UWM Center for Economic Development

Impact of Green Infrastructure on Property Values within the Milwaukee Metropolitan Sewerage District Planning Area: Case Studies

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About this report

This report was produced at the University of Wisconsin-Milwaukee Center for Economic Development (UWMCED), a unit of the College of Letters and Science at the University of Wisconsin-Milwaukee. UWMCED was established in 1990. The analysis and conclusions presented in this report are solely those of UWMCED; they do not necessarily reflect the views or opinions of the University of Wisconsin-Milwaukee. Further information about the Center for Economic Development and its reports is available at: www.ced.uwm.edu

UWMCED was selected by the Metropolitan Milwaukee Sewerage District (MMSD) to carry out this study. Further information about MMSD is available at: www.mmsd.com

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INTRODUCTION

The United States Environmental Protection Agency (EPA) is developing a federal Stormwater Rule that will provide performance standards and best management practices (BMPs) for new and redeveloped sites to better address stormwater management.[1] As part of this effort, the EPA is seeking to determine the financial impacts that green infrastructure strategies and practices have on property values.

> *"Relatively little information regarding the impacts of green infrastructure on property values is available in the literature. Impacts have been estimated but not verified for Milwaukee based on this limited information. Verification is needed (assuming positive impacts can be demonstrated) to catalyze more green infrastructure and better manage stormwater in the region." – MMSD*

In January of 2012, the Milwaukee Metropolitan Sewerage District (MMSD) contracted with the Center for Economic Development at UW-Milwaukee (CED) to analyze the financial impacts of MMSD's green infrastructure (GI) strategies on property values for four selected study areas within the MMSD service area. The project included two residential, one commercial, and one industrial study areas; the focus was to measure the impact that the specific GI project had on either the total assessment values or sales prices of the properties within the study areas. The primary method for analysis was through the development of hedonic regression models (three panel regressions and a cross-sectional regression), based upon review of other similar studies and strategies. In order to develop the study, CED and MMSD agreed upon the following assumptions:

- Hedonic panel (longitudinal) regression modeling measuring the impact of GI on commercial, industrial, and residential properties
- Use of property (assessment) data, Census, and other descriptive data for years 1998 -2011
- Privately owned properties
- Preference is given to measurement of practices occurring *on site* rather than on adjacent sites
- Green Infrastructure Strategies and Practices include any of the following or combinations thereof:
    - Greenways
    - Rain Gardens
    - Wetlands
    - Stormwater Trees
    - Green Roofs
    - Bio-Swales
    - Porous Pavement
    - Native Landscaping
    - Rain Barrels/Cisterns
    - Alleys/Streets/Parking Lots

[1]US EPA website on the stormwater rule http://cfpub.epa.gov/npdes/stormwater/rulemaking.cfm

Based on the available data, study timeframe, and scope, CED develop models for four distinct study areas; one was based on industrial properties (Menomonee Valley), one was

Identified Project Areas	Description
Study Area 1: Menomonee Valley	o Panel regression model for industrial properties o GI is on site or within close proximity; measuring a mix of GI techniques o Data Sources • City of Milwaukee property assessments (MPROP database) • US Census Bureau socio-economic data • Select infrastructure data provided by MMSD, Southeastern Wisconsin Regional Planning Commission, City of Milwaukee, and Milwaukee County Transit System o Comparable to all other 'like' industrial properties without GI in City of Milwaukee • Based on a mix of zoning and land use factors
Study Area 2: The Brewery	o Panel regression model for commercial properties o GI is on site or within close proximity; measuring a mix of GI techniques o Data Sources • City of Milwaukee property assessments (MPROP database) • US Census Bureau socio-economic data • Select infrastructure data provided by MMSD, Southeastern Wisconsin Regional Planning Commission, City of Milwaukee, and Milwaukee County Transit System o Comparable to all other 'like' commercial properties without GI in City of Milwaukee • Based on a mix of zoning and land use factors
Study Area 3: Lincoln Creek Neighborhood	o Panel regression model for residential properties o GI is not onsite – would be measuring impact on properties within a given distance/proximity and comparing to other similar residential properties o Data Sources • City of Milwaukee property assessments (MPROP database) • US Census Bureau socio-economic data • Select infrastructure data provided by MMSD, Southeastern Wisconsin Regional Planning Commission, City of Milwaukee, and Milwaukee County Transit System o Comparable to similar residential properties without GI in City of Milwaukee
Study Area 4: Shorewood Downspout Disconnection Program	o Cross-sectional regression model for residential properties o GI is on site; limited to downspout disconnection technique o Data Sources • Village of Shorewood property assessment data • US Census Bureau socio-economic data • Select infrastructure data provided by MMSD, SEWRPC, Village of Shorewood o Comparable to all other 'like' residential properties without GI in Village of Shorewood

based on commercial properties (The Brewery), and two were based on GI projects impacting residential properties (Lincoln Creek and Shorewood).

Fiscal Impacts

In addition to the regression models, CED provides further clarification on the fiscal impacts of green infrastructure in the Menomonee Valley, The Brewery, and Lincoln Creek, based on the hedonic regression models. Included is a review of studies on green infrastructure impacts on property values, and the findings for each of the three study areas. The findings include relevant development and financial histories for each study area, infrastructure costs, and estimates on the return on investment (ROI) based on the number of years it will take to pay off MMSD's initial infrastructure investments in the target areas in the form of higher property tax revenue. For further clarification, CED provides a discussion about the mass appraisal processes used by the City of Milwaukee and the State of Wisconsin in Appendix A, and a discussion about procedures related to tax increment financing in Appendix B.

Separating Green Infrastructure from Total Infrastructure Investments

This study was designed to use hedonic regression modeling to determine the impact of GI on property values using four unique case studies. The findings presented include background and context for the development processes that took place within each of the study areas. In regression modeling, properties "x" (in this case, properties impacted by GI development) are compared to similar properties "y" (properties not impacted by GI) in order to determine the extent to which the "treatment" (GI development) has, negatively or positively, impacted the property values. In two of the cases (the Menomonee Valley and The Brewery), other infrastructure and site improvements were developed concurrently with the GI, and therefore, it was impossible to isolate the impacts of the GI development within the two models. For example, in addition to the GI development, new sewer and water mains were laid, roads and bridges were built or repaved, and gas, electric, and other telecommunications lines were rerouted or placed within close proximity, as part of major redevelopment efforts that were centered around planned tax increment financing districts. This means that the results of these two models included the impact that the other site improvements had on the properties, and therefore, the findings presented on the fiscal impacts of the GI development also include information on the other investments.

It should also be noted that although savings estimates from greywater reduction were not incorporated into the study, the incorporation of GI into the developments likely provided significant savings to the MMSD and City of Milwaukee based on the reduction in the amount of additional grey infrastructure as well as the reduction in costs due to stormwater runoff that would need to be stored or processed in grey infrastructure. Based on estimates,[2] the cost to store and manage the same volume of stormwater is about 38 percent higher using

[2] S. Wise, J. Braden, D. Ghalayini, J. Grant, C. Kloss, E. MacMullen, S. Morse, F. Montalto, D. Nees, D. Nowak, S. Peck, S. Shaikh, and C. Yu *Integrating Valuation Methods to Recognize Green Infrastructure's Multiple Benefits*, Center for Neighborhood Technology, 2009. Available online at www.cnt.org/repository/CNT-LID-paper.pdf

Deep Tunnel technology over surface basins. The Center for Neighborhood Technology provides GI calculators that estimate the cost savings between green and grey infrastructure based on a range of development types and densities (for example, high density urban, urban single family, and new or single family low density suburban development).[3] The MMSD also provided anecdotal evidence of cost savings for several major infrastructure projects throughout the US (see Appendix C).

Studies on Green Infrastructure Impacts on Property Values

Most infrastructure investments, if well-designed, tend to have a positive impact on property values. Numerous studies and regression analyses have demonstrated that public infrastructure investments tend to increase economic activity, productivity, and property values, while also providing significant spillover effects that positively impact the quality of life in communities such as economic development and job growth, energy efficiency, and public health safety.[4] Most of these studies have focused on the more traditional forms of infrastructure (roads, water and sewer mains, telecommunication lines), while the fiscal impact of GI, being a relatively new form of infrastructure, has yet to be thoroughly investigated.

Green infrastructure, sometimes referred to as Low-Impact Development strategies (LIDs), is a fairly diverse group of strategies or practices that address a wide variety of environmental needs or objectives including mitigating hazards, aesthetically enhancing the built environment, producing clean energy, reducing the impacts of pollutants, and improving air or water quality. Most GI strategies address one or more of these environmental objectives. Additionally, GI strategies may be used to address or resolve problems within other types of infrastructure development (namely roads and sewers) or may be employed to lower the costs associated with the development of other infrastructure (again, roads and sewers). While there are different types and scales of green infrastructure - including wind, solar, and open space or wetland preservation - this discussion focuses on GI as a network of stormwater management practices, and limits the discussion to practices that are typical in a heavily urbanized area (green roofs, rain gardens, stormwater retention and detention basins, bioswales, permeable pavement and other strategies for capturing and filtering rainwater reducing stormwater runoff).

The Center for Neighborhood Technology (CNT) provides a guide[5] on the long list of benefits - economic, social, and environmental – as a result of GI efforts. These include, but are not limited to: reduction of water treatment needs, improvement of water quality, reduction in greywater infrastructure needs, reduction of flooding, increasing water supply through groundwater infiltration, reduced salt use, reduced energy use, improved air quality, reduced atmospheric carbon emissions, reduced urban heat island, improved aesthetics, increased recreational opportunities, improved natural habitat, and opportunity for public education.

[3] The Center for Neighborhood Technology provides several GI calculators online at greenvalues.cnt.org/green-infrastructure

[4] An Economic Analysis of Infrastructure Investment, Report by the US Department of the Treasury with the Council of Economic Advisors, October 2010. Available online at treasury.gov/resource-center/economic-policy/Documents/infrastructure_investment_report.pdf

[5] The Center for Neighborhood Technology *The Value of Green Infrastructure: A Guide to Recognizing Its Economic, Environmental, and Social Benefits*, 2010. Available online at www.cnt.org/repository/gi-values-guide.pdf

CNT also provides calculators to estimate the benefits for specific types of GI improvements (green roofs, rain gardens, native vegetation, vegetation filters, swales, and trees).[6] CNT and others have pointed out that each of these benefits has an intrinsic economic value that may go above and beyond the increase in values of the surrounding properties and that the difficulty in assessing their value may be in integrating the valuation of multiple benefits or in quantifying benefits that are not easily monetized.[7,8]

Although there is a significant amount of research on the environmental impacts of GI or LID strategies, the literature on the fiscal or financial impacts of GI is scant and relatively young. Most GI studies are limited to case studies or summarizing the costs and/or benefits of one or more practices in a single location based on unique criteria or under specific circumstances; currently, there is no general method for estimating or documenting the costs and benefits, including the impacts on property values, although some older studies that measure greenspace attributes may provide some ‘rules of thumb’. A CNT report by Wise et al provides a summary of the wide variety of benefits that most greenspace and GI techniques, including information about impacts to local property values, where available.[9] Most work explicitly referring to the impact of GI on property values is from the past decade although there is an earlier body of work that addresses the impact that natural amenities (forests, lakes, and rivers) or greenspace features have on property values.

Greenspace Studies

Beginning in the 1980s, studies that focus on the role of more traditional forms of green infrastructure, such as greenspace, have determined positive impacts on property values, urban aesthetics, and the environment and have established that natural amenities tend to have a positive impact on property values. In these studies, greenspace can be defined as trees, urban forestry, parks, wetlands, community gardens, water or other natural amenities. Most of this work has focused on the impact of greenspace on residential properties, rather than commercial or industrial properties.

Parks and open space studies have established the positive impacts on property values based on proximity. John Crompton’s work[10] has confirmed that a general rule of thumb indicates that properties that abut parks or open spaces tend to see, on average, a 20 percent premium or increase in value over similar properties. Studies[11,12] that focus on trees or forested areas demonstrate that proximity to wooded areas or more densely forested areas

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[6] The Center for Neighborhood Technology’s calculators are available online at greenvalues.cnt.org/green-infrastructure

[7] *Ibid*

[8] S. Wise, J. Braden, D. Ghalayini, J. Grant, C. Kloss, E. MacMullen, S. Morse, F. Montalto, D. Nees, D. Nowak, S. Peck, S. Shaikh, and C. Yu *Integrating Valuation Methods to Recognize Green Infrastructure’s Multiple Benefits*, Center for Neighborhood Technology, 2009. Available online at www.cnt.org/repository/CNT-LID-paper.pdf

[9] *Ibid*

[10] John L. Crompton *The Impact of Parks on Property Values: Empirical Evidence From the Past Two Decades*, Managing Leisure, Volume 10, 2005.

[11] Thomas A. More, Thomas Stevens, P. Geoffrey Allen, *Valuation of Urban Parks*, Landscape and Urban Planning 15: 139 – 152, 1988.

[12] Carol Mansfield, Subhendu Pattanayak, Will McDow, Robert McDonald, and Patrick Halpin, *Shades of Green: Measuring the Value of Urban Forests in the Housing Market*, Research Triangle Institute Working Paper 02_02, February 2002. Available online at www.rti.org/pubs/rtipaper_02_02.pdf

has a positive impact on property values. Studies,[13,14] have demonstrated that trees tend to enhance residential property values and can provide an increase in value in the range of 5 to 15 percent. Recent studies incorporate measures of tree density using GIS and satellite imagery; these have also confirmed the findings from the older studies.[15,16] The models developed for each of the MMSD case studies incorporate proximity to parks; in each case, parks in Milwaukee and Shorewood are the primary areas of forested lands, and as anticipated, CED found a positive correlation based on proximity to parks.

Water amenities such as rivers and lakes have also been found to have a positive impact on property values based on proximity or adjacency. A recent Michigan State University study[17] showed that properties adjacent (within 15 meters) to water amenities have an added 82 percent capitalization over comparable properties located over 150 meters away. The models developed for each of the MMSD case studies controlled proximity to Lake Michigan and nearby rivers.

Recent GI Studies

Most recent GI studies focus on the impact of specific stormwater management practices, the costs associated with development, potential reductions in costs to non-green stormwater management techniques, or the savings incurred by reductions in hazards such as flooding. The USEPA has documented numerous studies[18] that focus on the impacts of the costs of GI that address stormwater management problems. Recent efforts are taking a more holistic approach to understanding the economic impacts of GI within and throughout the development process and within the context of municipal infrastructure planning.[19] These studies are demonstrating that, as municipalities move towards incorporating GI strategies into their infrastructure toolbox, GI projects cannot be evaluated in the same manner that other infrastructure is assessed because of the wide variety of costs and benefits that need to be considered. Measuring the costs and benefits of GI becomes site specific given that there may be a wide variety of objectives that a GI project may be addressing; this is often not the case when planning a road or sewer, where the objectives may be few or simplistic. Planners and engineers are finding that the incorporation of GI necessitates an understanding of cost effectiveness that addresses capital and maintenance costs, hydrological performance and effectiveness, and its overall impact on local watershed

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[13] B.R. Payne *The Twenty-Nine Tree Home Improvement Plan*, Natural History, 82, 74-75, 1973.

[14] DJ Morales *The Contribution of Trees to Residential Property Values,* Journal of Arboriculture 6 (11), November 1980. Available online at www.actrees.org/files/Research/contribution_of_trees_to_residential_property_value.pdf

[15] Marius Thériault, Yan Kestens and François Des Rosiers *The Impact of Mature Trees on House Values and on Residential Location Choices in Quebec City*, Centre de Recherche en Aménagement et Développement, Université Laval. Available online at www.actrees.org/files/Research/impact_of_mature_trees_quebec.pdf

[16] Susan Wachter and Grace Wong, *What Is a Tree Worth? Green-City Strategies, Signaling and Housing Prices,* Real Estate Economics, Volume 36, Issue 2, pgs 213-239, 2008.

