Strategic Stormwater Solutions

for Transit-Oriented Development

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for Transit-Oriented Development

Final Report

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EXECUTIVE SUMMARY

Strategic Stormwater Solutions
for Transit-Oriented Development

Executive Summary

Beginning in 2014 the Twin Cities' new Light Rail Transit "Green Line" will operate along an 11-mile track connecting the downtowns of Saint Paul and Minneapolis in Minnesota. The Green Line is expected to spur desired redevelopment along the corridor. The redeveloped corridor is envisioned as a series of healthy and vibrant neighborhoods with ample parks and open spaces. Development will be implemented using Transit-Oriented Development (TOD) guidelines and sustainable principles.

Project Focus

Governmental agencies across the country are looking for techniques to improve environmental health and community livability. Agencies are also looking for more efficient approaches to delivering community services. This Strategic Stormwater Solutions for Transit-Oriented Development report outlines a concept for shared, stacked-function green infrastructure (SSGI) – a stormwater management approach that addresses environmental health, community livability and cost efficiencies within current statutory standards. The project investigated whether stormwater management along the Central Corridor could more robustly achieve the community's redevelopment vision for the corridor.

When redevelopment occurs in established urban communities, stormwater management facilities compete with other site features for limited and valuable space. Market-driven features such as floor area or parking space are premium uses; therefore stormwater facilities are being relegated underground a vast majority of the time. Since 2011, 84 percent of redevelopment sites along the Green Line requiring stormwater management placed stormwater below ground. When this happens, an opportunity to use stormwater to create a green, sustainable and vibrant community is lost.

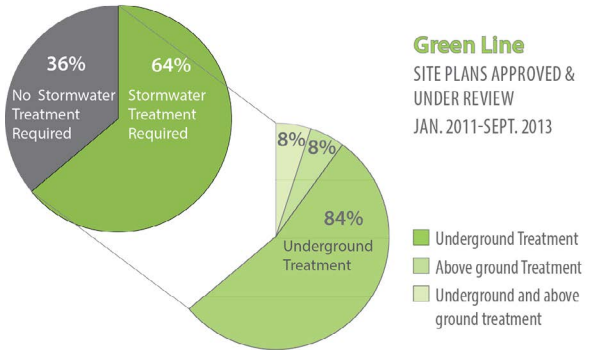
The study provides a stormwater management framework for the implementation of SSGI – a system in which stormwater runoff generated from multiple parcels is jointly treated in shared green infrastructure. The green infrastructure is located and designed to provide economic, environmental and social (triple bottom line) benefits to the community beyond treating stormwater, referred to as "stacked-function". The study also investigated how public art could highlight stormwater management and green infrastructure along the Green Line. A critical project premise was to develop strategic solutions that were fair, equitable, and provided mutual benefit to all parties involved; otherwise the solution would not be successful or replicable.

SSGI Implementation

While SSGI can be used to assist with quality delivery of TOD, the establishment of effective policies and implementation tools is critical to the successful implementation of SSGI. Proposed implementation procedures include:

Draft Policy Resolution

An initial policy resolution should highlight SSGI benefits and how it can facilitate achieving the City's adopted TOD goals. To increase policy makers' comfort with SSGI use and to refine implementation protocols, it is recommended that the resolution request authorization for preparing a feasibility study(s) and for SSGI pilot implementation.



Existing Stormwater Approach on the LRT Green Line

Perform Pilot Projects

Several pilot projects should be identified and performed for the purpose of testing and refining the SSGI implementation framework developed in this study. Prior to performing the pilot projects, engineering feasibility studies should be prepared for strategic locations along the Green Line where implementation of SSGI would achieve the City's redevelopment vision. If the pilot projects indicate that SSGI provides public and private benefits, another policy resolution authorizing the use of SSGI could be brought forward for adoption.

Revise Regulatory Framework

Current stormwater regulations differ across the cities and Watershed Management Organizations (WMO). If it is decided to move beyond pilot projects into a long-term implementation mode, existing stormwater rules and local ordinances will likely require modification. Pertinent topics (not necessarily exhaustive) to scrutinize at a finer level of detail would include on-site stormwater management, encroachments, code consolidation, and green requirements.

Institutionalize SSGI into Agency Processes

The institutionalization of SSGI into agency processes is critical to its implementation. The feasibility of SSGI should be discussed between implementing agencies and developers early in the development process, before significant time or funds are invested in developing a traditional site plan. The implementation of SSGI is not limited to the redevelopment of individual parcels. There are various scenarios that could trigger SSGI feasibility discussions, such as street reconstruction projects, replatting, or development of small area master plans.

SSGI may provide cost-efficient stormwater management for runoff from small parcels that otherwise would not receive treatment in the near future. Therefore, the development of a retrofit program that provides a process to initiate the SSGI feasibility discussion, evaluate opportunities and to identify potential funding mechanisms may be advantageous.

» *Green infrastructure is designed to enhance the urban fabric, providing economic, environmental and social (triple bottom line) benefits to the community beyond treating stormwater (referred to as "stacked-function") thereby galvanizing redevelopment.*

IMPLEMENTATION TOOLS

The successful implementation of SSGI entails the creation and use of multiple tools to educate Green Line development stakeholders about TOD benefits that can be achieved through the use of SSGI. The tools also serve to assist agencies with incorporating SSGI feasibility evaluations and implementation as standard practice. The following tools have been developed as base templates that agencies can modify to meet their agency's specific needs and goals.

» ***SSGI Assessment Tool***

The assessment tool provides a series of questions that agency staff can ask early in the development process to assess whether SSGI is a tool that can be used to further the goal of TOD for the proposed project at hand.

» ***Decision-making Flowcharts and Matrices***

At times the multitude of options and complexity of funding options can appear to be overwhelming. To assist agency staff, a series of sample flow charts and matrices templates have been developed that articulate the various funding options currently available.

» ***Pilot Project Educational & Outreach Materials***

Educational and outreach materials should be utilized to inform Green Line development stakeholders about potential pilot opportunities, if a community is interested in advancing SSGI approaches.

Findings and Conclusions

In a highly urban corridor, SSGI represents a balancing of risk, roles, and responsibilities (particularly for city departments where competing interests can exist) in the context of broader triple-bottom line benefits. Leadership from elected/appointed officials will be necessary to effectively support and advance with this strategic stormwater solution initiative. This may involve adopting resolutions, sponsoring code modifications, supporting or authorizing taxing districts, or other similar actions.

Flexibility Supports Vision

Stormwater management is currently performed on a parcel-by-parcel basis and segregated between private and non-private ownership. This is done to address mandates for on-site compliance, manage risk exposure for long-term maintenance demands, and simply due to the fact that urban parcels redevelop in a sporadic manner making it difficult to coordinate shared facilities. In practice, in dense urban areas, the status quo often results in development managing stormwater underground.

Yet, there are key events such as the construction of major infrastructure projects like light rail transit that trigger concentrated redevelopment where sharing of stormwater facilities may be feasible and conducive to the creation of desired TOD. This is of particular importance for small, space-constrained, urban redevelopment parcels where numerous programmatic requirements are competing for valuable space. In these situations, flexibility could be provided in the current stormwater management approach to allow for SSGI implementation, if doing so would be beneficial in achieving the community's corridor vision of green, vibrant, sustainable neighborhoods.

Define a Process

SSGI can be successfully implemented, but will likely involve a case-by-case approach. Therefore, processes must be put in place to assess its feasibility early in the development process. Tools must also be in place to assist agency staff and developers to efficiently structure a SSGI approach that creates a balanced approach for funding and risk management. These processes and tools must be general enough to work across a variety of possible development scenarios while acknowledging many stakeholders may potentially participate.

The SSGI Assessment Tool (in combination with an outreach brochure) is essential to establish a structured dialogue to identify where a potential project may be feasible, while also maintaining baseline expectations for stormwater management.

Development Scale is Important

While there are likely more, this study identified four SSGI approaches (Parks, Parking, Alleys, and Street Right-of-Way) that successfully provide triple bottom line benefits supportive of TOD. The study indicated that several of these approaches lend themselves more strongly to a particular scale of development (.i.e., small parcels versus urban villages).

Potential for Financial Balance

Government units have broad authority and multiple options to raise revenue for SSGI costs. This will likely require significant political leadership. Yet a financially "neutral" funding source is preferable, rather than relying upon grants or general funds solely from one municipal department. A financially neutral funding source, such as a tax district, allows for greater equity and predictability by virtue of collecting funds from directly benefiting properties.

Compared to estimated costs for stormwater facilities on an individual parcel basis, SSGI estimated costs result in net capital cost efficiencies overall. However, a challenge is developing a cost recovery approach that will fairly distribute the reduced costs to all parcels sharing the stormwater facility. For example, analyses herein that allocated costs based on contributing runoff volume (or impervious surface) resulted in some parcels realizing a relative cost increase compared to stormwater management being performed on an individual parcel basis. This allocation method is just one possibility; there may be other suitable allocation methods, depending on how SSGI is approached.

Therefore, careful consideration must be given when determining funding sources and developing cost recovery approaches for SSGI to ensure a balanced distribution of costs and benefits. Specifically, SSGI implementation will place a significant emphasis on the use of development agreements, license agreements or similar formal tools to address financial and obligatory arrangements. These tools will establish acceptable requirements, fees, noncompliance recourses, and other practicalities including long term responsibilities and liability. Fees, responsibilities and liability must run with the land. As a practical matter, license agreements should first be executed to formalize these arrangements, and then be incorporated as an exhibit to a development agreement.

Be Opportunistic

Runoff from untreated, small parcels that otherwise would not redevelop (i.e. receive stormwater management) in the near future can be effectively included in SSGI projects. SSGI provides an approach to opportunistically realize "excess capacity" in stormwater treatment in a cost effective manner, which may be utilized as a banked or brokered commodity depending on regulatory frameworks. This is very useful in a corridor where overall redevelopment is very incremental (especially small sites) and public land control is very limited. This may warrant the discussion or development of a retrofit program to capitalize on these opportunities when they arise.

"The many separate initiatives designed to maximize the Corridor's potential are starting to link together in significant ways...This plan will provide a critical tool for creating the vibrant, green and sustainable spaces envisioned in the station area plans-- while improving the quality of the Mississippi River."

-Mayor Christopher B. Coleman letter to Stakeholder Advisory Committee, August 2012.

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STRATEGIC STORMWATER SOLUTIONS for Transit-Oriented Development

Introduction Chapter 1

» Corridor Redevelopment Goals
» Stormwater Agencies and Initiatives along the Corridor
» Project Focus

Beginning in 2014 the Twin Cities' new Light Rail Transit "Green Line" will operate along an 11-mile track connecting the downtowns of Saint Paul and Minneapolis in Minnesota (see Figure 1.1). This Light Rail Transit (LRT) corridor is host to a wide variety of land uses including the two highly urban downtown cores, the Minnesota State Capitol, the University of Minnesota Twin Cities Campus, industrial and retail uses, and multi-family and single-family residences. A vast majority of the corridor is covered with impervious surfaces and there are few parks or green spaces. The corridor also hosts a wide range of socio-economic conditions and is a key gathering location for, and home to, a diverse array of ethnic communities, creating a rich cultural resource for the community. A change in development patterns in the Twin Cities and introduction of Transit-Oriented Development (TOD) guidelines will foster continued growth, bringing a strong need for additional open space to serve increased density.

Corridor Redevelopment Goals

Sixty percent (6.2 miles) of the Green Line lies within the municipal boundaries of the City of Saint Paul. The other 40 percent (4.8 miles) of the Green Line lies within the City of Minneapolis. The University of Minnesota Twin Cities campus comprises one mile of Minneapolis' 4.8-mile segment. As these agencies have planned for this new LRT line, the implementation of TOD emerged as a primary redevelopment goal for the corridor.

The Center for Transit-Oriented Development provides the following definition of TOD:

Transit-oriented development is often defined as higher-density mixed-use development within walking distance – or a half mile – of transit stations. Transit-oriented development projects should also:

› Increase "location efficiency" so people can walk and bike and take transit

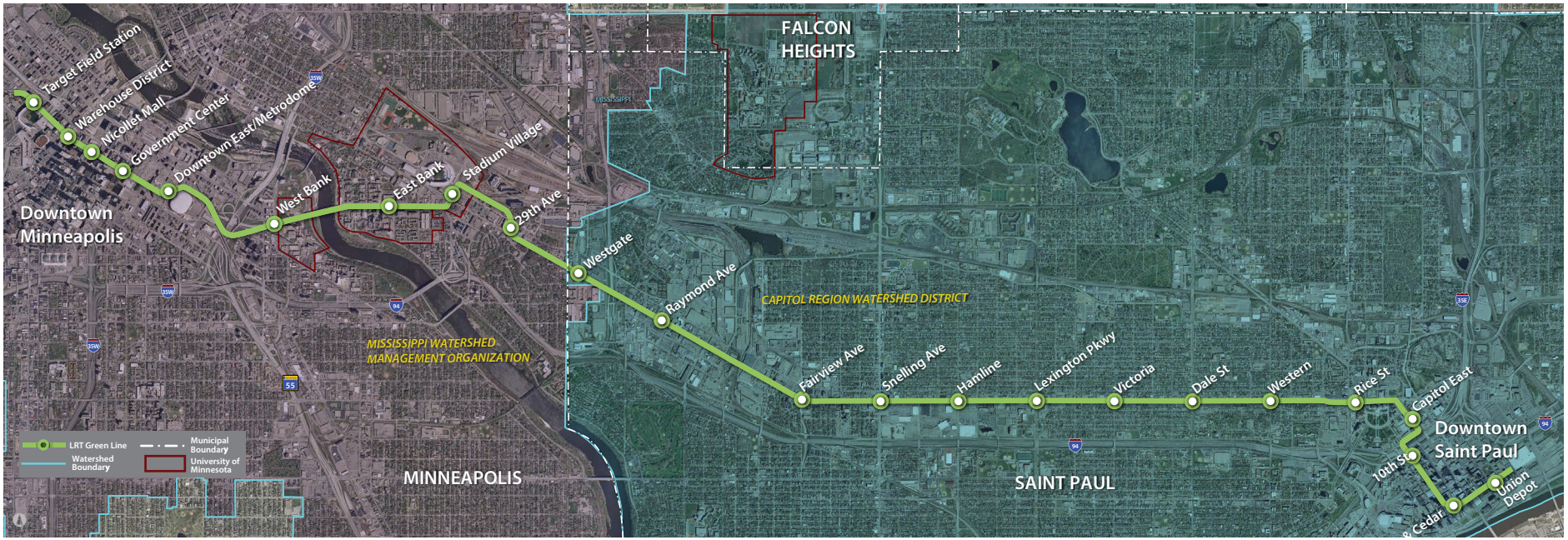


Figure 1.1 Corridor Map

- Boost transit ridership and minimize traffic
- Provide a rich mix of housing, shopping and transportation choices
- Generate revenue for the public and private sectors and provide value for both new and existing residents
- Create a sense of place
- TOD is really about creating attractive, walkable, sustainable communities that allow residents to have housing and transportation choices and to live convenient, affordable, pleasant lives—with places for our kids to play and for our parents to grow old comfortably.

