STORMWATER MANAGEMENT IN PHILADELPHIA: THE IMPORTANCE OF GREEN STORMWATER INFRASTRUCTURE AND COMMUNITY INVOLVEMENT IN GREATER CITYWIDE SUSTAINABILITY

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A Thesis Presented to

The Faculty of Humboldt State University

In Partial Fulfillment of the Requirements for the Degree

Master of Arts in Social Science: Environment & Community

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May 2018

ABSTRACT

STORMWATER MANAGEMENT IN PHILADELPHIA: THE IMPORTANCE OF GREEN STORMWATER INFRASTRUCTURE AND COMMUNITY INVOLVEMENT IN GREATER CITYWIDE SUSTAINABILITY

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In 2000, the Environmental Protection Agency (EPA) found the City of Philadelphia to be in violation of the Clean Water Act (CWA) of 1972 due to insufficient stormwater infrastructure. In 2011, Philadelphia initiated a 25-year, citywide plan called Green City, Clean Waters to reduce stormwater runoff by implementing green stormwater infrastructure (GSI). The plan promised significant community involvement in the process. I conducted semi-structured interviews with City employees and individuals in the community that have partnered with the City to administer GSI and participant observation of community meetings and used them to explore different neighborhoods' experiences with Green City, Clean Waters and the work that the City is doing to connect with the community. I then created an analytical framework to address resilience, reconnecting society and nature, sustainable urban governance and planning, social justice in urban redevelopment, community trust in government, collaboration, and stormwater management and sea level rise to evaluate Green City, Clean Waters' prioritization of community involvement and greater citywide sustainability. Philadelphia has been surpassing its goals for reducing stormwater runoff and increasing GSI, but to

achieve its long-term goals for Green City, Clean Waters, it will need help from the community. Recommendations I make for Green City, Clean Waters going forward include: dynamic public outreach; upgrading methods of communication with the community; community group networking; connecting with peer organizations; self-evaluation of progress; large-scale habitat restoration; and building momentum for citywide sustainability.

ACKNOWLEDGEMENTS

My sincerest thanks to everyone who helped me develop and complete my thesis. To Mark Baker for being a wonderful beacon to the Environment & Community Program, even during his time traversing the globe. To my committee members Yvonne Everett, Laurie Richmond, and John Meyer for sticking with me and providing your invaluable guidance. To my fellow Environment & Community students who provided their feedback, emotional support, and have been wonderful company to learn with and from. To those who allowed me to interview them and provided their enthusiasm and expertise in helping me learn more about Philadelphia and green stormwater infrastructure. To Philadelphia Water Department staff and consultants Andrew Baldridge, Darren Brown, Maggie Dunn, Aaron Kirkland, Tiffany Ledesma, Daniel Schupsky, and Liz Svekla. To Sarah Anton from the Passyunk Square Civic Association. To Zach Popkin from the Pennsylvania Horticultural Society. To my friends and family for their encouragement, interest in my work, and unconditional love.

Thank you.

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INTRODUCTION

When the Clean Water Act (CWA) was passed in 1972, the Environmental Protection Agency (EPA) was given the authority to regulate development and its effects on water quality. Sections 303 and 404 of the CWA include approval or denial of land use permits that involve point and non-point source discharge into waterways, fining cities for polluting surface waterbodies, and forcing them to desist (U.S. Environmental Protection Agency, December 9, 2016).

In 2000, the EPA found the City of Philadelphia to be in violation of the CWA, by allowing wastewater from its combined sewer system (CSS) to be discharged into local waterbodies, resulting in environmental pollution and public health hazards. The EPA required the City to find a way to resolve the problem of point and non-point source pollution, caused by stormwater runoff and combined sewer overflow (CSO) discharge (Karvoven 2011). The City, acting through the PWD, decided to use a low-impact development (LID)-based strategy called green stormwater infrastructure (GSI) to manage stormwater. They devised a 25-year plan entitled Green City, Clean Waters to significantly increase Philadelphia's greened acres to help decrease the total volume of stormwater that enters the CSS by using GSI to collect and disperse it (Philadelphia Water Department, June 1, 2011)[1]. Each greened acre is an acre of land that was

[1] Philadelphia's plan is a partnership with the EPA and Pennsylvania Department of Environmental Protection (PA DEP) designed to meet the standards the EPA has set (Philadelphia Water Department, December 1, 2011).

previously impervious, producing stormwater runoff, and has been outfitted with GSI to absorb and reduce stormwater runoff. The PWD equates each greened acre to reducing 27,158 gallons of stormwater runoff each year (Green, December 18, 2013). "Greening" is the process of turning previously developed, paved, often abandoned land into parks, medians and other greenways. Vegetation that is planted as a part of GSI projects also has secondary functions for offsetting climate change and improving air quality, by providing shade, creating moisture through evapotranspiration, and absorbing heat and carbon dioxide. Newly greened areas may also provide recreation opportunities for residents.

Community involvement in the planning and maintenance of Green City, Clean Waters is listed as a key element of the plan,

> "Ultimately, the goal is to partner with Philadelphians to identify the most strategic investments in green stormwater infrastructure that can meet the PWD's goal of reducing combined sewer overflows while also creating tangible physical, social, economic, and environmental benefits within our neighborhoods" (Philadelphia Water Department, June 1, 2011, p. 43)

The "Public Outreach and Participation" section of the plan outlines opportunities for a collaborative management system in which residents also become participants and stakeholders in the management of the City's water resources (City of Philadelphia & U.S. Environmental Protection Agency, April 10, 2012; Philadelphia Water Department, June 1, 2011). The shifts in stormwater management and greater inclusion of the community in the process that Green City, Clean Waters encompasses are a part of a broader initiative that the City, led by the Mayor's Office and Office of Sustainability, have created to make Philadelphia a greener, more sustainable place. The initiative, titled *Greenworks: A Vision for a Sustainable Philadelphia*, was started in 2009 and includes

the Green City, Clean Waters plan started in 2011. It seeks to realize a future of more efficient transportation, decreased waste production, cleaner streets, more trees, cleaner air and water, and environmental education and stewardship (Philadelphia Office of Sustainability, June 1, 2011; Philadelphia Office of Sustainability, November 2, 2016).

In our rapidly urbanizing world it is increasingly important for cities to have effective infrastructure management plans that not only focus on technical and economic feasibility but equally address social injustices and value community involvement in the process. In this thesis, I therefore interrogate the PWD's Green City, Clean Waters plan for stormwater management, which purports to prioritize GSI and community involvement. I review the literature on resilience, reconnecting society and nature, social justice in urban redevelopment, community trust in government, collaboration, and stormwater management and sea level rise to develop an analytical framework (Table 1) to address the questions:

1. How has the City shifted its management of stormwater from a purely CSS dependent approach to incorporating LID and mitigation for sea level rise?
2. What is the City's relationship with the community regarding stormwater management?
3. How effective has the PWD been in getting the community involved in stormwater management through Green City, Clean Waters?
4. Is the City living up to its promise to partner with residents in implementing LID and create physical, social, economic, and environmental benefits for the community?

Using the analytical framework developed from the literature, I present data that I collected from attending community meetings, interviewing PWD staff and partners that assist with administering GSI, and from a review of PWD education materials. These data show examples of what the PWD is doing to implement GSI, how they are including

the community in that process, and how the community has responded in neighborhoods across Philadelphia. I then use the analytical framework to evaluate the progress of Green City, Clean Waters with respect to community involvement and sustainability thus far (Table 2). In conclusion, I make recommendations for how the PWD can further enhance community involvement and sustainability efforts in the plan going forward (Table 3).

LITERATURE REVIEW

Contemporary stormwater management has begun to shift from a reliance on combined sewer systems (CSS) to low-impact development (LID) strategies, including green stormwater infrastructure (GSI). Rather than draining storm waters away from urban development through underground pipes, above ground green spaces will expand to capture water on site and allow it to filter into the groundwater. This approach to urban stormwater management is a major shift in urban planning that changes the face of urban places and urban residents' lives. How new stormwater management systems are introduced and implemented can have significant implications for social justice as well as for a city's resilience and sustainability over time. In this literature review, I explore society's relationship with nature, the importance of resilience and sustainability in restoring that relationship, social justice in urban planning, establishing trust and openness in government, the role of education and community involvement in collaborative management, gentrification caused by urban renewal, stormwater management, and GSI.

Many authors have provided frameworks using social and physical parameters for assessing society's relationship with its natural environment. They provided evidence in support of the idea that the connection between society and nature is extensive and an important part of achieving resiliency and sustainability in urban spaces. The two are closely connected and yet society's access to nature and the ability to self-manage in it are separated by powerful, political, and economic entities. Money and political power

historically erase the marginalized (Biehl & Bookchin, 1999; Feige, 2013; Gray, 2003; Karvoven, 2011; Swyngedouw, 2009). Social, economic, and political challenges are closely linked to the environment in which societies are built and the physical elements of a given environment can either inform how society exists in a natural space or be altered by society in substantial ways (Feige, 2013; Karvoven, 2011; Swyngedouw, 2009).

Resilience is "the capacity of a system to absorb disturbance and still retain its basic function and structure" (Walker & Salt, 2006, p. xiii). To be resilient, society cannot rely on technology and increased efficiency alone in our management of natural resources (Karvoven, 2011; Walker & Salt, 2006). We must consider additional, constructive strategies that create new options instead of limiting them. Walker and Salt (2006) argued that systems are socio-ecological and should be studied as a whole, including both environmental and human dimensions. These systems "have the capacity to change as the world changes while still maintaining their functionality" (Walker & Salt, 2006, p. 12). Changes to and within the system do not happen in isolation, and adaptive management and learning should be utilized with a diversity of approaches, such as inclusion of community (Gray, 2003; Walker & Salt, 2006).

Resilience theory states that for ecosystems to withstand and adapt to change, diversity and persistence are necessary. For example, wetlands provide ecosystem services including, water filtration, stormwater retention, and acting as a buffer during flooding and storm events. For wetlands to retain their ecosystem services, plants, animals, and soils must remain intact, healthy, and diverse (Holling, 1973). Resilience theory also applies to the relationship between people and urban ecosystems. Over time,

urban spaces create a rift between society and nature. For natural spaces to return, humans must be invested in shifting their resource use, rebuilding natural habitat, and see how the restoration of ecosystem services can provide healthier, more resilient urban spaces for them as well. Fostering urban ecosystem functions provides residents with ecosystem services that encourages an understanding of the importance of reconnecting society and nature.

Urban planning is a key element of governing urban spaces. Urban planning not only addresses the physical layout of streets, buildings, and green space, but it considers the locations and designs of these features to ensure that the people using urban spaces are benefitting from an improved quality of life (Campbell, 1996). Urban planning should improve the lives of the people using urban spaces by providing equitable access to public services including food, health care, housing, transportation, employment opportunities, education, and recreation (Barton & Tsourou, 2000).

City government is responsible for urban planning that provides residents equal access to benefits, regardless of socio-economic, cultural, or political status. Under the American Institute of Certified Planners Code of Ethics, it is the ethical responsibility of planners to advocate for social justice and "seek social justice by working to expand choice and opportunity for all persons, recognizing a special responsibility to plan for the needs of the disadvantaged and to promote racial and economic integration" (Prior, 2015). Although the social needs of residents are a foundational element of urban planning, urban planning often fails to adequately address social needs and the array of socio-economic differences experienced by the public (Barton & Tsourou, 2000). Social

justice can be defined as “the explicit recognition of structural inequalities in the world (along class, race, gender, institutional and other lines) and therefore the need for proactive, structural programs to counteract these inequalities” (Campbell, 2013, p. 76).

In a world of dynamic change, it is imperative that urban planning focuses on both sustainability and social justice so that cities are able to be resilient and adapt to transformative change in the future. Sustainability is defined as using resources in the present in ways that do not limit access to those resources for future generations (World Commission on Environment Development, 1987). Campbell (1996) suggested that environmental aspects of planning should be approached with social theory and community in mind to avoid injustices. Social justice, economic development, and environmental protection must be simultaneously represented (Campbell, 2013).

One of the challenges local governments face in distributing public resources equitably is avoiding situations where environmental impacts disproportionately affect socio-economically weaker communities or neighborhoods. Plumwood (1998) referred to these situations as ecojustice issues, where environmental problems are redistributed to underserved communities instead of eliminated altogether.

There is a deep history of social injustice tied to environmental problems related to infrastructure across the United States in the expansion of highways, the construction of airports, and the placement of industrial waste sites. Disruptive infrastructure can cause mental, physical, and social health problems in the people within close proximity to these structures (Evans, 2003). Highway expansions have divided communities physically and socio-economically and created barriers to fair access to community

resources in many cities (Mohl, 2014; South Carolina Department of Transportation, June 28, 2017). Airports in cities including New York and Santa Monica have been found to place burdens of air and noise pollution on neighborhoods adjacent to the airports, including an increased burden on lower income, minority communities (Gwynn & Thurston, 2001; Hu et al., 2009). Placement of industrial sites and toxic wastes in numerous locations across the country, including Warren County, North Carolina and Houston, Texas, ignores the needs of struggling communities that do not have the means to relocate, should not have to relocate, and deserve proper protection from these hazards (Taylor, 2014). As noted above, in our rapidly urbanizing world it is increasingly important for cities to have effective infrastructure management plans that not only focus on technical and economic feasibility but equally address social injustices and value community involvement in the process.

Curtin (2015) described an ideal management framework in which agreement between affected parties is mutually developed and accepted before the start of a project and collaboration amongst government and community entities is utilized in forming a unified set of goals. Through this balanced political process, personal views are put aside for the greater benefit of all, while room is made for learning from mistakes and adapting to challenges (Curtin, 2015; Gray, 2003).

Openness and transparency in decision-making help build trust between government and community by putting both on the same level (Putnam & Feldstein, 2003). Openness prevents government from being secretive and holding exclusive control of knowledge and power. Withholding access to knowledge limits democratic decision-

making and opportunities for collaboration. By being transparent, government creates an environment in which the public are more likely to trust that accomplishments can be made and feel empowered to participate (Schusler et al., 2003; Stiglitz, 2002).

Kondo et al. (2015) looked at the social and physical effects of urban green spaces on public health and safety. They found that urban spaces that appear to be run-down and neglected are avoided by outsiders. These spaces are deemed dangerous, dirty, or not worth the investment of time and energy. In addition, there is a positive correlation between green urban spaces and "social cohesion." Whether an underrepresented section of the community is unable to or disinterested in becoming more sustainable or it is already taking action to become more sustainable and going unnoticed, greater investment from not only the top-down but the wider community is valuable for success and "social cohesion" (Kondo et al., 2015). Andersson (2006) explained that people who get to experience these benefits of having more urban green spaces will be more likely to support movements towards urban sustainability and resiliency.

In order for more people to benefit from urban green space and support sustainability and resiliency, they need access to resources and opportunities for participation. Inequality in the availability and exchange of information is a failure of democracy, especially where the least powerful and most underrepresented sections of a community are concerned. A democratic community offers open opportunity for sharing of opinions, knowledge, and needs across social, political, economic and cultural divides. Plumwood (1998) extended the definition of democracy in societies to "not only permit but actively solicit the voice from below" (p. 211). Properly functioning economies

require natural, manufactured, financial and human capital (Flora & Flora, 2004; Hawken et al., 2013). Highlighted here is the importance of human capital, or "labor and intelligence, culture, and organization" (Hawken et al., 2013, p. 4). As Rossi (2015) emphasized, by recognizing the importance of community and the role of being a citizen, residents can develop their identity as valuable contributors to the governance of their city. Education and opportunities to get involved are imperative for inspiring the community to participate, make their voices heard, and enter positions of leadership (Gray, 2003; Karvoven, 2011).

As described by Kristina Smock (2004), the Community-Building Model and Civic Model of community organizing further show the importance of education, opportunities for participation and leadership. The Community-Building Model addresses the desire of small-scale communities, like a neighborhood, to be able to have their needs taken care of, where a lack of resources prevents them from doing so. Their strategy then becomes to work within the community to build partnerships and pool resources for forming their own power structure from within (Smock, 2004). Despite the community's independence, it is still tied to outside entities that hold power. Partnership is required between the community and some or all of the outside groups in order for the community to reach its goals. Building a framework based on small community groups breaks down the greater population into more manageable pieces. Cooperative management and addressing the needs of each part of the municipality's greater population makes a management system more productive (Korsar, 2015; Smock, 2004).

The Civic Model (Smock, 2004) addresses public order and structure within communities, which are enforced through monitoring within the community. Community meetings and events are spaces for defining acceptable behavior and for establishing forms of social control with which to govern the community. Policing and city-run services are incorporated into the social control framework for problem-solving and keeping a community in order (Smock, 2004). Community involvement is a necessary bridge between top-down and bottom-up entities and balancing the decision-making process to ensure that it is as democratic as possible (Lurie & Hibbard, 2008; Putnam & Feldstein, 2003).

Challenges of Gentrification

The positive outcomes of transforming urban spaces into more sustainable ones are plentiful, but they are not without negative consequences. A major critique of environmental restoration in urban environments is the negative social effects that can occur. As Brownlow (2006) explained, "new environmental narratives...accompany and expedite the exclusive, entrepreneurial agendas of gentrification and urban renewal" (p. 199). Initially, urban renewal is viewed as a positive strategy for solving physical issues in city spaces, but it can cause many social issues, intentionally or not. Urban renewal often attracts new capital and development instead of renewing existing space and structures. These physical changes that pave over existing foundations can have social implications of removing culture, altering the way that people use space, and creating economic barriers. Urban space is in constant flux and nature's place in that space is

always transforming and adapting. As urban space shifts, not everyone occupying that space benefits from those changes, and it is important for the entities managing urban planning projects to stay conscious of that fact (Heynen et al., 2006).

As physical and social barriers form during urban renewal, underserved and marginalized communities lose their trust in the government's ability to support and protect them. For governments to regain trust from the residents that they serve, they must recognize the extensive history of marginalization and racism that minorities were subjected to as urban spaces were established and developed over time (Putnam & Feldstein, 2003). It is not the case for all American cities, but Brownlow (2006) provided examples of how an influx of capital can widen the gap between the lower and upper classes. In some cases, the social divide may be further widened by the failure of the upper class and local government to maintain urban park spaces for the lower class. Purposefully neglecting urban park upkeep is a form of "racial spatial segregation" in that it makes space less attractive, more hazardous, and increases the crime rate. Upper class members of society are deterred from visiting these urban spaces and lower-class residents have no choice but to live cautious lives in unsafe, unkempt areas of the city (Brownlow, 2006).

How do governments then rectify the planning mistakes that were made without perpetuating their position of control? Brownlow (2006) went on to explain that coming from the perspective that the government is educating marginalized communities "'to understand the ecological importance of what they have [through participating in restoration activities]' appear, at best, naive and misinformed or, at worst, patronizing,

unsympathetic, and uninterested" (p. 211). Alternatively, Curtin (2015) saw potential for mending and collaboration in addressing urban environmental restoration. When governments take the initiative to consult communities and evaluate local concerns, they can create mutually-agreed upon goals, and self-reflexivity in government opens possibilities of transparency and the ability of community to trust in government (Curtin, 2015; Putnam & Feldstein, 2003).

Stormwater Management

The foundation for how to achieve society blending with nature, urban resilience and sustainability, open and inclusive governance, and prioritization of community involvement can be applied within the context of stormwater management, which is not often discussed in these arenas.

Stormwater management encompasses the regulation of rainfall and snowmelt that becomes runoff as it flows over impervious surfaces and is collected by an infrastructure system (National Research Council, 2009). As urban spaces became more common, more developed, and more populated throughout history, stormwater and wastewater management systems have needed to evolve to keep up with demand (Frost, 2013). Protection from flooding is particularly difficult in communities on the coast and rivers, built on marshlands or areas that experience tidal fluctuations. In these locations, there is simply a larger volume of surface and groundwater that can contribute to flooding during storms and high tides, or due to sea level rise or overdevelopment (National Research Council, 2009). Historically, cities have used a combined sewer system (CSS)

that collects stormwater from a site and combines it with wastewater before rerouting it to treatment facilities. With heavy rainfall or snowmelt events, CSS can become overloaded by the irregular volume of water. Water treatment plants are unable to accommodate the increased volume of water all at once, so the pipelines are given overflows that allow excess water to exit the CSS and pour into local streams, rivers or oceans. While diluted, the water that is dumped contains all manner of pollutants and may become a hazard to the environment and public health (Tibbetts, 2005). The hazards from flooding and polluted waters are often disproportionately borne by low-income communities located in undesirable low lying and flood prone areas, or near combined sewer overflows (CSO). These residents may lack the resources to educate and get members of the community involved in environmental stewardship efforts (Putnam & Feldstein, 2003).

Inadequate stormwater management often results in failed environmental protection and social injustice. For example, communities that lack the financial resources to implement more dynamic management systems may use grey stormwater infrastructure methods, such as sewage treatment plants that are overburdened and large, underground storage tunnels and tanks. These methods do nothing to reduce the amount of stormwater or improve water quality and are often costly (Flynn & Davidson, 2016).

In the 1990s, Syracuse, New York decided to build more sewage treatment plants in an effort to improve water quality in the county's Onondaga Lake. One of the plants was planned for the City's low-income, majority African American Southside neighborhood. Residents formed a community group opposing the treatment plant, and continued utilization of a system of CSOs, advocating that resources could be put towards

more low-impact, cost-effective methods. The community group succeeded in persuading the City of Syracuse to reverse its decision to build new treatment plants but were excluded from the negotiations that followed when Onondaga County sued Syracuse for refusing to sell land for the development of the plants. With a political shift in the County, development was ultimately halted in favor of community needs and green and grey stormwater management methods, but it took nearly 10 years of fighting to succeed (Perreault et al., 2012).

Commonly, one of the biggest issues with stormwater management plans is CSS that collect stormwater and wastewater in the same pipes. Large volumes of polluted water are routinely dumped into rivers, lakes, and oceans across the nation, including Cincinnati, Ohio (Green et al., 2013) and Mebane, North Carolina (Wilson et al., 2008), where the struggle to improve water quality and stormwater management is disproportionately felt by low-income minorities. Cities like Houston, Texas, that have increased exposure to natural hazards, experience prolonged recovery periods due to inadequate and unevenly distributed stormwater management and further expose socio-economically vulnerable populations (Zahran et al. 2008).

Sewage from residential and commercial properties used to be collected in ditches along urban roadways, with no plan for how to dispose of it, or dumped into nearby wetlands. Rainfall would also collect in the ditches, causing sewage to overflow into roadways and walkways (National Research Council, 2009). It is no wonder that this began to cause large-scale public health issues for urban residents.

In 1855, CSS were introduced in the United States. CSS are underground pipe systems that collect stormwater runoff, wastewater from homes and businesses, and industrial waste in a single pipeline. Stormwater and wastewater mix together as they make their way to wastewater treatment plants. During periods of significant rainfall, especially times of the year when storms and more frequent rainfall occur, and when greater than one inch is accumulated, CSS are designed to expel excess water into local waterbodies through CSO pipes (Figure 1). In these cases, either the pipes themselves or the treatment plants have reached capacity (Philadelphia Water Department, June 1, 2011; Tibbetts, 2005). Discharged water "moves more quickly, is hotter, and carries more pollutants than runoff from undeveloped areas" (National Research Council, 2009; Welker et al., 2013).