[17] Soji Adelaja, Yohannes Hailu, Rachel Kuntzsch, Mary Beth Lake, Max Fulkerson, Charles McKeown, Laila Racevskis, and Nigel Griswold *Comprehensive Study on Economic Valuation, Economic Impact Assessment, and State Conservation Funding of Green Infrastructure Assets in Michigan*, Land Policy Institute Michigan State University, 2008.

[18] Availalbe at USEPA website water.epa.gov/infrastructure/greeninfrastructure/gi_economics.cfm

[19] Hale Thurston (editor) *Economic Incentives for Stormwater Control*, CRC Press, 2012.

programming.[20] Although most studies on the costs of various GI focus on their ability to offset other costs, a few have specifically focused on the impact to real estate values and are listed below.

Stormwater Retention/Detention Basins:

Studies indicate that the impact of stormwater basins on surrounding property values may depend upon the design or the aesthetics of the basin and not just its functionality. Public perception about the facilities has shown that newer stormwater facilities that incorporate community amenities like parks or recreational facilities tend to be more attractive or preferred, while facilities that are more functional (particularly dry detention basins) or older facilities that may require maintenance are considered a detriment to the community, therefore negatively impacting property values.[21]

A 2009 study[22] measuring the impact of detention basins on nearby housing values found that the design of basin facilities has a critical impact on housing values. In this case study, researchers compared two types of basin designs, found that the functional basin with less aesthetic appeal had a negative impact on property values, while the basin with greater aesthetic appeal and recreational facilities had a significantly positive impact on the surrounding property values. This study incorporated a hedonic pricing model and used GIS to measure the impact on property values.

Green Roofs

Although Europe has embraced green roof technology for the past few decades, it is a relatively new practice in North America, although it has been growing rapidly.[23] A 2010 Canadian report[24] measured the benefits of green roofs based on 5 case studies selected from the US and Canada. Using a hedonic pricing model, their results indicated that a recreational rooftop garden increased property values by about 11 percent, while a productive green roof (ie one that grows vegetables) may only increase the value by 7 percent. This study also concluded that adjacent properties may also experience an added increase but only if they have a view of the roof. For example, adjacent properties (up to 500 feet in proximity) were experiencing a 5 percent increase in value, or a 2 percent increase if the property is between 500 and 1000 feet away, if the property maintains a view of the green roof. More studies are needed to confirm these findings.

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[20] Franco Montalto, Christopher Behn, and Ziwen Yu, *Accounting for Uncertainty in Determining Green Infrastructure Cost Effectiveness,* pages 71 to 100.

[21] Carol Emmerling-DiNovo *Stormwater Detention Basins and Residential Locational Decisions*, Journal of the American Water Resources Association Volume 31 (3), pages 515-521, 1995.

[22] Jae Su Lee and Ming Ha Li *The Impact of Detention Basin Design on Residential Property Value: Case Studies Using GIS in the Hedonic Pricing Model*, Landscape and Urban Planning, 89, pages 7 – 16, 2009. Available online at people.tamu.edu/~minghan/PDF/2009%20Lee%20and%20Li%20detention%20pond.pdf

[23] Green Roofs for Healthy Cities – North America. Information available online at www.greenroofs.org/index.php/about/aboutgreenroofs

[24] Ray Tomalty and Bartek Komorowski *The Monetary Value of the Soft Benefits of Green Roofs,* Smart Cities Research Services, Montreal, prepared for Canada Mortgage and Housing Corporation, 2010. Available online at www.greenroofs.org/resources/Monetary_Value_of_Soft_Benefits_of_Green_Roofs.pdf

Rain Gardens/Community Gardens

Studies on rain or community gardens are also scant. A review of the literature showed that a 2008 study[25] looking at the impact of community gardens on neighborhood property values and found that there was a positive correlation and that the impact was greater in more economically challenged neighborhoods. It also concluded that higher-quality gardens have the greatest positive impact. More research should be done in this area.

Bioswales

Use of bioswales is very new in the US, and is not standard practice. Although many studies have established their effectiveness in stormwater retention and filtration and have documented avoided construction costs, currently, no studies have yet specifically demonstrated the impact of bioswales on property values. The installation of bioswales during the redevelopment process would likely add value to a property if it resolves a recurring stormwater problem.

Pervious Pavement

Pervious or permeable pavement allows for stormwater infiltration and snowmelt onsite, reducing stormwater runoff into more expensive stormwater retention facilities or directly into streams or sewers. Although still not widespread, pervious pavement has been used throughout the US for at least the past decade and improvements are making it a more viable option for paving features like parking lots or driveways. Although its many environmental benefits and avoided construction costs have been documented, currently no studies exist showing its impact on property values. Again, the installation of pervious pavement would likely add value to a property if it is necessitated by a recurring stormwater problem.

LEED Studies

In 1998, the US Green Building Council developed the Leadership in Energy and Environmental Design (LEED) certification, a ratings system for buildings and properties that incorporate green strategies directly into the building designs. There are numerous studies on the impacts of LEED development but most of these are case studies that provide information on costs and savings related to construction and energy consumption. A few studies[26,27] have demonstrated the positive impacts on property values, that commercial buildings that are LEED certified can return higher rents than similar non-green properties, and that sales tend to be higher. It should be noted, full adoption of LEED strategies is still in its infancy and therefore more research is needed to fully flesh out the impacts that LEED development, including the different rating levels, has on property values.[28]

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[25] Ioan Voicu and Vicki Been *The Effect of Community Gardens on Neighboring Property Values,* Real Estate Economics, Volume 36, Issue 2, pp. 241-283. 2008

[26] Franz Fuerst and Patrick McAllister *Green Noise or Green Value? Measuring the Price Effects of Environmental Certification in Commercial Buildings*, School of Real Estate and Planning, University of Reading, 2008. Available online at mpra.ub.uni-muenchen.de/16625/9/MPRA_paper_16625.pdf

[27] Norm Miller, Jay Spivey, and Andy Florance *Does Green Pay Off?* Burnham-Moores Center for Real Estate, 2008. Available online at www.usgbc.org/ShowFile.aspx?DocumentID=5537

[28] Sofia Dermisi *Effect of LEED Ratings and Levels on Office Property Assessed and Market Values,* Journal of Sustainable Real Estate, Volume 1, Number 1, 2009. Available online at www.costar.com/josre/JournalPdfs/02-LEED-Ratings-Levels.pdf

DATA AND METHODOLOGY

Panel Regression Modeling and Cross Sectional Regression Modeling

Multiple regression modeling (also known as hedonic regression modeling when referring to pricing models) is the standard method for determining the value of a good or service by breaking it down into its component values. Within real estate valuation modeling, it is the primary method used for appraising properties as it allows for the determination of the portion of the assessed value or the sales price attributed to both the physical characteristics of the property itself as well as less tangible characteristics such as neighborhood quality.[29] Components that define the physical characteristics of a property include such variables as number of bedrooms, number of bathrooms, square footage, lot area, number of units, and so on, and are available from the local property assessors office. Variables that have been shown to impact the quality of the neighborhood also impact property values; these include distance to local amenities like parks or transit, as well as demographic characteristics such as population density, race or ethnicity, and household incomes.

CED reviewed a variety of regression models on real estate valuation, including those on residential, commercial, and industrial properties to assist in the development of the models. CED paid close attention to research within the local Milwaukee market, knowing that the data sources for the models would be the same or similar. Recent regression models using data from the Milwaukee area are discussed in the following:

- De Sousa, Chris, Changshan Wu, and Lynne Westphal *Assessing the Effect of Publicly Assisted Brownfield Redevelopment on Surrounding Property Values,* Economic Development Quarterly Volume 23, No. 3. May 2009.
- Kuethe, Todd *Measuring Local Aggregate House Prices.* International Real Estate Review, Volume 14, No. 1. 2011.
- Yu, Danlin *Modeling Owner-Occupied Single-Family House Values in the City of Milwaukee: A Geographically Weighted Regression Approach.* GIScience and Remote Sensing, September 2007.
- Yu, Danlin, Yehua Dennis Wei, and Changshan Wu *Modeling Spatial Dimensions of Housing Prices in Milwaukee, WI.* Environment and Planning B: Planning and Design, Volume 34. 2007.

The models for each of the four study areas include data compiled from a variety of sources including assessment data, demographic data, land use data, and geographic data. For the three models located within the City of Milwaukee, data from the City of Milwaukee Assessor's Office and the Master Property List (MPROP) provided the basis for the study and included all physical, legal, and financial variables. The City of Milwaukee Assessor's Office assesses all properties using a mass appraisal method on an annual basis which allows for a true longitudinal regression based on the changing annual data for each property over a specific time period. This type of longitudinal analysis is also referred to as a *panel regression analysis*.

[29] Benjamin, Guttery, and Sirmans. *Mass Appraisal: An Introduction to Multiple Regression Analysis for Real Estate Valuation*, accessible at www.real-analytics.com/FINC_674/Mass%20Appraisal.pdf

The Village of Shorewood provided assessment and sales data for their real estate stock; this also included all physical and financial variables, but due to the nature of Shorewood's assessment process, the use of sales data was preferred over assessments. Unlike the City of Milwaukee, the Village of Shorewood does not assess properties on an annual basis, but only at the point of sale, or when a permit is pulled, or alternatively, based on the State minimum requirement of once every ten years. Based on these data limitations, it was preferred to develop a *cross-sectional regression analysis.*

In addition to the assessment data, the City of Milwaukee's Department of City Development provided additional data including locations of Business Improvement Districts (BIDs) and Tax Increment Finance Districts (TIDs). MMSD provided all data, including shapefiles, on the locations and varieties of GI. Additional variables were assembled using US Census and American Community Survey data for socio-economic indicators, Wisconsin Department of Natural Resources data for brownfields, Southeastern Wisconsin Regional Planning Commission data on land uses, Milwaukee County Automated Mapping and Land Information System (MCAMLIS) for Shorewood parcels, and Milwaukee County Transit System data on transit nodes. The data was prepared using a combination of GIS analysis and database analysis.

Database Development

The first step in assembling a database for each of the four regression models involved selecting properties (study group cases) that are impacted by the GI and comparable properties that are not impacted by GI (control group cases). Using the data on GI provided by the MMSD, CED identified study group properties impacted by the GI development for each study area. Based on the attributes associated with the study group cases, CED developed selection criteria for accompanying control group cases. The selection criteria for the comparable properties focused primarily on use characteristics, including zoning and the land use category code, so that the comparison was not only between similarly zoned industrial properties, but also between properties with similar uses.

Variables

In this section, the physical, financial, demographic, and neighborhood quality variables included in our regression models are briefly outlined. Three models are distinguished for each of the target areas, which are grouped by property type: commercial, industrial, and residential. The four study areas correspond to the property types (for example, the selected Menomonee Valley properties are industrial, The Brewery properties are commercial, and Shorewood and Lincoln Creek properties are residential).

Dependent variables in the three City of Milwaukee models (Menomonee Valley, The Brewery, and Lincoln Creek) consist of the total assessed property value of each parcel, computed as the sum of assessed land and improvements by the City of Milwaukee's Assessor's Office on an annual basis. The variable is adjusted for inflation to 2011 dollars, and then logged to account for diminishing returns, as is standard practice in economic studies.

Due to the nature of the Village of Shorewood's assessment data, the dependent variable is the sales price for each property. Sales data was adjusted to 2011 dollars and transformed using the same natural log method used for the City of Milwaukee assessment data.

Independent variables, those measured for their impact upon the dependent variable, consist of a wide variety of physical, demographic or socioeconomic, or geographic characteristics. Many variables were compiled for each individual model, although upon regression, some variables showed no statistical significance so were not included in the final model. Although each model was unique, several independent variables are consistent across all study areas so were developed for each model.

- Building area and lot area are key independent variables across all four models; this type of physical description data is collected by the City of Milwaukee Assessor's Office as well as the Village of Shorewood Assessor. For Menomonee Valley and The Brewery, those properties without building improvements on them are included within the model and coded zero, such as parking lots and vacant properties.

- Some key census tract-level data are used in the models to control for various socioeconomic factors that play a role in determining property values. These include population density, percentage of black and Hispanic populations, percentage of persons living in poverty, adjusted median household income (logged), percentage of population with a high school diploma or bachelor's degree or higher, and commuting time. These figures were taken from Census and American Community Survey databases (2000 Census SF3 and 2010 American Community Survey 5 Year estimates). Because annual data for these variables is unavailable at the tract level, figures were calculated from the best available 2000 and 2010 estimates, and the annual data was then interpolated using data points as bookends and adjusting based on local trends.

- GIS was also used in this project to control for various features in the Milwaukee market that may impact property values. Other standard variables were added, such as the number of vacant properties and brownfield sites within 500 and 1,000 feet of each parcel. As proximity to parks is often considered to have a positive impact on property values, a variable measuring the number of parks as well as park acreage within a 500 and 1,000 foot radius was calculated for each model. As many properties are within active tax incremental finance districts (TIDs) and business improvement districts (BIDs), dummy variables for these factors are also included in the Menomonee Valley and The Brewery models. Distance to important geographic features in the Milwaukee area are also factored into the models. These include distance to Lake Michigan, distance to closest streams and rivers, distance to nearest bus stops, and distance to nearest freeway on-ramp.

The specific variables included in each model are listed under RESULTS.

Fiscal Impact Analysis and Return On Investment

The regression models do not tell the whole story of the fiscal impact of GI on property values; more information is needed to gain a full understanding of the relationship between GI and the assessed values. Estimating the amount of new or additional property tax revenues generated by new public improvements using a Return On Investment (ROI) approach can be a useful tool for assessing the value generated by these projects. This estimate can help show how much the newly generated property values contribute towards paying off the capital investment.

For each of the Study Areas, CED calculated the ROI based on the amount of new property tax revenue by taking the estimated amount of new property value and multiplying it by the annual property tax mill rate. It should be noted that spillover effects may encompass an area larger than the study area, but this only takes into account assessments within the defined geographic study area. Additionally, this does not take into account any additional revenues generated for the MMSD through user charges. It should also be noted that user charges tend to account for about 1/3 of the revenues generated for the MMSD for their budget (both operating and capital). This means that the study areas where new development is occurring (the Menomonee Valley and The Brewery) are more likely to generate significant increases in user charges, whereas user charges in the residential study areas (Lincoln Creek and Shorewood) are not likely to increase.

RESULTS

Study Area 1: The Menomonee Valley

Background

The Menomonee Valley is an industrial area located east of the City of Milwaukee's central business district. It encompasses an area approximately 4 miles long and ½ mile wide along the Menomonee River, and includes the eastern terminus of the Menomonee River as it flows west to east into the Milwaukee River estuary and on into Lake Michigan. From a historical perspective, the Menomonee Valley was Milwaukee's major industrial corridor beginning in the mid- to late-1800's, when Milwaukee was known as the "Machine Shop of the World". From 1879 to 1985, the Menomonee Valley was the location of the Milwaukee Road Shops, an enormous complex that made rail cars and locomotives. At its peak, over 50,000 employees worked at industries in the Menomonee Valley. By the 1980's, much of the heavy industry disappeared or had moved overseas. With over a century of heavy industrial use and with heavy industry in decline, the Menomonee Valley was significantly blighted and in dire need of cleanup and redevelopment.[30]

Due to the impact that a century of heavy industry had on the land and the Menomonee River that flows through the site, redevelopment required a significant amount of environmental cleanup, brownfield remediation, and site restoration. To address these concerns, in 1999 the Menomonee Valley Partners[31], a non-profit economic development organization, was established to serve as the lead agency in the redevelopment. They served to coordinate redevelopment efforts through numerous public agencies, private engineering

[30] More on the history of the Menomonee Valley is provided by Milwaukee Historian John Gurda at www.renewthevalley.org/media/mediafile_attachments/04/4-gurdavalleyhistory.pdf

companies and developers, and local businesses that remained in the Valley. In addition to the Menomonee Valley Partners, the MMSD, City of Milwaukee, HNTB, and Wenk Associates[32,33], played key roles in the planning and redevelopment of the Menomonee Valley.

