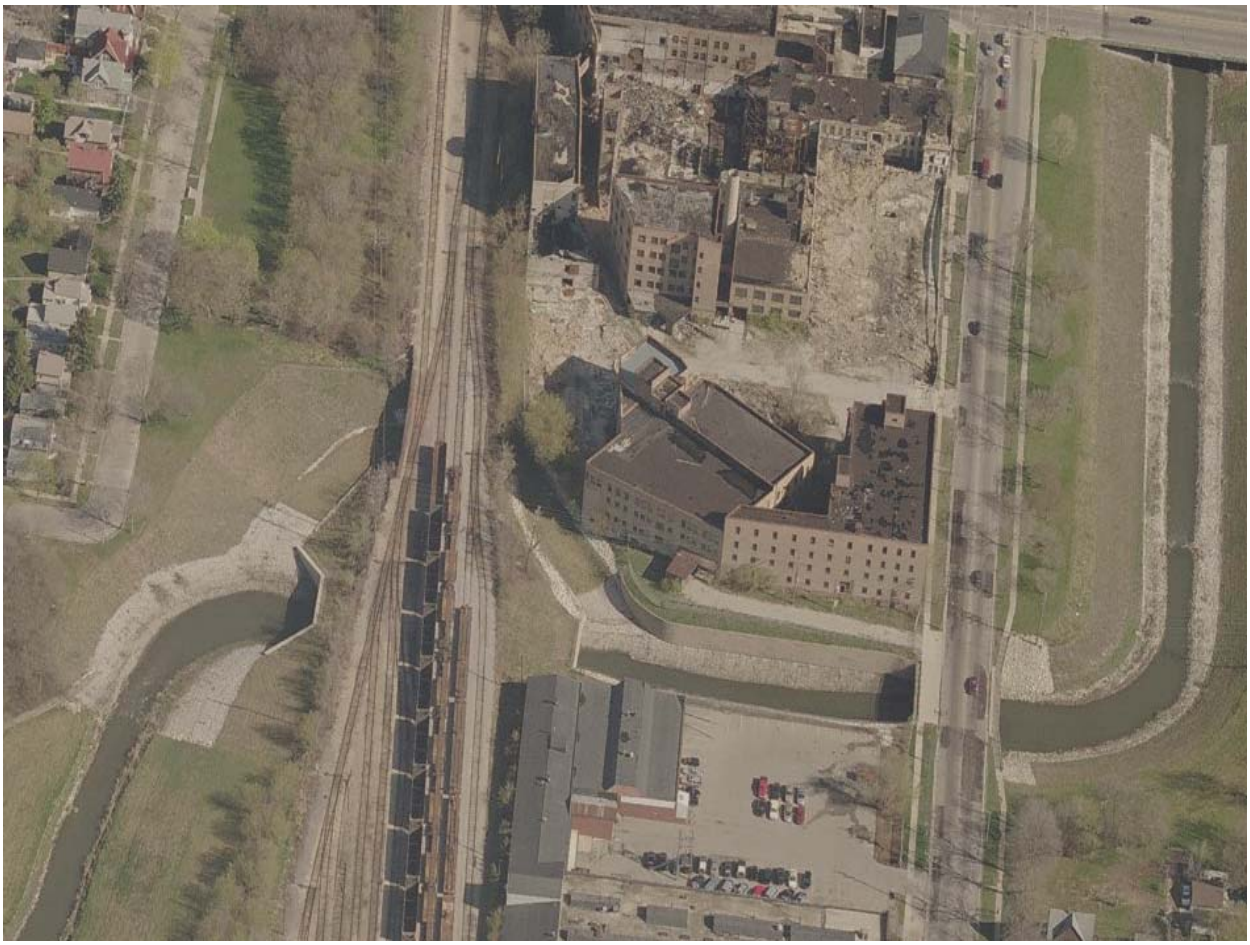

City of Milwaukee Department of City Development
Developing a Regional Approach to Storm Water Management in the 30th Street Industrial Corridor

Summary Report
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Submitted to
City of Milwaukee Department of City Development

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I. Introduction

Under natural conditions, most of the water that falls on earth is used by plants, evaporates into the air, or seeps into the soil and becomes groundwater. Water that does not evaporate or infiltrate into the ground is called runoff. As a watershed develops, natural areas are converted into fields, lawns, rooftops, roads, and parking lots, which reduce the amount of land available for the natural evaporation or infiltration of water into the ground. Water that falls on these surfaces quickly flows to our streams through the storm water drainage and sewer system. This urban condition contributes to the degradation of our water resources in a number of ways including the movement of pollutants from the urban landscape into our surface and ground water resources.

Nonpoint source pollutants such as oil and grease, road salt, eroding soil and sediment, metals, bacteria from pet wastes, and excess nutrients (nitrogen and phosphorus) from fertilizers are washed from streets, buildings, parking lots, construction sites, lawns and golf courses into streams and, ultimately, Lake Michigan. This pollution reduces the quality of our streams for aquatic life, as well as for human uses such as fishing, swimming, and bird watching. These pollutants accumulate as the water flows downstream and eventually begin to degrade the quality of Lake Michigan for similar and other uses. In this way, every small bit of pollution adds up to a very large problem. And in this way, every small action to reduce the pollution problem adds up for the greater good for everyone. Storm water management planning to improve water quality is one of the goals of this study, the State of Wisconsin, and the City of Milwaukee, and is one strategy for reducing the impact of runoff on our natural resources.

In an urban environment such as Milwaukee, commercial and industrial land uses have typically been clustered around rail and river corridors due to the ready access to transportation and a source of water for industrial processes. The 30th Street Industrial Corridor is one such concentrated area of industrial land uses. Unfortunately, these uses also typically involve chemicals and materials that, if allowed to enter the environment or the public realm, can be harmful to human health and environmental resources. Thus, efforts to manage nonpoint source pollution within the Corridor must also address these potentially harmful chemicals and materials.

At its peak, the industrial activity in the 30th Street Industrial Corridor supported many jobs for residents of this and outlying neighborhoods. However, as manufacturing has declined across the country, areas such as the Corridor experienced a loss of business and jobs as well as the consequent disinvestment in neighborhoods that naturally accompany an economic slowdown. Reinvestment and revitalization of the 30th Street Industrial Corridor and surrounding neighborhoods is an additional goal of the City of Milwaukee.

It is this combination of storm water management and economic development that is the subject of this study. Environmental and economic health are direct reflections of the type and location of land use activities, how we live in and manage our urban landscapes, and opportunities for engagement of the local population. The business-as-usual trajectory, using conventional development and storm water management practices, will result in continued degradation of water resources. However, a new trajectory that incorporates proven and environmentally-friendly storm water and landscape management practices can reverse this trend and begin the road to recovery.

II. Project Goals and Context

The City of Milwaukee is working with local, state and federal partners on a plan to redevelop the 30th Street Industrial Corridor, which is in need of revitalization and reinvigoration following a slowdown in economic activity. The Corridor has been declared a "Greenlight District", which means that it has been targeted by the City for reinvestment through Tax Incremental Financing and other economic development tools to attract and retain businesses and retain or create new jobs. Opportunities within the Corridor include underutilized industrial sites, nearby major transportation routes, and a large and eager workforce. The City intends to work within the Corridor to attract business and jobs, improve infrastructure, and improve existing residential and commercial areas.

This report summarizes the project designed to examine and develop ways to encourage economic development within the 30th Street Industrial Corridor by implementing sustainable storm water management strategies that help the City meet state water quality objectives. The project demonstrates how innovative storm water management practices can be integrated into a mixed-use built environment by taking advantage of opportunities within the right-of-way, on underutilized land, on public land, and in other areas where the landscape can be retrofit. Recommended program elements also consider community greening and aesthetic improvement and the initial (capital) and ongoing (maintenance) costs of implementation. The study area, which contains multiple land uses, is a test case for the City to help evaluate integrated storm water practices and economic development strategies that may be applicable in similar neighborhoods.

The project has three phases:

1. Phase 1 – Regional Storm Water Planning: identify program elements to be included in the study area plan.
2. Phase 2 – Engineering and Policy Recommendations: test and evaluate ability of storm water management alternatives to meet program water quality objectives.
3. Phase 3 – Implementation Plan: develop an implementation plan with estimated project costs.

The project is being directed by an Advisory Committee consisting of stakeholders and representatives from the City of Milwaukee Departments of City Development, Public Works, and Administration; Milwaukee Metropolitan Sewerage District; the U.S. Environmental Protection Agency Region 5; Wisconsin Department of Natural Resources; 30th Street Industrial Corridor Corporation; Milwaukee Riverkeeper; consultant to Menomonee Valley Partners; Groundwork Milwaukee; University of Wisconsin – Extension; and the Center for Resilient Cities. Funding for this project is provided by an Urban Nonpoint Source & Storm Water Planning Grant from the Wisconsin Department of Natural Resources and local matching funds.

III. Project Area (site context and conditions)

The 450 acre study area is located in north central Milwaukee and is bounded by West Hampton Avenue on the north, North 35th Street on the west, North 27th Street on the east, and West Concordia Avenue and West Townsend Street on the south. It is bisected north-south by Capitol Drive and east-west by the Soo Line (also known as Canadian Pacific or Wisconsin & Southern) Railroad corridor (see Appendix A Maps 1 & 2). A recently reconstructed reach of Lincoln Creek crosses through the study area to the north, and its floodplain does not appear to extend beyond the generous riparian corridor (see Appendix A Map 4). The area slopes generally towards the rail road corridor and Lincoln Creek in the center and north of the project area (see Appendix A Map 5). In fact, the majority (possibly all) of storm water runoff in the study area outfalls directly to Lincoln Creek and then to the Milwaukee River, both considered "impaired water bodies" and included on USEPA's 303(d) list. The study area is within the Separate Sewer system; an area of Combined Sewer system lies to the south (see Appendix A Map 7). Note that the former Tower Automotive site (a.k.a. Century City) is currently served by a combination of combined and separate sewers, but upon its redevelopment, it will likely be entirely separated; therefore it is included in the project study area.

Brownfields are present in the study area and will require special consideration in this study. Brownfields are abandoned or underused industrial and commercial facilities that are available for re-use but where expansion or redevelopment may be complicated by real or perceived environmental contamination. A number of Leaking Underground Storage Tank (LUST) sites and Environmental Repair (ERP) sites are located within the study area, which is to be expected given the Corridor's industrial legacy. Generally, a LUST site has soil and/or groundwater contaminated with petroleum. ERP sites are sites other than LUSTs that have contaminated soil and/or groundwater such as industrial spills or dumping and buried containers of hazardous substances. Many of these LUST and ERP sites have been closed and the issues for which the site was listed have been addressed (see Appendix A Map 6). The WDNR should be consulted as to the current state of LUSTs or ERPs. The status of these sites can change but the tracking number associated with the site remains the same, even after the site is remediated or otherwise closed.

Land use is fairly diverse within the Corridor, as shown in Table 1 and Map 5 (Appendix A). Manufacturing, construction and warehousing parcels make up 41% of the area (185 acres) but only 3% of the 920 parcels. Residential land use, on the other hand, makes up only 19% of the study area (85 acres) but 85% (781) of the parcels. To understand approximately how much of the study area has the potential to be developed or redeveloped, and would thus be required to meet the City's storm water standards (described below), this study assumes that residential land uses, transportation uses, and public and quasi public land uses (including schools, churches, and parks) are unlikely to be redeveloped. Commercial, industrial, and business land uses, as well as vacant and mixed use land uses, however, have a greater potential for redevelopment. This assessment did not conduct a parcel-by-parcel assessment to determine which are developable or underutilized.

Approximately 82 parcels making up 245 acres have the potential to be developed or redeveloped (vacant land, commercial, wholesale, retail, services, manufacturing). Of those parcels that potentially could be developed or redeveloped, 35 parcels (234 acres, 95%) are equal to or greater than 1 acre in size and may require storm water management measures be taken to meet state and local requirements (see Table 2).

Table 1 Land Use Summary

Number of Parcels	Land Use Category	Re-developable?	Area (acres)
477	Residential - Single Family	N	50
257	Residential – Duplex	N	27
47	Residential - Multi-Family	N	8
25	Manufacturing, Construction and Warehousing	Y	185
16	Wholesale and Retail Trade	Y	24
17	Vacant Land	Y	22
11	Services, Finance, Insurance and Real Estate	Y	9
4	Commercial - Mixed	Y	5
9	Mixed - Commercial and Residential	Y	1
19	Public Schools/Buildings, Churches, Cemeteries, Quasi-Public	N	66
33	Public Parks, Quasi-Public Open Space	N	48
5	Transportation	N	6
920	**Total**		**450**

Table 2 Developable Parcel Size

	Number of Re-developable Parcels	Total Area (acres)
Parcels w/Area => 1 acre	35	234
Parcels w/Area < 1 acre	47	12
Total	**82**	**245**

IV. Programmatic and Regulatory Framework (state and local programs and regulations)

Regulatory Framework

Development within the 30th Street Industrial Corridor will be regulated by a number of state and local regulations.

The Wisconsin Administrative Code section NR151 has separate requirements for the City and for land development. NR151.12 requires development to comply with storm water runoff performance standards for construction sites and post-construction storm water management.

NR151.12 requires 80% Total Suspended Solids removal for new development or 40% for redevelopment. Peak discharge rates for post-development conditions must be equal to or less than the rates for pre-development conditions. Infiltration standards also exist for residential and non-residential developments. Exemptions from these standards exist for redevelopment projects with no increase in parking lots or roads and for sites with less than 10% impervious area if the area of parking lots and roofs is less than 1 acre. The majority of redevelopment projects within the Corridor would be exempt from NR151.12 since most parcels are already mostly impervious and post-construction requirements for NR151 are exempted when there is no increase in "exposed parking lots and roads." Peak discharge rates requirements exemptions include projects that result in an insignificant change in hydrology, redevelopment projects, and in-fill development less than five acres. Infiltration requirement exclusions are offered for sites that prohibit the use of infiltration, such as industrial land use, low infiltration soils, high groundwater, or contaminated soils. Infiltration requirement exemptions exist for redevelopment areas, in-fill development less than five acres, and on sites with low infiltration soils or high groundwater. It should be noted that Section NR151 is currently under review and there may be changes to the exception for redevelopment.

Under Section NR151.13, major cities in Wisconsin, including Milwaukee are mandated to reduce their existing TSS load by 20% by 2008 and by 40% by 2013. The purpose for this project is to identify strategies and projects the City can use to meet these standards within the 30th Street Industrial Corridor.

Chapter 13 of the Milwaukee Metropolitan Sewerage District (MMSD) Rules defines minimum storm water management requirements within the sewer service area for runoff to watercourses under MMSD jurisdiction. Runoff management to control release rates is required for projects that increase impervious surface by 0.5 acres or more to prevent increases in regional flooding and stream bank erosion. For the 2-year storm and the 100-year storm, maximum release rates are 0.15 and 0.50 cubic feet per second per acre, respectively. Runoff management is not required for some residential infill projects and if the area of impervious surface after development will be 5% or less of the total area of the site.

Chapter 120 of the City of Milwaukee Code of Ordinances, titled *Storm Water Management Regulations*, requires a storm water management plan and maintenance requirements for development and redevelopment projects that result in a land-disturbing activity of one acre or more or that cause an increase of 0.5 acres or more of impervious area. The Milwaukee Metropolitan Sewerage District Chapter 13 release rates are enforced for projects that increase impervious area by 0.5 acres or more.

Projects that result in a land-disturbing activity of one acre or more (but that do not increase impervious area by 0.5 acres or more) are required to reduce peak flows by 10% (as compared to pre-development conditions. Chapter 120 also requires the following removal rates for TSS for projects in the separated sewer area (in the combined sewer area, only the runoff quantity requirements need to be met): 80% for new development; 40% for redevelopment; and 40% for infill development less than 5 acres. The City's *Manual of Storm Water Management Practices* includes guidance for the preparation of storm water management plans, details and specifications for BMPs, and maintenance plan requirements (available at: http://www.ci.mil.wi.us/router.asp?docid=12934).

The City's **storm water management utility** is discussed in section X Storm Water Utility Recommendations.

City Projects and Programs

A number of the City's projects and programs are relevant to the goals of this project. The City Department of Public Works has installed bioretention / filtration facilities into street right of ways within the parkway between the sidewalk and street. Several of these occur on 27th Street between Capitol and Roosevelt, where 14 bioretention planters were recently installed along with educational signage. The cost of this project was higher than anticipated and more difficult than expected due to subsurface utility lines that could not be moved or disturbed. Bioswales have also been installed on 91st Street, Grange Avenue, and in the Pabst redevelopment area (N. 9th Street and W. Winnebago St.) The Housing Authority of the City of Milwaukee is constructing the first green alley in the city. As another approach to improve water quality, the City installed storm water treatment units at two sites within the street right-of-way on West Hope Avenue and North 31st Street in the Corridor to treat approximately 10 acres each (20 acres total).

The Menomonee Valley Storm Water Park (also known as the 35th Street project) to the south and west of the project area is a 15-acre, regional scale green infrastructure element designed to detain flood water and remove 80% TSS. The storm water management areas have been integrated into a larger area that includes natural areas, open space, playing fields, and the Hank Aaron State Trail. It provides storm water management for an adjacent 60-acre industrial center for manufacturing redevelopment. A related project on 25th Street is designed to achieve 40% TSS reduction.

The Department of Public Works Capital Improvement Plan for Paving includes road maintenance work for a number of streets within the Corridor. The projects include pavement resurfacing, pavement reconstruction, curb and gutter, and streetscape improvements. These projects provide opportunities to integrate water management into existing construction projects, increasing the cost-effectiveness of right-of-way storm water management. These are discussed further in the "Capital Improvements on Public Property" section, below.

The Milwaukee Sustainable Boulevards program is focused on beautification of the streetscape and reduction of management costs through the installation of street trees and removing flower and shrub beds from the right-of-way. The 30th Street Industrial Corridor Corporation is planning a streetscape improvement program along Capitol Drive and includes crosswalks, lighting, trash receptacles, and benches. While this program is focused on reducing maintenance costs associated with boulevard planting beds, there may be opportunities to integrated bioretention and other measures while making improvements to the boulevards.

The City Department of Public Works has made three attempts to implement a downspout disconnection program. The program offered to have the City disconnect downspouts for free, and cash

rebates for homeowners choosing to disconnect their own downspouts. However, the program was not considered successful due to a general lack of homeowner interest and participation, resulting in approximately 300 homeowners participating out of 3,000 contacted. The DPW continues to encourage this as a storm water quantity control BMP, but there currently is no formal implementation program or assistance offered.

The Near North Side Area Planning project is currently underway and will develop a sub-area plan for the area surrounding the 30th Street Industrial Corridor. The plan is intended to build upon the strengths of the neighborhoods and encourage economic development. There is an opportunity to integrate storm water management into this plan.

The City of Milwaukee Forestry Department, in partnership with Milwaukee Public Schools, has also instituted a Green Schools program that uses federal grant money to replace asphalt with sod and trees. The program started in fall of 2008 with ten schools, one of which is on hold pending additional funding. The program now includes 15 schools (see list below). Under the City's green roof program, a green roof has been installed on the city owned building at 809 North Broadway, which was partially funded with Milwaukee Metropolitan Sewerage District grant funding.

1. French Immersion School
2. Greenfield School
3. Hawley Elementary
4. Spanish Immersion School
5. Humboldt Park School
6. Hartford School
7. Pierce School
8. Sherman Multicultural School
9. Urban Waldorf School
10. The Lincoln Center of the Arts (on hold pending additional grant funding)
11. Maryland Avenue School
12. Fernwood Elementary School
13. Cass Street School
14. Wisconsin Conservatory of Lifelong Learning
15. Starms Elementary School

V. Storm Water Management Strategies and Discussion

Communities across the country have taken a variety of approaches and measures to improve the management of water resources. Strategies range from purely regulatory approaches, which mandate developments to meet specific standards, to providing incentives and education to encourage behavior change. To be applicable to the 30th Street Industrial Corridor, it is clear that a number of the programs would have to be paired with other programs to help ensure successful implementation. For example, a rain garden program requires landowner education on maintenance and management. Strategies and examples of communities that have implemented them are presented below along with a discussion of relevance for Milwaukee's 30th Street Industrial Corridor. A summary of the researched communities and strategies is provided in Appendix B.

DRIVERS FOR PRIVATE SECTOR ACTION

Storm Water Ordinance

Storm water ordinances may be written to control both the quality and quantity of storm water runoff. Typical ordinances require that projects match pre-development runoff conditions or meet specific release rates and allowable runoff volume, which may be based on the capacity of the receiving sewer or water body. Water quality control requirements, many of them related to specific pollutants such as Total Suspended Solids or Total Phosphorous, are also written into many ordinances. Storm water ordinances typically include a site or impervious surface area threshold that triggers the ordinance requirements. All the ordinances reviewed are applied to new development but only some apply to redevelopment, particularly when there is no increase in impervious cover.

Philadelphia's ordinance allows projects that reduce the connected impervious area by 20% over the predevelopment condition to be exempt from channel forming and flood control detention requirements. It also suggests that projects over 5 acres practice water reuse and conservation and use BMPs to improve water quality. The State of Maryland requires the use of Environmental Site Design (i.e., low impact design using BMPs) to the maximum extent practicable to meet predevelopment runoff conditions (defined as "woods in good condition")., while redevelopment projects must reduce imperviousness by 20% or manage the quality of 20% of the impervious area with BMPs. Washington DC requires green roofs on new buildings unless the developer can prove that it is infeasible. Other communities establish stricter requirements in areas with sensitive receiving water bodies.

The ordinances and regulations that apply to Milwaukee (NR151, Chapter 13, and Chapter 120) generally require infiltration, peak flow control, and water quality control. As previously described, standards do not apply below certain thresholds. Within the Corridor, it is likely that most redevelopment would not increase impervious area and therefore the infiltration and rate control standards would not apply. However, there are many parcels that exceed one acre and therefore the water quality standards (40% TSS removal for redevelopment) could apply to many development and redevelopment projects in the Corridor as suggested by the numbers in Table 2, above.

Modifying the City's ordinance to increase applicability, though not perceived to be a significant economic investment for the City, is unlikely to be a popular storm water management approach since the ordinance was recently updated and additional regulations are rarely popular, particularly in an area attempting to attract redevelopment. However, the City should consider revising the ordinance within the next 5 years to expand the range of conditions (i.e., lower the threshold) that would trigger the ordinance and remove exemptions and exceptions. Such changes should initially be coupled with additional incentives and assistance programs to help reduce the burden on the regulated community

until the new standards become business-as-usual. Efforts to modify the storm water ordinance should be coupled with a code compatibility assessment to remove obstacles to storm water management.

Storm Water Utility Fee and Discount

A storm water utility fee is a charge levied to landowners for the use of a community storm water management system. The storm water utility fee is similar to fees levied for wastewater and water supply except impervious cover is typically used as the measure of the "service" being provided (as opposed to measured gallons of water or wastewater). Utility fees are typically used to maintain and update the existing sewer system and to fund staffing and other administrative needs for the system. Landowners may be assessed based on a flat annual rate (typically for single family residential) or on impervious area (typically for nonresidential). Ann Arbor, for example, has four residential rate tiers based on ranges of impervious area, and commercial fees are based on the area of imperviousness. Many other communities have similar systems except with only one residential rate.

A number of communities allow landowners to reduce (credit or discount) the utility fee in exchange for measures such as reduction in impervious area (Philadelphia), installation of BMPs and green roofs (Portland), and landowner education. Berlin calculates the credit based on how effective installed BMPs are at reducing runoff. The Charlotte-Mecklenburg region allows 40% of the allowable credit for reducing the peak runoff and 60% for reducing the volume. Minneapolis awards up to 50% fee discount for water quality control measures, a 50% credit for controlling the 10-year storm event on site, and 100% credit for controlling the 100-year event.

Depending on the utility fee rate, the fee has the potential to influence behavior as well as to provide a revenue source for storm water services being provided. If the utility fee is high enough relative to the cost to implement measures to reduce impervious cover or receive fee credits, landowners will be encouraged to implement improvements that reduce runoff or improve water quality.

The City's storm water management utility is discussed in Section X Storm Water Utility Recommendations.

Development Bonuses

Development bonuses can take a number of forms, such as increased Floor Area Ratio (FAR), reduced setbacks, or other measures that allow more square feet of commercial space or residential units to be built than under normal zoning and subdivision standards. A number of communities offer this increased development potential in exchange for storm water management practices that exceed applicable regulations. Chicago offers a density bonus for 50% or 2000 sq. ft. of green roof, whichever is greater. Portland also offers an FAR bonus in exchange for green roof installation within the Central City Plan District. Huntersville, North Carolina allows flexibility in zoning and development standards to accommodate BMPs, such as 25% reduction in setbacks, sidewalks on only one side of street, lower tree and shrub landscaping requirements, and allowed encroachment on required buffers.

Proposing or encouraging increased density in the 30th Street Industrial Corridor study area may not be well received by some neighborhood residents, which is common almost anywhere that increased density is proposed. However, the City Department of City Development uses other bonus-type incentives that are not as controversial such as allowing building to the lot line and easing setback requirements, which may be useful within the Corridor without modifying standard operating

procedures. However, a formal development bonus incentive program would provide greater predictability for developers and likely would increase usage of the bonuses.

Review and Permitting

Expedited permitting and waiving plan review fees are two incentives that effectively reduce the financial burden of administrative processing on a development project. The Chicago Green Permit program, for example, offers three tiers of benefits based on the number of green points earned from a menu of green practices similar to the LEED rating system. Three of the ten menu items have potential storm water benefits. In Tier 1, the applicant receives a permit in 30 days. Tier 2 offers a 30 day permit and waiver of project review fees of $5000 to $50,000. Tier 2 waives review fees and permits a project within 15 days. As an added incentive, the City assigns a single point of contact to shepherd the project through the review process. Philadelphia provides fast track permitting for projects with green roof and permeable paving components. Fast track permitting requires an early design review meeting with the Water Department, which allows the City to request changes early in the design process that would improve storm water management.

For expedited permitting to be an effective incentive, the time it currently takes to receive a permit must be fairly long and/or costly to the applicant. Chicago has a fairly long permitting period, which made the expedited permitting for the Green Permits program an effective incentive. In Milwaukee, permitting can take as little as 4-6 weeks, and it may be unreasonable to expect the City of Milwaukee to significantly reduce permitting time enough to make this a feasible incentive.

Funding, Financing and Economic Development Tools

Funding and financing programs provide development assistance in exchange for implementing BMPs that meet (if the development is below ordinance threshold) or exceed (if development is above ordinance threshold) ordinance requirements. Funding and financing programs to improve storm water management can be structured two ways. They can provide direct funding or financing of storm water improvement projects or improvements (e.g., Wisconsin DNR's Urban Nonpoint Source Construction Grants). The alternative is to couple increased storm water management requirements with existing funding or financing programs that have different underlying purposes (e.g., conditioning TIF financing – whose purpose is economic development – on implementation of advanced storm water measures).

In Chicago, $5000 grants (funded through a Commonwealth Edison settlement) are available for small scale green roofs on residential and commercial properties. Portland's Green Investment Fund, which is funded by the City of Portland and the Energy Trust of Oregon, offers $500,000 per year for projects that exceed local storm water standards. Tax breaks or rebates also reduce the financial burden on developers. New York City offers a one-year tax abatement of $4.50 per square foot (up to $100,000) for green roofs. Financing, on the other hand, provides loans with below-market rates to provide up front funding for green practices. Philadelphia offers storm water assistance loans for nonprofits and churches, which may have trouble meeting storm water requirements otherwise. The State of Ohio authorized the sale of bonds to fund green projects and brownfield redevelopment.

Lake County, Illinois and the Friends of the Chicago River have received block-type grants from the Illinois EPA Section 319 program for the Chicago River watershed. Under this program, Lake County and the Friends receive an annual allocation of funds that they then use to award grants to local municipalities and organizations to implement BMPs. The Wisconsin DNR may be able to award the City

a block grant to provide funds to Corridor businesses to retrofit and implement BMPs in redevelopment projects. However, the funds could not be used to meet permit requirements.

The Milwaukee Metropolitan Sewerage District provides direct grant assistance for implementing storm water best management practices to improve water quality and to demonstrate the importance of storm water best management practices in managing the volume, rate and quality of storm water runoff. Green roofs, permeable parking lots, rain gardens, and wetland detention basins have all been partially funded using MMSD grant funds. Grant funds have ranged from $26,000 to $682,000. Additional information on this funding source is included in the Landowner Assistance section below.

The City of Milwaukee commonly uses Target Investment Neighborhoods (TINs) to incentivize neighborhood improvement, and these could be used to guide development and storm water management. Overlay districts similar to these are also discussed below. TINs are designed to sustain and increase owner-occupancy, provide high quality affordable rental housing, strengthen property values, and improve the physical appearance and quality of life of neighborhoods. TIN program priorities are exterior, code-related repairs such as roofing, siding, and porch repairs, which are focused in a small area, generally six to twelve city blocks, for three years. Three primary forms of assistance are available in TINs, supported primarily by federal Community Development Block Grants and HOME funding. HOME grants help build, buy, and/or rehabilitate affordable housing for rent or homeownership and provide direct rental assistance to low-income people. The Home Rehabilitation Loan Program offers forgivable and low-interest loans for rehabilitation activities to income-qualified owner-occupants who reside within a TIN. The Rental Rehab Loan Program offers forgivable loans for rehabilitating rental properties located within a TIN. The Buy In Your Neighborhood Program (BIYN) is a special financing program designed to help homeowners purchase a rental property within three blocks on the house in which they live. There are two TINs in the 30th Street Industrial Corridor study area: the Bishop's Creek TIN, which is set to expire at the end of 2010, includes the area from the railroad and Lincoln Creek to 38th Street and from Congress Street to Hampton Avenue. The Eaton Neighborhood TIN, which will expire at the end of 2009, extends roughly from Teutonia/Roosevelt/Atkinson/24th Street to the Soo Line railroad, and from Capitol Street to Ruby Avenue).

Another economic development tool used by the City of Milwaukee is Tax Increment Financing (TIF). A Tax Incremental District (TID) is a special financing district within which TIF is used. TIF enables the City to borrow against the growth of the tax base within the District in order to create a pool of loan resources that can be used within the District. TIF has been used for various types of infrastructure projects in the City such as the RiverWalk and the Menomonee Valley Infrastructure and Storm water Park. There are currently two TIDs in the project area (TID #62 DRS Technologies & Power Controls and TID #72 Bishop's Creek) that are being used for facility upgrades and infrastructure improvement.

In Business Improvement Districts (BIDs), property owners in designated geographic areas voluntarily collect annual assessments which are spent on projects that enhance the local business environment. These may include improvements to the streetscape, marketing efforts, business recruitment activity, and security programs. BID 37 created for the 30th Street Industrial Corridor and managed by the 30th Street Industrial Corridor Corporation extends along the industrial area bordering the Soo Line railroad from West Glendale Avenue on the north to West Brown Street on the south.

The Redevelopment Authority of the City of Milwaukee (RACM), an independent corporation created by state statute, has the authority to prepare redevelopment and urban renewal plans and undertake redevelopment and urban renewal projects to eliminate blighting conditions that inhibit neighborhood reinvestment, to foster and promote business expansion and job creation, and to facilitate new business and housing development. RACM created a redevelopment plan for the former Tower Automotive facility in 2005. This plan incorporates the area bounded by West Capitol Drive, West Townsend Street,

West Hopkins Street, and North 35th Street (subtitled Century City). It is possible that opportunities for storm water management facilities or practices may arise on the Tower site as its future becomes clear.

Landowner Assistance (Residential)

Municipalities and other organizations can provide technical or financial assistance to landowners to encourage changes in behavior (such as reducing the use of phosphorous fertilizers) or to fund storm water BMPs such as rain gardens or downspout disconnection. Technical assistance may include providing design and construction assistance in the form of hands-on assistance, standard 'how-to' details, brochures, and other publications. The high owner occupancy rates make this area good for demonstration and residential assistance programs.

One of the most successful storm water assistance programs in the Milwaukee region is the Milwaukee Metropolitan Sewerage District's Storm Water Reduction BMP Demonstration Projects. Since 2003, MMSD has partnered with about 30 private and public property owners. The program requires a 50% cost share and the District has invested over $3 million in a wide variety of storm water practices. Each project has an educational component and a monitoring requirement. Projects have included implementing rain gardens at local auto salvage yards, installing a green roof at the Milwaukee County Zoo, and constructing a regional bioretention facility in the Menomonee Valley.

Wauwatosa and the Village of Shorewood are partnering with the Milwaukee Metropolitan Sewerage District to fund the installation of storm water best management practices on residential property. In Shorewood, the Village and MMSD have disconnected downspouts from the village storm sewer system on over 500 homes, installed 268 rain barrels, and built 61 rain gardens. In Wauwatosa, the partnership, which includes funding from the Wisconsin Department of Natural Resources, has created a residential rain garden program to help meet their 20% and 40% TSS reduction requirements. The program reimburses property owners $4.00 per square foot (up to $800) to install and maintain a rain garden as well as discounts on rain garden plants. It was reported that additional technical assistance from the municipality on rain garden installation could make the program more popular and successful. Ann Arbor has initiated a mandatory footing drain disconnection program to reduce the load on the sanitary sewer system created by the surge of storm water during rain events. The City pays up to $4,100 to disconnect the drains, which is funded through storm water utility fees. As an added incentive, the homeowner must pay all disconnection costs if no action is taken within 90 days of receiving notice to disconnect the drain. Portland has a similar financial assistance program for downspout disconnection, as well as providing technical assistance for dealing with runoff on site, such as with a rain garden. Rain barrel giveaways and educational workshops are other forms of assistance in use.

Providing assistance to Milwaukee residents and other landowners, such as grant funding and technical aid to install rain gardens, would reduce the number of projects (and associated cost) that would have to be implemented by the City Department of Public Works to meet NR151.13 requirements. Thus, there is financial justification for the City to provide landowner assistance. However, in order to be counted toward meeting NR151 requirements, a maintenance agreement must be in place to ensure proper management and function of the BMPs. Proper maintenance, in turn, would require sufficient landowner education regarding the maintenance and operations associated with BMPs. Therefore grants similar to the Wauwatosa Rain Garden program may be necessary to provide sufficient incentive to obtain maintenance agreement.

Shared System Opportunities

A neighborhood level storm water bank, such as the Menomonee Valley Storm Water Park, could be constructed to meet Chapter 120 ordinance requirements, reducing the design, administrative, and potential land area burden of on-site storm water management. Costs for constructing the storm water facility could then be recaptured as redevelopment projects occur. This would be allowed under MMSD's Chapter 13 requirements. To the extent that the storm water bank provided storm water benefit beyond what would be required of developers under NR151.12, construction of the bank would be an eligible project under the Urban Nonpoint Source Grants from Wisconsin DNR.

Philadelphia allows developers to transfer storm water management practices off site if they can not be addressed on site, as long as the benefit occurs within the same sewershed. Milwaukee regulations also allow off site storm water management provided that facility design standards of the storm water ordinance are met. Philadelphia and Maryland both incentivize redevelopment / infill development by applying heavy storm water management requirements for greenfield development and by waiving some requirements in infill locations.

PUBLIC SECTOR ACTIONS AND INITIATIVES

Capital Improvements on City Property

Capital improvements include best management practices (BMPs) and other built projects on public land that are initiated and funded by the City. These projects typically are the responsibility of the Department of Public Works and are included in the City's Capital Improvement Plan and budget. Demonstration and other visible projects signal the City's interest and investment in the Corridor, which will tend to attract private sector development and investment.

Permeable paving within the parking lane

Projects on public property may include those in the public right-of-way, such as the 27th Street parkway planters and curb bump outs, or the installation of permeable paving during a street reconstruction or resurfacing project. Additionally, projects could be constructed on publicly-owned property such as parks, parking lots, truck and maintenance fleet yards, and vacant properties that have reverted to the public tax rolls. For example, DPW and the County Parks Department could work together to create neighborhood parks with storm water management benefits that may also serve as a neighborhood amenity and attract businesses. It should be noted, however, that practices designed to infiltrate water will have to be examined in the context of other site conditions such as permeability, contamination, and depth of storm sewers.

Street storm water bumpouts

New York City, Chicago, Philadelphia, Portland, Seattle and Milwaukee have all initiated pilot and demonstration projects and programs that fall within this category of strategies, including sustainable programs for streets, rights-of-way, parkways, alleys, public parking lots, rooftops, parks and schools. Portland views most major infrastructure reconstruction projects as opportunities to install Green Streets projects. The list of Milwaukee's street infrastructure maintenance work plan projects included in the City Projects and Programs section above and Table 4 below would be a good starting point for considering public capital improvements. A green alley program similar to that in Chicago may also be a workable solution in the Corridor.

Urban storm water park

Because the Corridor is relatively flat and also largely built out, a single regional storm water solution would not be able to address the runoff from the entire Corridor. Thus, a distributed system that could be composed of multiple neighborhood level and/or a large number of highly distributed right of way and lot level systems will be necessary. This distributed system may include capital improvement projects on private property as well as City-owned property that can be integrated into an interconnected system of storm water management practices and green spaces, also known as Green Infrastructure. In this sense, Green Infrastructure refers to an integrated system of site specific best management practices (such as naturalized detention facilities, vegetated swales, porous pavements, rain gardens and green roofs) that are designed to maintain natural hydrologic functions by absorbing and infiltrating precipitation where it falls. These practices can be integrated into the neighborhood and knit together with neighborhood green spaces (including boulevard and parkway medians) and the Lincoln Creek stream corridor to form a Green Infrastructure network within the 30th Street Industrial Corridor. There are a number of public and private properties in close proximity that may allow for shared systems and/or public-private partnerships for BMP demonstration projects, as shown in Table 3 and Figure 1.

Naturalized storm water detention basin

Parking lot bioswales

Wide boulevards and parkways within the Corridor (for example Roosevelt Drive and North 30th between Roosevelt and Congress could be retrofit with rain

gardens. Center median boulevards are often more difficult to retrofit because streets are typically pitched such that water drains to the outside curb and not to the center median.

Public Works or other departmental capital improvement / infrastructure projects within the Corridor should be reviewed for opportunities to incorporate storm water management measures. For example, street projects (2010 and beyond) provide opportunities for right-of-way storm water management improvements. Initially, three or more pilot projects could be incorporated into proposed street improvement projects (e.g., permeable paving within the gutter line, permeable paving within the parking lane, and / or curb bump-out rain gardens at the intersections). Currently planned street improvement projects within the Corridor and possible alternative designs are described in Table 4.

