REPORT

Newark Greenstreets Initiative

Planning & Implementing Green Stormwater Infrastructure

March 20, 2015

Prepared by:

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Executive Summary

Under the auspices of a Local Government Capacity Building grant provided by Together North Jersey (TNJ) and the North Jersey Transportation Planning Authority (NJTPA), CDM Smith worked with staff from the City of Newark to enhance their ability to identify and act upon opportunities to deploy Green Stormwater Infrastructure (GSI) in the streetscape and on City-owned land to advance Newark's Greenstreets Initiative.

This report summarizes research findings, presents best practices and recommendations, and includes a number of technical appendices to support City staff as they continue to build their skills from site identification, to design, to construction documents, to implementation, maintenance and monitoring of GSI projects. Specifically, the City of Newark asked CDM Smith for technical assistance in the following tasks, in addition to overall project management:

(1) Research and discovery in selecting several potential pilot locations for GSI interventions;

(2) Preparation of concept-level designs, including an analysis of the stormwater diversion potential and cost estimates of such interventions as well as recommendations for the process and contracting tools to be used in future projects;

(3) Analysis of the City's existing Greenstreets specifications; and

(4) Preparation a horticultural manual with species specifically chosen to do well in an urban GSI context.

The technical deliverables prepared for this project are attached to this report as appendices. The report itself was prepared to assist Newark staff and its partners in interpreting and using the technical appendices by "telling the story" of the project in an accessible format.

As important context for this project, the City of Newark is currently working with several jurisdictions -- neighboring municipalities and the regional wastewater treatment plant, which is located in Newark -- on a new Long Term Control Plan to reduce the instances of Combined Sewer Overflow (CSO) into the Passaic River. This is desirable as a matter of public policy, but it is also a regulatory imperative as the U.S. Environmental Protection Agency works with localities to ensure compliance with the federal Clean Water Act. Newark's extensive pavement and relatively old infrastructure for sewage and wastewater treatment combine to lead to CSOs in most heavy rain events, generally after 15 minutes of continuous rain. Reducing CSOs is an imperative that gives the conversation about stormwater management, using both green and gray infrastructure, urgent relevance at the municipal and regional levels.

The urgency is also being felt at the level of community stakeholders. In Newark, over thirty community-based organizations and advocacy groups have come together to form Newark DIG (Doing Infrastructure Green!). This group meets monthly with support from the City of Newark, Rutgers University, NJ Department of Environmental Protection, and Passaic Valley Sewerage Commission (PVSC) to develop

and implement community pilot projects such as rain gardens and rain harvesting systems, to conduct outreach and education in the neighborhoods about the role of GSI in managing stormwater and improving quality of life, and to advocate with City and State policy-makers for a front-line role for GSI in addressing Newark's stormwater challenges.

Using this project for technical capacity development, the City of Newark launched a Greenstreets Initiative that identifies pilot projects for greening the urban landscape along City rights-of-way based upon community interest, environmental benefits, and potential to advance goals related to neighborhood revitalization, circulation and connectivity. In collaboration with Newark Office of Sustainability and City Planning Staff, the project has led to the preparation of engineering concept plans and technical design materials needed to advance GSI design. This has included the identification of designs and landscaping best suited to manage stormwater, survive an urban environment, and absorb pollution and greenhouse gas emissions. The Initiative has also led to a robust dialogue among City department staff and neighborhood stakeholders regarding GSI design and implementation in the context of pilot and stewardship projects.

Major findings during the course of the project were as follows:

- Newark streetscapes and City-owned lots present a wide range of opportunities for the deployment of GSI in all neighborhoods.
- Selection of pilot sites, several of which are suggested in this report, should be driven by considerations such as:
    - Overlap with community-driven public space priorities and public visibility;
    - Feasibility of location (i.e. physical suitability for collecting run-off);
    - Location in an area where reducing volume of stormwater entering the sewer system has the potential to reduce the incidences of CSOs at a particular outflow pipe; and
    - Cost feasibility of appropriate intervention.

- Newark should establish a cross-departmental team tasked by the Mayor to identify, design, and implement at least five GSI pilot projects in the next several years. This team should be led by the Water/Sewer Department, as the entity with regulatory responsibility for compliance with the State Long Term Control Plan. The team should also include staff from Planning, Sustainability, Engineering, and Neighborhood and Recreational Services

- GSI pilot projects should be developed in coordination with the efforts of the City of Newark to contribute to the combined Long Term Control Plan being developed by other municipalities that send waste to the Passaic Valley Sewerage Commission (Paterson, Guttenberg, Harrison, Kearny, East Newark, Jersey City, Bayonne, and the North Bergen and North Hudson Sewerage Authorities)

- In addition to pursuing pilot GSI projects based on the concept designs and recommendations in this report, Newark should begin a more comprehensive, city-wide assessment of GSI interventions that includes streetscape and vacant City-owned lots in every Ward as well as strategies for encouraging

participation of private landowners in adopting GSI systems, including creative financing mechanisms.

- Newark is joining a growing number of municipalities turning to GSI as a major component of a comprehensive, multi-pronged stormwater management strategy. Cities such as Philadelphia, New York City, and Syracuse have accumulated sufficient experience to demonstrate that GSI can be a cost-effective stormwater management tool with a range of important co-benefits for the community. These include beautification, amelioration of urban heat island effect, limited mitigation of flooding (first inch or two of rainfall only), and absorption of pollutants from both the air and water.

In light of its benefits and the regulatory impetus to consider GSI when planning for stormwater management, knowledge of GSI strategies and their effectiveness is critical for municipal staff. This is true not only for the staff traditionally tasked with managing the stormwater system. The creation of a cross-departmental team that commits to a process of collective learning and project implementation is one of the most important recommendations of this report. The selected technical assistance consultant, CDM Smith, held several trainings with City of Newark staff as part of its scope and found a high level of interest and commitment among those in attendance. The best practices, recommendations, and technical appendices in this report are designed to serve as a reference manual for the cross-departmental team as it continues to identify, design, and implement GSI projects over the coming years.

1 Introduction

The City of Newark seeks to create a more sustainable city environment, improving the urban design of neighborhoods, the infrastructure serving the City, and health and safety of residents and businesses. Implementation of Green Stormwater Infrastructure (GSI) is a key strategy by which Newark can both manage stormwater runoff more sustainably and promote sustainable community design and renewal. Greening the city through GSI can have positive effects on health and quality of life for Newark residents, as well as the vibrancy of Newark's business environment. Newark's Sustainability Action Plan identified the implementation of GSI as a major strategy available to the City to manage stormwater.

Newark's Sustainability Action Plan proposes a number of actions related to GSI, including:

- Double Newark's tree canopy and establish a stable source of revenue for tree maintenance.
- Implement a new Newark Stormwater Ordinance and promote GSI policies.
- Develop a stormwater infrastructure bank and explore options for funding stormwater Improvements through fees on runoff from impermeable surfaces.
- Integrate GSI standards into street maintenance and other city capital projects.
- Identify and implement new GSI pilot projects.
- Support neighborhood-based rain capture projects

Newark's Sustainability Action Plan, 2013
Vision Statement for Stormwater

Newark will use its land to absorb stormwater before it gets into the sewer system, and do that in ways that also cool and beautify its neighborhoods. Green infrastructure... will become a critical complement to the City's existing gray infrastructure of pipes and storage tanks. Strategically combining the two approaches will reduce instances of flooding and help prevent the sewer system from becoming overwhelmed. At the same time, Newark's use of green infrastructure will expand the network of green community spaces in order to cool and clean the air, beautify neighborhoods, and filter toxins and pollutants from the soil and water.

1.1 Purpose of the Study

The City of Newark faces a range of challenges to sustainable development related to the combination of two features of its landscape: an impervious surface ratio of approximately 70 percent, and an old and overburdened combined sewer system. These factors contribute to urban heat island, stormwater run-off, and air pollution challenges, all of which affect health and quality of life for Newark residents and the vibrancy of Newark's business climate. Newark faces federal and state regulatory requirements to control combined sewer overflow (CSO) and to improve its stormwater management in order to prevent pollution from entering the Passaic River. The City is currently under an Administrative Consent Order issued by the New Jersey Department of Environmental Protection (NJDEP) to control CSOs. The

use of GSI can reduce the amount of impervious cover, and address the overburdened combined stormwater and sanitary sewer system, which serves approximately half the city's land area (more than 11 square miles), and mitigate urban heat island impacts. The implementation of GSI is a key strategy by which Newark can create a more sustainable urban environment.

This report and the associated appendices describe how Newark wishes to increase its capacity to plan for and incorporate GSI through:

- Identifying and developing concept designs for a range of GSI elements that can be incorporated into the City of Newark's new Greenstreets initiative;
- Laying the groundwork to advance several GSI pilot projects and help identify stewardship opportunities to assist the City of Newark in maintaining GSI; and
- Identifying potential resources that will support implementation of pilot GSI projects, by applying effective site selection approaches, preferred site performance characteristics, relevant concept designs, selection of appropriate vegetation, and cost/efficient interventions and combinations of interventions.

This report provides planning-level and concept design guidance to assist in the implementation of GSI for the City of Newark, highlighting examples of GSI implementation elsewhere in the country. It also begins to organize supporting technical information about GSI implementation, and makes recommendations for improved city workflows and practices to help Newark create GSI throughout the city. The following chapters highlight strategies and design approaches that will advance GSI implementation.

1.2 What is GSI?

GSI, for the purposes of this report, can be defined as the natural and man-made landscapes and features that can be used to manage stormwater runoff. Examples of natural GSI include forests, meadows and floodplains. Examples of man-made GSI include green roofs, bioswales, rain gardens and rainwater cisterns which are designed to absorb and manage rainfall during storms. Numerous small-scale GSI interventions dispersed across an urban landscape can cumulatively control large volumes of urban stormwater runoff.

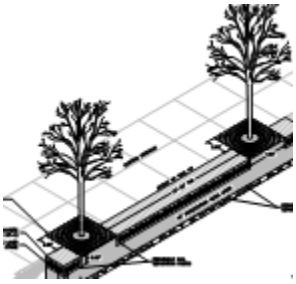
By reducing the amount of stormwater that enters the system, or delaying entry, these interventions provide a buffer that can prevent sewage-contaminated stormwater from entering the Passaic River. Figure 1 shows typical examples of GSI interventions drawn from several cities that lead the country in GSI implementation, including Philadelphia (Green Street Design Manual) and Portland, Oregon. The Appendices to this report include more detail on the wide variety of types and design options for GSI.

Figure 1 - GSI Best Management Practices

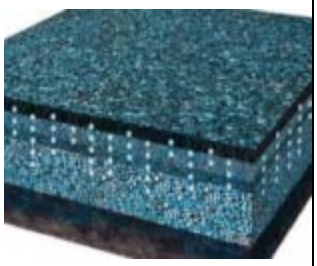
Stormwater Planter/Bioswales

Stormwater Bump-Out/Curb Extensions

Tree Trench



Permeable Asphalt/Pavement



Green Gutter

Drainage Well

Right-of-Way Bioswale

Rain Garden

Sources: Philadelphia Green Streets Design Manual, U.S. EPA, Rutgers Extension Service Water Resources Program.

1.3 What Can GSI Do?

GSI implementation can provide many benefits, as highlighted by the U.S. Environmental Protection Agency (EPA) in its 2010 report on Municipal GSI. There are a compelling set of reasons to implement GSI and its many benefits are listed in Table 1 below.

Table 1 - Benefits of GSI Implementation

- Environmental benefits
  - Improved water quality
  - Improved air quality from trees
  - Improved ground water recharge
  - Energy savings from reduced air conditioning
  - Reduced greenhouse gas emissions
  - Reduced urban heat stress
  - Reduced sewer overflow
- Financial benefits
  - Reduced construction costs compared with all-grey infrastructure, or compared with upsizing grey infrastructure for increased runoff
- Other social benefits
  - Improved aesthetics
  - More urban greenways
  - Increased public education on their role in stormwater management
  - Reduced flash flooding
  - Green jobs
  - Potential increase in economic development from improved aesthetics

Source: GSI Case Studies: Municipal Policies for Managing Stormwater with GSI; USEPA; August 2010; EPA-841-F-10-004

GSI offers triple bottom line benefits. Triple bottom line (abbreviated as TBL or 3BL) is an approach to assessing urban sustainability using three metrics: social, environmental (or ecological) and economic benefit. In addition to managing stormwater, GSI can cut air and water pollution; reduce local flooding and the urban heat island effect; improve the urban setting by providing greenery and, in some cases, sites for small parks and recreation.

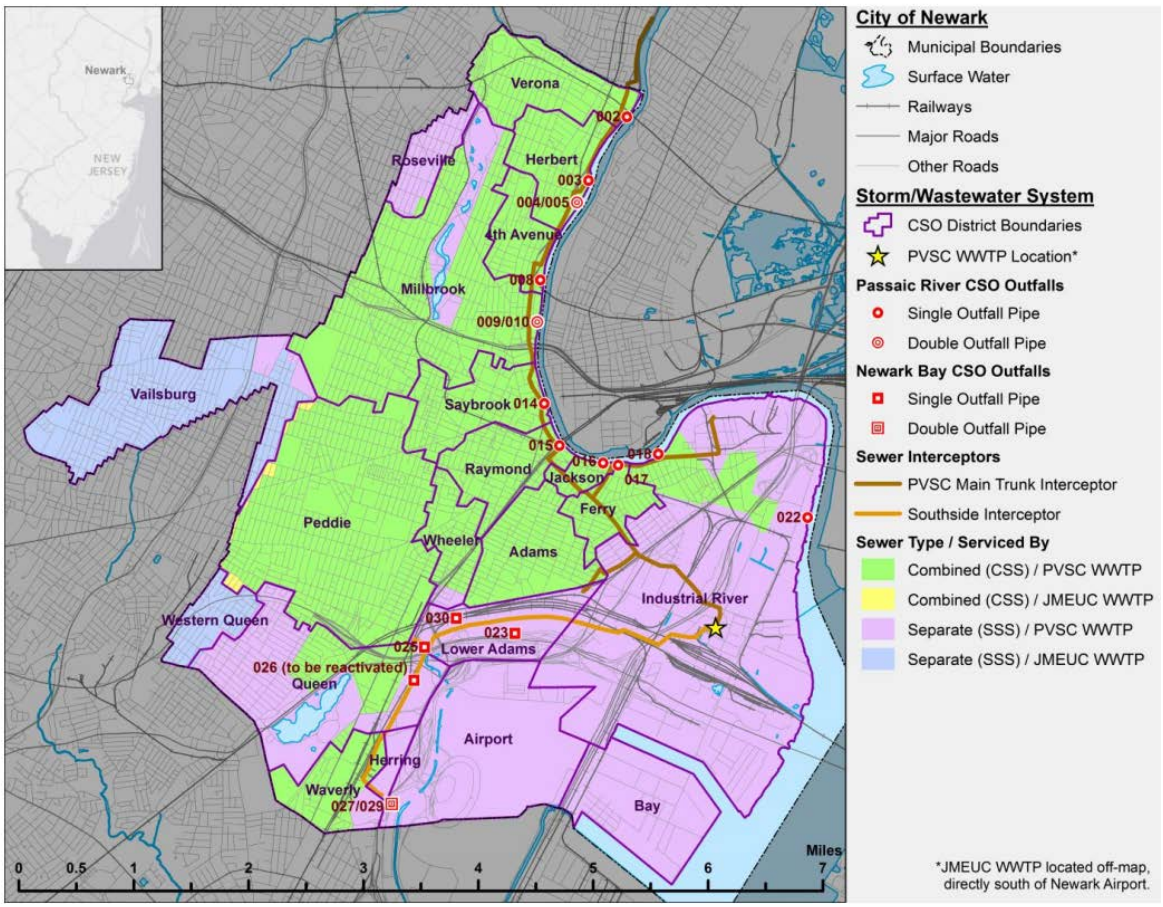
Gray infrastructure is and will remain critical for stormwater management. However, it does not improve the urban setting with green space, and it can require extensive pumping to bring stored wastewater to the treatment plant. Complementing gray infrastructure with thoughtfully designed green infrastructure allows a municipality to manage stormwater in ways that address a wider range of community goals and benefits. To do this, it is important to enhance the capacity of municipal staff to manage GSI. Both GSI and gray stormwater infrastructure present their own unique set of institutional challenges. One particular challenge of GSI is that it involves integration of intervention in a City's street environment, which requires concurrence from numerous City departments with respect to land use, urban design, transportation functions, and future maintenance. However, GSI can complement and enhance gray stormwater infrastructure by targeting TBL benefits yielding a holistic approach to stormwater management.