In essence, TOD enhances livability. For the purposes of this report, these two terms will be used interchangeably.

Saint Paul

Traversing the corridor from east to west, the Saint Paul segment of the corridor starts in, and runs through, the heart of downtown Saint Paul, past the Minnesota State Capitol, and then follows University Avenue to the western municipal limits. Numerous parcels along University Avenue are currently underperforming and are ready for redevelopment. With 14 of the 18 new stations along the Green Line lying within the Saint Paul municipal limits, the City and partnering organizations have been activity planning for anticipated redevelopment along the line.

Previous City-led planning efforts highlight the community's desire for TOD, an increase in the number of parks and open spaces along the corridor, and the use of green infrastructure. (Note: The "Green Line" was formerly referred to as the Central Corridor before official branding of the LRT.) These previous efforts have continued to build upon each other (see Figure 1.2) and include the following plans and studies:

- *Central Corridor Development Strategy plan (2007)*
- *Central Corridor station area plans (10 plans for stations along University Avenue; plus, one plan addressing all of the downtown stations) (2008)*
- *Mitigating the Loss of Parking in the Central Corridor study (2009)*

These City adopted plans call for the evaluation and revision, if appropriate, of existing policies such as stormwater management to better support the City's vision for the corridor. Additional efforts to facilitate desired development have included:

- Creation of the Traditional Neighborhood T4 Zoning District and updates to other Traditional Neighborhood Zoning Districts to facilitate higher density development, reduce parking demand, and create a more pedestrian- and transit-oriented environment.
- Rezoning of parcels along the corridor.
- Publication of a Transit-Oriented Development Guidebook.
- Establishment of a Design Center organization to facilitate early development review discussions.

Figure 1.2 Saint Paul Corridor Planning Efforts

In addition to the previous planning and zoning efforts, and concurrent with this plan, a park creation analysis is underway. The Minnesota Chapter of the Trust for Public Land, with participation from city partners, is spearheading the "Green Line Parks and Commons Initiative."

Minneapolis

From east to west, the City of Minneapolis' segment of the Green Line traverses University Avenue, the University of Minnesota campus and downtown. The City is experiencing significant redevelopment activity within, and adjacent to, the University. The downtown segment is also experiencing significant redevelopment as this section of the corridor is also a part of Metro Transit's Blue Line that has been operating for approximately eight years. Similar to Saint Paul, the City of Minneapolis and stakeholder organizations have been actively planning for anticipated redevelopment along the line. Previous planning efforts highlight the community's desire for TOD, vibrant and flexible

public spaces, along with environmental sustainability though the incorporation of green infrastructure and stormwater best management practices in transit–related redevelopment projects. Representative previous efforts include the following plans and studies:

- *The Minneapolis Plan for Sustainable Growth (2009)*
- *University of Minnesota East Gateway District Master Plan (2009)*
- *University of Minnesota Twin Cities Campus Master Plan (2009)*
- *Bridal Veil Subwatershed Study (2011)*
- *Stadium Village University Avenue Station Area Plan (2012)*

Stormwater Agencies and Initiatives along the Corridor

New TOD projects are expected to meet current stormwater treatment regulations. Stormwater requirements along the corridor are currently met on a parcel-by-parcel and a project-by-project basis with stormwater regulations varying based on jurisdictional standards and site size. As depicted in Figure 1.1, the Saint Paul segment lies within the jurisdiction of the Capitol Region Watershed District (CRWD), while the Minneapolis segment of the Green Line lies within the jurisdiction of the Mississippi Watershed Management Organization (MWMO). Both watershed organizations have a regulatory role as well as an advocacy and partnering role for stormwater management. Reducing stormwater runoff pollution and volume is emphasized.

Figure 1.3 Green Infrastructure on the Green Line Source : Capitol Region Watershed District

Several communities nationally are exploring "green infrastructure" in response to federal (Consent Decree) requirements for reducing wet weather flows to combined sewer systems. That driver is not a significant local issue because Saint Paul operates a fully separated stormwater system and Minneapolis has predominantly separated their stormwater and sanitary sewer systems. Nevertheless, Saint Paul and Minneapolis are both Phase I permittees under the National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) program. Both communities overall are required to control pollutants from the municipal separate storm sewer system and, as noted above, have in response developed programs to reduce pollution from public and private projects. Creatively implementing green infrastructure can provide multiple functions in a space-constrained environment. A creative approach would maintain reduction of urban runoff impacts while enhancing public realm livability and attracting investment and redevelopment. An exemplary first step towards green infrastructure along the corridor

occurred with the construction of the Green Line itself. The City of Saint Paul and partnering agencies collaborated to construct a stormwater "tree trench" system almost five miles in length on both sides of the light rail. This system was proposed as an innovative solution for meeting stormwater rules administered by CRWD. Runoff from the public right-of-way is used to irrigate 1,200 newly installed street trees along the corridor. This outcome resulted from viewing runoff as a resource that could be used to support environmental health and overall livability. Not only will this water support the long-term health and vitality of the urban forest, it will also reduce the quantity, and improve the quality, of water reaching the Mississippi River. In addition, healthy and mature street trees provide environmental benefits such as carbon sequestration and reduced heat island effects, while also creating a shady, comfortable environment that is supportive of walking. Additionally, CRWD voluntarily retrofitted a dozen boulevards on cross streets along the Green Line with stormwater planters and rain gardens, to further enhance water quality and the overall streetscape as depicted in Figure 1.3.

Due to active coordination between all parties involved, this street right-of-way now successfully accommodates numerous transportation, utility, environmental and social uses. Influenced by this creative approach, the study hypothesized that stormwater could be innovatively used to achieve new community-desired, vibrant, green spaces along the corridor while still meeting stormwater regulations.

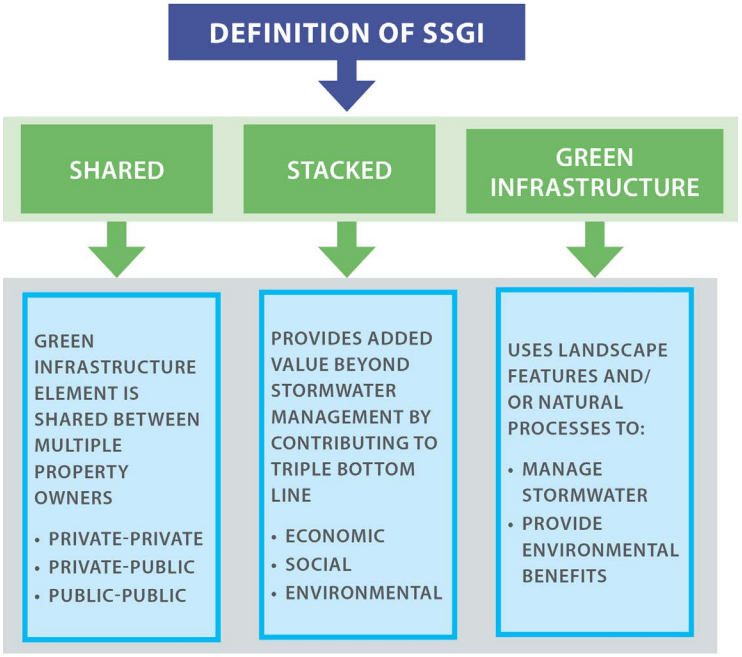


Figure 1.4 Definition of SSGI

Project Focus

Governmental agencies across the country are looking for techniques to improve environmental health and community livability. Agencies are also looking for more efficient approaches to delivering community services. This Strategic Stormwater Solutions for Transit-Oriented Development report outlines a concept for shared, stacked-function green infrastructure (SSGI) – a stormwater management approach that addresses environmental health, community livability and cost efficiencies within current statutory standards. The project investigated whether stormwater management along the Central Corridor could more robustly achieve the community's redevelopment vision for the corridor (see Figures 1.4 and 1.5).

When redevelopment occurs in established urban communities, stormwater management facilities compete with other site features for limited and valuable space. Market-driven features such as floor area or parking space are premium uses; therefore,

Figure 1.5 SSGI Relation to Benefits

stormwater facilities are being relegated underground a vast majority of the time. Since 2011, 84 percent of redevelopment sites along the Green Line requiring stormwater management placed stormwater below ground (see Figure 1.6). When this happens, an opportunity to use stormwater to create a green, sustainable and vibrant community is lost.

The study provides a stormwater management framework for the implementation of SSGI – a system in which stormwater runoff generated from multiple parcels is jointly treated in shared green infrastructure. The green infrastructure is located and designed to provide economic, environmental and social (triple bottom line) benefits to the community beyond treating stormwater, referred to as "stacked-function". The study also investigated how public art could highlight stormwater management and green infrastructure along the Green Line. A critical project premise was to develop strategic solutions that were fair, equitable, and provided mutual benefit to all parties involved; otherwise the solution would not be successful or replicable.

Green Infrastructure

Both nationally and locally, there is a movement towards the use of green infrastructure to manage stormwater. Several representative definitions of green infrastructure follow:

- *Green infrastructure uses vegetation, soils, and natural processes to manage water and create healthier urban environments. At the scale of a city or county, green infrastructure refers to the patchwork of natural areas that provides habitat, flood protection, cleaner air, and cleaner water. At the scale of a neighborhood or site, green infrastructure refers to stormwater management systems that mimic nature by soaking up and storing water. (United States Environmental Protection Agency)*
- *Green infrastructure is strategically planned and managed networks of natural lands, working landscapes and other open spaces that conserve ecosystem values and functions and provide associated benefits to human populations. (The Conservation Fund)*
- *Stormwater management approach that utilizes natural landscape features and hydrologic processes to treat stormwater by infiltrating, evapotranspiring, and/or reusing runoff. Green infrastructure also achieves other environmental goals such as carbon sequestration, reductions in urban heat island effect, improved air quality, improved wildlife habitat and increased opportunities for outdoor recreation. (Capitol Region Watershed District)*

While there are variations between these definitions, they all consistently state that green infrastructure uses landscape features and/or natural processes to manage and/or treat stormwater in a manner that provides environmental benefits. Green infrastructure aligns well with the vision for a revitalized central corridor that includes new green spaces along the corridor, along with environmentally sound and sustainable redevelopment.

Shared

When redevelopment occurs in older, established urban communities such as Saint Paul or Minneapolis, buildings, open space, surface parking, streets, alleys and stormwater facilities are all competing for limited and valuable space. In response to this situation, stormwater is typically being managed in expensive underground facilities that are quite large in order to meet water quantity and/or rate control requirements. In addition, most of the recently constructed facilities do not integrate stormwater with reuse or other features that could support corridor enhancements.

This study hypothesized it would be beneficial to construct shared stormwater facilities that collect and treat runoff from multiple parcels (both smaller and larger than one acre). These shared facilities could provide cost efficiencies, enable runoff/pollutant reduction for small parcels that otherwise may not require such treatment, and provide substantial water supplies that could be reused to improve the environmental and social character of the corridor.

Stacked-Function

This study hypothesized the space used for stormwater management, along with the captured stormwater runoff itself, can be used to provide triple bottom line benefits to the corridor beyond stormwater management, thereby creating a "stacked-function." For example, economic benefits can be achieved when space can be used to accommodate multiple functions such as stormwater facilities and parking facilities. Environmental benefits are realized when stormwater facilities mimic the natural hydrologic cycle or introduce new habitat into the urban environment. Social benefits result from the provision of new street trees and open spaces that improve corridor livability. In addition, when stormwater facilities are placed below ground, the community loses their understanding and personal experience with natural systems. Also lost is the opportunity to learn about the environmental impacts associated with increased impervious surfaces. By expressing stormwater management on the surface or using stormwater to support environmental benefits, a richer and meaningful environment is created.

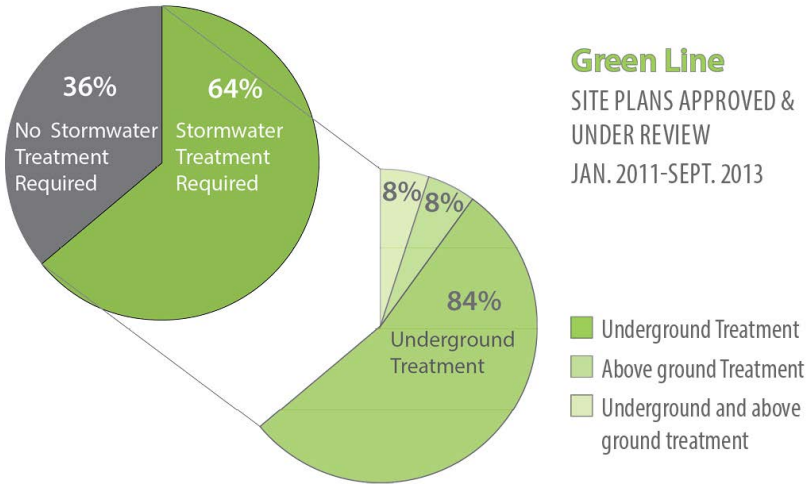


Figure 1.6 Existing Stormwater Approach on the LRT Green Line

The goal of this study was to identify feasible stormwater stacking opportunities that:

- Merged triple bottom line uses with stormwater facilities to make efficient use of valuable urban land.
- Reused captured stormwater runoff to enhance the environmental health and corridor livability.
- Provided opportunities to interpret, educate and celebrate water in the corridor through the artful design of stormwater facilities.

"The many separate initiatives designed to maximize the Corridor's potential are starting to link together in significant ways....This plan will provide a critical tool for creating the vibrant, green and sustainable spaces envisioned in the station area plans-- while improving the quality of the Mississippi River."

-Mayor Christopher B. Coleman letter to Stakeholder Advisory Committee, August 2012.

Project Approach
Chapter 2

» Set the Foundation
» Explore Opportunities
» Evaluate and Select Options
» Work Through the Details

The study was facilitated by the City of Saint Paul and was funded through a Sustainable Communities Regional Planning grant from the U.S. Department of Housing and Urban Development (administered by the Metropolitan Council) and through a grant from the MWMO.

A Stakeholder Advisory Committee (SAC) was established for the project. Committee members represented various departments in the Cities of Saint Paul and Minneapolis, CRWD, MWMO, the University of Minnesota, and the Saint Paul Riverfront Corporation. The SAC met 14 times over a 20-month period (February 2012 to September 2013) to provide insight and advise the project team.

