



*CENTER FOR
ENERGY AND
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**SUPPORTING
URBAN
GREEN INFRASTRUCTURE**

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for the
Science, Engineering, &
Technology Services Program

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University of Delaware

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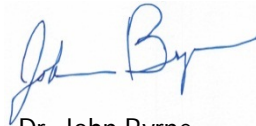
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Preface

It is a pleasure to present you with this report of the 2012 Science, Engineering, & Technology (SET) Services Program. The report is designed to provide the Delaware General Assembly and the citizens of this State with an overview of the increasing efforts in the U.S. to incorporate green infrastructure approaches into urban development. These initiatives are assisting many states and localities in more comprehensive efforts to improve stormwater management, water quality and ecosystem services; to reduce energy use; and to protect green spaces for recreational use and wildlife habitat.

We hope that this report will be useful to you in your discussions and deliberations relating to evaluating the potential for green infrastructure to address needs and opportunities in the State of Delaware.



Dr. John Byrne
Director and
Distinguished Professor of
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EXECUTIVE SUMMARY

Continued population growth in the U.S. overall, and in Delaware specifically, will reinforce the trends of increasing urbanization and decreasing levels of urban green space at both the national and state levels (Benedict and McMahon, 2001). Urbanization can alter hydrological systems, water quality, vegetation, and biodiversity, while contributing to the “urban heat island” effect (Pickett et al, 2011; Zhou et al, 2011). The increase in impervious surface area that almost always accompanies urbanization also leads to soils that are highly compacted, with low water permeability and high runoff rates (Scalenghe, 2009; Yang and Zhang, 2011; Viswanathan et al, 2011). Changes in land use and land cover in heavily urbanized environments can further negatively impact public health and well-being, due to increased noise and air pollution as well as reduced areas for exercise and recreation.

Reliance on conventional or “gray” infrastructure – consisting of stormwater pipes, drains, curbs, etc. – as a means to respond to water management and water quality issues has largely failed to cost-effectively address the negative impacts from urbanization. The conventional approach creates artificial hydrologic networks that concentrate runoff, increase water velocity, and reduce the retention and residence time of water in urbanized streams and rivers. This extensive hydrologic rerouting in urban areas leads to the increased nitrogen loading of ground and surface waters (Bernhardt et al, 2008), among a number of challenges. With these considerations in mind, new solutions to support sound water management and water quality in urban areas are needed. This report, for the Science, Engineering, & Technology (SET) Services Program – as supported by the Delaware General Assembly and the University of Delaware – aims to explore the potential of green infrastructure (sometimes noted as “GI”) in this regard. Through an analysis of five states’ experiences with green infrastructure development, the report provides recommendations for supporting the application of such approaches to meet demands and opportunities in Delaware.

Potential Benefits of a Green Infrastructure Approach in Delaware

Trees and forests perform a range of ecosystem services. Delaware’s estimated seven million trees on urban or community land annually remove 44,000 metric tons of carbon and 1,431 metric tons of air pollution. Yet without proper management, the urban forest canopy is expected to decrease by 50 percent over the next 30 years (Nowak et al, 2007b, 2009). More broadly, the Delaware Forest Service (DFS) in 2010 completed the *Delaware Forest Resource Assessment* and *Delaware Statewide Forest Strategy*, revealing that statewide forest coverage has become increasingly fragmented due to continued urban and suburban development, with other negative impacts by invasive flora and fauna. Between 2002 and 2009, six percent of Delaware’s unprotected forests were lost due to housing development (DFS, 2010c).

Over the last decade, parts of Delaware have experienced ongoing flooding and drainage issues, directly impacting the health and well-being of some of the state’s residents and businesses. The cost of the response of governmental agencies and programs to these events has had an indirect impact on all of

the state's taxpayers (Hughes, 2005). Meanwhile, Delaware's population has been growing over the last decade, and may reach 1,044,015 residents by 2030 according to some projections. In the past, population growth in Delaware has been accommodated by urban expansion into unincorporated areas outside existing municipalities (Weber, 2007; Delaware Forest Association, 2012).

The above trends imply significant impacts on water management and water quality in the First State. In Delaware, as well as in other states, water-related needs and challenges are addressed in the context of a number of policy and related drivers that operate from national to local scales. The Federal Clean Water Act and two permit programs used to enforce the Act, the Combined Sewer Overflow (CSO) Control Policy and the National Pollutant Discharge Elimination System (NPDES), are primary drivers for the adoption of green infrastructure in the U.S. The NPDES regulations have mandated the formulation and utilization of a municipal separate storm sewer system (MS4) program, and the CSO Control Policy calls for the creation of Long Term Control Plans (LTCPs) to limit or manage combined sewer overflows (EPA, 2010). Under this overarching federal regulatory structure, a primary role for states is to administer clean water revolving funds or similar funding structures created under the Clean Water Act and state laws. These funding structures make loans to projects to address point and nonpoint source water pollution control (Pollution Control Agency, 2012). In the First State, the Delaware Water Pollution Control Revolving Fund (DWPCRF), created in 1990 and administered by the Department of Natural Resources and Environmental Control (DNREC), utilizes capitalization grants provided by the EPA's Clean Water State Revolving Fund (CWSRF) Program. These grants are combined with a 20 percent state match to create a state revolving loan program for wastewater capital projects and nonpoint source pollution control projects.

Throughout the U.S., actions to comply with the above federal regulations largely take place at the local government level. As noted above, local governments have traditionally relied on conventional (or "gray") infrastructure such as sewage treatment plants. A major challenge facing many urban areas is the existence of combined sewage and stormwater pipes that, in the wake of precipitation events, can overflow. Such systems are particularly common in older cities, many of which are among the nation's largest cities (EPA, 2010). Decades ago, cities began attempting to address the problems associated with these combined systems by enlarging storage or treatment capacity, refurbishing aging pipes, and separating combined sewers. Yet these practices can be prohibitively expensive for some jurisdictions and may take decades to complete.

As part of its Clean Watersheds Needs Survey, the U.S. EPA estimated in 2004 that the capital investments needed to manage stormwater and wastewater pollution over a 20-year period would approximate \$202 billion (EPA, 2010). This figure is daunting, when considering that states and cities have faced uncertain, or insufficient, funding support from the federal government to help cover the costs of running and repairing public stormwater infrastructure, alongside the expenses linked to implementing LTCPs (EPA, 2010; U.S. Conference of Mayors, 2012).

Green infrastructure can help communities and urban areas to address imperatives ranging from the requirements of the Clean Water Act to sound asset management of public infrastructure (EPA, 2010). In

light of increasing awareness of these benefits, the EPA has worked to improve options for the utilization of such infrastructure. At the state level, updated permits are beginning to more explicitly engage the connections among impervious surfaces, runoff, and water quality (EPA, 2010). Yet many cities are pushing the EPA to go further, as they seek approval to utilize green infrastructure approaches instead of more traditional (and expensive) storage tanks, tunnels, and treatment facilities (Quinlan, 2012).

In Delaware, Executive Order #61 (2004), described in greater detail below, identifies green infrastructure “as Delaware’s natural life support system of parks and preserves, woodlands and wildlife areas, wetlands and waterways, productive agricultural and forest land, greenways, cultural, historic and recreational sites, and other natural areas all with conservation value” (DNREC, 2007). More broadly, investment in green infrastructure can provide cost-effective solutions¹ to urban infrastructure demands, while developing the network of green spaces necessary to contribute to ecosystem functioning and human well-being (Benedict and MacMahon, 2001). Through green infrastructure, vegetation provides ecosystem services and functions, including stormwater reduction, surface water quality improvements, air pollution removal, shade provision, reduction in electricity use, and support of natural habitat for plants and animals (Escobedo et al, 2011). These services and functions are achieved in urban areas by implementing green infrastructure such as urban forests, green roofs, riparian buffers, and low impact development techniques (bioretention ponds, swales, and pervious surfaces). Such approaches to urban water management are becoming increasingly popular due to their ability to provide multiple benefits (environmental, economic, energy, and equity), their flexibility for context and scale (community/neighborhood or regional/watershed), and their contribution to climate change mitigation and adaptation strategies. Green infrastructure also has the potential to create jobs (American Rivers, 2010).

Recent research suggests that the adoption of innovative green stormwater practices, if implemented robustly in Delaware, could benefit the First State in many ways. Examples include: improved water quality; reduced flood damage, pollution, and costs for water treatment; higher property values and tax revenues near waterbodies; and gains in recreation and tourism. These benefits could translate to an annual economic value of almost \$1 billion (Kauffman, 2011).

Policy Context in Delaware

In Delaware, certain policies and programs already exist to encourage the utilization of urban green infrastructure. These can be organized according to stormwater management, land use and development planning, and urban and community forestry initiatives.

Executive Order #62, issued in 2004 by then-Governor Ruth Ann Minner, created the “Task Force on Surface Water Management.” The Task Force was directed to “develop a statewide surface water

¹ A study by the Center for Urban Studies at Rutgers University found that annual operating and maintenance costs of traditional “gray” infrastructure in the state of New Jersey could be reduced by \$400 million through the implementation of development planning based on green infrastructure principles (Benedict and McMahon, 2001).

management strategy to integrate drainage, flood control and stormwater management” and to recommend strategies, where advisable, to “implement green infrastructure policies and goals” (Hughes, 2005).

In response to the Task Force on Surface Water Management’s 2005 report, the State of Delaware and DNREC have been working on revisions to the State’s sediment and stormwater management regulations. Draft regulations are currently in development; the current version was presented for public comment² with final regulations anticipated to be published in the summer of 2012. The proposed regulations aim to extend and improve upon current erosion and sediment controls on urban and rural lands and to utilize “sound water and land use practices (1.2)” for management of stormwater (DNREC, 2012b: Section 1). Meanwhile, funds to support planning for green infrastructure practices or methods for water quality improvement within developed and impaired watersheds have been available through Surface Water Matching Planning Grants (SWMPG) or the Community Water Quality Improvement Grant (CWQIG) Program (DNREC, 2011a). A companion manual, *Green Technology: The Delaware Urban Runoff Management Approach*, created by DNREC, provides information on established standards, specifications, and details for green technology best management practices (BMPs) that minimize stormwater impacts.

Delaware’s population growth highlights the need for sound land use planning and management (Zinn, 2003). Updating land use planning practices has been a high priority for the State and some local governments over the past two decades. Enacted in 1995, the Shaping Delaware’s Future Act began a process to update comprehensive planning laws for local communities. Governor Minner’s 2001 Livable Delaware Initiative included legislation that provided funding and planning resources for municipalities to develop comprehensive growth plans (C2ES, 2011).

More broadly, the Delaware Planning Act (DPA) (29 Del. C. §§9101 to 9903) requires a comprehensive review and certification process for local development plans³ as a means to attain compatibility and consistency among the interests of State, county and municipal governments. Established in 2003 to replace the Land Use Planning Act Process approved in 1996, the Preliminary Land Use Service (PLUS) process requires major land use changes to be reviewed by the Cabinet Committee on State Planning Issues (CCSPI) prior to submission to local governments (OSPC, 2012a, 2010; 29 Del. C. §92). A report entitled *Strategies for State Policies and Spending*, first issued in 1995 and updated in 2004 and 2010, guides State investment decisions to promote efficient development, protect agriculture and open space, discourage sprawl, and communicate with local governments on land-use matters (OSPC, 2010).

With regards to forests, current Delaware policy continues to be guided in part by Governor Minner’s Executive Order #61 (2004), which established a priority for recognizing and conserving the State’s green infrastructure, whether rural or urban. Executive Order #61 directed DNREC to: develop an inventory of all State-owned green infrastructure; coordinate with the Department of Agriculture to develop a statewide green infrastructure conservation and management strategy and public education and outreach program;

² The public comment period ended April 2, 2012.

³ Delaware law mandates that all counties and municipalities have a comprehensive plan in place (22 Del. C. §§701 to 711).

provide assistance to local governments in conserving green infrastructure; and improve coordination among State agencies and other conservation partners in collecting information (DNREC, 2007).

Delaware law (3 Del. C. §§1031 to 1038) establishes an Urban and Community Forestry (UCF) Program within the Department of Agriculture, under direction of the State Forester (DSG, 2012f). The UCF Program was established in response to the Federal Cooperative Forest Assistance Act of 1978, which authorized the U.S. Department of Agriculture to manage non-federal forested lands. The UCF raises public awareness on the importance of trees and forests and provides technical assistance for the development of municipal tree ordinances, urban tree inventories, and urban forest management plans. Grants (as funds are available) support tree inventory, planting, and management initiatives. Meanwhile, the State's Forest Stewardship Committee led the 2010 effort to address landscapes and recommend corresponding forest protection programs as part of the Forest Resource Strategy Report. Rural and urban priorities were identified. Twenty-three (40 percent) of Delaware's 57 communities were identified as high priority areas for urban forest conservation. Also noteworthy is the Ecological Restoration and Protection Initiative, launched in 2003 and led by the DNREC Division of Soil and Water, which utilizes wetland habitat, stream protection, and restoration activities to enhance water quality and reduce erosion.

Recommendations for Delaware

In Delaware, green infrastructure was a prominent focus of State government initiatives in the early part of the last decade⁴, and continues to be promoted within the contexts of stormwater management, land use and development planning, and urban forestry efforts as noted above. However, a more targeted, coordinated approach to urban green infrastructure across these and other sectors could potentially deliver additional benefits to Delaware residents. The following recommendations build on lessons learned from the case studies featured in this report – with attention to New York, Maryland, Pennsylvania, Illinois and California – as relevant to existing conditions in the First State.

Sustainable Revenue Streams for Green Infrastructure Financing

Limited financial resources are noted as a barrier to the advancement of green infrastructure planning and management. While the State of Delaware has successfully leveraged federal Clean Water State Revolving Funds with the establishment of the Delaware Water Pollution Control Revolving Fund (DWPCRF) in 1990, a national assessment of the use of these funds reveals that demand for this type of funding far outstrips supply (American Rivers, 2010). In the case studies reviewed for this report, state level grant programs to support green infrastructure in the contexts of water quality and urban forestry experience similar problems of excess demand. For example, Pennsylvania and California have exhibited funding difficulties for established grant programs due to reliance on unsustainable funding mechanisms or reluctance to pass additional bond referendums. The U.S. EPA's proposed budget for FY2012 results in a 27 percent cut (\$3,487M in FY2010 to \$2,540M in FY2012) to federal CWSRF and DWSRF (EPA, 2011),

⁴ This focus is most prominently captured in Governor Minner's Livable Delaware Initiative (Executive Order #14 of 2001 and #83 of 2006) which sought to guide urban growth with "thoughtful" planning which preserved and enhanced existing rural and urban green infrastructure (IPA, 2008).

cutting capitalization of DWPCRF and associated grants. Green infrastructure financing in Delaware, derived largely from these federal funding mechanisms, could face similar decreases. It is advisable, therefore, that Delaware explore additional, sustainable revenue streams to support green infrastructure. A few of these proposals are explored below.

Low Interest Loan Programs. Delaware's water infrastructure could benefit from additional capitalization of the State's revolving loan program. This would require a commitment from State policymakers and voters to provide additional funds through state bonds or a dedicated revenue fee to further finance the revolving loan program. An example of interest, here, is PENNVEST, created by the Commonwealth of Pennsylvania as a centralized agency to provide infrastructure grants and loans. In Pennsylvania, state voters approved \$870 million in general obligation bonds, in addition to capitalization from the Clean Water State Revolving Fund (CWSRF) and Drinking Water State Revolving Fund (DWSRF) (PENNVEST, 2011). With this capitalization, PENNVEST has not received state appropriated operations revenue since 1996, with operating revenues funded through interest and investment payments (PENNVEST, 2011). To ensure the long term stability of the program, policy could set a target date for such an agency to operate free of state-provided operating revenues. Modification of the criteria to increase points received, or to award bonus points for green infrastructure within the Green Project Reserve, could encourage the application or consideration of projects incorporating innovative green infrastructure.

Since 2009, PENNVEST has provided grants for 13 green infrastructure projects and 2 major municipal green infrastructure loans. This type of centralized infrastructure assistance authority can streamline the application, approval, and disbursement process for municipalities, operators, and organizations applying for CWSRFs, DWSRFs, and grants for water infrastructure improvements (including green infrastructure).

Financing from Developers. Maryland's Forest Conservation Act puts the financial burden of maintaining established forest cover levels on developers, thus removing state government from the direct responsibility of mitigating development-induced forest loss. Developers are responsible for the conservation and establishment of forestation and long-term protection or, if permitted by the county, submission of a payment-in-lieu.

County/Conservation District/Municipal Level Stormwater Utility Fees. The City of Philadelphia has incorporated a stormwater utility fee to help finance green stormwater infrastructure with goals of decreasing runoff and combined sewer overflows (CSOs). A stormwater utility fee helps leverage private investment in green infrastructure and other stormwater reduction BMPs through the utilization of a credit system.

As a means to leverage private green infrastructure investment and help fund green infrastructure projects that decrease stormwater runoff impacts, the State of Delaware could encourage the development of municipal or county-level (preferable) stormwater utilities. Stormwater utilities could be encouraged through the provision of technical and design assistance that eases the implementation burden. Such

information could be shared via a centralized web portal hosted and coordinated by DNREC. The standard stormwater utility model should include a tiered fee system based on the amount of impervious surface on a particular property. To leverage private investment into green infrastructure and further reduce stormwater quantity, a credit system should be included that reduces stormwater fees for customers that install and maintain effective green stormwater infrastructure systems. Adoption of the currently proposed stormwater regulations would greatly ease the requirements for establishment of a stormwater utility over current regulations.

Real Estate Transfer Tax. The New York State Environmental Protection Fund (EPF) is financed almost entirely through an appropriation of collected real estate transfer taxes. Allocations for the fund were as high as \$212 million in FY 2009 to 2010, with proposed allocations reduced to \$134 million for FY 2012 to 2013. Despite funding reductions, however, the EPF maintains a revenue stream without incurring the debt which results from public bonds. In Delaware, property transfers are currently taxed by the State at the rate of 2 percent of the property value unless the county already imposes a 1.5 percent tax as authorized by State law (22 Del. C.§ 1601 or 9 Del. C.§ 8102) in which case the State tax is fixed at 1.5 percent (DSG, 2012h). A portion of the revenue generated by the real estate transfer tax is allocated to the Delaware Land and Water Conservation Trust Fund (DLWCTF) managed by DNREC to support the acquisition and development of land for conservation. To extend the impact of the DLWCTF, it is recommended that the definition of eligible project types be broadened to include green infrastructure. Such an expansion would provide a stable funding source for statewide stormwater management initiatives and would be legislatively simpler than creating a new funding source.

Statewide Waste Surcharge. A fee assessed on garbage collected could be considered as a source of funding for green infrastructure, similar to the Environmental Stewardship Fund of Pennsylvania.

Coordinated, Intersectoral Fund to Manage GI Designated Financial Resources

Several funds dedicated to natural resource conservation currently exist in Delaware: the Urban and Community Forestry (UCF) grant program, the Delaware Land and Water Conservation Trust Fund (DLWCTF), and the Community Environmental Penalty Fund (CEPF). In 2011 approximately \$85,000 was available through the UCF, \$1.5 million via the DLWCTF, and \$665,000 from the CEPF (DFS, 2011; DNREC, 2012e, 2011c). To encourage green infrastructure throughout the state, these various funds could be consolidated (or coordinated), maintaining the legislatively mandated disbursement criteria – yet adding a requirement which specifies a portion of available financing dedicated to projects which support broadly defined urban green infrastructure. The funds could also be made eligible to nonprofits seeking to add to green spaces in an urban environment. This would legislatively be a simpler approach than attempting to create an altogether new source of funding.

Conservation Codes to Commit Developers to Forest Conservation

Maryland's Forest Conservation Act (FCA) constructs a direct connection between development-induced forest loss and forest replenishment and fosters an innovative approach to controlling and addressing forest loss. According to the 15-year FCA review report (1993 to 2007), the FCA helped to

retain 24,000 acres and replant 4,712 acres of forest (Maryland DNR, 2010). To preserve forest and minimize further loss, similar requirements could be considered in Delaware. Based on the Maryland FCA model, developers could be required to retain the most valuable forests, or conserve forests onsite, or plant to achieve a minimum forest cover rate. If existing forest must be removed to facilitate development, developers could be required to create new forest plantations. A compensation ratio based on the Delaware Strategies for State Policies and Spending identified land categories is recommended. If planting is determined to be impossible, developers should be required to make a payment-in-lieu that contributes to a forest conservation fund, which will be applied to forestation activities throughout the State.

Smart Growth Coordination

Urban sprawl is one of the key challenges facing green infrastructure conservation in Delaware. California, when facing a similar challenge, opted to legislate a more coordinated approach to both land use and transportation planning. A key objective of California's coordinated initiative is the reduction of emissions in these sectors. In addition to providing competitive grant program funding, establishment of the intersectoral Smart Growth Council is a cornerstone of California's smart growth coordination effort.

In Delaware, the Strategies for State Policies and Spending (1999, 2004, 2010) and the Livable Delaware Initiative (2001) created the basis for a coordinated land use planning institutional framework. A cabinet level intersectoral committee exists in the context of the Cabinet Committee on State Planning Issues (CCSPI) which is mandated to review and approve all county and municipal comprehensive plans, and the Preliminary Land Use Service (PLUS) review process allows for an additional level of intersectoral review on proposed developments. The recently updated Strategies for State Policies and Spending provides an investment prioritization framework that proposes to limit urban expansion beyond currently developed areas. What the California model provides, in addition to the intersectoral management and oversight infrastructure, is a competitive grant program funding structure which encourages collaborative, locally initiated solutions to transportation and development planning.

Revised Stormwater Management Regulations

Based on Governor Minner's Task Force on Surface Water Management, the currently proposed revisions to Delaware's Sediment and Stormwater Regulations shift the stormwater management focus from design standards to performance criteria aimed at reducing quantity of runoff and mimicking natural hydrologic processes. Adoption of the regulations *as proposed* is anticipated to encourage the use of green stormwater infrastructure to control stormwater runoff volume.⁵ Implementation of the level of green stormwater infrastructure required to achieve fishable, swimmable, and boatable water quality standards is expected to result in a 14:1 benefit-cost ratio (Kauffman, 2011). Meanwhile, adoption of the regulations as proposed would also ease the requirements for creation and implementation of stormwater utilities by: eliminating prerequisites for long range watershed master plans; removing the requirement for yearly inspections of all (public and private) stormwater management facilities; and reducing regulatory language

⁵ Final adoption of the current draft regulations is anticipated to occur during June or July 2012. Final public hearings in regards to the draft stormwater regulations were held in March 2012.

to allow county or municipal authorities the leeway to design utilities that best fit the local population. Stormwater utilities not only help to equitably fund the operation and capital expenditures of stormwater operations, but can additionally, if created properly, leverage private investment into green infrastructure.

Green Infrastructure Building Codes

Green infrastructure development can be hindered by local and county building codes which do not specify green infrastructure standards, or possibly even discourage green infrastructure. Building, plumbing, and electrical codes are currently adopted and enforced by counties (16 Del. C. §76). While Delaware has already adopted and enforces the most recent version of the International Energy Conservation Code, development and adoption of a Green Infrastructure Building Standards Code – such as the one adopted in California – by the State of Delaware can reduce existing technical barriers to increasing Delaware's green infrastructure. The CALGreen Green Building Standards Code provides an example of a multiple stakeholder and agency developed green infrastructure standard that a proposed Delaware Green Infrastructure Building Standards Code could emulate.

Expanded Scope of Grant Programs Supported By Green Infrastructure Funding

The 2010 Delaware Forest Resource Assessment identified a number of strategic goals (See Appendix A.1) for enhancing the delivery of benefits from its forest resource base, most notably: conservation and maintenance of soil and water resources; an increase in urban tree canopy; and an increase in the number of sustainably managed urban and community forests. Whereas Delaware has supported these activities through its UCF program for more than 20 years, an expansion of focus and structure might broaden the potential programmatic and public awareness benefits.

California has, in part, met the need to address issues of headwater, wetland forests, and waterway buffer zone protections for water quality management by including these issues in legislatively designated grant programs (AB31: Statewide Park Development and Community Revitalization Act of 2008 and California River Parkways Act of 2004). Critical to the success of the grant program is a requirement for stakeholder partnerships between municipal organizations and citizen or community groups. An additional requirement for potential grant recipients is for the proposed project to provide multiple environmental and social benefits.

Centralized Information Source for Green Infrastructure Benefits and Resources

At present there is limited programmatic coordination amongst the various state agencies which attempt to promote green infrastructure in Delaware. Coordination amongst counties and municipalities whose planning and zoning ordinances more directly impact local development activity is also limited. A centralized database for information and the financial resources available for public and private sector green infrastructure projects could streamline the processes required for individuals and institutions to access these resources. The centralized data source could additionally house information on BMPs for municipal level tree preservation, buffer zone, and urban tree canopy goals in addition to any comprehensive development, urban forest management plans formulated by any of Delaware's 57 municipalities.