1.4 How GSI Can Help Control Combined Sewer Overflows

Newark is responsible for managing huge volumes of wastewater – both sanitary sewage and stormwater runoff. Its success in this effort directly affects the health of Newark's waterways, the sustainability and efficiency of its infrastructure, and the health and safety of residents and businesses.

Approximately half of Newark's land area is served by two separate sewer systems (SSS) – one for collecting sanitary sewage and one for stormwater (Figure 2). For the other half of Newark, sanitary sewage and stormwater flows in a combined sewer system (CSS).

Figure 2: Map of SSS and CSS Service Areas with CSO Locations and WWTP Designation



Source: City of Newark Sewer System Master Plan, 2011

The CSS was constructed prior to 1910 and is mostly located at the city's center. In dry weather, the combined system delivers sanitary sewage to a treatment facility operated by the Passaic Valley Sewerage Commission (PVSC). However, in wet weather, stormwater, snow melt, and other surface runoff enters the combined sewers, and when the conveyance capacity of the system is exceeded (which can happen in rain events of 1 inch or over) the excess flow is diverted and discharged into the Passaic River and Newark Bay with minimal, if any, treatment – an event known as combined sewer overflow (CSO). CSOs are a major source of waterborne contaminants that impact the City's ability to comply with New Jersey federal water quality regulations.

Water Infrastructure in New Jersey's CSO Cities: Elevating the Importance of Upgrading New Jersey's Urban Water Systems, May 2014

In a NJ Future report, Dr. D. J. Van Abs, offers the following major observations about CSO compliance and management in New Jersey:

Starting from behind. CSO municipalities have old and aging water supply and sewer systems that will require extensive work and major expenditures if they are to remain viable. The longer we delay, the worse the problems will become at an accelerating rate.

Fiscally constrained. CSO municipalities as a group are fiscally constrained and have a history of population and job losses. These financial constraints have often forced a process of infrastructure triage, where only the worst known issues are addressed.

Diversity with common attributes. CSO municipalities are not uniform, but rather are characterized by different community types, population densities, economic bases and development trends. However, they also have many similarities, especially regarding their infrastructure issues.

Improving economic trends. Some CSO municipalities are experiencing and expect to continue positive economic trends that could play a major role in funding infrastructure improvements, but also in exacerbating the deterioration of those same infrastructure systems through development disturbances and greater demands on fragile pipes.

A turning point in action? The new NJPDES CSO Individual Permits can legitimately be seen as a regulatory turning point, providing much more detailed direction and clear consequences for CSO municipalities. However, the feasibility of successful CSO control will depend heavily on the selected controls, fiscal capacity of the CSO municipalities and relevant funding sources, and political will.

Gray and Green. Innovations in CSO controls, such as GSI, provide more opportunities to New Jersey CSO municipalities than existed just ten years ago, but will require each municipality to become familiar with the opportunities and limitations of each approach. Doing so will be difficult for small systems and municipalities, and so cooperative approaches will be vital.

Clear identification of benefits. Given that New Jersey CSO control costs will likely be in the low billions of dollars, it will be critical that decision makers and ratepayers have a clear sense that the results will Newark CSO web site and publications be worth the costs. The benefits can be in cleaner water resources, improved conditions for redevelopment and for maintaining existing property values, and improved neighborhoods.

Newark's sewers are aging, and the City will need to continue to increase its investments in rehabilitation and replacement of sewers.

There are 17 permitted CSO outfalls in Newark: 12 along the Passaic River and five in the peripheral ditch along the perimeter of Newark Liberty International Airport. A map of Newark and the Storm Sewer System (SSS) and the Combined Sewer System (CSO) is shown in Figure 2. The City is currently under an Administrative Consent Order issued by the New Jersey Department of Environmental Protection (NJDEP) to construct screening and netting facilities at its CSO points to control floatables and

other large solids. As part of its NJDEP discharge permitting, the City has also been asked to create an integrated Long Term Control Plan (LTCP) for CSO with other jurisdictions that send wastewater to Passaic Valley Sewerage Commission (PVSC) for treatment. These jurisdictions include: Paterson, Guttenberg, Harrison, Kearny, East Newark, Jersey City, Bayonne, and the North Bergen and North Hudson Sewerage Authorities.

Newark is heavily urbanized, contributing significant runoff that exacerbates its CSOs. Implementing GSI, and making the city greener and more permeable with greater capacity for local rainfall runoff storage, allows stormwater to be captured before it reaches the sewer system, thus reducing CSOs, protecting property from sewer backups, and mitigating local flooding. GSI, like rain gardens, bioswales, and tree pits, can also help address other municipal priorities by helping to reduce ambient air temperatures and lessen heat island, expand access to open spaces, improve air quality, lower energy demand, reduce greenhouse gas emissions, and make the city more resilient to the impacts of climate change.

The City of Newark will be required by NJDEP and USEPA to attenuate their combined sewer overflows, either by constructing underground storage and treatment (gray infrastructure), or by creating GSI, or some combination of both. GSI is one option, but not the only one needed to address Newark's stormwater and wastewater issues. The value of GSI lies in its multiple TBL benefits to the community.

1.5 GSI & Flooding Issues

The literature on stormwater frequently cites the benefits of GSI in reducing flooding and flood impacts. Periods of heavy rain can lead to basement flooding in homes and businesses, as well as pervasive street-level flooding, which is exacerbated by the extensive impervious surfaces that cover Newark, and often inadequate drainage facilities. In urban areas like Newark, GSI can often ameliorate localized flooding by retaining runoff onsite, either by infiltrating rainwater into the ground or by delaying the flow of runoff down streets and into local storm/combined sewers so it does not accumulate all at once in low areas. Thus, GSI can mitigate flood risk by slowing and reducing stormwater discharges.

However, it must be noted that while GSI has potential to attenuate localized flooding that occurs during frequent small storms, the ability of GSI to infiltrate and store the runoff volumes associated with large, less frequent storms is very limited. Thus, flooding during small rainfall events of 1 inch or less can be managed well by GSI, but larger storms are beyond the capacity of most GSI interventions. Also, for coastal flooding events, which are created by high tides, storm surges, and onshore winds, GSI is relatively ineffective. Thus, when promoting the advantages of GSI in reducing flooding, it is very important to specify the kinds of flooding that GSI is effective in addressing – localized small storm flooding, but not the large infrequent (100 year) storm events, nor coastal flooding, for the most part. GSI needs to be implemented in conjunction with some other strategy to effectively manage stormwater from the more frequent and intense storms that may result due to climate change. While GSI alone is not sufficient to manage the rainfall from larger storms, it can reduce the extent to which gray infrastructure improvements are needed for drainage, and thereby result in significant capital and debt service cost reductions.

2 GSI Best Practices

Newark, like many other highly urbanized areas, has relatively limited open space available for stormwater management. However, based on experience in other urban areas, there do not appear to be any restrictions particular to Newark that would preclude the use of GSI practices similar to those used in other urban areas, such as Philadelphia or New York. For simplicity, these GSI practices can generally be divided into “on-street” and “off-street” practices.

On-street practices are intended to generally address the street, sidewalk, and planting strip environment, while off-street practices are intended to address areas beyond the on-street environment, such as parks, schools, residential, commercial, or educational campuses, and vacant parcels. It should be noted that most GSI practices can be applied effectively in both settings.

GSI within the streetscape can be more costly than off-street settings due to the need to mitigate traffic conditions during construction and typical requirements to restore hardscape/street surfaces. However, streetscape GSI is recommended for Newark because the street and sidewalk right-of-way is the largest and most impervious land use within the City’s control and, therefore, provides Newark with ample potential to implement capital projects that include GSI on City controlled property.

Combining the availability of Newark-owned vacant properties with existing City relationships with GSI-supportive community groups provides a potential opportunity for Newark to capitalize on both resources in order to implement off-street GSI.

Both on-street and off-street GSI practices are applicable in Newark and have been compiled in the GSI Portfolio in the Appendices.

The collection of example GSI practices from comparable urban locations was gathered from the following sources:

- Philadelphia, PA
- New York, NY
- Portland, OR
- Seattle, WA
- Los Angeles, CA
- New Jersey (Rutgers Cooperative Extension Water Resources Program)
- GSI Product Specifications

In addition to the GSI Best Management Practice information that has been compiled by the cities and entities above, the U.S. EPA has prepared a report entitled "GSI Case Studies: Municipal Policies for Managing Stormwater with GSI" (USEPA; August 2010; EPA-841-F-10-004) that, using a case study approach, describes which cities are implementing the various GSI Best Management Practices.

Several GSI types have been visually represented in the Newark context in Section 3, and include descriptions of their stormwater management potential and design considerations and approximate costs.

Many examples of GSI exist that Newark can use as models. In coordination with the Engineering and Water and Sewer Departments, the Newark Sustainability Office has been evaluating non-structural standard details from the New Jersey Stormwater Best Management Practices Manual, specifically:

GSI Practices (Number of Cities in US Using Practice)

Program elements
LID/GI standards/ordinances/guidelines (6)
Fees and economic incentives (5)
Large-scale bioretention ponds (3)
Land acquisition/preserve open space (6)
Stream restoration (3)
Reforestation/tree planting/urban forestry (5)
Floodplain reconnection (1)
Wetland development (4)
Underground infiltration trenches/storage (3)
Green streets and alleys (10)
Permeable pavements (7)
Smaller-scale bioretention and infiltration (13)
Ecoroofs and blue roofs (6)
Impervious area reduction (3)
Rainwater harvesting (7)

- Bio-retention systems: plant-based filtration devices that remove pollutants through a variety of physical, biological, and chemical treatment processes;
- Pervious paving systems: materials that permit water to enter the ground by virtue of their porous nature or by large spaces in the material; and
- Vegetative filters: filters designed to remove suspended solids and other pollutants from stormwater runoff flowing through a length of vegetation.

2.1 GSI Implementation Considerations

The GSI siting and implementation factors in Table 2 were used to identify the 10 GSI pilot locations for this study. The siting and implementation factors present a series of planning and engineering design considerations that should be evaluated during the GSI planning process.

Table 2 - GSI Implementation Considerations

Land Ownership		
Y	**N**	
☐	☐	Is the proposed GSI site public land or private land? Does ownership affect design?
☐	☐	Are owners of vacant parcels / other open space willing to be a partner?
☐	☐	Are there on-site or adjacent site landowner conflicts?
Infiltration or Storage		
Y	**N**	
☐	☐	Are soil conditions suitable for infiltration of stormwater? (optimum situation)
☐	☐	Is groundwater at a depth sufficient to facilitate infiltration?
☐	☐	Is depth to bedrock sufficient for infiltration?
Site Topography		
Y	**N**	
☐	☐	Are there steep slopes >12% that would limit GSI capture/function?
☐	☐	Are street slopes less than 4%, to reduce drainage pipe depth?
☐	☐	Are slopes >5% that would limit the ability to implement porous pavement?
Utility Conflicts		
Y	**N**	
☐	☐	Are pipes needed to move stormwater from impervious surfaces to the proposed GSI site?
☐	☐	Are water, sewer, energy, communications, or other utilities present in/near proposed GSI locations that will constrain implementation / construction? Include in this review service laterals from the street to homes/businesses. Assess presence of hydrant and fire connections.
☐	☐	Can such utilities be relocated economically to allow implementation? If not, can they be encased or otherwise protected in place to allow implementation of GSI?
Drainage Analysis		
Y	**N**	
☐	☐	Is street slope suitable, and/or are stormwater inlets present to convey runoff to GSI? Where street slope is suitable, can curb cuts be implemented to allow street runoff to drain to GSI facilities?
Existing Environment		
Y	**N**	
☐	☐	Are there existing trees that are to remain and that are constraints to locating GSI?
☐	☐	Are there environmental conditions such as contaminated soil, monitoring wells, and groundwater wells that are near the proposed strategies?
☐	☐	Is this an area of localized flooding?
☐	☐	Has this area been identified to have flood reduction potential achievable using GSI, or do flood volumes exceed capacity of GSI?
☐	☐	Is there the potential for excessive sediment load (i.e., from adjacent landscaping)?

Vegetation & Landscaping		
Y	**N**	
☐	☐	Is there opportunity for trees to be planted in the project location using GSI designs (tree pits, tree planters)?
☐	☐	Are new trees needed along the street for succession planning? Are additional trees needed along the street for streetscaping design?
CSO LTCP Consistency		
Y	**N**	
☐	☐	Does the proposed GSI reduce runoff to a regulated CSO outfall?
☐	☐	Is it possible to monitor, model, and measure the runoff volume reduction and water quality improvement of the combined effect of GSI in the CSO subshed?
GSI Best Management Practice Selection		
Y	**N**	
☐	☐	Tree pits / Tree planters: Does the streetscape have the horizontal and vertical (e.g., underground utility) clearances needed to accommodate GSI installation?
☐	☐	Can stormwater runoff from the road and sidewalk be directed to the proposed tree trench location by surface flow, subsurface flow through a stone media, or piped flow?
☐	☐	Bioretention: Can flow be routed to swale/bioretention GSI (e.g. overland or via pipes)?
☐	☐	Can the GSI location be depressed, or are there mature trees or other features that cannot support reducing the bioretention GSI below existing grade?
☐	☐	Off-street / Open Space GSI: Is there sufficient elevation difference to direct water from the street to the open space?
☐	☐	Porous Pavement: Can subsurface soils accommodate infiltration?
Traffic & Pedestrian Safety		
Y	**N**	
☐	☐	Is there parking along the road and is a curbside walking path needed for car passengers to safely exit their vehicle without stepping into the GSI facility?
☐	☐	Is a bus stop present at the site or is bus traffic known to travel in parking lane?

2.2 GSI Best Practices

Table 3 identifies typical GSI types and listed references where such GSI interventions are being implemented, and where relevant guidance information is available.