Table 3 Potential Public and Private Project Sites

Location	Map Location	Ownership	Potential Project
4101 N 31st St (site of MMSD drop shaft)	A	Public	Neighborhood storm water / BMP facility
4131 N 31st St	B	Private	Permeable parking lot
3020 W Congress (DPW Ruby Yard)	C	Public	Neighborhood storm water / BMP facility
DRS, unused and deteriorating parking lot at north end of site	D	Private	Combined with Ruby Yard project
Eaton property parking lot	E	Private	BMPs such as bioretention islands
Triangular parking lots along/ northeast of Hopkins Rd	F	Private	Replace with storm water / BMP facilities
Tower property	G	Private	Reconfigure to support 3-5 acre storm water management facility integrated with commercial redevelopment project(s)
Bishop's Creek redevelopment project	H	Private	In the future, re-design storm water management system for greater pollutant removal

Table 4 Potential Street and Right-of-Way Improvement Projects

Location	Map Location	Work Plan	Alternative
N 28th St from W Atkinson Av to W Glendale Av	1	Asphalt Surface, Curb & Gutter (2009)	Permeable surfaces in the gutter line and/or entire parking lane; curb extension rain gardens.
W Capitol Dr from N 27th St to N 35th St	2	Capitol Drive Special Treatment (2009)	Streetscape improvement project could include right-of-way storm water planters.
W Glendale Av from N 27th St to N 32nd St	3	Asphalt Surface, Curb & Gutter (2009)	Permeable surfaces in the gutter line and/or entire parking lane; curb extension rain gardens.
Alley between W Hope Av, W Roosevelt Dr, N 29th St, and N 30th St	4	Concrete Alley (2011)	Permeable paving
N 29th St from W Melvina St to W Capitol Dr	5	Asphalt Reconstruct, Curb & Gutter (2011)	Permeable surfaces in the gutter line and/or entire parking lane; curb extension rain gardens.
N 34th St from W Capitol Dr to W Hopkins St	6	Asphalt Surface (2011)	Permeable surfaces in the gutter line and/or entire parking lane; curb extension rain gardens.
W Hopkins St from N 34th St to N 35th St	7	Asphalt Surface (2011)	Permeable surfaces in the gutter line and/or entire parking lane; curb extension rain gardens.

Note: This list is demonstrative and should be updated as new street improvements are scheduled.

Capital Improvements on Private Property

Capital improvements can also be installed on private property at the discretion of the landowner, at the suggestion or direction of the City as part of a regulated new or redevelopment project, or in exchange for financial or other incentives, such as a discount on storm water utility or conditions of development incentives. Public-private partnerships may also be used, whereby the City (or State) provides direct financial assistance to the property owner. A project on private property will only count toward Milwaukee's TSS mandate if there is a maintenance agreement between the landowner and the City. The maintenance agreements must be between 5 and 10 years for residential-scale projects such as rain gardens, and longer (up to perpetuity) for larger (commercial-scale) projects.

The Wisconsin DNR's Urban Nonpoint Source Grant program has funded projects on private property but requires a maintenance agreement. Illinois EPA routinely funds projects such as streambank stabilization, green roofs, permeable paving, etc under their nonpoint source (319) program. Seattle has entered into a public–private partnership to install biofiltration swales and street designs to manage 188 million gallons as part of an $8 million, 150-acre mixed-use redevelopment project. In the Corridor, Ruby Yard and the north portion of the DRS property could be combined to construct a larger storm water management facility. Another option would be to provide financial assistance to Eaton and other private landowners with large parking lots to retrofit their lots with permeable paving or bioretention swales. See Table 3 for a list of potential project sites and Figure 1 for locations.

Figure 1 Initial Capital Improvement Projects

Code Compatibility

City codes that influence the design and intensity of development should be examined and modified so that storm water management goals are supported rather than hindered. For example, parking minimums can result in oversized parking lots, creating unnecessary expanses of impervious surface and unnecessary volumes of storm water runoff. Street and paving regulations mandating the use of concrete or asphalt may contradict the use of permeable paving practices for storm water infiltration. Landscaping requirements for raised planting beds around parking lots may preclude the use of depressed bioinfiltration cells to capture and infiltrate storm water runoff.

Portland created a matrix to assess where codes were incompatible with storm water and BMP installation goals. The new parking code allows smaller than standard lots to reduce the heat island

effect, allow for additional landscaping, and manage storm water. Seattle's landscape code was modified to effectively reduce impervious area by requiring 30% functional (i.e., permeable) green space. In Berlin, new and redevelopment require 60% green space for residential uses, 40% for mixed uses, 30% for commercial / city center uses, and 70% of the required green area must be permeable.

The City of Milwaukee has already done some work on modifying paving material and parking requirements and allowing private storm water management practices in the right-of-way (e.g., permeable paving detention in the City streets of Josey Heights). However, other codes should also be examined, such as the plumbing code, which requires roof runoff to be connected to the sewer system rather than directed into a rain barrel, rain garden, or other infiltration measure.

New Overlay District and / or Guidelines

A new overlay district and/or development guidelines could be feasible for the Corridor, similar to that implemented for the Menomonee Valley and those being developed for an 800-acre Milwaukee River District. The Menomonee Valley guidelines require elements such as parking maximums and storm water management as a condition for the sale of City-owned parcels to developers. The 30th Street Industrial Corridor differs from the Menomonee Valley in that only a few parcels are owned by the City and that the city-owned parcels are scattered.

Development guidelines in the Corridor could require storm water best management practices or implement other water quality improving standards (e.g., maximum allowable impervious cover or minimum landscape requirements such as tree canopy cover) in exchange for targeted City investment in the Corridor. City investments could include creation of a TIF district, job training for local residents or employees, or accelerated City infrastructure improvements. Alternately, the City may offer additional density in return for storm water management within the district, as discussed in the Development Bonuses section above. The guidelines and City investments would need to be structured such that they would be viewed as a substantial net benefit to the development community rather than a burden. Whichever tools are selected to influence development and storm water management, they should be integrated into the Near North Side Area Plan and the Citywide Policy Plan, which are currently underway.

Engineering Standards

In addition to development guidelines, the City should consider developing engineering and storm water standards for all public projects such as street improvements, parking lot construction, etc. For example standard details for street and road projects should be updated, and possibly even pre-approved, to include permeable paving, bioretention, and other measures. Further Chapter 120 standards (or some variation, thereof) should be applied to street and road projects even when the projects fall below Chapter 120 thresholds. With these changes, all streets and other public property would eventually be retrofit to meet current storm water standards. The Wisconsin DNR TSS removal mandate under NR151.13 does not currently recognize such policy and institutional mechanisms for reducing TSS load.

Recognition Program

The City urban design awards program, in which good works are publicized, is already in place. The award for green projects could be modified, or a separate award created, for sustainable storm water management or green infrastructure practices. The City of Chicago Greenworks Awards include recognition for green buildings, green practices, and green products.

Education and Outreach / Manuals and Technical Assistance

Education, outreach, and technical training and assistance are a critical part of any campaign to raise awareness, change behavior, build technical capacity, and for implementing new storm water management practices. These activities and materials are often low-hanging fruit that do not require significant capital investment but have a significant positive impact. Many different materials, messages, and delivery mechanisms can be used to educate the public and provide technical assistance to professionals seeking to work within the City jurisdiction. Training workshops and conferences, BMP tours, and participatory installation projects are ways to get the public involved and educated. Online tools and materials, such as a library of BMP implementation precedents (Denver), are becoming increasingly used to provide access to the information needed for decision making. The City of Milwaukee's two TIN districts in the study area may provide a ready-made vehicle for education and outreach to residents and landowners.

Developers would benefit from a published list of trained engineers, consultants, and contractors who are qualified to design and install advanced storm water BMPs, which would help ease the burden of researching and interviewing firms. A list of the permits required for the different BMPs would also prove useful (Portland).

The City of Milwaukee is currently reviewing and updating its BMP manual, which shows how to design and install practices. The City should consider creating a detailed case book of exemplary projects that may be a more useful technical resource for the development community. Such a case book could include project costs, details, as-built drawings, lessons learned, performance, and success stories. As an initial step towards providing technical information to the development community, the City could post construction documents and details online for City BMP projects.

Job Training and Capacity Building

Job training, workforce development, and other types of social investment are important economic development strategies for the 30th Street Industrial Corridor community. Workforce development could include a "green corps" resource of labor and technical knowledge for project design, installation, and/or management of green roofs, permeable pavement, bioretention, and other specialized "green" measures. The City of Milwaukee should consider connecting any capital improvement projects with engaging the local workforce for some portion of the project design, installation, or maintenance.

The EPA has job training grants available for these types of "green collar" jobs. The City of Chicago Greencorps program is a six-month job training program in landscaping and horticulture, which trains approximately 50 people every year. Trainees are provided hands on experience in community garden projects and placed in internships with professional landscaping companies, which often leads to a permanent job. More locally, the Milwaukee Metropolitan Sewerage District uses the Milwaukee Community Service Corps for landscape management, which could also be trained for storm water BMP maintenance and installation. There also may be an opportunity to tap into the Mayor's youth

employment and volunteer program to assist landowners with home projects, which may include simple BMPs such as a downspout disconnection and rain gardens.

In addition to building workforce capacity, it is also important to help diversify existing contractors' capacities so they, in turn, become proponents of green infrastructure alternatives. Capacity building through training and project experience would benefit the local community as well as designers, builders, developers, landscapers, contractors and consultants seeking to design, build, and maintain green projects within the Corridor. As noted above, a published list of trained engineers and consultants qualified to work on BMP projects would help ease the burden of researching and interviewing firms. In the future, the City may wish to follow the lead of the MMSD, whose Requests for Proposals require a contractor to have sustainable design experience, which in turn provides an incentive for contractors to become trained. Those firms that provide evidence of sustainable design experience receive higher scores when contractor / consultant qualifications are assessed.

VI. Economic Development

Although this study did not include a formal market analysis, some important points regarding business attraction, retention, and economic development emerged from the two Advisory Committee meetings. Most businesses are attracted to the Corridor because the price of land is low. Development incentives are considered to be critical components of an economic development strategy, and most of the current businesses would be unlikely to implement additional storm water measures without significant financial or other incentives. Some businesses may be attracted by a regional storm water solution that would reduce the need to provide storm water control on their individual parcels. In addition, in some cases storm water could be highlighted as an amenity, perhaps in the form of a fountain or other exhibition.

Demonstration projects that indicate the City's interest and investment in the area, which may be as simple as additional street trees and other community beautification, will also be important for attracting new private sector development. New and different businesses, possibly with a 'green' orientation, could be attracted if the Corridor were more of a green community and a City focus on greening the Corridor. However, without initial public investment in green space and green practices, it may be difficult to attract those first green businesses. The Eaton Corporation, whose mission includes sustainability and environmental stewardship, could be encouraged to implement an initial 'touchstone' project that would make their mission more externally visible, encouraging other businesses to follow suit.

The City may also consider establishing a green incubator within the Corridor for start-up businesses manufacturing green products or providing green services. Similarly, the City might consider helping existing businesses and manufacturers within the Corridor retool their operations to produce green products or services. Other cities have guaranteed companies a minimum level of sales as an incentive for repurposing facilities and employees.

VII. Outreach and Capacity Building

Education, outreach, recognition, job training, capacity building, and manuals and technical assistance are critical components of any storm water strategy developed as a result of this study and should not be overlooked. Specifically, the Advisory Committee has an intense interest in promoting job training and capacity building as it relates to storm water management and other green infrastructure practices. Phase II of this project can help to establish demand for green infrastructure projects, through the identification of specific capital improvement projects for construction by the public sector and through the examination of policies that can streamline and encourage installation of these projects by private parties. With the demand in place, opportunities should arise for outreach, job training, and capacity building to increase the supply of qualified contractors and work force.

VIII. Strategy Implementation

In order to generate discussion and to help identify opportunities and challenges to the various storm water strategies, a Storm Water Strategy Implementation Matrix was developed and completed by the Advisory Committee and the project team. The matrix includes a qualitative assessment of each strategy in the following areas: City Finance Implications, Procedural Implications, Technical Issues, Market / Economics, and Political Implications. Rather than serve as a tool for selecting the most feasible strategies, (since the most feasible are not necessarily the most effective in achieving the State and City goals for the project) the matrix simply provides relevant implementation information in a summary format for the Committee to consider. This matrix is presented in Appendix C. To summarize the results of the implementation assessment, each strategy was given a total point score that represents the relative ranking of each strategy with the strategy with the most positive responses receiving the highest score. Natural breaks in the rankings were then used to determine whether the implementation feasibility was low, moderate, or high, as shown in Table 5.

According to this non-scientific assessment, the strategies with the greatest feasibility potential include Funding and Financing Incentives, Public Land Capital Improvements, Private Land Capital Improvements, Other Incentives, Recognition, and Education and Outreach, as shown in Table 5. Recognition, Education and Outreach / Technical Assistance are fairly easily achievable strategies and should be a component of any storm water strategy for the Corridor and beyond.

Following the discussion of the implementation feasibility of the storm water strategies, the Advisory Committee conducted a vote to generate rough priorities for two different types of strategies: policy strategies and installed / capital projects. The group did not vote on recognition, education and outreach, or manuals and technical assistance, assuming that these would be a part of the selected priority strategies. The full results of implementation feasibility ranking and voting is included in Table 5. As shown, modification of the current storm water utility fee and credit system was the highest rated policy strategy, with developing guidelines for the district being a distant second. Utilizing funding and financing incentives to induce BMP projects on private property was the highest rated capital project strategy and implementing capital improvement projects on public land was second.

Table 5 Strategy Implementation Feasibility and Poll Results

Policy Strategies	Votes	Implementation Feasibility
Storm Water Utility Fee Modifications	10	Moderate
New Overlay / District Guidelines	4	Moderate
Code Compatibility	2	Low
Storm Water Ordinance Modifications	2	Moderate
Development Bonuses	1	Moderate
Review and Permitting	0	Low
Recognition	NA	High
Education and Outreach / Manuals and Technical Assistance	NA	High
Job Training / Capacity Building	NA	Moderate
Installed / Capital Project Strategies		
Funding and Financing	10	High
Public Land Capital Improvements	6	High
Private Land Capital Improvements	4	High
Other Incentives	2	High
Landowner Assistance	0	Moderate

IX. Phase 1 Conclusions

Phase 1 of this study has resulted in a general understanding of the project study area conditions, of the local and state regulatory environment with regard to storm water management, and a fairly broad survey of common storm water management strategies in use across the country. The stated purpose of the grant that is funding the project is to conduct storm water management planning within the study area to recommend the pollution prevention infrastructure to prepare for and foster the redevelopment of that area. Based on this goal and on the presented information, discussion, and feedback from the Advisory Committee on the potential effectiveness and implementation feasibility of the various strategies presented, the work plan for Phases 2 and 3 of this project focuses primarily on those items that directly address TSS reduction in the near term through capital improvements on public and private property and modified street and road standards. Phases 2 and 3 also include a brief summary of research and recommendations for a utility credit system for the City of Milwaukee.

X. Storm Water Utility Recommendations

As presented in Section VIII above, the project Advisory Committee considered storm water utility fee modifications to be the highest priority policy strategy that the City of Milwaukee should pursue. In support of this action an assessment of other municipal storm water utilities was conducted and recommendations for amending the Milwaukee's program were developed.

Comparative City Assessment

An assessment of storm water utilities was conducted as a basis for making recommendations for improving the City of Milwaukee storm water utility. Three cities with well-developed storm water utilities were examined: Minneapolis (population 380,000), Philadelphia (1.45 million), and Portland, Oregon (550,000). Data and information were collected through research of municipal documents, third party reports, and personal interviews with municipal staff familiar with the storm water programs. The investigation focused on the structure and operation of the utility and credit / discount system. Details of each city's stormwater program can be found at www.ci.minneapolis.mn.us/stormwater, www.phila.gov/water, and www.portlandonline.com/bes. A summary table of the results of the investigation is provided in Appendix D.

All three city programs are designed to be revenue neutral so that annual utility fees cover all program costs including capital, operations, and city staff, however, the methods differ for distributing these costs to customers. All cities use impervious area to determine how fees are assessed to a property. Philadelphia and Portland levy flat rates on residential properties based on a standard residential impervious cover. Philadelphia includes residential uses of 4 units or fewer, while Portland includes single family, row homes, and duplexes in the flat rate, residential category. Minneapolis uses a three-tier (high, medium, and low) system for residential properties based on estimated impervious surface area. These rates are based on estimates of imperviousness for the average single family parcel, also known as Equivalent Stormwater Units (ESU) or Equivalent Residential Units (ERU), which are 1530sf, 500sf, and 2400sf for Minneapolis, Philadelphia, and Portland, respectively. Monthly residential rates for the three cities are: $10.77 per ESU (Minneapolis), $11.06 (Philadelphia), and $19.80 (Portland).

Non-residential properties are assessed using more complex calculations based on the type of land use and assumed or measured imperviousness.

- Minneapolis, for example, determines the monthly fee using gross lot size (based on tax records) and a coefficient of estimated imperviousness for each land use.
- Philadelphia charges landowners for a parcel's Gross Area (GA) and for its Impervious Area (IA): $0.528 per 500sf of a parcel's Gross Area, and $4.169 per 500sf of a parcel's Impervious Area. Impervious Area is measured using GIS and aerial photographs for parcels greater than 5000sf. Parcels smaller than 5000sf use 25% Impervious Area if undeveloped and 85% Impervious Area if developed.
- Portland levies fees based on the number of units (for 3- and 4-plex buildings), and the number of 1000sf units of imperviousness (for 5 unit residential and non residential properties.) Portland used aerial photography to establish rates in 1977.

To demonstrate the impact of these fee rates on non-residential property for the three cities, a typical big box retail facility with a site area of 700,000 square feet and an impervious surface area of 650,000 square feet was examined. In this scenario, the landowner would pay the following monthly fee: Minneapolis – $4,484; Philadelphia – $6,159; Portland – $5,759. A Milwaukee landowner's monthly fee for an equivalent property would be $1,884.

Credits and discounts to the utility fee are available in all three cities examined for both new development and retrofits.

- Minneapolis allows a reduction of 50% for property owners (residential and non-residential) making improvements / practices that improve the quality of runoff, and 50% or 100% for improvements / practices that reduce the quantity of runoff to pre-development conditions for the 10-year and 100-year events, respectively. An engineer or landscape architect must certify the practices, which are then verified by inspection.
- Philadelphia allows fee reductions for non-residential and condominium properties with demonstrated reductions in: (1) the Impervious Area by managing the first inch of runoff; (2) the Gross Area by proving a lower curve number or attenuation of the 2-year peak rate of runoff; and (3) meeting NPDES permit requirements. Up to 100% reduction in the utility fee is allowed. Documentation and verification are through applications, certification by registered professionals, and inspection by the city.
- Single family residential properties in Portland are awarded full or partial credit for management of roof runoff, small parcels, and the presence of trees, as indicated on the registration form. Credits for non-residential properties are awarded based on the area served by BMPs and the size or number of BMPs used to control pollution, flow rate, and volume. Portland's fee structure is somewhat different from the others in that 35% of the total fee is based on on-site storm water runoff from the property and 65% on off-site storm water runoff from roads, the right-of-way, etc. Up to 100% of the on-site charge can be credited, but none of the off-site charge may be credited. The city conducts initial on-site inspections with random audits in following years. A permit and inspection are required for practices built as part of new development.

City of Milwaukee Recommendations

Information on Milwaukee's storm water utility credit program was provided by the City Department of Public Works, Department of Administration, review of Milwaukee's City Ordinance 309-54 and associated Stormwater Management Charge Adjustment Policy, and a case study conducted by the Water Environment Research Foundation (July 2008). Milwaukee's program is similar to other surveyed programs.

The utility fee rate has been set to cover the total costs of the City's storm water program – capital projects, staff, operating expenses, maintenance, extension, replacement, debt service, and program costs including street sweeping, leaf collection, and urban forestry. Residential landowners (one to four residential units) pay a flat quarterly fee and non-residential landowners pay a fee based on impervious surface area converted to equivalent residential units (ERU) of 1,610 square feet. Rates increased from $8/quarter/ERU to its current level of $14/quarter/ERU over the past few years, the equivalent of $0.04/year/square foot of imperviousness. This rate is significantly lower than the annual rates for Minneapolis, Philadelphia, and Portland, which are $0.12, $0.27, and $0.10 per year per square foot of

imperviousness, and the City should consider raising the rate to a level commensurate with these other cities, or higher, as noted below.

Residential property owners may receive an adjustment to utility charges if the calculated area of impervious surface can be proven to be inaccurate. For non-residential parcels, up to 60% reduction in the utility fee is available through an appeals process to the Department of Public Works as outlined in the City Stormwater Management Charge Adjustment Policy. The remaining 40% of the fee, which can not be reduced, is intended to defray the cost of the stormwater system and program elements that are not attributable to individual landowners, similar to the Portland system of allowing a credit for on-site stormwater charges but not for off-site stormwater charges. Through the appeals process, the applicant must demonstrate, with supporting documentation, that an adjustment of the charge is warranted.

Non-residential property owners may be eligible for an adjustment of up to 60% of the utility fee at the discretion of the commissioner of public works or for the following conditions and circumstances.

- Direct discharge of storm water to a stream, where the discharge does not exceed water quality standards or where the landowner holds a municipal storm water discharge permit.
- Direct discharge from a non-residential property to the MMSD storm water collection system rather than the City's collection system.
- The presence of an on-site storm water sequestration system (including retention or detention basin, roof garden, bioretention facility, and rain garden) that reduces City's cost of providing service (through a reduction in the size or scope of the City's storm water collection system) or cost of controlling polluted runoff. In these cases, improvements must exceed the minimum code and storm water management plan requirements of Chapter 120.

It was suggested during an Advisory Committee meeting that the City may consider providing storm water credit for an offsite stormwater management facility as long as the facility is privately constructed and maintained.

As with the other cities examined, the City may want to consider instituting a credit system that more closely links the level of credit to the level of performance (i.e., the amount of reduction in runoff quantity and/or TSS load). Specifically, the TSS load portion of the credit should be tied directly to the annual reduction in sediment load the BMP system is estimated to provide and the resulting reduced cost of compliance to the City. Under this approach, the credit would be related to the load reduction and, therefore, land uses that generate higher TSS loads (such as commercial and industrial) would receive higher credits. A simpler but less targeted approach would tie the credit to the percent reduction in TSS load and all properties regardless of load characteristics would receive the same credit.

Based upon review of the other programs, there appears to be little benefit to instituting a more complex fee structure at this time. However, the City should review the total cost of their stormwater program, including the future cost of compliance with the 40% TSS reduction, to ensure adequate revenues. Presuming this review would result in an increase in the utility fee, the incentive value of the fee would increase since the potential credit would increase along with the increased fee.

Another potential incentive involves a City-financed grant and/or loan program to help fund BMPs within development or redevelopment projects that are not required to meet the City storm water ordinance (because they fall below the ordinance thresholds) and to help fund retrofit projects. Under this program, the owner could borrow against future stormwater utility credits to finance construction of BMPs. For example, the City would provide a loan to the owner for an amount equal to value of utility credits over the next ten years, and the City would be reimbursed by continued full utility payments for ten years. At the end of the ten year repayment period, the land owner would pay the reduced utility

fee based on the credit received for the installed BMPs. To encourage early adopters, such a program could begin as a combined grant/loan program whereby the City provides grant funding to cover a portion of the cost to install BMPs, and the balance of the cost financed as described above. As the program is implemented over time, the grant portion of the program can be reduced or phased out.

The City should also consider coordinating with MMSD and developing different goals for the separate and combined sewer areas. For example, volume reduction and rate control credits could be targeted in the combined sewer area, and water quality improvement credits could be targeted in the separated sewer area. This is not to say that runoff volume and rate should not be reduced in the separated sewer area, because storm water rates and volumes are also important from the standpoint of flooding and overall impairment to water bodies. Rather, the City could develop a credit system that requires all three components be addressed to receive the maximum allowable credit. The program could allow for partial credit for each of the three components. However, this would increase the complexity of the system since it would require development of a range of performance targets for each of the components, as with Minneapolis and Philadelphia.

Maintenance of onsite stormwater facilities is a frequently-raised concern when BMPs are discussed. The City should require a maintenance agreement, as well as short and long term management goals and tasks, for onsite facilities in order to grant the full 60% utility fee credit.

The City can take advantage of the educational opportunity to advance stormwater awareness through its website. A clearly worded, easily accessible website could inform the public about the purpose, need, structure, and rationale for the storm water utility. The program should clearly outline and convey the reasons for the fees, the conditions under which landowners can reduce their fees, and the practices that can be used to achieve utility fee credits (via a manual or similar document).

XI. Capital Improvements Evaluation

The second element of Phases 2 and 3 of this project was to investigate the study area for opportunities to make capital improvements designed to reduce Total Suspended Solid (TSS) loading to meet the City's 40% TSS reduction target. As part of this effort, further analysis of project sites chosen during Phase 1 was conducted, and additional project sites were chosen during Phases 2 and 3. Following selection of the sites, concept plans were developed for three public and three private sites using a variety of green infrastructure / storm water management practices. The concept plans for each site were then modeled using SLAMM software and preliminary cost estimates were generated.

Public and Private Site Selection

The initial step was to establish a final list of potential sites for conceptual level planning and engineering of capital improvements. In addition to reviewing 2-foot topography, storm sewer and sanitary sewer maps, as-built storm sewer depth, and land use information, the following information was considered when identifying additional possible project sites:

- Tributary area: The larger the tributary area, the larger the proportion of the corridor that is addressed by the project.
- Adjacent storm sewer depth: For projects intended to treat runoff from the storm sewer system, excessive depth can make it infeasible to treat the runoff using a surface BMP.
- Landowner interest: For private sites, a project is unlikely to move forward if the landowner is uninterested in participating.
- Site ownership (public or private): Ownership affects interest in participation and may also affect the level of public access.
- Ratio of treatment area to tributary area: Generally, the greater the treatment area to tributary area ratio, the greater the performance of the BMP. However, the cost effectiveness of BMPs may decrease somewhat with treatment area ratio since the BMP may be larger than necessary to meet the City's TSS removal requirement.
- Potential for site to be able to accept and treat offsite runoff: Sites with offsite tributary area are able to function as more regional facilities, treating a greater area and volume of runoff.
- Site orientation, size, and dimensions: Shape and orientation of the site can affect the ability to fit certain types of BMPs, particularly storm water ponds.

During Phase 1, eight public and private sites were considered. Phases 2 and 3 identified an initial group of twelve sites, including those from Phase 1. The twelve project sites were divided into two categories: public and private. Public sites are those parcels that are completely or partially owned by the City of Milwaukee or another public entity and may be used to treat runoff from both the site itself and from an offsite tributary area. In this sense, the 'public' sites could be considered regional in nature since they treat an area larger than the parcel itself. Private sites are those owned by a private entity that only address runoff from the site itself, not from an offsite area. Options for treating runoff from the public right-of-way were also examined, as discussed below. The right-of-way options include strategies that could be implemented within the public right-of-way.

Public Sites

- 4101/4131 North 31st Street
- Ruby Yard - 3020 West Congress
- North 30th Street Parkways
- 3201 West Hampton Avenue

Private Sites

- DRS Technologies Inc - 4265 North 30th Street
- Eaton Corporation - 4201 North 27th Street
- Aldrich Chemical - 2905 Hope Avenue
- Vapor Blast Manufacturing Company - 3025 West Atkinson Avenue
- Jonco - 4722 North 28th Street
- Triangular Parking Lots - West Hopkins Avenue
- Former Tower Automotive - 3533 North 27 Street
- Bishop's Creek Redevelopment

These sites were presented and discussed with the Advisory Committee to gain input on selection of three public and three private sites for further study. The Advisory Committee and City staff provided knowledge and background of project sites, including ownership, possible environmental concerns, and other factors.

Due to the impending purchase and potential redevelopment or reuse of the former Tower Automotive site (aka Century City), the Tower parcels and associated triangular parking lots were removed from consideration. The Bishops Creek Redevelopment site was removed from consideration since the development had already progressed too far to allow significant integration of alternative storm water management controls. Aldrich Chemical was removed from consideration due to the perceived lack of interest by the landowner. Jonco was removed from consideration due to limited opportunities to integrate storm water management practices on the site. 3201 West Hampton was removed from consideration due to a highly constrained site.

The three selected private sites have willing or interested landowners and site conditions that are considered favorable for storm water management alternatives. Likewise, the three public sites have favorable site characteristics and were considered as having potential for site improvements by the City. The final six sites selected are listed in Table 6 and located in Figure 2.

Table 6 Public and Private Sites

Public Sites
4101/4131 N 31st Street
Ruby Yard, 3020 W Congress
North 30th St Parkways
Private Sites
DRS Technologies Inc., 4265 N 30th St.
Eaton Corporation - 4201 N 27th St.
Vapor Blast Manufacturing Company - 3025 W Atkinson Av.

Right-of-Way Treatment

A large proportion of the corridor and a significant component of the TSS load are associated with street right-of-ways and adjacent tributary land areas. While a portion of these areas can be treated using regional strategies on public sites (such as Ruby Yard), other areas are not readily treated using regional BMPs due to a lack of land availability, deep storm sewers, and other constraints. Thus, strategies were developed for addressing right-of-way runoff within the area of the right-of-way.

Since most of the streets within the corridor are residential streets, a typical residential street was selected to evaluate right-of-way treatment options. Most of the residential blocks also have alleys; therefore alternatives for treating the alleys were also developed.

Water Management Strategies

Following selection of the sites and right-of-way options, preliminary schematic designs were produced using a variety of on-site storm water management practices including permeable pavers, bioinfiltration, reduced impervious surface area, natural landscaping, and green roofs.

Figure 2 Final Capital Improvement Project Locations

- ***Permeable pavers*** have a surface that allows rainwater runoff to pass through the surface. Beneath the pavers is a layer of open-graded stone that acts as a structural base as well as temporary storage for rainwater runoff. This temporary storage allows runoff to infiltrate into the subgrade or slowly drain through an underdrain. As rainfall runoff passes through the surface of the permeable pavers, sediment and associated pollutants common in urban runoff are filtered. Further, organic hydrocarbons that cling to the surface of the gravel are treated through microscopic organisms that use the gravel as a substrate. Permeable paver location options include alleys (full width and partial width), roadways (full width and parking lanes only), and parking lots. Permeable pavers have additional benefits over conventional pavement including reducing ice formation in winter, greater durability and longer replacement cycles, and the ability to remove and replace pavers to repair and maintain subsurface utilities.
- ***Bioinfiltration*** areas are vegetated features with a layer of permeable engineered soil over a layer of open-graded stone. Vegetation can include shrubs and trees. The rainwater runoff from adjacent impermeable streets or parking lots enters the bioinfiltration areas via curb cuts. The engineered soil surface acts to filter the rainwater runoff, and vegetation can absorb some of the nutrients found in runoff. The open-graded stone provides drainage for the engineered soil as well as temporary storage for rainwater runoff. Bioinfiltration options include neckdowns and curb extensions within the street right-of-way, depressions behind existing curb, and parking lot islands.
- ***Natural landscaping*** uses plants that are tolerant of urban conditions and typically have deep root systems. If properly designed, these natural landscape areas can be both a storm water management benefit and aesthetically pleasing. Natural landscapes also help create green space and improve biodiversity in urban areas. Natural landscapes can be installed in almost any area where turf grass or more ornamental vegetation exists. However, the owner and/or site manager must understand how to manage these plantings.

Permeable paving, bioinfiltration, natural landscaping, and green roof.

- ***Green roofs*** have a layer of highly permeable growing medium that allows rainfall to filter through it and be retained. They can also provide additional green space in the corridor and reduce urban heat island effects. A variety of green roof types and applications can be applied to nearly any rooftop, depending on the structural and roof drainage characteristics.

Following discussion with City staff, conceptual designs were produced for each of the six public and private sites. Descriptions of the site conceptual designs are provided below. It is important to note that these designs present only one of a few different options for applying the storm water management practices listed above, and that individual design applications can be implemented differently on each project site depending upon City and/or private landowner goals.

Project Performance Evaluation and Cost Estimates

Descriptions of the six public and private sites are provided below, including descriptions of existing conditions, alternative project layouts, and BMP implementation levels. For each of the alternative BMP systems, modeling results are provided along with cost estimates.

To evaluate the performance of each of the BMP systems, water quality models were prepared for each site using the SLAMM (Source Loading and Management Model) model and input parameters based on typical application of the various storm water management practices (naturalized storm water ponds, permeable pavers, bioinfiltration, green roofs, and natural landscaping). These models were used to determine baseline loading of total suspend solids (TSS) for existing conditions and for a range of combinations of storm water management practices for each site. The modeling results tables summarize the project site design alternatives and annual performance for runoff volume and TSS removal as a quantity and percentage reduction. Tables 8, 10, and 12 provide modeling results for public sites; Tables 15, 17, and 19 provide modeling results for private sites; and Tables 24, 25, and 26 show modeling results for right-of-way alternatives. The reduction reported for each BMP is relative to the baseline load conditions of the entire drainage area. Greater detail on the methods of analysis and SLAMM modeling input parameters and electronic SLAMM input files are located in Appendix F.

Detailed cost information for each of the six public/private site can be found in Appendix G. Four sites have more than one cost estimate. These additional estimates reflect different variations in design elements being implemented. These include the use of bioretention within impermeable parking lots, or permeable paver parking lots with no bioretention. Maintenance costs for permeable (porous unit) pavers, bioretention areas, and natural landscaping are presented in Table 7.

Table 7 Annual Storm Water Practice Maintenance Costs

Description	Cost Estimate
Porous Unit Pavers (per 1,000 sf)	$ 31
Sweeping, Remedial Maintenance	
Bioretention (per 1,000 sf)	$ 401
Fall clean up, hand pick up	
Natural Landscaping (per acre)	$ 1,250
Weed control, burn management	

Ruby Yard Water Quality Basin

The Ruby Yard public site contains approximately 4.33 acres of public (City of Milwaukee) and private land owned by DRS Technologies. The site is located south of the existing Department of Public Works Ruby Yard site, east of the Canadian Pacific Railway, north of DRS Technologies, and west of a residential neighborhood. Grass covers the northern half of the site, while the southern half is an underutilized parking lot. The existing site contains a large storm sewer that directs storm water flows from the neighborhood to the east underneath the adjacent railway and into Lincoln Creek.

The identified project would divert the existing storm sewer into a 0.85 acre open water forebay and pond or wetland designed as a neighborhood amenity with walking paths, picnic areas, and natural plantings. The design is intended to treat the adjacent 47 acre tributary area by intercepting flow from the existing storm sewer passing through the site. The depth of the sewer requires a relatively deep basin (eight feet below grade at its shallowest point on the site and up to 16 feet below the grade at the northwest corner of the proposed basin). Exhibits showing a schematic design and conceptual illustrations can be found in Figures 3, 4, and 5.

As shown in Table 8, the SLAMM model indicates that the project would reduce the TSS load from the 47 acre drainage area by 94%. However, the model indicates that there would be no runoff volume reduction benefit. In reality, there would be at least seasonal runoff reduction associated with evaporation from the pond surface between rainfall events.

There are several design considerations associated with this site.

- It has been reported that the water table is high in this area and may be above the invert of the existing storm sewer. Significant continuous groundwater flow through the basin would reduce the residence time for stormwater in the basin and therefore would also reduce the water quality performance of the basin.
- There is no evidence to indicate that the soils on the Ruby Yard site are contaminated. However, at least a Phase I environmental investigation should be conducted to assess the potential for contamination.
- Because the site is partially on DRS property, it may be difficult to provide easy access to both the public and DRS employees while also providing adequate security for DRS. A key-carded gate and security cameras between the basin and the DRS parking lot may be an option to address this issue.
- Safety concerns associated with an open water basin have been expressed, prompting a call for fencing around the potential basin. However, some experts believe that a visible, unfenced area would be safer than a fenced area obscured from view by vegetation. The fence may hinder access by emergency services personnel.

Table 8 Ruby Yard Modeling Results

Option #	BMP	Annual Performance			
		Runoff		TSS	
		Volume (cu ft)	% reduction	Load (lbs)	% reduction
Baseline	-	1,744,097	-	15,752	-
1	Wet Pond	1,744,097	0.0%*	920	94.2%

Option Notes:

Baseline — No controls applied to tributary area. Load based on High Density Single Family Residential.

1 — Wet retention treats neighborhood storm sewer flows from the east and south east. The open water wet pond is 1.8% of tributary area.
*Modeling resulted in no runoff volume reduction, however, a limited amount of infiltration and evapotranspiration would likely occur.

Table 9 provides an estimate of the engineering and construction costs for the Ruby Yard Water Quality Basin. Combining the data in the project performance table (Table 8) and the estimated cost table (Table 9) indicates that the unit cost of TSS reduction associated with the project is approximately $180 per pound of sediment removed.

Table 9 Ruby Yard Cost Estimate

See Appendix G for full cost breakdown and options. Maintenance costs are found in Table 7.