Menomonee Valley Stormwater Park

The primary funding mechanism for infrastructure development and environmental cleanup derived from tax increment financing districts (TIDs). Between 1999 and 2012, the City of Milwaukee created four TIDs to address the funding of public infrastructure in in the Menomonee Valley. The total authorized expenditures for the four TIDs is approximately $32M. This does not include the resurfacing of Canal Street, a project which cost $36.5M, the construction of the 6th Street Viaduct which cost about $50M, nor the $72M in public funding that went to improve Miller Park and 260 acres surrounding the baseball stadium.

The four TIDs are summarized as follows:

- 2004 - TID 53 – 'Menomonee Valley Shops'
    - Established in 2004
    - Estimated authorized expenditures: $22.7M
    - Base property value was around $4.75M and estimated cost recovery is the year 2031.

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[31] Information about the Menomonee Valley Partners and the redevelopment of the Menomonee Valley is available online at www.renewthevalley.org/

[32] The team of Wenk Associates and HNTB Corporation were selected in a national design competition which began the process of redeveloping of the Menomonee Valley.

[33] Wenk Associates provides a case study about the redevelopment of the Menomonee Valley online at www.lafoundation.org/research/landscape-performance-series/case-studies/case-study/135/pdf/

    - Focus of the project was the redevelopment of the former 134 acre Milwaukee Road Shops site (heavy industry) into a business park. The DNR provided a Green Space and Public Facilities Grant to offset some of costs for the development of the stormwater park located in the western part of the Valley.
    - Information available online at city.milwaukee.gov/ImageLibrary/Groups/cityDCD/business/TIF/2011-Reports/TID53.pdf
- 2005 - TID 57 – 'Harley Davidson Museum'
    - Estimated authorized expenditures: $5.75M
    - Base property value was $0 and estimated cost recovery is the year 2021
    - Focus of the project was the development of the Harley Davidson Museum and Hotel/Restaurant, which opened in 2008. The site is located on a 20 acre brownfield parcel along the Menomonee River, and the TID was for site improvements including brownfield/environmental remediation, dockwall construction, and grading to raise the site out of the 100 year floodplain.
    - Information available online at www.mkedcd.org/business/TIF/reports/TID57.pdf
- 2006 – TID 63 – 'Falk/Rexnord'
    - Estimated authorized expenditures: $2.5M
    - Base property value was $8.9M and the projected TID recovery is 2026.
    - Focus of the project was to assist the Falk/Rexnord corporation with a $35M upgrade and re-equipment of its facility, due to the site work and infrastructure necessitated by the Canal Street project.
    - Information available online at www.mkedcd.org/business/TIF/reports/TID63.pdf
- 2009 – TID 73 – 'City Lights' (Zimmerman Architectural Studios)
    - Estimated authorized expenditures: $2.0M TIF
    - A breakout of expenditures included $2M for streets and utilities, and $0.5M for sewer.
    - Base property value was around $4.6M and the projected TID recovery is 2034.
    - Focus was on extension of public road, upgrades to sanitary sewer and stormwater infrastructure for an area of existing buildings that include some existing occupied and abandoned buildings (warehouses). The area is blighted and includes historically designated buildings. An architectural firm rehabilitated one of the historic buildings for offices, and the area plan is designed for more office and light industrial redevelopment.
    - Information available online at city.milwaukee.gov/ImageLibrary/Groups/cityDCD/business/TIF/2011-Reports/TID73.pdf

The Menomonee Valley redevelopment has received very positive attention and accolades from numerous local, state, national and international groups for innovation in design, engineering, and planning. In 2008, the International Economic Development Council recognized the City of Milwaukee with an Excellence in Economic Development Award for its work in the Menomonee Valley. It was named as a finalist by the National League of Cities for an Award for Municipal Excellence in 2010, and in 2011, Landscapes of Place, LLC received an award from the American Society of Landscape Architects for its work in the Valley. The

Menomonee Valley Passage, a bridge designed by HGA Inc, received several local awards along with a statewide award from the American Council of Engineering Companies.

Green Infrastructure in the Menomonee Valley

Green infrastructure within the Menomonee Valley was developed over the past decade in conjunction with other infrastructure improvements, with improvements beginning in the eastern portion of the Valley in 2003. Most of the GI in the western portions was completed by 2007. In total (and not counting rain barrels), CED identified 12 GI projects within the Valley study area, consisting of a variety of bioretention facilities, green roofs, green alleys/ streets, porous pavement, and rainwater catchment facilities, with the largest being a three acre stormwater park. The stormwater park is the centerpiece of GI in the Menomonee Valley, and was named one of the Sierra Club's 'Best New Development Projects' for 2006. The stormwater park[34] and surrounding developable lands were engineered to enhance and integrate stormwater permeability throughout the western part of the Valley. It has both high aesthetic appeal and incorporates recreational facilities (ball fields and trails), indicating that it likely has had a very positive impact on surrounding property values.[35]

The Menomonee Valley Regression Model

Due to the availability of annual assessment data from the City of Milwaukee, CED developed a panel regression model for the Menomonee Valley study area. CED identified 140 industrial properties within the Menomonee Valley that were either directly or adjacently impacted by the GI developments; these properties comprised the Study Group. To test the impact that GI has on property values in the Valley, other properties outside the target area were also selected for comparison (Control Group properties). The control group properties were selected randomly, based on selected criteria that included similar zoning and 4-digit land use coding, as the Study Group properties. Criteria for control group selection also required that comparable properties were not located within the same assessment "neighborhoods" as the study group properties, and that such properties were not located within 500 feet of any GI. In other words, in the industrial model, as only a limited number of industrial land use codes were found within the Menomonee Valley Study Area, only properties with similar land use codes were included in the control group.[36] Using this method, CED identified 510 comparable properties (Control Group cases) that were not directly or adjacently impacted by any other GI, for a total of 650 cases (both Study and Control Group) for the year 2011. Map 1 shows the locations of Study and Control Group cases and GI for the Menomonee Valley model.

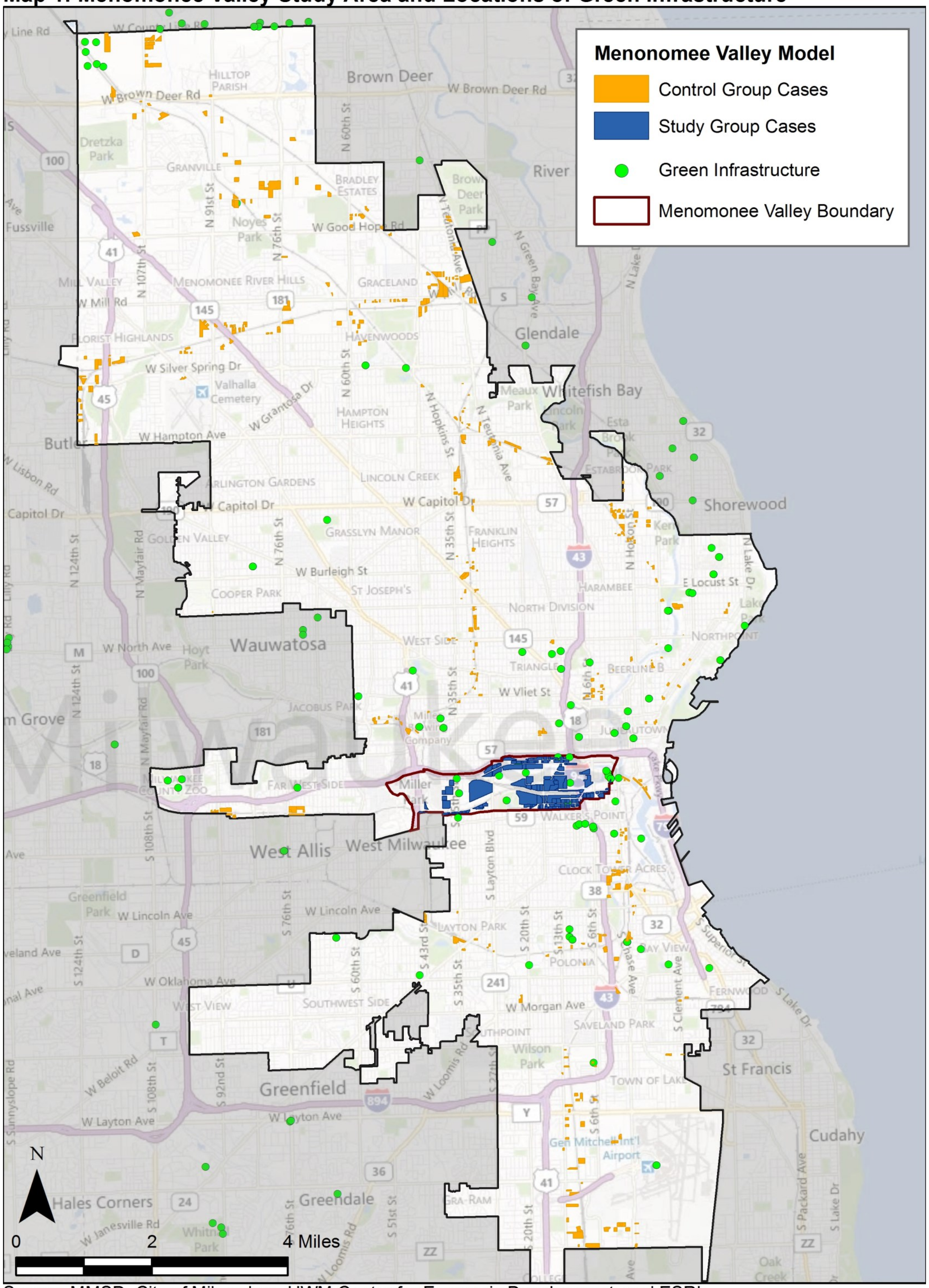
In order to capture the changes that show pre-development conditions, CED included data for all study group and control group properties going back to the year 2001. This meant that the entire Menomonee Valley model (650 properties) observed over 11 years (between 2001 and 2011), consisted of 7,150 observations. Some of these observations were dropped for

[34] More information on the Menomonee Valley's Stormwater Park is available online at dnr.wi.gov/ files/PDF/pubs/rr/RR827.pdf

[35] Jae Su Lee and Ming Ha Li *The Impact of Detention Basin Design on Residential Property Value: Case Studies Using GIS in the Hedonic Pricing Model*, Landscape and Urban Planning, 89, pages 7 – 16, 2009. Available online at people.tamu.edu/~minghan/PDF/2009%20Lee%20and%20Li%20detention% 20pond.pdf

[36] A full list of land use codes, zoning codes, and neighborhood codes used as selection criteria for cases included in the models are included in each model's spreadsheet.

Map 1: Menomonee Valley Study Area and Locations of Green Infrastructure



Source: MMSD, City of Milwaukee, UWM Center for Economic Development, and ESRI.

reasons including incomplete data or new or emergent properties. Therefore, the model included a total of 6,319 observations. This process of culling the data was repeated for each of the models.

In the Valley model, the key dependent variable is the total assessed value while the key independent variable in each target area is a dichotomous dummy variable indicating the presence of green infrastructure within 2,500 feet[37] of any given taxkey parcel (0 or 1). Although data on the Land and Improvements portions of the property assessments were collected and tested in preliminary versions of the model, CED chose to use the Total Assessed Value, which is the combined value of the land and improvements. A discussion with the City of Milwaukee's Assessor's Office indicated that the value of the land is significantly less important and changes with considerable less frequency than the value of improvements for developed properties. However, there are numerous industrial properties without major improvements (for example parking lots), therefore using the Total Assessed Value as the dependent variable was most preferred.

Model Results

The Menomonee Valley model shows the impact of green infrastructure on industrial properties within the City of Milwaukee. Overall, the model performs well and estimates a modest impact of green infrastructure on property values. Full regression results are listed in Table 1.

As Table 1 shows, holding all other variables constant, in any given year, the assessed property values of the Menomonee Valley industrial properties were 5.8 percent higher than they otherwise would have been without GI, in terms of the logged, adjusted assessed value of each property. This estimate is translated into a $13,300 increased assessed value for the average industrial property in Milwaukee. In other words, an average industrial property would expect a property value increase of roughly $13,300 with the construction of a green infrastructure project similar to those in the Menomonee Valley. Given that the average number of properties impacted by GI projects totals 117, CED estimates that the total impact of GI in the Menomonee Valley is about **$1,558,100 in added assessed value**. Because the estimates are calculated with averages, CED urges caution in using these figures in relation to actual properties.

Caution is also urged based on the concern that GI within Menomonee Valley was developed at the same time that some of the other infrastructure and improvements were being developed. What this indicates is that the results within the model include both the impacts of GI along with the impacts of the other infrastructure improvements that were occurring concurrently and therefore the estimated $1.56M in increased value should be attributed to redevelopment efforts as a whole.

The model coefficients indicate correlation and direction for the variables and help demonstrate the validity of the model. For example, as expected, the total assessed value of a property increases with an increase in both building area and parcel (lot) area. Also, the total assessed values are positively correlated with an increasing percentage of high school

[37] This distance accounts for properties within western portions of the Valley which were significantly further away from early GI development within the eastern part of the Valley. As of 2011, most properties within the Valley are located within 500 feet of a GI.

graduates, an increasing number of parks, or an increase in median household incomes. Distance to bus stops is also positively correlated, although proximity to nearest freeway entrance or nearest stream or river is not considered beneficial. The number of vacant parcels located within 1,000 feet of a property indicates a negative correlation; the greater the number of vacant parcels, the lower the assessment.

Table 1. Full Hedonic Model for Analyzing the Influence of Green Infrastructure on Assessed Values Industrial Properties Menomonee Valley Study Area

Variables	Coefficient	(Std. Error)	Sig. (P <|z|)
Green Infrastructure	0.058	(0.022)	0.010**
Building Area (in square feet)	4.70E-06	(0.000)	0.000**
Parcel Area (acres)	1.74E-06	(0.000)	0.000**
Distance to Lake Michigan	3.92E-06	(0.000)	0.327
Distance to Closest River or Stream	-1.63E-04	(0.000)	0.000**
Distance to Nearest Freeway Ramp	-1.02E-05	(0.000)	0.453
Distance to Nearest Bus Stop	6.74E-05	(0.000)	0.318
Tax Increment Finance District (TID)	-0.088	(0.026)	0.001**
Business Improvement District (BID)	0.118	(0.018)	0.000**
Number of Brownfields within 1,000 feet	0.017	(0.004)	0.000**
Number of Vacant Properties within 1,000 feet	-0.001	(0.000)	0.121
Number of Parks within 1,000 feet	0.020	(0.009)	0.033**
Percent of Population with High School Diploma	2.232	(0.122)	0.000**
Percent of Population In Poverty	0.946	(0.108)	0.000**
Percent of Population Black	-0.112	(0.095)	0.242
Median Household Income (log)	0.415	(0.051)	0.000**
Population Density	0.007	(0.005)	0.199
Parking Lot (dummy variable)	-0.094	(0.035)	0.007**
Constant	5.826	(0.557)	0.000**

NOTES: The table lists xtreg coefficients on the assessed value of industrial properties in the city of Milwaukee. The dependent variable is adjusted assessed property value (logged). N = 6,319 with 633 panels; overall $R^2 = 0.2734$.
** $p < 0.05$, * $p < 0.10$

The presence of an industrial property within an active Business Improvement District (BID) is also positively correlated with an increase in total assessed value. Surprisingly, presence within an active Tax Increment Financing District (TID) had a negative association, which goes against the premise that properties within TIDs have a tendency to experience greater increases in assessed values within a shorter time span than their counterparts outside of TIDs. This suggests that industrial properties within TIDs may not experience higher assessment growth than non-TID properties.[39] Although further study may be warranted for the impact of TID on industrial properties in Milwaukee, this is not necessary to show the impact of green infrastructure on properties within TIDs.