Table 3 - GSI Best Management Practice References

On Street Options	
Stormwater Planter/Bioswales	Refer to Green Streets Design Manuals for Philadelphia, Portland (OR), Seattle, Los Angeles, and NJDEP
Stormwater Bump-Out/Curb Extensions	Refer to Green Streets Design Manuals for Philadelphia, Portland (OR), Los Angeles
Tree Trench	Refer to Green Streets Design Manuals for Philadelphia, Los Angeles, and NJDEP
Permeable Asphalt/Pavement	Refer to Green Streets Design Manuals for Philadelphia, Seattle, Los Angeles, and NJDEP
Green Gutter	Refer to Green Streets Design Manual for Philadelphia
Drainage Well	Refer to Green Streets Design Manual for Philadelphia
Right-of-Way Bioswale	Refer to New York City Standards for Green Infrastructure and Portland (OR), Los Angeles
Off-Street Options	
Downspout Planter	Refer to NJDEP Guidance
Cistern	Refer to NJDEP Guidance
Rain Garden	Refer to NJDEP Guidance
Water Square	Refer to DeUrbanisten 2013 (Netherlands)

3. GSI Concept Development

This report identifies process guidelines and describes opportunities to implement GSI pilot projects in three neighborhoods of the City of Newark. The pilot projects focus on publicly owned land – streets, sidewalks, vacant City lots, and schools. The examples in the report provide the City of Newark with concept designs and process guidelines that will help the City reach its goal of implementing at least ten GSI projects in the next five years. Pilot projects will help demonstrate the effectiveness of GSI as a key tool for managing stormwater. Improved stormwater management that includes consideration of GSI is a requirement of federal and state law. City officials are currently working to improve stormwater management with support from a range of community stakeholders operating under the umbrella of Newark DIG (Doing Infrastructure Green!).

3.1 Existing Conditions: Opportunities and Challenges

Newark's existing Stormwater Ordinance requires that new land development or significant redevelopment projects capture 100 percent of its stormwater runoff on site, with slow release to City

sewers. This is a relatively stringent requirement compared to those of other New Jersey municipalities, and is very different from historic design practices. Developers are encouraged to consider non-structural elements (e.g., GSI), among other approaches, before relying on structural solutions (e.g., storm drains and structural detention basins). But application of GSI methods is not required.

The ordinance in its current form does not contain minimum design or performance standards to achieve GSI strategies. It includes policy language that encourages the use of non-structural elements (i.e., GSI). However, no minimum design standards or example specifications are yet included.

In recent years, City design standards are moving toward promoting pervious/permeable surfaces and stormwater retention and filtration. For example, new zoning standards for one to three-family homes limits front yard impervious coverage to no more than 55 percent of the front yard area. Newark's Streetscape Design Guidelines for Commercial Corridors encourages the use of permeable pavers as a pilot material, sets standard dimensions for tree pits, and promotes the use of infiltration planters as an alternative to planter pots. However, these approaches are relevant only to new development and re-development, and for the most part do not alter existing stormwater drainage systems. For this reason, identifying implementation approaches for GSI, as recommended in this report, offers much greater opportunity to retain stormwater runoff locally, reduce combined sewer overflows, and improve the water quality of runoff. About 70 percent of Newark is covered with impervious surfaces. This means that retrofitting GSI into existing neighborhoods has the potential to provide greater reduction in runoff than addressing new development and redevelopment, although that element of the City's future will also contribute to greener stormwater management (City of Newark, 2012)

3.2 Selecting GSI Pilot Locations

Relevant information and data for identifying GSI pilot project opportunities was evaluated, and included the following:

- Newark's Master Plan, Our City Our Future (2012);
- Neighborhood Strategic Plans;
- Transforming Lower Broadway: Our Quality of Life Roadmap;
- Planimetric and topographic digital maps with one-foot contour intervals provided by the Department of Engineering;
- Mayoral Press Release on Flood Prone Locations (November 26, 2013); and
- Input from the Division of City Planning, the Department of Water and Sewer Utilities, the Division of Traffic & Signals, and the Sustainability Office regarding on-going and planned initiatives.

A geographic analysis was conducted to begin the process of selecting GSI pilot areas. Beginning the process of implementing GSI pilot projects as soon as possible in Newark is critical for three reasons:

- To refine GSI implementation workflow among City agencies.
- To test how specific GSI designs and locations perform with respect to runoff reduction and water quality improvement.

- To benchmark costs of implementation against the benefits associated with GSI, such as CSO reduction and improved water quality in the waterways in the Newark region.

A planning level geographic analysis included a review of land use and street typology (to identify the diversity of urban forms in the City); imperviousness (to identify areas with potential to manage greater volumes of surface water); and availability of publicly-owned land (that could potentially be used to host GSI).

The various streetscape typologies that were identified in Newark were simplified into a "residential block typology" and a "non-residential block typology". Residential areas are characterized by medium densities of use accompanied by local schools, parks, and shopping. Non-residential areas are characterized by concentrated commercial and industrial land use, with significantly less amenities. This simplified approach allowed broader consideration of GSI implementation in the City. In addition, non-street-oriented typologies, which focused on individual land uses (e.g., around vacant parcels, around parks, and around schools) were determined in the field to be expandable to include designs that could be integrated into street-oriented GSI opportunities.

GSI can be applied in one form or another in almost any land use setting in Newark, provided there is sufficient contributing drainage area and that conflicting utilities and street improvements are minimal. For early implementation planning and pilot evaluation of GSI, more qualitative characteristics might also be considered in GSI site selection. For example, sites of priority interest to the City and community groups can be identified based upon neighborhood interest and visibility for public education purposes, and then evaluated more technically for consistency with GSI implementation characteristics. Once potential GSI sites are identified, a GSI design (or combination of GSI opportunities and designs) can be selected that fit the land use characteristics and the neighborhood design.

Within each candidate GSI pilot area, a digital elevation model was developed for the street network to characterize street slopes and drainage patterns. The purpose was to characterize the general drainage direction of the neighborhood streets, such that potential GSI opportunities could be identified at the low end of blocks where stormwater runoff is best captured, as opposed to "top of the hill" situations where stormwater management advantage is limited.

Subareas were identified that showed potential to implement GSI:

- low ends of blocks or "low point runoff collection areas";
- opportunities that take advantage of publicly-owned vacant properties;
- opportunities for clustering GSI if there are sites that are close to one another that could be combined to function synergistically;
- high public visibility/high public amenity advantages;
- synergies with existing plans and projects; and
- avoidance of major flooding locations, which are not typically well managed using GSI interventions.

The GSI site evaluation process described above relied on the City's existing data, and does not require sophisticated technical approaches to identify and evaluate potential GSI sites. After the preliminary evaluation, potential sites were screened to identify site specific considerations and constraints, and to inform selection of specific GSI practices appropriate for the sites.

The analysis of GSI suitability for Newark concluded that:

- While there are certainly notable differences among neighborhood land use mixes and designs in Newark, many neighborhoods offered good potential for GSI application and benefits.
- Most GSI interventions were suitable for the types of urban settings and conditions found throughout Newark.
- GSI pilot project locations could readily be identified that offered a diversity of land uses and GSI opportunity.
- Many locations were identifiable that are broadly representative of the city's urban form, so as to improve future GSI replicability and relevance.

Based on the GSI planning evaluations, data analyses, and field studies, specific GSI Pilot locations were identified in the Fairmount, Lower Broadway, and East Ferry neighborhoods. These locations are representative of urban typologies found in other neighborhoods throughout the city, thus enabling replication of design. The evaluation resulted in identification of 10 sites in the three neighborhoods. The range of potential pilot sites represents opportunities for evaluation of diverse GSI practices, and then for widespread replication throughout the City.

Concept designs have been prepared that are broadly representative of urban form throughout Newark. These concept designs are presented in Section 3.4.

3.3 GSI Implementation Initiated by Pilot Project Implementation

Newark, in the City's Master Plan, the Sustainability Action Plan, and Stormwater Management Plan seeks to achieve greater implementation of GSI, for all the reasons discussed in Section 1, including an improved environment and more economical stormwater management options. However, Newark is still very much in the early phases of its GSI implementation and only a few GSI projects have been implemented in the City, and current stormwater regulations and guidance encourage, but do not yet require, green stormwater designs.

A number of federal and professional groups have conducted research into the cost of GSI; the cost of engineering design, of construction, and the cost of monitoring and maintenance to assure continued functioning after construction.

Table 4 presents the costs of source control technologies, and seeks to compare costs of different approaches using units of cost per gallon of source control. This is an effective approach to identifying general costs, and to comparing the costs of different source control approaches.

Table 4 -Typical Costs of Source Control Technologies

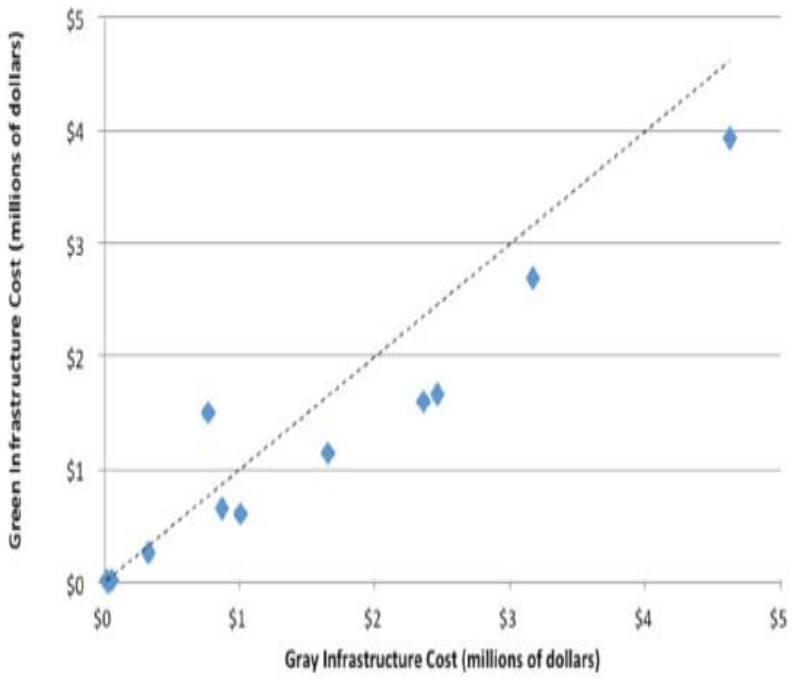
SOURCE CONTROL	INCREMENTAL CAPITAL COST (PER SQ. FT. OR UNIT)	NET PRESENT VALUE (PER SQ. FT. OR UNIT)	LIFESPAN (YEARS)	COST PER YEAR	GALLONS* (PER SQ. FT. OR UNIT)	COST TO CAPTURE GALLON	ANNUAL COST PER GALLON
Blue Roof (2-inch detention)	$4.00	$4.00	20	$0.20	1.25	$3.21	$0.16
Rain Barrel (55-gallon tank)	$200	$200	20	$10.00	55	$3.64	$0.18
Sidewalk Biofiltration	$36.81	$39.68	20	$1.98	8.60	$4.61	$0.23
Porous Asphalt Parking Lane	$8.13	$10.33	20	$0.52	2.18	$4.74	$0.24
Porous Concrete Sidewalk	$6.83	$8.67	20	$0.43	1.82	$4.77	$0.24
Swale	$18.73	$22.50	40	$0.56	1.82	$12.39	$0.31
Blue Roof (1-inch detention)	$4.00	$4.00	20	$0.20	0.62	$6.42	$0.32
Cistern (500-gallon tank)	$3,700.00	$3,700.00	20	$185.00	500	$7.40	$0.37
Greenstreet	$42.67	$82.79	30	$2.07	5.24	$15.81	$0.53
Sidewalk Reservoir	$98.48	$110.41	20	$5.52	3.74	$29.52	$1.48
Green Roof	$24.45	$62.39	40	$1.56	0.47	$133.37	$3.33
REFERENCE CASES	**INCREMENTAL CAPITAL COST (PER SQ. FT. OR UNIT)**	**NET PRESENT VALUE (PER SQ. FT. OR UNIT)**	**LIFESPAN**	**COST PER YEAR**	**CSO GALLONS (PER SQ. FT. OR UNIT)**	**COST TO CAPTURE GALLON**	**ANNUAL COST PER GALLON**
Newtown Creek Tunnel	$1,299,000,000	$1,300,000,000	50	$26,000,000	40,000,000	$32.50	$0.65
Flushing Bay Tunnel	$1,038,000,000	$1,039,000,000	50	$20,800,000	25,000,000	$41.56	$0.83

Note: **Gallons refers to the gallons of stormwater runoff that can be retained or detained by the source control technology.

Source: Green Infrastructure Case Studies: Municipal Policies for Managing Stormwater with Green Infrastructure; USEPA; August 2010; EPA-841-F-10-004

Research conducted by a consortium of professional groups, specifically American Rivers, the Water Environment Federation, the American Society of Landscape Architects and ECONorthwest, found that in many cases GSI costs are similar to, or less than, the costs of traditional gray piped and large volume storage approaches. This information is presented in Table 5, as drawn from the Joint Report of the consortium, which contains extensive information that supports the value and effectiveness of GSI in urban areas.

Table 5 - Green Infrastructure Costs verses Gray Infrastructure Costs



Green infrastructure project costs from EPA (2007) and equivalent gray infrastructure costs (n=12). Projects below the dotted line have lower green infrastructure costs than equivalent gray infrastructure costs.

Source: EPA 2007

3.4 GSI Neighborhood Drainage Analysis, Concept Design, and Cost Estimates

Ten pilot GSI project locations have been identified in three representative neighborhoods in Newark. The pilot locations have been identified in order to continue the process of assessing how to best implement GSI in Newark. In this section you will find short descriptions of the neighborhoods and pilot project locations, a discussion of drainage areas for the pilot project locations, general cost estimates for project construction, and potential concept designs for specific GSI interventions. The three pilot neighborhoods are presented on Figure 3 and are discussed below.

East Ferry Neighborhood - The area includes a diverse mix of residential, industrial, and supporting commercial and educational land uses, along the Passaic River.

Fairmount Neighborhood - The area is extensively residential, with supporting commercial and educational land uses.

Lower Broadway Neighborhood - The area includes a core commercial area, surrounded by lower density residential land uses to the north and higher density residential land uses to the south.