Strategic Stormwater Solutions for Transit-Oriented Development included both policy and technical evaluations. The study was organized into the following four phases, forming a replicable approach for other similar regions with TOD to consider:

› Set the Foundation
› Explore Opportunities
› Evaluate and Select Options
› Work Through the Details

Set the Foundation

This phase of the study focused on establishing an information base that following project phases would be built on. Select Phase One work tasks included issues identification, along with framing concepts and capabilities. For other regions considering replicating this initiative, it will be important to explore their own definitions and authorities, as this can vary based on community context, needs, and preferences.

Potential SSGI Implementation Barriers

Many of the potential SSGI implementation barriers identified by the SAC and a developer focus group revolved around long-term risk management and associated cost implications. The investigation quickly raised a number of logistic issues that a successful SSGI implementation approach must address, such as:

› Where will the SSGI be located and who will own the property?
› Who will administer, operate and maintain the SSGI?
› Can SSGI facilities be constructed in a phased manner to coincide with phased redevelopment?
› How can the initial SSGI construction be funded in a fair and equitable manner?
› How can the SSGI long-term operations and maintenance be funded in a fair and equitable manner?
› What contingency plans are needed in case redevelopment doesn't occur, or only partially occurs?
› Will SSGI work within the existing statutory framework?

The study quickly concluded that a "one size fits all" may not be a realistic SSGI implementation approach. The variable ways in which SSGI can be implemented lends to a case-by-case evaluation. However, general frameworks are needed to help guide implementation feasibility discussions.

Right-of-Way Considerations

Often, off-site stormwater management is construed as possibly involving the public right-of-way. Cities are the stewards of the right-of-way as the public right-of-way supplies a benefit to the civic community at large. The right-of-way must accommodate a variety of public needs, such as transportation facilities (e.g., streets, sidewalks, and transit), above and below ground utility services (e.g., water mains, storm and sanitary sewers, stormwater management practices to mitigate public projects, electric, gas, and cable services) and environmental enhancements (e.g., street trees and ground vegetation). Frequently, these various public uses are competing for the limited space available within the right-of-way. Therefore, the addition of any non-public use within the right-of-way involves significant risk for any governmental agency responsible for the public right-of-way.

Both Minneapolis and Saint Paul have long-standing processes to evaluate and control uses proposed for the right-of-way that may have direct benefit to only a limited group. Encroachment permits are issued as a means to review, approve and track non-public features within the right-of-way. Typically an applicant is required to demonstrate that a private "need" cannot be met on private property thereby justifying the permit.

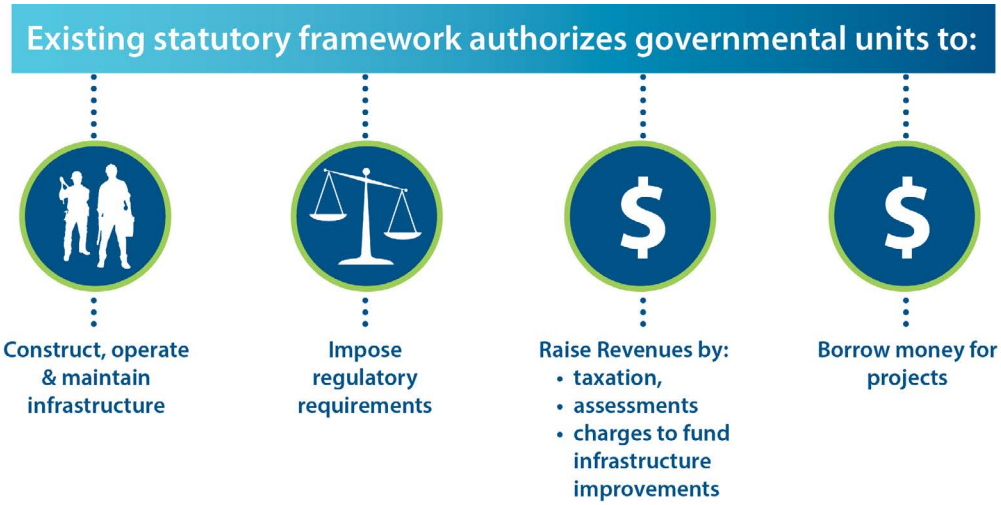


Figure 2.1 Governmental Authority

The public right-of-way provides possible real estate for hosting shared stormwater management. However, the placement of shared stormwater facilities in the right-of-way must provide public services and value beyond simply benefiting the developer, such as installing street trees that provide habitat, stormwater management, and shade, thereby improving neighborhood livability.

Developers Focus Group

Over the course of the project, the project team met with select developers with project experience in the Cities of Saint Paul and/or Minneapolis. The focus group indicated that sharing stormwater facilities between private developments and public agencies is the preferred approach versus sharing occurring solely between private developments. This is primarily due to perceived risk by developers and their financiers. The group also stated that the creation of new open spaces will make development parcels along the corridor more attractive to developers in comparison to other potential redevelopment parcels in the city that are not adjacent to open space. Developers prefer parcels adjacent to open spaces as they expect to receive higher returns on their investment through increased rents or unit sale prices. Finally, they indicated that predictable development processes are valuable. These insights helped inform the development of potential SSGI approaches.

Governmental Authority Relating to Stormwater Infrastructure

Current statutes provide cities, watershed districts and joint powers Watershed Management Organizations (WMO) authority to require stormwater management as a condition of subdivision or building activities. These governmental entities also have authority to acquire land and to construct, operate and maintain stormwater management infrastructure, either individually or in cooperation with other governmental units (see Figure 2.1). The statutes provide governmental units a broad array of options for funding stormwater facilities by raising funds from appropriate parties. Options range from utility charges and assessments against targeted or benefited properties, to ad valorem tax levies over the entire taxing jurisdiction or an appropriate sub district.

The existing statutory framework provides cities, watershed districts and joint powers WMOs with the key tools they need to implement desired stormwater infrastructure, including SSGI. Additional information regarding governmental authority relating to stormwater infrastructure can be found in Appendix **A**.

Existing Stormwater Rules and Regulations

Existing stormwater regulations within the corridor was another key project informant. Projects within the corridor generally need to meet the regulations of the following agencies:

- Cities of Saint Paul and Minneapolis
- Capitol Region Watershed District (CRWD)
- Minnesota Pollution Control Agency via the NPDES General Construction Permit

In addition, the MWMO has a set of guidelines that need to be adhered to if the project is being funded with a grant from the MWMO.

In general, redevelopment projects along the corridor will need to adhere to the most restrictive regulatory requirement that applies to that site. In all cases, requirements are triggered by a size threshold; each agency has different size criteria. Parcels less than one acre are considered "small" and generally are not required to achieve runoff/pollutant reduction. Therefore, dependent on size, the following three stormwater regulatory requirement categories may apply to redevelopment projects.

- **Rate Control** – Controls the rate at which stormwater runoff is discharged from a developed site, typically discharge rates are controlled to existing or presettlement conditions for a variety of storm events.
- **Volume Control** – Controls the amount of stormwater runoff from a site to encourage groundwater recharge, limit impacts to downstream systems, and remove soluble nutrients from runoff discharged from the site.
- **Water Quality** – Refers to the removal of specified pollutants to a designated level.

Additional information on the stormwater management regulations that applied to the corridor during the course of this study can be found in Appendix **B**.

Explore Opportunities

Key National Studies

Previous Central Corridor studies were reviewed to gain a clear understanding of Saint Paul's and Minneapolis' redevelopment visions for this corridor. In addition, reviews were preformed over the course of the project of national studies related to SSGI. Several concurrent studies of particular interest titled, *River North: Area Wide Green Infrastructure Study* (Wenk Associates, 2013), *Creating Clean Water Cash Flows* (Natural Resources Defense Council (NRDC), EKO Asset Management Partners, the Nature Conservancy, 2013) and *Banking on Green* (American Rivers, the Water Environment Federation, the American Society of Landscape Architects, ECONorthwest, 2012) were all investigating variations of SSGI, which affirmed this is an issue of interest across the country.

These national studies consistently indicated that green infrastructure was less expensive to construct than traditional gray infrastructure, regardless of scale.

The studies also illustrated that new models for stormwater management must be initiated through leadership within municipal government. Other regions can use these national studies to help inform replicability but communities should also evaluate their own local precedents.

Review of National and Local Precedents

Conceptually, shared, stacked-function stormwater management is not a new approach. Historically, for new developments in growing municipalities, the term "regional pond" was often used to describe a similar situation where one stormwater facility was built by a city for the benefit of many parcels, and by virtue of size may also provide passive recreational amenities and/or wildlife habitat. In other instances, smaller developments built common (shared) ponds in outlots, owned by homeowner associations. (However, often the outlot would go into tax-forfeiture and become owned by a city.)

SSGI builds on this general concept but seeks to employ it on a much smaller scale in a fully developed environment. Examples of SSGI can be found both locally and nationally. The following precedent projects were examined in more detail to better understand how SSGI is being applied, along with associated opportunities and constraints.

Fee-in-Lieu Program, Charlotte, NC – This community provides flexibility in their stormwater regulations in order to better facilitate desired redevelopment along a transit corridor. According to NRDC's report *Creating Clean Water Cash Flows,* the City of Charlotte instituted an off-site mitigation program to provide flexibility and reduce cost barriers for site-constrained redevelopment properties that supported growth and economic development along Charlotte's light rail system. An ordinance allows property developers to pay a one-time fee if cost or site constraints prevent them from meeting their stormwater retention mandates. The

Canal Park, Washington, D.C.
Source: http://www.canalparkdc.org

The Circle in Uptown Normal, IL Source: Hoerr Schaudt Landscape Architects

City charges developers a fee per impervious acre and constructs off-site facilities in a cost-efficient manner on city-controlled lands.

Stormwater Management Enhancement Districts, Philadelphia, PA – Also featured in NRDC's report *Creating Clean Water Cash Flows,* the City of Philadelphia facilitates the aggregation of properties into Stormwater Management Enhancement Districts (SMEDs), which are areas identified as having potential for large, coordinated green infrastructure projects. The City takes leadership in identifying SMEDs and contracts with an engineering specialist to evaluate potential green infrastructure retrofits that are technically, economically, and practically attractive and prepare a Stormwater Improvement Plan. These proactive steps taken by the City encourage the use of stormwater facilities that take advantage of economies of scale and also lower retrofit project assessment and analysis costs, thus incenting desired development.

The Circle in Uptown, Normal, IL – This project harvests, cleanses, and reuses co-mingled (public and non-public) stormwater runoff to create a water-based amenity in a new community open space.

Canal Park, Washington DC – Stormwater runoff captured from the site and adjacent private buildings will be harvested, cleansed and reused to create new water-based amenities and for toilet flushing in a new urban park.

Tartan Crossings
Photo: SRF Consulting Group

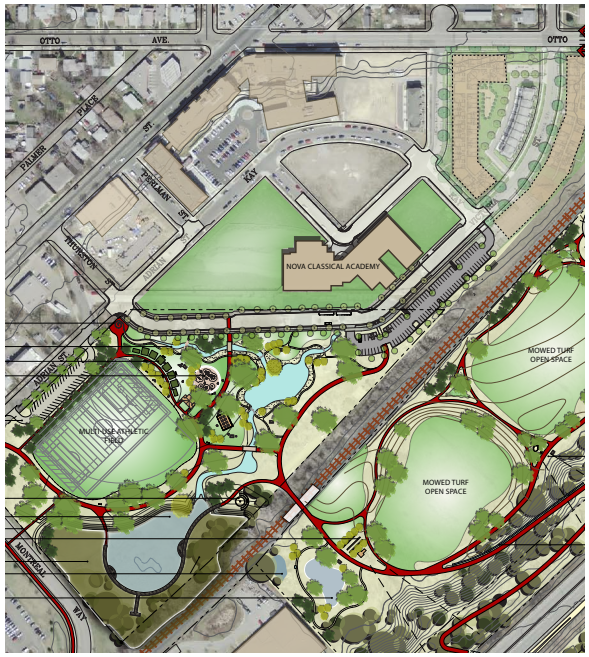
Tartan Crossings, Oakdale, MN – As part of the redevelopment of an underperforming strip mall into new commercial sites, the City's Public Works Department constructed an artistically designed shared stormwater feature that functions as a new recreational, aesthetic and educational amenity in public right-of-way.

Trout Brook Nature Sanctuary
Source: City of Saint Paul

Trout Brook Nature Sanctuary, Saint Paul, MN Stormwater runoff from an existing residential neighborhood will be daylighted from storm sewers, and cleansed through a series of ponds. Public art is woven into various site features, such as retaining walls and native plantings, to animate the space and educate sanctuary visitors. The treated runoff will provide a significant water source for a newly re-established historic waterway that will run through the sanctuary.

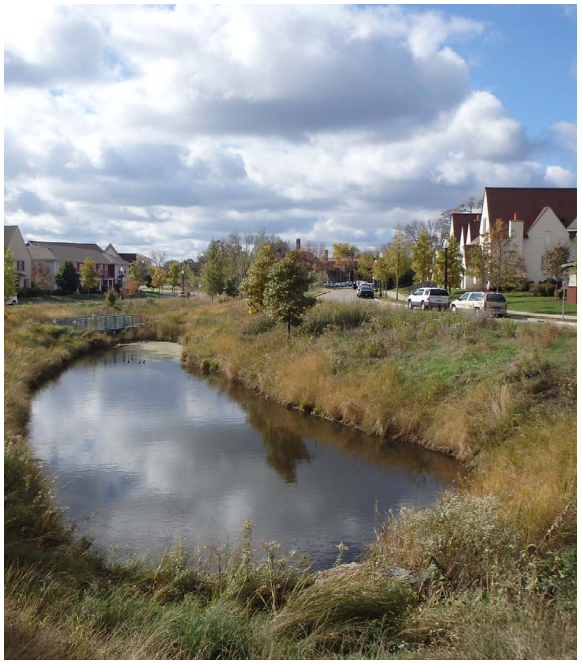
Central Corridor Boulevards
Source: Capitol Region Watershed District

Central Corridor Boulevards, Saint Paul, MN – A dozen boulevards on cross streets along the Green Line were retrofitted by the CRWD to incorporate stormwater planters and rain gardens. Localized runoff from the streetscape and, in some instances, parking lots, are treated by these features.



Victoria Park Master Plan
Source: Saint Paul Parks and Recreation

Victoria Park, Saint Paul, MN – Stormwater runoff from an adjacent street was directed into a stormwater swale within the newly created Victoria Park and will function as an aesthetic park feature.



Heritage Park
Source: SRF Consulting Group

Heritage Park, Minneapolis, MN – Stormwater runoff from residential redevelopment sites and adjacent neighborhoods is daylighted from storm sewers and cleansed through a series of filtration basins that are incorporated into a neighborhood street designed to emulate a parkway. The harvested stormwater provides water for new parkland amenity ponds.