Even with the advent of sewage treatment plants, cities that have CSS have continued to dump large volumes of wastewater. In these cases, sewage treatment plants may be able to process wastewater, but once it rains or there is significant snowmelt, the plants cannot handle the increased volume (National Research Council, 2009; Tibbetts, 2005). Additionally, when tides are high, tide gates in the CSS are designed to prevent overflow, regardless of whether or not the pipes and treatment plants have reached capacity, which can lead to back up and flooding on the street level (Philadelphia Water Department, June 1, 2011; Tibbetts, 2005). Once separate sewer systems (SSS) became an option in the early to mid-1900s, newer urban and suburban areas could utilize them, but presently it is too costly for most older, more developed cities to dig up and replace

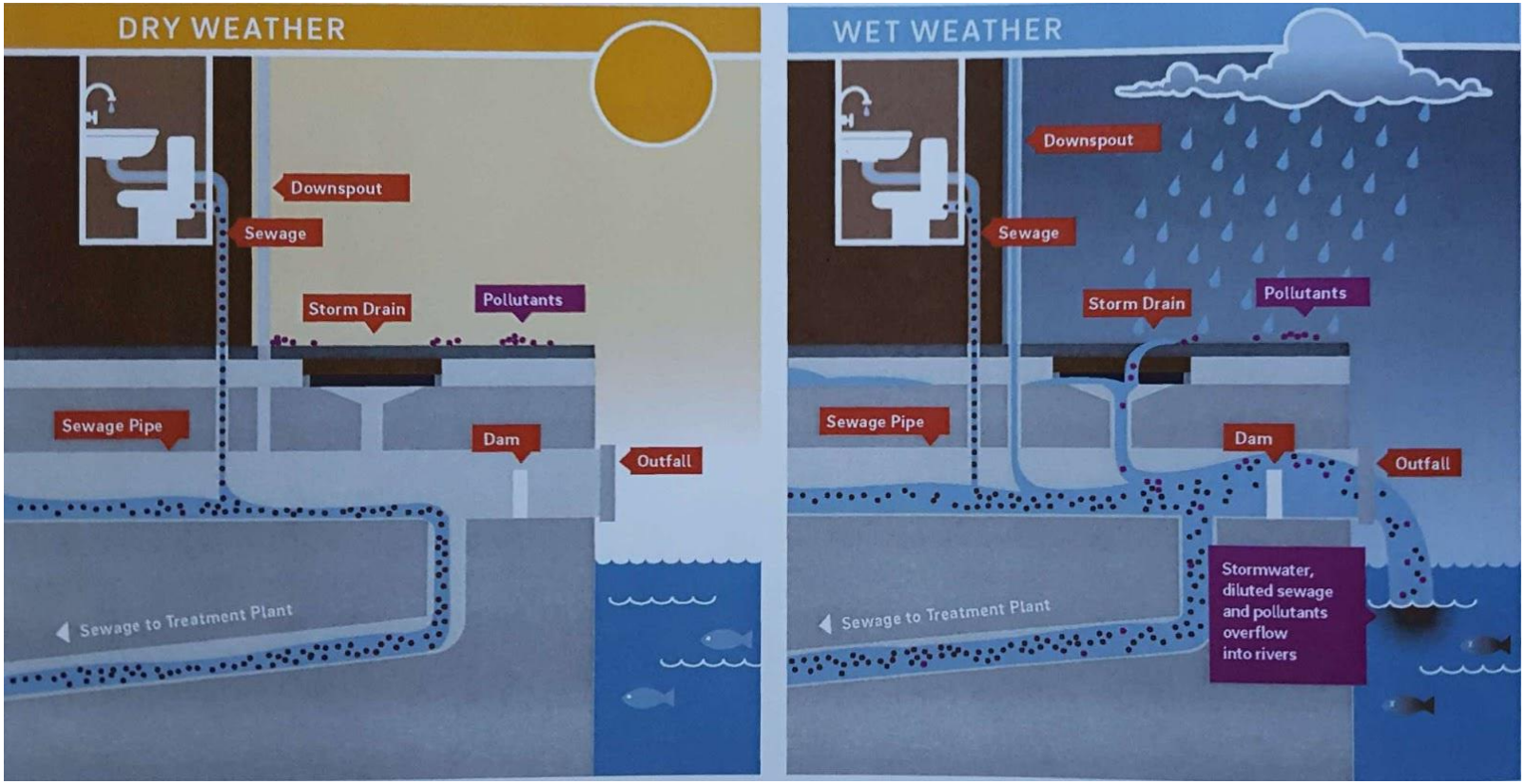

Figure 1. Difference of stormwater overflow during dry weather (left) and wet weather (right) in a combined sewer system (CSS). Diagram by the Philadelphia Water Department (PWD).

existing CSS infrastructure (U.S. Environmental Protection Agency, 1999; Tibbetts, 2005).

As an alternative, water departments and urban planners started to explore LID options for managing stormwater, including retention ponds, swales, and raingardens. LID is a strategy for replacing impervious surfaces, primarily pavement and rooftops, with vegetated surface area to prevent surface runoff and allow precipitation to be absorbed into the ground or flow directly into local waterbodies (National Research Council, 2009). Beyond this basic function, LID is also valued for aesthetics and opportunities for community enrichment (Echols & Pennypacker, 2008).

The Clean Water Act (CWA) of 1972 has been a major driver in the shift from CSS for stormwater management to LID. Sections 303 and 404 of the law address stormwater management, sewage treatment plant requirements, and the prohibition of point and non-point source pollution discharge into waterways. Furthermore, the CWA highlights the importance of creating plans to address non-point source pollution and gives the Environmental Protection Agency (EPA) authority to regulate water pollution discharge (U.S. Environmental Protection Agency, November 27, 2002). In April 1994, the EPA established the CSO Control Policy and the National Pollutant Discharge Elimination System (NPDES), mandating cities to reduce the number of their CSOs, write a short-term plan for managing CSO discharge, and create a long-term CSO control plan (Tibbetts, 2005; U.S. Environmental Protection Agency, December 9, 2016). The EPA uses their regulatory power under the CWA to evaluate cities' stormwater management plans, test for water quality, fine city governments for non-compliance, and

partner with cities to find ways to solve their water management issues (Echols & Pennypacker, 2008; U.S Environmental Protection Agency, November 27, 2002; U.S. Environmental Protection Agency, December 9, 2016).

Nationwide, climate change and sea level rise are further exacerbating the challenge of managing stormwater on a long-term scale. Unpredictable yearly rainfall and snowfall, irregularly high temperatures in winter months that cause greater rainfall and rapid snowmelt, and sea level rise are causing greater volumes of runoff and flooding, which puts greater demand on stormwater infrastructure (ICF Incorporated, L.L.C., August 1, 2014; U.S. Environmental Protection Agency, May 19, 2016).

Accounting for shifting weather patterns, sea level rise, and pervasive flooding in stormwater management plans is a necessity. Goals for greater resiliency and sustainability that include LID, habitat restoration, government networks, and community collaboration offer cities options for adaptability and improve upon the government's responsiveness to environmental and social justice issues (Dorworth & McCormick, 2015; Karvoven, 2011; U.S. Environmental Protection Agency, May 19, 2016). How the issues of climate change and sea level rise are presented, and how government communicates with the public about taking action are important. It is easy to identify the negative aspects of environmental challenges that we must face. The more difficult job is recognizing those challenges and finding opportunities to motivate the public to take action. Reconnecting society and nature, educating the public, and providing opportunities for involvement and collaboration are key for democratic decision-making and problem-solving (Hall, 2013; Plumwood, 1998).

Perales Monparler et al. (2015) referred to the shift towards reconnecting society in nature in urban spaces and the need for holistic, regenerative stormwater management. Implementing LID methods for stormwater management reconnects society and nature, highlights the benefits of ecosystem services, and seeks out collaboration between government and the community (Karvoven, 2011; Kivel, 2007; Perales Monparler et al., 2015; Randle, 2016).

Green Stormwater Infrastructure

One form of LID is GSI, which targets the reduction of stormwater runoff with the widespread installation of vegetation in the form of green roofs, rain gardens, tree trenches, and materials like porous pavement and pavers for gardens, driveways, and patios that allow water to be captured on site and seep through to the soil layers below (Appendix A; Figure 2; Philadelphia Water Department, June 1, 2011).

Seventeen cities are recipients of EPA assistance for the development of GSI programs under the CWA, which include requirements for community involvement to be built into stormwater management plans (U.S. Environmental Protection Agency, 2017). Seattle, Austin, Texas, Jacksonville, Florida, and Los Angeles are some of the other 17 cities partnered with the EPA.

As noted above, Philadelphia partnered with the EPA to develop LID and GSI strategies, which are being used as a part of the 25-year stormwater management plan called Green City, Clean Waters (Philadelphia Water Department, June 1, 2011). Philadelphia argues that its Green City, Clean Waters plan is unique in its approach to

Figure 2. Diagram of green stormwater infrastructure (GSI) project types used in the Philadelphia Water Department's (PWD) Green City, Clean Waters plan. Diagram by the PWD.

urban stormwater management because it set out to achieve large-scale coverage of LID and GSI, while making community involvement integral to the process (Philadelphia Water Department, June 1, 2011).

PHILADELPHIA'S STORMWATER MANAGEMENT HISTORY AND GREEN CITY, CLEAN WATERS

The City of Philadelphia was founded in 1682 by William Penn and his fellow European colonists. The settlers arrived in the area, with the Delaware and Schuylkill Rivers' extensive stream system and wetlands, choosing it as an ideal location to establish a port city. By the mid-1700s, Philadelphia was the fastest-growing city in America, and with it came rapid growth in agriculture, slaughterhouses, and industrial production including tanneries. Throughout the 18th and 19th centuries, it became standard practice for industries, as well as residents, to use rivers, streams, wetlands, and wells for dumping waste. The toxic mix of human, animal, and chemical wastes in the City's water system led to widespread disease and death (Boyer et al., 2010; U.S. Fish and Wildlife Service, 2001).

As a result, many of the streams were filled in, developed on top of, and replaced with pipe systems for waste, stormwater, and drinking water, including 3,000 miles for sewage (Figure 3; Philadelphia Water Department, June 1, 2011). Part of that water infrastructure is the combined sewer system (CSS) that collects stormwater and wastewater in the same pipelines. With a population of over 1.56 million (U.S. Census Bureau, 2016), Philadelphia's CSS is extensive, and 64 square miles of Philadelphia's nearly 133 square mile total area are within the CSS. Combined sewer overflows (CSO), the points where excess water from the CSS is dumped into local waterbodies, are located

Figure 3. Maps of Philadelphia streams before they were filled in (picture on left) and replaced with combined sewer system (CSS) pipelines (picture on right). Maps by the Philadelphia Water Department (PWD).

at 164 points along the Delaware River, Schuylkill River, Darby, Cobbs, Poquessing, Pennypack, Tacony, Frankford, and Wissahickon Creeks (Figure 4; Philadelphia Water Department, June 1, 2011).

Overflow discharge causes degradation of local freshwater and wetland habitats, as well as public health issues for residents that use these waters for boating, swimming, and fishing. Flows from CSOs are powerful and can cause additional environmental damage, such as erosion, to stream banks as water exits the pipes and collides with the ground. Philadelphia receives all of its drinking water, nearly 250 million gallons each day, from the Delaware and Schuylkill Rivers. None is taken from groundwater sources. Therefore, it is imperative that the City's watersheds are protected (National Research Council, 2009; Philadelphia Water Department, 2018a).

Rainfall data from 1902 to 2005 show that Philadelphia experiences an average of 65 "rainfall events" each year, causing CSOs to expel 16 billion gallons of stormwater and wastewater (Philadelphia Water Department, June 1, 2011). Although snowfall does not tend to cause overflow, a mix of snowfall, rainfall, and melting of snow during the winter months can. Climate change is expected to increase temperatures and precipitation globally through the end of the century and as early as 2020. Philadelphia is predicted to experience increased temperatures throughout the year and the greatest increase in precipitation each winter. Increased temperatures in the winter are expected to cause the corresponding increase in precipitation. From 1961 to 2000, average temperatures were 41.9 ºF during winter and 84.5 ºF in summer. Also during this time period, average

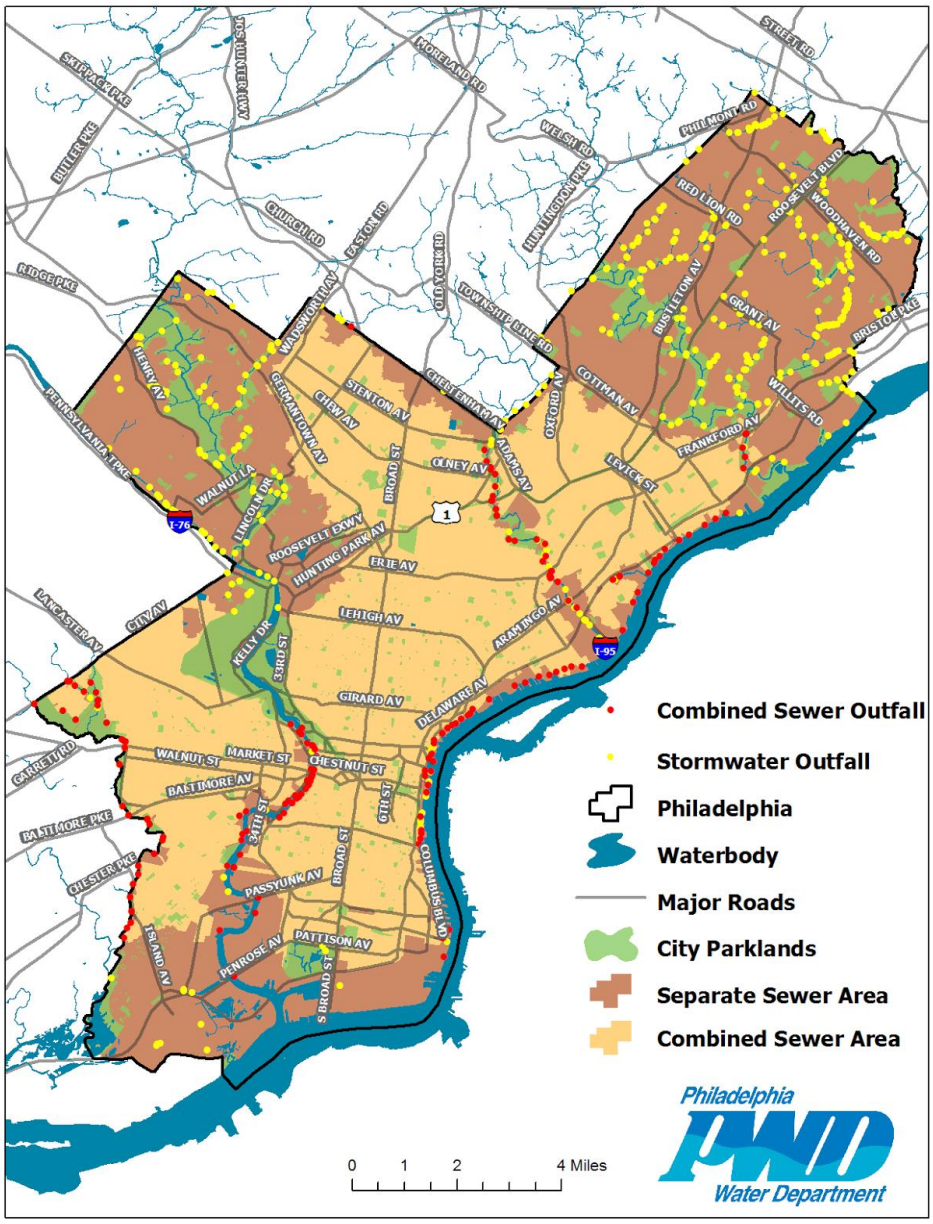

Figure 4. Map of combined sewer system (CSS) outfalls (red/dark dots) and separate sewer system (SSS) outfalls (yellow/light dots) located in Philadelphia. Outfall is another term for overflow. Map by the Philadelphia Water Department (PWD).

precipitation throughout the year was 44 inches. Average annual temperatures and precipitation increased overall 1930 to 1960 and 1980 to 2010. Annual temperatures are expected to continue to increase through the end of the century, with the largest change of 9.3 ºF between 2081 and 2099. Annual precipitation is projected to rise to over 49 inches by the end of the century as well (ICF Incorporated, L.L.C., August 1, 2014).

In April 1994, the EPA signed the CSO Control Policy with the City (U.S. Environmental Protection Agency, 2012). In December 2000, based on the CSO Control Policy guidelines, the EPA found the City to be in violation of the Clean Water Act (CWA) of 1972 (Karvoven, 2011). The City and Pennsylvania Department of Environmental Protection (PA DEP) signed a Consent Order and Agreement in June 2011 (Pennsylvania Department of Environmental Protection, June 1, 2011), followed by a Partnership Agreement between the City and the EPA in April 2012 (City of Philadelphia & U.S. Environmental Protection Agency, April 10, 2012). As defined in the EPA's Administrative Order for Compliance on Consent (AOCC), signed by the EPA and the PWD in September 2012, Philadelphia's CSOs were identified as contributors to point-source pollution (U.S. Environmental Protection Agency, 2012). Under the AOCC, and as the primary regulating body, the EPA can issue fines of up to $37,500 per day for civil penalties and imprisonment and up to $50,000 per day for criminal violations for the PWD's non-compliance of the AOCC and included agreements and policies (U.S. Environmental Protection Agency, 2012). Aside from potential fines, the PWD spends tens of millions of dollars annually in an effort to find solutions to CSO-caused water pollution (Philadelphia Water Department, June 1, 2011). The PWD is also obligated to

satisfy additional Federal requirements, including the National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer Systems (MS4) Stormwater Regulations, the Stormwater Management Act of 1978, and the Safe Drinking Water Act of 1974 (Pennsylvania Department of Environmental Protection, October 4, 1978; Philadelphia Water Department, December 1, 2011; U.S. Environmental Protection Agency, 1972; U.S. Environmental Protection Agency, November 27, 2002; U.S. Environmental Protection Agency, December 9, 2016).

To satisfy the EPA's regulations, Philadelphia has turned to LID, green stormwater infrastructure (GSI), and community involvement for managing stormwater runoff. Philadelphia's GSI plan, also known as Green City, Clean Waters, was submitted in September 2009 by the PWD and gained approval from the PA DEP in June 2011. On April 10, 2012, the EPA and the City signed a partnership agreement formally recognizing the Green City, Clean Waters stormwater management plan (U.S. Environmental Protection Agency, 2012; Philadelphia Water Department, December 1, 2011).

Green City, Clean Waters is broken down into sections including: the development of a long-term control plan for CSOs; water quality standards, and watershed management; detailed descriptions of the types of GSI used; an overview of the *Greenworks* sustainability plan merging the City's policies for air, water, greenhouse gas emissions and hazardous waste with national policies; the economic, social, and environmental benefits of the plan; and community outreach and initiatives (Philadelphia Water Department, June 1, 2011). The plan is meant to put a greater investment into the

City by restoring ecological health, improving public health and safety, creating more green public space, reducing water utility bills for residents and businesses, increasing property values by as much as 10.3%, and creating a 14% increase in employment opportunities (Sustainable Business Network, January 29, 2016). Increased greenery improves quality of life and recreation opportunities, reduces heat collection and lowers excessive temperatures during the hot summer months. Vegetation, especially trees, absorbs heat and carbon dioxide, helping to make the air cooler and cleaner (Philadelphia Water Department, 2018a).

Philadelphia developed an environmental policy regime at the start of the 21st century and the City has been gaining recognition for its work (Stokes et al., 2014). The City wants to be the "Greenest City in America" by reducing energy costs, improving the City's ecological footprint, and making the City more competitive in the emerging national green economy (Philadelphia Water Department, June 1, 2011).

Not only is the PWD working towards making stormwater management more sustainable, but other City agencies like the Pennsylvania Horticultural Society (PHS) and the Office of Transportation want to create greater green spaces and more energy efficient public transportation. In addition to problems with water pollution and flooding, Philadelphia has experienced a gradual decline in population and prosperity (Pew Charitable Trusts, June 1, 2011). The City sees the Green City, Clean Waters plan as an opportunity to invest in new infrastructure while becoming a more attractive city, competitive in the emerging national green economy. The PWD understands that sustainability, resiliency and "a paradigm shift in our approach to urban water resources"

are important for the future development of Philadelphia (Philadelphia Water Department, 2011, p. 1).

The plan also includes a "Public Outreach and Participation" portion, which states that its efforts include "notifying impacted communities, soliciting feedback, conducting outreach, strengthening partnerships, raising awareness and creating educational opportunities" (Philadelphia Water Department, December 1, 2011, p. 1-7). The PWD has made a purposeful decision to make community involvement a standard practice for stormwater management in the City. Sharing knowledge and educating the public open up opportunities for individuals to get involved, express their viewpoints, and become leaders in their communities (Philadelphia Water Department, June 1, 2011).

The PWD uses community meetings to get residents involved in GSI projects. As a City staff person explained, once the PWD has identified a location for a new GSI project, they draft a neighborhood map, contact all of the residents and businesses in the area by phone and letter, and schedule a community meeting. An Outreach Coordinator then leads a meeting held at a community space where a presentation on the proposed GSI projects is given, and attendees are given the opportunity to ask questions and provide feedback. Following the meeting, feedback is compiled and then factored into redesigns wherever the PWD sees fit (City staff person A 2016).

The PWD makes information about Green City, Clean Waters available online, at community meetings, and via email by request. Brochures are provided at community meetings outlining the purpose of Green City, Clean Waters with a map of proposed project areas (Figure 5).

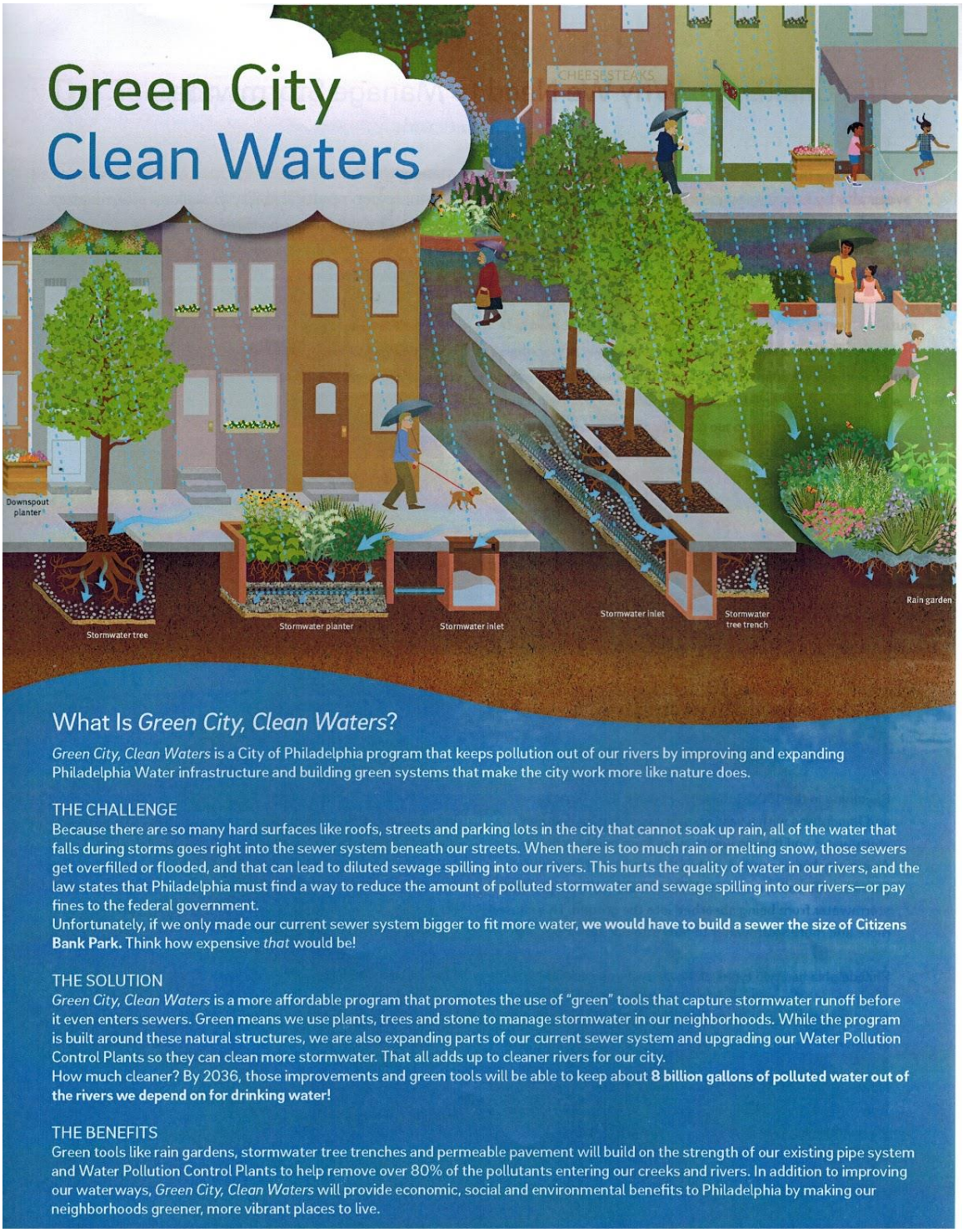

Figure 5. Cover of the Green City, Clean Waters brochure distributed at community meetings. Brochure by the Philadelphia Water Department (PWD). Scanned by the author.