Development of Arborist/Urban Forester Professional Resources

The relatively small size of the State of Delaware and its various municipalities (as compared to a state like California) can make access to a strong cadre of urban forest professionals, as assigned to individual municipalities, a somewhat challenging prospect. In addition to the above recommendation to support urban forest management infrastructure development through grant program requirements, the proposal of the 2010 Strategic Assessment is to share urban forest professionals, as well as strengthen relationships with the various urban and community forestry stakeholder groups (see Appendix A.3 of this report). Links to these organizations and a listing of professional resource persons could be posted on the recommended centralized website. In addition to facilitating municipal access to qualified professionals, this resource could be utilized by developers seeking “certified” forestry professionals to assist in developing Forest Stand Delineation and Forest Conservation Plans, as required by the recommended Maryland forest conservation model.

Expanded Public Awareness About Benefits of Green Infrastructure

Despite efforts from a variety of stakeholders to promote and expand green infrastructure throughout Delaware, awareness in the public and private spheres of these initiatives and their impacts remains limited. This limited awareness is documented in the 2005 Response Management Study conducted for DNREC. Accordingly, in addition to the centralized information source recommended above, the following public outreach activities are recommended.

Citizen Participation in Urban Greening/Urban Forestry. Urban greening/urban forestry resources in Delaware are primarily focused on public lands. By contrast, the State of Illinois allows private landowners (as opposed to only public land holders) of all sizes to participate in green infrastructure development through the Chicago Sustainable Backyards Program that was launched in 2011 (Abu-Absi, 2012). While California’s UCF Grant program does not specifically target homeowners, it does emphasize the greening of community lands which are not solely publicly owned. Several California municipalities, meanwhile, have had significant success in urban forest mapping by including the efforts of private citizens.

Providing individual homeowners with access to green infrastructure and urban forestry funding lightens the responsibility of state and municipal agencies in the management of these resources. The Delaware Nature Society actively promotes a Backyard Habitat program and encourages backyard rain barrels. The Delaware Center for Horticulture’s participation in the P1M campaign encourages private citizen participation in managing and monitoring the urban forest resource. Limited financial support for these types of citizen-oriented initiatives, however, restricts their potential. The State of Delaware could allocate additional resources to these partner organizations to continue and expand these types of public outreach initiatives.

Research Collaboration for Benefits Monitoring. Nowak (2007a, 2007b, 2009, 2011) has assessed the impact of urban green infrastructure, specifically urban forests, throughout the country and repeatedly has advocated for better research and monitoring of the benefits produced, in order to encourage its application

amongst stakeholders. In Delaware, research and monitoring activities could be conducted via collaborative efforts with research oriented stakeholders such as University of Delaware Extension Services, Delaware Center for Horticulture, etc.

CHAPTER 1: INTRODUCTION

1.1 Background

Urbanization can alter soil function, hydrological systems, water quality, vegetation, and biodiversity. The changes in land use and land cover in heavily urbanized environments can have negative impacts on public health and well-being due to increased noise and air pollution as well as reduced areas for exercise and recreation. Continued population growth in the U.S., and Delaware, will reinforce the trend of increasing urbanization and decreasing levels of urban green space at both the national and state levels (Benedict and McMahon, 2001). Conventional or “gray” infrastructure has failed to cost-effectively address the negative impacts from urbanization, and new solutions are needed. This report, for the Science, Engineering, & Technology (SET) Services Program – as supported by the Delaware General Assembly and the University of Delaware – aims to explore the potential of green infrastructure in this regard. Through an analysis of five states’ experiences with green infrastructure development, the report provides recommendations for supporting the application of such approaches to meet needs and opportunities in Delaware.

1.2 Environmental Impacts of Urbanization

The increase in impervious surface area that almost always accompanies urbanization has a number of negative impacts on environmental quality, including decreased water quality and increased flooding. Urbanization also leads to soils that are highly compacted. Compacted soil has low water permeability, high runoff rates, and decreased moisture content, that in turn increases soil CO₂ concentration and reduces vegetative root production (Scalenghe, 2009; Yang and Zhang, 2011; Viswanathan et al, 2011). An increase in the percentage of manmade structures and a decrease in vegetation alter the reflective and thermal properties of the urban landscape which results in higher temperatures in an urban core than in the surrounding rural areas – this is referred to as an “urban heat island” (Pickett et al, 2011; Zhou et al, 2011). Urban heat islands contribute to the creation of smog, increased energy consumption for the cooling of buildings, and air circulation patterns that disperse pollution into surrounding areas (Grimm et al, 2008).

The International Energy Agency (IEA) estimates that energy production for urban areas accounted for 71 percent of energy related greenhouse gas emissions in 2006, with an increase to 76 percent predicted by 2030 (IEA, 2008). Urban areas have become point sources for not only greenhouse gases, but also volatile organic compounds such as nitrous oxide (NO), nitrogen dioxide (NO₂), ozone (O₃), sulfur dioxide (SO₂), nitric acid (HNO₃), and other organic acids. The result is cities with high rates of acid and nitrogen deposition and high atmospheric concentrations of greenhouse gases such as carbon dioxide (CO₂), methane (CH₄), and O₃ (Grimm et al, 2008).

Nonpoint sources of water pollution in the urban area are widespread and difficult to track (Duh et al, 2008). The impervious surfaces of parking lots, roads, and buildings route runoff, and its associated

pollutants, directly into urban streams (Grimm et al, 2008). The stormwater pipes, drains, and curbs in urbanized areas create artificial hydrologic networks that concentrate runoff, increase water velocity, and reduce the retention and residence time of water in urbanized streams and rivers. This extensive hydrologic rerouting in urban areas leads to the increased nitrogen loading of ground and surface waters (Bernhardt et al, 2008). The water quality of lakes, rivers, and streams has been strongly correlated with the amount of urban land in a watershed – impervious surfaces and land use are important predictors in stream phosphorus concentrations (Pfeifer and Bennett, 2011).

Intensive urbanization – in the form of pollution, traffic, and human disturbance – reduces the diversity of the surrounding flora and fauna species due to habitat loss, transformation, fragmentation, and degradation (McKinney, 2008). Species diversity and density in urban flora communities are impacted by the human preference for certain plants and the importation of non-natives for landscaping and horticulture (McKinney, 2008; Williams et al, 2009). Habitat disturbance (fragmentation, loss, or degradation), heat island effects, and changes in soil properties due to urbanization tend to alter species composition, favoring species adapted for disturbance, heat, or dry conditions (Kowarik, 2011).

1.3 Green Infrastructure – A Tool to Mitigate the Negative Impacts of Urbanization

Green infrastructure has been defined by the Green Infrastructure Work Group, a joint initiative of The Conservation Fund and the U.S. Forest Service, as the following:

An interconnected network of waterways, wetlands, woodlands, wildlife habitats, and other natural areas; greenways, parks and other conservation lands; working farms, ranches and forests; and other wilderness and other open spaces that support native species, maintain natural ecological processes, sustain air and water resources and contribute to the health and quality of America's community and people (Benedict and MacMahon, 2001).

The President's Council on Sustainable Development has identified green infrastructure as a necessary component for implementing a comprehensive approach to sustainable community development. Investment in green infrastructure can provide cost-effective solutions⁶ to urban infrastructure needs, while simultaneously developing the network of green spaces necessary for maintaining ecosystem functioning and providing for human well-being (Benedict and MacMahon, 2001). Through green infrastructure, vegetation provides ecosystem services and functions, including stormwater reduction, surface water quality improvements, air pollution removal, shade provision, reduction in electricity use, and support of natural habitat in urban areas for plants and animals (Escobedo et al, 2011). These services and functions are used in urban areas by implementing green infrastructure such as urban forests, green roofs, riparian buffers, and low impact development techniques (bioretention ponds, swales,

⁶ A study conducted by the Center for Urban Studies at Rutgers University found that annual operating and maintenance costs of traditional "gray" infrastructure in the state of New Jersey could be reduced by \$400 million through the implementation of development planning based on green infrastructure principles (Benedict and McMahon, 2001).

and pervious surfaces). Green infrastructure solutions preserve and restore natural landscapes, prevent wasteful water use, and work with – rather than against – nature.

Green infrastructure approaches to increase the water retention capacity of urban areas include green roofs, wetland restoration, increased levels of permeable surfaces and initiatives such as rainbarrels and raingardens. Such approaches to urban water management are becoming increasingly popular due to their ability to provide multiple benefits (environmental, economic, energy, and equity), their flexibility for context and scale (community/neighborhood or regional/watershed), and their contribution to climate change mitigation and adaptation strategies. Green infrastructure also has the potential to create jobs. For example, installing green roofs on just one percent of the large buildings in U.S. cities would provide a significant economic boost to green roof manufacturers and suppliers, creating an estimated 190,000 jobs (American Rivers, 2010).

A number of trends can be identified as encouraging a shift to green infrastructure planning and investment including:

- Greater understanding of the problems of urban sprawl and landscape fragmentation by policymakers and the public;
- Public health concerns regarding poor air and water quality and increased obesity due to inactive lifestyles;
- Improved value and marketability of homes and properties near protected green spaces;
- Urban revitalization efforts that recognize the value of urban green infrastructure;
- State, regional, and community level smart growth policies and programs; and
- Federal water quality mandates (Benedict and MacMahon, 2001)

This SET report outlines the benefits of a green infrastructure approach to minimizing the environmental and economic impacts of modern development and the expansion of urban areas, with particular attention paid to initiatives that may benefit Delaware. A discussion of the general benefits of green infrastructure approaches throughout the U.S. (see Chapter 2) and barriers to their implementation (see Chapter 3) is followed by a review of relevant policies and programs in Delaware (see Chapter 4). Following these sections, the report reviews best practices from five U.S. states and explores policy options for using green infrastructure to meet the needs of the First State.

CHAPTER 2: POTENTIAL BENEFITS OF GREEN INFRASTRUCTURE

The following chapter identifies the specific contributions that green infrastructure can bring to communities and urban areas, with an emphasis on environmental, energy reduction, economic, and equity-related benefits.

2.1 Environmental Improvements

The following applications of green infrastructure can reduce the quantity of runoff that reaches urban waterways and can improve the water quality of any runoff by removing nutrients and pollutants. Forested riparian buffers benefit stream health by regulating stream temperature, due to the reduction in sunlight that reaches a stream, and providing denitrification to subsurface water flow, due to the nutrient uptake by tree roots (Newham et al, 2011). Urban trees intercept rainfall which serves an important function in decreasing stormwater runoff by temporarily storing precipitation in the canopy, reducing and delaying peak runoff, and reducing raindrop energy which minimizes damage to soil structure and protects soil infiltration capacity (Asadian and Weiler, 2009). For example, the Rattlesnake Run sewershed in Wilmington, Delaware, has a 5 percent canopy cover that reduces non-sanitary sewer flow by 1.4 percent compared to a baseline of no urban forest cover (Nowak et al, 2009). Further hydrologic analysis by the Urban Forest Effects (UFORE) model indicates increasing urban forest canopy cover from 5 percent to 45 percent would reduce non-sanitary flow by 10.7 percent.

Another green infrastructure technology, bioretention basins (see Figure 1 below), can lower the concentration of most targeted pollutants in runoff by decreasing the peak flow and volume of rain events from reaching streams or rivers, in addition to removing the majority of total suspended sediments (Hunt et al, 2008; Trowsdale and Simcock, 2011). Green infrastructure additionally figures prominently within low-impact development strategies which incorporate grass swales, cluster housing, shared driveways, rain gardens, and pervious concrete pavers. These strategies significantly decrease post-development peak and storm flow runoff, and decrease the amount of ammonia (NH₃), lead (Pb), and Zinc (Zn) exported by runoff (Bedan and Clausen, 2009). Green infrastructure in the form of green roofs (see Figure 2 below) reduces peak runoff from rainfall, captures small rainfall events, and captures and slowly releases larger rainfall events (Carpenter, 2011).⁷ Green roofs are able to retain 68 percent of rainfall volume for small rain events (less than 2.54 cm), reduce peak discharge by 90 percent, and delay runoff for more than two hours.

⁷ Green roofs are simply a vegetative layer grown on a rooftop. Green roofs are typically classified as “extensive” or “intensive.” Extensive green roofs are simpler, modular, and lightweight systems composed of hardy succulents requiring little maintenance and the least amount of additional structural support. Intensive green roofs are more like a conventional garden or park and can include larger plants such as trees and shrubs. Intensive roofs require more structural support, plant and soil maintenance, and higher initial investment (EPA, 2008).



FIGURE 1: Bioretention Basin, University of Delaware (photo by M. Schramm)

Urban vegetative cover physically removes air pollutants and CO₂, and indirectly reduces the CO₂ emissions that urban areas create. Air pollution mitigation is accomplished in an urban forest canopy through a dry deposition process which removes air pollutants such as SO₂, NO_x, CO, and particulate matter, and moves the pollutants into the plant tissue or washes them off the leaf surface by rainfall (Jim and Chen, 2008). Urban vegetation within the City of Los Angeles is responsible for the removal of 4,476 tons of air pollutants a year (Nowak et al, 2011). Urban forest management has been found to be moderately effective in offsetting annual CO₂ emissions in Miami-Dade County and Gainesville, Florida, with trees sequestering 1.8 percent (3.6 tons/hectare/year) and 3.4 percent (5.8 tons/hectare/year) of annual citywide carbon emissions (Escobedo et al, 2010). The effectiveness of air pollutant removal by urban forests varies by the composition of tree species, leaf surface area, principle time of growth, and local pollutant concentrations (Escobedo and Nowak, 2009; Mitchell et al, 2010).

Green infrastructure provides three methods of CO₂ reduction and sequestration: (1) vegetation directly sequesters and stores CO₂ within biomass; (2) green infrastructure reduces temperature by shading and evapotranspiration, resulting in reduced fossil fuel consumption from a reduced need for cooling; and (3) associated vegetation and soils provide storage of organic carbon (Escobedo et al, 2010). It is important to

note that urban forests can also be responsible for emissions in the form of pollutants emitted through urban tree maintenance activities or biogenic volatile organic compounds released directly from some species of trees (Jim and Chen, 2008; Dobbs et al, 2011). On average, however, green infrastructure offers a net reduction in atmospheric CO₂.



FIGURE 2: Green Roof, Colburn Hall, University of Delaware (photo by M. Schramm)

2.2 Energy Reduction

The shade effect provided by green infrastructure reduces thermal heating/cooling needs of homes and buildings in the summer. Pandit and Laband (2010) found that for every 10 percent of shade cover provided by vegetation to a residential home, electricity consumption was reduced by 1.29 kWh per day. A house with shade coverage of 19.3 percent lowered summertime electricity consumption by 9.3 percent, and homes with 50 percent coverage decreased consumption 14 percent over homes in full sunlight. Properly sited trees can reduce winter heating requirements by acting as a wind break. Zhou et al (2011) found the amount of woody vegetation cover to be the most important factor in mitigating the urban heat island effect, with the urban heat island mitigated more broadly by a combination of green roofs, increased tree canopy cover, and the use of light colored materials on houses and roofs. Reductions in CO₂ also can be achieved through the employment of vegetative green roofs, which decrease the amount of energy used by buildings for cooling (Susca et al, 2011).

2.3 Economics

Beyond environmental benefits such as pollution remediation, economic benefits also may be produced as a function of urban forests and green infrastructure. Due to the limited number of “marketable” goods and services currently provided by green infrastructure, however, these economic benefits come more in the form of indirect societal value, rather than from direct pricing (Tyrväinen et al, 2005).

Much of the indirect economic value of urban forests relates to property values. According to the U.S. Forest Service, urban forests have the potential to increase property values by as much as 10 to 20 percent, and attract buyers to properties that are for sale, thereby increasing property tax revenues (U.S. Forest Service, 2008). Similar positive impacts from urban forests on property values have been observed for decades and a recent study in Portland, Oregon, found that street trees can increase property value for a house, even when not directly on the property. In the neighborhoods surveyed, street trees within 100 feet of a house, on average, added \$8,870 to the price of a house (Donovan and Butry, 2010). Not only do trees increase property value, but studies have shown that – given the right conditions of neighborhood and property – trees near a house may also reduce the amount of time a property is on the market. Furthermore, street trees may provide economic benefits to owners of rental properties. For example, one study observed that trees on residential properties increased monthly rental rates \$5.22, on average, and an additional street tree increased the rental rate by \$21 (Donovan and Butry, 2011).

Other economic benefits derive from the environmental effects of urban forests and green infrastructure. Vegetation in urban areas has the potential to help alleviate such pollutive substances and chemicals as particulate matter, ozone, carbon monoxide, sulfur dioxide, and nitrogen dioxide. Vegetation also helps reduce ambient air temperature. Trees and shrubs can remove, on average, thousands of tons of pollution per year, valuing into the billions of dollars. In Los Angeles, California, urban trees remove about 1,976 tons of pollution per year, a value of about \$14.2 million, based on 2007 values. Furthermore, about 4,500 tons of pollution per year are removed by the combination of trees and other vegetation in Los Angeles, with an associated value of about \$32.4 million (Nowak et al, 2011). New York City’s urban forest removes about 2,202 tons of pollution each year, a societal benefit equivalent to \$10.6 million per year (Nowak et al, 2007a).

Urban green infrastructure can increase building energy efficiency by providing shade and evaporative cooling during summer months, as well as a buffer from cold winds in winter months. The interaction between trees and buildings has helped save approximately \$10.2 million in Los Angeles based on 2007 and 2010 energy cost estimates (Nowak et al, 2011), and \$11.2 million in New York City, based on 2002 energy cost estimates (Nowak et al, 2007a). By reducing energy consumptive use, pollution from power generation also is decreased (Nowak et al, 2011).

Urban forests provide additional value in protecting against climate change as trees remove CO₂ from the atmosphere. In Los Angeles, trees remove 77,000 tons of carbon per year, equivalent to \$1.6 million in monetary value. For carbon storage, Los Angeles trees have stored an estimated 1.3 million tons of

carbon in their wood, an estimated monetary value of \$26.3 million (Nowak et al, 2011). Table 1 shows the monetary value of pollution removal in different cities throughout the U.S. and Canada.

TABLE 1: Comparison of Urban Forests: City Totals, Trees Only

City	% Tree cover	Number of trees	Carbon storage (tons)	Carbon sequestration (tons/yr)	Pollution removal (tons/yr) ¹	Pollution removal value U.S. \$ ²
Calgary, Alberta ^a	7.2	11,889,000	445,000	21,400	326	2,357,000
Toronto, Ontario ^{a*}	19.9	10,220,000	1,221,000	51,500	1,283	10,474,000
Atlanta, GA ^b	36.7	9,415,000	1,344,000	46,400	1,663	12,213,000
Sacramento area, CA ^{c*}	17.0	6,889,000	1,487,000	71,700	2,914	21,730,000
Los Angeles, CA ^d	11.1	5,993,000	1,269,000	77,000	1,976	14,173,000
New York, NY ^b	20.9	5,212,000	1,350,000	42,300	1,677	11,834,000
Chicago, IL ^c	17.2	3,585,000	716,000	25,200	888	6,398,000
Baltimore, MD ^f	21.0	2,627,000	597,000	16,200	430	3,123,000
Philadelphia, PA ^b	15.7	2,113,000	530,000	16,100	576	4,150,000
Washington, DC ^g	28.6	1,928,000	526,000	16,200	418	2,858,000
Oakville, Ontario ^h	29.1	1,908,000	147,000	6,600	190	1,421,000
Scranton, PA ⁱ	22.0	1,198,000	93,000	4,000	72	514,000
Boston, MA ^b	22.3	1,183,000	319,000	10,500	284	2,092,000
Woodbridge, NJ ^j	29.5	986,000	160,000	5,600	210	1,525,000
Minneapolis, MN ^k	26.4	979,000	250,000	8,900	306	2,242,000
Syracuse, NY ^f	23.1	876,000	173,000	5,400	109	836,000
San Francisco, CA ^a	11.9	668,000	194,000	5,100	141	1,018,000
Moorestown, NJ ^j	28.0	583,000	117,000	3,800	118	841,000
Jersey City, NJ ^j	11.5	136,000	21,000	890	41	292,000
Casper, WY ^a	8.9	123,000	37,000	1,200	37	275,000
Freehold, NJ ^j	34.4	48,000	20,000	550	22	162,000

Source: Nowak et al, 2011

Economic benefits are generated by green infrastructure even when the higher upfront costs are considered. A green roof, for instance, could cost more in construction than conventional roofs. A report by the Portland, Oregon, Ecoroof Program indicates that green roof construction costs are, on average, \$10 to \$25 per square foot more than conventional roofs. When considering lifecycle costs, however, green roof benefits far exceed the costs through stormwater peak flow reduction, energy savings, and carbon/pollution sequestration (David Evans and Associates, Inc., 2008). In this regard, a green roof with a 40-year life could yield up to \$400,000 worth of benefits (David Evans and Associates, Inc., 2008). Street trees also show greater benefits than costs. Various U.S. cities, including Fort Collins, Colorado, and Glendale, Arizona, have found that, even when they spend \$13 to \$65 per tree each year in maintenance, the net benefits for each tree range from \$31 to \$85 (Soares et al, 2011).

Other green infrastructure devices such as rain gardens, filter strips, permeable surfaces, bioretention ponds, and constructed wetlands may actually be less expensive than traditional “gray” infrastructure solutions. A report by American Rivers suggests that a 0.1 acre bioretention pond in Denver, Colorado,

costs 17 percent less than a conventional stormwater pond. Similarly, the EPA reports that the State of Washington reduced construction costs by 15 to 80 percent through low impact development stormwater design (Kauffman, 2011).

Another economic benefit is the increased revenue from businesses that directly, and indirectly, utilize green infrastructure. Studies show that consumers are more likely to stay longer, spend more money, and return to areas with more green space (Joye et al, 2010; U.S. Forest Service, 2008). Survey respondents claim better overall experiences with green infrastructure, such as trees and shrubs, and a willingness to travel longer distances and return to business districts with such environmental qualities. This behavior could lead to an increased spatial radius in which to market local businesses. Consumers in these districts also were more willing to accept higher prices on goods compared to those in “less green” business districts (Joye et al, 2010).

2.4 Green Space and Equity

While the environmental and economic benefits of ‘green space’ or ‘green infrastructure’ have certainly become more prominent over the last decade, other reasons to use green infrastructure relate to issues of human health and equity. Residents of cities and suburbs face significant health risks caused by the air and water pollution due to intensive urbanization (Yadav et al, 2011). With rapidly growing urban and suburban populations pushing ever outward, attention to the provision or expansion of natural green areas is often neglected (Syphard et al, 2011). Studies have shown a connection between green spaces (parks, grass, landscaping cutouts, etc.) and human physical and mental health (Jones et al, 2009). Green infrastructure in an urban setting (which can include, but is not limited to, parks, turf grass, community gardens, rooftop gardens, and landscaping) is often a neglected resource to combat some of the maladies that can be caused by urban living.

In general, people take pride in areas that are more aesthetically pleasing. In a study done in Chicago, apartment buildings with maintained vegetation experienced half as much crime as opposed to areas without vegetated spaces. These areas also experienced less vandalism and buildup of debris. Along with stress relief, the benefit of visual exposure to vegetation can also result in improved productivity and overall morale in a business workplace (Barton and Pineo, 2009).

Individuals who reside closer to parks tend to have healthier lifestyles, are more active, and live longer lives (Barton and Pineo, 2009). In addition to parks or large open recreation areas, smaller areas such as landscaped cutouts found in parking lots and traffic islands, and rooftop and/or community gardens also provide essential mental health benefits. Several studies have shown that individuals considered “mentally stressed” experience noticeable relief at the sight of natural scenes (Barton and Pineo, 2009). Improving the mental health of individuals can enhance the overall health of a community. Beyond reducing exposure to toxins and pollutants, social and environmental justice concerns can be addressed by allowing all citizens to have greater exposure to natural areas and green infrastructure.

CHAPTER 3: BARRIERS TO GREEN INFRASTRUCTURE

States and cities in the U.S. address water-related needs and challenges in the context of a number of policy and related drivers. This section of the report details these drivers at national to local scales, with attention to general policy trends that are emerging to support greater utilization of green infrastructure in place of so-called 'gray' or conventional options. Also identified are lingering challenges to more ambitious reliance on green infrastructure, from a number of different dimensions.

3.1 Federal Clean Water Act

The Federal Clean Water Act and two permit programs used to enforce the Act, the Combined Sewer Overflow (CSO) Control Policy and the National Pollutant Discharge Elimination System (NPDES), are primary drivers for the adoption of green infrastructure in the U.S. The NPDES regulations have mandated the formulation and utilization of a municipal separate storm sewer system (MS4) program, and the CSO Control Policy calls for the creation of Long Term Control Plans (LTCPs) to limit or manage combined sewer overflows (EPA, 2010).

Under the overarching federal regulatory structure described above, a primary role for states is to administer clean water revolving funds or similar funding structures created under the Clean Water Act and state laws. These funding structures make loans to projects to address point and nonpoint source water pollution control projects (Pollution Control Agency, 2012). States are mandated, under Section 303(d) of the Clean Water Act, to create priority rankings of impaired waters and to formulate Total Maximum Daily Loads (TMDLs) for these identified water bodies (EPA, 2012a).