Hamline Green Alley
Photo: SRF Consulting Group

Hamline Library Green Alley, Saint Paul, MN – The City implemented pilot construction of a porous bituminous pavement alley that collects and infiltrates stormwater runoff from the alley itself and adjacent private and public parcels.

Public Art Integration

In 2009, the City of Saint Paul passed a public art ordinance that calls for public artist involvement in City planning studies and City capital improvement projects. The ordinance states that, "Public art strengthens public places and enhances and promotes Saint Paul's identity as a livable and creative city and a desirable place to live, work and visit." Public art is a key contributor to enhanced livability. As stated above, it helps to create unique, identifiable, and stimulating environments that provide meaning and value to those who interact with the artwork.

The Strategic Stormwater Solutions for Transit-Oriented Development study developed a public art concept titled, "FLUXion ≈ gARTens." This concept was based on the idea of 'Public Art' as 'Green Placemaking' and 'Green Placemaking as Public Art' where harvested stormwater is integrated into a proposed network of green art spaces/places referred to as "gARTens" (e.g., gardens, pocket parks and art works) that are collaboratively designed by artists, the property owners, and landscape architects or engineers. The individual gARTens would be publically accessible, authentic, placed-based, green places created as environmental, economic, social, and aesthetic sites along the corridor. These public artworks would help build a distinct community narrative so neighborhood residents would be invested in, use, and take ownership of these newly created spaces.

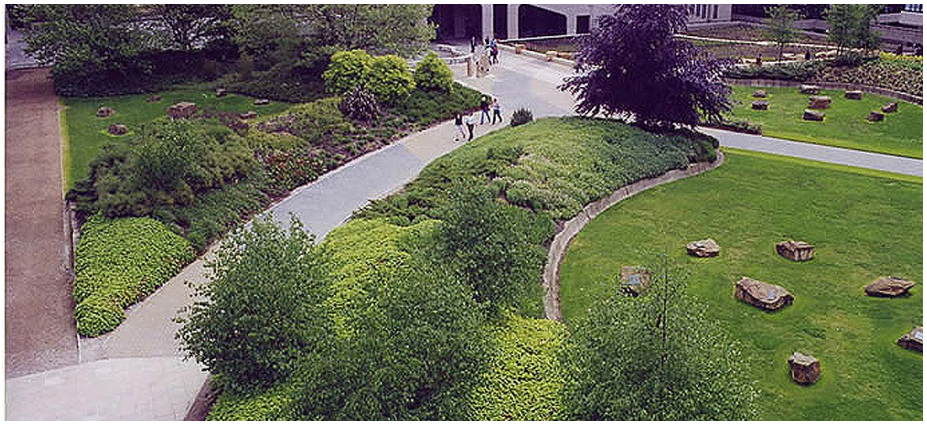
'FLUXion ≈ gARTens' could be branded and utilized with an interactive website that maps, illustrates, documents and describes all the connected 'gARTens' where a person could travel gARTen to gARTen with the help of a smart phone or ipad.

'FLUXion ≈ gARTens' could also function as satellite arboretums and botanical gardens that are mapped, illustrated and utilized through an interactive website, and possibly integrated into the University of Minnesota Arboretum System. This could introduce neighborhood residents and visitors to different plant species and aid in their identification.

Additional information about 'FLUXion ≈ gARTens' can be found in Appendix **C**.

» *Top-"Floating Bouys' on Underground Cistern,by Lango Hansen L.A. , Portland Community College Photo: Lango Hansen, L.A.*

» *Bottom-"Urban Waterfall" by Linda Wysong, Portland Community College, Water Education Plaza, Portland, OR. Photo: Linda Wysong*



» *Top- Glendale Townhome Community Gardens. Photo: makingbettermn.org*

» *Bottom- "Meet, Sit and Talk" , Lorna Green,1995. The Chancellors Court, University of Leeds. Planting Scheme by Allan R Ruff.*

» *Top- 'Beckoning Cistern', Buster Simpson, Seattle, WA. Photo: Buster Simpson*

» *Bottom- Source: Homesthetics Architecture Art & Design. Homesthetics.net*

Evaluate and Select Options

Potential Redevelopment Sites Identification

The project team solicited stakeholders and reviewed previous station area plans and sub area studies to identify potential future redevelopment projects along the corridor.

A total of 37 potential redevelopment sites were identified (see Figures 2.2-2.4). This list was screened and narrowed down to a pool of ten. Sites were selected from the pool to perform the conceptual design studies. While a number of screening criteria were used, final selection was primarily based on:

- ***A geographical distribution of sites*** – the number of potential sites selected were approximately proportionate to the length of the Green Line within each of the cities.
- ***A range of large and small sites*** – The success of various SSGI approaches may be influenced by the size of the site; therefore, a range of site sizes was desired.
- ***Potentially contaminated sites*** – A large number of sites along the corridor are assumed to be contaminated, given the long history of development along the corridor. Therefore, some of the sites should allow the project team to examine whether the sites could accommodate the larger filtration requirements associated with contaminated soils.
- ***Near to mid-term development potential*** – Sites that were further along in the development process would allow the project team to work with known development programs, which would better flush out implementation issues.

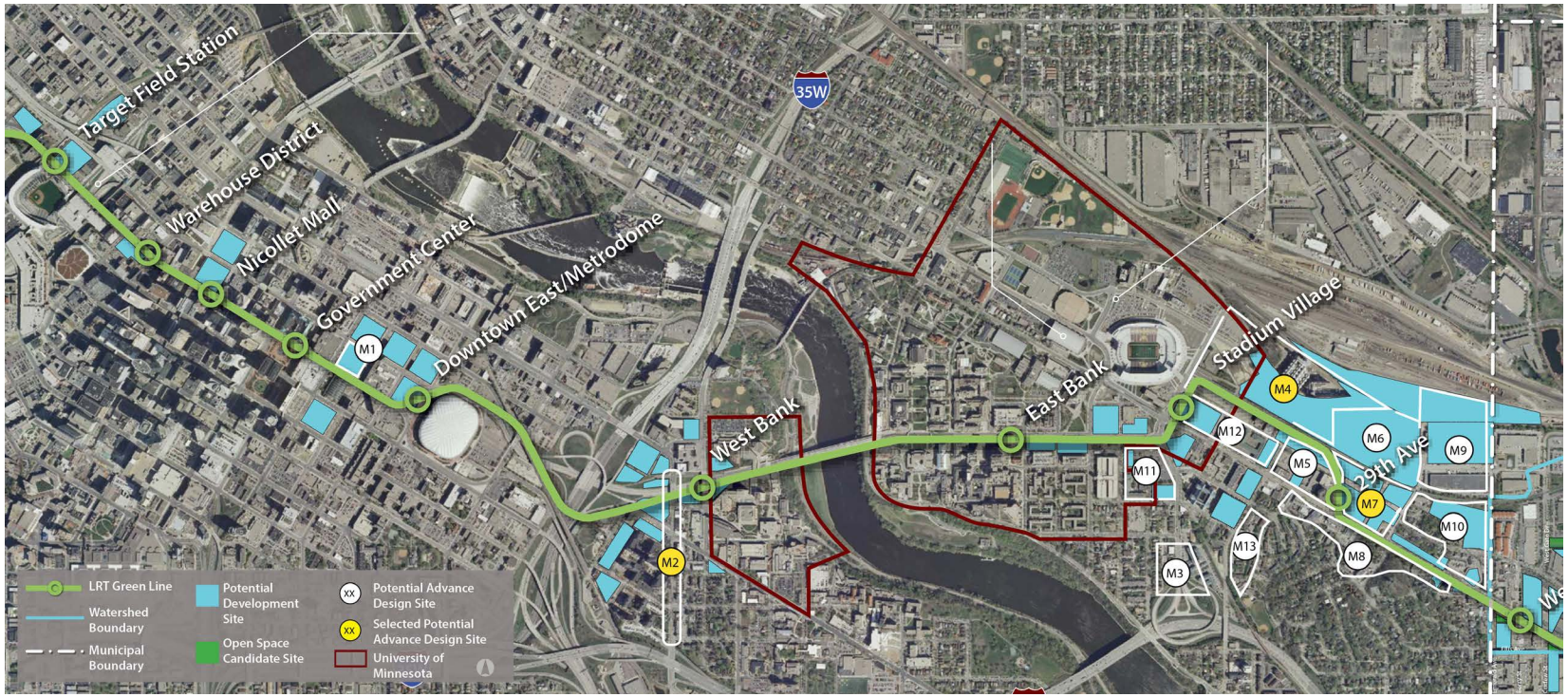


Figure 2.2 Potential Redevelopment Sites Minneapolis

Figure 2.3 Potential Redevelopment Sites, Saint Paul (West Segment)

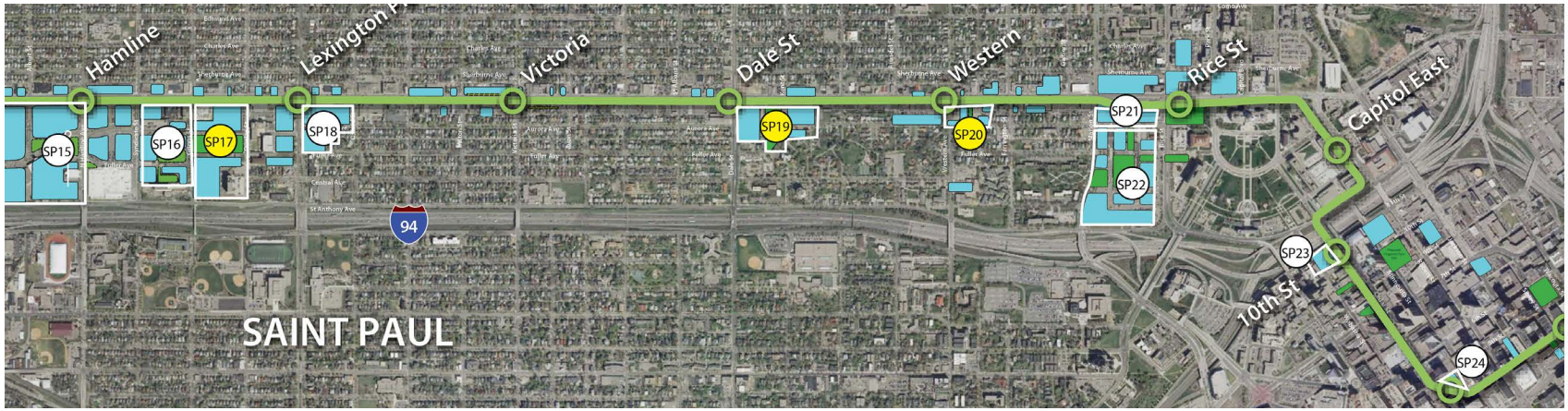


Figure 2.4 Potential Redevelopment Sites, Saint Paul (East Segment)

Potential SSGI Approaches

Potential SSGI approaches were developed and four were selected for additional feasibility analysis. As stated earlier, a critical project premise was to develop strategic solutions that were fair, equitable, and provided mutual benefit to all parties involved. The successful implementation of any of the potential approaches is contingent upon the development of a balanced distribution of benefits, costs, and risk. Note that these approaches are not mutually exclusive but were evaluated individually to simplify analysis.

NEW PUBLIC PARKS/OPEN SPACES

Hosting stormwater in new public parks benefits adjacent redevelopment as it eliminates the spatial constraints of treating stormwater on site and reduces soft development costs. Developers also benefit by the adjacency of a new open space, which makes their parcel more desirable to potential tenants or purchasers. By taking stormwater into a park facility, the City obtains capital and maintenance funding from the developer that will help finance the shared, stacked-function portion of park construction and maintenance. It also allows other city projects to participate in the facility, such as stormwater treatment for new or reconstructed streets. By sharing a stormwater facility, economies of scale can be achieved, resulting in reduced construction costs for all parties sharing the shared facility. Shared stormwater facilities in public parks also provide a cost effective opportunity to treat stormwater from adjacent parcels currently not receiving treatment that are not anticipated to redevelop in the near future.

SHARED PARKING FACILITIES

A key component of TOD is the creation of a pedestrian friendly environment and the efficient use of available space, which may result in the development of shared parking facilities. Owners of parking facilities and those using it typically develop mutually-agreeable operating and liability arrangements. It is feasible that a water treatment facility could be built into new parking structures or under shared parking lots and the legal agreement expanded to include the shared stormwater facility. This type of shared facility also allows for the accumulation of a significant volume of water that will support reuse options, such as irrigation or building toilet flushing.

GREEN ALLEYS

A vast majority of blocks in Saint Paul are served by alley access. These "shared" driving facilities are strategically located to conveniently collect and store stormwater runoff. New pervious pavements allow for the infiltration of water, while still providing the structural support needed for vehicle movement. Alleys are also typically free of major underground utilities that compete for underground space with stormwater facilities. While this approach doesn't heighten awareness of water, it does support efficient use of space in highly urbanized environments.

STREET RIGHT-OF-WAY

Green infrastructure located in street boulevards (e.g., tree trenches, rain gardens, and boulevard swales) can host shared stormwater treatment facilities. Runoff collected in these facilities can be used to irrigate new streetscape plantings that would increase environmental health, improve streetscape aesthetics, and provide a comfortable walking environment. These facilities also heighten residents' awareness of and connection to water and natural processes in the urban landscape.

Application of SSGI at Different Development Scales

Two potential redevelopment sites were used to test how SSGI could be incorporated into redevelopment projects of varying scale.

The first site selected, known as the Bus Barn site, is representative of large-scale, urban village redevelopment areas (see Figure 2.5). With a size of 34-acres, the Bus Barn site is envisioned as a long-term, phased development area. It was assumed that select streets and blocks would be reconfigured and that significant demolition and reconstruction of buildings would occur. The Saint Paul Transit-Oriented Development Guidebook for the Central Corridor identifies four urban village redevelopment sites along the Saint Paul segment of the Green Line.

The second site, known as the Brownstone site, is representative of small parcel redevelopment projects. The Brownstone site was selected because it is small in scale, yet exceeds one acre (see Figure 2.5). Small projects typically consist of existing building expansions, or the complete demolition of several structures, parcel assembly and development of a larger building.

Concepts were developed for each of the four SSGI approaches on both the Bus Barn and Brownstone sites, for a total of eight SSGI concepts. One representative concept for each of the development scales are illustrated in Figures 2.6 and 2.7. The concepts illustrated how the stormwater runoff can be artistically expressed as it supports new corridor vegetation or as an artwork or interpretative element. A comparison of the individual basis estimated costs to conceptual SSGI estimated costs indicated that cost efficiencies

Figure 2.5 Development Scale Concept Sites

can be achieved through the sharing of stormwater facilities. It was also determined that the incremental cost increase associated with the provision of runoff/pollutant reduction measures, in addition to rate control, for a shared facility is not significant. Additional information on the concepts can be found in Appendix **D**.