Information sheets about some of the higher profile, completed stream restoration and GSI project sites are available for self-guided visits. It is also standard for each project site to include a sign or plaque for passersby to read and learn about the purpose of the plan (Figure 11). The PWD and Green City, Clean Waters websites contain pages of information about the plan, a blog, photos and videos. They explain how to get involved and provide feedback, as well as provide a calendar of community meetings, trash cleanups, and outdoor activities. Also available on the Green City, Clean Waters website is the Big Green Map (Figure 6), which is an evolving and interactive record of all of the GSI projects that have been completed or are in progress. Furthermore, the PWD has several social media accounts, including Facebook, Twitter, and Instagram where they post updates about the Green City, Clean Waters plan, community events, educational programs, and can receive feedback from the general public.

A system is also in place for the community to contact the PWD for maintenance crews to visit a particular project or area when needed. The community is not obligated to maintain GSI projects, but the PWD has created initiatives to encourage communities to participate in the ongoing maintenance of GSI projects, including the Rain Check and Soak It Up! Adoption programs and public events like tree plantings and trash cleanups.

The Rain Check program seeks to get residents excited about participating in GSI projects at their homes and businesses. Five thousand residents have participated since the program began (Philadelphia Water Department, April 10, 2017). Rain Check is a partnership between the PWD, PHS, and Sustainable Business Network (SBN).

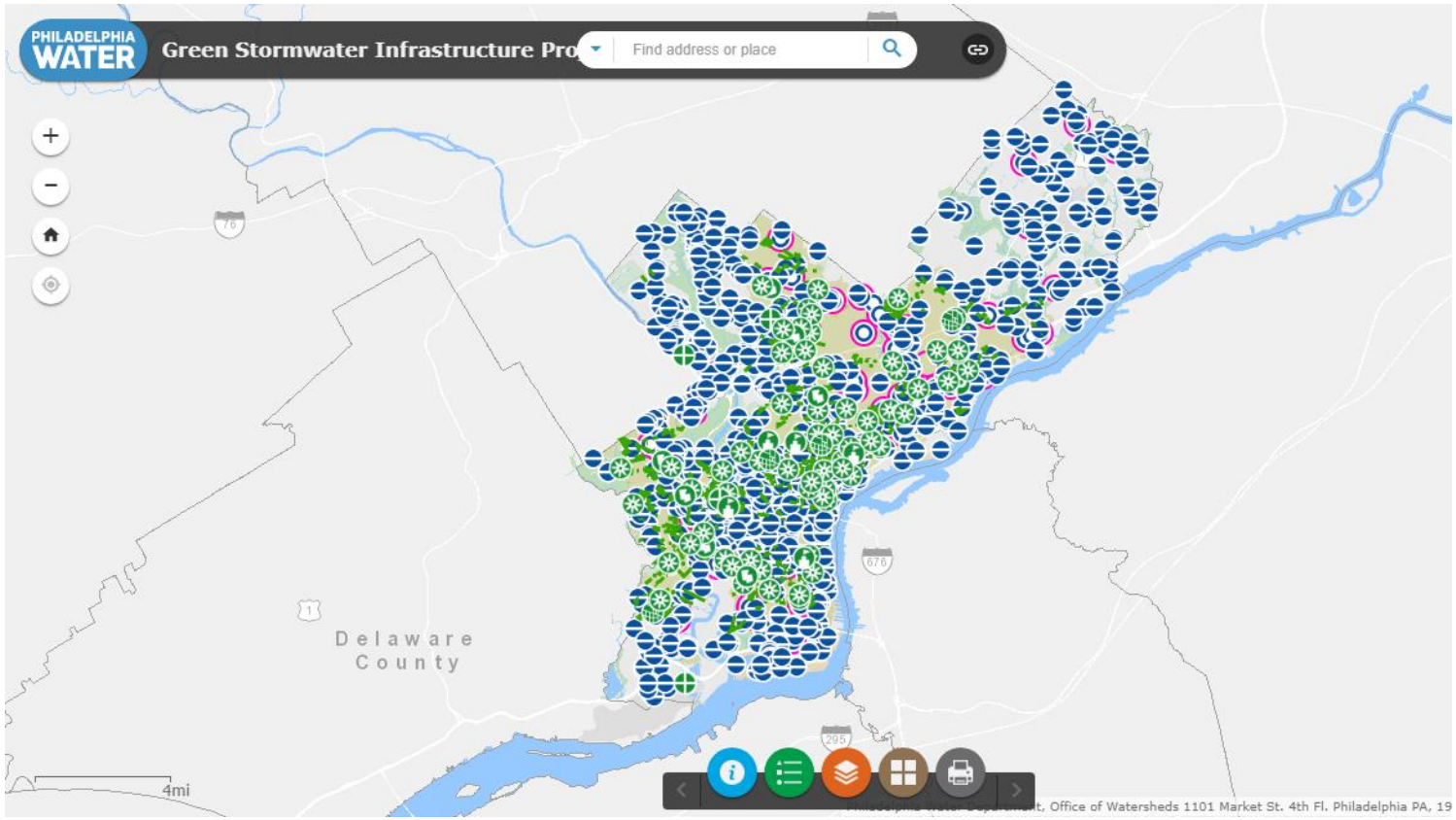

Figure 6. A snapshot of the Philadelphia Water Department's (PWD) interactive Big Green Map, which marks the location of every green stormwater infrastructure (GSI) project. Map created by the PWD and ESRI.

Residents can receive a free rain barrel after attending a training workshop and discounts on a downspout planter, rain garden, or porous pavement for their home. Installation and construction are organized by the PWD and PHS. By taking advantage of the Rain Check program, residents receive rate reductions on their water bills (Philadelphia Water Department, June 1, 2011; Philadelphia Water Department, April 10, 2017).

The PWD also runs a program called Soak It Up! Adoption which partners the PWD and the Pennsylvania Environmental Council (PEC) with communities that are interested in taking control of GSI projects in their neighborhood, reporting to the PWD, and active efforts to involve the community in the Green City, Clean Waters plan. Community groups that join Soak It Up! Adoption receive a $5,000 grant to hire community members or recruit volunteers to participate in the maintenance of a GSI project (Philadelphia Water Department, June 1, 2011). As of May 2017, 17 community groups have been given Soak It Up! Adoption grants (Philadelphia Water Department, 2018d).

The City seems to see the extent to which it has decided to involve the community as unique. A study done by Stokes et al. (2014) shows that community involvement is integral to furthering environmental initiatives in Philadelphia. Community Development Corporations, civic associations, and business-improvement organizations doing work centrally in Philadelphia play a regular role in serving the City's sustainability plan. Whether or not the primary purpose of these groups includes environmental initiatives, they align their business plans and mission statements with Philadelphia's environmental policy towards greater sustainability. Despite its status as the fifth largest city in America

with the “lowest median income and retail sales per capita, and the highest percentage of its population in poverty”, Philadelphia has a strong environmental policy and is making progress with plans like Green City, Clean Waters (Stokes et al., 2013, p. 3). The policy regime consists of five categories - energy, environment, equity, economy, and engagement. Stormwater management falls under the category of equity (Stokes et al., 2014).

In Stokes et al.’s (2014) survey of 40 Philadelphia community-based organizations (CBO), 58% reported working with the PWD on sustainability-focused projects. The survey also evaluated the frequency with which CBOs collaborate with City departments on a monthly basis - the PWD (12%), Streets Department (30%), Parks and Recreation (29%), and the Office of Sustainability (10%). Many small CBOs with small budgets may have limited funds and staff to provide services to their community members, but they can also partner with larger organizations like the PWD to get residents involved in GSI projects such as Soak It Up! Adoption and Rain Check (Stokes et al., 2014).

Funding for GSI projects comes from the City’s sewer and stormwater utility bills, contractors involved in the design and construction of GSI, private contributors, crowdfunding, and grants. Grants are available from the PWD and Philadelphia Industrial Development Corporation (PIDC), including the Stormwater Management Incentives Program (SMIP) and the Greened Acre Retrofit Program (GARP), for contractors and businesses in Philadelphia that are also PWD customers.

As evidenced by the partnerships required to fund Rain Check, Soak It Up! Adoption, and development grants, the PWD relies on collaboration from a variety of federal, state, public, and private sources for the success of their GSI projects. The initial September 2011 Green City, Clean Waters plan included $1.2 billion allocated from the PWD's budget for construction, operation, and maintenance costs. According to the plan, this amount is estimated to grow to $2.4 billion by the 25-year mark in 2036. In the first five years of the plan, $51 million in grants from public and private sources were gathered for future public service projects, as a result of investments in GSI projects thus far (Philadelphia Water Department, June 1, 2011). With continued investment in GSI by an array of public and private stakeholders, especially development and construction firms, total investments are projected to reach $3 billion. Additionally, the PWD received grants from the William Penn Foundation, PA DEP, Army Corps of Engineers, and the EPA for green development projects. These investments and grants helped to offset the $150 million that was spent by the PWD each year for repairing and upgrading existing stormwater infrastructure and saved the City, as well as water utility customers, money going forward (Philadelphia Water Department, June 1, 2011).

Philadelphia is not the first city to use GSI, but the scope of what the PWD wants to accomplish with the Green City, Clean Waters plan makes it unique (Philadelphia Water Department, June 1, 2011). Philadelphia is the first U.S. city of its size to adopt a large-scale management plan using LID to regulate their stormwater system. Grey infrastructure projects for Philadelphia were estimated to cost $10 billion and require large-scale digging and installation of new sewer infrastructure, without solving the

City's long-term water management problems (Philadelphia Water Department, June 1, 2011). The cost of GSI projects is a lot lower, with an estimated cost of $2 billion in Philadelphia, and GSI projects are far more dynamic and adaptable (Philadelphia Water Department, June 1, 2011).

June 2016 marked the first five of the 25 years the plan has been planned for. Every five years, the EPA and PA DEP are required to evaluate the progress of the plan, and the PWD given opportunities to make improvements (Philadelphia Water Department, October 30, 2016). In the first five years, over 1,600 GSI projects were completed at more than 440 locations, covering 837.7 acres. Over 2,980 rain barrels were installed, and 1.5 billion gallons of water each year were prevented from becoming polluted overflow (Philadelphia Water Department, October 30, 2016). The goal for 2021 is to reach a total of 2,148 acres of GSI projects that can divert 2 billion gallons of polluted water from overflow pipes annually. Goals of acres covered and gallons of water diverted will increase in 2026, 2031, and 2036 until the 25-year benchmark is reached in 2036. Through the plan, the PWD estimates that it will be able to reduce stormwater pollution by 85% and save the City $5.6 billion (Philadelphia Water Department, June 1, 2011; Philadelphia Water Department, October 30, 2016).

While the technical achievements of the GSI plan seem to be on track, it is less clear how well the City is living up to its goal of involving citizens collaboratively in the stormwater management effort. To find out more about what the City is doing to include community involvement and citywide sustainability in its Green City, Clean Waters plan, I address the questions:

1. How has the City shifted its management of stormwater from a purely CSS dependent approach to incorporating LID and mitigation for sea level rise?
2. What is the City's relationship with the community regarding stormwater management?
3. How effective has the PWD been in getting the community involved in stormwater management through Green City, Clean Waters?
4. Is the City living up to its promise to partner with residents in implementing LID and create physical, social, economic, and environmental benefits for the community?

METHODS

I chose the City of Philadelphia for my case study because I grew up in a suburb of the City and spent a lot of time there throughout my life. My emotional and familial ties to the City also made me curious to learn more about elements of the City that I would not normally be exposed to. I wanted to use this opportunity to not only learn more about stormwater management and how city government can involve the community in urban resource management, but to simply expand upon my familiarity with Philadelphia.

The umbrella for analyzing the Green City, Clean Waters plan is governance, diversity, and social justice. How the City has chosen to include its residents informs how effective and balanced the plan will be able to be. I used semi-structured interviews, participant observation, and document review as the basis of my analysis of Green City, Clean Waters, with a focus on how the City values community involvement in the plan and provides equal opportunities across physical, social, cultural, and economic boundaries.

In order to capture the opinions and viewpoints of individuals influencing and affected by the Philadelphia Water Department's (PWD) Green City, Clean Waters plan, I conducted semi-structured interviews with 14 people involved in green stormwater infrastructure (GSI) and community education programs across Philadelphia[2]. These

[2] Approval of my research was obtained from the Institutional Review Board (IRB) on June 3, 2016 (IRB 15-246). In accordance with IRB guidelines, consent forms were collected from each interviewee prior to being interviewed (Appendix B).

individuals include engineering consultants, public affairs staff and maintenance workers from the PWD, engineering consultants from CDM Smith and Trans-Pacific Engineering Corporation, an environmental educator from Wild West Philly, a community-based education program, and staff people from the Passyunk Square Civic Association (PSCA), located in South Philadelphia. This group of informants represent the top-down, administrative perspective on the Green City, Clean Waters plan. It was not my intention to interview individuals that are employed by, or partner with, the PWD exclusively, but I not only set out to understand the community involvement aspects of stormwater management, but how stormwater is managed in Philadelphia in general. They provided knowledge of the PWD, the current and future goals of Green City, Clean Waters, GSI, and insight into how the City perceives and values stormwater management, sustainability, and community involvement that community members may not have been able to provide to the same extent.

I identified interviewees by searching the PWD website and event calendar, which includes GSI community meetings for public affairs and outreach staff, including staff of relevant community organizations involved in planning of GSI projects in a given area. In addition, I utilized snowball sampling by asking each interviewee for recommendations of other individuals to contact, community meetings to attend, and GSI site locations to visit.

I designed interview questions with the purpose of having each interviewee share their experience with the PWD and Green City, Clean Waters, interacting with residents

in GSI planning and educational capacities, and their opinions on the success of the Green City, Clean Waters plan (Appendix C).

In addition to conducting semi-structured interviews, I participated in community meetings, organized in part by the PWD and aimed at informing City residents about GSI projects and noted the viewpoints and opinions expressed by Philadelphia residents who attended. Community meetings are often planned with the assistance of engineering firms, neighborhood associations, and community facilities. Each meeting provides information and an open forum for residents to express their thoughts, questions, and concerns. Passively recording this feedback did not provide as detailed of a perspective as interviewing a selection of community members, as it did with my primary informants, and perhaps increased the likelihood that the results of my analysis could favor the PWD, intentionally or not. Although, attending community meetings allowed me to hear first-hand accounts and perceptions of how community members interact with GSI projects, to what extent they are included in the planning, implementation, and maintenance process, and what their opinions are about the PWD, Green City, Clean Waters, and GSI.

I collected further information about stormwater management in Philadelphia and the Green City, Clean Waters plan from visits to the Fairmount Water Works Interpretive Center and individual GSI sites in Kensington, Northern Liberties, Girard Estates, and Pennsport. The Fairmount Water Works Interpretive Center provided me with a historical background on water resource management in Philadelphia and an overview of how the physical and social landscapes of the City have changed over time as water resource infrastructure has developed. Visiting GSI sites gave me opportunities to take photos,

read public educational materials posted at the sites, and observe public use of the spaces where GSI projects are installed.

I audio-recorded interviews and community meetings and took written notes. I captured photos of GSI projects and related infrastructure and collected reference materials such as brochures (Figure 5) and GSI site maps. I transcribed and coded audio recordings and notes from interviews and community meetings. When referring to or quoting interviewees and community meeting participants throughout this thesis, I cite each individual with a system that protects confidentiality according to the IRB (e.g. "City staff person A", "City partner A", or "community meeting speaker A").

Based on the theoretical focus of governance, planning, and social justice in my literature review, I formed an analytical framework composed of emerging themes including resilience through reconnecting society with nature, social justice in urban redevelopment, community trust in government, collaborative management, and stormwater management and response to sea level rise (Table 1). I used these themes to explore and evaluate the City's relationship with the community regarding stormwater management, and the Green City, Clean Waters plan's effectiveness in addressing community involvement and citywide sustainability in its management of stormwater (Table 2). In conclusion, I make recommendations based on what aspects have been successful and should continue, as well as changes that may improve the success of the plan going forward (Table 3).

ANALYSIS

This inquiry focuses on the degree to which Green City, Green Waters is achieving the goal of prioritizing community involvement and citywide sustainability through socially, economically and environmentally sustainable urban governance and planning. Through my literature review, I identified the following themes that address the issues of community involvement and sustainability (Table 1).

Resilience through reconnecting society with nature: By shifting the management of stormwater to include habitat restoration and low-impact development (LID), the City of Philadelphia is becoming more resilient. Resiliency is based on adaptability, sustainability, and reconnecting society and nature. Green City, Clean Waters is a part of Philadelphia's larger *Greenworks* plan for sustainability that includes sustainable energy, transportation, and resource use. Urban spaces that demonstrate the City's valuing of nature, stewardship, and reconnecting society with the environment will likely be more adaptable to change and resilient during crises (Walker & Salt, 2006; Feige, 2013; Swyngedouw, 2009; Holling, 1973).

Social justice in urban redevelopment: Beyond physical elements of design, urban planning is meant to improve quality of life and sustainability for all of the individuals using urban space. Urban redevelopment has the potential to gentrify communities and create socio-economic, cultural, and political divides between residents. It is the responsibility of city government to be proactive in addressing and preventing

Table 1. The themes and primary supporting literature that make up the framework used for analyzing Green City, Clean Waters and the City of Philadelphia's attention to community involvement and sustainability.

Theme	**Analysis**	**Literature**
Resilience through reconnecting society with nature	Resilience, adaptability, and valuing options for sustainable energy, transportation, and resource use.	Walker and Salt (2006) Feige (2013) Swyngedouw (2009) Holling (1973)
Social justice in urban redevelopment	Prioritizing diversity and equality as shifts in the social, cultural, economic, and political makeup of urban spaces occur.	Barton and Tsourou (2000) Campbell (1996; 2013) Brownlow (2006) Heynen et al. (2006)
Restoring community trust in government	Education, access to resources, and participation for marginalized communities can help restore trust in government.	Curtin (2015) Smock (2004) Plumwood (1998) Putnam and Feldstein (2003)
Collaboration with diverse stakeholders	Large-scale management requires collaboration from public and private stakeholders, with support from the community.	Rossi (2015) Karvoven (2011) Gray (2003)
Stormwater management and sea level rise response	Utilizing habitat restoration and low-impact development (LID) strategies to address climate change and sea level rise.	Karvoven (2011) Randle (2016) Dorworth and McCormick (2015)

potential social inequalities and injustices that may stem from redevelopment (Barton & Tsourou, 2000; Campbell, 1996; Campbell, 2013; Brownlow, 2006; Heynen et al., 2006).

Restoring community trust in government: Openness and transparency are key to building trust between government and community. Sharing of knowledge and power allows the community opportunities to participate and feel they are valued. Access to educational resources and opportunities for participation are especially important for underrepresented portions of the community. To repair the relationship, government must recognize inequalities and actively support and seek representation from marginalized communities (Curtin, 2015; Smock, 2004; Plumwood, 1998; Putnam & Feldstein, 2003).

Collaboration with diverse stakeholders: Green City, Clean Waters is a broad plan with ambitious goals for reducing large volumes of stormwater and increasing green spaces over a 25-year period. The Philadelphia Water Department (PWD) is unable to manage or fund a large-scale revitalization project like this on its own, and requires collaboration from public and private stakeholders, and support from the community. From the perspective of community members, they may be interested in grassroots revitalization of their neighborhoods, but they often do not have sufficient resources. Collaboration between the government, other community groups, and private stakeholders may be mutually beneficial (Rossi, 2015; Karvoven, 2011; Gray, 2003).

Stormwater management and sea level rise: The Green City, Clean Waters plan seeks to find more effective ways for Philadelphia to manage stormwater, improve water quality, and reduce flooding. These issues are a citywide problem that are exacerbated by climate change and sea level rise. Continuing to use a combined sewer system (CSS) to

manage stormwater has proved to be insufficient, so habitat restoration and LID strategies are being utilized instead. Refocusing on environmental protection and implementing green stormwater infrastructure (GSI) gives the City more dynamic options (Karvoven, 2011; Randle, 2016; Dorworth & McCormick, 2015).

Together these themes provide the analytical framework that is the basis for the following evaluation and discussion of Green City, Clean Waters using examples of community outreach, education, and partnerships across Philadelphia in conjunction with stormwater management projects, habitat restoration, and citywide sustainability initiatives. I use the data I collected from interviews, participant observation, and document review as examples to discuss Green City, Clean Waters within the analytic framework. My data highlights individual locations throughout Philadelphia, including Elmwood in Southwest Philadelphia, Northern Liberties and Kensington in North Philadelphia, and Passyunk Square, Girard Estates, Ralph Brooks Park, and Smith Playground in South Philadelphia. I also highlight organizations, including John Heinz National Wildlife Refuge (John Heinz NWR) and Wild West Philly (Figure 7; Table 2).

