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Green Infrastructure in Parks:

A Guide to Collaboration, Funding, and Community Engagement

U.S. Environmental Protection Agency, Office of Water

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Rich Dolesh, National Recreation and Park Association
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Alisha Goldstein, PE, District of Columbia Department of Energy and Environment
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Jayne Spector, Langan Engineering & Environmental Services
Robert Cantoreggi, Town of Franklin, Massachusetts, Department of Public Works
Kate Sjoberg, Town of Franklin, Massachusetts, Department of Public Works

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INTRODUCTION

This guide is intended to encourage partnerships between park agencies and stormwater agencies aimed at promoting the use of green infrastructure on park lands. Green infrastructure can help to maximize the environmental, economic, and social benefits of parks. By building strong partnerships, agencies can improve park lands and access to parks, better manage stormwater, increase community resiliency to shifting weather patterns, and provide funding to implement and maintain park enhancements that benefit the community.

The guide offers information on why partnerships between stormwater managers and parks managers can be beneficial and how you can create such partnerships. The guide presents an overview of green infrastructure and describes practices that can be used to manage stormwater in parks. In addition, you will find information on factors that influence the selection of appropriate green infrastructure practices, such as maintenance requirements.

The guide is designed to provide you with a stepwise approach for building relationships with potential partners, and includes information on how to identify and engage partners, build relationships, involve the community, leverage funding opportunities, and identify green infrastructure opportunities. It includes recommendations on the types of projects that are most likely to attract positive attention and funding, and which provide a wide range of benefits.

Case studies are included to illustrate the approaches presented in the guide. These real-life examples portray how partnerships between municipal stormwater agencies and parks departments have improved recreational resources in the community, enhanced environmental protection, and reduced risks and burdens.

For those who wish to go deeper into a topic, the guide includes short descriptions and links to external resources that provide more detail on the material presented within.

HOW GREEN INFRASTRUCTURE CAN ENHANCE PARKS

Enhances Recreation Value

Green infrastructure can be used to create or enhance amenities in parks. For example, hiking or biking trails can be built incorporating green infrastructure. Restoration of degraded areas can provide wildlife habitat and viewing areas and opportunities for outdoor education. Green infrastructure practices can be designed to reduce pollutants discharged into waterbodies and reduce the threat of illness from recreational contact due to wading, swimming, or boating.

Buried streams and springs can be unearthed and restored to provide interactive water features such as wetlands, ponds, and creeks for public use. Natural drainage ways and infiltration practices can be used to help maintain adequate flows to these waterbodies.

Creates Attractive Park Features

Green infrastructure practices designed to infiltrate runoff can include a diverse palette of native plants and locally adapted plants of many textures and colors. These bioretention areas can be designed with pathways and benches for public enjoyment and planted to attract beneficial wildlife such as butterflies or other pollinators.

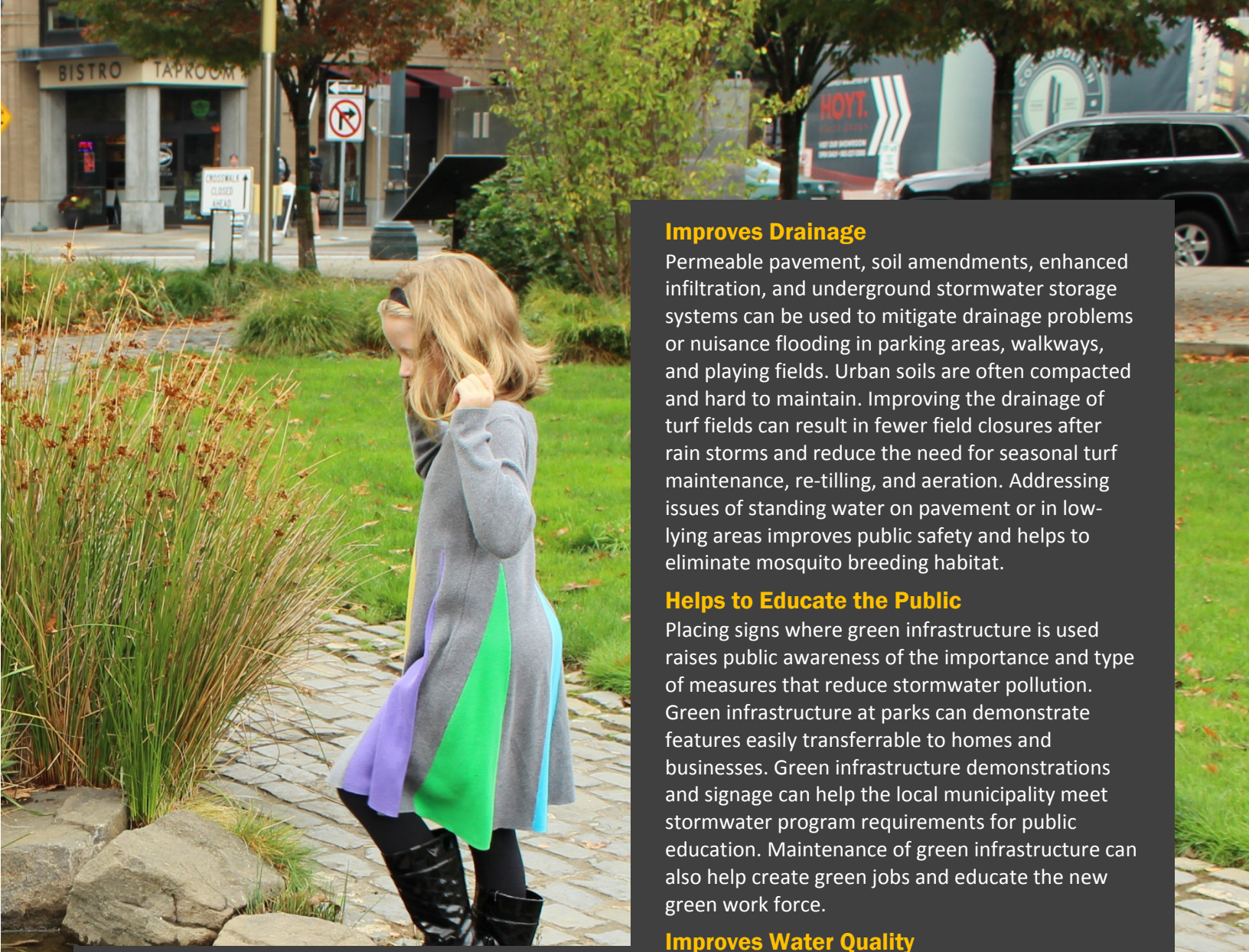
Drainage and infiltration areas can be designed to enhance the topography of the park and provide picnicking and play areas, as well as visual or physical barriers to create special areas for meditation or wildlife viewing. Trees, shrubs, and ornamental grasses, in addition to being visual amenities, can be used to reduce noise and cut-throughs.

Enhances Social and Environmental Equity

Green infrastructure can be used to enhance public wellbeing in underserved or underprivileged communities. These communities often lack adequate park access and facilities. Newly created and rehabilitated parks can enhance the health of local residents by providing opportunities for physical activity, interactions with nature, and destination community gathering places.