Figure 2 – Neighborhood GSI Pilot Project Opportunities

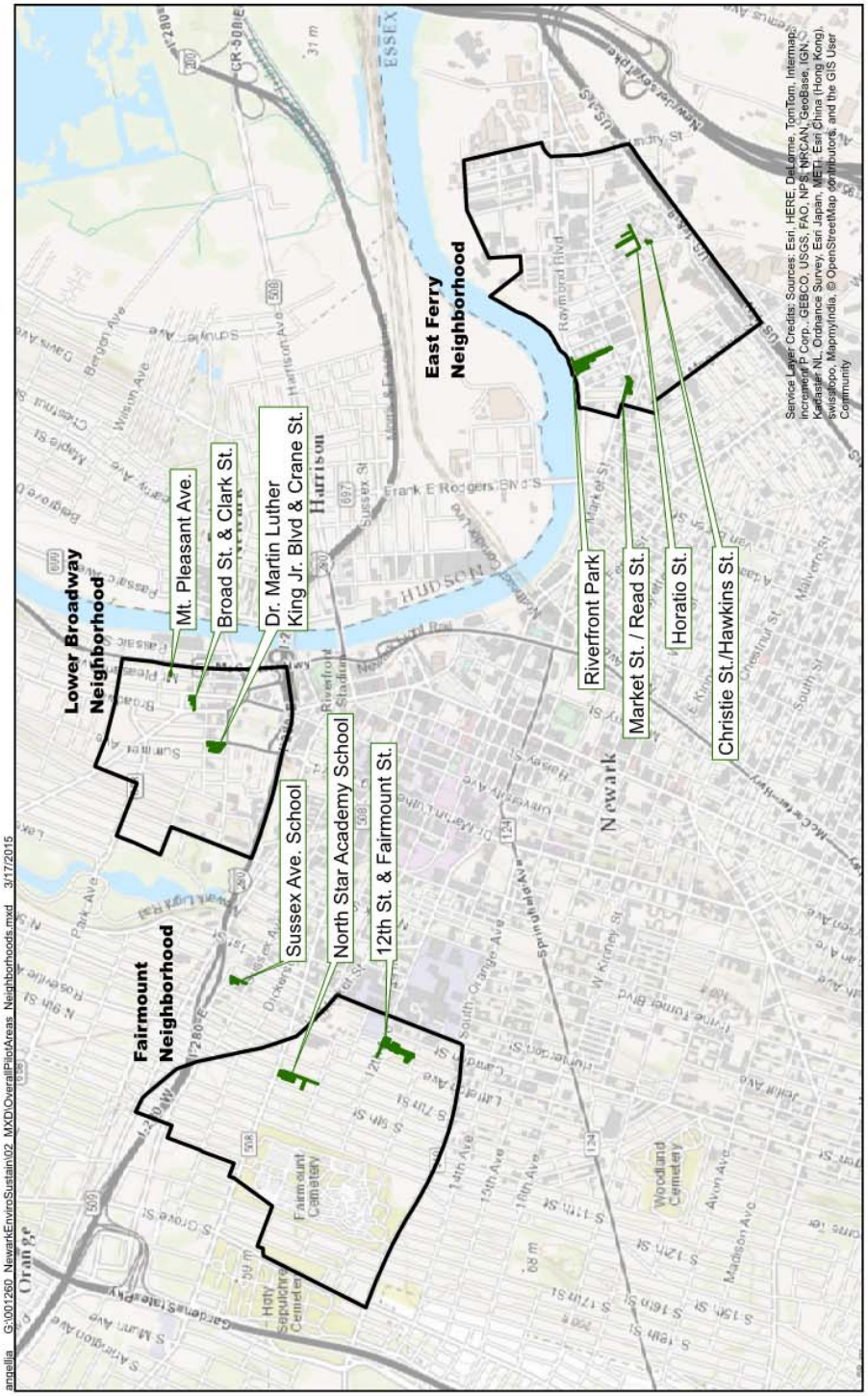


Figure 3
Neighborhood GSI Pilot Project Opportunities

3.4.1 East Ferry Neighborhood GSI Pilot Project Opportunities

Four potential GSI pilot project sites were selected in the East Ferry neighborhood. They included both a large park-based GSI opportunity and other smaller streetscape GSI interventions. Drainage area analysis, the estimated cost, and concept designs for pilot projects in this neighborhood are presented below.

- Consider a GSI site near Riverfront Park, to assess how to create a design that is replicable to riverfront park locations in other areas of Newark.
- The housing demolition near Horatio Street allows for new design concepts to be applied that would integrate street and on-site GSI interventions

Drainage Analysis of Concept Designs

The neighborhoods of proposed pilot projects were evaluated with respect to the drainage area that would likely flow to the GSI intervention locations. The calculated contributing drainage areas to each GSI pilot project are delineated in Figure 4. The specific drainage area calculated for each GSI site is presented in Table 6.

The drainage areas captured for each potential GSI project in the East Ferry neighborhood range from about 3,000 square feet to nearly 100,000 square feet. General practice in locations such as Philadelphia suggest that a GSI project needs to manage drainage from at least 5,000 square feet of impervious surface to begin to be cost-effective, although exceptions to this rule-of-thumb are numerous. For example, where multiple GSI are working together in a catchment area, or where they are connected in series, each subcatchment area can cumulatively manage impervious drainage areas larger than 5,000 square feet. Larger contributing drainage areas provide greater economies of scale, provided that there is sufficient on street and off street land area available for GSI.

Table 6 - Newark Greenstreets Pilot Area - East Ferry

Drainage Areas to Proposed GSI Intervention Sites

Neighborhood	Site Location	Impervious Area (square feet)	Vegetated Area (square feet)	Total Drainage Area Captured by GSI (square feet)	Total Drainage Area (square feet)
East Ferry	Horatio Street between Hawkins and Vincent Street	2,764	-	2,764	44,552
	Riverfront Park between Raymond Boulevard and Brill Street	97,329	-	97,329	97,329
	Hawkins Street between Christie Street and Brinsmaid Place	5,589	-	5,589	5,589
	Market Street between Fleming Ave and Fillmore Street	38,445	-	38,445	38,445

Figure 3 – East Ferry Neighborhood Drainage Area Analysis

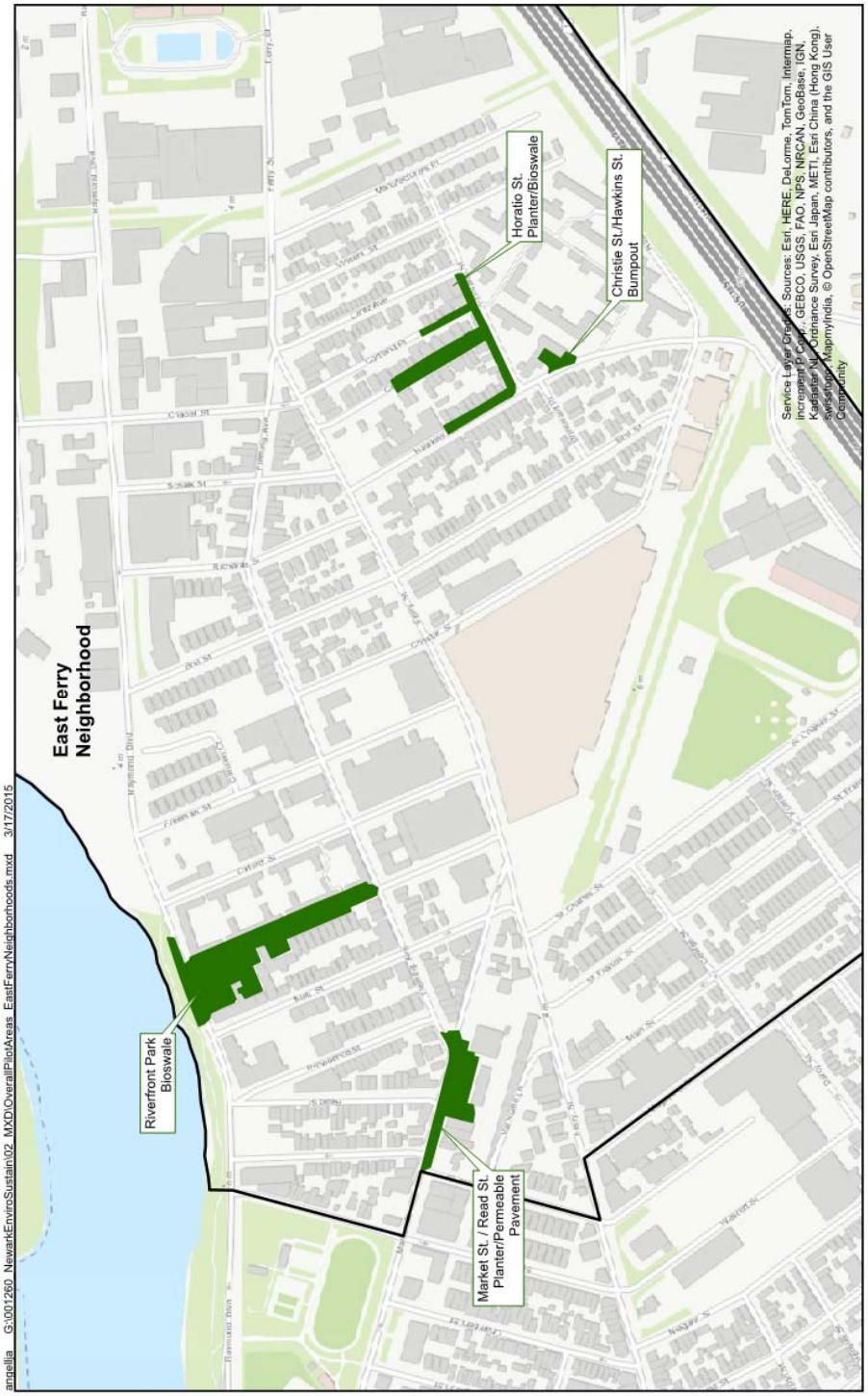


Figure 4
East Ferry Neighborhood
Drainage Area Analysis

CDM Smith

Cost Analysis of Concept Designs

Project cost estimates for the concept designs in the East Ferry range from $45,000 to about $366,000 (Table 7). The cost estimates exclude the cost of land because most are assumed to be implemented on public or donated property. Costs are strongly influenced by the complexity of the design, the subsurface soil and geology, and the volume of runoff to be managed. Costs in similar mid-Atlantic region cities typically range from $100,000 to $300,000 per acre of impervious surface runoff managed in the GSI project. This wide range of typical construction costs is due to the wide variations encountered in local subsurface geology (rock vs. soil), design approach, interfering subsurface utilities, contractor experience, and unanticipated and undocumented conditions.

Source references used for the cost estimates were prepared by the Rutgers University Cooperative Extension Service Water Resources Program, and were based on the following:

- Winning bid by for Camden County MUA's GSI projects in City of Camden, Spring 2014;
- Contractor bid estimates for Hoboken rain garden/curb-extension/bump out, July 2014; and
- RSMeans cost estimating references for the construction industry.

Concept designs for GSI pilot projects in the East Ferry neighborhood follow on Figures 5 through 8.

Table 7 - East Ferry Neighborhood Costs

DESCRIPTION	Quantity	Units			Total Cost High	NOTES
Horatio Street (btw Hawkins St & Vincent St)						
Stormwater Planter	800	Sq. Ft.	$ 70.00	$ 85.00	$ 56,000.00	$ 68,000.00	Average planter is 200 sq ft; 4 planters (a planter per block)
Pervious Concrete Sidewalk	4728	Sq. Ft.	$ 20.00	$ 25.00	$ 94,560.00	$ 118,200.00	Length of Horatio St from Hawkins St to Vincent St is 698 ft, average sidewalk width 8 ft; there are 7 tree pits estimated at 8 sq ft (4 x 4)
Landscape Plantings	1	L.S.	$ 15,000.00	$ 25,000.00	$ 15,000.00	$ 25,000.00	
20% Incidental Costs					$ 33,112.00	$ 42,240.00	
Project Total					$ 198,672.00	$ 253,440.00	
Christie Street, Brill Street and Hawkins Street below Ferry Street						
Stormwater Planter	1000	Sq. Ft.	$ 70.00	$ 85.00	$ 70,000.00	$ 85,000.00	Average planter is 200 sq ft; a planter to be installed for every fire hydrant (4 on Hawkins, 0 on Christie, 1 on Brill)
20% Incidental Costs					$ 14,000.00	$ 17,000.00	
Project Total					$ 84,000.00	$ 102,000.00	
Intersection of Market Street and Read Street						
Stormwater Planter	2800	Sq. Ft.	$ 70.00	$ 85.00	$ 196,000.00	$ 238,000.00	Average planter is 200 sq ft; 14 units of 40 ft. can fit into the 566 ft. length of Market St.
Pervious Concrete Sidewalk	1728	Sq. Ft.	$ 20.00	$ 25.00	$ 34,560.00	$ 43,200.00	Assuming sidewalk width is 8 ft, there is 4528 sq ft of sidewalk; removing soley the area of stormwater planters from the quantity
Curb Reconstruction	566	Linear Ft.	$ 36.00	$ 42.00	$ 20,376.00	$ 23,772.00	Length adjacent parking lots on Market St between Read St and Mott St
20% Incidental Costs					$ 50,187.20	$ 60,994.40	
Project Total					$ 301,123.20	$ 365,966.40	
Riverfront Park						
Rain Gardens	1500	Sq. Ft.	$ 10.00	$ 25.00	$ 15,000.00	$ 37,500.00	Average rain garden is 500 sq ft; Assuming able to implement a minimum of 3 gardens
20% Incidental Costs					$ 3,000.00	$ 7,500.00	
Project Total					$ 18,000.00	$ 45,000.00	

Figure 4 - Site Evaluation and Concept Design for Horatio Street

Figure 5 - Site Evaluation and Concept Design for Christie Street, Brill Street, and Hawking Street

Figure 6 - Site Evaluation and Concept Design for Intersection of Market and Read Streets

Figure 7 - Site Evaluation and Concept Design for Riverfront Park

Figure 8 - Fairmount Neighborhood Drainage Area Analysis

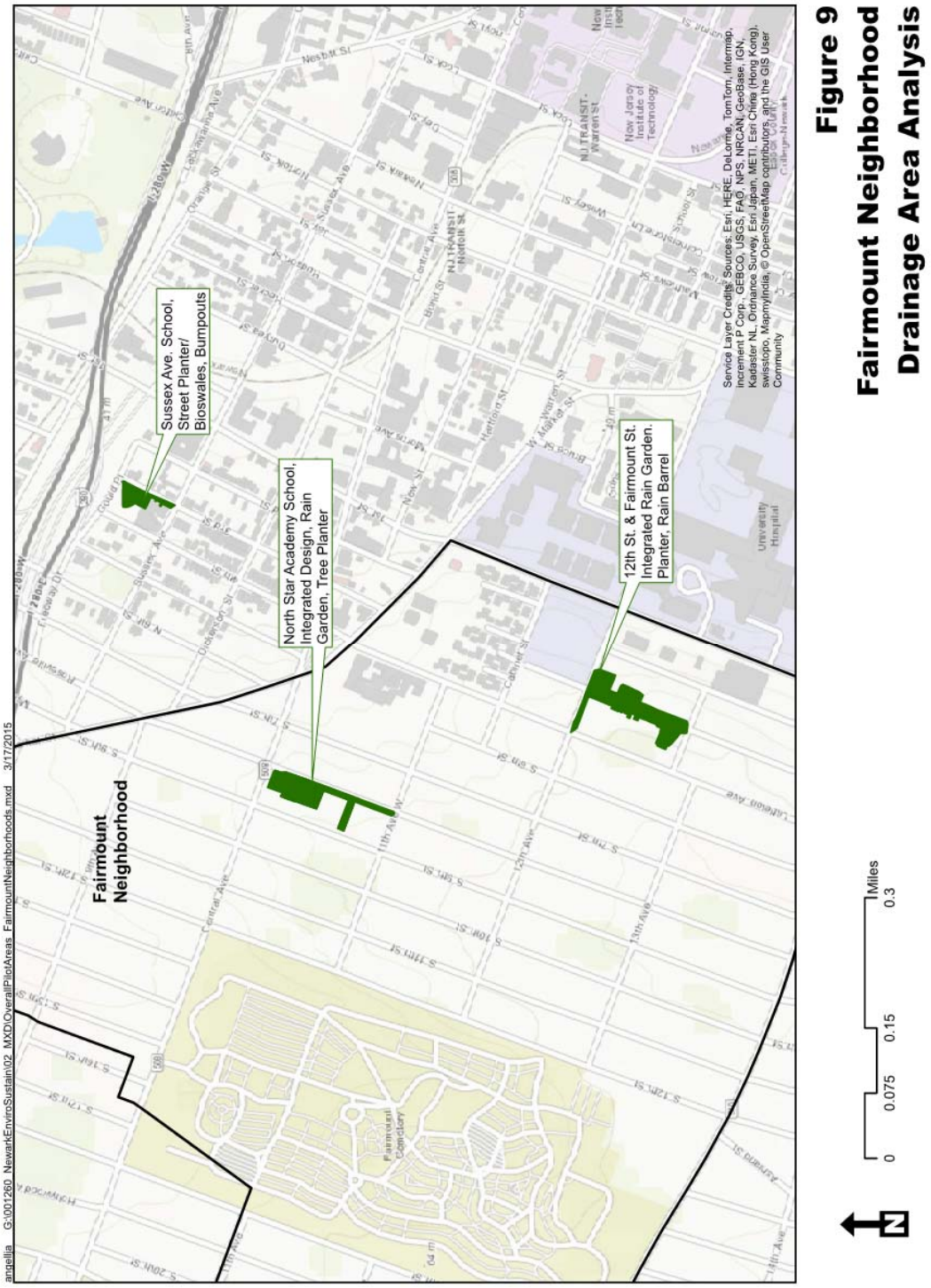


Figure 9
Fairmount Neighborhood Drainage Area Analysis

3.4.2 Fairmount Neighborhood GSI Pilot Project Opportunities

This study evaluated three potential GSI pilot project sites in the Fairmount neighborhood. Vacant property was considered for GSI in this area, because of the interest of a major community partner in re-using such sites, and because the Fairmount neighborhood plan considers converting vacant lots into community open space. Examples of specific opportunities include the Sussex Avenue School, based on a recent successful application for 319(h) grant funding for GSI streetscape work around the school. Because this GSI pilot location is near a school, and because there is concern about excessive vehicle speeds in this area, interest has been expressed in GSI designs that also provide traffic calming. Traffic calming is the addition of streetscape designs that alter driver behavior and improve conditions for non-motorized street users, by building speed bumps, curb bump-outs, changes in street surface, etc. Bump-outs, in particular, allow the addition of GSI in locations where retrofitting GSI is constrained, and are illustrated in the concept designs.

