higher priority on the use of raised planters rather than concrete to define parking areas and separate pedestrian and vehicle zones, especially around the 30th Street Station.

40th Street Portal Redevelopment

Time Frame: RFP issued for design in 2011
Led by: University City District
Connection to *Green City, Clean Waters*: The plan does not specifically mention stormwater management but the preliminary designs called for raised planters, street trees, and an overall reduction in the impervious coverage on the one-acre site.
The Water Department's Role: Support stormwater management features of the site design to maximize creation of greened acres.

One of the gateways studied in the UCD Gateway Study that has received continued attention is the 40th Street Trolley Portal area. The Gateway Study details a plan to redevelop this busy intersection where more than 3,200 transit riders pass through each day. The plan calls for repaving of the site to create safer pedestrian pathways over the trolley tracks, a 1600 SF cafe with outdoor seating, raised planters, 15 new street trees, public art, interpretive signage and pedestrian lighting.[57] These improvements will work nicely with the recently landscaped SEPTA tunnel adjacent to the site. Stormwater management is not mentioned specifically as a driver behind these design suggestions but if planted properly, raised planters and street trees can help manage stormwater on the site. The UCD announced an RFP for design services to enhance the 2007 vision for the site in April of 2011. The work proposed in the new RFP would be completed in late 2011.[58]

Sports Complex Special Service District *scssd.org*

Time Frame: Ongoing
Led by: Sports Complex Special Service District
Connection to *Green City, Clean Waters*: This area may present a prime opportunity for installation of stormwater management practices due to the high percentage of impervious cover.
The Water Department's Role: Work with partners to evaluate implementation opportunities and tools.

This area of Philadelphia is rich with history and potential for economic development and green infrastructure. The district is interested in incorporating landscaping into their property management and the Water Department is interested in integrating on-site stormwater management and CSO abatement. It is also important for the Water Department to partner with the Philadelphia City Planning Commission as they draft a district plan for the Lower South District, which includes the Stadium District, in the fall of 2011. Incorporating green stormwater infrastructure into this property represents the largest potential project area, in terms of potential greened acres created, that the Water Department has identified so far. Therefore it is very important to coordinate the Water Department recommendations for stormwater management into the Planning Commission's district plans and urban design studies. For example, PCPC is interested in how to make the pedestrian experience between AT&T Station and the stadiums safer and more enjoyable. Green streets elements such as porous pavement, bioswales and street trees could

[56] http://www.universitycity.org/_files/docs/ucd-gateways-final-plan.pdf
[57] http://www.universitycity.org/_files/docs/ucd-gateways-final-plan.pdf pages22-24
[58] http://www.universitycity.org/_files/docs/40th-street-portal-design-rfp.pdf

help buffer pedestrians from vehicular traffic in the parking lots while providing stormwater management and aesthetic benefits.

Community Development Corporations

Philadelphia is home to dozens of community development corporations (CDCs) which focus on neighborhood-scale, community-based planning, job skills development, greening and economic development. Table 3 lists some of the CDCs which are directly involved with programs which are related to *Green City, Clean Waters* initiatives and potential partners on future green infrastructure projects in these neighborhoods.

Table 3: Examples of Community Development Corporations in Philadelphia

Community Development Corporation	Website	Related Work
Fairmount CDC	www.fairmountcdc.org	• Neighborhood plans • "Vital neighborhoods" program • "Clean and green" (includes tree planting) • Public art
Delaware River City Corporation	www.drcc-phila.org	• Build, maintain and promote the North Delaware Greenway
East Falls Development Corp.	www.eastfallsdevelopment.org	• East Falls Model Stormwater Projects • Workshops for the community about green stormwater management
New Kensington CDC	www.nkcdc.org	• Vacant land management • Sustainable 19125 • Waterfront development/planning
Nicetown CDC	www.nicetowncdc.org	• NTCDC is contracted by the City of Philadelphia and PHS to maintain more than 230 vacant land parcels in Northwest Philadelphia • Manage Nicetown Park and working on designs for Nicetown Skate Park
Ogontz Avenue Revitalization Corp.	www.ogontzave.org	• Cleaning and greening • Streetscape development
Wynnefield Overbrook Revitalization Corp.	www.wynnebrook.org	• Infrastructure planning & improvements • Neighborhood planning (current project: 54th Street Revitalization)

New Kensington Community Development Corporation nkcdc.org

The Water Department recently partnered with the New Kensington Community Development Corporation (NKCDC) on The Big Green Block project completed in May 2011.[59] Green stormwater projects at the site include stormwater tree trenches and two rain gardens that manage runoff from 1.2 acres.[60] NKCDC was the first community in Philadelphia to use vacant land management as a revitalization strategy and also established the community group "Sustainable 19125" which is active in green initiatives such as tree planting, recycling and water resource protection.

Nicetown Community Development Corporation nicetowncdc.org

Nicetown CDC was established in 1999 to provide economic, housing and small business development services to the Nicetown community. The organization also works in the areas of community engagement and special events planning. The group's accomplishments include commercial corridor revitalization, Nicetown Park, afterschool and summer youth programs, a Community Land Care and Community Orchard Program and a neighborhood energy

[59] http://www.nkcdc.org/announcements/bgb
[60] http://www.phillywatersheds.org/big-green-block-0

center.[61]

Nicetown Skate Park

Time Frame: Conceptual design complete
Led by: Nicetown Community Development Corporation
Connection to *Green City, Clean Waters*: Conceptual designs for this 2.5 acre vacant lot include a skate park, community garden and sufficient rain gardens to hypothetically manage runoff from the road above.
The Water Department's Role: Provide technical assistance as needed and measure the creation of Greened Acres.

In February of 2010 PCPC released the "Nicetown Redevelopment Area Plan." Plan objective #4 is to "Enliven areas with active parks." This objective focuses on an expansion of Nicetown Park to a 2.5 acre adjacent vacant lot. The ownership of the lot is currently split between the City and RDA. However due to the low possibility of commercial or residential development under Route 1; RDA is interested in transferring the site in full to the City for development as a skate park and community garden with sufficient stormwater infrastructure in place to handle runoff from the road above. This project is still listed as a concept on the Nicetown CDC website[62] and no timeline or budge is set as of yet although some conceptual designs have been created.

UNIVERSITY MASTER PLANS

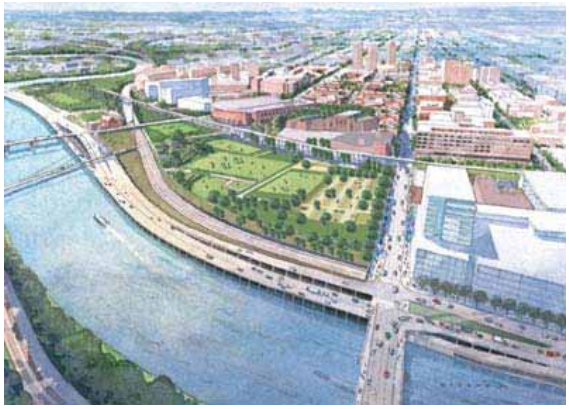
University of Pennsylvania *www.pennconnects.upenn.edu*

Time Frame: Published in 2007
Led by: University of Pennsylvania, Campus Development Planning Committee
Connection to *Green City, Clean Waters*: The University's *Penn Connects* plan calls for several large green open space projects that include on-site green stormwater management. The plan also calls for smart land use plan, increased open space and mitigation of stormwater issues.
The Water Department's Role: The Water Department can provide design and monitoring assistance as needed through the Green Institutions program and track the creation of Greened Acres through projects as they are completed.

When the *Penn Connects* plan was released in 2007, several large green open space projects were proposed including Penn Park and Shoemaker Green. The plan also includes recommendations for smart land use planning, increased open space and mitigation of storm water issues.

Penn Park

Penn Park is a 24-acre park in West Philadelphia set to be completed in 2011. "About 70% of the Penn Park site was previously asphalt and concrete paving, which channeled stormwater into the city's combined sewer and storm system. Penn Park will increase campus open space by 20% and feature a rich mix of new athletic fields and public recreation amenities. The use of pervious pavements and open fields has the capacity to capture over 13,000 cubic feet of stormwater at the ground level during a rain event, reducing the burden on the city's treatment plants and keeping Philadelphia's rivers cleaner. Additional stormwater capacity will be provided by incorporating green roofs on new buildings, consistent with the recommendations of the US Green Building Council."[63]



chronicle.com/blogs/buildings/u-of-pennsylvania-will-spend-40-million-on-a-new-penn-park/5439

[61] http://nicetowncdc.org/aboutntcdc.html
[62] http://nicetwoncdc.org/programs.html
[63] http://www.pennconnects.upenn.edu/growing_greener/water_management.php

Shoemaker Green

Andropogon Associates' design for this 3.75 acre site will transform the site, currently occupied by tennis courts, into a public commons and green open space that will be an east-west gateway between Locust Walk and the new Penn Park. The project was selected as one of 100+ projects being tested for a new sustainable landscape rating system being developed by the Sustainable Sites Initiative. The design, which was approved by the University in fall 2010, includes rain gardens, porous pavers, a cistern, native plants, wildlife habitat, and recycling of existing site materials. The $8 million project is proposed to be completed in fall 2012.[64]

www.pennconnects.upenn.edu/find_a_project/by_category/landscape/shoemaker_green_images.php

Green Campus Partnership www.upenn.edu/sustainability

Penn's Green Campus Partnership created a *Climate Action Plan* for the University which calls for LEED Silver certification of all new construction and major renovations, a 20% increase in campus green space through the construction on green roofs on existing buildings and the establishment of sustainable campus planning protocols.

Temple University *www.temple.edu/2020*

Time Frame: Published 2020 Master Plan in 2010
Led by: Temple University Office of Sustainability
Connection to *Green City, Clean Waters*: Temple has expressed interest in increasing green space and decreasing surface lot parking on their campus creating opportunities for the Water Department to work with them to create Greened Acres that would benefit the City as a whole.
The Water Department's Role: Continue partnership to create a stormwater master plan and provide design and monitoring assistance as needed through the Green Institutions program and track the creation of Greened Acres through projects as they are completed.

In "20/20: A Framework for Campus Development" Temple University established that it wishes to work with its existing footprint, reconfiguring pedestrian access and safety by creating more green spaces, urban plazas and improving the streetscape in general. The "Temple Development Criteria" includes "increase green space" and "decrease surface lot parking." The document also states that "Temple 20/20 aims to serve as a model for sustainable design and to promote a culture of responsible practices throughout the university community."[65]

The transit oriented development project currently referred to as "Residence, Dining and Retail Complex" is currently under construction at the intersection of North Broad Street and Cecil B. Moore Avenue. General streetscape improvements will include street trees and stormwater planters.[66]

[64] http://www.pennconnects.upenn.edu/find_a_project/by_category/landscape/shoemaker_green_overview.php
[65] http://www.temple.edu/2020/sustainability/
[66] http://www.temple.edu/2020/projects/new-residence/index.asp

Stormwater Master Plan

The Water Department is seeking to develop a partnership with Temple University to create a Stormwater Master Plan for the campus that will align with Temple's 20/20 vision. This collaborative effort will seek to integrate stormwater management components into capital building plans. Maximizing stormwater management on the campus will be coupled with the Water Department's public green investment on streets and public spaces within the campus.

Drexel University *www.drexel.edu/facilities/design/masterPlan/*

Time Frame: Published in 2007
Led by: Drexel University Office of Sustainability
Connection to *Green City, Clean Waters*: Drexel has expressed interest in increasing green space and utilizing green building and landscape design standards to create a more sustainable University. This creates opportunities for the Water Department to work with the University to create strategic Greened Acres on the University's campus that would benefit the University and decrease the amount of stormwater unnecessarily entering the combined sewer system.
The Water Department's Role: Continue partnership to create a stormwater master plan and provide design and monitoring assistance as needed through the Green Institutions program and track the creation of Greened Acres through projects as they are completed.

The 2007 Master Plan for Drexel University's West Philadelphia Campus was triggered by a decade of growth in the University's infrastructure. However, the document is considered flexible and should accommodate new and changing conditions. It is important to note that Drexel University does have sustainability guidelines and supportive green building and landscape design standards in place which were considered in this plan as well.[67]

This plan outlines Drexel's desire for a more consistent streetscape including street trees. The University would also like to increase utilization of green space including the conversion of a section of Race Street into a pedestrian mall with the incorporation of more street trees.

Stormwater Master Plan

Drexel University has expressed interested in developing a stormwater master plan to plan for stormwater management before individual capital improvements or new buildings. Opportunities for public/private partnerships between the Water Department and Drexel will be sought.

JFK Boulevard

An additional, more detailed campus master plan for 2012-2041 (Drexel@150) was also recently published. This master plan focuses on infill development and continuing to heighten Drexel's academic abilities and position within the city. Therefore, the redevelopment of the JFK Boulevard corridor between Drexel University and the 30th Street Station is an important part of the Plan to heighten the University's image and connection to the City and its transportation systems.

An important component of this corridor's redevelopment is a green street project that is a result of collaboration between the Water Department, Drexel University, the City Planning Commission and the Powelton Village Association. Drexel has expressed additional support for this project by promising an additional $160,000 for landscaping. This project is planned to be completed by spring 2012.

Green Infrastructure Investments

The University predicts that there will be growth and infrastructure improvements over the next five years "Today $232 million has been allocated for construction already in progress and scheduled for completion in 2011, and an estimated $300 million will be allocated for projected construction projects through 2016."[68] And many of these

[67] http://webedit.drexel.edu/facilities/design/standards/
[68] http://www.drexel.edu/facilities/design/masterPlan/

projects will incorporate green building practices. For example, the Papadakis Integrated Sciences Building, which will incorporate a 5-story living wall and be the University's first LEED Silver building, is under construction.[69]

Saint Joseph's University *www.sju.edu*

Time Frame: None
Led by: Saint Joseph's University
Connection to *Green City, Clean Waters*: Enhanced outdoor recreational facilities and some parking lot landscape improvements on their James J. Maguire Campus.
The Water Department's Role: The Water Department can provide technical assistance as needed through the Green Institutions program and track the creation of Greened Acres through projects as they are completed.

Although the SJU campus does not lie in a section of the City serviced by a combined sewer system and is therefore not a priority location for implementing green stormwater infrastructure as part of the Water Department's CSO control program, they do have some innovative and interesting stormwater management concepts being implemented currently.

Green Roof Leader

In October of 2009, Saint Joseph's University received a $1 million grant from the Department of Energy's Energy Efficiency and Renewable Energy Program. The grant funded the formal establishment of the Institute for Environmental Stewardship and projects involving biofuel production and a comparison of green roof systems.[70] The 6,800 sq. ft., variable depth extensive green roof system will be used for research and education. The grant also funded two workshops for homeowners and land managers related to stormwater management.

James J. Maguire Campus

Renovations to the James J. Maguire Campus of SJU focus on enhanced outdoor recreational facilities and some parking lot landscaping improvements. Plans, including "effective stormwater facilities" and artificial turf which should increase infiltration capacity of the fields, were approved by the Water Department's Plan Review program in fall of 2010.[71]

La Salle University *www.lasalle.edu*

Time Frame: None
Led by: La Salle University
Connection to *Green City, Clean Waters*: La Salle University has expressed interest in energy and water efficient building practices which suggests that the Water Department will be able to partner with the University to create more Greened Acres on their 130-acre campus property in northwest Philadelphia.
The Water Department's Role: The Water Department can provide technical assistance as needed through the Green Institutions program and track the creation of Greened Acres through projects as they are completed.

This 150-year-old university has a 130-acre campus in northwest Philadelphia. The University has recently entered the realm of green building through the addition of a large green roof and other energy- and water-efficiency measures in a large science center expansion.

Holyroyd Hall Science Center

The renovated and expanded Holyroyd Hall Science Center, completed in the fall of 2009, features an 8,400 square foot green roof and in-ground infiltration system which will allow much of the site's drainage to be disconnected from the city's sewer system. The site also features water-efficient landscaping.[72]

[69] http://webedit.drexel.edu/facilities/design/currentProjects/
[70] http://www.sju.edu/news/archives/energy_grant_100710.html
[71] http://www.sju.edu/resources/community/maguirecampus/pdf/ad.pdf
[72] http://collegian.lasalle.edu/en/1/1/387/

REGIONAL PARTNERSHIPS WITH SUSTAINABLE INITIATIVES

Business United for Conservation (BUC)
sbnphiladelphia.org/initiatives/business_united_for_conservation/

Time Frame: None
Led by: Sustainable Business Network of Greater Philadelphia
Connection to *Green City, Clean Waters*: BUC is interested in identifying and addressing barriers to industry best practices which could include green building and green business practices.
The Water Department's Role: The Water Department supports these organizations and partnerships and will communicate program developments to member industries and companies and seek colloaborative opportunities.

The Green Economy Task Force, an initiative of the Sustainable Business Network of Greater Philadelphia (SBN), created four publications as part of the Emerging Industries Project. One of these publications identified the need to establish an industry partnership to jumpstart private investment in green stormwater infrastructure; hence Business United for Conservation (BUC) was created in March 2010. BUC is an industry partnership of companies that provide conservation and pollution mitigation services (reducing GHG emissions, waste and pollution, conserving water and other natural resources) in the Philadelphia region. BUC is committed to identifying and addressing barriers to industry growth, workforce needs, business-to-business procurement opportunities, industry best practices and technology trends.

Related Publications

"Capturing the Storm: Profits, Jobs and Training in Philadelphia's Stormwater Industry" and "Gray to Green: Jumpstarting Private Investment in Green Stormwater Infrastructure" are recent publications from SBN that evaluate local green stormwater practices and barriers to implementation. *Gray to* Green outlines several funding opportunities for private implementation of GSI, each with their own challenges for implementation:

(1) **Establish Green Stormwater Infrastructure Service Companies (GISCs)**
"GISCs would conduct an "audit" by evaluating each property and identifying which strategies are the most appropriate and represent the most cost savings. […] Calculating the long-term costs and payback periods, they would devise a financing structure that, on a monthly basis, would be equal to or less than the stormwater fee that the customer would otherwise have to pay to the utility."[73] – This is very similar to what the Water Department /PIDC Stormwater Management Incentives Program does: "A Selection Committee comprised of staff from the Water Department and PIDC will evaluate applications based on the technical merit of the stormwater management practice and the credit of the applicant."[74] – "Loans shall be consistent with the payback period of the stormwater mitigation measure, up to 15 years."[75]

(2) **Implement On-Bill Financing**
This program would require participants to have "[stormwater] audits and retrofits performed on their properties by a pre-approved contractor, with [the Water Department] paying the upfront costs. Participants then pay the cost of the project over time as a line item on their [stormwater] bill."[76] However, the authors of the report admit that it may be unreasonable for the Water Department to loan money to their customers for stormwater retrofits.

(3) **Work with Insurance Companies to Include Discounts for Green Stormwater Infrastructure in Insurance Packages**

[73] http://www.sbnphiladelphia.org/images/uploads/EIP_GrayToGreen_final_lowres.pdf
[74] http://www.pidc-pa.org/userfiles/file/financing/loans/Stormwater-Management-Incentives-Program-10-10.pdf
[75] http://www.pidc-pa.org/userfiles/file/financing/loans/Stormwater-Management-Incentives-Program-10-10.pdf
[76] http://www.sbnphiladelphia.org/images/uploads/EIP_GrayToGreen_final_lowres.pdf

The third funding incentive identified involves the insurance companies recognizing the flood-reduction and heat island effect reduction benefits of green stormwater infrastructure. However, it is highly likely that the Water Department would need to invest in more research and education to demonstrate to insurance companies that small-scale implementation of green stormwater infrastructure will reduce the risk of sewer back-ups and flooding and that this will result in financial benefits.

Greater Philadelphia Green Business Program *phillygreenbiz.com*

Time Frame: None
Led by: Greater Philadelphia Green Business Program
Connection to *Green City, Clean Waters*: This program establishes an incentive for businesses to implement green stormwater management retrofits because the commitment checklist includes a section on exterior water management.
The Water Department's Role: The Water Department should collaborate with this program and make provide technical assistance to member industries and companies.

The Green Business Program's intent focuses on a checklist of green operational practices designed for office users. Once a key company leader has signed the commitment, the company will be ranked as Basic, Silver or Gold based on the number of green practices it has adopted. Companies across the Philadelphia metropolitan area are making a public promise to change their daily business practices to reduce negative impacts on the environment.
This program establishes an incentive for businesses to retrofit because the commitment checklist includes a section on exterior water management detailing how businesses can get green business points for litter prevention, signage, stormwater basin maintenance procedures, water-saving irrigation practices and establishment of rain gardens.

Currently, the number of businesses committed to green business operational practices through this program is up to 103 indicating a strong movement towards more sustainable business operations in the Philadelphia region.

FEDERAL AND REGIONAL SUSTAINABILITY PARTNERSHIPS

Partnership for Sustainable Communities *www.sustainablecommunities.gov*

Time Frame: Ongoing partnership formed in 2009
Led by: U.S. Department of Housing and Urban Development, U.S. Department of Transportation and the U.S. Environmental Protection Agency
Connection to *Green City, Clean Waters*: Coordination at the federal level will support the streamlining process for *Green City, Clean Waters* through increased inter-city agency collaboration and local partnerships and federal level support of green infrastructure and urban planning that may align with the Water Department's programs
The Water Department's Role: Monitor progress and opportunities with this national Partnership

In June 2009, the U.S. Department of Housing and Urban Development (HUD), U.S. Department of Transportation (DOT), and the U.S. Environmental Protection Agency (EPA) joined together to form the Partnership for Sustainable Communities, an unprecedented agreement to coordinate federal housing, transportation, and environmental investments. The Partnership works to protect the public health and the environment, promote equitable development, and address the challenges of climate change. The agencies are working together to identify opportunities to build more sustainable and "livable" communities and to remove policy or other barriers that deter sustainable development.

Complete streets and new transportation infrastructure initiatives could incorporate "green" streets principles. All vegetated infrastructure practices also improve air and water quality. New sustainable development promotes reinvestment in existing communities and achievement of stormwater management goals. Coordination at the federal level will simplify the streamlining process for *Green City, Clean Waters* through increased inter-city agency collaboration and local partnerships. The focus on valuing communities and neighborhoods can be applied to healthy, safe and connected urban neighborhoods and greenways as well.

In August 2010 the Water Department's GSI programs (revised regulations and impervious-based billing) were featured in the EPA document: "Green Infrastructure Case Studies: Municipal Policies for Managing Stormwater with Green Infrastructure"

Water is not one of the Partnership's 2011 priority areas. However, the 2010 Progress Report from the Partnership highlights the fact that they "explicitly recommend that states make funding decisions [from their State Revolving Fund for Water Infrastructure] that are consistent with the Livability Principles." The success of this policy recommendation is currently being tested in Maryland, New York and California. Smart Growth Implementation Assistance (SGIA) funds are available for stormwater management. There have been no SGIA projects in Pennsylvania since the program started in 2005. The EPA website includes additional green infrastructure resources.

Delaware Valley Smart Growth Alliance *www.delawarevalleysmartgrowth.org*

Time Frame: None
Led by: Delaware Valley Smart Growth Alliance
Connection to *Green City, Clean Waters*: Their smart growth criteria include points for stormwater BMPs such as rain gardens, gray water re-use, and native landscaping.
The Water Department's Role: Coordinate and collaborate with this group.

DVSGA establishes smart growth criteria for the Philadelphia Metropolitan Region and certifies projects as compliant with the smart growth criteria. This is just a form of recognition that the Water Department could pursue for their projects to increase publicity. There were three projects recognized by DVSGA in 2008 that were in Philadelphia and incorporated green stormwater infrastructure: (1) 2.0 University Place: green roof and gray water recycling system; (2) 777 South Broad: pervious paving; (3) West Philly Extended-Stay Hotel: green roof and pervious hardscapes. (Please note: all of these projects were only in the planning and review stages when they received this recognition).

New 2011 simplified criteria include points for stormwater BMPs such as rain gardens, gray water re-use, native landscaping and green building standards which could include additional green stormwater infrastructure.

Delaware Valley Green Building Council *www.dvgbc.org*

Time Frame: None
Led by: Delaware Valley Green Building Council
Connection to *Green City, Clean Waters*: The DVGBC initiated a study of barriers to sustainable water practices in Philadelphia.
The Water Department's Role: Work with DVGBC to understand and address issues related to green stormwater infrastructure implementation.

Delaware Valley Regional Planning Commission *www.dvrpc.org*

The Delaware Valley Regional Planning Commission (DVRPC) is dedicated to uniting the region's elected officials, planning professionals and the public with a common vision for the Delaware Valley region. DVRPC helps build consensus and policy for improved transportation, smart growth, strong economy and a healthy environment.

Connections: The Regional Plan for a Sustainable Future

Time Frame: 2009-2035
Led by: Delaware Valley Regional Planning Commission
Connection to *Green City, Clean Waters*: The plan recognizes that community-scale green infrastructure can contribute to more livable communities.
The Water Department's Role: Collaborate with DVGBC on opportunities identified by this report.

"Connections" was adopted by the DVRPC Board on July 23, 2009 as the long-range plan for the Greater Philadelphia region (including the 9-county Philadelphia Metro area). The plan addresses land use, environmental health, economic competitiveness and transportation policies, and includes a set of fiscally constrained transportation projects.

The "Connections" Plan supports the Water Department's green principles in several ways. The plan recognizes that community-scale green infrastructure, including increased tree coverage, green streets, green schoolyards and urban

agriculture, can contribute to more livable communities. The plan also seeks to establish an integrated network of bicycle facilities that connect communities and increase accessibility.

Appendix IV

Case Study: The Big Green Block

GREEN CONNECTION: BIG GREEN BLOCK TO THE RIVER

Big Green Block at the Shissler Recreation Center

Description: Stormwater management, streetscape improvements, pathways, energy efficiency retrofits, field improvement and art interventions in and around Shissler Recreation Center.
Partners: Philadelphia Parks & Recreation, PHS, NKCDC, PWD, Councilman Clarke, Councilwoman Sanchez and Mural Arts Program
Funding: $950,000 in leveraged capital

Kensington CAPA High School

Description: First LEED Platinum High School in the region.
Partners: Philadelphia School District, Youth United for Change, Office of Councilwoman Sanchez, Philadelphia Education Fund, NKCDC, FNA, EKNA, Empowerment Zone

Palmer Park

Description: Existing park, owned and managed by Philadelphia Parks & Recreation. New benches and pedestrian fixtures.

Columbia Ave Tree Plantings

Description: Street Tree Plantings
Partners: PHS, Philadelphia Parks & Recreation

Stormwater Intersection: Columbia and Thompson

Description: Design and build model stormwater intersection at Columbia and Thompson
Partners: NKCDC, PWD, PHS, DEP
Funding: $200,000 ($120,000 capital plus in-kind services)

Corridor Gateway: Columbia & Girard

Description: Streetscape improvements on Girard and a gateway at Girard and Columbia. Gateway designed by Studio Bryan Hanes.
Partners: NKCDC, Neighborhoods Now, Preservation Alliance, Mural Arts, Girard Avenue Coalition, PHS, PWD, Philadelphia Parks & Recreation, and Studio Bryan Hanes
Funding: $300,000 in capital leveraged

Penn Treaty Park

Description: New master plan for Penn Treaty Park
Partners: Led by Philadelphia Parks & Recreation with support from Friends of Penn Treaty Park, PHS, William Penn Foundation, DCNR, FNA, Penn Praxis, NKCDC, and Studio Bryan Hanes

Norris Street Connection

Description: Streetscape improvements to create safer pedestrian environment between the EL and Frankford
Partners: NKCDC, PA Elm Street Program, Mural Arts Program, PHS, Phila Weed and Seed, PIDC, NeighborWorks America and the City of Philadelphia Commerce Department
Funding: $213,000 in funding leveraged

Konrad Square

Description: New furniture and plantings and new stormwater management system with stormwater tree trenches.
Partners: Friends of Konrad Square, PHS, PWD, DCED, Office of Councilman DiCicco
Funding: $100,000

Garden Center

Description: NKCDC's Garden Center serves as a neighborhood resource in greening efforts.

Frankford Avenue Streetscapes

Description: Implement streetscape designs and improvements between York and Columbia.
Partners: NKCDC, City of Philadelphia Streets Department, Commerce Department, LISC, Hometown Streets, DVRPC, PennDOT
Funding: $3,300,000 in leveraged capital

Hetzell Field

Description: Revitalized playing field for youth, owned by the Department of Recreation
Partners: Fishtown Athletic Club,Philadelphia Parks & Recreation, School District of Philadelphia
Funding: $70,000

Hetzell & Adaire Stormwater Tree Trenches

Description: Stormwater management tree trenches in front of Adaire School and Hetzel Field
Partners: PHS, Philadelphia Parks & Recreation, School District of Philadelphia

Fishtown Recreation Center

Description: Existing recreation center, owned and managed by the Philadelphia Department of Recreation

Art and Intrigue

Description: Artistic interventions to draw people down Girard Ave to the Delaware River. Two murals on Girard will help map the way and temporary art components will follow down Columbia.
Partners: NKCDC, Mural Arts Program, and Fishtown Area Business Association
Funding: $100,000

Green Connection: Big Green Block

BIG GREEN BLOCK

The Big Green Block is exemplary of the types of green stormwater infrastructure projects that the Philadelphia Water Department will be working on throughout the next 25 years as we move forward with our implementation of the *GCCW* plan.

The Big Green Block is located in the New Kensington/Fishtown neighborhoods of Philadelphia within the Delaware Direct watershed. The Big Green Block area is bounded by Front Street, Frankford Avenue, Palmer Street, and Norris Street, totaling 20 acres, and includes the Shissler Recreation Center and Kensington CAPA High School.

GREEN STORMWATER INFRASTRUCTURE

The green stormwater infrastructure systems at the Big Green Block mitigate runoff from impervious surfaces within the public right-of-way, recreation center parcels, and school property, showing how several of PWD's land based programs, including Green Streets, Green Public Property, and Green Schools could be implemented. The planned stormwater tree trenches on Palmer Street, Montgomery Street, and in the field adjacent to Hewson St. and Blair St. will treat street run-off by infiltration and evapotranspiration, while watering the trees. Rain gardens on the Shissler Recreation Center property will also allow for detention of stormwater, as well as infiltration. The Kensington CAPA master plan features a porous pavement parking area, underground detention and infiltration facilities, rain gardens, green roofs covering 50% of the roof area, and rainwater cisterns for reuse, making this school a significant component of the Big Green Block. With other sustainable features such as geothermal heating and cooling and maximized daylighting, the school should achieve a LEED Platinum rating. Collectively, the green stormwater infrastructure systems installed at the Big Green Block equal 4.8 greened acres.

The Big Green Block initiative promotes greening and stormwater management of the city blocks within the neighborhood surrounding the Shissler Recreation Center by showcasing green stormwater infrastructure examples and engaging the local community through interpretive art, connecting green stormwater infrastructure to the neighborhoods' local river, the Delaware River, and the importance of water. The collaborative work on the Big Green Block was made possible only through strong partnerships and by actively involving the local community, resulting in an area that has been transformed into a neighborhood amenity that integrates stormwater management into the context of Philadelphia's neighborhoods.

In addition, neighborhood scale connections between this project and other projects could be made as green stormwater infrastructure and greening projects align to connect this part of the New Kensington/Fishtown neighborhood to the Delaware River. The illustration titled 'Green Connection: Shissler to the River' demonstrates this connection and gives an overview of each project.

PARTNERSHIP

The significant site improvements at the Big Green Block are a result of the collaboration between the Philadelphia Water Department (PWD), the Pennsylvania Horticultural Society (PHS), New Kensington Community Development Corporation (NKCDC), Sustainable 19125, Mural Arts Program, and Philadelphia Parks & Recreation. The Kensington Creative and Performing Arts School (CAPA) implemented several green stormwater infrastructure systems on its property, spurred by Philadelphia's stormwater regulations and potential LEED certification. The school achieved a LEED Platinum rating.

PARTNER DESCRIPTIONS, ROLES AND CONTRIBUTIONS

Philadelphia Water Department

Mission

Through *GCCW*, the Philadelphia Water Department seeks to protect and enhance our watersheds by managing stormwater with innovative green stormwater tools, maximizing economic, social, and environmental benefits to Philadelphia and creating a green legacy for future generations.

Role and Contributions

On Palmer Street, PWD has installed a stormwater tree trench with 5 trees, which manages street and sidewalk runoff from Palmer Street and Frankford Ave. On Montgomery Ave. PWD has installed stormwater tree trenches with 6 trees, which manage street and sidewalk runoff from Montgomery Ave. and Frankford Ave. A stormwater tree trench in sport field/ball park on the side of Blair St. contains 2 trees and manages street and sidewalk runoff from Blair St. and Berks St. Another stormwater tree trench in sport field/ball park on the side of Hewson Street contains 3 trees and manages street and sidewalk runoff from Hewson St. and Blair St. The total drainage area managed by these green stormwater infrastructure systems will be 54,290 square feet. In addition, PWD will planting street trees on Berks St. and Blair St. to increase canopy cover and shade.

PWD coordinated closely with PHS on the design and construction of the rain gardens at Shissler Recreation Center to benefit both partners. The rain gardens were oversized to include an increased amount of stone storage, accommodating additional run off from Blair Street. In return PWD installed the overflow connection between the existing sewer pipe and the rain gardens at a lower cost than PHS would have been able to do.