The investigation highlighted that construction of certain SSGI approaches can be sequenced to better correlate to phased redevelopment (e.g., alleys and street right-of-way), while other SSGI approaches are best constructed simultaneously with the first phase of redevelopment followed by future phases connecting into the established stormwater facility (e.g., shared parking and parks).

Another finding indicated a distinct SSGI dichotomy between small parcels and other redevelopment types. Comparing ease of implementation against need or benefit it is easier to implement a SSGI facility that serves a limited number of large parcels than numerous small, scattered unrelated redevelopment parcels. This is due to fewer voices in the public-private dialogue, less modifications required to existing drainage systems, and more predictability in timing and financing. However, small parcels have less available space for overall site design including landscaping, are not required to provide volume/pollutant reduction, and may have less access to financial resources. The relative need for SSGI to service small parcels is high yet the ability to implement SSGI may be more complex, compared to other redevelopment types.

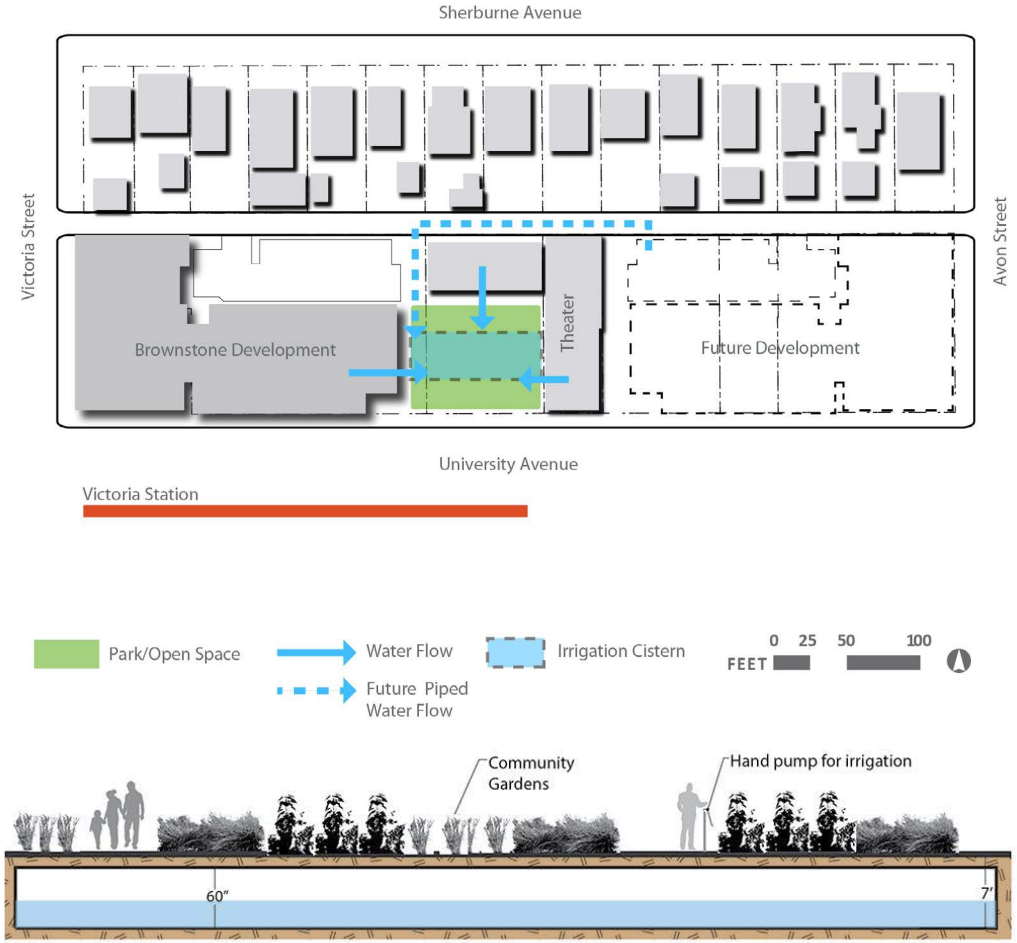


Figure 2.6 Brownstone New Private Open Space Concept

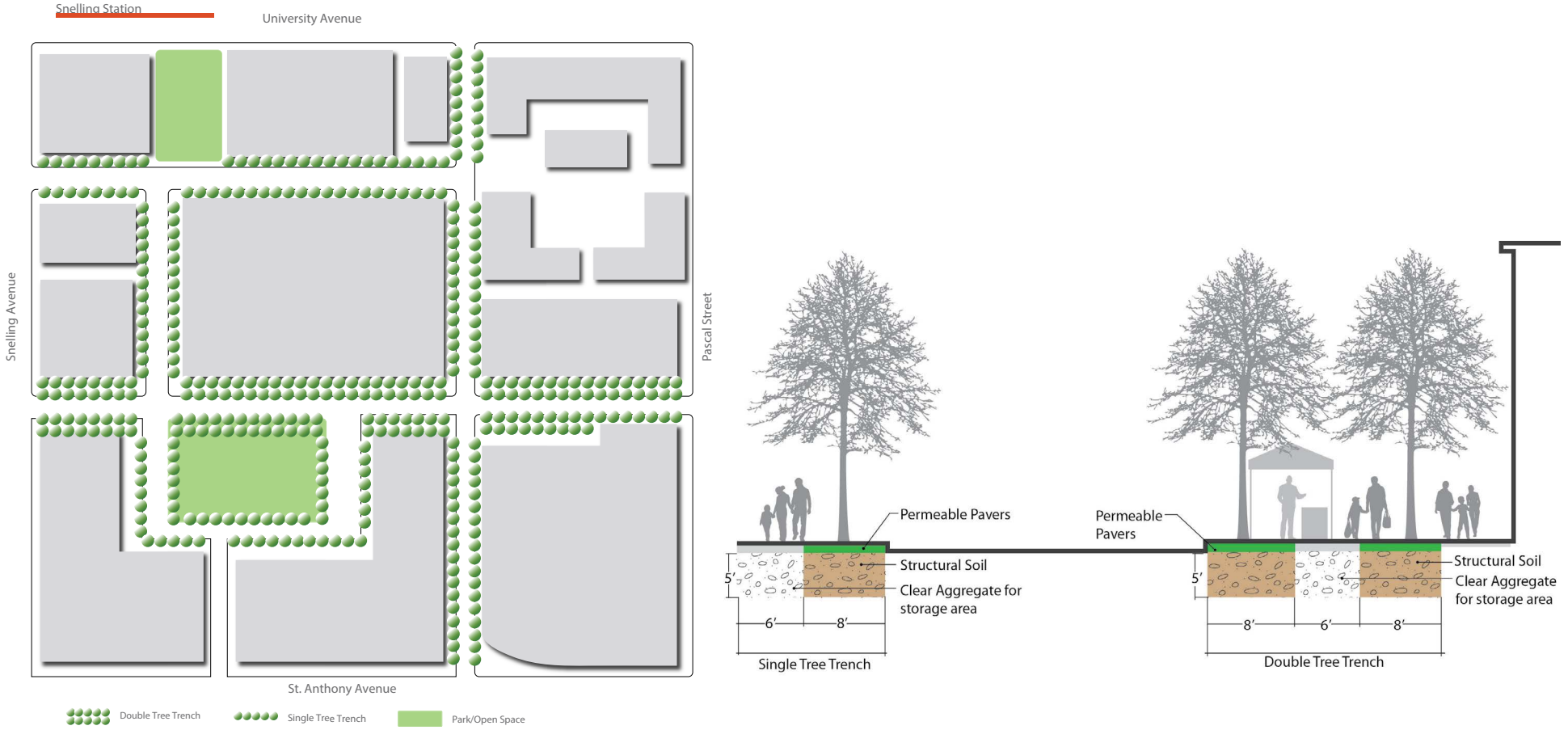


Figure 2.7 Bus Barn Street Right-of-Way Concept

Work Through the Details

Based on the findings from the investigation of different development scales, it was deemed appropriate to continue investigating the four potential SSGI approaches and to further test two of the SSGI approaches on potential active development sites along the corridor. The concepts developed for these sites were theoretical in nature and did not imply that development of the concept would ultimately occur. Refer to Appendix **E** for details of the investigation.

For the following two sites, or any other potential site to be considered, a thorough engineering feasibility study is absolutely critical to ensure constructability, refine estimates of probable cost, and provide adequate specificity to inform final design.

Boeser Site

The first site selected, known as the Boeser site, is located near the Green Line Prospect Park/29th Avenue station in Minneapolis (see Figure 2.8). A local developer is pursuing the redevelopment of an obsolete industrial site into a multi-family apartment building. The existing street (4th Street), scheduled for reconstruction by the City of Minneapolis, would be reconfigured within the existing 80-foot street right-of-way. The shared, stacked green infrastructure (SSGI) concept developed for purposes of this study, though based on the actual location and site conditions and a preliminary proposed redevelopment, is theoretical and does not imply that the City of Minneapolis will ultimately approve any or all of the concept elements.

SHARED

The concept was based on the premise that runoff from the Boeser site would be managed in the adjacent street right-of-way, along with runoff from a future redevelopment parcel located across the street (see Figure 2.9).

STACKED-FUNCTION

The street concept envisions a high amenity street that accommodates pedestrians, bicycles and cars and includes space for outdoor gathering. The street concept artistically highlights and celebrates the movement of stormwater runoff down buildings and into aesthetically designed flow-through planters and rain gardens, which support new street vegetation and habitat. New street trees are installed in structural tree trenches overlaid with permeable pavers (see Figures 2.11-2.14).

TRIPLE BOTTOM LINE BENEFITS

» ***Economic***

A comparison of the individual basis estimated costs (prepared under a side analysis not included in this report's scope [Boeser Site Stormwater Feasibility, MWMO]) to conceptual SSGI estimated costs indicated that the use of SSGI results in net capital cost efficiencies overall.

A preliminary analysis was performed to determine how much financial contribution would be required from each participant directly benefiting from the shared green infrastructure system. This "cost recovery" analysis is predicated on the assumption that an initial capital funding source (e.g. bonds) is necessary to initiate construction, with a recovery over time (e.g. assessment). However, a cost recovery analysis revealed complexities, particularly when allocating costs based on contributing runoff volume (or impervious surface). For this scenario, the developer realized a disproportionate amount of savings relative to the City in the shared system, resulting in inequity.

» ***Environmental***

Beyond the environmental benefits of stormwater management, the vegetated filtration basins and new street trees irrigated with harvested stormwater provide numerous environmental benefits, such as habitat creation, urban heat island mitigation, and air quality improvement.

» ***Social***

The provision of stormwater supported vegetation in the street right-of-way improves livability by creating comfortable outdoor environments for walking and recreating. Increasing street activity strengthens the social fabric of the city and improves safety.

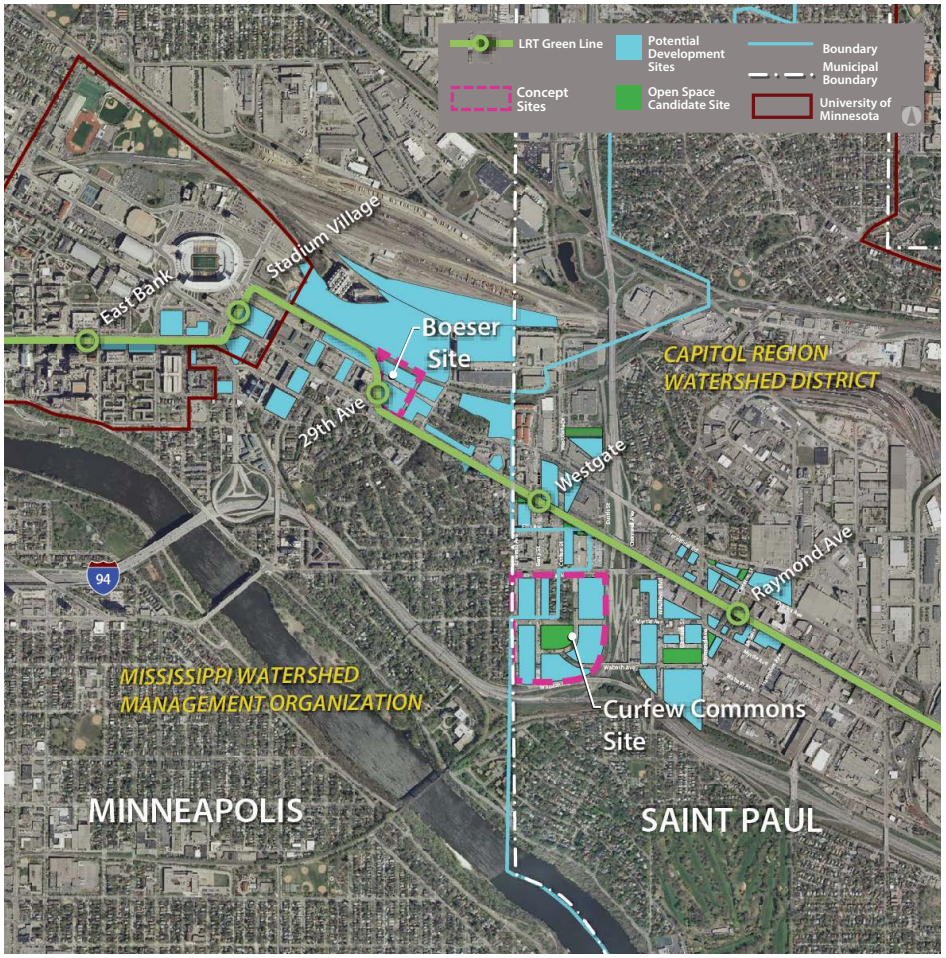


Figure 2.8 Concept Sites Context Map

Figure 2.9 Boeser Site Concept Drainage Area

PUBLIC ART

Public art concepts for the Boeser site focus on creating a sensory experience, a place for celebrating and interacting with water. Water could be taken from the rooftops through a kinetic sculpture that interacted with the flow of water, creating sound and reflecting light. The water would then be conveyed into the rain gardens (see Figure 2.10).

OTHER CONSIDERATIONS

This concept could be replicated along the length of the street reconstruction, which extends beyond the subject block. The existing street (4th Street) is a Municipal State Aid (MSA) road which has specific design standards. The SSGI concept was designed to address MSA standards.

