A Business Model Framework for Market-Based Private Financing of Green Infrastructure

Funded by the Great Lakes Protection Fund

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Prepared by:

ECT Environmental Consulting & Technology, Inc.

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1.0 EXECUTIVE SUMMARY

The scope of this project was to identify the barriers to private investment in green infrastructure and to recommend how best to eliminate those barriers. The Project Team was directed to assess financial options available to public and private entities, explore potential demonstration pilot projects, identify likely business models that would facilitate private investment, and receive input from the community of practitioners and experts that may facilitate public-private partnerships (P-3) for green infrastructure funding.

This project focused on identifying obstacles, developing business model frameworks to encourage private investment, and identifying pilot-scale projects that could demonstrate the effective use of private investment to deliver green infrastructure.

Green infrastructure is an approach to water management that protects the natural drainage patterns while restoring the hydrologic cycle. By improving stormwater management and flood mitigation, it has shown to be effective in enhancing community safety and quality of life. Utilizing both natural and engineered systems, a comprehensive green infrastructure program can cleanse stormwater, conserve ecosystem functions, and provide a wide array of benefits to people and wildlife. Green infrastructure solutions can be implemented on differing scales ranging from site-level installations to broader, watershed-level efforts. On the local scale, green infrastructure practices include rain gardens, permeable pavements, green roofs, infiltration planters, trees and tree boxes, and rainwater harvesting systems. At the largest scale, the preservation and restoration of natural landscapes (such as forests, floodplains, and wetlands) provide additional benefits to the larger green infrastructure program.

To date, investments in green infrastructure have been driven by differing motivations. Communities invest in green infrastructure to limit the cost of managing peak stormwater flows and/or combined sewer overflow (CSO) control. Private property owners choose to invest in green infrastructure to limit their stormwater discharge fees and/or limiting the cost of water for irrigation. Foundations and/or non-governmental organizations (NGOs) invest in green infrastructure to improve the quality of life in an area.

Many of the drivers that should entice the private investment of constructing and maintaining green infrastructure are in place; and, yet, private capital has largely chosen to stay on the sidelines. In fact, a majority of large investments in green infrastructure seen to date are the result of funding from public utilities or grants from environmental agencies and private foundations. Even in Philadelphia, which has championed private investment in green infrastructure and leads the nation, very little private money has become available.

"Although Philadelphia's parcel-based fee system is a good first step toward drawing private investment to green infrastructure, many economic barriers remain." (*Valderrama et al., January 2013*).

Accordingly, the Great Lakes Protection Fund contracted with ECT and its team of subconsultants (which included Geosyntec Consultants, Galardi Rothstein Group, and Greenleaf Advisors) to evaluate market-based approaches to green infrastructure – that is, to assess methods available to encourage private investors to finance green infrastructure. This project focused on identifying obstacles, developing business model frameworks to encourage private investment, and identifying pilot-scale projects that could demonstrate the effective use of private investment to deliver green infrastructure in areas where funding remains a challenge. Although highly desirable, given limited resources, full-scale implementation was considered outside of the scope of this project.

In general, municipalities pay for building and maintaining traditional stormwater infrastructure using a variety of methods. These can be divided into five groups:

1) No Stormwater Fees – The costs of stormwater management is funded through general funds, sewer rates, water rates, and/or other unrelated funding sources.
2) Stormwater Fees Not Tied to Discharge Quantity – These fees are typically charged to property owners with little or no association to areas, impervious surface, or best management practices (BMPs).
3) Stormwater Fees Tied to Discharge Quantity – A property owner can reduce their stormwater fees by reducing their runoff, either total volume, peak discharge, or both.
4) Stormwater Fees Tied to Discharge Quantity and Allows Offsite Mitigation – A property owner can reduce their stormwater fees by reducing runoff from their site, from an offsite location, or both.
5) Stormwater Fees Tied to Discharge Quantity and Allows/Encourages Private Investment – A property owner, or a group of owners, can reduce their long-term cost by allowing a private entity (either for-profit or non-profit) to design, build, operate, and maintain infrastructure for a fee.

Along with other deliverables, this project sought to leverage item 5) of the groups presented above.

Municipalities/utilities have practical, institutional, and political difficulties committing to multiyear payments for green infrastructure programs. The challenge of guaranteed repayment has also made it difficult for most communities to utilize Clean Water State Revolving Funds (SRFs) (*EPA, 2014*) to finance green infrastructure. Public utilities remain responsible for permit compliance and demand regulatory certainty. They need assurances of long-term performance of green infrastructure including specifics of the amount of water captured. At the same time, many utility managers believe that the financial underpinnings of their current stormwater fee schedule are insufficient to install the facilities necessary to comply with their Combined Sewer Overflow (CSO), Sanitary Sewer Overflow (SSO), or Municipal Separate Storm Sewer System (MS4) permit requirements. These managers are seeking innovative solutions to infuse additional capital.

Traditional venture capital and private equity companies desire to invest in scalable enterprises that have a substantial market for their products and services. They typically seek a clear exit plan for their investors and show little interest in project level investment. Instead, they seek to fund businesses that may specialize in green infrastructure. Noting that these businesses prefer large scale investments, a business model framework for aggregation of services is a key to private capital in green infrastructure.

In spite of successful municipally-financed green infrastructure projects across the country, certain questions persist, including:

1) Under what applications and circumstances is green infrastructure less expensive than gray infrastructure?
2) What are the real, long-term costs and benefits of successful green infrastructure projects?
3) How can private investors get a return on their investment that is commensurate with the risk they are taking?
4) How can public utilities be assured of regulatory compliance and long-term performance/maintenance of green infrastructure on private property?

Information has been collected documenting the maturation of green infrastructure programs from across the Great Lakes region and the nation. This information supports the belief that green infrastructure, when sited properly, has a lower overall cost than gray infrastructure. It further reinforces the understanding that green infrastructure – while less expensive initially – requires ongoing maintenance to achieve long-term success. Furthermore, the financial incentives for investing in green infrastructure vary with the entity responsible for managing the stormwater runoff and the geographic region in which the entity is located.

> *Between 2009 and 2013, global conservation impact investments from private investors totaled only $1.9 Billion but these investments are growing at an average annual rate of nearly 26%. In a 2014 report, NatureVest and EKO Asset Management Partners (EKO) indicated that challenges to future investments include a shortage of deals with appropriate risk/return profiles, not a lack of capital.*

Leading municipalities and entities that are implementing innovative programs, as well as investors contemplating private investments in green infrastructure, were interviewed for this research. Discussions continued at a Chicago workshop hosted by ECT on June 11, 2014. Two streams of private capital that were focused upon in this workshop, that included: 1) the venture capital and private equity companies that sought a clear exit plan for their investors showed no interest in providing project-level investment and instead sought to fund companies or businesses that specialize in green infrastructure products and services; and, 2) businesses that could be formed to design, build and maintain green infrastructure but only if those businesses could operate at sufficient scale in sizeable markets. Noting that small-scale projects were not desired by private investors, discussions were held on the role of "Aggregators" to pool smaller projects to a scale that made private investment more attractive, and a framework of an "Aggregator business model" was presented and analyzed. In all cases, private capital sources sought clarity on the size of risk/reward profile, as well as the ways of capturing the returns on their investments.

Estimates of private capital in green infrastructure are non-existent but estimates for conservation projects are available. *Investing in Conservation, A Landscape Assessment of an Emerging Market* (*NatureVest/EKO, 2014*) looked at sizing the global impact investment, i.e. investments intended to generate a return on the principal while also driving a positive impact on natural resources or ecosystems. They estimated that between 2009 and 2013, global conservation impact investments were $23.4 billion. However, out of this, only $1.9 billion came from private investors, and the rest were from development financial institutions such as the International Finance Corporation. That said, while the private investors invested only $1.9 billion, that funding has grown at an average rate of 26% per year. In fact, between 2014 and 2018, private investors expect to deploy $5.6 billion.

The NatureVest/EKO report further estimated that the typical Internal Rate of Return (IRR) across investment types, was in the range of 5-9.9% with private equity investments having the highest range of 10-14.9%. These returns are somewhat lower than reported elsewhere for broader impact investing market. Lastly, NatureVest/EKO report further indicated that the challenges to future investments include a shortage of deals with appropriate risk/return profiles, and not a lack of money. One way of overcoming this limitation identified by the report was capital stacking, i.e. combining private capital with more risk-tolerant funding such as government loans and concessionary capital from philanthropic sources. The caveat to private investment is that the principal repayment must be assured. This challenge remains a key constraint to the entry of private investment in green infrastructure.

> *A key constraint to private equity investment is that principal repayment must be assured.*

Key conclusions from this project are:

- Aggregation can reduce project costs by spreading the upfront administrative costs over a larger project base. A typical aggregator transaction could comprise of a range of storage solutions that are designed to utilize a collection of least cost solutions that provides measurable results with sufficient redundancy to assure continued permit compliance. A framework of a business model for an aggregator business is a key outcome of this project.

- The three main customers for aggregator businesses are: water makers such as property owners (through runoff from hardscape and rooftops) and owners of transportation corridors such as a department of transportation, etc.), water takers (such as wastewater utilities), and other users who may have use for water (for example, a power plant or a farmer).
- Key product that the aggregator is selling is to manage stormwater and turning it from a "dumb" retention to "smart" storage, which is distinguished by:
  - Volume (storage)
  - Location (reflecting the cost of water varies depending on the geographical location), and
  - Operational profile (representing the changes in natural hydrograph of stormwater movement)
- The four sources of private capital that could play a role in the green infrastructure sector include private equity and venture capital companies that invest in for-profit businesses, entities that invest private and philanthropic capital in conservation projects that deliver financial returns and clear environmental benefits, companies that already are in the infrastructure business and may have an interest in adding green infrastructure to their portfolio, and homeowners that may or may not have triple bottom-line-related interests.
- There are parallels between distributed electricity market and proposed market for water related green infrastructure services.
- The SRF loans, when available, are a source of low-cost financing; for private investment to be a key player in the market, the need for capital must exceed what's available through this federal program unless capital stacking becomes more common.
- If capital stacking were to become common, states/regions with the largest concentration of stormwater utilities will benefit most. The top three states with largest number of stormwater utilities are Florida, Minnesota, and Wisconsin (*Campbell, 2013*).
- The driver to spur private financing of green infrastructure must go beyond environmental vision and some regulatory drivers are needed.

> *The three main customers for aggregators are:*
>
> - *Water makers, such as property owners or owners of transportation corridors such as Department of Transportation;*
> - *Water takers, such as wastewater utilities; and*
> - *Other users who may have use for water, for example a power plant or a farmer.*

- The control systems to manage a distributed water storage program (both gray and green) exist and are proven. The administrative/legal systems to support project aggregation and/or financing remain the challenge.
- Technology will increase the effectiveness of green solutions
- In the Great Lakes basin, there is room for an early adopter study of engaging private equity companies that looks to map the "social impact" of such efforts that lead to creating a value chain and rate of return guarantees.

> *If capital stacking were to become common, states with the largest concentration of stormwater utilities will benefit most. As of 2013, top three states with largest number of stormwater utilities are Florida, Minnesota, and Wisconsin.*

In this report, an attempt to assess the value and costs of green infrastructure is discussed in Section 2.0. A summary of barriers and possible remedies to the use of green infrastructure is presented next in Section 3.0. An exploration of potential demonstration pilot projects across the Great Lakes is discussed in Section 4.0. This is followed by drawing a parallel with the energy sector in Section 5.0. Then a model framework for an aggregator business model is presented in Section 6.0. Section 7.0 and 8.0 showcases a Chicago workshop as well as follow-up discussions to test the business-model concepts. The report concludes with summary and conclusions in Chapter 9.0. Chapter 10.0 lists important documents and websites that were used in creating this report.