Description	Cost Estimate
Demolition	$ 1,711,149
Pavement removal, excavation	
Storm Sewer	$ 39,770
Storm sewer, manholes	
Landscape	$ 163,310
Planting material , plant plugs, trees	
Site Amenities & Erosion Control	$ 137,763
Access paths, fence, erosion mat	
Subtotal	**$ 2,051,992**
Contingency (20%)	$ 410,398
Final Engineering	$ 205,199
Total	**$ 2,667,589**

Figure 3 Ruby Yard

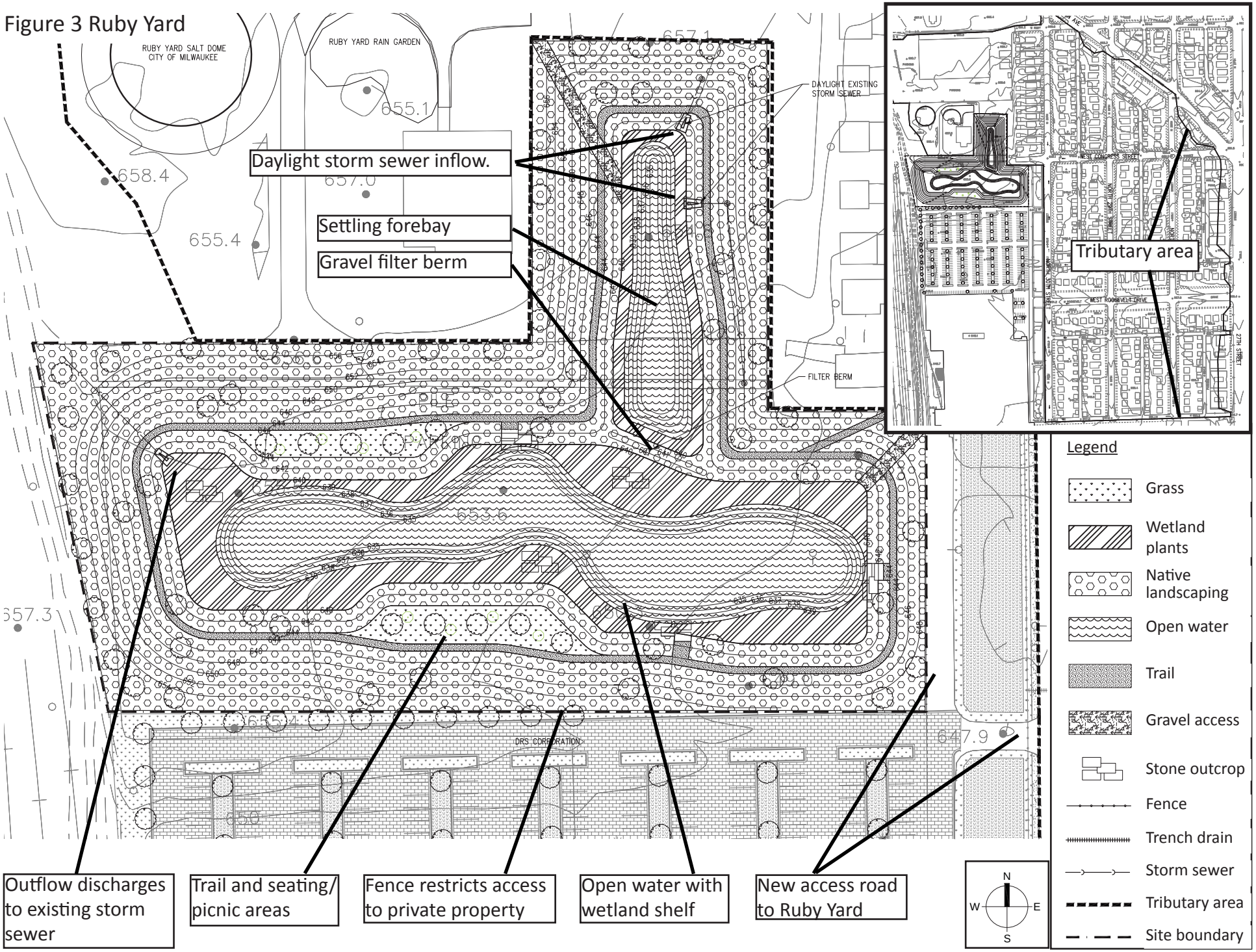


Figure 4 Ruby Yard

Figure 5 Ruby Yard

North 30th Street Parkway Bioswales

The North 30th Street Parkways contain approximately 1.5 acres of both public (City of Milwaukee street right-of-way) and private land (DRS Technologies) that consists of turf grass and pavement. The parkways are south and west of a residential neighborhood, east of DRS Technologies, and north of Eaton Corporation. The indentified project involves construction of bioretention swales in the large parkway as shown in the schematic design and conceptual illustrations in Figures 6, 7, and 8.

The parkway bioretention would receive surface runoff from 7.1 acres of tributary area residential neighborhood to the east. Trench drains would be required to divert storm water flows away from the street curb and gutter drainage system storm inlets and into the bioinfiltration area 1.0 acre in size. This bioinfiltration area should be planted with natural and adaptive plants and include a sidewalk along North 30th Street so residents can view the plantings and signage that could be incorporated into the project site.

As shown in Table 10, the SLAMM model indicates that the project would reduce the TSS load from the 8.6 acre drainage area (drainage area plus project area) by 78%. Further, SLAMM estimates that average annual storm runoff volumes would be reduced by 48%.

There are several design considerations associated with this site.

- As indicated above, existing storm inlets must be disabled to allow the entire drainage area to reach the bioswales. Preliminary site investigation indicates that eight trench drains would be required across the crown of North 30th Street along with replacement of existing storm inlet covers with solid covers.
- The drainage area of the 30th Street bioswales is contained within the drainage area of the Ruby Yard project. Thus, it may not be necessary to implement both projects if TSS removal is the only goal. However, the 30th street bioswales have the added advantage of reducing runoff volumes as well as reducing TSS load.

Table 10 North 30th Street Parkways Modeling Results

Option #	BMP	Annual Performance			
		Runoff		TSS	
		Volume (cu ft)	% reduction	Load (lbs)	% reduction
Baseline	-	302,976	-	2,562	-
1	Bioswale	155,957	48.5%	557	78.3%

Option Notes:

Baseline — No controls applied to tributary area. Load based on High Density Single Family Residential.

1 — Bioswale treats roadway runoff from a portion of neighborhood to the east. Bioswale Area is 14.3% of drainage area.

Table 11 provides an estimate of the engineering and construction costs for the 30th Street parkway bioswales. Combining the data in the project performance table (Table 10) and the estimated cost table (Table 11) indicates that the unit cost of TSS reduction associated with the project is approximately $540 per pound of sediment removed. However, it should be noted that the project also includes a number of amenities such as sidewalk, street trees, and lush landscape that could be an amenity to the DRS property.

Table 11 North 30th Street Parkways Bioswales Cost Estimate

See Appendix G for full cost breakdown and options. Maintenance costs are found in Table 7.

Description	**Cost Estimate**
Demolition	$ 254,113
Pavement removal, excavation	
Bioretention Material	$ 461,030
Amended soil, underdrain, planting material	
Landscape	$ 7,965
Planting material, trees	
Site Amenities & Erosion Control	$ 113,213
Sidewalk, erosion blanket	
Subtotal	**$ 836,321**
Contingency (20%)	$ 167,264
Final Engineering	$ 83,632
Total	**$ 1,087,217**

Figure 6 North 30th Street Parkways

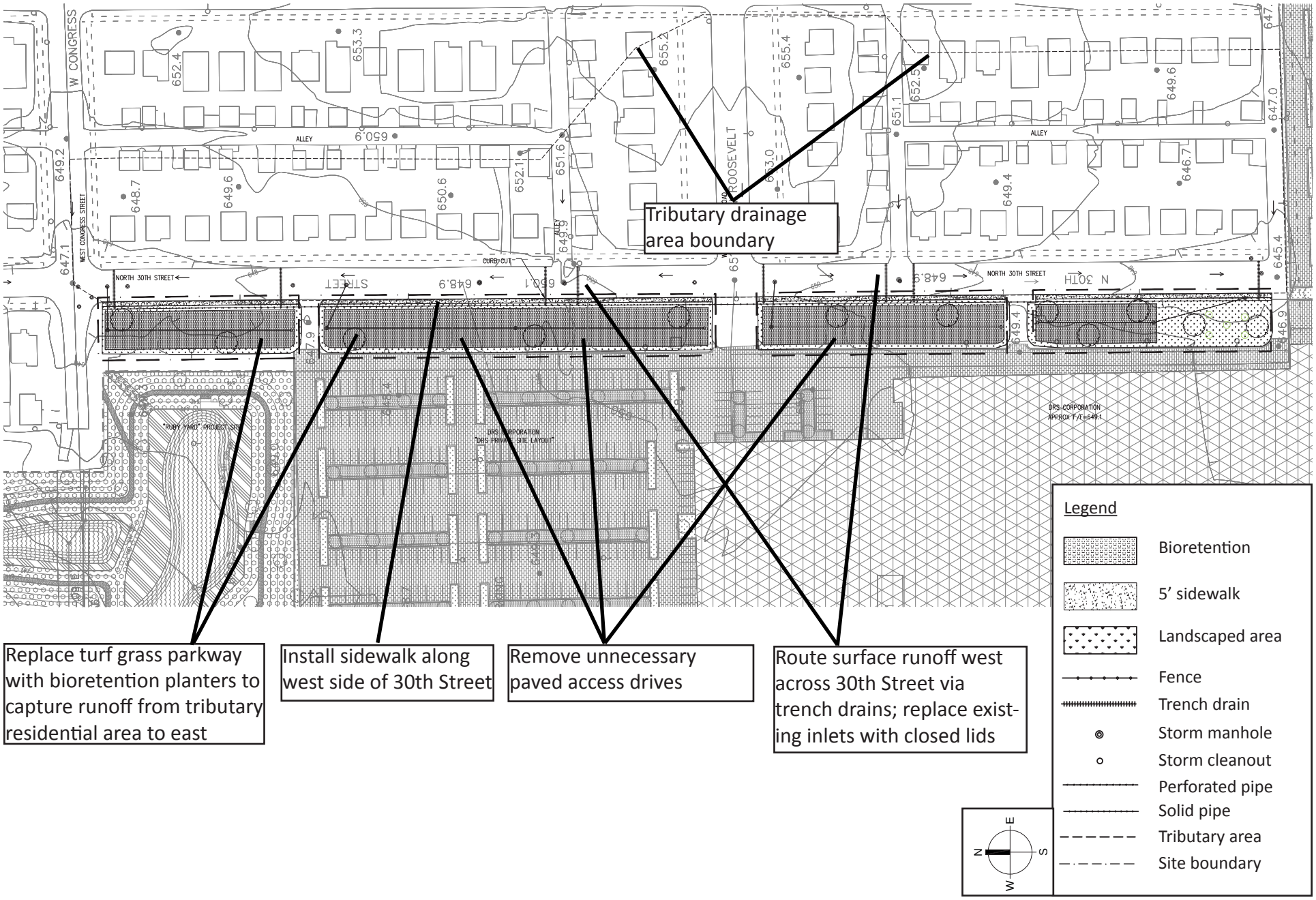


Figure 7 North 30th Street Parkways

Figure 8 North 30th Street Parkways

4101/4131 North 31st Street

4101/4131 North 31st Street contains 3.8 acres of gravel and grass covered public land that contains a building and drop shaft for the Milwaukee Metropolitan Sewer District (MMSD). The site is south of DRS Technologies and north of Ned's Pizza Perfecta on Capitol Drive. Storm water runoff flows from west to east toward the North 31st Street right-of-way where it enters a storm sewer. The proposed project includes installation of a "green" parking lot at the north end, a natural landscaped park at the south end, and a bioretention swale along 31st Street to treat street runoff. Exhibits showing a schematic design and conceptual illustrations can be found in Figures 9, 10, and 11. The illustration shows all identified elements that could be incorporated into the site.

The potential project would treat storm water that falls directly on the property as well as nearly 800 linear feet of the western half of North 31st Street. The project is divided into northern and southern sections of 1.6 and 2.2 acres respectively. The northern section would contain a parking area potentially used by DRS Technologies and could include permeable pavers and/or bioinfiltration in the parking lot. The southern area would provide a storm water BMP demonstration park that could include a permeable paver access drive for use by MMSD. The park could contain seating areas, natural landscapes, bioinfiltration, and educational signage about sustainable storm water management applications. Use as a park would not preclude the site from serving other uses in the future.

This project is different than Ruby Yard and 30Th Street Parkway Bioswales projects since it primarily treats runoff from the site itself but very little offsite area (0.4 acres of street). SLAMM was used to evaluate a number of options for the northern and southern portions of the site. The results of the SLAMM model are shown in Table 12. As indicated, the TSS load could be reduced from 29% to 97%, and the average annual storm runoff volume could be reduced from 20% to 95%, depending on the practices implemented. The percent reduction values indicated in Table 12 are relative to the entire site and not only to the area that the practice treats. As a result, a practice such as permeable paving that is very effective at reducing sediment loads shows a more modest reduction relative to the entire site since the remainder of the site is untreated.

Several design considerations are associated with this site.

- The site is known to contain contaminated subsurface soils that may require a clean soil or paved cap. While permeable paving or bioretention soil could meet the cap requirements, assessment of the potential migration of contaminates caused by infiltration needs to be conducted. If migration is a concern, lining of permeable paving and bioretention areas may be necessary to prevent runoff from seeping through the contaminated soils.
- The location of the project site along the railroad right-of-way may make it attractive for a future commuter station, should the line be used for commuter transportation. However, the park would not necessarily preclude redevelopment of the southern portion of the site as a commuter station and parking.
- While access to the site is very good, visibility and adjacency for potential park users is limited.

Table 12 4101/4131 North 31st Street Modeling Results

Option #	Southern Section		Northern Section		Annual Performance			
					Runoff		TSS	
	Landscape	BMP	Landscape	Paving	Volume (cu ft)	% reduction	Load (lbs)	% reduction
Baseline	-	-	-	-	194,937	-	3,383	-
1	Natural	-	-	-	111,894	42.6%	2,261	33.2%
2	-	Bioswale	-	-	100,053	48.7%	1,914	43.4%
3	Natural	Bioswale	-	-	88,441	54.6%	1,737	48.7%
4	-	-	Bioswale	-	154,699	20.6%	2,399	29.1%
5	-	-	-	Permeable	137,756	29.3%	2,180	35.6%
6	-	-	Bioswale	Permeable	115,785	40.6%	1,751	48.2%
7	Natural	-	Bioswale	-	71,655	63.2%	1,277	62.3%
8	Natural	-	-	Permeable	54,714	71.9%	1,059	68.7%
9	-	Bioswale	Bioswale	-	59,815	69.3%	930	72.5%
10	-	Bioswale	-	Permeable	42,873	78.0%	711	79.0%
11	Natural	Bioswale	Bioswale	Permeable	9,287	95.2%	105	96.9%

Option Notes:

Baseline	No controls applied to tributary area. All land cover assumed to be industrial area paving.
1 - 11	For Southern Area options, "-" indicates existing condition remains. Bioswale area = 4% of tributary area.
1 - 11	For Northern Area options, "-" indicates either asphalt paving or landscape w/o bioretention. Bioswale area = 8% of tributary.
1 - 11	The removal rates indicated are relative to the load from the entire site, even for practices that treat only a portion of the site.
1	Natural landscape used to reduce runoff from Southern Open Area.
2	Bioswale used to treat runoff from 31st Street and Southern Open Area .
3	Natural Landscape. Bioswale used to treat runoff from 31st Street and Southern Open Area .
4	Bioswales in Northern Parking Lot Islands.
5	Permeable pavers within the Northern Parking Area.
6	Permeable pavers and bioswales within Northern Parking Area.
7	Natural landscaping in the South. Bioswale in the North.
8	Natural landscaping in the South, permeable pavers the North.
9	Bioswale to treat road runoff and Southern section. Bioswales in the North.
10	Bioswale to treat road runoff and Southern section. Permeable paving in the North.
11	Natural Landscape and bioswales in the South. Bioswales and permeable pavement in the North.

Table 13 provides an estimate of the engineering and construction costs for the 4101/4131 N 31st Street project. Although a formal analysis was not performed, Option 10 provides the greatest value and was therefore chosen for cost estimating. This option includes the permeable paving parking lot in the north and the bioretention area along 31st Street to treat runoff from 31st Street and the southern portion of the site. Since the southern portion of the site may eventually be used for commuter parking, the cost estimate for this option includes no re-vegetation of the area outside the bioswale. The unit cost of this alternative is approximately $300 per pound of sediment removed.

In addition to Option 10, Option 11 was cost estimated since it provides significant community amenities in addition to the water quality benefits. These amenities include a landscaped park with benches, a walking path, and educational kiosks to explain the importance and practices of rainwater management. The unit cost of this alternative is approximately $575 per pound of sediment removed.

Table 13 4101/4131 North 31st Street Cost Estimate (Option 11)

The following cost estimate is for Option #11. See Appendix G for full cost breakdown and options. Maintenance costs are found in Table 7.

Description	**Cost Estimate**
Demolition	$ 657,949
Excavation, material removal/disposal	
Storm Sewer / Underdrain	$ 31,275
Storm sewer, manholes	
Bioretention Materials	$ 93,991
Amended soil, stone, planting material	
Porous Unit Pavers*	$ 355,159
Pavers, stone, geotextile	
Landscape	$ 46,225
Planting material, trees, natives	
Site Amenities & Erosion Control	$ 363,340
Fence, erosion mat, benches, walls	
Subtotal	**$ 1,453,948**
Contingency (20%)	$ 290,790
Final Engineering	$ 145,395
Total	**$ 1,890,133**
*Use of pervious asphalt or concrete in place of porous unit pavers would increase the paving line item cost by 3% and 67% respectively. See Appendix for full cost breakdown.	

Table 14 4101/4131 North 31st Street Cost Estimate (Option 10)

The following cost estimate is for Option #10. See Appendix G for full cost breakdown and options. Maintenance costs are found in Table 7.

Description	**Cost Estimate**
Demolition	$ 114,999
Excavation, material removal/disposal	
Storm Sewer / Underdrain	$ 31,275
Storm sewer, manholes	
Porous Unit Pavers*	$ 307,262
Pavers, stone, geotextile	
Bioretention Materials	$ 37,165
Amended soil, stone, planting material	
Landscape	$ 40,655
Planting material, trees, natives	
Site Amenities & Erosion Control	$ 89,062
Fence, erosion mat	
Subtotal	**$ 620,418**
Contingency (20%)	$ 124,084
Final Engineering	$ 62,042
Total	**$ 806,543**
*Use of pervious asphalt or concrete in place of porous unit pavers would increase the paving line item cost by 3% and 67% respectively. See Appendix for full cost breakdown.	

Figure 9 4101/4131 North 31st Street

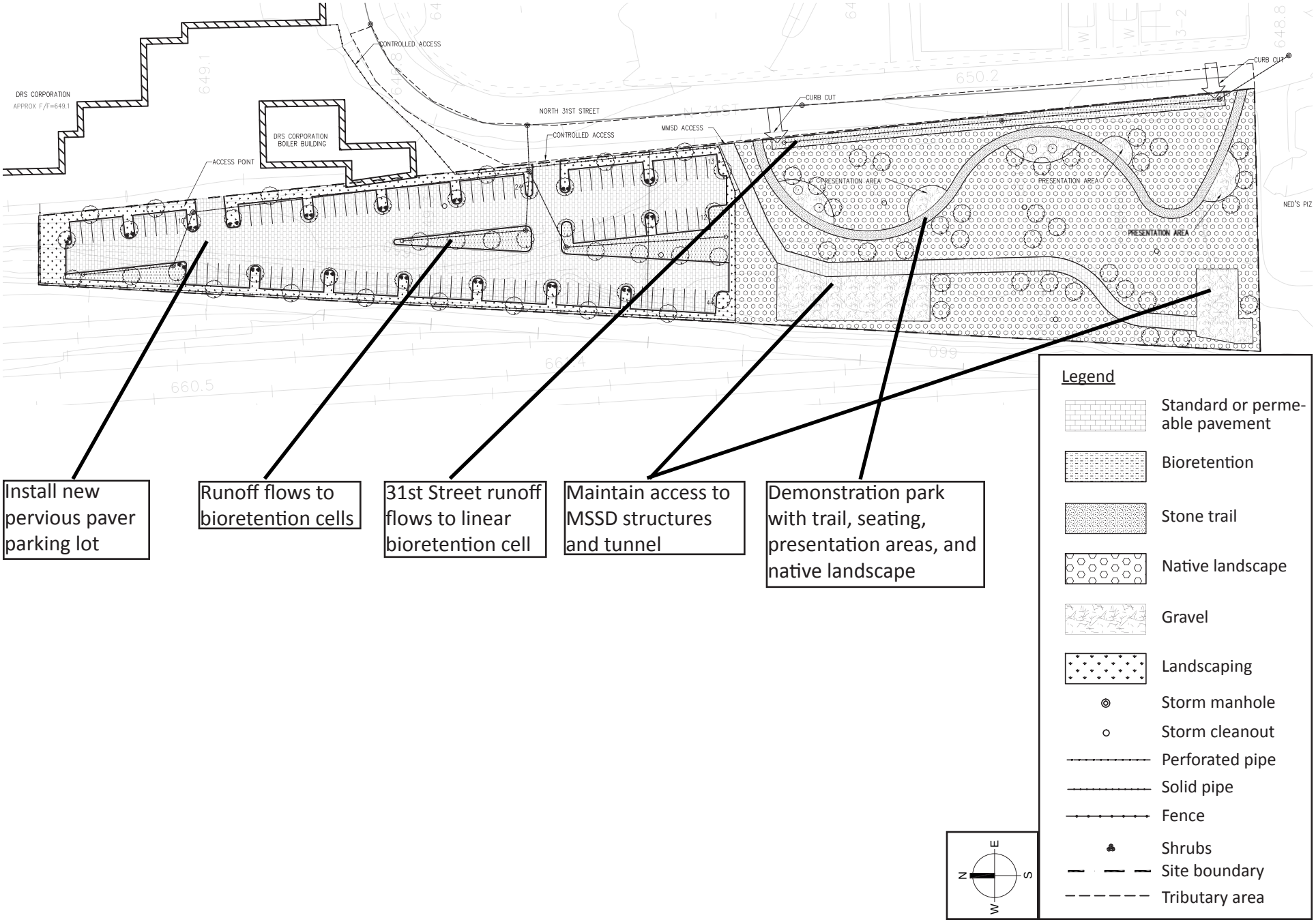


Figure 10 4101/4131 North 31st Street

Figure 11 4101/4131 North 31st Street

DRS Technologies Inc.

The DRS Technologies site (17.8 acres of private land) is covered primarily by an asphalt parking lot and the building. The site is located south of Ruby Yard, east of the Canadian Pacific Railway, north of Capitol, and west of Eaton Corporation and a residential neighborhood. Approximately two-thirds of the existing parking lot drains from west to east toward North 30th Street and the remainder drains west to the railway right-of-way. Storm sewers drain the parking lot and the building roof. The North 30th Street Parkways project site is on the eastern edge of the DRS parking lot. Identified potential components of the project include a green roof along with permeable paving and bioretention swales in the north parking lot as shown in the schematic design and conceptual illustrations (Figures 12, 13, and 14). As with the 4101/4131 N. 31st Street site, the figures show all of the components identified as potential elements to be incorporated into the site. The figures also show an alternative parking lot layout along with an increase in green space to accommodate the bioswales and to ensure that the bioswales would capture the runoff.

This project is similar to the 4101/4131 N. 31st Street site in that it treats only runoff generated on the site. SLAMM was used to evaluate a number of options as indicated in Table 15. The results of the SLAMM model show that the TSS removal rate could be as low as 7% and as high as 90%, depending on the practices implemented. In the SLAMM model, roofs produce only approximately 12% of the sediment load of industrial parking lots. This fact, combined with the fact that the remainder of the site remains untreated in the green roof-only option, results in a low removal rate for the green roof option (Option 1).

Although the bioswale option only treats the pavement area and not the roof or landscape areas, the removal rate for bioswales is relatively high since the pavement produces the most TSS. Option 3 assumes that all the site paving is converted to permeable paving and therefore addresses more area than the bioswale-only option. This fact combined with the fact that permeable paving is very effective at reducing sediment load, results in a removal rate for the permeable paving option that is significantly higher than the bioswale option. Option 4, which combines bioswales and permeable paving, results in only a very small increase in performance relative to permeable paving. This is because permeable paving produces very little runoff for most events and therefore the bioswales are treating a relatively small amount of runoff.

There are several design considerations associated with this site.

- An alternative to the green roof system, treating roof runoff at grade within a bioretention system, was considered. However, the building has internal roof drains that discharge directly to the storm sewer. Thus, significant internal re-plumbing would have been required to provide a discharge to a surface bioretention system and this option was not considered further.
- Most of the site naturally drains to the east toward the 30th Street parkway bioswales previously discussed. Thus, if the 30th Street project proceeds, most of this site could be addressed with those bioretention swales rather than the project identified here.
- As indicated previously, the parking arrangement would need to be re-oriented to accommodate the bioswales and to ensure that runoff would be captured by the bioswales, which would slightly reduce the capacity of the parking lot.
- Portions of the DRS parking lot may need re-paving, providing an opportunity to convert paving material from asphalt to permeable pavers.
- Although the permeable paving option identified here includes landscaped parking medians, it could be constructed without planters resulting in no or low reduction in parking capacity.

Table 15 DRS Technologies Modeling Results

Option #	Roof	Parking Lot		Annual Performance			
				Runoff		TSS	
	Practice	Landscape	Paving	Volume (cu ft)	% reduction	Load (lbs)	% reduction
Baseline	-	-	-	1,048,000	-	8132	-
1	Green	-	-	794,179	24.2%	7602	6.5%
2	-	Bioswale	-	801,225	23.5%	4,268	47.5%
3	-	-	Permeable	619,200	40.9%	1,450	82.2%
4	-	Bioswale	Permeable	615,597	41.3%	1,394	82.9%
5	Green	-	Permeable	365379	65.1%	838	89.4%
6	Green	Bioswale	-	547404	47.8%	3680	54.7%
7	Green	Bioswale	Permeable	361776	65.5%	806	90.1%

Option Notes:

Baseline	No controls applied to tributary area. Load based on Industrial land use.
1 - 7	"-" indicates either asphalt paving or landscape w/o bioretention. Bioswale area = 11% of tributary area.
1 - 7	0.60 acres of the site includes landscape and other areas that remain untreated.
1 - 7	The removal rates indicated are relative to the load from the entire site, even for practices that treat only a portion of the site.
1,5-7	Green Roof volume reduction (52.6%) based on EPA "Green Roofs for Stormwater Runoff Control" .
1	Green roof modeled as bioretention with only itself as drainage area to determine TSS removal.
2	Bioswale in the northern parking lot only, South(western) parking area not treated.
3	Permeable pavers in all paved areas. Storage provided under pavers with underdrain.
4	Bioswales in Northern parking area only. Permeable pavers in all paved areas.
5	Green roof and permeable pavers in all paved areas.
6	Green roof and bioswales in Northern parking area.
7	Green roof, Northern parking area bioretention, and permeable pavers.

Two cost alternatives are presented In Tables 16 and 17. The first alternative retrofits most of the existing pavement area with permeable interlocking concrete pavers (Option 3). If the parking lot requires repaving due to poor condition, this alternative provides the most value since it provides very high pollutant removal performance as well as providing a new, long lasting pavement surface. The unit cost of this alternative is approximately $580 per pound of sediment removed.

If the parking lot does not require repaving, the second alternative (Option 2) would be the most cost effective. Under this option, the existing paving is retained but bioretention swales are installed in the parking lot as landscape islands, as depicted in Figures 12, 13, and 14. Because this alternative does not involve repaving the entire parking lot, it is much less expensive yet still provides a significant reduction in TSS load. As indicated previously, the parking layout would have to be re-configured as shown such that the bioswales would intercept the runoff from the parking lot. The unit cost of this alternative is approximately $220 per pound of sediment removed.

Table 16 DRS Technologies Cost Estimate – Permeable Paving (Option 3)

See Appendix G for full cost breakdown and options. Maintenance costs are found in Table 7.

Description	Cost Estimate
Demolition	$ 647,274
Pavement removal, excavation	
Storm Sewer / Underdrain	$ 113,705
Storm sewer, underdrain, manholes	
Porous Unit Pavers*	$ 2,118,543
Pavers, stone, geotextile	
Landscaping	$ 95,707
Planting material, trees	
Erosion Control	$ 9,912
Erosion mat	
Subtotal	**$ 2,985,142**
Contingency (20%)	$ 597,028
Final Engineering	$ 298,514
Total	**$ 3,880,684**
*Use of pervious asphalt or concrete in place of porous unit pavers would increase the paving line item cost by 3% and 67% respectively. See Appendix for full cost breakdown.	
Cost estimate does not include green roof.	

Table 27 DRS Technologies Cost Estimate – Bioswale Retrofit Option (Option 2)

See Appendix G for full cost breakdown and options. Maintenance costs are found in Table 7.

Description	Cost Estimate
Demolition	$ 121,826
Pavement removal, excavation	
Storm Sewer / Underdrain	$ 113,705
Storm sewer, underdrain, manholes	
Bioretention Materials	$ 412,370
Amended soil, stone, planting material	
Subtotal	**$ 674,901**
Contingency (20%)	$ 129,580
Final Engineering	$ 64,790
Total	**$ 842,271**
Cost estimate does not include green roof.	

Figure 12 DRS Technologies Inc.

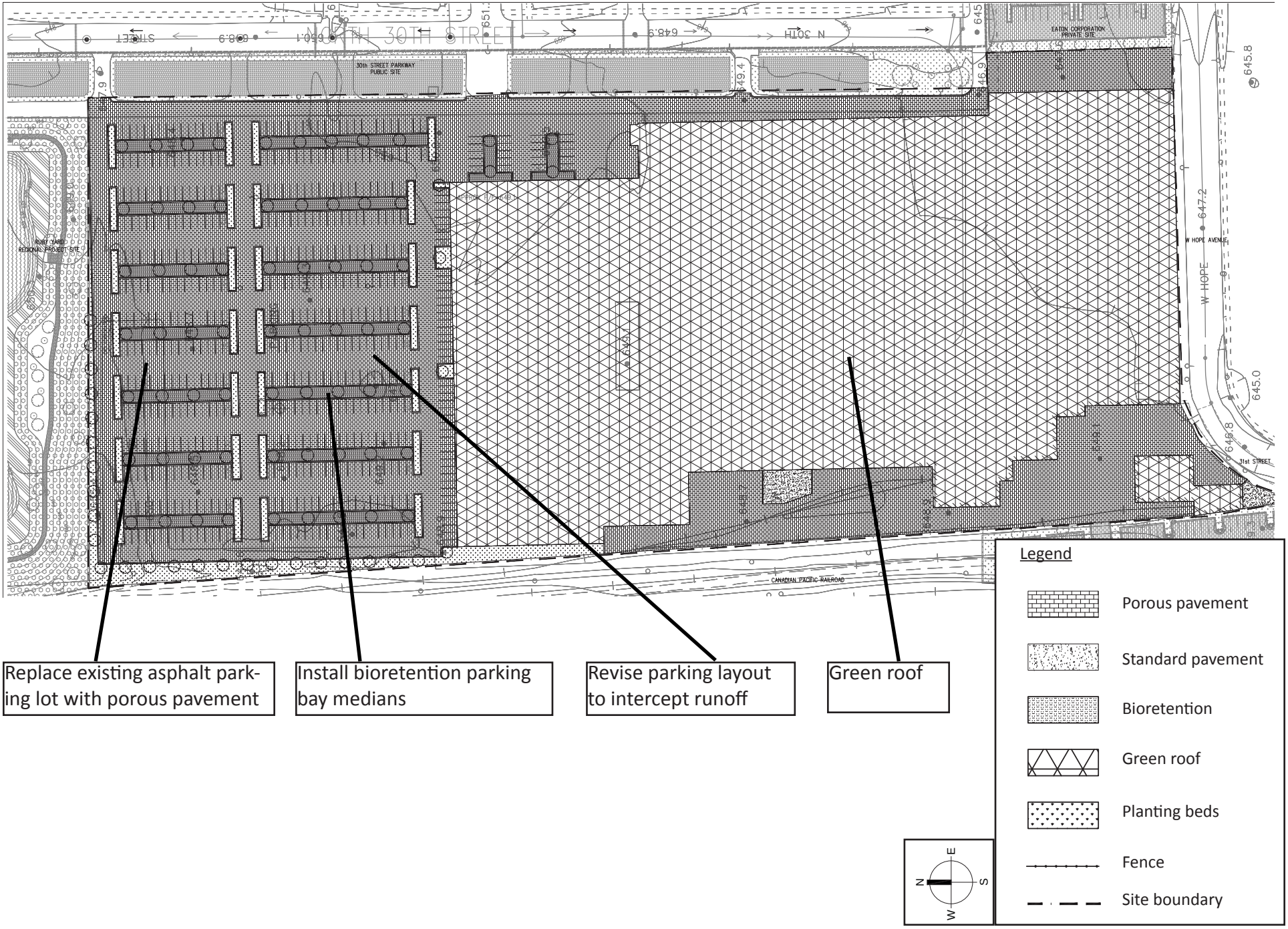


Figure 13 DRS Technologies Inc.

Figure 14 DRS Technologies Inc.

Eaton Corporation

The Eaton Corporation project site (5.0 acres of private land) is covered primarily by an asphalt parking lot, building, and limited landscape. The site is located south and west of a residential neighborhood, east of DRS Technologies, and north of Aldrich Chemical. The front parking lot drains from north to south toward the West Hope Avenue storm sewer while the rear parking lot drains southeast to northwest toward the North 30th Street storm sewer. The roof drains directly to the storm sewer.

Potential project components include a green roof, permeable pavers, and bioinfiltration in the front and rear parking areas, which is facilitated by an alternative parking layout and an increase in green space for the property as depicted in the schematic design and conceptual illustrations in Figures 15, 16, and 17. In addition, a revised parking layout could provide a more defined pedestrian walkway through the rear parking lot.

Like the 4101/4131 N. 31st Street and DRS project sites, this project only treats runoff generated on the site itself; no offsite runoff is treated. SLAMM was used to evaluate a number of options as indicated in Table 18. Although the components of this site are similar to DRS, the Eaton site has much less roof area in proportion to the overall site and therefore the results for the two sites differ. The results of the SLAMM model show that the TSS removal rate could be as low as 1% and as high as 92%, depending on the practices implemented. The very small removal rate associated with installing only a green roof (small relative to DRS) is a direct result of the proportionately smaller roof area.

Due to the grading in the area of the east parking lot, the bioswale option (Option 2) treats only the west parking lot and not the front parking lot or the roof. Because the west parking lot is a significant proportion of the site, the bioswale option still has a high removal rate. Option 3 assumes that nearly all the site paving is converted to permeable paving and therefore addresses more area than the bioswale-only option. This fact, combined with the fact that permeable paving is very effective at reducing sediment load, results in a removal rate for the permeable paving option that is higher than the bioswale option. Option 4, which combines bioswales and permeable paving, results in only a small increase in performance relative to permeable paving. This is because permeable paving produces very little runoff for most events and therefore the bioswales are treating a relatively small amount of runoff.

There are several design considerations associated with this site.

- Like the DRS building, the Eaton roof is drained with internal downspouts discharging directly to the storm sewer and therefore an at-grade bioretention system to treat roof runoff was infeasible.
- Although the general orientation of the parking lot could stay the same, the parking would need to be re-striped to accommodate the bioswale options identified in Table 18 to allow space for the bioswales.
- Although the permeable paving option identified here includes landscape planters, it could be constructed without planters with no or low loss of parking capacity.
- The existing parking lot is in serviceable condition and therefore Eaton Corporation may not be interested in repaving the lot at this time. Thus, installation of bioretention may be more attractive to the owner from a cost perspective.

Table 18 Eaton Corporation Modeling Results

Option #	Roof	Parking Lot		Annual Performance			
				Runoff		TSS	
	Practice	Landscape	Paving	Volume (cu ft)	% reduction	Load (lbs)	% reduction
Baseline	-	-	-	270,399	-	3,457	-
1	Green	-	-	246,737	8.8%	3,408	1.4%
2	-	Bioswale	-	107,428	60.3%	905	73.8%
3	-	-	Permeable	95,863	64.5%	455	86.8%
4	-	Bioswale	Permeable	69,945	74.1%	321	90.7%
5	Green	-	Permeable	72,200	73.3%	400	88.4%
6	Green	Bioswale	-	83,766	69.0%	856	75.2%
7	Green	Bioswale	Permeable	46,282	82.9%	272	92.1%

Option Notes:

Baseline	No controls applied to tributary area. Load based on Industrial land use.
1 - 7	"-" indicates either asphalt paving or landscape w/o bioretention. Bioswale area = 15 % of tributary area.
1 - 7	0.72 acres of the site includes landscape and other areas that remain untreated.
1 - 7	The removal rates indicated are relative to the load from the entire site, even for practices that treat only a portion of the site.
1,5-7	Green Roof volume reduction (52.6%) based on EPA "Green Roofs for Stormwater Runoff Control" .
1	Green roof modeled as bioretention with only itself as drainage area to determine TSS removal.
2	Bioswales western parking lot only, eastern/central park area untreated.
3	Permeable pavers used in all parking areas. Storage provided under pavers with under drain.
4	Bioswales in western parking lot only. Permeable pavers in all parking areas.
5	Green roof and permeable pavers in all parking areas.
6	Green roof and bioswales in northern parking area.
7	Green roof, western parking lot bioswales, and permeable pavers in all parking areas.

Two cost alternatives are presented In Tables 19 and 20. The first alternative repaves the front and rear parking lots in permeable interlocking concrete pavers (Option 3). If the parking lot requires repaving due to poor condition, this alternative provides the most value since it provides very high pollutant removal performance as well as providing a new, long lasting pavement surface. The unit cost of this alternative is approximately $610 per pound of sediment removed.

If the parking lot does not require repaving, the second alternative (Option 2) would be the most cost effective. Under this option, the existing paving is retained but bioretention swales are installed in the parking lot as landscape islands as depicted in Figures 15, 16, and 17. Because this alternative does not involve repaving the entire parking lot, it is much less expensive yet still provides a significant reduction in TSS load. The unit cost of this alternative is approximately $150 per pound of sediment removed.

Table 19 Eaton Corporation Cost Estimate

The following cost estimate is for Option #3. See Appendix G for full cost breakdown and options. Maintenance costs are found in Table 7.

Description	Cost Estimate
Demolition	$ 279,251
Pavement removal, excavation	
Storm Sewer / Underdrain	$ 61,155
Storm sewer, underdrain, manholes	
Porous Unit Pavers*	$ 897,670
Pavers, stone, geotextile	
Landscaping	$ 58,548
Planting material, trees	
Site Amenities & Erosion Control	$ 104,706
Concrete pavement, fence, erosion mat	
Subtotal	**$ 1,401,331**
Contingency (20%)	$ 280,266
Final Engineering	$ 140,133
Total	**$ 1,821,730**
*Use of pervious asphalt or concrete in place of porous unit pavers would increase the paving line item cost by 3% and 67% respectively. See Appendix for full cost breakdown.	
*Cost estimate does not include green roof.	

Table 20 Eaton Corporation Cost Estimate - Bioswale Retrofit (Option #2)

See Appendix for full cost breakdown and options. Maintenance costs are found in Table 7.

Description	Cost Estimate
Demolition	$ 52,005
Pavement removal, excavation	
Storm Sewer / Underdrain	$ 61,155
Storm sewer, underdrain, manholes	
Bioretention Material	$ 177,360
Amended soil, stone, planting material	
Subtotal	**$ 290,520**
Contingency (20%)	$ 58,104
Final Engineering	$ 29,052
Total	**$ 377,676**
*Cost estimate does not include green roof.	