Figure 2.10 Representative Public Art Concepts

» *Top- Green Streets of Portland, Oregon. Land Perspectives, landperspectives.wordpress.com*

» *Middle- 'Water Brand' by Hartness Vision Photo: AECCafe-ArchShowcase Summit Singhai*

» *Bottom- Holalokka, Oslo, Norway. Atelier Dreiseitl.*

Figure 2.11 Boeser Concept Plan- Canopy View with Section Line

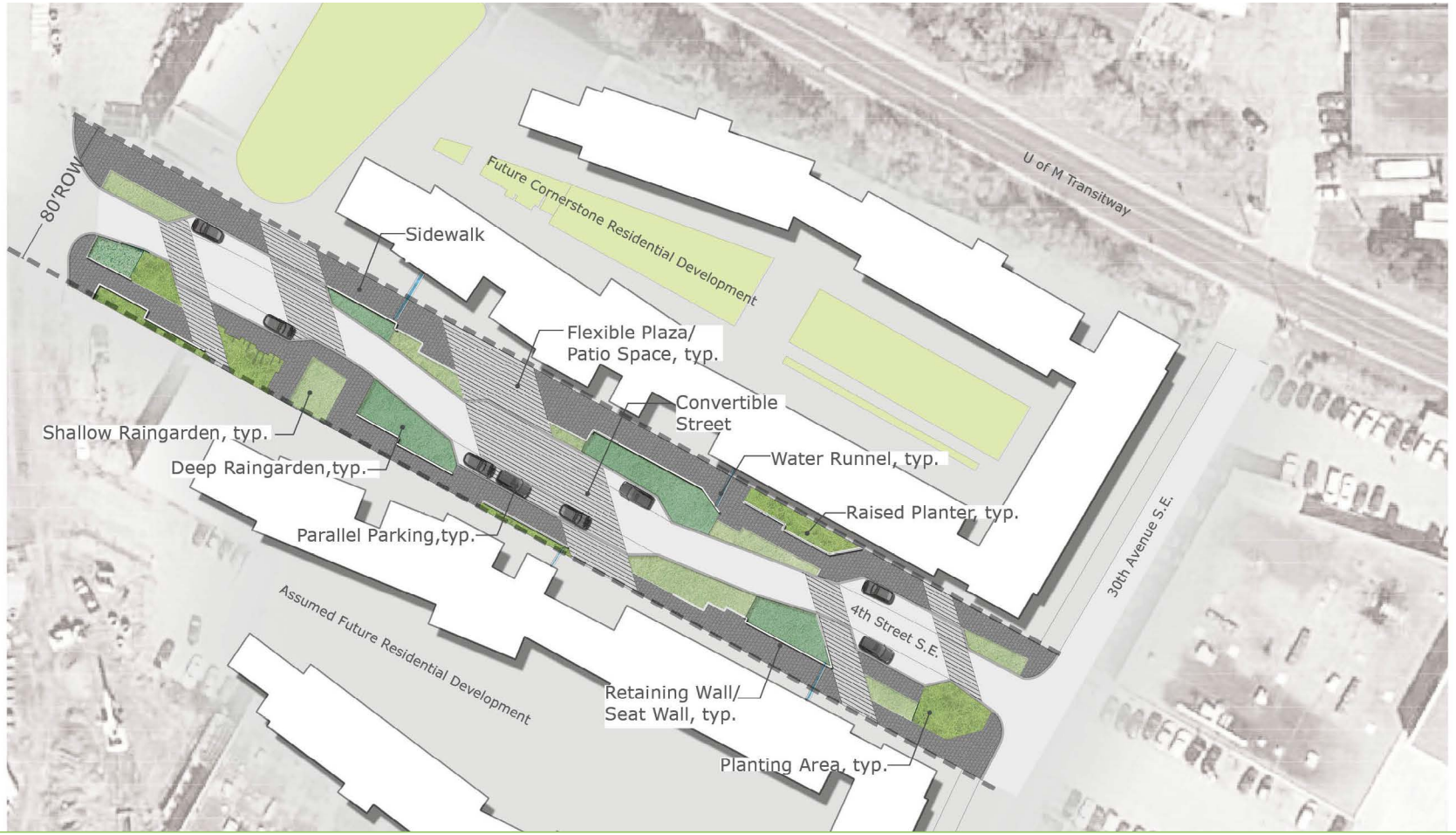


Figure 2.12 Boeser Concept Plan- Ground Plane Detail

Figure 2.13 Boeser Concept: Illustrative Section Perspective- Overall Space Allocation

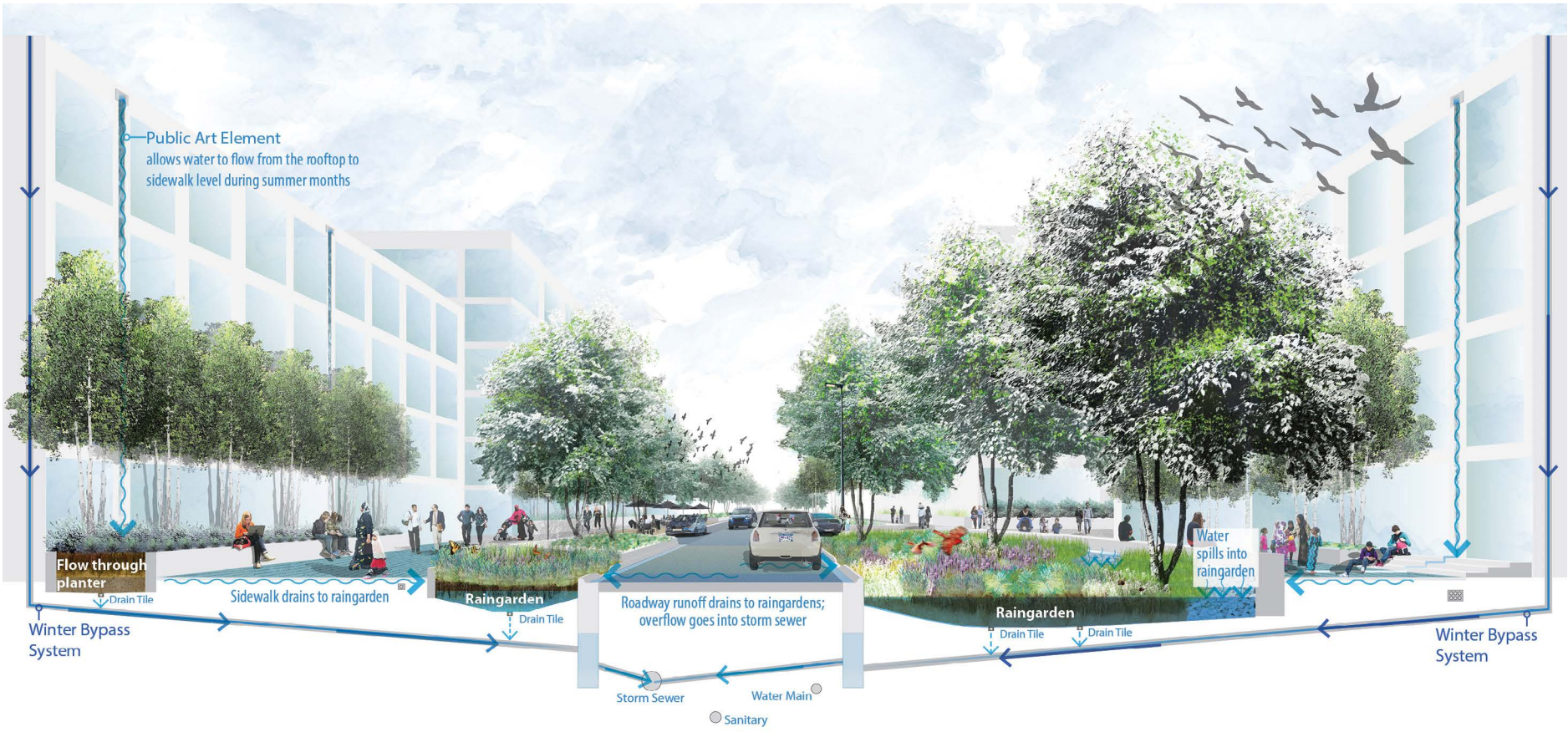


Figure 2.14 Boeser Concept: Illustrative Section Perspective- Stormwater Diagram

Curfew Commons Park Site

The second site, known as Curfew Commons, is located near the Green Line Westgate Station in Saint Paul (see Figure 2.8). The Station Area Plan projects high density residential growth in this industrial area and envisions additional accessible parkland to support this anticipated growth.

SHARED

The park concept directs stormwater runoff from the adjacent multi-family redevelopment site and from the new streets and uses that water as an amenity in a new park (see Figure 2.15). Those sharing the stormwater facility include the developer and various City Departments (Parks and Public Works).

STACKED-FUNCTION

The concept depicts stormwater management within the park taking the form of filtration basins (see Figures 2.17-2.20). The basins which surround a great lawn area are designed to provide quiet passive park uses when they are dry, which is a majority of the time. Art elements are designed to highlight runoff volumes resulting from varying rainfall events and to celebrate the movement of water when the basins overflow. The lawn incorporates an underground irrigation system that is fed with water that has passed through the filtration basins.

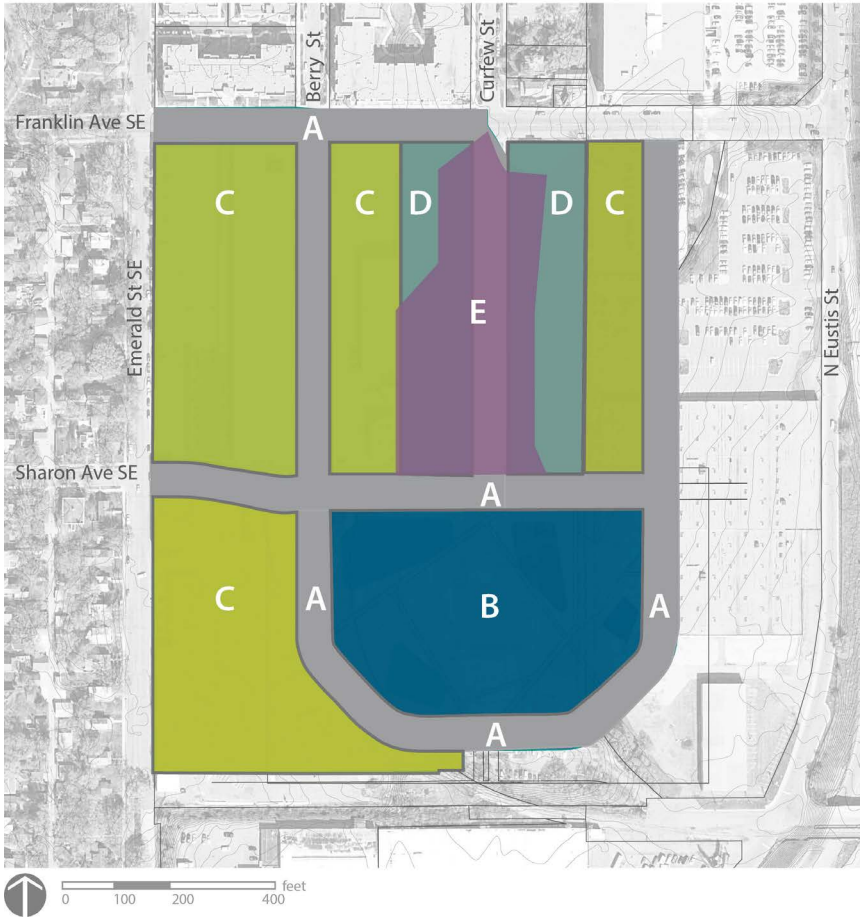


Figure 2.15 Curfew Commons: Conceptual Drainage Area

- A Streets
- B Park
- C New Development
- D Existing Residential (draining to new development)
- E Curfew Street/Contributing Residential

TRIPLE BOTTOM LINE BENEFITS

» ***Economic***

Similar to the Boeser Site, a comparison of the individual basis estimated costs to conceptual SSGI estimated costs indicated that SSGI results in net capital cost efficiencies overall.

A preliminary analysis was performed to determine how much financial contribution would be required from each participant directly benefiting from the for a shared green infrastructure system. This "cost recovery" analysis is predicated on the assumption of an initial capital funding source (e.g. bonds) is necessary to initiate construction, with a recovery over time (e.g. assessment). A cost recovery analysis that allocated costs based on contributing runoff volume (or impervious surface) indicated the developer and City's Public Works Department would receive notable savings. (This assumes Public Works would construct new streets but alternatively this could be done by the developer under Ordinance Permit). However, the analysis revealed the City's Parks and Recreation Department would bear slightly more expense for stormwater construction, operation and maintenance, relative to an individually implemented stormwater system.

The cost comparisons also indicated that operations and maintenance costs associated with green infrastructure exceed gray infrastructure operations and maintenance costs.

By taking stormwater into a park facility, the City obtains a capital and maintenance funding source that will help finance the shared, stacked-function portion of park construction and maintenance. For a majority of the time, the stormwater facility will be dry and will serve a recreational use, yet the funds used to construct and maintain the facility are derived by its stormwater function.

While not empirically established through this study, discussions with the development community indicated that creation of new open spaces will make development parcels along the corridor more attractive to developers in comparison to other potential redevelopment parcels in the city that are not adjacent to open space. Developers prefer parcels adjacent to open spaces as they expect to receive higher returns on their investment through increased rents or unit sale prices. In turn, redevelopment of underperforming parcels increases the City's tax base.

» ***Environmental***

Beyond the environmental benefits of stormwater management, the vegetated filtration basins in the park will introduce new habitat to the urban core. The conversion of pavement to vegetated surfaces will also help mitigate the urban heat island effect.

» ***Social***

Using stormwater features to facilitate parkland development will provide needed open space amenities for an underserved area. The stormwater supported irrigation of the great lawn enhances the visual appeal and turf health for an area that is anticipated to receive heavy use. This will heighten livability by providing a place for exercise and recreation.

PUBLIC ART

The intent of the FLUXion ≈ gARTens concept for Curfew Commons was to delight, educate and reinforce the triple bottom line benefits provided by SSGI.

› Plantings could recall pre-European settlement plantings (most likely Oak Savanna habitat) and native materials could be used to help interpret and educate about the natural landscape and create a connection to the Mississippi river (see Figure 2.16).

› Terraced retaining walls, seating elements, spillways, etc. could all incorporate public art and would be designed to enliven and animate water (see Figure 2.16, 2.19 and 2.20).

› Playground area located in the SW corner would be integrated into the larger concept of the park to celebrate water and teach children about different ecosystems.

ADDITIONAL CONSIDERATIONS

The findings also indicated that runoff from smaller parcels currently not receiving treatment can be effectively included in SSGI projects.

Finally, the investigation and resulting SAC discussion of findings suggested that the strongest benefit derived from SSGI implementation may be the community enhancements and associated improved livability, as these are key redevelopment outcomes desired. Additional information on these conceptual designs can be found in Appendix **E**.