Reduces Maintenance

Green infrastructure can be used to help reduce maintenance at parks. Stormwater utility funds can be used to improve drainage, reduce erosion, and eliminate standing water. The health of vegetation can be improved through better drainage and the maintenance burden can be reduced. Good drainage systems that promote infiltration or overland flow can help reduce mosquito breeding habitat and disperse water over a larger vegetated area and potentially reduce irrigation needs. Converting high maintenance vegetation (such as turf) to lower maintenance native vegetation can reduce the need for supplemental water and other inputs such as fertilizers and pesticides. Mowing and weeding frequency might also be reduced. Green infrastructure areas can help reduce problems caused by high runoff or sedimentation of streams.



Improves Drainage

Permeable pavement, soil amendments, enhanced infiltration, and underground stormwater storage systems can be used to mitigate drainage problems or nuisance flooding in parking areas, walkways, and playing fields. Urban soils are often compacted and hard to maintain. Improving the drainage of turf fields can result in fewer field closures after rain storms and reduce the need for seasonal turf maintenance, re-tilling, and aeration. Addressing issues of standing water on pavement or in low-lying areas improves public safety and helps to eliminate mosquito breeding habitat.

Helps to Educate the Public

Placing signs where green infrastructure is used raises public awareness of the importance and type of measures that reduce stormwater pollution. Green infrastructure at parks can demonstrate features easily transferrable to homes and businesses. Green infrastructure demonstrations and signage can help the local municipality meet stormwater program requirements for public education. Maintenance of green infrastructure can also help create green jobs and educate the new green work force.

Improves Water Quality

Stormwater volume and pollutant reductions can be achieved with green infrastructure to help local municipalities meet regulatory requirements. Park spaces offer a wealth of pervious surface that can be used to absorb rainwater and runoff from adjacent developed landscapes that currently drain directly to piped collection systems.

Benefits the Overall Environment

Green infrastructure can be used to reduce urban heat island impacts by incorporating vegetation, especially trees, where pavement or conventional turf landscapes existed before. Vegetated green infrastructure can also sequester carbon via CO_2 uptake during photosynthesis, which traps carbon in the biomass and helps reduce greenhouse gases. Green infrastructure planted with native and locally adapted plants can attract beneficial wildlife such as birds, butterflies, and other pollinators.

Provides Economic Benefits

Green infrastructure can be installed to earn stormwater utility credits in stormwater fee areas, and the parks could receive funds from such programs. Parks with green infrastructure might be able to apply for maintenance funding or have their best management practices (BMPs) maintained by an outside party, depending on the type of BMPs and the types of approaches taken by the local municipality. Where rainwater harvesting has been incorporated, captured water can be used for irrigation or other graywater uses, reducing costs associated with potable or recycled water use. Upgraded stormwater management systems could also reduce maintenance costs or reduce capital costs to upgrade essential stormwater management infrastructure. Destination parks could also stimulate community-level investments due to the desirability of being near the park.

Relationship Between Parks and Green Infrastructure

A typical park already contains open space areas that absorb stormwater and offer water quality, habitat, and aesthetic benefits. Park infrastructure—parking lots, roads, buildings, playing fields, courts, and other man-made surfaces—can be built or retrofitted to treat stormwater or drain to enhanced pervious surfaces. The following are some opportunities to enhance park features using green infrastructure.

Parking Lots

- Bioretention in landscaped areas, medians, and roundabouts
- Permeable pavement in parking stalls, overflow parking, and walkways
- Trees in landscaped areas
- Amended soils to improve infiltration, pollutant removal, and plant health

Visitor Centers

- Bioretention demonstration gardens
- Pollinator gardens that treat stormwater
- Green roofs
- Rainwater barrels and cisterns
- Planter boxes in space-limited areas

Playing Fields

- Temporary detention storage
- Permeable pavement in parking stalls, overflow parking, and walkways

Paved Trails, Walkways, and Roads

- Permeable pavement walkways, parking, and fire lanes
- Trees planted along roadsides and pathways

Wetlands and Drainage Systems

- Natural areas along stream channels
- Constructed wetlands created in existing drainage areas
- Wildlife habitat areas that serve as stormwater runoff areas

Renderings by Heather Conn and Nicole Chapman, Tetra Tech. Playing field photo by Alisha Goldstein, USEPA. Cistern photo by Jason Wright, Tetra Tech.

Common Questions About Green Infrastructure

What do I need to know about green infrastructure, and what does the public need to know about green infrastructure and how it relates to parks?

Why choose green over gray infrastructure?

There are a variety of benefits of choosing green infrastructure over traditional gray infrastructure (e.g., concrete pipes), including:

- It's more attractive, effective, and multifunctional.
- It provides habitat for beneficial wildlife.
- It can reduce maintenance and eliminate mosquito breeding habitat.
- It can incorporate existing park features—both natural elements and man-made infrastructure.
- Using it can reduce infrastructure costs compared to gray infrastructure.

Will it attract nuisance wildlife?

Not if you design and maintain it correctly according to local standards and the following guidelines:

- Choose the right mix of plants to attract beneficial wildlife (e.g., birds, pollinators).
- Select green infrastructure elements that eliminate standing water that could serve as mosquito breeding habitat, and design facilities to drain in 72 hours. Ensure permanent pools don't become stagnant.
- Nuisance wildlife can occur in all parks. Good design and attentive management such as eliminating food sources and providing securely covered trash receptacles can reduce or eliminate problems.
- Inspect practices regularly to remedy any problems.

Will the stormwater features be unattractive or create safety hazards?

Not if you use green infrastructure, because:

- Green infrastructure practices are typically integrated into the landscape and rely mainly on soils, vegetation, and infiltration to reduce runoff.
- Traditional stormwater management creates detention basins and wet ponds that are often unsightly and need fences to keep out the public.
- Green infrastructure features can be designed with aesthetics in mind and can even incorporate benches, art, or sculptural designs.

How do you ensure public safety and limit liability?

- If possible, design features to infiltrate runoff.
- Design stormwater elements that minimize the risk potential for park users such as eliminating trip hazards, adding crushed stone paths, or designing boardwalks or viewing platforms.
- Create water areas (e.g., permanent pools, water features) with the public in mind. Careful design, clear sight lines, and natural features such as wetland fringes can reduce or eliminate hazards.
- Limit access to gently sloping bank areas around water features by adding natural screens and barriers, and allow public access where it can be controlled or monitored by park staff.

Mosquito Control

Green infrastructure can be designed to limit mosquito breeding. Green infrastructure design standards allow for standing water for short periods of time—usually 48 to 72 hours—which is much shorter than the time needed for mosquitoes to develop from larvae to adults. When designed to this standard and properly maintained, green infrastructure ensures that water is infiltrated into the ground quickly enough to limit nuisance insects.

Mosquito control via green infrastructure also reduces the need for parks managers to use insecticides for mosquito control—an overall benefit to health, safety, and the environment.

Who will pay for the project?

- Stormwater utilities often have program funding that can be used to construct and maintain stormwater features in parks.
- In some cases, stormwater management agencies may provide direct funding to parks to operate and maintain stormwater management features that the stormwater utility builds in the park or areas adjacent to the park.
- Depending on the jurisdiction, costs can be shared across agencies.
- Grants might be available from the state or other granting organizations, such as nongovernmental agencies that have an interest in enhancing the park and the community in general. Examples of such funds include community revitalization, smart growth, or watershed restoration funds.
- A wider range of grants could be available because of the multifunctional nature of such projects (e.g., park enhancement, watershed, and neighborhood improvement grants).