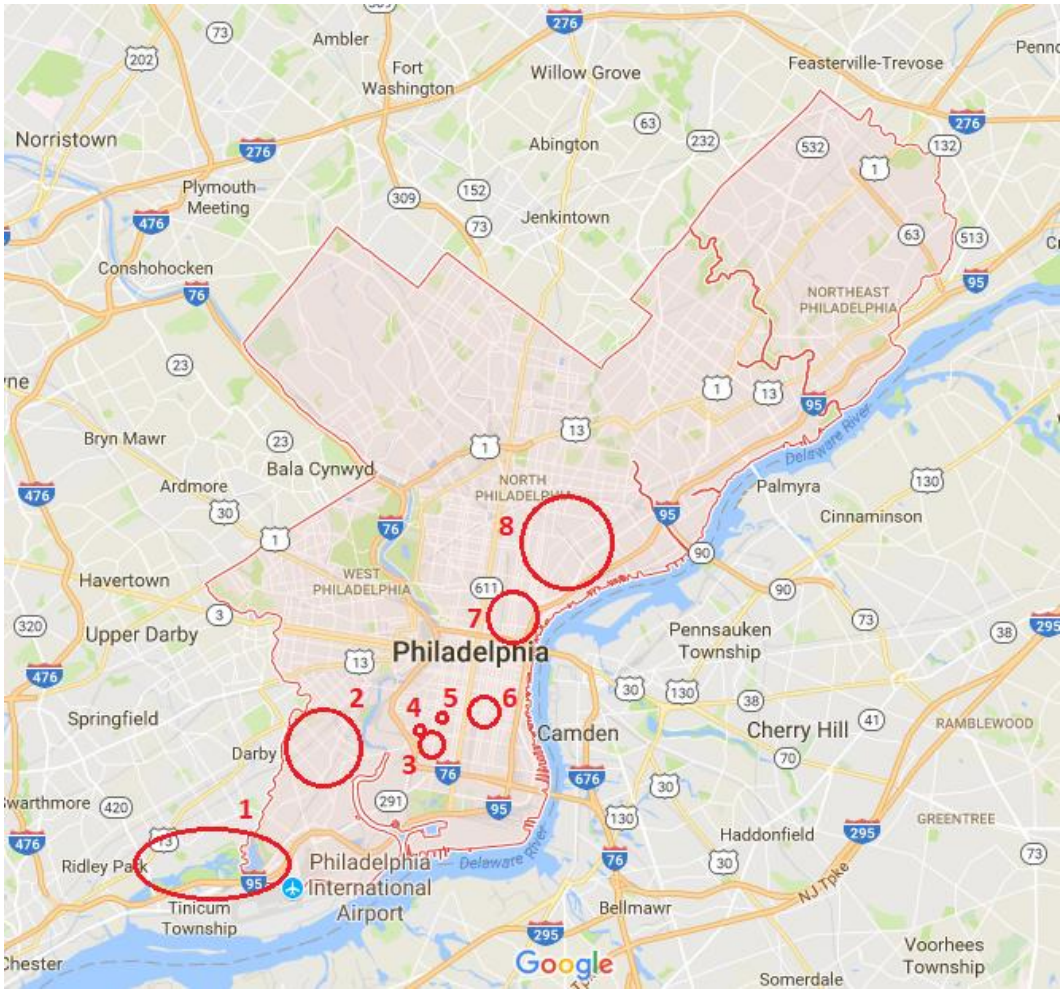

Figure 7. Map of case study site locations (1-John Heinz National Wildlife Refuge, 2-Elmwood, 3-Girard Estates, 4-Smith Playground, 5-Ralph Brooks Park, 6-Passyunk Square, 7-Northern Liberties; 8-Kensington. Map by Google and author.

Table 2. Summary of the analysis of each of the case study site locations in Philadelphia where data was collected.

Location	**Analysis**
John Heinz National Wildlife Refuge	By partnering with organizations that are providing environmental conservation and educational opportunities, the Philadelphia Water Department (PWD) can expand its strategies for addressing habitat restoration as a form of stormwater management, combating flooding and sea level rise.
Elmwood	• Partnerships with community groups like Wild West Philly that promote stewardship and collaboration are helping the PWD achieve greater resilience through reconnecting society with nature. • A history of flooding and marginalization has led to Elmwood's distrust of the PWD to solve its problems. To repair their relationship, the PWD needs to provide better access to knowledge and participation.
Girard Estates	Miscommunication and frustration can develop between the PWD and the community when contact is infrequent and community members lose confidence in the PWD's ability to sufficiently address their needs and concerns.
Ralph Brooks Park and Smith Playground	Some revitalization projects may require a group of diverse stakeholders to provide feedback and funding, but it is important for them to have similar goals and prioritize community ownership of the projects.
Passyunk Square	Some neighborhoods want to take ownership of green stormwater infrastructure (GSI) projects, and it is important for the PWD to listen to community needs and concerns.
Northern Liberties	GSI can cause complex physical and socioeconomic effects on neighborhoods, including gentrification and needs for education, stewardship, and employment opportunities.
Kensington	Large-scale redevelopment projects like the American Street Improvement Project and the Big Green Block have the potential to cause social justice issues and require stakeholder collaboration and to be monitored closely.

Resilience through Reconnecting Society with Nature

In Elmwood (Figure 8), the PWD has used community meetings to connect with residents and educate them about Green City, Clean Waters. They have also worked with community groups in West Philadelphia as collaborators, in an attempt to use community-led education to tackle the need for more environmental education about stewardship, and urban sustainability. Wild West Philly is a community-run and PWD-funded education program training local youth. The program began in 2014 and each year it trains a group of students to participate in nature walks as docents, act as watershed ambassadors, and represent the PWD. Wild West Philly plans its own events, partners with other organizations in the area, including Southwest Community Development Corporation, Cobbs Creek Neighbors, Cobbs Creek Community Environmental Education Center, and John Heinz NWR, and contracts with the PWD to occasionally partner with their staff to table at events or lead nature walks. On nature walks, Wild West Philly docents include nearby GSI projects as points of interest, provide a background on stormwater management and the purpose of Green City, Clean Waters, and give attendees information on how to get involved with GSI.

A primary goal of Wild West Philly is interesting people in nature and spending time outside and teaching how Philadelphia's urban spaces can also be green spaces (City partner A 2016). A Wild West Philly staff person described to me the impact of nature walks on participants in this way,

Figure 8. Map of the Elmwood neighborhood of Southwest Philadelphia, outlined. Map by Google.

> "They seemed to be paying attention to the things I was saying about nature having a history, cities having an ecology, things like that, trying to blur the nature-culture divide, because that's important. My feeling is that people are pretty interested in this stuff and really enjoy having an opportunity to go for walk in a green space and particularly have an interpretive product delivered to them. I think that probably affects people's long-term attitudes...from everything that I've read, the more time that people spend in green space, it does affect these sorts of attitudes. It's a form of trying to affect behavior without prescribing behavior" (City partner A 2016).

In our conversation, the Wild West Philly staff person expressed uncertainty about the PWD's level of investment with the group. When asking about how involved the PWD is with junior stewards while they are a part of Wild West Philly and beyond, the staff person replied,

> "I think they've always been interested to find out, but they've never taken an active role. You'd probably need to talk to them to see what their exact thinking is about it. There's a sort of wall there, because I'm not a direct employee. They have contractors who are sort of in-house contractors who serve as employees, but we're not that either. We're sort of one step or two steps removed from knowing what the actual internal thinking is" (City partner A 2016).

At the same time, this individual also expressed satisfaction with how supportive the PWD has been with funding Wild West Philly and giving stipends to the group's junior stewards (City partner A 2016). It seems to me that the PWD is genuinely interested in supporting community education programs like Wild West Philly, but the commitment only goes so far. When I spoke with this staff person, the future of Wild West Philly was uncertain, and they had only been able to have two events that summer (City partner A 2016). Perhaps the distance between the PWD and Wild West Philly perceived by this staff person is due to a lack of communication, funding to hire more staff, or prioritization on the part of the PWD to stay abreast of what is happening with the small

groups they have partnerships with throughout the City. It is especially important to support smaller groups like Wild West Philly that are valuable assets to the community and to the PWD but are understaffed and underfunded.

PWD does not have a complete list of all of its community partnerships, but their website features four educational partners and 42 watershed partnerships across Philadelphia's seven watersheds. As Green City, Clean Waters evolves, and it seems that the list will shift as well. As it does, it is in the PWD's best interest to provide more support for them beyond being a source of funding. Community-based programs like Wild West Philly assist the PWD in expanding how they collaborate with and learn from the community. Models like Wild West Philly may be able to expand into in other places and help the PWD to better understand the needs of Elmwood and other West Philadelphia neighborhoods like it. The relationship between the government and community groups that are enthusiastic about getting involved is important for expanding opportunities for stewardship, education, and community involvement that will support the longevity of Green City, Clean Waters.

Social Justice in Urban Redevelopment

Redevelopment is occurring across Philadelphia, and social justice should be made a priority citywide. Here I will focus on the Northern Liberties and Kensington neighborhoods in North Philadelphia, and the Passyunk Square neighborhood in South Philadelphia as examples of Green City, Clean Waters' redevelopment projects that have

the potential to gentrify and cause social justice issues for residents of these neighborhoods.

Redevelopment and Gentrification in Northern Liberties

Northern Liberties is one of the neighborhoods in Philadelphia experiencing gentrification caused by redevelopment. From 1990 to 2010, the Caucasian population of Northern Liberties (Figure 9) grew by 103.5%, the Hispanic population grew by 7.2%, and the Asian population grew by 453%, while the African American population decreased by 26.1%[3]. The neighborhood's population is currently 42% African American, 41% Caucasian, 9% Hispanic, and 5% Asian (Pew Charitable Trusts, June 1, 2011. In Upper Northern Liberties, the median household income increased 83% from $43,824 in 2000 to $80,154 between 2010 and 2014. In Lower Northern Liberties, the median household income increased 54% from $53,809 in 2000 to $83,086 between 2010 and 2014 (Pew Charitable Trusts, May 19, 2016).

The influence of the increase in more Caucasians and individuals with higher incomes moving to Northern Liberties has led to the neighborhood being known as a center for a younger, "hipster" community who have brought with them new development. Specialty coffee shops and bars are becoming fixtures of the neighborhood, and the construction of new, trendy housing that is reminiscent of cities like Portland,

[3] The categories of "Hispanic" and "Asian" used throughout the Analysis portion of this thesis come from Pew Charitable Trust's report based on Philadelphia's census data. As the report explains, "all Hispanics or Latinos, regardless of race, are counted solely as people of Hispanic origin." Two-thirds of Hispanics in Philadelphia are Puerto Rican. Asian populations encompass Chinese, Indian, Vietnamese and Korean (Pew Charitable Trusts, June 1, 2011; Pew Charitable Trusts, March 24, 2012).

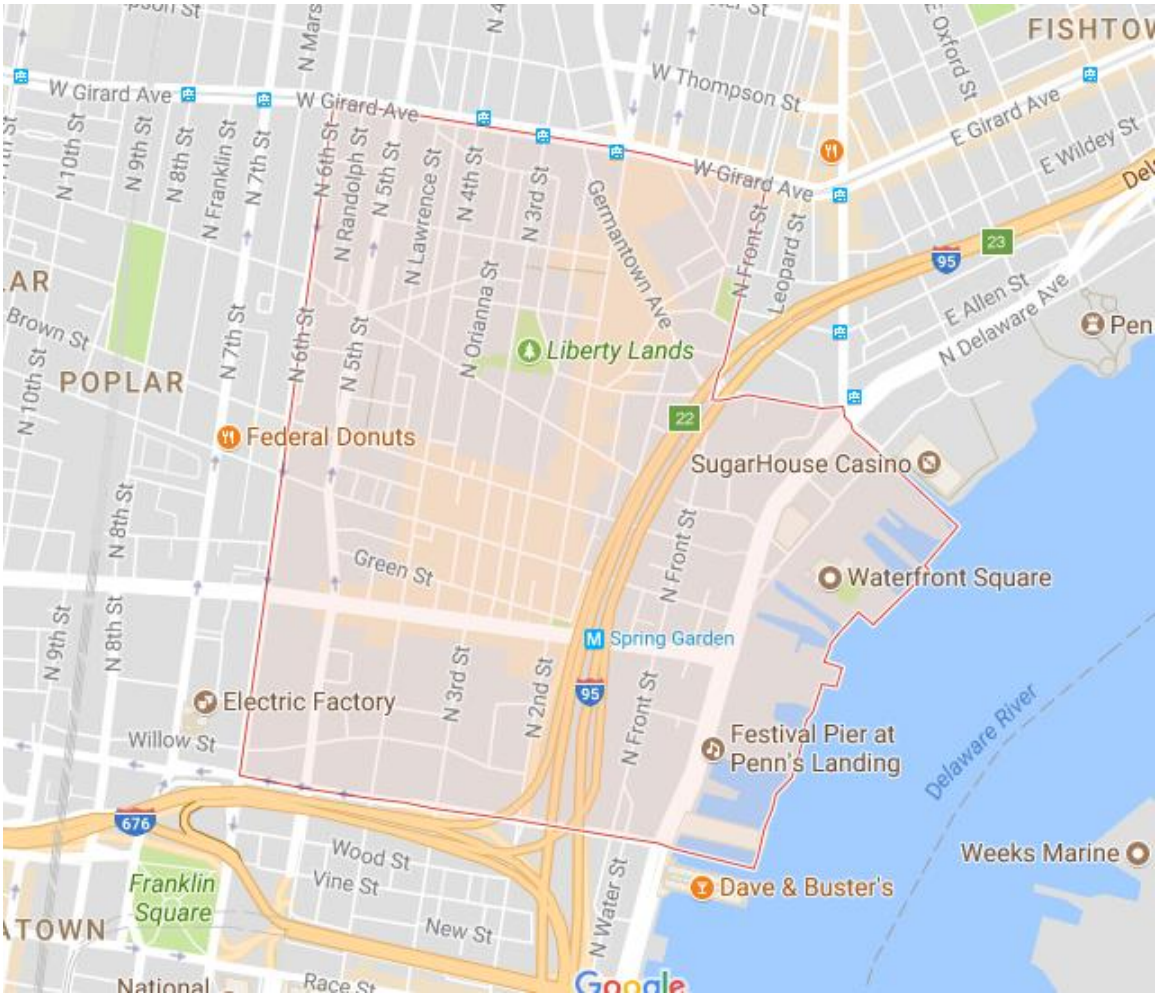

Figure 9. Map of the Northern Liberties neighborhood of North Philadelphia, outlined. Map by Google.

Oregon and Seattle, Washington stands out amongst the traditional brick, row-home aesthetic that is a large part of the identity of Philadelphia (Figure 10). Household income has increased along with the influx of white people. As a result, property rental rates have gone up, making it difficult for lower-income individuals and families to remain in the neighborhood.

Liberty Lands is a two-acre park containing GSI projects in the middle of Northern Liberties. It has a large community garden, a playground, an abundance of open space, lawns, trees and other vegetation, benches, murals, and is dog-friendly. The community garden is supported by the Pennsylvania Horticultural Society (PHS), the murals were planned by Philadelphia's Mural Arts program, and other elements, including trash cans, benches, picnic tables, and a playground, were planned and implemented by Parks and Recreation. The GSI projects were installed by the PWD, including a tree trench at one end of the park and a substantial rain garden. With all of these elements, Liberty Lands has become a thriving space for people to work in the garden, picnic and relax, walk their dogs, and play with their children.

Representatives of the PWD mentioned in my interviews with them that they have received negative feedback at community meetings from senior citizens and from individuals that City staff identify as "affluent", "yuppie", and "hippie" (City staff persons A and B 2016). They explained that some older community members see GSI as a safety hazard, opportunities for crime, and a gateway to gentrification (City staff person D 2016). Some of the younger residents think that they do not need the government to take care of greening the City. They argue that they could just as effectively do the type

Figure 10. Photos of traditional brick row homes (top) that are common across Philadelphia, and modern row homes (bottom) that are becoming the popular style for new development in Northern Liberties. Photos by Weichert Realtors (top) and the author (bottom).

of work that the Green City, Clean Waters plan implements, including gardening and installation of rain barrels without assistance from the PWD (City staff persons A and B 2016). PWD engineering consultants and public affairs staff that I interviewed believe this may be true in some cases, but those community members are in a unique position, where other portions of the population may not have the same opportunities and resources (City staff person D 2016). Some communities require more of a focus on environmental education in schools, need more public programs to help children and adults get out and learn about GSI and environmental stewardship, or lack the money or time to be able to prioritize volunteering or additional responsibilities outside of work and family obligations (City staff persons E and F 2016).

The City has partnered with community groups to engage underserved segments of the public in Green City, Clean Waters and environmental stewardship and to get necessary labor to implement GSI projects. PowerCorps PHL is an AmeriCorps-affiliated service program for at-risk youth. The program aims to reorient participants with service work that will teach them how to be stewards of the environment, contributors to their community, and gain practical skills for finding a career.

I interviewed two PWD staff persons that are a part of GSI maintenance crews and were hired by the City following their service in PowerCorps PHL (City staff persons E and F 2016). Both are formerly-incarcerated residents of West Philadelphia who entered the Re-Integration Service for Ex-Offenders (RISE) program, an initiative of Philadelphia's Mayor Jim Kenney. Through RISE they joined PowerCorps PHL, a branch of AmeriCorps, which is a service-learning program for at-risk youth. During

their PowerCorps PHL service, the two staff persons gained environmental stewardship knowledge and strategies for entering the workforce. Through the partnership with AmeriCorps, the PWD hired them to be maintenance apprentices.

One of these apprentices had this to say about their experience with the PWD, "During the year that I was with PowerCorps it opened my eyes to things I wasn't used to, as far as the jobs I had, like Sales Associate, cleaning. And actually being able to be outside and do more physical work with my hands was a change and experience for me that gave me a better idea of what it is to work around areas that I'm from and do things for my community that I haven't done before" (City staff person E 2016).

They are the first two apprentices from service programs like PowerCorps PHL to be hired as full-time PWD employees. They both stated that they feel reconnected to their communities and consider Green City, Clean Waters to be an effective plan that has the potential to transform Philadelphia. They would like to see a future in Philadelphia where there is an easy bridge between volunteering or interning in green industry via community-based programs to becoming an employed civil servant. They see this as "the best thing to do, because this is our community, this is our city. Who else is there to maintain it, to help keep these systems functioning?" (City staff person F 2016). PowerCorps PHL gave them employment opportunities that no one else would give them,

> "Once I was released, I tried to find employment on my own and every time I interviewed I ran into another obstacle, as far as my background, I never got the job. So, when I was at my wits end, I went down to the program and they had introduced me to PowerCorps" (City staff person F 2016).

Community programs like PowerCorps PHL provide community members with employment and opportunities to engage with and do work in their communities. As one of the PWD staff persons explained about their time with PowerCorps PHL, “Doing the hands-on work was something that I never did, and it created a lot of opportunities for me, and made me more valuable for the job world. The green industry is growing so rapidly as days go on” (City staff person E 2016). As these two PWD staff persons expressed during our interviews, the work that they are doing has been an inspiration to other community members who witness the work that they are doing. They explained to me that peers that have come from similar backgrounds of growing up in socio-economically struggling neighborhoods in West Philadelphia, including individuals that have been incarcerated at a young age, see them as role models. Fellow service workers and community members see the work that these PWD employees are doing, which may spark their interest in being involved doing similar work. Both employees see the excitement building around Green City, Clean Waters and Philadelphia becoming a more sustainable city. Fellow civil servants from AmeriCorps, PowerCorps PHL, and other City government departments are interested in joining programs that are involved with the PWD and maintaining GSI. When these PWD employees speak with friends from their neighborhood that have had similar life experiences, they discover that their friends are looking to improve their lives with environmental education programs and green job opportunities (City staff persons E and F 2016).

Being a maintenance worker requires being outside in neighborhoods throughout the City. This visibility inspires curious community members to ask about the work that

is being done, so workers need to receive supplemental training to learn about the broader goals of Green City, Clean Waters. When community members see firsthand what civil servants like the maintenance crew members do, and maybe get a chance to speak with them, they can get a better understanding of what the City is trying to achieve and how it can benefit them. Maintenance workers are an extension of Green City, Clean Waters and these two have taken extra steps to connect with community members (City staff persons E and F 2016). At a GSI site adjacent to a day camp, they invited the curious campers and their chaperone to ask questions and help out. "It was an opportunity to show what we know. We showed them how to re-root, put them in the ground, flare roots, all of that stuff. They helped us out. It made me feel good," explained one of the workers (City staff person F 2016).

Seeing first-hand that the City is working on improving stormwater management and having the opportunity to interact with City staff builds interest and enthusiasm. As City staff I spoke with saw it, that interest and enthusiasm can set off a chain reaction and get more community members involved in City initiatives like Green City, Clean Waters (City staff persons E and F 2016). Another element of Green City, Clean Waters that helps to educate the public is posting of signage (Figure 11) at GSI sites, which provides a jumping-off point for community members who want to ask the PWD and its workers more about the projects while they are doing site visits and at community meetings.

Not all of the feedback that these City staff persons have received from community members while they are doing fieldwork is positive (City staff persons E and F 2016). The people that do not see benefits to GSI projects tend to be individuals that,

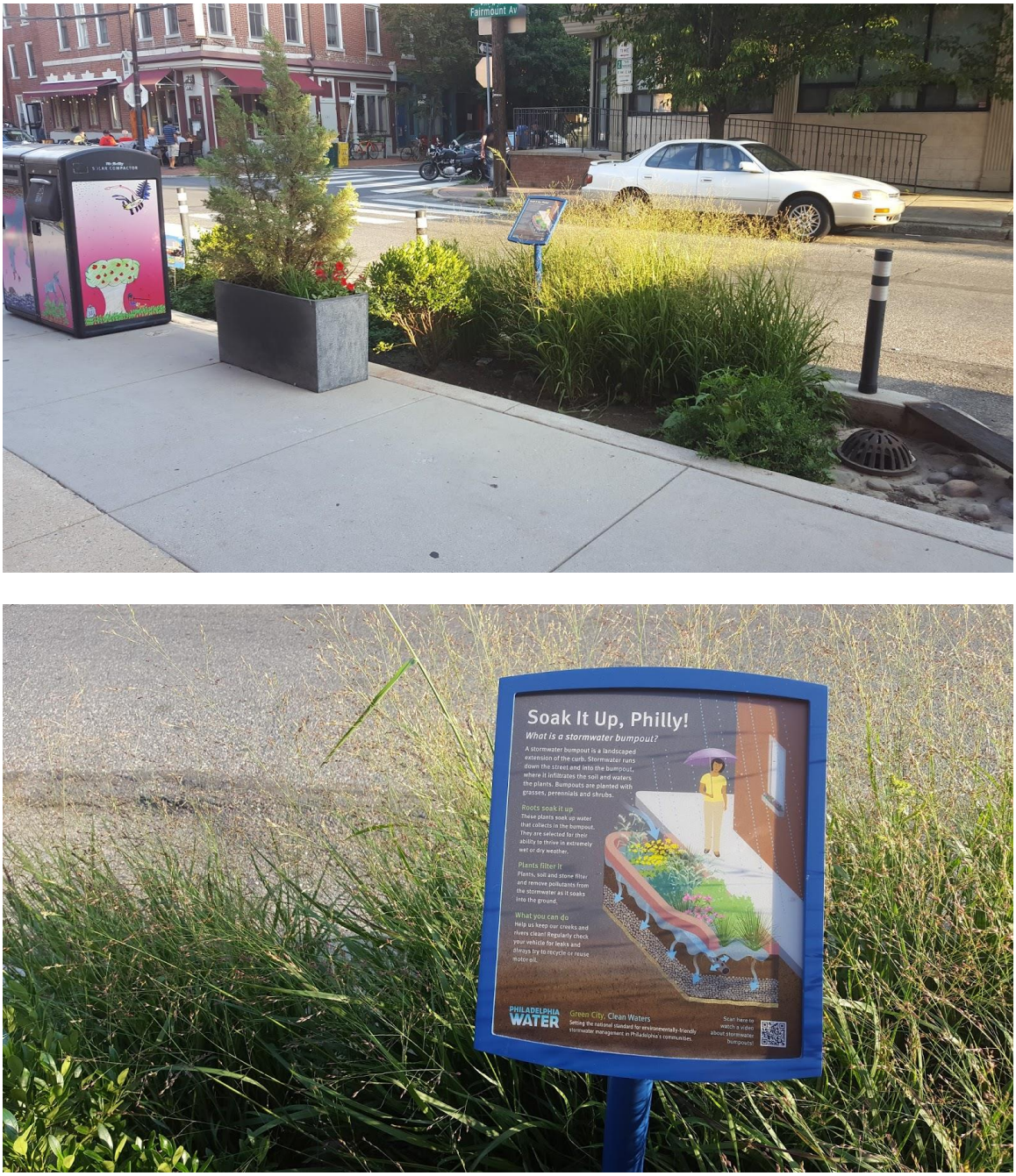

Figure 11. A green stormwater infrastructure (GSI) bumpout in the Northern Liberties neighborhood of North Philadelphia (top). A Green City, Clean Waters educational sign posted in the center of the bumpout pictured above (bottom). Photos by the author.

according to one City staff person, “are a little bit older and maybe stuck in their ways, and maybe do not understand the full picture and potential of what this project can do” (City staff person F 2016). They further explained that older individuals may also feel the PWD is doing damage to their neighborhoods and property by installing GSI. Older generations may find increased government intervention as a threat to their neighborhood. Some people in the community may see GSI as a way to improve Northern Liberties, to make it greener and more attractive, but others may see it as gentrification or a safety hazard (City staff persons A and F 2016). I also learned from hearing community members speak at meetings that it is the perception of some that digging up the sidewalk creates opportunities for injury, taking away parking spaces is a continual issue in a city that is notorious for insufficient parking, and changing the overall look of public spaces can invite unwelcome activity. In some cases, more trees are perceived as increased cover for criminal behavior. Both viewpoints are valid and need to be considered when planning for GSI. Moving Philadelphia towards a more sustainable future should not have to alienate its residents, especially the most socio-economically disadvantaged ones.