2.0 VALUE AND COSTS OF GREEN INFRASTRUCTURE

2.1 *Value of Green Infrastructure*

Early reports produced by national groups, including the U.S. Environmental Protection Agency's (EPA) *Reducing Stormwater Cost through Low Impact Development (LID) Strategies and Practices (EPA, 2007),* suggested that green infrastructure was less costly in nearly all situations. Subsequent works by municipalities and the EPA have concluded that the most resilient solution with the least cost is a combination of gray infrastructure augmented by green infrastructure (*Odefey, 2012*). Some notable work products on this topic include (see Chapter 10.0 for additional bibliography details):

- Banking on Green, 2012.
- Northeast Ohio Regional Sewer District Green Infrastructure Plan, 2012.
- The Value of Green Infrastructure, 2010.
- Milwaukee Metropolitan Sewer District Regional Green Infrastructure Plan, 2013.

Much of the economic analysis performed to-date to substantiate the investment in green infrastructure has relied on "triple bottom line benefits," which are three interrelated categories of benefits: economic, social, and environmental. This analysis has value when measuring the sustainability of a given project, but is largely irrelevant to a private investor seeking a return on their investment (including entities funding "social impact" efforts) and/or a public works official working within a very constrained budget (unless their constituents value and demand it).

2.1.1 The Value of Green Infrastructure to Private Property Owners Including Commercial Entities/Industries

In 2013, the Natural Resources Defense Council (NRDC) issued a report, *The Green Edge: How Commercial; Property Investment in Green Infrastructure Creates Value (Clements et al., 2013*), that addressed the broader benefits to commercial property owners. They concluded:

> *"In many cities, private property owners can receive a stormwater fee credit for installing green infrastructure. However, even in cities with relatively high stormwater fees and available credits, the value of the credit alone often will not provide a sufficient economic incentive to motivate investment in these environmentally beneficial practices." (Clements et al., 2013)*

> *A 2013 NRDC report (Clements et al., 2013) concluded that commercial property owners receive a much greater return on investment -- and have a much stronger business case for green infrastructure investments when incorporating certain other benefits – than when considering stormwater fee savings alone.*

In order to encourage further use of green infrastructure, the NRDC report attempted to identify and quantify the range of additional economic benefits that green infrastructure can bring to property owners. They concluded that commercial property owners receive a much greater return on investment -- and have a much stronger business case for green infrastructure investments -- than when considering stormwater fee savings alone. This is because the benefits of green infrastructure for private, commercial property owners included other items such as:

- Increased rents and property values
- Increased retail sales
- Energy savings
- Reduced infrastructure costs
- Reduced costs associated with flooding
- Reduced water bills

- Increased mental health and worker productivity for office employees
- Reduced crime

Lastly, many major industries and commercial entities have incorporated green infrastructure into their stormwater management specifications as a matter of corporate policy that seeks to showcase a better, greener citizen of a community. These decisions are value-based, and not solely financial in nature.

2.1.2 The Value of Green Infrastructure to Communities with Combined Collection Systems

Stormwater from a small storm that enters a combined collection system adds a cost to the operation of a wastewater treatment system. But large storms from rainfalls and snowmelts that result in CSOs have far bigger consequences, and while they may occur infrequently, reducing or eliminating the associated peak flows using gray solutions is extremely expensive. Noting that CSOs are a regulatory concern but costs for treatment are not, the value to the utility of reducing stormwater entering a collection system by green infrastructure is great.

> *Before considering private storage options, utilities need to know the cost of providing that storage, how that cost compares to traditional "gray infrastructure" approaches, and whether it results in promised reduction of CSOs.*

However while the value of this "out-of-system" storage is great, utilities seek assurances that a known capacity will be available for use during a CSO-causing event as a utility is responsible for compliance. Before considering private storage options, utilities also need to know the cost of providing that storage, how that cost compares to traditional gray infrastructure approaches, and whether it results in promised reduction of CSOs.

2.1.3 The Value of Green Infrastructure to a Separate Storm Sewer System Community

The responsibility to control the quality of stormwater is clearly placed on municipalities. Due to the implementation of MS4 permit program, the presence of a regulatory driver forces the larger MS4 communities to deal with the cost of improving the quantity/quality of the runoff they generate. These include communities like Ann Arbor, Michigan; Washington, DC; and Milwaukee, Wisconsin, which now have regulatory drivers requiring them to better manage their stormwater quantity and quality. These are the communities that have become innovators, and continue to look for creative ways of lowering costs while improving stormwater management. Given the budgetary constraints, each of these municipalities is looking to private investment as a means of leveraging their limited resources.

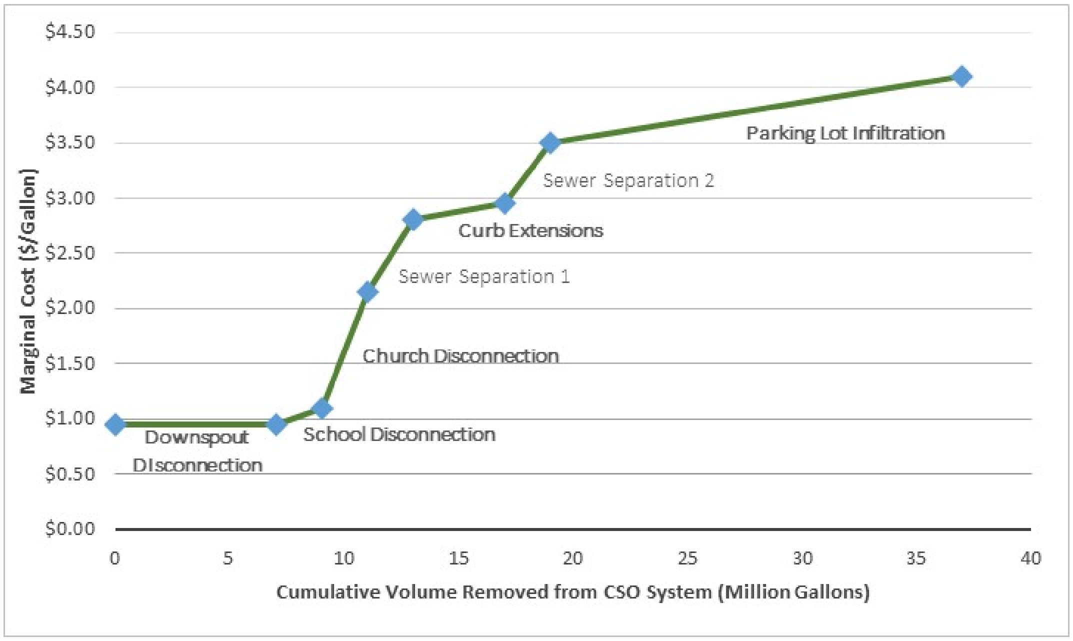
2.2 *Cost of Green Infrastructure*

The cost of green infrastructure is now known. For many years, utilities hesitated to commit to green infrastructure in part because the costs were largely unknown. Recently, the public works community has assembled summaries of realistic cost estimates for green infrastructure. *(Northeast Ohio Regional Sewer District, 2012)* These costs allow comparison using cost-per-gallon captured or cost-per-linear foot of road when comparing green and gray solutions. Thus, green infrastructure costs can be easily compared to costs associated with traditional gray solutions like partial separation of combined areas. Using this combined data set, a municipality can then integrate green and gray approaches to prioritize projects using the marginal cost per gallon removed as a metric.

> *"The City of Portland, Oregon integrated green and (gray) approaches to stormwater to demonstrate that downspout disconnections curb extensions that include vegetated swales, and parking lot infiltration were among the most cost-effective options for meeting CSO abatement goals. The costs for these approaches ranged from $0.89 to $4.08 per gallon removed." (Odefey, 2012) (See Figure 2-1)*

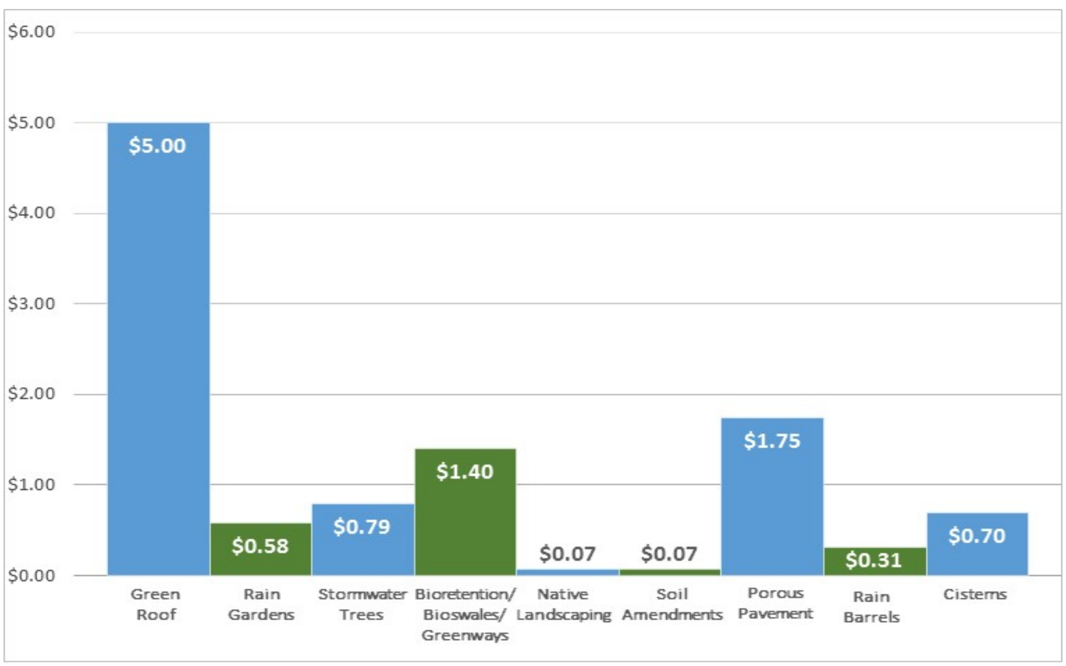
Thus the most cost-effective green solutions are combined with low-cost gray solutions (partial separation) to yield the optimal mix of green and gray infrastructure.

Figure 2-1: Costs and Cumulative Volume of Stormwater Removed from the CSO System through Various Gray and Green Strategies (Green in Bold). *(Odefey, 2012)*



Additional estimates of green infrastructure costs from Milwaukee Metropolitan Sewerage District's (MMSD) Regional Green Infrastructure Plan are presented in Table 2-1 and Figures 2-2 and 2-3.

Figure 2-2: Incremental Cost per Square Foot Managed *(Milwaukee Metropolitan Sewerage District, 2013)*



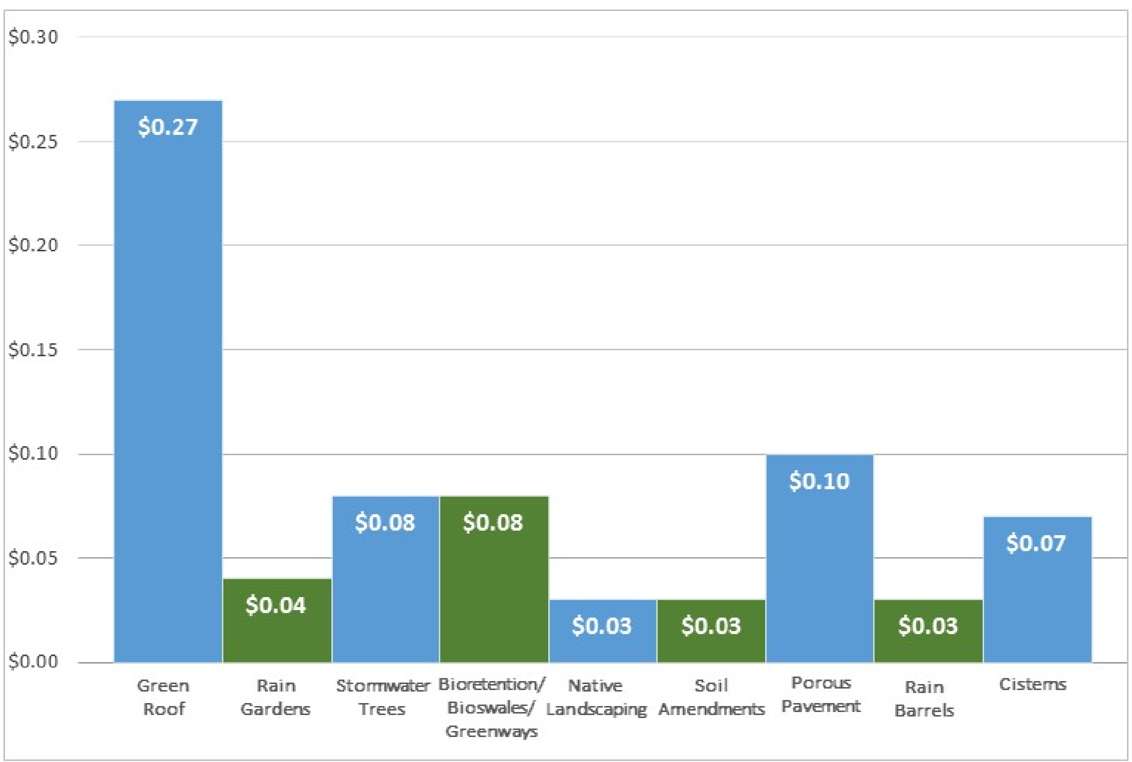
Note: The green infrastructure strategies supporting green alleys, streets, and parking lots are included in other strategies. The wetlands Green Infrastructure Strategy is encouraged but not quantified in the plan.