Figure 15 Eaton Corporation

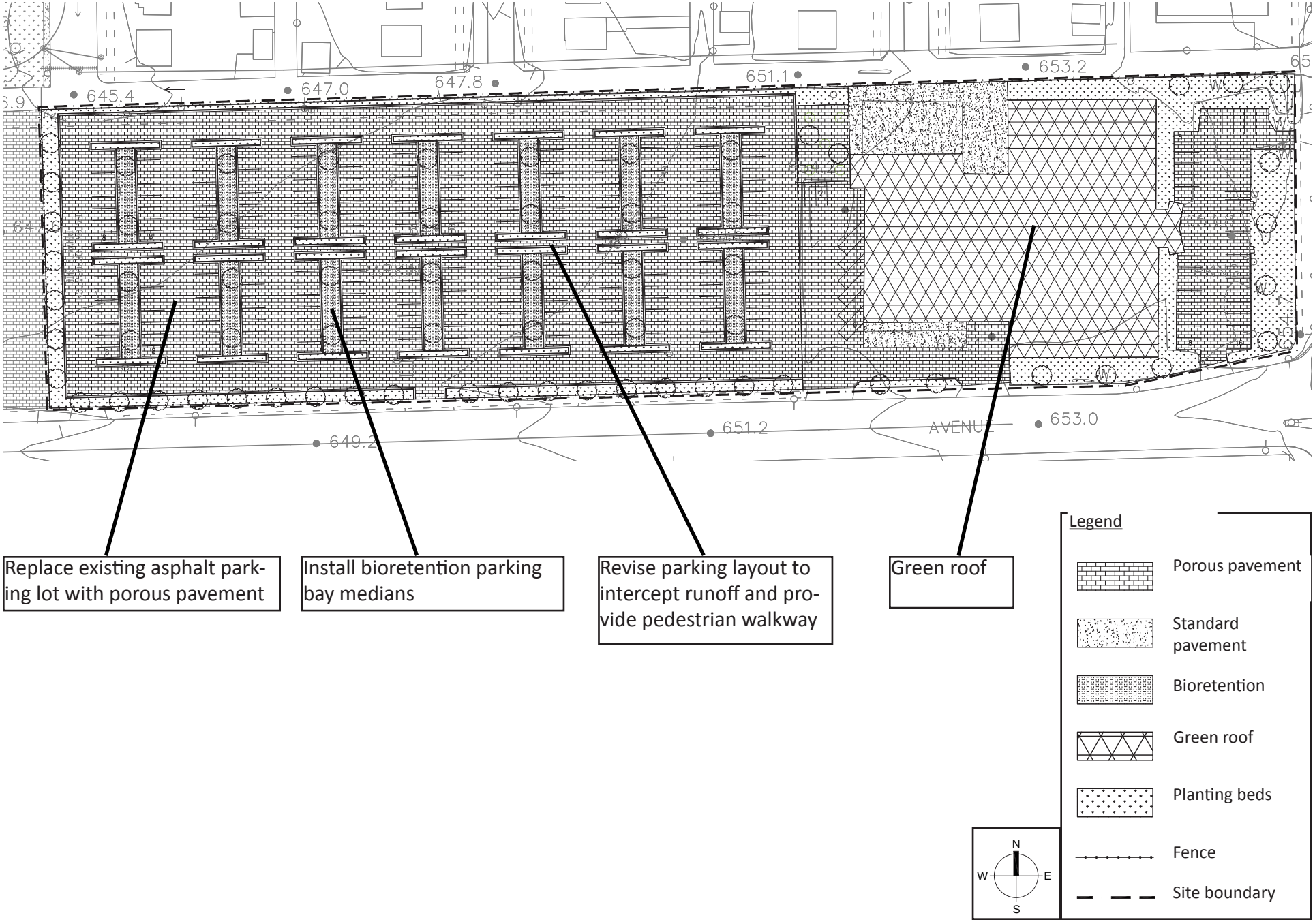


Figure 16 Eaton Corporation

Figure 17 Eaton Corporation

Vapor Blast Manufacturing Company

The Vapor Blast project site is 5.9 acres of private land covered by gravel parking area, three existing buildings, and open space comprised of turf grass and wooded areas. Site runoff generally flows from north to south, except for the northern edge of the site and approximately half of the main building roof of the main building. The existing gravel parking lot has poor drainage that results in areas of standing water following storm events and winter snowmelt. The three roofs drain directly to grade. The site is located south of an industrial site, east of the Canadian Pacific Railway, north of the Ruby Yard Department of Public Works site, and west of a residential neighborhood.

Identified project components could include permeable pavers and bioinfiltration in the parking areas and natural landscape over most of the existing grass and wooded areas. Because of the existing site layout and general grading of the site, the improvements could be made without changing the general layout of the parking. However, the plan includes removal of some existing pavement on the eastern portion of the site identified by the owner as unnecessary.

The schematic design and conceptual illustrations in Figures 18, 19, and 20 show permeable pavers in the parking lot, bioinfiltration on the north and south sides of the building, biofiltration along the lower edge of the parking lot, and green roof. The illustrations show implementation of all the identified BMP options for the site.

Like the 4101/4131 N. 31st Street, DRS, and Eaton sites, this project only treats runoff generated on the site. SLAMM was used to evaluate a number of options as indicated in Table 21. However, this site has a number of unique attributes that allow additional treatment strategies. Because most of the site drains south toward the vegetated portion of the site, the vegetated area could be used as a large filter strip for most of the site runoff at a relatively low cost. This is Option 1 in Table 21.

Unlike DRS and Eaton, the building roof drains to grade providing an opportunity to treat roof runoff. Existing small vegetated areas adjacent to the building could be converted into bioretention for roof runoff allowing the runoff for the Vapor Blast main building to be treated at grade. Because this option exists, no green roof option was evaluated. In addition to the bioretention adjacent to the building, this option (Option 2) includes a bioswale along the lower edge of the parking lot to treat the parking lot runoff. As can be seen in Table 21, this option approaches near complete removal of TSS. This building roof bioretention option would at least partially address the excessive ponding problems in the parking lot described by the owner.

Option 3 replaces bioretention with permeable paving. Option 3 would better address the drainage problems within the parking lot. However, because of the way the SLAMM model treats permeable pavement, this option does not treat the roof runoff. Thus, the TSS removal reported in Table 21 is not as high as the bioretention option. However, in practice, the removal rate for this option could likely be nearly as high as Option 2. Option 4 combines all of the potential project components. As can be see from Table 21, this option provides only marginally higher removal rate than Option 2.

There are several design considerations associated with this site.

- Although the most cost effective option would be to install the filter strip, it does nothing to address the parking lot drainage concerns of the owner.
- Although installation of permeable pavement would not be as cost effective as some of the other options, it would best address the concerns of the owner.

Table 21 Vapor Blast Manufacturing Modeling Results

Option #	Open Space	Parking Lot & Roof		Annual Performance			
				Runoff		TSS	
	Landscape	Landscape	Paving	Volume (cu ft)	% reduction	Load (lbs)	% reduction
Baseline	-	-	-	152,751	-	912	-
1	Filter Strip	-	-	81,924	46.4%	401	56.1%
2	Filter Strip	Bioswale	-	3,153	97.9%	33	96.3%
3	Filter Strip	-	Permeable	76,571	49.9%	228	75.0%
4	Filter Strip	Bioswale	Permeable	2,742	98.2%	31	96.6%

Option Notes:

Baseline	No controls applied to tributary area. Load based on Industrial land use.
1 - 4	Open Space Area options, "-" indicates existing turf remains.
1 - 4	Parking Lot & Roof options, "-" indicates either asphalt paving or landscape w/o bioretention. Bioswale area = 18 % of tributary.
1	Filter strip treats parking lot and south half of roof – Filter strip modeled as very broad swale with width equal to length of parking lot.
2	Bioswale on north & south side of building & south edge of parking.
3	Permeable pavement. Filter strip for roof and excess permeable pavement runoff.
4	Filter Strip, bioswale on north and south sides, and permeable pavement.

For the Vapor Blast site, the lowest cost option (Option 1) would be to establish native vegetation on the south side of the site, utilizing the vegetation as a filter strip to treat the runoff from the majority of the site, including the most of the roof and all the paved area. While this option would significantly reduce the TSS load, it would not address the drainage problems within the parking lot. Thus, a second cost estimate is provided for installation of permeable paving and the filter strip (Option 3).

The unit cost of the first alternative is $42 per square pound of sediment removed and the unit cost of the second alternative is $830 per pound of sediment removed.

Table 22 Vapor Blast Manufacturing Cost Estimate

The following cost estimate is for Option #1. See Appendix for full cost breakdown and options. Maintenance costs are found in Table 7.

Description	Cost Estimate
Demolition	$ 6,694
Brush clearing, remove stumps	
Planting Materials	$ 8,549
Seeding	
Subtotal	**$ 15,242**
Contingency (20%)	$ 3,048
Final Engineering	$ 3,048
Total	**$ 21,339**
*Cost estimate does not include green roof.	

Table 23 Vapor Blast Manufacturing Cost Estimate

The following cost estimate is for Option #3. See Appendix for full cost breakdown and options. Maintenance costs are found in Table 7.

Description	**Cost Estimate**
Demolition	$ 96,076
Excavation, disposal	
Storm Sewer / Underdrain	$ 20,725
Storm sewer, underdrain, manholes	
Porous Unit Pavers*	$ 241,943
Pavers, stone, geotextile	
Landscaping	$ 34,683
Planting material, trees, natives	
Site Amenities & Erosion Control	$ 43,250
Sidewalk, fence	
Subtotal	**$ 436,677**
Contingency (20%)	$ 87,355
Final Engineering	$ 43,668
Total	**$ 567,680**
*Use of pervious asphalt or concrete in place of porous unit pavers would increase the paving line item cost by 3% and 67% respectively. See Appendix for full cost breakdown.	
*Cost estimate does not include green roof.	

Figure 18 Vapor Blast

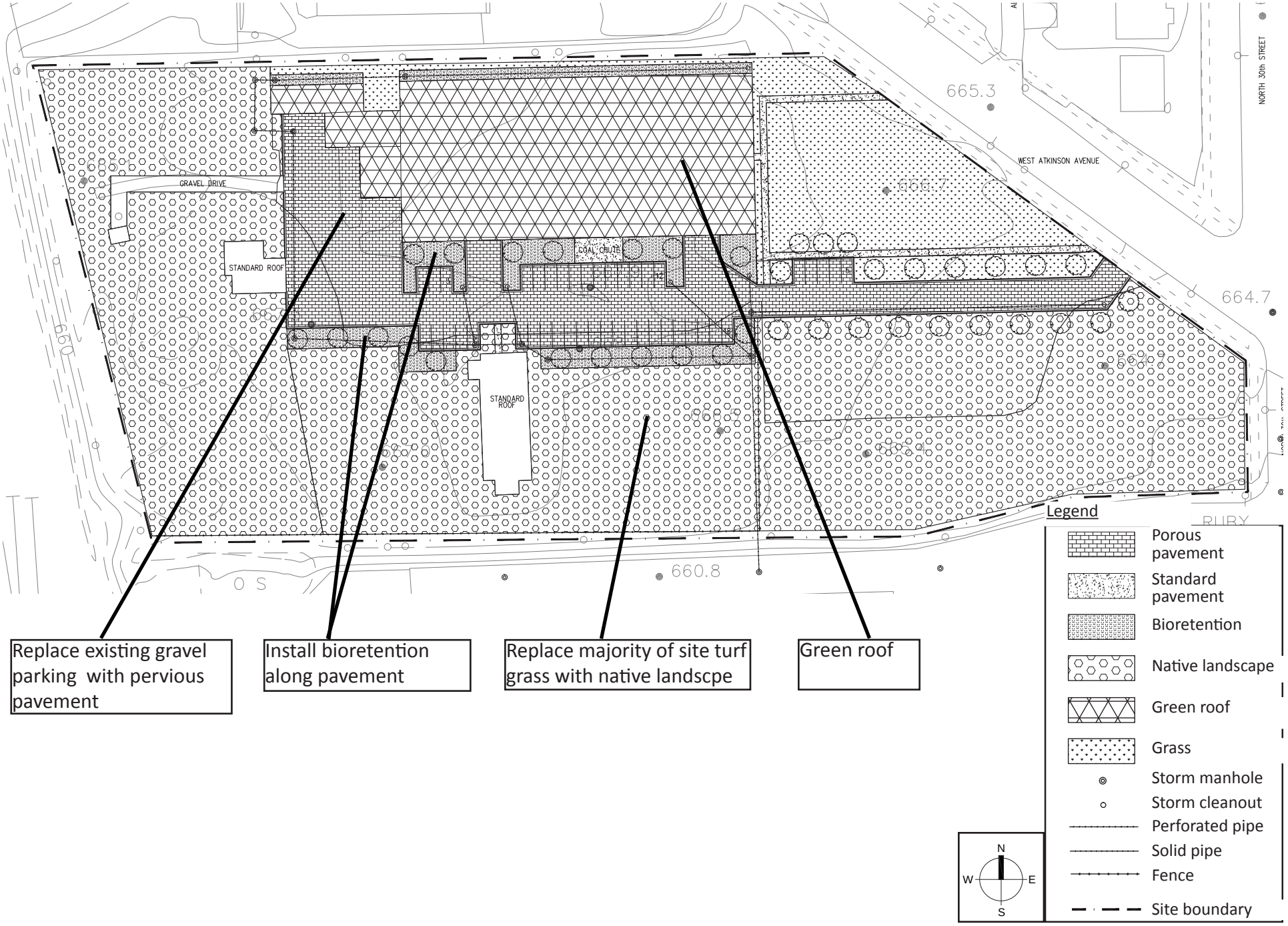


Figure 19 Vapor Blast

Figure 20 Vapor Blast

Right-Of-Way

Throughout the corridor there are over 110 acres of public right-of-way. This includes residential streets, residential alleys, and nonresidential streets. Residential right-of-ways are those that are primarily surrounded by residential properties with an approximate pavement width of 30 feet. They receive storm water runoff from the roadway and the fronts of the adjacent residential lots, including approximately half the roof area. Alley rights-of-way are those areas that allow rear access to residential lots with approximate pavement widths of 18 feet. They typically have less traffic than the residential right-of-way and receive runoff from the alley pavement and backyards of the adjacent residential lots, including approximately half the roof area. Nonresidential rights-of-way are those that are bordered primarily by nonresidential activities and have a pavement width in excess of 40 feet. They typically receive only the storm water runoff from the right-of-way itself, with minimal runoff from adjacent properties. Tables 24, 25, and 26 display the modeling results for the residential rights-of-way, alley, and nonresidential rights-of-way.

The residential right-of-way (ROW) includes two alternative practices: 1) neckdown bioswales at the middle and end of each block and 2) permeable pavers. The neckdown bioswales are areas where the curb extends into the street to reduce the street width for a specified length. This extension of the curb provides additional surface area between the curb and the sidewalk to install bioretention that can intercept and treat storm water runoff flowing through the curb and gutter system.

For the permeable pavement option, the runoff from areas outside the pavement (lawns, sidewalks, and roofs) would be untreated since the road is crowned and the off-pavement runoff would drain to the gutter and not onto the permeable pavers. The proposed permeable paver system is similar to that used for the public and private sites. The conceptual design options are shown in Figures 21, 22, and 23.

The alley ROW evaluation includes one practice that is deployed at two different levels. In this case the permeable pavers system would be similar to that used for the street ROW, but could cover either the full width of the pavement section or only the middle half of the pavement section. Bioinfiltration practices were not evaluated for the alley ROW due to the limited space available outside the alley pavement. Due to limitations in the SLAMM model, the permeable paving alley model only treats runoff from the pavement itself and not run-*on* from the adjacent lot area. It is likely, however, that a half-paved alley would infiltrate run-on from adjacent paved alley and yield nearly the same TSS removal results as the fully permeable alley. The schematic design options are shown in Figures 24 and 25.

The non-residential ROW evaluation includes one practice that is deployed at three different levels: behind-the-curb bioinfiltration practices were sized such that the bioinfiltration surface area is 1%, 4%, and 8% of the tributary area. The bioinfiltration areas would be located between curb and the sidewalk. Permeable pavers were not evaluated in this right-of-way due to the higher speeds of traffic on nonresidential roadways and typical design guidance that recommends against use of permeable pavers where posted speed limits exceed 25 to 30 mph. The schematic design is shown in Figure 26.

The results of the SLAMM model for the three ROW types are shown in Tables 24, 25, and 26. For the residential street ROW, the bioswales are only 1% of the drainage area and therefore the performance is relatively low (approximately 11%). Although the permeable paving option (Option 2) only treats a portion of the drainage area, it treats the portion that produces the greatest load of total suspended solids, and, therefore, the performance of the permeable pavement option is relatively high (over 49% TSS removal relative to the total baseline load).

The permeable alley removes a similar amount of sediment as the permeable street. However, because the area of the alley is smaller than the area of the street relative to the total drainage area, the performance level of the alley system is lower than the performance level of the street system.

For the commercial ROW, the TSS removal performance level is roughly proportional to the area of bioretention since the volume of runoff able to be treated by the bioretention facility is roughly proportional to the area of bioretention.

Table 24 Residential Right-Of-Way Modeling Results

Option #	Yard Area BMP	Street Area Paving	Annual Performance			
			Runoff		TSS	
			Volume (cu ft)	% reduction	Load (lbs)	% reduction
Baseline	-	-	78,644	-	433	-
1	Bioswale	-	69,390	11.8%	384	11.2%
2	-	Permeable	52,259	33.6%	219	49.4%
3	Bioswale	Permeable	43,082	45.2%	186	57.0%

Option Notes:

Baseline	No controls applied to tributary area. Load based on High Density Single Family Residential.
1	Bioswales at mid block and end of block treat runoff from roadway and yards and roofs.
2	Permeable pavement full width of street, treats only rainfall directly onto roadway.
3	Mid block and end of block bioswales, full width permeable pavement.
1 & 3	Bioswale area = 1 % of total tributary area.

Table 25 Alley Right-Of-Way Modeling Results

Option #	Alley Area Paving	Annual Performance			
		Runoff		TSS	
		Volume (cu ft)	% reduction	Load (lbs)	% reduction
Baseline	-	82,266	-	454	-
1	1/2 Permeable	75,594	8.1%	400	11.9%
2	Permeable	63,463	22.9%	302	33.6%

Option Notes:

Baseline	No controls applied to tributary area. Load based on High Density Single Family Residential.
1	Permeable pavement comprises half of the alley width and treats only rainfall that falls directly on the permeable pavement, a limitation of the SLAMM modeling capabilities.
2	Permeable pavement comprises the full width of the alley and treats only rain falling directly onto the permeable pavement, a limitation of the SLAMM modeling capabilities.

Table 26 Nonresidential Right-Of-Way Modeling Results

Option #	ROW Area	Annual Performance			
		Runoff		TSS	
		Volume (cu ft)	% reduction	Load (lbs)	% reduction
Baseline	-	164,423	-	4927	-
1	1% Bioswale	154,779	5.9%	4543	7.8%
2	4% Bioswale	127,164	22.7%	3519	28.6%
3	8% Bioswale	90,507	45.0%	2128	56.8%

Option Notes:

Baseline	No controls applied to tributary area. Load based on Commercial land use.
1	Bioswale area is 1% of tributary area.
2	Bioswale area is 4% of tributary area.
3	Bioswale area is 8% of tributary area.

Costs for selected options are provided in Tables 27, 28 and 29. For the residential right-of-way, the permeable pavement option was selected for cost estimating because the removal rate is much greater than for the bioswales, and because the interlocking permeable pavers also provide a longer lasting and more durable pavement surface than asphalt. The unit cost for the permeable pavement street system is approximately $1,440 per pound of sediment removed.

For the residential alley, the full width permeable pavement option was selected for cost estimating because there is little cost difference between installation of a full width and half width alley. The unit cost for the permeable pavement street system is approximately $1,430 per pound of sediment removed.

For the non-residential right-of-way, the option with 4% bioswale area was selected for cost estimating since it may not be feasible under many circumstances to provide a larger proportion of bioswale, and because the removal rate for the 1% bioswale area is very low. The unit cost for the bioretention system in the non-residential right-of-way is approximately $110 per pound of sediment removed. This is very cost effective in comparison to the other practices. However, the overall removal rate is less than the mandated 40% TSS removal. Because of the cost effectiveness of this practice, larger bioretention systems should be considered where there is available space.

Table 27 Residential Right-Of-Way Cost Estimate (Option #3)

See Appendix for full cost breakdown and options.

Description	**Cost Estimate**
Demolition	$ 45,918
Pavement removal, earthwork	
Storm Sewer / Underdrain	$ 27,002
Storm sewer, underdrain, manholes	
Bioretention Material	$ 12,866
Amended soil, stone, planting material	
Porous Unit Pavers*	$ 150,496
Pavers, stone, geotextile	
Erosion Control	$ 468
Erosion mat	
Subtotal	**$ 236,750**
Contingency (20%)	$ 47,350
Final Engineering	$ 23,675
Total	**$ 307,775**
*Use of pervious asphalt or concrete in place of porous unit pavers would increase the paving line item cost by 3% and 67% respectively.	

Table 28 Alley Right-Of-Way Cost Estimate (Option #2)

See Appendix for full cost breakdown and options.

Description	Cost Estimate
Demolition	$ 31,336
Pavement removal, earthwork	
Storm Sewer / Underdrain	$ 22,102
Storm sewer, underdrain, manholes	
Porous Unit Pavers	$ 113,241
Pavers, stone, geotextile	
Erosion Control	$ 512
Erosion mat	
Subtotal	**$ 167,191**
Contingency (20%)	$ 33,438
Final Engineering	$ 16,719
Total	**$ 217,349**
*Use of pervious asphalt or concrete in place of porous unit pavers would increase the paving line item cost by 3% and 67% respectively.	

See Appendix for full cost breakdown and options.

Table 29 Nonresidential Right-Of-Way Cost Estimate (Option #2)

See Appendix for full cost breakdown and options.

Description	Cost Estimate
Demolition	$ 17,550
Earthwork	
Storm Sewer / Underdrain	$ 21,164
Storm sewer, underdrain, manholes	
Bioretention Material	$ 76,449
Amended soil, stone, planting material	
Subtotal	**$ 115,163**
Contingency (20%)	$ 23,033
Final Engineering	$ 11,516
Total	**$ 149,712**

Figure 21 Residential Right-of-Way Neckdown Bioswales

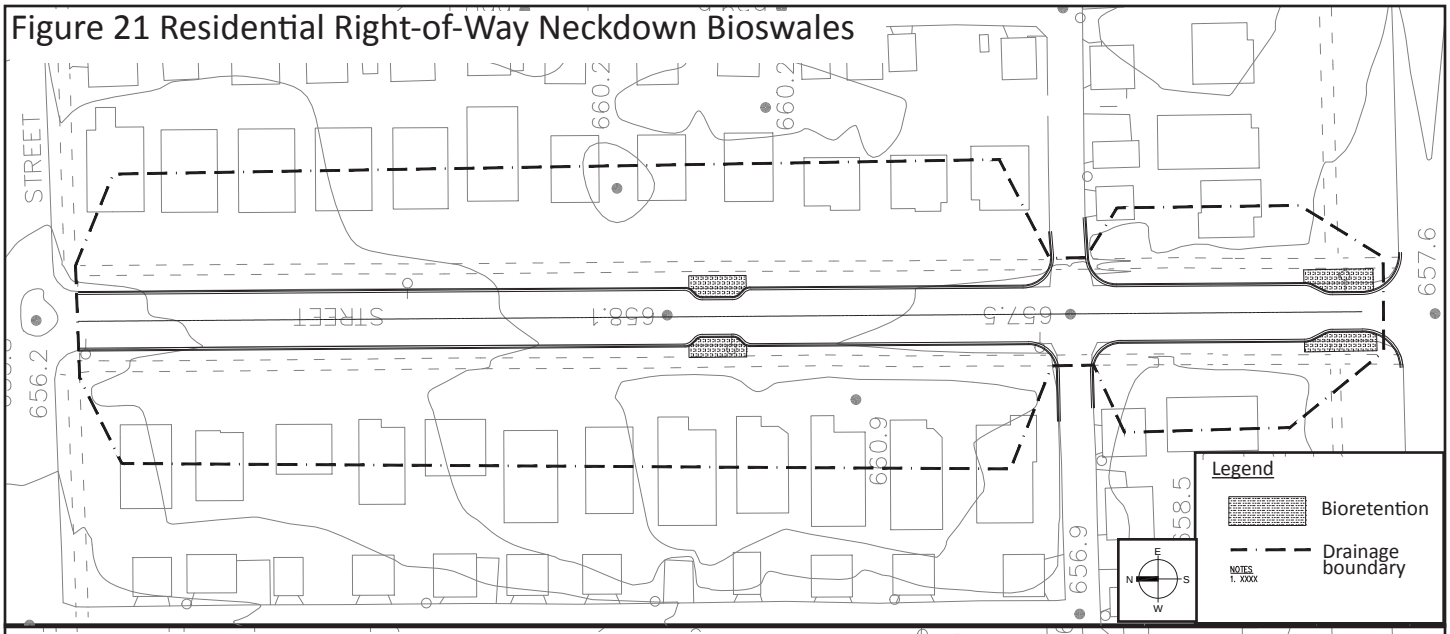


Figure 22 Residential Right-of-Way Pavers

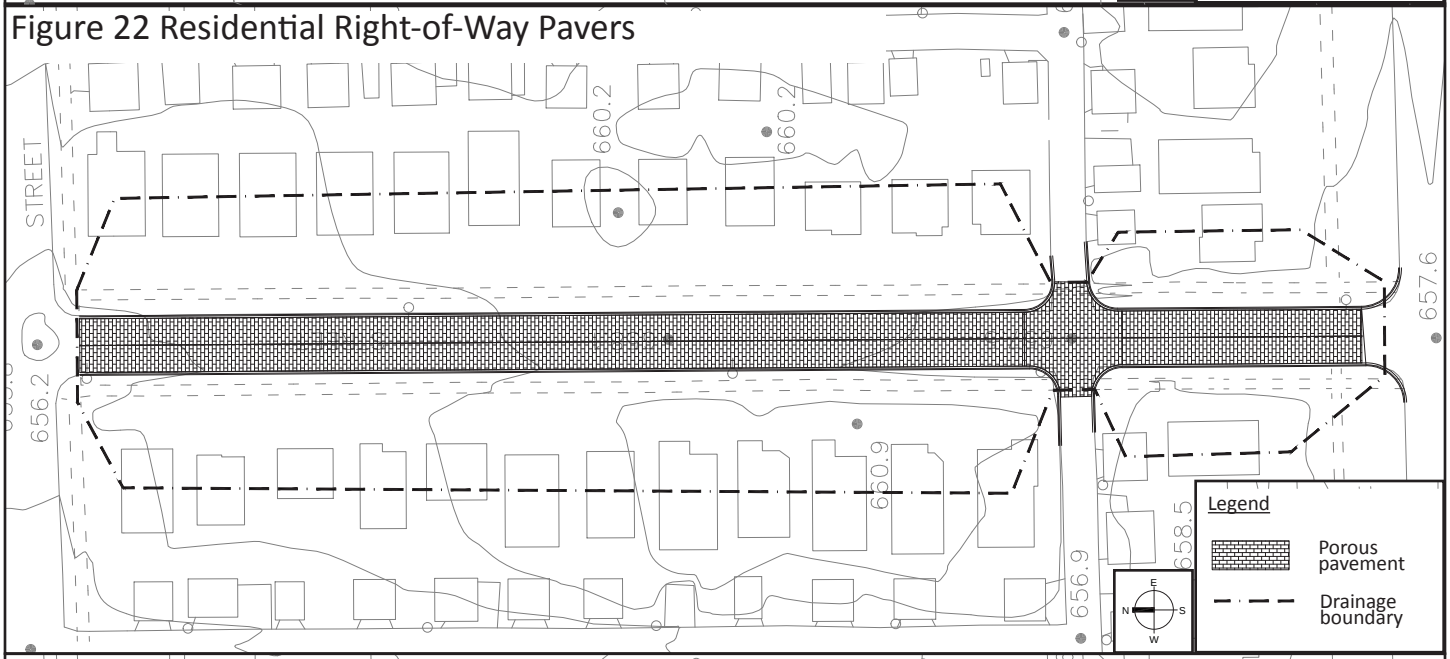


Figure 23 Residential Right-of-Way Bioswales and Pavers

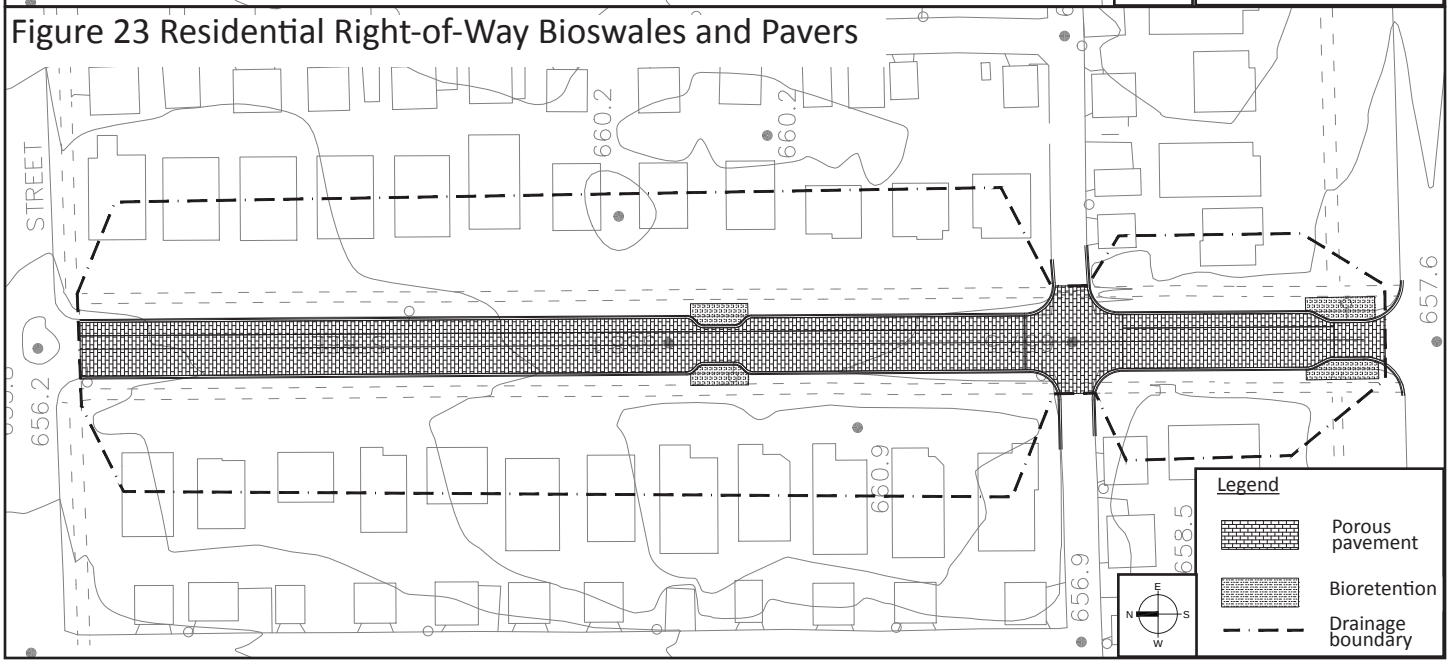


Figure 24 Alley Right-of-Way Partial Pavers

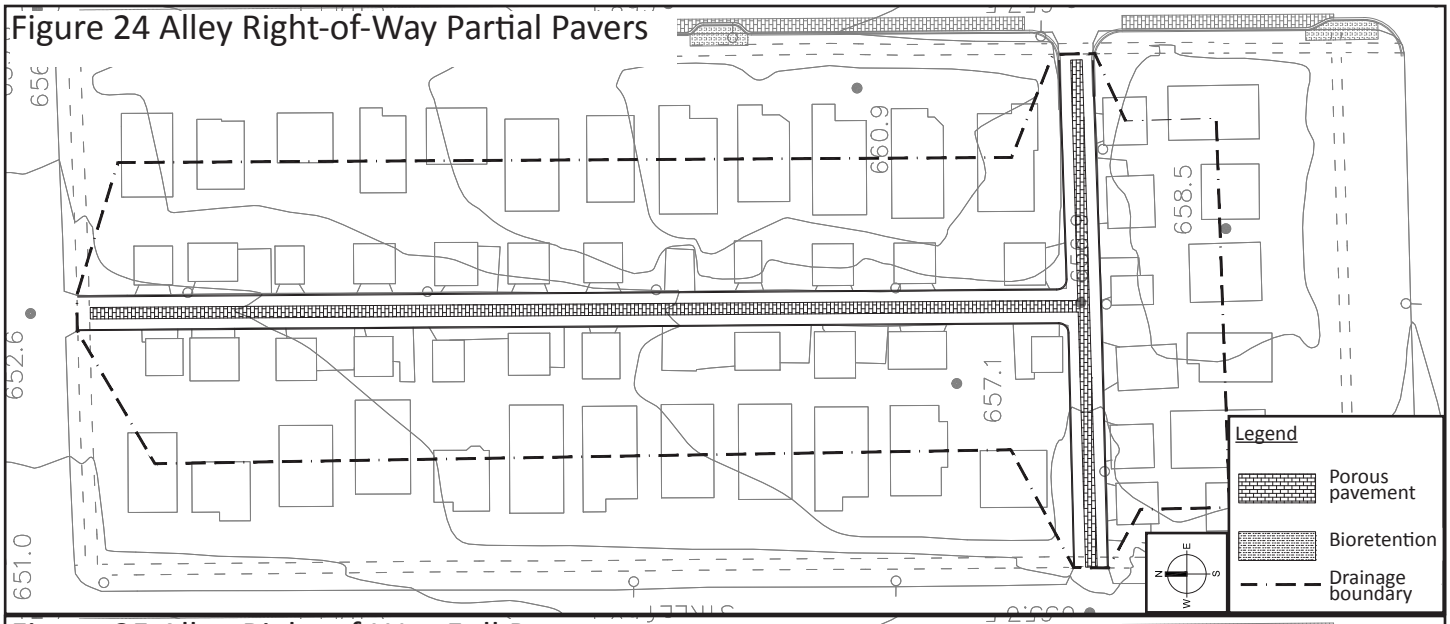


Figure 25 Alley Right-of-Way Full Pavers

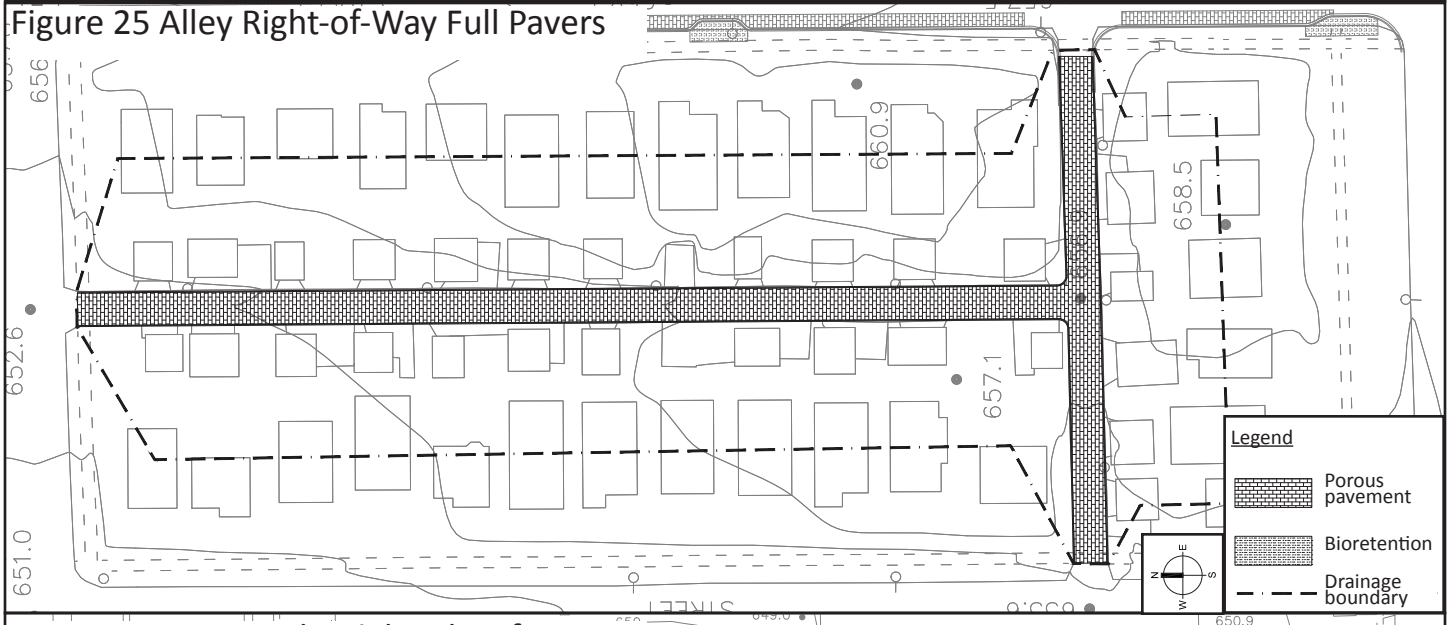
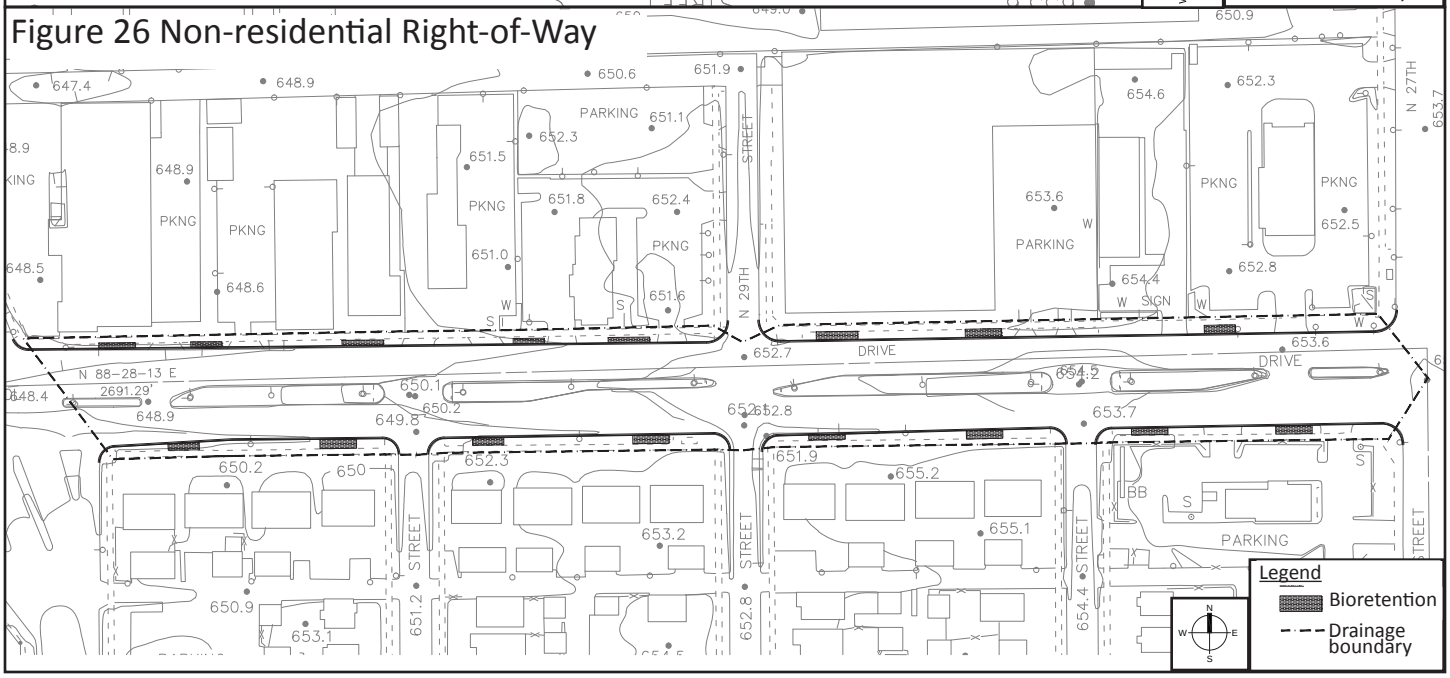


Figure 26 Non-residential Right-of-Way



Corridor Evaluation

In addition to the hydrologic and water quality evaluation of the individual private and public sites, an evaluation of the potential corridor wide performance of BMP implementation was conducted. As described below this evaluation required assumptions of TSS load by land use, typical BMP performance for each land use, and an assumed level of implementation throughout the corridor.