While they have heard criticism, these maintenance workers have also heard positive feedback, especially from younger community members who understand how green projects like GSI can benefit Philadelphia into the future. “They learn about this in school. When I was in school we didn’t learn about GSI and green job opportunities,” explained one of the workers. “This is something that’s new to everybody” (City staff person E 2016). Education about GSI and environmental stewardship by not only the

PWD but in school curricula too are key, especially for younger generations. PowerCorps PHL and the PWD try to keep enthusiasm around community education going by scheduling community cleanup and tree-planting events. Through program partnerships like PowerCorps PHL, the PWD gets elementary, middle, and high school students out in the field to get first-hand experience managing systems by cleaning inlets, changing filter bags, mulching and pruning vegetation (City staff persons E and F 2016).

The effects of GSI on Northern Liberties and the opinions of residents have been complex, especially when considering the shifting social and economic history of the neighborhood. Here the social challenges of community education, stewardship, and employment in green industry for struggling minority groups meet the physical challenges of gentrification as the neighborhood has gone through drastic changes in population and socio-economic demographics. Longevity of Green City, Clean Waters in neighborhoods like Northern Liberties that are going through significant changes, and have complex and divided identities, requires greater support from the PWD if it is to achieve its GSI goals. As demographics of the neighborhood shift, staying active and aware of the subtleties in managing GSI in Northern Liberties may help in making education, participation, and communication an option across the neighborhood's socio-economic divisions.

American Street Improvement Project and Large-scale Redevelopment in Kensington

Kensington, adjacent to Northern Liberties, is another neighborhood in North Philadelphia experiencing broad changes due to redevelopment and demographic shifts. The change in the African American population in Kensington has not been as drastic as

in Northern Liberties. It has increased by 3.6% from 1990 to 2010. At the same time, the Caucasian population has decreased by 24.2%, but remains over 50% of Kensington's total population. The Hispanic population has increased by 143.8% and in North Philadelphia in general, and the Asian population has increased by 53.5% (Pew Charitable Trusts, June 1, 2011; Pew Charitable Trusts, March 24, 2012). From 2000 to 2011, the median household income of Kensington increased from $28,679 to $39,319, and from 2011 to 2016, it further increased to $52,500 (Pew Charitable Trusts, March 24, 2012; U.S. Census Bureau, 2000; U.S. Census Bureau, 2012-2016).

The American Street Improvement Project encompasses a 14-block stretch of Kensington, which falls outside of the designated area of Kensington shown on the map (Figure 12), but it is still considered to be located within the Kensington neighborhood. Neighborhood names are sometimes fluid in Philadelphia, and the Philadelphia Planning Commission does not keep official record of changing boundaries. The American Street Improvement Project has a broad scope of objectives including installing GSI, promoting safe streets, enhancing public space, improving access to transportation, and supporting development of existing and new industry. Collaboration from an array of government, industry, and community partners is needed to properly plan, implement, and manage such a large project. Construction is expected to begin in March 2018 and be completed by December 2020 (American Street Improvement Project, April 26, 2018).

Small-scale GSI projects like those being planned across Philadelphia are also being planned for Kensington, but the American Street Improvement Project is a special

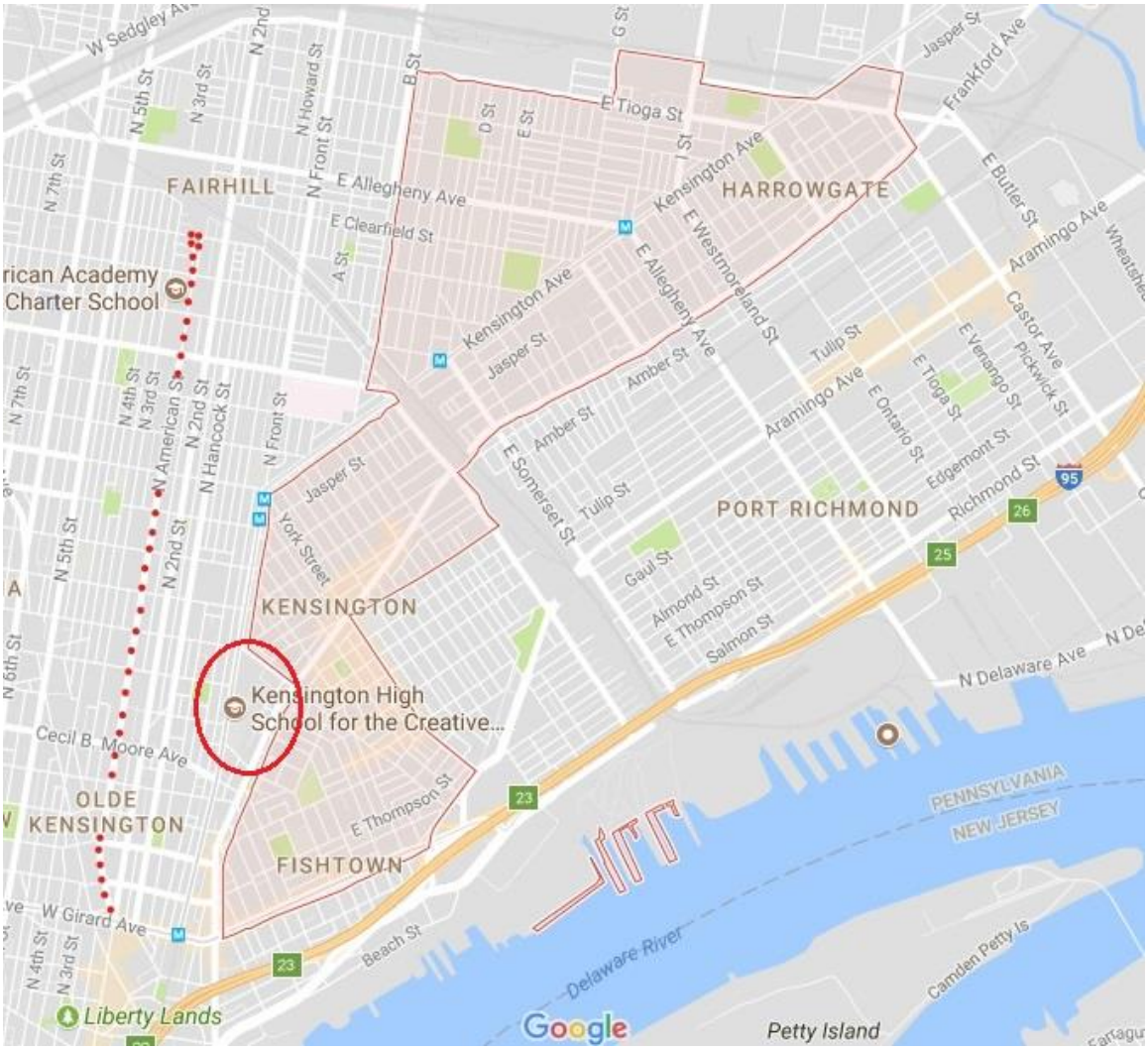

Figure 12. Map of the American Street Improvement Project (dotted line) and the Big Green Block (circled) in the Kensington neighborhood of Northern Philadelphia, outlined. Map by Google and the author.

case of GSI planning amongst those that I observed. It is on a larger scale and is being coordinated and funded by a multi-department effort by the Streets Department, U.S. Department of Transportation, Commerce Department, and the PWD. As the PWD Outreach Coordinator that I spoke with regarding the American Street Improvement Project referred to it, the goal of the project is to plan for "complete streets" (City staff person D 2016). Not only will GSI be installed, but public park space, sidewalks and safer street crossings, more lighting, bike lanes, clearer road signs and pavement markings, and reconfigured parking are being included in the plans. This portion of Kensington has a long history of being industry-heavy, and revitalization plans are to keep the space accessible for small-scale industries and distributors while improving public accessibility, reducing stormwater runoff, and lowering commercial and residential stormwater bills (Philadelphia Water Department, November 11, 2011). Commercial and residential properties are charged utility fees by the average square footage of the gross area and impervious surface of the property (Philadelphia Water Department, 2018b).

Planning on a large scale within a framework of achieving "complete streets" is important for appealing to the needs and concerns of residents that may not prioritize environmental issues. They may have every day personal issues, jobs, families to take care of that are of greater priority. The Outreach Coordinator involved with the American Street Improvement Project was aware of these priorities,

> "...what I find is that in neighborhoods that don't have a lot of investment in their neighborhood, people aren't as concerned about green infrastructure or the river. They're more concerned with safety, vandalism, and trash, which makes a lot of

> sense. You have to confront those things every day, as opposed to water quality, which isn't always obvious" (City staff person D 2016).

Addressing a greater scope of issues like safety, trash, parking, public space, and transportation will allow for more room for addressing stormwater issues and a more engaged public. Once the public is convinced that their needs and concerns are being taken into account, they might have greater trust in their government and will have a greater interest in issues like water quality and desire to participate in environmental stewardship.

In July 2016, two open houses were planned for community members to attend, learn about the project, and provide feedback. They were advertised by the Project Steering Committee on social media, flyers, and local media outlets (American Street Improvement Project, April 26, 2018). Each meeting was four hours long and the one that I attended attracted about 100 people. The open house offered refreshments, a welcome table, an opportunity to complete a survey about the project (Appendix D), and tables with information about sections of the proposed plans. Each table was dedicated to a portion of the 14-block project with dedicated staff, detailed maps, and sticky notes to write suggestions and comments on.

PWD engineers and outreach staff, and representatives from the Streets Department, GSI Partnerships, and Philly 311 were on hand to answer questions and direct attendees to maps of interest to them. Philly 311 is a public information and contact service for non-emergency situations that allows the public to report, make suggestions,

or ask questions about a variety of government services and issues they may be having (Philadelphia Water Department, 2018c).

Surveys are a part of the PWD's approach to learning more about resident demographics in conjunction with education and involvement in Green City, Clean Waters. The PWD recognizes that there are socio-economic differences throughout the City that affect the ability of community groups to contribute to planning, education, and ensuring higher turnout at meetings, and it takes those into account when planning community outreach strategies. The PWD Outreach Coordinator that I met with to discuss the American Street Improvement Project assured me that,

> "White areas usually are the most advantaged and have the most reception, but obviously we are working on that. That's something that we recognize, and we're doing a bunch of surveys to see where the baseline is at and adapting those different surveys into outreach" (City staff person D 2016).

I contacted the American Street Improvement Project Team regarding the survey distributed at the open houses. A representative informed me via email that feedback from it and the sticky notes was compiled and provided to the Design Team (City staff person J 2016). They also referred me to the project's website, which includes preliminary information about the planning stages and will serve as an ongoing source of project updates as construction progresses. The "We Heard You" section of the website compiles feedback that was received on the sticky notes and surveys from the open houses (American Street Improvement Project, April 26, 2018). Suggestions and comments include a desire for more trees and greener spaces to make the neighborhood's industrial, concrete spaces more environmentally friendly, attractive and accessible for

public use, plus bike lanes and revamped sidewalks for safer transportation. Others include concerns about the need for more street lights and surveillance for safety and security, reduction in parking, collection of trash from the GSI projects, potential tripping hazards caused by installation of the GSI projects, and the likelihood that people will mistakenly drive over stormwater bumpouts. Being in a heavily-industrialized neighborhood, there are also concerns about the convergence of bike lanes and truck traffic (American Street Improvement Project, April 26, 2018). American Street is very wide with multiple one-way lanes divided by medians. In several spots, there are turn lanes for trucks to make wide turns into businesses and industrial lots. Adding parking, bike lanes, and usable public space on the medians could create obstacles and potentially dangerous situations.

In addition to the survey distributed at the open houses addressing that project in particular, the PWD has conducted their own surveys, as well as contracted with Temple University and other partners to conduct broader, citywide surveys to get a better idea of what people knew about Green City, Clean Waters and what their opinions on the plan were. According to the Outreach Coordinator assisting with the American Street Improvement Project, who was also involved in tracking survey data,

> "While the survey was open, we tracked it to make sure we were getting a good sample. Most respondents were from primarily white and wealthy communities, but we did get responses from across economic and demographic backgrounds. We did find that where there is more GSI and more organized communities, they are more aware of what's going on. We're working within that system, so it's hard to change that, but we definitely want to" (City staff person D 2016).

They shared with me results of one of the citywide surveys conducted February to April 2016 on the "public's awareness of and attitude towards Green City, Clean Waters in their neighborhoods" (City staff person D 2016). Of the 1487 respondents, a majority of them have some understanding of the plan (49%) or are at least aware of its existence (28%), support public investment in GSI (62%), and are willing to work with the PWD to increase and improve GSI (72%). Respondents also see GSI as having a positive effect on neighborhood beauty (94.9%), property values (86.5%), and waterway health (92.7%). Opinions are predominantly positive or neutral on crime reduction (42.8%/54%), the local economy (74.4%/34.2%), ease of transportation (36.7%/58.8%), traffic safety (50.4%/46.7%), and pedestrian safety (60.9%/36.7%) (City staff person D 2016).

Maximizing the number of survey responses should perhaps be made a priority to get the most accurate and even representation of the neighborhood's demographics. Follow-up open houses were planned for July 2017 to continue receiving community feedback on the redevelopment plans. Pooling resources from the PWD, Streets Department, Pennsylvania Department of Transportation, and Commerce Department helped to make the community meetings successful and attract a large number of community members to attend and provide feedback on proposed plans. The scale of the project is complex and ambitious, so having many industry, government, and community partners will be necessary as the project progresses to keep the City abreast and ahead of any shifting development issues and needs of Kensington residents.

Community Ownership of Stormwater Management in Passyunk Square

As the City of Philadelphia continues to set goals towards greater citywide sustainability, the shift has begun to have a range of effects. While some people consider them to be positive changes to their neighborhoods, others primarily see the negative impacts they can have. Older generations throughout the City have established their neighborhood identities, and some of those identities have become solidified in Philadelphia's history. Certain neighborhoods across Philadelphia are known for particular social demographics and cultural elements, but as time progresses and the socio-economic makeup of the City develops, the composition of these neighborhoods is shifting. Between 1990 and 2010, the eastern side of South Philadelphia, including Passyunk Square (Figure 13), saw a 28.8% decrease in its Caucasian population, while the African American population increased by 1.1%, Hispanics by 317.1% and Asians by 277.4%. Despite these changes, this area is still predominantly Caucasian, over 50% (Pew Charitable Trusts, June 1, 2011). From 2000 to 2011, Passyunk Square's median household income increased from $34,431 to $36,561. From 2011 to 2016, it further increased to $46,108 (Pew Charitable Trusts, March 24, 2012; U.S. Census Bureau, 2000; U.S. Census Bureau, 2012-2016).

In recent history, South Philadelphia has come to be known for its Italian population. The daily Italian Market is touted as America's oldest outdoor market and is a cultural landmark of this region of Philadelphia. Interviews with staff from the Passyunk Square Civic Association (PSCA) revealed the concerns of older Italian-American residents, who feel the PWD's plans for GSI projects will negatively transform

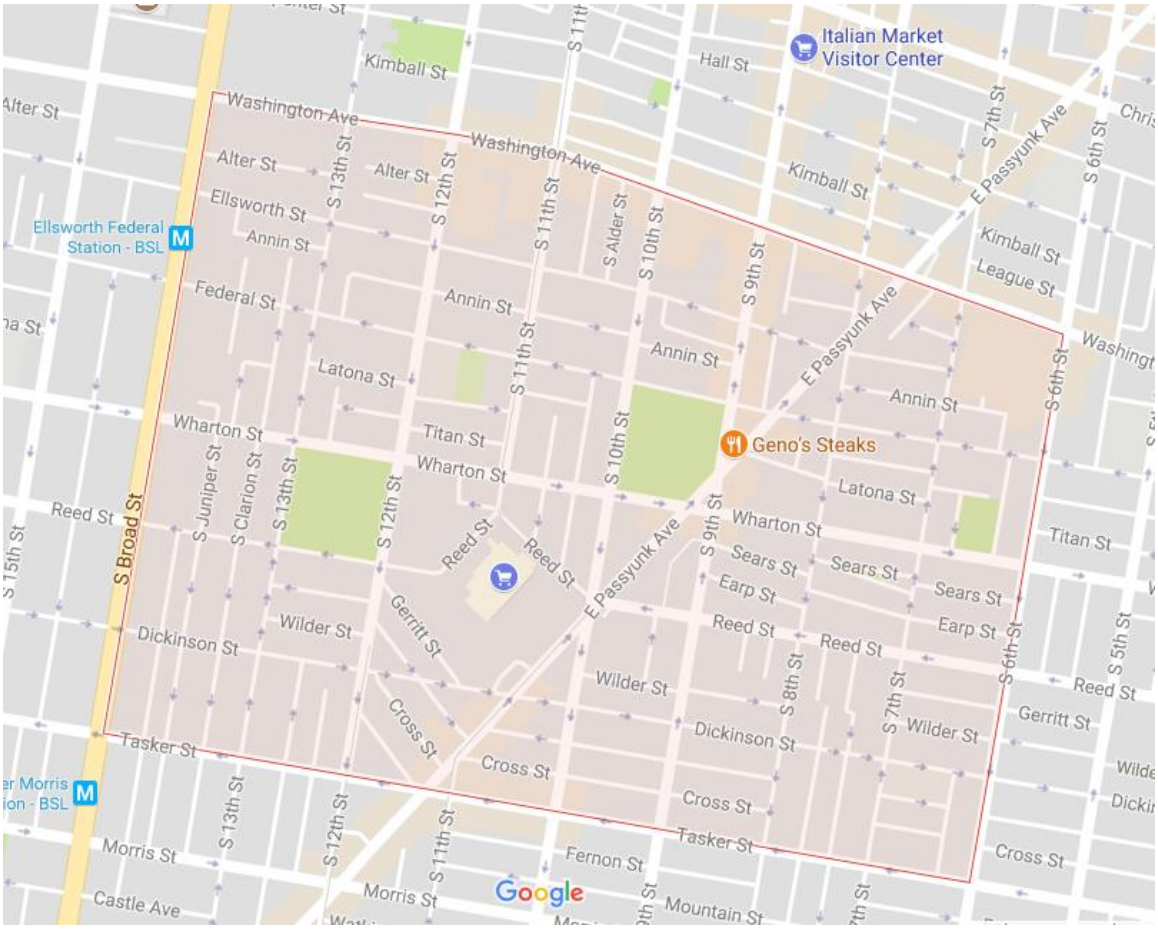

Figure 13. Map of the Passyunk Square neighborhood of South Philadelphia, outlined. Map by Google.

their South Philadelphia neighborhoods (City partners B and C 2016). Residents shared their opinions and concerns with PSCA staff at neighborhood meetings and events that increased greening and installation of trees have the potential to raise property values and taxes, and to attract younger generations, who will change their neighborhoods' identities, make it more difficult to keep sidewalks and streets clean, and reduce safety (City partners B and C 2016). One of the highlights of Green City, Clean Waters is increased property values, but these are only beneficial to some and can make it difficult for other residents on fixed incomes to afford their homes and stay in their neighborhoods (Philadelphia Water Department, June 1, 2011). As for the ways in which GSI projects make it difficult to keep city spaces clean and safe, as PSCA staff understand it,

> "There are folks that will pour bleach in the roots, they didn't like bushes, the stuff that falls down off of trees, seeds, berries and whatnot. It's dirty and gets on their car...Someone theorized, back in the day, maybe when Philadelphia was not such a safe place to live, any time of greenery that was an obstruction was unsafe and represented danger, it's a safety hazard. It's something they didn't grow up with, they didn't grow up with trees" (City partner C 2016).

If there is truth to this way of thinking about trees in urban spaces, it helps to shed light on the way that older generations tend to think about the stormwater system and trash. Sewers used to be the standard way to dump waste, and it was normal behavior for residents to dump their waste into local streams or wetlands that had not been filled in. It is the daunting task of the PWD to change these thought processes and ingrained behavior.

As indicated by PSCA staff, more recently, Passyunk Square has come to attract new demographics that are interested in the changes that are happening because of Green

City, Clean Waters and whose ideas differ from those of older residents of the area (City partners B and C 2016). As PSCA staff see the impetus for the transformation of the neighborhood,

> "I think there is a demographic of wealthier people who don't want to move to the suburbs. Families and professionals who are interested in making this a place to stay to raise families and things like that...there is, I don't want to say urbanization, but there is a little bit of that, putting lots of resources, personal resources, towards continuing to develop the neighborhood...the work that the Water Department does is attractive to that kind of person, I think. It reinforces the idea that Philadelphia is a great, sustainable city that Philadelphia is working towards being a sustainability capital" (City partner B 2016).

The structure of the Green City, Clean Waters plan appears to be facilitating community-building across Philadelphia on multiple scales, between City government and individual neighborhoods, between different neighborhoods, as well as between community members in each neighborhood. Where these community-building connections are lacking, there is interest in the connections being made. One staff person from PSCA expressed their desire to have more opportunities to connect with other neighborhood organizations to share their experiences working with the PWD and being a part of the maintenance of GSI projects, "I would love it if they could help to build out a network so that Soak It Up! Adoption grantees could learn from one another and it would be a great engagement method" (City partner B 2016).

Another staff person with PSCA described their experiences working with the PWD as "really, really wonderful. They're really open to any idea that I throw at them" (City partner C 2016). Having foresight in the planning process, considering local social situations, and being self-reflective strengthens governance for the long-term.

Decentralization of stormwater management is proving to be a large task and bringing the public back into the decision-making process helps to facilitate the process.

In PSCA's experience, they have found enthusiasm for getting involved in GSI in the neighborhood to be unmanageable within the parameters of the PWD's goals. There is a Passyunk resident who is interested in extending their love of gardening from their home to the rain garden across the street. Access to the rain garden is restricted physically with a fence and the PWD also wants to keep track of maintenance and has chosen a specific set of plants that are to be used in the site. The resident considers their gardening ability to be an asset to the neighborhood and finds the restriction to be frustrating. The messages the PWD is sending to the public about the purpose of the GSI projects, beautification, and community involvement are sometimes confusing not only for residents but for PSCA staff,

> "I didn't understand this...that the plants really are, for the most part, about making it beautiful; about decoration. That there's the water part of it is really about basins underneath those structures. You look at those and you think, 'Oh, that's great it's so efficient because they're using the water to water the plants', and it's not really that. It's about mitigating runoff because you've got dirt instead of sidewalk, absolutely, but it's not necessarily about 'oh now we're gonna water the plants with this water'" (City partner B 2016).