Who will pay for maintenance?

Parks managers often are concerned about the lack of funds available to maintain their parks. Maintenance of stormwater features in parks can be funded by numerous methods which vary by the institutional arrangements in a given jurisdiction. For example:

- If the community has a stormwater utility, money can be set aside for green infrastructure maintenance.
- If both parks agencies and stormwater agencies receive general funds, a maintenance budget can be negotiated and allocated according to each agency's responsibilities.
- When deciding to engage in creative management arrangements such as these, be sure that funds are budgeted before the project is constructed and that long-term operation and maintenance needs are incorporated into the continuing operating budget. This will help ensure that adequate funds are allocated to the agency responsible for the maintenance burden.

Who will perform maintenance?

Maintenance arrangements will be determined by the institutional structure of the jurisdiction. For example:

- If funds are allocated to supplement the existing park maintenance activities, park maintenance staff or contractors managed by the park can perform the necessary maintenance.
- Most green infrastructure practices can be maintained by landscape professionals who have received some supplemental training specific to the stormwater practices being implemented.
- In other cases, the stormwater agency might want to either directly manage maintenance or oversee maintenance to ensure proper functioning of the stormwater management practices.
- Maintenance responsibilities can also be divided between the park maintenance staff and staff trained or managed by the stormwater utility, depending on the practices employed. For example, maintenance of bioretention facilities typically can be taken care of by the regular landscape crews as long as they understand what to mow and weed and how to identify problems. More difficult maintenance activities, such as the use of vacuum sweepers for permeable pavements or the maintenance of water features, could be performed by the stormwater utility.
- Ideally, the details, responsibilities, and funding allocations should be worked out in a memorandum of understanding (MOU) or other such agreement between agencies (see page 18).

Should we be concerned about maintenance becoming a burden?

All landscape and stormwater features require maintenance. Green infrastructure features usually are not more maintenance intensive, especially if they are designed correctly:

- Most vegetative practices like rain gardens are maintained like any landscaping—weeding, pruning, digging, and removing trash.
- Rainwater harvesting practices require simple cleaning of gutters and downspouts.
- Permeable pavement is low maintenance but can benefit from occasional vacuum sweeping.

Special equipment, excepting vacuum sweepers, generally is not needed. Municipal governments often have the in-house expertise and equipment. If not, the work can be contracted to an outside company.

GETTING STARTED

Adding green infrastructure practices in a park is a multi-step process that involves a variety of stakeholders. The first phase of any project involves identifying partners. Engaging with partners from the outset of the project will ensure that the necessary expertise is available to guide the project from an idea through its implementation. The second phase includes relationship building, leveraging funds, identifying which green infrastructure practices to use, and planning for maintenance. Selection of high-visibility pilot projects can draw attention to the work being undertaken and encourage community support.

The following sections walk through the steps in the process. Case studies are provided to highlight examples of successfully projects.

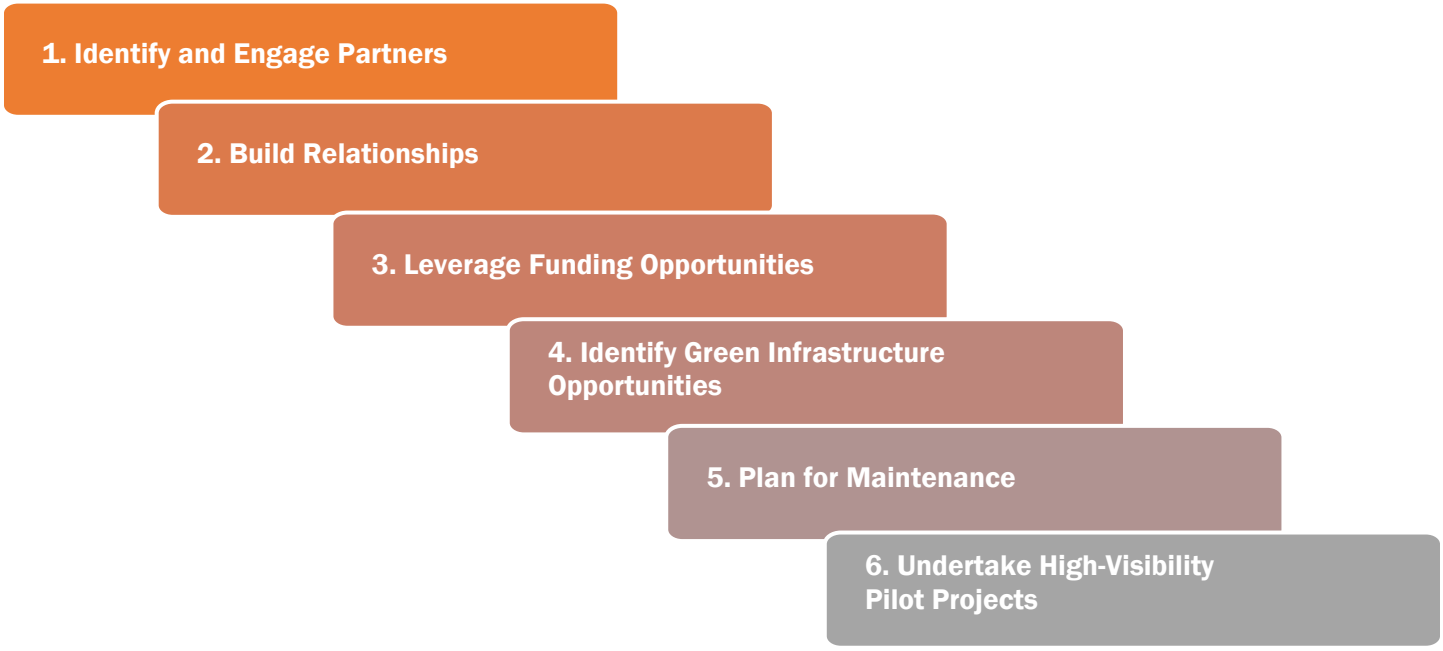


Figure 1. Process for implementing green infrastructure.

1. Identify and Engage Partners

Establishing partnerships is critical to determining whether there is interest and funding to incorporate green infrastructure into park lands. The impetus for using green infrastructure can come from elected officials, a park superintendent, a stormwater utility manager, the water regulatory agency, or the department of conservation or natural resources.

The following are example partnerships:

- A stormwater utility approaches a park superintendent because the agency sees opportunities to manage significant volumes of water on park areas.
- An elected official has a vision of a park with water features and a sustainability plan that promotes the revitalization of the community through the enhancement of the park.

Case Study: Indianapolis Cultural Trail — Indianapolis, Indiana

The Indianapolis Cultural Trail: A Legacy of Gene & Marilyn Glick is an 8-mile bike and pedestrian path in downtown Indianapolis, Indiana. The trail, completed in 2013, links the city's six cultural districts, neighborhoods, the city's 40 miles of greenway trails, and other areas of the downtown. Each of the cultural districts maintains a unique identity, with various amenities including shopping, recreation, entertainment, and dining. By linking these districts, residents and visitors to the city can more easily enjoy a healthy lifestyle and access both open spaces and cultural activities. Activities such as fun runs and spring cleanups engage the community in being active and in protecting and maintaining the trail. The trail has been recognized with a number of awards, and the New York Times included Indianapolis and the trail on its list of 52 Places to Go in 2014.