[39] Richard Dye and David Merriman *Tax Increment Financing: A Tool for Local Economic Development,* Land Lines (Lincoln Institute paper) Vol 18, No 1. January 2006. Accessible online at www.lincolninst.edu/pubs/1078_Tax-Increment-Financing

The number of brownfields showed an unexpectedly positive correlation with total assessed values; this positive correlation may make sense for industrial properties as open brownfields are likely indicative of intensively used industrial areas which may explain the positive correlation. It should be noted that this model only included brownfield locations that were designated 'open' by the Wisconsin Department of Natural Resources, and were limited to two WDNR categories, Leaking Underground Storage Tanks (LUSTs) and Environmental Repair Sites (ERPs). Any 'closed' sites, those considered remediated, were excluded from the study.

Fiscal Impact: The Menomonee Valley

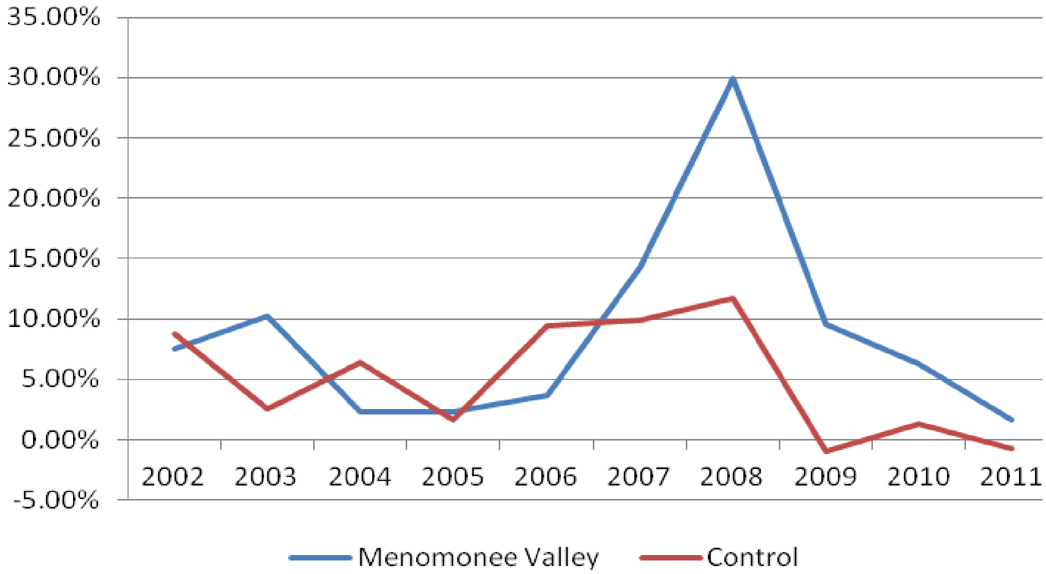
Return On Investment

The estimated cost of public infrastructure improvements and environmental remediation in the Menomonee Valley between 2001 and 2011 was about $41M. Of this, about $32M was provided as an investment in infrastructure (roads, sewer, water, and utilities) through the four TIDs, and approximately $9M was spent on environmental remediation, which included all brownfield remediation, greenspace development, and green infrastructure. The total cost of green infrastructure investment in the Valley is estimated at **$1.8M**, which includes both public and private investments; of this, approximately **$835,000** was provided by the MMSD.

In the study area, property value growth for industrial properties was higher after the implementation of the TIF districts, as expected. As Figure 1 shows, beginning in 2007, property value growth in the Menomonee Valley outpaced the rate for the comparable industrial properties. The property value growth rate was actually lower for the study group in 2004 and 2006, suggesting perhaps that the impact of infrastructure on industrial property values may have been delayed in the first years of the TIF districts. Assessment growth in the study group between 2007 and 2011 outperformed the control group.

In the Menomonee Valley model, the industrial property values were estimated to be $1,558,100 higher in any given year as a result of the new green infrastructure. MMSD's average annual mill rate from 2003 through 2011 is $1.48. Thus, the estimated amount of *additional* property tax revenue directly connected to the Menomonee Valley total infrastructure projects is $2,300 per year. At this rate, MMSD's initial capital investment of $835,000 will be paid off in 360 years, or the year 2360, if based on the increase; this however, is based on the results from the model as stated in average estimates. Based on the model, the estimate indicates that the 117 industrial properties (a yearly average of those included in the study group) would expect to generate about $1,558,100 in additional assessed value in any given year between 2001 (base year) and 2011 (latest year of data). As mentioned in Appendix A, some of the properties or observations within the model were dropped due to incomplete data. This estimate of $1,558,100 does not include any of the non-industrial properties (commercial and residential) also located within the Valley that likely were also impacted by the GI. It also does not take into account the overall increase in assessed values that the properties have and will continue to experience over time.

Figure1: Property Value Growth Rates in the Menomonee Valley and Control Target Areas, 2002-2011



Source: City of Milwaukee MPROP database and UWM-Center for Economic Development

Table 2 and Figure 2 show changes in assessed values between the industrial properties in the control group and the study group over the study period, adjusted to reflect 2011 dollars. Not all industrial properties were included within the model for every given year, in either the study group or control group. The model begins in 2001 with 104 properties and ends in 2011 with 140, with the addition of 36 industrial properties in the study group. For the control group, which again is every other similar comparable industrial property within the City of Milwaukee, the model begins with 436 properties in 2001 and ends in 2011 with 509 properties. For the control group, the average assessed values increased through 2008, but have since declined slightly; overall assessment growth rates have remained stagnant since 2008.

The additional 36 industrial properties added as of 2001 created over $78.6M in assessed value, or about 46 percent of the $170.3M in total assessed values for the 140 properties in 2011. Whether or not such an increase would have occurred had the GI infrastructure improvements been included along with the other infrastructure improvements is debatable, but it is undeniable that the development would not have occurred *but for* all of the investments in infrastructure improvements and TIDs.

Figure 2 shows the average assessed value for the study group industrial properties in the Menomonee Valley compared to the control group properties between 2001 and 2011. The average assessments are also adjusted to reflect 2011 dollars. The average assessments in the control group grew steadily between 2001 and 2008, and then began to experience a slight but general decline in 2009. Between 2001 and 2006, the study group also experienced a similar steady increase, but between 2006 and 2008, there was a significant increase in the average assessment, which included the addition of at least 8 new properties including the multi-million dollar Harley Davidson Museum in 2008. And between 2009 and 2011, as the control group properties were experiencing a reduction in value due to the impact of the Great Recession, the study group properties were maintaining their overall value if not slightly increasing.

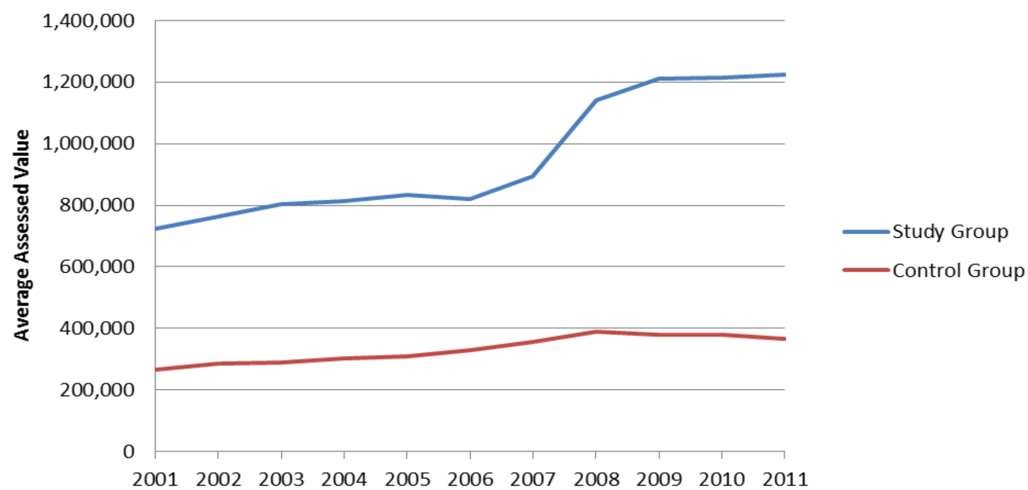
Table 2: Comparison of Assessed Values for the Study and Control Groups within the Menomonee Valley Model

Year	Study Group				Control Group			
	Proper-ties	Total As-sessed Value	Average Assessed	Growth Rate	Proper-ties	Total As-sessed Val-	Average Assessed	Growth Rate
2001	104	75,233,145	723,396	--	436	115,807,484	265,613	--
2002	106	80,886,664	763,082	7.5	440	125,930,508	286,206	8.7
2003	111	89,207,703	803,673	10.3	447	129,198,672	289,035	2.6
2004	112	91,241,883	814,660	2.3	454	137,486,387	302,833	6.4
2005	112	93,330,453	833,308	2.3	453	139,712,174	308,415	1.6
2006	118	96,813,589	820,454	3.7	466	152,952,429	328,224	9.5
2007	124	110,674,367	892,535	14.3	473	168,107,658	355,407	9.9
2008	126	143,790,214	1,141,192	29.9	481	187,855,065	390,551	11.7
2009	130	157,543,696	1,211,875	9.6	488	185,947,938	381,041	-1.0
2010	137	167,517,374	1,213,894	6.3	498	188,298,577	378,110	1.3
2011	140	170,256,000	1,224,863	1.6	509	186,818,348	367,030	-0.8

Note: Assessed values are adjusted for inflation to reflect 2011 dollars.
Source: City of Milwaukee MPROP database and UWM-Center for Economic Development

In addition to the industrial properties, as of 2011, there are an additional 222 non-industrial taxable properties located within the Menomonee Valley. These are the commercial and residential properties as well as properties under some sort of development that were also likely positively impacted by the GI and other infrastructure development. Map 2 shows the distribution of all taxable properties in the Menomonee Valley based on use. Table 3 summarizes the non-industrial properties (residential and commercial) and their assessed values in 2011. As of 2011, the total assessed value of these properties was about $100.6M. Of note, these include the new Harley Davidson Museum complex. Assisted through the development of a $5.75M TID through the City of Milwaukee, this property had a $0 base value in 2005 and was assessed at about $15M in 2011.

Figure 2: Average Assessed Value for Industrial Properties, 2001 to 2011



Note: Assessed values are adjusted for inflation to reflect 2011 dollars.
Source: City of Milwaukee MPROP database and UWM-Center for Economic Development

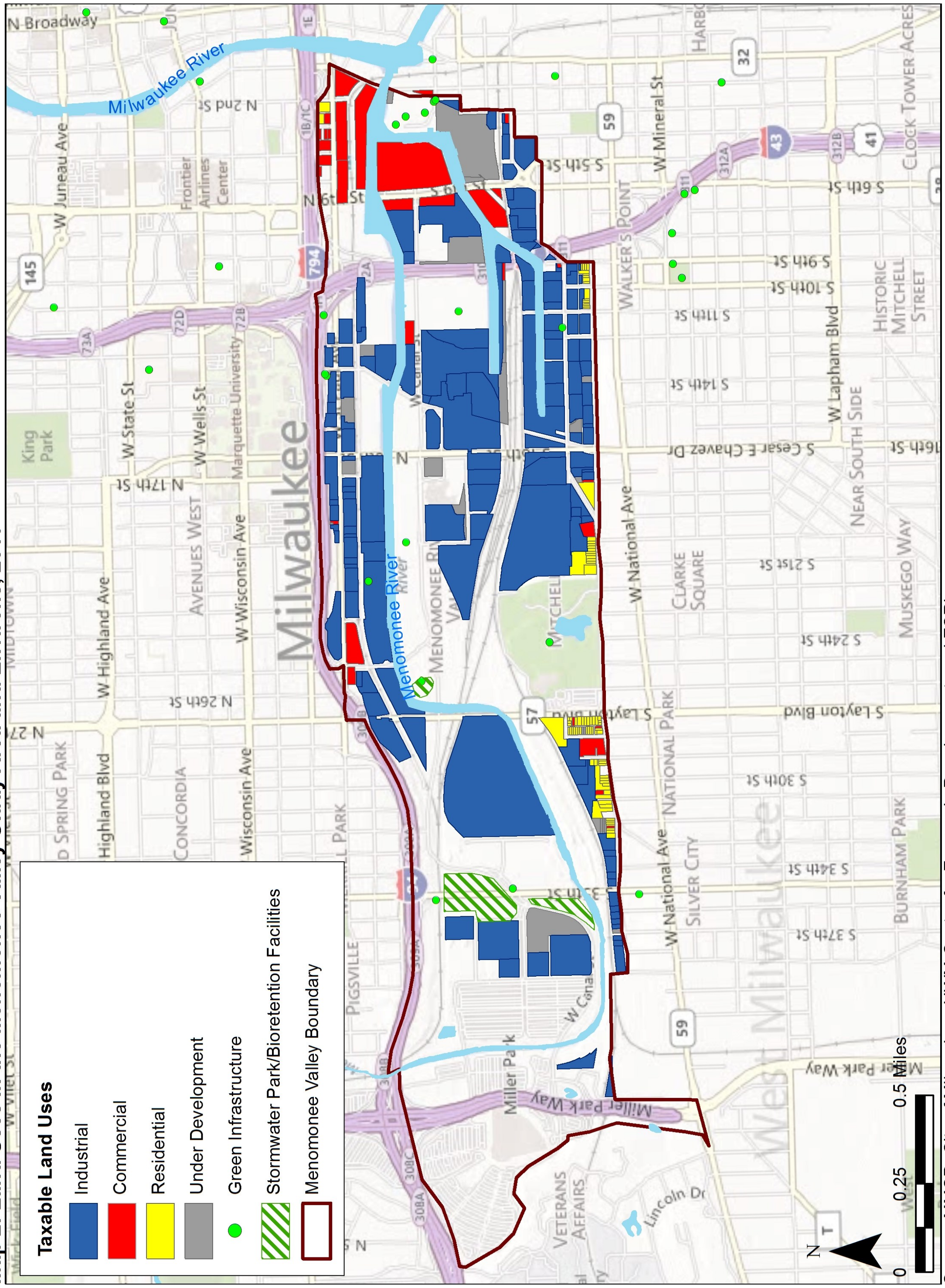
Table 3: Non-Industrial Land Uses and Assessments in the Menomonee Valley, 2011

Land Use Type	Number of Parcels	Total Assessed Value
Commercial	35	52,025,300
Residential	163	40,485,600
Under Development[1]	24	8,061,100
SUBTOTAL	222	100,572,000
Industrial Properties	140	170,256,000
TOTAL	**362**	**270,828,000**

[1] A total of 24 properties within the Valley study area were identified as under development in 2011. These properties will likely add additional assessed value upon completion.
Source: City of Milwaukee MPROP database and UWM-Center for Economic Development

The total assessed value of taxable properties in the Menomonee Valley Study area is estimated to be about $270.8M in 2011, which, when adjusted for inflation is considerably higher than the same properties in 2001 ($168.0M, adjusted to reflect 2011 dollars). With an estimated mil rate of $1.48, the MMSD should anticipate receiving about ***$400,800*** in annual revenue generated from the total assessed value of all taxable properties within the Menomonee Valley study area. Under current conditions, it would be anticipated that at this rate, ***MMSD's initial capital investment of $835,000 will be paid off in 3 years*** or by the year 2014. This assumes that all of the revenue generated from the Menomonee Valley going to the MMSD would be used to pay off the GI. Given the impact that all infrastructure

Map 2: Land Uses in the Menomonee Valley Study Area and Environs, 2011



Source: MMSD, City of Milwaukee, UWM Center for Economic Development, and ESRI.

investment has had on development in the Valley, and based upon the performance of the four TIF districts and the recruitment activity of the Menomonee Valley Partners in developing additional parcels (those under development or vacant), it is anticipated that continued development will occur and that the payoff for the GI investments will occur sooner than 2031 (anticipated end year for TID 53). In addition, it should be noted that this analysis does not take into consideration any additional revenues generated by the additional user charges nor any costs that were likely to accrue had the GI not been developed.