Table 2-1: Stand-alone Costs (per green infrastructure SF and per SF managed) and the Relationship to Incremental Costs (*Milwaukee Metropolitan Sewerage District, 2013)*

Green Infrastructure Strategy	Stand-alone Cost ($/SF)	Loading Ratio (Ratio of Area Managed to Area of GI)	Stand-alone Cost ($/SF Managed)	Incremental GI Cost Compared to Stand-alone Cost	Description of Cost Assumption
Green Roofs[1]	$11.50	1.0	$11.50	43%	Median PWD cost ($11.50/SF)
Rain Gardens	$10.00	12.0	$0.83	70%	Middle of FCGS range rounded up to $10/SF
Stormwater Trees[2]	$0.80	0.5	$1.58	50%	FCGS cost
Bioretention/Bioswale	$24.00	12.0	$2.00	70%	Average between PWD[3] and SUSTAIN[4] demonstration project
Native Landscaping/Soil Amendments	$0.11	1.0	$0.11	60%	Middle of FCGS[5] range, rounded up to nearest $1,000
Porous Pavement	$10.00	4.0	$2.50	70%	$10/SF, approximately 90 percent of median PWD costs
44-gallon Rain Barrels[6]	$120 (each)	N/A	$0.34	90%	Middle of FCGS range rounded up to nearest $10
1,000-gallon Cisterns[7]	$5,000 (each)	N/A	$0.78	90%	$5/gal., middle of FCGS range for 1,000-gal cistern

[1]Incremental cost of green roofs set to 43 percent to match MMSD's $5/SF ($217,800/acre) green roof incentive program.
[2]Trees are assumed to have an average 10-foot canopy radius (314 SF), with 50 percent assumed to be overhanging impervious area.
[3]PWD is Philadelphia Water Department.
[4]SUSTAIN is from (MMSD 2011) Determining the Potential of Green Infrastructure to Reduce Overflows in Milwaukee.
[5]FCGS is "Fresh Coast Green Solutions" (MMSD 2009).
[6]Each rain barrel is assumed to manage 350 SF of rooftop; therefore, 124.5 barrels are required for 1 acre of roof.
[7]Each 1,000-gallon cistern is assumed to manage 6,500 SF of impervious area; therefore, 6.7 cisterns are required for 1 acre.

Figure 2-3: Incremental Cost per Annual Gallon Captured *(Milwaukee Metropolitan Sewerage District, 2013)*



Note: The green infrastructure strategies supporting green alleys, streets, and parking lots are included in other strategies. The wetlands Green Infrastructure Strategy is encouraged by not quantified in the plan.

2.3 Conclusions

The increase in interest in the use of green infrastructure as a means of managing stormwater has been driven by the need for low-cost methods on reducing both the volume and pollutant load associated with peak wet weather flows. The public works professionals have begun to embrace the green alternatives as a matter of financial necessity. Most recognize the benefits of green infrastructure but retain the responsibility for permit compliance under increasing financial pressures. As a result, most would welcome an alternative that provides substantial private funding.

In recent years, much has been learned about the values and costs of green infrastructure. The key lessons learned include:

1) The costs associated with implementing a large scale green infrastructure program are now known.
2) The most resilient and least-cost solution to managing stormwater discharges is a combination of gray infrastructure augmented by green infrastructure.
3) Triple line benefits are not compelling to private investors unless they are homeowners interested in other tangible benefits.
4) Commercial property owners have sufficient "additional" benefits to justify their own investment in green infrastructure.
5) Utilities managing combined collection systems can easily document savings when implementing a large-scale green infrastructure program to reduce the peak stormwater entering their collection system (thereby reducing CSOs).
6) Progressive separated communities recognize that the ever increasing requirements of the MS4 program can best be accomplished with an integrated green infrastructure program.
7) Municipalities are now beginning to revisit their stormwater fee/rate programs to encourage private investment for programs deemed too costly for municipal financing alone.

3.0 BARRIERS AND POSSIBLE REMEDIES: FINANCING OPTIONS FOR GREEN INFRASTRUCTURE

3.1 Barriers

Private entities are interested in investing in green infrastructure but barriers remain. Until these barriers are addressed, it is unlikely that a major private green infrastructure investment be utilized. These barriers include:

- The lack of a reliable revenue stream over the life of a project. A key barrier to developing large-scale effective green infrastructure systems is the absence of a committed revenue stream to repay the need capital as well as fund the long term maintenance.

> *Because stormwater management has been undervalued (and often free), it is difficult to have property owners and/or public utilities commit resources to green infrastructure unless there is a regulatory driver to improve services.*

- The lack of projects with sufficient scale to attract private investors and provide a measurable reduction in flows. Investors are unwilling to absorb the significant administrative "overhead" of contracting with a municipality without significant scale.
- Venture capital and private equity companies typically invest in companies not in projects. Typically, private capital companies do not want to own and/or operate "projects", they invest in companies. Private investors also demand a clear exit strategy for their investment. There are exceptions to this as select private funds have been known to invest in a series of projects and/or a team, rather than a company, so long as a cash flow stream is in place.
- Fear of change and/or increased liability. Communities and private property owners are comfortable getting stormwater off their site as rapidly as possible. On-site flooding is of far more concern than water quality impairments downstream. The result is a reluctance to change. Even when grant funds were available to reduce/eliminate the capital costs, many municipalities chose not to proceed because they feared flooding or other unanticipated consequences.
- Inability to identify sufficient financial benefit to overcome the lack of regulatory drivers. Because stormwater management has been undervalued (and often free), it is difficult to have property owners and/or public utilities commit resources to green infrastructure unless there is a regulatory reason to improve service. Communities that are required to address CSO control, SSO control, and/or downstream flooding have many reasons to invest in low-cost solutions. Communities without these challenges do not.

These constraints, while formidable, are being addressed in major municipalities across the nation. They are presented below, after a summary of common methods to fund stormwater is provided.

3.2 Possible Sources of Private Financing of Green Infrastructure

There are four sources of private capital that could play a role in funding green infrastructure:

- Private equity companies seeking investment opportunities in green infrastructure, both in companies as well as in projects – e.g. Baltimore based *Ecosystem Investment Partners*.
- Entities that invest private and philanthropic capital in conservation projects that deliver financial returns and

clear environmental benefits – e.g. J.P. Morgan Chase funded and The Nature Conservancy (TNC) managed NatureVest.
- Companies that already are in the contract operations/infrastructure business and may have an interest in adding green infrastructure to their contract operations portfolio – e.g. Rhode Island-headquartered Corvias Group.
- Homeowners that are motivated for a number of reasons that may include triple bottom-line considerations.

The traditional private equity and venture capital companies:

- Typically, but not always, focus on investing in companies, not individual projects, and are not expected to *directly* play a role in green infrastructure projects. They have shown a willingness to finance public/private partnerships if an aggregator is included to identify projects, properties, and benefits that can subsequently be designed, constructed, operated, and maintained.
- Believe that a regulatory driver is required to assure long-term performance (and payment).

A variation on private capital groups are entities that invest private and philanthropic capital in conservation projects that deliver both financial returns and environmental benefits. Groups such as TNC have established NatureVest to fill this role.

The capital available from companies that already are in the contract operations/infrastructure sector is only available to projects that pay returns that reflect the risk associated with these types of projects. This, of course, requires a dedicated revenue stream to pay for both capital and operations.

Regardless of the source of capital, the dedicated revenue can come from municipally collected stormwater fees, savings from averted private stormwater fees, committed general bonding, or commitments (under contract) from the general operating budget. Dedicating operating costs through multiple budgets and various political terms is viewed as a capital risk for green systems and therefore demands a higher interest rate.

3.3 Current Common Methods to Fund Stormwater

The EPA has summarized the most common methods of funding stormwater in an effort to spotlight the advantages of implementing programs that incentivize sound stormwater management of private property. The following is adapted from EPA's publication *Funding Stormwater Programs*[1] *(EPA, 2009)*.

- Service Fees (Including Stormwater Utilities)
  Stormwater fees, which are typically based on property type or area, provide for regulatory compliance and operation/maintenance costs, and are charged to both tax-paying and tax-exempt properties. Some communities include stormwater management costs within their water or sanitary sewer system budgets, often basing fees on metered water flow. However, a property's metered water flow bears no relationship to the stormwater runoff it generates. For example, the stormwater runoff from the impervious area of a shopping center's buildings and parking lots is significant, but its use of metered water is relatively small.

> *Regardless of the source of capital, the dedicated revenue can come from municipally collected stormwater fees, savings from averted private stormwater fees, committed general bonding, or commitments (under contract) from the general operating budget.*

[1] References in this fact sheet and conclusions in the Report to any non-federal product, service, or enterprise do not constitute an endorsement or recommendation by the EPA, or confirmation of accuracy in the Report. The information provided in fact sheet is only intended to be general summary information to the public. It is not intended to take the place of written laws, regulations, permits, or EPA policies.

- Property Taxes/General Fund
  Many communities fund stormwater management through property taxes paid into their general funds, but in the competition for general fund dollars, stormwater management improvements are typically considered low priority unless the municipality is reacting to a recent major storm or regulatory action. This system is not proportional to flow contributions, because the basis for determining property taxes, assessed property value, is irrelevant to the cost of stormwater management for that property. Additionally, tax-exempt properties, such as governmental properties, schools, colleges, and universities, do not support any of the cost of stormwater management, even though many of them are major contributors of stormwater runoff.
- Special Assessment Districts or Regional Funding Mechanisms
  If a stormwater construction project benefits only a portion of a municipality, it can be funded by fees assessed only to those properties within that area, called a special assessment district. Separate stormwater utility districts can also be formed within a town or by bringing several towns together to form a district. The Michigan "Drain Code" was specifically enacted to allow this type of financial arrangement. There might be some cases where regional or multiple jurisdictional funding mechanisms would be useful. For example, if an impaired stream has a fairly small watershed spanning parts of several municipalities, the cost of stormwater implementation could be shared among the municipalities and the funding could be managed by an existing regional authority such as a soil and water conservation district. Funding could involve fees, as well as credits, for existing BMPs or retrofits.
- System Development Charges (SDCs)
  Municipalities could develop stormwater SDCs tied to the area of the customer's property. SDCs (also known as connection fees or tie-in charges) are one-time fees commonly charged to new customers connecting to a water or sanitary sewer system. In this way, new customers buy into the existing infrastructure, and/or the infrastructure expansion necessary to serve them. The amount of the new customer's SDC is typically based on an estimated water demand of the new customer.