PWD and Philadelphia Department of Parks & Recreation shared costs for the installation of the stormwater tree trenches in the Shissler Recreation Center ball field. Philadelphia Parks & Recreation secured funds through the local council people and hired a contractor to renovate the ball field at Shissler Recreation, one of the last cinder fields left in the City. Through an interfund transfer, PWD funded the cost for the stormwater tree trenches, while the contractor hired by the Philadelphia Department of Parks & Recreation installed the stormwater tree trenches based on the construction drawings provided by PWD. PWD worked closely with Philadelphia Department of Parks & Recreation to time and phase this installation.

Additional green stormwater infrastructure projects are being led by the Philadelphia Water Department. A rain garden will be constructed at the intersection of Trenton Street and Norris

Street. PWD is also planning a stormwater bump-out for the intersection of Columbia Ave. and Thompson St., as well as a stormwater tree trench on Thompson St. which will manage street and sidewalk runoff from both Columbia Ave. and Thompson St.

New Kensington Community Development Corporation (NKCDC) and Sustainable 19125
Mission
NKCDC is a nonprofit organization dedicated to revitalizing the Kensington, Fishtown, and Port Richmond neighborhoods in Philadelphia. Its mission is to strengthen the physical, social, and economic fabric of the community by being a catalyst for sustainable development and community building.

Sustainable 19125
Sustainable 19125 is a community-driven initiative led by NKCDC with support from the Pennsylvania Horticultural Society. Sustainable 19125 is a broad and innovative partnership among community residents, businesses, and numerous government, nonprofit, and for profit, partners to make 19125 the greenest zip code in the city. For more information go to:

Role and Contributions
New Kensington CDC was the catalyst for the initiation of this project and brought PA Department of Environmental Projection funding to the effort. PHS worked on a master plan for the site with input from NKCDC and Philadelphia Water Department. The 'Big Green Block' is a program of Sustainable 19125 initiative and is combined with 'Green Blocks' and the 'Walk, Bike, Ride' campaign to provide community educational and action opportunities. New Kensington CDC has been crucial in being the connection to the local community, while also educating the neighborhood about the Big Green Block project. Building on the success of the project to date, New Kensington CDC has been able to secure additional grant funding to dedicate toward the Big Green Block project.

Pennsylvania Horticultural Society (PHS) and Philadelphia Green
Mission
PHS motivates people to improve the quality of life and create a sense of community through horticulture.

Philadelphia Green
PHS's **Green City Strategy** promotes a comprehensive approach to revitalizing and maintaining the city's green infrastructure as a key element in urban renewal. Philadelphia Green puts this approach into action by partnering with local residents, community groups, government, and businesses to:

- Develop and preserve community green space
- Plant trees
- Create green streetscapes
- Revitalize parks and public spaces
- Reclaim abandoned land
- Provide long-term landscape management

- Support open space planning
- Build community capacity

Role and Contributions

PHS through their Philadelphia Green program, was crucial in convening regular meetings for coordinating the Big Green Block project. PHS contributed financially to the project through grant funding from William Penn. PHS created a master plan for a majority of the Shissler Recreation Center site with input from New Kensington CDC, PWD, Mural Arts Program, Philadelphia Parks & Recreation and the local community. PHS designed and installed two vegetated infiltration gardens (rain gardens) in the parking lot area which manage the rainwater runoff from the parking lot and a portion of Blair Street. In addition, PHS installed stormwater tree trenches along Norris Street as well. In addition, the community outreach efforts were led by PHS in coordination with NKCDC staff.

Philadelphia Parks & Recreation (PP&R)

Mission

PP&R's charge is to develop and adopt written, enforceable standards related to the use of the city's park and recreational land and facilities, make recommendations to enhance revenue opportunities, and assist in promoting parks and recreational facilities and programs. Its goal is to increase the visibility and enormous opportunities that Philadelphia has to recapture its position as the nation's leader in the park and recreation field and sustain the legacy of William Penn's "greene countrie town."

Role and Contributions

PP&R has supported the Big Green Block project in various ways. PP&R, with the support of PWD, led the effort in organizing the Green Ribbon event highlighting the Big Green Block project, at the same time as launching the merger of two separate departments, the Fairmount Park Commission and Department of Recreation, into PP&R. The capital improvements PP&R contributed to this project transformed the formerly cinder field at the Shissler Recreation Center, into a brand new grass field. PP&R helped to secure a significant amount of funds from the local council people, Darrel Clarke and Maria D. Quiñones-Sánchez, for the field improvements. As mentioned previously, PP&R coordinated with PWD to install stormwater tree trenches. In addition, they have committed to creating enhanced recreational programming. Shissler Recreation Center, a property of PP&R, was host to many community meetings crucial to educating the community about the improvements.

In the future, it is hoped that a partnership for outreach and maintenance efforts for the green stormwater infrastructure systems on site and in the area could be developed in conjunction with PP&R and Shissler Recreation Center staff.

City of Philadelphia Mural Arts Program (MAP)

Mission

The City of Philadelphia Mural Arts Program unites artists and communities through a collaborative process, rooted in the traditions of mural-making, to create art that transforms public spaces and individual lives.

Role and Contributions

The Mural Arts Program involvement in the project is through its Restored Spaces Initiative. PWD is beginning a process to fully integrate green stormwater infrastructure into the Restored Spaces Initiative by developing demonstration projects that link green stormwater infrastructure with interpretive art. The Mural Arts Program's Restored Spaces Initiative – a multi-year, multisite project designed to engage underserved youth from the Mural Corps after school art education program and from local schools and civic institutions in the creation of multidimensional works of public art that focus on environmental education. This Initiative uses public art to catalyze the reclamation and restoration of our cityscape while creating sustainable and vibrant projects that foreground the elements of environmental education, urban sustainability, and revitalization.

To date MAP has transformed both sides of a large wall, between the Shissler Recreation Center and the Kensington CAPA School, with murals that relate the Delaware River to its watershed. The walls of the Shissler Recreation Center building have been painted with murals depicting river forms and with ceramic tiles with various water related textures. In addition, murals and mosaics along walls and sidewalks of Norris Street connecting the neighborhood to the Delaware River have been installed. Other plans include continuing this connection with medallions depicting organisms living in water, from Norris Street through the Shissler Recreation Center on Blair Street which now connects to Palmer leading down to the Delaware River.

PWD funding ($50,000) will be utilized to redesign the existing, cracked spray park at Shissler Recreation Center as an interactive site of water recreation and stormwater management. The play space will be connected to the PHS installed rain garden closest to the spray park, and include interpretive and interactive play elements. The rain garden will collect stormwater that currently drains directly into the City's combined sewer system and instead manage the water on-site through natural means – infiltration and evaporation. Other stormwater management design elements may include runnels. Furthermore, Mural Arts is working with PP&R, the PHS, and local neighborhood while planning this project.

PROCESS

A core portion of the partners, including PHS, NKCDC, and the Philadelphia Water Department attended monthly meetings convened by PHS to discuss any issues related to planning, design, and construction of Big Green Block components. In addition, the Mural Arts Program held several meetings outlining its work with the public. The rain garden portion of the project was reviewed by both PWD project team members and PWD Stormwater Plan Review as required by Philadelphia' Stormwater Regulations.

Appendix V

Private SMP Operation and Maintenance Agreement

OPERATIONS & MAINTENANCE AGREEMENT
FOR STORMWATER MANAGEMENT PRACTICES

THIS AGREEMENT made and entered into this day of , 2011, by and between Maxwell D. Paul & Sandra Paul ("**Property Owners**"), and the City of Philadelphia through the Water Department ("**City**" or "**PWD**").

WHEREAS, the Property Owner is the owner of certain real property at 4800-18 Chestnut Street, 4820-26 Chestnut Street, 4828-30 Chestnut Street, 4832-34 Chestnut Street & 4836-4838 Chestnut Street, Philadelphia, Pennsylvania, as described more particularly in **Exhibit A** attached hereto and made a part hereof ("**Property**");

WHEREAS, the Property Owner is proceeding to build on and develop the Property;

WHEREAS, the health, safety, and welfare of the residents of Philadelphia, Pennsylvania, require that on-site stormwater management practices be constructed and maintained on the Property;

WHEREAS, the Post-Construction Stormwater Management Plan and the Operations and Maintenance Plan ("**O&M Plan**"), which is expressly made a part hereof and attached hereto as **Exhibit B**, as approved or to be approved by the Water Department, provides for management of Property's stormwater; and

WHEREAS, the City requires that on-site stormwater management practices as shown on the O&M Plan be constructed and adequately maintained by the Property Owner then in title.

NOW, THEREFORE, in consideration of the foregoing premises, the mutual covenants contained herein, and the following terms and conditions, the parties hereto agree as follows:

1. Construction.

Property Owner shall construct the on-site stormwater management practices ("**SMPs**") in accordance with the plans and specifications identified in the O&M Plan (attached hereto as **Exhibit B**).

2. Operation & Maintenance Responsibility.

(a) This Agreement shall serve as the signed statement by the Property Owner accepting responsibility for operation and maintenance of stormwater treatment measures as set forth in this Agreement until the responsibility is legally transferred to another entity.

(b) This Agreement shall serve as notice to all successors and assigns of the title to Property of the obligations herein set forth. At such time as the Property is transferred, the new owner of the Property shall have the rights and responsibilities of the Property Owner as defined in this Agreement.

3. Maintenance of SMPs by Property Owner.

(a) Maintenance Standards.

Property Owner shall not destroy or remove or allow to be destroyed or removed SMPs from the Property or modify the SMPs in a manner that materially lessens effectiveness, and shall at Property Owner's sole expense, adequately maintain the SMPs in good working condition acceptable to the City in accordance with the O&M Plan, attached hereto as **Exhibit B**. This includes, but is not limited to all pipes and channels built to convey stormwater to the facility, as well as all structures, improvements, and vegetation provided to control the quantity and quality of the stormwater. Adequate maintenance is herein defined as good working condition so that the SMPs are performing their design functions within expected tolerances.

(b) Performance of Maintenance Work.

The Property Owner, his agent, or assign shall perform the work reasonably necessary to keep these facilities in good working order as appropriate. In the event an operation and maintenance schedule for the SMPs (including sediment removal) is outlined on the approved O&M Plan, then Property Owner shall use its best efforts to assure that the schedule will be followed.

4. Inspection by Property Owner.

Property Owner shall conduct inspections of the SMPs according to the schedule in the O&M Plan attached hereto as **Exhibit B**. The purpose of the inspection is to ensure safe and proper functioning of the SMPs. The inspection shall cover the entire facilities, including, but not limited to, berms, outlet structure, pond areas, and access roads.

5. Recordkeeping.

Property Owner shall retain a record of maintenance activities and inspections related to SMPs for a period of at least three (3) years. Such records shall verify that inspection and maintenance have been conducted pursuant to this Agreement. The City may request Property Owner to provide copies of any or all maintenance and inspection documentation prepared during the prior three years; Property Owner shall comply with any such requests within ten (10) business days after receipt of such request.

6. Inspection by City.

The Property Owner hereby grants permission to the City, its authorized agents and employees, to enter upon the Property upon providing forty-eight (48) hours written notice and, in any case, at reasonable times and without unreasonable disruption to inspect the SMPs in order to ensure SMPs are being adequately maintained and are continuing to perform the designed function. Any deficiencies identified by the City shall be reported to the Property Owner in writing.

7. Failure of Property Owner to Maintain SMP.

(a) Nuisance.

Property Owner agrees that failure to adequately maintain SMPs may constitute a public nuisance that is a threat to public health and safety and to the environment.

(b) City may Perform Maintenance.

In addition to any rights the City may have under law, if the Property Owner fails to adequately maintain the SMPs in good working condition as determined by the City, the City shall notify the Property Owner in writing of any and all deficiencies. If Property Owner fails to take action to correct deficiencies within thirty (30) business days of receipt of such notice, the City may enter upon the Property and take whatever steps reasonably necessary to correct deficiencies identified and charge the reasonable costs of such repairs to the Property Owner, its successors and assigns. Where deficiencies are such that cause imminent threat to public health or the environment, the City may take immediate steps necessary to protect public health and/or the environment and charge the reasonable costs of such repairs to the Property Owner, its successors and assigns. This provision shall not be construed to allow the City to erect any structure of permanent nature on the land of the Property Owner.

(c) Reimbursement by Property Owner of City Expenditures.

In the event the City, pursuant to this Agreement, performs work pursuant to Section 7(b), or expends any funds in performance of said work for labor, use of equipment, supplies, materials, and the like, the Property Owner shall reimburse the City upon written demand, within thirty (30) days of receipt thereof for all actual costs reasonably incurred by the City hereunder.

(d) Right to Lien.

In the event the Property Owner fails to reimburse the City within thirty (30) days after demand under paragraph 7(c), the City may place a lien on the Property for the entire amount due.

8. No Waiver.

Any delay or failure on the part of the City to exercise any rights, powers, or remedies herein provided shall not be construed as a waiver thereof or acquiescence of such breach or of any future breach.

9. No Obligation to Maintain by City.

It is expressly understood and agreed that the City is under no obligation to routinely inspect, maintain or repair such SMPs, and in no event shall this Agreement be construed to impose any such obligation on the City.

10. No Additional Rights.

It is the intent of this Agreement to ensure the proper maintenance of the SMPs by the Property Owner. This Agreement shall not create any new rights not otherwise provided by law for damage alleged to result from or caused by SMPs or stormwater runoff.

11. Covenant Running with Land.

The Property Owner agrees whenever the Property is held, sold, conveyed or otherwise transferred, the Property shall be subject to this Agreement which shall apply to, bind and be obligatory to all then current owner(s) of Property. This Agreement shall constitute a covenant running with the land, and shall be binding on the Property Owner,

its administrators, executors, assigns, heirs and any other successors in interest until such time as the Property Owner submits a new Operations and Maintenance Agreement to the City, such new agreement is approved by the City, which approval shall not be unreasonably withheld, and all conditions of City's approval are satisfied, such as construction including new SMPs. The obligations and responsibilities of Property Owner set forth in this Agreement shall apply to the then current owner of the Property.

12. Agreement to be recorded.

Property Owner, or the City by mutual written agreement, shall record this Agreement in the Philadelphia Department of Records at the Property Owner's expense. The City shall be the sole beneficiary of the conditions and restrictions set forth herein and such conditions and restrictions shall run with the land in favor of the City. Failure to record this Agreement shall not diminish the effect of this Agreement.

13. Condominium Owners Association or Homeowners Association Declaration.

This Agreement and its Exhibits shall be attached and/or incorporated into any Declaration of a condominium owner's association or homeowner's association that is responsible for maintenance of the SMPs. Failure to attach and/or incorporate this Agreement shall not diminish the effect of this Agreement.

14. Release of Agreement.

In the event that the City determines that the SMPs located on the Property are no longer required, then the City, at the request of Property Owner, shall execute a release of this Operations and Maintenance Agreement, which the Property Owner, or the City by mutual agreement, shall record in the Philadelphia Department of Records at the Property Owner's expense. The SMP(s) shall not be removed from the Property unless such a release is so executed and recorded.

15. Amendments.

This Agreement may only be amended, revised or modified by a written document signed by the then current owner(s) of the Property and the City.

IN WITNESS WHEREOF, and intending to be legally bound hereby, the parties hereto have caused the Agreement to be duly executed the day and year first above written.

APPROVED AS TO FORM

_____
City of Philadelphia
Law Department

City of Philadelphia

By: _____
Christopher Crockett
PWD, Director of Planning & Research

Property Owner

By: _____
Maxwell D. Paul

Property Owner

By: _____
Sandra Paul

ACKNOWLEDGEMENT

COMMONWEALTH OF PENNSYLVANIA :
: ss.
COUNTY OF PHILADELPHIA :

On this _____ day of _____, 2011, before me, a Notary Public for the Commonwealth of Pennsylvania, the undersigned Officer, personally appeared Christopher Crockett, who acknowledged himself to be the Director of Planning & Research of the City of Philadelphia Water Department, and that he, as such Director of Planning & Research, being authorized so to do, executed the foregoing instrument for the purposes therein contained by executing the same by himself as such Director of Planning & Research.

IN WITNESS WHEREOF, I hereunto set my hand and Notarial Seal.

_____
Notary Public

ACKNOWLEDGEMENT

COMMONWEALTH OF PENNSYLVANIA :
: ss.
COUNTY OF _____ :

On this _____ day of _____ 2011, before me, a Notary Public for the Commonwealth of Pennsylvania, the undersigned Officer, personally appeared Maxwell D. Paul & Sandra Paul, who acknowledged himself/herself to be the Owners of the properties under development, and that s/he, as such Owners, being authorized so to do, executed the foregoing instrument for the purposes therein contained by executing the same by her/himself as such Owners.

IN WITNESS WHEREOF, I hereunto set my hand and Notarial Seal.

_____
Notary Public

Exhibit A

METES AND BOUNDS DESCRIPTION
LANDS NOW OR FORMERLY
CENTRAL CITY TOYOTA, INC.
MAP 17 S 19, LOT 4
B.R.T./O.P.A. #88-2147406
CITY AND COUNTY OF PHILADELPHIA, 60TH WARD
COMMONWEALTH OF PENNSYLVANIA
PHILADELPHIA DISTRICT STANDARD

BEGINNING AT A POINT ON THE SOUTHERLY LINE OF CHESTNUT STREET (80 FOOT WIDE RIGHT-OF-WAY, LEGALLY OPEN), SAID POINT BEING DISTANT 250.00 FEET ON A COURSE OF NORTH 78 DEGREES 59 MINUTES 00 SECONDS WEST FROM THE POINT OF INTERSECTION CONNECTING THE SOUTHERLY LINE OF CHESTNUT STREET AND THE WESTERLY LINE OF 48TH STREET (80 FOOT WIDE RIGHT-OF-WAY, LEGALLY OPEN), THENCE;

1. ALONG THE DIVIDING LINE BETWEEN MAP 17 S 19, LOT 4 AND MAP 17 S 19, LOT 5, LANDS NOW OR FORMERLY CENTRAL CITY TOYOTA, INC., SOUTH 11 DEGREES 01 MINUTES 00 SECONDS WEST, A DISTANCE OF 215.17 FEET TO A POINT ON THE NORTHERLY LINE OF SANSOM STREET (50 FOOT WIDE RIGHT-OF-WAY, LEGALLY OPEN), THENCE;

2. ALONG THE NORTHERLY LINE OF SANSOM STREET, NORTH 78 DEGREES 59 MINUTES 00 SECONDS WEST, A DISTANCE OF 50.00 FEET TO A POINT, THENCE;

3. ALONG THE DIVIDING LINE BETWEEN MAP 17 S 19, LOT 4 AND MAP 17 S 19, LOT 6, LANDS NOW OR FORMERLY CENTRAL CITY TOYOTA, INC., NORTH 11 DEGREES 01 MINUTES 00 SECONDS EAST, A DISTANCE OF 215.17 FEET TO A POINT ON THE SOUTHERLY LINE OF CHESTNUT STREET, THENCE;

4. ALONG THE SOUTHERLY LINE OF CHESTNUT STREET, SOUTH 78 DEGREES 59 MINUTES 00 SECONDS EAST, A DISTANCE OF 50.00 FEET TO THE POINT AND PLACE OF BEGINNING.

CONTAINING 10,759 SQUARE FEET OR 0.24698 ACRES

THIS PROPERTY SUBJECT TO RESTRICTIONS, COVENANTS AND/OR EASEMENTS EITHER WRITTEN OR IMPLIED.

THIS DESCRIPTION WAS WRITTEN BASED UPON A MAP ENTITLED “ALTA/ACSM LAND TITLE SURVEY, CENTRAL CITY TOYOTA, INC.”, PREPARED BY CONTROL POINT ASSOCIATES, INC., DATED 1-14-2011, FILE NO. CP10204, SHEET 1 OF 1.

METES AND BOUNDS DESCRIPTION
LANDS NOW OR FORMERLY
CENTRAL CITY TOYOTA, INC.
MAP 17 S 19, LOT 5
B.R.T./O.P.A. #88-2147405
CITY AND COUNTY OF PHILADELPHIA, 60TH WARD
COMMONWEALTH OF PENNSYLVANIA
PHILADELPHIA DISTRICT STANDARD

BEGINNING AT A POINT ON THE SOUTHERLY LINE OF CHESTNUT STREET (80 FOOT WIDE RIGHT-OF-WAY, LEGALLY OPEN), SAID POINT BEING DISTANT 200.00 FEET ON A COURSE OF NORTH 78 DEGREES 59 MINUTES 00 SECONDS WEST FROM THE POINT OF INTERSECTION CONNECTING THE SOUTHERLY LINE OF CHESTNUT STREET AND THE WESTERLY LINE OF 48TH STREET (80 FOOT WIDE RIGHT-OF-WAY, LEGALLY OPEN), THENCE;

1. ALONG THE DIVIDING LINE BETWEEN MAP 17 S 19, LOT 5 AND MAP 17 S 19, LOT 15, LANDS NOW OR FORMERLY MAXWELL D. & SANDRA PAUL, SOUTH 11 DEGREES 01 MINUTES 00 SECONDS WEST, A DISTANCE OF 215.17 FEET TO A POINT ON THE NORTHERLY LINE OF SANSOM STREET (50 FOOT WIDE RIGHT OF WAY, LEGALLY OPEN), THENCE;

2. ALONG THE NORTHERLY LINE OF SANSOM STREET, NORTH 78 DEGREES 59 MINUTES 00 SECONDS WEST, A DISTANCE OF 50.00 FEET TO A POINT, THENCE;

3. ALONG THE DIVIDING LINE BETWEEN MAP 17 S 19, LOT 4, LANDS NOW OR FORMERLY CENTRAL CITY TOYOTA, INC AND MAP 17 S 19, LOT 5, NORTH 11 DEGREES 01 MINUTES 00 SECONDS EAST, A DISTANCE OF 215.17 FEET TO A POINT ON THE SOUTHERLY LINE OF CHESTNUT STREET, THENCE;

4. ALONG THE SOUTHERLY LINE OF CHESTNUT STREET, SOUTH 78 DEGREES 59 MINUTES 00 SECONDS EAST, A DISTANCE OF 50.00 FEET TO THE POINT AND PLACE OF BEGINNING.

CONTAINING 10,759 SQUARE FEET OR 0.24698 ACRES

THIS PROPERTY SUBJECT TO RESTRICTIONS, COVENANTS AND/OR EASEMENTS EITHER WRITTEN OR IMPLIED.

THIS DESCRIPTION WAS WRITTEN BASED UPON A MAP ENTITLED “ALTA/ACSM LAND TITLE SURVEY, CENTRAL CITY TOYOTA, INC.”, PREPARED BY CONTROL POINT ASSOCIATES, INC., DATED 1-14-2011, FILE NO. CP10204, SHEET 1 OF 1.

METES AND BOUNDS DESCRIPTION
LANDS NOW OR FORMERLY
CENTRAL CITY TOYOTA, INC.
MAP 17 S 19, LOT 6
B.R.T./O.P.A. #88-2147407
CITY AND COUNTY OF PHILADELPHIA, 60TH WARD
COMMONWEALTH OF PENNSYLVANIA
PHILADELPHIA DISTRICT STANDARD

BEGINNING AT A POINT ON THE SOUTHERLY LINE OF CHESTNUT STREET (80 FOOT WIDE RIGHT-OF-WAY, LEGALLY OPEN), SAID POINT BEING DISTANT 300.00 FEET ON A COURSE OF NORTH 78 DEGREES 59 MINUTES 00 SECONDS WEST FROM THE POINT OF INTERSECTION CONNECTING THE SOUTHERLY LINE OF CHESTNUT STREET AND THE WESTERLY LINE OF 48TH STREET (80 FOOT WIDE RIGHT-OF-WAY, LEGALLY OPEN), THENCE;

1. ALONG THE DIVIDING LINE BETWEEN MAP 17 S 19, LOT 6 AND MAP 17 S 19, LOT 4, LANDS NOW OR FORMERLY CENTRAL CITY TOYOTA, INC., SOUTH 11 DEGREES 01 MINUTES 00 SECONDS WEST, A DISTANCE OF 215.17 FEET TO A POINT ON THE NORTHERLY LINE OF SANSOM STREET (50 FOOT WIDE RIGHT-OF-WAY, LEGALLY OPEN), THENCE;

2. ALONG THE NORTHERLY LINE OF SANSOM STREET, NORTH 78 DEGREES 59 MINUTES 00 SECONDS WEST, A DISTANCE OF 50.00 FEET TO A POINT, THENCE;

3. ALONG THE DIVIDING LINE BETWEEN MAP 17 S 19, LOT 6 AND MAP 17 S 19, LOT 9, LANDS NOW OR FORMERLY CENTRAL CITY TOYOTA, INC., NORTH 11 DEGREES 01 MINUTES 00 SECONDS EAST, A DISTANCE OF 215.17 FEET TO A POINT ON THE SOUTHERLY LINE OF CHESTNUT STREET, THENCE;

4. ALONG THE SOUTHERLY LINE OF CHESTNUT STREET, SOUTH 78 DEGREES 59 MINUTES 00 SECONDS EAST, A DISTANCE OF 50.00 FEET TO A THE POINT AND PLACE OF BEGINNING.

CONTAINING 10,759 SQUARE FEET OR 0.24698 ACRES

THIS PROPERTY SUBJECT TO RESTRICTIONS, COVENANTS AND/OR EASEMENTS EITHER WRITTEN OR IMPLIED.

THIS DESCRIPTION WAS WRITTEN BASED UPON A MAP ENTITLED “ALTA/ACSM LAND TITLE SURVEY, CENTRAL CITY TOYOTA, INC.”, PREPARED BY CONTROL POINT ASSOCIATES, INC., DATED 1-14-2011, FILE NO. CP10204, SHEET 1 OF 1.

METES AND BOUNDS DESCRIPTION
LANDS NOW OR FORMERLY
MAXWELL D. & SANDRA PAUL
MAP 17 S 19, LOT 15
B.R.T./O.P.A. #88-2147402
CITY AND COUNTY OF PHILADELPHIA, 60TH WARD
COMMONWEALTH OF PENNSYLVANIA
PHILADELPHIA DISTRICT STANDARD

BEGINNING AT A POINT ON THE SOUTHERLY LINE OF CHESTNUT STREET (80 FOOT WIDE RIGHT-OF-WAY, LEGALLY OPEN), SAID POINT BEING DISTANT 100.00 FEET ON A COURSE OF NORTH 78 DEGREES 59 MINUTES 00 SECONDS WEST FROM THE POINT OF INTERSECTION CONNECTING THE SOUTHERLY LINE OF CHESTNUT STREET AND THE WESTERLY LINE OF 48TH STREET (80 FOOT WIDE RIGHT-OF-WAY, LEGALLY OPEN), THENCE;

1. ALONG THE DIVIDING LINE BETWEEN MAP 17 S 19, LOT 15 AND MAP 17 S 19, LOT 17, LANDS NOW OR FORMERLY CENTRAL CITY TOYOTA, INC., SOUTH 11 DEGREES 01 MINUTES 00 SECONDS WEST, A DISTANCE OF 215.17 FEET TO A POINT ON THE NORTHERLY LINE OF SANSOM STREET (50 FOOT WIDE RIGHT-OF-WAY, LEGALLY OPEN), THENCE;

2. ALONG THE NORTHERLY LINE OF SANSOM STREET, NORTH 78 DEGREES 59 MINUTES 00 SECONDS WEST, A DISTANCE OF 100.00 FEET TO A POINT, THENCE;

3. ALONG THE DIVIDING LINE BETWEEN MAP 17 S 19, LOT 5, LANDS NOW OR FORMERLY CENTRAL CITY TOYOTA, INC, NORTH 11 DEGREES 01 MINUTES 00 SECONDS EAST, A DISTANCE OF 215.17 FEET TO A POINT ON THE SOUTHERLY LINE OF CHESTNUT STREET, THENCE;

4. ALONG THE SOUTHERLY LINE OF CHESTNUT STREET, SOUTH 78 DEGREES 59 MINUTES 00 SECONDS EAST, A DISTANCE OF 100.00 FEET TO THE POINT AND PLACE OF BEGINNING.

CONTAINING 21,517 SQUARE FEET OR 0.49397 ACRES

THIS PROPERTY SUBJECT TO RESTRICTIONS, COVENANTS AND/OR EASEMENTS EITHER WRITTEN OR IMPLIED.

THIS DESCRIPTION WAS WRITTEN BASED UPON A MAP ENTITLED “ALTA/ACSM LAND TITLE SURVEY, CENTRAL CITY TOYOTA, INC.”, PREPARED BY CONTROL POINT ASSOCIATES, INC., DATED 1-14-2011, FILE NO. CP10204, SHEET 1 OF 1.

METES AND BOUNDS DESCRIPTION
LANDS NOW OR FORMERLY
CENTRAL CITY TOYOTA, INC.
MAP 17 S 19, LOT 17
B.R.T./O.P.A. #88-2147401
CITY AND COUNTY OF PHILADELPHIA, 60TH WARD
COMMONWEALTH OF PENNSYLVANIA
PHILADELPHIA DISTRICT STANDARD

BEGINNING AT A POINT OF INTERSECTION CONNECTING THE SOUTHERLY LINE OF CHESTNUT STREET (80 FOOT WIDE RIGHT-OF-WAY, LEGALLY OPEN) AND THE WESTERLY LINE OF 48TH STREET (80 FOOT WIDE RIGHT-OF-WAY, LEGALLY OPEN), THENCE;

1. ALONG THE WESTERLY RIGHT-OF-WAY LINE OF 48TH STREET, SOUTH 11 DEGREES 01 MINUTES 00 SECONDS WEST, A DISTANCE OF 215.17 FEET TO A POINT OF INTERSECTION CONNECTING THE WESTERLY LINE OF 48TH STREET AND THE NORTHERLY LINE OF SANSOM STREET (50 FOOT WIDE RIGHT-OF-WAY, LEGALLY OPEN), THENCE;

2. ALONG THE NORTHERLY LINE OF SANSOM STREET, NORTH 78 DEGREES 59 MINUTES 00 SECONDS WEST, A DISTANCE OF 100.00 FEET TO A POINT, THENCE;

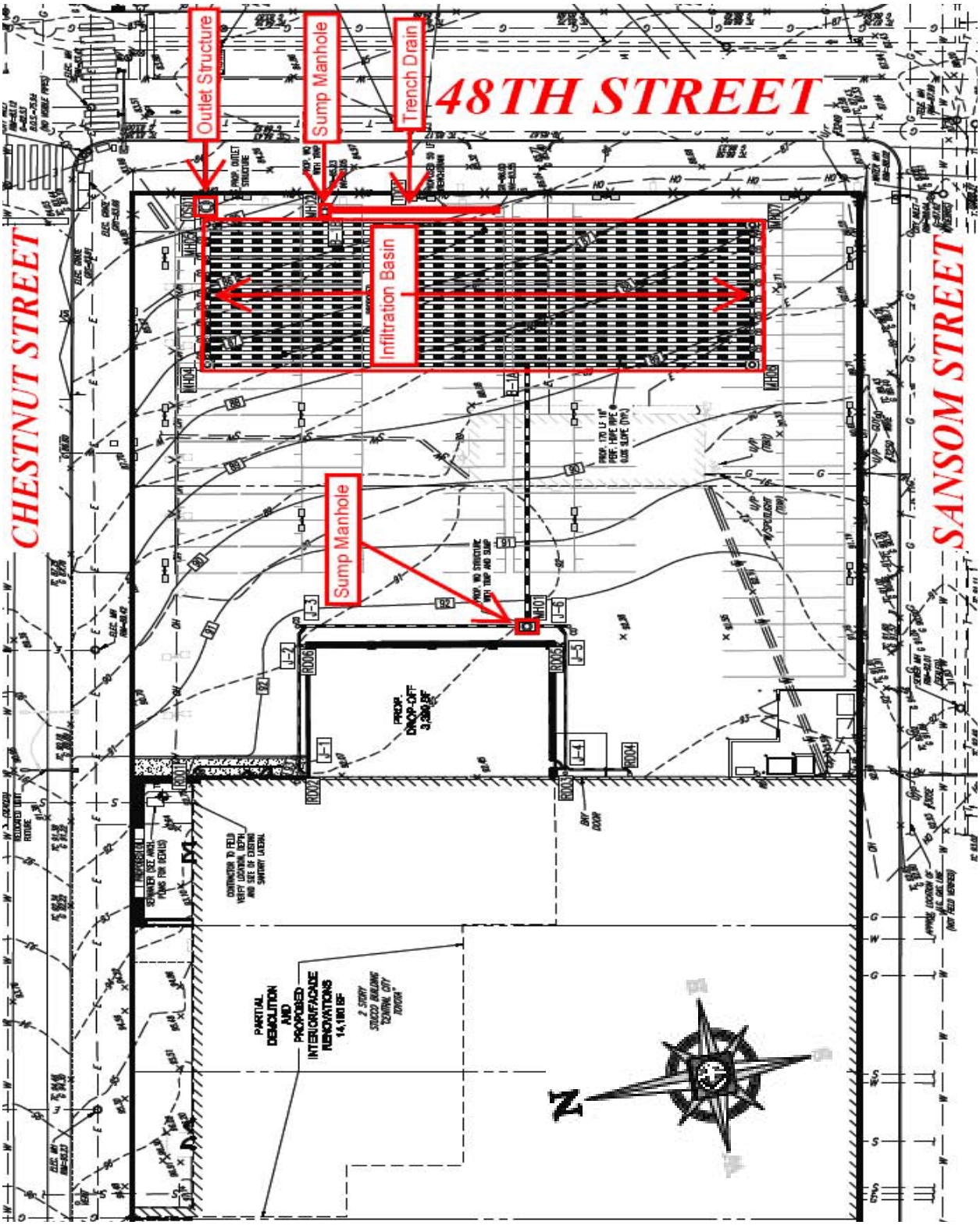
3. ALONG THE DIVIDING LINE BETWEEN MAP 17 S 19, LOT 17, LANDS NOW OR FORMERLY CENTRAL CITY TOYOTA, INC. AND MAP 17 S 19, LOT 15, LANDS NOW OR FORMERLY MAXWELL D. PAUL AND SANDRA PAUL, NORTH 11 DEGREES 01 MINUTES 00 SECONDS EAST, A DISTANCE OF 215.17 FEET TO A POINT ON THE SOUTHERLY LINE OF CHESTNUT STREET, THENCE;

4. ALONG THE SOUTHERLY LINE OF CHESTNUT STREET, SOUTH 78 DEGREES 59 MINUTES 00 SECONDS EAST, A DISTANCE OF 100.00 FEET TO THE POINT AND PLACE OF BEGINNING.