Land Use

The 30th Street Corridor project area is approximately 562 acres and contains eight major land use areas. These include:

- Multifamily Residential
- Single Family Residential
- Commercial
- Industrial
- Open Space and Parks
- Residential Right-of-Way
- Alley Right-of-Way
- Nonresidential Right-of-Way

A number of these land uses behave similarly from a hydrologic and water quality perspective and therefore the land uses could be combined for purposes of estimating TSS reduction performance. Commercial and industrial properties are almost entirely composed of roof and paving and therefore those two uses were combined when modeling the corridor as a whole. Similarly, single family and multi-family uses are very similar since virtually all the multifamily units consist of two flats on individual lots. Also, there is very little park area and, in many cases, the areas identified as park are undeveloped lots within the residential neighborhoods. Table 30 shows the combined land uses for the corridor wide evaluation.

Table 30 Corridor Land Use Cover Types

Land Uses Cover Type	Area (ac)
Multifamily/Single Family/Open Space	128
Commercial/Industrial	323
Residential/Alley ROW	43
Nonresidential ROW	68
Totals	**562**

Notes:
Multifamily and Single Family land use areas combined to HDRWA (High Density Residential with Alleys)
Commercial and Industrial land use areas combined to LI (Light Industrial), LI also contains the Railroad ROW
Open Space and Parks incorporated into HDRWA

BMP Performance

Based on the SLAMM model results for the private and public site analysis, removal rates were estimated for individual practices in typical applications. As Table 31 shows, the performance of several of the BMPs depends on the specific application of those BMPs. For example, very high performance levels are achieved for permeable paving parking lots since most of the drainage area is permeable and most of the area is treated. However, for permeable streets and alleys in residential neighborhoods, only the streets and alleys are permeable and treated and the remainder of the drainage area (lawns, sidewalks and roofs) is untreated, resulting in more moderate performance results.

Table 31 Average Removal Rates for Applications

	Application	Total Suspended Solids			Runoff		
		Baseline	With BMP		Baseline	With BMP	
		Load	Load	% removal	Load	Load	% removal
		lbs/ac	lbs/ac	%	cu ft/ac	cu ft/ac	%
1	Green Roof	123	36	71%	58,816	27,879	53%
2	Parking w/Bioswale (10%)	972	359	63%	56,394	49,666	12%
3	Parking w/ Permeable Pavement	972	43	96%	56,394	11,525	80%
4	Com ROW w/Bioswale (4%)	1412	223	29%	47,112	44,349	6%
5	Residential w/ ROW Bioswale (2%) & half permeable alley	203	178	12%	36,822	33178	10%
6	Residential w/ Permeable Pvmt Streets & full permeable alley	203	118	41%	36,822	26482	28%
7	Pvmt Conversion to Natural Landscape	814	292	64%	53804	15179	72%

Notes:

1 Roof load based on industrial land use. TSS removal rate based on 50% of storms produce no runoff, and green roofs remove 43% of runoff during storm events that do produce flows, so 71% removal was assumed for commercial and industrial areas.

Green roof volume reduction (52.6%) based on EPA's "Green Roof for Stormwater Removal Rate Application Runoff Control"

2,4,5 Percentage indicates proportion of drainage area that is covered with bioswale.

2 Parking lot load based on industrial land use. Removal rate applicable to industrial and commercial.

3 Parking lot load based on industrial land use. Removal rate applicable to industrial and commercial.

4 Bioswale area based on intermediate Nonresidential ROW template.

5 Bioswale area from Residential ROW template. Load and removal rate based on combined residential ROW & alley ROW templates

6 Load and removal rate based on combined residential ROW & alley ROW templates

7 Reduction in TSS and Runoff based on difference in loading and runoff for different cover types

Corridor-wide Performance

Utilizing the corridor land uses in Table 30 and the average loading and removal rates in Table 31, corridor-wide loading and removal rates were calculated as shown in Table 32. As indicated, the commercial/industrial land use was further subdivided into properties with varying proportion of roof area. This land use was subdivided because the TSS loading rate for commercial/industrial parking lots is approximately eight times the loading rate for roofs. Further, there are a number of strategies for treating runoff from parking lots, but there are few strategies for treating roof runoff when the roofs drain directly to the storm sewer system.

Although there are a number of BMP systems that could be applied to the various land uses as discussed in the private sites evaluations (DRS, Eaton, and Vapor Blast), the strategies selected for the corridor wide evaluation in Table 32 were those found to be cost effective and applicable to most sites. Using the loading rates and removal rates shown, a uniform level of BMP implementation of 65% was necessary across the entire Corridor to achieve a corridor-wide TSS load reduction of 40%. Table 32 presents one of many possible combinations of BMPs and implementation levels that could be used to achieve the overall rate of 40%.

Examination of the TSS loads in Table 31 shows the commercial/industrial (non-residential) right-of-way land use as the single greatest source of TSS (after subdividing the commercial/industrial land use) and produces 34% of the Corridor TSS load. Further, non-residential right-of-ways are difficult to treat to a high level using bioretention since there is often very limited space available to install bioretention along non-residential streets. The combined high loading rate and low removal rate of the non-residential right-of-ways was a significant contributor to the need for the 65% BMP implementation level in Column E of Table 32.

Table 32 Corridor Wide TSS Load Reduction

Land Use	Area	No Control Unit Load	No Control Load	BMP % Reduction	% Of Area Treated	Post BMP Load
Column #	A	B	C	D	E	F
	ac	lbs/ac/yr	lbs/yr	%	%	lbs
High Density Residential w/ROW & alley permeable pvmt	124	203	25,187	41%	65.0%	18,427
Non-residential ROW w/ 4% bioretention	68	1412	96,159	29%	65.0%	78,296
Com/Ind - 0% Roof w/ perm pvmt	16	877	14,146	95%	65.0%	5,414
Com/Ind - 25% Roof w/ perm pvmt	81	666	53,701	90%	65.0%	22,163
Com/Ind - 50% Roof w/ perm pvmt	161	454	73,343	81%	65.0%	34,510
Com/Ind - 80% Roof w/ perm pvmt	65	201	12,988	46%	65.0%	9.098
High Density Residential - Ruby Yard	38	202	7,658	94%	100.0%	447
High Density Residential - 30th St Pkwy	9	202	1,834	78%	100.0%	399
Green Space (Along Lincoln Creek)	23	EXEMPT	EXEMPT	EXEMPT	EXEMPT	EXEMPT
Totals	562	507	**285,016**			**168,755**
					Corridor Load Reduction	**40.8%**

Notes:

High Density Residential assumed to have permeable streets and alleys, no treatment for lot area
Nonresidential ROW bioswale area based on intermediate Nonresidential ROW template.
Light Industrial (0% Roof coverage) is approximately 5% of the total Light Industrial area. Permeable pavement
Light Industrial (25% Roof coverage) is approximately 25% of the total Light Industrial and Commercial area. Perm pvmt, no green roof.
Light Industrial (50% Roof coverage) is approximately 50% of the total Light Industrial and Commercial area. Perm pvmt, no green roof.
Light Industrial (80% Roof coverage) is approximately 20% of the total Light Industrial and Commercial area. Perm pvmt, no green roof.
The green space along Lincoln Creek has been removed from consideration since this area was recently restored
Columns D and E can be altered based on expected BMP applications and implementation areas

Corridor-wide TSS reduction should be viewed as a long term project. Implementing TSS reduction strategies will require involvement by numerous stakeholders from both the public and private sectors. Columns D and E in Table 32 can be revised to reflect alternative treatment strategies being applied to varying proportions of the Corridor area and to assist in planning to achieve the 40% TSS reductions mandated by the Wisconsin Department of Natural Resources.

XII. Conclusions and Recommendations

Conclusions

Based on the analysis presented in this report, the following conclusions were made.

- Analysis of certain BMP strategies is somewhat constrained by the SLAMM model.
    - Permeable pavements are a "source control" in the SLAMM model and therefore they do not have the ability to receive run-on to treat areas outside the permeable pavement area. While excessive amounts of run-on is not recommended for permeable pavements, there may be other opportunities, such as using permeable pavement alleys to treat driveway and garage roof runoff, that could not be analyzed.
    - SLAMM does not have a module to analyze green roofs and therefore the performance of green roofs had to be based on limited information. There are significant numbers of published and unpublished materials with information on runoff volume reduction for green roofs; however, there is virtually no information on TSS reduction due to green roofs.
- On many existing commercial buildings, treatment of roof runoff using bioinfiltration or other strategies at ground level is difficult since most larger buildings have internal roof drains that discharge directly to the storm sewer. Thus, in many circumstances a green roof is the only option for treating roof runoff.
- Based on the relatively low roof TSS loading rates generated by SLAMM and the high cost, green roofs are the least cost effective strategy for meeting the TSS standard. This fact will tend to discourage use of green roofs despite the other benefits of green roof systems, including reduction in heat island effect, reduction in runoff volumes, and improved building heating and cooling performance.
- Although the existing grading of the Eaton and DRS Parking lots allow for effective installation (retrofitting) of bioswales, some parking lots may not. For example, it would generally be infeasible to install an effective bioswale in a parking lot with a single drive lane that receives the majority of the runoff. Thus, a bioswale retrofit alternative may not be feasible on many sites without regrading the parking lot such that the runoff drains towards landscape islands or landscaped edges.
- There is a wide range in the cost effectiveness of the various practices identified. The most cost effective measure evaluated was installation of a filter strip at the Vapor Blast site at approximately $40 per pound of sediment removed. However, the applicability of this practice was limited to the Vapor Blast site. The next most cost effective measure was the Ruby Yard project at approximately $130 per pound of sediment removed. However, this project was followed closely by retrofitting of bioretention into parking lots or commercial rights of way where the cost per pound of sediment removed ranged from $110 to $220. Installation of permeable pavers within parking lots is approximately $660 per pound of sediment removed based on the Eaton and DRS evaluations. While permeable pavement is less cost effective (in dollars per pound of sediment removed) than regional basins or retrofitting of bioretention, it also provides a superior paving material and is more space efficient. Installation of permeable pavers within residential streets is less cost effective than use within commercial parking lots ($1,440/Lb vs $660/Lb). However, due to the other benefits, the value of permeable paving streets is worthy of further consideration. Although not specifically evaluated, permeable paving within commercial/industrial streets would likely be more cost effective than for residential streets (and similar to the cost efficiency of parking lots) due to the higher sediment load associated with these non-residential streets. Other cost considerations:

- As hinted to above, the cost effectiveness of a particular BMP depends on the loading rate from its drainage area as well as the cost and performance of the BMP. A particular BMP that achieves 70% TSS removal for a given hydraulic loading, will remove more pounds of sediment from a land use that generates 1,000 lbs of TSS per acre than a land use that generates only 300 lbs of TSS per acre.
- When evaluating the cost effectiveness of permeable paving, life cycle costs and the other benefits of permeable paver systems should be considered. The additional benefits of permeable pavers include greater reduction in runoff volumes, much greater longevity when compared to asphalt, reduction in heat island effect compared to asphalt (depending on paver color), and reduced water quality impacts associated with coal tar sealants used on asphalt surfaces.
- While a higher cost solution than use of permeable pavement or bioretention alone, combining permeable pavement and bioretention has many benefits. These include higher TSS reduction performance, the ability to provide retention and detention for larger storm events (up to 100-year event), and improved plant performance within the bioretention due to lower salt loading.

- There is overlap in the drainage areas for the Ruby Yard and the North 30th Street Parkway Planters projects. Thus, it may not be cost effective to implement both projects. The corridor wide evaluation assumes that the drainage area of the 30th Street planters is removed from the drainage area of Ruby Yard.
- With the exception of the non-residential right-of-way land use, 40% TSS removal is achievable throughout the Corridor's land uses. However, achieving greater than approximately 30% TSS removal for the non-residential right-of-way will be difficult unless permeable pavement is used. This is due to the limited space available for bioretention. Although some non-residential streets may have conditions that would allow greater than 4% bioswale area, it may be necessary to use some form of permeable paving rather than bioretention where there is a need to achieve 40% or greater TSS removal.
- The corridor-wide evaluation revealed that it will be difficult to achieve the 40% TSS removal goal for the Corridor. The analysis shows that 65% of the land area in the corridor must be addressed to achieve the standard unless other measures are used. A significant source of sediment in the corridor is the non-residential right-of-ways (commercial and industrial streets) discussed above. Since this land use produces 34% of the TSS load in the corridor, treating this land use to less than the 40% level requires a significant increase in the proportion of the corridor that has be treated with BMPs.
- The proposed conceptual site plans would have little to no potential for affecting cultural, historical, endangered and threatened resources in the area, including any impacts on wetlands or Chapter 30 conflicts. The potential for environmental hazards on the prospective sites is possible due to the industrial nature of the corridor and existing contamination. If any resources or environmental hazards are encountered in project development they should be addressed on a project by project basis.

Recommendations

Based on the results of this analysis and the conclusions above, the following recommendations are provided.

Storm Water Utility Recommendations

- A modified utility credit system that applies to both non-residential *and* residential landowners may help the City achieve its storm water management goals by including and educating residential landowners as well as others.
- Milwaukee's utility rate is significantly lower than the rates for comparable cities, and the City should consider raising the rate to a level commensurate with these other cities so that it acts as a stronger economic incentive for landowners to implement on-site storm water management systems.
- The City may want to consider a revised credit system that is tied to a reduction in runoff quantity and/or improvement in runoff quality. Currently, a credit would not be granted unless the system reduces the cost of providing storm water service or controlling polluted runoff. Thus, the City should consider connecting specific on-site BMPs to an assumed or modeled reduction in the City's cost of compliance with the State water quality mandate as described in greater detail in the "Stormwater Utility Recommendations" section of this report.
- The City should consider a TSS reduction grant and/or loan program for redevelopment and retrofit projects. Over time, redevelopment could be one of the larger opportunities for reducing the Citywide TSS load. A grant and/or loan program targeting redevelopment projects that fall below the City's stormwater ordinance threshold could both encourage redevelopment and improve water quality in a cost effective manner. This cost-share program could take the form of a grant and/or loan financed through the storm water program that would be repaid by the landowner through deferred utility credits as described in greater detail in the "Stormwater Utility Recommendations" section.
- The City should consider targeting volume reduction and rate control credits in the combined sewer area and water quality improvement credits in the separated sewer area. This may be a component of a credit system that requires all three components be addressed to receive the maximum allowable credit, with the quantity and quality components receiving different weighting in the combined and separated areas.
- A maintenance agreement, as well as short and long term management goals and tasks, should be required for on-site storm water management facilities in order to grant the full 60% utility fee credit.
- A clearly worded, easily accessible website could inform the public about the purpose, need, structure, and rationale for the storm water utility; the conditions under which landowners can reduce their fees; and the practices that can be used to achieve utility fee credits.

Capital Improvement Recommendations

- Perform the next phase of site investigation and hydrologic, and hydraulic design for the Ruby Yard site. Specifically, obtain a detailed survey of the site along with a geotechnical investigation to refine grading and earthwork requirements and assess groundwater levels and potential soil contamination. Concurrently, the City should continue to negotiate and coordinate with DRS regarding use of the property, public access, and site security issues.
- Perform the next phase of hydrologic and hydraulic design for the North 30th Street Parkway bioretention planters. The planters project should be evaluated in conjunction with the Ruby Yard project to determine if both projects are necessary or if Ruby Yard may be able to provide treatment of the drainage areas for both projects.
- Implement permeable pavement pilot projects on several city streets to identify design challenges, determine implementation costs, determine maintenance requirements, and evaluate performance. Pilot projects should occur on streets of varying traffic load and speed to assess suitability under a range of conditions. A range of permeable pavement materials, including permeable pavers, permeable asphalt, and permeable concrete should be evaluated. Permeable paver systems are longer lasting and more maintainable than permeable asphalt and concrete. However, permeable pavers are not appropriate for streets with posted speed limits greater than 25 to 30 mph since high speed traffic can "vacuum" out the fine gravel used to fill the crevices between pavers.
- Continue right-of-way bioretention pilot projects to refine design elements, improve cost efficiencies, and evaluate performance.
- Depending on the outcome of the permeable streets pilot project mentioned above and the current ROW bioretention pilot projects, the City should consider a Citywide policy that supports the installation of permeable pavement and/or ROW bioretention during full depth residential and alley replacement and, potentially, for commercial streets as well. Water quantity and quality benefits and life cycle costs should be considered when evaluating this policy. The City should incorporate installation of permeable paving and/or bioretention into their right-of-way Capital Improvement Plan, which could be partially funded by the stormwater program and associated stormwater utility.
- The City should encourage partner agencies (Housing Authority of City of Milwaukee, Redevelopment Authority of City of Milwaukee, etc) to incorporate these elements into agency policies and projects.
- As a strategy for meeting the 40% TSS reduction requirement, Wisconsin DNR should consider accepting municipal policies mandating that future street and parking lot replacements use permeable paving and/or bioretention. Incorporating permeable paving into the City's long term street replacement program will be a more efficient use of public funds than retrofitting existing streets that are currently in serviceable condition. In the long term, this policy could result in the City exceeding the Citywide 40% TSS removal standard.
- Wisconsin DNR and the City should develop easement, maintenance, and other standards for BMPs that will be installed on private property to meet the City's 40% TSS removal requirement.
- Continue discussions with interested commercial/industrial property owners and assist in grant preparation and design assistance. For each site, meet with the property owner and perform pavement condition evaluations to determine the strategy that most cost effectively meets the City and landowner's short and long term needs. For sites where the pavement is in poor condition and in need of replacement, the owner should consider interlocking concrete pavers for their longevity

as well as water quality and quantity benefits. For sites where the pavement is in good condition, the owner should consider installing bioretention swales, which would be a lower cost option than permeable pavement. The feasibility of bioretention swales to treat runoff will need to be evaluated for each parking lot since existing grading may make bioretention swales infeasible (for example under conditions where runoff drains to the drive lanes).

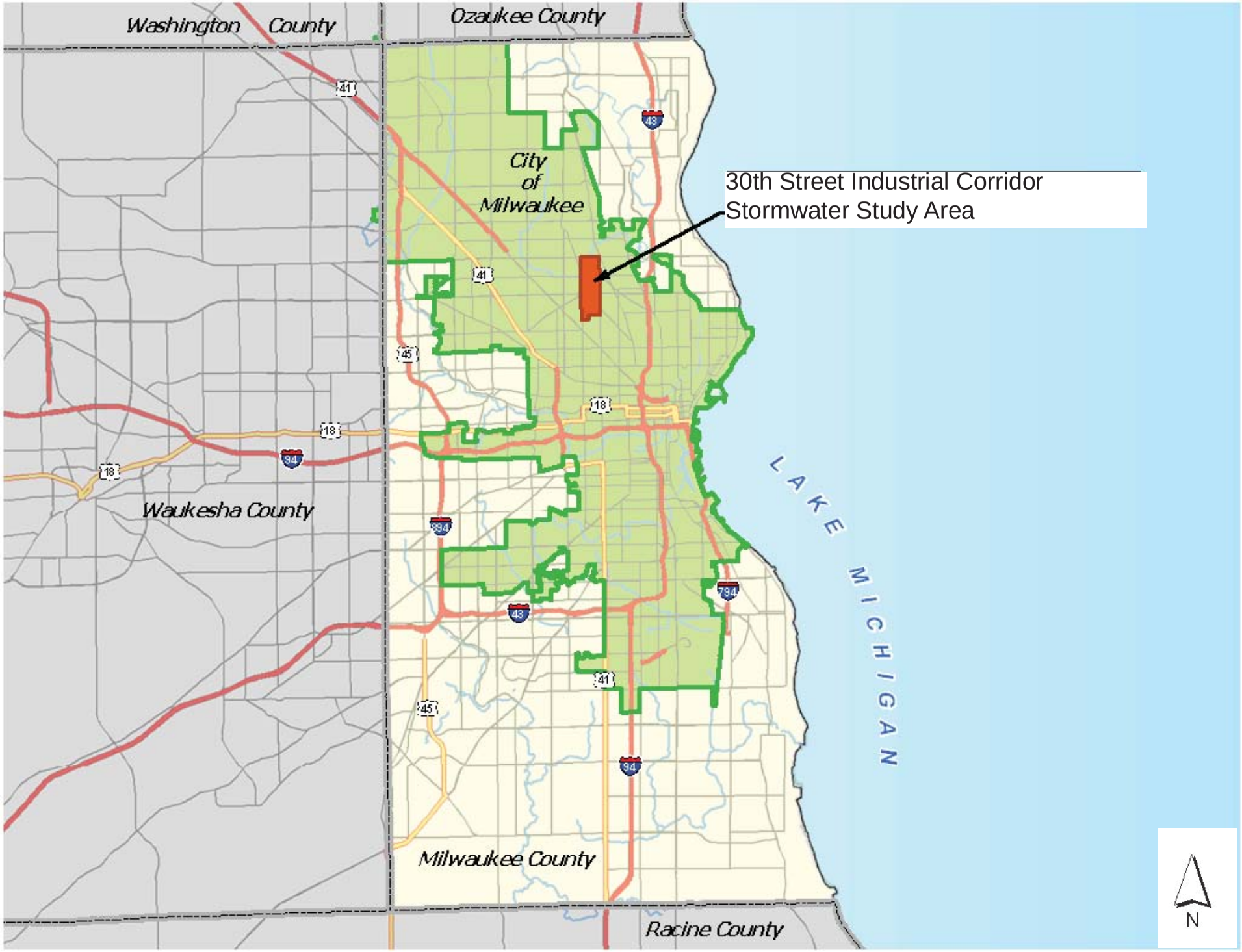
- Prioritize several 'low hanging fruit' projects to establish a track record and demonstrate success. The City should consider funding a relatively large proportion of early projects to encourage participation in the first several projects. For example, the Vapor Blast site contains a large open space area that could be used for demonstration projects at a relatively low cost. Further, Vapor Blast appears to have an owner interested in bioretention or permeable paving that will also help address parking lot drainage and ponding problems.
- Stay current on potential existing and emerging sources of funding for storm water management and green infrastructure projects, such as Department of Housing and Urban Development Neighborhood Stabilization Funds. Recent webinars sponsored by HUD and USEPA have highlighted use of HUD funds for stormwater management projects.

Program Recommendations

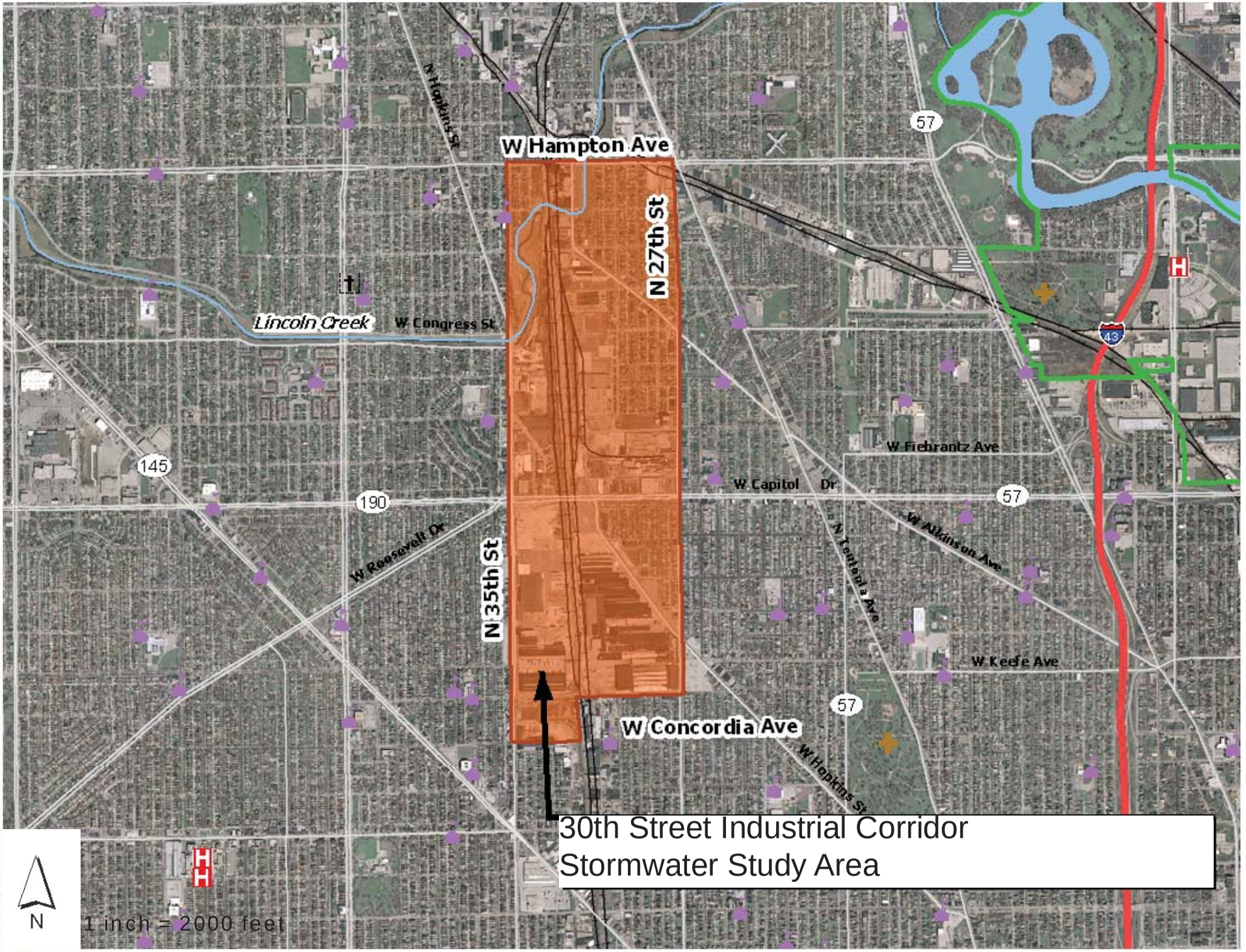
- Continue to look for opportunities to incorporate trees and other vegetation into the urban landscape, particularly in this heavily paved industrial corridor.
- Promote the multiple benefits provided by green infrastructure approaches as compared to conventional approaches to encourage greater adoption of green infrastructure practices into new development and redevelopment projects.
- While it is apparent that the City and MMSD are cooperating in efforts to manage storm water, these two agencies should consider creating a combined / coordinated utility, credit, and BMP program to reduce stormwater discharges to the City's waterways as well as to reduce combined sewer overflows and storage and treatment costs associated with combined sewer areas.