> *In 2007, Connecticut directed its Department of Environmental Protection to use $1 million of state grant funds that the legislature provided for wastewater facility construction to be used by three communities to develop stormwater utilities as pilot programs.*

- Grants & Low-Interest Loans
  Stormwater management grants are available for various types of projects on a state-by-state basis. Clean water or drinking water SRF dollars can be used to fund development of a utility or related capital projects. State environmental programs could consider working with the legislature to set up a pool of funds for towns to help set up districts, which could then be repaid once the fees are established. In June 2007, Governor Jodi Rell of Connecticut signed into law Public Act 7-154, also known as the Municipal Stormwater Authority Pilot Program. Under this law, Connecticut directed its Department of Environmental Protection to use $1 million of state grant funds that the legislature provided for wastewater facility construction to be used by three communities to develop stormwater utilities as pilot programs. The Maine Department of Environmental Protection provides a small amount of grant money, to be matched by the community, to help establish stormwater utility districts. Stormwater projects that are not required as part of a National Pollution Discharge Elimination System (NPDES) permit can be funded through the Clean Water Act, section 319 nonpoint source grant program, administered by states.
- Issuance of bonds
  The most common method of stormwater funding is the issuance of bonds by the municipality or the utility. Many utilities will

identify problems and solutions for the foreseeable future, such as during a five-year capital plan, and then issue municipal bonds to fund the capital program.

3.3.1 Service Fees and Types of Stormwater Utilities

There are three traditional methods that stormwater utilities use to calculate service fees. These are sometimes modified slightly to meet unique billing requirements. Impervious areas are the most important factor influencing stormwater runoff and is, therefore, a major element in each method. None of these traditional approaches provides significant incentives for property owners to reduce their stormwater discharge (and therefore their fees). These shortcomings have limited the interest in private, third party investment and, more importantly, has caused some courts to classify them as a tax rather than a fee. These courts have determined that a fee must be based upon the service rendered and thus a property owner must be allowed to reduce – and possibly eliminate – the fee by reducing the stormwater runoff.

There are three basic types of stormwater utility financing: Equivalent Residential Units, Intensity of Development, and Equivalent Hydraulic Area. An overview, and advantages and disadvantages are presented below:

3.3.1.1 Equivalent Residential Unit (ERU) (Also known as the Equivalent Service Unit (ESU) method)

More than 80 percent of all stormwater utilities use the ERU method. Parcels are billed on the basis of how much impervious area is on the parcel, regardless of the total area of the parcel. This method is based on the impact of a typical single family residential (SFR) home's impervious area footprint. A representative sample of SFR parcels is reviewed to determine the impervious area of a typical SFR parcel. This amount is called one ERU. In most cases, all SFRs up to a defined maximum total area are billed a flat rate for one ERU. In some cases, several tiers of SFR flat rates are established on the basis of an analysis of SFR parcels within defined total area groups. Having such a tiered-SFR, flat-rate approach improves the equitability of the bills sent to homeowners. The impervious areas of non-SFR parcels are usually individually measured. Each non-SFR impervious area is divided by the impervious area of the typical SFR parcel to determine the number of ERUs to be billed to the parcel.

Advantages

The relationship (or nexus) between impervious area and stormwater impact is relatively easy to measure and explain to the public on the basis of *you pave, you pay*. The number of billable ERUs can be determined by limiting the parcel area review to impervious area only. Because pervious area analysis is not required, this approach requires the least amount of time to determine the total number of billing units.

Disadvantages

The private property owner has little or no ability to reduce their stormwater fees by modifying their on-site drainage and thus have little incentive to reduce their peak flow runoff. Because the potential impact of stormwater runoff from the pervious area of a parcel is not reviewed, this method is sometimes considered to be less equitable than the Intensity of Development (ID) or Equivalent Hydraulic Area (EHA) methods because runoff-related expenses are recovered from a smaller area. This method could still be used to charge a fee to all parcels, pervious as well as impervious, to cover expenses not related to areas, such as administration and regulatory compliance.

3.3.1.2 Intensity of Development (ID)

This stormwater cost allocation system is based on the percentage of impervious area relative to an entire parcel's size. All parcels, including vacant/undeveloped, are charged a fee on the basis of their ID, which is defined as the percentage of impervious area of the parcel. Rates are calculated for several ID categories. These ID categories are billed at a sliding scale, as shown in Table 3-1. For example, an SFR parcel, which is categorized as moderate development, would pay \$0.16/month/1,000 square feet (or \$1.60 for a 10,000 square-feet lot).

Table 3-1: Rates Based on Percentage of Impervious Area (*EPA, 2009*)

Category *(impervious percentage range)*	Rate per month per 1,000 sq. ft. of total served area *(Impervious plus pervious)*
Vacant/Undeveloped (0%)	$0.08
Light development (1% to 20%)	$0.12
Moderate development (21% to 40%)	$0.16
Heavy development (41% to 70%)	$0.24
Very heavy development (71% to 100%)	$0.32

3.3.1.3 Equivalent Hydraulic Area (EHA)

Parcels are billed on the basis of the combined impact of their impervious and pervious areas in generating stormwater runoff. The impervious area is charged at a much higher rate than the pervious area.

Advantages

The EHA method accounts for flow from the pervious portion of parcels. Therefore, it is often seen to be more equitable than the ERU method. It accounts for undeveloped/vacant parcels and allows them to be billed. It is perceived to be fairer than the ID method because parcels are billed on the basis of direct measurements of pervious and impervious areas to which hydraulic response factors are applied to determine a unique EHA for such parcels.

Disadvantages

Because pervious area analysis is required in addition to impervious area, this approach requires more time to determine the total number of billing units. It is also more complicated to explain to customers than the ERU method.

3.3.2 Shortcomings Inherent in Typical Stormwater Utility Fees

The stormwater fees described above are a tremendous improvement over non-volume-related methods of paying for stormwater management but they still have tremendous shortcomings. Stormwater fees calculated by most stormwater utilities are designed for ease of implementation – not for environmental effectiveness. More importantly, they provide very limited financial incentives for increasing the amount of stormwater removed from the collection system – particularly during wet weather events.

For example, when impervious surface area is the only driver for determining stormwater fees, a private property owner has no incentive to divert water away from the impervious area to the pervious surface. Further, there is no incentive to increase the infiltration rate of that pervious surface through appropriate plantings and/or infiltration enhancement devices. The cost of constructing and maintaining these improvements yield no change in the calculated stormwater fee.

From an environmental policy point of view, the most effective green infrastructure programs remove stormwater from the collections system (through infiltration, evapotranspiration, and/or rainwater harvesting) as well as reduce the peak flows during wet weather events through on-site storage). An innovative stormwater fee structure can provide the incentives to encourage their use while an innovative stormwater ordinance can mandate these same drivers.

Innovative stormwater fees provide incentives for private property owners to reduce their runoff. (Note: these incentives have been required by the Michigan courts as a means of differentiating fees from taxes and would require a vote of the affected population by the Headlee Amendment).

Prescriptive stormwater ordinances and/or volume related stormwater fees have sufficient financial drivers to attract private investment. The challenge remains that the resulting transaction must be of sufficient size to encourage the private investor to absorb the front-end administrative costs prior to execution of the contract.

3.4 Leveraging Alternative Financing Mechanisms

Most municipalities can finance infrastructure at very reasonable interest rates if they commit the "full faith and credit" of the community. However, municipalities also have a great many demands on their available capital. Thus, a community must limit its borrowing or lose the advantage of low-cost financing. Financing vehicles that can utilize private funds are attractive, particularly if the vehicle does not impact a municipality's bond rating.

The caveat to private financing is that the principal repayment must be assured. This challenge remains the largest constraint to the private investment of green infrastructure.

Advantages

To best manage available cash, a municipality could use private funds to construct green infrastructure in an effort to free up capital for other needed projects while shifting the burden of operations and maintenance to a third party. Utilities hope to access that money at the lowest possible interest rate. In private capital markets, the interest rate is directly tied to the risk of default. The actual contract between the public utility and the private investor will define the risks and guarantees. Together, these will determine the interest rate relative to municipal bonds and the impact on the utility's balance sheet. Private investors would prefer the commitment of the "full faith and credit" of the public entity. However, this commitment would cause the rating agencies to view the investment as "debt-like" and have a negative impact on the utility's credit rating and debt ceiling.

P-3s are established to share the risk and reward of constructing and operating facilities for the benefit of the general public. Municipalities are attracted to P-3s because they can defer up-front costs. This is of particular interest to entities that are approaching their bonding limit. Conversely, investors are attracted because of the high level of transparency, investment premiums, and secured repayment streams.

Private investors and partners have access to funding beyond the tens of billions of dollars available to fund infrastructure – notably, philanthropic capital and impact-oriented capital. An internationally-recognized NGO currently has access to hundreds of millions of dollars for green infrastructure construction, operation, and maintenance at near zero interest. The caveat was that the principal repayment must be assured. This challenge remains the largest constraint to private investment in green infrastructure.

3.4.1 Public-Private Partnerships

P-3s are established to share the risk and reward of constructing and operating facilities for the benefit of the general public. Municipalities are attracted to P-3s because they can defer up-front costs. This is of particular interest to entities that are approaching their bonding limit. Conversely, investors are attracted because of the high level of transparency, investment premiums, and secured repayment streams.

3.4.2 Contracting with a Third Party to Operate & Manage System

Municipalities have often contracted with third parties to provide specialty services, from equipment rentals to lawn cutting services. However, typically, permit compliance is not addressed by these contracts. There are plenty of exceptions (*DWSD, 2014*). These are simple contracts designed to provide the private entity payment that covers the capital cost, depreciation, operating, and maintenance costs. This same model could easily be applied to green infrastructure.

3.4.2.1 Capital Leases

Capital leases provides sufficient flexibility to encourage private investment in a distributed network of stormwater BMPs. Capital leases can address the municipal procurement/contracting requirements and thereby allow a utility to pay a third party to establish and maintain a distributed stormwater system for a given period of time – perhaps tied to permit requirements. The lease could provide many of the benefits of ownership to the municipality - most notably, accessing capital markets - without requiring direct ownership of that asset. It is a vehicle through which further discussions on financing large-scale transaction-based financing can be initiated.

"A capital lease is treated as a purchased asset for accounting purposes, meaning it is recorded as an asset on the balance sheet and depreciated over time." An operating lease is *". . .a lease treated as a true rental for accounting purposes. Operating lease payments are recorded as rental expense." (Harvard University, 2014)*

The Financial Accounting Standards Board has ruled that a lease should be treated as a capital lease if it meets any one of the following four conditions:

1) The lease life exceeds 75% of the life of the asset.
2) There is a transfer of ownership to the lessee at the end of the lease term.
3) There is an option to purchase the asset at a "bargain price" at the end of the lease term.
4) The present value of the lease payments, discounted at an appropriate discounted rate, exceeds 90% of the fair market value of the asset.

In the case of green infrastructure, either options 1) or 4) are applicable. The transfer of ownership of the asset as is required in 2) or 3) above could be considered if appropriate.

The capital lease must:

- Allow a utility to finance the equipment using private capital funds,
- Allow the third party to operate and maintain the equipment within the stated utility stormwater management goals,
- Provide a mechanism for the third party to provide sub-lease payments, if necessary, to the property owner where the green infrastructure or other capital asset is located,
- Allow a utility to leverage private capital to implement a larger-scale system throughout an urban area, and
- Simplify construction on well-placed private property.

Municipalities with substantial CSO control requirements, aggressive Total Maximum Daily Load (TMDL) limits, and recent MS4 permits (that incorporate volume capture requirements) have been the first to enact the most progressive stormwater utilities. This underscores the important role regulatory policies could play in this arena.

A private aggregator can look to two potential sources of repayment: 1) direct payments from the municipality to offset anticipated stormwater management costs, and 2) payment from private property owners to offset their anticipated stormwater fees. Public funding can be accessed to lower a municipality's cost of required stormwater improvements – notably CSO control costs. Private property owners should be allowed to share the savings of reduced stormwater fees that result from a third-party-funded BMP. To invest in the lowest cost (and most effective) BMP, an aggregator would seek access to targeted private property in order to locate the stormwater management asset, which is then negotiated between the aggregator and each individual property owner. The costs and benefits would then be shared and negotiated between the aggregator and the property owner based upon the financial relief to the private property owner.