CONTAINING 21,517 SQUARE FEET OR 0.49397 ACRES

THIS PROPERTY SUBJECT TO RESTRICTIONS, COVENANTS AND/OR EASEMENTS EITHER WRITTEN OR IMPLIED.

THIS DESCRIPTION WAS WRITTEN BASED UPON A MAP ENTITLED “ALTA/ACSM LAND TITLE SURVEY, CENTRAL CITY TOYOTA, INC.”, PREPARED BY CONTROL POINT ASSOCIATES, INC., DATED 1-14-2011, FILE NO. CP10204, SHEET 1 OF 1.



SMP Location Map

Exhibit B

Trench Drain

Description: There is one (1) trench drain on site. The trench drain consists of U-shape reinforced concrete channel with 8 inch thick bottom an sides and inside dimensions of 24 inch with a variable depth. It also includes a NEENAH foundry pattern No. R-4990-HX with Type C grate and Type X frame.
Location: The trench drain is identified on the location map on p. 14 of this Agreement.

Operation & Maintenance Plan

Maintenance Activity
• Clean out leaves, trash and other debris on regular intervals to maintain function. • Inspect for sediment and debris buildup. Remove sediment buildup when it exceeds 2-inches in depth or if it begins to constrict flow path. • Identify sources of sediment contamination and control when native soil is exposed or erosion channels are present.

Exhibit B

Sump Manhole

Description: There are two (2) sump manholes on site. The precast reinforced concrete structures consist of a 60 foot maximum length with 5 inch thick walls and a depth that varies. The structure has a manhole frame and lid for access and maintenance. A sump and trap is included for pre-treatment of stormwater flow prior to entering proposed infiltration basin.
Location: The sump manholes are identified on the location map on p. 14 of this Agreement.

Operation & Maintenance Plan

Maintenance Activity
• Inspect for sediment and debris buildup. Remove sediment buildup when it exceeds 2-inches in depth or if it begins to constrict flow path. • Identify sources of sediment contamination and control when native soil is exposed or erosion channels are present.

Exhibit B

Subsurface Infiltration Basin

Description: There is one (1) subsurface infiltration basin on site. It has eighteen rows of 18 inch perforated ADS pipes of varying lengths and dimensions of 50 feet X 162 feet. These pipes are imbedded in AASHTO #57 stone double wash, 6 inches of clean washed pea gravel and all sides of the basin are wrapped with non-woven geotextile fabric on the top and sides.
Location: The subsurface infiltration basin is identified on the location map on p. 14 of this Agreement.

Operation & Maintenance Plan

Maintenance Activity
• Regularly clean out gutters and catch basins to reduce sediment load to infiltration system. Clean intermediate sump boxes, replace filters, and otherwise clean pretreatment areas in directly connected systems. • Inspect and clean all components and connections to subsurface infiltration system as needed. • Evaluate the drain-down time of the subsurface infiltration system to ensure the drain-down time of 24-72 hours.

Exhibit B

Outlet Control Structure

Description: There is one (1) outlet control structure on site. The modified Type 4 Penndot box has outside dimensions of 60 inches X 60 inches. There is an 18 inch RCP pipe connecting from Manhole 5 and a 15 inch RCP pipe connecting to the storm sewer line.
Location: The outlet structure is identified on the location map on p. 14 of this Agreement.

Operation & Maintenance Plan

Maintenance Activity
• Inspect outlet control devices after several storms to ensure that they are functioning properly and that there are no erosion problems developing. • Identify and control source of sediment contamination when native soil is exposed or erosion channels are present. • Inspect for sediment and debris buildup. Remove sediment buildup exceeding 2 inches in depth or when it begins to constrict the flow path.

Appendix VI

Stormwater Credit Program Application Form B

Request Number (City use only)

CITY OF PHILADELPHIA
FORM B
STORMWATER CREDITS APPLICATION

I. General Information:

OPA/BRT Account #: _____ Date: _____

PWD Account #: _____

Property Address: _____

PWD Post Construction Stormwater Management Plan (PCSMP) Approval: Yes ☐ No ☐

Stormwater Tracking #: _____

Owner:

Name: _____

Mailing Address: _____

Phone: _____

Email: _____

Registered Professional:

Name: _____

Company: _____

Mailing Address: _____

Phone: _____

Email: _____

Authorized Representative (if not Owner):

All correspondence pertaining to this application should be communicated to:

Name: _____

Title: _____

Mailing Address: _____

Phone: _____

Email: _____

Owner's Company Seal:

II. Registered Professional Certification:

I certify that the all maps, plans, and supporting documentation are an accurate representation of the subject property and its current conditions, and that the required calculations have been performed as per acceptable standards.

Registered Professional: _____

Registration Number: _____

_____ _____

Signature of Professional Date

III. Credit Request & Application Fee:

Please indicate which credit(s) you are applying for and the percentage or square footage of credit you are requesting. An application fee of **$150 (non-refundable)** must be submitted with this application. The application fee can be paid by check or money order to the City of Philadelphia Water Department.

☐ **Gross Area (GA) Credit**

Option 1: NRCS-CN: _____ %

Option 2: Peak Rate Attenuation: _____ Square Feet

The GA Credit application requirements are listed on FORM B1 of this application. Approved GA Credit will be applied towards the GA Charge.

☐ **Impervious Area (IA) Credit:** _____ Square Feet

The IA Credit application requirements are listed on FORM B2 of this application. Approved IA Credit will be applied towards the IA Charge.

☐ **NPDES Permit Credit:**

The NPDES Credit application requirements are listed on FORM B3 of this application. Approved NPDES Permit Credit will result in a 7% credit applied towards the entire SWMS Charge.

IV. Owner Certification and Right-of-Entry:

I certify that the information contained in this application is, to the best of my knowledge, correct and represents a complete and accurate statement. I further understand that the approved Stormwater Credits will be based on the information provided, and the City may revoke the credit if it later determines the information provided is inaccurate. I hereby grant permission to the City, its authorized agents and employees, to enter the Property upon providing 48 hours written notice and, in any case, at reasonable times and without unreasonable disruption to inspect the Property to ensure that the provided information accurately represents the current stormwater management conditions.

_____ _____

Signature of Owner / Authorized Representative Date

_____

Print Name

* Details on the application requirements and required supporting documentation are provided in the Storm Water Credits and Adjustment Appeals Manual available at www.phila.gov/water/stormwater_billing.

Send the completed application, fee, and supporting documentation to:
SWMS Charge Adjustment Appeals / Credits Review Coordinator
Philadelphia Water Department
1101 Market St., 4th Floor
Philadelphia, PA 19107

For inquiries, please call 215-685-6387
or email PWD.StormwaterCredits@phila.gov.

B1 - GROSS AREA CREDIT

Option 1: GA Credit Based on NRCS-CN

Required Information

PWD will only review completed credits applications. An application is complete when all of the required supporting documents are received by PWD.

Check if attached	**All of the following must be provided with this application:**
	Site Plan (signed and sealed by Registered Professional)***
	Soils Map (downloadable maps available through the NRCS Web Soil Survey http://websoilsurvey.nrcs.usda.gov)
	Completed GA Credit Worksheet (available online at www.phila.gov/water/stormwater_billing and page 5 of this application)

Option 2: GA Credit Based on Attenuation of Peak Rate of Runoff

Required Information

PWD will only review completed credits applications. An application is complete when all of the required supporting documents are received by PWD.

Check if attached	**For properties with a PWD-approved PCSMP, all of the following must be provided:**
	Stormwater Management Plan (signed and sealed by a Registered Professional)**
	Photos of the SMP and surrounding drainage area
	SMP as-built drawings OR a document certifying that SMP(s) are built according to PWD approved drawings
	Record of inspections and maintenance activity for each SMP

Check if attached	**For properties without a PWD-approved PCSMP, all of the following must be provided:**
	Stormwater Management Plan (signed and sealed by a Registered Professional)**
	Photos of the SMP and surrounding drainage area
	Hydrologic and hydraulic calculations demonstrating that the credit requirement is being met
	Stormwater Management Report/Summary*
	Stormwater Management Practice detail drawings (e.g. cross-section, elevation)

*The attached Stormwater Management Report/Summary must contain at least the following:
1. Description of SMP(s)
2. Description of contributing drainage areas to SMP(s)
3. Description of means of conveyance to SMP(s)

**The attached Stormwater Management Plan must contain at least the following:
1. Name of Property Owner
2. Property Address
3. North arrow, legend and graphical scale
4. Site contours
5. Impervious and pervious area delineations with area estimates
6. Property lines
7. Street lines and names
8. All drainage infrastructure including conveyance pipes, inlets, drains, and roof leaders
9. Location of SMP(s)
10. Signature and Seal of Registered Professional (dated)

***The attached Site Plan must contain at least the following:
1. Soils delineations and area estimates
2. Cover type delineations and area estimates
3. Description of means of conveyance to SMP(s)
4. Accurate representation of current property conditions

B1 - GROSS AREA CREDIT WORKSHEET INSTRUCTIONS FOR NRCS CURVE NUMBER (OPTION 1)

1. For each cover type on the subject property, list the hydrologic soil group of the underlying soil in Column C and the corresponding Curve Number (CN) value in Column D.
2. In Column E enter the area that each cover type encompasses.
3. Multiply the values in Column D and E, and place the product in Column F.
4. When all values have been calculated and entered, find the sums of Columns E and F, and place these values at the bottom of the worksheet in the corresponding row titled "TOTAL SUMS".
5. To find the Average CN, divide the total sum of Column F by the total sum of Column E.
6. Calculate the percent age of GA Credit. To do this, round the Average CN to the nearest whole number, subtract from 87, and multiply the difference by 7. If the Average CN is over 86, then the property does not qualify for GA Credit. The highest percentage of GA Credit that can be awarded is 100%.

Table 5.4: PWD Accepted Curve Number Values

Cover Description		Curve Number for Hydrologic Soil Group				
Cover Type	Hydrologic Condition	A	B	C	D	Ub
Lawns, parks, golf courses, etc.						
	Poor (grass cover < 50%)	68	79	86	89	79
	Fair (grass cover 50% to 75%)	49	69	79	84	69
	Good (grass cover > 75%)	39	61	74	80	61
Meadow		30	58	71	78	58
Athletic Fields		68	79	86	89	79
Porous Turf		70	70	79	84	69
Brush (brush-weed-grass mixture with brush the major element)						
	Poor	57	73	82	86	73
	Fair	43	65	76	82	65
	Good	32	58	72	79	58
Woods-grass combination (orchard or tree farm)						
	Poor	57	73	82	86	73
	Fair	43	65	76	82	65
	Good	32	58	72	79	58
Woods						
	Poor	45	66	77	83	66
	Fair	36	60	73	79	60
	Good	30	55	70	77	55
Paved parking lots, roofs, driveways. streets, etc.		98	98	98	98	98
Gravel		76	85	89	91	89
Dirt		72	82	87	89	87
Porous Pavement		70	70	74	80	70
Permeable Pavers		70	70	79	84	70
Pour-in-Place Rubber		70	70	74	80	70
Green Roof		86	86	86	86	86

BI - GA CREDIT WORKSHEET
FOR NRCS CURVE NUMBER (OPTION 1)

Column A	Column B	Column C	Column D	Column E	Column F
Cover Type	Hydrologic Condition	Hydrologic Soil Group	CN	Area (SF)	Product
Lawn, parks, golf courses, etc.	Poor(grass cover <50%)				
	Fair(grass cover 50-75%)				
	Good(grass cover >75%)				
Meadow	NA				
Athletic Fields	NA				
Porous Turf	NA				
Brush	Poor				
	Good				
	Fair				
Wood-grass combination	Poor				
	Good				
	Fair				
Woods	Poor				
	Good				
	Fair				
Paved parking lots, roofs, driveways, streets, etc.	NA				
Gravel	NA				
Dirt	NA				
Porous Pavement	NA				
Permeable Pavers	NA				
Pour-in-Place Rubber	NA				
Green Roof	NA				
TOTAL SUMS					

Average CN
(∑ F / ∑ E) _____

% GA Credit
_____

B2 - IMPERVIOUS AREA CREDIT

Required Information

PWD will only review completed credits applications. An application is complete when all of the required supporting documents are received by PWD.

Check if attached	**For properties with a PWD-approved PCSMP, all of the following must be provided with this application:**
	Stormwater Management Plan (signed and sealed by a Registered Professional)**
	Photos of the SMP and surrounding drainage area
	SMP as-built drawings OR a document certifying that SMP(s) are built according to PWD approved drawings
	Record of inspections and maintenance activity for each SMP since the SMP was installed

Check if attached	**For properties without a PWD-approved PCSMP, all of the following must be provided with this application:**
	Stormwater Management Plan (signed and sealed by a Registered Professional)**
	Photos of the SMP and surrounding drainage area
	Stormwater Management Report/Summary*
	SMP detail drawings (e.g. cross-section, elevation)

*The attached Stormwater Management Report/Summary must contain at least the following:
1. Description of SMP(s)
2. Description of contributing drainage areas to SMP(s)
3. Description of means of conveyance to SMP(s)

**The attached Stormwater Management Plan must contain at least the following:
1. Name of Property Owner
2. Property Address
3. North arrow, legend and graphical scale
4. Site contours
5. Impervious and pervious area delineations with area estimates
6. Property lines
7. Street lines and names
8. All drainage infrastructure including conveyance pipes, inlets, drains, and roof leaders
9. Location of SMP(s)
10. Signature and Seal of Registered Professional (dated)

B3 - NPDES PERMIT CREDIT

Required Information

PWD will only review completed credits applications. An application is complete when all of the required supporting documents are received by PWD.

Check if attached	**All of the following must be provided with this application:**
	Copy of NPDES Industrial Stormwater Permit
	Copy of the results of the required PaDEP *Discharge Monitoring Report* from the current year

Appendix VII

Analysis of SMP Maintenance Protocols

Analysis of SMP Maintenance Protocols

Introduction

The information provided in this document is based on research conducted on nationwide Green Stormwater Infrastructure maintenance programs and manuals.

Research was conducted over the summer of 2011 and consisted of a nation-wide query of current green stormwater programs and their respective guidelines, manuals, checklists or other practices associated with green infrastructure maintenance activities

A total of 152 stormwater maintenance manuals were evaluated from a mix of cities, states, and government agencies. The result is a compilation of relevant data to support the development of PWD's *Green City, Clean Waters* program, including:

- Program financing, including both funding and cost,
- Maintenance frequency,
- Inspection requirements,
- Partnerships opportunities in terms of work performed, program management and funding
- Reporting of maintenance and inspections
- Design issues

Specific field practices, including irrigation, vegetation management, sediment removal, materials, and underdrain systems are also compiled in the following pages. This extensive research has been compiled into "Spotlight" reviews of each Stormwater Management Practice and their respective maintenance activities, design suggestions, issues or concerns, costs and any additional valuable information gained from research. This compendium document will be updated as the Water Department gathers additional information on maintenance practices and procedures from other entities around the country.

Green Stormwater Infrastructure Maintenance
Spotlight on *Bio-Infiltration/Bio-Retention*

1. Introduction

This section outlines the information that was gathered for the following types of SMPs:

Wetland: A vegetated basin designed principally for pollutant removal. They normally hold runoff for periods longer than 72 hours. Constructed wetlands also provide extended detention of a variety of storm events.

Gravel Wetland: One or more cells filled with crushed rock designed to support wetland plants. Stormwater flows subsurface through the root zone of the constructed wetland where pollutant removal takes place.

Bio-Retention Basin: A large excavated depression landscaped with native grasses or vegetation that temporarily detains stormwater and provide controlled stormwater flow. Infiltration can be designed where feasible.

Rain Garden: Rain gardens are vegetated areas designed to infiltrate and/or detain and release stormwater. Rain gardens are also commonly referred to as bio-infiltration basins and bio-retention basins. They are typically small in scale and are often integrated into landscape features (ex: median strips). Rain gardens can also function as a management device that can capture, store, or infiltrate runoff from roof leaders.

A list of documents pertaining to the above mentioned SMPs are provided under the references section and can be used to pursue further information or clarification on the topics discussed in this report.

2. Maintenance Activities

The following table provides an overview of the frequency, inspection requirements and field practices related to bio-infiltration/bio-retention maintenance. This information was compiled from various manuals; the specific maintenance activities for bio-infiltration/bio-retention devices are described below.

Frequency	Inspection Requirements	Field Practices	Wetland	Gravel Wetland	Bio-Retention Basin	Rain Garden
As Needed	▪ Ensure that at least 50% of shallow marsh area is covered by wetland vegetation. ▪ Remove woody vegetation within 15 ft of the toe embankment or 25 ft from the principal spillway or growing on other structural features. ▪ Inspect for erosion, cracking, embankment subsidence, burrowing animals, sediment and clogging in the emergency spillway, drain and forebay. ▪ If erosion channels are evident, they can be stabilized with additional growth medium that is similar to the original. Use small stones to stabilize the erosion along the drainage paths.	▪ If sediment build-up is preventing flow through the wetland, remove gravel and sediment from cells. Replace with clean gravel and replant vegetation. ▪ Remove sediment from main cells of pond once the original volume has been significantly reduced every 5-10 years. ▪ Remove sediment from forebay every 5-6 years or when 50% full; from wetland if 25% of capacity is lost or long flow path of water is hindered. ▪ Repair/replace structural elements as necessary. ▪ Remove larger burrowing animals as necessary. ▪ Replace mulch over the entire area every 2-3 years. ▪ Replace pea gravel diaphragm when needed. ▪ Do not stockpile snow in rain garden and do not place grass clippings/landscape waste in rain garden in order to prevent clogging of bioswale soil mix, which would limit infiltration capacity. ▪ Replace soil once/every 20 years or as needed. ▪ Fertilize once initially. ▪ The basin floor should be covered with a 3”-4” layer of mulch.	X	X	X	X
Monthly	▪ Ensure that inlets and outlets to each submerged gravel wetland cell are free from debris and not clogged. ▪ Monthly-Quarterly or after a major storm (>1”) inspect low flow orifices and other pipes for clogging; check the permanent pool or dry pond area for floating debris, undesirable vegetation; investigate the	▪ Mow rain garden if needed.	X	X	X	X

Frequency	Inspection Requirements	Field Practices	Wetland	Gravel Wetland	Bio-Retention Basin	Rain Garden
	shoreline for erosion; monitor wetland plant composition and health. ▪ Inspect plants to make sure they are free of pests and diseases.					
Quarterly	▪ Inspect wetland for abnormal algae growth and address as needed.	▪ Clean and remove debris from inlet/outlet structures. ▪ Mow side slopes. ▪ Repair/replace vegetation as necessary to maintain full cover.	X		X	
Semi-Annually	▪ Monitor wetland plant composition and health; Identify invasive plants. ▪ The rain garden system should drain within 48 hours of a storm event. Core aeration can be used to refresh infiltration capacity. ▪ Inspect grass filter strip for erosion or gullying.	▪ Mow, remove debris, remove undercut, eroded, and back soil area. ▪ Harvest wetland plants; replant vegetation; repair broken mechanical components (if needed). ▪ Remove sediments if they are within 18" of an outlet opening. ▪ In spring and fall add 1" of mulch to rain garden. ▪ Prune rain garden. ▪ Re-seed if necessary.	X		X	X
Annually	▪ Check for sediment build-up in general bed. ▪ Ensure that 50% of plants survive each year; check for invasive wetland plants. ▪ Inspect wetland in early spring. ▪ Inspect daylight pipes and overflow pipes to make sure they aren't clogged. ▪ Inspect pH of infiltration/planting soils in the rain garden soils. If pH is below 5.2, limestone should be applied. If the pH is above 7.0-8.0, then iron sulfate plus sulfur can be added to reduce the	▪ Stock with mosquito fish for mosquito control. ▪ For discharges less than 200 ft from cold-water fisheries, inspect gravel trench outlet after every storm in first 3 months, then annually. ▪ Mow side slopes, embankments, emergency spillways, and access road at least annually, preferably after August. ▪ Harvest wetland plants that have been "choked out" by sediment build-up. ▪ The pH of soils should be tested to establish acidic levels. If the pH is below 5.2, lime should be added. If the pH is above 7.5, they gypsum should be added. ▪ Burn vegetation or clip standing dead vegetation stalks in order to maintain weed free vegetation. Stems and seed heads can be left for winter interest, wildlife cover, and bird food. If burning isn't possible, dead plant material should be trimmed when new growth is 4"-6" tall.	X	X	X	X

Frequency	Inspection Requirements	Field Practices	Wetland	Gravel Wetland	Bio-Retention Basin	Rain Garden
	pH.					
Upon Failure	▪ Ponded water should infiltrate into the filter media within 48-72 hours of a storm event; prolonged ponding indicates that the filter media or underdrain system requires maintenance.	▪ Sparse vegetation or clumps of cattail do not properly treat stormwater. Try to find the cause of the problem and fix it to ensure dense vegetation. Cut back excessive cattail shoots. ▪ Large cattail colonies should be removed with a backhoe. Chemical application may be used for small or new cattail growth.	X			X

3. Issues/Concerns

The following issues were described in various manuals or documents and assembled here for the benefit of inventorying specific concerns with maintaining these types of SMPs:

- Rain Gardens:
  - Detritus may need to be removed approximately twice a year. Perennial plantings may be cut down at the end of the growing season.
  - Within the first year, 10% of plants may die. Survival rates increase with time.
- SW Wetland water level should remain near the drawdown device, except under drought conditions.
- Fertilize grass only lightly. Excessive fertilizer is a pollutant.
- If a constructed wetland is not retaining pollutant at expected levels, the following steps should be taken:
  - Check to make sure that the desired levels of pollutant capture are realistic. For example, if the sediment size distribution contains an uncharacteristically large fraction of fines, the hydraulic retention time may not be adequate to achieve the desired retention rate. If retention of the desired pollutant is not realistic, consider implementing another SW treatment practice to achieve desired results. Or, if the pollutant is primarily in dissolved form and the vegetation in the wetland is known not to uptake the pollutant at significant levels, it is unrealistic to expect significant levels of retention.
  - Perform a sediment capacity test to determine the remaining sediment storage capacity of the wetland. If the storage capacity is exhausted or nearly exhausted, the retained sediment should be removed.

4. Design Suggestions

The following information has come from the various maintenance documents and describes suggestions to be made at the design level to alleviate maintenance issues.

- It is best for runoff to be pretreated via swales and/or filter strips before entering the rain garden to avoid sediment accumulations. Plants should be selected to reduce maintenance needs and to tolerate snow storage and winter salt and sand, where appropriate.
- Extended Detention Basin: The side slopes shall conform as closely as possible to re-graded or natural land contour, and shall not exceed 4:1. Slopes showing excessive erosion may require erosion control and safety measures.

5. Costs

The cost of maintenance is an important role in planning green infrastructure projects as well ensuring that they are viable. The following information reviews cost discrepancies from various sources.

- Rain gardens range between $10 - $40 per square foot.
- New development rain gardens cost approximately $5 - $7 per cubic foot of storage volume provided.
- Constructed Wetlands: Maintaining pre-treatment grates and forebays by removing trash and silt from them requires only a few minutes each month and the cost for unskilled labor at a rate of $8.00/hour should result in a monthly fee of less than $20.00.
- Gravel wetland cost/acre: $22,327.

6. References

The following documents were used to compile data for this report and also include relevant inspection reports/checklists.

ID	Location	Title	Year
CA-SA-1	Sacramento, CA	Stormwater Quality Design Manual for the Sacramento and South Placer Regions	2007
CA-SA-3	Sacramento, CA	Caltrans Stormwater Quality Handbook	2003
EPA-5	EPA	Stormwater Best Management Practice Design Guide Vol. 2 – Vegetative Bio-Filters	2004
GA-2	Georgia	Stormwater Wetlands: Georgia Stormwater Management Manual Vol. 2	2001
GA-5	Georgia	Bio-Retention Areas: Georgia Stormwater Management Manual Vol. 2	2001
GA-11	Georgia	Submerged Gravel Wetlands: Georgia Stormwater Management Manual Vol. 2	2001
GA-GC-1	Gwinnett County, GA	Stormwater Systems and Facilities Installation Standards and Specifications	2006
I-AUS-1	New South Wales, Australia	App. D – Stormwater Maintenance Plan	2007
IA-3	Iowa	Bioretention Systems – Iowa Stormwater Management Manual	2009
IL-CH-3	Chicago, IL	Stormwater Management Ordinance Manual	2011
KA-KC-1	Kansas City, KA	Manual of Best Management Practices for Stormwater Quality	2008
MA-1	Massachusetts	Vol. 2 Chp. 2 – Structural Best Management Practice Specifications for the Massachusetts Stormwater Handbook	
MA-2	Massachusetts	Massachusetts Statewide Stormwater Management Training Seminar Series	
MD-CE-1	Centreville, MD	Environmental Site design Manual	2007
ME-6	Maine	Underdrained Bio-retention Cell: Maine Stormwater Best Management Practices Manual	2005
MN-2	Minnesota	Housekeeping Best Management Practice Maintenance	1999
MN-MI-1	Minneapolis, MN	Stormwater Best Management Practice Operation and Maintenance Bioretention/Rain Garden	2005
NC-1	North Carolina	Backyard Rain Gardens – North Carolina Cooperative Extension	
NC-2	North Carolina	Stormwater Control Inspection and Maintenance Manual	2010
NC-RA-1	Raleigh, NC	Stormwater Management Design Manual	2002
NY-2	New York	New York State DOT – Region 8 – Stormwater Facilities Operation and Maintenance Manual	2003
SC-BC-1	Beaufort County, SC	Manual for Stormwater Best Management Practices	2010
TN-CH-1	Chattanooga, TN	Maintenance of Detention Devices – Stormwater Best Management Practices Manual	2003
TN-KI-1	Kingsport, TN	Stormwater Management Manual	
U-UMN-5	University of MN	Maintenance for Biologically Enhanced Practices	
WA-CC-1	Clark County, WA	Stormwater Facility Maintenance Manual	2000

The following maintenance and inspection checklists were found during this research process. They list exactly what to look for during inspection, how to solve a problem, if any, and at what time to perform all these tasks.

SMP	PDF Name	Location	Title of Source	Year
Constructed Wetlands	ChattanoogaTN_ConstructedWetlands.pdf	Chattanooga, TN	Maintenance of Detention Devices – Stormwater Best Management Practices Manual	2003
Pond Facilities	GwinnettCountyGA_PondFacilities.pdf	Gwinnett County, GA	Stormwater Systems and Facilities Installation Standards and Specifications	2006
Bioretention Area	KingsportTN_BioretentionAreas.pdf	Kingsport, TN	Stormwater Management Manual	
Submerged Gravel Wetland	KingsportTN_SubmergedGravelWetland.pdf	Kingsport, TN	Stormwater Management Manual	
Stormwater Wetland	KingsportTN_SWWetland.pdf	Kingsport, TN	Stormwater Management Manual	
Rain Garden	LibertyvilleIL_RainGarden.pdf	Libertyville, IL	Maintenance Plan Stormwater Management System	2004
Bioretention	MI_Bioretention.pdf	Michigan	Low Impact Development Manual for Michigan – App. F	
Rain Garden	MinneapolisMN_RainGarden.pdf	Minneapolis, MN	Stormwater Best Management Practice Operation and Maintenance Plan Bioretention/Rain Garden	2005
Bioretention Facilities	MN_BioretentionFacilities.pdf	Minnesota	Stormwater Maintenance Best Management Practice Resource Guide	2009
Stormwater Wetland	NC_SWWetland.pdf	North Carolina	Stormwater Control Inspection and Maintenance Manual	2010
Bioretention Filter	NY_BioretentionFilter.pdf	New York	New York State Management Design Manual – App. G	2003
Stormwater Pond/Wetland	NY_SWPond&Wetland.pdf	New York	New York State Management Design Manual – App. G	2003
Treatment Wetland	PierceCountyWA_TreatmentWetland.pdf	Pierce County, WA	Stormwater Maintenance Manual	
Wetponds	PierceCountyWA_Wetponds.pdf	Pierce County, WA	Stormwater Maintenance Manual	
Infiltration/Filtration/Bioretention	PulaskiCountyAR_InfiltrationFiltrationBioretention.pdf	Pulaski County, AR	Stormwater Management and Drainage Manual	2010
Stormwater Pond and Wetland	PulaskiCountyAR_SWPond&Wetland.pdf	Pulaski County, AR	Stormwater Management and Drainage Manual	2010
Bioretention	VA_Bioretention.pdf	Virginia	Virginia Stormwater Management Handbook – Chp. 9	2009
Constructed Wetlands	VA_ConstructedWetlands.pdf	Virginia	Virginia Stormwater Management Handbook – Chp. 9	2009

Green Stormwater Infrastructure Maintenance
Spotlight on *Disconnection – Roof Leaders*

1. Introduction

This section outlines the information that was gathered for the following types of SMPs:

Rain Barrel/Cistern: A storage device that captures and stores runoff from roof leaders and is effective in reducing runoff volume from small storms. Stored water may be discharged to a pervious area, or treated and distributed to serve a variety of on-site water needs (ex: irrigation). Functions to the design potential when device is properly emptied after storm events.

Stormwater Planter: A structure filled with planting media and planted with herbaceous vegetation, shrubs, or trees. Planters are designed to detain, treat, infiltrate or release runoff from sidewalks, streets or rooftops. Can be designed below street grade and/or above grade when feasible.

A list of documents pertaining to the above mentioned SMP is provided under the references section and can be used to pursue further information or clarification on the topics discussed in this report.

2. Maintenance Activities

The following table provides an overview of the frequency, inspection requirements and field practices related to various roof leaders' maintenance. This information was compiled from various manuals; the specific maintenance activities for roof leaders' are described below.

Frequency	Inspection Requirements	Field Practices	Rain Barrel	Cistern	SW Planter
As Needed	▪ Inspect the cistern periodically to ensure debris doesn't clog the system. ▪ Check for leaks at connection points. ▪ Inspect roof catchments to ensure that minimal amounts of particulate matter or other contaminants are entering the gutter and downspout. ▪ Inspect diverts, cleanout plugs, screens, covers, and overflow pipes and repair or replace as needed.	▪ Remove trash, sediment and debris from catch basins, trench drains, curb inlets, and pipes to maintain at least 50% conveyance at all times. ▪ Repair/seal cracks. Replace when repair is insufficient. ▪ Irrigate as needed. ▪ Manually remove weeds. ▪ Screen all vents to prevent mosquito breeding. ▪ Rain barrel must be sealed during warm months and drained before winter.	X	X	X
Monthly	▪ N/A	▪ For maximum benefits, empty the barrel between rain events in the wet season.	X		
Quarterly	▪ Inspect inlets or outlets, liner and foundation, cracked drain pipes, dead or strained vegetation, tall or overgrown plants, weeds, gullies, erosion, and ponding. ▪ Inspect rooftop detention for clogging after every storm greater than 1".	▪ Periodically remove debris and sediment from planter. ▪ Repair/replace vegetation as necessary to maintain full cover.			X
Semi-Annually	▪ N/A	▪ Use larvicides for mosquito control.	X		
Annually	▪ Inspect storage area to ensure that encroachments or renovations do not reduce available storage.	▪ Clean the cistern/rain barrel interior with a brush and vinegar or other non-toxic cleaner that will not degrade water quality or harm the cistern. The washout cleaning can be disposed of onsite to vegetated areas if disinfecting agents are adequately diluted so they don't harm plants.	X	X	X
Upon Failure	▪ During times of extended drought, look for physical features of stress.	▪ Rake, till, or amend to restore infiltration rate.			X

3. Issues/Concerns

The following issues were described in various manuals or documents and assembled here for the benefit of inventorying specific concerns with maintaining these types of SMPs:

- Parking lane planters:
    - They present a need for additional hand sweeping of gutter areas between the tree basin curb and the sidewalk curb.
    - They may present difficulties with repairing concrete pavement located between the tree basin and sidewalk.
    - On-street bike parking would preclude mechanical street sweeping and additional maintenance should be accounted for.

4. Design Suggestions

The following information has come from the various maintenance documents and describes suggestions to be made at the design level to alleviate maintenance issues.

- Planters should be structurally separate from the adjacent sidewalk to allow for future maintenance without disturbing the sidewalk.
    - Expansion joint satisfies this requirement.
- In the dry season, plants are maintained with a state-of-the-art drip irrigation system.

5. Costs

The cost of maintenance is an important role in planning green infrastructure projects as well ensuring that they are viable. The following information reviews cost discrepancies from various sources.

- Rain Barrels: $20-$150. Homeowners can make their own to reduce costs
- For new development and redevelopment, infiltration planters are often less expensive than more conventional SW management facilities because of the high value of real estate.

6. References

The following documents were used to compile data for this report and also include relevant inspection reports/checklists.