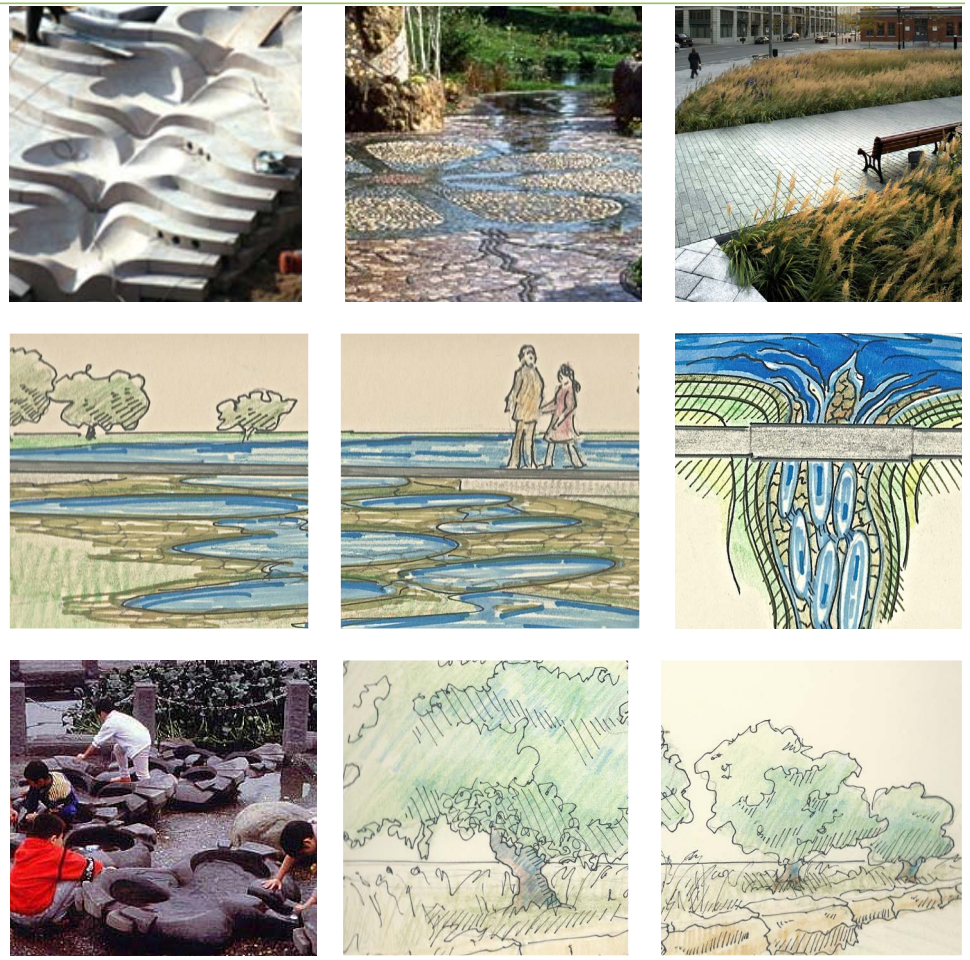


Figure 2.16 Representative Public Art Concepts

» *Top Row- Rainwater Sculpture, Herbert Dreiseitl. Waterworks Garden, Lorna Jordan. Freres-Charon Plaza, Affleck and de la Riva*

» *Middle Row- Public art sketch concepts for Curfew Commons, Craig David.*

» *Bottom Row- 'The Living Water Garden'. Chengdu Schuan Province, China, 1999. Public art sketch concepts for Curfew Commons, Craig David.*

Figure 2.17 Curfew Commons Concept: Illustrative Plan - Canopy View with Section Line

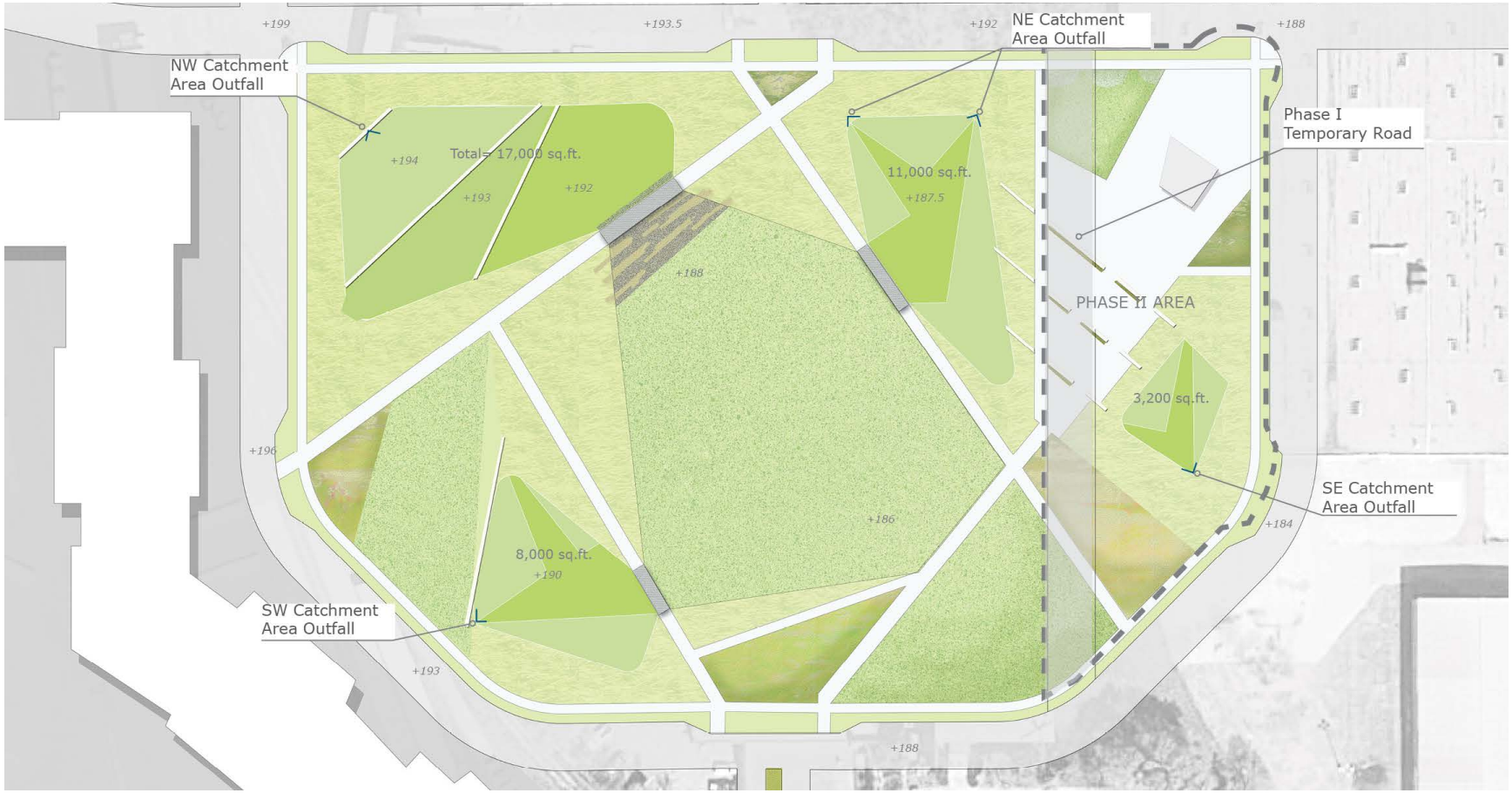


Figure 2.18 Curfew Commons Concept: Illustrative Plan- Ground Plane Detail

Figure 2.19 Curfew Commons Concept : Illustrative Section

Figure 2.20 Curfew Commons Concept : Section Detail

SSGI Implementation Chapter 3

» Draft Policy Resolution
» Perform Pilot Projects
» Revise Regulatory Framework
» Institutionalize SSGI into Agency Processes
» Public Art Implementation

While SSGI can be used to assist with quality delivery of TOD, the establishment of effective policies and implementation tools is critical to the successful implementation of SSGI. Proposed implementation procedures include:

Draft Policy Resolution

A recommended first step to implement SSGI is the development and adoption of a SSGI policy resolution. An initial policy resolution should highlight SSGI benefits and how its use can facilitate achieving the City's adopted TOD goals. To increase policy makers' comfort with SSGI use and to refine implementation protocols, it is recommended that the resolution request authorization for preparing a feasibility study(s) and for pilot implementation of SSGI. SSGI policy resolutions can be brought forward to those agencies that influence or direct stormwater management implementation, primarily municipalities and MWOs. A sample policy resolution template, as found in Appendix **F**, can be tailored to each agency's specific needs and circumstances.

Perform Pilot Projects

Several pilot projects should be identified and performed for the purpose of testing and refining the SSGI implementation framework developed in this study. The use of pilot projects allows agencies to further attempt the approach without making a commitment in perpetuity to its implementation. A municipal agency will likely need to initiate the identification and selection of pilot projects in partnership with other stakeholder agencies and the development community. Establishing public-private partnerships very early in the site development process will foster the most benefit to assessing suitability and interest for a pilot effort.

Prior to performing the pilot projects, engineering feasibility studies should be prepared for strategic locations along the Green Line where implementation of SSGI would achieve the City's redevelopment vision. Pilot site locations must be evaluated more closely to thoroughly understand existing conditions and proposed improvements. A feasibility study would evaluate soil conditions, drainage patterns, infrastructure and utility locations, and would develop an approach or combination of approaches that illustrates the properties served, the level of treatment, probable cost, and other pertinent information. Pilot sites should be selected to test various SSGI:

- Development scales.
- Approaches, such as green alleys, parks or parking.
- Funding and cost recovery mechanisms.

Potential pilot sites for Saint Paul and it's watershed partner include all those identified in Appendix **D**, Figures 5 and 6. Additional sites can be considered based on Station Area Plans, redevelopment timelines, or other influencing factors. Priority consideration for implementation could be warranted for emerging urban village redevelopments such as SP3 (Westgate/ Curfew Commons) and SP14 (Bus Barn), both evaluated within this study.

After a designated number of pilot projects have been implemented, monitored and evaluated, agencies can make the determination whether the approach provides desired TOD benefits, and that agencies (i.e. staff) are fully capable of successfully delivering this approach. If SSGI is deemed feasible, modifications to implementation protocols identified through the pilot process should be incorporated into the SSGI framework. Another benefit of performing pilot projects is the creation of demonstration sites for others to see and learn from should SSGI be deemed feasible.

If the pilot projects indicate that SSGI provides public and private benefits, another policy resolution authorizing the use of SSGI could be brought forward for adoption.

Revise Regulatory Framework

There are regulatory considerations for SSGI implementation, in addition to addressing logistic issues and overall risk management. As noted previously, both cities are NPDES permittees, yet current stormwater requirements differ across the cities and WMOs. If elected/appointed officials choose to move beyond pilot projects into a long-term implementation mode, it will likely require modification of existing stormwater rules and local ordinances.

Pertinent topics (not necessarily exhaustive) to scrutinize at a finer level of detail would include:

› **On-site management.** The current CRWD rules require an applicant to follow a regimented series of stormwater compliance steps, the first requiring stormwater be managed on-site (Rule C.3(2)i). Both municipalities reflect that stormwater must be managed on-site (e.g. Minneapolis Chapter 54.70(1)a.1.; Saint Paul Chapters 69.504b and 63.319(a)). Minneapolis does have provisions for off-site stormwater management considerations but the wording indicates that provision is not to be used to circumvent on-site requirements. Flexibility would need to be incorporated into these processes to allow shared facilities when their use provides public benefit.

› **Encroachment.** Cities of Saint Paul and Minneapolis both have requirements relating to encroachments into the right-of-way, which can potentially inform successful SSGI implementation.

› **Code consolidation.** The City of Saint Paul has multiple locations for expressing stormwater management requirements. Any revisions would need to include all locations to ensure there are no conflicts or discord.

› **Green requirements.** Cities of Saint Paul and Minneapolis have regulatory tools which, in certain circumstances, encourage the use of natural features and vegetation in stormwater management. (Minneapolis Chapter 54.70(3)ii; Saint Paul Chapters 63.319(b)1 and 66.344(b)5) These could be expanded or adapted to better support stacked-function green infrastructure implementation.

Jurisdictional stormwater regulations need to be reviewed and modified to remove or clarify regulations that specifically prohibits or discourages SSGI implementation. At minimum, regulations could be amended to create a section specific to shared, stacked-function green infrastructure, and potentially incorporate a "pre-approved" status for redevelopments that utilize a shared system for which overall design and performance criteria has been established and verified (e.g., a Master Plan).

Additionally, the City of Saint Paul has a charter prohibiting the diversion of park uses (Saint Paul Chapter 13.01.1). Through SAC discussions, it was determined that retrofitting SSGI into existing Green Line parks (within Saint Paul) would not be a high priority. Given that SSGI can be used as tool to assist with the development of new Saint Paul parks along the Green Line, its use should be strongly considered. Before this tool can be realized, Saint Paul will need to evaluate if changes are necessary to the existing charter to allow for the incorporation of SSGI in new parks along the Green Line. To that end, the City has already developed an official interdepartmental Cooperative Agreement that has been used to retrofit existing parks for large-scale stormwater runoff reduction. The "Green Line Parks and Commons" analysis being prepared by the Trust for Public Land may provide further clarification on this issue.

Institutionalize SSGI into Agency Processes

The institutionalization of SSGI into agency processes is critical to its implementation. The feasibility of SSGI should be discussed between implementing agencies and developers early in the development process, before significant time or funds are invested in developing a traditional site plan. Traditional review procedures, such as site plan review, occur too late in the development process to introduce SSGI discussions as developers have already invested time and funding into the plans being brought forward for agency review. Therefore, SSGI implementation may require modifications to existing agencies processes to allow for early discussion and evaluation.

The implementation of SSGI is not limited to the redevelopment of individual parcels. There are a number of scenarios that could trigger SSGI feasibility discussions, such as:

› Street reconstruction project

› Replatting assembled land(s)

› Construction project requiring stormwater management permits

› New public facility construction (e.g., schools, libraries, parks)

› Development of a small area master plan or stormwater retrofit analysis

Inserting SSGI feasibility discussions and evaluations into these agency processes is a key step in institutionalizing SSGI. An additional step is to identify opportunity and high priority sites, for example as shown in Appendix **D**.

SSGI may provide cost-efficient stormwater management for runoff from small parcels that otherwise would not employ treatment in the near future. Therefore, the development of a retrofit program that provides a process to initiate the SSGI feasibility discussion, evaluate opportunities and identify potential funding mechanisms may be advantageous. A retrofit program would likely parallel Philadelphia's Stormwater Management Enhancement District, described under National Precedents in this report.

Implementation Tools

The successful implementation of SSGI entails the creation and use of multiple tools to educate Green Line development stakeholders about TOD benefits that can be achieved through the use of SSGI. The tools also serve to assist agencies with incorporating SSGI feasibility evaluations and implementation as standard practice. The following tools have been developed as base templates that agencies can modify to meet their agency's specific needs and goals.