The capital lease allows the third party to operate and maintain the equipment within the stated utility stormwater management goals. It also provides a mechanism for the third party to provide sub-lease payments if necessary to the property owner where the green infrastructure or other capital asset is located.

3.4.2.2 Stormwater Utilities (Payments from Stormwater Fees)

The permit status and associated compliance for many major facilities were reviewed over the past two years. Many of the most forward thinking utilities also had substantial regulatory requirements placed on them. Thus municipalities with substantial CSO control requirements, aggressive TMDL limits, and recent MS4 permits (that incorporate volume capture requirements) have been the first to enact the most progressive stormwater utilities. Many of these are already revising their fee structures to encourage private investment either on a site-by-site basis or through the use of an aggregator.

A performance-based stormwater ordinance can provide incentives for private property owners to seek out low-cost stormwater management services from private entities. The recently enacted MS4 permit in Washington, D.C., imposes substantial stormwater capture requirements on dense and expensive parcels. To provide relief to property owners on which the requirements are imposed, the municipal stormwater ordinance and fee package allows private property owners to: 1) provide stormwater capture at other, less-costly locations, 2) buy this service from an approved third party, or 3) pay the municipality a fee in lieu of managing their stormwater (with which the municipality constructs off-site capture facilities). This program was initiated in 2013 and by the end of 2014, some smaller-scale, third-party providers were approved to provide some of the needed stormwater facilities.

In some municipalities with significant stormwater fees but limited ways of transacting innovative private solutions, development may be hampered as private developers are hesitant to invest when notified of significant ongoing stormwater fees. In these municipalities, the utilities are working to enact more progressive stormwater programs.

3.4.2.3 On-Bill Financing (OBF) (Cost recovery based on Cost Savings)

OBF leverages stormwater or wastewater savings to pay for lower cost green infrastructure solutions to existing stormwater challenges. OBF enables utilities and their rate-payers to benefit from green infrastructure without an upfront cost or the need to maintain the system. OBF has been used for electricity upgrades and solar energy. OBF is viewed as more straightforward as it provides clear cost savings to the consumer.

OBF could be used to provide the needed cash stream to attract private investment. Another option is to work with both the municipality and the homeowners to have OBF of infrastructure that would provide lower stormwater fees for the immediately affected property owners. This would allow low-interest financing to be used to pay the upfront cost of green infrastructure and for maintenance of the infrastructure. To be successful, both the municipality and the homeowners must be convinced that the proposed green infrastructure solution is the least-costly solution. A good example of this type of joint solution is the Tolgate Wetlands project that was initiated and implemented by the Ingham County (Michigan) Drain Commissioner. *(Dempsey, 2006)* The stormwater relief needed to prevent basement flooding was first proposed to be a major (gray) stormwater relief project. Instead, the excess stormwater was diverted to a series of vegetated ponds that both cleansed the water before its release into the Grand River as well as provided irrigation water for the adjacent golf course. The project saved the rate payers at least $17 million. The project was publically financed, owned, and operated. However, the financial drivers were in place to attract private financing if the drain commissioner had chosen to pursue them.

4.0 EXPLORING DEMONSTRATION PROJECTS ACROSS THE GREAT LAKES: LESSONS LEARNED

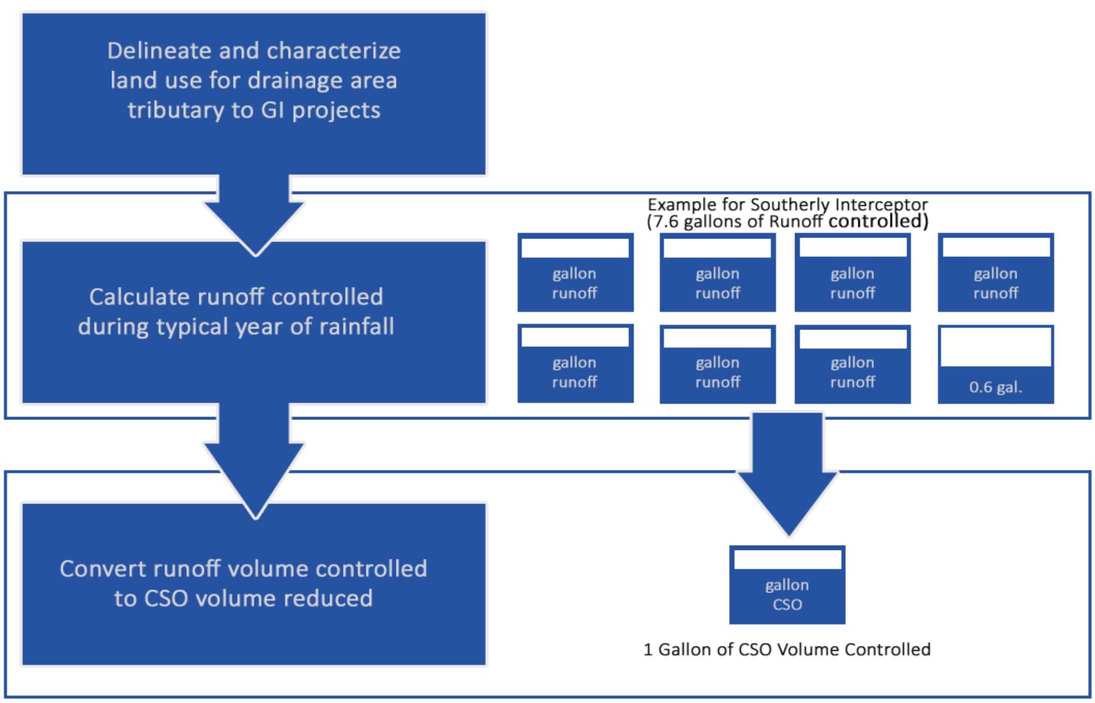
4.1 The Scale of Projects

The scale of green infrastructure solutions varies widely and it can be constructed on a regional scale over a larger area to a very small scale on individual sites. Distributed green systems that is intelligently designed and built over a larger area are more likely to have a measurable impact. Focusing on smaller, individual projects alone makes quickly influencing changes in peak runoff volume difficult. Regulators must show patience in building a system that realizes these improvements in water quantity and quality.

As an example, Washington, D.C., which has an aggressive, regulatory-driven green infrastructure program, expects to only impact one percent of the land area each year. In other, less comprehensive programs, the selection of locations and sizing of a green infrastructure project is more often a function of the available funding rather than a specific hydrologic benefit. While any project that limits the amount of water entering a collection system – particularly during wet weather – is beneficial, this un-coordinated approach does not yield significant reductions in peak flows and/or CSOs.

As green infrastructure continues to gain traction as an effective option, there is also an emerging, better understanding of the hydrologic responses of "greening" older urban areas. Recent studies in Cleveland, Ohio, have suggested that to reduce one gallon of CSO, green infrastructure must capture as much as 7.6 gallons of stormwater as shown in Figure 4-1 (*Northeast Ohio Regional Sewer District, 2012*).

Figure 4-1: Process to Calculate CSO Volume Reduction for Each GI Project *(Northeast Ohio Regional Sewer District, 2012)*



While that estimate seems high to some, the authors argue that the nature of older sewer systems allows groundwater to flow into the leaky pipes, limiting deep groundwater infiltration of surface stormwater. This means that water is not diverted from the sewer system, but instead slowed; peak discharges delayed, but not eliminated. Other studies have shown that augmented green systems can increase infiltration and prevent these wet weather events from entering the sewer system, even in large events.

4.2 Demonstration Pilot Projects

The early phase of this project focused on smaller, project-level pilot efforts. The initial concept was to develop a pilot that could be scaled up later. A key challenge with this approach is that it would not produce a measurable outcome for stormwater management and would not provide for an adequate return for potential operators of a system.

Viable green infrastructure pilots, to assess on-the-ground opportunities and challenges, included:

- *Walnut Way Conservation Corps. in Milwaukee, Wisconsin*
- *Chicago Housing Authority Dearborn Homes and U of C Campus, both in Chicago, Illinois*
- *Paul Revere Primary and Intermediate Schools in Blue Island, Illinois*
- *Recovery Park use of Campbell School in Detroit, Michigan*

The team evaluated existing technology for managing cisterns and vegetated green infrastructure through modeling to gauge their potential effectiveness. The targeted customers identified were wastewater and stormwater utilities because they have stormwater management responsibilities. These included several municipalities and wastewater utilities (MMSD, the Metropolitan Water Reclamation District of Greater Chicago [MWRD], and the Detroit Water and Sewerage Department [DWSD]).

Potential pilot project sites were reviewed on areas where there was a strong need to address stormwater problems and there was potential cost-savings to utilities and/or private property owners.

Several viable pilots were identified and a select few that had the greatest likelihood of success were chosen. These included:

- Walnut Way Conservation Corps. in Milwaukee, Wisconsin
- Chicago Housing Authority Dearborn Homes and University of Chicago (U of C) Campus, both in Chicago, Illinois
- Paul Revere Primary and Intermediate Schools in Blue Island, Illinois
- Recovery Park use of Campbell School in Detroit, Michigan

4.2.1 Walnut Way Conservation Corps. in Milwaukee, Wisconsin

A Milwaukee-based organization, Walnut Way Conservation Corps. sought to replace its existing above-ground cisterns with a technologically-equipped "smart" underground cistern system to support ongoing programs, including installing rain gardens and rain barrels to manage stormwater runoff at the neighborhood level. A "smart" cistern system uses control technologies to maximize stormwater capture and minimize wet weather discharge to the sewer system by assuring that the storage volume is available at the beginning of the wet weather event.

Analyses by the team indicated that a series of larger cisterns can be constructed and operated to sustain a 2-inch rainfall. However, while this type of stand-alone project can be successful, there were logistical and financial difficulties for a project only dealing with this specific location. Funding was difficult to come by and high density meant there was not enough space for a cistern. When discussing potential financing for a project, it became clear that the only option available in the near-term would be a traditional grant from MMSD for only the capital costs of the project. The lesson learned from this project is that while there are real opportunities to engage communities in better managing stormwater through the use of green infrastructure, the approach needs to be broadened from one that is grants-based to one that attracts willing partners. P-3 could be a viable option.

4.2.2 Chicago Housing Authority Dearborn Homes and U of C Campus, both in Chicago, Illinois

This pilot project, if implemented, would reduce peak flows into the MWRD collection system and provide non-potable water for irrigation of the immediate area. The MWRD continues to seek cost-effective ways of limiting peak flows in the combined sewer collection system. This means that MWRD could find it cost-effective to fund green infrastructure in lieu of building more, larger CSO-control facilities (and associated drainage improvements).

U of C showed strong interest in utilizing planned, required storage capacity for rainwater harvesting. The city has provided a variance for the stormwater ordinance that would allow the use of the valves, and monitoring/control technologies to optimize the operation.

The goal of the proposed pilot would be to place a smart control valve on the existing tank for reuse of the water and also to release water in advance of a rain event in order to keep the water from the combined sewers. The Chicago Housing Authority would then have the opportunity to use technology to control the water in a single, large, existing 600,000-gallon tank that holds and slowly releases stormwater to the combined sewer collection system. This project could provide significant opportunities for keeping stormwater out of the storm sewer system as well as lowering the cost of stormwater management for the housing authority. However, concern regarding reopening the city-issued stormwater permit caused this project to languish.

This project had potential to provide opportunities for better stormwater management as the city has an existing inventory of these types of tanks that do not have control valves. If multiple, existing tanks were retrofitted to hold water for release after a rain event, the cumulative effect could be substantial. Discussions with the U of C elicited their interest in utilizing planned storage capacity for rainwater harvesting. The city has provided a variance for the stormwater ordinance that would allow the use of the valve and the monitoring and control technology to optimize the operation.

4.2.3 Paul Revere Primary and Middle Schools in Blue Island, Illinois

This pilot project, if implemented, would reduce the peak discharge to the MWRD collection system, reduce/eliminate neighborhood basement flooding, and eliminate the need for a costly sewer expansion.