ID	Location	Title	Year
CA-LA-1	Los Angeles, CA	Green Streets and Alleys Design Guidelines Standards – 1st Edition	2009
CA-SA-1	Sacramento, CA	Stormwater Quality Design Manual for the Sacramento and South Place Regions	2007
CA-SF-2	San Francisco, CA	San Francisco Better Streets Plan – Policies and Guidelines for the Pedestrian Realm	2010
CA-VE-2	Ventura, CA	Green Streets Matrix – Dept. of Public Works	2008
IL-CH-3	Chicago, IL	Stormwater Management Ordinance Manual	2011
IL-CH-4	Chicago, IL	A Guide to Stormwater Best Management Practices	2003
IL-LI-1	Libertyville, IL	Maintenance Plan Stormwater Management System	2004
IN-ID-1	Indianapolis, IN	4.1 Green Roofs	
KA-KC-1	Kansas City, KA	Manual of Best Management Practices for Stormwater Quality	2008
MA-1	Massachusetts	Vol. 2 Chp. 2 – Structural Best Management Practice Specifications for the Massachusetts Stormwater Handbook	
MD-CE-1	Centreville, MD	Environmental Site Design Manual	2007
NC-1	North Carolina	Backyard Rain Gardens – North Carolina Cooperative Extension	
NY-1	New York	New York Stormwater Management Design Manual – Chp. 5	
OR-PO-1	Portland, OR	Stormwater Management Manual – Operation and Maintenance – Chp. 3	
TN-NA-1	Nashville, TN	Green Infrastructure Design Using Low Impact Development	2009
U-UMN-5	University of MN	Maintenance for Biologically Enhanced Practices	

The following maintenance and inspection checklists were found during this research process. They list exactly what to look for during inspection, how to solve a problem, if any, and at what time to perform all these tasks.

SMP	PDF Name	Location	Title of Source	Year
Cistern	PierceCountyWA_Cistern.pdf	Pierce County, WA	Stormwater Maintenance Manual	
Drywells, French Drains, or Downspouts	TumwaterWA_DrywellsFrenchDrainsDownspouts.pdf	Tumwater, WA	Stormwater Facility Maintenance Guide	2002
Rain Tanks and Cistern	VA_Cistern.pdf	Virginia	Virginia Stormwater Management Handbook – Chp. 9	2009
Rooftop Disconnection	VA_RooftopDisconnection.pdf	Virginia	Virginia Stormwater Management Handbook – Chp. 9	2009

Green Stormwater Infrastructure Maintenance
Spotlight on *Green Roofs*

1. Introduction

This section outlines the information that was gathered for the following types of SMPs:

Green Roof: A vegetated surface installed over an existing roof surface. Vegetated roofs are effective in reducing the volume and velocity of stormwater runoff. A typical green roof consists of a waterproofing and root barrier layer, insulation, drainage and filter layer, growth media, and plants. Green Roofs can either be installed as a fixed structure or as a series of removable modules.

A list of documents pertaining to the above mentioned SMP is provided under the references section and can be used to pursue further information or clarification on the topics discussed in this report.

2. Maintenance Activities

The following table provides an overview of the frequency, inspection requirements and field practices related to green roof maintenance. This information was compiled from various manuals; the specific maintenance activities for green roofs are described below.

Frequency	Inspection Requirements	Field Practice
As Needed	▪ Inspect for ponding, dead or stressed vegetation, tall or sun scorched grass, weeds, and mechanical equipment for leaks and spills.	▪ Weeding should be manual with no pesticides or herbicides used. ▪ Irrigation can be accomplished through hand watering or automatic sprinkler system if necessary during the establishment period. ▪ Drain inlet pipe should be cleared when soil substrate, vegetation, debris or other materials clog the drain inlet. ▪ Plant material should be maintained to provide 90% plant cover. ▪ Mulch, water, and cover with plants as needed. ▪ Prune tall, dry grasses and remove clippings. ▪ Remove any woody substances that may become established on the roof.
Quarterly	▪ Growing medium inspection for evidence of erosion from wind or water.	▪ During first year, basic weeding, fertilizing and in-fill planting may be required. ▪ If erosion channels are evident, they can be stabilized with additional growth medium similar to the original material.
Semi-Annually	▪ Qualified staff should thoroughly inspect the roof twice/year in the spring and fall. ▪ Look for problems such as split seams, separated layers, failed flashings, clogged drains, surface punctures. ▪ Inspection should include an examination of the building interior areas as directly below the roof. ▪ Pay particular attention to rooftop equipment and other roof penetrations, such as skylights, exhaust fans, air handlers, and vent stacks. Grease from exhaust fans, oil leaking from HVAC units, and air pollutants can damage roof materials.	▪ Debris and sediment removal, if necessary. ▪ Weed. ▪ Repair any leaks or structural deficiencies.
Annually	▪ Inspect drain inlet pipe and contaminant system.	▪ If fertilizer is necessary, only apply once/year and only use fertilizers containing nitrogen, phosphorous, potassium, and micronutrients to support the living plants.

3. Issues/Concerns

The following issues were described in various manuals or documents and assembled here for the benefit of inventorying specific concerns with maintaining these types of SMPs:

- Unhealthy plant causes have been seen from the following situations: Over-watering, lack of watering, over-fertilization, HVAC condensate, air vent damage, people.
- For a green roof, weeds are considered as plants that can penetrate the membrane, dry out and cause a fire hazard, or are invasive species.
- Manual or mechanical removal is suggested for weeding. Trimming and edging are usually not necessary.

- Leaks are rare, but if they occur they are usually around membrane penetrations such as vents. Contact the manufacturer for repair or replacement parts

4. Design Suggestions

The following information has come from the various maintenance documents and describes suggestions to be made at the design level to alleviate maintenance issues.

- Low maintenance: Sedum plants

5. Costs

The cost of maintenance is an important role in planning green infrastructure projects as well ensuring that they are viable. The following information reviews cost discrepancies from various sources.

- Tend to range from $8 - $25 per sq. foot, depending on how intensive the system is
- Maintenance costs for green roof: $1.25-2.00/square foot for the first 2 years only.
- Over the 40 year life of the ecoroofs, the net benefit to the private property owner is $404,000. (in 2008 dollars)
- There is an immediate and long term benefit to the public. At year 5, the benefit is $101,660, and at year 40 the benefit is $191,421.

6. References

The following documents were used to compile data for this report and also include relevant inspection reports/checklists.

ID	Location	Title	Year
CT-MA-1	Manchester, CT	From Grey to Green – Sustainable Practices for Redeveloping A Vacant Shopping Center	2010
EPA-3	EPA	Operation and Maintenance of Green Infrastructure	
IL-CH-3	Chicago, IL	Stormwater Management Ordinance Manual	2011
IL-CH-4	Chicago, IL	A Guide to Stormwater Best Management Practices	2003
MA-1	Massachusetts	Vol. 2 Chp. 2 – Structural Best Management Practice Specifications for the Massachusetts Stormwater Handbook	
MA-2	Massachusetts	Massachusetts Statewide Stormwater Management Training Seminar Series	
MD-CE-1	Centreville, MD	Environmental Site Design Manual	2007
OR-PO-1	Portland, OR	Stormwater Management Manual – Chp. 3	
OR-PO-11	Portland, OR	Cost Benefit Evaluation of Ecoroofs	2008
PA-2	Pennsylvania	The Pennsylvania Green Building Operation & Maintenance Manual	
TN-NA-1	Nashville, TN	Green Infrastructure Using Low Impact Development	2009

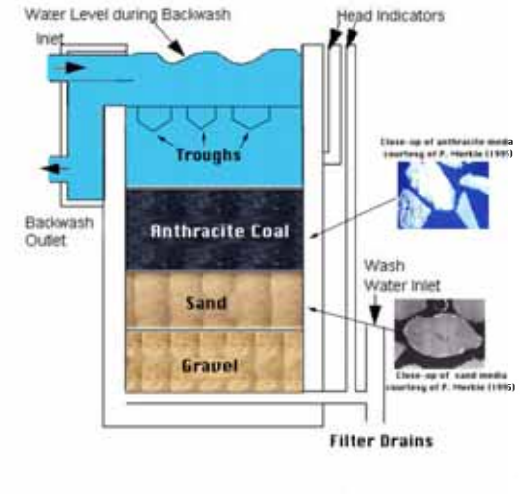
The following maintenance and inspection checklists were found during this research process. They list exactly what to look for during inspection, how to solve a problem, if any, and at what time to perform all these tasks.

SMP	PDF Name	Location	Title of Source	Year
Green Roof	IndianapolisIN_Green_Roofs.pdf	Indianapolis, IN	Stormwater Design and Specification Manual	
Vegetated Roofs	VA_VegetatedRoofs.pdf	Virginia	Virginia Stormwater Management Handbook – Chp. 9	2009

Green Stormwater Infrastructure Maintenance
Spotlight on *In-System Treatment*

1. Introduction

This section outlines the information that was gathered for the following types of SMPs:



Sand Filters: Sand filters work by providing the particulate solids with many opportunities to be captured on the surface of a sand grain. As fluid flows through the porous sand along a tortuous route, the particulates come close to sand grains. Then they can be captured.

StormTreat Filter: The StormTreat Systems structure is a manufactured device designed to manage stormwater quality by capturing, retaining and passing runoff through a series of sedimentation chambers and a bio-filter. The sedimentation chambers trap the majority of larger particles such as suspended solids and skim and retain floating pollutants including oil and other hydrocarbons.

Bio-Filter: The bio-filter is comprised of a specific soil media planted with wetland plants and is designed to remove a wide range of pollutants from stormwater including total suspended solids, phosphorous, nitrogen, metals, bacteria, hydrocarbons and some dissolved pollutants.

Drains: A drain is designed to drain excess rain and ground water from paved streets, parking lots, sidewalks, and roofs.

A list of documents pertaining to the above mentioned SMPs are provided under the references section and can be used to pursue further information or clarification on the topics discussed in this report.

2. Maintenance Activities

The following table provides an overview of the frequency, inspection requirements and field practices related to in-system stormwater treatment maintenance. This information was compiled from various manuals; the specific maintenance activities for in-system treatment devices are described below.

Frequency	Inspection Requirements	Field Practices	Sand Filter	StormTreat Filter	Bio-Filter	Drains
As Needed	▪ Inspect for clogged inlets or outlets, weeds, large shrubs and trees, ponding, gullies, erosion, and cracked drain pipes, liners, walls, or traps. ▪ Inspect for proper dewatering. Infiltration basin should be dewatered 48 hours after a storm event. ▪ A record should be kept of the dewatering time. ▪ Inspect for rillying and gullying of embankments or sedimentation forebay. ▪ Check bio-filter every 2 weeks after major storms.	▪ Remove sediment and debris from silt traps, trench drains, inlets, and pipes to maintain at least 50% conveyance capacity at all times. ▪ Repair/seal cracks. Replace when repair is insufficient. ▪ Manually remove weeds. ▪ Prevent large root systems from damaging subsurface structural components. ▪ Do not apply herbicides or pesticides. ▪ Rake and remove layer of oil and sediment and restore infiltration rate. ▪ Restore outfalls or splash blocks where necessary. ▪ Fill, lightly compact, and install flow spreader/plant vegetation to disperse flow. ▪ Replace sand layer in filtration basin when filtration capacity is diminished. ▪ Clean drains; jet-vac if needed. ▪ Remove sediment when buildup exceeds 3". Sediment can be removed by hand using a shovel or rake or from larger areas by excavation. ▪ Watering may be necessary to establish plant growth during the first few months. Remove debris and weeds as needed.	X	X	X	X
Monthly	▪ Check the contributing drainage area, facility, inlets and outlets for debris; Check to ensure that the filter surface is not clogging.	▪ Mow and stabilize (prevent erosion, vegetate denuded areas) the area draining to the sand filter. Collect and remove grass clippings. ▪ Remove trash and debris.	X	X	X	X
Quarterly	▪ N/A	▪ If filter is vegetated with grass, mow to a maximum height of 12".	X		X	
Semi-Annually	▪ Inspect batter drains for evidence of deterioration or scour. This is required for both lined and unlined batter drains.	▪ Repair or replace any damaged parts; stabilize eroded areas.	X			X

Annually	▪ Check to see that the filter bed is clean of sediment and the sediment chamber is not more than 50% full or 6", whichever is less, of sediment. ▪ Inspect grates, inlets, outlets, and overflow spillway to ensure good condition and no evidence of erosion. ▪ Check to see if stormwater flow is bypassing the facility. ▪ Ensure that no noticeable odors are detected outside the facility.	▪ Repair leaks from the sedimentation chamber or deterioration of structural components. ▪ Remove the top few inches of sand and cultivation of the surface when filter bed is clogged. ▪ Clean-out accumulated sediment from filter bed chamber it exceeds 1". Sediment should be removed from the sedimentation chamber when 6" have accumulated at the bottom. ▪ Replenish mulch layer to its original depth every 2 years. The removed mulch layer shall be properly disposed of or roto-tilled into the surface. Ensure that mulch does not contain seeds of plants considered invasive.	X			X
Upon Failure	▪ If at any time, it is determined that filtration rates are too large or the total suspended solids retention rate is too low, it is likely that there is a shortage circuit in the filter media. One should perform a visual inspection of the filer media to ensure no holes, ruts, or other openings in the media that would allow runoff to pass without being sufficiently filtered. Or one can perform a capacity test to determine filtration rates at various locations. ▪ Outflow rate should be checked if necessary.	▪ Snake and flush underdrain system to remove any blockages, if water is not draining within 48 hours after a storm event.		X	X	

3. Issues/Concerns

The following issues were described in various manuals or documents and assembled here for the benefit of inventorying specific concerns with maintaining these types of SMPs:

- StormTreat Filters: Fertilization of the planting on the structure must be avoided.

4. Costs

The cost of maintenance is an important role in planning green infrastructure projects as well ensuring that they are viable. The following information reviews cost discrepancies from various sources.

- Media Filters: The cost of replacing the media depends on the type of filtration media. Sand is rather inexpensive; some filtration media is more expensive. Disposable artificial media may range from $100 to more than $1,000 depending on size of filters and materials used. Filter media may have special disposal requirements.
- Maintenance of smaller bio-filters can be performed by a small landscaping team using a hand mower and rakes. To maintain grass at a height of no more than 8", mowing may be required every 10 days to 2 weeks during summer. Generally, this is included within normal landscaping activities and is included with that cost, which will be determined by the size of the area maintained.

5. References

The following documents were used to compile data for this report and also include relevant inspection reports/checklists.

ID	Location	Title	Year
CA-SA-1	Sacramento, CA	Stormwater Quality Design Manual for the Sacramento and South Placer Regions	2007
CO-DC-3	Douglas County, CO	Standard Operation Procedure for Sand Filter Basin	2006
I-AUS-1	New South Wales, Australia	App. D – Stormwater Maintenance Plan	2007
ME-5	Maine	Grasses Underdrain Soil Filter – Maine Stormwater Best Management Practices Manual	2005
ME-7	Maine	StormTreat Filter – Maine Stormwater Best Management Practices Manual	2005
OR-PO-1	Portland, OR	Stormwater Management Manual – Chp. 3	
TN-CH-1	Chattanooga, TN	Maintenance of Detention Devices – Stormwater Best Management Practices Manual	2003
TN-KI-1	Kingsport, TN	Stormwater Management Manual	
U-UMN-2	University of MN	Maintenance for Filtration Practices	

The following maintenance and inspection checklists were found during this research process. They list exactly what to look for during inspection, how to solve a problem, if any, and at what time to perform all these tasks.

SMP	PDF Name	Location	Title of Source	Year
Bio-Filters	ChattanoogaTN_Biofilters.pdf	Chattanooga, TN	Maintenance of Detention Devices	2003
Surface Sand Filter	KingsportTN_SurfaceSandFilter.pdf	Kingsport, TN	Stormwater Management Manual	
Sand and Organic Filter	NY_Sand&OrganicFilter.pdf	New York	New York State Stormwater Management Design Manual – App. G	2003
Sand Filter Above Ground	PierceCountyWA_SandFilterAbove.pdf	Pierce County, WA	Stormwater Maintenance Manual	
Sand Filter Below Ground	PierceCountyWA_SandFilterBelow.pdf	Pierce County, WA	Stormwater Maintenance Manual	
Sand Filters	TumwaterWA_SandFilters.pdf	Tumwater, WA	Stormwater Facility Maintenance Guide	2002

Green Stormwater Infrastructure Maintenance
Spotlight on *Pervious Pavement*

1. Introduction

This section outlines the information that was gathered for the following types of SMPs:



Porous Asphalt: Porous asphalt pavement consists of an open-graded coarse aggregate, bonded together by asphalt cement, with sufficient interconnected voids to make it highly permeable to water.

Porous Concrete: Pervious concrete consists of specially formulated mixtures of Portland cement, uniform, open-graded coarse aggregate, and water. Pervious concrete has enough void space to allow rapid percolation of liquids through the pavement.

Grid/Lattice Systems: A pavement surface composed structural units with void areas that are filled with pervious materials such as sand or grass turf. Porous pavers are installed over a gravel base course that provides storage as runoff infiltrates through the porous paver system into underlying permeable soils.

A list of documents pertaining to the above mentioned SMP is provided under the references section and can be used to pursue further information or clarification on the topics discussed in this report.

2. Maintenance Activities

The following table provides an overview of the frequency, inspection requirements and field practices related to pervious pavement maintenance. This information was compiled from various manuals; the specific maintenance activities for pervious pavements are described on the following page.

Frequency	Inspection Requirements	Field Practices	Porous Concrete	Grid/ Lattice Systems	Porous Asphalt
As Needed	▪ Ensure contributing area is clear of debris and stabilized.	▪ Surface sedimentation of reinforced turf shall be removed by a vacuum sweeper and not be power-washed into the bed. ▪ Maintain planted areas adjacent to pavement. ▪ Immediately clean any soil deposited on pavement. ▪ Do not allow construction staging, soil/mulch storage, etc. on unprotected pavement surface. ▪ Snow plowing is fine but should be done carefully (set blade slightly higher than usual). Snow plow piles should not be left on the side of the pavement to melt as clogging of pores can develop more quickly. ▪ Salt application is acceptable, although more environmentally benign deicers are preferable. Road salt application can be reduced up to 75%. ▪ May need occasional refilling of crushed rock or gravel. ▪ Remove trash and debris. ▪ Repair eroded areas and address the cause. ▪ For interlocking pavers: periodically add joint material (sand) to replace material that has been moved/worn by traffic or weather. ▪ Mow upland and adjacent areas, and seed bare areas. ▪ Prevent large root systems from damaging subsurface structural components.	X	X (requires mowing (grass at 2”-4”) and irrigation as needed)	X
Monthly	▪ Ensure free of sediment and make sure that the system dewaters between storms.	▪ N/A	X	X	X
Quarterly	▪ Water depth in the well shall be measured at 0-, 24-, and 48- hour intervals after a storm to determine the clearance rate.	▪ Vacuum Sweep. ▪ Facility managers are generally advised to high pressure hose and then vacuum.	X	X	X
Semi-Annually	▪ Inspect overflow outlet works and look for clogged outlet structure and ponding water above outlet elevation.	▪ Vacuum, pressure was or power blow entire surface. ▪ Clean inlets draining to the subsurface bed. ▪ Remove noxious weeds and unwanted vegetation. Treat with herbicide or hand pull. ▪ Broom, blow, rotary brush or sweep entire	X	X	X

		surface (alternate-vacuum entire surface).			
Annually	▪ Inspect for surface deterioration or spalling. ▪ After a major storm monitor percolation rate of parking lot system.	▪ Vacuum sweeping or high pressure hosing required to maintain function.	X	X	X
Upon Failure	▪ N/A	▪ Total rehabilitation including top and base course as needed. ▪ Spot clogging can be handled by drilling ¼" – ½" holes through the pavement every few feet. ▪ Repair potholes and cracks using conventional asphalt patching mixes as long as the cumulative area does not exceed 10% of the parking lot area. ▪ Damaged areas less than 50 square ft can be patched with porous or standard asphalt.	X	X	X

3. Issues/Concerns

The following issues were described in various manuals or documents and assembled here for the benefit of inventorying specific concerns with maintaining these types of SMPs:

- Sand or ash shall never be applied to porous pavement.
- DO NOT use surfactants
- Do not use sand during the winter months
- Surface should never be seal-coated.
- Pervious paving can be difficult to maintain and difficult to repair in small batches if using porous concrete and asphalt.
- Restrict dirt-prone activities such as driving over parking lot with muddy tires, accessing the fields via the parking lot, or stockpiling soil directly on pavement in order to prevent blinding of pavement. The surface should be kept clean from debris such as leaves. No materials storage. No parking of heavy equipment or vehicles for extended periods of time. Do NOT use sand or gravel for ice/snow reduction to prevent blinding of pavement pores. Do NOT stockpile snow in bioswales or rain garden.
- Pavement washing systems or compressed air units are not recommended.

4. Design Suggestions

The following information has come from the various maintenance documents and describes suggestions to be made at the design level to alleviate maintenance issues.

- Landscaped areas should be designed and/or maintained such that they will not discharge debris to the paver system, or that such debris is removed often; repair or reinstall the porous paver system, including the top and base course.
- Driveways with disconnected pavement require no additional maintenance over traditional driveways but accumulations of sediment adjacent to driveway need to be removed periodically to keep surface water flowing evenly into the adjacent porous area.
- Many pavers are designed to have pore space vegetation.
- Pervious pavement isn't recommended for high-traffic volumes due to durability, maintenance issues and load bearing concerns.
- "Cold-In-Place Recycling" process grinds off the existing asphalt, mixes it with new oil on site and then repaves the road. By using the grindings on site and remixing it with new oil, no new aggregates are needed, so 100% of the grindings are re-cycled. This avoids trucking in large amounts of new asphalt concrete, which is environmentally friendly and reduces project costs.
- "Warm Mix" asphalt allows the producers of asphalt pavement material to lower the temperature at which the material is mixed and placed on the road. An additive is mixed with the asphalt that allows it to be compacted at lower temperatures, so that it does not need to be heated up as much. This process eliminates about 70% of the hydrocarbon fumes that come from heated asphalt. This also allows for paving during cooler months of the year.
- The use of sand-set pervious pavers and low-expenditure landscape SW facilities over utility lines might actually reduce the need for cutting and replacing concrete and asphalt and improve access to underground utilities.
- It might be more advantageous to plan on replacing an aging utility line during the Green Street or parking lot construction than to wait to replace it at a later date.

- If rock mulch is not sized appropriately, based on the expected sediment load and runoff, it can be a maintenance headache to clean out sediment in the voids between larger rocks.

5. Costs

The cost of maintenance is an important role in planning green infrastructure projects as well ensuring that they are viable. The following information reviews cost discrepancies from various sources.

- Installation costs can be as much as 2-3 times greater than conventional concrete or asphalt.
- Estimates annual maintenance cost for porous pavement parking lot at $200/acre, which includes regular inspections as well as jet hosing and vacuum sweeping.
- Gravel paver system: Stalls are constructed using 100% recycled material at a unit cost of $4.75/sq ft, maintenance is minimal, requiring roughly 8 hours a month at $160/month.
- Permeable concrete sidewalks: $54.16/sq yard compared to traditional concrete sidewalks: $101.16/sq yard.
- Cost analysis by Olympia, WA found that maintenance cost for pervious pavement was still lower than the traditional pavement when cost of SW management was considered.
    - This was based on the ease of use, debris removal, and the performance pace.
- With proper maintenance, permeable paving materials have a proven durability of up to 30 or more years and increases lifespan over asphalt.

6. References

The following documents were used to compile data for this report and also include relevant inspection reports/checklists.

ID	Location	Title	Year
CA-SA-1	Sacramento, CA	Stormwater Quality Design Manual for the Sacrament and South Placer Regions	2007
CA-SF-1	San Francisco, CA	San Mateo County Sustainable Green Streets and Parking Lots Design Guidebook – 1st Edition	2009
CA-SF-2	San Francisco, CA	San Francisco Better Streets Plan – Policies and Guidelines for the Pedestrian Realm	2010
CA-VE-1	Ventura, CA	Pavement Maintenance Plan	
CO-DC-1	Douglas County, CO	Standard Operating Procedures for Extended Detention Basin	2006
CT-MA-1	Manchester, CT	From Grey to Green – Sustainable Practices for Redeveloping A Vacant Shopping Center	2010
EPA-1	EPA	Green Parking Lot Resource Guide	2008
EPA-2	EPA	Green Streets Managing Wet Weather with Green Infrastructure Municipal Handbook	2008
EPA-3	EPA	Operation and Maintenance of Green Infrastructure	
GA-7	Georgia	Porous Concrete – Georgia Stormwater Management Manual Vol. 2	2001
GA-12	Georgia	Modular Porous Paver System – Georgia Stormwater Management Manual Vol. 2	2001
GA-GC-1	Gwinnett County, GA	Stormwater Systems and Facilities Installation Standards and Specifications	2006
ID-1	Idaho	Catalog of Stormwater Best Management Practices for Idaho Cities and Counties	2005
IL-CH-3	Chicago, IL	Stormwater Management Ordinance Manual	2011
IL-CH-4	Chicago, IL	A Guide to Stormwater Best Management Practices	2003
IL-LI-1	Libertyville, IL	Maintenance Plan Stormwater Management System	2004
KA-KC-1	Kansas City, KA	Manual of Best Management Practices for Stormwater Quality	2008
MD-CE-1	Centreville, MD	Environmental Site Design Manual	2007
NY-1	New York	New York State Stormwater Management Design Manual – Chp. 5	
OR-PO-1	Portland, OR	Stormwater Management Manual – Operation and Maintenance – Chp. 3	
TN-KI-1	Kingsport, TN	Stormwater Management Manual	
U-UCD-1	UC Davis	Green Streets – An Innovative Design Approach for Northern California	2009
WA-CC-1	Clark County, WA	Stormwater Facility Maintenance Manual	2000

WA-SE-1	Seattle, WA	Traffic Control Plan – Construction and Maintenance – Chp. 5	
WA-SE-3	Seattle, WA	High Point Community – Natural Drainage and Landscape Maintenance Guidelines for Right-of-way and Open Space	2010

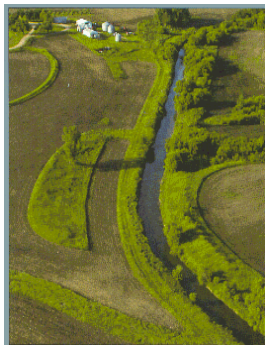
The following maintenance and inspection checklists were found during this research process. They list exactly what to look for during inspection, how to solve a problem, if any, and at what time to perform all these tasks.

SMP	PDF Name	Location	Title of Source	Year
Modular Porous Pavement Systems	KingsportTN_ModularPorousPaverSystems.pdf	Kingsport, TN	Stormwater Management Manual	
Porous Pavement	KingsportTN_PorousPavement.pdf	Kingsport, TN	Stormwater Management Manual	
Porous Parking Lot	LibertyvilleIL_PorousParkingLot.pdf	Libertyville, IL	Maintenance Plan Stormwater Management Systems	2004
Pervious Pavement	PierceCountyWA_PerviousPavement.pdf	Pierce County, WA	Stormwater Maintenance Manual	
Permeable Pavement	VA_PermeablePavement.pdf	Virginia	Virginia Stormwater Management Handbook – Chp. 9	2009

Green Stormwater Infrastructure Maintenance
Spotlight on *Pretreatment*

1. Introduction

This section outlines the information that was gathered for the following types of SMPs:



Swale: A vegetated basin designed to convey, attenuate and/or infiltrate stormwater runoff. In some cases, they are used to enhance water quality benefits. Porous media can be added to the swale base to enhance infiltration and water quality benefits.

Filter Strip: Vegetated areas that are situated between surface water bodies and cropland, grazing land, forestland, or disturbed land. They are generally in locations where runoff water leaves a field, with the intention that sediment, organic material, nutrients and chemicals can be filtered from the runoff water.

Check Dam: A small, temporary or permanent dam constructed across a drainage ditch, swale or channel to lower the speed of concentrated flows for a certain design range of storm events.

Level Spreader: An erosion control device designed to reduce water pollution by mitigating the impact of high-velocity stormwater surface runoff. The device reduces the energy level in high-velocity flow by converting it into sheet flow, and disperses the discharged water so that it may be infiltrated into soil.

A list of documents pertaining to the above mentioned SMPs are provided under the references section and can be used to pursue further information or clarification on the topics discussed in this report.

2. Maintenance Activities

The following table provides an overview of the frequency, inspection requirements and field practices related to pretreatment devices' maintenance. This information was compiled from various manuals; the specific maintenance activities for pretreatment devices are described below.

Frequency	Inspection Requirements	Field Practice	Swale	Filter Strip	Check Dam	Level Spreader
As Needed	▪ Inspect vegetation on side slopes for erosion and formation of rills or gullies, correct as needed. ▪ Inspect for pools of standing water, litter, uniformity in cross-sections and longitudinal slope and inlets/outlets for signs of clogging. ▪ Inspect for concentrated flows, sediment accumulation, adequacy of grass coverage in grassy filter strip, and erosion in contributing drainage area. ▪ Swales should be carefully monitored so they do not contribute sediment to receiving waters. ▪ For earth check dams, pronounced cracks on the embankment surface indicate the first stages of potential dam failure. Transverse cracks generally indicate differential settlement of the dam; can provide pathways for excessive seepage. Longitudinal cracks may be due to inadequate compaction of the dam during construction or shrinkage of the clay on the top of the embankment during prolonged dry conditions. ▪ Inspect for dense clumps of cattail which do not allow water to pass and remove if necessary. Can be removed by cutting/pulling the shoots below water level or other means. ▪ Inspect for swale issues due to flooding. ▪ Inspect channel linings periodically and repair as needed.	▪ Remove sediment from pretreatment when depth exceeds ½ design depth; clean/repair when drawdown exceeds 36 hrs. ▪ The top several inches of filter shall be replaced with fresh material when water ponds on the surface of the bed for more than 72 hours. The removed sediments should be disposed of in an acceptable manner. ▪ Harvesting and pruning of excessive growth will need to be done occasionally. Weeding to control unwanted or invasive plants may also be necessary. Add new mulch only as necessary for bio-retention cell. ▪ Mow and trim vegetation to ensure safety, aesthetics, proper swale operation, or to suppress weeds and invasive vegetation; dispose of cuttings in a local composting facility; mow only when swale is dry to avoid rutting. ▪ Plant alternative grass species in the event of unsuccessful establishment. ▪ Re-seed bare areas; install appropriate erosion control measures when native soil is exposed or erosion channels are forming. ▪ Rototill and replant swale if draw down time is more than 48 hours. ▪ Water during dry periods, fertilize, and apply pesticide only when absolutely necessary. ▪ Filter strips need grass to be cut no less than 4”. Greater than 5” is preferred. Maximum of 8”. ▪ Fertilize and lime as needed to maintain dense vegetation. ▪ Use a rake/shovel to remove any sediment accumulated by hand in the bottom of the channel when depth reaches 2”. ▪ Repair rills in channel bottom with compacted topsoil, anchored with mesh or filter fabric, seed, and mulch. ▪ Maintain 4”-10” deep rock check dams at 12-20 ft intervals. ▪ Manually remove weeds. ▪ Replace mulch when needed. ▪ Percolation test once every 3 years; completely replace soil once every 20 years. ▪ If the filter was designed for nutrient removal, remove any harvested vegetation and dispose of outside the filter/buffer strip. ▪ Remove sediment when it reaches 50% of checkdam height. ▪ Remove sediment from swale once it has accumulated to 10% of the original design volume.	X	X	X	

Frequency	Inspection Requirements	Field Practice	Swale	Filter Strip	Check Dam	Level Spreader
		▪ If ruts develop, fill them with coarse soil, level the surface, and re-seed. ▪ Vegetation should only be removed when it reduces free movement of water throughout the ditch.				
Monthly	▪ N/A	▪ Maintain vegetation monthly during first year to enhance appearance and prevent erosion/clogging of bio-swale soil mix.	X			
Quarterly	▪ Inspect all vegetated strip components expected to receive and/or trap debris and sediment for clogging and excessive debris and sediment accumulation. ▪ Inspect storm overflow inlets to make sure they aren't clogged.	▪ Remove sediment during dry periods. ▪ Minimum of 4 grass cuttings/year.		X		
Semi-Annually	▪ The soil filter should be inspected after every major storm in the 1st year and then every 6 months to ensure that it is draining within 48 hours following a 1" storm or greater. ▪ Vegetated areas should be inspected for erosion, scour and unwanted growth. This should be removed with minimum disruption to the planting soil bed and remaining vegetation. ▪ Inspect all level spreading devices for trapped sediment and flow spreading abilities. ▪ Inspect grass filer strip for erosion or gullying. ▪ Inspect trees, shrubs, and vegetation to evaluate their health.	▪ If mowing is desired, only hand-held string trimmers or push-mowers are allowed on the filter (no tractor) and the grass bed should be mowed to a height no less than 6". ▪ Remove sediment and correct grading and flow channels during dry periods. ▪ Refresh infiltration capacity of bioswale if monitoring reveals reduced infiltration capacity. Core aeration can be used. ▪ Meadow buffers may be mowed no more than twice per year.	X	X		
Annually	▪ Inspections should be conducted and when possible coordinated to correspond with a significant storm (2"-3" of rainfall). ▪ Inspect pH of soil in planting area. If the pH is below 5.2, limestone should be applied. If the pH is above 7.0-8.0, then iron sulfate plus sulfur can be added to reduce pH. ▪ Inspect to make sure the level spreader is promoting uniform, diffused flow along its entire	▪ Sediment and plant debris should be removed from the pretreatment structure at least annually. ▪ Correct any erosion problems and damage to vegetation. ▪ Burn vegetation or clip standing dead vegetation stalks in order to maintain weed-free vegetation. Stems and seed heads can be left for winter interest, wildlife cover, and bird food. If burning isn't possible, dead plant material should be trimmed when new growth is 4"-6" tall. ▪ Every 3 years replace mulch within entire bioswale. ▪ After the first year, only spot clipping (or spot chemical treatment) should be done, rather than	X	X		X

Frequency	Inspection Requirements	Field Practice	Swale	Filter Strip	Check Dam	Level Spreader
	length.	clipping or otherwise treating the entire strip. If noxious weeds develop, clip in the spring to prevent weed seeds from dispersing. ▪ De-thatch swale bottom and remove thatching. Disc or aerate swale bottom. ▪ Every 5 years: scrap swale bottom, and remove sediment to restore original cross-section and infiltration rate. Seed or sod to restore ground cover. ▪ Mow grassy filter strips at least once per year. Vegetated filter strips should not be mowed in order to allow for natural succession.				
Upon Failure	▪ Level spreaders are designed to convert concentration flow to sheet flow before it enters a buffer or filter strip; erosion within the buffer or filter strip is an indication that the level spreader is not functioning properly.	▪ N/A				X

3. Issues/Concerns

The following issues were described in various manuals or documents and assembled here for the benefit of inventorying specific concerns with maintaining these types of SMPs:

- Grass should not be trimmed extremely short, as this will reduce the filtering effect of the swale. The cut vegetation should be removed to prevent the decaying organic litter from adding pollutants to the discharge from the swale. The mowed height of the grass should be 2”-4” taller than the maximum flow depth of the design water quality storm. A minimum mow height of 6” is generally recommended.
- Drainage Swales:
    - Excessive and Repeated Erosion:
        - When working in swales, protect from compaction by placing 2-4 foot long by 6”-8” wide boards for walking and standing on in swales, to distribute weight.
        - Install cobbles at top of erosion channel. Cobble area should be 3 times the width of the erosion channel and at least 12” minimum length.
    - Repeated Sediment Buildup:
        - Identify upstream source and install cobbles at the source.
    - Excessive Vegetation:
        - Determine that pruning or other routine maintenance is not adequate or feasible to maintain proper plant density and aesthetics in an efficient manner.
        - Determine if planting type should be replaced to avoid ongoing maintenance issues.
            - An aggressive grower under perfect growing conditions should be transplanted to a location where it will not impact flow.
        - Look for areas that were planted too densely.
            - A moderate grower planted too densely should be thinned by transplanting some individuals to make space for future growth while allowing for adequate flow-through.
- A good time to clean is during the growing season, when it’s easiest to reestablish vegetation. (Generally April – June, and Sept. – Oct.)