Study Area 2: The Brewery

Background

The Brewery is the site of the former Pabst Brewery complex, which first opened in Milwaukee in 1844. Pabst was once the nation's largest brewer, with sales reaching a high of 15.6 million barrels in 1978 before they began to decline. In 1996, Pabst laid off 70 percent of its Milwaukee workforce, shifted the remainder of its production to Stroh Brewing Co.'s La Crosse plant, and moved the company headquarters to San Antonio, Texas. The 19th Century buildings were in significant disrepair and created a blighted neighborhood along the western edge of the City's central business district, adjacent to the Interstate 43 corridor.

The preservation of the 28 Pabst buildings was ensured in 2001, when they were added to the National Register of Historic Places. The buildings are distinct due to their German Renaissance Revival architectural style, which reflected the character of the city in the late 19th century. In 2002, a group of developers purchased the property for $10.3M with plans to redevelop it into a retail and entertainment district for about $317M, but when their proposed plans failed to receive a $41M TIF district, they sold the property to the Zilber Company in 2006.

The Zilber Company subsequently renamed it "The Brewery" and began working with the City of Milwaukee to develop a TIF district for infrastructure financing. Much of the infrastructure redevelopment at The Brewery has incorporated both public and private funds. Redevelopment efforts have been collaborative between the various developers (Zilber, Gorman & Co, TMP Development/Dermond), private industries, non-profits, and numerous public agencies and the City of Milwaukee and the MMSD. In 2007, the City of Milwaukee authorized a $29M TIF district to cover the costs of site remediation, demolition, easement purchases, and infrastructure development and redevelopment:

- 2004 - TID 67 – 'Brewery Project'
    - Established in 2007
    - Authorized expenditures for this TID are $29
    - Base property value was around $9.25M and estimated cost recovery is the year 2031.
    - Focus of the project was the redevelopment of the former Pabst Brewery complex. The project will ultimately contain a mix of residential, office, educational, and retail space. In addition to the investments in infrastructure, a significant amount of the TID funding was used for historic preservation easements ($7M) and for demolition and abatement ($9.4M).
    - Available online at city.milwaukee.gov/ImageLibrary/Groups/cityDCD/ business/TIF/2011-Reports/TID67.pdf

Although much of the work is complete, including public infrastructure GI, much of the redevelopment within The Brewery is ongoing as of 2013. Buildings are being retrofitted for a variety of commercial and residential uses and it has become known as a model for sustainable development. The Brewery competed in a pilot project for the US Green Building Council's LEED for Neighborhood Development program, and in 2011 received LEED Platinum status for the development, a major honor. This award was given to only 4 neighborhood design/developer teams out of a highly competitive field of 250. Based on this, it is noted that GI is integral to The Brewery development, and that it is unlikely that LEED Platinum status would have been achieved without the GI improvements. Sustainable strategies that have been incorporated into The Brewery[40] include:

- Brownfield Redevelopment
- Historic Preservation
- Mixed-use Neighborhood
- Diverse and affordable housing
- Storm Water Management
- Streetscape Greening
- Heat Island Reduction
- Compact Development
- Shared Transportation
- Structured Parking
- Demolition and Construction Waste Management

It should be noted that although development at The Brewery has been ongoing since 2006 and that assessments have significantly increased (year after year basis), the impact of the Great Recession has likely slowed the pace of development, but will likely increase given the performance. This study area should be reviewed once more development occurs or once all authorized TIF funds are disbursed; discussions with the developers indicate that future GI projects are in the works.

Green Infrastructure in The Brewery

As part of the $29 million TIF for environmental cleanup, demolition, construction of new infrastructure GI development played a key role in redeveloping The Brewery. Much of the focus has been on sustainable

Bioswale at The Brewery

[40] The Brewery's sustainable strategy is available online at www.thebrewerymke.com/sustainability/index.htm

redevelopment including LEED certified buildings as well as historic preservation. Redevelopment within this area is still ongoing which indicates that it is recommended that this study be updated once development is complete.

GI within The Brewery is being developed in conjunction with much of the infrastructure and improvements. GI features located throughout The Brewery include permeable roads and porous pavement for green parking lots, green roofs, green alleys, raingardens, and rainwater catchment facilities (rain barrels, and cisterns). Zilber Park integrates a variety of GI into its design, including an entire underground rainwater catchment facility. Tree lawns and other landscaping will result in 200 percent more trees in the redevelopment area. Of note, roadside bioswales are integrated directly into the road and sewer infrastructure, indicating that the model results capture the impacts of the GI along with the impacts of the other forms of infrastructure. Given the nature of the development, it may not be feasible to definitively separate the impacts of GI from the rest of the infrastructure, but it should be noted that GI was intrinsic to the success of The Brewery and that its LEED for Neighborhood Development platinum status has likely had a significantly positive impact on assessments as well as rents.[41,42,43]

The Brewery Regression Model

Due to the availability of annual assessment data from the City of Milwaukee, CED was able to perform a panel regression analysis for The Brewery study area. CED identified 34 commercial properties within The Brewery that were either directly or adjacently impacted by the GI developments; these properties comprised the Study Group. The same method used for selecting potential comparable (Control Group) properties in the Menomonee Valley was also used for The Brewery, based on zoning, land use coding, and neighborhood coding variables of the Study Group properties; again all properties that were within 500 feet of any other GI were eliminated. This method allowed CED to identify 265 commercial properties identified as Control Group cases for a total of 299 properties in the model. The results of the 265 Control Group parcels included much of the Third Ward (condo/ conversions with some office and 1st floor commercial retail) along with commercial parcels in Riverworks area (BIDs 25 and 36). This is due to the concentration of the C9G zoning code in these locales, although there are some comparable properties scattered throughout the City. Map 3 shows the locations of properties and green infrastructure for The Brewery model.

Although development in The Brewery began in 2006, CED selected 2003 as the initial base year for the analysis, given that a prior development had been proposed and speculation about redeveloping the property began early in the decade. This means that over 9 years, there were 2,691 observations of the 299 properties within the initially assembled database.

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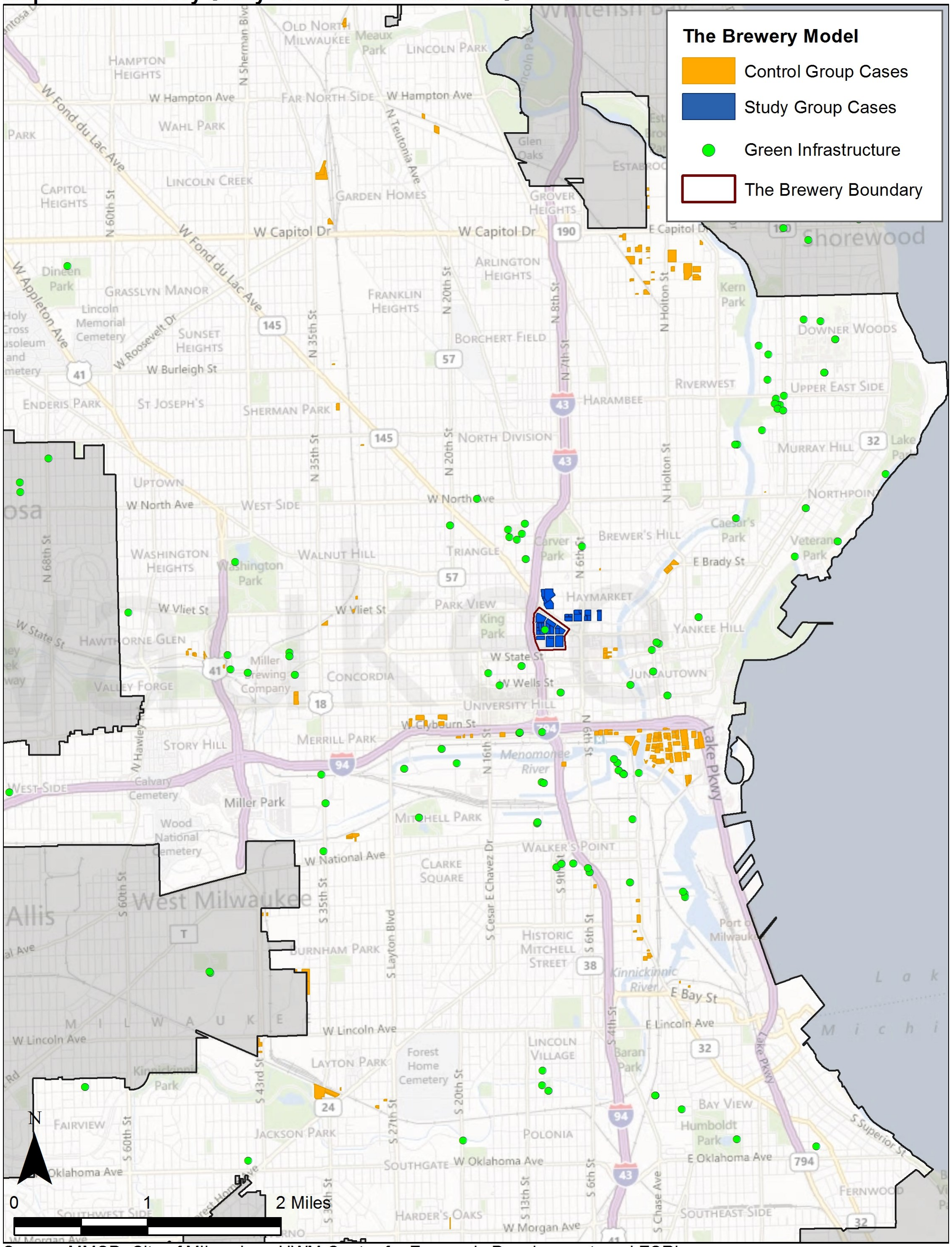
[41] Franz Fuerst and Patrick McAllister *Green Noise or Green Value? Measuring the Price Effects of Environmental Certification in Commercial Buildings*, School of Real Estate and Planning, University of Reading, 2008. Available online at mpra.ub.uni-muenchen.de/16625/9/MPRA_paper_16625.pdf

[42] Norm Miller, Jay Spivey, and Andy Florance *Does Green Pay Off?* Burnham-Moores Center for Real Estate, 2008. Available online at www.usgbc.org/ShowFile.aspx?DocumentID=5537

[43] Sofia Dermisi *Effect of LEED Ratings and Levels on Office Property Assessed and Market Values,* Journal of Sustainable Real Estate, Volume 1, Number 1, 2009. Available online at www.costar.com/josre/JournalPdfs/02-LEED-Ratings-Levels.pdf

Map 3: The Brewery Study Area and Locations of Green Infrastructure



Source: MMSD, City of Milwaukee, UWM Center for Economic Development, and ESRI.

After culling the database for dropped properties or missing variables, the entire assemblage included 2,359 observations.

Like the Menomonee Valley model, the key dependent variable is the total assessed value while the key independent variable in each target area is a dichotomous dummy variable indicating the presence of green infrastructure within 500 feet[44] of any given taxkey parcel (0 or 1). Although data on the land and improvement portions of the property assessments were collected and tested in preliminary versions of the model, CED chose to use the Total Assessed Value, which is the combined value of the land and improvements.

Certain variables that are commonly used in regression modeling for commercial properties were not available for this model. CED initially wished to include age of building, but this data is not collected for commercial or industrial properties as it is less indicative of building quality than other condition-related variables. Also, CED initially set out to assign lease or rental data (dollars per square foot) for each of the properties. Although the assessor collects some of this data, it is not consistently available across all commercial properties, and, as lease data within a single building may vary significantly among different units, CED was unable to adequately assign an average lease per square foot for each property.

Model Results

Overall, The Brewery model performs well, although somewhat worse than the industrial Menomonee Valley model, and estimates a moderate impact of green infrastructure on property values. Full regression results are listed in Table 4.

As Table 4 shows, holding all other variables constant, in any given year, the assessed property values of The Brewery commercial properties were 11.4 percent higher than they would have been without green infrastructure. This estimate is translated into a $22,000 increased assessed value for the average commercial property[45] in Milwaukee, or in other words, an average commercial property would expect an increase of roughly $22,000 with the construction of a green infrastructure project similar to those in The Brewery.

Given that the average number of properties impacted by GI projects totals 22, CED estimates that the total impact of green infrastructure in The Brewery to be **$485,000 in added assessed value**. Because the estimates are calculated with averages, CED urges caution in using these figures in relation to actual properties.

Like the Menomonee Valley model, the coefficients indicate correlation and direction for the variables and help demonstrate the validity of the model. For example, as expected, the total assessed value of a property increases with an increase in building area. However, in this model, the parcel area does not indicate positive correlation with the total assessed value; this likely has more to do with the compact nature of the commercial developments within the analysis; as most of the model properties are located in or near Milwaukee's Central

[44] This includes all properties located within 500 feet of a GI and east of Interstate Highway 43 which acts as a geographic barrier.

[45] The average commercial property is assessed at $161,504 and is not in a TID or BID, nor is it a parking lot. All other variables are held constant at their mean.

Business District, building area is more likely impacted by the number of stories rather than its parcel size.

Table 4. Full Hedonic Model for Analyzing the Influence of Green Infrastructure on Assessed Values of Commercial Properties : The Brewery Study Area

Variables	Coefficient	(Std. Error)	Sig. (P <|z|)
Green Infrastructure	0.114	(0.057)	0.047**
Building Area (square feet)	3.29E-06	(0.000)	0.000**
Parcel Area (square feet)	0.000	(0.000)	0.000**
Distance to Lake Michigan	0.000	(0.000)	0.000**
Distance to Closest River or Stream	-0.001	(0.000)	0.000**
Distance to Nearest Freeway Ramp	9.17E-06	(0.000)	0.873
Distance to Nearest Bus Stop	0.000	(0.000)	0.174
Tax Increment Finance District (TID)	-0.002	(0.064)	0.973
Business Improvement District (BID)	0.100	(0.093)	0.283
Number of Brownfields within 1,000 feet	0.044	(0.011)	0.000**
Number of Vacant Properties within 1,000 feet	0.007	(0.003)	0.054*
Number of Parks within 1,000 feet	0.033	(0.022)	0.151
Percent of Population: High School Graduates	0.647	(0.174)	0.000**
Percent of Population: In Poverty	1.054	(0.185)	0.000**
Percent of Population: Black	0.383	(0.229)	0.095*
Median Household Income (log)	0.203	(0.093)	0.031**
Population Density	0.012	(0.012)	0.337
Parking Lot (dummy)	-0.497	(0.082)	0.000**
Constant	9.694	(0.992)	0.000**

NOTES: The table lists xtreg coefficients on the assessed value of commercial properties in the city of Milwaukee. The dependent variable is adjusted assessed property value (logged). N = 2,348 with 297 panels; overall $R^2 = 0.5025$.
** $p < 0.05$, * $p < 0.10$

As anticipated, there are positive correlations between the total assessed values and an increasing percentage of high school graduates, an increasing number of parks, an increase in population density, proximity to freeways, and an increase in median household incomes. Surprisingly, there is a positive correlation with the number of vacant parcels located within 1,000 feet of a property; this means that the greater the number of vacant parcels in the vicinity, the higher the total assessed value. Although counterintuitive, given the context or the nature of the development adjacent to The Brewery over the past decade, this should come as no surprise, given the proximity to the numerous vacant parcels created during the demolition of the Park East freeway during the early part of the decade.

The presence of an industrial property within an active Business Improvement District (BID) was also positively correlated with an increase in total assessed value. And like the Menomonee Valley model, again CED sees a negative correlation between total assessed values and presence within an active Tax Increment Financing District (TID). Again, this may be an artifact of the TID process itself or the means in which CED measured active TID properties within the model.