SSGI ASSESSMENT TOOL

Given that a number of factors must align in order to utilize SSGI, the determination whether SSGI is feasible needs to occur on a case-by-case basis. This study suggests that agency staff use an assessment tool to help evaluate whether SSGI would be appropriate. A sample assessment tool template, as shown in Figure 3.1, provides a series of questions that agency staff can ask early in the development process to assess whether SSGI is a tool that can be used to further the goal of TOD for the proposed project at hand. This tool is envisioned to be used by agency staff that first interact with the development community, as an early determination of feasibility is essential if SSGI is to be successfully implemented.

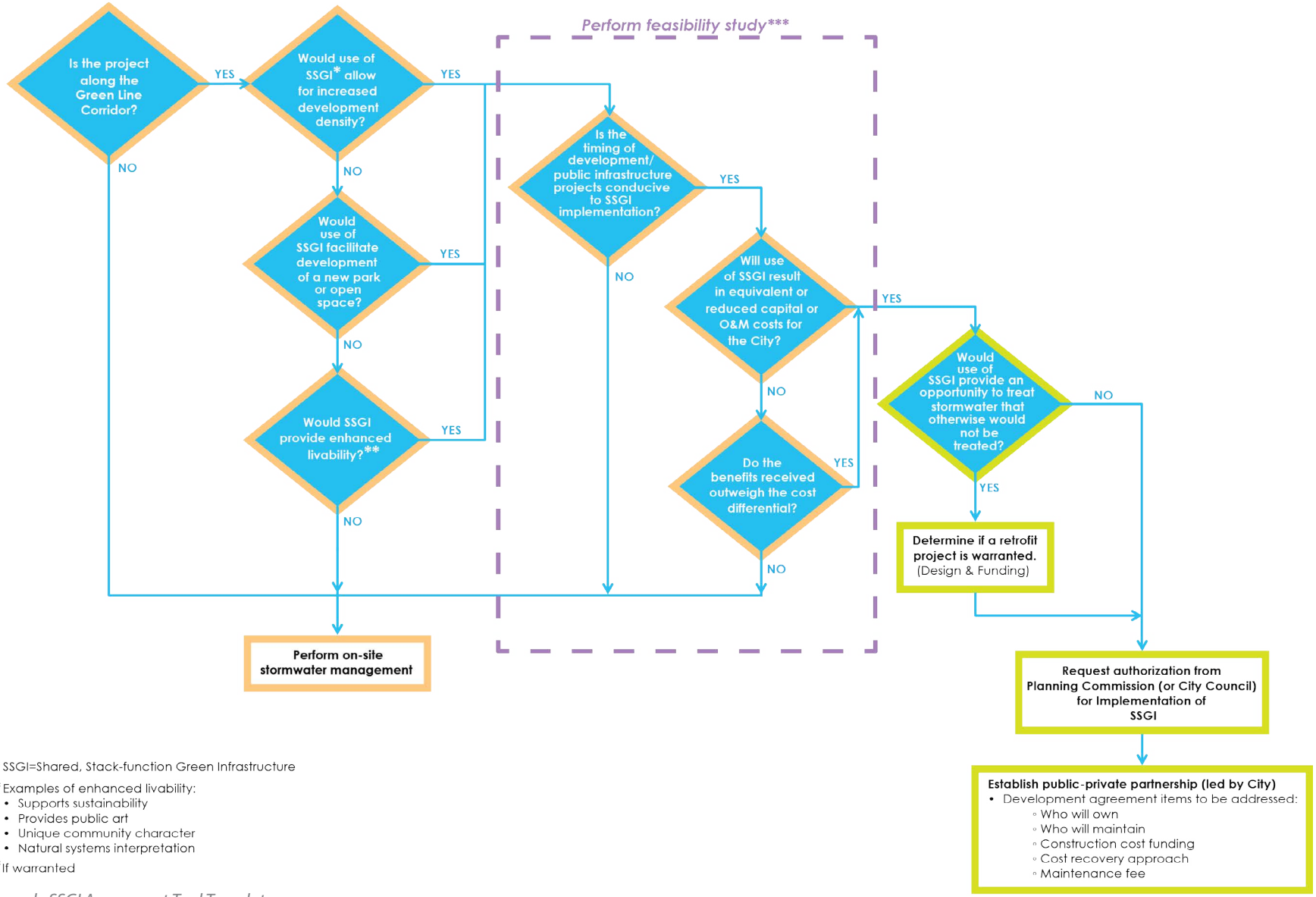
DECISION-MAKING FLOWCHARTS AND MATRICES

Numerous options exist for how SSGI can be implemented and funded. At times the multitude of options and complexity of funding options can appear to be overwhelming. To assist agency staff with the evaluation of funding options, a series of sample flow charts and matrices templates have been developed that articulate the various funding options currently available. The flowcharts are designed to lead agency staff through a series of questions and then provide funding alternatives based on answers provided. The matrices provide more detail about the opportunities and constraints associated with the various funding options. Additional information on these tools can be found in Appendix **F**.

PILOT PROJECT EDUCATIONAL AND OUTREACH MATERIALS

Educational and outreach materials should be utilized to inform Green Line development stakeholders about potential pilot opportunities, if a community is interested in advancing SSGI approaches. The audience primarily would involve developers, but also could help inform elected/appointed officials about TOD benefits that can be achieved through SSGI pilot projects. The materials help provide a consistent message about current stormwater challenges, the intent of SSGI and the potential opportunity, given that SSGI use is not formally adopted.

Education and outreach materials may be useful when a developer begins initial dialogue with the city, a Green Line neighborhood group, or other early stages of property redevelopment. The materials can be complementary to existing resources such as Saint Paul's *TOD Guidebook for the Central Corridor*. At a minimum, the outreach materials can help encourage and foster site designs that more creatively incorporate natural vegetation into stormwater management. A sample brochure can be found in Appendix **F**.



*SSGI=Shared, Stack-function Green Infrastructure

**Examples of enhanced livability:
- Supports sustainability
- Provides public art
- Unique community character
- Natural systems interpretation

***If warranted

Figure 3.1 Sample SSGI Assessment Tool Template

Public Art Implementation

The implementation of the 'FLUXion ≈ gARTens' concept along the Central Corridor is contingent upon establishing community buy-in and support for the concept, along with the commitment from an arts organization to facilitate and coordinate its implementation. Similar to SSGI, educational and outreach materials need to be developed to inform the community about the stacked-function benefits that FLUXion ≈ gARTens can provide to the Green Line and surrounding community and to develop community support for voluntary implementation. With the City's adoption of the public art ordinance in 2009, a mechanism is in place to implement artworks into public projects. Yet, in order for FLUXion ≈ gARTens to be successfully implemented, gardens in the network must be implemented beyond public projects. The development community must see the value FLUXion ≈ gARTens will provide for their properties and want to participate using their own funds or through a competitive grant process.

Finally, an arts organization must also find value in the concept and volunteer to market, find funding, and oversee its implementation. In addition to traditional arts funding foundations and existing arts grant programs, the stacked-function of FLUXion ≈ gARTens (i.e., stormwater or plant identification, stormwater education, and urban agriculture) may open up other potential construction and maintenance funding sources such as health improvement grants, job training programs, MWOs, or educational institutions. Additional information on public art implementation tools can be found in Appendix **G**.

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Findings & Conclusion Chapter 4

The Green Line has established a remarkable precedent with respect to implementing green infrastructure via the extensive tree trench system and other practices. This provides a critical fulcrum to leverage additional green infrastructure investment to achieve a vibrant corridor.

In a highly urban corridor, SSGI represents a balancing of risk, roles, and responsibilities (particularly for city departments where competing interests can exist) in the context of broader triple-bottom line benefits. Leadership from elected/appointed officials will be necessary to effectively support and advance this strategic stormwater solution initiative. This may involve adopting resolutions, sponsoring code modifications, supporting or authorizing taxing districts, or other similar actions.

Flexibility Supports Vision

Stormwater management is currently performed on a parcel-by-parcel basis and segregated between private and non-private ownership. This is done to address mandates for on-site compliance, manage risk exposure for long-term maintenance demands, and simply due to the fact that urban parcels redevelop in a sporadic manner making it difficult to coordinate shared facilities. In practice, in dense urban areas the status quo often results in development managing stormwater underground.

Yet, there are key events such as the construction of major infrastructure projects like light rail transit that trigger concentrated redevelopment where sharing of stormwater facilities may be feasible and conducive to the creation of desired TOD. This is of particular importance for small, space-constrained, urban redevelopment parcels where numerous programmatic requirements are competing for valuable space. In these situations, flexibility could be provided in the current stormwater management approach to allow for SSGI implementation, if doing so would be beneficial in achieving the community's corridor vision of green, vibrant, sustainable neighborhoods.

Define a Process

SSGI can be successfully implemented, but will likely involve a case-by-case approach. Therefore, processes – such as decision trees or screening methods – must be put in place to assess its feasibility early in the development process. Tools such as flowcharts identifying necessary incremental commitments must also be in place to assist agency staff and developers to efficiently structure a SSGI approach that creates a balanced approach for funding and risk management. These processes and tools must be general enough to work across a variety of possible development scenarios while acknowledging many stakeholders may potentially participate.

The SSGI Assessment Tool (in combination with an outreach brochure) is essential to establish a structured dialogue to identify where a potential project may be feasible, while also maintaining baseline expectations for stormwater management.

Development Scale is Important

While there are likely more, this study identified four SSGI approaches (Parks, Parking, Alleys, and Street Right-of-Way) that successfully provide triple bottom line benefits supportive of TOD. In addition, the study indicated that several of these approaches lend themselves more strongly to a particular scale of development. For example, while green alleys can be incorporated into all scales of development, this approach is a more viable option for use with small scale development projects than the parks approach. Likewise, a structured parking approach is better aligned with an urban village development scale. Figure 4.1 highlights the applicability of the four SSGI approaches to different development scales.

Potential for Financial Balance

Government units have broad authority and multiple options to raise revenue for SSGI costs. This will likely require significant political leadership. Yet a financially "neutral" funding source is preferable, rather than relying upon grants or general funds solely from one municipal department. A financially neutral funding source, such as a tax district, allows for greater equity and predictability by virtue of collecting funds from directly benefiting properties.

Compared to estimated costs for stormwater facilities on an individual parcel basis, SSGI estimated costs result in net capital cost efficiencies overall. However, a challenge is developing a cost recovery approach that will fairly distribute the reduced costs to all parcels sharing the stormwater facility. For example, analyses herein that allocated costs based on contributing

runoff volume (or impervious surface) resulted in some parcels realizing a relative cost increase compared to stormwater management being performed on an individual parcel basis. This allocation method is just one possibility; there may be other suitable allocation methods, depending on how SSGI is approached.

Therefore, careful consideration must be given when determining funding sources and developing cost recovery approaches for SSGI to ensure a balanced distribution of costs and benefits. Specifically, SSGI implementation will place a significant emphasis on the use of development agreements, license agreements or similar formal tools to address financial and obligatory arrangements. These tools will establish acceptable requirements, fees, noncompliance recourses, and other practicalities including long term responsibilities and liability. Fees, responsibilities and liability must run with the land. As a practical matter, license agreements should first be executed to formalize these arrangements, and then be incorporated as an exhibit to a development agreement.

Be Opportunistic

Runoff from untreated, small parcels that otherwise would not redevelop (i.e., employ stormwater management) in the near future can be effectively included in SSGI projects. SSGI provides an approach to opportunistically realize "excess capacity" in stormwater treatment in a cost effective manner, which may be utilized as a banked or brokered commodity depending on regulatory frameworks. By casting a wide net on how much drainage area is potentially included in a SSGI project, larger gains in water quality can be attained with minimal additional cost. This is very useful in a corridor where overall redevelopment is very incremental (especially small sites) and public land control is very limited. This may warrant the discussion or development of a retrofit program to capitalize on these opportunities when they arise.

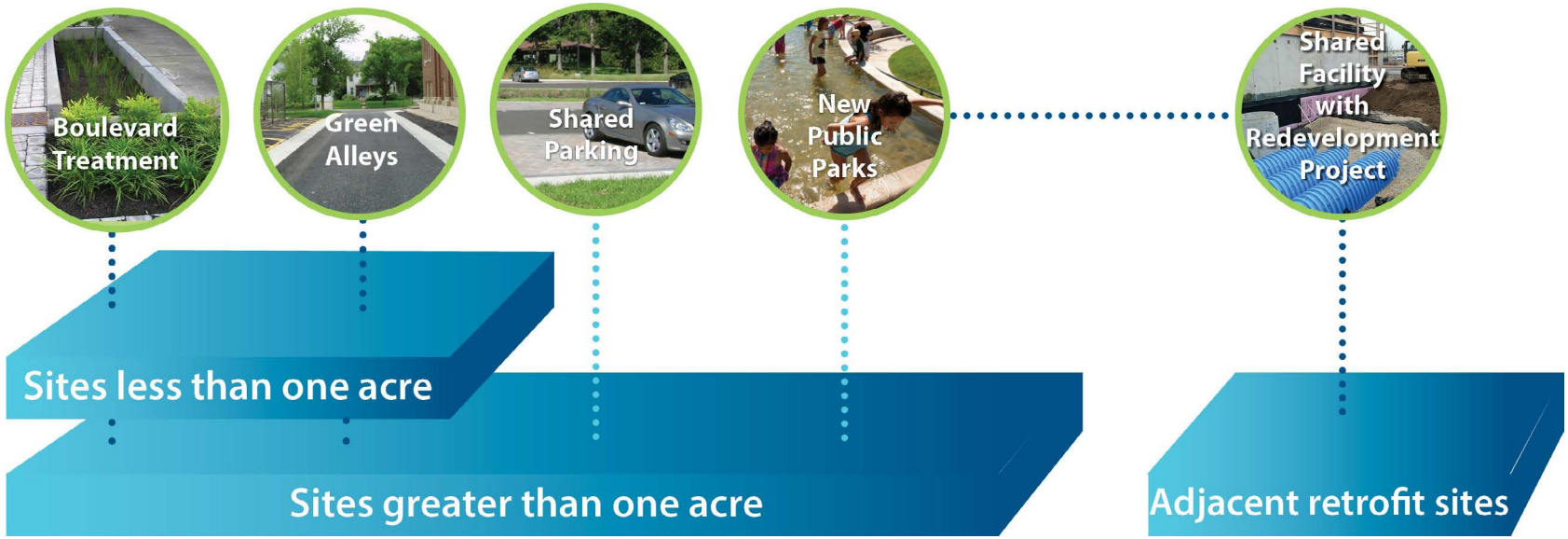

Figure 4.1 Possible SSGI Implementation Approaches