Actions to comply with these federal regulations largely take place at the local government level. Local governments have traditionally relied on conventional (or "gray") infrastructure such as sewage treatment plants.

3.2 Regulatory Challenges

A major challenge facing many urban areas is the existence of combined sewage and stormwater pipes that, in the wake of precipitation events, can overflow. Such systems are particularly common in older cities, many of which are among the nation's largest cities (EPA, 2010). Decades ago, cities began attempting to address the problems associated with these combined systems by enlarging storage or treatment capacity, refurbishing the aging networks of pipes, and separating the combined sewers. Yet these practices can be prohibitively expensive for some jurisdictions, cause major disruptions to traffic and the daily life of citizens, and take decades to complete.

As part of its Clean Watersheds Needs Survey, the U.S. EPA estimated in 2004 that the capital investments needed to manage stormwater and wastewater pollution over a 20-year period would approximate \$202.5 billion (EPA, 2010). This figure is daunting, particularly when considering that states

and cities have faced uncertain, or insufficient, funding support from the federal government to help cover the costs of running and repairing public stormwater infrastructure, alongside the expenses linked to implementing LTCPs (EPA, 2010). The federal government makes just under \$2 billion available to states annually for clean water revolving funds or similar funding structures. In contrast, local governments invested \$103 billion in projects to manage stormwater and wastewater pollution (U.S. Conference of Mayors, 2012). Due to the prospect of even greater capital investments needed to meet more stringent regulatory requirements, cities have begun to push the EPA for approval to utilize green infrastructure approaches instead of more traditional (and expensive) storage tanks, tunnels, and treatment facilities (Quinlan, 2012), as a means to meet the mandates in more economically efficient ways.

3.3 Emerging Policy Trends

Green infrastructure can help communities and urban areas to address imperatives ranging from the requirements of the Clean Water Act to sound asset management of public infrastructure (EPA, 2010). In light of increasing awareness of these benefits, the EPA has worked to improve options for the utilization of such infrastructure. Since 2007, the EPA's Office of Water has issued four policy memos expressing support for the incorporation of green infrastructure into CSO remedies and NPDES permits. The EPA has been working to formulate guidance for state permit writers that allows green infrastructure to successfully comply with MS4 permit conditions.

At the state level, updated permits are beginning to more explicitly engage the connections among impervious surfaces, runoff, and water quality (EPA, 2010). With increasing numbers of states incorporating provisions for the encouragement or requirement of green infrastructure within MS4 permits (EPA, 2012a), even more cities – beyond those already bringing green infrastructure into municipal stormwater codes – should be galvanized to enact policies or programs for green infrastructure as a means to earn regulatory credit vis-à-vis NPDES permit requirements (EPA, 2010).

To generate new data and to quantify the benefits of green infrastructure options, the EPA has created a Green Infrastructure Action Strategy (EPA, 2010). The EPA's Office of Enforcement and Compliance Assurance (OECA) also has been working to develop guidance for the utilization of green infrastructure in LTCPs. Such efforts will help to clarify the value and effectiveness of green infrastructure and may allow for its more specific inclusion into LTCPs, enforcement orders, and permits. Some cities, such as Philadelphia (spotlighted in Chapter 5 of this report as part of the Pennsylvania case study), are engaging innovative efforts to meet CSO Control Policy compliance mandates by revising LTCPs to incorporate green infrastructure approaches (EPA, 2010). Philadelphia's plan to employ trees and grass to absorb polluted stormwater at a cost of \$1.6 billion, a relative bargain compared to many "gray" business-as-usual approaches – represents a premier large-scale effort in the U.S. to evaluate if more moderately priced green infrastructure can effectively replace expansion of conventional infrastructure to address water pollution in cities. Under Philadelphia's agreement with the EPA, the Agency will aid the city's effort by pulling together technical expertise and assisting in a national design competition (Quinlan, 2012).

States may help to support green infrastructure through clean water revolving funds or similar funding structures created under the Clean Water Act and state laws. The funds may make loans to projects to address point and nonpoint source water pollution control projects (Pollution Control Agency, 2012). Meanwhile, cities and municipal governments are increasingly implementing policies or approaches to support green infrastructure, as a means to meet – and in some cases, exceed – Clean Water Act requirements (EPA, 2010). Fundamental to such efforts by cities is the improved integration of federal and state regulations, improved interagency cooperation, and a proactive engagement with enforcement and management issues. There also appears to be a trend for attempting to avoid “single objective spending” and instead favoring approaches that have multiple benefits beyond just runoff reduction, or only stormwater management, etc. Focusing on both public and private sectors, and targeting both watershed and neighborhood scales, emerging policy and programs include: stormwater fees and stormwater fee discounts, stormwater regulations, capital and transportation projects, demonstration and pilot projects, outreach and education (EPA, 2010), review and alteration of local or county codes and ordinances to promote comprehensive planning, low impact development, and conservation design (PCA, 2012).

3.4 Key Challenges to Advancing Green Infrastructure at State and Local Levels

Even as the particular options chosen for green infrastructure are likely to vary based on population, demographic trends, hydrologic regime, and government structure in given jurisdictions, the barriers to development of green infrastructure also may vary, depending on the local natural environment and socio-economic context. The existence of such barriers can help to explain why many states and cities have yet to robustly embrace green infrastructure choices, despite the growing evidence of their cost effectiveness and ecological value. Some of these barriers, broken down along financial, physical, legal/regulatory, technical, and institutional barriers, are outlined below.

Financial Barriers:

- Insufficient data regarding the cost and benefits of action and the perceived high cost
- Lack of upfront funding at all levels, joined with weak coordination or integration of programs and funds

Physical Barriers:

- Limited space, particularly in heavily urbanized areas
- Difficulty in integrating green infrastructure into areas or zones already filled with existing “gray” infrastructure

Legal and Regulatory Barriers:

- State and municipal rules can be lacking, conflicting, or restrictive
- State water, land-use, forestry policies, and property rights can be complicating factors

Technical Barriers:

- Lack of understanding and knowledge of what green infrastructure is and the benefits it provides

- Deficiency of data demonstrating benefits, costs, and performance
- Insufficient technical knowledge and experience in establishment and maintenance
- Lack of design standards, best management practices, codes and ordinances that facilitate the design, acceptance, and implementation of green infrastructure

Institutional Barriers:

- Lack of prioritization and insufficient political will to develop green infrastructure, as the aesthetic and ecological values of green infrastructure are often underappreciated
- Insufficient and inaccessible information about green infrastructure and its benefits for political leaders, administrators, agency staff, developers, builders, and the public

(Clean Water America Alliance, 2011)

For green infrastructure development in Delaware, policies and programmatic opportunities exist to address each of the above challenges. Such opportunities, based on an analysis of the current context related to green infrastructure within the First State and a review of best practices for green infrastructure development in New York, Maryland, Pennsylvania, Illinois and California, are outlined in Chapters 4 through 6 of this report.

CHAPTER 4: DELAWARE'S GREEN INFRASTRUCTURE

Over the last decade, parts of Delaware have experienced ongoing flooding and drainage issues, directly impacting the health and well-being of some of the state's residents and businesses. The cost of the response of governmental agencies and programs to these events has had an indirect impact on all of the state's taxpayers (Hughes, 2005). With regards to environmental impacts, some 86 percent of Delaware's 2,509 miles of rivers and streams are impaired for swimming due to high bacteria, 97 percent do not meet fish and wildlife water quality standards, and more than 100 miles of waters are under fish consumption advisories due to polychlorinated biphenyl (PCBs), metals and pesticides, according to the 2010 303(d) List⁸ (Kauffman, 2011). These adverse impacts will likely be exacerbated by population growth, which is projected to result in 1,044,015 residents by 2030. A significant portion of this growth will likely take place in Sussex and Kent Counties. To help ensure that this concentrated increase of population and associated development does not place undue strain on state water or hydrologic resources, an investment of \$43.4 million has been made, just in water and wastewater improvements, throughout Delaware from fiscal years 2002 to 2008 (Cabinet Committee on State Planning Issues, 2008).

Recent research suggests that the adoption of innovative green stormwater practices, if implemented robustly in Delaware, could benefit the First State in a number of ways. Examples include: improved water quality; reduced flood damage, pollution, and costs for water treatment; higher property values and tax revenues near waterbodies; and gains in recreation and tourism. These benefits could translate to an annual economic value of almost \$1 billion (Kauffman, 2011).

This chapter explores Delaware's efforts to respond to the above considerations over the past two decades.

4.1 Stormwater Management

4.1.1 Task Force on Surface Water Management

Issued in 2004, Governor Ruth Ann Minner's Executive Order #62 created the "Task Force on Surface Water Management." The Task Force was directed to "develop a statewide surface water management strategy to integrate drainage, flood control and stormwater management," and to recommend strategies, where advisable, to "implement green infrastructure policies and goals" (Hughes, 2005).

Approved recommendations that resulted from the Task Force include:

1. Recommendation #5A – Stormwater utilities should be established at the local or county levels as a funding mechanism for the purpose of surface water management and provide a simplified, comprehensive approach to flooding and runoff problems.

⁸ The 303(d) list is the list of threatened and impaired waters submitted by states to the EPA every two years to meet requirements of the federal Clean Water Act.

2. Recommendation #5B – A proposed stormwater utility fee should be utilized for planning, capital construction, administration, and maintenance.
3. Recommendation #9 – State stormwater and sediment regulations should be updated and revised to establish performance standards for sediment and stormwater practices.
4. Recommendation #22 – Conservation design should be used as a way to reduce reliance on conventional structural stormwater management practices.
5. Recommendation #23 – Continued stormwater management education and outreach should be promoted, specifically through creation of material related to “Green Technologies,” best management practices (BMPs), and conservation design (Hughes, 2005).

The Department of Natural Resources and Environmental Control (DNREC) also created a companion manual, *Green Technology: The Delaware Urban Runoff Management Approach*, which established standards, specifications, and details for green technology BMPs that minimize stormwater impacts. Design standards are established for filter strips, biofiltration swales, bioretention and infiltration trenches. Landscaping specifications establish standards for plant selection, ordering, planting practices, and maintenance measures (Lucas, 2004).

4.1.2 Proposed Regulations

Current Regulation: In 1990, the Delaware Erosion and Sediment Control Act (Act) was enacted into law based on the legislative findings that impervious surfaces had decreased soil infiltration capacity and contributed to soil erosion, sedimentation and pollution of state waters (7 Del. C. §4001 (a)). The Act's explicit new policy was to “provide for control and management of stormwater runoff consistent with sound water and land use practices” (7 Del. C. §4001 (b)).

The Act requires all persons engaging in land disturbing activity to submit a sediment and stormwater management plan to DNREC for approval and to obtain a permit before proceeding with any proposed development. The Act gives authority to Conservation Districts⁹, counties, or municipalities to adopt a fee system to help fund sediment and stormwater program implementation that shall not exceed \$80.00 per disturbed acre. Authority is also granted to DNREC, Conservation Districts, counties, or municipalities to establish a stormwater utility to fund long range watershed master planning, watershed retrofitting, and facility maintenance. DNREC is further given authority to develop and publish regulations, minimum standards, guidelines, criteria for delegation to other entities, and model stormwater ordinances (7 Del. C. §4001 (a)).

Proposed Regulations: In response to the Task Force on Surface Water Management's 2005 report, the State of Delaware and DNREC¹⁰ have been working on revisions to the state's sediment and stormwater

⁹ The primary purpose Conservation Districts, a subdivision of the state government, is to implement water and soil conservation programs and work with landowners (primarily in agriculture) to protect water and soil resources (7 Del. C. §39Chapter 39).

¹⁰ The Regulatory Advisory Committee was formed to help guide revisions and includes representatives from: the Delaware Association of Surveyors; Clean Water Council; Delaware Contractors Association; Water Resources Agency; DelDOT; Delaware Nature Society; New Castle County; Office of State Planning Coordination; ACEC; Dept. of Education; Kent County; League of Local Governments; State of Delaware Department of Justice; Homebuilders Association of Delaware; Sussex

management regulations. Draft regulations are currently in development; the current version was presented for public comment¹¹ with final regulations anticipated to be published in the summer of 2012. The regulations are expected to be finalized and adopted by the end of 2012 (Kauffman, 2012).

The proposed regulations recognize the need for proper land management to reduce the challenge that sedimentation and stormwater pose to Delaware's water quality. The original regulations state that "stormwater runoff *may* reasonably be expected to be a source of pollution to waters of the State, and *may* add to existing flooding problems (1.1)" (DSG, 2012a). The proposed regulations' General Provisions state that the delivery of nonpoint pollution such as nutrients, erosion, and sedimentation is caused by accelerated stormwater runoff – a condition intensified when infiltration and stable ground cover are replaced by impervious surfaces such as parking lots and roads (DNREC, 2012b: Section 1). Accelerated stormwater velocity contributes to erosion and consequential sedimentation and nonpoint source pollution as seen in waterways, ultimately threatening fish and wildlife as well as agricultural, domestic, industrial, and recreational uses of the state's waters. As such, the purpose of the proposed regulations is to extend and improve upon current erosion and sediment controls on urban and rural lands, and to utilize "sound water and land use practices (1.2)" for the management of stormwater (DNREC, 2012b: Section 1).

If the proposed regulations are promulgated, no land can be disturbed without an approved Sediment and Stormwater Management Plan – which must be approved prior to commencement of construction (not counting general earth moving). Elements of the Plan include stormwater management plans for both construction and post-construction, an Operation and Maintenance Plan, as well as hydrologic and hydraulic computations. Approved plans would be valid for three years, but can be extended by the delegated agency (DNREC, 2012b: Section 3). Certain activities are exempt from these requirements, such as construction that disturbs less than 5,000 square feet and agricultural practices that already have a soil and water conservation plan – unless such plans need to be updated and revised. Projects commenced prior to the promulgation of these regulations are also exempt. The proposed regulations authorize fees, no greater than \$80.00 per disturbed acre, for projects seeking approval of their Sediment and Stormwater Management Plan (DNREC, 2012b: Section 1).

Under the proposed regulations, stormwater management begins during construction and continues post-construction. During construction, BMPs used must conform to those specified in the Delaware Erosion and Sediment Control Handbook. Turbid discharges must be controlled with best-available technologies. Land disturbances must be limited and followed with permanent or temporary stabilization of the soil, in accordance with the Delaware Erosion and Sediment Control Handbook (DNREC, 2012b: Section 4). Post-construction stormwater management must strive to replicate natural watershed hydrologic processes. Management methods to achieve this include: the preservation, conservation and enhancement of natural flow paths, vegetative cover, natural open spaces and riparian areas;

County; Board of Registered Landscape Architects; DNREC Division of Water Resources; DNREC Office of the Secretary; and the Delaware Association of Conservation Districts (DNREC, 2009).

¹¹ The public comment period ended April 2, 2012.

disconnection of impervious surfaces; treatment of runoff at the source; and any other measures that help replicate natural hydrologic processes (DNREC, 2012b: Section 5).

Current regulations establish design criteria through a preferred hierarchy with “green technology BMPs” considered first and other practices and detention considered second, based on engineering and hardship approvals (DSG, 2012a). The proposed regulations change this design criteria by requiring: (a) runoff reduction to minimize downstream impacts, reduce pollutant load, and increase groundwater recharge; (b) runoff, from disturbed areas that were previously forests or meadows in the pre-development condition, is to be reduced to a rate equivalent to that associated with the previous condition; and (c) all remaining disturbed areas shall employ runoff reduction practices to achieve an effective imperviousness that is equivalent to 0 percent (DNREC, 2012b: Section 5). Management systems will also have to be properly maintained by owners for as long as they own the property, as specified in the approved Plan Operation and Management Proposal (DNREC, 2012b: Section 7).

The proposed regulations further establish revised criteria for the implementation and financing of a stormwater utility. Implementation of a stormwater utility requires development of a local utility ordinance. Financing must be reasonable and equitable and charge all users, including state agencies, for their share of runoff. Program components that can be funded through the utility include, but are not limited to, program administration, planning and engineering, maintenance, regulation, enforcement, and capital construction (DNREC, 2012b: Section 10).

4.1.3 Programs

Stormwater Utilities – Stormwater Funding: Stormwater utilities are established as an administrative organization “created for the purposes of funding sediment control, stormwater management or flood control planning, design, construction, maintenance, and overall resource needs by authorized and imposed changes” (7 Del. C. §40). Currently, Lewes and Wilmington are the only municipalities in Delaware with established stormwater utility fees (Kauffman, 2012). The Lewes Board of Public Works’ Electric, Water and Sewer Utility charges a \$5 monthly flat fee on all customers for maintenance and operational costs associated with the stormwater system (Lewes BPW, 2011). No credit system is in place for customers able to reduce stormwater volumes (Kauffman, 2012). Wilmington charges a quarterly stormwater fee, using a tiered system based on impervious area and land use. The quarterly fee ranges from \$11.69 to \$46.78 for residential customers, based on an average impervious surface cover for residential units (City of Wilmington, 2012). Non-residential customers pay a charge based on the same residential rate, but charges are based on actual gross area and impervious cover estimates (City of Wilmington, 2012). Annual stormwater credits are granted for properties that control the quantity of stormwater entering the combined sewer system, separate stormwater system, or surface water systems (City of Wilmington, 2008). Credits also are available for properties that implement BMPs which control pollutants and enhance water quality (City of Wilmington, 2008). This credit system provides incentives to property owners to invest in BMPs to control the quantity and quality of stormwater runoff.

A stormwater utility has distinct advantages over tax revenue as a dedicated funding source for the operation of stormwater programs. Contributions to stormwater funding are equitably allocated on the basis of impervious surfaces. Additionally, with a stormwater utility, *all* stormwater contributors are charged for their respective runoff. Under current stormwater funding in most of Delaware (with the exception of utilities in Wilmington and Lewes), tax-exempt entities do not contribute revenues required for stormwater management. Furthermore, a stormwater utility provides a dedicated and sustainable revenue stream. Finally, a stormwater utility fee is relatively easy to implement by using billing systems already in place for water, sewer, property assessments, etc.

Delaware Water Pollution Control Revolving Fund: Created in 1990 and administered by DNREC, the Delaware Water Pollution Control Revolving Fund (DWPCRF) utilizes capitalization grants provided by the EPA's Clean Water State Revolving Fund Program. These grants are combined with a 20 percent state match to create a state revolving loan program for wastewater capital projects and nonpoint source pollution control projects. Coordination and recommendation of projects receiving loans from the Fund are made by the Clean Water Advisory Council. The Council's duty is to evaluate, establish, and adopt a long term (no less than six years) plan for funding wastewater capital projects (see 29 Del. C. §8003 (11) and (12)). The Council authorizing law was amended in 2005 to expand the Council's role to include stormwater management.

TABLE 2: Project Priority List Ranking
Criteria Adapted from DNREC, 2011

The criteria used by the Council to prioritize projects is outlined in Table 2. Based on these criteria, projects with the highest score are expected to deliver the highest environmental benefit. The criteria were developed and established by DNREC and the Council in 2010.

Category	Points	Bonus Points
I. Water Quality Protection	45	10
II. Targeted Waterbodies	20	--
III. Clean Water Priorities	20	10
IV. State Strategies	10	--
V. Green Project Reserve	10	--
VI. Sustainability	15	--
VII. Land Conservation	0	10
Total	120	30

Clean Water Advisory Council - Grant Programs: Surface Water Matching Planning Grant (SWMPG): In 2011, the Council announced the availability of Surface Water Matching Planning Grants (SWMPG) to support planning and engineering/feasibility analysis of surface water improvement projects and activities, with a focus on improving water quality in impaired watersheds of the developed landscape (DNREC, 2011a). Funding comes from the DWPCRF non-federal administrative account. Grants are limited to \$50,000 annually and require a 50/50 cash match. Preference is given to projects that plan to acquire implementation funding through the DWPCRF.¹² Eligible projects include planning for stormwater retrofits, water quality improvement, stream and wetland restoration, and green infrastructure practices (DNREC, 2011a). Eligible applicants are restricted to Delaware state agencies and programs, subdivisions of the state government, counties, and municipalities.

¹² The reason for this criteria is to help ensure communities have the ability to pay back DWPCRF loans, through securing grants to fund as much of the project planning and construction as possible.

Community Water Quality Improvement Grant (CWQIG) Program: The CWQIG program is also funded by the DWPCRF non-federal administrative account. This program assists municipal governments, agencies and programs, nonprofits, educational institutions, community organizations, and homeowner associations with implementing programs or projects to improve water quality within impaired watersheds (DNREC, 2011b). Eligible projects are selected by the Council. The CWQIG awarded \$418,721 and \$500,000 in 2010 and 2011, respectively (Webb, 2012). Programs and projects are selected based on demonstration of innovative and sustainable practices and use of techniques or methods for water quality improvement within developed and impaired watersheds. Preference is given to projects that plan to acquire implementation funding through the DWPCRF. Individual grants range from \$25,000 to \$50,000 (DNREC, 2011b).

4.2 Land Use and Development Planning

4.2.1 Background

As noted, Delaware's population is expected to continue to grow dramatically over the next fifteen years. In the past, population growth in Delaware has been accommodated by urban expansion into unincorporated areas outside existing municipalities (Weber, 2007; Delaware Forest Association, 2012). Such growth highlights the need for sound land use planning and management (Zinn, 2003), and updating land use planning practices has been a high priority for the State and some local governments over the past two decades. Enacted in 1995, the Shaping Delaware's Future Act began a process to update comprehensive planning laws for local communities. Governor Minner's 2001 "Livable Delaware Initiative" included legislation that provided funding and planning resources for municipalities to develop comprehensive growth plans (C2ES, 2011). However, action at the State level has a limited impact since county and municipal governments in Delaware have the primary authority to manage land-use, zoning, and the development and implementation of comprehensive local development plans. The State's primary impact on local land use is through supporting infrastructure such as roads, schools, emergency services, and social services that are planned and funded by the State (OSPC, 2010). The challenge for land use planning and development is to balance local (municipal and county) authority with state government development and funding priorities.

4.2.2 Regulations

The Delaware Planning Act (DPA): The Delaware Planning Act (29 Del. C. §§9101 to 9903) requires a comprehensive review and certification process for local development plans as a means to attain compatibility and consistency among the interests of state, county and municipal governments. As required by the DPA, the Office of State Planning Coordination (OSPC) needs to hold a pre-application meeting to review proposed plans. Within twenty business days following the date of the meeting, the OSPC shall prepare a report which:

- Documents the degree to which the county or municipal comprehensive plan or amendments or revisions has incorporated the State's goals, policies and strategies;
- Includes a detailed list of findings, recommendations, and objectives;

- Identifies improvements, revisions, or other actions desired to address and resolve inconsistencies; and
- Sets forth a timeline and process for negotiations with the county or municipality for achieving consistency (DSG, 2012b; 2012c)

For municipal comprehensive plans, the OSPC shall submit this report to the Governor or designee for certification. The Governor may designate the State Planning Coordinator as the designee who may prescribe any policies and procedures deemed necessary to allow municipal plans to be certified by the OSPC provided that the plan, amendment, update, or revision thereto is found to be consistent with state goals, policies, and strategies and not in conflict with plans of other jurisdictions. If there is a finding that such a plan, amendment, revision, or update is inconsistent or if there is a dispute, the report and the plan are to be forwarded to the Cabinet Committee for State Planning Issues (CCSPI)¹³ and shall follow the same process as for the certification of county plans. For a county or municipality's comprehensive plan, the OSPC shall submit it to the CCSP and within 45 days of receipt, the CCSPI shall issue its findings and recommendations and submit the proposed plan to the Governor or designee¹⁴ for certification or return the plan to the municipality or county for revision. The municipality or county has the right to accept or reject any or all of the recommendations (DSG, 2012d). If the proposed local comprehensive plan or revision or amendment is objected to by the OSPC, the OSPC shall immediately enter into negotiation with the county or municipality in an attempt to solicit agreement and resolution. If the OSPC and the county or municipality fail to reach agreement after 45 days, the OSPC shall report the extent of negotiation to the CCSPI for dispute resolution (DSG, 2012d).

The CCSPI, comprised of Secretaries from the major state agencies whose portfolios impact on land use, and the OSPC, were both established by the DPA to guide, assist, and coordinate planning activities at state, county, and local levels (DSG, 2012d). The CCSPI serves in an advisory capacity to the Governor and provides a statewide land use strategy including recommendations concerning major public and private works and facilities. The OSPC also functions in an advisory capacity and serves as the secretary to the CCSPI (OSPC, 2012b; DSG, 2012d).

Preliminary Land Use Service (PLUS): Established in 2003 as a replacement for the Land Use Planning Act Process approved in 1996, the PLUS process requires major land use changes to be reviewed by the CCSPI prior to submission to local governments (OSPC, 2012a, 2010; 29 Del. C. §92). The PLUS Process has a three-fold purpose:

- Identify and mitigate potential development impacts which may affect areas beyond local boundaries;
- Fully integrate state and local land use plans; and

¹³ The CCSPI serves in an advisory capacity to the Governor and is comprised of: the Secretaries of DNREC, Transportation, Agriculture, Finance, Education, Safety and Homeland Security, Health and Social Services, and the Directors of the Delaware Economic Development Office, the Office of Management and Budget, the Delaware State Housing Authority, and the State Planning Coordinator (OSPC, 2012).