Fiscal Impact: The Brewery

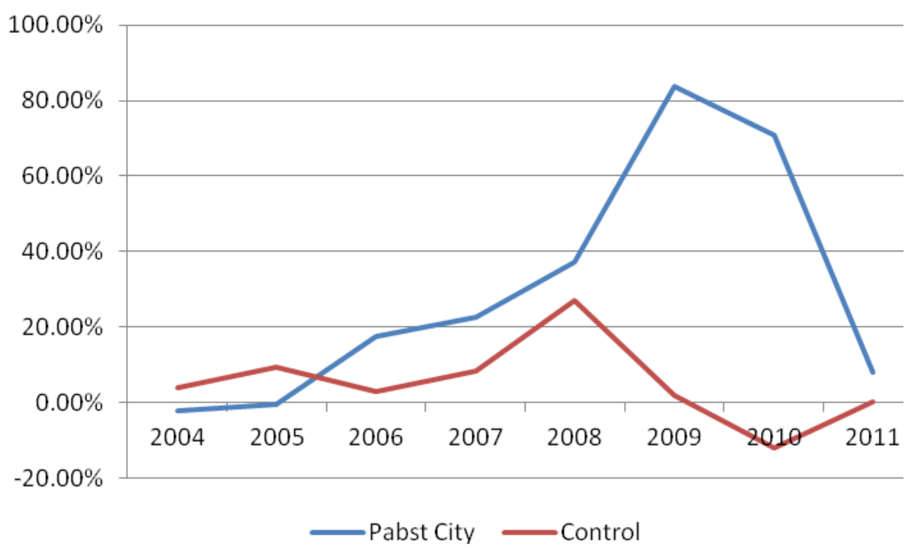
Return On Investment

As of 2011, the total investment in infrastructure in The Brewery is estimated at about \$11.6M with more investment anticipated. Of the \$29M in authorized TIF expenditures, a significant amount of the authorized TIF expenditures went to site preparation; approximately \$9.4M went to demolition and abatement (including brownfield mitigation), and just over \$7M went towards historic preservation easements. Between 2006 and 2011, about \$6.6M of public funding has been expended on the construction sewer and water facilities, and the paving of approximately 5,000 feet of new roadway. The total cost of public and private green infrastructure investments in The Brewery is approximately \$3.2M to date with additional private investment planned. Of the green infrastructure, \$2.2M came from private sources (Zilber and other developers). According to MMSD, their total GI expenditures to date are \$1.04M. An additional \$1.5M in public funding is expected to be approved for the construction of additional underground storm water retention systems, and an additional \$5M investment by Zilber for a green parking structure is also anticipated.

Again, total infrastructure investments took place at the same time as green infrastructure investments making it difficult to separate the impact of one from the other within the model. In The Brewery target area, property value growth far exceeded the rate for the control group; and again, this is likely due to the planned redevelopment efforts targeting the area. As Figure 3 shows, beginning in 2006, at the beginning of site redevelopment, property values grew at a significantly faster pace in The Brewery than for the control group properties. Prior to the TIF district, property value growth actually lagged behind the rate for the control group properties.

In The Brewery, property values are estimated to be \$485,000 higher in any given year as a result of the new green infrastructure. This is attributed to the 34 commercial properties identified within the model. MMSD's average annual mill rate from 2005 through 2011 is \$1.44. Thus, the estimated amount of *additional* property tax revenue directly connected to The Brewery green infrastructure projects is \$699 per year for these 34 properties. At this rate, MMSD's initial capital investment of \$1,038,000 will be paid off in 1,485 years if based solely on the increase; however, this is based on the results from the model as stated in average estimates. Based on the model, the estimate indicates that the 34 commercial or mixed-use properties (a yearly average of those included in the study group) would expect to generate about \$485,000 in additional assessed value in any given year between 2003 (base year) and 2011 (latest model year). Like the Menomonee Valley model, some of the properties or observations within the model were dropped due to incomplete data or if it was a new or emergent property.

Figure 3: Property Value Growth Rates in The Brewery and Control Target Areas, 2004-2011



Note: Assessed values are adjusted for inflation to reflect 2011 dollars.
Source: City of Milwaukee MPROP database and UWM-Center for Economic Development

Figure 3 demonstrates that properties in The Brewery were underperforming in comparison to similar properties prior to the purchase by Zilber in 2006. In fact, in 2004 and 2005, The Brewery properties were experiencing negative growth rates. Beginning in 2006, property value growth in The Brewery outpaced the rate in comparable commercial and mixed-use properties. As control group property assessments began to decline due to the Recession (starting in 2008), The Brewery properties continued experiencing an increase, likely due to the impact of the TIF and infrastructure development. Control group properties experienced negative growth in 2010, and as of 2011, are hovering around 0 percent. Although The Brewery growth rate declined during the Recession, it still outperformed the control group properties and remained just below 10 percent in 2011.

Table 5 and Figure 4 show changes in assessed values between the commercial and mixed-use properties in the control group and the study group over the study period, adjusted to reflect 2011 dollars. Not all properties were included within the model for every given year, in either the study group or the control group. The model begins in 2003 with 15 properties and ends in 2011 with 34 properties, with the addition of 19 new commercial or mixed-use properties (126 percent increase) in the study group. For the control group, the model begins with 221 properties in 2003 and ends in 2011 with 264 properties, a 19 percent increase in properties. The average assessed values fluctuated over this time period (increased through 2008 and have since declined).

Table 5: Comparison of Assessed Values for the Study and Control Groups within The Brewery Model

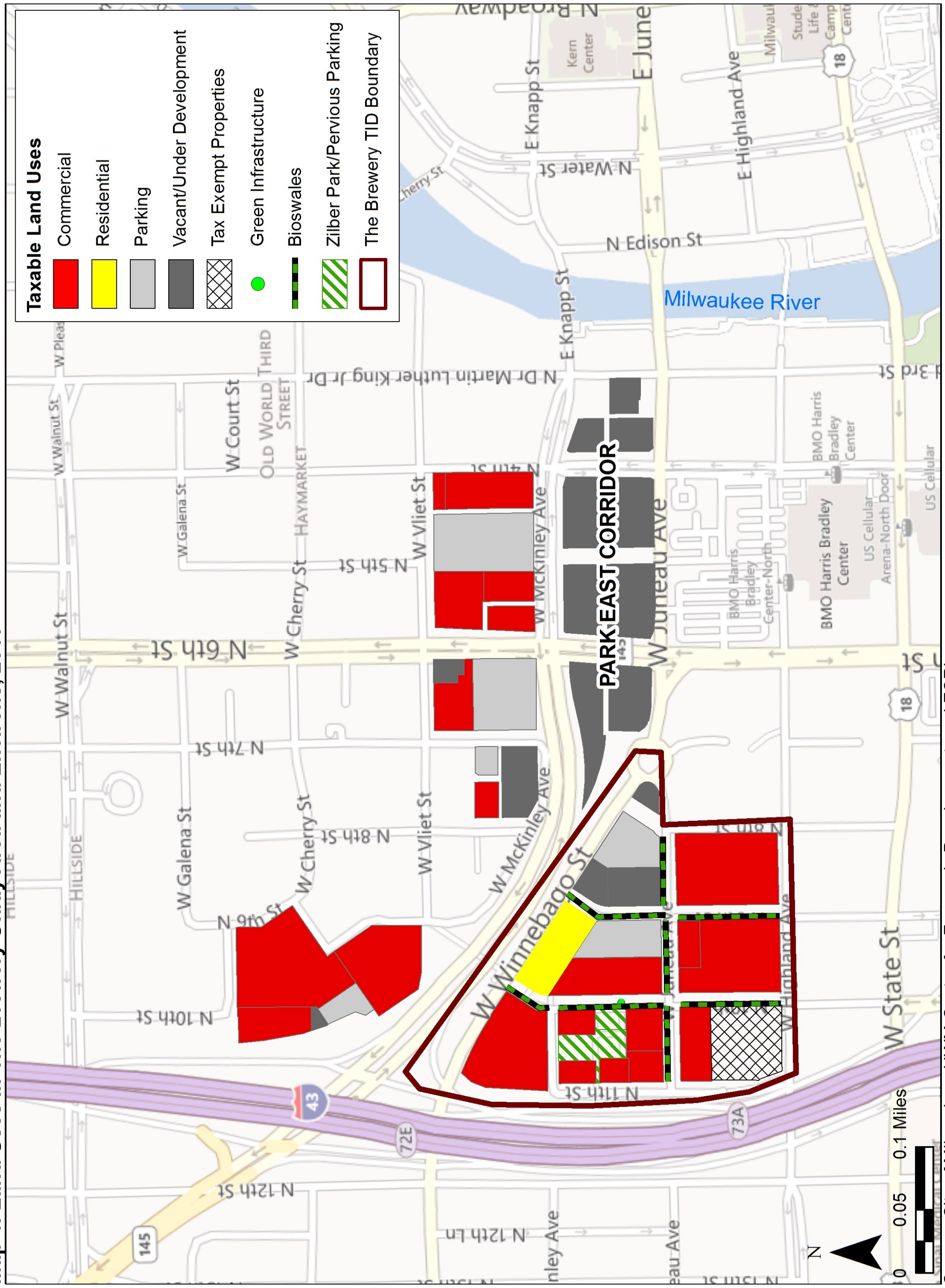
Year	Study Group				Control Group			
	Proper-ties	Total Assessed	Average Assessed	Growth Rate	Proper-ties	Total Assessed	Average Assessed	Growth Rate
2003	15	6,589,099	439,273	--	221	138,014,47	624,500	--
2004	15	6,448,788	429,919	-2.1	223	143,688,20	644,342	4.1
2005	16	6,425,208	401,576	-0.4	225	157,172,39	698,544	9.4
2006	17	7,549,300	444,076	17.5	231	161,954,46	701,102	3.0
2007	17	9,258,389	544,611	22.6	242	175,430,31	724,919	8.3
2008	22	12,699,894	577,268	37.2	245	222,720,76	909,064	27.0
2009	30	23,327,749	777,592	83.7	259	226,746,02	875,467	1.8
2010	32	39,892,359	1,246,636	71.0	259	199,808,92	771,463	-11.9
2011	34	43,082,200	1,267,124	8.0	264	200,038,50	757,722	0.1

Note: Assessed values are adjusted for inflation to reflect 2011 dollars.
Source: City of Milwaukee MPROP database and UWM-Center for Economic Development

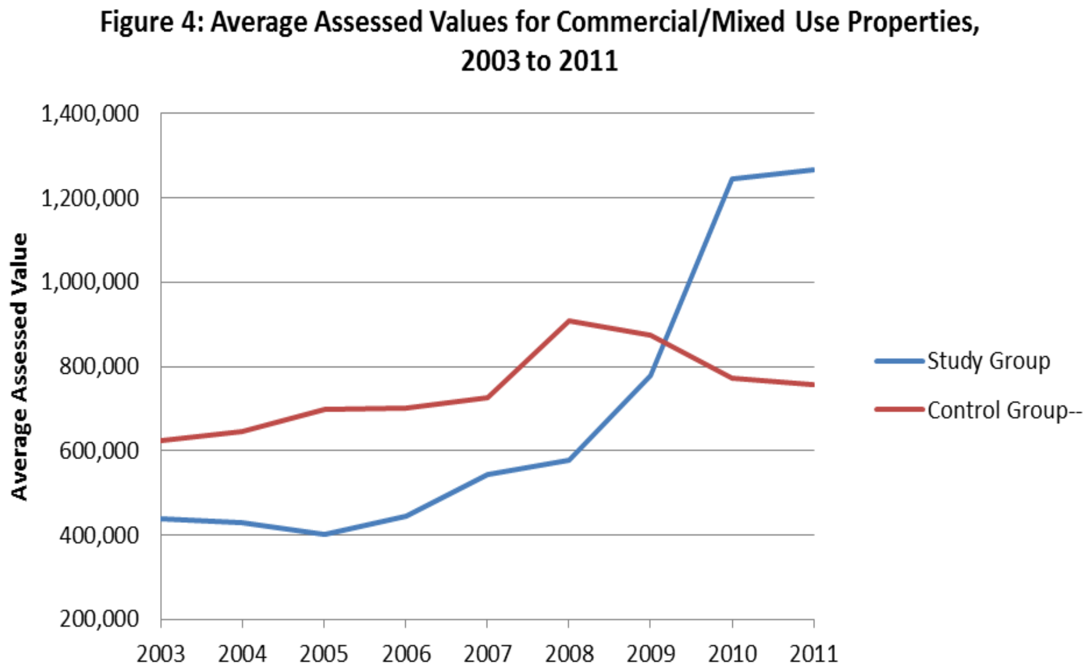
The additional 19 properties added as of 2003 created about $30.5M in additional assessed value in 2011, or about 71 percent of the $43.1M in total assessed values for the 34 properties in 2011. Whether or not such an increase would have occurred had the GI infrastructure improvements been excluded from the redevelopment efforts is unclear. It's also impossible to parse specific GI improvement projects within the model to determine which GI projects had the most impact on property values. The LEED Platinum Certification status for the redevelopment project was, however, dependent upon most if not all of the GI improvements and the status of such a high level certification added a significant amount of value to the redevelopment.

Figure 4 shows the average assessed value for the study group industrial properties in The Brewery compared to the control group properties between 2003 and 2011. The average assessments are adjusted to reflect 2011 dollars. The average assessments in the control group grew steadily between 2003 and 2008, and then began to experience a decline in 2009, with a significant decline between 2009 and 2010. Between 2003 and 2006, the study group property values were declining, but between 2006 and 2011, there has been a significant increase in the average assessments, which included the addition of at least 12 new properties onto the tax rolls. Again, it should be noted that between 2008 and 2011, as the control group properties were experiencing a significant reduction in value due to the impact of the Recession, The Brewery properties were increasing in value.

Map 4: Land Uses in The Brewery Study Area and Environs, 2011



Source: City of Milwaukee, UWM Center for Economic Development, and ESRI.



Note: Assessed values are adjusted for inflation to reflect 2011 dollars.
Source: City of Milwaukee MPROP database and UWM-Center for Economic Development

Unlike properties in the Menomonee Valley, The Brewery is bordered by a freeway to the west, vacant land to the east, and a significant number of non-taxable properties or public facilities to the north and south, meaning that any spillover effects from the The Brewery development on neighboring properties are fairly limited. There are, however, a significant number of vacant, undeveloped properties which may be positively impacted by the development in the future. These include properties in the adjacent Park East Corridor, a former freeway spur that has remained mostly undeveloped since its demolition in the early 2000's. Map 4 shows the uses of properties located in The Brewery and the location of the Park East Corridor.

The total assessed value of taxable properties in The Brewery is estimated to be about $43.1M in 2011, which, when adjusted for inflation is considerably higher than the same properties in 2003 ($6.6M, adjusted to reflect 2011 dollars). With an estimated mill rate of $1.44, the MMSD should anticipate receiving about ***$62,000*** in annual revenue generated from the total assessed value of all properties within The Brewery. Under current conditions, it would be anticipated that at this rate, ***MMSD's initial capital investment of $1,038,000 would be paid off in about 17 years*** or by the year 2028. This assumes that all of the revenue from The Brewery would be used to pay off the GI investment. Given the impact that all infrastructure investment has had on development in The Brewery, and based upon the performance of the TIF thus far, it is anticipated that continued development will occur and that the payoff for the GI investments will occur sooner than 2028. In addition, it should be noted that this analysis does not take into consideration any additional revenues generated by the additional user fees nor any costs that were likely to accrue had the GI not been developed.

Study Area 3: Lincoln Creek

Background

Lincoln Creek is a 9-mile long tributary of the Milwaukee River, a 21-square-mile drainage area located primarily within the City of Milwaukee. Flooding in areas adjacent to Lincoln Creek had been a problem since the 1960's, and an increase in runoff and a decrease in quality of runoff meant that portions of the creek prone to flooding had become a safety concern. By the 1990's, the MMSD began formulating a plan to address flooding problems throughout Lincoln Creek and identified key problems including the loss of wetlands, urban development and the increase in amount of impervious surfaces, undersized culverts, and insufficient channel capacity. Two portions of the creek bed had been lined with concrete in the 1960's, restricting ground absorption and increasing flow velocity during flooding events leading to hazardous conditions for nearby residents. Residences along the Creek were also impacted by two 100-year floods in 1997 and 1998.