Figure 2. Cyclist riding the Indianapolis Cultural Trail alongside stormwater planters. (Source: Clark Wilson, USEPA)

The construction of the trail resulted in a number of amenities, including:

- 5 acres of new landscaping
- 86 bike racks
- 7 public art projects along the trail
- A bikeshare program with 29 stations that includes subsidized passes for low-income residents

In addition to new landscaping, designers installed 25,400 square feet of stormwater planters. These planters better enable stormwater to slowly drain into the ground, reducing stormwater runoff, flow rate, volume and pollutants, and recharging groundwater supplies.

The trail is the result of efforts by a number of public and private collaborators, including the city of Indianapolis, Central Indiana Community Foundation, and several not-for-profit organizations. Initial planning for the project took place in 2001–2003, with $4 million raised for initial study and design. In 2004, the city gave permission for the trail to be built on the city right-of-way, and the groundbreaking took place in 2007. The total project cost was $63 million, with $27.5 million in private funding and $35.5 million in federal transportation funding (including a $20.5 million TIGER grant from the U.S. Department of Transportation).

- The state or local department of transportation has a project that requires offsite mitigation of stormwater, and the park could be the best and most affordable place in which to locate stormwater management practices. In this case, the department of transportation might be strongly motivated to provide incentives in the form of park enhancements and maintenance concessions so that the parks manager clearly sees reasons to engage in such partnerships.
- The parks manager approaches the local utility regarding potential opportunities for funding to support restoration of stream channels, eroded areas, or areas prone to flooding (e.g., recreational fields that are frequently rendered unusable by floodwaters).

Park agencies can work with local governments and quasi-governmental utility agencies that are responsible for managing stormwater to prevent flooding and meet water quality regulations. This might be a public works, engineering, or planning department; drainage district; or water and sewer authority. Many stormwater agencies have an interest in implementing green infrastructure and might be able to fund or cost-share the design, construction, or maintenance of green infrastructure.

Stormwater agencies will be aware of priority areas that could benefit from green infrastructure, such as those with known water quality problems, undersized or failing drainage infrastructure, and a history of localized flooding or combined sewer overflows. Once these areas are identified, stormwater agencies can work with parks agencies to narrow down potential locations for green infrastructure and provide advice on site suitability, design, and engineering considerations. They can also identify possible green infrastructure funding from stormwater-related revenue or dedicated grant/loan programs.

Stormwater agencies can contact park agencies—either individual park managers or park agency leadership—depending on the scale of desired efforts. They might want to look at a single park for a project or evaluate parks citywide for green infrastructure opportunities. Ultimately, multiple levels of park management will need to be involved in the decision making.

Environmental Justice

Historically, many cities have had limited park space and recreational amenities in economically disadvantaged neighborhoods. In more recent years, there has been an increase in active community engagement in these underserved areas to improve previously neglected or derelict spaces and to reimagine how these areas can become public park space.

Citizens can benefit from living or working near park spaces by participating more in healthy physical activity, experiencing a positive sense of community, and having more equitable access to environmental resources such as parks and open space. Park spaces offer areas where neighbors can gather for play, exercise, social interaction, or other leisure activities. Studies have shown that having access to parks or green space can contribute to improved psychological health and wellbeing of those who live or work nearby by reducing stress.

When community members come together to correct environmental damage or to rehabilitate and redesign parks, they are able to actively participate in the decision-making process and gain a voice in improving the local environment and community livability.

Governmental Agency Partners

Other agencies and departments can have a stake in green infrastructure and park enhancements.

- **The local executive office** (mayor, commissioner, etc.) might want to promote clean water, sustainability, and green jobs to maintain green infrastructure.
- **Transportation departments** can partner with parks to achieve better drainage along problematic roads or intersections. Underutilized open space at interchanges can be used for both stormwater management and recreation. Transportation departments might have funds to mitigate the impacts of transportation projects on sensitive areas such as wetlands and wildlife habitat. These funds might be used to create constructed wetlands, stormwater/habitat ponds, or other green infrastructure elements in parks.
- **School districts** can partner with parks departments to create living laboratories and green infrastructure park projects that are part of an environmental curriculum. These features can also promote physical education and interaction with nature.

- **Community colleges and technical schools** can work with parks to establish a green jobs training program for green infrastructure design, installation, and maintenance.
- **Public health agencies** might want to see underperforming parks revitalized or have new parks created in underserved neighborhoods.
- **Planning agencies** might seek to maximize the use of open space that is vacant or dilapidated. Or they could want to connect systems of parks and open space to capitalize on the environmental and social benefits gained by adding green infrastructure elements.
- **Sustainability agencies** might want to incorporate green infrastructure into economic development plans and achieve green infrastructure targets through park improvements or park creation (e.g., converting brownfields). Partnerships with parks can achieve sustainability goals in a number of ways, including providing minimum per capita areas of green space, park access within a maximum distance, or tree canopy coverage.

Community Partners

Community groups can be important partners who serve as advocates for park improvements, the use of green infrastructure, and the creative use of interdepartmental funds. For example:

- **Neighborhood and community associations** can lend public support for park enhancements and recruit volunteers to help construct and maintain the features.
- **Business improvement districts** can be a funding source for park development, improvements, or maintenance. Funding generally comes from financial assessments on businesses and property owners who might benefit from their proximity to the park.
- **Watershed groups** recognize the need to mitigate stormwater impacts from developed areas to protect water resources. These groups can apply for or allocate grant funding for green infrastructure projects and mobilize volunteers to assist with construction and maintenance.
- **Friends of parks** and other recreation, conservation, or environmental groups can recruit volunteer labor for help with project implementation and maintenance.
- **Urban forestry advocates** and Arbor Day groups could support tree-planting to enhance the urban tree canopy.
- **Local businesses** and **garden clubs** could provide plants and volunteers for green infrastructure features.

There are many real-life examples of how park agencies and stormwater agencies collaborated to identify green infrastructure opportunities, build better relationships, leverage funding opportunities, and solve a diverse set of other challenges through the use of green infrastructure in parks. The case study examples featured on the following pages highlight successful collaborative efforts to incorporate green infrastructure into the design of parks to improve stormwater management, enhance park aesthetics, and foster community access and use of park space, while lowering operating costs using green infrastructure practices in lieu of gray infrastructure.

Business Improvement Districts

Business improvement districts (BIDs) can offer a unique funding source to maintain and improve parks. A BID is a group of businesses in a given area that pay a fee to fund local projects. In some areas, businesses have been shown to benefit from the proximity to park space, and those businesses have organized to collect fees from members to invest in local improvement.

For example, in the Washington, DC area, the Capitol Riverfront BID manages 10 acres of park space that attracts both residents and nonresident visitors to enjoy the park areas and local events. These parks, located in urban areas that were formerly underdeveloped, are attractions for a growing community of new residents and businesses.