The Paul Revere Primary and Middle Schools have a large number of downspouts connected to the combined sewer system. Thirteen years ago, the primary school was built on open land behind a middle school. The schools are surrounded by a densely populated neighborhood with smaller, single-family homes with small yards. The construction met all stormwater permitting requirements. The construction of the newer school increased the amount of roof and impervious surfaces.

Prior to the primary school construction, there were limited problems with basement flooding in nearby homes. After construction, the sewer system became overwhelmed during large rain events, leading to an increase in the number and severity of nearby basements flooding.

The increased runoff from the building of the school is approximately 35,000 gallons in a two-inch rain. The Project Team found that neither disconnecting downspouts from the elementary school and connecting them to rain barrels, nor installing larger cisterns at the middle schools would solve the flooding problem. However, nearly 175 cisterns, each holding 220 gallons, would offset the runoff change that resulted from the construction of the primary school. This would require approximately four cisterns per home to hold the rooftop runoff of a two-inch rain, and is a potentially workable solution.

Currently, there is no existing financial incentive to the school system to reduce this peak runoff and thus, little incentive to incur the cost of installing and operating the automated system. The proposed system also needs to be built on private properties with legal restrictions and concerns remain about the lack of operating capital available to manage such a system if owned and operated by a third party.

4.2.4 Recovery Park at Campbell School in Detroit, Michigan

This pilot project, if implemented, would reduce peak discharges into the DWSD collection system and provide non-potable water for use in irrigating an urban farm being developed by Recovery Park.

Recovery Park is developing a large-scale urban agriculture practice in Detroit, Michigan. The roof of the abandoned Campbell School was considered for non-potable irrigation water. The Campbell School has just over an acre of impervious rooftop area. This rooftop alone generates approximately 47,000 gallons of stormwater runoff during a typical one-year, 24-hour storm event of 1.87 inches. This volume of water quickly drains into the City of Detroit's combined sewer system, consuming capacity in the piping network as well as requiring treatment at the wastewater treatment facility. By simply utilizing a series of technologically-equipped cisterns, this runoff could be used for irrigation on the school property instead of flushed down the drain to be treated. The cisterns would save Recovery Park money on irrigation and treatment costs and reduce peak flows during wet weather events.

> *The DWSD has an active program to build green infrastructure as a low-cost way of reducing CSO frequency and volume as a requirement of their NPDES permit. They are also actively working on an improved stormwater charge system that will provide incentives on-site stormwater capture.*

The team calculated the diversion of this volume from the rooftop area and away from the combined sewer would result in projected treatment savings of approximately $200 per event through the reduction in utility usage, chemical usage, and treatment process requirements. The school could see further savings of approximately $500 due to reduced irrigation water and sanitary costs. If the city allowed the area captured by cisterns to be considered more pervious, the school would also save an additional $7,000 per year in nonresidential drainage fees.

The DWSD has an active program to build green infrastructure as a low-cost way of reducing CSO frequency and volume as a requirement of their NPDES permit. Recovery Park has been chosen as a demonstration site using Detroit's Great Lakes Shoreline Cities Green Infrastructure Grant. They are also actively working on an improved stormwater charge system that will provide incentives for on-site stormwater capture.

4.3 Lessons Learned

The Great Lakes basin encompasses a very large region where a multitude of small-scale projects could be implemented. These individual projects could have a societal benefit as they improve the quality of life and further educate the general public about the benefits of green infrastructure. However, whether the projects are vegetation-based or using cistern-type, delayed-delivery rain water, the financing to execute them is hard to come by. And in many instances, the added value of these individual projects are small and many regulatory barriers exist. Accordingly, scaling up of a set of discrete projects is badly needed. Progressive stormwater fee structures are needed and can be further assisted by new, regulatory drivers that could make large-scale green infrastructure programs more viable.

Finally, there are many barriers to the successful implementation of green infrastructure. First, a lack of common understanding delays actions and interests. Second, a lack of clear responsibilities between public and private sector creates distrust, or perhaps discontent, on both sides. Further, there is limited and sometimes contradictory agency guidance for any entity wishing to implement green infrastructure. Third, green infrastructure takes both initial capital and on-going maintenance costs, and these funds are not readily apparent. Most of these barriers exist regardless of the scale of the green infrastructure project. Therefore, breaking these barriers at the largest possible scale through education, state and federal regulatory reform, and access to capital is the only logical approach. Promoting any single pilot program is simply unlikely to create any meaningful impact to stormwater management or alleviating the barriers of implementation.

5.0 ROLE OF AGGREGATION OF DISTRIBUTED STORMWATER STORAGE SOLUTIONS

5.1 Background

Project aggregation can group smaller projects and monetize them as a single, larger project. This can address many of the challenges presented earlier that inhibit private investment. The aggregated portfolio of projects increases the financial attractiveness of stormwater retrofit projects by: 1) providing opportunities to work through intermediaries that are willing and able to reduce and/or absorb transaction costs, 2) efficiently managing many projects simultaneously to reduce project development costs, and 3) help investors manage risk by diversifying the quantity and character of projects in a stormwater investment portfolio.

Both public and private sides of a potential private investment in green infrastructure - the regulated entity and the private investor - are reticent to initiate a transaction for a small project. Both acknowledge and avoid the relativity high transaction costs. Municipalities fear that the impact of any privately-financed, small project would be immeasurable. The private investor seeks to place large amounts of funds into any given transaction. Aggregation can address these concerns.

Packaging a number of small projects into an aggregated portfolio provides the scale to measure progress while also increasing the financial attractiveness of the projects. There are a number of types of entities that can serve as an aggregator including government agencies, NGOs, and private entities.

An aggregator has the same concerns as any private investor. They seek regulatory and revenue certainty. However, if the assurances of repayment are sufficient, the aggregator can assume the "up-front" duties required to initiate a successful project. These will include:

1) Identify and vet potential projects,
2) Acquire the rights from the existing public/private property owner,
3) Predict the volume of water managed within the constraints of the municipality,
4) Identify the cost of construction and long-term maintenance,
5) Determine the financial value of the aggregated projects, and
6) Prepare a written offer to provide the service for a given price over a given period.

> *Aggregation can reduce project costs through simple economies of scale. If multiple projects proceed in parallel, the aggregator can expect efficiencies as data collection, infiltration testing, modeling, design, permitting proceeds simultaneously. Similarly simultaneous construction lowers costs. Lastly, long term monitoring and/or maintenance is best performed at multiple sites by a trained and efficient team.*

This represents a lot of "high-risk" work. If the effort does not result in a reliable, cost-effective solution for the municipality, the project will not proceed. Predictive models will be questioned and vetted by both the municipality and the regulators. It will require legal review and negotiations with multiple land owners. There are many opportunities for the project to become unviable. For this reason, few private investors have been willing to provide the up-front funds to initiate this type of effort. However, if a municipality or foundation were willing to fund the difficult and costly "up-front" efforts, private funding is available.

Aggregation can also reduce project costs through simple economics. If multiple projects proceed in parallel, the aggregator can expect efficiencies as data collection, surveys, infiltration testing, modeling, design, and permitting proceeds simultaneously. Similarly, simultaneous construction lowers costs. Lastly, long-term monitoring and/or maintenance is best performed at multiple sites by a trained and efficient team.

5.2 Lessons from Energy Sector

A member of the Project Team, Greenleaf Advisors, has been engaged with Intelligent Generation (www.intelgen.com) in developing the aggregation of distributed energy solutions and delivering those solutions into the wholesale power markets. While the development of networked energy solutions is still in its infancy, the participants and industry structure and infrastructure are rapidly advancing and there may be useful lessons for the water sector. In this section, an elementary understanding of the relevant energy marketplace is presented with comments on its relationship to potential, parallel structures and participants in water sectors.

The supply of electricity is generated by both public utilities and private producers and then distributed via the grid by local utility operators (e.g. ComEd in the Chicago market). Additional sources of generation are provided behind the meter by local generation (e.g. solar on rooftops) that supplies energy to the adjoining building with excess power going onto the grid (receiving credit via net metering in some places). This can create problems for the grid operator, who does not control the supply of this distributed power, leading to destabilization of the grid and the power markets that support it. Smarter solutions are being crafted with energy storage (e.g. batteries) and associated control devices (e.g. inverters governed by intelligent software in the cloud where a service aggregator directs the assets use). Allocation decisions for the use of those battery assets are based upon such factors as building load demand, battery storage levels, and energy pricing for retail use, as well as wholesale energy services (e.g. frequency regulation for grid stabilizing purposes – here the battery is provisioned to supply or receive energy from the grid).

The energy-storage units and associated energy-system components (i.e. Battery Management Systems, inverters, and integration software) are rapidly evolving and expanding with the growth of renewable energy supplies (e.g. wind and solar). A network of such storage units has the potential to deliver higher performance and efficiency when governed by an algorithm that optimizes several factors such as battery-asset life (battery life decreases with deep cycling) and energy pricing, provisioning stored energy to the grid when most needed (valuable) during peak demand periods. A network of storage assets can serve as a "virtual power plant" when all assets are coordinated for efficient delivery. Intelligent Generation holds the patent to this network application and along with select industry partners (e.g. financiers, electrical engineering and solar installation companies) is developing a service that delivers valuable aggregated energy services.

One of water's primary advantages is that the capability to store the asset (potable water) and the liability (stormwater and wastewater) exists to varying extents. But, inherent in this advantage are two significant challenges. The first is that water, unlike electricity, is not fully fungible. The second challenge is that stormwater "generation" is intermittent, like solar and wind energy, not dispatachable, like fossil-fuel or nuclear-generated electricity.

At a historical, fundamental level, the electric and water grids have striking parallels. Once the flow of electricity leaves generation sources, it flows over a single, monolithic grid that begins with major trunks (transmission lines) and gradually down scales through substations and distribution circuits to the end customer. Similarly, on the "generation" (or s u pply) side, potable water is distributed through pumping stations and mains that down scales to end use.

On the collection side, storm and wastewater collection occurs at distributed points that increase in scale to a centralized, unified system of mains and treatment plants. Water's equivalent of energy storage exists in different forms of reservoirs, ranging in size from rain barrels to retention ponds to the Great Lakes. However, water storage is often "offline" in that it is shunted off the grid for later drainage or use. In the analogy to electricity, water has both significant advantages and disadvantages to its electric grid counterpart. One of water's primary advantages is that the capability to store the asset (potable water) and the liability (storm and wastewater) exists to varying extents. But inherent in this advantage are two significant challenges. The first is that water, unlike electricity, is not fully fungible. An electron from solar energy is the same as an electron from a nuclear power plant. But a potable water supply is not the same as an untreated storm or wastewater supply. The second challenge is that stormwater "generation" is intermittent, like solar and wind energy, not dispatachable, like fossil-fuel or nuclear-generated electricity. And while stored rain water may not be potable, it can certainly be used for functions like (urban) agriculture, toilets, and thermal cooling. The nature of these two challenges suggest that an evolution towards grid networks integrated with storage solutions can be as applicable to water as they are to electricity.

One can envision water storage devices being bid into markets that will peak in anticipation of flood events and those with excess capacity to their local demands will have valuable storage to sell.

Parallel apparatus exist that can advance networked distributed solutions in the water sector with existing utility infrastructure and entities (potable, storm and wastewater distribution and storage). What is needed is the aggregation of distributed market services to the water utilities via enabling the connection and control of the storage asset when it can benefit the utilities' storage and distribution systems as impacted by other sources and demands. As points of comparison between the energy and water sectors - energy capacity constraint relates to water reservoir constraint, grid stability relates to water conveyance capacity/stability, and building energy load demand relates to property storm retention requirements. These assets can be managed in a fashion that does not disrupt service to customers. For optimization, it requires weather forecasting of the area flows (energy/water) with emphasis on local load demands (electricity/stormwater management needs) and storage levels (battery/cistern levels). A further parallel exists when one considers the energy produced by the solar panel with the local supply of water from rainfall.