Finding a balance between the expectations of the PWD and the community in terms of involvement, taking ownership of GSI, and properly managing stormwater will need some further consideration. PSCA staff want their neighbors to succeed in being proactive in the community, but understand the reservations that the PWD seem to be having,

> "You have very enthusiastic neighbors...people with great expertise and great ability to do something very beautiful, like this garden that's on the corner...If you're the Water Department, you can't depend on someone with that level of expertise always being there to take care of something like that. So, to let them do whatever they want to and then there's nobody to maintain it if they move out of the neighborhood, or whatever it might be, is always a challenge" (City partner B 2016).

The PWD has decided to work with this gardener and provide them with a list of plants that are appropriate for planting in the rain garden. An interesting follow-up would be to see if this has continued to be the case and if the PWD and this individual have run into any further issues with allowing him to contribute to the GSI site.

PSCA staff that I interviewed explained that the Association is contracted with the PWD to provide services that help facilitate GSI projects, including Rain Check and Soak It Up! Adoption (City partners B and C 2016). These connections with the PWD are beyond the other projects that PSCA also handles for the neighborhood, including beautification and tree planting, co-running a community garden with the Pennsylvania Horticultural Society, and coordinating with Mural Arts on new murals in the neighborhood. As a PSCA staff person explains,

> "We kind of see ourselves as a facilitator...helping neighbors make connections with each other, so that when there's a project that comes through our neighborhood, we're ready to help people who want to make something happen in the neighborhood network with community members" (City partner B 2016).

PSCA and PHS coordinate on the Tree Tenders program that gets community members to participate in tree-planting events and teaches the public how to plant and care for trees. They also work together on PHS's City Harvest program that gets community members gardening.

Passyunk Square's Columbus Square Park was one of the first locations chosen by the PWD for a pilot GSI project. PSCA has remained a partner of the PWD's in helping to get community members interested in participating in Rain Check, installing rain barrels and planters at their homes, but it has been more difficult finding people for Soak It Up! Adoption. The program requires staff that PSCA does not have and volunteers from the community to monitor the care of GSI projects in Passyunk Square. It has been the experience of PSCA staff that,

> "sometimes volunteers are hard to manage that way, where you have very clear expectations and you know, people are doing it in their spare time and it's not the same as hiring somebody and paying somebody to do something" (City partner B 2016).

Passyunk Square residents have shown a mix of resistance and enthusiasm towards the PWD making changes to their neighborhood with GSI projects. Respecting the diversity and varying cultures of South Philadelphia, while educating community members about why GSI is important and can benefit them can build a better relationship between the City and the community. The PWD needs to listen more closely to concerns about how development is affecting culture, safety, and aesthetics, and work with community members to reconcile differences of opinion of what Passyunk Square needs. Calling on community groups like PSCA can release some of that burden. Building a network of community facilitators is giving the community a lot of extra responsibilities, and Passyunk Square residents want to take initiative and ownership of their neighborhood, but the PWD should support them accordingly.

Restoring Community Trust in Government

Residents in some other parts of Philadelphia are losing their trust in the City to address their primary concerns while managing stormwater in their neighborhoods. Here I present examples of the relationship the City has with Elmwood, in Southwest Philadelphia, and Girard Estates, in South Philadelphia, as GSI projects are being installed in these neighborhoods.

Flooding and Government Distrust in Underserved Elmwood

West Philadelphia is historically one of the most overlooked portions of the City, in terms of demographically and socio-economically disadvantaged communities. Disadvantaged communities are outliers in society that have disproportionately less access to social services and opportunities for participation than other communities have (Brownlow, 2006; Plumwood, 1998). In Philadelphia, there is a long history of African American populations being marginalized (Brownlow, 2006).

Located in Southwest Philadelphia, the Elmwood neighborhood's (Figure 8) population is growing and, since 1990, it has shifted from having a predominantly Caucasian population to now having over 75% African American, with significant increases in Hispanic and Asian populations as well. Between 1990 and the 2010 census, the Caucasian population fell by 87.7% while the African American population rose by 54.1%, the Hispanic population rose by 247.9%, and the Asian population rose by 140.6%. Citywide since 1990, the Caucasian population decreased by 31.9% and primarily moved to outlying neighborhoods in Northeast and Northwest Philadelphia,

plus Center City and suburbs beyond City limits (Pew Charitable Trusts, June 1, 2011). From 2000 to 2011, Elmwood's median household income increased from $25,973 to $30,581. From 2011 to 2016, it decreased to $29,972 (Pew Charitable Trusts, March 24, 2012; U.S. Census Bureau, 2000; U.S. Census Bureau, 2012-2016). These amounts are some of the lowest across Philadelphia (Pew Charitable Trusts, March 24, 2012). Elmwood's predominantly African American population is struggling with managing flooding. The PWD implemented its Green City, Clean Waters plan in Elmwood, but City staff I interviewed explained that the City was unprepared to address residents' concerns with large-scale flooding issues. As a result, they received feedback from residents that they felt helpless, underserved, and had lost trust in the government to adequately address their needs (City staff person C 2016).

In July 2016, the PWD held a community meeting in Elmwood to introduce new GSI projects for the neighborhood. The meeting was held at the 12th Police District Headquarters in Elmwood, and attended by local police, staff from the State of Representatives Office of Pennsylvania, and John Heinz NWR staff. John Heinz NWR staff were there to present a $1 million grant that the U.S. Fish and Wildlife Service awarded the Refuge, and opportunities for using the funding for wildlife corridors and pocket parks (City staff person C 2016; U.S. Fish and Wildlife Service, March 31, 2016). The PWD were expecting sixty people to attend, but an estimated 100 people did. To get a greater turnout, the PWD scheduled the meeting in conjunction with an existing community meeting meant to address broader neighborhood topics, and food and a raffle were included in the event (City staff person C 2016).

I spoke with a PWD staff person who attended the meeting about their experience. The meeting was intended to introduce residents to GSI projects proposed for the area (Figure 14). However, it ended up highlighting residents' concerns about widespread basement flooding. As the PWD staffer explained, Elmwood is a "classically underserved area" which has led the residents of Elmwood to be concerned about how the PWD is going to address flooding issues, how GSI projects are going to change their neighborhood, and whether or not the PWD will be able to adequately address their concerns (City staff person C 2016).

Located in between the Schuylkill River and Cobbs Creek, Elmwood has a history of waterways being used as sewers and being harnessed to become a part of the CSS. As industrialization began to spread rapidly through Southwest Philadelphia in the 19th and 20th centuries, the original 6,000 acres of wetlands that once existed in the City were winnowed down to 250 acres (U.S. Fish and Wildlife Service, 2001). Removing the complex stream system and extending the surface area of impervious surface in a historically wetland-dominant area has made Southwest Philadelphia sensitive to flooding (The Delaware Riverkeeper Network, May 1, 2006). According to a PWD public affairs staff person, there were reports that houses in the neighborhood have been slowly sinking on their foundations (City staff person C 2016).

In 2005, the PWD put together a Basement Protection Program (BPP) to mitigate basement flooding and the potential for property damage. Applicants who qualified for BPP had a backwater valve installed on the pipe on their property that prevented

Figure 14. Map of green stormwater infrastructure (GSI) projects proposed for the Elmwood neighborhood of Southwest Philadelphia. Map by the Philadelphia Water Department (PWD) and author.

wastewater from reentering the home when the volume of water in the CSS was high and likely to spill over into basements instead of at a CSO or make its way to a wastewater treatment plant. The PWD considered BPP to be a short-term solution to the City's flooding issues but saw it as an opportunity to buy some time while habitat restoration and GSI strategies were developed and implemented as long-term solutions (Philadelphia Water Department, February 3, 2016). However, as I experienced while attending the community meeting, these distinctions were lost on some Elmwood residents who were not able to distinguish between City staff responsible for addressing issues of flooding and the new GSI projects.

At the Elmwood meeting, some residents expressed their interest in GSI and beautification of their neighborhood. These individuals wanted to learn more about GSI, plant types, and how to contribute by planting their own green features at their homes and give feedback on other infrastructure features like location and design of trash cans and benches in Elmwood. However, a large portion of residents attending the meeting wanted to focus on the basement flooding issues which PWD staff present were unprepared to address.

Clearly it is the PWD's responsibility to address residents' concerns to the best of their ability, but as basement flooding was not a target of the Green City, Clean Waters plan, the department staff were unprepared to address the primary concern of citizens at the meeting. The City staff person I spoke with understood the importance of providing an open forum for residents interested in "exercising the opportunity to address governmental officials for not serving the community," and when Elmwood residents

took full advantage of the opportunity and made their voices heard, they embraced the contention (City staff person C 2016). In the opinion of the staff person, portions of the City that get the most attention, especially Center City, will always be fine, but it is the duty of the PWD to make sure that underserved neighborhoods have their voices heard. He understood his role as a representative of the City to be transparent and, despite being unable to adequately address flooding, do his due diligence in listening and being present. From his viewpoint, "the project is going to happen anyway…we want to do outreach and good outreach" (City staff person C 2016).

Non-GSI features are not within Green City, Clean Waters purview, but I believe it is the responsibility of PWD staff working on GSI projects to pass along community feedback to other relevant City staff. A question here is whether it is adequate to have PWD staff forwarding feedback to other City departments, or whether it would be more effective for each meeting have dedicated staff from various departments attending community meetings alongside PWD staff? If the appropriate staff people are not present to answer residents' questions, the Outreach Coordinator facilitating the meeting should set aside time for residents to express their concerns, as was done at this meeting. First and foremost, the issue of basement flooding needs to be addressed. While other PWD staff work on those issues, it is important for Green City, Clean Waters outreach staff to keep trust between the community and the government by allowing people to speak their mind and feel heard. Alternatively, PWD staff should be could be trained on a broader range of topics that might be raised by meeting attendees so that they can more confidently, completely, and efficiently answer questions.

Staff could have achieved a more successful meeting by considering the broader scope of social and environmental challenges that Elmwood has been experiencing. As City staff explained to me, they were expecting this meeting to reflect other GSI meetings from around the City that have been dominated by residents wanting to talk about the loss of parking and digging up of streets but found instead that the majority of concerns were about flooding (City staff person C 2016). As they see it, GSI is "not designed to alleviate flooding", but this is not true (City staff person C 2016). Managing water that is a part of the CSS is a portion of a greater water resource management problem in Philadelphia. Regardless, with staff from the State Representative's Office and John Heinz NWR in attendance, the meeting was an opportunity to present not only the immediate issue of stormwater management in Elmwood but the greater issue of stormwater management on a citywide scale. Restoring wildlife habitat, in this case wetlands, by building a wildlife corridor and pocket parks is a broader scale approach to increasing the green acreage available for absorbing stormwater and acting as a buffer for fortifying developed land from flooding. It was the City staff person's responsibility to accurately and completely represent other issues that the City is attempting to address under the umbrella of citywide sustainability.

The community meeting in Elmwood was the first one that the City staff person I interviewed had taken the lead in planning and presenting (City staff person C 2016). This individual struggled to address community members' concerns with flooding and could have benefitted from the support of other PWD staff that had more experience with community meetings and a broader knowledge of basement flooding and the needs of the

neighborhood. Training outreach staff to have a broader knowledge of the City's *Greenworks* sustainability plan will better prepare them to serve the community. Another option is to have multiple staff people with a variety of specialties attend each community meeting so that they can address community members' questions and comments more accurately. The PWD may not be able to solve all of the problems that are brought to light during large projects like Green City, Clean Waters, but they should develop their approaches to management to best serve the community. The City has the opportunity to regain Elmwood's trust by making sure resources are continually available for the community to learn, participate, and be able to serve themselves.

From my perspective, the community meeting in Elmwood helped to educate the public about GSI and provided a forum for feedback from the community, but it is also failed to adequately address the community's concerns. It is the responsibility of the PWD to take what they learn from these meetings and improve Green City, Clean Waters. Elmwood's history as an underserved community can change with the best quality of support that the PWD can provide.

Miscommunication and Frustration in Girard Estates

Like Passyunk Square, Girard Estates (Figure 15) has a strong identity and is protective of it. It became clear from the community meeting that I attended that community members in the neighborhood are comfortable with letting their voices be heard. The PWD's visit to the neighborhood was met with frustration, anger, and distrust. There was a lack of communication between the PWD and the community before the visit, which grew during the community meeting. Now it is the PWD's responsibility to

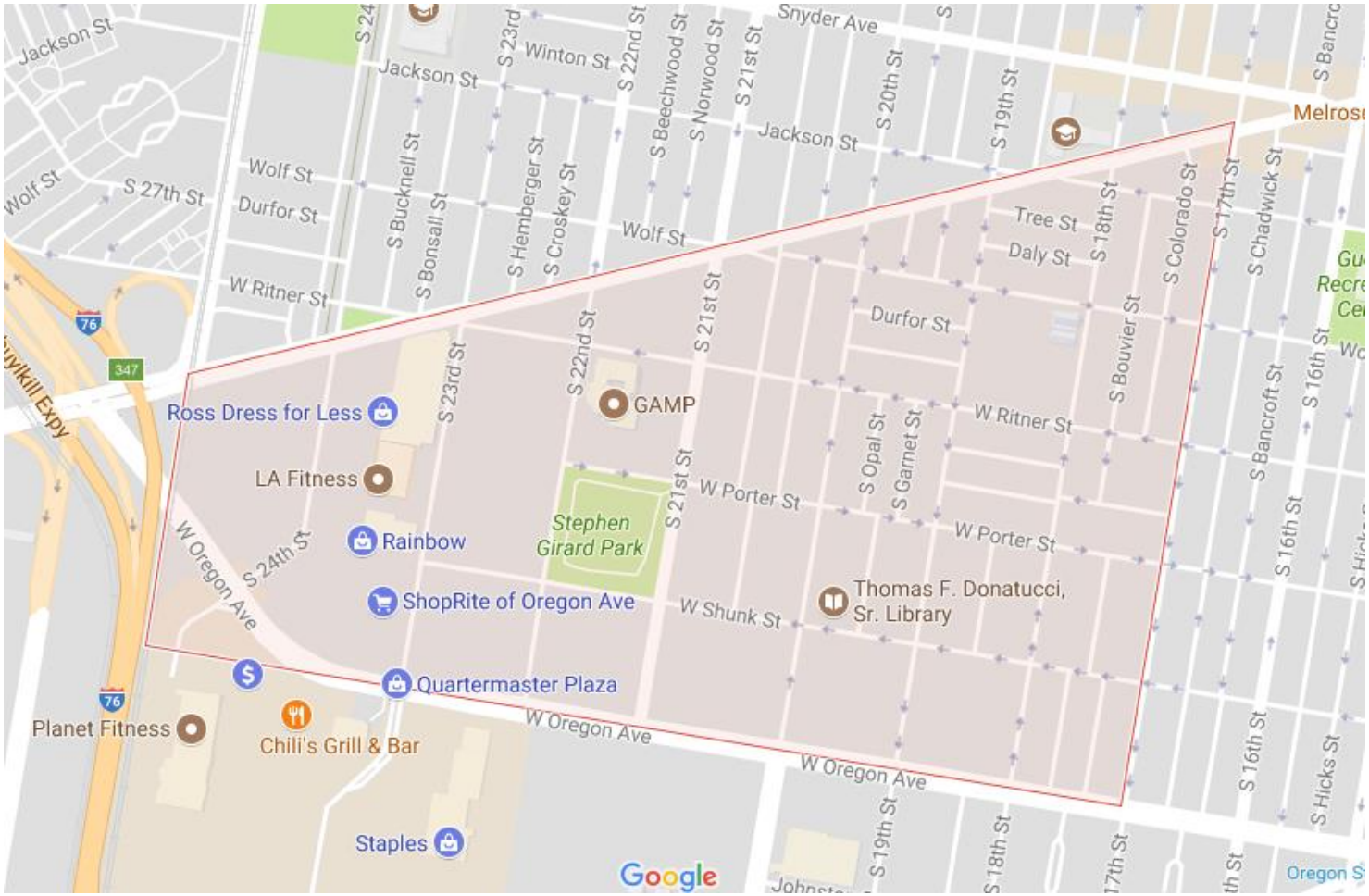

Figure 15. Map of the Girard Estates neighborhood of South Philadelphia, outlined. Map by Google.

repair their relationship with Girard Estates and regain their trust with more opportunities for collaboration.

A community meeting for Green City, Clean Waters was held in the Girard Estates neighborhood and hosted by the Girard Estates Neighborhood Association. Anoutreach staff person from the PWD was in attendance to present Green City, Clean Waters and proposed GSI projects for the neighborhood (City staff person H 2016). Turnout for the meeting was relatively low, with about 25 attendees. As they do with each community meeting, the PWD sent letters and made phone calls to about 700 addresses in Girard Estates. The PWD staff person explained during the meeting that they had received feedback from community members prior to the meeting and asked for a show of hands during the meeting, that letters and phone calls were received late the day before or the day of the meeting. Ideally these would be sent out sooner and they apologized for the late notice (City staff person H 2016).

Despite the turnout being low for the meeting, community members had a lot of comments about parking, construction, and trash. Overwhelmingly, the community members who provided feedback seemed to be on the offensive and disbelieving that the PWD would adequately address their concerns. Several of the residents were harsh critics of the PWD's plans for the neighborhood's Girard Park and told the public affairs staff person, "you don't live here" (community meeting speaker A 2016) and "you'll be causing a lot of grief" (community meeting speaker B 2016).

As I witnessed from attending the community meeting in Girard Estates, reduced availability of parking spaces as a result of stormwater bumpouts being installed on the

perimeter of the park, was a key concern of residents. Several residents attending the meeting also expressed their concern for safety hazards for motorists and pedestrians during construction. Parking was already at a premium, and in some cases, residents regularly resorted to parking illegally (City staff person A 2016). Anger over reduction of parking was not unique to Girard Estates, but it was one of the primary complaints heard during the meeting.

The neighborhood has historical buildings, brick sidewalks in some places, and Girard Park has a historical fountain on one of its corners. A resident also made it a point that after GSI projects are completed, older parts of the neighborhood should retain the coarse, exposed aggregate pavement that has become a historical element of the aesthetics of Girard Estates. The community member who brought up the issue felt that construction in designated historical areas like Girard Estates has been disruptive not only to residents but to visitors who are there to observe the historical sites (community meeting speaker C 2016).

Trash proliferation is another issue that Philadelphia is trying to combat citywide, and alongside parking, it was of the most mentioned concerns during the community meeting. In the following quote, a community member questioned the policy for routine maintenance of stormwater drains and GSI projects that regularly collect trash from the sidewalk and street,

> "Is there a policy for the City to clean them so-often? You mentioned putting little placards on the inlets. I mean, that's not going to work, that's not Philadelphia. Traditionally they have been used as garbage disposals and also toilet refuse for dogs. I have two of them on my property. It's very difficult to get them to be

> cleaned. It would help in terms of what you're trying to achieve here" (community meeting speaker D 2016).

Another concern of Girard Estates residents in attendance at the community meeting was the number of undeveloped commercial lots and those that they would like to see renovated. There is a series of strip-malls along the southern edge of the neighborhood that abut Interstate-76. Some residents in attendance at the community meeting found the area to be "scary as hell" for pedestrians. They said they feel unsafe, not only because there is a lack of sidewalks, but the space itself is unappealing, dirty, and attracts unsavory behavior (community meeting speaker E 2016).

In cases like this, where residents were very aware of what was happening in their neighborhood on a daily basis, it appeared that there was a disconnect between what PWD staff were experiencing during their visits throughout their districts and what residents experienced every day. When PWD Outreach Coordinators visited a neighborhood infrequently, or for the first time, their presence could be seen as authoritarian and controlling. Girard Estates residents at this meeting seemed to lack confidence in the PWD's ability to adequately inform residents of community meetings, respect the history of the neighborhood, and sufficiently address persistence issues with trash and parking.

As a PWD Outreach Coordinator said regarding their thoughts on the importance of having community meetings about GSI projects, "community buy-in is key and necessary for long-term success" (City staff person A 2016). To hit the ambitious targets set in the Green City, Clean Waters 25-year plan, the PWD considers community input to

be an important part of the planning stage of proposed projects to ensure that they are done correctly from the start (City staff person A and B 2016).

Collaboration with Diverse Stakeholders

In this section I focus on collaboration between public and private stakeholders to achieve revitalization projects in Kensington, North Philadelphia, and at Ralph Brooks Park and Smith Playground in South Philadelphia.

Stakeholder Collaboration and the Big Green Block in Kensington

A few blocks east of the American Street Improvement Project is another large multi-element project GSI site known as the Big Green Block (Figure 16). Like the American Street Improvement Project, the Big Green Block falls outside of the designated area of Kensington shown on the map (Figure 12), but it is still considered to be located within the Kensington neighborhood. Completed in 2010, the aptly-named Big Green Block is a city block packed with amenities for the community and a variety of GSI projects. The block boasts the Shissler Recreation Center, a football field, baseball diamond, and smaller activity field, a dog park, a playground and fountains, benches, porous pavement, tree trenches and large rain gardens with educational signage, murals, and several sections of green roof on the neighboring Kensington Creative & Performing Arts High School. As the PWD's fact sheet on the Big Green Block shows, the high school,

> "is the first LEED-platinum certified public high school in the nation, constructed on a former brownfield site. Besides providing students with a brand new school, the project contributed to a truancy rate reduction from 35% to zero and boosted

Figure 16. Map of the Big Green Block in the Kensington neighborhood of Northern Philadelphia. Map by the Philadelphia Water Department (PWD).

> graduation rates from 29% to 69%" (Philadelphia Water Department, July 8, 2016).

Like the American Street Improvement Project, to complete this comprehensive project, several government agencies needed to be involved, including the PWD, Philadelphia Parks and Recreation, PHS, New Kensington CDC, the Mural Arts Program, and the School District of Philadelphia. Having the entire block available allowed for fewer planning restrictions, but compromise and collaboration with the community and other stakeholders was necessary. A PWD GSI Planner explained an example of the PWD collaborating with Parks and Recreation,

> "If we want to use a large portion of their site for stormwater management, but a part of that site is used or programmed for something like a baseball field or a soccer field, we work with Parks and Rec. We try to do something subsurface, or rain gardens around the edges of the park, and put the majority of our system underneath a new ball field. So, in that case, we work with the community and the park and everybody gets something, and we wind up improving a ball field" (City staff person G 2016).

The location of the Big Green Block was chosen, because Kensington was in dire need of a new high school, space for community recreation, and more multi-use, greened park areas (City staff person G 2016). By collaborating with other government agencies and the School District of Philadelphia, the PWD was able to satisfy the desires of the community while dedicating a large area of the Big Green Block to GSI projects. With the large-scale redevelopment projects that had already been completed as a part of Green City, Clean Waters, like the Big Green Block, and future plans like the American Street Improvement Project, changes to Kensington's physical, social, and economic landscapes had begun to occur and were expected to continue. To prevent further demographic shifts

during the redevelopment of Kensington, the PWD and the group of stakeholders that planned the Big Green Block should monitor community use of the space and continue to collect feedback on what the community wants out of the space.

Diverse Stakeholders and Funding of Community-led Revitalization of Ralph Brooks Park and Smith Playground

Ralph Brooks Park (Figure 17) and Smith Playground (Figure 18) are individual parks within South Philadelphia neighborhoods that provide strong examples of how GSI can transform spaces physically and socially. This was a pair of park projects that were initiated by residents of the surrounding neighborhoods and revitalized with collaboration from a diverse group of stakeholders and funders.