¹⁴ The State Planning Coordinator may not be the designee for the review and certification of county plans.

- Bring state agency staff together with developers and local officials early in the process (OSPC, 2012a).

PLUS review meetings are held monthly, the results of which are shared with applicants as well as local planning authorities, who must make their final approval decision known to the OSPC (DSG, 2012c). Local jurisdictions retain their final decision-making authority over proposed local land use planning actions.

Strategy for State Policies and Spending: A report entitled *Strategies for State Policies and Spending*, first issued in 1995 and subsequently updated in 2004 and 2010, guides state investment decisions to promote efficient development patterns, protect agriculture and open space, discourage sprawl, and communicate with local governments on land-use matters (OSPC, 2010). The CCSPI defined two fundamental policies to guide these strategies: (1) State spending should promote sustainable quality, efficiency, and compact growth; and (2) State policies should foster coordination and resource protection, not degradation (OSPC, 2010).

The Report establishes a framework for allocating state resources and identifying the focus of various program efforts. Under the framework, land is classified into Investment Levels 1, 2, 3, 4, and 'out-of-play' areas based on the different types of funding priorities identified for each area. Figure 3 below shows the state's strategies for policies and spending according to the various levels and out-of-play areas. The Strategy Levels encourage a compact city planning model which aims to concentrate development in existing urbanized areas and prevent urbanization from encroaching into surrounding lands. The development priority lowers as Investment Levels change from 1 to 4, whereas the conservation priority level becomes greater. The Strategy Levels have a dual effect on green infrastructure development. On the one hand, natural resources are effectively conserved in low-priority development areas; on the other hand, the intensified development imposes a significant challenge to the development of green infrastructure in high-priority developed areas.

Development of State Impact Fees: State impact fees are based on an equitable approach to planning and financing the public services required by new growth and development, and aim to:

- Ensure the provision of adequate public facilities;
- Promote orderly growth and development via uniform standards which require that new growth and development pay a proportionate share of the cost of new municipal services and facilities; and
- Establish standards for determination of impact fees for state facilities and services (DSG, 2012b; 29 Del. C. §§9121 to 9125).

The determination of impact fees considers recommended fee levels for development in environmentally sensitive areas, secondary development areas, and rural areas as identified by the *Strategies for State Policies and Spending*, adopted by the CCSPI in 1999.

Impact fees are not assessed for developments in communities or developing areas (DSG, 2012b). Impact fees are to be imposed for development with respect to state public facilities:

- Roads, streets and bridges, including rights of way, traffic signals, landscaping and any local components of state or federal highways;
- Transit facilities;
- State-provided police and emergency services; and
- Schools (DSG, 2012b)

Local Comprehensive Plans (Municipal and County): Delaware law mandates that all counties and municipalities have a comprehensive plan in place (22 Del. C. §§701 to 711). A planning commission prepares a comprehensive development plan which encourages the most appropriate use of the municipal physical and fiscal resources. The comprehensive planning process requires coordination with other municipalities, the county, and the State during plan preparation (DSG, 2012e).

The municipal comprehensive plan is a municipal development strategy which identifies a jurisdiction's position on population and housing growth, expansion of its boundaries, development of adjacent areas, redevelopment potential, general approaches to land use as well as the underlying policies, statements, and goals (DSG, 2012e). The plan stands as the basis for the development of zoning regulations.

The municipalities must provide, to the Governor's Advisory Council on Planning Coordination, annual written reports regarding the status of their comprehensive plans and implementation. Municipalities are also required to review the continued relevance of their adopted comprehensive plans every five years. Every ten years, approved comprehensive plans are required to be revised, updated and amended as necessary, and readopted. Amendments or revisions are submitted to the OSPC for review, and subsequently made available for public comment (DSG, 2012e).

The county comprehensive plan is constructed for the purpose of promoting general welfare, health and safety, as well as securing coordinated plans for public facilities. The plan mainly covers that portion in the county which is not included within the corporate limits of any city or town, unless territory within such corporate limits is included upon request made by the governing body of authority of any such city or town (DSG, 2012j). A county comprehensive plan shall be forwarded to the State and all municipalities within the county for review (DSG, 2012k). The county comprehensive plan is required to be updated every five years (Sussex County Government, 2012).

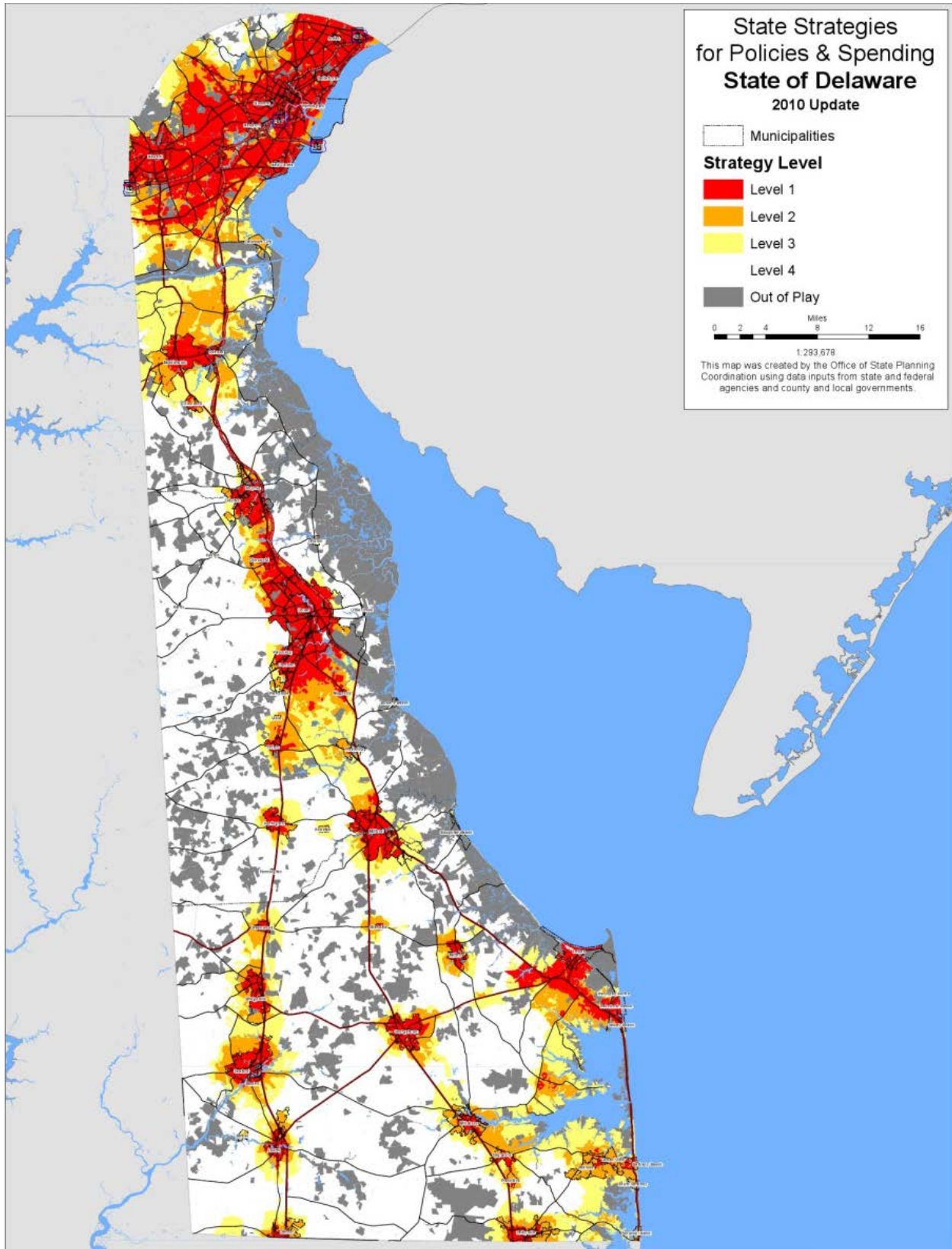


FIGURE 3: State Strategies for Policies and Spending
(Source: OSPC, 2010)

4.3 Urban and Community Forestry

4.3.1 Background

Trends for forests in Delaware have seen a continued reduction in quantity and quality. Urban or developed lands in Delaware increased from 14 percent in 1990 to 17.8 percent in 2007. As much as 6 percent of the state's unprotected forests (16,000 acres) became part of housing developments during the period 2002 to 2009. Large forest blocks are decreasing, with a current average landholding of 10 acres, compared to 30 acres only three decades ago (DFS, 2010c). Less than 30 percent of the land in Delaware is under secondary forest cover and the majority of this forest is privately-owned, heavily fragmented, and managed predominantly for production forestry (Weber, 2007; Delaware Forestry Association, 2012).

Trees and forests perform a range of ecosystem services. Delaware's estimated seven million trees on urban or community land annually remove 44,000 metric tons of carbon and 1,431 metric tons of air pollution. Yet without proper management, the urban forest canopy is expected to decrease by 50 percent over the next 30 years (Nowak et al, 2007b, 2009).

A 2007 assessment of Delaware's urban and community forests provided an important baseline for identifying changes in this resource and further offered recommendations for the allocation of technical and financial resources to develop standards, practices, and guidelines to prevent further loss of urban forest. Recommendations included the need for more field data and long-term monitoring of urban forest management activities (Nowak et al, 2007b). In 2010, the Delaware Forest Service (DFS) completed the *Delaware Forest Resource Assessment* and *Delaware Statewide Forest Strategy*, revealing that statewide forest coverage has become increasingly fragmented due to continued urban and suburban development¹⁵, with other negative impacts by invasive flora and fauna. A summary of the assessment and proposed strategy is found in Appendix A.1 of this report. The DFS's 2011 Annual Report reinforced these findings, identifying three major threats to maintaining healthy forest resources: poor management; invasive plants and pests, and fragmentation. Another deficiency is limited public knowledge about the importance of forest resources and the programmatic support available from the state forest services agency (DFS, 2011).

4.3.2 Regulations

Urban and Community Forestry Program: Delaware law (3 Del. C. §§1031 to 1038) establishes an Urban and Community Forestry (UCF) Program within the Department of Agriculture, under direction of the State Forester, and advised by a 13-member multi-stakeholder Delaware Community Forestry Council (DSG, 2012f). Objectives of the UCF program include:

- Assist municipalities in establishing urban and community forestry programs as well as public support for proper urban tree care;

¹⁵ Between 2002 and 2007, some 14,000 (out of 380,000) acres of forestland were approved for development. Remaining lands are increasingly subdivided into smaller parcels, which makes forest land management increasingly difficult (DFS Strategic Plan).

- Advise municipalities in developing and coordinating urban and community policies, programs, and activities;
- Provide grants (as funds are available) to support tree planting and maintenance as well as development and implementation of community forestry plans for public lands;
- Conduct public awareness campaigns on the importance of trees and forests;
- Provide technical assistance, planning and analysis for urban and community forestry-related projects;
- Assist with municipal level training on urban and community forestry issues such as tree disease, insect control, tree planting and maintenance; and
- Provide volunteer opportunities for Delaware residents and public organizations to participate in urban and community forestry activities (DSG, 2012f)

The DFS also has become involved in the land development review process, providing developers with technical recommendations on protection of forest resources within their proposed projects. In 2011, the UCF Program contributed to the Preliminary Land Use Service (PLUS) land development review process (DFS, 2011).

The DFS is funded by federally-awarded State and Private Forestry (S&PF) funds¹⁶, other federal funds, state funds, and support from partner stakeholders. In addition to providing technical forestry assistance to rural and urban forest stakeholders, DFS administers a range of grant programs. These include Community Forestry Grants, Rural Volunteer Fire Company Grants, Wildland Fire Management Grants, support for the Delaware State Fire School, and education grants to support outdoor learning and the development of associated forestry curricula (DFS, 2010c). Additional S&PF funds (\$100,000) are allocated to forest inventory studies, economic analysis of forest resources, promotion of forestry BMPs for improving water quality in the Chesapeake Bay watershed, and targeted efforts to address issues of forest health and invasive species.

Forestry Practices Erosion and Sedimentation (E&S) and Seed Tree Laws: The E&S Law requires that all silviculture practices over one acre in size apply BMPs (such as forested buffers along waterways) to minimize erosion and sedimentation. The Seed Tree Law states that silviculture practices on lands comprising more than 10 acres and containing a minimum 25 percent of native, economically important Delaware tree species (loblolly pine, shortleaf pine, pond pine, or yellow-poplar) reforest using these species to achieve a minimum of 400 healthy distributed trees per acre (DFS, 2011). DFS monitors these laws by requiring all silviculture activities (defined by the regulations as any “forest management” activity) on parcels of more than one acre to obtain a permit which describes the best practices the landowner proposes to use to comply with these two forest management regulations. The DFS monitors all forest management activities to ensure compliance with the E&S Law (DFS, 2011).

¹⁶ Approximately \$600,000 annually (DFS, 2010c).

4.3.3 Policy

The State's Forest Stewardship Committee led the 2010 effort to address landscapes and recommend corresponding forest protection programs as part of the Forest Resource Strategy Report. Rural (located mainly within Delaware watersheds) and urban priorities were identified. Twenty-three (40 percent) of Delaware's 57 communities were identified as high priority areas for urban forest conservation¹⁷ using a weighted index that assessed four criteria: current levels of urban tree canopy (25 percent), percentage of impervious surface (25 percent), risk of fire in the wildland-urban interface (15 percent), and population density (35 percent) (DFS, 2010a, 2010c). Of the high priority communities, only five (Wilmington, Dover, Rehoboth Beach, Newark, and Delaware City) have a DFS-recognized urban forest management program¹⁸ in place. Only one locale currently has a Community Wildfire Protection Plan (CWPP) (DFS, 2010d).

The Strategy Report also identified multi-state priority areas – the Chesapeake Bay Watershed, I-95 Corridor, Delmarva Peninsula, and Delaware River Watershed (DFS, 2010c). A five-year timeframe (2009 to 2013) was identified for implementing 19 strategies and 78 goals to address issues pertaining to the following: forest health; markets for forest products; sustainable forest management; and public awareness of forest benefits (DFS, 2010b). The Natural Heritage and Endangered Species Program and Wildlife Action Plan of DNREC provide the basis for mapping the state's natural resources and are intended to guide land use planning. Given that front end conservation and planning are considered more cost effective approaches to natural resource management than restoration, resource inventory and mapping are considered important initial steps in the management process (DNREC, 2012a).

Current forest policy continues to be guided in part by Governor Minner's Executive Order #61 (2004), which established a priority for recognizing and conserving the state's green infrastructure, whether rural or urban. Executive Order #61 identifies Delaware's green infrastructure "as Delaware's natural life support system of parks and preserves, woodlands and wildlife areas, wetlands and waterways, productive agricultural and forest land, greenways, cultural, historic and recreational sites, and other natural areas all with conservation value" (DNREC, 2007). An Advisory Council on Planning Coordination was established to identify guiding principles, conservation acreage targets, and priority conservation areas. Executive Order #61 directed DNREC to: develop an inventory of all State-owned green infrastructure; coordinate with the Department of Agriculture to develop a statewide green infrastructure conservation and management strategy and green infrastructure public education and outreach program; provide assistance to local governments in conserving green infrastructure; and improve coordination among State agencies and other conservation partners in collecting and managing green infrastructure information (DNREC, 2007).

¹⁷ Seventeen communities were labeled high priority for urban tree canopy and six communities were high priority for wildland/urban interface (DFS, 2010c).

¹⁸ The DFS (2010d) identifies an urban and community forest management program as having professional urban forestry staffing, an urban forest ordinance, an advisory committee, and an approved forest management plan. An approved Urban Forest Management Plan consists of a resource inventory supported by a set of management prescriptions for maintaining its long term health (Personal Communication with Henry Poole, DFS, 3/26).

The Green Infrastructure Conservation Committee (GICC), with representation from every DNREC division, the Delaware Department of Agriculture, the Delaware Department of Transportation, the Delaware Solid Waste Authority (DSWA) and the Delaware Economic Development Office, was formed in response to the Order and developed the following goals for 2024:

- Preserve 50 percent of the state's remaining unpreserved commercially viable forest land;
- Preserve 50 percent of the state's remaining unpreserved cropland; and
- Preserve 100 percent of the remaining natural resource and recreational priorities (DNREC, 2012c)

A Green Infrastructure Conservation Coordinator, with appropriate staffing to oversee this effort, was also proposed. According to DNREC officials, the initiative's momentum waned after green infrastructure resources were inventoried and mapped and limited funds remained appropriated for the continuation of a coordinated management effort (Love, 2012).

4.3.4 Programs

Numerous programs exist to provide technical assistance to landowners for long-term sustainable management of privately held forest resources (Private Land Management, Forest Stewardship, Forestland Preservation, Forest Legacy and Cost Share Programs, Forest Management Database); however, these programs predominantly target commercially viable rural forest resources (DFS, 2011). A brief description of the various programs which support these forest resources can be found in Appendix A.2. Other relevant forest programs are described below.

Urban and Community Forestry (UCF) Program: The UCF Program was established in response to the Federal Cooperative Forest Assistance Act of 1978, which authorized the U.S. Department of Agriculture to manage non-federal forested lands. Under the Act, states are eligible to receive federal funds for urban forestry once an urban forest council – to oversee development of a statewide urban forest management plan – has been established.

The DFS oversees the UCF which provides technical assistance for the development of municipal tree ordinances, urban tree inventories, and urban forest management plans. The DFS grant program supports tree inventory, planting, and management initiatives by cities, towns, communities, developers and local governments. The program, funded through a grant from the U.S. Forest Service and state funds appropriated to the Department of Agriculture Forest Service budget¹⁹, offers as much as \$100,000 annually to support urban forest management activities on public lands. Individual grants are up to \$5,000 and must be matched (50/50) with non-federal funds, or in-kind contributions (DFS, 2012a; 2012b). The DFS has awarded over \$1.5 million to more than 200 organizations over the life of the program (DFS, 2011). In 2011, the oversubscribed program awarded 28 Delaware communities a total of \$82,525 in UCF

¹⁹ Urban and Community Forestry drew \$200,000 (out of a total \$2,008,103) of the overall Delaware Forestry Budget in 2011 (DFS, 2011).

tree planting or management grants; the bulk of the recipients were in New Castle County²⁰ (DFS, 2011). The DFS provides public outreach and education regarding UCF programs and initiatives through its website, newsletters and workshops. The Delaware Center for Horticulture provides program assistance by helping prospective grant applicants with their proposals (DCH, 2009).

Tree Management Grants are designed to: promote the proper care of urban trees; diversify, enhance and promote urban forest stewardship; and encourage sustainable urban and community forestry programs throughout the state. Grant funds can be used to conduct tree inventories for streets, parks, and other public open spaces, to develop professional community forestry plans, or to conduct tree maintenance activities such as pruning, hazard removal, stump, and debris removal. Grants are one-time awards for activity on public lands (those owned by state, county or local government or civic associations) and must be matched. Projects are assessed for their ability to encourage sustainable urban forestry through planning and management, mitigation of tree hazards, promotion of community partnerships, and provision of an educational component. New applicants receive priority (DFS, 2012a).

Other Urban Forest Programs: The Delaware UCF is supplemented by a range of programs initiated and coordinated by various stakeholders. Several of the urban and community forest stakeholders who support these activities are listed in Appendix A.3. Those programs with green infrastructure implications are described below.

Spruce Up Delaware. As a pilot program administered jointly by the DFS, the Delaware Nature and Landscape Association, and the Delaware Community Forestry Council, with support from four local garden centers, Spruce Up Delaware provided \$10 discounts to homeowners on tree purchases over a brief two month period in 2008. Due to limited success (only 130 trees were purchased), the program was not continued (DFS, 2008a).

Tree City and Tree Friendly Communities. With assistance from the Arbor Day Foundation, the Delaware UCF program in 2010 identified 15 Delaware communities as Tree Cities and 7 communities as Tree Friendly, a recognition of locales with active urban forestry programs. To be certified, 'tree cities' must achieve the following: establish a board or commission to guide community decisions regarding urban forest resources; develop a community tree ordinance which requires the tree board to develop and implement an annual community forestry work plan; establish a "tree" budget of a minimum \$2 per household in residential communities; and celebrate trees through a special tree-centered Arbor Day event. Rehoboth Beach has received this distinction for the past 21 years. Tree friendly communities must implement three activities which support and encourage urban forest resources (DFS, 2011).

²⁰ The 2011 UCF grant distribution by county was: New Castle County with 17 grants totaling \$48,544; Kent County with 2 grants totaling \$5,934; and Sussex County with 9 grants totaling \$28,047.

Trees for Wilmington Coalition. The Wilmington Beautification Commission (WBC) emerged in 2004 out of an advisory group convened by the Wilmington City Council. The WBC initially responded to a desire to aesthetically improve the urban landscape and eventually incorporated additional goals to increase public levels of environmental awareness and support the city's greenhouse gas reduction goals²¹ (DCH, 2009). Developed from a WBC working group, the Trees for Wilmington (TFW) goal is to improve the city's urban forest and promote sustainable management techniques in response to local infrastructure needs. Stakeholders for TFW include residents, government agencies, municipal employees, and policymakers (DCH, 2009). The WBC established a set of working principles that emphasized the need for public participation, short and long term planning, and diverse funding. A \$75,000 grant from the Home Depot Foundation provided the means to conduct an urban forest assessment, set priorities for improving green urban infrastructure, and establish an urban forest management plan. Part of the plan involved the establishment of a new city ordinance which created the institutional infrastructure (an Urban Forest Administrator position and an Advisory Tree Committee) to oversee the management plan (DCH, 2009). Despite the fact that the return on urban infrastructure investment is \$2.58 in benefits, city investment at that time in green infrastructure was 1/400 the level for gray infrastructure. To address this disparity, TFW is committed to tracking and financially demonstrating the benefits of green infrastructure, as well as searching for additional funding sources (DCH, 2009).

Plant One Million (P1M). The Delaware Center for Horticulture leads the P1M public awareness and inventory mapping campaign for Delaware. The tri-state, 13-county initiative was designed to build a regional, multi-stakeholder, public participation approach to advancing urban forestry. An integral component of the project is to capture data on all trees planted as part of the campaign, which was launched in January 2011. Data for the mapping project is captured by the Philly Tree Map²², a web-based map database of trees within the project area.

The Delaware Ecological Network (DEN). The DEN is an attempt to establish a statewide conservation network and comprehensive inventory of Delaware's natural habitats. The project was based on a concept of green infrastructure which aims to: link natural areas through a network of connected spaces in order to protect aquifers, watersheds, and native wildlife; to provide adaptive capacity to ecosystems; and to address the challenges of climate change. Funded by The Conservation Fund, DEN used GIS data to create a map that identifies areas and priorities for action (Weber, 2007).

Ecological Restoration and Protection Initiative. Launched in 2003 and led by the DNREC Division of Soil and Water, the Ecological Restoration and Protection Initiative is a multi-agency, multi-stakeholder, predominantly federally-funded initiative that utilizes wetland habitat, stream protection, and restoration

²¹ The City of Wilmington committee pledged Kyoto Protocol goals of a 7 percent reduction below 1990 levels by 2012, and a 20 percent reduction by 2020 (DCH, 2009).

²² Philly Tree Map is a collaborative initiative of state government, nonprofits, businesses, and citizens within the state of Pennsylvania. The Project is based on code developed by the Urban Tree Map project of San Francisco, which was supported by the California Urban and Community Forest Grant Program. See <http://phillytreemap.org/>.

activities to enhance water quality, reduce erosion, and improve wildlife habitat. An assessment of the project in 2006 revealed that the 60+ implemented projects established over 480 acres of grasses, forests, wetlands, and riparian corridors and restored over 7,225 feet of streams and shoreline (DNREC, 2006). According to DNREC²³, numerous state programs, federal initiatives (USDA Natural Resources Conservation Services Environmental Quality Incentives Program, and the U.S. Fish and Wildlife Service Partners for Fish and Wildlife and Coastal Programs), and nonprofit organization (Ducks Unlimited) initiatives also contribute to wetlands management, conservation, and habitat restoration. Some of the projects funded by these organizations are administered by Delaware's three Conservation Districts (New Castle, Kent and Sussex) (DNREC, 2012d).

Proposed First State Trails and Pathways Plan. The Delaware Department of Transportation (DOT) and DNREC have been tasked by current Governor Jack Markell, via Senate Concurrent Resolution #13 in June 2011²⁴, to research the development of an interconnected trails network for non-motorized travel and recreation. The statewide network is intended to connect with new and existing local and regional trail systems. In addition to developing local cycling and eco-tourism based economies and expanding safe and affordable transportation options for residents, the project would expand the state's green infrastructure network by connecting natural habitats with native landscaped pathways and trails. The utilization of "current resource management and model sustainability practices in the construction and maintenance of projects (e.g. stormwater, native landscaping, habitat, etc.)" is required. Phase I priorities include implementing a series of trail upgrade recommendations in each county. Phase II will require developing linkages between the various trails and pathways (DSG, 2012g).