- Storm inlet trash excluders: Only prevents trash from entering tributaries.
- Bioswales in existing developed neighborhoods will be difficult to maintain without an on-going funding commitment such as Maintenance Assessment District.
- Avoid using water to clean up work sites. Sweep or vacuum dust and debris from the repair job. Do not wash materials into storm sewers.
- Do not stockpile snow in bioswale. Do not place grass clippings/landscape waste within bioswale in order to prevent clogging of bioswale soil mix, which would limit infiltration capacity.

4. Design Suggestions

The following information has come from the various maintenance documents and describes suggestions to be made at the design level to alleviate maintenance issues.

- Pre-treatment measures can help reduce the maintenance requirements of bio-retention facilities and clogging of soils overtime.
    - Ex: Swales to filter out coarse sediments and debris or pea gravel border which acts to spread flow evenly and drop out large particles.
- Recommendations regarding swale design and installation standards:
    - Minor slumping and mower scalping associated with cross-sectional geometry of the swale.
        - Eliminate sharp lateral transitions from design.
    - Side slope failure leading to sediment inputs and reduced ability to support healthy vegetation:
        - Follow current specifications of 3:1 (preferably less) side slope, particularly in areas prone to high flows and/or saturated conditions.
    - Hydraulic conditions that promote rill formation, erosion, high velocities, etc.
        - Incorporate the following into the configuration:
            - Swale depth: top width < 0.15
            - Minimum bed width = 3 ft
            - For depth > 3ft, bed width > depth +1
            - Side slopes < 33% (never > 50%)
            - Potential treatment volume: impervious drainage area > 0.30
            - Mean longitudinal slope < 2.5%
    - Down-cutting and toe erosion:
        - Provide a wide bed to promote variable flow patterns. Generally, problems that are not prevalent in swales with a wetted bed that exceeds 36". Specify armoring and control structures in areas prone to erosive or continual flows. Erosion at a steeply sloping point inlet can be avoided with an energy dissipater and, within the channel, by using check dams.
    - Standing water:
        - Attempt to avoid standing water by careful grading to avoid depressions in ditch beds and compaction of the soil. Finish the construction by tilling if the soil has become compacted.
    - Undesirable vegetation composition:
        - a) In ditches without a surface or subsurface base flow source, plant a mix of herbaceous species including grasses and other forms, after preparing an appropriate seed bed. Obtain a qualified botanist's or landscape professional's advice to select the species and specify the preparation. b) In ditches with a surface or subsurface base flow source, determine whether conditions will support wetland herbaceous plants. Establish them if the determination is positive, with the help of a qualified wetland botanist or landscape professional.
- To reduce scour and encourage re-growth in filter strips:

    - Time cleaning to coincide with reduced flows but sufficient precipitation to enhance germination success of re-vegetation seed.
    - Place energy dissipaters, stilling basins, or flow spreaders where high discharge infalls are present.
    - Use polymers, mulches, or erosion control mattings on side slopes and, possibly, in channel beds.
    - Use temporary check structures (cobble dams, straw bales, transverse silt fencing), especially in facilities where no healthy vegetation exists downstream of the cleaned section.
- Filter strips are restricted to the outer 50 ft of the buffer zone.
- Protect storm drains:
    - If runoff contains sediment, use gravel-filled filter bags or an equivalent product to build berms around inlets. Gravel-filled bags are more stable than chip-filled bags.
    - Catch basin inserts are also an acceptable sediment trapping option. At stream crossings, trap materials using screens or another form of containment. Use containment BMPs to protect roadside ditches during wet weather.
- Grass bottoms in the BI swales seldom need replacement since grass serves as a good filter material. If silty water is allowed to trickle through the turf, most of the suspended material is strained out within a few yards of surface travel. Well-established turf on a swale floor will grow up through sediment deposits forming a porous turf and preventing the formation of an impenetrable layer. Grass planted on swale side slopes will prevent erosion.

5. Costs

The cost of maintenance is an important role in planning green infrastructure projects as well ensuring that they are viable. The following information reviews cost discrepancies from various sources.

- Storm inlet trash excluders: On-going maintenance and costs will increase as more are installed.
- Bioswales cost less than conventional considerations.
- Swale:
    - Construction cost (per linear foot): $4.50-$8.50 (from seed)/$15-$20 (from sod)
    - Annual O&M cost (per linear foot): $0.75
    - Total annual cost (per linear foot): $1 (from seed)/$2 (from sod)
    - Lifetime (years): 50
- Underground pipe construction cost (per linear foot): $2 per foot per inch of diameter (ex: a 12: pipe would cost $24 per linear foot)
- Curb and Gutter:
    - Construction cost (per linear foot): $13-$15
    - Lifetime (years): 20
- Vegetated Filter Strips:
    - Straw Mulch:
        - Apply at a rate of 1.5 – 2.0 tons/acre
        - Costs: Flat area average: $275/acre; sloped area average: $400/acre
    - Top-soiling:
        - Apply at a depth of 4”
        - Range: $1.25 - $2.25 sq. yards
        - Average: $1.75/sq. yard
- Grass Swales construction costs: $16-$49 per linear meter

6. References

The following documents were used to compile data for this report and also include relevant inspection reports/checklists.

ID	Location	Title	Year
CA-1	California	Stormwater Quality Handbooks	2003
CA-LA-1	Los Angeles, CA	Green Streets and Green Alleys Design Guidelines Standards – 1st Editions	2009
CA-SF-2	San Francisco, CA	San Francisco Better Streets Plan – Policies and Guidelines for the Pedestrian Realm	2010
CA-VE-2	Ventura, CA	Green Streets Matrix – Dept. of Public Works	2008
CT-1	Connecticut	Connecticut Guidelines for Soil Erosion and Sediment Control	2002
EPA-5	EPA	Stormwater Best Management Practices Design Guide Vol. 2 – Vegetative Bio-Filters	2004
GA-8	Georgia	Enhanced Swales – Georgia Stormwater Management Manual Vol. 2	2001
GA-9	Georgia	Filter Strip – Georgia Stormwater Management Manual Vol. 2	2001
GA-10	Georgia	Grass Channel – Georgia Stormwater Management Manual Vol. 2	2001
ID-1	Idaho	Catalog of Stormwater Best Management Practices for Idaho Cities and Counties	2005
ID-2	Idaho	Erosion and Sediment Control Best Management Practices Manual	2011
IL-CH-3	Chicago, IL	Stormwater Management Ordinance Manual	2011
IL-CH-4	Chicago, IL	A Guide to Stormwater Best Management Practices	2003
IL-LI-1	Libertyville, IL	Maintenance Plan Stormwater Management System	2004
IN-ID-2	Indianapolis, IN	4.4 Stormwater Green Infrastructure Guidance – Filter Strips	2008
KA-KC-1	Kansas City, KA	Manual of Best Management Practices for Stormwater Quality	2008
MA-1	Massachusetts	Vol. 2 Chp. 2 – Structural Best Management Practice Specifications for the Massachusetts Stormwater Handbook	
MD-CE-1	Centreville, MD	Environmental Site Design Manual	2007
ME-3	Maine	Vegetated Buffers – Maine Stormwater Best Management Practices Manual	2005
ME-9	Maine	Vegetated Swales – Maine Stormwater Best Management Practices Manual	2005
MI-1	Michigan	Low Impact Development Manual for Michigan – App. F	
MI-3	Michigan	Buffer/Filter Strips	1997
MN-2	Minnesota	Housekeeping Best Management Practice Maintenance	1999
NC-2	North Carolina	Stormwater Control Inspection and Maintenance Manual – North Carolina DOT	2010
NC-GR-1	Greensboro, NC	Stormwater Management Manual	2009
NC-RA-1	Raleigh, NC	Stormwater Management design Manual	2002
NV-1	Nevada	Stormwater Quality Manuals – Nevada DOT	2006
NY-1	New York	New York State Stormwater Management Design Manual – Chp. 5	
OR-PO-1	Portland, OR	Stormwater Management Manual – O&M – Chp. 3	
PA-3	Pennsylvania	Best Management Practices #: Vegetated Swale	
TN-KI-1	Kingsport, TN	Stormwater Management Manual	
U-UMN-5	University of MN	Maintenance for Biologically Enhanced Practices	
VA-FA-1	Fairfax, VA	Stormwater Pond and Wetlands Maintenance Guidebook	2004
WA-1	Washington	Vegetated Stormwater Facility Maintenance	2000
WA-BG-1	Battle Ground, WA	Stormwater Facility Maintenance Manual	2009
WA-CC-1	Clark County, WA	Stormwater Facility Maintenance Manual	2000
WA-SE-3	Seattle, WA	High Point Community – Natural Drainage and Landscape Maintenance Guidelines for Right-of-way and Open Space	2010

The following maintenance and inspection checklists were found during this research process. They list exactly what to look for during inspection, how to solve a problem, if any, and at what time to perform all these tasks.

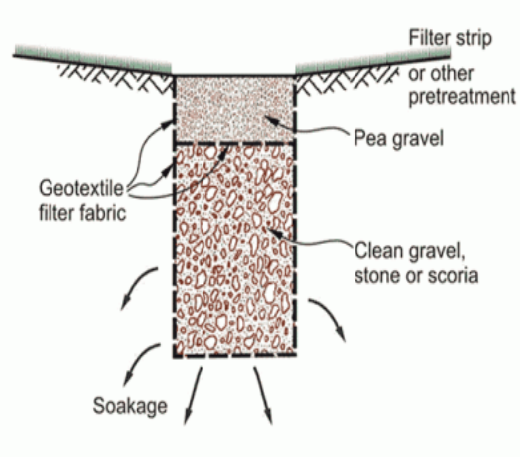
SMP	PDF Name	Location	Title of Source	Year
Bio-filtration Swale	AR_BiofiltrationSwales.pdf	Arkansas	Generic Stormwater Maintenance Manual – App. 8B	

Dispersion Trenches	AR_DispersionTrenches.pdf	Arkansas	Generic Stormwater Maintenance Manual – App. 8B	
Enhanced Swales	KingsportTN_EnhancedSwales.pdf	Kingsport, TN	Stormwater Management Manual	
Filter Strip	KingsportTN_FilterStrip.pdf	Kingsport, TN	Stormwater Management Manual	
Grass Channel	KingsportTN_GrassChannel.pdf	Kingsport, TN	Stormwater Management Manual	
Bioswale/Bioretention	LibertyvilleIL_BioswaleBioretention.pdf	Libertyville, IL	Stormwater Management System Maintenance Plan	2004
Vegetated Swale	MartinezCA_VegetatedSwale.pdf	Martinez, CA	Stormwater Control Operation and Maintenance Plan	
Bioswale Filter Strip	MI_BioswaleFilterStrip.pdf	Michigan	Low Impact Development for Michigan – App. F	
Level Spreader	NC_LevelSpreader.pdf	North Carolina	Stormwater Control Inspection and Maintenance Manual	2010
Swale	NC_Swale.pdf	North Carolina	Stormwater Control Inspection and Maintenance Manual	2010
Open Channel	NY_OpenChannel.pdf	New York	New York State Stormwater Management Design Manual – App. G	2003
Bio-infiltration Swale	PierceCountyWA_BioinfiltrationSwaels.pdf	Pierce County, WA	Stormwater Maintenance Manual	
Field Inlet	PierceCountyWA_FieldInlet.pdf	Pierce County, WA	Stormwater Maintenance Manual	
Filter Strip	PierceCountyWA_FilterStrip.pdf	Pierce County, WA	Stormwater Maintenance Manual	
Wet Bio-infiltration Swale	PierceCountyWA_WetBioinfiltrationSwales.pdf	Pierce County, WA	Stormwater Maintenance Manual	
Grass Swale	PierceCountyWA_GrassSwale.pdf	Pierce County, WA	Stormwater Maintenance Manual	
Open Channel	PierceCountyWA_OpenChannel.pdf	Pierce County, WA	Stormwater Maintenance Manual	
Conveyance Pipes, Ditches, and Swales	TumwaterWA_ConveyancePipesDitchesSwales.pdf	Tumwater, WA	Stormwater Facility Maintenance Guide	2002
Storm Filter	TumwaterWA_StormFilter.pdf	Tumwater, WA	Stormwater Facility Maintenance Guide	2002
Dry Swale	VA_DrySwales.pdf	Virginia	Virginia Stormwater Management Handbook – Chp. 9	2009
Filtering Practices	VA_FilteringPractices.pdf	Virginia	Virginia Stormwater Management Handbook – Chp. 9	2009
Filter Strips	VA_FilterStrips.pdf	Virginia	Virginia Stormwater Management Handbook – Chp. 9	2009
Grass Channels	VA_GrassChannels.pdf	Virginia	Virginia Stormwater Management Handbook – Chp. 9	2009
Wet Swales	VA_WetSwales.pdf	Virginia	Virginia Stormwater Management Handbook – Chp. 9	2009

Green Stormwater Infrastructure Maintenance
Spotlight on Subsurface *Infiltration/Detention*

1. Introduction

This section outlines the information that was gathered for the following types of SMPs:



Infiltration Trench: A subsurface structure designed to detain runoff and allow infiltration, if possible. The outflow component controls stormwater runoff peak rates and quantity.

Vaults/Tanks: An underground structure designed to manage excess stormwater runoff on a developed site, often in an urban setting. This type of SMP may be selected when there is insufficient space on the site to infiltrate the runoff or build a surface facility such as a detention/retention basin.

Drywell: A subsurface storage facility that temporarily stores and infiltrates stormwater runoff from the roofs of residential structures.

A list of documents pertaining to the above mentioned SMPs are provided under the references section and can be used to pursue further information or clarification on the topics discussed in this report.

2. Maintenance Activities

The following table provides an overview of the frequency, inspection requirements and field practices related to subsurface infiltration/detention maintenance. This information was compiled from various manuals; the specific maintenance activities for subsurface infiltration/detention are described below.

Frequency	Inspection Requirements	Field Practices	Infiltration Trench	Vault/ Tank	Drywell
As Needed	▪ Inspect to see if more than ½ of the cross-section of a vent is blocked at any point or the vent is damaged. ▪ Inspect for any voids or openings allowing soil or ground water to enter the facility. ▪ Look to see if any part of the tank/pipe is bent more than 10% out of shape. If so replace/fix it. ▪ Inspect outflow location to make sure a tail-water condition is not impeding discharge from the device. If this is the case, the tail-water level must be lowered.	▪ Clean out drywells when sediment depth is greater than 1/3 of the distance between the base and inlet pipe. Should be performed in a way that makes certain removed sediment and water isn't discharged back into the storm sewer. ▪ Control erosion, stabilize banks, remove excessive debris, and clean and repair inlet/outlet pipes. ▪ Prevent large root systems from damaging subsurface structural components. ▪ Tilling of subgrade soil below reservoir may be necessary prior to backfill. ▪ Replace pea gravel/topsoil surface fabric when clogged. ▪ Remove any vegetation growing on basin floor or trench. Tilling may be necessary to control weed growth and overcome the effects of soil compaction. Before tilling, sediment and vegetation must be removed. If a filter fabric is present surface, remove it so not to harm it. Remove woody vegetation within 15 ft of the toe embankment, or 25 ft of the principal spillway. ▪ Remove large burrowing animals from structural features. ▪ Fertilization should be avoided unless absolutely necessary. ▪ Snow removed from any on-site or off-site areas may not be stored over an infiltration area. ▪ Grass should be mowed to an average height of 3"-9" depending on site characteristics. ▪ Remove sediment when it accumulates to 10% of the depth of a rectangular vault or 1/10 the diameter of a round tank or vault. ▪ Repair all cracks greater than ¼".	X	X	X
Monthly	▪ Inspect drywell after every major storm for the first few months, then quarterly. ▪ Watering and fertilization of pre-treatment SMPs should be provided the first few months to help establishment.	▪ Measure the water depth in the observation well at 24- and 48- hour intervals after a storm. Calculate clearance rates. ▪ Ensure the contributing drainage area, facility, and inlets are clear of debris. Ensure that the contributing area is stabilized. Remove sediment and oil/grease from pre-treatment devices, as well as overflow structures. Mow grass filter strips as necessary and remove grass clippings.	X		X
Quarterly	▪ Ground water should be analyzed for indicator	▪ Floating debris should be removed.	X	X	

Frequency	Inspection Requirements	Field Practices	Infiltration Trench	Vault/ Tank	Drywell
	parameters such as pH, specific conductance, dissolved oxygen, and chloride. Zinc has been found as a stable heavy metal and should also be measured.				
Semi-Annually	▪ Inspect pre-treatment devices and diversion structures for sediment buildup and structural damage.	▪ Clean drywell gutters, rain drains, and silt traps. ▪ Check observation wells following 3 days of dry weather. Failure to percolate within this time period indicates clogging.	X		X
Annually	▪ Drywells should be inspected and surrounding areas for pollutants such as leaks from dumpsters, minor spills, and oil dumping.	▪ Disc or otherwise aerate bottom of trench. ▪ De-thatch basin bottom. ▪ Remove sediment from forebay every 5-6 years or when 50% full; from basin or trench when sediment has accumulated to a depth of 5" or when basin is clogged. ▪ Mow side slopes, embankments, emergency spillway, and access roads in August. Dispose of removed vegetation in an upland location. ▪ Remove any trash, debris, and sediment that accumulated in tank/vault.	X	X	X
Upon Failure	▪ N/A	▪ If the drywell doesn't dissipate stormwater, it should be replaced or repaired. It is possible to restore some drywell capacity by water-jetting clogged openings. Another option is installing a new drywell or drainage trench, and converting the clogged drywell into a sediment trap. This has the advantage of providing a sediment trap and some amount of spill trapping. The sediment trap conversion requires grouting the holes, covering the base with concrete, and adding piping. ▪ Perform total rehabilitation of the trench to maintain design storage capacity. Excavate trench walls to expose clean soil. ▪ If bypass capacity is available, it may be possible to regain or increase the infiltration rate in the short term by providing an extended dry period. ▪ When the aggregate layers of the trench below the top layer of filter cloth exhibit clogging conditions, the entire trench should be rehabilitated, starting with excavation of all aggregate, removal of all filter cloth, and rescarification of the bottom and side of the trench.	X		X

3. Issues/Concerns

The following issues were described in various manuals or documents and assembled here for the benefit of inventorying specific concerns with maintaining these types of SMPs:

- Dry/Underground Detention Basins: Chemicals such as copper sulfate used to inhibit algae growth in the water quality pond degrade water quality. Since the pond's main function is to enhance water quality, these chemicals should not be used. Rather, reducing the amount of fertilizer application and ensuring that the pond outlets are properly functioning so the pool is flushed periodically will help to deter algae growth.
- Safety: Work inside underground structures requires special OSHA-required confined space equipment and procedures. The most practical option may be to contract with a sewer-cleaning contractor.
- A drywell can last up to 30 years with proper construction and maintenance.
- Disposal of waste from maintenance of drainage facilities shall be conducted in accordance with federal, state, and local regulations.
- Removed sediment must be disposed in the garbage as solid waste. Water should be disposed of in a sanitary sewer after oils are removed using oil absorbent materials or other mechanical means. Used oil absorbents should be recycled or disposed according the manufacturer's instructions.
- Repairing a clogged drainage trench will involve excavation and replacement of part or all of the facility.

4. Design Suggestions

The following information has come from the various maintenance documents and describes suggestions to be made at the design level to alleviate maintenance issues.

- Infiltration BMPs are only recommended for small nonresidential sites where the owners can be held accountable for the required maintenance activities.

5. References

The following documents were used to compile data for this report and also include relevant inspection reports/checklists.

ID	Location	Title	Year
GA-1	Georgia	Detention Structural Stormwater Controls – Georgia Stormwater Management Manual	
GA-14	Georgia	Underground Detention – Georgia Stormwater Management Manual Vol. 2	2001
GA-GC-1	Gwinnett County, GA	Stormwater Systems and Facilities Installation Standards and Specifications	2006
IA-1	Iowa	Infiltration Trenches – Iowa Stormwater Management Manual	2009
IA-2	Iowa	Infiltration Basins – Iowa Stormwater Management Manual	2009
ID-1	Idaho	Catalog of Stormwater Best Management Practices for Idaho Cities and Counties	2005
IL-CH-3	Chicago, IL	Stormwater Management Ordinance Manual	2011
KA-KC-1	Kansas City, KA	Manual of Best Management Practices for Stormwater Quality	2008
MA-1	Massachusetts	Vol. 2 Chp. 2 – Structural Best Management Practice Specifications for the Massachusetts Stormwater Handbook	
MD-CE-1	Centreville, MD	Environmental Site Design Manual	2007
ME-4	Maine	Infiltration Best Management Practices	2005
MI-1	Michigan	Low Impact Development for Michigan – App. F	
MN-2	Minnesota	Housekeeping Best Management Practice Maintenance	1999
NC-2	North Carolina	Stormwater Control Inspection and Maintenance Manual	2010
NC-GR-1	Greensboro, NC	Stormwater Management Manual	2009
NY-2	New York	New York State DOT – Region 8 – Stormwater Facilities Operation and Maintenance Manual	2003

ID	Location	Title	Year
OR-PO-1	Portland, OR	Stormwater Management Manual – Operation and Maintenance – Chp. 3	
SC-BC-1	Beaufort County, SC	Manual for Stormwater Best Management Practices	2010
TN-CH-1	Chattanooga, TN	Maintenance of Detention Devices – Stormwater Best Management Practices Manual	2003
U-UMN-3	University of MN	Maintenance for Infiltration Practices	
U-UMN-4	University of MN	Maintenance for Sedimentation Practices	
WA-BG-1	Battle Ground, WA	Stormwater Facility Maintenance Manual	2009
WA-CC-1	Clark County, WA	Stormwater Facility Maintenance Manual	2000

The following maintenance and inspection checklists were found during this research process. They list exactly what to look for during inspection, how to solve a problem, if any, and at what time to perform all these tasks.

SMP	PDF Name	Location	Title of Source	Year
Infiltration Trench	AR_InfiltrationTrench.pdf	Arkansas	Generic Stormwater Maintenance Manual – App. 8B	
Tanks/Vaults	AR_TanksVaults.pdf	Arkansas	Generic Stormwater Maintenance Manual – App. 8B	
Infiltration Trench	KingsportTN_InfiltrationTrench.pdf	Kingsport, TN	Stormwater Management Manual	
Underground Detention	MN_UndergroundDetention.pdf	Minnesota	Stormwater Maintenance Best Management Practice Research Guide	2009
Underground Treatment Devices	MN_UndergroundTreatmentDevices.pdf	Minnesota	Stormwater Maintenance Best Management Practice Research Guide	2009
Drywell	PierceCountyWA_Drywell.pdf	Pierce County, WA	Stormwater Maintenance Manual	
Infiltration Facilities	PierceCountyWA_InfiltrationFacilities.pdf	Pierce County, WA	Stormwater Maintenance Manual	
Infiltration Trench	PierceCountyWA_InfiltrationTrench.pdf	Pierce County, WA	Stormwater Maintenance Manual	
Inlet/Outlet Pipe	PierceCountyWA_InletOuletPipe.pdf	Pierce County, WA	Stormwater Maintenance Manual	
Tanks/Vaults	PierceCountyWA_TanksVaults.pdf	Pierce County, WA	Stormwater Maintenance Manual	
Wet Vault	PierceCountyWA_WetVault.pdf	Pierce County, WA	Stormwater Maintenance Manual	
Closed Detention Systems.	TumwaterWA_ClosedDetentionSystems.pdf	Tumwater, WA	Stormwater Facility Maintenance Guide	2002
Wet Vaults	TumwaterWA_WetVaults.pdf	Tumwater, WA	Stormwater Facility Maintenance Guide	2002

Green Stormwater Infrastructure Maintenance
Spotlight on *Surface Infiltration/Detention*

1. Introduction

This section outlines the information that was gathered for the following types of SMPs:

Stormwater Basin: A large excavated depression landscaped with native grasses or vegetation that temporarily detains stormwater and provide controlled stormwater flow. Infiltration can be design where feasible.

Detention Basin: A stormwater management facility installed on, or adjacent to, tributaries of rivers, streams, lakes or bays that is designed to protect against flooding and, in some cases, downstream erosion by storing water for a limited period of time. These basins are also called “dry ponds”, “holding ponds”, or “dry detention basins” if no permanent pool of water exists. Some detention ponds are also “wet ponds” in that they are designed to permanently retain some volume of water at all times.

Infiltration Basin: A type of BMP that is used to manage stormwater runoff, prevents flooding and downstream erosion, and improves water quality in an adjacent river, stream, lake or bay. It is essentially a shallow artificial pond that is designed to infiltrate stormwater through permeable soils into the groundwater aquifer. Infiltration basins do not discharge to a surface water body under most storm conditions, but are designed with overflow structures that operate during flood conditions.

A list of documents pertaining to the above mentioned SMPs are provided under the references section and can be used to pursue further information or clarification on the topics discussed in this report.

2. Maintenance Activities

The following table provides an overview of the frequency, inspection requirements and field practices related to various surface infiltration/detention maintenance. This information was compiled from various manuals; the specific maintenance activities for surface infiltration/detention devices are described below.

Frequency	Inspection Requirements	Field Practice	Basin	Detention Basin	Infiltration Basin
As Needed	▪ Note any standing water or evidence of extended ponding not intended in the design or function of the system. ▪ Maintain 4”-10” deep rock check dams at 12’-20’ intervals. ▪ Repair/seal cracks. Replace when repair is insufficient. ▪ Check and record drawdown time during and after major storm events to document infiltration rates. ▪ Inspect for algae growth. Treat with EPA approved chemicals. ▪ Check for signs of unhealthy or overpopulation of fish and plants. ▪ Note signs of pollution, such as oil sheens, discolored water or unpleasant odors. ▪ Inspect inlet/outlet after any storm greater than 0.5” for clogging and remove debris.	▪ Sediment removal in the forebay shall occur when 50% of the total forebay capacity has been lost. ▪ The sediment chamber outlet devices shall be cleaned and/or repaired when drawdown times within the chamber exceed 36 hrs. ▪ Open channel sediment buildup within the bottom of the channel or filter strip shall be removed when 25% of the original Water Quality Volume (WQV) has been exceeded. ▪ Side slopes should be maintained as needed to promote dense vegetative cover with extensive root growth that enhances infiltration through the slope surface, prevents erosion and consequent sedimentation of the basin floor, and prevents invasive weed growth. ▪ Repair undercut or eroded areas. ▪ Mow side slopes. ▪ Manage pesticide and nutrients. ▪ Inlets and outlets should be regularly cleared to prevent obstructions and reduced efficiency of the system. ▪ All mechanical equipment, such as gates, valves, locks, or other components, must be kept in working order in case of emergency. ▪ In wet pond systems, eliminate regular mowing of the shoreline edge to a minimum of 5-10 ft and allow vegetation to grow to 24”-30”. Reduced mowing will promote deeper root growth and soil stability at the pond edge. The vegetation will filter runoff from surrounding areas reducing nutrients and other pollutants in the pond. The vegetation will also deter use of the facility by unwanted Canada geese through the physical and visual barrier. ▪ Remove sediment from wet pond every 5-10 years. ▪ Remove sediment from dry pond every 2-10 years. ▪ Replace splash blocks or inlet gravel/rock. ▪ Fill, lightly compact, and install plant vegetation to disperse flow. ▪ Rake, till, or amend to restore infiltration rate. ▪ Stabilize 3:1 slopes/banks with plants. ▪ Remove sediment when it accumulates to 2” or if the facility does not drain between storms or meets 90% of design capabilities. If the facility has a sediment trap, clean out facility when ½ ft accumulates. ▪ Trees should not be allowed to grow on	X	X	X

Frequency	Inspection Requirements	Field Practice	Basin	Detention Basin	Infiltration Basin
		emergency overflows and berms that are over 4 ft high. Trees can block flows and roots can lead to berm failure. Remove woody vegetation within 15ft of the toe of the embankment, or 25ft of the principal spillway. ▪ A 4" layer of clean sand or turf grass must be maintained at all times. ▪ Use jet-vac to remove debris if needed. ▪ The vegetative cover should be maintained at 85%. ▪ The underdrain system should be flushed and its components replaced/repaired as necessary. A high-pressure hose can be used to flush out underdrain systems by spraying water into cleanouts. ▪ Remove poisonous, nuisance vegetation, and noxious weeds. ▪ Clean out basin when its storage capacity drops below 15mm per hectare of drainage area.			
Monthly	▪ The gravel trench outlet should be inspected monthly for the first year, and then semi-annually to verify that the pond is slowly emptying through the gravel filter for a short time after the storm and that potentially clogging material such as decaying leaves are not preventing discharge through the gravel.	▪ Mowing should be done when needed (10-14 times/year). ▪ Meadow Management: Reduce mowing frequency of the basin bottom and embankments to a single monthly mowing at a height of 6"-8" during the months of May-Sept. ▪ Clean out inlet/outlet pipes.	X		
Quarterly	▪ Inspect and clean pre-treatment devices.	▪ N/A			X
Semi-Annually	▪ Note erosion of pond banks or bottom. ▪ Inspect inlet/outlet integrity, side slopes, or other features damaged, significant erosion, graffiti, or vandalism, etc. ▪ Inspect for sediment accumulation in the inlet pipes.	▪ Cut back grass and prune overgrowth. ▪ Average plant heights are greater than 12". Cut or remove vegetation and clippings once during the wet and dry season. ▪ Remove trash and debris. ▪ Manually remove weeds. ▪ It's important to clean out sediment that might be restricting water flow. Remove sediment with a shovel and wheel barrow if it is blocking water flow. Small amounts of removed sediment can be spread evenly on upland areas and seeded with watered vegetation. ▪ If stone around outlet pipe has accumulated sediment, vegetation and/or debris to an extent that water is not flowing through the stone and out of the pond as originally designed, then the stone should be replaced with clean 3" diameter stone choked with a clean 6A stone.	X	X	
Annually	▪ Inspect for damage to the embankment. Monitor for sediment	▪ Annual mowing of the pond buffer is only required along maintenance right-of-way and	X	X	X

Frequency	Inspection Requirements	Field Practice	Basin	Detention Basin	Infiltration Basin
	accumulation in the facility and forebay. ▪ Examine to ensure that inlet/outlet devices are free of debris and operational. ▪ Inspect burrows, holes, or mounds annually and after vegetation trimming. Where burrows cause seepage, erosion, and leakage, backfill firmly. ▪ Inspect riprap at the inlet pipes. ▪ The extended dry detention basin shall be evaluated every 2 years to assess the need for a major cleanout. ▪ Inspect check pond dams.	the embankment. The remaining buffer can be managed as a meadow. Mow preferably after August. ▪ Seed or sod to restore dead or damaged ground cover. ▪ Irrigate as needed and mulch banks annually. Do not apply fertilizers, herbicides, or pesticides. ▪ Every 5-7 years remove sediment from the forebay when it has accumulated to 5". ▪ Dredging should be considered every 10 years to assure that the pond can retain water and filter out pollutants. ▪ Removal of the top foot or so of soil is generally necessary every 5-10 years. If only dense clay remains after soil removal, it may be necessary to replace the removed sediments with clean topsoil, which should be seeded. Soil should be removed during drier summer periods to allow time for the grass to become re-established in the bottom of the basin. ▪ Maintain grass on check dam to prevent erosion and correct erosion problems before they become serious. ▪ Clean catch basins when they become 1/3 full to maintain sediment trapping capacity. Remove debris and litter as well. ▪ Basins should be re-mulched every 2-3 years.			
Upon Failure	▪ A thorough inspection of the observation points should be made if there is a decrease in retention basin capacity. Inspection points can include monitoring ports built into the base of the facility and water table depth monitoring wells. Water levels in these inspections points can provide information about the performance of the facility. ▪ Infiltration basins should drain completely during dry periods; standing water in the basin may indicate the need for maintenance. ▪ Filtration basins should drain within 40 hours after a storm event; prolonged ponding indicates that the filter media or underdrain system requires maintenance.	▪ If after 2 applications (2 seasons) of reseeding/revegetating growth is still unsuccessful, consider installation of an erosion blanket or equivalent protection over eroding areas. No erosion blanket should be installed in the basin invert. ▪ Identify and remove pollutant sources to the facility. ▪ If the facility is overflowing for storms it was designed to infiltrate, it needs to be repaired. This requires removing accumulated sediment and cleaning or rebuilding the system so that it works according to design. ▪ If liner has more than 3 holes with ¼" diameter in it, replace the liner.	X		X

3. Issues/Concerns

The following issues were described in various manuals or documents and assembled here for the benefit of inventorying specific concerns with maintaining these types of SMPs:

- Dry Ponds:
    - If any level of assessment reveals that a dry pond is not draining a runoff event less than or equal to the design storm volume within the specified design time, the following measures should be taken:
        - Inspect all outlet structures for clogging and/or structural damage. Remove debris and repair/replace outlet structure, if necessary.
        - Inspect the outflow location(s) to make sure a tail-water condition is not impeding discharge from the pond. If this is the case, the tail-water should be eliminated or the outlet modified in such a way that drainage occurs within the desired time.
        - If the pond still does not drain within the specified design time, the hydraulics of the pond should be re-evaluated and the geometry and outlet structure redesigned.
    - If a dry pond is not retaining suspended solids (or other sorbed pollutants) at expected levels, the following steps should be taken:
        - Check to make sure that the desired levels of pollutant are realistic. If retention of the desired pollutant is not realistic, consider implementing another SW treatment practice to achieve desired results.
        - Perform a sediment capacity test to determine the remaining sediment storage capacity of the pond. If there is no remaining capacity or if the capacity is nearly exhausted, the entrained sediment should be removed to allow for additional storage.
        - If there is adequate storage capacity remaining in the pond and pollutant removal is still less than expected values, a tracer study should be performed to determine if short-circuiting is occurring. If short-circuiting is occurring, consider adding one or more baffles or retrofitting the pond to redirect the flow of runoff in a way that eliminates or minimizes short-circuiting.
- Common plant diseases:
    - Dark gray to tan sunken spots on leaves: May be caused by anthracnose.
        - Avoid overhead watering.
        - Add mulch to root zone.
        - Increase air circulation around plant.
        - Remove and destroy infected portions of plant.
    - Blackened portions of plant: May be caused by fire-blight.
        - Remove and destroy infected portions of plant, pruning 6” minimum from diseased area.
    - Dull, yellow leaves, sparse, wilting, whitish fungal tissue below on roots below soil line: May be caused by oak root fungus.
        - Remove tree and all roots larger than ½“ in diameter.
    - White to gray circular patches, poor growth and fruiting: May be caused by powdery mildew.
        - Spray infected areas with water early in the day to wash spores from plants.
        - Spray with IPM-approved natural treatment, such as Neem oil, vegetable oil or a 10:1 mix of water and milk.
    - Wilting, leaves with poor color and premature drop: May be caused by root rots or water molds:
        - Check irrigation to eliminate over-watering.
        - Check for and remedy poor drainage.
    - Yellow to purple-brown bumps on leaf underside or yellow spots: May be caused by rust.
        - Remove infected leaves.
        - Remove fallen leaves or branches.
        - Increase air circulation around plants.