Appendix A
Study Area Maps

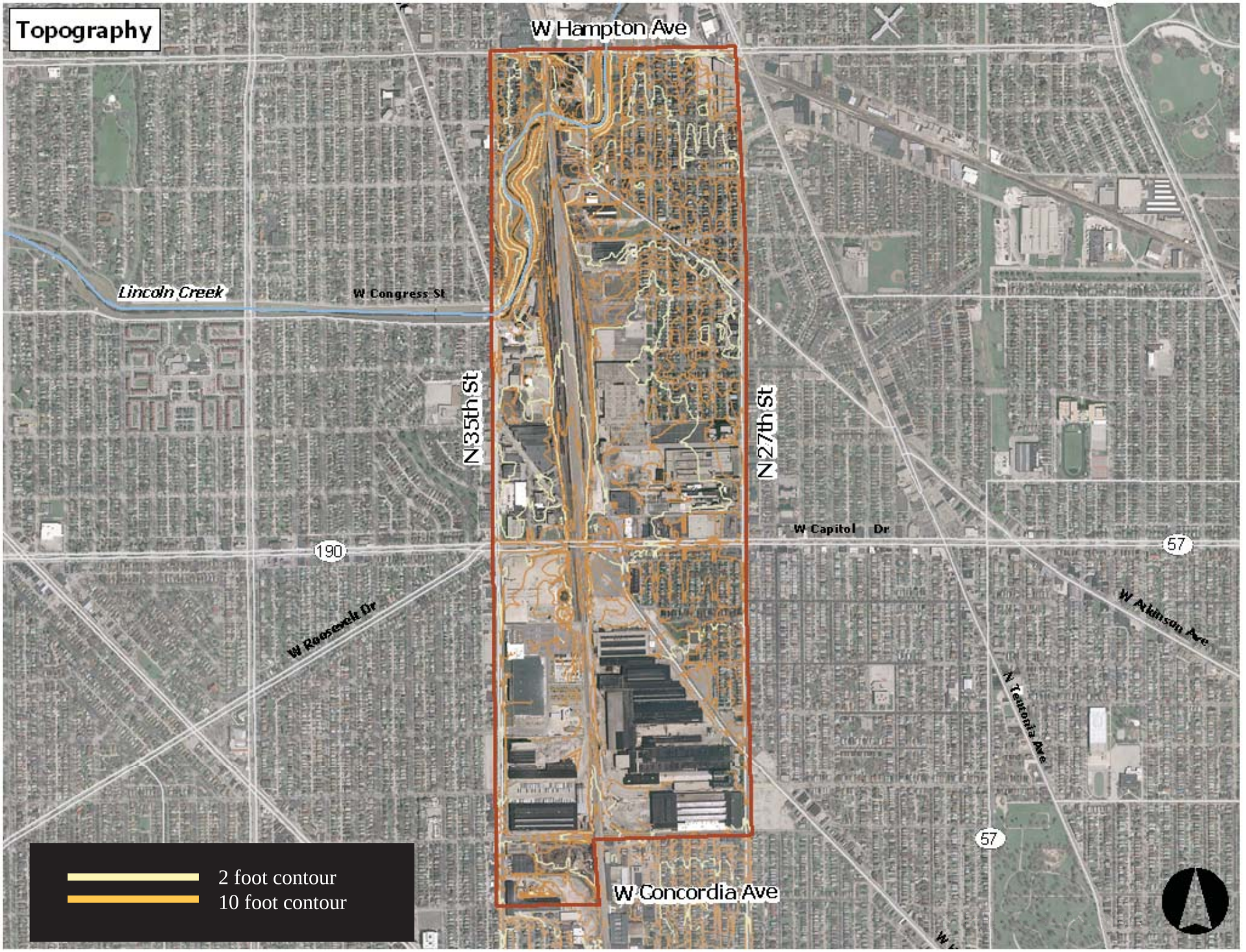
Map 1 Site Location and Context



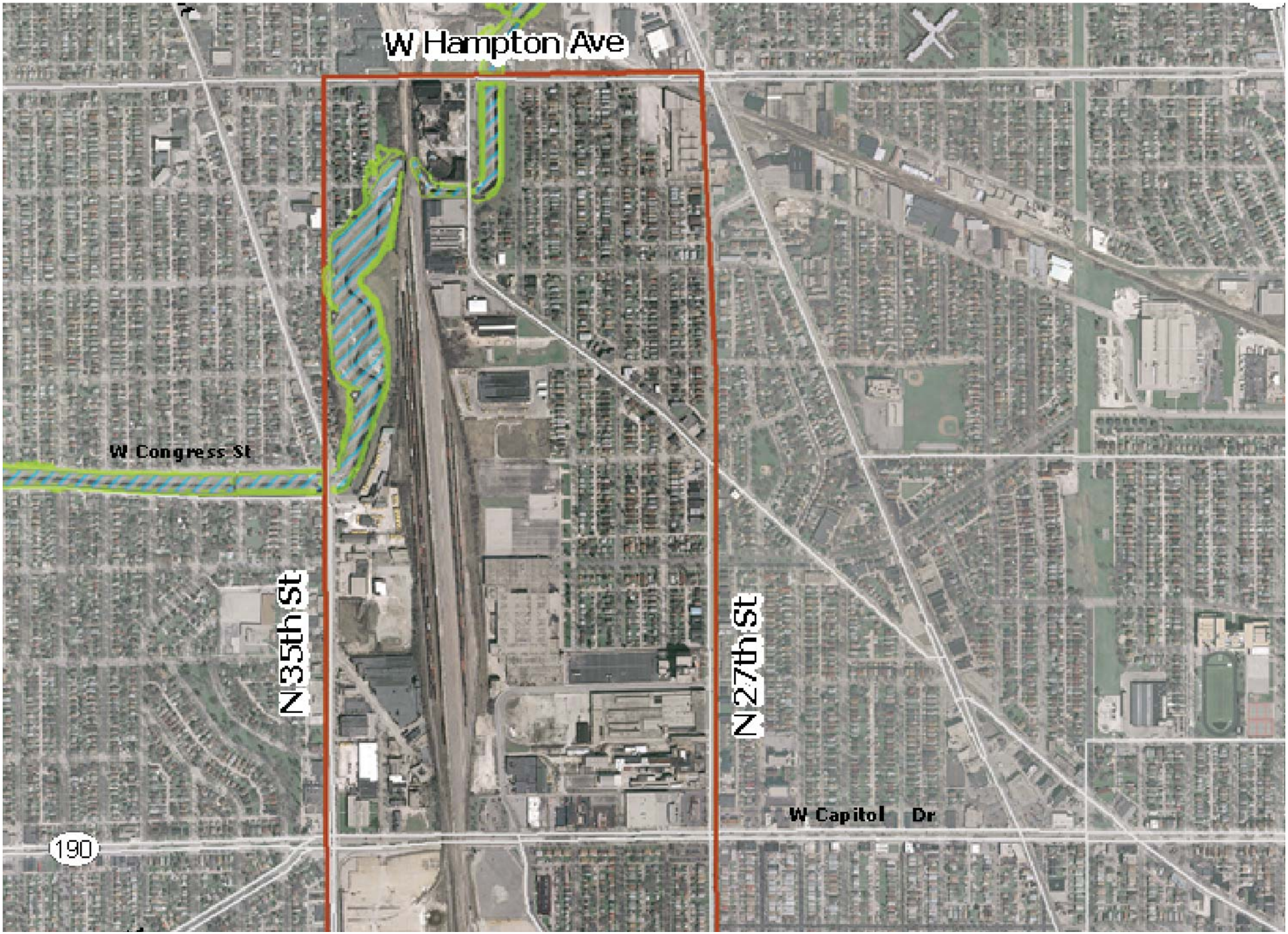
Map 2 Project Area



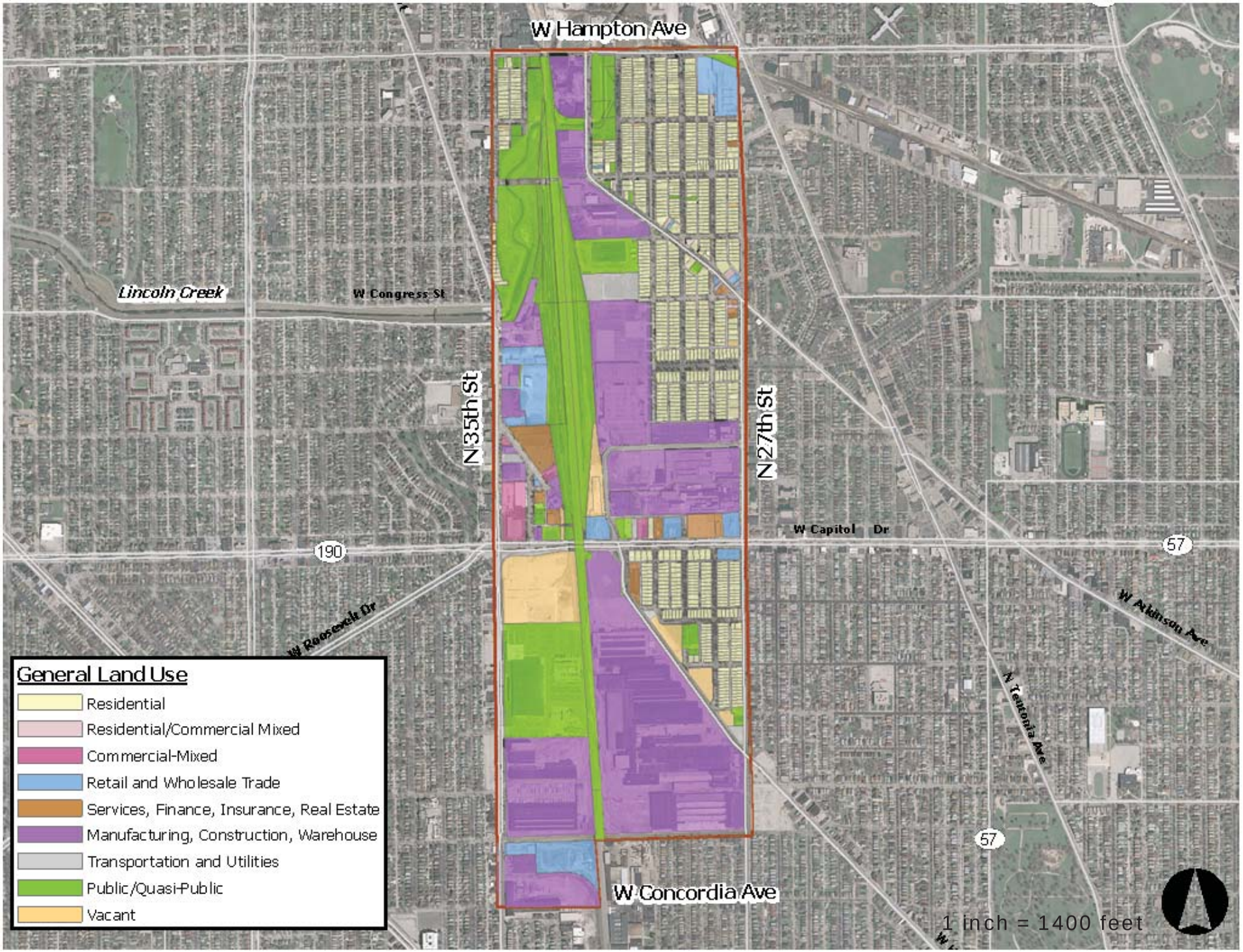
Map 3 Topography



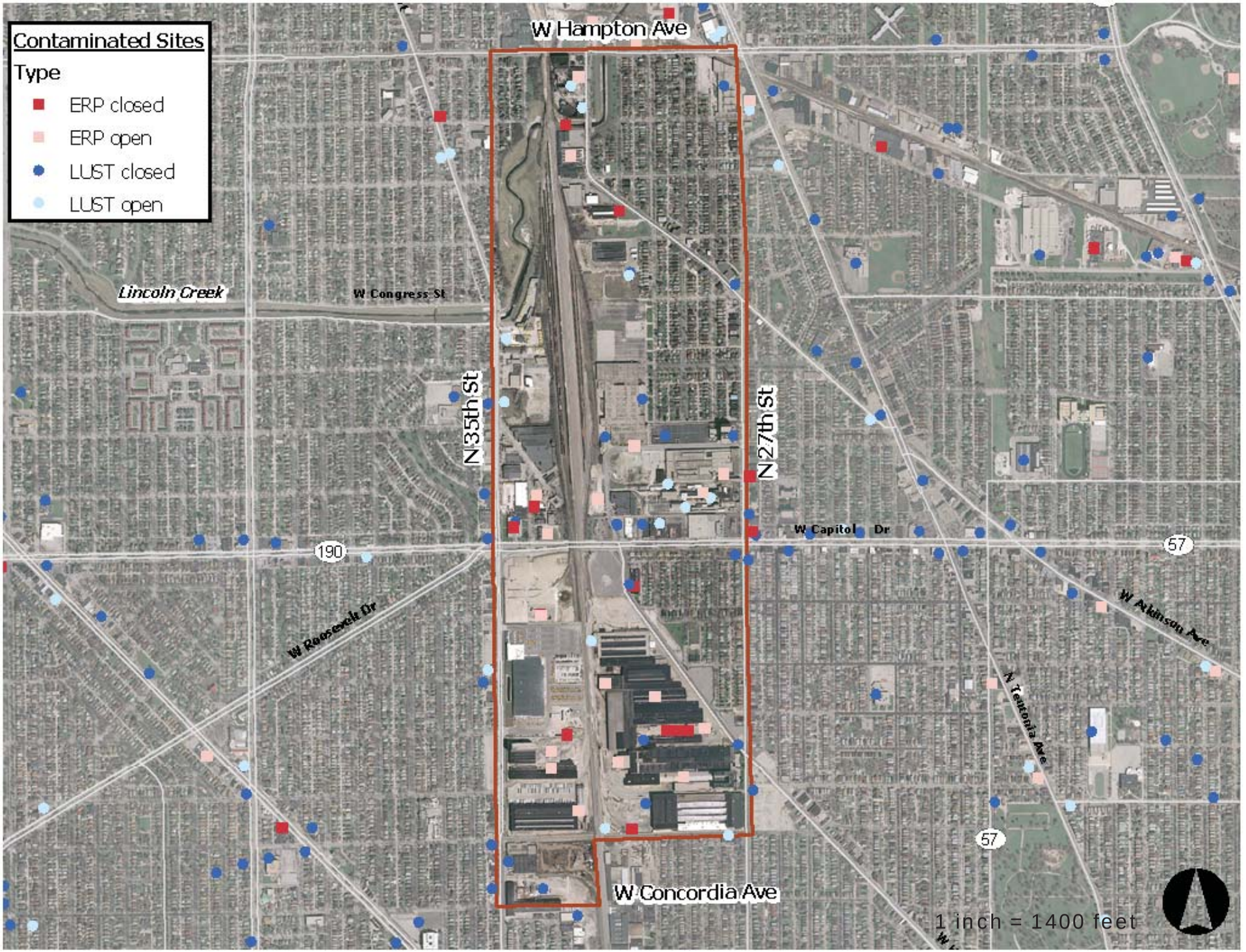
Map 4 FEMA Floodplains



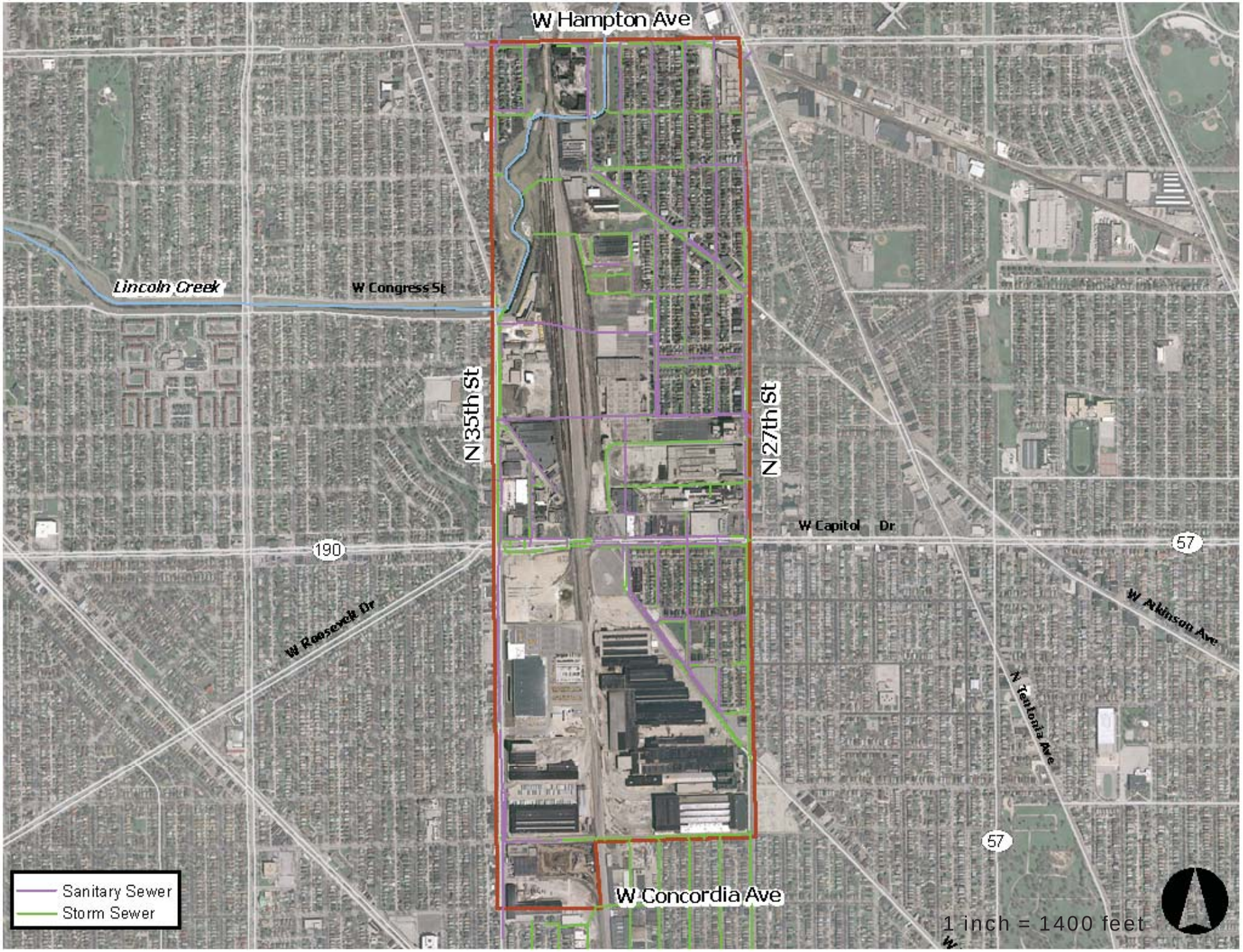
Map 5 Land Use



Map 6 Contaminated Sties



Map 7 Site Stormwater and Wastewater Utilities



Appendix B
Stormwater Strategy Summary

	Drivers for private sector action				
City	**SWM Ordinance Details**	**SWM Utility Details**	**Utility Fee Discounts (indexed to practices or imperv area)**	**Development Bonuses (FAR, units/acre)**	**Fast Track Permitting / Priority Review / Fee Waivers / Free Consultation**
Ann Arbor, MI	Ordinance applies to development and redevelopment; requires control of a water quality event, a channel forming event, and the 100-year event. 100-year event has specified release rate in cfs/acre. WQ and channel forming events require detention period; AA also has ordinance regulating the use and application of manufactured fertilizer containing phosphorus.	Utility rate based on impervious cover determined by aerial photography and viewable online; four rate tiers based on range of impervious area for residential; rate based on impervious cover area for commercial.	For residential: RiverSafe Homes (review educational info, take a survey, etc to receive credit) saves $1.24/Q; rain barrels installed saves $1.79/Q; rain garden, cistern, and dry well installation saves $2.80/Q. For commercial: Community Partners program saves 17.3% or 1.79/Q; Meeting stormwater ordinance standards (Chapter 63) saves 19.5%; other stormwater management saves 17.3%.		
Charlotte-Mecklenburg Co Area	Adopted by communities June 2007; requires 85% TSS removal from 1st inch of rainfall; standard varies by watershed, e.g., 70% TP removal in P impaired watersheds; open space requirement depends on % of built up area in watershed; goal to protect lake / source water quality	Charlotte: Residential I (up to 2000 sf imp): $6.13/mo; Res II (2000+ sf): $8.02 per month; Comm: $120.37/mo/ac. Cornelius, Huntersville, Matthews, Mint Hill, Pineville and Uninc Mecklenburg Co: Res I (up to 2000 sf imp): $3.54/mo; Res II (2000+ sf): $4.24 per month; Comm: $57.36/mo/acre. Davidson Res: $12.37 (billed twice a year); Comm: $32.85/ac/mo.	Discount if stormwater does not enter public drainage system, or if property owner reduces amount of runoff. Multi-family residences and businesses that install specially-designed storm water controls receive 40% credit for peak reduction, 60% for volume reduction. Application must be completed by engineer.		
Chicago, IL	Ordinance requires volume control and rate control. Ordinance applied to all development above a threshold, including redevelopment and disturbed impervious cover. Requires retention of 0.5 inch runoff from impervious areas. 100-year release rate based on existing sewer capacity.			Density bonus offered for 50% or 2000 s.f. green roof, whichever is greater.	Green Permit program: 3 tiers of benefits: tier 1=30 day permit; tier 2=30 day permit + review fee waived ($5000 to $50,000); tier 3=15 day permit and review fee waived; tiers based on LEED rating for commercial projects and two star rating under Chicago Green Homes program for residential projects; applicants may choose from green menu items (green roof, renewable energy, affordability, accessibility, on-site power generation, TOD, innovation, water management, exceed LEED or Chicago Green Homes, natural ventilation; chicago designates a 'case worker' for green permit projects
Denver, CO		Urban Drainage and Flood Control District (UDFCD) planning, design, and construction funded by a mil levy on communities supplemented by matching funding from each community receiving improvements			
Milwaukee, WI	2-year and 100-year release rate requirement and TSS removal. Ordinance only applies to increase in impervious area	Residents pay a flat fee; commercial owners pay based on impervious surface area; may be a fee-in-lieu / off site buy in program, though Advisory Committee was unaware of one.	60% credit available for sites riparian to waterways. Unofficial reduction for stormwater management, requires landowner to appeal the fee and document SWM practices.	City currently will allow modification of setbacks to accommodate development on odd-shaped lots; could potentially be used to incentivize stormwater BMPs.	Since permitting currently only takes 4-6 weeks, it is unlikely that expedited permitting would be a large enough incentive. Whether permitting fees could be reduced has not been explored.
Minneapolis, MN		Yes	Up to 50% discount for practices addressing stormwater quality; credit for practices addressing stormwater quantity - 50% credit for 10-year control & 100% credit for 100-year control.		
New York City, NY		Yes	School construction receives credit for stormwater management, green roofs, and reducing imperv area.		

Milwaukee 30th Street Industrial Corridor Stormwater Management Strategy Summary

	Drivers for private sector action				
City	**SWM Ordinance Details**	**SWM Utility Details**	**Utility Fee Discounts (indexed to practices or imperv area)**	**Development Bonuses (FAR, units/acre)**	**Fast Track Permitting / Priority Review / Fee Waivers / Free Consultation**
Philadelphia, PA	Channel protection, flood control, and nonstructural site design requirements for developments above a threshold; redevelopment must comply with water quality and nonstructural site design requirements, possibly channel protection and flood control. Projects may be exempt from channel reqs and flood control reqs if connected impervious area is reduced by 20% relative to predevelopment; must retain first flush; for projects > 5ac where practical use swales in lieu of curb and gutter, remove oil and grease and sediment from stormwater discharges, conserve water, native vegetation buffers along ponds or basins	Rate based on ERU (equivalent residential unit), 20% of fee is based on total site area, 80% of fee is based on impervious area, which can be reduced to reduce fee.	50% discount for res and business for decreasing DCIAs (directly connected impervious areas)		Unofficial fast track for green roof and permeable paving projects; use outside contractors to provide free design services / assist with plan review; use as incentive to get early design review meeting with developers. Philadelphia Water Dept now sees development plans before zoning permit review and request changes to meet water quality reqs; worked with development industry to streamline the process.
Portland, OR	Ordinance requires retention, detention, and water quality control. Must retain 10-year, 24-hour runoff, where feasible. Must limit peak discharge to pre-development conditions for 2-year through 25-year events. Must achieve 70% TSS removal for 90% of the average annual runoff. Have varying standards for seperate sewer and combined sewer areas and for discharge to streams vs discharge to existing storm sewers.	Fee based on impervious area. 65% of fee based on off site drainage system, 35% based on private property / on-site contribution to sewer system ($7.73 per 1000 sf imperv area) can be reduced with BMPs	Discount based on practices, not impervious area; reduce up to 100% of on-site fee component (35% of total stormwater charge). Clean River Rewards offers discounts for addressing roof runoff for single-family residential using simple checklist. Address roof and paved areas for commercial, industrial, and multi-family based on s.f. of impervious area treated; partial credit for tree planting, less than 1000sf imperviousness, downspout disconnection, rain gardens, and other BMPs; full credit for ecoroofs.	FAR Bonus for Green Roofs within the Central City Plan District	
Santa Monica, CA	Urban Runoff Management Ordinance				
Seattle, WA	Have stormwater ordinance. Also have Seattle Green Factor program in landscaping code requires 30% vegetated or functional equivalent for multifamily, commercial, and parking lots; green roof weighted 0.7, permeable paving 0.6, large trees 0.4, shrubs 0.3, lawn 0.2 in meeting the 30% requirement.	Detailed Rate structure (see table on separate page) based on aerial photo interpreted impervious surface area	Credit available for on-site runoff management, as outlined in municipal code; landowner is required to maintain BMPs; Fee-in-Lieu allowed; discounts for low-income, elderly, and disabled.		
State of Maryland	State requires protections based on Water Quality Volume, Recharge Volume, and Channel Protection Storage Volume; Env Site Design (ESD) must be used to Maximum Extent Practicable to maintain predevelopment runoff conditions (defined as 'woods in good condition'); redevelopment projects must reduce imperviousness by 20%, or SWM BMPs must control quality of 20% of impervious area, or a combination (proposal in works to increase to 50%)		Stormwater credit given for natural area preservation, which may be removed from calcs for water quality reqs; credit for rooftop disconnection and infiltration (area removed from imperv area calcs), and a lot of flexibility to get credits (surface disconnection, runoff to buffers as sheet flow, grass channels, environmentally sensitive design (ESD), narrow streets, permeable pavers, shared driveways...)		
Washington DC	Requires LID practices; requires green roof unless developer can prove it can't be done; stricter requirements in Anacostia Waterfront Development Zone	Proposed	Proposed: elimination of effective (connected) impervious area receive full discount, partial reduction receive partial discount; reductions can occur by reducing imperv area or installing BMPs; percentage discounts may be different for each BMP		

	Drivers for private sector action			
City	**Funding and Financing (tax credits, rebates, abatement; low interest loans, loan guarantees; grants)**	**Recognition (awards, press, signage, certificates)**	**Landowner Assistance (technical, installation, grants, SWM audits)**	**Other Incentives (reduced infrastructure requirements; SWM infrastructure as development incentive; off site banks / mitigation)**
Ann Arbor, MI			Mandatory footing drain disconnection program (disconnect from sanitary sewer), payment for 'core work' of up to $4,100 paid for by utility fees, homeowner pays for any additional work and equipment; homeowner pays all charges if they take no action within 90 days of receiving notice	
Charlotte-Mecklenburg Co Area				Allows a 'buy down' option in which a certain percentage of TP removal requirement can be achieved via a fee paid to the City of Charlotte to construct TP removal BMPs elsewhere; Huntersville allows setbacks to be reduced by 25% to accommodate BMPs, allows sidewalks on one side of street, lower standard for trees and shrubs, encroachment on buffers for BMP installation.
Chicago, IL	$5000 green roof grants for small scale commercial and residential properties; Chicago Green Homes program; funding / TIF / taxing assistance in exchange for earning green points from menu items. State provides 319 grants to implement BMPs on private property in watersheds with approved plans.	Greenworks Awards for Green Buildings, Green Practices, and Green Products. Chicago Wilderness Awards for Native landscaping	Encourages downspout disconnection; sells rain barrels for $15; $5000 green roof grants.	City is considering incentives for going beyond the SWM requirements.
Denver, CO				
Milwaukee, WI	No known programs were suggested, but seems to be a viable option.	The City already has a recognition / awards program that could be expanded specifically for stormwater management projects that meet the water quality objectives of the city.	Downspout disconnection program in place but limited application.	The Menomonee Valley Stormwater Park functions as a development incentive within that district; a similar program may work in the Industrial Corridor.
Minneapolis, MN			$2000 residential, $30,000 commercial / government grants for installing BMPs.	
New York City, NY	Projects seeking NYC capital funding of $10m or 50% cost of building construction must meet LEED requirements; one-year tax abatement of $4.50 per s.f. of green roof up to max $100,000		Rain barrel give-away with instructions and optional educational workshops.	

	Drivers for private sector action			
City	**Funding and Financing (tax credits, rebates, abatement; low interest loans, loan guarantees; grants)**	**Recognition (awards, press, signage, certificates)**	**Landowner Assistance (technical, installation, grants, SWM audits)**	**Other Incentives (reduced infrastructure requirements; SWM infrastructure as development incentive; off site banks / mitigation)**
Philadelphia, PA	Staged, multi-year Green Roof Tax Credit of up to 25% of cost or $100,000 through a tax reduction; stormwater assistance loans for nonprofits and churches to implement BMPs.		Rain barrel give away program.	Allows transfer of storm water management practices off site (but in same sewershed) if unable to be addressed on site; stricter requirements associated with conversion of green space to development encourages developers to do infill instead.
Portland, OR	Green Investment Fund offers $500,000 / yr for development to go beyond the mandated standard; Community Watershed Stewardship Grants for water related projects; total $300,000 for now or retrofit ecoroofs (one project could get total funding); uses loans to lower the financing costs of energy efficiency; Watershed Investment Funds and Green Investment Funds; federal grants		Pays residents to disconnect downspouts and provides assistance in dealing with the runoff, e.g., rain gardens; Clean and Healthy River Strategy expands the downspout disconnection program, encourages commercial landowners to install swales, plant street and landscaping; offers incentives to landowners to reduce runoff.	Stormwater Trading
Santa Monica, CA	Stormwater enterprise fund and utility manages funding, permitting, maintenance, planning, design, construction, restoration, regulation, water quality testing, and stormwater drainage inspection		Landscaping grants.	
Seattle, WA			Downspout disconnection within CSO boundary (Rainwise Incentive Program)	City installing large scale biofiltration swale / street redesign to handle 188m gallons of runoff as part of an $8m mixed use redevelopment project, integrating public drainage with private development; Seattle Green Factor; Rainwise Incentive Program for retrofits
State of Maryland	Funds for project implementation, revolving loans, low interest financing (Maryland Linked Deposit Program); Water Quality Infrastructure Program; Stormwater Pollution Control Program provides 75% of project costs up to $500,000 to retrofit pre-1984 development areas			Some stormwater management requirements may be waived for redevelopment / infill; alternatives to on site management include fees, off site BMP implementation for comparable drainage area and impervious area, stream restoration, and retrofits elsewhere
Washington DC			River Smart Homes, $1200; considering downspout disconnection, rain barrel, rain garden, and green roof assistance	

	Public sector actions and initiatives					
City	**Education and Outreach (workshop, training, pubs, events, website, signage, tours, funding sources, lists of qualified contractors)**	**Manuals and Technical Assistance (standards, design manual, illustrations, checklists, examples, calculations and coefficients)**	**Capital Improvements / Demonstrations / Pilot Projects (on public land and in public right-of-way)**	**Code Compatibility (remove disincentives and incompatibilities with green SWM approach, e.g., zoning, subdivision, parking, landscaping, plumbing**	**New Plan, Policy, Department, Authority, or Partnerships (to facilitate process, provide info, education; cross departmental cooperation; public-private-NGO cooperation)**	**Additional Comments and Economic Development Impacts / Incentives**
Ann Arbor, MI		Best Management Practices for Storm Water: A Developers' Guide for Ann Arbor				
Charlotte-Mecklenburg Co Area	Charlotte tells residents where the money goes: 73% to storm water projects inside the City limits, 15% to Countywide storm water projects, 12% to administrative costs; County provides info on the Return on Investment for stormwater fees: "For each County storm water fee dollar spent on flood mitigation, Mecklenburg County receives up to $3.00 in federal and/or state grants. For each County storm water fee dollar spent on water quality, Mecklenburg County receives nearly $2.00 in federal and/or state grants."	Huntersville Water Quality Design Manual; Mecklenburg Co provides a stormwater fee reduction technical manual for meeting requirements.				Huntersville has aggressive WQ standards, due to polluted source water (MacDonald Ck in Catawba watershed reservoir system); economic development in Huntersville has not been impacted by SWM requirements; growth has been high, commercial development is up, no incentives needed; ordinance development included stakeholders and developers, all of whom bought in to it.
Chicago, IL	Numerous groups provide LID and BMP training and workshops	Many booklets including Guide to Stormwater Management BMPs; Green Alley Handbook includes various practices, example projects and illustrations.	Sustainable Streets Pilot Initiative on Cermak Road and Blue Island Ave; Green Alleys pilot program; Green Roofs on City Hall, Chicago Transit Authority headquarters, DuSable Harbor, Chicago Center for Green Technology; other practices tested by conducting first on city-owned property, e.g., rain gardens.	Green Urban Design (GUD) project was designed to identify incompatibilities within city's standards and ordinances.	Chicago Water Agenda; Dept of Environment has equal status as Planning, Parks, and Public Works and work collaboratively on projects, e.g., street right-of-way retrofits.	
Denver, CO	Annual training conference; online library of BMP implementation precedents; Clear Choices for Clean Water brochures for public; booklet targeted to industrial stormwater BMPs; provide list of qualified engineers and consultants	Urban Storm Drainage Criteria Manual; pattern book for specific development scenarios within designated areas, e.g., industrial corridor, Stapleton Airport	Stapleton Airport redevelopment		water quality increasingly being considered by public works, public health, parks and recreation, community planning and development, and asset management departments.	
Milwaukee, WI	Milwaukee has a stormwater management manual, but other education and outreach has been lagging since the departure of a key staff member.	Stormwater manual; Sustainable Design Guidelines for development within the Menomonee Valley Industrial area (renewthevalley.org)	27th Street pilot; Green Schools Initiative; Green roofs on city hall complex, Milwaukee Metropolitan Sewerage District, Great Lakes Water Institute, and Highland Gardens; Menomonee River Valley Industrial Site; Highland Gardens; Alterra Coffee Roasters.	The City has or is in the process of modifying the stormwater code to allow alternative stormwater management, e.g., permeable paving, and has reduced parking requirements to reduce impervious surface	Menomonee Valley Partnership	
Minneapolis, MN						
New York City, NY		High Performance Infrastructure Guidelines	Green Streets; Million Trees; Staten Island Bluebelt captures and treats water in ponds, wetlands, and streams and replaces costly infrastructure; Jamaica Bay Watershed Protection Plan Pilot Programs; green roof-blue roof pilot study; parking lot design pilot study; Housing Authority SWM BMP pilot study; porous pavement pilot; streetside infiltration pilot; constructed wetland pilot; tree pit pilot study.	Commercial and community-facility parking lot standards modified to reduce heat island, add trees, and manage stormwater; street tree planting standards; landscaping / open space for residential yards.		

	Public sector actions and initiatives					
City	**Education and Outreach (workshop, training, pubs, events, website, signage, tours, funding sources, lists of qualified contractors)**	**Manuals and Technical Assistance (standards, design manual, illustrations, checklists, examples, calculations and coefficients)**	**Capital Improvements / Demonstrations / Pilot Projects (on public land and in public right-of-way)**	**Code Compatibility (remove disincentives and incompatibilities with green SWM approach, e.g., zoning, subdivision, parking, landscaping, plumbing**	**New Plan, Policy, Department, Authority, or Partnerships (to facilitate process, provide info, education; cross departmental cooperation; public-private-NGO cooperation)**	**Additional Comments and Economic Development Impacts / Incentives**
Philadelphia, PA			Streets Dept Projects; demo project in ten program areas: streets, schools, driveways, alleys, institutions, homes…		Development Services Committee; new Office of Watersheds; ties storm water management to other city goals such as beautification, recreation, landscaping, bike lanes…Green Plan Philadelphia; Sewershed Plan.	
Portland, OR	Tours; stormwater utility fee credit calculator available on website; brochure describing what permits are required for different stormwater BMPs, e.g., swale, green roof, rain garden, perm pavers; online technical assistance; workshops for residential and commercial landowners.	Stormwater management manual and spreadsheet models designed to ease calculations, streamline formulas with simple coefficients.	City imposes Green Streets requirement on itself for major infrastructure projects, e.g., a water main replacement; Stormwater BMPs at schools.	Created a matrix to assess where codes were incompatible with desired BMPs; parking code now allows parking lot to be smaller than standard; parking lot landscape code requires landscape area of 10% of impervious area in addition to perimeter landscaping	Stormwater Policy Advisory Committee; Sustainable Stormwater Management Program tests BMPs, provide technical assistance, partner with property owners and agencies for design and installation, develop policy and program areas.	Residents consider the stormwater management installations as neighborhood improvements / beautification.
Santa Monica, CA	Technical resources and publications, public education, educational videos, youth training, door hangers, presentations, drain stenciling.		Green Streets; stormwater management in parks.			
Seattle, WA	Provides instructions on 'how to apply' for utility fee credit, provides a credit calculator (pdf) and examples of credit calculation on website; provides map of city with designated fee credit areas identified.		Green Streets: SEA Streets reduced impervious surface area, installed swales and rain gardens; 110th Cascade Project designed cascading pool design; Broadview LID standards for CIP projects.	Seattle Green Factor in landscaping code effectively reduces impervious area by requiring 30% functional green space.		Residents like the rain gardens, planters, and redesigned streets; report improved neighborhoods and property values.
State of Maryland		Stormwater Design Manual establishes requirements for quantity, quality, and groundwater recharge.				Stormwater management requirements in place since 1983 and now part of standard practice for developers; Montgomery County and Annapolis can afford to have stringent standards because these are desirable places to live and developers still want to go there
Washington DC						

Additional Programs and Details

Shorewood, WI	Madison, WI	Wauwatosa, WI	Wisconsin Municipalities	Burnsville, MN	State of Ohio	Toledo, OH	Kansas City, MO
Downspout disconnection program	Stormwater utility.	Rain garden program; landowner signs 5-year maintenance agreement that is connected to deed/ title and passes to new owners.	61 towns with utilities (since 1993); ERU size ranges from 1610 (Milwaukee) to 10,850 (Barron); fee per ERU ranges from $15 (pleasant prairie) to $109 (Appleton); 33 give fee credits between 20% - 100%.	Rain Garden demonstration project to capture street runoff in older neighborhood; funding provided by regional planning agency and city; Dakota County Soil and Water Conservation District conducted home runoff audits.	Authorized sale of bonds to fund green projects and brownfield redevelopment	Up to 50% credit for impervious area managed by BMPs; 10% credit for brownfield reuse, 30% credit for forested buffer or swale.	10,000 Rain Gardens Initiative provides three day-long how-to training sessions for landscapers, businesses, and municipal employees; website with technical info, background info, examples and photos; e-newsletter; list of landscape and gardening firms; city is considering updating internal engineering standards and details for permeable paving, bioretention streetscape improvements, bioretention parking lot islands.

Bellevue, WA	Orlando, FL	Montgomery County, MD	State of West Virginia	Berlin, Germany	Westfalia Region, Germany	Vancouver, BC
Stormwater utility and parks department collaborate to build multi-objective facilities, e.g., a detention facility and soccer field, a stormwater vault under a tennis court.	Proactive BMP inspection and maintenance program with staff and equipment; dedicated engineering inspector for stormwater BMPs	RainScapes Rewards for runoff reduction: $1200 residential, $5000 commercial and multifamily.	Developers meet a lower stormwater standard for infill than for greenfield development.	Green Area Ratio / Green Area Factor for new and redevelopment: residential 60% green area; mixed use 40% green area; commercial/city center 30% green area. 70% of green area must be permeable: parks, gardens, open spaces. contribution of green technologies toward the requirement are weighted based on ecological function. for stormwater utility fee credits, various BMPs have weights based on performance that determine how much credit can be awarded per BMP.	Water quality driven stormwater management requirements; state provides $10 DM per square meter of area turned from impervious to pervious surface.	Integrated LID program with greenways program for multiple benefits.

Green Area Ratio = (area of technology 1 X weighting) + (area of technology 2 X weighting)... /

Brief summary of incentive structures

Goal of Incentive	Mechanism for Fee Reduction	Process for Implementation
Reduce Imperviousness	Percent fee reduction	Percent reduction in imperviousness
	Per-square-foot credit	Square feet of pervious surfaces
On-site Management	Percent fee reduction	List of practices with various credits
	Quantity/Quality credits (performance-based)	Total area (square feet) managed
Volume Reduction	Percent fee reduction	Percent reduction in imperviousness
	Performance-based quantity reduction	Performance-based
		Total area (square feet) managed
		Practices based on pre-assigned performance values
Use of Specific Practices	Percent fee reduction	List of practices with various credits
	One time credit	

Seattle Stormwater Rates	2007	2008
Small Residential - Annual rate per parcel (1)	$142.00	
Under 3000 sq. ft.		$91.38
3000-4999 sq. ft.		$132.65
5000-6999 sq. ft.		$179.27
7000-9999 sq. ft.		$213.00
All Other Properties - Annual rate per 1,000 square feet (2)		
Open Space	$4.30	n/a
Undeveloped (0-15% Impervious)	$7.47	
Regular		$11.21
Low Impact (3)		$9.09
Light (16-35% Impervious)	$12.38	
Regular		$18.58
Low Impact (3)		$16.99
Medium (36-65% Impervious)	$22.47	
Regular		$32.83
Low Impact (3)		$26.63
Heavy (66-85% Impervious)	$29.28	$42.52
Very Heavy (86-100% Impervious) (4)	$36.38	$50.53

(1) Single Family Residential & Duplex parcels less than 10,000 square feet which are charged a flat
(2) 2007 All Other Properties rates were on a per acre basis and have been converted to per 1,000
(3) A customer in the Undeveloped, Light or Medium rate category with a significant amount of highly
(4) "Very heavy" does not necessarily mean heavily developed. A parking lot would be classified as

Appendix C
Strategy Implementation Matrix

		City Finance Implications					Procedural Implications			Technical Issues			Market		Political Implications					
		Economic feasibility from City perspective (cost) (+,o,-)	Would significant City capital investment be required? (no+, yes-)	Would significant staff resources be required to implement? (no+, yes-)	Is there an established funding source?	Can a funding source be tapped?	Change in ordinance required? (no+, yes-)	Change in utility required? (no+, yes-)	Change in SOP required? (no+, yes-)	Technical feasibility? (easy +, neutral o, difficult -)	How effective could it be at meeting TSS requirements? (high+, low-)	Time required to implement (0-1 yr, 1-5 yr, 5+ yr)	Does it promote economic development?	Would the market support it? Is there enough demand? (+,o,-)	Would the neighborhood / landowners / public support it? (+,o,-)	Would City departments (DPW, DPD, DF) support it?	Would MMSD support it?	Would likely implementing department support it?	Would it work in the 30th St. Corridor?	Would it work City-wide?
1	Modify the SWM Ordinance	+	+	o	o	o	-	+	o	+	+	+	o	o	-	o	o	o	o	+
2	Modify the SWM Utility Fee details	+	+	o	o	o	-	-	o	o	+	o	+	+	-*	+	+	+	+	+
3	Establish / formalize Utility Fee Discounts / Credit	+	+	-	o	o	-	-	-	o	+	o	+	+	+*	+	+	+	+	+
4	Density Bonuses (FAR, units/acre)	+	+	o	o	o	-	+	-	o	o	o	+	+	o	+	o	+	o	o
5	Fast Track Permitting / Priority Review / Fee Waivers / Free Consultation	o	+	-	o	o	o	+	-	-	o	o	+	+	o	-	o	-	+	+
6	Funding and Financing Incentives (TIF, tax credits, rebates, low interest loans, development grants)	+	+	o	+	o	+	+	-	o	+	o	+	+	+	+	+	+	+	+
7	Landowner Assistance (technical, installation, grants, SWM audits)	-	o	-	o	+	+	+	-	o	+	+	+	+	+	-	+	-	+*	+
8	Other Incentives (offsite stormwater banks with recapture)	o	o	-	+	TBD	+	+	+	TBD	+	o	+	+	+	+	+	+	+	+
9	Capital Improvements / Demonstration & Pilot Projects (on public land and in public right-of-way)	-	-	o	+	+	+	+	-	TBD	+	o	+	+	+	+	+	+	+	+
9a	Capital Improvements / Demonstration & Pilot Projects (on private land and in public/private)	o	-	-	+	+	+	+	-	TBD	+	o	+	+	+	+	+	+	+	+
10	Code Compatibility Audit (remove disincentives and incompatibilities with green SWM approach)	o+	o	-	-	o	-	+	-	o	-	-	+	+	o	+	+	+	o	+
11	New Partnership, Overlay / District Guidelines (to facilitate the process and work with ICC)	o	+	-	-	-	+	+	-	+	o	o	o	o	-	+	o	+	+	o
12	Recognition (awards, press, signage, certificates)	+	+	o	+	+	+	+	-	+	-	+	+	+	+	+	+	+	+	+
13	Education and Outreach (workshops, publications, events, website, signage, tours, funding sources, lists of qualified contractors)	o	+	-	+	+	+	+	-	+	o	+	+	+	+	+	+	+	+	+
13a	Building Contractor Capacity / Green Corps training	o	+	-	o	TBD	+	+	-	-	-	-	+	+	o	+	+	+	+	+
14	Manuals and Technical Assistance (standards and design manual, illustrated, checklists, examples of how to present info, locally appropriate calculations and coefficients)	o	+	-	o	+	+	+	-	o	o	o	+	+	o	+	+	+	+	+

* Utility fee discount / credit system unlikely to provide incentive without an increase in the utility fee.

Appendix D
Stormwater Utility Research

	Minneapolis, MN	Philadelphia, PA	Portland, OR	Milwaukee, WI
1. How was the target amount of the total fees to be collected determined? Some cities develop an annual capital projects and maintenance budget and use that as the amount to be collected. Others may include some or all of the cost of City stormwater staff.	Revenue neutral, designed to cover all costs (capital and operating, including city staff).	Revenue neutral, designed to cover all costs (capital and operating, including city staff).	Revenue neutral, designed to cover all costs (capital and operating, including city staff).	Revenue neutral, designed to cover all costs (capital and operating, including city staff, street sweeping, leaf collection, and urban forestry).
2. How are the fees assessed to a property? E.g., is it a flat rate per acre of parcel? Flat rate per acre of impervious cover? Flat rate per residential unit?	The stormwater utility fee is based on impervious area and is charged on a per unit basis. Each ESU (Equivalent Stormwater Unit) is 1,530 square feet of impervious area on a property. SF properties fall into three rate tiers based on estimated impervious surface. Fees for other uses based on: ((gross lot size*land use coefficient)/1530sf (ESU))*($10.77) .	Philadelphia is transitioning to a new system. The Stormwater Management Service Charge is based on two parameters: the average Gross Area square footage and the average Impervious Area square footage for all properties.	Single family has a flat monthly charge based on 2400 square feet of impervious area. Other residential (up to a four-plex) is charged per unit assuming 1000 sq ft/unit. Multi-family (above 4-unit) and non-residential are charged based on actual impervious surface measurements.	Residential properties (1-4 units) have a flat quarterly charge based on 1610 square feet of impervious area, or 1 ERU (Equivalent Residential Unit). All other properities are charged based on their estimated number of ERUs. The ERU rate is $14/quarter. ERUs for commercial properties were estimated using GIS photography.
3. Are there different rates for different land uses? E.g., for residential versus commercial versus industrial land uses? Or for single family residential versus multi-family buildings?	Yes. Different uses apply different coefficients to the rate calculation. Fees for uses other than SF are based on ((gross lot size*land use coefficient)/1530sf (ESU))*($10.77). See Appendix A, *Sewer Storwater Rate Resolution*	Yes, for residential (4 units or fewer assessed flat rate of $11.06/month) and condo/non-residential.	Yes. Categories explained below.	Yes. See above. There are two classes, residential and non-residential
4. What is the dollar rate / fee per residential unit, per acre of impervious cover, or other measure they use to charge landowners?	SF residential has three flat rate tiers (high, med, low) based on estimated impervious area. Other land uses use a multiplier that (presumably) is a proxy for estimated imperviousness, e.g., 0.95 for a car sales lot, 0.20 for a cemetery or vacant lot. See Appendix A, *Sewer Storwater Rate Resolution*	Residential $11.06/month; Non Residential is a complex rate formula involving Gross Area and Impervious Area. (www.phila.gov/water/Stormwater_how)	Single family, row homes, and duplex - $19.80/month; 3-plex and 4-plex - $8.25/unit/month; developments of 5 units or more - $8.25/1000 sq feet impervious/month; non-residential $8.86/1000 sq feet impervious/month.	$14/ERU/quarter. One ERU = 1610 square feet of impervious area.
5. If the answer to #2 is impervious area, how is that area measured? E.g., through direct, on-site measurement? Analysis using GIS or aerial photographs? Generalized for all parcels of a particular land use?	National impervious area averages of high/medium/low gross square footage are applied to different land uses. ESU=1530sf. Single family properties are billed as follows: High (1.25ESU) =$13.46; Medium (1.00ESU) =$10.77; Low (0.75ESU) =$8.08. For non-SF residential these averages are applied based on gross square footage calculated as part of tax records.	Average rates are established for residential users yielding a flat monthly utility fee. Non Residential>5000SF = impervious area found using GIS and aerial photos; Non Residential < 5000SF and undeveloped = 25% Impervious Area; Non Residential < 5000SF and developed = 85% Impervious Area. An online GIS tool shows parcels, impervious area, and details.	Aerial photography used to establish rates (in 1977.) Subsequent adjustments based on building permit information.	ERUs for commercial properties were estimated using GIS and aerial photography (from 2000.) Property owners can request the Department of Public Works to conduct an on-site measurement of impervious area.