Newark-owned vacant parcels on 8th Street between 11th Avenue and Central Avenue that flank the North Star Academy Elementary School were identified. In particular, the property to the south of the school was identified as a site that the Urban League is interested in improving. And the existing Martin Luther King Jr. Community Garden to the north of the school property might also be integrated into a GSI concept.

Drainage Analysis of Concept Designs

The neighborhoods in which pilot projects are proposed were evaluated with respect to the drainage area that would likely flow to the GSI intervention locations. Figure 9 outlines the calculated contributing drainage areas to each GSI pilot project. Table 8 presents the specific drainage area calculated for each GSI site. The drainage areas for each potential GSI project in the Fairmount neighborhood range from about 11,000 square feet to nearly 100,000 square feet.

Table 8 - Newark Greenstreets Pilot Area - Lower Broadway

Drainage Areas to Proposed GSI Intervention Sites

Neighborhood	Site Location	Impervious Area (square feet)	Vegetated Area (square feet)	Total Drainage Area Captured by GSI (square feet)	Total Drainage Area (square feet)
Lower Broadway	Dr. Martin Luther King J. Boulevard between Crane Street & 7th Ave.	10,837	37,834	48,671	48,671
	Mt. Pleasant Avenue between Gouverneur Street and Clark Street	3,667	-	3,667	3,667
	Clark Street at Broad Street	8,641	7,402	16,043	16043

Cost Analysis of Concept Designs

Estimates of probable project costs for the concept designs in the Fairmount neighborhood are presented on Table 9. The costs estimated for the pilot projects do not include land cost, because most are assumed to be implemented on public or donated property. Costs for the projects, which are very approximate, range from $72,000 to about $216,000 for pilot locations in the Fairmount neighborhood. The costs are strongly influenced by the complexity of the design and the volume of runoff to be managed. Costs average from $100,000 per acre to $300,000 per acre of impervious runoff surface managed in the GSI project.

Concept designs for the Fairmount neighborhood are presented in Figures 10 through 13.

Table 9 - Fairmount Neighborhood Costs

DESCRIPTION	Quantity	Units	Estimate Low	Estimate High		Total Cost Low	Total Cost High	NOTES
12th Ave & Fairmont Ave - Vacant Lot								
Clearing and Grubbin	1	Lump Sum	$ 7,500.00	$ 10,000.00		$ 7,500.00	$ 10,000.00	
Rain Gardens	500	Sq. Ft.	$ 10.00	$ 25.00		$ 5,000.00	$ 12,500.00	Average rain garden sized project is 500 sq ft
Site Amenities	1	Lump Sum	$ 10,000.00	$ 12,500.00		$ 10,000.00	$ 12,500.00	
Landscape Plantings	1	Lump Sum	$ 8,000.00	$ 10,000.00		$ 8,000.00	$ 10,000.00	
Stormwater Planters	800	Sq. Ft.	$ 70.00	$ 85.00		$ 56,000.00	$ 68,000.00	Average sized planter is 200 sq ft; Length of sidewalks on Fairmount and 12th Ave are 100 ft each; Assuming 2 planters per avenue
Pervious Concrete Sic	1600	Sq. Ft.	$ 20.00	$ 25.00		$ 32,000.00	$ 40,000.00	Assuming width of sidewalk to be 8 ft on each side
Cistern	1	Each	$ 2,500.00	$ 5,000.00		$ 2,500.00	$ 5,000.00	
Community Garden B	15	Each	$ 400.00	$ 600.00		$ 6,000.00	$ 9,000.00	
Public Gathering Spac	1	Lump Sum	$ 6,000.00	$ 8,000.00		$ 6,000.00	$ 8,000.00	
Permeable Paver Entr	225	Sq. Ft.	$ 20.00	$ 25.00		$ 4,500.00	$ 5,625.00	Assuming gathering area to be no more than 15 ft x 15 ft
20% Incidental Costs						$ 27,500.00	$ 36,125.00	
Project Total						$ 165,000.00	$ 216,750.00	
North Star Academy - Vacant Lot on S 8th St								Lot size about 4484 sq ft (59 ft x 76 ft)
Clearing and Grubbin	1	Lump Sum	$ 7,500.00	$ 10,000.00		$ 7,500.00	$ 10,000.00	
Rain Gardens	1000	Sq. Ft.	$ 10.00	$ 25.00		$ 10,000.00	$ 25,000.00	Average rain garden about 500 sq ft
Retaining & Seat Wall	1	Lump Sum	$ 12,000.00	$ 15,000.00		$ 12,000.00	$ 15,000.00	
Landscape Plantings	1	Lump Sum	$ 8,000.00	$ 10,000.00		$ 8,000.00	$ 10,000.00	
Street Tree Planter Bo	3	Each	$ 2,500.00	$ 3,000.00		$ 7,500.00	$ 9,000.00	
Pervious Concrete Sic	376	Sq. Ft.	$ 20.00	$ 25.00		$ 7,520.00	$ 9,400.00	Length is about 59 ft, width assumed to be 8 ft; Removing 96 sq ft based on tree planter boxes (each about 32 sq ft)
Pedestrian Pathway	1	Lump Sum	$ 3,500.00	$ 5,000.00		$ 3,500.00	$ 5,000.00	
Public Gathering Spac	1	Lump Sum	$ 6,000.00	$ 8,000.00		$ 6,000.00	$ 8,000.00	
20% Incidental Costs						$ 12,404.00	$ 18,280.00	
Project Total						$ 74,424.00	$ 109,680.00	
Sussex Avenue School								
Street Tree Planter Bo	4	Each	$ 2,500.00	$ 3,000.00		$ 10,000.00	$ 12,000.00	Average sized planter is 200 sq ft; could implement 4 planters
Pervious Concrete Sic	1920	Sq. Ft.	$ 20.00	$ 25.00		$ 38,400.00	$ 48,000.00	Length of 3rd St if ~340 ft, width assumed to be 8 ft; not taking into consideration current tree pits
20% Incidental Costs						$ 9,680.00	$ 12,000.00	
Project Total						$ 58,080.00	$ 72,000.00	

Figure 9 - Site Evaluation and Concept Design for 12th and Fairmount Avenue

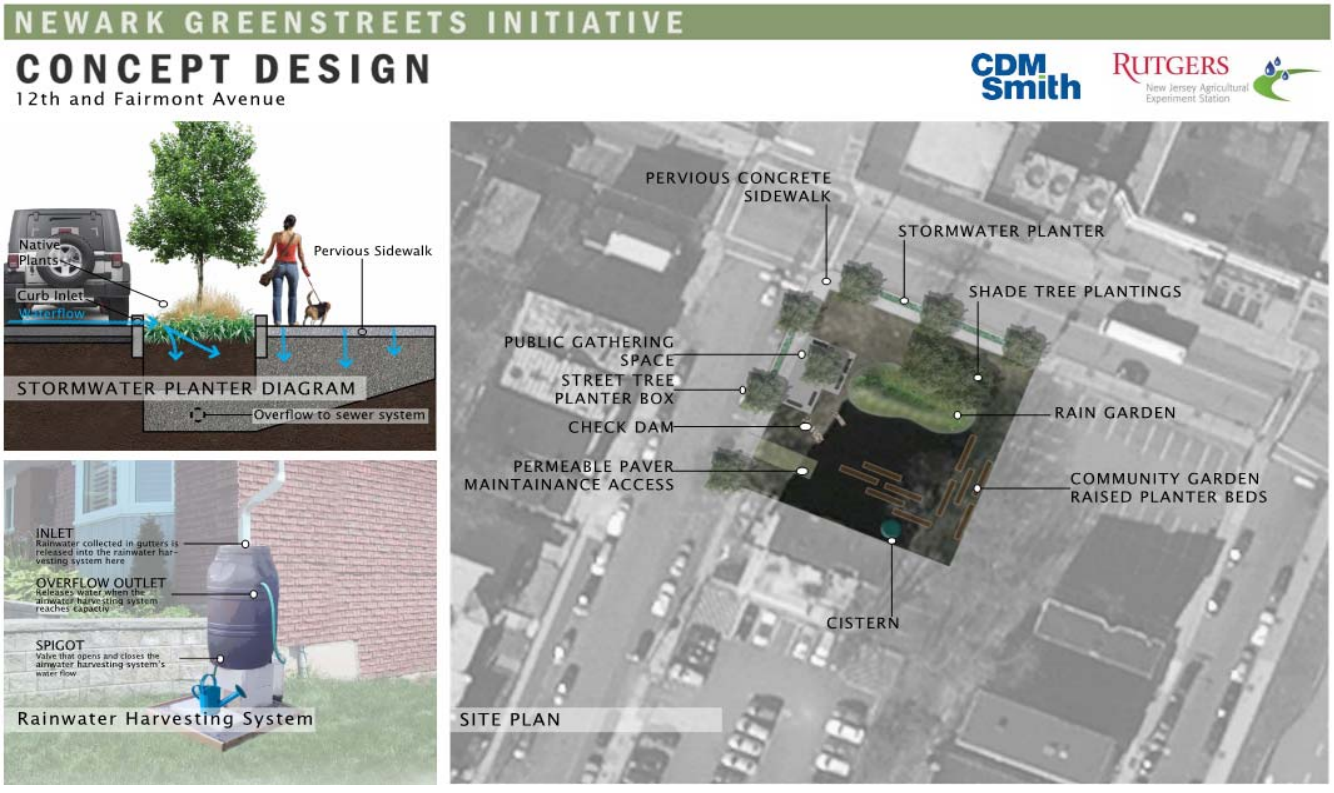


Figure 10 - Site Evaluation and Concept Design for North Star Academy Elementary School

Figure 11 - Site Evaluation for Sussex Avenue School

Figure 12 - Concept Design for Sussex Avenue School

3.4.3 Lower Broadway Neighborhood GSI Pilot Project Opportunities

Three potential GSI pilot project sites were identified in the Lower Broadway neighborhood. As with the other sites, they focus on vacant properties under municipal ownership as well as rights of way. The neighborhood is characterized by a main commercial corridor – Bloomfield Avenue – through which thousands of commuters drive daily. Small retail shops line the corridor, which is surrounded by low-rise multi-family housing as well as several high-rise buildings. The intensity of cars commuting through the neighborhood combined with the local retail uses that serve area residents accessing the corridor on foot produces a local landscape that is sometimes dangerous to pedestrians. Therefore, traffic improvements have been highlighted as an important element in the Lower Broadway Neighborhood Plan. The neighborhood currently has an exciting streetscaping opportunity for GSI that would enhance a recently completed streetscape improvement project. For this reason, several streetscape GSI pilot sites were evaluated in this neighborhood.

Drainage Analysis of Concept Designs

The neighborhoods in which pilot projects are proposed were evaluated with respect to the drainage area that would likely flow to the GSI intervention locations. Figure 14 outlines the calculated contributing drainage areas to each GSI pilot project. Table 10 presents the specific drainage area calculated for each GSI site. The drainage areas for each potential GSI project range from about 4,000 square feet to nearly 50,000 square feet in the Lower Broadway neighborhood.

Cost Analysis of Concept Designs

Estimates of probable project costs for the concept designs in the Lower Broadway neighborhood are presented on Table 11. The costs estimated for the pilot projects do not include a land cost, because most are assumed to be implemented on public or donated property. Costs for the projects, which are very approximate, range from $78,000 to about $240,000. The costs are strongly influenced by the complexity of the design and the volume of runoff to be managed. Costs average from $200,000 per acre to $300,000 per acre of impervious runoff surface managed in the GSI project. Concept designs for GSI pilot projects in the Lower Broadway neighborhood are presented on Figures 15 through 18.