    - Coniferous trees, particularly cedar and cypress species, exhibiting yellowing, wilting, or browning through all or most of crown: May be caused by Phytophthora spp., a fungus which attacks the roots.
        - Consult immediately with a certified arborist.
        - Test root material and/or adjacent soil for presence of the fungus.
        - If disease is strongly suspected or confirmed, remove tree and surrounding soil from site.
        - Use extreme care not to spread or track any soil or plant material from site of diseased tree to other areas of site.
    - Clean and disinfect any equipment used to remove, handle, or transport any diseased plant material or soil.
- Infiltration Basins:
    - Sediment should be removed only when the surface is dry and "mud-cracked."
    - Light equipment must be used in order to avoid compacting soils. After removal of sediment, the infiltration area should be deep tilled to restore infiltration rates.
- How to prevent algae blooms:
    - Soil test – Have your soil tested to find out which nutrients it may be lacking.
    - Mow high – Avoid mowing directly to the edge of lakes and streams. Grass clippings can get into the water and add excess nutrients as they breakdown. Having turf grass directly at the edge of a pond also can exacerbate erosion problems.
    - Use low or no phosphorous fertilizers – Most soils tested throughout Southeast Michigan show that high levels of phosphorous are already in the soil.
    - Use slow-release nitrogen that meets this criterion – Natural organic fertilizer or synthetic fertilizer with 50% or more water soluble nitrogen.
    - Fertilize after and not before a rain event or irrigation – Never fertilize when heavy rain is predicted. Rain can wash the fertilizer into the pond and promote algae growth.
    - Remove dead vegetation – These materials release excess nutrients as they decompose and will lead to more algae growth.
    - Use pond water, which can be rich in nutrients, to water your lawn.
- Mosquito control:
    - Prevent debris and soil from washing into the pond to create mosquito breeding habitat.
    - Use bacterial larvicides available from home improvement stores in pre-treatment devices.
    - Stock fish to eat mosquito larvae. Sunfish and mosquito fish are best.
    - Install aerator (foundation) to reduce stagnation and decrease mosquito population.
    - Install bat houses or purple martin houses to encourage these insect-eating animals.

4. Design Suggestions

The following information has come from the various maintenance documents and describes suggestions to be made at the design level to alleviate maintenance issues.

- SW control facilities are, in effect, water body buffers where pesticides and fertilizer are not normally used.
- Detention basin:
    - Observation wells and access points to allow for the inspection and removal of accumulated sediment must be included in the design of subsurface systems.
    - A shallow detention basin designed to be used for other purposes, such as recreation, is more likely to be well-maintained.
- SW Pond: You should NOT plant landscaping on the top of the basin walls.
- Infiltration Basin**:** Do not mow when the ground is wet to avoid compaction of the bottom soils.

    - Basins can be designed with a 6”-12” layer of sand on the bottom or a filter fabric to facilitate removal.
    - If the sediment is accumulating faster than the growth of the turf-grass, the pre-treatment system needs to be re-evaluated. Maintenance of the pre-treatment system (sediment forebay, filter strip, grass) must occur on a regular basis to prevent heavy sediment build-up in the basin. The operating life of the pre-treatment system or inlet/bypass structure will likely be shorter than the infiltration basin, and will require occasional structural repair or equipment replacement.
- Maintenance access should be at least 12 ft wide; having a maximum slope of no more than 15%; and be appropriately stabilized to withstand maintenance equipment and vehicles.
- Provide emergency/maintenance gravity drain, if practicable.

5. Costs

The cost of maintenance is an important role in planning green infrastructure projects as well ensuring that they are viable. The following information reviews cost discrepancies from various sources.

- Preventative Measures for Wet Detention Ponds:
    - Cleanup in areas around pond - $20.00/month
    - Mowing grass around pond - $40 per ½ acre
    - Removing small trees from dam - $20/hour. After initial removal, mowing will keep trees from growing on dam.
- Dry Detention Ponds:
    - Maintaining pre-treatment grates, forebays, and catch basins by removing debris and sediment: $8.00 per hour ($20.00/month).
    - Removal of accumulated debris from a detention basin can be performed by a small work crew with shovels and wheelbarrows or by small excavation equipment. Assuming that one foot of soil (or less) is removed from the basin and the basin is less than 2,000 sq. feet, the cost for soil removal may range from $250-$750.
- Catch basin retrofits: The City replaces a portion of old catch basins every year, either in conjunction with road or other utility projects, or as a standalone retrofit project.
    - Annual program cost: $50,000
- Infiltration Basins:
    - Preventative measures:
        - Cleaning grates and other pre-treatment devices $20/month.
        - Mowing/landscaping: $10-$15/hour.
    - Maintenance:
        - Tilling (@ $10/hour) $40-$80 (larger infiltration basins may be higher).
        - Removal of sediment form infiltration basin: $250-$750 (average size pond).
        - Replacement topsoil and labor: $750-$1,000 (average size infiltration basin).
- **Detention Basins:**
    - Expected costs for annual routine maintenance: Approximately 3-5% of the construction cost.
    - Expected costs for sediment removal:
        - Mobilization: $2,500 - $5,000
        - Dredging work: $10/cy - $20/cy
        - Disposal off-site: $45/cy - $75/cy
    - Expected costs for pre-cast concrete replacement outlet structure: $5,000 - $15,000 depending on size of structure, access, and complexity of the installation

6. References

The following documents were used to compile data for this report and also include relevant inspection reports/checklists.

ID	Location	Title	Year
CA-SA-1	Sacramento, CA	Stormwater Quality Manual for the Sacramento and South Placer Regions	2007
CA-SA-3	Sacramento, CA	Caltrans Stormwater Quality Handbook	2003
CO-DC-1	Douglas County, CO	Standard Operating Procedures for Extended Detention Basin	2006
GA-1	Georgia	Detention Structural Stormwater Controls – Georgia Stormwater Management Manual	
GA-4	Georgia	Stormwater Ponds – Georgia Stormwater Management Manual Vol. 2	2001
GA-6	Georgia	Dry Detention/Dry ED Basins – Georgia Stormwater Management Manual Vol. 2	2001
GA-13	Georgia	Multi-purpose Detention Areas – Georgia Stormwater Management Manual Vol. 2	2001
GA-GC-1	Gwinnett County, GA	Stormwater Facilities Installation Standards and Specifications	2006
IA-2	Iowa	Infiltration Basins – Iowa Stormwater Management Manual	2009
ID-1	Idaho	Catalog of Stormwater Best Management Practices for Idaho Cities and Counties	2005
ID-2	Idaho	Erosion and Sediment Control Best Management Practice Manual	2011
IL-CH-3	Chicago, IL	Stormwater Management Ordinance Manual	2011
IL-CH-4	Chicago, IL	A Guide to Stormwater Best Management Practices	2003
KA-KC-1	Kansas City, KA	Manual of Best Management Practices for Stormwater Quality	2008
LA-BR-1	Baton Rouge, LA	Stormwater Best Management Practice for East Baton Rouge Parish – Master Development Program	
MA-1	Massachusetts	Vol. 2 Chp. 2 – Structural Best Management Practice Specifications for the Massachusetts Stormwater Handbook	
MD-3	Maryland	Maryland Stormwater Design Manual	2000
ME-1	Maine	Peak Flow Control/Detention Basins – Maine Stormwater Best Management Practices Manual	2005
ME-2	Maine	Wet Ponds – Maine Stormwater Best Management Practices Manual	2005
MI-1	Michigan	Low Impact Development Manual for Michigan – App. F	
MI-4	Michigan	Catch Basins	1992
MI-5	Michigan	Infiltration Basins	1992
MN-2	Minnesota	Housekeeping Best Management Practice Maintenance	1999
NC-2	North Carolina	Stormwater Control Inspection and Maintenance Manual	2010
NC-GR-1	Greensboro, NC	Stormwater Management Manual	2009
NC-RA-1	Raleigh, NC	Stormwater Management Design Manual	2002
NJ-2	New Jersey	New Jersey Stormwater Best Management Practice Manual – Standard for Extended Detention Basins	2004
NJ-3	New Jersey	Stormwater Management Basins and Their Maintenance	
NV-1	Nevada	Stormwater Quality Manuals	2006
NY-2	New York	New York State DOT – Region 8 – Stormwater Facilities Operation and Maintenance Manual	2003
OR-PO-1	Portland, OR	Stormwater Management Manual – Operation and Maintenance – Chp. 3	
SC-BC-1	Beaufort County, SC	Manual for Stormwater Best Management Practices	2010
SC-GC-1	Greenville County, SC	Stormwater Pond Management and Maintenance	
TN-CH-1	Chattanooga, TN	Maintenance of Detention Devices – Stormwater Best Management Practices Manual	2003
TN-KI-1	Kingsport, TN	Stormwater Management Manual	
U-UMN-4	University of MN	Maintenance for Sedimentation Practices	
WA-BG-1	Battle Ground, WA	Stormwater Facility Maintenance Manual	2009
WA-CC-1	Clark County, WA	Stormwater Facility Maintenance Manual	2000

WA-FE-1	Ferndale, WA	Stormwater Pond Maintenance	
WA-SE-3	Seattle, WA	High Point Community – Natural Drainage and Landscape Maintenance Guidelines for Right-of-way and Open Space	2010

The following maintenance and inspection checklists were found during this research process. They list exactly what to look for during inspection, how to solve a problem, if any, and at what time to perform all these tasks.

SMP	PDF Name	Location	Title of Source	Year
Catch Basin	AR_CatchBasin.pdf	Arkansas	Generic Stormwater Maintenance Manual – App. 8B	
Ponds	AR_Ponds.pdf	Arkansas	Generic Stormwater Maintenance Manual – App. 8B	
Dry Detention Pond	ChattanoogaTN_DryDetentionPond.pdf	Chattanooga, TN	Maintenance of Detention Devices – Stormwater Best Management Practices Manual	2003
Infiltration Basin	ChattanoogaTN_InfiltrationBasin.pdf	Chattanooga, TN	Maintenance of Detention Devices – Stormwater Best Management Practices Manual	2003
Wet Detention Basin	ChattanoogaTN_WetDetentionBasin.pdf	Chattanooga, TN	Maintenance of Detention Devices – Stormwater Best Management Practices Manual	2003
Conventional Dry Detention Basin	KingsportTN_ConventionalDryDetentionBasin.pdf	Kingsport, TN	Stormwater Management Manual	
Dry Extended Detention Basin	KingsportTN_DryExtendedDetentionBasin.pdf	Kingsport, TN	Stormwater Management Manual	
Stormwater Basin	KingsportTN_StormwaterBasin.pdf	Kingsport, TN	Stormwater Management Manual	
Detention	MI_Detention.pdf	Michigan	Low Impact Development Manual for Michigan – App. F	
Detention Pond	MI_DetentionPondChecklist.pdf	Michigan	Maintaining Your Detention Pond – A Guidebook for Private Owners in Southeast Michigan	
Infiltration	MI_Infiltration.pdf	Michigan	Low Impact Development Manual for Michigan – App. F	
Infiltration	MN_Infiltration.pdf	Minnesota	Stormwater Maintenance Best Management Practice Report	2009
Stormwater Ponds	MN_StormwaterPonds.pdf	Minnesota	Stormwater Maintenance Best Management Practice Report	2009
Dry Detention Basin	NC_DryDetentionBasin.pdf	North Carolina	Stormwater Control Inspection and Maintenance Manual	2010
Bioretention Basin	NC_BioretentionBasin.pdf	North Carolina	Stormwater Control Inspection and Maintenance Manual	2010
Filtration Basin	NC_FiltrationBasin.pdf	North Carolina	Stormwater Control Inspection and Maintenance Manual	2010
Hazardous Spill Basin	NC_HazardousSpillBasin.pdf	North Carolina	Stormwater Control Inspection and Maintenance Manual	2010
Infiltration Basin	NC_InfiltrationBasin.pdf	North Carolina	Stormwater Control Inspection and Maintenance Manual	2010
Wet	NC_WetDetentionBasin.pdf	North Carolina	Stormwater Control Inspection and	2010

Detention Basin			Maintenance Manual	
Infiltration Practices	NY_InfiltrationPractices.pdf	New York	New York State Stormwater Management Design Manual – App. G	2003
Catch Basin	PierceCountyWA_CatchBasin.pdf	Pierce County, WA	Stormwater Maintenance Manual	
Detention Pond	PierceCountyWA_DetentionPond.pdf	Pierce County, WA	Stormwater Maintenance Manual	
Infiltration Retention Pond	PierceCountyWA_InfiltrationRetentionPond.pdf	Pierce County, WA	Stormwater Maintenance Manual	
Storm Filter	PierceCountyWA_Stormfilter.pdf	Pierce County, WA	Stormwater Maintenance Manual	
Catch Basin Insert	TumwaterWA_CatchBasinInsert.pdf	Tumwater, WA	Stormwater Facility Maintenance Guide	2002
Catch Basins and Inlets	TumwaterWA_CatchBasins&Inlets.pdf	Tumwater, WA	Stormwater Facility Maintenance Guide	2002
Ponds	TumwaterWA_Ponds.pdf	Tumwater, WA	Stormwater Facility Maintenance Guide	2002
Extended Detention Ponds	VA_ExtendedDetentionPonds.pdf	Virginia	Virginia Stormwater Management Handbook – Chp. 9	2009
Infiltration Practices	VA_InfiltrationPractices.pdf	Virginia	Virginia Stormwater Management Handbook – Chp. 9	2009
Wet Ponds	VA_WetPonds.pdf	Virginia	Virginia Stormwater Management Handbook – Chp. 9	2009

Green Stormwater Infrastructure Maintenance
Spotlight on *Other Forms*

1. Introduction

This section outlines the information that was gathered for the following types of SMPs:

Vegetation: Ground cover provided by plants.

Manhole: The top opening to an underground utility vault to house an access point for making connections or performing maintenance on underground and buried public utility and other services.

Closed Conduit: Closed structure for the free passage of water and waste flows.

Debris Barrier: A barrier that stops trash, debris, and large objects from flowing into the stormwater best management practice.

Catch Basin Insert: A type of debris barrier.

Facility Discharge Point: A ditch, stream, or other area where stormwater is emptied into.

Flow Restrictor: An object that attempts to slow the flow of water.

Storm Pipe: Underground pipes through which stormwater flows.

A list of documents pertaining to the above mentioned SMPs are provided under the references section and can be used to pursue further information or clarification on the topics discussed in this report.

2. Maintenance Activities

The following table provides an overview of the frequency, inspection requirements and field practices related to other forms of stormwater maintenance. This information was compiled from various manuals; the specific maintenance activities for other forms of stormwater treatment are described below.

Subject	Field Practice	Inspection Requirement	Frequency
Vegetation	▪ Mulch to prevent competition, or mow or clip competitive vegetation, where possible. ▪ Use herbicides only where mulching has failed and mowing and clipping aren't possible. ▪ Fertilize in needed areas in late fall or early spring before leaves emerge. ▪ For evergreens, use only ½ the recommended amount of fertilizer. ▪ Most ground covers need yearly trimming to promote growth. Trim back from trees, flower beds, fences, and buildings. ▪ Add additional mulch as needed until the area is completely stabilized.	▪ N/A	▪ For hardwoods, vegetation must be controlled for at least 3 growing seasons. ▪ For conifers, vegetation must be controlled for at least 2 growing seasons. ▪ Ideally, newly planted trees should receive 1" of water each week for the first 2 years after planting. ▪ Like shrubs, fertilizers may only be needed once every 3-4 years, depending on the results of soil tests.
Manhole	▪ N/A	▪ Inspect for damage or missing block and mortar. ▪ Inspect for derby within the structure.	Annually
Closed Conduit	▪ Typical cleaning closed drains and pipes. ▪ Culvert Cleaning.	▪ Video Inspections.	▪ Every 10 years ▪ Every 25 years ▪ Annually
Debris Barrier	▪ Replace missing/bent bars. ▪ Repair or replace missing trash screen. ▪ Clean trash racks when debris is plugging more than 20% of the openings or when obstructions to fish passage are created.	▪ Inspect for bent or missing bars.	As needed
Catch Basin Insert	▪ It is easier to remove the filter media if it has drained and dried. ▪ Remove trash and litter from the filter. ▪ Removed sediment must be handled and disposed of as solid waste.	▪ If inserts are used for trapping sediment on a construction project, they should be inspected after every major storm.	▪ During wet season, should be inspected every 2 weeks. During dry season, should be inspected every 2 months.
Facility Discharge Point	▪ Stabilize ditch or stream banks; report any erosion.	▪ Inspect for obvious signs of poor water quality and any evidence of oil, gasoline, sewage or other pollutants. ▪ Effluent discharge from facility should be clear; identify and remove source and report it.	As Needed
Flow Restrictor	▪ Remove sediment within 1 ½ feet of the bottom of an orifice plate. Remove trash and debris that may block the orifice plate or overflow pipe. ▪ Repair anything that has been damaged.	▪ Inspect when facility doesn't drain properly or other problems occur.	Annually
Storm Pipe	▪ Clean pipes when sediment depth is	▪ Pipes are difficult to	As Needed

Subject	Field Practice	Inspection Requirement	Frequency
	greater than 20% of pipe diameter. When cleaning a pipe, minimize sediment and debris discharges from pipes to the storm sewer. Install downstream debris traps before cleaning and then remove material. ▪ Repair or replace pipes when a dent or break comes more than 20% of the pipe diameter. ▪ Repair/replace pipes damaged by rust or deterioration.	inspect requiring special equipment and training. Usually, if a problem occurs, the owner needs to call a sewer or plumbing contractor to inspect, repair or clean pipelines.	

3. Issues/Concerns

The following issues were described in various manuals or documents and assembled here for the benefit of inventorying specific concerns with maintaining these types of SMPs:

- Persons handling used filters from catch basin inserts should wear rubber gloves and safety protection.
- Storm Pipe: Generally, use mechanical methods to remove root obstructions from inside storm sewer pipes. Do not put rood-dissolving chemicals in storm sewer pipes. If there is a problem, remove the vegetation over the line.

4. References

The following documents were used to compile data for this report and also include relevant inspection reports/checklists.

ID	Location	Title	Year
MI-1	Michigan	Low Impact Development Manual for Michigan – App. F	
MI-7	Michigan	Trees, Shrubs and Ground Covers	1992
WA-BG-1	Battle Ground, WA	Stormwater Facility Maintenance Manual	2009
WA-CC-1	Clark County, WA	Stormwater Facility Maintenance Manual	2000

The following maintenance and inspection checklists were found during this research process. They list exactly what to look for during inspection, how to solve a problem, if any, and at what time to perform all these tasks.

SMP	PDF Name	Location	Title of Source	Year
Access Road and Easement	AR_AccessRoad&Easement.pdf	Arkansas	Generic Stormwater Maintenance Manual – App. 8B	
Control Structures	AR_ControlStructures.pdf	Arkansas	Generic Stormwater Maintenance Manual – App. 8B	
Fencing	AR_Fencing.pdf	Arkansas	Generic Stormwater Maintenance Manual – App. 8B	
Oil/Water Separator	AR_OilWaterSeparator.pdf	Arkansas	Generic Stormwater Maintenance Manual – App. 8B	
Record of Engineering	Australia_RecordOfEngineering.pdf	Australia	Stormwater Maintenance Plan	2007
Record of Water Quality Monitoring	Australia_RecordOfWaterQualityMonitoring.pdf	Australia	Stormwater Maintenance Plan	2007
Maintenance Inspection Form	CastleRockCO_MaintInspectionForm.pdf	Castle Rock, CO	Stormwater Management Facility Operation and Maintenance	2009
Media Filters	ChattanoogaTN_MediaFilters.pdf	Chattanooga, TN	Maintenance of Detention Devices	2003
Design	GreensboroNC_DesignChe	Greensboro, NC	Stormwater Management	2009

SMP	PDF Name	Location	Title of Source	Year
Requirements	cklist.pdf		Manual	
Inspection Checklist	GreensboroNC_InspectionChecklist.pdf	Greensboro, NC	Stormwater Management Manual	2009
Catch Basin Insert	PierceCountyWA_CatchBasinInsert.pdf	Pierce County, WA	Stormwater Maintenance Manual	
CDS Media Filtration System	PierceCountyWA_CDSMedia.pdf	Pierce County, WA	Stormwater Maintenance Manual	
Coalescing Plate	PierceCountyWA_CoalescingPlate.pdf	Pierce County, WA	Stormwater Maintenance Manual	
Compost Soil	PierceCountyWA_CompostSoil.pdf	Pierce County, WA	Stormwater Maintenance Manual	
Control Structure	PierceCountyWA_ControlStructure.pdf	Pierce County, WA	Stormwater Maintenance Manual	
Debris Barrier	PierceCountyWA_DebrisBarrier.pdf	Pierce County, WA	Stormwater Maintenance Manual	
Ecology Embankment	PierceCountyWA_EcologyEmbankment.pdf	Pierce County, WA	Stormwater Maintenance Manual	
Energy Dissipater	PierceCountyWA_EnergyDissipater.pdf	Pierce County, WA	Stormwater Maintenance Manual	
Fencing	PierceCountyWA_Fencing.pdf	Pierce County, WA	Stormwater Maintenance Manual	
Gates	PierceCountyWA_Gates.pdf	Pierce County, WA	Stormwater Maintenance Manual	
Grounds	PierceCountyWA_Grounds.pdf	Pierce County, WA	Stormwater Maintenance Manual	
Oil/Water Separator	PierceCountyWA_OilWaterSeparator.pdf	Pierce County, WA	Stormwater Maintenance Manual	
Vortechs Stormwater System	PierceCountyWA_VortechsSWSystem.pdf	Pierce County, WA	Stormwater Maintenance Manual	
Annual Stream Inspection	SanLuisObispoCA_AnnualStreamInspection.pdf	San Luis Obispo, CA	Stream Maintenance and Management Program for the San Luis Obispo Creed Watershed	2003
Access Roads and Easements	TumwaterWA_AccessRoads&Easements.pdf	Tumwater, WA	Stormwater Facility Maintenance Guide	2002
Baffle Oil/Water Separator	TumwaterWA_BaffleOilWaterSeparator.pdf	Tumwater, WA	Stormwater Facility Maintenance Guide	2002
Coalescing Plate Oil/Water Separator	TumwaterWA_CoalescingPlateOilWater.pdf	Tumwater, WA	Stormwater Facility Maintenance Guide	2002
Control Structures Flow Restrictors	TumwaterWA_ControlStructursFlowRestrictors.pdf	Tumwater, WA	Stormwater Facility Maintenance Guide	2002
Debris Barriers	TumwaterWA_DebrisBarriers.pdf	Tumwater, WA	Stormwater Facility Maintenance Guide	2002
Energy Dissipaters	TumwaterWA_EnergyDissipaters.pdf	Tumwater, WA	Stormwater Facility Maintenance Guide	2002
Fencing, Shrubbery, Gates	TumwaterWA_FencingShrubberyGates.pdf	Tumwater, WA	Stormwater Facility Maintenance Guide	2002
Grounds and Landscaping	TumwaterWa_GroundsLandscaping	Tumwater, WA	Stormwater Facility Maintenance Guide	2002
Soil Compost Amendments	VA_SoilCompostAmendments.pdf	Virginia	Virginia Stormwater Management Handbook – Chp. 9	2009

Appendix VIII

Education & Outreach Materials

Philadelphia Water Department

Green City, Clean Waters
2011

Green City, Clean Waters

Background

On June 1, 2011, the PA Department of Environmental Protection and the Philadelphia Water Department (PWD) signed a groundbreaking agreement that will allow PWD to officially implement its Green City, Clean Waters plan. PWD plans to invest approximately $2.4 billion over the next 25 years to significantly reduce Combined Sewer Overflows (CSOs) – a combination of sewage and stormwater that overflows into our rivers and streams when it rains (see box below for more information). To ensure this public investment not only results in clean and beautiful waterways, but also provides tangible, additional benefits to our citizens, PWD is dedicating a large portion of this plan to a green stormwater infrastructure (GSI) approach. The target investment for green stormwater infrastructure is $1.67 billion, along with $345 million in wet weather treatment plant upgrades and $420 million in adaptive management.

Combined sewer overflow episodes and stormwater run-off volumes have increased over time as land development has led to replacement of pervious areas with impervious surfaces, such as roadways and buildings, which are characteristic of urbanized landscapes like Philadelphia. In turn, this affects Philadelphia's watersheds by impairing water quality and degrading stream habitats. Green stormwater infrastructure contributes to alleviating the CSO problem and its effects by integrating pervious areas that manage stormwater throughout Philadelphia.

The Vision

The Philadelphia Water Department's vision behind the Green City, Clean Waters plan is to unite the City of Philadelphia with its water environment, creating a green legacy for future generations while incorporating a balance between ecology, economics and equity. The green stormwater infrastructure approach is an essential factor in making this vision a reality.

Green Stormwater Infrastructure

Our definition of green stormwater infrastructure includes a range of soil-water-plant systems that intercept stormwater, infiltrate a portion of it into the ground, evaporate a portion of it into the air, and in some cases release a portion of it slowly back into the sewer system. As a result, less stormwater enters the combined sewer system, ultimately reducing CSOs. Integrating green stormwater infrastructure into a highly developed area like Philadelphia requires a decentralized and creative approach to planning and design. Various tools can be implemented to accomplish this, including stormwater planters, rain gardens and green roofs.

WATERSHED ISSUES

What Are Combined and Separate Sewer Systems?

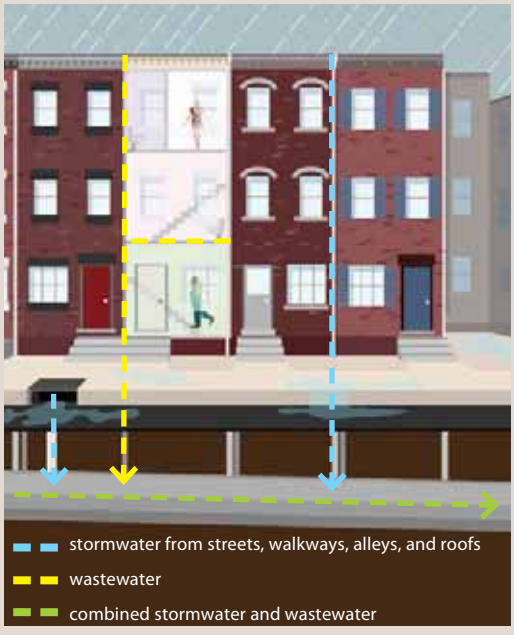
The City of Philadelphia has one of the first sewer systems in the country, with portions dating back to the second half of the 19th century. Much of that original infrastructure is still operational today. PWD's significant commitment to continuously inspect and maintain the 3,000 mile system of pipes, manholes, storm drains, and control chambers will sustain the use by City residents for years to come.

The City of Philadelphia's sewer system is comprised of both combined and separate sewer systems. A combined sewer system (CSS) is simply a single sewer system that carries both sewage and stormwater in one pipe, to a water pollution control plant for treatment before being released to a waterway. During moderate to heavy rainfall events, the system will reach capacity, overflow, and discharge a mixture of sewage and stormwater directly to our streams and rivers from the 164 permitted Combined Sewer Overflow (CSO) outfalls within the City. Sixty percent of the City of Philadelphia, or 64 square miles, is within the combined sewer system drainage area. Four watersheds, generally comprised of the older areas of the City of Philadelphia, receive CSO discharges.

The remainder of the City of Philadelphia's sewer system is drained by what is called a separate sewer system. A separate sewer system collects stormwater in a storm sewer pipe and discharges it directly to a waterway, while the sanitary sewage collected from homes, businesses, and industry is collected in a sanitary sewer pipe and taken to the water pollution control plant for treatment before being released to the waterways.

Watersheds Receiving CSO Discharges	mi^2 drained within Phila	served by CSS (approx)
Tookany/Tacony-Frankford Creek	19	80%
Cobbs Creek	6	80%
Delaware River	40	71%
Schuylkill River	36	40%

This amounts to 64 square miles of Combined Sewer Service drainage area for potential implementation.



PWD's Land-Based Green Programs

The Philadelphia Water Department is developing eight Green Programs, each with a number of associated implementation tools – including technical assistance, design services, policy changes, regulatory tools, funding commitments and incentives to manage stormwater.

- **Green Streets**
  Green Streets emphasize the capture of stormwater runoff from public right-of-ways, such as streets. Various green stormwater infrastructure practices can be employed, such as stormwater tree trenches, planters, and bump-outs, or pervious pavement.
- **Green Homes**
  Residential roofs make up a significant amount of impervious cover in the City. PWD wants to work with homeowners to help them undertake projects to mitigate the impact of roof runoff. The Green Homes program envisions a number of small-scale solutions that homeowners can carry out themselves. These potential projects include installing rain barrels and/or disconnecting rain leaders to rain gardens or flow-through planters. More ambitious actions could include reducing the amount of imperious pavement, planting trees or building green roofs.
- **Green Schools**
  Schools are important neighborhood anchors and, therefore, offer excellent opportunities to educate the local community about green stormwater infrastructure. An array of green stormwater infrastructure practices can be implemented on school properties, such as rain gardens, green roofs, pervious pavement, tree trenches, and rain barrels.
- **Green Public Facilities**
  The value in retrofitting public facilities with green stormwater infrastructure allows public facilities to lead by example. The full array of green stormwater infrastructure practices can be implemented at public facilities, including rain gardens, green roofs, pervious pavement, stormwater tree trenches, rain barrels, and cisterns.
- **Green Parking**
  Retrofit and redesign of existing parking lots presents an opportunity to reduce stormwater runoff while also improving the visual appearance within communities. A number of green stormwater infrastructure practices can be used to manage stormwater in parking lots including vegetated strips and swales, rain gardens, infiltration beds and trenches and pervious pavements.
- **Green Open Space**
  Draining the nearby highly pervious areas to the open spaces enhances the visual appearance and the amenities at parks, in addition to managing stormwater runoff. Parks and recreation centers provide excellent opportunities to implement highly visible demonstration projects.
- **Green Industry, Business, Commerce and Institutions**
  The City's new stormwater management regulations for development and redevelopment and the parcel-based billing for stormwater management services provide incentives for private entities to install green stormwater infrastructure.
- **Green Alleys, Driveways, and Walkways**
  Philadelphia has many smaller alleys, driveways and walkways that are currently impervious. These often underutilized areas present an opportunity to retrofit, to allow infiltration, or to redesign. Such projects include diverted rooftop runoff to green stormwater infrastructure at the end of an alley and within the public right-of-way.