	Minneapolis, MN	Philadelphia, PA	Portland, OR	Milwaukee, WI
6. Can the utility fee be reduced if the landowner installs stormwater practices (in other words, is there a credit available)? Is the utility fee reduced for reductions in the quantity of runoff leaving the site? For improvement in the quality of runoff leaving the site? For reduction in the rate of runoff leaving the site? All of the above? How are these documented?	Fee can be reduced 50% for water quality improvements, 50%-100% for water quantity improvements. (Cannot exceed 100%). Stormwater quality credit allows use of 14 different BMPs and a landowner application; quantity credit requires tools/practices to retain 10-year, 24-hour storm event (for 50% credit) and the 100-year, 24-hour storm event to pre-developed conditions (for 100% credit), with certification by engineer or LA. Verification: Ratepayer certifies that improvements and calculations are correct and city verifies with on-site inspection.	Only for non-residential and condo associations. Credit given for reducing IA Impervious Area (manage first inch of runoff according to the Philadelphia Stormwater Guidance Manual at phillyriverinfo.org), GA Gross Area (demonstate a property curve number less than 87, or demonstrate attenuation of 2-year peak rate of runoff), and NPDES (meet NPDES permit requirements). Documented through applications, certification, and inspection. See Appendix B for details.	Clean River Rewards Program (Appendix C). Single family: credit awarded for management of roof runoff (100%= 100%discount; partial= 67%discount; developed area<1000sf= 25%discount; 4 or more trees= 8% discount); allowable practices are listed on the Registration Form and marked by landowner as simply present / absent. Non-residential: discount based on control of pollution, flow rate, and disposal (volume) of runoff, all equally weighted; allowable practices are listed on the Registration Form and are based on developed area served by the BMP and the BMP size or count. Applications for credit are submitted by the property owner. The City verifies with on-site visit. No performance standard is established.	The stormwater fee can be reduced by replacing impervious surface with pervious surfaces. A full description of the City's adjustment policy can found in Council file 050620. Stormwater BMPs can only receive credit if they can be shown to reduce the City's cost to manage stormwater.
7. Is the utility fee reduced for parcels that meet the requirements of the current stormwater ordinance (relative to those that were developed prior to stormwater ordinance) or only for going beyond the requirements of the stormwater ordinance?	Fee reduced for property owners who take steps to reduce quantity or improve quality. New and redevelopment are held to the same rates and credit formulas.	Only for improvements made under the new rules and regulations. New and redevelopment are held to the same rates and credit formulas.	Retroactive credit, and single one-time adjustment, are available for improvements made prior to June 2007. See Section 7 of Appendix C for regulations. New and redevelopment are held to the same rates and credit formulas.	Only for improvements that go above and beyond the minimum code.
8. Can the utility fee be reduced for paying the fee in full on time?	No	No	No	No
9. Can the utility fee be reduced for taking part in some sort of stormwater education activity?	No	No	No	No
10. Are there other ways to reduce the fee? How are they documented?	Improvements noted above.	Improvements/Credits noted in Section 2.3 of Appendix B.	Opportunities outlined in Clean River Rewards program, Appendix C.	No
11. What is the maximum allowable credit? Is it 25%? 50% 100%?	Up to 100%	Non-residential/condo association up to 100%. None for Residential.	Stormwater fee is separated into 35% for on-site stormwater (property) and 65 % for off-site stormwater (roads, public right-of-way). Up to 100% of the on-site charge may be credited by the rewards program.	Up to 60%
12. If there is a credit system, how is persistence of the BMP and/or its performance verified. For example, if a credit is provided for installing a green roof, how is it verified that the green roof is still there.	City reserves the right to inspect but enforcement and inspection is not rigorous.	Registered professionals must sign and seal the information. (List of registered professionals is avaialble on the Philadelphia website.) City may inspect property. Credit renewal application is required every four years.	Intial on-site inspections are completed. Honor system in following years with random audits completed. If stormwater facilities are built as part of new development, a permit and inspection are required.	City inspection
13. How is payment of the fee enforced? Through the possibility of placing a lien on the property? Threat of cutting off water supply to the property?	If the utility bill is not paid, it will be assessed to the property taxes.	If the water bill is not paid, and the property owner has not asked for help from the City, the water will be shut off.	Water and sewer utility bill. If property owner doesn't pay the bill, there are a heirarchy of collection methods. State law does allow a transfer to the property tax bill.	If the utility bill is not paid, it will be assessed to the property taxes.
14. How are the fees billed? As a separate utility bill? As part of the property tax bill? As part of the water utility bill or another utility bill?	A water/sewer/garbage/drainage bill sent to each property.	It is a line item on the water/sewer account. If the property doesn't have a water/sewer account, it is sent as a separate utility bill.	Utility bill; single charge is independent of water and sewer use charges.	The Stormwater Management Fee is one of several fees on the Municipal Services bill, which includes water fees, solid waste fees, sewerage charges, sewage treatment, and snow and ice collection. http://www.city.milwaukee.gov/ImageLibrary/Groups/WaterWorks/files/Municipal_Services_Brochure_Feb2010.pdf

Appendix E
Additional Site Illustrations

Ruby Yard

North 30th Street Parkways

North 30th Street Parkways

4101/4131 North 31st Street

4101/4131 North 31st Street

4101/4131 North 31st Street

4101/4131 North 31st Street

4101/4131 North 31st Street

DRS Technologies Inc.

DRS Technologies Inc.

Eaton Corporation

Eaton Corporation

Vapor Blast

Appendix F
Storm Water Modeling Details

[SLAMM input files to be provided electronically]

Biofiltration Control Device

Land Use: Drainage System

Biofilter Number 1

Device Properties

Top Area (sf)	3790
Bottom Area (sf)	2540
Total Depth (ft)	3.75
Typical Width (ft) (Cost est. only)	10.00
Native Soil Infiltration Rate (in/hr)	0.020
Native Soil Infiltration Rate COV	N/A
Infil. Rate Fraction-Bottom (0-1)	1.00
Infil. Rate Fraction-Sides (0-1)	0.00
Rock Filled Depth (ft)	1.00
Rock Fill Porosity (0-1)	0.36
Engineered Soil Type	User Defined
Engineered Soil Infiltration Rate (in/hr)	3.96
Engineered Soil Depth (ft)	1.50
Engineered Soil Porosity (0-1)	0.27
Percent solids reduction due to Engineered Soil (0 -100)	100.00
Inflow Hydrograph Peak to Average Flow Ratio	3.80
Number of Devices in Source Area or Land Use	1

Add Outlet/ Discharge

Outlet/Discharge Options

- 1. Sharp Crested Weir
- 2. Broad Crested Weir
- 3. Vertical Stand Pipe
- 4. Evaporation
- 5. Rain Barrel/Cistern
- 6. Underdrain Outlet

Edit Egisting Outlet

Selected Outlets

1 - Broad Crested Weir
2 - Vertical Stand Pipe

Change Geometry

Copy Biofilter Data | Paste Biofilter Data

Route Through Wet Detention Pond First

Select Native Soil Infiltration Rate

- Sand - 8 in/hr
- Loamy sand - 2.5 in/hr
- Sandy loam - 1.0 in/hr
- Loam - 0.5 in/hr
- Silt loam - 0.3 in/hr
- Sandy silt loam - 0.2 in/hr
- Clay loam - 0.1 in/hr
- Silty clay loam - 0.05 in/hr
- Sandy clay - 0.05 in/hr
- Silty clay - 0.04 in/hr
- Clay - 0.02 in/hr
- Rain Barrel/Cistern - 0.00 in/hr

Use Random Number Generation to Account for Infiltration Rate Uncertainty

Select Particle Size File

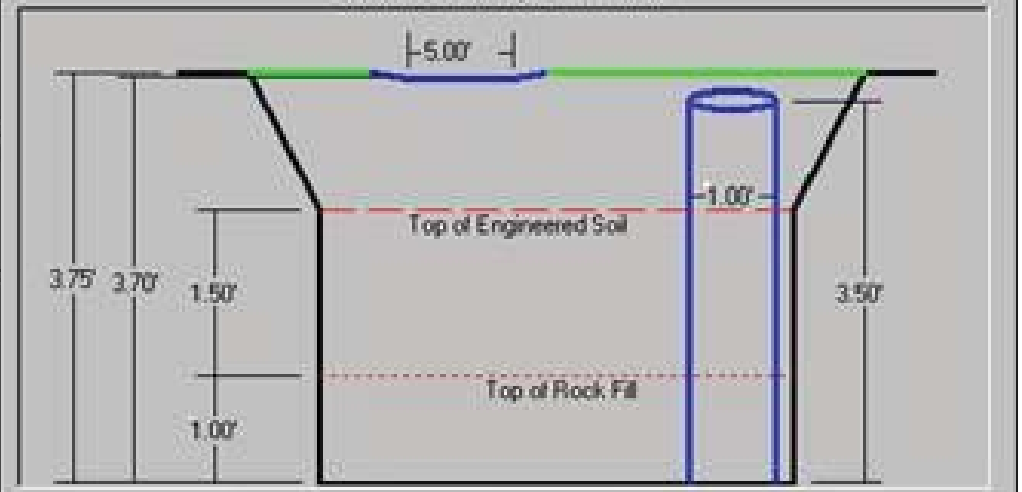
Does not need a particle size distribution

Source Areas from Land Use that Contribute Runoff to Biofiltration Control Device(s)

- Roof Top 1
- Roof Top 2
- Roof Top 3
- Roof Top 4
- Roof Top 5
- Paved Parking Storage 1
- Paved Parking Storage 2
- Paved Parking Storage 3
- Unpaved Parking Storage 1
- Unpaved Parking Storage 2
- Playground 1
- Playground 2
- Driveway 1
- Driveway 2
- Driveway 3
- Sidewalk w/Curb 1
- Sidewalk w/Curb 2
- Street Area 1
- Street Area 2
- Street Area 3
- Large Landscaped Area 1
- Undeveloped Area
- Small Landscaped Area 1
- Small Landscaped Area 2
- Small Landscaped Area 3
- Other Pervious Area
- Other Dir Conct Imp Area
- Other Part Conct Imp Area
- Paved Land and Shoulder 1
- Paved Land and Shoulder 2
- Paved Land and Shoulder 3
- Paved Land and Shoulder 4
- Paved Land and Shoulder 5
- Large Turf Areas
- Undeveloped Areas
- Other Pervious Areas
- Other Directly Connecting
- Other Partially Connecting

1 Fraction of Runoff from Drainage System Routed to Drainage System Biofilters (0 - 1)

Biofilter Geometry Schematic



Refresh Schematic | Delete | Cancel | Continue

Porous Pavement Control Device

Land Use: Industrial

Source Area: Paved Parking/Storage 3

Total Area: 5.51 **Porous Pavement Number 1**

Porous pavement area (acres): 5.51

Inflow Hydrograph Peak to Average Flow Ratio 3.0

Pavement Geometry and Properties

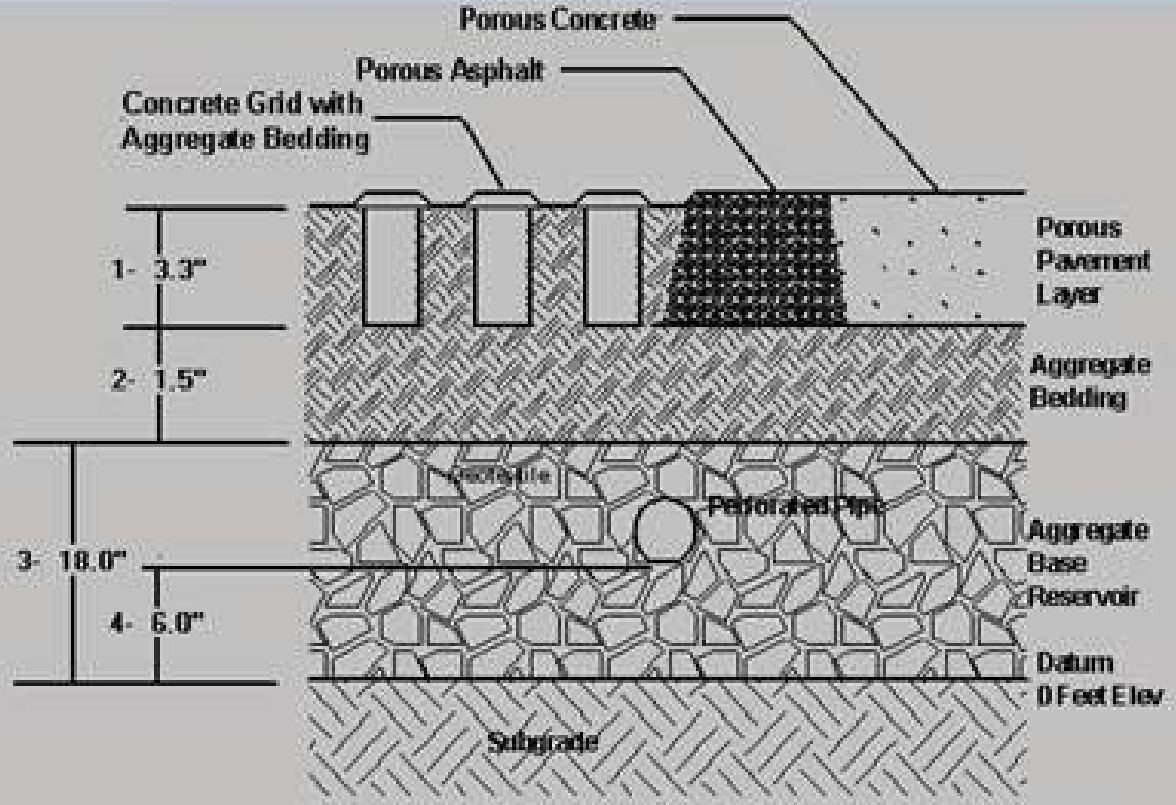
1 - Pavement Thickness (in)	3.3
Pavement Porosity (0-1)	0.10
2 - Aggregate Bedding Thickness (in)	1.5
Aggregate Bedding Porosity (0-1)	0.35
3 - Aggregate Base Reservoir Thickness (in)	18.0
Aggregate Base Reservoir Porosity (0-1)	0.35

Outlet/Discharge Options

Perforated Pipe Underdrain Diameter, if used (inches)	4.00
4 - Perforated Pipe Underdrain Outlet Invert Elevation (inches above Datum)	6.0
Number of Perforated Pipe Underdrains	1
Subgrade Seepage Rate (in/hr) - select below or enter	0.10
Use Random Number Generation to Account for Uncertainty in Seepage Rate	☐
Subgrade Seepage Rate COV	

Select Subgrade Seepage Rate

- ○ Sand - 8 in/hr
- ○ Loamy sand - 2.5 in/hr
- ○ Sandy loam - 1.0 in/hr
- ○ Loam - 0.5 in/hr
- ○ Silt loam - 0.3 in/hr
- ○ Sandy silt loam - 0.2 in/hr
- ○ Clay loam - 0.1 in/hr
- ○ Silty clay loam - 0.05 in/hr
- ○ Sandy clay - 0.05 in/hr
- ○ Silty clay - 0.04 in/hr
- ○ Clay - 0.02 in/hr



Surface Pavement Layer Infiltration Rate Data

Initial Infiltration Rate (in/hr)	20.00
Percent of Infiltration Rate After 3 Years (0-100)	25.0
Percent of Infiltration Rate After 5 Years (0-100)	15.0
Percent of Original Infiltration Rate Upon Cleaning (0-100)	50.0
Time Period Until Complete Clogging Occurs (yrs)	20.0

Restorative Cleaning Frequency

- ○ Never Cleaned
- ○ Three Times per Year
- ○ Semi-Annually
- ◉ Annually
- ○ Every Two Years
- ○ Every Three Years
- ○ Every Four Years
- ○ Every Five Years
- ○ Every Seven Years
- ○ Every Ten Years

Continue | Cancel | Delete Control

Appendix G
Detailed
Cost Estimates

Milwaukee 30th Street Corridor
Preliminary Cost Estimate
Ruby Yard (Public Site)
June 2010

AB

Item #	WI DOT Spec #	Description	Units	Unit Cost	Quantity	Cost
		Demolition				
1	204.0100	Pavement Removal (6")	SY	$3.00	16155	$48,465
2	204.0210	Removing Manholes	EA	$450.00	11	$4,950
3	204.0245	Removing Storm Sewer (21")	LF	$19.00	210	$3,990
4	204.0245	Removing Storm Sewer (42")	LF	$40.00	70	$2,800
5	204.0245	Removing Storm Sewer (48")	LF	$44.00	420	$18,480
6	205.0100	Excavation - Common	CY	$4.00	61275	$245,100
7	617.0100	Hauling & Disposal of Common Material	CY	$22.00	63062	$1,387,364
		Demolition Subtotal				**$1,711,149**
		Storm Sewer				
8	608.0248	Storm Sewer Pipe Reinforced Concrete Class III (48")	LF	$125.00	240	$30,000
9		Flared End Section (21")	EA	$750.00	2	$1,500
10		Flared End Section (48")	EA	$1,800.00	1	$1,800
11		Manhole (48" dia.)	EA	$2,050.00	3	$6,150
12		Rip Rap at Outlets	CY	$40.00	8	$320
		Storm Sewer Subtotal				**$39,770**
		Planting Material				
13		Plugs - Wetland Shelf (12" Centers)	SY	$54.00	2360	$127,440
14		Seeding - Native	SY	$0.55	11600	$6,380
15		Seeding - Grass	SY	$1.50	760	$1,140
16		Trees (2" Cal.)	EA	$450.00	63	$28,350
		Planting Material Subtotal				**$163,310**
		Miscellaneous				
17		Vehicular Gravel Access Path	SY	$18.00	205	$3,690
18		Pedestrian Gravel Path (1" Crushed Stone)	SY	$6.00	1030	$6,180
19	616.0208	Fence Chain Link (8')	LF	$50.00	2150	$107,500
20		Erosion Mat	SY	$1.50	13595	$20,393
		Miscellaneous Subtotal				**$137,763**

Subtotal	**$2,051,992**
Contingency (20%)	$410,398
Final Engineering*	$205,199
Total	**$2,667,589**

* Final engineering estimates include soil borings, initial topographic survey, permitting

Note

1. Costs shown for hauling and disposal of material (common and contaminated) are estimates. These units costs could vary greatly depending up many factors.

Milwaukee 30th Street Corridor
Preliminary Cost Estimate
30th Street Parkways (Public Site)
June 2010

AB

Item #	WI DOT Spec #	Description	Units	Unit Cost	Quantity	Cost
		Demolition				
1	204.0100	Pavement Removal (6")	SY	$3.00	560	$1,680
2	205.0100	Excavation - Common**	CY	$4.00	9630	$38,520
3	617.0100	Hauling & Disposal of Common Material	CY	$22.00	9723	$213,913
		Demolition Subtotal				**$254,113**
		Bioretention Material				
4		Engineered Soil (12" Bioretention)	CY	$57.00	1645	$93,765
5		Open Graded Stone (18" Bioretention)	CY	$25.00	2467.5	$61,688
6		Geotextile	SY	$2.10	4935	$10,364
7	612.0106	Pipe Underdrain - Perforated HDPE (6")	LF	$12.00	1000	$12,000
8		Storm Sewer Pipe - Solid HDPE (12")	LF	$11.00	260	$2,860
9		Perforated Pipe Clean Out	EA	$475.00	4	$1,900
10		Storm Sewer Manhole (24" dia.)	EA	$1,850.00	5	$9,250
11		Plugs - Bioretention (12" Centers)	SY	$54.00	4935	$266,490
12		Seeding - Bioretention	SY	$0.55	4935	$2,714
		Bioretention Material Subtotal				**$461,030**
		Planting Material				
13		Seeding - Grass	SY	$1.50	2310	$3,465
14		Trees (2" Cal.)	EA	$450.00	10	$4,500
		Planting Material Subtotal				**$7,965**
		Miscellaneous				
15		Trench Drain	LF	$200.00	360	$72,000
16		5' Sidewalk	LF	$25.50	1190	$30,345
17		Erosion Mat	SY	$1.50	7245	$10,868
		Miscellaneous Subtotal				**$113,213**
					Subtotal	**$836,321**
					Contingency (20%)	$167,264
					Final Engineering*	$83,632
					Total	**$1,087,217**

* Final engineering estimates include soil borings, initial topographic survey, permitting
** Assumes 78" total Bioretention depth (48" open depth, 12" Eng Soil, 18" stone)

Note
1. Costs shown for hauling and disposal of material (common and contaminated) are estimates. These units costs could vary greatly depending up many factors.

Milwaukee 30th Street Corridor
Preliminary Cost Estimate
4101/4131 31st Street (Public/Private Site) - **Southern Section**
June 2010

AB

Item #	WI DOT Spec #	Description	Units	Unit Cost	Quantity	Cost
		Demolition				
1	205.0100	Excavation - Common (6")**	CY	$4.00	1546	$6,184
2		Excavation - Contaminated (36")***	CY	$12.00	9276	$111,317
3	204.0210	Removing Manholes	EA	$450.00	4	$1,800
4	617.0100	Hauling & Disposal of Common Material	CY	$22.00	1546	$34,014
5		Hauling & Disposal of Contaminated Material	CY	$44.00	9276	$408,164
		Demolition Subtotal				**$561,479**
		Storm Sewer/Underdrain**				
6	612.0106	Pipe Underdrain - Perforated HDPE (6")	LF	$12.00	371	$4,452
7		Storm Sewer Pipe - Solid HDPE (12")	LF	$11.00	69	$759
8		Perforated Pipe Clean Out	EA	$475.00	2	$950
9		Storm Sewer Manhole (48" dia.)	EA	$2,050.00	2	$4,100
		Storm Sewer Subtotal				**$10,261**
		Bioretention Material				
10		Engineered Soil (12" for Bioretention)	CY	$57.00	140	$8,001
11		Open Graded Stone (18" for Bioretention)	CY	$25.00	211	$5,264
12		Geotextile	SY	$2.10	442	$929
13		Plugs - Bioretention (12" Centers)	SY	$54.00	421	$22,740
14		Seeding - Bioretention	SY	$0.55	421	$232
		Bioretention Material Subtotal				**$37,165**
		Porous Unit Pavers				
15		Concrete Curb & Gutter, B6.12	LF	$16.00	954	$15,264
16		Porous unit paving, pavers & no. 8 setting bed, machine install	SY	$45.50	582	$26,496
17		Open Graded Stone (12" for Porous Unit Pavers)	CY	$25.00	194	$4,853
18		Geotextile	SY	$2.10	611	$1,284
		Porous Unit Pavers Subtotal				**$47,897**
		Planting Material				
19		Seeding - Native Landscaping	SY	$0.55	6454	$3,550
20		Trees (2" Cal.)	EA	$450.00	34	$15,300
		Planting Material Subtotal				**$18,850**
		Miscellaneous				
21		Import Clean Material (36")	CY	$22.00	9276	$204,082
22		Gravel Pedestrian Paths	SY	$12.00	1225	$14,704
23		Park Benches	EA	$1,200.00	3	$3,600
24		Landscaping Walls	VSF	$66.00	630	$41,580
25		Erosion Mat	SY	$1.50	6875	$10,313
		Miscellaneous Subtotal				**$274,278**
					Subtotal	**$949,930**
					Contingency (20%)	$189,986
					Final Engineering*	$94,993
					Total	**$1,234,909**

* Final engineering estimates include soil borings, initial topographic survey, permitting
** Assumes 6" removal over entire site
*** Assumes removal of 36" additional material on entire southern site
**** A storm sewer/underdrain system is required if either bioretention or a porous unit paver system or both is employed

Note
1. Costs shown for hauling and disposal of material (common and contaminated) are estimates. These units costs could vary greatly depending up many factors.

Milwaukee 30th Street Corridor
Preliminary Cost Estimate
4101/4131 31st Street (Public/Private Site) - **Northern Section**
Bioretention & Standard Pavement
June 2010

AB

Item #	WI DOT Spec #	Description	Units	Unit Cost	Quantity	Cost
		Demolition				
1	205.0100	Excavation - Common (6")**	CY	$4.00	1148	$4,591
2		Excavation - Contaminated (4")***	CY	$12.00	130	$1,565
3	204.0210	Removing Manholes	EA	$450.00	2	$900
4	617.0100	Hauling & Disposal of Common Material	CY	$22.00	1148	$25,253
5		Hauling & Disposal of Contaminated Material	CY	$44.00	130	$5,738
		Demolition Subtotal				**$38,047**
		Storm Sewer/Underdrain**				
6	612.0106	Pipe Underdrain - Perforated HDPE (6")	LF	$12.00	319	$3,828
7		Storm Sewer Pipe - Solid HDPE (12")	LF	$11.00	501	$5,511
8		Perforated Pipe Clean Out	EA	$475.00	3	$1,425
9		Storm Sewer Manhole (48" dia.)	EA	$2,050.00	5	$10,250
		Storm Sewer Subtotal				**$21,014**
		Bioretention Material				
10		Engineered Soil (12" for Bioretention)	CY	$57.00	215	$12,234
11		Open Graded Stone (18" for Bioretention)	CY	$25.00	322	$8,049
12		Geotextile	SY	$2.10	676	$1,420
13		Plugs - Bioretention (12" Centers)	SY	$54.00	644	$34,770
14		Seeding - Bioretention	SY	$0.55	644	$354
		Bioretention Material Subtotal				**$56,826**
		Asphalt Pavement				
15		Concrete Curb & Gutter, B6.12	LF	$16.00	2405	$38,480
16		Asphalt Pavement (2" Wearing, 2" Binder)	SY	$15.50	4464	$69,199
17		Stone Base (6")	SY	$21.00	4464	$93,753
		Asphalt Pavement Subtotal				**$201,432**
		Planting Material				
18		Seeding - Grass	SY	$1.50	1350	$2,025
19		Shrubs	EA	$50.00	102	$5,100
20		Trees (2" Cal.)	EA	$450.00	45	$20,250
		Planting Material Subtotal				**$27,375**
		Miscellaneous				
21		Import Clean Material (4")	CY	$22.00	130	$2,869
22	616.0208	Fence Chain Link (8')	LF	$50.00	1205	$60,250
23		Erosion Mat	SY	$1.50	1994	$2,991
		Miscellaneous Subtotal				**$66,110**

Subtotal	**$410,805**
Contingency (20%)	$82,161
Final Engineering*	$41,080
Total	**$534,046**

* Final engineering estimates include soil borings, initial topographic survey, permitting
** Assumes 6" removal over entire site
*** Assumes removal of 4" additional material from southern portion
**** A storm sewer/underdrain system is required if either bioretention or a porous unit paver system or both is employed

Note
1. Costs shown for hauling and disposal of material (common and contaminated) are estimates. These units costs could vary greatly depending up many factors.

Milwaukee 30th Street Corridor
Preliminary Cost Estimate
4101/4131 31st Street (Public/Private Site) - **Northern Section**
Porous Unit Pavers & No Bioretention
June 2010

AB

Item #	WI DOT Spec #	Description	Units	Unit Cost	Quantity	Cost
		Demolition				
1	205.0100	Excavation - Common (6")**	CY	$4.00	1148	$4,591
2		Excavation - Contaminated (36")***	CY	$12.00	988	$11,862
3	204.0210	Removing Manholes	EA	$450.00	2	$900
4	617.0100	Hauling & Disposal of Common Material	CY	$22.00	1148	$25,253
5		Hauling & Disposal of Contaminated Material	CY	$44.00	988	$43,493
		Demolition Subtotal				**$86,100**
		Storm Sewer/Underdrain**				
6	612.0106	Pipe Underdrain - Perforated HDPE (6")	LF	$12.00	319	$3,828
7		Storm Sewer Pipe - Solid HDPE (12")	LF	$11.00	501	$5,511
8		Perforated Pipe Clean Out	EA	$475.00	3	$1,425
9		Storm Sewer Manhole (48" dia.)	EA	$2,050.00	5	$10,250
		Storm Sewer Subtotal				**$21,014**
		Porous Unit Pavers				
10		Concrete Curb & Gutter, B6.12	LF	$16.00	2405	$38,480
11		Porous unit paving, pavers & no. 8 setting bed, machine install	SY	$45.50	4464	$203,132
12		Open Graded Stone (18" for Porous Unit Pavers)	CY	$25.00	2232	$55,806
13		Geotextile	SY	$2.10	4688	$9,844
		Porous Unit Pavers Subtotal				**$307,262**
		Planting Material				
14		Seeding - Grass	SY	$1.50	1994	$2,991
15		Shrubs	EA	$50.00	218	$10,895
16		Trees (2" Cal.)	EA	$450.00	59	$26,769
		Planting Material Subtotal				**$40,655**
		Miscellaneous				
17		Import Clean Material (36")	CY	$22.00	988	$21,747
18	616.0208	Fence Chain Link (8')	LF	$50.00	1205	$60,250
19		Erosion Mat	SY	$1.50	1994	$2,991
		Miscellaneous Subtotal				**$84,987**

Subtotal	**$540,018**
Contingency (20%)	$108,004
Final Engineering*	$54,002
Total	**$702,024**

* Final engineering estimates include soil borings, initial topographic survey, permitting
** Assumes 6" removal over entire site
*** Assumes removal of 36" additional material from southern portion
**** A storm sewer/underdrain system is required if either bioretention or a porous unit paver system or both is employed

Note
1. Costs shown for hauling and disposal of material (common and contaminated) are estimates. These units costs could vary greatly depending up many factors.

Milwaukee 30th Street Corridor
Preliminary Cost Estimate
4101/4131 31st Street (Public/Private Site) - **Northern Section**
June 2010

AB

Item #	WI DOT Spec #	Description	Units	Unit Cost	Quantity	Cost
		Demolition				
1	205.0100	Excavation - Common (6")**	CY	$4.00	1148	$4,591
2		Excavation - Contaminated (36")***	CY	$12.00	1174	$14,084
3	204.0210	Removing Manholes	EA	$450.00	2	$900
4	617.0100	Hauling & Disposal of Common Material	CY	$22.00	1148	$25,253
5		Hauling & Disposal of Contaminated Material	CY	$44.00	1174	$51,641
		Demolition Subtotal				**$96,470**
		Storm Sewer/Underdrain**				
6	612.0106	Pipe Underdrain - Perforated HDPE (6")	LF	$12.00	319	$3,828
7		Storm Sewer Pipe - Solid HDPE (12")	LF	$11.00	501	$5,511
8		Perforated Pipe Clean Out	EA	$475.00	3	$1,425
9		Storm Sewer Manhole (48" dia.)	EA	$2,050.00	5	$10,250
		Storm Sewer Subtotal				**$21,014**
		Bioretention Material				
10		Engineered Soil (12" for Bioretention)	CY	$57.00	215	$12,234
11		Open Graded Stone (18" for Bioretention)	CY	$25.00	322	$8,049
12		Geotextile	SY	$2.10	676	$1,420
13		Plugs - Bioretention (12" Centers)	SY	$54.00	644	$34,770
14		Seeding - Bioretention	SY	$0.55	644	$354
		Bioretention Material Subtotal				**$56,826**
		Porous Unit Pavers				
15		Concrete Curb & Gutter, B6.12	LF	$16.00	2405	$38,480
16		Porous unit paving, pavers & no. 8 setting bed, machine install	SY	$45.50	4464	$203,132
17		Open Graded Stone (18" for Porous Unit Pavers)	CY	$25.00	2232	$55,806
18		Geotextile	SY	$2.10	4688	$9,844
		Porous Unit Pavers Subtotal				**$307,262**
		Planting Material				
19		Seeding - Grass	SY	$1.50	1350	$2,025
20		Shrubs	EA	$50.00	102	$5,100
21		Trees (2" Cal.)	EA	$450.00	45	$20,250
		Planting Material Subtotal				**$27,375**
		Miscellaneous				
22		Import Clean Material (36")	CY	$22.00	1174	$25,821
23	616.0208	Fence Chain Link (8')	LF	$50.00	1205	$60,250
24		Erosion Mat	SY	$1.50	1994	$2,991
		Miscellaneous Subtotal				**$89,062**
					Subtotal	**$598,009**
					Contingency (20%)	$119,602
					Final Engineering*	$59,801
					Total	**$777,411**

* Final engineering estimates include soil borings, initial topographic survey, permitting
** Assumes 6" removal over entire site
*** Assumes removal of 36" additional material from southern portion
**** A storm sewer/underdrain system is required if either bioretention or a porous unit paver system or both is employed

Note
1. Costs shown for hauling and disposal of material (common and contaminated) are estimates. These units costs could vary greatly depending up many factors.

Milwaukee 30th Street Corridor
Preliminary Cost Estimate
4101/4131 31st Street (Public/Private Site) - **Full Site**
Permeable Pavers (North) & Native Landscaping (South)
June 2010

AB

Item #	WI DOT Spec #	Description	Units	Unit Cost	Quantity	Cost
		Demolition				
1	205.0100	Excavation - Common (6")**	CY	$4.00	2694	$10,776
2		Excavation - Contaminated (36")***	CY	$12.00	10450	$125,401
3	204.0210	Removing Manholes	EA	$450.00	2	$900
4	617.0100	Hauling & Disposal of Common Material	CY	$22.00	2694	$59,267
5		Hauling & Disposal of Contaminated Material	CY	$44.00	10450	$459,805
		Demolition Subtotal				**$656,149**
		Storm Sewer/Underdrain**				
6	612.0106	Pipe Underdrain - Perforated HDPE (6")	LF	$12.00	319	$3,828
7		Storm Sewer Pipe - Solid HDPE (12")	LF	$11.00	501	$5,511
8		Perforated Pipe Clean Out	EA	$475.00	3	$1,425
9		Storm Sewer Manhole (48" dia.)	EA	$2,050.00	5	$10,250
		Storm Sewer Subtotal				**$21,014**
		Asphalt Pavement				
10		Concrete Curb & Gutter, B6.12	LF	$16.00	954	$15,264
11		Asphalt Pavement (2" Wearing, 2" Binder)	SY	$15.50	582	$9,021
12		Stone Base (8")	SY	$25.00	582	$14,550
13		**Asphalt Pavement Subtotal**				**$38,835**
		Porous Unit Pavers				
14		Concrete Curb & Gutter, B6.12	LF	$16.00	2405	$38,480
15		Porous unit paving, pavers & no. 8 setting bed, machine install	SY	$45.50	4464	$203,132
16		Open Graded Stone (12" for Porous Unit Pavers)	CY	$25.00	2232	$55,806
17		Geotextile	SY	$2.10	4688	$9,844
		Porous Unit Pavers Subtotal				**$307,262**
		Planting Material				
		Seeding - Grass	SY	$1.50	1350	$2,025
18		Seeding - Native Landscaping	SY	$0.55	6454	$3,550
		Shrubs	EA	$50.00	102	$5,100
19		Trees (2" Cal.)	EA	$450.00	70	$31,500
		Planting Material Subtotal				**$42,175**
		Miscellaneous				
20		Haul & Import Clean Material (36")	CY	$22.00	10450	$229,902
21		Gravel Pedestrian Paths	SY	$12.00	1225	$14,704
22		Park Benches	EA	$1,200.00	3	$3,600
23		Landscaping Walls	VSF	$66.00	630	$41,580
24		Erosion Mat	SY	$1.50	7804	$11,706
		Miscellaneous Subtotal				**$301,492**

Subtotal	**$1,366,927**
Contingency (20%)	$273,385
Final Engineering*	$136,693
Total	**$1,777,005**

* Final engineering estimates include soil borings, initial topographic survey, permitting
** Assumes 6" removal over entire site
*** Assumes removal of 36" additional material on entire southern site
**** A storm sewer/underdrain system is required if either bioretention or a porous unit paver system or both is employed

Note
1. Costs shown for hauling and disposal of material (common and contaminated) are estimates. These units costs could vary greatly depending up many factors.

Milwaukee 30th Street Corridor
Preliminary Cost Estimate
4101/4131 31st Street (Public/Private Site) - **Full Site**
Porous Unit Pavers (North) & Bioretention (South)
June 2010

AB

Item #	WI DOT Spec #	Description	Units	Unit Cost	Quantity	Cost
		Demolition				
1	205.0100	Excavation - Common (6")**	CY	$4.00	1148	$4,591
2		Excavation - Contaminated (36")***	CY	$12.00	1174	$14,084
3	204.0210	Removing Manholes	EA	$450.00	2	$900
4	617.0100	Hauling & Disposal of Common Material	CY	$22.00	1148	$25,253
5		Hauling & Disposal of Contaminated Material	CY	$44.00	1595	$70,170
		Demolition Subtotal				**$114,999**
		Storm Sewer/Underdrain**				
6	612.0106	Pipe Underdrain - Perforated HDPE (6")	LF	$12.00	690	$8,280
7		Storm Sewer Pipe - Solid HDPE (12")	LF	$11.00	570	$6,270
8		Perforated Pipe Clean Out	EA	$475.00	5	$2,375
9		Storm Sewer Manhole (48" dia.)	EA	$2,050.00	7	$14,350
		Storm Sewer Subtotal				**$31,275**
		Porous Unit Pavers				
10		Concrete Curb & Gutter, B6.12	LF	$16.00	2405	$38,480
11		Porous unit paving, pavers & no. 8 setting bed, machine install	SY	$45.50	4464	$203,132
12		Open Graded Stone (18" for Porous Unit Pavers)	CY	$25.00	2232	$55,806
13		Geotextile	SY	$2.10	4688	$9,844
		Porous Unit Pavers Subtotal				**$307,262**
		Bioretention Material				
14		Engineered Soil (12" for Bioretention)	CY	$57.00	140	$8,001
15		Open Graded Stone (18" for Bioretention)	CY	$25.00	211	$5,264
16		Geotextile	SY	$2.10	442	$929
17		Plugs - Bioretention (12" Centers)	SY	$54.00	421	$22,740
18		Seeding - Bioretention	SY	$0.55	421	$232
		Bioretention Material Subtotal				**$37,165**
		Planting Material				
19		Seeding - Grass	SY	$1.50	1994	$2,991
20		Shrubs	EA	$50.00	218	$10,895
21		Trees (2" Cal.)	EA	$450.00	59	$26,769
		Planting Material Subtotal				**$40,655**
		Miscellaneous				
22		Import Clean Material (36")	CY	$22.00	1174	$25,821
23	616.0208	Fence Chain Link (8')	LF	$50.00	1205	$60,250
24		Erosion Mat	SY	$1.50	1994	$2,991
		Miscellaneous Subtotal				**$89,062**

Subtotal	**$620,418**
Contingency (20%)	$124,084
Final Engineering*	$62,042
Total	**$806,543**

* Final engineering estimates include soil borings, initial topographic survey, permitting
** Assumes 6" removal over entire site
*** Assumes removal of 36" additional material from contaminated areas
**** A storm sewer/underdrain system is required if either bioretention or a porous unit paver system or both is employed

Note
1. Costs shown for hauling and disposal of material (common and contaminated) are estimates. These units costs could vary greatly depending up many factors.