In New York City, the Friends of Hudson Park are seeking to create a similar model with the Hudson River Park BID. This BID would collect fees from for residents of neighborhoods bordering Hudson River Park, rather than from local businesses. A recent study of the area found that residential property values have increased since the park had been restored with open green space, bike lanes, and commercial areas. Advocates say that the BID could raise $5 million dollars per year of the $14 million dollars needed to run and maintain the park annually.

MOVING FORWARD

2. Build Relationships

Once you have identified potential partners, these partners can be engaged by working with them to identify common mutually beneficial goals. Parks supervisors and other potential partners can also explore creative funding arrangements to secure adequate funding to implement park projects that meet the goals of the respective partners.

Case Study: Partnering to Create Herron Park — Philadelphia, Pennsylvania

In 2009, the city of Philadelphia proposed a 20-year plan to improve stormwater management and water quality in local streams and rivers. This approach focused on using green infrastructure to change the city's drainage and provide other benefits to the local community. The Philadelphia Recreation Department and the Philadelphia Water Department collaborated on the redevelopment of Herron Park in Philadelphia, a 1.12-acre park that was largely covered in concrete. The departments worked together to blend new recreational and aesthetic amenities with stormwater management elements. The park features:

- A playground.
- A porous surface basketball court.
- A push-button activated "sprayground" that only runs when people are present.
- More than 80 native and adapted trees, shrubs, grasses, and a rain garden with more than 3,000 water-tolerant native plants.
- A vegetated swale.
- An infiltration trench.

Figure 3. Top: east entrance of the park in 2011 after new green infrastructure elements were installed. Bottom: conditions in 2009, before renovation. (Source: Langan Engineering)

Both the basketball court and playground meet multiple goals. The porous asphalt surface on the basketball court allows water to pass through to the soil below, including water from an adjacent street that is redirected to the court. The pervious safety surface of the playground is made from recycled tires to meet playground safety requirements and infiltrate water. Other green design elements include a vegetated swale that serves as a passive lawn area and slows stormwater before it enters the drainage system. A new infiltration trench with a perforated pipe laid in gravel replaced a traditional concrete drain, allowing stormwater to soak into the soil beneath the porous play surface while ensuring proper drainage. The green infrastructure elements help retain the first inch of rainfall from the site itself as well as runoff from 1.17 acres of adjacent, impervious land. The park reconstruction, which cost $1.1 million, helps the Philadelphia Water Department meet its legal obligation under a 2011 consent decree with the U.S. Environmental Protection Agency to reduce combined sewer overflows into the Delaware River by 85 percent.

3. Leverage Funding Opportunities

Partnerships with sister departments, nongovernmental organizations, and other state or local entities can lead to funds that can be used to improve the park or create and operate new parks that incorporate multifunctional green infrastructure components. For example:

- **Water providers** can fund infiltration-based green infrastructure projects such as rain gardens and bioswales that recharge groundwater supplies.
- **Stormwater utilities** can use a portion of their dedicated fee to build green infrastructure that treats runoff from impervious surfaces in high-priority areas.
- **Watershed and environmental groups** can apply for grants to implement green infrastructure projects that benefit downstream waters, create wildlife habitat, reduce urban heat, and expand the tree canopy.

Case Study: Collaborative Funding at Cromwell Park — Shoreline, Washington

Cromwell Park in Shoreline, Washington, is a 9-acre park designed to combine stormwater detention and treatment with recreation. One goal in the original design of the park was to capitalize on the existing wetland and subterranean bog as a way to improve stormwater management in this area of town, rather than adding gray infrastructure. The park, which was constructed for $1.65 million with joint funding from the 2006 Parks and Open Space Bond Levy and the Surface Water Utility, includes a number of green infrastructure practices:

Figure 4. Cromwell Park from above. (Source: Gaynor, Inc.)

- A 1.33-acre constructed bioretention facility (constructed wetland) and enhanced natural wetlands.
- Bioswales to guide, capture, and filter stormwater.
- Curb cuts to facilitate stormwater inflow to infiltration areas.
- Porous pavers to further promote soil infiltration, rather than piping flows to nearby streams.

These improvements enhance stormwater management, control flooding that had been problematic in the past, and improve overall water quality. Stormwater flows into the constructed wetland areas, which filter the water and serve as a holding basin, allowing for infiltration. The wetland increases the capacity of the stormwater system by retaining one acre-foot of water without expanding any of the gray infrastructure. In addition to these benefits, the local community can enjoy the many recreational improvements, such as an irrigated sports field, walking paths/trails, play equipment, landscaping, picnic facilities, benches, and drinking fountains. Restoration of the natural wetland, native plantings, and paths that complement the natural features of the park support an enhanced natural habitat. Cromwell Park is jointly maintained by the Parks and Recreation Department and the Surface Water Utility.

4. Identify Green Infrastructure Opportunities

Where should green infrastructure be installed in parks? Below are some ideas to get the most benefit from green infrastructure at your site.

Capture Runoff

Look for opportunities where runoff from park land and adjacent rights-of-way can be directed to pervious park spaces or other green features designed to retain stormwater. For example:

- Use curb cuts to direct water from roadways to landscaping or other pervious areas.
- Create a vegetated swale along the perimeter of the property with ornamental shrubs, grasses, and other landscaping elements to collect and infiltrate offsite run-on or runoff.
- Build a rain garden to capture runoff and feature plants that attract butterflies or birds.

Case Study: Treating Offsite Runoff at Hunter Point South Waterfront Park **Long Island City, New York**

Hunter Point South Waterfront Park, in Queens, New York, is a 5.5-acre park located directly on the waterfront in a former industrial area of Long Island City. The park provides a multi-use open space that incorporates an array of design features to encourage recreational activities, manage stormwater, and conserve water and power.

Figure 5. Hunter Point South Waterfront Park. (Source: ESTO)

Hunter Point South Waterfront Park includes a multi-use, grassy oval framed by a continuous path and a pleated steel roof shade pavilion. The oval field serves as a landscaped play area for most of the year, but it can also handle storm surges on the flood-prone site. Adjacent to the oval, a canopied pavilion houses Parks Department offices, restrooms, and a café. The structure is designed to withstand uplift in case of flooding, and its roof directs rainwater into bioswales that manage stormwater onsite. The park also features a play area, basketball courts, adult fitness facilities, a children's playground, and a dog run.

At the park's perimeter, a bioretention area filters stormwater from the new Center Boulevard and surrounding streets, minimizing impacts on the city's drainage infrastructure. Photovoltaic panels located on the pleated roof of the pavilion generate 37,000 kWh per year, powering more than half of the park's energy needs.

Target Hard Surfaces

Impervious surfaces generate the most runoff. Reducing the amount of impervious surface at the park can have a big impact on water quality and localized flooding. Options include:

- Evaluate parking demand and convert underused parking spaces to landscaped area.
- Convert low-traffic stalls and lanes to permeable pavement.
- Use pervious asphalt or concrete for basketball courts and other paved areas.

Another way to reduce the impact of impervious surfaces is to direct the runoff they generate to pervious areas rather than the storm drain system or nearby waterbodies. Options include:

- Disconnect gutter downspouts so that water flows over landscaped, pervious areas or is captured for later use.
- Reconfigure parking lots (e.g., cut curbing at strategic spots) so runoff drains to landscaped areas.
- Grade walkways and plazas to drain toward turf grass, natural areas, and other pervious areas.