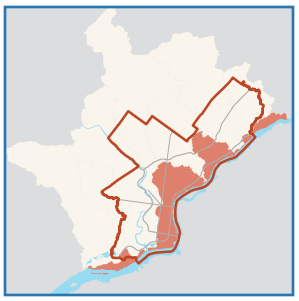
Benefits of Green Stormwater Infrastructure

PWD has undertaken a Triple Bottom Line analysis of the environmental, social, and economic benefits of the Green City, Clean Waters plan. This triple bottom line accounting means expanding the traditional financial reporting framework to take into account ecological and social performance so that the total benefits can be evaluated against the financial investment. At the conclusion of the 25 year Green City, Clean Waters plan, PWD anticipates the following benefits:

- **Elimination of the mass of pollutants that would be removed by 85% volumetric capture of wet weather flow:** CSO reduction of approximately 7.9 billion gallons/year
- **Enhanced Groundwater Recharge:** important for maintaining base flow rates in local rivers and streams
- **Additional habitat and recreation space:** increase of up to 1 million recreational user-days/year
- **Increased carbon sequestration:** up to1.5 billion pounds of carbon dioxide emissions avoided or absorbed
- **Air quality benefits from fully-grown trees will on average lead to (each year):**
  Up to 1–2 avoided premature deaths
  Up to 20 avoided asthma attacks
  Up to 250 fewer missed days of work or school/ year
- **Reduced energy and fuel demands:** reduction of up to 6 million kW-hr of electricity and 8 million kBTU of fuel used per year
- **Mitigation of Urban Heat Island effect:** trees and vegetation provide shade and naturally cool areas with a dense concentration of surfaces that absorb heat, such as pavement and buildings
- **Higher property values:** increase in property values of 2-5% in greened neighborhoods
- **Creation of jobs:** about 250 people employed in Green Jobs/year

Green City, Clean Waters

Green Streets
Columbus Square



Delaware Direct Watershed

CONTACT
Jessica Brooks
215.685.6038
jessica.K.brooks@phila.gov

STATUS
Complete

PARTNERS
Philadelphia Water Department
Philadelphia Parks & Recreation
Streets Department
Columbus Square Advisory Council
Passyunk Square Civic Association
Christopher Columbus Charter School's Green Club

LOCATION
Address
1300 Reed St.
Philadelphia, PA

TOOLS EMPLOYED
Stormwater Planters

PROJECT DESCRIPTION
The stormwater planters at Columbus Square are the first of their kind to be installed by the Philadelphia Water Department, converting a portion of Reed Street into a Green Street. PWD will use the lessons learned from this project to refine stormwater planter designs and their implementation. The Office of Watersheds worked with Philadelphia Parks and Recreation and many community partners to design a series of streetside stormwater planters that capture runoff from the contributing street and sidewalk areas. A stormwater planter manages street and sidewalk runoff through infiltration and evapotranspiration (or detention and slow-release when underlying soils do not allow for infiltration). The stormwater planters benefit our streams and rivers by reducing stormwater flows into the overburdened combined sewer system, while benefiting the surrounding community through greening a significant sidewalk area and enhancing neighborhood aesthetics.

WATERSHED BENEFITS
- Mitigates runoff from impervious surfaces within the public right-of-way
- Additional landscaping and tree canopy cover provide visual interest, aesthetic appeal, mitigate the urban heat island effect, in addition to providing a passive recreation amenity
- Provides demonstration projects to inform larger-scale, long-term program

Philadelphia Water Department

Green City, Clean Waters
October 2010

The Darby-Cobbs Watershed Partnership

The Cobbs Creek and the Cobbs Creek Park are true amenities for the region, offering over 25 parks and recreation facilities just in the city of Philadelphia. In one day, you could play bocce, walk through a natural lands trail, see a great blue heron or red tail fox in the forest, play a round of golf, roller skate, swim in a recreation center pool, visit an urban environmental education center, and then take a bike ride – to Bartram's Garden or to the John Heinz Wildlife Refuge where you can kayak or canoe. The opportunities in the Cobbs Creek Park are endless!

The Darby-Cobbs Watershed Partnership (DCWP) is a network of public, private, and non-profit partners working to create and implement a watershed management plan that addresses water quality and quantity issues. The partners develop and conduct stormwater management projects, municipal ordinance revisions, and public education and outreach events.

Mission of the DCWP: To improve the environmental health and safe enjoyment of the Darby-Cobbs watershed by sharing resources through cooperation of the residents and other stakeholders in the watershed. The goals of the initiative are to protect, enhance, and restore the beneficial uses of the Darby-Cobbs waterways and riparian (streamside) areas. Watershed management seeks to address the adverse physical, biological, and chemical impacts of land uses.

WHAT WE'RE DOING

The Philadelphia Water Department's Role

The Philadelphia Water Department (PWD) is a major organizer and supporter of the Darby-Cobbs Watershed Partnership.

In 2004, PWD's first stream restoration project on Cobbs Creek was completed. The project reach began downstream of the Marshall Road Bridge abutments and continued downstream for 900 ft. In addition to infrastructure protection (an exposed sewer pipe), which was the ultimate goal of the project, the Marshall Road Stream Restoration Project serves as a pilot project for habitat restoration, stream bank stabilization, natural channel design and water quality improvement.

In 2009, PWD commissioned the environmental engineering services of a joint-venture team composed of the firms O'Brian and Gere Inc. and BioHabitats Inc. to conduct the Cobbs Creek Stream Restoration Feasibility Study. The Cobbs Creek Feasibility Study was tailored to provide planning-level guidance concerning recommended restoration practices along Cobbs Creek. As such, the study highlighted the existing conditions, impairments, constraints and opportunities associated with stream restoration and wetland construction along 7.1 miles of Cobbs Creek from the northern extent of the City at City Line Avenue to the Woodland Dam at Woodland Avenue. At this time, PWD and the Department of Parks and Recreation are currently working together to identify a suitable grouping of reaches to prioritize and move into the design phase.

The Marshall Road Stream Restoration Project serves as a pilot project for habitat restoration, stream bank stabilization, natural channel design and water quality improvement.


August 19, 1999


October 24, 2004


January 14, 2005


May 5, 2008

Watershed Facts

Area

The Darby-Cobbs watershed drains approximately 77 square miles; The Cobbs Creek subwatershed is approximately 22 square miles.

Municipalities

The watershed encompasses areas of Chester, Delaware, Montgomery, and Philadelphia Counties, with all or parts of 31 municipalities, including Easttown, Tredyffrin, Aldan, Clifton Heights, Collingdale, Colwyn, Darby, East Lansdowne, Folcroft, Glenolden, Haverford, Lansdowne, Marple, Millbourne, Morton, Newtown, Norwood, Prospect Park, Radnor, Ridley Park, Ridley, Rutledge, Sharon Hill, Springfield, Tinicum, Upper Darby, Yeadon, Lower Merion, and Narberth.

Population

The watershed as a whole is home to about 460,000 residents, but population density is much higher in and near the City of Philadelphia. About 230,000 people, or half of the watershed's residents, live in the Cobbs Creek subwatershed.

Stream Miles

The Darby-Cobbs watershed contains approximately 135 linear miles of streams, about 33 miles of which are in the Cobbs Creek subwatershed.

Amenities

Playgrounds

61st & Baltimore
61st St & Baltimore St

Granahan
65th St & Callowhill St

Papa Playground
6839 Landsdowne Ave

Rose Playground
1300 North 75th St

Francis Myers
58th St & Kingsessing St

Sayre-Morris Playground
59th St & Spruce St

Tustin
60th St & Columbia St

Whitby Playground Area
Whitby St & Cobbs Creek Parkway

Albert W. Christy
56th St & Christian St

Cibotti
7700 Elmwood Ave

Eastwick Regional
80th St & Mars Place

McCreesh
66th St & Regent St

Recreation

Cobbs Creek Recreation Center
250 S 63rd St

Cobbs Creek Community Environmental Education Center
700 Cobbs Creek Parkway

Laura Sims Rink
200 S 63rd St

Golf Courses

Golf Course: Karakung & Old Cobbs Creek
7400 Landsdowne Ave

Swimming Pools

James Finnegan
69th St & Grovers St

Francis Myers
58th St & Kingsessing St

Kingsessing
50th St & Chester St

Sayre-Morris Playground
59th St & Spruce St

Tustin
60th St & Columbia St

Whitby Playground Area
Whitby St & Cobbs Creek Parkway

Albert W. Christy
56th St & Christian St

Parks

Bocce Woods
Above 63rd St & Market St

Cedar Park
50th St & Baltimore St

Cobbs Creek West
58th St & Kingsessing St

Nichols Park
Race St & Conestoga St

Historic Buildings

Bainbridge Manor
City Line Ave & 77th

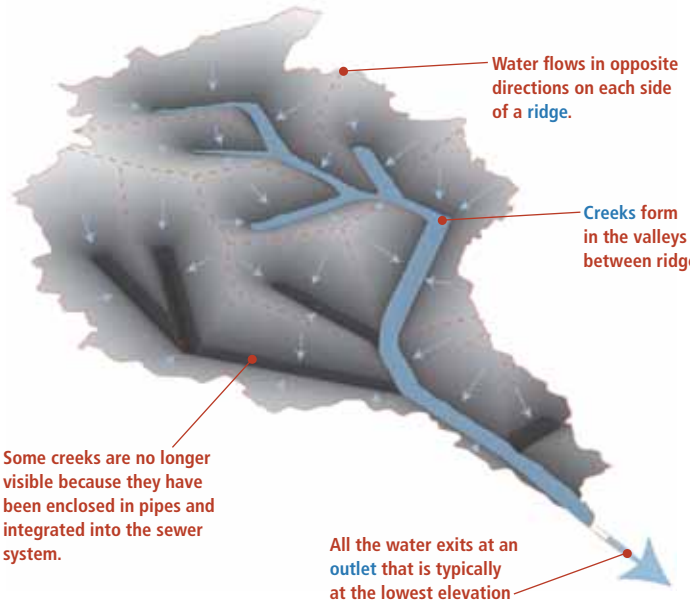
Blue Bell Tavern
Cobbs Creek Pkwy & Woodland Ave

Watershed Partners

Partner Organizations	Phone Numbers	Website or Email
60th Street West Market Street Business Association	215.748.3830	wmba60@verizon.net
Achievability	215.748.8750	www.achieve-ability.org
Clean Air Council	215.567.4004	www.cleanair.org
Cobbs Creek Community Environmental Education Center	215.685.1900	cobbscreekcenter.org
Cobbs Creek Recreation Center	215.685.1983	www.phila.gov/findrec/RecCenterDetails.aspx?ID=885
Cobbs Creek West Community Association	610.352.3053	Cobb's Creek West Community Association on Facebook
Darby Creek Valley Association	610.789.1814	www.dcva.org
Delaware County Planning Commission	610.891.5200	www.co.delaware.pa.us/planning
Delaware County Conservation District	610.892.9484	www.delcocd.org
Friends Central Middle School	610.649.7440	www.friendscentral.org
Friends of Mt. Moriah Cemetary	215.729.1295	www.mountmoriah.info
Laura Sims Skatehouse Foundation	215.685.1995	www.phila.gov/findrec/RecCenterDetails.aspx?ID=776
Lower Merion Conservancy	610.645.9030	www.lmconservancy.org
Men of Cobbs Creek		mccphiladelphia@yahoo.com
Millbourne Borough	610.352.9080	www.millbourneborough.org
Montgomery County Conservation District	610.489.4506	www.montgomeryconservation.org
Morris Park Restoration Association		www.morrisparkphiladelphia.org
Neighbors of Cobbs Creek at Callowhill	267.679.7053	
Partnership CDC	215.662.1612	www.partnershipcdc.wordpress.com
Pennsylvania Environmental Council	215.545.4570 x107	www.pecpa.org
Philadelphia Parks and Recreation	215.683.3600	www.phila.gov/recreation
Philadelphia Water Department	215.685.6213	www.phillywatersheds.org
Upper Darby Township	610.789.1814	www.upperdarby.org
Yeadon Borough	610.284.1606	www.yeadon.boroughs.org

What is a watershed?

A watershed is an area of land within which all water from rain or snow drains into a body of water, such as a river, lake, or ocean.



Darby-Cobbs Watershed Partnership

If you're interested in being a member of the Darby-Cobbs Watershed Partnership to help transform the health of the creek and watersheds, please visit our website:

http://www.phillywatersheds.org/your_watershed/darby_cobbs/partnerships

For more information, you can also contact Khiet Luong, Pennsylvania Environmental Council, (215) 545-4570 x107 or kluong@pecpa.org.

JOIN PWD

FOR THE UNVEILING OF PHILADELPHIA'S 1ST GREEN ROOF BUS SHELTER

A BUS SHELTER IS alive

Launch of the Green City, Clean Waters plan with the unveiling of the Green Roof Bus Shelter

Release of the 2011Greenworks Progress Report

Recognition of Howard Neukrug as the recipient of the "Special Chapter Award" from the Pennsylvania-Delaware Chapter of the American Society of Landscape Architects

Tips on what residents can do to manage stormwater at the Green City, Clean Waters station

Wednesday
June 15th
12:30PM-1:30PM

Bus shelter at
15th and Market

Mayor Michael Nutter

Howard Neukrug
Philadelphia Water Department Commissioner

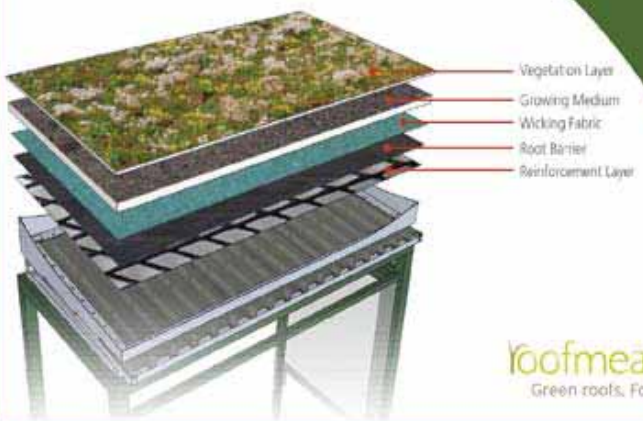
Rina Cutler
Deputy Mayor of Transportation and Utilities

Katherine Gajewski
Director of Sustainability

Roofmeadow, Inc.

Titan

Green City, Clean Waters



Roofmeadow
Green roofs. For good.

The Green City, Clean Waters plan details the Philadelphia Water Department's vision for protecting and enhancing our watersheds by managing stormwater with innovative green infrastructure, maximizing economic, social, and environmental benefits to Philadelphia and creating a green legacy for future generations.

GREEN STORMWATER INFRASTRUCTURE TOOLS

PWD's Land-Based Green Programs will each utilize a unique mix of green stormwater infrastructure tools. The majority of these examples have been implemented locally, demonstrating the use of green stormwater infrastructure in Philadelphia. The additional examples are located in Portland, Oregon, as noted.

A stormwater tree trench is a system of trees that are connected by an underground infiltration structure. On the surface, a stormwater tree trench looks just like a series of street tree pits. However, under the sidewalk, there is an engineered system to manage the incoming runoff. This system is composed of a trench dug along the sidewalk, lined with a permeable geotextile fabric, filled with stone or gravel, and topped off with soil and trees. Stormwater runoff flows through a special inlet, (storm drain), leading to the stormwater tree trench. The runoff is stored in the empty spaces between the stones, watering the trees and slowly infiltrating through the bottom. If the capacity of this system is exceeded, stormwater runoff can bypass it entirely and flow into an existing street inlet.

Stormwater Tree Trench

Mill Creek Tree Trench
Philadelphia, PA

A stormwater bump-out is a vegetated curb extension that protrudes into the street either mid-block or at an intersection, creating a new curb some distance from the existing curb. A bump-out is composed of a layer of stone that is topped with soil and plants. An inlet or curb-cut directs runoff into the bump-out structure where it can be stored, infiltrated, and taken up by the plants (evapotranspiration). Excess runoff is permitted to leave the system and flow to an existing inlet. The vegetation of the bump-out will be short enough to allow for open site lines of traffic. Aside from managing stormwater, bump-outs also help with traffic-calming, and when located at crosswalks, they provide a pedestrian safety benefit by reducing the street crossing distance.

Stormwater Bump-out

Portland, OR

A stormwater planter is a specialized planter installed into the sidewalk area that is designed to manage street and sidewalk runoff. It is normally rectangular, with four concrete sides providing structure and curbs for the planter. The planter is lined with a permeable fabric, filled with gravel or stone, and topped off with soil, plants, and, sometimes, trees. The top of the soil in the planter is lower in elevation than the sidewalk, allowing for runoff to flow into the planter through an inlet at street level. These planters manage stormwater by providing storage, infiltration, and evapotranspiration of runoff. Excess runoff is directed into an overflow pipe connected to the existing combined sewer pipe.

Stormwater Planter

Columbus Square
Philadelphia, PA

Pervious pavement is a specially designed pavement system that allows water to infiltrate through the pavement and never become runoff. This system provides the structural support of conventional pavement, but is made up of a porous surface and an underground stone reservoir. The stone reservoir provides temporary storage before the water infiltrates into the soil. There are many different types of porous surfaces including pervious asphalt, pervious concrete, and interlocking pavers. Interlocking pavers function slightly differently than pervious concrete and asphalt. Rather than allowing the water to penetrate through the paving, pavers are spaced apart with gravel or grass in between the pavers that allows for infiltration.

Pervious Pavement

Mill Creek Basketball Court
Philadelphia, PA

Plants and Stormwater Management

Trees, shrubs, and flowers help manage rain, or stormwater, through catching rain drops on their leaves and branches before the stormwater becomes runoff, as it hits the ground. The stormwater collected on these surfaces can easily evaporate into the air. Additionaly, plants help manage stormwater runoff not only by allowing water to infiltrate into the soil, but also by a process called evapotranspiration, in which water is taken up by plant roots and transpired through their leaves. Plants and soil also help in filtering stormwater runoff.

A green roof is a roof or section of roof that is vegetated. A green roof system is composed of multiple layers including waterproofing, a drainage layer, an engineered planting media, and specially selected plants. Green roofs can be installed on many types of roofs, from small slanting roofs to large commercial flat roofs. Two basic types of green roofs have been developed, extensive and intensive. An extensive green roof system is a thin, (usually less than 6 inches), lighter-weight system planted predominantly with drought-tolerant succulent plants and grasses. An intensive green roof is a deeper, heavier system designed to sustain more complex landscapes. A green roof is effective in reducing the volume and velocity of stormwater runoff from roofs by temporarily storing stormwater, slowing excess stormwater release into the combined sewer system, and promoting evapotranspiration.

Green Roof

Fencing Academy of Philadelphia
Philadelphia, PA

A rain barrel or cistern is a structure that collects and stores stormwater runoff from rooftops. The collected rain water can be used for irrigation to water lawns, gardens, window boxes or street trees. By temporarily holding the stormwater runoff during a rain event, more capacity can be added to the city's sewer system. However, rain barrels and cisterns only serve an effective stormwater control function if the stored water is used or emptied between most storms so that there is free storage volume for the next storm. Rain barrels are designed to overflow into the sewer system through the existing downspout connection in large storm events. Although these systems only store a small volume of stormwater, collectively, they can be effective at preventing large volumes of runoff from entering the sewer system

Rain Barrel/Cistern

Residential Rain Barrel
Philadelphia, PA

A rain garden is a garden designed to collect runoff from impervious surfaces such as roofs, walkways, and parking lots, allowing water to infiltrate into the ground. The garden is typically moderately depressed (lower than the surrounding ground level), with the bottom layer filled with stone, so runoff can collect and pond within it. The site is graded appropriately to cause stormwater to flow into the rain garden area from the nearby impervious area. The water ponds on the surface, is used by the vegetation in evapotranspiration, and infiltrates into the subsurface stone storage and soil. Rain gardens can be connected to sewer systems through an overflow structure, but usually they are sized to infiltrate the collected stormwater runoff within 72 hours. Flexible and easy to incorporate into landscaped areas, rain gardens are suitable for many types and sizes of development and retrofits. Rain gardens are effective at removing pollutants and reducing stormwater runoff volume.

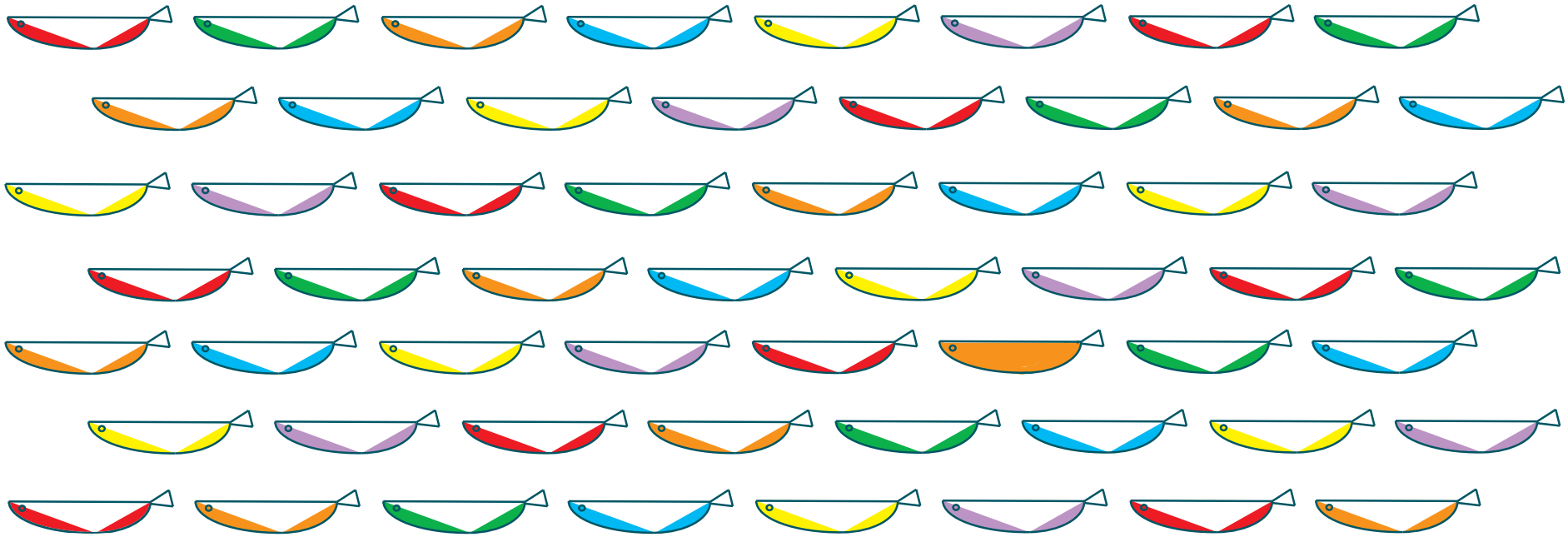
Rain Garden

Wissahickon Charter School
Philadelphia, PA

A downspout planter is a structure that is designed to allow stormwater from roof gutters to flow through and be used by the plants. Downspout planters are filled with gravel, soil, vegetation and are connected to the roof downspout to let water flow in. They temporarily store stormwater runoff on top of the soil and filter sediment and pollutants as water infiltrates down through the planter. They are typically waterproofed, and the bottom of the planter is normally impervious. Thereby, planters do not infiltrate runoff into the ground, rather they rely on evapotranspiration and short-term storage to manage stormwater. Excess water can overflow into the existing downspout connection. Downspout planters can be constructed in many sizes and shapes, and with various materials, including concrete, brick, plastic lumber or wood.

Downspout Planter

Philadelphia Water Department Facility
Philadelphia, PA



2011 PHILLY FUN FISHING FEST

Saturday,
September 10, 2011
7am-11am
Awards Ceremony - 11:30 pm

On Schuylkill Banks
See map on back for details.

Register at
www.phillywatersheds.org/fishingfest
or call 215.685.6300
Deadline to register: September 6, 2011

FREE to the public

NO fishing license required

Catch and release

Fishing gear will be available for loan, on a first come, first serve basis

Prizes awarded in various categories (Must be present to claim prize)

Bring a lunch and refreshments

After the Fishing Fest, continue the fun and take a shuttle bus from 25th and Chestnut St. to Coast Day events at Penn's Landing on the Delaware River.

We encourage you to walk, bike, use public transportation, or car pool to the Fish Fest. See map on back for details.

PHILADELPHIA PARKS & RECREATION

Philadelphia Water Department

schuylkill banks

EVERY SEASON STARTS AT DICK'S SPORTING GOODS

PLANO

Registration area on Schuylkill Banks, under the Walnut St. Bridge

Awards Ceremony

The Philly Fun Fishing Fest is accessible by walking, biking, or public transit. Parking is available.

Look for these symbols:

Schuylkill River Trail

Benjamin Franklin Pkwy.
676
Vine St. Exp.
76
Logan Circle
Race St.
23rd St.
22nd St.
21st St.
20th St.
John F. Kennedy Blvd
Market St.
Coast Day
BUS
REGISTRATION
Walnut St. Bridge
76
Chestnut St.
24th St.
Sansom St.
Walnut St.
Locust St.
25th St.

2011 PHILLY FUN FISHING FEST

1st Annual COBBS CREEK 5k RUN / WALK
(Re)Discover Your Park!

SAVE THE DATE
Saturday, April 23, 2011
Cobbs Creek 5k Run/Walk

Important Information

When: 8am- Registration
9am- Run Begins
9:30am- Walk Begins

Where: 63rd & Cedar Street
Philadelphia

Fees: $20 - Runners ($25 Day of Event)
$60 - Group of 5 Runners
$15 - Walkers
$40 - Group of 5 Walkers
$10 - Youth (Ages 13 - 18)
FREE - Children (Ages 12 and Under)
Runners will be timed

Registration Instructions

For online registration, please visit:
www.phillywatersheds.org/cobbscreek5k

For telephone registration, please call
Mr. Khiet Luong at 215-545-4570 x 107.

Darby-Cobbs Watershed Partnership

Delaware Direct Watershed

Join us for a Planting Day!

Come out and help us make the neighborhood parking lot beautiful. We have de-paved the lot and we now need your help in transforming the lot into a series of rain gardens. We will be planting shrubs, bushes, and trees, so grab your gloves, gardening tools and give a hand!

Saturday, April 30th, 2011
5312 Eadom Street
9:00 AM

With your help, the lot will look like this!

Philadelphia PWD Water Department

To sign up to volunteer, please email or call Amanda Jayne, Philadelphia Water Department: PWD-Watersheds.Coop10@phila.gov
Or 267-625-0589

Contact: John Digiulio, Philadelphia Water Department, John.Digiulio@phila.gov

For Immediate Release: **May 10th, 2011**

Unveiling of Philadelphia's 1st Porous Green Street!

PHILADELPHIA – On Tuesday, May 10th 2011 at 1:30 PM, the Philadelphia Water Department (PWD), the Philadelphia Streets Department (PSD), and state and local officials will kick-off the unveiling of the City's first porous green street to be installed on the 800 Block of Percy Street. The installation of this "Green Street" is exciting for these two departments, as it is the city's first and one we hope to replicate many times over in the future. As a component of PWD's Green City, Clean Waters Program, local residents and community officials are invited to come see the porous asphalt in action, as the Philadelphia Water Department Commissioner Howard Neukrug demonstrates how this green street works. These street projects are designed to encourage Philadelphians to partake in green infrastructure practices and find out how they can become involved. This is just one street in the many streets of Philadelphia, but with one street at a time we can work to protect the quality of our waterways.

This Green Street project is a component of the *Green City, Clean Waters* program, the Department's innovative and environmentally sustainable plan to improve the operation of our sewer infrastructure through a green approach. In line with this idea, the steps that we are taking here today, replacing traditional impervious asphalt with porous pavement, we will be able to monitor the effect and benefits we will have over several years to come. The Philadelphia Water Department has a mission of keeping our drinking water safe, our rivers clean, and our City green through these avenues and with the help of interested and involved advocates of green infrastructure. Philadelphia will truly be a model for cities around the country to follow suit and change the way they manage their stormwater.

In attendance will be Water Commissioner Neukrug; as well as Clarena Tolson, Streets Department Commissioner; Rina Cutler, Deputy Mayor of Transportation and Utilities; Councilman Frank DiCicco, for the City of Philadelphia; and the Mayor Michael Nutter.

More information about the event can be found at www.phillywatersheds.org or contact questions@phillywatersheds.org.

Green City Clean Waters

Join us for the unveiling of Philadelphia's 1st Porous Green Street!

Date: **Tuesday, May 10**
Time: **1:30-2:30 p.m.**
Where: 800 block of Percy Street
(Between Christian & Catharine,
South Philadelphia)

Participating Representatives
Mayor Michael Nutter
Philadelphia Water Department Commissioner Howard Neukrug
Philadelphia Streets Department Commissioner Clarena Tolson
Deputy Mayor of Transportation and Utilities Rina Cutler
Councilman Frank DiCicco

You will get to see the street in action!
Join us for a water balloon toss!

For more information on *Green City, Clean Waters* please visit www.phillywatersheds.org or contact questions@phillywatersheds.org

Philadelphia Water Department

Philadelphia Water Department

For more information, please visit:
www.phillywatersheds.org

This home is a **Green Home**.

Green City, Clean Waters

Green City, Clean Waters is the Philadelphia Water Department's vision for protecting and enhancing our watersheds* by managing stormwater (rain or melting snow) with innovative green infrastructure, such as a Rain Barrel, Flow-Through Planter, and a Rain Garden.

Thank you for being a Green City, Clean Waters partner!

*Watershed: A watershed is an area of land in which all of the water drains into a body of water, such as the Delaware River and the Schuylkill River in Philadelphia.

Green City, Clean Waters

COMMUNITY ORIENTATION PACKET

Philadelphia Water Department

TABLE OF CONTENTS

GREEN CITY, CLEAN WATERS

Background

On September 1, 2009, the Philadelphia Water Department (PWD) submitted the *Green City, Clean Waters* plan to the PA Department of Environmental Protection (DEP) and the U.S. Environmental Protection Agency (EPA) to detail how PWD will invest approximately $1.6 billion over the next 20 years to significantly reduce Combined Sewer Overflows (CSOs) – a combination of sewage and stormwater that overflows into our rivers and streams when it rains (see box below for more information). To ensure this public investment not only results in clean and beautiful waterways, but also provides tangible, additional benefits to our citizens, PWD is dedicating a large portion of this plan to a green stormwater infrastructure (GSI) approach.

Combined sewer overflow episodes and stormwater run-off volumes have increased over time as land development has led to replacement of pervious areas with impervious surfaces, such as roadways and buildings, which are characteristic of urbanized landscapes, like Philadelphia. In turn, this affects Philadelphia's watersheds by impairing water quality and degrading stream habitats. Green stormwater infrastructure contributes to alleviating the CSO problem and its effects, by integrating pervious areas that manage stormwater throughout Philadelphia.

The Vision

The Philadelphia Water Department's (PWD) vision behind the Green City, Clean Waters Plan is to unite the City of Philadelphia with its water environment, creating a green legacy for future generations while incorporating a balance between ecology, economics and equity. The green stormwater infrastructure approach is an essential factor in making this vision a reality.

Green Stormwater Infrastructure

Our definition of green stormwater infrastructure includes a range of soil-water-plant systems that intercept stormwater, infiltrate a portion of it into the ground, evaporate a portion of it into the air, and in some cases release a portion of it slowly back into the sewer system. As a result, less stormwater enters the combined sewer system, ultimately reducing CSOs. Integrating green stormwater infrastructure into a highly developed area like Philadelphia requires a decentralized and creative approach to planning and design. Various tools can be implemented to accomplish this, including stormwater planters, rain gardens and green roofs. Examples of these green stormwater infrastructure tools can be found on p.10. Implementing innovative green stormwater infrastructure (GSI) throughout our City can maximize economic, social, and environmental benefits for Philadelphia.

What Are Combined and Separate Sewer Systems?

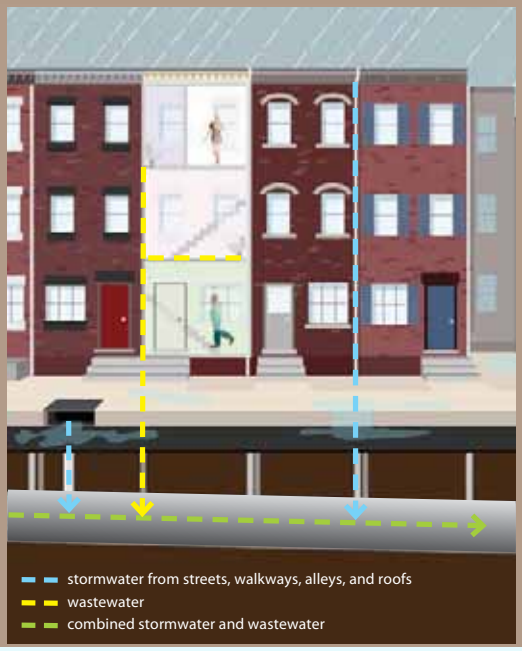
The City of Philadelphia has one of the first sewer systems in the country, with portions dating back to the second half of the 19th century. Much of that original infrastructure is still operational today. PWD's significant commitment to continuously inspect and maintain the 3,000 mile system of pipes, manholes, storm drains, and control chambers will sustain the use by City residents for years to come.