4.4 Understanding Green Infrastructure Programs and Needs

A 2005 study conducted for DNREC by Responsive Management revealed that improving water quality and controlling development were top issues for conservation professionals as well as the general public. Little was known, however, by either demographic, of the Livable Delaware Green Infrastructure Initiative, which proposed to address both issues via green development strategies. Once informed of the Initiative's existence, the groups' support for the effort was overwhelmingly positive. The study highlighted the overlap in DNREC Divisions which addressed issues related to green infrastructure, each with varying success in reaching different target market audiences (see Table 3). Greater partnerships and coordination amongst DNREC Divisions as well as with external agencies and organizations, along with assistance in marketing and promotion, were accordingly identified as important for increasing the efficacy of green infrastructure awareness. A dedicated site on the DNREC homepage for Green Infrastructure was also identified as an important tool for increasing awareness of green infrastructure benefits as well as programs and other important resources. A dedicated green infrastructure coordinator to liaise and coordinate efforts amongst divisions, agencies, and other stakeholders was also cited as important to improve stakeholder support (Responsive Management, 2005). Another recommendation for public support for green infrastructure

²³ See <http://www.dnrec.delaware.gov/Admin/DelawareWetlands/Pages/default.aspx>

²⁴ The Governor also requested an allocation of \$7 million from the FY 2012 Capital Improvements bond bill to support the initiative.

programs, as part of the study, was the inclusion of a feedback mechanism to provide timely information on the impact of program participation (Responsive Management, 2005).

TABLE 3: Topic Areas Addressed by DNREC Division Education Programs

Topic Area	Divisions that Significantly Address this Topic Area	Divisions that Moderately Address this Topic Area	Divisions that Minimally Address this Topic Area
<i>Water Quality</i>	Soil and Water Conservation Water Resources	Parks and Recreation	Air and Waste Management Fish and Wildlife
<i>Industrial Practices</i>	Air and Waste Management	Soil and Water Conservation	Parks and Recreation
<i>Land Management</i>	Fish and Wildlife Soil and Water Conservation		Air and Waste Management Parks and Recreation Water Resources
<i>Residential Development</i>	Soil and Water Conservation	Fish and Wildlife	Air and Waste Management
<i>Legislation for Green Infrastructure Conservation</i>	Fish and Wildlife	Soil and Water Conservation Water Resources	
<i>Commercial Development</i>		Soil and Water Conservation	Air and Waste Management Fish and Wildlife
<i>Waste Quality/ Disposal Practices</i>	Air and Waste Management	Soil and Water Conservation Water Resources	Parks and Recreation
<i>Open/Green Space</i>	Parks and Recreation Soil and Water Conservation	Fish and Wildlife	Air and Waste Management
<i>Wetlands</i>	Fish and Wildlife Parks and Recreation Soil and Water Conservation Water Resources	Air and Waste Management	
<i>Habitat</i>	Fish and Wildlife Soil and Water Conservation	Water Resources	
<i>Water Quantity</i>		Soil and Water Conservation	Fish and Wildlife Parks and Recreation
<i>Forests</i>	Parks and Recreation Water Resources	Air and Waste Management Fish and Wildlife	
<i>Agricultural Practices</i>	Soil and Water Conservation	Fish and Wildlife Water Resources	Air and Waste Management Parks and Recreation
<i>Ecotourism</i>		Fish and Wildlife Parks and Recreation Soil and Water Conservation	
<i>Native Wildlife Species</i>	Fish and Wildlife Soil and Water Conservation	Parks and Recreation	
<i>Public Access to parks, recreation, etc.</i>	Fish and Wildlife Soil and Water Conservation	Parks and Recreation	Air and Waste Management
<i>Invasive Species</i>	Fish and Wildlife Soil and Water Conservation	Parks and Recreation	
<i>Native Plant Species</i>	Fish and Wildlife Soil and Water Conservation	Parks and Recreation	Water Resources

Note: Topics are sorted by percentage of the public who feel the topic is extremely important.

Source: Responsive Management, 2005

CHAPTER 5: CASE STUDIES

The following case studies illustrate how various U.S. states are supporting green infrastructure approaches. The states of New York, Maryland, Pennsylvania, Illinois and California are highlighted, with special emphasis on innovative policies and programs and outcomes to date.

5.1 New York

The New York City Watershed is a complicated system of interconnected reservoirs, controlled lakes, and underground aqueducts that originates in the Catskill Mountain Region and Hudson River valley (NYCMOA, 1997) and provides drinking water to approximately 8 million New York City residents and some 1 million residents in the surrounding counties of Westchester, Putnam, Ulster, and Orange (NYSDEC, 2012a). The water provided through this system is the largest unfiltered water system in the U.S. (NYSDEC, 2012b).

To ensure that high quality, low cost drinking water remains available to residents, the New York City Watershed Protection Program was created in 1997 with the signing of the New York City Watershed Memorandum of Agreement (MOA). The MOA is a comprehensive partnership among watershed organizations – state agencies such as the New York State Department of Environmental Conservation (NYSDEC) and the Department of State; the county governments for Greene, Delaware, Schoharie, Sullivan, Ulster, Putnam and Westchester counties; federal agencies such as the EPA; and various nonprofit and educational organizations (NYSDEC, 2012b; 2012c). The partnership's efforts aim to avoid the high costs of water treatment processes, \$8 to 10 billion for the construction of a water treatment facility with \$1 million daily for operation alone (NYSDEC, 2012b), while preserving the economic vitality of communities within the watershed (New York State Environmental Facilities Corporation, 2012). Because it works to protect the water source, the EPA has allowed the partnership as long as quality indicators are met (EPA, 2012b).

The roles of the partners within the agreement vary, with some providing financial assistance, some implementing projects, and others providing a more advisory role. With the signing of the agreement, the NYSDEC created an office specifically for the management and oversight of the program – the Office of the New York City Watershed Program (NYCWP). The NYCWP provides services such as technical support and expertise for watershed protection programs as well as regulatory and non-regulatory oversight of programs specifically enumerated in the MOA dealing with stormwater management and land acquisition. The NYCWP also administers funding for projects (NYSDEC, 2012d). Financial resources administered by the NYSDEC are derived from the state and federal levels, with particular support coming from the statewide Water Quality Improvement Project Program (WQIP) and the New York City Watershed WQIP (NYSDEC, 2012e). The WQIP works as a competitive, reimbursement grant program that directs money from the New York State Environmental Protection Fund, a fund primarily financed by real estate transfer taxes (NYSDEC, 2007). In 2010, \$61.5 million was awarded to 101 projects, \$20 million of which went to projects specifically designated as green infrastructure and oriented to smart-growth principles (NYSDEC, 2010a). Applicants eligible for WQIP grant funds include soil and water conservation districts,

municipalities of different sizes (towns, cities, and villages), and in some cases, nonprofit corporations. Types of projects eligible entail those that address water quality management, municipal wastewater treatment, nonagricultural nonpoint source control and mitigation, aquatic habitat restoration, and municipal separate storm sewer systems. The WQIP projects can earn up to 85 percent reimbursement (NYSDEC, 2012f). Federal sources of funding, as administered by the NYSDEC, are the Federal Safe Drinking Water Act – for projects that would address monitoring, surveillance and research – and the Federal Water Resources Development Act, to address design and construction of water-related infrastructure (NYSDEC, 2012f; 2012g).

The NYSDEC, along with a range of public, private and volunteer organizations, is also a partner in the state's Urban and Community Forestry (U&CF) Program. The U&CF Program has worked for more than 20 years to provide technical and financial assistance to communities interested in fostering tree growth in urban settings. Technical assistance, provided by professional NYSDEC foresters, centers mostly on the proper selection, planting, and maintenance of street trees. UC&F program administration is provided by the nonprofit organization ReLeaf (Gorka, 2012; Kramarchyk, 2012). The organization began as a loose, grassroots network that became more formalized with the requirements for states to have urban forestry programs under the Federal Cooperative Forestry Act of 1978 and as grant funding for urban forestry became more readily available. As the coordinating organization, ReLeaf receives federal funding from the U.S. Forest Service and the America the Beautiful Act, under specific requirements such as a forestry resource and assessment strategic plan by the NYSDEC. ReLeaf uses this funding to support the administration and execution of its various projects, including the employment of full-time regional foresters who assist with the specific foresting needs of their areas, as each region has its own respective goals and issues to address. For instance, the region incorporating New York City focuses most of its efforts on the planting and maintenance of street trees whereas upstate regions focus more on open space foresting. With nine regions in the state, the regional coordinators meet monthly to share information, request assistance from other regions, and put on workshops for volunteers (the individuals from the communities actually doing the urban forestry). ReLeaf volunteers help educate their respective communities, assist community project implementation, and help manage project finances (Kramarchyk, 2012).

Financial assistance from the U&CF is delivered primarily in the form of cost-share grants which are administered by the NYSDEC. Source funding for the grant program comes from the state's Environmental Protection Fund. In 2011, about \$1 million was made available for Round 10 of U&CF grants with requests ranging from \$2,500 to \$62,500 depending on the population of the municipality and a 50/50 matchup from the communities, excluding other state funding (NYSDEC, 2012i). Projects eligible for funding are those that will enhance and manage community tree cover and provide educational opportunities to residents about the value and potential benefit of urban trees. Eligible projects include the formulation of tree management plans and inventories, the planting and maintenance of trees and shrubs, and the development of green infrastructure projects such as rain gardens. Green infrastructure projects should, using noninvasive tree and plants species, address stormwater management, urban heat island effects, combined sewer overflow, energy demand production, or brownfield restoration (NYSDEC, 2010b). The NYSDEC foresters assess project outcomes at the time of completion. If goals have been met, then the

project is provided grant money. Should goals not be met, then the relevant issues must be addressed, or the reimbursement becomes unavailable (Gorka, 2012). The success of this cost-share grant program is measured in the tens of thousands of trees that are planted and maintained throughout the state, among other projects.

Also of interest in the case of New York is the Environmental Protection Fund (EPF), which is primarily financed through New York State's Real Estate Transfer Tax (RETT), which in the past year generated over \$600 million. The RETT ensures a secure resource for project monies by utilizing revenues that already exist, preventing the state from incurring any debt, particularly in economically difficult years (Bicking et al, 2011; Ringewald, 2012). The RETT is collected at a rate of \$2 per every \$500, to be paid by the seller unless exempt, thereby making the buyer pay, with 1 percent of sales tax for sales of \$1 million or more to be paid by the buyer unless exempt, thereby making the seller pay (New York State Department of Taxation and Finance (NYS DTF), 2011).

In its first fiscal year, the EPF was appropriated \$31 million, a figure that continually grew to a 2009-2010 appropriation of \$212 million (Bicking et al, 2011). Governor Andrew Cuomo's current proposed budget for fiscal year 2012-2013 appropriates \$134 million, compared to the \$132.5 billion in the state's overall spending plan, a decrease in appropriations that is currently being debated (Ringewald, 2012).

TABLE 4: Categories of New York EPF
(Source: Bicking et al, 2011)

Money directed into the fund is divided into three main categories, which are open space, solid waste, and parks, recreation, and historic preservation. The uses for each category, as designated by the State Environmental Protection Law, are summarized above in Table 4. After an initial allocation, funds are made available on an as-needed basis to capital projects administered by several state agencies. These include the NYSDEC, Department of State, Department of Agriculture and Markets, the Empire State Development Corporation, and the Office of Parks, Recreation, and Historic Preservation (Bicking et al, 2011).

Account	Category
Open Space	Supports opens space land conservation; biodiversity stewardship and research; agricultural and farmland protection; non-point source abatement and control; Long Island Central Pine Barrens area planning and Long Island south shore estuary reserve planning; and operation and management of Albany Pine Bush Preserve.
Solid Waste	Supports non-hazardous municipal landfill closure; municipal waste reduction or recycling; waste prevention; developing, updating or revising local solid waste management plans; and the development of pesticide sales and use database in conjunction with Cornell University
Parks, Recreation & Historic Preservation	Supports municipal park; historic preservation; urban cultural parks; waterfront revitalization; and coastal rehabilitation.

The success of the EPF can be seen in the returns on investment. A study by the Trust for Public Land, a national conservation organization, shows that for every \$1 invested into environmental protection, there is a \$7 economic return. The EPF also has funded activities that not only help to bolster the

economy, as seen in the \$1.9 billion generated by visitor spending to the New York State Park system, but also help to support job creation as seen in the 130,000 positions provided in the state by outdoor recreation activities, an EPF supported industry (Hendrick, 2012).

5.2 Maryland

Maryland's Forest Conservation Act (FCA), enacted in 1991, stands as the first law in the U.S. to control documented forest loss due to land use changes (Burke and Dunn, 2010). If forest loss is inevitable, developers are required to reforest at mandated ratios or to afforest on other lands, preferably with native plants (Hilsenrath et al, 1996; Honecny, 2012). The FCA protects Maryland forests by making the identification and protection of forests and other sensitive areas an integral part of the site planning process (Maryland DNR, 2010). The FCA is administered by the Maryland Department of Natural Resources' (DNR) Forest Service, but implemented by local governments (Maryland DNR, 2011). Local authorities are required to ensure the best forests are protected from development and identify the best areas for reforestation and establish forest conservation ordinances pertaining to land development with areas 40,000 square feet (0.42 ha) or greater. Prior to development, developers must generate and submit two documents to the Maryland DNR: (1) a forest stand delineation (FSD²⁵) which supplies information on the condition of the existing forest; and (2) a forest conservation plan (FCP²⁶) which aims to conserve the most valuable portions of the forest for each development project (Galvin et al, 2000). The FSDs and FCPs must be prepared by qualified professionals (a licensed forester, licensed landscape architect, or other qualified professionals approved by Maryland DNR).

The Maryland DNR plays a leading role in the implementation of the FCA, generating guidelines and suggestions for local authorities and requiring them to develop their own ordinances based on specific local conditions. For example, Carroll County adopted a local ordinance tailored to its agricultural character – special emphasis is placed on off-site replanting (Burke and Dunn, 2010).

Local authorities are granted discretion in administering the FCA, while developers are provided flexibility to meet the regulation by planting or retaining forest on-site, through afforestation and reforestation, or by paying a fee-in-lieu of compliance (Hardie and Nickerson, 2003). Each local jurisdiction in Maryland must either adopt a Forest Conservation Program in response to the state law or, in the case of a municipality, assign its authority to the county. Local programs must be consistent with state requirements, but also may be more stringent. The FCA also requires the state to provide assistance to local governments in developing forest conservation ordinances, while local governments are required to report annually to the state on the results and progress of FCA implementation. Every five years, a comprehensive statewide review report is issued by the Maryland DNR (2010).

²⁵ According to FCA, FSD consists of an application form (Appendix B.1), map, and summary of specific field data collected (Maryland DNR, 2012).

²⁶ The FCP includes an application form and worksheet (Appendix B.2) showing the calculation of forest disturbed and retained and whether replanting trees will be required, and a plan for the long-term maintenance or protection of these trees (Maryland DNR, 2012).

The FCA presents three options for developers to conserve existing forest and to compensate for forest loss during the land use change process. The first option is *Afforestation*, which means that developers are required to establish a forest on an area not presently in forest cover. The FCA provides the minimum forest cover rate for a variety of land use categories:

- For agriculture and resource areas and medium density residential areas, tracts having less than 20 percent of the net tract area in forest cover shall be afforested up to 20 percent of the net tract area; and
- For institutional development areas, high density residential areas, mixed use/planned unit development areas, and commercial/industrial use areas, tracts having less than 15 percent of the net tract area in forest cover shall be afforested up to 15 percent of the net tract area (MSG, 2012a).

Afforestation is required to be accomplished within one year or two growing seasons after completion of the development project (MSG, 2012a).

The second option is *Reforestation*, which means that developers are required to construct a new plantation to replace the previously existing forest removed as a result of a regulated development. The clearance of existing forest cover only happens after “every reasonable effort to minimize the cutting or clearing of trees and other woody plants is exhausted” (MSG, 2012a). The FCA establishes the forest conservation threshold for all land categories:

- Agricultural and resource areas: 50 percent of net tract area
- Medium density residential areas: 25 percent of net tract area
- Institutional development areas: 20 percent of net tract area
- High density residential areas: 20 percent of net tract area
- Mixed use and planned unit development areas: 15 percent of net tract area
- Commercial and industrial use areas: 15 percent of net tract area

The reforestation ratios are distinguished when the cleared forest cover is above and below these thresholds. For all existing forest cover measured to the nearest one-tenth acre cleared on the net tract area above the applicable forest conservation threshold, the area of forest removed should be reforested at a ratio of one-fourth acre planted for every one acre removed. For all existing forest cover measured to the nearest one-tenth acre cleared on the net tract area below the applicable forest conservation threshold, the area of forest removed should be reforested at a ratio of two acres planted for every one acre removed. Each acre of forest retained on the net tract area above the threshold could be credited against the total number of acres required to be reforested (MSG, 2012a). Reforestation is required to be accomplished within one year or two growing seasons after completion of the development project (MSG, 2012a).

The third option is *Payment-in-lieu*. If afforestation and reforestation cannot be reasonably accomplished on-site or off-site, developers are required to contribute money to a Forest Conservation Fund according to the following ratio guidelines:

- On or before September 30, 2014, for a project inside a priority funding area²⁷, at a rate of 30 cents per square foot of the area of required planting; and for a project outside a priority funding area, at a rate of 36 cents per square foot of the area of required planting; and
- After September 30, 2014, for a project inside a priority funding area, at a rate adjusted for inflation as determined by the Department annually by regulation; and for a project outside a priority funding area, at a rate that is 20 percent higher than the rate set in the priority funding area (MSG, 2012a).

The Forest Conservation Fund may only be spent on reforestation and afforestation activities, maintenance of existing forests, and achieving urban canopy goals, and may not revert to the general fund of the state (MSG, 2012a). After receipt of the payment-in-lieu, the funds should be applied to reforestation or afforestation activities within two years or three growing seasons. At the end of this period, any unused portion of the payment shall be returned to the person who provided it²⁸ (MSG, 2012a).

According to the FCA, retention has the highest priority for forest conservation. On-site afforestation or reforestation may be utilized where the retention options have been exhausted. Off-site afforestation or reforestation is only utilized where the applicant demonstrates that no reasonable on-site alternative exists, or where:

- Any on-site priority areas for afforestation or reforestation have been planted; or
- The applicant has justified to the satisfaction of the State of Maryland or the local jurisdiction that environmental benefits associated with off-site afforestation or reforestation would exceed those derived from on-site planting (MSG, 2012a).

All local governments having planning and zoning authority are required by the State to develop a local forest conservation program consistent with the intent, requirements, and standards of FCA (MSG, 2012). The FCA has been effective in guiding local authorities to establish concrete ordinances on the county level. All but two counties require developers to reforest, afforest, or provide a payment-in-lieu. Harford County does not allow the payment-in-lieu, and Carroll County has developed a Forest Bank program as an alternative to the payment (Honecny, 2012a).

The FCA also allows for a Forest Mitigation Bank program as part of the forest conservation program. The local jurisdiction which implements this program may develop standards and adopt regulations for the

²⁷ Priority funding area is defined in 5-7B-01 of the State Finance and Procurement Article in the Maryland Code. The priority area can be a municipal corporation, an enterprise zone, a certified heritage area, those areas of the state between Interstate Highway 495 and the District of Columbia, and those areas of the state located between Interstate Highway 695 and Baltimore City (MSG, 2012b).

²⁸ The refunding measure mainly aims to ensure that the applicants, who initially could not find a planting site and then happen to find a planting site after making the payment, may get their payment back. But as of April 2012, this has not happened. Once the applicant pays, they will continue looking for a planting site. Most local ordinances do not apply this refunding measure option (Honecny, 2012b).

creation and use of forest mitigation banks, including criteria for tracking, crediting, maintaining, bonding, and reporting on mitigation bank activities (MSG, 2012a). Currently, Carroll County is the only county utilizing a Forest Bank Program as an alternative to fee-in-lieu payments (Honecny, 2012a). This pioneering initiative, which creates a market for ecosystem services via planting contracts directly between the developer and landowner, emerged from the county's Forest Conservation Code initiated in 1992 in response to the statewide FCA. This program is credited for much of Carroll County's success in retaining forests and increasing off-site planting. To establish a forest bank, property owners must first be approved to participate. A property owner whose land is already forested may still submit an application to the county for approval of a forest bank. The county makes its determination based on the physiographic priorities established in the Carroll County Forest Conservation Manual, e.g., whether the location, size, and other characteristics of the property are suitable.

Once an application is approved, a bank establishment plan (a checklist example of this plan can be found in Appendix B.²⁹) must be developed and submitted to the County. In order to protect new plantings, the bank owner (e.g., property owner) accepts responsibility for permanent protection and gives up any development rights on the newly planted property. The forest bank then needs to be certified. Certification requires completion of a 36-month forest maintenance period and adherence to specified tree survival rates. Land developers pay for the establishment of forest banks with costs driven by the market. During the past 10 years, though the forest banking price has fluctuated, the range has remained stable – generally from \$11,000 to \$15,000 per acre. Once a forest bank is established on a particular property, it is listed in the forest bank list created by the Carroll County Bureau of Resource Management. The potential developer/buyer can then contact the bank owner directly to buy the forest credits, which are expressed in acres (Bowman, 2012).

The forest credits are rarely sold in one transaction, especially when the forest bank is large. It generally requires numerous projects over a long period of time to completely use the bank acreage. When a development project utilizes a forest bank to satisfy state conservation obligations, the developer buys the forest bank credits from the forest bank owner. The owner, in turn, provides a forest bank purchase agreement, whereby the bank owner promises and assumes all legal obligations for the off-site forest requirements, including posting a monetary bond, inspections, survival rate guarantee, maintenance, etc. The "buyer" or developer provides a written 'proof of purchase' of forest bank credits (for a specific project) which is signed by both parties and presented to the Carroll County Bureau of Resource Management. Forest bank transactions are recorded in the state land records and subject to inspection every three years to ensure the terms of the conservation easement continue to be met (Slater and Edwards, 2010).

²⁹ The bank establishment plan is a plan for creating a forest bank approved by the County, consistent with the County's Technical Manual and pursuant to the requirements and priorities of the County's forest conservation program. If natural regeneration is incorporated in the plan, the plan must reflect the suitability of the location for regeneration and must include a framework for maintenance, until regeneration proves successful (Carroll County Government, 2012).

5.3 Pennsylvania

The Commonwealth of Pennsylvania provides financial support to municipalities and organizations for planning and construction of urban green infrastructure. Financial support is provided through the Pennsylvania Infrastructure Investment Authority (PENNVEST), Growing Greener (GG) grants, and H2O PA Grants. Through the utilization of these state-provided financing resources, the cities of Lancaster and Philadelphia have made significant efforts to implement green infrastructure to reduce and treat stormwater runoff and combined sewer overflows (CSOs).

As an independent agency of the Commonwealth of Pennsylvania, PENNVEST was established by Act 16 in 1988 to provide grants and low interest loans to owners and operators of sewer, water, and stormwater systems for infrastructure improvements (Act 1988-16). PENNVEST is operated under a Board of Directors composed of the Governor, Secretary of Environmental Protection, Secretary of Community and Economic Development, Secretary of General Services, Secretary of Budget, appointed members from the General Assembly, and individuals appointed by the Governor (Act 1988-16). Sources of revenue for PENNVEST include appropriated state and federal funds, proceeds from the sale of bonds, repayment of loan principal, payment of interest on loans made by the authority, and interest earned on the investments of authority moneys (Act 1988-16). Operations revenue comes from investment earnings, loan repayments, and allowable federal administrative expenses (PENNVEST, 2011a). Since 1996, PENNVEST has not received state operating appropriations.

PENNVEST (2011b) is also responsible for the financing and administration of federal Clean Water State Revolving Funds (CWSRF) and federal Drinking Water State Revolving Funds (DWSRF). Twenty percent (\$11,698,400 for 2011) of CWSRF funds are intended to fund green infrastructure projects, provided there is sufficient demand for project funding (PA, 2011b).

The 1999 Environmental Stewardship and Protection Act established a fund within the state treasury known as the Environmental Stewardship Fund (ESF) with a five-year, \$650 million appropriation from the general budget and a \$0.25 per ton fee on municipal waste (Act 1999-68). The ESF provides funds for GG grants awarded by PENNVEST, the Department of Environmental Protection (DEP), the Department of Conservation and Natural Resources (DCNR) and the Department of Agriculture (DA). The DEP GG grants are awarded to counties, municipalities, conservation districts, and watershed organizations for planning and implementation of local watershed based conservation efforts and for improving the quality of water polluted by mining, agriculture and urban runoff. Project selection criteria are included in Appendix C. The PENNVEST GG grants are awarded for stormwater, water, and sewer infrastructure projects (Act 1999-68). Act 2002-90 reauthorized GG funding from the Environmental Stewardship Fund through July 1, 2012 with an increased \$4 per ton fee on municipal garbage (Act 2002-90).