Case Study: Converting Concrete to Green Space at Historic Fourth Ward Park — Atlanta, Georgia

Completed in 2011, Historic Fourth Ward Park is a 17-acre urban park located along Atlanta's BeltLine, a former railway being redeveloped as a multi-use trail. It is situated in a lowland area that had experienced flooding and sewer overflows during storms.

The site of the park was originally a mix of industrial and commercial property, including areas that had become vacant or blighted. City planners wanted to provide the surrounding neighborhood with a multipurpose green space in which residents could gather, while at the same time improving stormwater management. The park includes:

- A 2-acre stormwater retention pond bordered by plantings and a walkway that can capture runoff from a 100-year storm.
- An underground cistern that allows for the reuse of nonpotable water, and rain gardens with constructed wetlands.
- An increase in pervious groundcover.
- Recreational amenities including open meadows and lawns, an amphitheater, a skate park, playgrounds, and a multi-use field.

Figure 6. Top: Historic Fourth Ward Park. Bottom: conditions before construction. (Source: Steve Carrol, HDR)

The park is owned and managed by the city of Atlanta and supported by the Historic Fourth Ward Park Conservancy. The land for the park was donated by Georgia Power and BB&T, with funding provided by the Atlanta BeltLine Partnership Capital Campaign, the Department of Watershed Management, Park Improvement Bonds, and the Atlanta BeltLine Tax Allocation District. It is estimated that the green infrastructure features in the park saved Atlanta more than $15 million compared with installing conventional gray infrastructure drainage alternatives. Development of the park has allowed Atlanta to meet a federal consent decree regarding combined sewer overflows and waste treatment.

Take Advantage of Areas with Infiltration Potential

Are there areas of your park with great drainage, such as those with sandy soils? These spots can infiltrate a large amount of stormwater and are preferred locations for green drainage practices. Locating these features in a well-drained area saves money because the native soil can be used, and temporary standing water after storms is minimal.

Case Study: Recharging Water Supplies with Treated Stormwater — Los Angeles, California

Sun Valley Park in Los Angeles County, California, was converted to a multi-use site that reduces flooding, treats stormwater, and conserves water while continuing to provide recreational benefits. The park collects runoff from a 21-acre drainage area. The stormwater is piped into a treatment system to remove pollutants. Treated water then flows to infiltration basins located underground beneath the soccer and baseball fields to recharge the groundwater aquifer. The project also includes enhancements to recreational amenities, including new sport fields, seating, lighting, and signage. Project benefits include:

- Reduced flooding
- Water conservation (30 acre-feet/year)
- Native plant landscaping
- Recreational ballfields, lighting, bleachers

The project was completed in 2006 for approximately $7 million. It was funded by a Department of Water Resources Local Groundwater Assistance Grant, a Proposition 12 Grant through TreePeople, and the Los Angeles County Flood Control District.

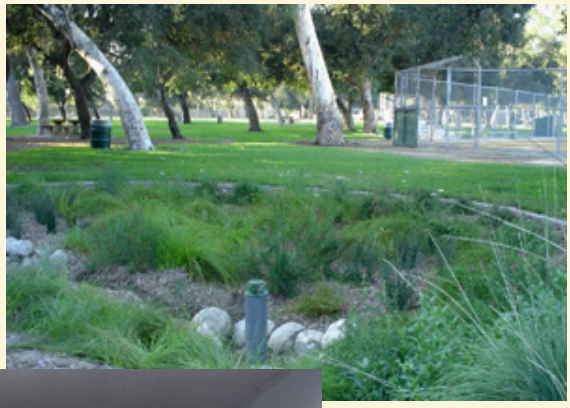


Figure 7. Top: Sun Valley Park vegetated swales. Bottom: underground infiltration gallery. (Source: Los Angeles County Flood Control District)

Case Study: Enhancing Infiltration at Elmwood Park — Omaha, Nebraska

The city of Omaha completed the Elmwood Park project in combination with a neighborhood sewer separation project to help reduce combined sewer overflows while providing an amenity in a residential neighborhood. The city's Public Works Department collaborated with the Parks, Recreation, and Public Property Department to construct several new storm sewers that divert stormwater from approximately 30 acres of the existing combined sewer system to the nearby Elmwood Park. Infiltration and treatment of that stormwater is provided by dry detention ponds, bioretention gardens with native plantings, and a series of grade-control slotted weirs that allow water to pass after reaching a certain depth.

The system is designed to handle flows from a 100-year storm—a significant improvement over the previous combined sewer's inability to handle flows from a 10-year storm. The project removes a large volume of flow from the overburdened sewer system, and the diversion project enabled city designers to install smaller gray infrastructure upgrades in the downstream portions of the system due to the reduced demand. The park is a highly visible and well-used recreational facility, and the diversion project has become a visual focal point that is enjoyed by residents who watch the water cascade through the weirs during a rain storm. Carefully selected vegetation enhances the park's visual appearance.

The final project cost was $1.2 million, and city officials estimate $550,000 in savings over a traditional gray infrastructure solution to combined sewer overflows. The project eliminated the need to upgrade existing gray infrastructure in downstream areas at additional cost. Officials also say that the system is working well and requires minimal maintenance.

Figure 8. Top: view from the bottom of the system which is planted with a variety of deep-rooted native plants. Bottom: conditions before the project. (Source: City of Omaha Stormwater and CSO Programs)

Protect Riparian Areas and Floodplains

In some locales, riparian areas have been replaced, destroyed, or negatively impacted by development and redevelopment projects. Green infrastructure practices such vegetated buffers and living shorelines can be used to protect and restore riparian areas and floodplains.

Case Study: Restoring Natural Drainage in Gene Green Beltway 8 Park — Houston, Texas

Gene Green Beltway 8 Park, 230 acres of park land in Houston, was created in 1997 by Harris County Precinct Two and the Harris County Flood Control District in an area that was previously underserved by parks. Phase I construction included the core of the park, which was completed in August 2008 at a cost of $5.5 million.

Figure 9. Gene Green Beltway 8 Park. (Source: Landscape Online)

The park serves dual functions of flood control and recreation and is a buffer between Liberty Lake subdivision and Carpenter's Bayou. Approximately two-thirds of the park is a detention basin that can withstand periodic flooding.

Other features include:

- An amphitheater stage and seating
- A BMX track
- Trails
- Sports fields
- Wetland plantings that filter stormwater
- A meandering stream

The park design includes stormwater filtering with native prairie grass, recycled concrete riprap berms, a meandering stream with native vegetation, and bioswales in the parking lot. The stream runs through the park and detention basin to Carpenter's Bayou and filters and dissipates stormwater from the adjacent Liberty Lakes subdivision and the park facilities.

The detention basin area has flooded several times—including during Hurricane Ike in 2008—but the features within the basin have survived intact, despite the assault by the "costliest hurricane in Texas history." Future master plan activities include excavating a lake/wetland for additional stormwater filtration within the detention basin, and preserving a pristine stand of old-growth cypress within the Carpenter's Bayou oxbow.