Named after a child from Point Breeze who was shot and killed, Ralph Brooks Park was one of the central community spaces in the neighborhood. Transformation of the space in the ways that residents wanted was deeply important for Point Breeze (Figure 19). Residents of Point Breeze initiated the revitalization of Ralph Brooks Park so that they could have a nicer park and community gathering space, but they lacked the funding to make it happen. As the PWD outreach staff person designated to these projects explained, despite the desire to see revitalization of their community spaces, community engagement with the Ralph Brooks Park and Smith Playground projects and turnout to the first scheduled community meeting was low at first (City staff person H 2016).

The PWD staff person told me during our interview that the neighborhoods surrounding both park spaces had large African American and low-income populations, with affordable housing including low-income high-rise apartments nearby. There had

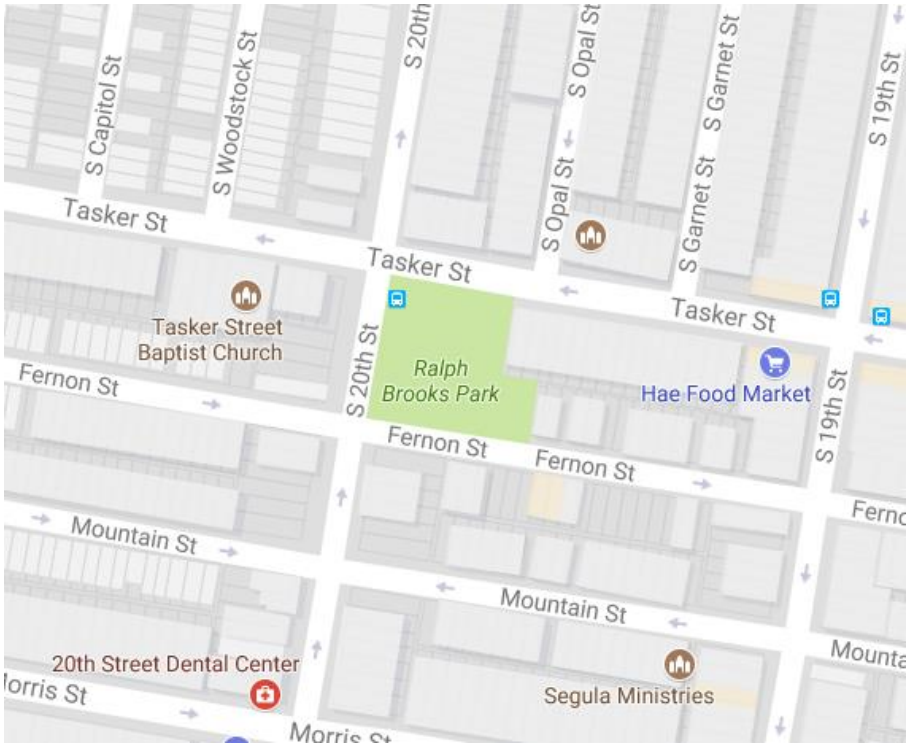

Figure 17. Map of Ralph Brooks Park in the Point Breeze neighborhood of Philadelphia. Map by Google.

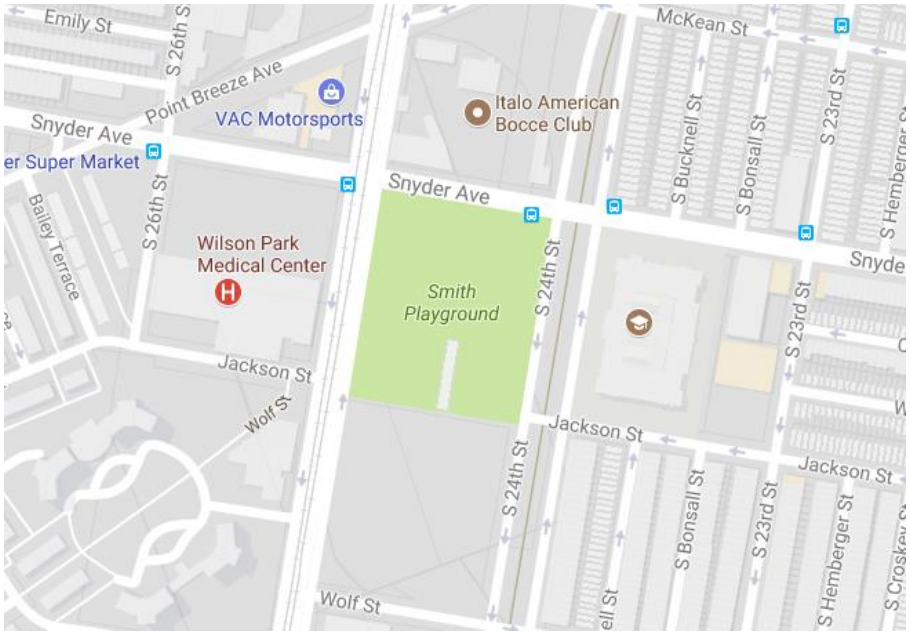

Figure 18. Map of Smith Playground in South Philadelphia. Map by Google.

Figure 19. Photos of Ralph Brooks Park in the Point Breeze neighborhood of South Philadelphia before (top) and after (bottom) revitalization. Photos by Port Urbanism (top) and the Philadelphia Water Department (PWD) (bottom).

been concerns about the benefits of the playground to the local community, but community members had taken control of planning and making improvements to the property. When the project was initiated, the PWD staff person received feedback from community members that they were hesitant to believe the PWD would support the local community and businesses over their primary goals for Green City, Clean Waters. Further complicating the matter, Smith Playground's Recreation Center Director changed three times in two years, which made it difficult to get things done and for the PWD to establish a relationship with community leaders (City staff person H 2016).

To address the issue of low turnout to community meetings, the PWD and the Urban Roots non-profit collaborated in spreading the word, posted flyers throughout the community, and made robocalls. The PWD was interested in who was using the parks so that they could be more comprehensive in scheduling community events, planning, and management efforts. As a result of the efforts of the PWD and Urban Roots, subsequent meetings had more attendees (City staff person H 2016).

Plans for Smith Playground included GSI features, a new recreation center, a turn field for baseball, football, and general recreation, basketball courts, playground space, fitness trail, and murals (Figure 20). The projected cost of the renovations was $3,095,000. Significant contributions came from City Councilman Kenyatta Johnson, former Mayor Michael Nutter, the PWD, Parks and Recreation, the National Football League, Make the World Better Foundation, Urban Roots, Tuttleman Family Foundation, and 25th Century Foundation.

Figure 20. Information sheet for the Smith Playground Revitalization Project. Sheet by Make the World Better Foundation and Urban Roots.

Renovation of both sites was funded in part by the Make the World Better Foundation, started by former Philadelphia Eagles football player Connor Barwin (City staff persons A, B and H 2016). Barwin's celebrity provided unique opportunities for fundraising and advertising campaigns that the PWD used to get communities and investors interested in Green City, Clean Waters. Funding from Make the World Better Foundation came from a large group of contributors, such as community funding, private foundations and funders, and money that had been crowd-funded through events like benefit concerts. Connor Barwin then matched the funds that were raised during fundraising events. Once he learned of the community's desire to revitalize Ralph Brooks Park, it became Connor Barwin's goal to help the community succeed, without taking ownership of the project (City staff persons A, B, and H 2016). It is important for stakeholders to have similar goals for revitalization efforts for them to be successful and prioritize the wants and needs of the community.

Connor Barwin left Philadelphia when he was traded from the Eagles to the Los Angeles Rams in 2017, but he has stated that he will remain dedicated to the work that he started with Make the World Better Foundation (The 700 Level, March 9, 2017). Celebrity appears to have worked in the favor of Ralph Brooks Park and Smith Playground. The key was allowing the needs of the community to come first in the planning process and providing a solid foundation for those needs to be met. Providing a framework for revitalization projects that the community can take ownership of will help them live on once construction has been completed and the celebrity is gone.

Stormwater Management and Sea Level Rise Response

Historically, South and Southwest Philadelphia primarily consisted of lands with the lowest elevations in the City and thousands of acres of tidal marsh that were often completely submerged at high tide (Philadelphia Water Department, 2018a). These factors, paired with the presence of numerous "changeable streams" including Hollander's and Shackaminsing Creeks, made it necessary for a series of dikes to be built and the marshlands to be filled in to allow for agriculture and development (Philadelphia Water Department, 2018a). By 2017 there was little surface evidence to suggest that these areas used to be marshland, and Hollander's and Shackaminsing Creeks no longer existed. Without the healthy and complex system of streams and wetlands that once existed, flooding had become a persistent issue in South and Southwest Philadelphia.

To address issues of flooding, the City and USFWS have looked to habitat restoration. Designated by the U.S. Congress in 1972, John Heinz NWR was established to protect the last remaining tidal wetlands in Pennsylvania. It was the first urban wildlife refuge in the United States, and an extremely important part of the region's natural habitat for endangered species and migratory birds (The Delaware Riverkeeper Network, May 1, 2006). John Heinz NWR is located in Southwest Philadelphia, along the City's border, adjacent to the Philadelphia International Airport, Interstate-95, and heavy industrialization.

As the backbone of John Heinz NWR, Darby Creek required a great amount of attention as a part of the overall restoration of the refuge. Cobbs Creek, which adjoins

with Darby Creek just north of the refuge, is a part of the Darby-Cobbs Creek watershed and contributes pollutants from upstream as well. Before they reach John Heinz NWR, Darby and Cobbs Creeks have traveled through miles of its urbanized watershed that has been altered with heavy industrialization and general residential and commercial development. With these alterations come water pollution from industrial wastes, habitat loss and restructuring, and CSO discharges (The Delaware Riverkeeper Network, May 1, 2006). Community groups like The Delaware Riverkeeper Network, Darby Creek Valley Association, Darby-Cobbs Watershed Partnership, and Friends of Heinz Refuge have formed in response to restoration of John Heinz NWR and the Darby-Cobbs watershed (Darby Creek Valley Association, 2005; The Delaware Riverkeeper Network, May 1, 2006).

The refuge has been added to a network of 14 urban wildlife refuges in the United States. Through the Urban Wildlife Refuge Partnership network, Philadelphia and USFWS seek to reconnect City residents with natural spaces and providing educational opportunities for the public to learn about the importance of habitat restoration (U.S. Fish and Wildlife Service, 2016). The goals of the Partnership are to be a "multifaceted community engagement program, which includes innovative hands-on programming at John Heinz NWR, schools and neighborhoods, engaging Philadelphians in conservation action" (U.S. Fish and Wildlife Service, 2016, p. 1). Youth and underrepresented portions of the community are particularly important audiences for these programs as new generations and the diverse populations in the Darby-Cobbs Creek watershed are needed

to become environmental stewards of John Heinz NWR (U.S. Fish and Wildlife Service, 2001; U.S. Fish and Wildlife Service, 2016).

While Green City, Clean Waters continues to expand the number of GSI projects across Philadelphia to decrease stormwater runoff, John Heinz NWR addresses issues of habitat restoration to combat flooding caused by climate change and sea level rise. Philadelphia will need to continue to utilize both strategies to make significant headway in combatting flooding and environmental issues caused by stormwater runoff.

DISCUSSION

The Philadelphia Water Department (PWD) has been very successful at reaching, and surpassing, its goals for reducing stormwater runoff and increasing greened acreage across the City of Philadelphia (Philadelphia Water Department, October 30, 2016), but there is room for significant improvement in achieving its goals for community involvement and citywide sustainability as Green City, Clean Waters continues.

Community-based groups and programs like Passyunk Square Civic Association (PSCA), Wild West Philly, and PowerCorps PHL are a valuable resource for the PWD in connecting with the community, planning new green stormwater infrastructure (GSI) projects, and recruiting participants for Soak It Up! Adoption and Rain Check. These groups and programs assist the PWD with educating the community, getting more people interested in environmental stewardship, and finding people to do the work that is required to reach the goals of Green City, Clean Waters.

There is a network of watershed partnerships already established between the PWD community groups through Philadelphia's seven watersheds. New and struggling community groups like Wild West Philly need support to join and stay a part of the network. Each community group helps PWD to better understand the needs of the City's neighborhoods and may need extra support.

By supporting the community's connection with nature through opportunities for learning about habitat restoration and stormwater management, volunteering, and stewardship, Philadelphia is strengthening its adaptability as an urban space (Gray, 2003;

Perales Monparler et al., 2015). Prioritizing adaptability and sustainability will help the City become more resilient (Walker & Salt, 2006; Holling, 1973).

Urban redevelopment has the potential to shift the demographics of surrounding neighborhoods. Urban renewal causes gentrification because it seeks new capital and new development of commercial and residential spaces that overshadow existing spaces. Neighborhood redevelopment, including new businesses, housing, and public services like GSI are meant to "improve" space and quality of life, but physical changes can cause unwanted social, cultural, and economic changes. Abrupt development can affect access to community amenities, property values, and how residents navigate space (Brownlow, 2006; Heynen et al., 2006). Prioritizing business and redevelopment interests without addressing diversity and low-income housing can lead to social injustice, marginalization, and a fracturing within neighborhoods (Barton & Tsourou, 2000; Campbell, 1996; Campbell, 2013; Brownlow, 2006; Heynen et al., 2006).

Northern Liberties, Kensington, and Passyunk Square have experienced shifts in the racial, cultural, and economic makeup of their neighborhoods. As I learned from Passyunk Square, some neighborhoods are predisposed to getting engaged in Green City, Clean Waters and wanting to participate in making Philadelphia a more sustainable city. These days, people that move to Passyunk Square might do so because they see it as a place that fosters sustainability and is a progressive exception to a majority of the rest of the City. Preferential focus on some neighborhoods can slow progress elsewhere in the City, as PSCA staff explained,

> "I think that that plays into some gentrification issues with people coming in wanting to address these very high-minded kinds of ideas when there are very basic super essential problems in neighborhoods in Philadelphia, in terms of poverty, basic maintenance of rec centers and that kind of thing" (City partner B 2016).

When City staff focus their resources on specific neighborhoods that already have a socio-economic advantage, it has the potential to slow their progress in working with other neighborhoods that need attention.

Partnering with more groups like PSCA and PowerCorps PHL to employ underserved communities, promote stewardship and green jobs, and provide more links between the PWD and community members may help reduce the negative effects of redevelopment. Expanding volunteer, educational, and employment opportunities can help the PWD and the community see reciprocal positive effects during development of stormwater management projects. Community groups seem to be excited about taking initiative and getting their neighborhoods involved, but they may lack the staff and resources to do so and could benefit from a network of PWD partners.

The foundation of urban planning is improving quality of life and sustainability for all individuals using urban space (Campbell, 1996). As it is going through redevelopment, the City needs to stay acutely aware of the potential effects new GSI projects can have to urban development. The surveys that the American Street Improvement Project Team distributed to community members attending the open houses in Kensington were intended to keep the team abreast of demographics and community interest. This strategy can help tailor planning to the complex needs of the community as

demographics shift and help planners evaluate how changes to neighborhoods may benefit some but not all people (Heynen et al., 2006; Prior, 2015).

Demographic "spatial segregation" of a neighborhood, or portion of one, can occur when there is a divide in how different races, classes, or another demographic subset receive different access to benefits (Brownlow, 2006). For example, Elmwood has not benefitted to the degree that other neighborhoods have. Large-scale flooding caused by precipitation, ground saturation, and sea level rise are complex issues that Elmwood is struggling with. Elmwood is not alone in its struggle, but its socio-economic status has placed a disproportionate burden of dealing with flooding on the neighborhood, which can be considered an ecojustice issue (Plumwood, 1998). Of the case studies I have presented, Elmwood has experienced the most dramatic demographic shift from predominantly Caucasian to African American and has one of the lowest median incomes across Philadelphia. As environmental hazards increased, the Caucasian population had the means to move to more expensive neighborhoods in Center City, the edges of North Philadelphia, and the suburbs. As a result, Elmwood's social distinction as an underserved portion of the community has grown.

Marginalization has led to Elmwood's distrust of City government. Like Elmwood, Girard Estates has expressed its distrust in City government to properly address their needs. Residents voiced their dissatisfaction with trash cleanup, anger at parking spaces being taken away by GSI projects, and a concern for safety with undeveloped and neglected commercial property in the neighborhood. The PWD also

failed to communicate sufficiently with the neighborhood on the scheduling of the meeting.

Going forward, the PWD can mend their relationship with Elmwood and Girard Estates by finding more effective ways to inform people of community meetings, providing an open space for residents to feel heard and respected, and giving them opportunities to participate and collaborate in the planning of GSI projects. It is especially important for the City to identify other neighborhoods that are experiencing similar challenges and allocate additional resources for outreach there.

The City must find more effective ways to build trust and allow concerned residents to take ownership, so they feel heard, included, and in control of their neighborhoods (Smock, 2004). Continual education about Green City, Clean Waters, Philadelphia's water infrastructure system, and the importance of GSI for drinking water quality and environmental protection may help ease concerns. The level of trust between the City and the community appears to vary amongst the case study neighborhoods. It is the City's responsibility to provide quality outreach to all neighborhoods, regardless of location, demographics, pre-existing resources, and current level of community interest. Training PWD staff to have a broad knowledge of issues that neighborhoods across the City may be struggling with could improve their ability to provide quality outreach. Doing so could foster openness and transparency, which are key to building trust (Curtin, 2015; Plumwood, 1998; Putnam & Feldstein, 2003).

One of the steps that Philadelphia has taken to increase public participation in GSI projects and sharing of knowledge with City government is creating a "City of

Philadelphia Green Streets Design Manual" for public and private use (Philadelphia Office of Transportation and Utilities, February 11, 2014). In a "Letter from the Deputy Mayor," the Deputy Mayor for Transportation and Utilities encouraged interagency collaboration within City government, and leadership from "community groups, developers, and City staff" to create something with the help of the manual (Philadelphia Office of Transportation and Utilities, February 11, 2014). While it is unclear how effective the manual has been at involving the public, it did open doors of opportunity for collaboration and sharing of knowledge.

Systematically making community input the first step in the design of new GSI projects puts the community in a position of power. Standardizing procedures for the City to seek community feedback as the project begins, will likely mean fewer changes required to adjust management decisions in the future; therefore, creating a more resilient plan. Considering the broad scope and ambitious goals of Green City, Clean Waters, efficiency will also be important over the remainder of the 25-year plan.

Some of the GSI plans under Green City, Clean Waters are large-scale, multi-element projects that consist of public and private, as well as residential and commercial interests. The American Street Improvement Project and the Big Green Block in Kensington, and Smith Playground and Ralph Brooks Park in South Philadelphia required a collaborative planning effort and funding from an array of public and private sources. Particularly in the revitalization projects for Ralph Brooks Park and Smith Playground, it was important for them to be community-led. Financial support for the Make the World Better Foundation came from a large group of public and private

contributors, and Connor Barwin's celebrity helped spark interest in the revitalization projects, but community needs came first before funder and developer goals.

Successful project management in these instances must include collaboration, a unified set of goals, and flexibility for addressing development challenges, as well as opportunities for the community to take positions of leadership (Curtin, 2015; Gray, 2003; Karvoven, 2011; Rossi, 2015). As Green City, Clean Waters expands across the city, the PWD has collaborated with other City departments, community organizations, and private donors to assist with constructing and funding GSI projects. Collaboration with the community has been particularly important for building interest, educating the public, and finding more hands to get the job done (Curtin, 2015; Rossi, 2015; Karvoven, 2011; Gray, 2003).

Climate change and increased precipitation are not only causing stormwater management issues in Philadelphia but the expanding issue of flooding as well. Flooding throughout Philadelphia is caused by a combination of environmental issues, including tides and storm surges, a high water table, loss of open space, and urban development (ICF Incorporated, L.L.C, August 1, 2014; Philadelphia Office of Transportation and Utilities, 2014). Naturally occurring tidal cycles have been affected by sea level rise which has exaggerated high tides (ICF Incorporated, L.L.C., August 1, 2014; The Delaware Riverkeeper Network, May 1, 2006; U.S. Fish and Wildlife Service, 2001). Throughout its history, Philadelphia has done a poor job of protecting its systems of streams and wetlands. Since the 18th century, Philadelphia's once abundant wetland habitats have been reduced to a single area that is no longer able to provide the ecosystem

services more extensive wetlands once provided (Boyer et al., 2010; U.S. Fish and Wildlife Service, 2001).

The City is now placing much greater value in its remaining natural spaces and the ecosystem services they provide in flood prevention, storm buffers, and water filtration. The City's approach to managing flooding is becoming more dynamic over time. Starting with GSI and programs like the Basement Protection Program (BPP) to offset stormwater runoff and flooding from sea level rise and overdevelopment, the City is looking towards broader scale low-impact development and habitat restoration as long-term solutions (Philadelphia Office of Sustainability, November 2, 2016; Philadelphia Water Department, June 1, 2011; Philadelphia Water Department, February 3, 2016).

Resilience theory indicates the importance of diversity and redundancy for allowing ecological systems to adapt to change (Holling, 1973). As it strives to become a more sustainable city and to address its flooding issues, Philadelphia is working towards becoming more resilient to environmental change. By taking a multi-faceted approach to water system management, including a partnership with the U.S. Fish and Wildlife Service's (USFWS) John Heinz National Wildlife Refuge (John Heinz NWR), Philadelphia is recognizing the fact that tidal zones are dynamic and require adaptive management plans to account for fluctuations and uncertainties (Karvoven, 2011; Randle, 2016; Dorworth & McCormick, 2015).

To form a fuller picture of how successful the PWD has been at addressing community involvement and citywide sustainability in Green City, Clean Waters across Philadelphia, I would conduct additional research. First, I would do interviews with more

community organizations that collaborated with the PWD, individuals participating in Rain Check and Soak It Up! Adoption, residents of more neighborhoods in West Philadelphia experiencing flooding, and John Heinz NWR staff working on flood management. Second, I would expand my data to include neighborhoods that are in portions of Northwest and Northeast Philadelphia that are further from Center City, to get a broader representation of data. Third, I would follow up with the PWD to get additional survey results from the American Street Improvement Project open houses, as well as other demographic data that the PWD has collected in conjunction with Green City, Clean Waters. I would also do more detailed research on how demographics have shifted across the city, including census data from subsequent years following my initial research to see how neighborhood demographics are continuing to shift.

RECOMMENDATIONS FOR IMPROVEMENT TO GREEN CITY, CLEAN WATERS

Throughout my analysis here, I produced a variety of recommendations for how the City of Philadelphia and the Philadelphia Water Department (PWD) can improve the Green City, Clean Waters plan for achieving greater community involvement and citywide sustainability. I broke these recommendations down into categories to highlight themes in the primary feedback that I received from City staff and community members (Table 3). Recommendations include more dynamic strategies for public outreach, and upgrades to how the City uses phone calls, their website, and social media to connect with the community. Helping community groups facilitating green stormwater infrastructure (GSI) to network with one another will help to get more work done at the community level. By connecting with peer government organizations in and out of Philadelphia, the PWD can develop more effective stormwater management plans and self-evaluate Green City, Clean Waters as it progresses. Putting a greater focus on large-scale habitat restoration to address flooding, and using the momentum and success that Green City, Clean Waters has had thus far will help to expand sustainability across Philadelphia. The categories are also closely related and should be considered as a part of a broader, interwoven plan of action.

Dynamic Public Outreach

More dynamic methods of public outreach, that allow the PWD to be adaptable, are needed to address stormwater management issues. Community engagement should

Table 3. Recommendations for how the City of Philadelphia and the Philadelphia Water Department (PWD) can improve Green City, Clean Waters for achieving greater community involvement and citywide sustainability.