Table 10 - Newark Greenstreets Pilot Area - Fairmount

Drainage Areas to Proposed GSI Intervention Sites

Neighborhood	Site Location	Impervious Area (square feet)	Vegetated Area (square feet)	Total Drainage Area Captured by GSI (square feet)	Total Drainage Area (square feet)
Fairmount	Sussex Avenue School	10,876	400	11,276	11276
	Fairmount Avenue at 12th Avenue	13,205	11,450	24,655	95,983
	South 8th Street between Central Avenue and 11th Ave West (North Star Academy Elementary School)	47,450	10,894	58,344	58,344
	South 8th Street between Central Avenue and 11th Ave West (North Star Academy Elementary School)	6,425	13,488	19,913	19913

Figure 13 - Lower Broadway Neighborhood Drainage Analysis

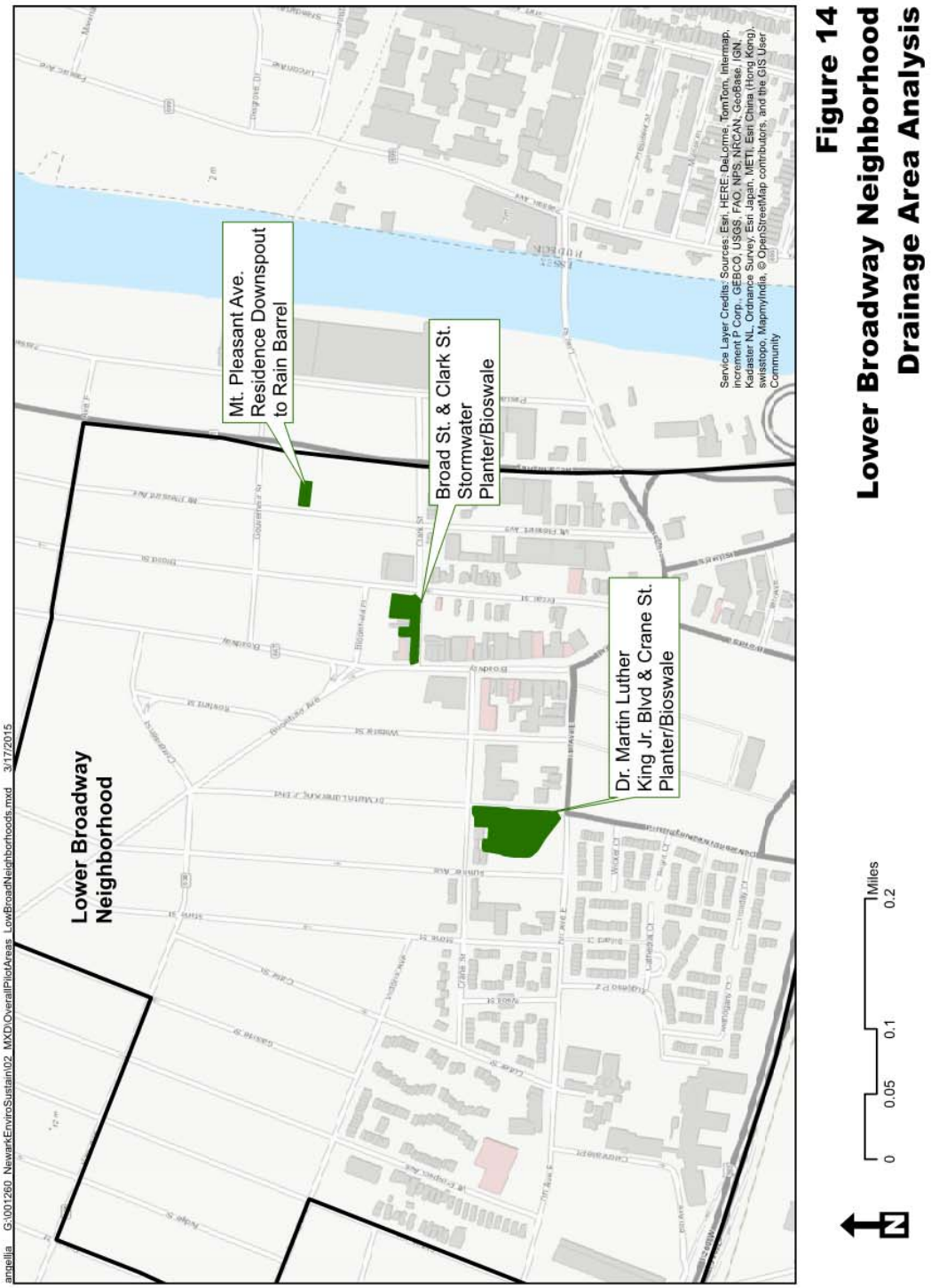


Figure 14
Lower Broadway Neighborhood Drainage Area Analysis

Table 11 - Lower Broadway Neighborhood Costs

Newark Green Infrastructure Demonstration Projects

Estimate of Probable Costs

DESCRIPTION	Quantity	Units	Estimate Low	Estimate High	Total Cost Low	Total Cost High	NOTES
LOWER BROADWAY NEIGHBORHOOD							
Broad & Clark Community Garden							
Cistern	1	Each	$ 2,500.00	$ 5,000.00	$ 2,500.00	$ 5,000.00	
Permeable Paver Entrance	225	Sq. Ft.	$ 20.00	$ 25.00	$ 4,500.00	$ 5,625.00	Assuming gathering area to be no more than 15 ft x 15 ft
Street Tree Planter Box	6	Each	$ 2,500.00	$ 3,000.00	$ 15,000.00	$ 18,000.00	
Stormwater Planter	800	Sq. Ft.	$ 70.00	$ 85.00	$ 56,000.00	$ 68,000.00	Average sized planter is 200 sq ft; could implement 4 planters
Pervious Concrete Sidewalk	1024	Sq. Ft.	$ 20.00	$ 25.00	$ 20,480.00	$ 25,600.00	Length of 80 ft along Clark and 78 ft along Broad; assuming width of 8 ft
20% Incidental Costs					$ 19,696.00	$ 24,445.00	
Project Total					$ 118,176.00	$ 146,670.00	
Mount Pleasant Avenue							
Downspout Planter Boxes	15	Each	$ 2,500.00	$ 3,600.00	$ 37,500.00	$ 54,000.00	
Rain Barrels	15	Each	$ 550.00	$ 700.00	$ 8,250.00	$ 10,500.00	
20% Incedental Costs					$ 9,150.00	$ 12,900.00	
Project Total					$ 54,900.00	$ 77,400.00	
Dr. Martin Luther King Blvd							
Stormwater Planter	1600	Sq. Ft.	$ 70.00	$ 85.00	$ 112,000.00	$ 136,000.00	Average sized planter is 200 sq ft; could implement 8 planters
Curb Reconstruction	356	Linear Ft.	$ 36.00	$ 42.00	$ 12,816.00	$ 14,952.00	
Pervious Concrete Sidewalk	1960	Sq. Ft.	$ 20.00	$ 25.00	$ 39,200.00	$ 49,000.00	Assuming width of 10 ft
20% Incidental Costs					$ 32,803.20	$ 39,990.40	
Project Total					$ 196,819.20	$ 239,942.40	

Figure 14 - Site Evaluation for Broad Street and Clark Street

Figure 15 - Site Evaluation for Broad Street and Clark Street

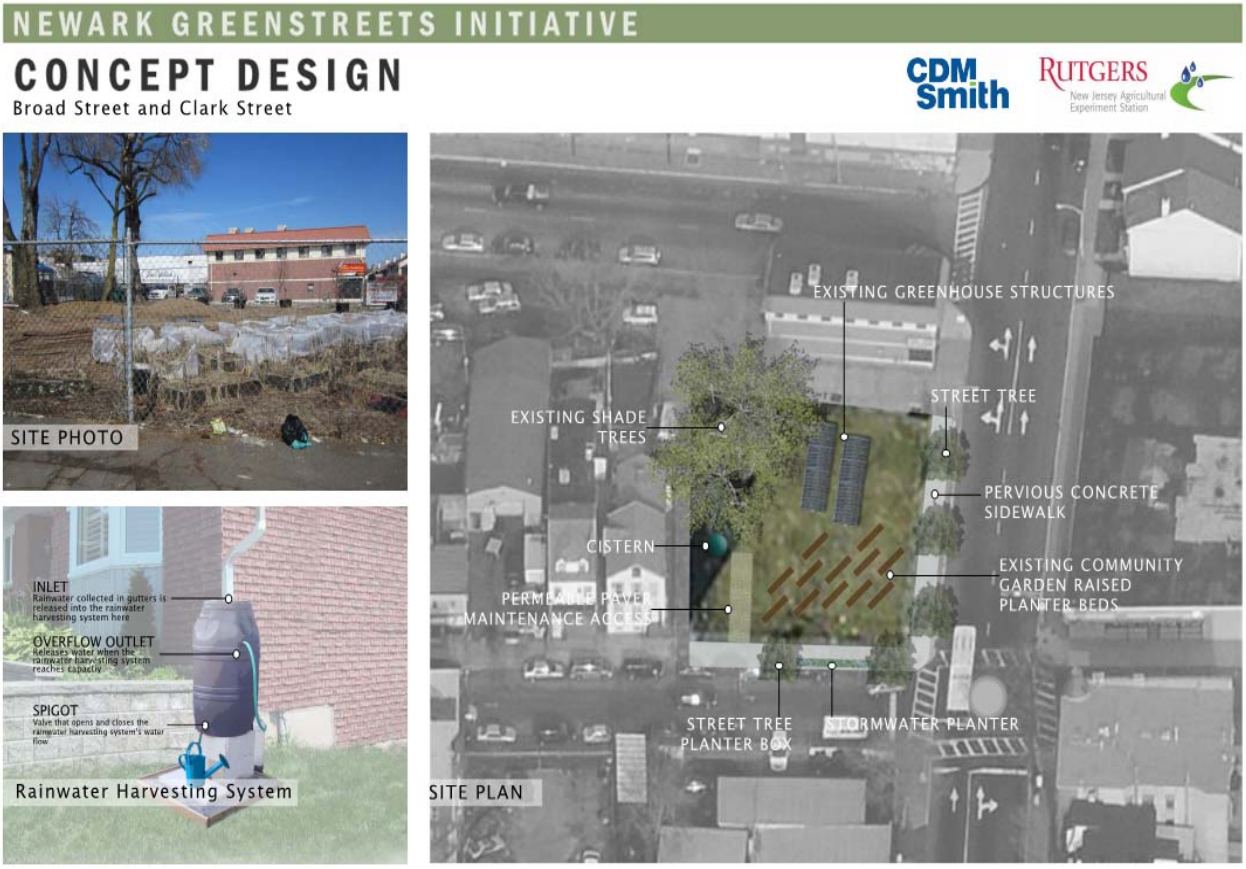


Figure 16 - Site Evaluation and Concept Design for Mt. Pleasant Avenue

NEWARK GREENSTREETS INITIATIVE

SITE EVALUATION

Mt. Pleasant Avenue

CDM Smith

RUTGERS New Jersey Agricultural Experiment Station

Site Address	Mt. Pleasant Ave between Gouverneur Street & Clark Street Newark, NJ 07104
Neighborhood	Lower Broadway
Assessment	This site is a streetscape along rows of private condominiums and single family homes. Potential for green infrastructure should be focused on infiltration and storage of runoff. Proposal includes permeable paving on the condominium side (Mt. Pleasant Ave North) and rain barrels or stormwater planters on the single family home side (Mt. Pleasant Ave South).

NEWARK GREENSTREETS INITIATIVE

CONCEPT DESIGN

Mt. Pleasant Avenue

CDM Smith

RUTGERS New Jersey Agricultural Experiment Station

Figure 17 - Site Evaluation and Concept Design for Dr. Martin Luther King Jr. Blvd

NEWARK GREENSTREETS INITIATIVE

SITE EVALUATION

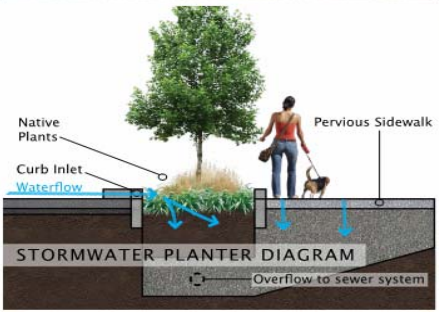
Dr. Martin Luther King Jr. Blvd

Site Address	MLK Blvd. between Crane St & 7th Ave Newark, NJ 07104
Neighborhood	Lower Broadway
Assessment	This site is a streetscape adjacent to a large developable vacant lot. There are several existing tree pits that can be multiplied and replicated along MLK Blvd. Stormwater planters can be added to the tree pits to capture stormwater runoff from the street and vacant lot.

NEWARK GREENSTREETS INITIATIVE

CONCEPT DESIGN

Dr. Martin Luther King Jr. Blvd



4 GSI Program Recommendations

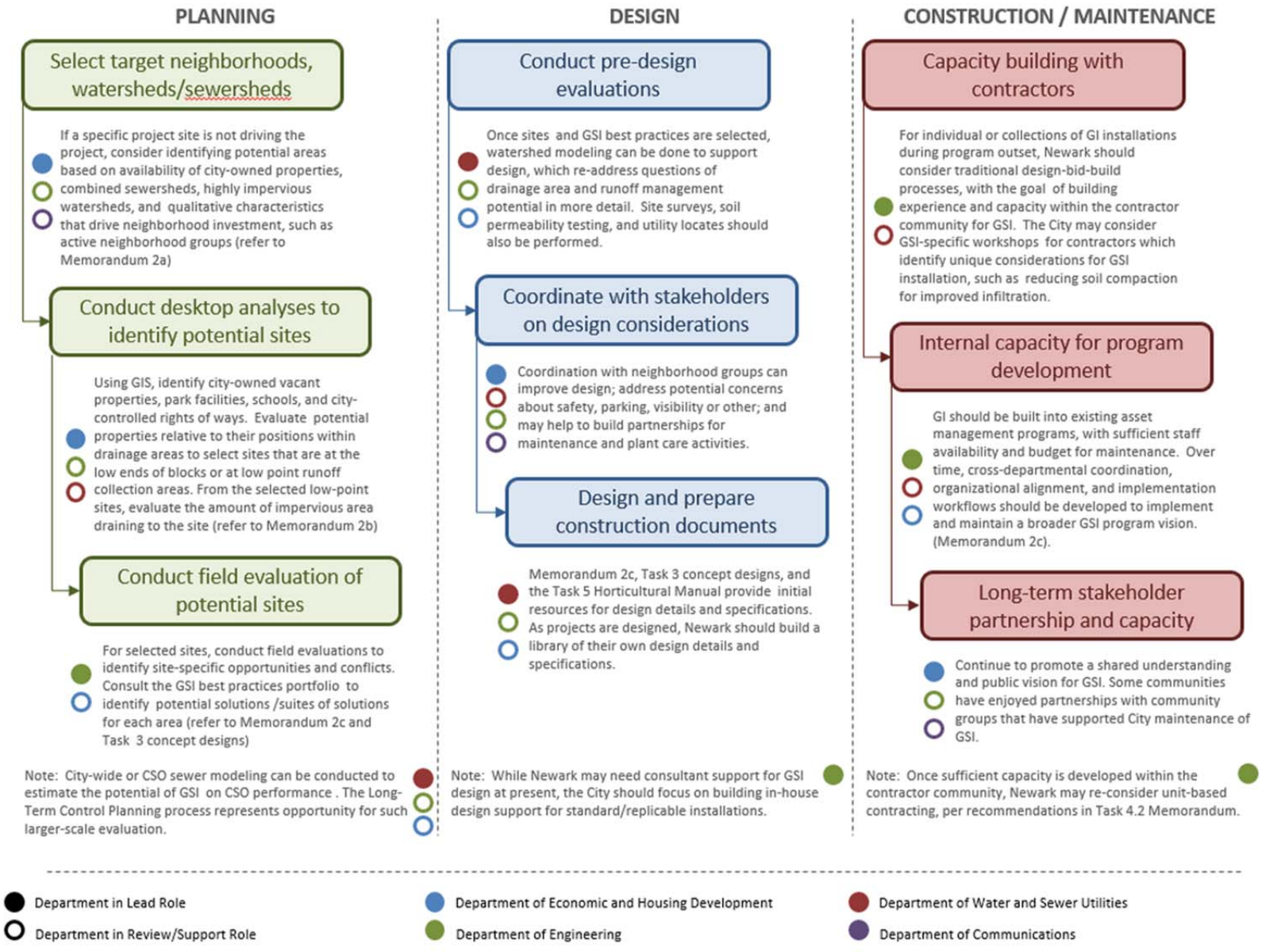
Section 4 provides a set of recommendations to improve implementation of GSI in Newark, including elements of City program development to support GSI infrastructure. Recommendations address the full range of implementation factors, including GSI planning, evaluation, design, construction, maintenance, funding, and partnership development. Opportunities to leverage and advance GSI implementation citywide are identified.