Pricing/value lesson: When a property owner takes itself off the electrical grid in whole or in part during peak periods, it reduces its retail demand and capacity charges from that utility. Those charges are set by the customer's usage during peak demand periods, and the capacity charges are applied every month based upon the peak five hours of annual usage. This is because the utility has to support a system of generation capacity to meet its highest annual demand, which becomes very expensive if only used for a short period. The storage asset begins to pay for itself by reducing usage during peak periods (~30% reduction in annual retail bill). In addition, the grid operator will pay lucrative, wholesale, power-market fees for access to that battery to stabilize the grid at 60 Hz frequency; for the most part, the utility will put as much flow back into the battery as it takes off for this frequency regulation service. In the water sector, if utilities applied premiums for storm outflows during large events, they could instill market-based solutions with intelligent management of their storage assets.

The electricity frequency regulation market is a Dutch auction with all parties receiving the clearing price for the amount they bid. Similarly, one can envision water storage devices being bid into markets that will peak in anticipation of flood events and those with excess capacity to their local demands will have valuable storage to sell. It will require modeling of the water flows in time and space so that the balancing services can be well forecasted to meet the utilities' conveyance and storage requirements building upon today's watershed models. With proper alignment of utility rate structures and private markets, similar participants may emerge in the water sector.

6.0 FRAMEWORK OF A BUSINESS MODEL FOR AGGREGATORS

6.1 Components of the Business Model for Aggregators

A business model describes the rationale of how an organization creates, delivers, and captures value in economic, social, cultural, or other contexts. Literature provides very diverse interpretations and definitions of a business model. A systematic review and analysis of manager responses to a survey defines business models as the design of organizational structures to enact a commercial opportunity. Further extensions to this design logic emphasize the use of narrative or coherence in business model descriptions as mechanisms by which entrepreneurs create extraordinarily successful growth opportunities.

> *The three main customers for aggregators are:*
>
> - *Water makers, such as property owners or owners of transportation corridors such as a department of transportation;*
> - *Water takers, such as wastewater utilities; and*
> - *Other users who may have use for water, for example a power plant or a farmer.*

The Project Team began creating the framework of a business model for aggregators. To develop this framework, the Project Team used a Business Model Canvas (*Osterwalder et al., 2010*), which is a strategic management and lean startup template for developing new or documenting existing business models. Basically, it is a visual chart with elements describing an opportunity's value proposition, infrastructure, customers, and finances. It assists businesses in aligning their activities by illustrating potential trade-offs.

The Project Team hosted several discussions to further fine-tune the findings, and the outcome is outlined below as well as presented in Figure 6-1.

1) Customer segments: There are three main customers for aggregators, namely:

- Water makers such as property owners (through runoff from hardscape and rooftops) and owners of transportation corridors such as a department of transportation, etc.)
- Water takers (such as wastewater utilities).
- Other users who may have use for water (for example, a power plant or a farmer).

2) Value proposition for the business model: The aggregators offer the following:

- Key commodity/product that the aggregator market is selling (to enable the aggregation/coordination of water makers, technology, and capital) is to manage stormwater and turning it from a "dumb" retention to "smart" storage, which is distinguished by:
  - o Volume (storage),
  - o Location (reflecting the cost of water varies depending on the geographical location), and
  - o Operational profile (representing the changes in natural hydrograph of stormwater movement).
- Aggregators are offering scale and simplicity to the customers.
- Services offered by aggregators could include differing contracts based on commodity and various segments of water takers, water makers, and other users of water.
- Customer needs include reduced stormwater inflow:
  - o To combined sewer system,
  - o To streams during large rain events,
  - o Reducing downstream flooding, and

Figure 6-1: Business Model Canvas

KEY PARTNERS

Who are your key partners/ suppliers? What are the motivations for the partnerships?

An Aggregator can provide any of the following services to enable a market: contractually represent multiple property owners; access to capital; Provide BMP technology; and implement BMP. While there is a need to develop the reverse of "follow the water" to understand all partners, some key partners are the following:

- Financing companies (Capital Leasing companies).
- All key customer segments such as water takers/makers/other users.
- Third party system implementers/managers, maintainers.
- Risk Managers and insurances.

KEY ACTIVITIES

What key activities does your value proposition require? What activities are important the most in distribution channels, customer relationships, revenue stream . . ?

- Identify area where distributed tank infrastructure would be implemented.
- Gain access to properties where tanks would be located.
- Understand the sizing of cisterns.
- Understand who installation and/or operates.
- Assess property and liability insurance issues such as whose insurance covers it (utility, property owner or third party).
- Understand if a property owners needs to provide any maintenance or what happens when a property owner wants or needs to remove a BMP.

Key Resources

What key resources does your value proposition require? What resources are important the most in distribution channels, customer relationships, revenue stream . . ?

- Tanks/Cisterns as well as vegetation based GI (note that vegetated infrastructure not eligible for capital leases).
- Management technology to hold water during rain and release capacity before a rain event.
- Aggregation contract.
- Capital funding through bonds that can be used to pay for distributed system.

VALUE PROPOSITIONS

What core value do you deliver to the customer? Which customer needs are you satisfying?

- Key commodity/product that the aggregator market is selling (to enable the aggregation/ coordination of water makers, technology, and capital) is to manage stormwater and turning it from a "dumb" retention to "smart" storage, which is distinguished by a) volume (storage) b) location (reflecting the cost of water varies depending on the geographical location), and c) operational profile (representing the changes in natural hydrograph of storm water movement).
- Aggregators are offering scale and simplicity to the customers.
- Services offered by aggregators could include different sorts of contracts based on commodity and various segments of water takers, water makers, and other users of water.
- Customer problems being solved include reduced stormwater inflow a) to combined sewer system, b) streams during large rain events, c) downstream flooding, and d) flooding in basements where collection systems are inadequate.
- Additional customer needs met include: a) avoid costs for centralized storage for CSOs, and b) delayed timing of storm water.

CUSTOMER RELATIONSHIPS

What relationship that the target customer expects you to establish? How can you integrate that into your business in terms of cost and format?

- Water takers could get into a relationship with an aggregator. Aggregator could have relations with insurances, monitoring equipment installer etc.
- Utilities could work with property owners to gain access to property to install BMPs/tank and determine how they want it managed within parameters of system.

CHANNELS

Through which channels that your customers want to be reached? Which channels work best? How much do they cost? How can they be integrated into your and your customers' routines?

- Meetings with water takers.
- Meetings with capital lease firms.
- Water makers, although they will be harder to reach due to the distributed nature.

CUSTOMER SEGMENTS

Which classes are you creating values for? Who is your most important customer?

- Water makers (such as property owners (through runoff from hardscape and rooftops), owners of transportation corridors such as Department of Transportation etc.)
- Water takers (such as wastewater utilities).
- Other users who may have use for water (for example a power plant or a farmer).

COST STRUCTURE

What are the most costs in your business? Which key resources/activities are most expensive?

- The flow of money is dependent on location.
- Most expensive key resources include available cisterns and water tanks. A mapping of the major costs avoided is not yet done and so unfortunately, much of aggregator base is in its infancy and currently lacking.

REVENUE STREAMS

For what value are your customers willing to pay? What and how do they recently pay? How would they prefer to pay? How much does every revenue stream contribute to the overall revenues

- Water makers may only be willing to pay for anything when it becomes a financial liability to them.
- Water makers currently pay minimal cost for stormwater problems.
- Leasing could be another way to pay for the services offered by aggregators.
- One form of payments could be capital bonds offered by water takers.
- Stormwater fees as a way to repay bonds? Think of as extension of piped infrastructure under streets.
- Determine payment for maintenance of systems - operations or capital.
- Do property owners get "rent" for use of property? How is that paid? Payment? Credit? Rebate?

Osterwalder et al, 2010

- Preventing flooding in basements where collection systems are inadequate.

- Additional customer needs met include:
  - Avoid costs for centralized storage for CSOs, and
  - Delayed timing and reduction of stormwater peaks.

A green infrastructure aggregator's key products are the following:

- *Volume via storage,*
- *Locationally varying cost of water, and*
- *Operational profile that represents the changes in natural hydrograph of stormwater movement.*

3) Some key partners are the following:
   - Financing companies (capital leasing companies).
   - All key customer segments such as water takers/makers/other users.
   - Third-party system implementers/managers/ maintainers.
   - Risk managers and insurance agencies.

4) Key activities of the business model require the following:
   - Identify area where distributed storage infrastructure would be implemented.
   - Gain access to properties where storage would be located.
   - Understand the sizing of cisterns/tanks/ponds.
   - Understand who installs and/or operates.
   - Assess property and liability insurance issues, such as whose insurance covers it (utility, property owner, or third party).
   - Understand if property owners need to provide any maintenance, or what happens when a property owner wants or needs to remove a BMP.

5) Customer relationships needed to make this model successful include:
   - Water takers could provide an opportunity to enter into a relationship with an aggregator (or multiple aggregators). Aggregator could have relations with insurances, monitoring equipment installer etc.
   - Utilities and/or aggregator could work with property owners to gain access to property to install BMPs/tank and determine how they want it managed within parameters of system.

6) Key resources needed include:
   - Tanks/cisterns/pond storage as well as vegetation-based infiltration/evapotranspiration opportunities.
   - Management technology to hold water during rain with a release capacity before a rain event.
   - Aggregation contract with municipality and/or private property owners.
   - Capital funding to be used to pay for distributed system.

7) Channels include:
   - Meetings with water takers
   - Meetings with capital providers
   - Water makers

Key partners of an aggregator could include financing companies, key customers such as water takers/makers, third party maintainers, risk managers, and insurances, among others.

8) Cost structure considerations include:
   - Cost of avoided runoff for each proposed project.
   - The flow of money between water makers, water takers and aggregator.
   - The cost of key resources including cisterns and water storage tanks, and pond construction.

9) Revenue-streams considerations include:
   - Water makers may be willing to pay if it reduces their stormwater fee.
   - Water makers currently pay minimal costs for stormwater problems – this is likely to change in larger urban areas over the next five years.

- Leasing could provide a financial vehicle for municipalities to pay for the services offered by aggregators.
- Capital bonds provide low-cost financing available to water takers, but, typically, these entities have used these funds internally.
- Stormwater fees as a way to repay bonds. This dedicated cash stream allows for very low-interest costs.
- Determine responsibility for maintenance of systems - operations or a capital expense.

7.0 TESTING THE BUSINESS MODEL FRAMEWORK: CHICAGO WORKSHOP

On June 11, 2014, the Project Team hosted a workshop in the City of Chicago. The primary goal of the workshop was to review the aggregator business model presented in Section 6.0. In addition, the Project Team sought input on the following:

- Identify the liabilities and financial risks associated with green infrastructure, and how those risks could be mitigated and/or assigned.
- Identify revenue streams that could be captured.
- Identify other ways to attract private capital into green infrastructure implementation.
- Discuss other similar projects in which the attendees may already be engaged or aware of.

The attendees were requested to assess strategic pathways to identifying stormwater management opportunities, and to discuss how the aggregation of those opportunities could allow management as a singular, integrated system to capture/manage substantial water volumes. Lastly, the workshop focused on drivers and financing options that provide greater opportunity for third parties and aggregators to finance, manage, and/or operate distributed stormwater systems.

Nearly two dozen attendees were invited and came to the June 2014 Business Model Framework Workshop in Chicago. They included representatives from private equity and venture capital companies, utilities and municipalities, federal government, and non-profits.

Nearly two dozen attendees were invited and attended the meeting. Attendees included the following:

- Private equity and venture capital companies:
  - Ms. Lydia Miller, Watershed Capital Group,
  - Mr. William Houston, Elsworth & Associates, and
  - Mr. Mahesh Lunani, dFOUNDRY.
- Utilities and municipality representatives:
  - Mr. Kevin Shafer, Milwaukee Metropolitan Sewerage District,
  - Mr. John Murray, Metropolitan Water Reclamation District,
  - Mr. Brian Van Wye, Washington, D.C.,
  - Abby Crisostomo, Metropolitan Planning Council, and
  - Mr. Aaron Koch, City of Chicago.
- Federal government:
  - Mr. Bob Newport, U.S. Environmental Protection Agency.
- Capital leasing or green financing companies:
  - Mr. Ben Disney, Ameresco, and
  - Mr. David South, West Monroe Partners.
- Technology providers:
  - Mr. Jay Marhoefer, Intelligent Generation, and
  - Mr. Maurin Lovera, Veolia.
- Non-profits/foundations:
  - Ms. Helen Taylor, The Nature Conservancy,
  - Mr. Tom Hodgman, The Nature Conservancy,
  - Ms. Suzanne Malec-McKenna, Chicago Wilderness,
  - Ms. Theresa Connor, Water Environment Research Foundation (WERF),
  - Ms. Shannon Donley, Great Lakes Protection Fund, and
  - Mr. David Rankin, Great Lakes Protection Fund.