Recommendation	**Description**
Dynamic public outreach	Outreach efforts could include a broad set of topics beyond green stormwater infrastructure (GSI) (e.g. crime, employment, education, property values, culture, and history) to more effectively address community questions and concerns.
Upgrading methods of communication with the community	The PWD uses landline phone calls and mail as the primary methods for communicating with the community, which are becoming increasingly outdated. Finding ways to use the internet, social media, emails, and texting could improve communication.
Community group networking	Building networks for community groups partnering with the PWD could build stronger relationships between the City and the community and provide a way for community groups to connect and share resources.
Connecting with peer organizations	Connecting with peer organizations could give the PWD opportunities to learn new strategies for stormwater management, sustainability, and government-community collaboration.
Self-evaluation of progress	Due to the large scale of Green City, Clean Waters, the PWD should take initiative in evaluating not only the technical goals of the plan but how community involvement and socio-economic issues are progressing as well.
Large-scale habitat restoration	The City should form partnerships with federal entities and community groups to set goals for habitat restoration in order to strengthen wetlands and stream systems, reduce flooding, and increase overall sustainability and resilience.
Building momentum for citywide sustainability	The PWD has made significant progress in achieving its goals for Green City, Clean Waters, and they should use this momentum to be able to continue its success over the remainder of the plan. They will need to prioritize innovation, adaptation, and collaboration to do so.

overlap with other aspects of the plan, so cross-training of PWD staff should happen, especially with public affairs and outreach staff that are acting as a bridge between the community and the PWD. Issues that are raised while managing stormwater span from crime, employment, and education to property values, culture, and history. Outreach staff need to have a broader knowledge of the City's *Greenworks* sustainability plan, while focusing on specific issues that a given neighborhood is struggling with. Residents are very aware of what is happening in their neighborhood on a daily basis, and PWD staff need to make a better effort to look at planning and management issues from that viewpoint. Having PWD staff be able to reconcile the goals of Green City, Clean Water and what the reality of resources, education, and involvement are in the community will make them better prepared to serve the community.

Restructuring community meetings to be more like the American Street Improvement Project open houses in Kensington could attract more community members. The American Street Improvement Project is unique in that it is covering a large area of redevelopment, but elements of how the open houses were run could increase turnout to other meetings. Open houses give more of the community a greater window of time to attend meetings. They are more interactive, allowing the public to mull over the project and consider what needs they would like to have met. Open houses also include a team of representatives and stakeholders from different City departments that can address a broader range of questions and concerns more accurately.

Beyond community meetings, PWD maintenance workers that spend a majority of their time out in the field are a valued part of Green City, Clean Waters, and they could

potentially be an even greater resource for connecting with the public. Maintenance workers, like the ones that I spoke with, get opportunities to interact with the public while they are in the field doing their job, but they are often too busy to attend GSI community meetings. They explained to me that their supervisor keeps them abreast of what is discussed at community meetings and what to expect when visiting new GSI sites. As they spend time in the field, they are representatives of the PWD that are exposed to community feedback on a regular basis and can get more frequent updates on the status of individual GSI projects.

Upgrading Methods of Communication with the Community

The technology the PWD utilizes to stay in touch with the community is due for some upgrades. It is becoming increasingly uncommon for people to still have landline phones, using a cell phone as their primary home phone number instead. Cell phone numbers are not readily available like landlines are, so the PWD should experiment with ways to use the internet, social media, emails, and texting to maneuver around this obstacle. Surveying residents about their preferred methods of communication may help the PWD get a clearer idea of how to more efficiently contact residents.

The Green City, Clean Waters website contains a wealth of interesting and helpful information about the plan, including ways to get involved and contact the PWD, but the website could be more user friendly. It is great that the PWD is sharing lots of information with the public, but the website is very wordy and navigating it can be overwhelming. It is difficult to find concentrated information about GSI projects in

specific neighborhoods and get updates on the progress of projects. In my own navigation of the website, I discovered broken or out-of-date links. PWD staff have also expressed their dissatisfaction with the site and have mentioned that a revamp to make it clearer and more accessible is in the long-term goals for the plan.

The PWD also has a presence on social media platforms including Twitter, Instagram, and Facebook. They post frequently about river cleanup events, volunteer opportunities, and how to get involved in GSI projects. Social media is a central component to how many people discover news and events, so it is important that the PWD stays active on these platforms. Where they can go further is partnering with peer organizations that are utilizing social networks and working towards similar goals of increased sustainability throughout Philadelphia.

Community Group Networking

Neighborhood associations can provide a wealth of knowledge about how development is affecting culture, safety, demographics, and economics, and the best ways to work with community members to reconcile differences of opinion between what the City is planning and what residents want and need.

Networks for small-scale community groups like Wild West Philly that are involved in environmental education and stewardship would also be beneficial for the PWD in delegating planning and maintenance and creating longer-lasting relationships with community partners. It was not obvious to me during my interviews with PWD staff which community leaders and organizations are getting involved in Green City, Clean

Waters. Community groups are the gateway into neighborhoods and can assist with scheduling community meetings, discovering the wants and needs of neighborhood, and finding participants to get work done. The PWD can learn from more groups like Passyunk Square Civic Association (PSCA), PowerCorps PHL, and Wild West Philly how to better collaborate with and learn from the community. Residents want to take initiative and ownership of their neighborhoods, and the City should support them accordingly.

Connecting with Peer Organizations

Outreach to peer organizations and other cities' water departments could help expand the sharing of information and strategies for more successful stormwater management, sustainability, and government-community collaboration. This could include finding City funds or grants for PWD staff to attend GSI conferences like the Grey to Green Conference in Toronto, the Great Lakes & St. Lawrence Green Infrastructure Conference in Detroit, and the Operation & Maintenance of Stormwater Control Measures Conference in Denver. Networking and learning from other cities can strengthen Green City, Clean Waters. One of the PWD Planners that I spoke with had attended a low-impact development (LID) conference in Portland, ME that attracted representatives from cities across the country and from abroad interested in sharing information about GSI. Not every city using LID strategies for utility management is utilizing GSI and working with the community the same way that the PWD is. Sparking dialogue with other cities that can learn from Philadelphia can also create opportunities

for Philadelphia to learn new strategies in turn. Philadelphia has hosted forums for discussion of LID, and they should look for more opportunities to have more of these events.

Self-evaluation of Progress

As Green City, Clean Waters progresses, and the PWD meets its goals, it might become easy to be distracted by the successes and overlook the areas that need improvement. Facilitating a 25-year long plan is a complicated task with many moving parts, and one of those parts should be self-evaluation. The Environmental Protection Agency (EPA) and Pennsylvania Department of Environmental Protection (PA DEP) are the overseers of Green City, Clean Waters, but the PWD should give themselves the task of evaluating how they are addressing community engagement, education, and socio-economic issues related to stormwater management.

To prevent demographic shifts and ensure that education, participation, and communication are options for all socio-economic groups, the PWD can monitor community use of the space and continue to collect feedback on what the community wants out of the space. If the PWD stays cognizant of these occurrences, Green City, Clean Waters can have a broader reach, avoid overlooking struggling neighborhoods, and more efficiently allocate their resources.

A way to evaluate trends is to continue conducting studies and surveys in conjunction with local colleges and universities to learn more about GSI and community involvement in Green City, Clean Waters. Keeping track of the demographics can give

the PWD an idea of who is primarily participating in Green City, Clean Waters so that it becomes clearer over time what trends are forming and parts of the City that need more attention. The studies can act as quality control and assess the progress of Green City, Clean Waters from a variety of foci. The City already has a number of projects with Temple University, University of Pennsylvania, Drexel University, and Villanova University. A PWD Planner spoke to their work with Temple,

> "They were working on a development master plan...so we integrated ourself into that project and made sure there was a stormwater component to that. We check in with them to see if there are places we can help with the master plan...There are lots of minds working with us to come up with solutions and tweaking the standard practices that we use now. We're constantly trying to adapt our program, which I think is really interesting" (City staff person G 2016).

The evaluation process can be dynamic, with the involvement of the EPA, the PWD, universities, and community, and provide positive opportunities for educators and researchers. Surveys will assist with keeping track of the demographics of the community members participating. Gaps in who the project is reaching can be identified and given more attention.

Despite the success of the first five years of the plan, future planning and management strategies should resist fully trusting in its success without properly evaluating the details of the process and looking for improvement. Green City, Clean Waters is an extensive plan and the timeline is long. As time goes on, it may become easier to lose sight of the work that has been done earlier on in the 25-year span of the plan. Self-reflection will help the PWD remain open about their progress with Green City, Clean Waters and foster trust between them and the public they are serving.

Large-scale Habitat Restoration

John Heinz National Wildlife Refuge (John Heinz NWR) is a unique part of Philadelphia and an asset to a city, like a lot of large port cities, that has heavily fortified its riverbanks with concrete, brick, stone, and metal. Wetlands are naturally a protective ecological feature that strengthen marine habitats, provide key habitat for animals and plants, filter water, and act as a buffer during fluctuating tides and storms (The Delaware Riverkeeper Network, May 1, 2006; Beatley & Brower, 2002). They have the potential to regain their proper function if U.S. Fish and Wildlife Service (USFWS), John Heinz NWR and the City continue to set goals for habitat restoration, as well as education and reconnection between Philadelphia residents and the City's natural spaces. Partnering with the USFWS also allows the PWD to benefit from the more expansive financial resources of a federal agency.

Restoring wetlands and reducing flooding in the face of climate change are huge challenges for the City and it is becoming clearer that resilience will not be achieved through engineering alone. The work of the PWD, John Heinz NWR, and community partnerships like The Delaware Riverkeeper Network focus on making diversity and community an integral part of their plans for greater sustainability in the management of the combined sewer system (CSS) and GSI, wetland habitats, and the City's remaining stream system.

Looking beyond Green City, Clean Waters, it is imperative that flooding and environmental restoration throughout Philadelphia are also tackled by a range of City

entities, including not only the PWD but the Philadelphia Horticultural Society (PHS), Streets Department, Parks and Recreation, EPA, PA DEP, USFWS, among others. Habitat restoration and use of space throughout the City will need to be viewed through similar lenses in order to achieve lasting effects and manage flooding on a greater scale for the long-term.

Building Momentum for Citywide Sustainability

Public affairs staff that I spoke with consider the level of investment that the PWD has put into water utility management to be unusual. Continuing to be unusual can be a positive decision for Philadelphia's future. The PWD has made a lot of progress with Green City, Clean Waters thus far, but a lot will need to happen to ensure that this momentum can persist. The PWD will need to continue to be innovative, adaptive, and open in their management of stormwater to meet their goals over the next 20 years.

Green City, Clean Waters seems to be having an increasingly positive effect on Philadelphia, its water quality, and spaces for community involvement and community-building, but there are still some roadblocks to community ownership. PWD outreach and public affairs staff that I interviewed made it a point that they are prioritizing the community to the greatest extent of their abilities, but they are still ultimately beholden to the EPA's regulations.

Trusting the community to take ownership of their Soak It Up! Adoption sites and make them their own in terms of plant inputs and customizing them to the aesthetics of a given neighborhood. Soak It Up! Adoption grants are supposed to give the grantee the

freedom to spend the money as they see fit. If a certain set of rules is mutually agreed upon to satisfy the needs of the PWD while allowing the community to take ownership, this could be a positive way to allow residents that are particularly interested in maintaining GSI sites to be able to do what they envision.

Taking what makes Philadelphia's management of stormwater unique and celebrating it can help to encourage more input throughout the future of Green City, Clean Waters. The primary purpose of Green City, Clean Waters is to satisfy the EPA and achieve compliance with the Clean Water Act (CWA), but so much more can be achieved. The PWD should see Green City, Clean Waters and what the EPA has mandated as a gateway to further opportunities for Philadelphia to become a more dynamic, resilient, adaptive, diverse, sustainable, progressive city. It can become more sustainable not only in its management of stormwater but in energy use, waste reduction, transportation, and availability of green jobs. Employment opportunities in green industries will be beneficial not only to City government, but commercial and residential interests as well. The City has the momentum to transform Philadelphia into an example of sustainable urban space and how City government and City residents can collaborate to achieve this designation.

CONCLUSION

The City of Philadelphia and Philadelphia Water Department (PWD) have experienced successes and setbacks in the first five years of the Green City, Clean Waters plan. They are surpassing the goals that have been set for reducing stormwater runoff and increasing greened spaces across the City, but there remains a lot of room for improvement in their goals for community involvement and citywide sustainability.

The foundational steps for the success of Green City, Clean Waters have been made with community meetings, Rain Check, Soak It Up! Adoption, and partnerships with community groups to educate the public and encourage participation. Despite these successes, my analysis highlights insufficiencies in addressing resilience through reconnecting society and nature, social justice in urban redevelopment, restoring community trust in government, collaboration with diverse stakeholders, and stormwater management and sea level rise response.

To address these insufficiencies, I recommend that the PWD consider adding and expanding on dynamic public outreach, upgrading methods of communication with the community, community group networking, connecting with peer organizations, self-evaluation of progress, large-scale habitat restoration, and building momentum for citywide sustainability in their future implementation of Green City, Clean Waters.

Green City, Clean Waters is a massive plan with ambitious goals, and it is difficult to address issues on such a large scale. The goals of Green City, Clean Waters are impressive, and it will take a continual citywide effort to achieve them. It is the

responsibility of the PWD to address issues of social inequality and community involvement to the best of their ability and strive to make them priorities throughout the 25-year span of the plan, and well beyond its completion. They need to keep pressure on themselves and the City to ensure that community involvement remains top priorities as Green City, Clean Waters progresses over the next twenty years.

The Green City, Clean Waters and the City's umbrella *Greenworks* sustainability plan has a lot of potential for transforming the City socially, economically, and environmentally. To achieve the shift in the overall mindset, the community needs to be able to put their trust in City government. It is the City's obligation to be open, transparent, and create an environment that allows the community to share that trust. Furthermore, the City must provide the community with education, resources, and opportunities to participate. As they celebrate five years of success and look forward to the progress and possibilities that can be made over the next twenty years, the City and the PWD need to be self-reflexive and hold themselves to the highest standards of equality, collaboration, engagement, and innovation.

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APPENDICES

APPENDIX A

APPENDIX B

Consent Form

Before you decide whether or not to participate in this interview process, please take time to read the following form and ask any questions you may have regarding this information and the interview process.

Purpose of the project: I am a graduate student in the Environment & Community M.A. program at Humboldt State University in Arcata, California. My goal is to learn more about how the City of Philadelphia has incorporated stakeholders such as local residents and businesses and community organizations in green stormwater infrastructure project planning and implementation. Public involvement and education can be important to achieve greater acceptance and implementation of green infrastructure projects that foster long term community resilience. Your participation would provide valuable information that can be used to inform future implementation and management decisions.

What I will ask you to do: I will ask you to have a conversation with me about your involvement in green stormwater infrastructure in Philadelphia, as well as your perceptions and opinions of the extent to which the community should have a say in green stormwater infrastructure, if you feel that the community has been given ample opportunities to participate, and any changes you would like to see happen. The interview will take place at a mutually agreed upon location. The duration will be approximately 1 hour.

Risks and benefits: I do not anticipate any risks, but feel free to let me know of any concerns you may have before, during, or after the interview. The level of confidentiality of your participation will be dependent on the option chosen below. There will be no compensation for participating, although I greatly appreciate your input. Your interview will greatly benefit my research.

__ I may be quoted directly and cited by name.
__ I may be quoted directly, but not cited by name. (Cited as: “resident”, “city employee”, etc.)
__ I may be quoted directly, but not cited in any way.
__ I do not wish to be quoted directly, nor have my name cited.

In addition to the option chosen above, please select any of the below options that apply.

__ I may be audio-recorded.
__ I may be photographed.

I, Julie Groff, can be contacted at jcg626@humboldt.edu or (856) 761-6868. My faculty advisor, Yvonne Everett, can be contacted at Yvonne.Everett@humboldt.edu or (707) 826-4188.

If you have any concerns with this study, contact the Chair of the Institutional Review Board for the Protection of Human Subjects, Dr. Ethan Gahtan, at eg51@humboldt.edu or (707) 826-4545. If you have questions about your rights as a participant, report them to the Humboldt State University Dean of Research, Dr. Rhea Williamson, at Rhea.Williamson@humboldt.edu or (707) 826-5169.

Thank you for your time!

Statement of Consent: I understand that participation in this study is entirely voluntary and the investigator will answer any questions from the participants at any time. I may stop participating at any time and I may decide not to answer any specific questions I do not feel comfortable answering. I have read the above information and consent to take part in this interview.

Your Signature _____ Date _____

Your Name (printed) _____

APPENDIX C

Interview Questions

Questions for City Staff or Partner Organizations

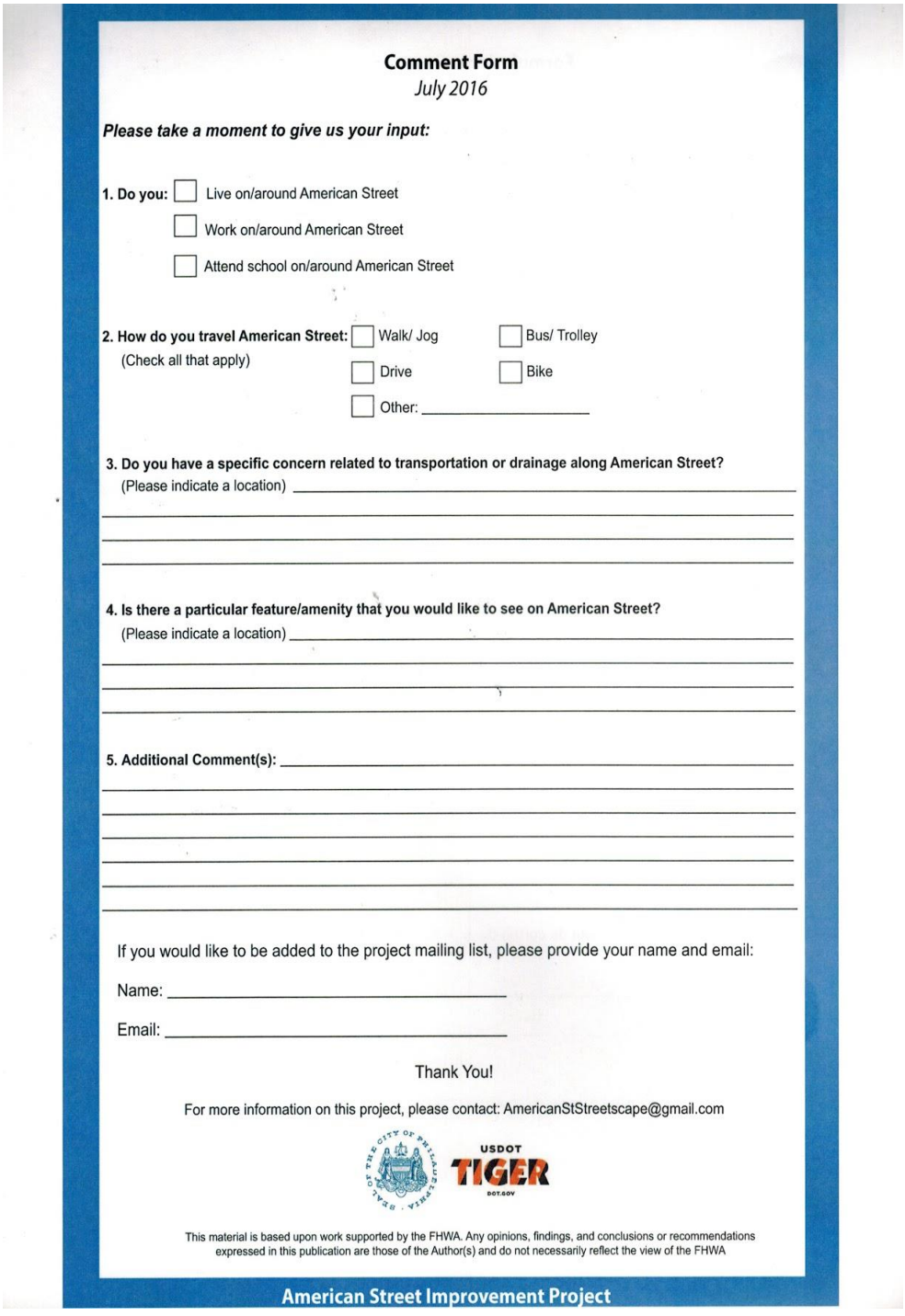
1. What is your role in the management of green stormwater infrastructure in the City of Philadelphia?
    a. What challenges to implementation and management of green stormwater infrastructure projects have you experienced?
2. In your opinion, how successful has the implementation and management of green stormwater infrastructure projects been?
    a. Are there any changes that you would like to see made?
3. What factors go into the City's determination of where to implement green stormwater infrastructure projects?
4. How are green stormwater infrastructure projects funded?
    a. Is funding allocated to certain neighborhoods?
    b. Is funding prioritized for residential or commercial areas?
    c. Have you experienced barriers to getting projects funded?
5. Where would you like to see more funding, education, and promotion go for green stormwater infrastructure projects?
6. Does the City involve the public in green stormwater infrastructure planning and implementation?
    a. If so, how?
7. Why does the City involve community/residents in green stormwater infrastructure implementation, management, and maintenance?
8. Do you feel that there are ample opportunities for the community/residents to get involved in green stormwater infrastructure projects?

Questions for Community Members and Community Organizations

9. Are you interested in becoming more involved in the implementation and management of green stormwater infrastructure?
10. Do you feel that you, your neighborhood, and your community are being sufficiently supported and encouraged to participate in green stormwater infrastructure implementation and management?
11. Are you satisfied with the decisions the City has made in using green stormwater infrastructure to address ecological and public health issues caused by stormwater runoff?
12. Has the implementation of green stormwater infrastructure projects changed how you see and identify with your neighborhood?
    a. Has it changed how you see and identity with Philadelphia as a whole?
13. Do you consider the City to be more aesthetically pleasing due to green stormwater infrastructure implementation?
    a. Have you noticed changes within specific neighborhoods?

14. What green stormwater infrastructure projects have you participated in?
    a. Have you used any in your own home or business?
    b. What results have you seen?
    c. Are you satisfied with these results?
    d. What benefits or hardships have you experienced as a result of green stormwater infrastructure in your home or business?
15. Have you participated in any public meetings or volunteer events related to green stormwater infrastructure?
    a. Who were they hosted by?
    b. Did you find them to be helpful, educational, or informative?
    c. Would you like to have greater access to public meetings or volunteer events related to green stormwater infrastructure?

APPENDIX D



Comment Form
July 2016

Please take a moment to give us your input:

1. Do you: ☐ Live on/around American Street
☐ Work on/around American Street
☐ Attend school on/around American Street

2. How do you travel American Street: (Check all that apply)
☐ Walk/ Jog ☐ Bus/ Trolley
☐ Drive ☐ Bike
☐ Other: _____

3. Do you have a specific concern related to transportation or drainage along American Street?
(Please indicate a location) _____

4. Is there a particular feature/amenity that you would like to see on American Street?
(Please indicate a location) _____

5. Additional Comment(s): _____

If you would like to be added to the project mailing list, please provide your name and email:

Name: _____

Email: _____

Thank You!

For more information on this project, please contact: AmericanStStreetscape@gmail.com

USDOT TIGER DOT.GOV

This material is based upon work supported by the FHWA. Any opinions, findings, and conclusions or recommendations expressed in this publication are those of the Author(s) and do not necessarily reflect the view of the FHWA

American Street Improvement Project