The City of Philadelphia's sewer system is comprised of both combined and separate sewer systems. A combined sewer system (CSS) is simply a single sewer system that carries both sewage and stormwater in one pipe, to a water pollution control plant for treatment before being released to a waterway. During moderate to heavy rainfall events, the system will reach capacity, overflow, and discharge a mixture of sewage and stormwater directly to our streams and rivers from the 164 permitted Combined Sewer Overflow (CSO) outfalls within the City. Sixty percent of the City of Philadelphia, or 64 square miles, is within the combined sewer system drainage area. Four watersheds, generally comprised of the older areas of the City of Philadelphia, receive CSO discharges.

The remainder of the City of Philadelphia's sewer system is drained by what is called a separate sewer system. A separate sewer system collects stormwater in a storm sewer pipe and discharges it directly to a waterway, while the sanitary sewage collected from homes, businesses, and industry is collected in a sanitary sewer pipe and taken to the water pollution control plant for treatment before being released to the waterways.

Watersheds Receiving CSO Discharges	mi² drained within Phila.	served by CSS (approx)
Tookany/Tacony-Frankford Creek	19	80%
Cobbs Creek	6	80%
Delaware River	40	71%
Schuylkill River	36	40%

This amounts to 64 square miles of Combined Sewer Service drainage area for potential implementation.



Green Streets

Streets and sidewalks are by far the largest single category of public impervious cover, accounting for roughly 38% of the impervious cover within the combined sewer service area. (Note: impervious cover associated with streets in front of parks was not included in this percentage; these streets will be included in the “Green Public Open Space” program).

To mitigate the impact of this impervious area, PWD has developed green street designs to provide stormwater management, while maintaining the primary function of the street for vehicles and pedestrians. A green street uses a combination of vegetated and engineered strategies to manage rain or melting snow, (stormwater runoff), at its source. Green street designs incorporate various green stormwater infrastructure tools, including stormwater tree trenches, stormwater planters, stormwater bumpouts, and pervious pavement. Using these tools, a green street captures stormwater runoff from streets and sidewalks, infiltrates it into the soil to recharge groundwater, and reduces the amount of stormwater runoff that would otherwise make its way into Philadelphia’s combined sewer system.

PWD is working to align its green stormwater infrastructure practices with street greening programs associated with GreenWorks’ ambitious greening goals. Coordination of PWD’s program with other city programs will encourage maximum effectiveness. Ultimately, the Green Streets program should result in setting a “green standard” for streets within the City. Partners include PennDOT and the City of Philadelphia Streets Department.

Stormwater Tree Trench

Before

After

Benefits of Green Stormwater Infrastructure

PWD has undertaken a Triple Bottom Line analysis of the environmental, social, and economic benefits of the *Green City, Clean Waters* plan. This triple bottom line accounting means expanding the traditional financial reporting framework to take into account ecological and social performance so that the total benefits can be evaluated against the financial investment. The figures associated with the following benefits are specific to Philadelphia.

- **Reduced Combined Sewer Overflow events:** 5-8 billion gallons of CSO avoided per year
- **Enhanced Groundwater Recharge:** important for maintaining base flow rates in local rivers and streams.
- **Additional habitat and recreation space:** increase of over 1 million recreational user-days/year
- **Increased carbon sequestration:** 1.5 billion pounds of carbon dioxide emissions avoided or absorbed
- **Improved air quality:** on average leading to
  1–2 avoided premature deaths
  20 avoided asthma attacks
  250 fewer missed days of work or school/ year
- **Reduced energy and fuel demands:** reduction of approximately 6 million kW-hr of electricity and 8 million kBTU of fuel used per year
- **Mitigation of Urban Heat Island effect:** trees and vegetation provide shade and naturally cool areas with a dense concentration of surfaces that absorb heat, such as pavement and buildings
- **Higher property values:** increase in property values of 2-5% in greened neighborhoods
- **Creation of jobs:** about 250 people employed in Green Jobs/year

Concerned about basement back-ups?

The Philadelphia Water Department has a program that can help with basement sewer back-ups- the PWD Basement Backup Protection Program: http://www.phila.gov/water/pdfs/bbp_0803.pdf. Additionally, PWD is continually working to increase the efficiency of its collection system.

PWD's Land-Based Green Programs

The Philadelphia Water Department is developing eight Green Programs, each with a number of associated implementation tools – including technical assistance, design services, policy changes, regulatory tools, funding commitments and incentives to manage stormwater.

- **Green Streets**
- **Green Homes**
- **Green Schools**
- **Green Public Facilities**
- **Green Parking**
- **Green Open Space**
- **Green Industry, Business, Commerce and Institutions**
- **Green Alleys, Driveways, and Walkways**

In the initial phases of our Land-Based Green Programs, we are focusing on the Green Streets and Green Homes programs. Please refer to PWD's website, **www.phillywatersheds.org**, for information about the other programs listed above.

A key to the success of this strategy is that immense opportunity exists for implementation on publicly-owned land, such as City-owned property, streets, and rights-of-way, which constitute 45% of the impervious land area of the City. With this in mind, the initial approach is to focus on Green Streets by implementation in Model Neighborhoods.

Green Street Implementation

A vision of green street implementation.

Green Street Site Selection Process

1. Identification – Sites are identified by a variety of different methods including block petitions, requests by city agencies such as Fairmount Park, School District requests, concurrent projects by private and public partners, and neighborhood greening projects.

2. Screening – Sites are investigated in consideration of the design factors noted below. Existing features, design opportunities, and site limitations are all recorded.

3. Selection – Sites are selected based upon their feasibility and cost-effectiveness, a consideration of any neighborhood planning activities, and the potential to team up with other concurrent projects.

We are always interested in working with civic groups and city agencies that are planning renewal projects. If you know of an opportunity, please contact us:
questions@phillywatersheds.org

Green Street Design Factors

To determine if a street is a good candidate for the installation of green infrastructure, PWD designers consider a range of factors. The main site characteristics used for considering a block's green street potential are described below. In addition to these physical features, other important factors such as coordination with other agencies, neighborhood capacity and support, and regulatory challenges can influence selection.

Utilities in Footway or Near Curbline: The presence of utility lines, such as water, sewer, gas, electric, or telecommunication lines, under the sidewalk or near the curbline make our designs more difficult. It is not always possible to build our systems over these lines.

Number of Parcels: Each property, or parcel, has its own utility service laterals that cross the sidewalk. Blocks with fewer parcels therefore have fewer utility conflicts and are thereby pose fewer design limitations.

Street Trees and Obstructions Upslope of Inlets: Construction of our stormwater systems disturbs the sidewalk and surrounding area. We want to manage stormwater as close to the inlet as possible to capture the largest drainage area. Therefore, any structures upslope of the inlet, especially trees with their large root systems, limit the space in which we can construct.

Sidewalk Width: Wider sidewalks increase the space in which we can safely infiltrate stormwater, allowing us to manage greater volumes of stormwater.

Building Setback: Setback of the building increases the space in which we can safely infiltrate stormwater within the right of way.

Street Slope: Relatively flat streets are favored for our designs. It is more challenging and expensive to construct our systems in steeper streets.

Drainage Area: The larger the drainage area, the more stormwater we can manage. It is more cost-effective to construct systems for larger drainage areas.

Soil Investigation Results: Soil testing provides information about soil infiltration rates, the presence of bedrock or other limiting zones, soil contamination, and other conditions. These factors influence the feasibility and type of designs that can be implemented.

Green Homes

Residential roofs make up 20% of all impervious cover in the City. Success for this program lies in the simplicity of residential scale stormwater management solutions distributed throughout Philadelphia.

Residents can implement the following green stormwater management solutions on their properties:

- Installing rain barrels or flow-through planters to collect roof runoff
- Disconnecting downspouts and using site slopes to direct runoff to pervious areas (rain garden) or small drywells
- Reducing paved areas and replacing them with pervious pavement or gardens
- Planting container gardens to reduce stormwater runoff in areas with space restrictions and no opportunity for pavement removal

By implement these solutions themselves, residents can achieve benefits at a minimal cost. Installation and use of rain barrels have already proven popular through the participation of Philadelphia area residents in the PWD Rain Barrel program, and if implemented on a larger scale, can ultimately affect a significant amount of impervious cover. Additionally, more ambitious (and somewhat more costly) measures are suggested, including the installation of a green roof or capturing stormwater in larger cisterns for reuse.

When implementing any of these green stormwater infrastructure solutions care should be taken to not impact adjacent properties through additional stormwater flow. Precautions include providing a proper safe overflow to the existing combined sewer system in larger storm events, and allowing for appropriate installation distances between any green stormwater infrastructure solutions and the residence, as well as other property lines. Visit our website for more information about the design and installation of these solutions:
http://www.phillywatersheds.org/whats_in_it_for_you

A rain barrel installed in the backyard of a South Philadelphia home.

An example of a newly installed residential rain garden.

Rain Barrels

Rain Barrel Elements

A rain barrel or cistern is a structure that collects and stores stormwater runoff from rooftops. Downspouts lead the stormwater from the roof to into the rain barrel, where it is temporarily stored for various uses. Rain barrels usually consist of a plastic storage container with lid, a system that diverts water into the barrel, an overflow pipe, a screen to keep out debris and mosquitos, and a water spigot to which a hose can attach.

Rain Barrel Benefits

By temporarily holding the stormwater runoff during a rain event, more capacity can be added to the city's sewer system, and reduce pollution and combined sewer overflows to our creeks and rivers, our drinking water source. However, rain barrels and cisterns only serve an effective stormwater control function if the stored water is used or emptied between storms, freeing up storage volume for the next storm. Rain barrels are designed to overflow into the sewer system through the existing downspout connection in large storm events. Although these systems only store a small volume of stormwater, collectively they can be effective at preventing large volumes of runoff from entering the sewer system and nearby creeks and rivers, as well as reducing CSOs. Rain barrels promote water conservation by saving, on average, 1,300 gallons of water during the summer. This can add up to significant savings. Storing stormwater for garden and lawn use helps recharge groundwater naturally.

Rain Barrel Uses

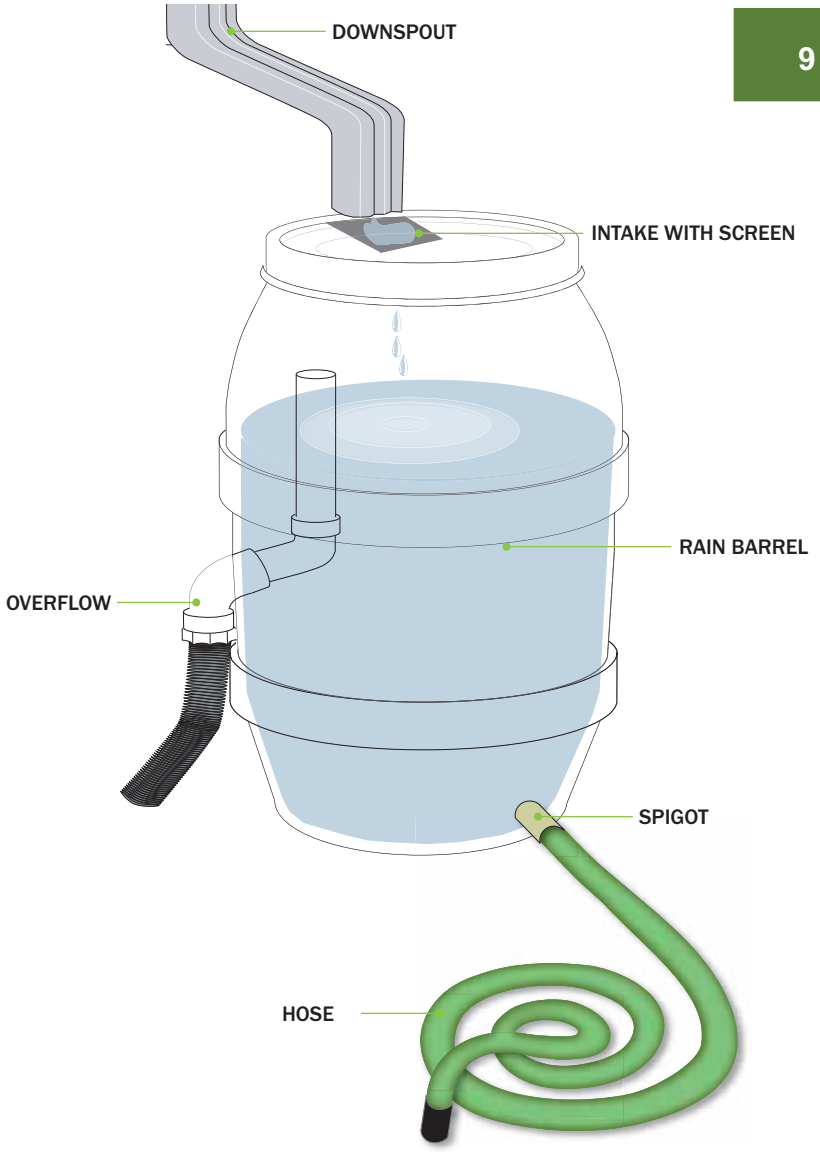
The collected rain water can be used:

- to water lawns, gardens, window boxes or street trees
- to wash down patio furniture
- to fill a bird bath
- to wash cars

How can I get a Rain Barrel?

The Philadelphia Water Department is distributing a limited supply of rain barrels to residents located within the watersheds of Philadelphia free of charge, in an effort to promote the reduction of stormwater runoff impacts. In order to receive a rain barrel, it is mandatory to attend a rain barrel workshop to be educated on the installation and use of the rain barrel. There is a one-per-household limit. Rain barrel workshops are held in locations around the city throughout the year. The workshops are organized on a watershed-basis, meaning you can only attend a workshop organized for your watershed.

http://www.phillywatersheds.org/whats_in_it_for_you/rainbarrel



IMPORTANT: Water stored in rain barrels needs to be used or emptied between storms to free up storage volume for the next storm.

How can I make my own Rain Barrel?

Instructions for building and installing a rain barrel can be found in PWD's Homeowner's Guide to Stormwater Management. This guide also lists resources where rain barrels can be purchased, and how to implement other stormwater management solutions around the home.

http://www.phillywatersheds.org/doc/Homeowners_Guide_Stormwater_Management.pdf

GREEN STORMWATER INFRASTRUCTURE TOOLS

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Stormwater Tree Trench

Mill Creek Tree Trench
Philadelphia, PA

A stormwater bump-out is a vegetated curb extension that protrudes into the street either mid-block or at an intersection, creating a new curb some distance from the existing curb. A bump-out is composed of a layer of stone that is topped with soil and plants. An inlet or curb-cut directs runoff into the bump-out structure where it can be stored, infiltrated, and taken up by the plants (evapotranspiration). Excess runoff is permitted to leave the system and flow to an existing inlet. The vegetation of the bump-out will be short enough to allow for open site lines of traffic. Aside from managing stormwater, bump-outs also help with traffic-calming, and when located at crosswalks, they provide a pedestrian safety benefit by reducing the street crossing distance.

Stormwater Bump-out

Portland, OR

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Stormwater Planter

Portland, OR

Pervious pavement is a specially designed pavement system that allows water to infiltrate through the pavement and prevents it from becoming runoff. This system provides the structural support of conventional pavement, but is made up of a porous surface and an underground stone reservoir. The stone reservoir provides temporary storage before the water infiltrates into the soil. There are many different types of porous surfaces including pervious asphalt, pervious concrete, and interlocking pavers. Interlocking pavers function in a slightly different way than pervious concrete and asphalt. Rather than allowing the water to penetrate through the paving, pavers are spaced apart with gravel or grass in between the pavers that allows for infiltration.

Pervious Pavement

Mill Creek Basketball Court
Philadelphia, PA

Plants and Stormwater Management

Trees, shrubs, and flowers help manage rain, or stormwater, through catching rain drops on their leaves and branches before the stormwater becomes runoff, as it hits the ground. The stormwater collected on these surfaces can easily evaporate into the air. Additionaly, plants help manage stormwater runoff not only by allowing water to infiltrate into the soil, but also by a process called evapotranspiration, in which water is taken up by plant roots and transpired through their leaves. Plants and soil also help in filtering stormwater runoff.

A green roof is a roof or section of roof that is vegetated. A green roof system is composed of multiple layers including waterproofing, a drainage layer, an engineered planting media, and specially selected plants. Green roofs can be installed on many types of roofs, from small slanting roofs to large commercial flat roofs. Two basic types of green roofs have been developed, extensive and intensive. An extensive green roof system is a thin, (usually less than 6 inches), lighter-weight system planted predominantly with drought-tolerant succulent plants and grasses. An intensive green roof is a deeper, heavier system designed to sustain more complex landscapes. A green roof is effective in reducing the volume and velocity of stormwater runoff from roofs by temporarily storing stormwater, slowing excess stormwater release into the combined sewer system, and promoting evapotranspiration.

Green Roof

Fencing Academy of Philadelphia
Philadelphia, PA

A rain barrel or cistern is a structure that collects and stores stormwater runoff from rooftops. The collected rain water can be used for irrigation to water lawns, gardens, window boxes or street trees. By temporarily holding the stormwater runoff during a rain event, more capacity can be added to the city's sewer system. However, rain barrels and cisterns only serve an effective stormwater control function if the stored water is used or emptied between most storms so that there is free storage volume for the next storm. Rain barrels are designed to overflow into the sewer system through the existing downspout connection in large storm events. Although these systems only store a small volume of stormwater, collectively, they can be effective at preventing large volumes of runoff from entering the sewer system

Rain Barrel/Cistern

Residential Rain Barrel
Philadelphia, PA

A rain garden is a garden designed to collect runoff from impervious surfaces such as roofs, walkways, and parking lots, allowing water to infiltrate into the ground. The garden is typically moderately depressed (lower than the surrounding ground level), with the bottom layer filled with stone, so runoff can collect and pond within it. The site is graded appropriately to cause stormwater to flow into the rain garden area from the nearby impervious area. The water ponds on the surface, is used by the vegetation in evapotranspiration, and infiltrates into the subsurface stone storage and soil. Rain gardens can be connected to sewer systems through an overflow structure, but usually they are sized to infiltrate the collected stormwater runoff within 72 hours. Flexible and easy to incorporate into landscaped areas, rain gardens are suitable for many types and sizes of development and retrofits. Rain gardens are effective at removing pollutants and reducing stormwater runoff volume.

Rain Garden

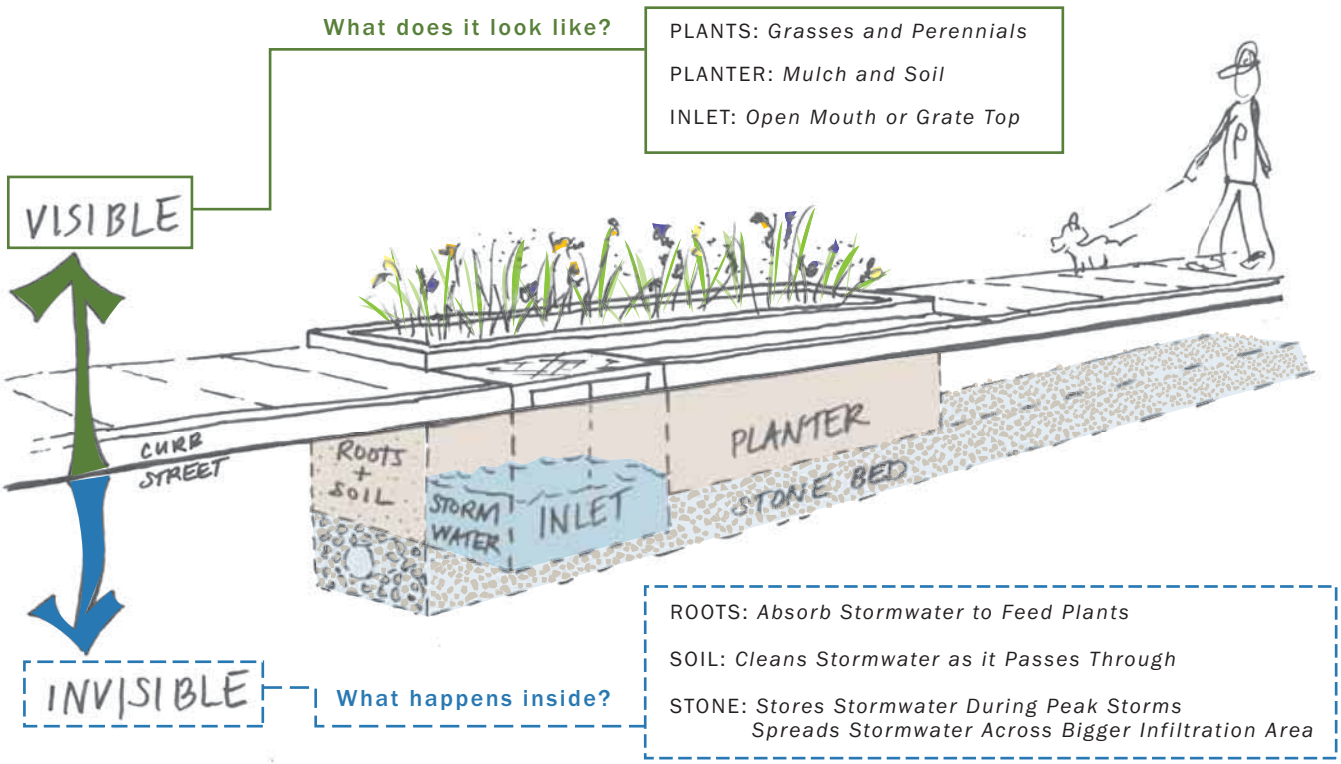
Wissahickon Charter School
Philadelphia, PA

A flow-through planter is a structure that is designed to allow stormwater from roof gutters to flow through and be used by the plants. Flow-through planters are filled with gravel, soil, vegetation and a connection to the roof downspout to let water flow in. They temporarily store stormwater runoff on top of the soil and filter sediment and pollutants as water infiltrates down through the planter. They are typically waterproofed, and the bottom of the planter is normally impervious. Thereby, planters do not infiltrate runoff into the ground, rather they rely on evapotranspiration and short-term storage to manage stormwater. Excess water can overflow into the existing downspout connection. Flow-through planters can be constructed in many sizes and shapes, and with various materials, including concrete, brick, plastic lumber or wood.

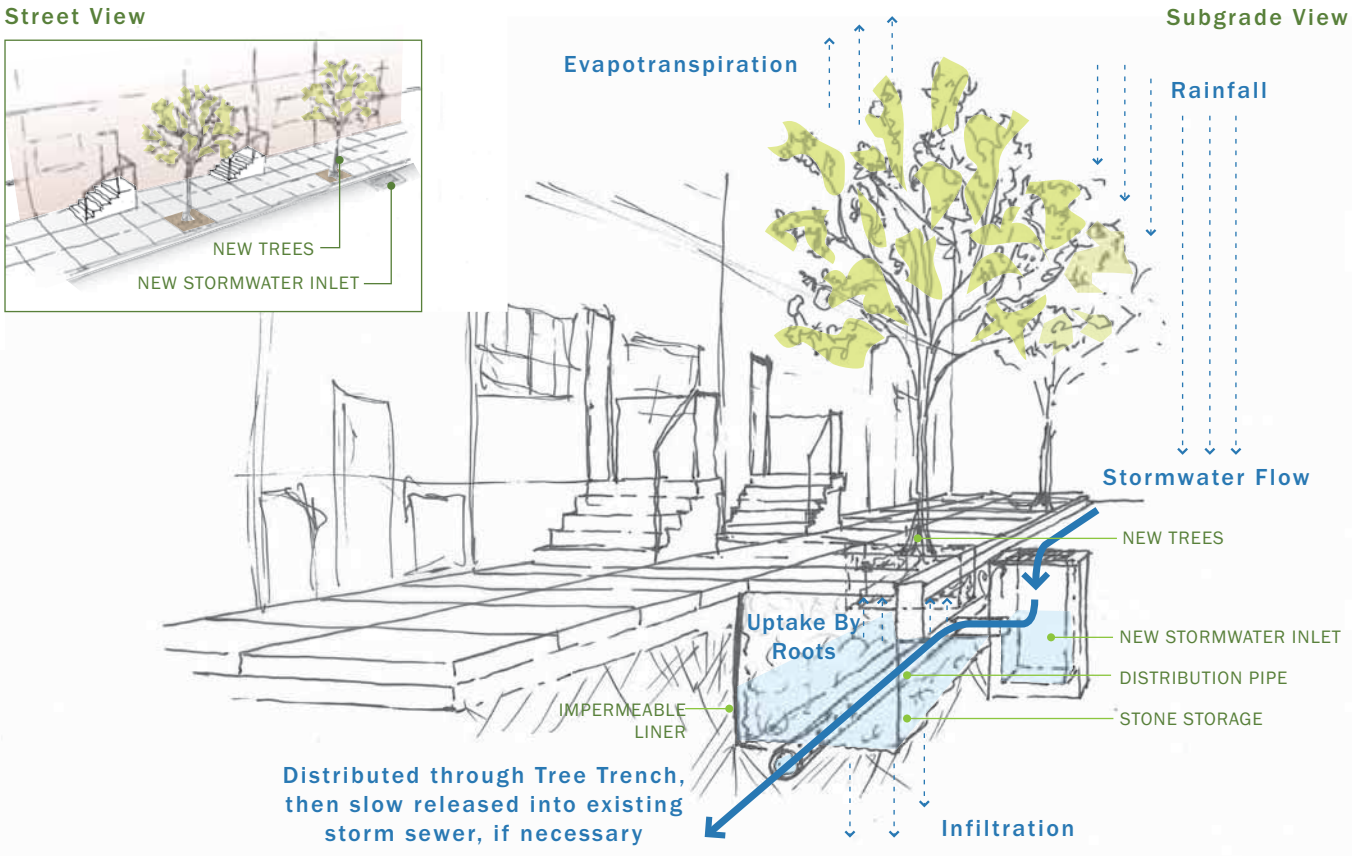
Flow-through Planter

Portland, OR

GREEN STREETS: STORMWATER PLANTER



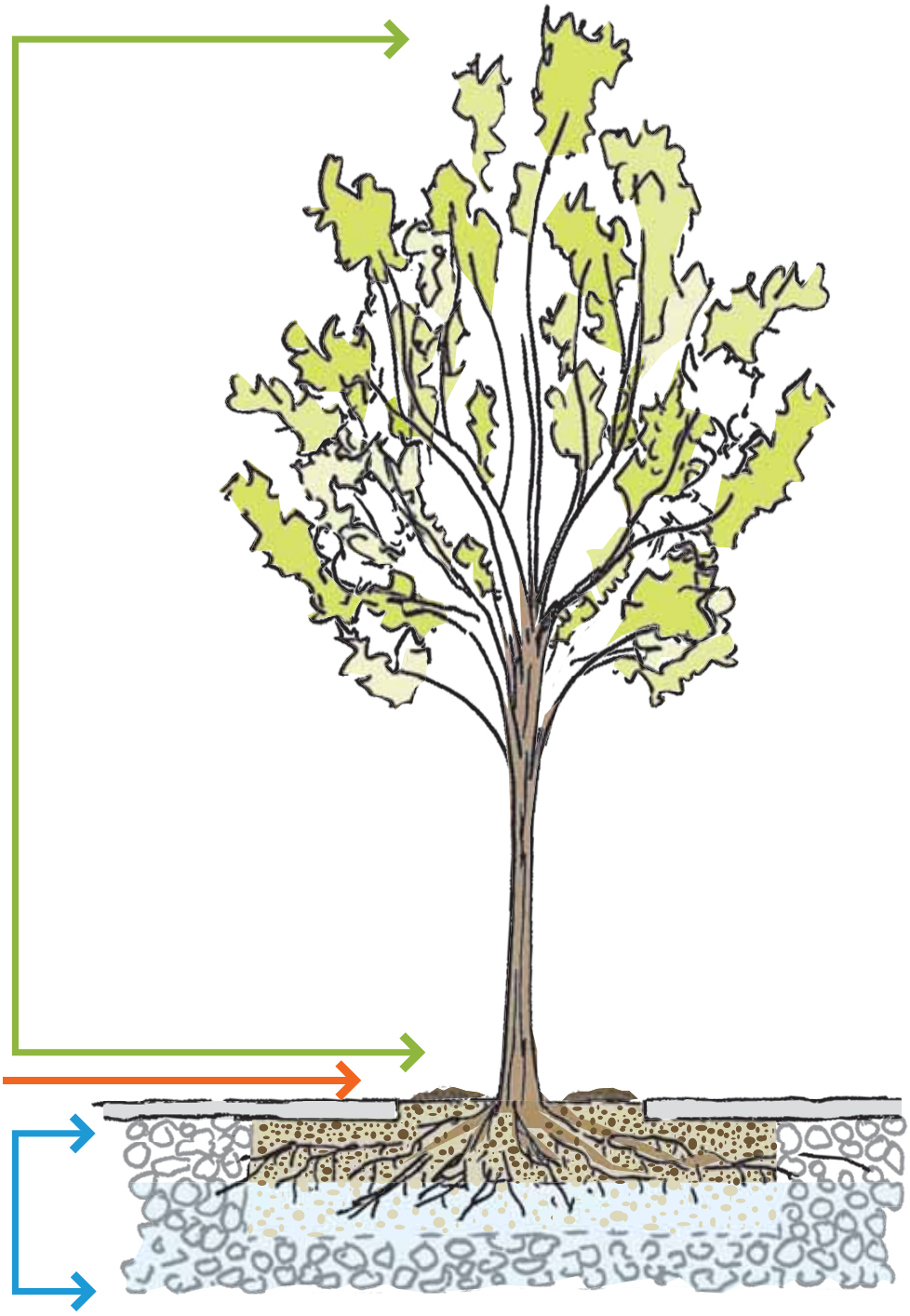
GREEN STREETS: STORMWATER TREE TRENCH



Stormwater Tree Trench: Maintenance Responsibilities

Responsibility for maintenance of green stormwater infrastructure will be shared by various partners. Green stormwater infrastructure implemented on streets or the right-of-way will be maintained through PWD in-house staff, other City department staff, such as Fairmount Park, and contractors. Fairmount Park maintenance responsibilities for street trees include tree inspection, pruning, and tree removal. PWD will specifically be responsible for subsurface green stormwater infrastructure, distribution pipe cleaning, and stormwater inlet cleaning. Property owners and residents are responsible for minimal routine maintenance, including litter clean up, pet waste removal, and, most importantly, watering of trees and vegetation, during their 1-2 year establishment period, as indicated below.

FAIRMOUNT PARK
Tree Inspection
Pruning
Removal of Unsafe Trees



RESIDENTS
Litter Clean Up
Pet Waste Removal
Watering

PHILADELPHIA WATER DEPARTMENT
Subsurface Infrastructure
Distribution Pipe Cleaning
Stormwater Inlets Cleaning

Resources

Philadelphia Water Department (PWD)
Office of Watersheds
http://www.phillywatersheds.org

The Philadelphia Water Department offers several resources:

- Green Street planning, design and implementation
- Rain Barrel Workshops
  http://www.phillywatersheds.org/rainbarrel/
- Green stormwater infrastructure implementation educational materials for homeowners, business owners, and community groups:
  http://www.phillywatersheds.org/whats_in_it_for_you
- Events calendar
  http://www.phillywatersheds.org/whats_in_it_for_you/events
- Facebook page
  http://www.facebook.com/green.cities.clean.waters
- Twitter
  http://twitter.com/Green4CleanH2O

Fairmount Park Commission (FPC)
http://www.fairmountpark.org/

The Fairmount Park Commission manages all Park and street trees in the City of Philadelphia. So, if you observe a problem with your tree or if you'd like your tree inspected for removal, pruning, or would like to have a tree planted, please call the Fairmount Park Street Tree Management Division Office.

Street Tree Management Division Office
Frances Piller, District Manager
Tel 215-685-4363
Fax 215-685-4364
E-mail fpc.streettree.info@phila.gov

- Street tree maintenance request form:
  http://www.fairmountpark.org/pdf/FPC_tree_request.pdf
- Tree care:
  http://www.fairmountpark.org/TreeCare.asp

Pennsylvania Horticultural Society (PHS)
http://www.phsonline.org

The Pennsylvania Horticultural Society designs and builds green projects throughout the greater Philadelphia area, in collaboration with a variety of partners including PWD. Additionally, PHS offers training and guidance to the community including the following resources:

- Tree Tenders class:
  In support of TreeVitalize, PHS, in partnership with Penn State Cooperative Extension, offers nine hours of hands-on tree care training for residents of the five-county Philadelphia region. The free training will cover tree biology, identification, planting, proper care and working within your community.
  http://www.pennsylvaniahorticulturalsociety.org/phlgreen/tree-training.html
- Tree Planting:
  http://www.pennsylvaniahorticulturalsociety.org/phlgreen/current-trees.html
- Garden Tenders class: Philadelphia Green's Garden Tenders is a self-help training course for community groups and non-profit organizations within the city of Philadelphia that are interested in starting community gardens on vacant lots in parks, around schools and churches. The responsibility for creating and maintaining a garden belongs to each group.
  http://www.pennsylvaniahorticulturalsociety.org/phlgreen/gardentenders.html