Land uses within the Lincoln Creek subwatershed are predominantly residential, mostly detached owner-occupied single-family homes with duplexes scattered throughout the neighborhood. Housing density is approximately 4 to 5 houses per acre in an urban setting, and most of the housing stock dates to the 1950's. Property values in the area (average value estimated at $86,000[46] in 2011) are considerably lower than the average in the City of Milwaukee ($123,000 citywide in 2011). Comparatively, the average assessed values for 2011 for the study group was $79,000 while properties in the control group were about $113,000. Also, the housing foreclosure crisis that began in 2008 has impacted this area to a greater extent than many other parts of the City.[47]

Green Infrastructure in Lincoln Creek

In order to reduce the flooding hazard, the MMSD began developing a comprehensive watershed management plan for Lincoln Creek in 1992.[48] Techniques to address flooding included creek and habitat restoration, channel widening, naturalization, and the use of soil and bioengineering techniques to control for erosion. The entire Lincoln Creek project had multiple components, including channel and habitat restoration, naturalization, concrete removal, the addition of adjacent stormwater detention basins, and bridge replacement. About two miles of concrete were removed during the project, which added curves and three detention ponds to prevent flooding during rainstorms and pools and riffles to encourage fish and wildlife habitation. Stream restoration and engineering took place in multiple phases beginning in 1999 and 2002, and total costs for the stream restoration project were about $120M.

Aside from bridge removal and reconstruction along Teutonia Boulevard, the entire Lincoln Creek restoration project is a green infrastructure investment with significant improvements to both the functionality of stormwater retention and the aesthetic appeal of the stream. Studies on stormwater retention and detention basins indicate that older facilities that may

[46] Average assessed values for single family homes in Aldermanic District 1.

[47] City of Milwaukee's Neighborhood Stabilization Program 2 Application, available online at city.milwaukee.gov/ImageLibrary/Groups/cityDCD/milwaukeestrong/pdfs/FinalNSP2Application.pdf

[48] Available online at v3.mmsd.com/AssetsClient/Documents/waterqualityresearch/lincoln_creek_report.pdf

require maintenance are viewed as a detriment and likely to decrease surrounding property values, particularly if visible.[49] Improvements in aesthetic appeal are likely to improve surrounding property values; such is the case with Lincoln Creek where removal of the blighted concrete liner and addition of new vegetation and landscaping acted to significantly improve the aesthetics of the neighborhood. It should be noted that although the CED model focused on the two areas adjacent to the concrete lined portions of the creek, properties within the entire subwatershed were likely positively impacted by the restoration efforts.

The Lincoln Creek Regression Model

Due to the availability of annual assessment data from the City of Milwaukee, CED was able to perform a panel regression analysis for the Lincoln Creek study area. To avoid problems that could arise from measuring a variety of GI over such a large area, the Lincoln Creek model was developed by CED to measure the impact that a portion of the flood control and environmental restoration project had on residential properties. To do this, CED focused specifically on the neighborhoods surrounding the improvements within Reaches 2 and 6; these improvements included the removal of the concrete lining, widening and deepening the creek bank, and habitat restoration. Map 5 shows the locations of the two reaches and the surrounding properties that comprise the study area.

The study area was comprised of primarily detached single family homes so for the study group properties, detached single family homes within 600 feet of the two reaches were selected. In total, this yielded 963 properties for the Study Group. The same method used for selecting potential comparable control group properties in Menomonee Valley and The Brewery was also used for Lincoln Creek, based on zoning, land use coding, and neighborhood coding variables of the study group properties. Again all properties that were within 500 feet of any other GI were eliminated. Due to the large number of single family homes with similar zoning located throughout the City of Milwaukee, a sample of potential comparables was selected randomly using GIS to ensure that the sample was also geographically random; 1,281 single family residential properties were selected for the Control Group cases, for a total of 2,244 properties in the model (a very robust sample size).

Reconstruction of Reaches 2 and 6 began in 1999, therefore CED selected 1998 as the initial base year for the analysis. This means that over 14 years, there were 31,402 observations of the 2,244 properties within the initially assembled database. After culling the database for dropped properties or missing variables, the entire assemblage included 31,285 observations.

The City of Milwaukee's MPROP database includes detailed residential data. In addition to the assessment values, it includes data on the number of bedrooms, bathrooms, age (as year built), square footage for building and lot size, occupancy, and so forth. In addition to the MPROP data, the same Census tract variables were assigned for each parcel and data was further developed to include proximity information for a variety of amenities (parks, Lake Michigan, bus stops, freeway onramps) as well as nuisances (brownfields, vacant parcels).

[49]Carol Emmering-DiNovo *Stormwater Detention Basins and Residential Locational Decisions*, Journal of the American Water Resources Association Volume 31 (3), pages 515-521, 1995.

Like the Menomonee Valley and The Brewery models, the key dependent variable is the total assessed value while the key independent variable in each target area is a dichotomous dummy variable indicating absence of presence of GI (0 or 1). Although data on the Land Value and Improvements Value portions of the property assessments were collected and tested in preliminary versions of the model, CED chose to use the Total Assessed Value, which is the combined value of the land and improvements.

Model Results

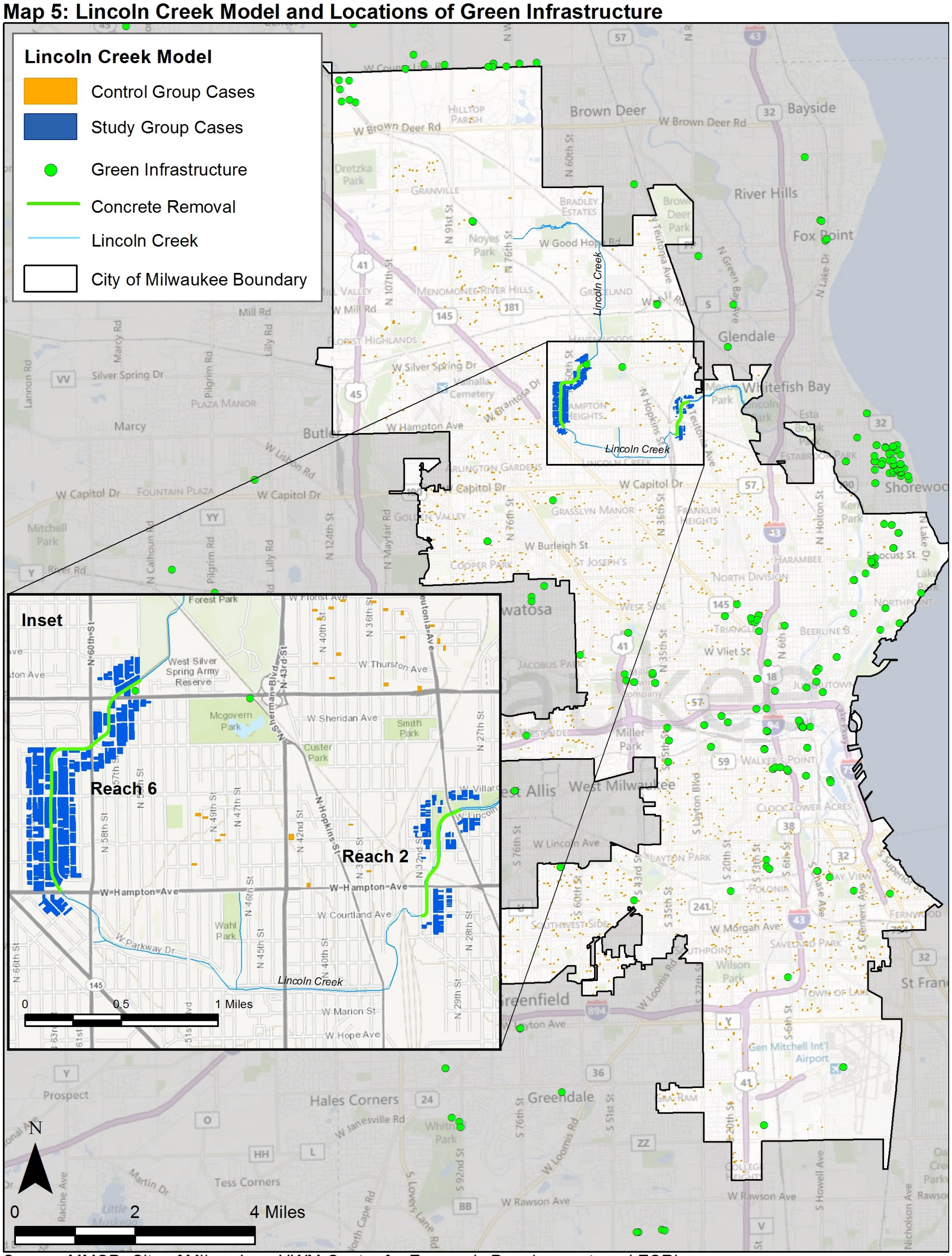
In comparison to the other three models, the Lincoln Creek model performed the best, and estimates a fairly sizeable impact of green infrastructure on property values. Full regression results are listed in Table 6.

Lincoln Creek

As Table 6 shows, holding all other variables constant, in any given year, the assessed values of Lincoln Creek residential properties were 20.4 percent higher than they otherwise would have been without the GI. While this figure may seem high at first, because the average property value of a single-family home in Lincoln Creek was $56,900 in 1999 (in 2011 dollars), any sizeable infrastructure project should have increased the value significantly. Indeed, the average assessed value of a single family home in the Lincoln Creek neighborhood rose to $76,500 in 2011.

Overall, after controlling for other factors, the model estimates a $19,200 increased assessed value for the average residential property in Milwaukee.[50] In other words, an average single-family home would expect an increase of roughly $19,200 with the construction of a green infrastructure project similar to those in Lincoln Creek.

Map 5: Lincoln Creek Model and Locations of Green Infrastructure



Source: MMSD, City of Milwaukee, UWM Center for Economic Development, and ESRI.

The estimate translates into a total green infrastructure impact of **$18,328,000** in Lincoln Creek. Again, because the estimates are calculated with averages, CED urges caution in using these figures in relation to actual properties. Unlike The Brewery and Menomonee Valley models, the impact of the green infrastructure within the Lincoln Creek model was not impacted by other infrastructure development; therefore, the results of this model are complete and can be attributed solely to the redevelopment of the Creek and installation of GI measures.

Like the Menomonee Valley and The Brewery models, the coefficients indicate correlation and direction for the variables and help demonstrate the validity of the model. For example, as expected, the total assessed value of a property increases with an increase in building area and lot size (parcel area), and an increase in the number of bathrooms. Most of the proximity variables are behaving as expected; there are positive correlations between proximity to Lake Michigan, nearest streams, freeway onramps, and bus stops. There is an unanticipated negative correlation with the number of vacant parcels within 1,000 feet and an unexpected positive correlation is observed with the number of brownfields, but like The Brewery and Menomonee Valley models, this may reflect problems in the data (for example limiting it to open LUSTs and ERPs) rather than the model.

One method of testing the validity of the model is by measuring the age and the number of bedrooms and by transforming these variables. In hedonic regression models of residential properties in the US, a couple of patterns have emerged involving the age of a house and the number of bedrooms it contains. Housing values tend to decline based on age, but only to a certain point; this point is usually somewhere in the middle of the 20th Century (1950s), and as houses get progressively older (pre-WWII) the values tend to go back up. This can be seen by transforming (squaring) the age variable; this effect is observed within the Lincoln Creek model.

A similar phenomenon is observed with the number of bedrooms a house contains. Although in general, housing values tend increase as the number of bedrooms increases, there is a tipping point when the addition of more bedrooms fails to add value to the house. Additional bedrooms tend to be smaller, and given an average household size of less than 3 persons, houses with more than 4 or 5 bedrooms tend to experience a decline in the added value of additional bedrooms. Again, the model demonstrates this with the transformation (squaring) of the bedroom variable.

The impact of parks proved very interesting. Data on the number of parks was collected within a 500 and 1,000 foot radius for each residential property. Although a higher number of parks within a 500 foot distance were observed to have a negative correlation on assessed values, a higher number within a 1,000 foot distance had a positive correlation. This indicates that although being close (within 1,000 feet) of a park has a positive impact on value, being very close (within 500 feet) could be

a nuisance. Although the overall positive impact on properties has been well documented, the results of this study indicate that very close proximity to parks (adjacency) may create a

[50] The average sale price of a single-family residential home in 2011 is assessed at $90,253 and has 3 bedrooms.

negative premium for housing values, possibly due to negative attributes associated with parks (safety or noise factors).

Table 6. Full Hedonic Model for Analyzing the Influence of Green Infrastructure on Assessed Values of Single-Family Residential Properties: Lincoln Creek Study Area

Variables	Coefficient	(Std. Error)	Sig. (P <|z|)
Green Infrastructure	0.204	(0.003)	0.000**
Building Area (square feet)	4.102E-04	(0.000)	0.000**
Parcel Area (square feet)	1.690E-05	(0.000)	0.000**
Age	-4.387E-03	(0.000)	0.000**
Age^2	2.630E-05	(0.000)	0.000**
Bedrooms	0.267	(0.015)	0.000**
$Bedrooms^2$	-0.039	(0.002)	0.000**
Baths	0.099	(0.007)	0.000**
Distance to Lake Michigan	4.890E-06	(0.000)	0.000**
Distance to Closest River or Stream	7.300E-06	(0.000)	0.005**
Distance to Nearest Freeway Ramp	9.800E-06	(0.000)	0.000**
Distance to Nearest Bus Stop	1.930E-05	(0.000)	0.027**
Number of Brownfields within 1,000 feet	0.015	(0.002)	0.000**
Number of Vacant Properties within 1,000 feet	-0.0070	(0.000)	0.000**
Number of Parks within 500 feet	-0.0671	(0.005)	0.000**
Number of Parks within 1,000 feet	0.0500	(0.004)	0.000**
Percent of Population In Poverty	0.7305	(0.026)	0.000**
Percent of Population: Black	-0.2601	(0.013)	0.000**
Percent of Population: Hispanic	1.1105	(0.026)	0.000**
Percent of Population: High School Graduates	2.4755	(0.028)	0.000**
Median Household Income (log)	0.1624	(0.013)	0.000**
Population Density	-0.010	(0.000)	0.000**
Constant	6.691	(0.154)	0.000**

NOTES: The table lists xtreg coefficients on the assessed value of residential properties in the city of Milwaukee. The dependent variable is adjusted assessed property value (logged). N = 30,176 with 2,163 panels; overall R^2 = 0.7536.
** $p < 0.05$, * $p < 0.10$

Fiscal Impact: Lincoln Creek

Return On Investment

The Lincoln Creek improvements within the study area (Reaches 2 and 6) included the costs of the removal of concrete lining of the creek, widening/deepening the channels and banks, adding low-flow habitat, bridge revetment work, and adding a bypass culvert totaled approximately $10.95M. This project also required major bridge renovations; many of these costs were covered by the Wisconsin Department of Transportation and the City of Milwaukee and were not factored into the analysis although costs incurred by the MMSD including those associated with bridge revetments are included.

Reach 2: $4.5M

- Widen creek bank
- Remove concrete
- Grading and Erosion Control
- Add low flow habitat
- Widen channel beneath bridge
- Add bypass culvert
- Bridge revetments

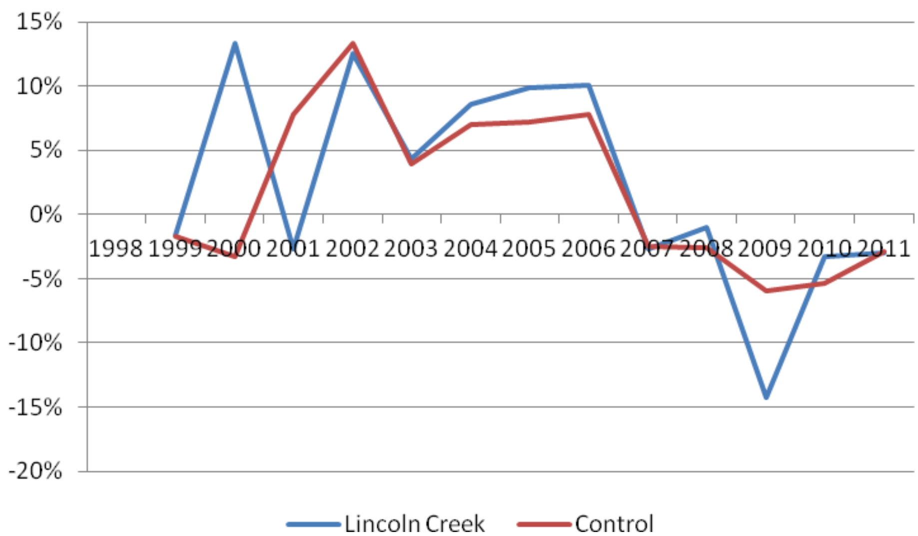
Reach 6: $6.45M

- Widen & deepen creek
- Remove concrete
- Grading and Erosion control
- Add low flow habitat
- Bridge revetments

Figure 5 shows how property value growth compares across the Lincoln Creek and the control target areas. Property value growth in the Lincoln Creek area spiked in 2000 after the beginning of the project and outpaced the growth rate in the control area during the mid 2000's, after the Lincoln Creek green infrastructure projects were completed, indicating that GI had positive impact on the houses in the area.