5. Plan for Maintenance

Define Roles and Responsibilities

It is important to determine who will operate and maintain the project over the long term and define roles and responsibilities. Some agencies document the installation and maintenance roles and responsibilities using MOUs to clarify who (e.g., stormwater agency, park agency, department of transportation, public works department) is responsible for inspecting and maintaining green features. The MOU can include a maintenance schedule to ensure that all parties know what is needed to ensure the long-term function of the green infrastructure features.

Perform Maintenance and Repairs

Ensuring the health of vegetation is one of the key factors in the successful performance of green infrastructure practices. Maintaining vegetation is an important component of a maintenance program. Typical maintenance activities include watering during the establishment phase, conducting assessments of plant health, pruning, mulching to control weeds, removing unwanted vegetation, and planting replacements as necessary. To promote plant health and properly manage runoff, porous soils need to be assessed and replaced if they become clogged. Infiltration and drainage features often need to be checked for clogging—they might require trash, debris, and sediment removal and sometimes structural and erosion-related repairs.

MOUs

A **memorandum of understanding (MOU)** is an important tool to clearly identify each department's or agency's roles and responsibilities. Parks and stormwater departments or agencies are not the only ones that might be involved. If the green infrastructure project overlaps or affects the right-of-way, transportation agencies might also need to be included to ensure that their input is sought and their objectives, responsibilities, and requirements are documented.

Elements of an MOU

- Describe the property and features for which responsibility is shared.
- Detail funding sources and amounts for design/construction and maintenance, including requirements for each.
- List each department's objectives, roles and responsibilities, and legal requirements.
- Define methods of communication or collaboration.
- State the term of agreement, e.g., from date of signature until…
- Outline procedures for modifying, extending, or severing the agreement.

Ensure Optimal Performance

Green infrastructure infiltrates runoff through soils or other filtration media to filter out pollutants and retain stormwater; therefore, the permeability and overall health of the soil is critical to performance. Infiltration rates can diminish over time if the surface of an infiltration feature becomes clogged with fine sediment, organic matter (leaf litter), or other materials that prevent percolation. Soils can also become compacted if they are subject to excessive foot or vehicle traffic. Soils might need to be excavated, scraped, aerated, tilled, or replaced if standing water is present several days after a storm, indicating poor drainage. Permeable pavement might need to be vacuumed or, in the most challenging cases, removed and reinstalled to restore permeability.

Engage Community Service Organizations

In many areas, parks agencies have opportunities to hire individuals from community service organizations, youth conservation corps, or other youth summer employment programs. This type of engagement provides younger people with valuable opportunities to improve the communities in which they live, provides skills training and job experience, and results in citizens who are knowledgeable about the environment.

Capitalize on the Potential for Green Jobs

Green infrastructure maintenance lends itself well to workforce training, because the work typically does not require advanced training or education beyond high school. Green infrastructure maintenance jobs can be filled with young, seasonal workers through a summer hiring program for teens and college students. Park and stormwater agencies can partner with workforce development agencies to provide access to operation and maintenance jobs with long-term career potential for disadvantaged community members. In addition to maintenance, there is long-term, career-oriented green job potential because landscaping, landscape design, engineering, and construction-related skills can be taught and learned through the construction of green infrastructure in parks.

Developing a green jobs workforce can have a positive impact on the environment and local communities. As the use of green infrastructure increases, so does the demand for a skilled green workforce. When parks managers implement green infrastructure in park areas, employment opportunities arise for individuals to install and maintain features. Green jobs can range from entry-level (e.g., landscape maintenance) to highly skilled positions (e.g., installation of pervious concrete and green roofs); plus, programs exist to provide training so workers can ensure proper functionality of green infrastructure elements.

Many programs target the underemployed urban workforce to provide job skills and instill a sense of community ownership. Programs can offer classroom-based learning, hands-on training, and certifications, as well as assist in job placement. For instance, State University of New York, College of Environmental Science and Forestry (SUNY ESF), and its partners have

developed a program to train underemployed residents of Syracuse, NY—the Green Train Landscaping and Urban Ecology (GLUE). The program focuses on training the underemployed workforce, while at the same time promoting environmental stewardship. The program emphasizes the use of green infrastructure to address water quality issues caused by stormwater runoff in the Onondaga Lake Watershed.

Other programs focus on education of young persons to provide a future green workforce. As part of its NatureWORKS program, the nonprofit group Jobs for the Future has been studying the potential for green jobs, seeking to identify current and emerging trends in the green infrastructure workforce and examining the potential for job creation in this area. Its recent publication, *Greenprint: A Plan to Prepare Community College Students for Careers in the Clean Economy*, provides recommendations for how community colleges can implement educational programs to prepare graduates for green jobs. The group plans to publish similar documents on the full range of public and private installation and maintenance and inspection jobs in green infrastructure, including details of several national certification efforts currently underway.

Certifications in green jobs are available from a number of organizations, including the National Green Infrastructure Certification Program (NGICP). NGICP has established national certification standards for green infrastructure workers involved in construction, inspection, and maintenance of green infrastructure. The goals of this program are to (1) establish a career path for skilled workers related to green infrastructure, (2) support the development of proficient green workforces, (3) ensure that international best practice standards are met, and (4) advance the establishment of sustainable communities by promoting green infrastructure as an environmentally and economically beneficial stormwater management option.

Case Study: Starting with a Small-Scale Project at Fletcher Field — Franklin, Massachusetts

In the town of Franklin, Massachusetts, a rain garden was installed at Fletcher Field, a multi-use park that includes a playground, a baseball field, and basketball court, and picnic area. Installation of this rain garden with native shrubs and plants provided aesthetic improvements while simultaneously capturing runoff from the parking lot. This project was constructed in 2010 at a cost of $16,000. The town was able to maximize resources by having Department of Public Works crews install the soils, mulches, signs, and plants. This project highlights multiple benefits of implementing green infrastructure: the opportunity for site-specific stormwater management, improvement of green space for the community to enjoy, and public education.

Figure 10. Fletcher Field rain garden. (Source: City of Franklin, Massachusetts)

6. Undertake High-Visibility Pilot Projects

Think about selecting one or more high-visibility sites for a pilot project. Successful pilot projects in areas with high foot traffic can help to garner support from the community for more green practices. Partner with the media to explain the purpose and benefits of the projects, and highlight the community partnerships, donors, and volunteers involved in making the projects happen.

Case Study: Creating a Waterfront Green Showcase at Ferrous Site Park — Lawrence, Massachusetts

In 2015, Groundwork Lawrence (GWL) completed the redevelopment of Ferrous Site Park, a former foundry constructed in 1845. Since the early 2000s, GWL has partnered with the city of Lawrence, the Commonwealth of Massachusetts, and community partners to establish a park at the site. During that time, GWL has used the site as a laboratory for youth education programs that explore the ecology of the urban area.