The flow chart presented in Figure 19 (GSI Program Considerations) summarizes the narrative discussion below. The recommendations are based on lessons learned from the analyses conducted for this project and for GSI projects across the country, from review of City documents and data, as well as discussions with City staff.

The excerpt below, from NJ Future's report on Water Infrastructure in NJ's CSO Cities, offers in insightful "framing perspective" that places the city GSI functions in the context of broader urban improvement processes.

> *The most successful CSO programs in the nation occur where cities accept CSO controls as a challenge to be met in the broader context of urban revitalization, rather than as just another regulatory burden. Political leadership is critical to success. Addressing CSOs as an issue solely of engineering and utility management will not be sufficient to achieve the cost-effective, multi-faceted, multi-benefit successes being seen in other cities. The same is true of water supply systems. The various local sewer and water supply utilities cannot individually achieve the necessary level of coordination and cross-fertilization among city departments, regional and state agencies, and the private sector that high-level leadership can achieve.* ***Considerable innovation will be required in development practices, utility management, and State regulatory approaches to achieve the most cost-effective approach to the sustainability of water utility services and to improving our waters so that they can become a point of pride for New Jersey, and not just the recipients of our wastes.***
>
> Source: **Water Infrastructure in New Jersey's CSO Cities: Elevating the Importance of Upgrading New Jersey's Urban Water Systems**, May 2014, by NJ Future/Dr. D. J. Van Abs

Figure 18 – GSI Program Considerations



4.1 GSI Planning Considerations

Select Target Neighborhoods: As discussed in Section 1, this study included a siting process for Newark designed to identify neighborhoods and GSI sites within neighborhoods suitable for potential GSI investment. A geographic analysis was conducted to support neighborhood selection, which included evaluation of land use to identify sufficiently diverse urban forms; permeability to identify areas with potential for a greater amount of surface water to manage; and availability of city-owned parcels that could potentially be used for GSI installations (refer to Appendix 2a). The intent of this analysis was to identify pilot locations and to develop a process for prioritizing future neighborhood GSI investments. This analysis concluded, however, that while there were certainly differences among neighborhoods, any one neighborhood has sufficient potential for GSI application and benefits and qualitative criteria such as partnerships, visibility, and synergy with redevelopment or development initiatives may be better prioritization drivers. Internal and external stakeholders should be consulted to identify synergies and partnership opportunities.

GSI is applicable to almost any land use typology in the city. Specific individual site applications require sufficient drainage area and consideration of site characteristics. When prioritizing future GSI projects, the geographic analysis conducted for this study can be used, which evaluates site, demographic, drainage, and urban topology conditions.

Most cities implementing GSI use several site identification methods simultaneously. One approach is to identify city-owned/public properties in a given neighborhood, and then determine which have sufficient drainage area/impervious area potential. However, it is often useful to conduct evaluations for larger subwatershed/sewershed areas. If the City possesses sewer mapping and subwatershed or subsewershed runoff data, it can analyze the amount of impervious area in a subwatershed, and assess a more area-wide design approach to GSI siting. The City then can further overlay boundaries that are more social or programmatic in nature to address non-engineering community goals.

New York City is moving ahead with a forward looking plan to integrate GSI into water and sewer upgrades and future development, and is creating policy to address three planning needs: (1) identifying how to implement the most cost-effective and feasible controls; (2) studying the feasibility of promising GSI technologies and designs; and (3) exploring funding options for stormwater runoff/GSI. The PlaNYC Sustainable Stormwater Management Plan 2008 sets forth a proactive program that requires research and evaluation of the feasibility of implementation approaches, as is needed for Newark. It is suggested that Newark follow the research and policy development for major GSI implementation cities (e.g., NYC, Philadelphia, Washington, DC) and asses the applicability of GSI planning developments for the city.

Identify Potential Sites: Regardless of how or even if neighborhoods, watersheds, or sewersheds are prioritized, particular sites of interest to the City and community groups can be identified and then evaluated specifically for GSI opportunity (refer to appendix 2b). For future site identification, simple analyses can be performed to support similar identification of potential sites as follows:

- Utilize in-house land use and property ownership data to identify potential properties that may support GSI installations, including city-owned vacant properties, park facilities, schools, and city-controlled rights of ways.
- Evaluate potential properties relative to their positions within drainage areas to select sites that are at the low ends of blocks or at low point runoff collection areas.
- From the selected low-point sites, evaluate the amount of impervious area draining to the site. At this stage, this can be a qualitative evaluation to further select sites with greater amounts of impervious area for GSI management.
- Additional subjective considerations may support further narrowing of potential locations, such as visibility, community support, synergy with other initiatives, or a desire to cluster GSI installations.

The desktop evaluation utilizes the city's existing data and does not require sophisticated GIS analytical approaches to identify potential sites. Once sites are identified, a GSI analysis can be selected that fits the land use characteristics (refer to Memorandum 2c and Task 3 Concept Designs).

Conduct Field Evaluation of Potential Sites: Potential sites, identified by the above-described desktop analysis or by stakeholders should be field screened to identify site specific considerations and constraints and to inform selection of specific GSI practices appropriate for the sites. Once selected, more detailed hydrologic and hydraulic analyses could be done to support GSI selection and design (refer to Appendix 2c and Task 3 concept designs), which re-address questions of drainage area and runoff management potential in more detail. This study did not include detailed field evaluations for engineering design purposes; the goal of the present effort was to identify work that Newark staff could apply during the engineering design of pilot and future facilities, pursuant to the siting and concept design recommendations of this study.

4.2 GSI Engineering Considerations

Conduct Pre-Design Evaluations: Building upon the planning phase identification, initial field vetting, and GSI selection described above, sites should be evaluated in more detail to support design. This includes evaluation of the site for conflicting utilities (water, sewer, gas, electric, etc.), site survey, and soil permeability testing. Site-specific runoff modeling can be done to support design, which can resolve any questions about drainage characteristics, runoff management potential, and design performance. Such evaluations influence placement and sizing of GSI, and determine if and how the installation will be connected to the sewer.

Coordinate with Stakeholders on Design Considerations: Coordination with neighborhood groups can improve design and address potential concerns about safety, parking, visibility or other issues as well as may help to build partnerships for maintenance and plant care activities. This may be particularly important where community groups are present and active, and if coordination was conducted during the planning stages. The Departments of Economic and Housing Development and Communications can provide support and continuity as appropriate.

Design and Prepare Construction Documents: Engineering plans, design details, and engineering specifications can generally be drawn from other similar GSI installations, and are then adapted to city and state design standards and site-specific context. Appendix 2c, concept designs, and the Horticultural Manual provide initial resources. As projects are designed, Newark should begin to build a library of their own design details and specifications.

4.3 GSI Construction/Implementation Considerations

A wide array of both opportunities and challenges face the City of Newark in implementing GSI as a core approach to managing stormwater and complying with combined sewer overflow regulations.

In terms of challenges, NJ Future's Water Infrastructure report identifies the multiple missions and dispersed institutional structure involved in water management in Newark: "At this time, the Department of Water and Sewer Utilities is a single administrative unit that handles two independent self-supporting utilities. It has three divisions, each of which has people who are dedicated to either water or sewer. The Department Director reports to the Business Administrator, who reports to the Mayor. The city council approves rates, budgets and contracts but is not involved with administrative decisions or operations." (Water Infrastructure in New Jersey's CSO Cities: Elevating the Importance of Upgrading New Jersey's Urban Water Systems; New Jersey Future; May 2014)

Newark's existing resources and challenges can be described in relation to four objectives:

1. Creating a shared public vision for stormwater management and community greening;
2. Extending the shared vision for GSI to City departments;
3. Expanding the institutional capacity of City departments to implement GSI; and
4. Increasing the financial resources to implement GSI.

These factors are discussed further below.

Shared Public Vision for Stormwater Management

In terms of creating a shared public vision for stormwater management that prioritizes GSI, Newark has already undertaken important groundwork:

1. The 2013 Sustainability Action Plan lays out a vision that combines stormwater management needs with the need to expand green community spaces and improve public design standards. The Plan proposes implementation of ten pilot GSI projects. The research and recommendations of this study support the pilot projects.
2. Newark city agency staff have established many relationships with community and civic groups that support GSI. In 2014, these groups came together to form Newark DIG (Doing Infrastructure Green!). This new coalition of community organizations, technical assistance providers, regulators, environmental advocacy groups, and city agency staff meets monthly to coordinate

and advance activities that promote GSI as a community-driven solution to Newark's stormwater challenges. Newark DIG has already engaged the Municipal Council and is poised to begin a larger public awareness campaign.

3. Early pilot projects such as the new playground at Sussex Avenue School, the new Riverfront Park, and a range of rain harvesting systems serving community gardens in all five wards contribute functional examples of the potential of GSI.

4. Newark's political leadership has expressed strong commitment to addressing stormwater challenges in ways that enhance community quality of life.

5. Newark staff have engaged with NJ Future and Together North Jersey toward the advancement of GSI, and this report recommends continuing to leverage such non-profit organizational support.

All the ingredients currently exist for the development of a clear public vision on stormwater management centered on GSI.

Extending Shared Vision to Departmental Level

Extending the shared vision for GSI to City departments is a challenge for Newark, due to City budget constraints on staffing and equipment and due to the ordinary challenges of creating programs that require effective coordination among several City agencies and members of the public. While case-by-case coordination among departments has been occurring, such as coordinating a green traffic triangle at Badger and Clinton Avenues, a holistic cross-departmental commitment, approach, and vision for GSI is recommended, with the Department of Water and Sewer Utilities as lead. Cross-departmental coordination, organizational alignment, and new implementation workflows are needed to effectively implement a shared vision. This cross-departmental approach is not unusual among cities working to implement GSI, and is being pursued robustly in cities such as Philadelphia, San Francisco, and Seattle.

Technical Capacity

City staff require additional technical support and training related to GSI engineering and construction inspection. There is need to increase technical capacity to plan, design, and implement GSI. Temporary support could be considered from the state universities, such as Rutgers Cooperative Extension Water Resources Program, and through contracts with planning and engineering firms, until City technical capacity is in place.

Financial Resources and Capacity

Implementing GSI requires new financial mechanisms because stormwater management in New Jersey's cities has traditionally been poorly funded. New requirements for reducing combined sewer overflows and for managing stormwater system discharges under U.S. EPA's new MS4 program will require spending that is significantly greater than past budget allocations.

US EPA's Municipal Separate Storm Sewer System Permit Program

Polluted stormwater runoff is commonly transported through Municipal Separate Storm Sewer Systems (MS4s), from which it is often discharged untreated into local waterbodies. To prevent harmful pollutants from being washed or dumped into an MS4, urban areas must obtain a NPDES permit and develop a stormwater management program. No funding is currently available from the State or federal government for MS4 compliance; this is regarded by USEPA as part of compliance with the Clean Water Act.

Internal Capacity for Program Development: GSI should be built into existing asset management programs, with sufficient staff availability and budget for maintenance. Newark's existing resources and challenges generally require extending the shared vision for GSI among city departments and increasing staff and financial resources for implementation of GSI. A strong mayoral mandate and the need to respond to federal and state requirements associated with the CSO Long Term Control Plan permitting process will continue to facilitate change. While this report suggests department roles, as the program matures, cross-departmental coordination, organizational alignment, and implementation workflows should be further developed to implement and maintain a broader GSI program vision (*refer to Memorandum 2c*).

Capacity Building with Contractors: Many in the construction contractor community may not be familiar with the particular considerations of GSI construction. For example, typical construction practice compacts the soil, which would hinder the infiltration functionality of GSI. The City may consider organizing workshops for contractors which identify unique considerations for GSI installation. For individual or collections of GSI installations during program outset, Newark should consider traditional design-bid-build processes, with the goal of building experience and capacity within the contractor community for GSI. Once sufficient capacity is developed within the contractor community, the City may re-consider the unit-based on-call contracting model (*refer to Task 4.2 Memorandum*).

4.4 GSI Funding Considerations

The principal mechanism for GSI funding, and for improving stormwater management in Newark is through the existing sewer fee collection system, whereby the City charges a combined fee to customers for provision of water and sewer and stormwater services. Current state law does not specifically allow for a municipality to create a Stormwater Utility, or a separate fee for stormwater utility services, but neither does it prohibit creation of a stormwater utility. This lack of clarity in NJ law has resulted in municipalities and cities waiting for clarifying legislation or regulatory guidance (similar to recent changes in Pennsylvania stormwater utility law). (NJ allows for the creation of a wide range of municipal utilities—parking, swim club, shooting range, etc.—and it appears that a stormwater utility is possible, but would need approval of the governing body, which has not occurred to date.) Until state enabling

legislation is enacted that clarifies municipal authority, implementation of stormwater utility funding will likely not be pursued for Newark and New Jersey's cities.

Current sewer fee collection by Newark is designed to meet the capital renewal and replacement requirements and needs for both sewer and stormwater control. However, the current fee structure does not appear sufficient to address impending CSO abatement requirements, nor does it meet the funding needs for transitioning Newark from a gray storm sewer system to one that integrates green stormwater management into its urban fabric.

Alternative stormwater funding approaches are potentially available to Newark, whereby developers who seek to build in the City on sites where stormwater is required to be managed (under Newark's new stricter requirements), but do not have property of appropriate site conditions for stormwater management/GSI could place funds into an account designed to allow larger-scale (and potentially more economical) implementation of GSI in nearby drainage subsheds. It would be necessary to demonstrate that such approaches can achieve similar or better reductions in stormwater runoff and CSO impact. Again, this approach is not currently explicitly allowed, but has been negotiated between developer and the city in other locations, such as Philadelphia.

Overall, future statewide legislative change to allow collection of utility fees specifically dedicated to stormwater management offer the best long-term opportunity for GSI funding. Because New Jersey law is silent on this issue, and because stormwater system maintenance and renewal costs are embedded in the fees charged for sanitary sewer service, the untangling of this issue is critically needed to allow New Jersey's CSO cities, and those municipalities seeking to improve stormwater management, to create a dedicated fund specifically reserved for investment in managing stormwater runoff, in addition to separate charges for sanitary sewer services.

4.5 Program Development

Internal Roles and Functions: As the department charged with regulatory responsibility for Combined Sewer Overflows, the City's Department of Water and Sewer Utilities is well-positioned to coordinate and lead the cross-departmental process that provides the best approach to planning, design, and implementation of GSI for Newark. Planning and design should occur in close coordination with the Division of City Planning within the Economic & Housing Development Department with consultation with immediate neighbors of proposed projects and input from Newark DIG! All technical specifications and designs should be reviewed and approved by the Traffic & Signals Division within the Engineering Department. Finally, the planting and landscaping plan should be reviewed and approved by the director of Neighborhood and Recreational Services, in order to ensure that an adequate maintenance plan is in place.

All GSI projects must draw on a careful understanding of the needs, interests, concerns related to location, community interactions, design, and maintenance; identify synergies with other capital improvement projects; and support utility master planning efforts such as the upcoming Long-Term Control Plan. While Newark may need consultant support for GSI design at present, the City should

focus on building in-house design support for standard replicable installations that can be easily adapted to site-specific context.