TABLE 5: PENNVEST Green Infrastructure Loans and Grants (2009-2012)

Project Name	Description	Amount
Millvale Boro – TreeVitalize Project	Millvale and the Western Pennsylvania Conservancy will plant 850 trees, and install bioswales to reduce stormwater runoff.	\$703,525 Grant
Lancaster City Green Investments	This project includes pervious pavement parking lots, streets and alleys, infiltration and bioretention systems, green roofs, rain gardens and rain barrels. The project will capture runoff from 951,000 sq. feet in the combined sewer district of Lancaster City.	\$7,000,000 Loan
Wilkinsburg – TreeVitalize Project	Wilkinsburg with the Western Pennsylvania Conservancy will plant 500 2" diameter trees to reduce stormwater runoff.	\$500,000 Grant
PA Cleanways – Cobb Creek, West Philadelphia Stormwater Mitigation Project	The project will remove non-native and invasive flora and plant up to 400 trees to reduce stormwater runoff into this urban creek.	\$136,429 Grant
Villanova University Downspout Disconnection Program	The project will disconnect 40,000 sq. feet of impervious surface removing 85,000 cubic feet of runoff.	\$55,912 Grant
Friends of the Pittsburgh Urban Forest – City of Pittsburgh Parking Lot Initiative	This project will install tree, landscaping and permeable pavers in parking lots throughout Pittsburgh to reduce stormwater and CSO load.	\$274,393 Grant
Western Pennsylvania Conservancy – TreeVitalize	This project will plant 6,250 new trees along commercial and residential corridors in Pittsburgh to reduce stormwater flows.	\$2,400,000 Grant
Chester County Conservation District Brandywine Christina Stormwater BMPs	This project will construct six riparian buffers, eleven rain gardens, two stream bank restorations, two dirt and gravel roads, eleven agricultural BMPs, and two stormwater basin retrofits.	\$1,832,839 Grant
PA Environmental Council OhioPyle Green Infrastructure Projects	This project will install 22,780 sq. feet of pervious paving, 132 rainbarrels, 500 and 1200 gallon cisterns, and 3,083 linear feet of concrete curb to reduce stormwater runoff.	\$1,312,718 Grant
PA Urban and Community Forestry Council Green Stormwater Management Counties	This project will plant 1,000 trees in urban MS4 municipalities along streets and parking lots.	\$300,000 Grant
Lehigh City – County Environmental Center	This project includes a 1,350 sq. foot green roof and a 1,500 gallon rainwater storage system for use in building components using non potable water.	\$40,000 Grant
Towamencin Twp – Fischer's Park Pervious Pavement Project	This project will construct a \$35,910 sq. foot pervious pavement parking lot with infiltration bed and bioretention islands to store 9,170 cu ft of stormwater, treat 85 percent of suspended solids, 85 percent of phosphorus, and 30 percent of nitrates from stormwater runoff.	\$281,964 Grant
Factoryville Boro – Factoryville and Clinton Township Municipal Park	This project will construct a 3,000 sq. yard "green" parking lot to serve an existing community park.	\$85,600 Grant
York Twp – Stump Park Green Infrastructure Improvements	This project will include low impact development stormwater strategies including two porous asphalt parking lots, several bioretention/rain gardens, emergent plantings and site wide tree planting, and erosion and sedimentation control devices and landscaping.	\$460,673 Grant
Philadelphia City – Green Infrastructure for Stormwater Management	The overall project will consist of green streets, public facilities, public open spaces, school and environmental restoration.	\$30,000,000 Loan

Source: PENNVEST, 2012b; 2012c; 2012d

The H2O PA Act established the H2O PA Grant in 2008, providing single and multi-year grants to municipalities and authorities for the construction, improvement, expansion or rehabilitation of water supply, sewage disposal, or stormwater systems (Act 2008-63). The program is managed by the Commonwealth Financing Authority (CFA, 2009). Applicants must provide match funding of no less than 50 percent of the

award amount, and match funding can come from PENNVEST loans and grants. Eligible projects are between \$500,000 and \$20,000,000 (CFA, 2009). Applications are reviewed and evaluated by the CFA, Department of Community and Economic Development, DEP, and PENNVEST to determine the eligibility and competitiveness of the project (CFA, 2009). Funding is provided by an \$800 million bond funded by the Pennsylvania Gaming Economic Development and Tourism Fund (Act 2008-63). From 2009-2012, PENNVEST provided grants for 13 green infrastructure projects with GG and CWSRF funds and two municipal green infrastructure loans (see Table 5). The DEP provided GG grant resources to 16 green infrastructure projects in the same time period.

Since 2006, the Growing Greener Grant program has experienced financial instability. The Growing Greener II Program (Act 2005-45) allocated a \$625,000,000 "Growing Greener Bond Fund" (Act 2005-1) passed by voters for "the maintenance and protection of the environment, open space and farmland preservation, watershed protection, abandoned mine reclamation, acid mine drainage remediation and other environmental initiatives" (Act 2005-45). Growing Greener II (GGII) provides grants to the same projects and agencies as GG, but with expansion to include the Energy Development Authority, Community and Economic Development, the Fish and Boat Commission and Pennsylvania Game Commission (Act 2005-45) (Renew Growing Greener, 2010). From 2005 to 2008, the Pennsylvania DEP provided 13 GGII grants to urban green infrastructure projects (see Table 6). However, revenue from the Environmental Stewardship Fund (\$4.25/ton fee on municipal waste), originally appropriated for GG grants, is now used to pay the debt service for the Growing Greener Bond Fund (Legislative Budget and Finance Committee, 2010). Section 6115 D4 of Act 45 states that up to \$60 million of the Environmental Service Fund shall be used annually to pay principle and interest on the debt service; this has been interpreted as "must allocate" and not an option (Heath, 2012). The Environmental Stewardship Fund revenues range from \$65 million to \$84 million per year (Legislative Budget and Finance Committee, 2010). Once all the GGII Bonds (June 30, 2009) were issued, the debt service payments (payments toward interest and principal) increased to \$50 million annually. By July 30, 2011, virtually all of the \$625 million in GGII funds had been expended or committed, leaving \$15 million in the Environmental Stewardship Fund for Growing Greener type projects.

TABLE 6: DEP Growing Greener Grants (2009-2012)

Project	Description	Amount
Delaware Valley College	Delaware Valley College proposes seven projects to capture rainfall and reduce stormwater. Projects include converting a stormwater retention basin to an infiltration basin, wetland creation and roof runoff capture.	\$86,000
Lower Allen Township	Proposal to plant a 50' riparian buffer along 720' of impaired stream. Project will include removal of invasive plants and planting of native plants.	\$55,298
Pennsylvania Resource Council	This project will present educational sessions for residents on riparian land stewardship and rain barrel use. Sessions will include assembly of rain barrels for participants to take home and install.	\$18,455
Montgomery County Commissioners	Proposal to replace most of the concrete and stone paving on the existing multilevel plaza above the downtown Norristown parking garage with a vegetative roof.	\$277,339
Pennsylvania Horticultural Society	Project to continue funding for TreeVitalize, a public-private partnership to restore tree cover with a focus on implementing riparian buffers.	\$250,000
Albert M Greenfield Home and School Association	This project plans to transform the exterior school property from mostly impervious surface to green space with plans for the property to manage most of the stormwater produced onsite and mitigate CSOs into the Schuylkill River.	\$200,000
Somerset County Conservation District	This project proposes to implement a rain barrel initiative in Somerset, with a goal of installing 200 rain barrels at residences. The project also plans to educate the local population and government about the value of rain barrel use.	\$24,338
Venango Conservation District	Proposal to design and construct up to 10 stormwater BMPs in the Lower Two Mile Run watershed, including riparian buffers, infiltration trenches, vegetated swales, rain gardens and other BMPs.	\$225,000
City of Lancaster	This project will plan, design and install various green infrastructure stormwater BMPs on 10 blocks within Lancaster City and conduct public outreach and education.	\$225,000
Jonestown Borough	This project will design and plan three rain gardens and construct one of the three.	\$41,373
Temple University	This project will install 12,000 gallons of rainwater storage capacity at Temple University greenhouses to manage roof runoff and use the stored water on a daily basis to water plants in and around the facility.	\$53,150
Pennsylvania Horticultural Society	Project will continue funding for the TreeVitalize program.	\$200,000
Westmoreland County Conservation District	Project will implement stormwater retrofits and BMPs at sites owned by Westmoreland County Industrial Development Corporation. Projects include permeable pavements, retrofitting existing detention ponds, and utilization of canopy trees.	\$97,590
Pennsylvania State University	Project will design and construct five raingardens, a green roof, rainbarrels and a living wall on Penn State Behrend campus.	\$36,495
City of Lancaster	This project will install innovative stormwater BMPs as part of the city's green infrastructure plan by retrofitting five alleys to capture and infiltrate 1.6 million gallons of runoff per year.	\$263,120
Jonestown Borough	This project will construct two large raingardens.	\$54,653
Pennsylvania Environmental Council, Inc.	This project will assist commercial and institutional property owners in an urban neighborhood to install stormwater control retrofits. The grant will fund outreach, engineering and design and construction.	\$200,000
Venango Conservation District	This project will design and construct up to 20 raingardens, place 50 rainbarrels with installation/usage workshops, and five stormwater reuse cistern systems.	\$150,846

Source: DEP, 2012a

The City of Lancaster (2011) published Pennsylvania's first Class 3 Green Infrastructure Plan (GIP) in April 2011 with assistance from LIVE Green, Pennsylvania DEP, DCNR, and the Lancaster County Planning Commission. Lancaster's GIP creates goals for strengthening the city's economy; improving residential health and quality of life; creating water quality responsive green infrastructure programs; reducing pollution, stormwater and CSOs; achieving higher benefits and lower costs on infrastructure investments; and establishing the city as a national leader in green infrastructure. According to local sources, construction of grey infrastructure to eliminate CSOs and meet federal and state water quality standards would cost the City of Lancaster over \$250 million. As an alternative, the city plans on spending \$140 million over 25 years to establish green infrastructure that manages 1,265 acres of impervious surface, reduces one billion gallons of runoff per year and meets state and federal CSO reduction requirements. The city estimates the cost of utilizing grey infrastructure to reduce CSOs at \$0.23 per gallon, while green infrastructure reduces CSOs at a cost of \$0.18 per gallon (City of Lancaster, 2011).

Implementation and construction costs of projects in the GIP are financed by a \$7 million loan from PENNVEST at a 1.495 percent interest rate for the first five years, and 2.965 percent for the remaining 15 years (Harris, 2011). The city also received a DEP GG grant of \$225,000 and a DEP H2O PA Grant of \$1.4 million for construction of green infrastructure projects detailed in the GIP (Sorace, 2012). The GIP proposes the establishment of stormwater billing based on impervious cover to create a revenue stream for future project and maintenance costs and to drive private investment into reducing stormwater runoff with a credit system (City of Lancaster, 2011).

Philadelphia's commitment to reducing stormwater and CSOs with green infrastructure is detailed by the Philadelphia Water Department's (PWD) CSO Long Term Control Plan Update, called the Green City, Clean Waters Program. Philadelphia's program addresses multiple state and federal regulatory requirements, including the EPA Combined Sewer Overflow Control Policy, EPA Stormwater Regulations, the Pennsylvania Stormwater Management Act, and the Safe Drinking Water Act.

The program is committed to investing over \$1 billion in green stormwater infrastructure over the next 20 years, with an anticipated \$2 billion return in benefits over 40 years (PWD, 2009). The PWD is utilizing a \$30,000,000 PENNVEST loan (approved April 2009) for construction of green infrastructure demonstration projects (PWD, 2011a). The loans are provided at 1.193 percent for the first five years, and 2.107 percent for the final 15 years (PWD, 2011a). Additional funding will be generated by a stormwater fee implemented in July 2010 (PWD, 2009). The fee is assessed to all property owners and calculated by the amount of gross area and impervious area on the property. For fiscal year 2012, residential owners are charged \$11.06 per month. The fee is based on an average gross area of 2,090 square feet and average impervious area of 1,060 square feet on residential properties, and a rate of \$0.528/500 square feet of gross area, and \$4.169/500 square feet of impervious surface (PWD, 2102). Nonresidential and condominium properties are subject to the same rates, but the fees are calculated based on actual gross area and average 85 percent impervious area coverage. Nonresidential and condominium properties over 5,000 square feet are charged based on actual gross area and actual impervious area measured through GIS and orthoimagery (PWD, 2012). Gross area and impervious area credits are available for

nonresidential and condominium properties with a stormwater management plan implementing BMPs (not limited to but including green infrastructure) that reduce impervious area or retain stormwater on site (PWD, 2010). Credits are approved after site inspection and must be renewed every four years.

Green infrastructure monitoring, evaluation, and performance standards are established in Philadelphia's Green City, Clean Water Implementation and Adaptive Management Plan. Green infrastructure ownership and maintenance responsibilities are tracked within the PWD's project tracking system (PWD, 2011b). Metrics include water quality performance standards, equivalent mass capture (total dissolved solids, biological oxygen demand, fecal coliform, etc.), and total greened acres (PWD, 2011b). Progress toward meeting performance standards are reviewed yearly for the first five years (June 1, 2011 - June 1, 2016) and at five-year intervals afterwards. An adaptive management approach is implemented based on program assessments to ensure performance standards and goals are met, and to maximize benefits and minimize costs of implementation.

Since 2009, the PWD has constructed four green infrastructure projects and completed designs on four projects, with 19 projects in other phases of design (PWD, 2011). Some 14 greened acres have been built with a total of 75 greened acres planned to be completed. Lancaster's and Philadelphia's respective green infrastructure plans have served as blueprints to other interested governments seeking to leverage funding and investment into public green infrastructure projects, as a means for cost effective urban stormwater management.

5.4 Illinois

Section 15 of Public Act 96-0026 of the Illinois Green Infrastructure for Clean Water Act of 2009 mandated a study on green infrastructure in Illinois that was carried out by the Illinois EPA (IEPA, 2011a) with the assistance of researchers from the University of Chicago. This study involved an assessment of established green infrastructure throughout the state and attempted to evaluate effective BMPs and policies that could guide these practices to greater implementation. What follows is a summary of relevant state stormwater management policies and the aforementioned green infrastructure study, with a discussion of municipal level ordinances which support green infrastructure.

The Federal Clean Water Act Amendments of 1987 established the National Pollution Discharge Elimination System (NPDES) permit approach for Municipal Stormwater Sewer Systems (MS4s). The permit requires MS4s to implement six minimum control measures as stipulated by the U.S. EPA (IEPA, 2009). Some of these measures include: (1) public education on stormwater management; (2) public participation; (3) illicit discharge detection and elimination; (4) construction process requirements; and (5) post construction requirements. In order to meet these permit requirements, urbanized areas (areas with a total resident population greater than 50,000 and population density greater than 500 per square mile) must, as of April 2009, consider incorporation of green infrastructure practices into their stormwater program to the maximum extent practical (IEPA, 2009). There are, however, no required standards of green infrastructure specified by the permit. This lack of comprehensiveness in the Stormwater Plan is avoided in the ordinances of individual counties in northeast Illinois as explained later, where a majority of

the 440 MS4s in the state are located (Jaffe et al, 2010). The general stormwater permit for MS4s was last re-issued with an effective date of April 1, 2009, valid until March 31, 2014 (IEPA, 2009).

The Clean Water and Drinking Water State Revolving Funds (SRFs) have traditionally been used for stormwater infrastructure but not for green infrastructure in Illinois. The American Recovery and Reinvestment Act of 2009 stipulated that 20 percent of the SRF must be used for water and energy conservation projects, of which green infrastructure is a subset (i.e., the GPR: Green Project Reserve) (EPA, 2009). The Illinois Green Infrastructure Grant (IGIG), established with federal funds in 2010 based on the recommendation of the Illinois EPA green infrastructure study, witnessed tremendous success (IEPA, 2011b). Grant applications were solicited under one of three project categories: (1) CSO rehabilitation; (2) Stormwater Retention and Infiltration; and (3) Small Projects. The projects had maximum allowable grant amounts of \$3 million, \$750,000 and \$75,000, with a minimum local match requirement of 15, 15, and 25 percent for the three categories, respectively. In its first cycle for fiscal year 2011, \$5 million was disbursed as grant money to 14 out of 154 applicants (IEPA, 2011b). The IGIG was intended to bridge the gap between funding available at the time for green infrastructure (primarily NPDES grants) and funding awaited under the retrofit of the SRF program to satisfy the Green Project Reserve criteria (Davis, 2012). The Milwaukee Avenue Green Corridor Development program of the Metropolitan Planning Council and the 35th Ward Office is one of two projects in Chicago that secured green infrastructure funding (\$200,000). The grant was used to fund a sub-grant program for smaller scale green infrastructure on properties along Milwaukee Avenue (MAGDCP, 2012). State-administered Section 319 federal grants, allocated specifically for dealing with nonpoint source pollution, represent another source of funds for green infrastructure projects in the state (EPA, 1987).

The green infrastructure study cited above highlighted stormwater management plans implemented in twelve northeast Illinois counties that contain comprehensive retention standards for private property owners (Jaffe et al, 2010). These counties had been given the authority to formulate their own stormwater management plans by Public Act 85-905 (55 ILCS 5/5 1062.2) created in the aftermath of two severe stormwater events (1986 and 1987) in the Chicago area. The first involved two weeks of consistent rainfall, and the second entailed 13 inches of rain in a 24-hour period (CMAP, 2011).

Given the size and diversity of geographic and development conditions across the state, Illinois supports county level independence in establishing stormwater management and green infrastructure ordinances. The standards of a few key counties are summarized in Table 7 below.

TABLE 7: Summary of Standards for Four Illinois County Stormwater Plans

County	Release Rate	Volume Control Mechanism	Water Quality Measures	Green Infrastructure Allowance
Cook	2 yr, 24 hr: 0.04 cfs/acre 100 yr, 24 hr: 0.15 cfs/acre	The first 1" of runoff to be retained on site	Infiltration and flow through practices	Retention based practices required to achieve volume control mechanism
Kane	100 yr, 24 hr: 0.10 cfs/acre	The first 0.75" of runoff to be retained below the primary gravity outlet of the site	Native wetland plantings required	Stormwater BMPs may be implemented for development that requires less than 1 acre-foot storage
Kendall	2 yr, 24 hr: 0.04 cfs/acre 100 yr, 24 hr: 0.15 cfs/acre	Hierarchy of steps required to control runoff volume increases	Promotes retention and infiltration to improve water quality	Promotion of use of BMPs and native plantings
Lake	2 yr, 24 hr: 0.04 cfs/acre 100 yr, 24 hr: 0.15 cfs/acre	Hierarchy of steps required to control runoff volume increases	Runoff volume reduction hierarchy of practices	Preservation of natural infiltration given importance in BMPs

Note: cfs = cubic feet per second

Source: Adapted from Jaffe et al, 2010

Chicago, a part of Cook County, has long been a leading U.S. city with regards to green infrastructure. The draft Cook County Watershed Management Ordinance requires retention standards to be achieved by means of the runoff control practices recommended, many of which are green infrastructure-based. The draft ordinance also specifies maximum release rates for the two-year and 100-year storms of 0.04 and 0.15 cfs/acre, respectively (Cook County, 2009). The plan is currently awaiting the results of an Economic Impact Statement to determine its possible economic impacts. The City of Chicago, however, has already developed numerous programs to encourage green infrastructure. Its Green Roofs program successfully installed 71 green roofs throughout the city during 2005 to 2007. The Green Alleys program (administered by the Chicago Department of Transportation) has witnessed significant success with permeable pavements, with some 150 locations constructed around the city. The Sustainable Backyards program provides up to a 50 percent discount to home or property owners on the cost of small scale measures like rain barrels, native vegetation, and trees (City of Chicago, 2011a). Limited funds, however, have forced a decrease in the number of such projects currently being implemented throughout the city.

Chicago additionally offers a Green Permit program that allows for expedited permitting and a possible waiver of applicable fees up to \$25,000 for developers who include LEED (Leadership in Energy and Environmental Design) certified green technologies in their building plans, to include green infrastructure such as green roofs. Developers of smaller scale projects apply for a green permit under the Green Homes Program (City of Chicago, 2011b).

Kane County, similar to other counties in northeast Illinois, has a Stormwater Ordinance in place which establishes retention and detention standards. The requirement for retention is that the first 0.75 inches of rainfall is to be held under the primary gravity outlet of the site. The ordinance allows for a maximum release rate of 0.1 cfs per acre in the event of a 100-year storm (Kane County, 2005) and requires native vegetation to be planted in detention basins to absorb assimilated rainwater. The fee-in-lieu required of

property developers who wish to avoid green infrastructure³⁰ measures is \$90,000/acre-foot of storage, an option chosen by many developers and paid to the county government to support existing stormwater management infrastructure (Thavong, 2012). Developers must still pay heed to the relevant U.S. EPA's minimum control measures as enforced in the state of Illinois. The city of Aurora within Kane County has implemented several green infrastructure demonstration projects throughout the city. One such project is a bio-filtration facility that treats stormwater from the Lincoln Avenue commuter parking lot with native vegetation and uses a sand filter for further cleaning. This design treats the first three-fourths of an inch of runoff from the 4.5 acre parking lot, decreases peak discharge by 25 percent, removes 5,612 pounds of Total Suspended Solids (TSS), and averts 1,342 pounds of Chemical Oxygen Demand (COD) per year. Similarly the Spring Street Rain Gardens are 50-foot long rain gardens that use landscaped native vegetation and underlying sand and gravel to treat stormwater from 1.3 acres of adjacent street and residential property. This infrastructure achieves a reduction in volume runoff of 72 percent and removes 288 pounds of TSS and avoids 113 pounds of COD per year (City of Aurora, 2010).

5.5 California

With the passage of the Urban Forestry Act of 1978, the State of California recognized the multiple benefits of urban forestry and established a regulatory framework to support its development. Observing that urban forest resources were under threat from population growth and urban expansion, the Act set out to reverse the loss of urban forests through technical and financial support. In addition to defining urban forestry, the Act identifies the importance of trees in conserving energy, mitigating air pollution and excessive noise, providing wildlife habitat, and improving human well-being through access to nature. The Act authorizes the California Department of Forestry and Fire Protection (Calfire) to implement programs to improve urban forest practices, assist communities seeking to utilize the benefits of urban forests, and encourage urban forest demonstration projects that maximize those benefits for the community, including the utilization of urban forest biomass or reduced urban green waste. Calfire achieves this goal through its Urban and Community Forest (UCF) Grant Program (see Table 8) and seven regional Urban Forestry Field Specialists, who provide technical assistance in planning and implementation of urban forestry projects by communities, municipal governments and nonprofit organizations. The UCF is governed by a comprehensive urban forestry action plan developed by the 17-member California Urban Forestry Advisory Committee (CUFAC). The CUFAC is further charged with program evaluation and provision of recommendations on strategies and protocols to ensure urban forestry meets its targeted greenhouse gas (GHG) reduction target, an additional 3.5 million tons of CO₂-e sequestered by 2020 (CUFAC, 2009).

³⁰ Green infrastructure requirements differ in the stormwater ordinances of the various counties. In Kane County the ordinance specifies green infrastructure requirements as native vegetation and deep rooted grasses. Others specify vegetative strips, minimizing impervious cover in site design and preserving natural features.

TABLE 8: Calfire Urban and Community Forestry Grant Program Categories

Project Type	Description	Grant Amount	Match State/Other
Leafing Out	Entry level grant program intended to provide modest funding for projects in any Urban Forestry Program Grant category. Eligible entities include local governments, special districts, nonprofit organizations and schools.	\$2,500 - \$30,000	75/25
Green Trees for the Golden State	Urban tree planning and up to two years of initial maintenance. Preference given to tree planting to optimize the multiple benefits with special attention given to air quality and energy conservation. Recipients must provide tree maintenance for a minimum of three years after project completion. Nonprofit applicants are allowed up to 5 percent administration and overhead expenses. Project funding must supplement rather than supplant existing local government initiatives.	\$40,000 - \$100,000	75/25
Education	Creating and developing an educational or training program that features the benefits and advancement of sustainable urban forestry or urban greening efforts.	\$30,000 - \$150,000	75/25
Inventory	<i>For local governments only.</i> Establishing or adding to an existing tree inventory. Applicant must have an existing urban forest/street tree protection system (city ordinance, etc.) Applicant must have an existing urban forester, arborist or other person responsible for urban forest resources.	\$30,000 - \$200,000	75/25
Management Plan	<i>For local governments only.</i> Establishing a new management plan or updating an existing management plan. Applicant must have an existing urban forest/street tree protection system (city ordinance, general plan, etc.). Applicant must have on staff a current (updated within the last 10 years) tree inventory and urban forester, arborist or other person responsible for urban forest resources. Grant recipient must implement and utilize the "Management Plan".	\$30,000- \$100,000	75/25
Leading Edge Projects	For projects falling within the scope of the Urban Forestry Act of 1978 but not able to fit in one of the other Urban Forestry Grant Programs above. These projects should be unique and forward thinking.	\$30,000 - \$500,000	75/25

Source: Calfire, 2011d

The Act is one of several key pieces of (subsequent) legislation (Assembly Bill 32: Global Warming Solutions Act of 2006 [AB32]; Senate Bill 375: Climate Change and Regional Transportation Planning Act of 2008 [SB375]; Senate Bill 732: Sustainable Communities and Climate Protection Act of 2008 [SB732]; and the Urban Park Act of 2001) which promote urban forestry and green infrastructure throughout the state, primarily through technical assistance and a range of competitive grant programs (see Appendix D for a summary table of California's Green Infrastructure Programs). Each of these laws establishes a process for setting goals and objectives within its respective sectoral area and for enacting policies and programs typically identified through needs assessment. They further identify the implementing or coordinating agency and public funding source.