Milwaukee 30th Street Corridor
Preliminary Cost Estimate
DRS Corporation (Private Site)
Bioretention & Standard Pavement
June 2010

AB

Item #	WI DOT Spec #	Description	Units	Unit Cost	Quantity	Cost
		Demolition				
1	204.0100	Pavement Surface Removal (6")	SY	$3.00	37238	$111,714
2	205.0100	Excavation - Common (6")**	CY	$4.00	8480	$33,919
3	204.0210	Removing Manholes	EA	$450.00	7	$3,150
4	617.0100	Hauling & Disposal of Common Material	CY	$22.00	14686	$323,096
		Demolition Subtotal				**$471,879**
		Storm Sewer/Underdrain* **				
5	612.0106	Pipe Underdrain - Perforated HDPE (6")	LF	$12.00	3485	$41,820
6		Storm Sewer Pipe - Solid HDPE (12")	LF	$11.00	1385	$15,235
7		Perforated Pipe Clean Out	EA	$475.00	20	$9,500
8		Storm Sewer Manhole (48" dia.)	EA	$2,050.00	23	$47,150
		Storm Sewer Subtotal				**$113,705**
		Bioretention Material				
9		Engineered Soil (12" for Bioretention)	CY	$57.00	1242	$70,817
10		Open Graded Stone (18" for Bioretention)	CY	$25.00	1864	$46,590
11		Geotextile	SY	$2.10	3914	$8,219
12		Plugs - Bioretention (12" Centers)	SY	$54.00	3727	$201,270
13		Seeding - Bioretention	SY	$0.55	3727	$2,050
		Bioretention Material Subtotal				**$328,946**
		Asphalt Pavement				
14		Concrete Curb & Gutter, B6.12	LF	$16.00	11085	$177,360
15		Asphalt Pavement (2" Wearing, 2" Binder)	SY	$15.50	32243	$499,765
16		Stone Base (8")	SY	$25.00	32243	$806,072
		Asphalt Pavement Subtotal				**$1,483,197**
		Planting Material				
17		Seeding - Grass	SY	$1.50	2895	$4,343
18		Shrubs	EA	$50.00	190	$9,500
19		Trees (2" Cal.)	EA	$450.00	95	$42,750
		Planting Material Subtotal				**$56,593**
		Miscellaneous				
20		Erosion Mat	SY	$1.50	2895	$4,343
		Miscellaneous Subtotal				**$4,343**
					Subtotal	**$2,458,662**
					Contingency (20%)	$491,732
					Final Engineering*	$245,866
					Total	**$3,196,261**

* Final engineering estimates include soil borings, initial topographic survey, permitting
** Assumes 10" total Asphalt Pavement depth (2" wearing course, 2" binder courser, 8" stone base)
*** A storm sewer/underdrain system is required if either bioretention or a porous unit paver system or both is employed

Note
1. Costs shown for hauling and disposal of material (common and contaminated) are estimates. These units costs could vary greatly depending up many factors.
2. Green roof materials are not included in this cost estimate

Milwaukee 30th Street Corridor
Preliminary Cost Estimate
DRS Corporation (Private Site)
Bioretention Retrofits
June 2010

AB

Item #	WI DOT Spec #	Description	Units	Unit Cost	Quantity	Cost
		Demolition				
1	204.0100	Pavement Surface Removal (6")	SY	$3.00	4596	$13,789
2	205.0100	Excavation - Common (30" Bioretention)**	CY	$4.00	3106	$12,424
3		Saw Cutting	LF	$2.00	5214	$10,428
4	617.0100	Hauling & Disposal of Common Material	CY	$22.00	3872	$85,185
		Demolition Subtotal				**$121,826**
		Storm Sewer/Underdrain**				
5	612.0106	Pipe Underdrain - Perforated HDPE (6")	LF	$12.00	3485	$41,820
6		Storm Sewer Pipe - Solid HDPE (12")	LF	$11.00	1385	$15,235
7		Perforated Pipe Clean Out	EA	$475.00	20	$9,500
8		Storm Sewer Manhole (48" dia.)	EA	$2,050.00	23	$47,150
		Storm Sewer Subtotal				**$113,705**
		Bioretention Material				
9		Concrete Curb & Gutter, B6.12	LF	$16.00	5214	$83,424
10		Engineered Soil (12" for Bioretention)	CY	$57.00	1242	$70,817
11		Open Graded Stone (18" for Bioretention)	CY	$25.00	1864	$46,590
12		Geotextile	SY	$2.10	3914	$8,219
13		Plugs - Bioretention (12" Centers)	SY	$54.00	3727	$201,270
14		Seeding - Bioretention	SY	$0.55	3727	$2,050
		Bioretention Material Subtotal				**$412,370**
					Subtotal	**$647,901**
					Contingency (20%)	$129,580
					Final Engineering*	$64,790
					Total	**$842,271**

* Final engineering estimates include soil borings, initial topographic survey, permitting
** A storm sewer/underdrain system is required if either bioretention or a porous unit paver system or both is employed

Note
1. Costs shown for hauling and disposal of material (common and contaminated) are estimates. These units costs could vary greatly depending up many factors.
2. Green roof materials are not included in this cost estimate

Milwaukee 30th Street Corridor
Preliminary Cost Estimate
DRS Corporation (Private Site)
Porous Unit Pavers & No Bioretention
June 2010

AB

Item #	WI DOT Spec #	Description	Units	Unit Cost	Quantity	Cost
		Demolition				
1	204.0100	Pavement Surface Removal (6")	SY	$3.00	37238	$111,714
2	205.0100	Excavation - Common (17" Pavers, 30" Bioretention)**	CY	$4.00	15226	$60,903
3	204.0210	Removing Manholes	EA	$450.00	7	$3,150
4	617.0100	Hauling & Disposal of Common Material	CY	$22.00	21432	$471,507
		Demolition Subtotal				**$647,274**
		Storm Sewer/Underdrain* **				
5	612.0106	Pipe Underdrain - Perforated HDPE (6")	LF	$12.00	3485	$41,820
6		Storm Sewer Pipe - Solid HDPE (12")	LF	$11.00	1385	$15,235
7		Perforated Pipe Clean Out	EA	$475.00	20	$9,500
8		Storm Sewer Manhole (48" dia.)	EA	$2,050.00	23	$47,150
		Storm Sewer Subtotal				**$113,705**
		Porous Unit Pavers				
9		Concrete Curb & Gutter, B6.12	LF	$16.00	11085	$177,360
10		Porous unit paving, pavers & no. 8 setting bed, machine install	SY	$45.50	32243	$1,467,051
11		Open Graded Stone (18" for porous unit pavers)	CY	$25.00	16121	$403,036
12		Geotextile	SY	$2.10	33855	$71,096
		Porous Unit Pavers Subtotal****				**$2,118,543**
		Planting Material				
13		Seeding - Grass	SY	$1.50	6608	$9,912
14		Shrubs	EA	$50.00	861	$43,045
15		Trees (2" Cal.)	EA	$450.00	95	$42,750
		Planting Material Subtotal				**$95,707**
		Miscellaneous				
16		Erosion Mat	SY	$1.50	6608	$9,912
		Miscellaneous Subtotal				**$9,912**

Subtotal	**$2,985,142**
Contingency (20%)	$597,028
Final Engineering*	$298,514
Total	**$3,880,684**

* Final engineering estimates include soil borings, initial topographic survey, permitting
** Assumes 23" total porous unit paver system depth (5" paver, 18" open graded stone)
*** A storm sewer/underdrain system is required if either bioretention or a porous unit paver system or both is employed
**** Porous asphalt increases pavement cost by 4%, porous concrete increases pavement cost by 74%

Note
1. Costs shown for hauling and disposal of material (common and contaminated) are estimates. These units costs could vary greatly depending up many factors.
2. Green roof materials are not included in this cost estimate

Milwaukee 30th Street Corridor
Preliminary Cost Estimate
DRS Corporation (Private Site)
June 2010

AB

Item #	WI DOT Spec #	Description	Units	Unit Cost	Quantity	Cost
		Demolition				
1	204.0100	Pavement Surface Removal (6")	SY	$3.00	37238	$111,714
2	205.0100	Excavation - Common (17" Pavers, 30" Bioretention)**	CY	$4.00	18332	$73,327
3	204.0210	Removing Manholes	EA	$450.00	7	$3,150
4	617.0100	Hauling & Disposal of Common Material	CY	$22.00	24538	$539,840
		Demolition Subtotal				**$728,031**
		Storm Sewer/Underdrain* **				
5	612.0106	Pipe Underdrain - Perforated HDPE (6")	LF	$12.00	3485	$41,820
6		Storm Sewer Pipe - Solid HDPE (12")	LF	$11.00	1385	$15,235
7		Perforated Pipe Clean Out	EA	$475.00	20	$9,500
8		Storm Sewer Manhole (48" dia.)	EA	$2,050.00	23	$47,150
		Storm Sewer Subtotal				**$113,705**
		Bioretention Material				
9		Engineered Soil (12" for Bioretention)	CY	$57.00	1242	$70,817
10		Open Graded Stone (18" for Bioretention)	CY	$25.00	1864	$46,590
11		Geotextile	SY	$2.10	3914	$8,219
12		Plugs - Bioretention (12" Centers)	SY	$54.00	3727	$201,270
13		Seeding - Bioretention	SY	$0.55	3727	$2,050
		Bioretention Material Subtotal				**$328,946**
		Porous Unit Pavers				
14		Concrete Curb & Gutter, B6.12	LF	$16.00	11085	$177,360
15		Porous unit paving, pavers & no. 8 setting bed, machine install	SY	$45.50	32243	$1,467,051
16		Open Graded Stone (18" for porous unit pavers)	CY	$25.00	16121	$403,036
17		Geotextile	SY	$2.10	33855	$71,096
		Porous Unit Pavers Subtotal****				**$2,118,543**
		Planting Material				
18		Seeding - Grass	SY	$1.50	2895	$4,343
19		Shrubs	EA	$50.00	190	$9,500
20		Trees (2" Cal.)	EA	$450.00	95	$42,750
		Planting Material Subtotal				**$56,593**
		Miscellaneous				
21		Erosion Mat	SY	$1.50	2895	$4,343
		Miscellaneous Subtotal				**$4,343**

Subtotal	**$3,350,160**
Contingency (20%)	$670,032
Final Engineering*	$335,016
Total	**$4,355,208**

* Final engineering estimates include soil borings, initial topographic survey, permitting
** Assumes 23" total porous unit paver system depth (5" paver, 18" open graded stone)
*** A storm sewer/underdrain system is required if either bioretention or a porous unit paver system or both is employed
**** Porous asphalt increases pavement cost by 4%, porous concrete increases pavement cost by 74%

Note
1. Costs shown for hauling and disposal of material (common and contaminated) are estimates. These units costs could vary greatly depending up many factors.
2. Green roof materials are not included in this cost estimate

Milwaukee 30th Street Corridor
Preliminary Cost Estimate
Eaton Corporation (Private Site)
Bioretention & Standard Pavement
June 2010

AB

Item #	WI DOT Spec #	Description	Units	Unit Cost	Quantity	Cost
		Demolition				
1	204.0100	Pavement Surface Removal (6")	SY	$3.00	17515	$52,544
2	205.0100	Excavation - Common (6" Pavement, 30" Bioretention)**	CY	$4.00	1307	$5,227
3	204.0210	Removing Manholes	EA	$450.00	3	$1,350
4	617.0100	Hauling & Disposal of Common Material	CY	$22.00	4226	$92,967
		Demolition Subtotal				**$152,087**
		Storm Sewer/Underdrain* **				
5	612.0106	Pipe Underdrain - Perforated HDPE (6")	LF	$12.00	1420	$17,040
6		Storm Sewer Pipe - Solid HDPE (12")	LF	$11.00	640	$7,040
7		Perforated Pipe Clean Out	EA	$475.00	9	$4,275
8		Storm Sewer Manhole (48" dia.)	EA	$2,050.00	16	$32,800
		Storm Sewer Subtotal				**$61,155**
		Bioretention Material				
9		Engineered Soil (12" for Bioretention)	CY	$57.00	523	$29,792
10		Open Graded Stone (18" for Bioretention)	CY	$25.00	784	$19,600
11		Plugs - Bioretention (12" Centers)	SY	$54.00	1568	$84,672
12		Seeding - Bioretention	SY	$0.55	1568	$862
13		Geotextile	SY	$2.10	1646	$3,457
		Bioretention Material Subtotal				**$138,384**
		Asphalt Pavement				
14		Concrete Curb & Gutter, B6.12	LF	$16.00	6720	$107,520
15		Asphalt Pavement (2" Wearing, 2" Binder)	SY	$15.50	13124	$203,427
16		Stone Base (8")	SY	$25.00	13124	$328,108
		Asphalt Pavement Subtotal				**$639,056**
		Planting Material				
17		Seeding - Grass	SY	$1.50	3489	$5,234
18		Shrubs	EA	$50.00	134	$6,700
19		Trees (2" Cal.)	EA	$450.00	67	$30,150
		Planting Material Subtotal				**$42,084**
		Miscellaneous				
20		Concrete Base (8")	SY	$35.00	170	$5,950
21		Concrete Pavement (6")	SY	$33.00	170	$5,610
22		Erosion Mat	SY	$1.50	3489.222	$5,234
23	616.0208	Fence Chain Link (8')	LF	$50.00	1735	$86,750
		Miscellaneous Subtotal				**$103,544**

Subtotal	**$1,136,309**
Contingency (20%)	$227,262
Final Engineering*	$113,631
Total	**$1,477,202**

* Final engineering estimates include soil borings, initial topographic survey, permitting
** Assumes 12" total Asphalt Pavement depth (2" wearing course, 2" binder crouse, 8" stone base)
*** A storm sewer/underdrain system is required if either bioretention or a porous unit paver system or both is employed

Note
1. Costs shown for hauling and disposal of material (common and contaminated) are estimates. These units costs could vary greatly depending up many factors.
2. Green roof materials are not included in this cost estimate

Milwaukee 30th Street Corridor
Preliminary Cost Estimate
Eaton Corporation (Private Site)
Bioretention Retrofits
June 2010

AB

Item #	WI DOT Spec #	Description	Units	Unit Cost	Quantity	Cost
		Demolition				
1	204.0100	Pavement Surface Removal (6")	SY	$3.00	1974	$5,922
2	205.0100	Excavation - Common (30" Bioretention)**	CY	$4.00	1307	$5,227
3		Saw Cutting	LF	$2.00	2436	$4,872
4	617.0100	Hauling & Disposal of Common Material	CY	$22.00	1636	$35,985
		Demolition Subtotal				**$52,005**
		Storm Sewer/Underdrain**				
5	612.0106	Pipe Underdrain - Perforated HDPE (6")	LF	$12.00	1420	$17,040
6		Storm Sewer Pipe - Solid HDPE (12")	LF	$11.00	640	$7,040
7		Perforated Pipe Clean Out	EA	$475.00	9	$4,275
8		Storm Sewer Manhole (48" dia.)	EA	$2,050.00	16	$32,800
		Storm Sewer Subtotal				**$61,155**
		Bioretention Material				
		Concrete Curb & Gutter, B6.12	LF	$16.00	2436	$38,976
9		Engineered Soil (12" for Bioretention)	CY	$57.00	523	$29,792
10		Open Graded Stone (18" for Bioretention)	CY	$25.00	784	$19,600
11		Plugs - Bioretention (12" Centers)	SY	$54.00	1568	$84,672
12		Seeding - Bioretention	SY	$0.55	1568	$862
13		Geotextile	SY	$2.10	1646	$3,457
		Bioretention Material Subtotal				**$177,360**

Subtotal	**$290,520**
Contingency (20%)	$58,104
Final Engineering*	$29,052
Total	**$377,676**

* Final engineering estimates include soil borings, initial topographic survey, permitting
*** A storm sewer/underdrain system is required if either bioretention or a porous unit paver system or both is employed

Note
1. Costs shown for hauling and disposal of material (common and contaminated) are estimates. These units costs could vary greatly depending up many factors.
2. Green roof materials are not included in this cost estimate

Milwaukee 30th Street Corridor
Preliminary Cost Estimate
Eaton Corporation (Private Site)
Porous Unit Pavers & No Bioretention
June 2010

AB

Item #	WI DOT Spec #	Description	Units	Unit Cost	Quantity	Cost
		Demolition				
1	204.0100	Pavement Surface Removal (6")	SY	$3.00	17515	$52,544
2	205.0100	Excavation - Common (17")**	CY	$4.00	6198	$24,790
3	204.0210	Removing Manholes	EA	$450.00	3	$1,350
4	617.0100	Hauling & Disposal of Common Material	CY	$22.00	9117	$200,567
		Demolition Subtotal				**$279,251**
		Storm Sewer/Underdrain* **				
5	612.0106	Pipe Underdrain - Perforated HDPE (6")	LF	$12.00	1420	$17,040
6		Storm Sewer Pipe - Solid HDPE (12")	LF	$11.00	640	$7,040
7		Perforated Pipe Clean Out	EA	$475.00	9	$4,275
8		Storm Sewer Manhole (48" dia.)	EA	$2,050.00	16	$32,800
		Storm Sewer Subtotal				**$61,155**
		Porous Unit Pavers				
9		Concrete Curb & Gutter, B6.12	LF	$16.00	6720	$107,520
10		Open Graded Stone (18" for porous unit pavers)	CY	$25.00	6562	$164,054
11		Porous unit paving, pavers & no. 8 setting bed, machine install	SY	$45.50	13124	$597,157
12		Geotextile	SY	$2.10	13781	$28,939
		Porous Unit Pavers Subtotal****				**$897,670**
		Planting Material				
13		Seeding - Grass	SY	$1.50	5057	$7,586
14		Shrubs	EA	$50.00	416	$20,812
15		Trees (2" Cal.)	EA	$450.00	67	$30,150
		Planting Material Subtotal				**$58,548**
		Miscellaneous				
16		Concrete Base (6")	SY	$28.00	170	$4,760
17		Concrete Pavement (6")	SY	$33.00	170	$5,610
18		Erosion Mat	SY	$1.50	5057.222	$7,586
19	616.0208	Fence Chain Link (8')	LF	$50.00	1735	$86,750
		Miscellaneous Subtotal				**$104,706**

Subtotal	**$1,401,331**
Contingency (20%)	$280,266
Final Engineering*	$140,133
Total	**$1,821,730**

* Final engineering estimates include soil borings, initial topographic survey, permitting
** Assumes 23" total porous unit paver system depth (5" paver, 18" open graded stone)
*** A storm sewer/underdrain system is required if either bioretention or a porous unit paver system or both is employed
**** Porous asphalt increases pavement cost by 4%, porous concrete increases pavement cost by 71%

Note
1. Costs shown for hauling and disposal of material (common and contaminated) are estimates. These units costs could vary greatly depending up many factors.
2. Green roof materials are not included in this cost estimate

Milwaukee 30th Street Corridor
Preliminary Cost Estimate
Eaton Corporation (Private Site)
June 2010

AB

Item #	WI DOT Spec #	Description	Units	Unit Cost	Quantity	Cost
		Demolition				
1	204.0100	Pavement Surface Removal (6")	SY	$3.00	17515	$52,544
2	205.0100	Excavation - Common (17")**	CY	$4.00	7504	$30,017
3	204.0210	Removing Manholes	EA	$450.00	3	$1,350
4	617.0100	Hauling & Disposal of Common Material	CY	$22.00	10423	$229,314
		Demolition Subtotal				**$313,225**
		Storm Sewer/Underdrain* **				
5	612.0106	Pipe Underdrain - Perforated HDPE (6")	LF	$12.00	1420	$17,040
6		Storm Sewer Pipe - Solid HDPE (12")	LF	$11.00	640	$7,040
7		Perforated Pipe Clean Out	EA	$475.00	9	$4,275
8		Storm Sewer Manhole (48" dia.)	EA	$2,050.00	16	$32,800
		Storm Sewer Subtotal				**$61,155**
		Bioretention Material				
9		Engineered Soil (12" for Bioretention)	CY	$57.00	523	$29,792
10		Open Graded Stone (18" for Bioretention)	CY	$25.00	784	$19,600
11		Plugs - Bioretention (12" Centers)	SY	$54.00	1568	$84,672
12		Seeding - Bioretention	SY	$0.55	1568	$862
13		Geotextile	SY	$2.10	1646	$3,457
		Bioretention Material Subtotal				**$138,384**
		Porous Unit Pavers				
14		Concrete Curb & Gutter, B6.12	LF	$16.00	6720	$107,520
15		Open Graded Stone (18" for porous unit pavers)	CY	$25.00	6562	$164,054
16		Porous unit paving, pavers & no. 8 setting bed, machine install	SY	$45.50	13124	$597,157
17		Geotextile	SY	$2.10	13781	$28,939
		Porous Unit Pavers Subtotal****				**$897,670**
		Planting Material				
18		Seeding - Grass	SY	$1.50	3489	$5,234
19		Shrubs	EA	$50.00	134	$6,700
20		Trees (2" Cal.)	EA	$450.00	67	$30,150
		Planting Material Subtotal				**$42,084**
		Miscellaneous				
21		Concrete Base (8")	SY	$35.00	170	$5,950
22		Concrete Pavement (6")	SY	$33.00	170	$5,610
23		Erosion Mat	SY	$1.50	3489.222	$5,234
24	616.0208	Fence Chain Link (8')	LF	$50.00	1735	$86,750
		Miscellaneous Subtotal				**$103,544**
					Subtotal	**$1,556,062**
					Contingency (20%)	$311,212
					Final Engineering*	$155,606
					Total	**$2,022,880**

* Final engineering estimates include soil borings, initial topographic survey, permitting
** Assumes 23" total porous unit paver system depth (5" paver, 18" open graded stone)
*** A storm sewer/underdrain system is required if either bioretention or a porous unit paver system or both is employed
**** Porous asphalt increases pavement cost by 4%, porous concrete increases pavement cost by 71%

Note
1. Costs shown for hauling and disposal of material (common and contaminated) are estimates. These units costs could vary greatly depending up many factors.
2. Green roof materials are not included in this cost estimate

Milwaukee 30th Street Corridor
Preliminary Cost Estimate
Vapor Blast (Private Site)
Native Landscaping Only
June 2010

AB

Item #	WI DOT Spec #	Description	Units	Unit Cost	Quantity	Cost
		Demolition				
1		Brush Clearing	AC	$385.00	2.1	$809
2		Cut/Chip light trees, remove stumps	AC	$5,350.00	1.1	$5,885
		Demolition Subtotal				**$6,694**
		Planting Material				
3		Seeding - Native Landscaping	SY	$0.55	15543	$8,549
		Planting Material Subtotal				**$8,549**
					Subtotal	**$15,242**
					Contingency (20%)	$3,048
					Final Engineering	$3,048
					Total	**$21,339**

Milwaukee 30th Street Corridor
Preliminary Cost Estimate
Vapor Blast (Private Site)
Bioretention & Standard Pavement
June 2010

AB

Item #	WI DOT Spec #	Description	Units	Unit Cost	Quantity	Cost
		Demolition				
1		Gravel Surface Removal (6")***	SY	$2.00	6113	$12,226
2	205.0100	Excavation - Common (4" Additional Pavement, 30" Bioretention)**	CY	$4.00	1484	$5,936
3	204.0210	Removing Manholes	EA	$450.00	3	$1,350
4	617.0100	Hauling & Disposal of Common Material	CY	$22.00	2503	$55,061
		Demolition Subtotal				**$74,572**
		Storm Sewer/Underdrain**				
5	612.0106	Pipe Underdrain - Perforated HDPE (6")	LF	$12.00	1055	$12,660
6		Storm Sewer Pipe - Soild HDPE (12")	LF	$11.00	495	$5,445
7		Perforated Pipe Clean Out	EA	$475.00	6	$2,850
8		Storm Sewer Manhole (48" dia.)	EA	$2,050.00	11	$22,550
		Storm Sewer Subtotal				**$43,505**
		Bioretention Materials				
9		Engineered Soil (12" for Bioretention)	CY	$57.00	434	$24,734
10		Open Graded Stone (18" for Bioretention)	CY	$25.00	651	$16,272
11		Geotextile	SY	$2.10	1367	$2,870
12		Plugs - Bioretention (12" Centers)	SY	$54.00	1302	$70,296
13		Seeding - Bioretention	SY	$0.55	1302	$716
		Bioretention Materials Subtotal				**$114,888**
		Asphalt Pavement				
14		Concrete Curb & Gutter, B6.12	LF	$16.00	1605	$25,680
15		Asphalt Pavement (2" Wearing, 2" Binder)	SY	$15.50	3592	$55,678
16		Stone Base (6")	SY	$21.00	3592	$75,434
		Asphalt Pavement Subtotal				**$156,792**
		Planting Material				
17		Seeding - Native Landscaping	SY	$0.55	15543	$8,549
18		Seeding - Grass	SY	$1.50	3012	$4,518
19		Shrubs	EA	$50.00	76	$3,800
20		Trees (2" Cal.)	EA	$450.00	38	$17,100
		Planting Material Subtotal				**$33,967**
		Miscellaneous				
21		Sidewalk (5' Width)	LF	$25.50	500	$12,750
22	616.0208	Fence Chain Link (8')	LF	$50.00	610	$30,500
		Miscellaneous Subtotal				**$43,250**
					Subtotal	**$466,975**
					Contingency (20%)	$93,395
					Final Engineering*	$46,697
					Total	**$607,067**

* Final engineering estimates include soil borings, initial topographic survey, permitting
** Assumes 10" total pavement depth (2" wearing crouse, 2" binder course, 6" base course)
*** Assumes removal of top 6" of gravel pavement area
**** A storm sewer/underdrain system is required if either bioretention or a porous unit paver system or both is employed

Note
1. Costs shown for hauling and disposal of material (common and contaminated) are estimates. These units costs could vary greatly depending up many factors.
2. Green roof materials are not included in this cost estimate

Milwaukee 30th Street Corridor
Preliminary Cost Estimate
Vapor Blast (Private Site)
June 2010

AB

Item #	WI DOT Spec #	Description	Units	Unit Cost	Quantity	Cost
		Demolition				
1		Gravel Surface Removal (6")***	SY	$2.00	6113	$12,226
2	205.0100	Excavation - Common (17")**	CY	$4.00	2311	$9,244
3	204.0210	Removing Manholes	EA	$450.00	3	$1,350
4	617.0100	Hauling & Disposal of Common Material	CY	$22.00	3330	$73,256
		Demolition Subtotal				**$96,076**
		Storm Sewer/Underdrain****				
5	612.0106	Pipe Underdrain - Perforated HDPE (6")	LF	$12.00	1055	$12,660
6		Storm Sewer Pipe - Soild HDPE (12")	LF	$11.00	495	$5,445
7		Perforated Pipe Clean Out	EA	$475.00	6	$2,850
8		Storm Sewer Manhole (48" dia.)	EA	$2,050.00	11	$22,550
		Storm Sewer Subtotal				**$43,505**
		Bioretention Materials				
9		Engineered Soil (12" for Bioretention)	CY	$57.00	434	$24,734
10		Open Graded Stone (18" for Bioretention)	CY	$25.00	651	$16,272
11		Geotextile	SY	$2.10	1367	$2,870
12		Plugs - Bioretention (12" Centers)	SY	$54.00	1302	$70,296
13		Seeding - Bioretention	SY	$0.55	1302	$716
		Bioretention Materials Subtotal				**$114,888**
		Porous Unit Pavers				
14		Concrete Curb & Gutter, B6.12	LF	$16.00	1605	$25,680
15		Porous unit paving, pavers & no. 8 setting bed, machine install	SY	$45.50	3592	$163,441
16		Open Graded Stone (18" for porous unit pavers)	CY	$25.00	1796	$44,901
17		Geotextile	SY	$2.10	3772	$7,921
		Porous Unit Pavers Subtotal				**$241,943**
		Planting Material				
18		Seeding - Native Landscaping	SY	$0.55	15543	$8,549
19		Seeding - Grass	SY	$1.50	3012	$4,518
20		Shrubs	EA	$50.00	76	$3,800
21		Trees (2" Cal.)	EA	$450.00	38	$17,100
		Planting Material Subtotal				**$33,967**
		Miscellaneous				
22		Sidewalk (5' Width)	LF	$25.50	500	$12,750
23	616.0208	Fence Chain Link (8')	LF	$50.00	610	$30,500
		Miscellaneous Subtotal				**$43,250**
					Subtotal	**$573,629**
					Contingency (20%)	$114,726
					Final Engineering*	$57,363
					Total	**$745,718**

* Final engineering estimates include soil borings, initial topographic survey, permitting
** Assumes 23" total porous unit paver system depth (5" paver, 18" open graded stone)
*** Assumes removal of top 6" of gravel pavement area
**** A storm sewer/underdrain system is required if either bioretention or a porous unit paver system or both is employed

Note
1. Costs shown for hauling and disposal of material (common and contaminated) are estimates. These units costs could vary greatly depending up many factors.
2. Green roof materials are not included in this cost estimate

Milwaukee 30th Street Corridor
Preliminary Cost Estimate
Vapor Blast (Private Site)
Permeable Pavers & Native Landscaping
June 2010

AB

Item #	WI DOT Spec #	Description	Units	Unit Cost	Quantity	Cost
		Demolition				
1		Gravel Surface Removal (6")***	SY	$2.00	6113	$12,226
2	205.0100	Excavation - Common (17")**	CY	$4.00	1696	$6,785
3	204.0210	Removing Manholes	EA	$450.00	3	$1,350
4	617.0100	Hauling & Disposal of Common Material	CY	$22.00	2715	$59,732
		Demolition Subtotal				**$80,093**
		Storm Sewer/Underdrain**				
5	612.0106	Pipe Underdrain - Perforated HDPE (6")	LF	$12.00	525	$6,300
6		Storm Sewer Pipe - Soild HDPE (12")	LF	$11.00	250	$2,750
7		Perforated Pipe Clean Out	EA	$475.00	3	$1,425
8		Storm Sewer Manhole (48" dia.)	EA	$2,050.00	5	$10,250
		Storm Sewer Subtotal				**$20,725**
		Porous Unit Pavers				
9		Concrete Curb & Gutter, B6.12	LF	$16.00	1605	$25,680
10		Porous unit paving, pavers & no. 8 setting bed, machine install	SY	$45.50	3592	$163,441
11		Open Graded Stone (18" for porous unit pavers)	CY	$25.00	1796	$44,901
12		Geotextile	SY	$2.10	3772	$7,921
		Porous Unit Pavers Subtotal				**$241,943**
		Planting Material				
13		Seeding - Native Landscaping	SY	$0.55	15543	$8,549
14		Seeding - Grass	SY	$1.50	1302	$1,953
15		Shrubs	EA	$50.00	76	$3,800
16		Trees (2" Cal.)	EA	$450.00	38	$17,100
		Planting Material Subtotal				**$31,401**
		Miscellaneous				
17		Sidewalk (5' Width)	LF	$25.50	500	$12,750
18	616.0208	Fence Chain Link (8')	LF	$50.00	610	$30,500
		Miscellaneous Subtotal				**$43,250**

Subtotal	**$417,412**
Contingency (20%)	$83,482
Final Engineering*	$41,741
Total	**$542,636**

* Final engineering estimates include soil borings, initial topographic survey, permitting
** Assumes 23" total porous unit paver system depth (5" paver, 18" open graded stone)
*** Assumes removal of top 6" of gravel pavement area
**** A storm sewer/underdrain system is required if either bioretention or a porous unit paver system or both is employed

Note
1. Costs shown for hauling and disposal of material (common and contaminated) are estimates. These units costs could vary greatly depending up many factors.
2. Green roof materials are not included in this cost estimate

Milwaukee 30th Street Corridor
Preliminary Cost Estimate
Residential Right-Of-Way (Private Site)
June 2010

AB

Item #	WI DOT Spec #	Description	Units	Unit Cost	Quantity	Cost
		Demolition				
1	204.0100	Pavement Surface Removal (6")	SY	$3.00	2353	$7,058
2	205.0100	Excavation - Common (17")**	CY	$4.00	1111	$4,444
3	204.0210	Removing Manholes	EA	$450.00	3	$1,350
4	617.0100	Hauling & Disposal of Common Material	CY	$22.00	1503	$33,066
		Demolition Subtotal				**$45,918**
		Storm Sewer/Underdrain* **				
5	612.0106	Pipe Underdrain - Perforated HDPE (6")	LF	$12.00	1421	$17,052
6		Perforated Pipe Clean Out	EA	$475.00	8	$3,800
7		Storm Sewer Manhole (48" dia.)	EA	$2,050.00	3	$6,150
		Storm Sewer Subtotal				**$27,002**
		Bioretention Material				
8		Engineered Soil (12" for Bioretention)	CY	$57.00	49	$2,770
9		Open Graded Stone (18" for Bioretention)	CY	$25.00	73	$1,822
10		Plugs - Bioretention (12" Centers)	SY	$54.00	146	$7,872
11		Seeding - Bioretention	SY	$0.55	146	$80
12		Geotextile	SY	$2.10	153	$321
		Bioretention Material Subtotal				**$12,866**
		Porous Unit Pavers				
13		Concrete Curb & Gutter, B6.12	LF	$16.00	1405	$22,480
14		Open Graded Stone (18" for porous unit pavers)	CY	$25.00	1063	$26,579
15		Porous unit paving, pavers & no. 8 setting bed, machine install	SY	$45.50	2126	$96,748
16		Geotextile	SY	$2.10	2233	$4,689
		Porous Unit Pavers Subtotal****				**$150,496**
		Miscellaneous				
17		Erosion Mat	SY	$1.50	312	$468
		Miscellaneous Subtotal				**$468**
					Subtotal	**$236,750**
					Contingency (20%)	$47,350
					Final Engineering*	$23,675
					Total	**$307,775**

* Final engineering estimates include soil borings, initial topographic survey, permitting
** Assumes 23" total porous unit paver system depth (5" paver, 18" open graded stone)
*** A storm sewer/underdrain system is required if either bioretention or a porous unit paver system or both is employed
**** Porous asphalt increases pavement cost by 3%, porous concrete increases pavement cost by 64%

Note
1. Costs shown for hauling and disposal of material (common and contaminated) are estimates. These units costs could vary greatly depending up many factors.

Milwaukee 30th Street Corridor
Preliminary Cost Estimate
Alley Right-Of-Way (Private Site)
June 2010

AB

Item #	WI DOT Spec #	Description	Units	Unit Cost	Quantity	Cost
		Demolition				
1	204.0100	Pavement Surface Removal (6")	SY	$3.00	1559	$4,677
2	205.0100	Excavation - Common (17")**	CY	$4.00	736	$2,945
3	204.0210	Removing Manholes	EA	$450.00	4	$1,800
4	617.0100	Hauling & Disposal of Common Material	CY	$22.00	996	$21,914
		Demolition Subtotal				**$31,336**
		Storm Sewer/Underdrain* **				
5	612.0106	Pipe Underdrain - Perforated HDPE (6")	LF	$12.00	1421	$17,052
6		Perforated Pipe Clean Out	EA	$475.00	2	$950
7		Storm Sewer Manhole (48" dia.)	EA	$2,050.00	2	$4,100
		Storm Sewer Subtotal				**$22,102**
		Porous Unit Pavers				
8		Concrete Containment Curb & Gutter	LF	$16.00	1537	$24,592
9		Open Graded Stone (18" for porous unit pavers)	CY	$25.00	736	$18,406
10		Porous unit paving, pavers & no. 8 setting bed, machine install	SY	$45.50	1472	$66,996
11		Geotextile	SY	$2.10	1546	$3,247
		Porous Unit Pavers Subtotal****				**$113,241**
		Miscellaneous				
12		Erosion Mat	SY	$1.50	342	$512
		Miscellaneous Subtotal				**$512**

Subtotal	**$167,191**
Contingency (20%)	$33,438
Final Engineering*	$16,719
Total	**$217,349**

* Final engineering estimates include soil borings, initial topographic survey, permitting
** Assumes 23" total porous unit paver system depth (5" paver, 18" open graded stone)
*** A storm sewer/underdrain system is required if either bioretention or a porous unit paver system or both is employed
**** Porous asphalt increases pavement cost by 3%, porous concrete increases pavement cost by 60%

Note
1. Costs shown for hauling and disposal of material (common and contaminated) are estimates. These units costs could vary greatly depending up many factors.

Milwaukee 30th Street Corridor
Preliminary Cost Estimate
Nonresidential Right-Of-Way (Private Site)
June 2010

AB

Item #	WI DOT Spec #	Description	Units	Unit Cost	Quantity	Cost
		Demolition				
1	205.0100	Excavation - Common (36")	CY	$4.00	675	$2,700
2	617.0100	Hauling & Disposal of Common Material	CY	$22.00	675	$14,850
		Demolition Subtotal				**$17,550**
		Storm Sewer/Underdrain				
3	612.0106	Pipe Underdrain - Perforated HDPE (6")	LF	$12.00	837	$10,044
4		Perforated Pipe Clean Out	EA	$475.00	16	$7,600
5		Storm Sewer Pipe - Soild HDPE (12")	LF	$11.00	320	$3,520
		Storm Sewer Subtotal				**$21,164**
		Bioretention Materials				
6		Containment Curb	LF	$16.00	1078	$17,248
7		Engineered Soil (12" for Bioretention)	CY	$57.00	225	$12,825
8		Open Graded Stone (18" for Bioretention)	CY	$25.00	338	$8,438
9		Geotextile	SY	$2.10	709	$1,488
10		Plugs - Bioretention (12" Centers)	SY	$54.00	675	$36,450
11		Seeding - Bioretention	SY	$0.55		**$76,449**
		Bioretention Materials Subtotal				

Subtotal	**$115,163**
Contingency (20%)	$23,033
Final Engineering*	$11,516
Total	**$149,712**

* Final engineering estimates include soil borings, initial topographic survey, permitting

Note
1. Costs shown for hauling and disposal of material (common and contaminated) are estimates. These units costs could vary greatly depending up many factors.