- Project Team:
    - Dr. Sanjiv Sinha, ECT,
    - Mr. Jim Ridgway, ECT,
    - Mr. Jeff Edstrom, ECT,
    - Mr. John Andersen, Greenleaf Advisors,
    - Mr. Peter Mulvaney, Greenleaf Advisors,
    - Mr. Eric Rothstein, Galardi Rothstein Group, and
    - Mr. Marcus Quigley, Geosyntec Consultants.

During the workshop, a set of presentations were made on the following topics:

- Great Lakes Protection Fund project on market-based approaches to Green Infrastructure (by Jeff Edstrom, Sanjiv Sinha, and Jim Ridgway)
- Aggregation of distributed water solutions (by Jay Marhoefer and John Andersen)
- Stormwater retention credit and trading (by Brian Van Wye)
- Feedback from WERF subscribers on green infrastructure program needs (Theresa Connor)

Aside from further fine-tuning of the business model already presented in Section 6.0, the following were key conclusions from the workshop:

- Attendees indicated appreciation for Washington, D.C.'s trading framework and wondered about the possibility of replicating it in the Great Lakes watersheds with CSOs.
- There is a possibility of economics of scale so far as specific practice (such as cisterns) costs are concerned. As green infrastructure practices gain in popularity, the cost of implementation will be reduced.

The SRF loans are cheap; and consequently, in order for private investment to be a key player in the market, the need for capital must exceed that available through this federal program.

- Technology will increase the effectiveness of green solutions. A typical aggregator transaction could comprise of a range of storage solutions that are designed by technology experts that accommodates a set of distributed basins controlled by cloud-based systems.
- MMSD indicated a willingness to be a leader in hosting an intelligent aggregator in the Great Lakes basin.
- The SRF loans, when available, are a source of low-cost financing; for private investment to be a key player in the market, the need for capital must exceed what's available through this federal program.
- In general, attendees agreed that the driver to spur private financing cannot be vision alone, and some regulatory drivers are badly needed. This is further evidenced in Washington, D.C., where the driver is the EPA-issued MS4 permit.

In the Great Lakes basin, there is room for an early adopter study of engaging private equity companies that looks to map the "social impact" of such efforts that lead to creating a value chain and rate of return guarantees.

- One attendee commented that the challenge is no longer the technological aspects of distributed water solutions – the technology exists and is proven. Aggregation and/or financing remains the challenge.
- One attendee commented that in most municipalities, there is currently nothing in their rate structure that provides an incentive to water makers to participate in any green infrastructure activity.
- The private equity funders indicated that their community will only participate if the returns are high, their participation is in companies (not projects), and there is an exit plan.
- In the Great Lakes basin, there is room for an early adopter study of engaging private equity companies that looks to map the "social impact" of such efforts that lead to creating a value chain and rate of return guarantees.

8.0 FOLLOW UP DISCUSSIONS

8.1 Operationalizing the Business Model

After developing the business model framework, the Project Team has had discussions with individuals representing organizations that seek better stormwater management and have the potential to pay for it. These discussions included MMSD, Chicago Wilderness, DWSD, and the City of Ann Arbor.

8.2 MMSD: Using GI Plan to Set Numerical Goals and Targeted Planning of Areas

MMSD has a green infrastructure plan in place with numerical targets for water kept out of the sewer system. There is a need to develop an approach that would encourage third parties to develop, implement, and maintain targeted systems in different parts of the district. This should be done in conjunction with other areas of the region where a coordinated system can be developed and implemented. Any plan, whether regulatory or request for proposal based, would need to work within this context of numerical goals. Specific areas, such as a street or several block area would be targeted and proposals solicited for developing green infrastructure that can manage the targeted volume of stormwater required in that area to be held back from the sewer system. The infrastructure would be allowed to be either vegetated or quasi-gray.

The Project Team's discussions with MMSD have focused on the potential of the development of the framework third-parties to construct, operate, and maintain a green infrastructure system in specific areas.

8.3 City Of Detroit/DWSD: Coordinating on Right Sizing a City

The City of Detroit and its suburban customers have agreed to new governance as part of the larger Detroit bankruptcy process. The city-wide collection system, as well as its operation and maintenance, will remain a city department, but the interceptor system and the wastewater treatment plant will be moved to a regional authority in return for a $50 million per year payment for 40 years to the City of Detroit from the suburban customers. DWSD staff believes that the on-going green infrastructure program will continue and become a bigger part of their CSO control program. To do this, they anticipate the extension of the existing Wayne County Stormwater Ordinance across Detroit with full enforcement of the existing or revised stormwater fee. Together, these could provide sufficient certainty to attract private capital to design, build, and operate green infrastructure systems.

Many key partners in Detroit recognize the importance of building green infrastructure as a means of building a sustainable Detroit. Detroit Future City, an organization dedicated to coordinating a vision for Detroit's future, created a framework vision that has green and blue infrastructure as a foundation for redevelopment. However, funding remains a challenge. Several private entities have shown interest in bringing substantial investment capital to greening Detroit, but the availability is dependent on the city's ability to establish a payback mechanism. DWSD is working to establish this mechanism, but it has yet to be fully operational.

The Project Team's discussions to-date have focused on the following:

1) Work with investment capital firms to clarify their interests and needs and present these to both DWSD and the City Administration.
2) Work with an existing long-established neighborhood NGO to establish their interest and capacity to becoming green infrastructure aggregators. Several (notably Warren Conner Development Coalition, and The Greening of Detroit) have already initiated green

infrastructure programs and have the capacity to support much larger programs.

3) Work with DWSD to ensure that the consent decree requirements can be met and potentially exceeded through a larger management context for stormwater.
4) Work with DWSD so that any final stormwater ordinance has the ability to provide sustainable payment streams to attract private investors. Encourage the incorporation of volume based design standards, off-site mitigation, a "payment in lieu of" program, and other successful programs from across the nation.

8.4 City of Ann Arbor: Contrasting Stormwater Fees versus a Trading System

The City of Ann Arbor has been a leader in stormwater management for several decades. Early leadership was in response to a city-wide interest in restoring the Huron River, as well as addressing TMDL impairments caused by stormwater runoff. To meet these challenges, the city established a basic stormwater utility in the late 1980s. They revised it in 2007 to allow for fees based on the area of impervious surfaces on properties. The stormwater utility generates about $6 million per year from these fees. The city currently requires volume control for new construction and reconstruction based on impervious surface plus disturbed area (200 sq. ft. for residential and 5,000 sq. ft. for commercial properties). They are proud of their success to date, but, like other municipalities, are looking to private investment to accelerate the use of green infrastructure, provide access to lower cost BMPs on private property, and leveraging the existing stormwater fees.

The Project Team introduced the City of Ann Arbor to the stormwater managers from Washington, D.C., and discussed the stormwater aggregation business model concept. As these discussions continue, the following issues will be kept in mind in developing an aggregation system in the city and the watershed:

1) Connect Ann Arbor city leaders, stormwater managers, and leading NGOs (including the Huron River Watershed Council) to potential aggregators in the for-profit and non-profit sectors that are currently seeking investment opportunities in green infrastructure;
2) Review and identify stormwater utility fees to determine how it can best be aligned with an aggregation system that would encourage private investment as a means for developing a more effective stromwater management system; and
3) Work with the city, the stormwater managers and aggregator(s) to assemble a collection of green Infrastructure projects of sufficient size to see measurable effects and attract private investment.

8.5 MWRD, Blue Island, and Chicago Wilderness: Building Distributed System in a Targeted Area

MWRD has significant CSO problems. It is in the process of constructing three, large reservoirs to hold stormwater at times when the wastewater treatment plants are overwhelmed to address some of the CSO problems. The main difficulty is that the collection system is inadequate in some areas preventing excess stormwater from entering the existing storage reservoirs, so it backs up into basements. The district has a vision for a "fourth reservoir" of distributed stormwater storage that holds the water back before it enters the collection system. Building a distributed system in a targeted area to solve a specific problem can show that green infrastructure is an effective tool to reducing stress on the existing collection system. There is a need to develop a pilot in an area like the Blue Island neighborhood with targeted funding for construction, as well as a long-term plan for maintaining the system.

The Project Team's discussions have focused on working with the MWRD to identify a capital bond structure that also includes long-term maintenance over a ten-year period. There is also a need to connect with Chicago Wilderness's bigger vision for the Chicago region.

9.0 LESSONS LEARNED AND SUGGESTED FUTURE STEPS

9.1 *Lessons Learned*

The team set out to develop a market-based approach to green infrastructure. In the process, it determined that there is a need to focus on developing a business model based on available revenue streams and in areas where there are regulatory and economic drivers that make green infrastructure an economically-viable option.

The primary lessons learned from this project include the following:

- There are four sources of private capital that could play a role in the green infrastructure sector:
  - Private equity and venture capital companies that invest in for-profit businesses.
  - Entities that invest private and philanthropic capital in conservation projects that deliver financial returns and clear environmental benefits.
  - Companies that already are in the infrastructure business and may have an interest in adding green infrastructure to their portfolio.
  - Private-property owners that may, or may not have triple bottom-line-related interests.

> *A key take away of this project is a business model framework for aggregation of green infrastructure services. This framework elucidates inter-relationships between various elements such as value proposition, customer segments, customer relationships, channels, key activities/partners/resources, cost structure, and revenue streams*

- The private equity and venture capital companies:
  - Typically focus on investing in companies, not projects, and are thus not expected to *directly* play a role in green infrastructure projects. They may, however, be a significant driver in funding companies that do.
  - Believe that lack of a regulatory driver is a problem as the regions investing heavily in green infrastructure are mostly led by visionaries with "social good" in mind.
- The capital from groups that invest private and philanthropic capital in conservation projects that deliver financial returns and clear environmental benefits, is already working.
- The capital from companies that already play a role in infrastructure recognize that:
  - Financing is still a barrier and there needs to be a dedicated revenue stream to pay for both capital and operations.
  - Dedicated revenue can come from municipally-collected stormwater fees, savings from averted private stormwater fees, committed general bonding, or committed (under contract) from the general operating budget.
  - Dedicating operating costs through multiple budgets and various political terms remains a concern for private entities because green systems that requires lower capital costs but more operations and maintenance revenue.
- For all sources of capital:
  - Packaging a number of small projects into an aggregated portfolio would further provide the scale needed to further motivate private capital.
- Without exceptions, utilities and municipalities are eager to try to find ways to encourage public-private partnerships in green infrastructure. The Project Team

believes that the proposed aggregator framework goes a long way in accomplishing that (although a regulatory/financial driver will still be needed).

- A key take away of this project is a first draft of a detailed business model framework for aggregation of services offered. This framework clarifies and then elucidates inter-relationships between various elements such as the following:
  - Value propositions
  - Customer segments
  - Customer relationships
  - Channels
  - Key activities/partners/resources
  - Cost structure, and
  - Revenue streams

9.2 Topics Needing Further Scrutiny

By no means an exhaustive list, the following topics need additional scrutiny:

- What is the total size of the green infrastructure market in the Great Lakes basin?
- What key drivers exist that dictate this market size?
- Is the market expanding or contracting?
- Who are or could be the main investors in this space?
- How can the investments be structured? What capital stacking strategies can be adopted?
- What is the potential IRR for various types of investments?
- Are there locations in the Great Lakes where green infrastructure is needed more?
- What are the perceptions of private liability?
- What are the risk avoidance mechanisms present?

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