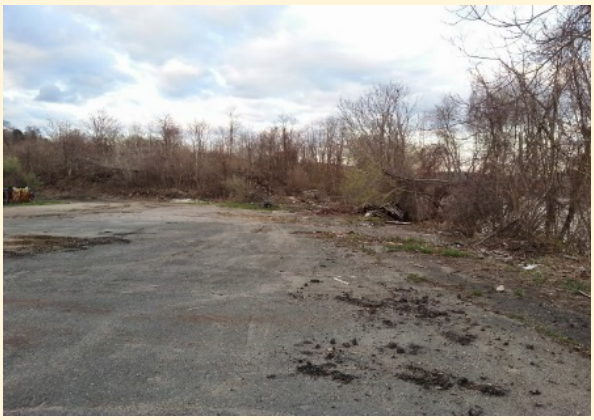
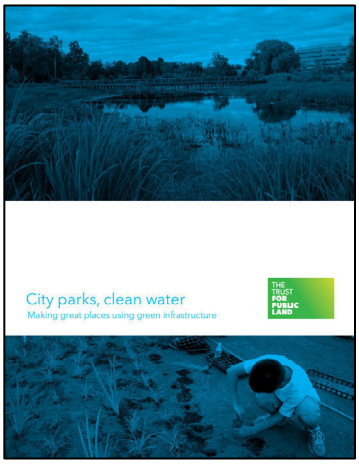


Figure 11. Top: Ferrous Site Park area before redevelopment. Bottom: park conditions after redevelopment. (Source: Groundwork Lawrence)

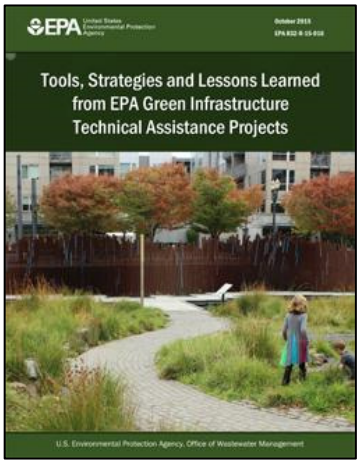
Redevelopment addressed brownfield concerns and met the city's overall goals of transforming the entire North Canal mill district into a thriving mixed-use, transit-oriented development. Funding for the $2.75 million project came from the city of Lawrence, the National Park Service, Groundwork USA, and the Commonwealth of Massachusetts. Over a period of 24 months, the site was redeveloped to include recreation areas and green features, including:

- Ferrous Terrace: This overlook at the historic canal spillway has a pavilion providing shelter for summertime education programs and community gatherings.
- Wild Arboretum: Rows of trees that thrive in urban conditions and provide food for a range of animals. The tree species will be labelled to teach about urban forestry and ecology.
- Ferrous Hill: The sand castings from the former industrial foundry adjacent to the park have been reshaped as a meadow mound with panoramic views.
- Wild Woodland: A remnant woodland habitat representative of the species that grew on the site before park development.
- River Edge Forest: Preserved and restored riparian habitat along the Spicket and Merrimack rivers.
- Pathways: Central to the park's design is a new looping pathway network that provides safe and universal access to excellent views of the rivers and the waterfall at the end of the North Canal.
- Rain Garden: This feature will intercept and infiltrate stormwater from a 50-year storm event from the adjacent industrial property. Previously the water was discharged directly into the Merrimack River via asphalt swales.

USEFUL RESOURCES

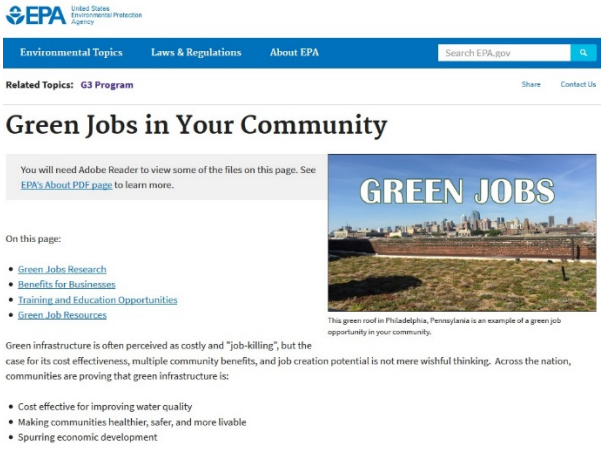


[City Parks, Clean Water: Making Great Places Using Green Infrastructure]
Trust for Public Lands 2016

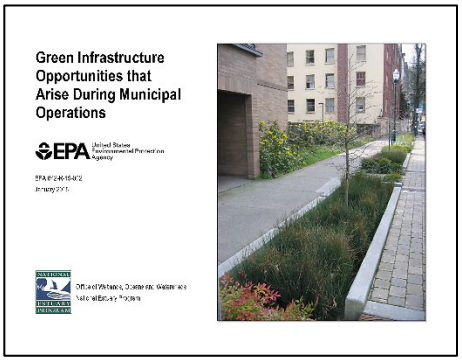


[Tools, Strategies and Lessons Learned from EPA Green Infrastructure Technical Assistance Projects]
USEPA 2015

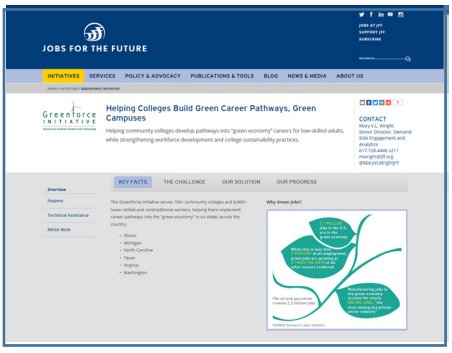
[How Cities Use Parks for Green Infrastructure]
American Planning Association, City Parks Forum



[Green Jobs in Your Community]
USEPA



[Green Infrastructure Opportunities that Arise During Municipal Operations]
USEPA 2015



[Greenforce Initiative]
Jobs for the Future 2016

PARKS GREEN INFRASTRUCTURE ACTIONS CHECKLIST

Consider the following actions at your park to implement green infrastructure:

	Action	Benefit to Parks
☐	Convert turf areas with high maintenance requirements to bioretention areas or other naturalized areas	Reduces maintenance and other costs associated with the management of turf
☐	Install cisterns or rain barrels to collect roof runoff for irrigation	Reduces potable or recycled water use
☐	Install permeable pavement or pavers	Reduces runoff, pavement maintenance, and use of deicers
☐	Amend soils to improve infiltration	Eliminates standing water and mosquito breeding habitat
☐	Install bioretention in underutilized perimeter areas	Reduces runoff and flooding and beautifies low-use landscaped areas
☐	Include educational signage describing BMPs and stormwater impacts	Creates opportunities for environmental education
☐	Install green roofs	Increases lifespan of roof, lowers energy cost, and manages stormwater
☐	Remove unnecessary impervious surfaces	Reduces runoff and decreases erosion

These green infrastructure actions can help park agencies meet one or more of the following goals and priorities, including:

- Enhancing park aesthetics with natural drainage.
- Providing recreational opportunities in underserved communities.
- Meeting the demand for better park features.
- Reducing landscape and facility maintenance.
- Improving drainage in low-lying areas.
- Eliminating mosquito breeding habitat.
- Improving the quality of compacted urban soils.
- Providing habitat for ecological diversity.
- Sharing costs among agencies.
- Providing ideal locations for green stormwater management.

In 2005 the Philadelphia Water Department created the 1-acre Saylor Grove stormwater treatment wetland in a boggy area of the city's Fairmount Park. The wetland serves as a public amenity while also treating a portion of the 70 million gallons of stormwater runoff generated by 156 acres of urban lands upstream of the park.

United States Environmental Protection Agency

U.S. Environmental Protection Agency
Office of Water
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