Urban forestry and green infrastructure are legislated to support climate change mitigation and adaptation strategies by SB732 and SB375. SB375 provides for climate change, transportation, and development planning coordination amongst state agencies and establishes criteria for distributing funds to support AB32 goals and objectives through sustainable communities planning as part of a larger regional transportation planning process. SB732 is considered the companion bill to SB375, providing funds to

support local communities with sustainable planning and establishing the interagency, cabinet-level Sustainable Growth Council (SGC)³¹ to coordinate the effort (SGC, 2011; Garrett et al, 2011).

The SGC achieves its tasks primarily through a Sustainable Communities Planning Grant program and an Urban Green Grant Program, both of which provide funding to municipal organizations for urban greening projects which contribute to AB32 targets. An additional SGC initiative is the Health in All Policies Initiative established in response to Executive Order S-04-10, which established a multi-sectoral task force to guide a collaborative effort to improve health through supporting sustainable communities and inserting health considerations in all statewide policies and programs. Parks and urban greening were identified by the task force as being at the center of healthy and sustainable communities.

The nexus between urban greening and public health is further supported by Assembly Bill 31 (AB31), the Statewide Park Development and Community Revitalization Act of 2008 (an update of the Urban Park Acts of 2001 and 2006), and the California River Parkways Act of 2004. AB31 authorized funding for local assistance competitive grant programs for the establishment of parks, recreation areas, and corresponding facilities, ideally with community participation and particularly in critically underserved urban neighborhoods suffering from high unemployment and illegal activities. The Parkways Act established the California River Parkways Grant Program, administered by the Secretary of the Natural Resources Agency, to provide grants for the acquisition, restoration, protection and development of river parkways offering multiple benefits of recreation, riverine habitat protection, and floodwater management (California Government, 2012d; NRA, 2011).

In all grant programs, priority is awarded to projects which provide multiple environmental benefits (GHG reduction, water quality and conservation, recycling, energy efficiency), involve regional coordination, and address public health and safety issues. Projects with multi-stakeholder involvement in the planning, implementation and upkeep phases receive priority status.

The California Green Buildings Standards Code (referred to as CALGreen), adopted January 1, 2011 as part of California Code of Regulations, Title 24, Part 11 (CBSC, 2010a), establishes green building standards to include green infrastructure practices as part of California's Building Code. The purpose of CALGreen is to improve public health, safety, and the general welfare by enhancing the construction and design of buildings with the use of methods that reduce negative environmental impacts, or produce positive environmental impacts (CBSC, 2010a). The code was developed and adopted with input from the Air Resources Board, Department of General Services, Integrated Waste Management Board, Department of Water Resources and the California Energy Commission (CBSC, 2010b). CALGreen establishes separate mandatory standards for residential and nonresidential buildings, with voluntary standards based on two rating tiers for projects that incorporate additional measures. The California Building Code is

³¹ The SGC was created in 2008, with operating guidelines approved in 2009. The 2012 to 2014 Draft Strategic Plan is currently out for comment. Council Members include the secretaries of CA Natural Resources Agency; Environmental Protection; Business, Transportation and Housing; Health and Human Services; the Director in the Governor's Office of Planning and Research; and an additional member appointed by the Governor (Garrett et al, 2011).

republished every three years and CALGreen is expected to be modified, enhanced and expanded through stakeholder input during future publications (CBSC, 2010a; 2010b). Table 9 (see next page) provides a list of green infrastructure measures and requirements to meet CALGreen standards.

TABLE 9: Green Infrastructure Measures Required by CALGreen

Type of Measure	Scope	Requirement
Mandatory – Residential Construction	Stormwater	Development over one acre requires stormwater drainage and retention during construction with retention basins to store stormwater on site. Site must be planned and developed to keep surface water out of buildings with swales, water retention gardens, French drains, and other approved management measures (Section 4.106).
Voluntary – Residential Construction	Site Design – Landscape Design	Post-construction landscape design should ensure areas disrupted during construction are restored with native vegetation and patterns. Turf area should be limited to no more than 50 percent of landscaped area (Tier 1), or no more than 25 percent (Tier 2). Native California vegetation or drought tolerant plants and trees should be used for 75 percent of landscaped vegetation (Section A4.106.3).
Voluntary – Residential Construction	Site Design – Water Permeable Surfaces	Utilize permeable pavement for parking, walking or patio surfaces. Permeable pavement should make up no less than 20 percent of total surfaces (Tier 1) or no less than 30 percent (Tier 2) (Section A4.106.4).
Voluntary – Residential Construction	Outdoor Water Use – Rainwater Systems	A rainwater system that captures, stores and reuses water captured from at least 65 percent of the available roof area (Section A4.304.2).
Voluntary – Residential Construction	Water Resistance and Moisture Management – Roof Drainage	Gutter and downspout systems route water at least five feet away from the foundation or connect to landscape drains that discharge into a dry well, bioswale, rainwater capture system or other approved on site location (Section A4.407).
Voluntary – Nonresidential Construction	Site Development – Low Impact Development	Peak stormwater runoff reduced by employing two of the following BMPs: Rain gardens; cisterns and rain barrels; green roofs; roof leader disconnection; permeable and porous paving; vegetated swales or tree preservation (Section A5.106.3).
Voluntary – Nonresidential Construction	Site Development – Exterior Wall Shading	Provide vegetative shading on east, south and west facing walls with windows. Shading should provide 30 percent coverage to a height of 20 feet or the top of the wall (whichever is less). Plant species should reach desired coverage within five years (Section A5.106.7).
Voluntary – Nonresidential Construction	Site Development – Heat Island Effect	Reduce non-roof heat island effects by providing 50 percent tree canopy coverage (mature within five years) over paved areas (Section A5.106.11).
Voluntary – Nonresidential Construction	Outdoor Water Use – Potable Water Reduction and Elimination	Provide water efficient landscape irrigation design that reduces or eliminates potable water use by choosing plants based on plant coefficient of water use, and use of captured rainwater (Sections A5.304.4-A5.304.5).
Voluntary – Nonresidential Construction	Outdoor Water Use – Restoration of Disturbed or Developed Sites	Restore all landscaped areas disturbed by construction with local and noninvasive plants. Protect or restore 50 percent of previously developed or graded sites with adaptive or noninvasive vegetation (vegetated roofs may apply to calculation) (Sections A5.304.6-A5.304.7).

Source: CBSC, 2010a

California has traditionally enjoyed strong public support for stewardship activities, with more than 54 state and local funding measures – generating approximately \$13 billion in resources – having passed since 1988 (Calfire, 2010a). Issues related to urban forestry in California continue to grow in prominence, as an expanding urban population (94 percent of the total state population lives in an urban setting) and the increasing threat of climate change³² place pressure on forest resources (Calfire, 2011c). Urban forests and green infrastructure, in particular, have been identified as contributing to improved air quality, increased energy efficiency (via reduced demand), and climate change mitigation through carbon sequestration (Calfire FRAP, 2010b). Additionally, these green urban resources are viewed increasingly as significant providers of climate adaptation services. However, legislation to secure additional funding continues to be held back due to limited public support. Bond-generated funds, frozen during the 2008 to 2009 economic recession, are nearly depleted. Grant programs are expected to continue for one more cycle utilizing unspent funds from previous rounds. Accordingly, income from the recently approved cap-and-trade program is becoming more attractive as a potential source of urban forestry/green infrastructure funding.³³

³² Urban forest resources are particularly vulnerable to pests and disease infestations, and to the encroachment of wildfire into the urban/wildland interface.

³³ Telephone conversation with Chuck Mills, Grants Program Manager, California Re-Leaf, 1/23/2012.

CHAPTER 6: ANALYSIS AND RECOMMENDATIONS

Despite the range of benefits from green infrastructure, a host of barriers – financial, physical, legal and regulatory, technical, and institutional – limit its application and expansion. In the case of Delaware, green infrastructure was a prominent focus of state government initiatives in the early part of the last decade³⁴, and while it continues to be quietly promoted within the contexts of stormwater management, land use and development planning, and urban forestry, a more conscious, coordinated approach to utilizing green infrastructure across these and other sectors could potentially deliver additional benefits to all Delaware residents. A summary of the recommendations for expanding and enhancing the application of green infrastructure in Delaware is found in Table 10 below.

TABLE 10: Summary of Green Infrastructure Recommendations

Green Infrastructure Barriers	Green Infrastructure Facilitators
Financial	<ol style="list-style-type: none"> 1. Sustainable revenue streams for green infrastructure funding 2. Coordinated intersectoral fund to manage green infrastructure designated financial resources
Physical	<ol style="list-style-type: none"> 3. Conservation Codes to commit developers to forest conservation 4. Smart growth coordination
Legal and Regulatory	<ol style="list-style-type: none"> 5. Revised Stormwater Management regulations
Technical	<ol style="list-style-type: none"> 6. Green infrastructure building codes
Institutional	<ol style="list-style-type: none"> 7. Expanded range of programs supported by green infrastructure funding 8. Centralized information source on green infrastructure benefits and resources 9. Develop urban forest/arborist resource pool 10. Enhanced public awareness (from citizens to legislators) about the benefits of green infrastructure

6.1 Sustainable Revenue Streams for Green Infrastructure Financing

Limited financial resources are noted as a barrier to the advancement of green infrastructure planning and management as evidenced in part by the dissolution of Delaware’s Green Infrastructure Conservation Committee, the oversubscription of supportive grant programs, and the limited amount of grant funding available (\$5,000 cap on urban and community forestry grants). While the State of Delaware has successfully leveraged federal Clean Water State Revolving Funds with the establishment of the Delaware Water Pollution Control Revolving Fund in 1990, a national assessment of the use of these funds reveals that demand for this type of funding far outstrips supply (American Rivers, 2010). In the case studies

³⁴ This focus is most prominently captured in Governor Minner’s Livable Delaware Initiative (Executive Order #14 of 2001 and #83 of 2006) which sought to guide urban growth with “thoughtful” planning which preserved and enhanced existing rural and urban green infrastructure (IPA, 2008).

reviewed for this report, state level grant programs to support green infrastructure in the contexts of water quality and urban forestry experience similar problems of excess demand; a circumstance which grows increasingly challenging as demand continues to rise and financial resources either remain stagnant or are in decline. Pennsylvania and California have exhibited funding difficulties for established grant programs due to reliance on unsustainable funding mechanisms or reluctance to pass additional bond referendums. The U.S. EPA's proposed budget for FY2012 results in a 27 percent cut (\$3,487M in FY2010 to \$2,540M in FY2012) to federal CWSRF and DWSRF (EPA, 2011), cutting capitalization of DWPCRF and associated grants. Green infrastructure financing in Delaware, derived largely from these federal funding mechanisms, could face similar decreases. It is advisable, therefore, that Delaware explore additional, sustainable revenue streams to support green infrastructure. In addition, the grant and loan programs likely to be supported by these sources of sustainable funding will be better positioned to promote equitable economic impacts and additional social and environmental benefits. A few of these proposals are explored below.

- Low Interest Loan Programs. The Commonwealth of Pennsylvania created PENNVEST as a centralized agency to provide infrastructure grants and loans. Since 2009, this agency has provided grants for 13 green infrastructure projects and 2 major municipal green infrastructure loans (City of Philadelphia and City of Lancaster). This type of centralized infrastructure assistance authority can streamline the application, approval, and disbursement process for municipalities, operators, and organizations applying for Clean Water State Revolving Funds, Drinking Water State Revolving Funds, and grants for water infrastructure improvements (including green infrastructure).

Delaware's water infrastructure could benefit from additional capitalization of the state's revolving loan program. This would require a commitment from state policymakers and voters to provide additional funds through state bonds or a dedicated revenue fee to further finance the revolving loan program. Taking an example from PENNVEST, state voters approved \$870 million in general obligation bonds, in addition to capitalization from the CWSRF and DWSRF (PENNVEST, 2011). With this capitalization, PENNVEST has not received state appropriated operations revenue since 1996, with operating revenues funded through interest and investment payments (PENNVEST, 2011). To ensure the long term stability of the program, policy could set a target date for such an agency to operate free of state-provided operating revenues. Modification of the criteria to increase points received, or award bonus points for green infrastructure within the Green Project Reserve, could encourage the application or consideration of projects incorporating innovative green infrastructure methods.

- Financing from Developers. Maryland's Forest Conservation Act puts the financial burden of maintaining established forest cover levels on the developers, thus removing state government from the direct responsibility of mitigating development-induced forest loss. Developers are responsible for the conservation and establishment of forestation and long-term protection or, if permitted by the county, submission of a payment-in-lieu. Although developers were initially concerned with the costs of this requirement, complaints have largely ceased with the realization that keeping trees can reduce overall construction costs by eliminating the expense of removing mature trees. Additionally, the

expenditures are relatively small in comparison with the total cost of most development projects (Honecny, 2011).

Carroll County's Forest Bank Program creates an efficient off-site planting program. As planting agreements are constructed directly between the developer and the land owner, the process requires minimum governmental participation. Government's primary role in the process is approving prospective bank owners and maintaining a registry of buyers and sellers. Market access to prospective buyers of forest credits is important in reducing the time it takes to recoup the forest bank owner's investment. The challenges of time constraints and financial carrying costs make it desirable and practical for developers to have a third party establish and maintain the forest bank.

Revenue from carbon offsets could provide another source of urban green infrastructure funding. California is currently considering the possibility of allocating a portion of expected revenues of the soon to be implemented statewide cap and trade carbon emissions reduction initiative to forest resource conservation and protection. Although the carbon emissions reduction program in which Delaware participates is a regional one (Regional Greenhouse Gas Initiative - RGGI), an investigation into the full range of allowable energy efficiency programs is recommended particularly given that urban green infrastructure, specifically trees, has been demonstrated to produce energy reduction benefits.

- County/Conservation District/Municipal Level Stormwater Utility Fees. The City of Philadelphia has incorporated a stormwater utility fee to help finance green stormwater infrastructure with goals of decreasing runoff and combined sewer overflows (CSOs). A stormwater utility fee helps leverage private investment in green infrastructure and other stormwater reduction BMPs through the utilization of a credit system.

As a means to leverage private green infrastructure investment and help fund green infrastructure projects that decrease stormwater runoff impacts, the State of Delaware could encourage the development of municipal or county-level (preferable) stormwater utilities. Stormwater utilities could be encouraged through the provision of technical and design assistance (e.g., the sharing of information about standardized models for county and/or municipal stormwater utilities) which eases the implementation burden. Such information could be shared via a centralized web portal hosted and coordinated by DNREC. The standard stormwater utility model should include a tiered fee system based on the amount of impervious surface on a particular property. To leverage private investment into green infrastructure and further reduce stormwater quantity, a credit system should be included that reduces stormwater fees for customers that install and maintain effective green stormwater infrastructure systems. Adoption of the currently proposed stormwater regulations would greatly ease the requirements for the establishment of a stormwater utility over current regulations.

- Real Estate Transfer Tax. The New York State Environmental Protection Fund (EPF) is financed almost entirely through an appropriation of collected real estate transfer taxes. Allocations for the fund

were as high as \$212 million in FY 2009 to 2010, with proposed allocations reducing to \$134 million for FY 2012 to 2013. Despite funding reductions, however, the EPF maintains a revenue stream without incurring the debt which results from public bonds. Property transfers in Delaware are currently taxed by the State at the rate of 2 percent of the property value unless the county already imposes a 1.5 percent tax as authorized by State law (22 Del. C. § 1601 or 9 Del. C. § 8102) in which case the state tax is fixed at 1.5 percent (DSG, 2012h). A portion of the revenue generated by the real estate transfer tax is allocated to the Delaware Land and Water Conservation Trust Fund (DLWCTF) managed by DNREC to support the acquisition and development of land for conservation. Three separate accounts are used to disburse funds – the Project, Stewardship and Earnings accounts of which the latter two receive earnings from the Endowment Account of the Fund. Funds in the Earnings account are made available to local park districts or state agencies upon request, provided the funds are matched.³⁵ Private entities and nonprofits are not eligible to receive these funds. Funds in the Stewardship account are divided amongst the Division of Fish and Wildlife, Division of Parks and Recreation, Division of Historical and Cultural Affairs, and the Department of Agriculture's Forest Service. Project account funds are used by DNREC to finance the planning and acquisition of land for conservation (DSG, 2012i). Approximately \$1 million is presently annually credited to the Endowment account and \$9 million a year to the Project account. The earnings on these accounts are used for the purpose of planning and purchase of land for conservation including lands for recreational city parks (DSG, 2012i). To extend the impact of the DLWCTF, it is recommended that the definition of eligible project types be broadened to include green infrastructure projects, including stormwater management practices such as rain gardens, bio-retention basins, etc. Such an expansion would provide a stable funding source for statewide stormwater management initiatives and would also be legislatively simpler than creating a new funding source.

- Statewide Waste Surcharge. A fee assessed on garbage collected could be considered as a source of funding for green infrastructure, similar to the Environmental Stewardship Fund of Pennsylvania.
- Motor Vehicle Toll Surcharge. Delaware has a Transportation Trust Fund (TTF) which finances road construction and maintenance, public transportation services, and other motor vehicle related services and capital projects. Funded by revenue streams such as tolls, Department of Motor Vehicles fees, and gas taxes, the TTF works to invest in the State's transportation infrastructure and to address its deterioration over time (DelDOT, 2011). Despite current and projected difficulties in meeting funding demands through the TTF (DelDOT, 2011), the State might consider applying toll revenue streams to an environmental trust fund. The University of Maryland's Environmental Financing Center recently prepared a report for the Delaware Estuary outlining this type of funding opportunity suggesting an environmental fee which the Report identified as an Estuary Fee. A vehicle toll surcharge of 5 cents could yield \$15 million annually from toll payers in the Estuary states (Pennsylvania, New Jersey, and

³⁵ Match exceptions are made for local park districts which can request up to 75 percent of project funds, or state agencies which can request full funding.

Delaware) (Environmental Finance Center, 2006). A similar surcharge in Delaware could help the state finance research on transportation based watershed protection issues.

6.2 Coordinated, Intersectoral Fund to Manage GI Designated Financial Resources

Several funds dedicated to natural resource conservation currently exist in Delaware: the Urban and Community Forestry (UCF) grant program, the Delaware Land and Water Conservation Trust Fund (DLWCTF), and the Community Environmental Penalty Fund (CEPF). In 2011 approximately \$85,000 was available through the UCF, \$1.5 million via the DLWCTF, and \$665,000 from the CEPF (DFS, 2011; DNREC, 2012e, 2011c).

As noted earlier, the DLWCTF resides under the jurisdiction and control of DNREC and receives appropriations from statewide realty transfer taxes which are then applied to the state's conservation program. The CEPF is supported by a contribution of 25 percent of all penalties collected by DNREC directed to assist communities directly impacted by the environmental infraction and must provide some level of environmental enhancement. Grants are provided to achieve community-level social and environmental benefits via community-focused research and training, collaborative problem-solving partnerships, and technical assistance activities. Funds can be accessed by Delaware based civic and community organizations, nonprofit entities, educational institutions, counties and municipal governments as well as state and quasi-state agencies operating in the affected districts with 501 C(3) status. Entities without federal tax exemption must partner with an organization which is and who will serve as the project's fiscal manager. The CEPF is overseen by a Community Involvement Advisory Committee (CIAC) who maintains a public accessible database of collected penalties. Grant applications must demonstrate a 25 percent (financial or in-kind) match in funding and be completed within the grant year (DNREC, 2011c).

Many of the state and nonprofit agencies involved in urban green infrastructure cite a lack of adequate financial resources as a limiting factor in its expansion, despite the range of short and long term environmental, social, and economic benefits this type of investment provides. As a means of encouraging green infrastructure throughout the state, these various funds could be consolidated (or coordinated), maintaining the legislatively mandated disbursement criteria – yet adding a requirement which specifies a portion of available financing dedicated to projects which support broadly defined urban green infrastructure. The funds could also be made eligible to nonprofits seeking to add to green spaces in an urban environment. This would legislatively be a simpler approach than attempting to create an altogether new source of funding.

6.3 Conservation Codes to Commit Developers to Forest Conservation

Urbanization is a leading cause of forest loss, fragmentation and degradation in Delaware. Between 2002 and 2009, six percent of the State's unprotected forests were lost due to housing development. Delaware's forest cover is becoming increasingly fragmented due to continued urban and suburban development (DFS, 2010c).

Maryland's Forest Conservation Act constructs a direct connection between development-induced forest loss and forest replenishment and fosters an innovative approach to controlling and financing forest loss. According to the 15-year FCA review report (1993 to 2007), the FCA helped to retain 24,000 acres and replant 4,712 acres of forest (Maryland DNR, 2010). To preserve forest and minimize further loss, similar requirements could be considered in Delaware. Based on the Maryland FCA model, the developers could be required to:

- Retain the most valuable forests. Maryland's FCA requires potential developers to develop a Forest Stand Delineation (FSD) which supplies information about the existing forests before the development process. FSD should ensure that existing forests which are valuable for urban ecology can be preserved.
- Conserve forests onsite or plant to achieve a minimum forest cover rate. The 2010 Strategies for State Policies and Spending identified four land classification categories based on development priorities; this category framework could be utilized as the basis for determining the minimum forest cover rate on various parcels which is suggested to increase from Level 1 to Level 4 areas.
- If existing forest must be removed to facilitate development, developers could be required to create new forest plantations to compensate for the loss. A compensation ratio based on the Delaware Strategies for State Policies and Spending identified land categories is recommended. Native species should be required for all reforestation/afforestation activities, following the guidelines established by Delaware's Forestry Practices Erosion and Sedimentation and Seed Tree Laws.
- If planting is determined to be impossible, developers should be required to make a payment-in-lieu that contributes to a forest conservation fund which will be applied to forestation activities throughout the state. Payment levels could be established based on the land categories, e.g., high-priority development areas may have a lower payment ratio, while the low-priority development areas may have a higher payment ratio. Delaware has authorized State Impact Fees to promote an equitable planning and financing environment (29 Del. C. §§9121 to 9125). The payment-in-lieu could be proposed as a portion of this fee.

6.4 Smart Growth Coordination

Urban sprawl is one of the key challenges facing green infrastructure conservation in Delaware. California, when facing a similar challenge, opted to legislate a more coordinated approach to both land use and transportation planning which attempts to control and minimize the negative impacts of urban sprawl. A key objective of California's coordinated urban and transportation planning initiative is also to seek emissions reductions in these sectors. In addition to providing competitive grant program funding, establishment of the intersectoral Smart Growth Council is a cornerstone of California's smart growth coordination effort.

In Delaware, the Strategies for State Policies and Spending (1999, 2004, 2010) and the Livable Delaware Initiative (2001) created the basis for a coordinated land use planning institutional framework. A cabinet level intersectoral committee exists in the context of the Cabinet Committee on State Planning Issues (CCSPI) which is mandated to review and approve all county and municipal comprehensive plans,

and the Preliminary Land Use Service (PLUS) review process allows for an additional level of intersectoral review on proposed developments. The recently updated Strategies for State Policies and Spending provides an investment prioritization framework which proposes to limit urban expansion beyond currently developed areas. What the California model provides, in addition to the intersectoral management and oversight infrastructure, is a competitive grant program funding structure which encourages collaborative, locally initiated solutions to transportation, and development planning.

6.5 Revised Stormwater Management Regulations

Based on Governor Minner's Task Force on Surface Water Management, the currently proposed revisions to Delaware's Sediment and Stormwater Regulations shift stormwater management focus from design standards to performance criteria aimed at reducing quantity of runoff and mimicking natural hydrologic processes. Adoption of the regulations *as proposed* is anticipated to encourage the use of green stormwater infrastructure to control stormwater runoff volume.³⁶ Implementation of the level of green stormwater infrastructure required to achieve fishable, swimmable, and boatable water quality standards is expected to result in a 14:1 benefit-cost ratio (Kauffman, 2011). Adoption of the regulations as proposed would also ease the requirements for creation and implementation of stormwater utilities by: eliminating prerequisites for long range watershed master plans; removing the requirement for yearly inspections of all (public and private) stormwater management facilities; and reduction of regulatory language allowing county or municipal authorities the leeway to design utilities that best fit the local population. Stormwater utilities not only help equitably fund the operation and capital expenditures of stormwater operations, but can also, if created properly, leverage private investment into green stormwater infrastructure.

6.6 Green Infrastructure Building Codes

Green infrastructure development can be hindered by local and county building codes which do not specify green infrastructure standards, or possibly even discourage green infrastructure. Building, plumbing and electrical codes are currently adopted and enforced by counties (16 Del. C. §76). While the State has already adopted and enforces the most recent version of the International Energy Conservation Code, development and adoption of a Green Infrastructure Building Standards Code, such as the one adopted in California, by the State of Delaware can reduce existing technical barriers to increasing Delaware's green infrastructure.