Additional Studies and Analysis: The Long-Term Control Plan (LTCP) that will be developed by the Passaic Valley Sewerage Commission represents an excellent opportunity to conduct City-wide or CSO sewer modeling to estimate the potential of GSI on CSO performance. The LTCP process can help identify the areas contributing to each combined sewer outfall and how GSI implemented within each boundary can support reduction in stormwater contributing to that particular outfall. This process would benefit from the opportunity identification data described above. The LTCP provides opportunity for both prioritizing areas and for developing the evaluation models. Accordingly, the City should consider evaluating, designing, and bidding packages of GSI focused on addressing specific watershed or CSO problems.

Community Engagement: Newark has already begun establishing important groundwork for GSI through its Sustainability Action Plan, through Newark DIG!, and the many relationships with community and civic groups (*refer to Memorandum 2a*) that support GSI. These types of relationships and programs provide a good start in establishing a shared public vision for GSI. However, it is critical for each project's success that the residents and visitors that use the space have ample opportunity to weigh in on the prospective designs. The pilot project under development at Badger Avenue and Clinton Avenue is a clear example of the benefits of community-driven design. That traffic triangle doubles as a public park and is used regularly by community members as a gathering place. These community members can serve as stewards of the new space, but only if they are engaged in the design process. The stormwater planter and increased tree canopy that will transform this concrete traffic triangle will reduce run-off from Clinton Avenue and greatly enhance quality of life for the people that use the space.

Both the Departments of Economic and Housing Development and Communication have roles in continuing to facilitate community partnership development. Such partnerships can be advantageous for selecting target areas; identifying design improvements, such as for visibility and safety during the design process; addressing concerns such as parking reduction or mosquito control; and building partnership for longer-term maintenance support, which has been part of the success in communities within Philadelphia and other cities.

4.6 Regional Connections, Implementation, and Next Steps

Together North Jersey established the **Local Government Capacity Grant Program** (LGCGP) to provide financial and technical assistance to County and municipal members to conduct planning activities in northern New Jersey. The program is intended to foster planning activities that are consistent with the goals of **Together North Jersey's Regional Plan for Sustainable Development** (RPSD) project. The funding source for the LGCG program is a combination of funds from the United States Department of Housing and Urban Development (US HUD) and from the Federal Highway Administration (FHWA) and Federal Transit Administration (FTA) passed through the North Jersey Transportation Planning Authority (NJTPA). In order to facilitate the interagency review process, guidance has been provided regarding key elements that must be addressed in the final report, in this case, the **Newark Greenstreets Initiative**.

This section of the Plan summarizes the key elements that are required to be addressed by the funding agencies.

Key Elements: Using this project for technical capacity development, the City of Newark has launched a Greenstreets Initiative that identifies pilot projects for greening the urban landscape along City rights-of-way based upon community interest, environmental benefits, and potential to advance goals related to neighborhood revitalization, circulation and connectivity. In collaboration with Newark's Office of Sustainability and City Planning Staff, the project has led to the preparation of:

- Engineering concept plans and technical design materials needed to advance GSI design, and identification of designs and landscaping best suited to manage stormwater, survive an urban environment, and absorb pollution and greenhouse gas emissions.

- A robust dialogue among City department staff and neighborhood stakeholders regarding GSI design and implementation, in the context of pilot and stewardship projects.

General Recommendations (Issues, Recommendations, and Implications): New GSI implementation processes were recommended for Newark City departments and staff that provide cross-departmental interaction toward the advancement of GSI. Newark will be participating in a combined sewer overflow Long Term Control Plan under federal and state regulations that will require significant changes in the way it manages stormwater runoff from impervious surfaces in the City. Policy, planning, and institutional changes generally recommended by this study included:

- **Increase City planning and engineering technical capacity** to plan, site, design, and monitor the performance of GSI.

- **Create new mechanisms for cross-departmental interaction** to assure the most effective GSI implementation possible.

- **Continue and expand community engagement efforts to promote GSI**, such as coordination with Newark DIG, and neighborhood groups.

- Reach out to the business community and Greater Newark Chamber of Commerce to **better identify how GSI facilities can enhance and improve the business environment**.

- Identify regulatory constraints to improved and explicit stormwater management funding, and work the State and legislative officials, TNG, and non-profits like NJ Future, to **create needed enabling authority to implement stormwater fees**.

- Build on pilot projects to **increase implementation capacity for GSI in Newark**, and to increase the awareness of City residents of the value and benefit to neighborhoods.

Specific Recommendations: To identify the need for improved linkage between policy, design capacity, and implementation processes, ten pilot projects are recommended in this study.

Recommendations that resulted from evaluating the capacity of the City to implement GSI, and the ten pilot projects, include the following.

Policy and Institutional Recommendations

- **The City's Department of Water and Sewer Utilities (holding regulatory responsibility for Combined Sewer Overflows) is best positioned to coordinate and lead a cross-departmental effort to coordinate GSI implementation, and should set in motion actions to promote such coordination.** The Department of Water and Sewer Utilities provides the best approach to planning, design, and implementation of GSI for Newark.
- **Planning and design should occur in close coordination with the Division of City Planning within the Economic & Housing Development Department** with consultation from neighborhood residents of the proposed GSI project and input from Newark DIG! (Newark DIG is a community-based non-governmental organization whose goal is the establishment of sustainable green infrastructure to better manage stormwater runoff, and reduce combined sewer overflows.)
- **All technical specifications and designs should be reviewed and approved by the Traffic & Signals Division within the Engineering Department.**
- Finally, **GSI design and landscaping plans proposed for construction should be reviewed and approved by the director of Neighborhood and Recreational Services**, in order to ensure that an adequate maintenance plan is in place.
- Newark should consider temporary technical support services for GSI design until its capacity to address such work expands. **The City should focus on building in-house design support for standard replicable installations that can be easily adapted to site-specific context.**
- **A regional multi-party Long-Term Control Plan (LTCP) to reduce Combined Sewer Overflows that will be developed by Passaic Valley Sewerage Commission. This effort represents an excellent opportunity to conduct sewer modeling to estimate the potential of GSI in reducing combined sewer overflows**. The LTCP provides additional opportunity for both prioritizing areas for action and for developing more detailed runoff evaluation models; Newark should be a robust participant in the LTCP process, as it needs to assure that its responsibilities for CSO reduction are proportionate to its contribution, especially given that Newark is only one of nine parties to the permit.

Inclusion and Engagement of Traditionally Under-Represented Communities

Along both economic and demographic dimensions, most residents of Newark can be considered "underrepresented" relative to the general population of the Together North Jersey (TNJ) region (see Table 12). The City of Newark's population is comprised of about 278,000 residents, roughly 54 percent of whom are African American and 34 percent of whom are Latino. The percentage of Newark's residents classified by the census as "minority" is approximately twice that of the TNJ region as a whole (88.4 percent relative to 42.6 percent). Over one quarter of households live in poverty in Newark, relative to less than 9 percent of households in the TNJ region. Almost 24 percent of Newark residents have limited English proficiency; in the TNJ region, the rate is half of that at 13 percent. Given that many traditional planning processes in urban areas of North Jersey have historically prioritized the needs of suburban commuters travelling by car through or around the city, it is worth noting that in Newark almost 40 percent of households are carless compared to a TNJ rate of 12.5 percent. The outreach conducted for the Greenstreets project specifically solicited input about the pedestrian experience in the target neighborhoods in order to ensure representation for this portion of Newark's population. Newark also hosts a disproportionate share of the region's subsidized and public housing.

To ensure inclusion of and engagement with traditionally under-represented communities within Newark, the Newark Greenstreets Initiative study included a number of actions designed to connect GSI pilot projects with existing community-led conversations about neighborhood improvement. The Newark Sustainability Office reached out to several community development organizations with missions to provide for the social service needs of residents, in particular low-income neighborhoods. Residents in these neighborhoods - East Ferry, Fairmount, and Lower Broadway - have higher poverty rates, lower educational attainment, worse health and educational outcomes, and higher unemployment than their counterparts at the county and regional levels. Each of the neighborhoods has developed a stakeholder-led neighborhood improvement plan and has supported the development of local neighborhood associations. The neighborhoods were chosen in part in order to benefit from guidance and feedback on GSI locations from these entities.

In partnership with these organizations, the Sustainability Office solicited feedback from residents and staff about where GSI might be beneficial from a public space and neighborhood amenity point of view. The groups include: La Casa de Don Pedro; Ironbound Community Corporation; Urban League of Essex County; and Unified Vailsburg Services Organization. Three of the groups work in neighborhoods that were selected as pilot areas by the CDM Smith project. All four participate in Newark DIG, a city-wide coalition that also includes a number of local environmental nonprofits and residents engaged in community gardening and tree planting. Further, meetings of Newark DIG served as educational and training workshops to enhance local knowledge of GSI as well as opportunities to receive community input on GSI design. The CDM Smith project was presented twice at monthly Newark DIG meetings, which have an attendance of approximately 25 organizational representatives.

Table 122 – Comparative Profile of Traditionally Underrepresented Populations in Newark and TNJ Region, 2010

Variable	Newark	Together North Jersey Region
Households in Poverty[2]	23,370	209,488
Percent Households in Poverty	25.2%	8.9%
Minority Population[1]	245,018	2,800,362
Percent Minority	88.4%	42.6%
Non-Hispanic Minority Population	151,272	1,515,462
Percent Non-Hispanic Minority	54.6%	23.0%
Hispanic Population	93,746	1,284,900
Percent Hispanic	33.8%	19.5%
Persons with Limited English Proficiency (5 Years+)[2]	60,025	837,019
Percent Persons with Limited English Proficiency	23.6%	13.7%
Carless Households[2]	35,613	295,271
Percent Carless Households	38.5%	12.5%
HUD Units[4]	20,747	84,907
Units/1,000 Population	*75*	*13*
Public Housing Units	8,209	31,069
Units/1,000 Population	*30*	*5*
Multi-Family Housing Units	8,674	38,689
Units/1,000 Population	*31*	*6*
Low-Income Tax Credit Units	3,864	15,149
Units/1,000 Population	*14*	*2*

Sources:
[1] U.S. Census Bureau, 2010 Census; [2] U.S. Census Bureau, 2006-2010 American Community Survey; [3] U.S. Census Bureau 2008-2012 American Community Survey; [4] U.S. Department of Housing and Urban Development, A Picture of Subsidized Households, 2012, Using 2010 Census Geography

Newark DIG meetings included:

- City of Newark's Office of Sustainability
- Clean Water Action and Clean Water Fund
- Greater Newark Conservancy
- Ironbound Community Corporation
- La Casa de Don Pedro
- Newark Environmental Commission
- New Jersey Department of Environmental Protection
- New Jersey Tree Foundation
- NY/NJ Baykeeper
- Passaic Valley Sewerage Commission
- Rutgers Cooperative Extension Water Resources Program
- Trust for Public Land
- Unified Vailsburg Services Organization
- Urban League of Essex County

The Sustainability Office staff also worked with organizers with the three CDCs to engage residents active in neighborhood associations on the question of where GSI belongs in their communities. Through neighborhood association meetings, staff reached approximately 30 individual residents. Some of the most specific recommendations came from community development corporation staff, who work regularly with residents on community priorities. The staff members pointed to the desirability of connecting GSI projects with community projects such as: (1) Water resources for conversion of vacant lots into community gardens, via cisterns connected to adjacent roofs or curb cuts that channel stormwater from the street; (2) Beautification and greening of streetscapes, including tree planting, stormwater planters, and bioswales; and (3) Enhanced school gardens and playgrounds. Sustainability and Planning staff attend the monthly Newark DIG meetings, which have become a central clearinghouse for community stakeholders interested in engaging on how GSI can be used to advance local neighborhood priorities.

It should be noted that CDM Smith also presented at two meetings of City staff responsible for stormwater management, including Water/Sewer, Engineering, Planning, and Neighborhood Services. These meetings helped advance a central goal of this project: to increase government staff capacity to plan, design, implement, and monitor GSI pilot projects.

The process for siting new GSI pilot projects that is recommended in this study includes opportunities for community engagement. Community outreach from City staff is an essential component in achieving a best practice result with GSI, particularly since community stakeholders are often called upon to assist with volunteer maintenance activities. The nature of GSI siting is such that the planning process is highly context sensitive with respect to location. The process includes a requirement to gather input from residents that will use the site every day, particularly potentially vulnerable populations such as seniors, youth, individuals with health issues, and residents with limited English proficiency. These stakeholders

help inform City staff in defining the final location, form, and maintenance strategy on each pilot project.

Funding Resources

- Current sewer fee collection by Newark is designed to meet the capital renewal and replacement requirements and needs for both sewer and stormwater control. However, **the current fee structure does not appear sufficient to address impending CSO abatement requirements, nor does it meet the funding needs for transitioning Newark from a gray storm sewer system to one that integrates green stormwater management** into its urban fabric.

- **Overall, future statewide legislative change to allow collection of utility fees specifically dedicated to stormwater management offer the best long-term opportunity for GSI funding.** Because New Jersey law is silent on this issue, and because stormwater system maintenance and renewal costs are embedded in the fees charged for sanitary sewer service, the untangling of this issue is critically needed to allow New Jersey's CSO cities, and those municipalities seeking improved stormwater management, to create a dedicated fund specifically reserved for investment in managing stormwater runoff, in addition to separate charges for sanitary sewer services.

Regional Context

The Newark Greenstreets Initiative recommends the adoption of a series of internal policies and practices to insure that GSI implementation occurs within a cross-departmental process, and that new funding mechanisms be identified with Legislative and State officials so that new tools for GSI implementation are available for municipalities in the region. Newark is but one of many CSO cities in NJ that need better mechanisms for GSI implementation, because traditional stormwater management approaches are ineffective for GSI.

New methods and approaches for siting, planning, engineering, cross-department interaction, funding, and monitoring are recommended in this study that will be useful in addressing the Regional Plan for Sustainable Development (RSPD) goals. Inherently, GSI is a more sustainable approach to stormwater management, and the approaches and technical information provided in this project will be valuable for all RSPD locations, whether they need to meet CSO permit goals, or whether they wish to manage stormwater more sustainably. The GSI implementation recommendations apply to virtually every place type within the region. Few, if any, municipalities and cities have implemented GSI to date – the approach is new and has just been approved by U.S. EPA, and is being promoted as a more sustainable approach to stormwater management.

- Lessons learned during the process of implementing the pilot projects are expected to influence stormwater management regionally and, in turn, the RPSD. In order for this to happen, the siting, planning, and implementation efforts need to be documented. This is important for achieving improved stormwater management over time and the successful achievement of desired outcomes.

- City staff and other stakeholders that are to be affected by or involved in the implementation of the policy and recommendations need to be a part of the development process.
- This effort, and its recommended approach and products, can serve as a model for similar efforts by other counties and municipalities throughout the region which may or may not have adopted or implemented GSI implementation approaches.

Livability and the Environment		**Economic Competitiveness and Workforce Development**		**Society and Community**	
Land Use & Urban Design	↑	Asset-Based Infrastructure Development	↑	Health & Safety	↑
Transportation	↑	Workforce Preparedness & Training	→	Arts & Culture	↘
Housing	→	Industry Sector Development	→	Education	→
Energy & Climate	↑	Business Environment & Entrepreneurial Support	→		
Natural Lands	→				
Air Quality	→				
Water Resources	↑				

↑ Significantly associated with topic
→ Associated with topic
↘ Minor association with topic

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Appendices

(See separate file/document)

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