The CALGreen Green Building Standards Code provides an example of a multiple stakeholder and agency developed green infrastructure standard that a proposed Delaware Green Infrastructure Building Standards Code could emulate. The purpose of these building codes are to improve public health, safety, and welfare by enhancing construction and building design to reduce negative environmental impacts and produce positive environmental benefits. Successful development and adoption of a green infrastructure building code would likely require the involvement of multiple state level agencies as well as the building community. A successful code would provide for revision, modification, enhancement and expansion to

³⁶ Final adoption of the current draft regulations is anticipated to occur during June or July 2012. Final public hearings in regards to the draft stormwater regulations were held in March 2012.

ensure the code remains relevant based on new green infrastructure techniques and data. State coordinated training programs and workshops for inspectors, site designers, and contractors are also recommended to ensure full understanding of why codes are implemented and what they mean.

6.7 Expanded Scope of Grant Programs Supported By Green Infrastructure Funding

The 2010 Delaware Forest Resource Assessment identified a number of strategic goals (See Appendix A.1) for enhancing the delivery of benefits from its forest resource base, most notably: conservation and maintenance of soil and water resources, an increase in urban tree canopy, and an increase in the number of sustainably managed urban and community forests. Whereas Delaware has supported these activities through its UCF program for over 20 years, an expansion of focus and structure might broaden the potential programmatic and public awareness benefits.

California has, in part, met the need to address issues of headwater, wetland forests, and waterway buffer zone protections for water quality management by including these issues in legislatively designated grant programs (AB31: Statewide Park Development and Community Revitalization Act of 2008 and California River Parkways Act of 2004). An Urban and Community Grant program has operated in California for over a decade and is considered a cost-effective way to engage municipalities and community organizations in developing innovative approaches to green infrastructure development beyond basic tree planting. Critical to the success of the grant program is a requirement for stakeholder partnerships between municipal organizations and citizen or community groups. An additional requirement for potential grant recipients is for the proposed project to provide multiple environmental and social benefits.

The level of technical assistance provided by the administering agency (in Delaware, DNREC is likely to be the best suited agency) throughout the application process helps to ensure a relatively diverse pool of applicants. Flexibility in match requirements, allowing more disadvantaged communities to provide a smaller match component, is an additional source of encouragement for groups/localities which might not otherwise apply.

To encourage urban forestry and develop urban and community forestry management infrastructure at the municipal level, the California UCF Grant provides a model for an additional recommendation. The grant program is progressive in its structure by requiring municipalities to have an urban forest/street tree protection ordinance in place, as well as an existing forestry professional prior to being eligible for funding to conduct a tree inventory. Similarly, grants for urban forest management plans are only provided once an urban forest inventory has been conducted. While there is a separate grant category for educational programs, all projects receiving grant funding are required to provide a public outreach and educational component to the project. While currently not required in California, municipal grant funding could also require establishment of an individually determined urban tree canopy goal³⁷ to be approved along with the

³⁷ An established urban tree cover goal with flexibility to adjust to unanticipated natural and manmade events should not be confused with a rigidly imposed mandate, which is not the intent of this recommendation.

grant award. Additionally, all projects are required to obtain clearance from the Department of Environmental Quality that the proposed project supports the state's environmental quality regulations.

6.8 Centralized Information Source for Green Infrastructure Benefits and Resources

At present there is limited programmatic coordination amongst the various state agencies which attempt to promote green infrastructure in Delaware. Coordination amongst counties and municipalities whose planning and zoning ordinances more directly impact local development activity is also restricted. A centralized database for information and financial resources available for public and private sector green infrastructure projects could streamline the processes required for individuals and institutions to access these resources. The centralized data source could additionally house information on BMPs for municipal level tree preservation, buffer zone, and urban tree canopy goals in addition to any comprehensive development, urban forest management plans developed by any of Delaware's 57 municipalities.

Natural Resources (including cultural and historical sites) Inventories prepared by DNREC could also be filed here, along with links to relevant Federal, State, and local land use ordinances, with a discussion of their impact on and support for green infrastructure. Including a listing of all conservation easements, land trusts, and other conservation arrangements could lay the groundwork for a forest banking program as discussed in Section 6.1.

6.9 Development of Arborist/Urban Forester Professional Resources

The relatively small size of the State of Delaware and its various municipalities (as compared to a state like California) can make having a strong cadre of urban forest professionals as assigned to individual municipalities a somewhat challenging prospect. In addition to the above recommendation to support urban forest management infrastructure development through grant program requirements, the proposal of the 2010 Strategic Assessment is to share urban forest professionals, as well as strengthen relationships with the various urban and community forestry stakeholder groups (see Appendix A.3). Links to these organizations and a listing of professional resource persons could be posted on the centralized website. In addition to facilitating municipalities with access to qualified professionals, this resource could be utilized by developers seeking "certified" forestry professionals to assist in developing Forest Stand Delineation and Forest Conservation Plans, as required by the recommended Maryland forest conservation model.

6.10 Expanded Public Awareness About Benefits of Green Infrastructure

Despite efforts from a variety of stakeholders to promote and expand green infrastructure throughout Delaware, awareness in the public and private spheres of these initiatives and their impacts remains limited. This limited awareness is documented in the 2005 Response Management Study conducted for DNREC. Accordingly, in addition to the centralized information source recommended above, the following public outreach activities are recommended:

- ***Citizen Participation in Urban Greening/Urban Forestry***

Urban greening/urban forestry resources in Delaware are primarily focused on public lands. In contrast, the State of Illinois allows private landowners (as opposed to only public land holders) of all

sizes to participate in green infrastructure development through the Chicago Sustainable Backyards Program that was launched in 2011. While California's UCF Grant program does not specifically target homeowners, it does emphasize the greening of community lands which are not solely publicly owned.

The Chicago Sustainable Backyards program offers residents 50 percent rebates up to \$100, \$60, \$50 and \$40 to purchase trees, native plants, compost bins, and rain barrels, respectively. This popular program is funded by a \$45,000 grant under the U.S. EPA Pollution Prevention Program and a \$315,000 grant under the USDA's Forest Service Great Lakes Restoration Initiative Grant Program (Abu-Absi, 2012). Several California municipalities, meanwhile, have had significant success in urban forest mapping by including private citizens' efforts in the planting as well as documentation efforts. The software code utilized by the regional Plant One Million (P1M) campaign was developed by a collaborative stakeholder effort in California which was partially funded by the Calfire UCF Grant Program.

Providing individual homeowners with access to green infrastructure and urban forestry funding lightens the responsibility of state and municipal agencies in the management of these resources. The Delaware Nature Society actively promotes a Backyard Habitat program and encourages backyard rain barrels. The Delaware Center for Horticulture's participation in the P1M campaign encourages private citizen participation in managing and monitoring the urban forest resource. Limited financial support for these types of citizen-oriented initiatives, however, restricts their potential. The State of Delaware could allocate additional resources to these partner organizations to continue and expand these types of public outreach initiatives.

- *Research Collaboration for Benefits Monitoring*

Nowak (2007a, 2007b, 2009, 2011) has assessed the impact of urban green infrastructure, specifically urban forests, throughout the country and repeatedly advocates for better research and monitoring of the range of benefits produced for public institutions, private sector business, and the general public in order to encourage its application amongst the range of stakeholder groups. Research and monitoring activities could be conducted through collaborative efforts with research oriented urban green infrastructure stakeholders such as University of Delaware Extension Services, Delaware Center for Horticulture, etc.

CHAPTER 7: CONCLUSION

Urban green infrastructure is considered a win-win proposition by many, as it has the potential to address public concerns about quality of life issues (water quality, air pollution, and urban sprawl) through the utilization of materials and techniques incorporating natural processes, thus contributing to environmental conservation and protection. Although not yet mandated at the federal level, growing levels of U.S. EPA support for urban green infrastructure suggest that future water quality mandates may increasingly require green infrastructure solutions. The case studies in this report highlight states and municipalities that have already recognized the multiple benefits, including cost-effectiveness, of urban green infrastructure. Based on the assessment of three key issues (stormwater management, land use planning, and urban and community forestry), the State of Delaware seems well positioned to support urban green infrastructure. The recommendations outlined in Chapter 6 summarize steps taken in other states to facilitate this trend. They represent an interconnected set of actions and initiatives which can be implemented sequentially as resources permit.

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Appendix A: Delaware Policies and Programs

A.1 Delaware Forest Resource Assessment (2010) Strategies³⁸

ISSUE #1: Forest Health and Functionality – threatened by loss, fragmentation, exotic invasives, uncontrolled natives, loss of certain native species, and wildfire.

Goal: Reduce loss, fragmentation and parcelization.

- Provide incentives for landowners to maintain forest lands
- Encourage state, county, and local governments to incorporate forests and forest benefits into land use planning
- Establish urban tree canopy goals

Goal: Improve forest diversity

- Work with stakeholders to establish goals for maintaining native forest types

Goal: Control native pests and non-native invasive species

- Improved monitoring

Goal: Reduce wildfire

- Train and equip volunteer fire companies to combat wild fires
- Work with at risk communities within the wildland/urban interface to reduce risk

ISSUE #2: Forest Markets – need for adequate, long term and diverse markets for forest products.

Goal: Accurate forest/wood inventories.

- Improve and refine state's forest inventory to better estimate species and quantities available for forest product markets
- Coordinate with neighboring states to ensure that markets are sustainable and adequate in size

Goal: Improve traditional forest markets

- Work with forest products industry stakeholders in the region to support traditional markets and develop markets for low-valued timber (bio-energy)

Goal: Develop non-wood/ecosystem services markets

- Promote markets for ecosystem services, e.g., Bay Bank Program and Regional Greenhouse Gas Initiative, for rural and urban forest resources

ISSUE #3: Sustainable Forest Management – limited technical and financial assistance prevents adequate management of rural and urban forests.

Goal: Rural forest management and assistance

³⁸ Proposed strategies correspond to the seven criteria of forest sustainability established through the international Montreal Process and address all aspects of forest management – biological diversity, productive capacity, forest health, soil and water resources, carbon cycles, social aspects, and legal and economic issues (DFS, 2010c).

- Coordinate with other natural resource professionals to provide technical assistance to landowners
- Expand outreach to as many landowners as possible
- Consider providing assistance on a landscape/watershed scale (would incorporate regional, interstate agencies)
- Expand cost-share programs
- Explore opportunities for additional incentives

Goal: Urban forest management and assistance

- Provide technical assistance to municipalities and civic associations to develop long terms plans for urban forest management (inventories, management plans, tree canopy goals)
- Expand outreach to as many municipalities as possible
- Maintain and expand funding
- Explore avenues to provide certified arborists/urban foresters for municipalities

ISSUE #4: Public Awareness and Appreciation – problem of limited exposure of educators and students to forests and other natural resources; outreach and education tend to reach same populations, with limited public understanding of the importance of rural and urban forests and the diversity of land use interests.

Goal: Student education

- Encourage comprehensive forestry/natural resource curriculum in K-12 education, and encourage outdoor classrooms
- Integrate Project Learning Tree, Project Wet, Project Wild curricula into teacher training programs
- Provide educational opportunities through various mediums (including electronic) to landowners
- Provide urban forestry education to municipal leaders and civic organizations
- Promote rural and urban forestry successes to the general public

A.2 Programs Supporting Commercially Viable Rural Forest Resources

Landowner Assistance Program

State professional foresters are available to assist private landowners with technical advice on reforestation, timber harvesting, and forest management plan development, including establishing forest stewardship plans. In 2011, this technical assistance reforested 323 acres of private land, protected 3,000 acres in forest stewardship plans, and assisted 11 landowners with silviculture practices on 362 acres (DFS, 2011).

State Funded Cost Share Program

The Cost Share program, funded by timber revenue from state forests, helps landowners develop and improve their silviculture plans. The program requires a 50-50 match in funding. In FY 2011, \$9,018 assisted 11 landowners to improve silviculture activities on 362 acres (DFS, 2011).

Forest Legacy Program

Funded by USFS State and Private Forestry Legacy Areas funds, the program helps states protect working forest lands via direct purchase or the creation of conservation easements. Four areas within the state were identified as priority areas for forest protection: White Clay Creek, Blackbird/Blackiston, Redden/Ellendale, and Cypress Swamp (DFS, 2012a).

A.3 DE Urban and Community Forestry Stakeholders

- DFS UCF
- Delaware Forest Stewardship Committee
- Delaware Center for Horticulture
- UD Cooperative Extension
- Delaware Urban and Community Forest Council
- Delaware Nature Society (DNS)
- Delaware Forestry Association
- Delaware Landscape Association
- The Nature Conservancy
- The Conservation Fund

Appendix B: Maryland FCA Case Study

B.1 Forest Conservation Application

EFFECTIVE DECEMBER 1, 2011

FOREST CONSERVATION APPLICATION

Submit All Application Documents in Duplicate

Project Name PROJECT # _____
 Location
 Description

Watershed name Subwatershed #
 County Municipality

Maryland Grid Coordinates centroid: ft North ft East
 North American Datum Year: 1927/1983/1991 (circle one)
 ADC: Year Page Grid
 Tax Map # Grid # Parcel # Block #
 Lot # District/Account#
 Liber Folio

By signing below, the applicant certifies that he or she has the legal right to implement proposed planting, maintenance and/or a long-term protection agreement. The applicant further certifies that the property subject to a long-term protection agreement is not otherwise protected under federal, state or local programs.
 Applicant's Signature date

Applicant Name Owner: Y N (circle one)
 Firm Name
 Address
 City State Zip Code
 Phone #

Indicate if applicant or agent is to be the contact (Circle)

Agent Name
 Firm Name
 Address
 City State Zip Code
 Phone #

FOREST STAND DELINEATION INFORMATION

Total Tract Area Ac.
 Area within 100 year floodplain Ac.
 Area remaining in agriculture Ac.
 Other Ac.
 Net Tract Area Ac.
 Area of Existing Forest Ac.
 Area of Existing NTW forest Ac.
 Total Area in Sensitive Areas Ac.
 Forested Stream Buffers (50 ft. wide minimum) Y/N one/both sides (circle)
 Buffer Area Forested Ac. length ft.
 Steep slopes Y/N
 Threatened and Endangered species Y/N

Dominant & CoDominant Forest Species

FSD Prepared by (print) Lic. LA, Lic. Forester, Qualified Prof. (circle)
pg. 1 of 2

In accordance with Maryland Annotated Code, Natural Resources Article Section 5-1607(c) and COMAR 08.19.04.03B, the applicant must submit written justification for projects that disturb the priorities for retention and protection under Section 5-1607(c) and COMAR 08.19.04.03E.

Per 5-1607(c)(2), a variance is required for disturbance to 1) rare, threatened and endangered tree, shrub or plant species, 2) trees associated with historic structures or is designated a national state or local Champion Tree, and 3) trees with 30 in dbh or 75% of the dbh of the MD State Champion Tree.

PROJECT # _____

FOREST CONSERVATION PLAN INFORMATION

Existing Land Use Category

Residential / Commercial / Industrial / Agriculture / Resource / Mixed Use / PUD / Institutional

Proposed Land Use

Afforestation Threshold

Conservation Threshold

Proposed Area of Disturbance
% in Sensitive Areas

Total Ac.
%

Proposed Forest Clearing
in Sensitive areas
in NTW

Total Ac.
Ac.
Ac.

Forest Retention Onsite Ac.
in Long Term Protection

Offsite Ac.
Ac.

Forest Conservation Required Ac.

Forest Conservation Provided Ac.

Planting Onsite Ac. Offsite Ac.
Sensitive Area Planting Ac.

Stream Buffer established: length (ft) width (ft)

Other:

Offsite Location

County

Tax Map

Parcel

District/Account #

Maryland Grid:
North American Datum Year

ft. N

ft. E

ADC: Year

Page

Grid

Subwatershed

Planting Responsibility:

Maintenance Responsibility:

Phone #

Total Long Term Protection Acreage Ac.
% in Sensitive Areas

%

Long Term Protection Agreement Type

Fee-in-lieu Amount \$

Acres:

FCP Prepared by

(print) Lic. LA, Lic. Forester, Qualified Professional (circle)

Mail to the appropriate office:

Eastern Region

MD DNR Forest Service
201 Baptist St.
Salisbury, MD 21801
(410) 543-6745

Central Region

MD DNR Forest Service
2 S. Bond St.
Bel Air, MD 21014
(410) 836-4551

Southern Region

MD DNR Forest Service
8023 Long Hill Rd
Pasadena, MD 21122
(410) 360-9774

Western Region

MD DNR Forest Service
3 Pershing St. Rm 101
Cumberland, MD 21502
(301) 777-2137

B.2 Forest Conservation Plan Worksheet

FOREST CONSERVATION WORKSHEET		Note: Use 0 for all negative numbers that result from the calculations.
Net Tract Area		
A. Total Tract Area		A=
B. Deductions (Critical Area, area restricted by local ordinance or program)		B=
C. Net Tract Area Net Tract Area = Total Tract (A) - Deductions (B)		C=
Land Use Category: Medium Density Residential		
D. Afforestation Threshold (Net Tract Area [C] x _____%)		D =
E. Conservation Threshold (Net Tract Area [C] x _____%)		E=
Existing Forest Cover		
F. Existing Forest Cover within the Net Tract Area		F=
G. Area of Forest Above Conservation Threshold		G=
If the Existing Forest Cover (F) is greater than the Conservation Threshold (E), then G = F - E; otherwise G = 0.		
Breakeven Point		
H. Breakeven Point (Amount of forest that must be retained so that no mitigation is required)		H=
(1) If the Area of Forest Above Conservation Threshold (G) is <u>greater than</u> 0, then H = (0.2 x the Area of Forest Above Conservation Threshold (G)) + the Conservation Threshold (E);		
(2) If the Area of Forest Above Conservation Threshold (G) is <u>equal to</u> 0, then H= Existing Forest Cover (F)		
I. Forest Clearing Permitted Without Mitigation		I=
I = Existing Forest Cover (F) - Breakeven point (H)		
Proposed Forest Clearing		
J. Total Area of Forest to be Cleared		J=
K. Total Area of Forest to be Retained		K=
K = Existing Forest Cover (F) - Forest to be Cleared (J)		
Planting Requirements		
If the Total Area of Forest to be Retained (K) is <u>at or above</u> the Breakeven Point (H), <u>no planting is required, and no further calculations are necessary</u> (L=0, M=0, N=0, P=0, Q=0, R=0).		
Otherwise, calculate the planting requirement(s) as follows:		
L. Reforestation for Clearing Above the Conservation Threshold		L=
(1) If the Total Area of Forest to be Retained (K) is <u>greater than</u> the Conservation Threshold (E), then L = the Area of Forest to be Cleared (J) x 0.25;		
(2) If the Forest to be Retained (K) is <u>less than or equal to</u> the Conservation Threshold (E), then L = Area of Forest Above Conservation Threshold (G) x 0.25		
M. Reforestation for Clearing Below the Conservation Threshold		M=
(1) If Existing Forest Cover (F) is <u>greater than</u> the Conservation Threshold (E) <u>and</u> the Forest to be Retained (K) is <u>less than or equal to</u> the Conservation Threshold (E), then M = 2.0 x (Conservation Threshold (E) - Forest to be Retained (K))		
(2) If Existing Forest Cover (F) is <u>less than or equal to</u> the Conservation Threshold (E), then M = 2.0 x Forest to be Cleared (J)		
N. Credit for Retention Above the Conservation Threshold		N =
If the area of Forest to be Retained (K) is greater than the Conservation Threshold (E), then N = K - E; Otherwise N=0		
P. Total Reforestation Required P = L + M - N		P=
Q. Total Afforestation Required		
If Existing Forest Cover (F) is less than the Afforestation Threshold (D), then Q = Afforestation Threshold (D) - Existing Forest Cover (F)		Q=
R. Total Planting Requirement R = P + Q		R=

B.3 Carroll County Forest Bank Checklist

Carroll County Bureau of Resource Management

Forest Conservation

FOREST BANK / OFF-SITE RESERVE CHECKLIST

NOTE: County must certify bank before credit can be sold.

FOREST BANK / OFF-SITE RESERVE NAME: _____

FOREST BANK / OFF-SITE RESERVE LOCATION: _____

The Forest Bank / Off-Site Reserve submittal shall include the information listed below. Additional information about these requirements may be found in the Carroll County Forest Conservation Manual.

Indicate X or N/A Below

1. **Forest Bank / Off-Site Reserve Application:**
 - a. Completed application
 - b. Site location map
 - c. Map must include existing site conditions: i.e., topography, soils, wetlands, flood plain, streams, surrounding physiography, contiguous forest, steep slopes (25%), rock outcrops, etc.

2. **Forest Bank / Off-Site Reserve Establishment Plan:**
 - _____ a. Boundaries of area to be planted
 - _____ b. Existing site conditions, i.e., topography, soils, wetlands, flood plain, streams, surrounding physiography, contiguous forest, steep slopes (25%), rock outcrops, etc.
 - _____ c. Area to be planted
 - _____ d. Signage (around planting and detail on plan)
 - _____ e. Fencing (if required)
 - _____ f. Plant species (stocking & spacing)
 - _____ g. Tubex (detail) (if required)
 - _____ h. Planting design showing typical layout
 - _____ i. Planting detail for planting stock specified
 - _____ j. Post management program (i.e., easement & maintenance agreement unless natural regeneration)
 - _____ k. Title certificate covering the affected property
 - _____ l. Planting specifications
 - _____ m. Metes & Bounds Description
 - _____ n. Letter of credit or other form of bond (need paperwork)
 - _____ o. Deed of Easement:
By Developer _____ or By County Attorney _____
 - _____ p. Maintenance & Management Agreement:
By Developer _____ or By County Attorney _____
 - _____ q. Compliance with BGE Specifications for Planting (see 115-21. Of the Carroll County Forest Conservation Ordinance).
 - _____ r. The Forest Bank / Off-Site Reserve Establishment Plan must show a list of all acreage used and the sites that have utilized the bank acreage. A total of acreage remaining for use must be provided.
 - _____ s. Need a plan for each site using banking that shows acreage previously used and acreage to be used for the new project.

Appendix C: Pennsylvania Case Study: Selection Criteria for Pennsylvania DEP Growing Greener Grant Selection

1. The project proposal must include and explain the problem and how the work will be done.
2. Will the project improve the watershed and address pollution. Are there quantitative benefits to the project?
3. Is there a clear watershed focus, and does it fit into the watershed plan goals?
4. Are there measurable environmental benefits, what are they?
5. What is the timeframe for the project? Has design and permitting been completed? If needed has the agreement with landowners been secured?
6. Is there a plan for continued project support over the long term? Have operations, maintenance and replacement been detailed?
7. Does the project demonstrate or encourage community involvement?
8. Are there opportunities for public participation?
9. A detailed budget must be included, are all budget costs allowable and reasonable?
10. Is match funding or service provided?
11. Is the project organizer qualified and have the capacity to execute the project?
12. Does the proposal demonstrate need for funding?
13. Are responsibilities outlined?
14. Is the project consistent with local comprehensive plans and zoning ordinances?
15. Preference will be given to projects that use Request for Proposals (RFP) when subcontractors are needed for contractual services or construction bidding.
16. Is there evidence that the applicant has explored alternatives for solving the problem?
17. Projects that support major DEP priorities will be given scoring preference.

(Created from DEP, 2012b)

Appendix D: California Case Study: Summary of California Agencies and Programs Which Support Urban Green Infrastructure

Implementing/ Oversight Agency		Name of Grant Program	Enabling Legislation		Guiding Policy and/or Strategic Plan
			Jurisdiction/Oversight	Funding	
URBAN FORESTRY	Calfire	1. Urban and Community Forestry Grant Program Management Plan Grant Leafing Out Grant Leading Edge Inventory Grant Green Trees Grant Education Grant Urban Wood Utilization Program	Urban Forests Act of 1978	Prop 40 (2002) Prop 84 (2006)	Forest and Rangeland Assessment and Strategy; CUFAC Forestry Action Plan
CLIMATE CHANGE MITIGATION/ADAPTATION	NRA In cooperation with Dept. of Transportation (CalTrans)	2. Environmental Enhancement and Mitigation Program (EEMP) Highway Landscaping/Urban Forestry Resource Lands Roadside Recreation Environmental Impact Assessment	Transportation Blueprint Legislation of 1989	Highways Code Section 164.56 Up to \$10 million annually	
	NRA in coordination w/SGC	3. Urban Greening Projects	SB 732	Prop 84	SGC Strategic Plan, HiAP Task Force Report
	Department of Conservation in coordination w/SGC	4. Sustainable Community Planning Grant Program	SB 732	Prop 84	SGC Strategic Plan, HiAP Task Force Report
URBAN GREENING & PUBLIC HEALTH	Department of CA State Parks	5. Statewide Park Development and Community Revitalization Program	AB 31	Prop 84	SGC Strategic Plan, HiAP Task Force Report
	Natural Resources Agency (NRA)	6. River Parkways	River Parkways Act	Prop 50 Prop 84	SGC Strategic Plan, HiAP Task Force Report
	Department of Water Resources	7. Urban Streams Restoration Project	Urban Water Management Planning Act	Prop 84	

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