In Lincoln Creek, CED's regression modeling estimates that combined property values were $18,328,000 higher in any given year as a result of the new green infrastructure, or saw an average gain of about $19,200 for the average property. MMSD's average annual mill rate from 2003 through 2011 is $1.48, thus, the estimated amount of new property tax revenue directly connected to the Lincoln Creek green infrastructure projects is about $27,100 per year for those 963 properties. Unlike the other two study areas (Menomonee Valley and The Brewery), this gain in assessed values over the control group was attributed solely to green infrastructure and not to a combination of multiple forms of infrastructure development along with assistance from TIF. This gain simply represents the impact from the 963 properties within the model or those houses within two blocks of the creek (roughly 600 feet or 1/8 of a mile) and therefore, it is likely that spillover effects were significant on the other nearby properties in the neighborhood. As other reaches within the Creek were also undergoing GI enhancements, other nearby properties within the subwatershed were also likely positively impacted by the stream restoration.

Figure 5: Property Value Growth Rates in Lincoln Creek and Control Target Areas, 1999-2011



Note: Assessed values are adjusted for inflation to reflect 2011 dollars.
Source: City of Milwaukee MPROP database and UWM-Center for Economic Development

Table 7 and Figure 6 show changes in assessed values between the residential properties in the control group and the study group over the study period, adjusted to reflect 2011 dollars. Not all properties were included within the model for every given year, but both the control and study groups were extremely stable over the 13 year period, meaning that there were not a significant number of properties added or removed from the model. The model begins in 1998 with 959 properties and ends in 2011 with 961 properties, less than a 1 percent change. For the control group, the model begins with 1,193 properties in 1998 and ends in 2011 with 1,207 properties, about a 1 percent increase. Unlike the Menomonee Valley or The Brewery where infrastructure development was followed by a considerable amount of new development, the Lincoln Creek study area was fully developed (net increase of 2 properties, or less than 1 percent) and therefore all increases in property assessment were for existing properties.

The control group represents a range of typical similar properties (single-family homes) throughout the City of Milwaukee and is similar to the mean average for single family homes in Milwaukee. The properties in the study area outperformed the control group, but were significantly less than the averages of the control group. Most significantly, between 1999 and 2000, average home values rose for the study area, while they were declining for the control group, indicating a strong initial increase from the GI. Additionally, the study area properties also experienced a more significant decline in 2009 (-14.3 percent), likely due to the disproportionate impact of the housing foreclosure crisis.

Table 7: Comparison of Assessed Values for the Study and Control Groups within the Lincoln Creek Model

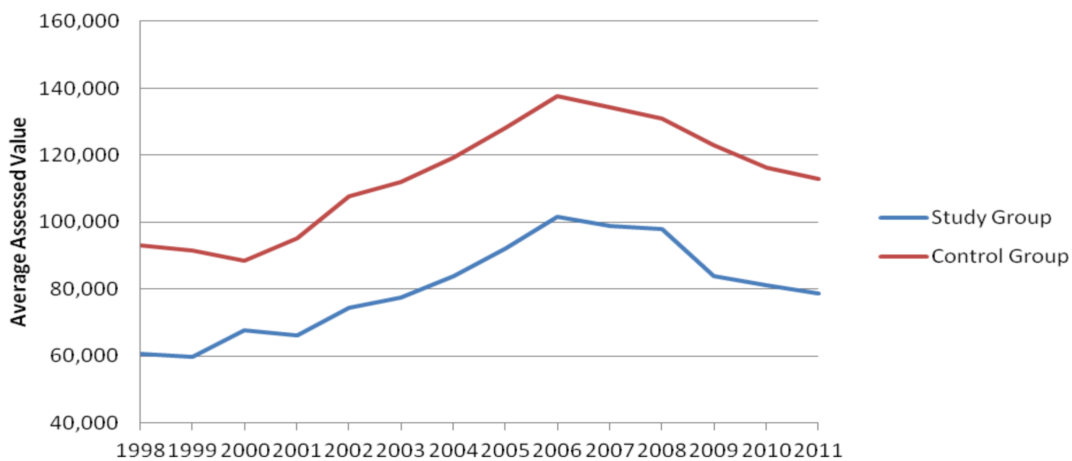
Year	Study Group				Control Group			
	Proper-ties	Total As-sessed Val-	Average Assessed	Growth Rate	Proper-ties	Total As-sessed Val-	Average Assessed	Growth Rate
1998	959	58,248,826	60,739	--	1,193	111,163,71	93,180	--
1999	958	57,323,088	59,836	-1.5	1,195	109,255,75	91,427	-1.9
2000	958	64,951,010	67,799	13.3	1,195	105,703,36	88,455	-3.3
2001	957	63,230,130	66,071	-2.5	1,196	113,901,82	95,236	7.7
2002	958	71,184,495	74,305	12.5	1,199	129,096,41	107,670	13.1
2003	958	74,249,642	77,505	4.3	1,197	134,126,59	112,052	4.1
2004	960	80,598,302	83,957	8.3	1,202	143,472,79	119,362	6.5
2005	960	88,553,413	92,243	9.9	1,201	153,853,36	128,104	7.3
2006	960	97,480,808	101,543	10.1	1,205	165,910,31	137,685	7.5
2007	959	94,862,660	98,918	-2.6	1,205	161,841,23	134,308	-2.5
2008	959	93,929,775	97,946	-1.0	1,205	157,657,31	130,836	-2.6
2009	959	80,507,676	83,950	-14.3	1,205	148,303,66	123,074	-5.9
2010	960	77,835,773	81,079	-3.4	1,206	140,358,09	116,383	-5.4
2011	961	75,500,500	78,565	-3.1	1,207	136,347,60	112,964	-2.9

Note: Assessed values are adjusted for inflation to reflect 2011 dollars.
Source: City of Milwaukee MPROP database and UWM-Center for Economic Development

Aside from some fluctuations throughout the decade, the Lincoln Creek study area houses outperformed the control group comparables over the course of the decade. The total assessed value of houses in the Lincoln Creek study area is estimated to be about $75.5M in 2011, or about 29.6 percent higher than in 1998 ($58.3M); in comparison, the control group houses increased by 22.7 percent over the time period ($111.1M in 1998 and $136.3M in 2011). Also, between 1998 and 2011 average assessed values increased more for the study area properties (29.3 percent) than for the control group (21.2 percent). Given the persistent flooding problems associated with the study area properties, it is unlikely that they would have performed as well as the comparables without the GI intervention.

Map 6 highlights the land uses located within the 600 foot boundary or 'buffer' area of Reaches 2 and 6. Reach 2 has a wider variety of uses including commercial and industrial

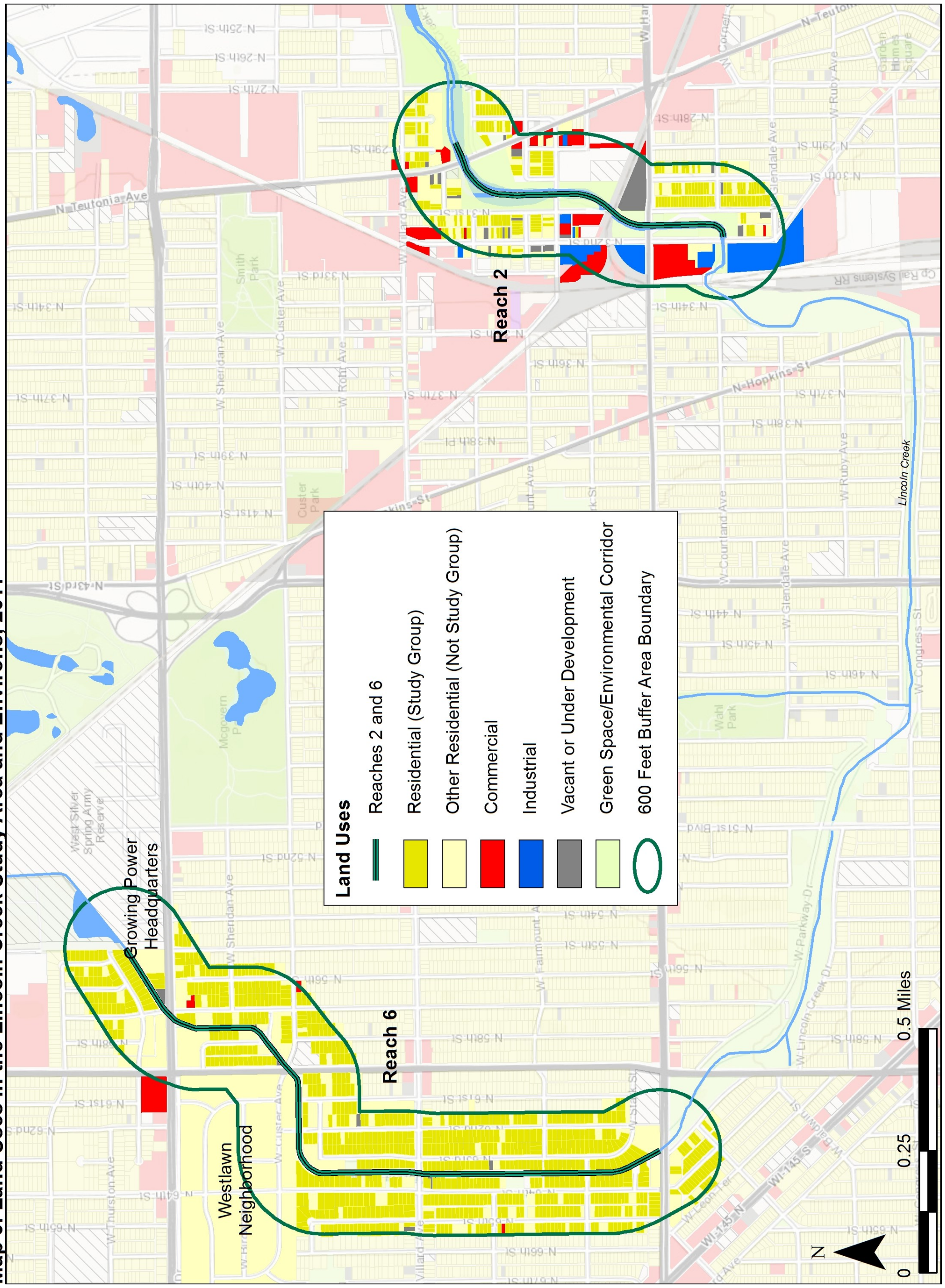
Figure 6: Average (Mean) Assessed Values for Single Family Homes, 1998 to 2011



properties located primarily along 32nd Street near the intersection of Hampton Avenue. Several rail lines bisect the Reach 2 area and there are numerous duplex or smaller multiplex units in this area. Reach 6 is more homogeneous in its uses and properties within 600 feet of Reach 6 are almost exclusively single-family residences. Westlawn public housing development abuts a small portion of Lincoln Creek; redevelopment and revitalization efforts began on Westlawn in 2010. Although Westlawn itself is not a taxable property, undoubtedly the redevelopment efforts will help to further stabilize the surrounding neighborhood. Also of note, the headquarters of Growing Power is located at 55th Street and Silver Spring Drive and its much anticipated vertical farm will be developed at the adjacent former Army Reserve training site; these sites are at the most upstream portions of Reach 6. This development will likely also have a very positive impact on the surrounding properties.

Table 8 summarizes the properties within the study area that were not included in the model. In addition to the 961 residential properties included in the study, there are an additional 401 taxable properties located within the 600 foot buffer area of Reaches 2 and 6 that were also likely positively impacted by the GI development. These properties added an additional $43.7M in property assessments to the $75.5M from the study properties for a total of $119.2M in assessed values in 2011. Based on MMSD's average annual mill rate of $1.48 (2003 through 2011), approximately ***$176,430*** in tax revenues are generated annually for the properties located in the study area for the MMSD. Under current conditions, it would be anticipated that at this rate, MMSD's initial capital investment of $10.95M would be paid off in 62 years if solely reliant upon the tax revenues generated by these properties. Again, this does not take into consideration any additional costs that were likely to accrue had the GI not been developed, nor the negative impact on property values given the history of flooding within the study area.

Map 6: Land Uses in the Lincoln Creek Study Area and Environs, 2011



Source: City of Milwaukee, UWM Center for Economic Development, and ESRI.

Table 8: Land Uses and Assessments within the 600 Foot Buffer Boundary in Lincoln Creek Reaches 2 and 6, 2011

Land Use Type	Number of Parcels	Total Assessed Value
Commercial	30	6,622,300
Industrial	11	2,070,300
Under Development[1]	33	102,600
Residential Properties Not in Study Group[2]	343	34,914,100
SUBTOTAL	417	43,709,300
Residential Properties in Study Group	961	75,500,500
TOTAL	**1,378**	**119,209,800**

[1] One of the vacant properties within the study area was identified as under development in 2011. This will add additional assessed value upon completion.
[2] Of these, approximately 16 are non-taxable residential properties including Westlawn Neighborhood, Wisconsin's largest subsidized housing complex which began a major renovation in 2010.
Source: City of Milwaukee MPROP database and UWM-Center for Economic Development

Study Area 4: Shorewood Downspout Disconnection and Rain Gardens Program Study Area

Background

The Village of Shorewood is a fairly affluent inner-ring suburb of the City of Milwaukee, located along Lake Michigan. Much of the Village was developed in the 1920's and 1930's and it is part of the MMSD's Combined Sanitary Sewer System. This means that stormwater is directed into the sanitary sewer system during major rain events rather than being separated into a stormwater sewer system, retention basin, or other more modern practice for stormwater control. Directing stormwater into the sanitary sewer system increases the risk for sewer overflows or backups and can cause basement flooding of sewer effluent creating a major health hazard during major storm events or flooding.

Green Infrastructure in Shorewood

The MMSD developed a downspout disconnection program based on flooding problems in the late-1990's to direct stormwater away from the sanitary sewer system thereby reducing the number and severity of sewer and basement backups during heavy rains. The Village of Shorewood actively promotes the practice and requires a permit to ensure proper downspout disconnection.[51] Major flood events in more recent years (including several 100-year storms) have spurred more interest in mitigating the impact of stormwater on the sanitary sewer system, and Shorewood and the MMSD are working together to promote several programs.

[51] More on the Downspout Disconnection Program is available at www.villageofshorewood.org/index.asp?Type=B_BASIC&SEC=%7B0D29E319-E42F-4606-A719-356172BDBFAD%7D or v3.mmsd.com/DownspoutDisconnect.aspx


From Left to Right: Downspout Disconnection and Rain Garden in Shorewood

In 2007, MMSD initiated a rain gardens program that would promote and alleviate some of the costs associated with building rain gardens. Like rainbarrels and the downspout disconnection program, rain gardens reduce the amount of stormwater entering into the sanitary sewer system. Property owners are encouraged to develop rain gardens and are provided assistance by the MMSD through grant funding or through access to plant materials with a reduced cost. The Village of Shorewood promotes this project for private residences and in 2012 launched the Shorewood Waters Project, working with the MMSD and others to build and promote the use of rain gardens as part of the Great Lakes Restoration Initiative Grant.[52]

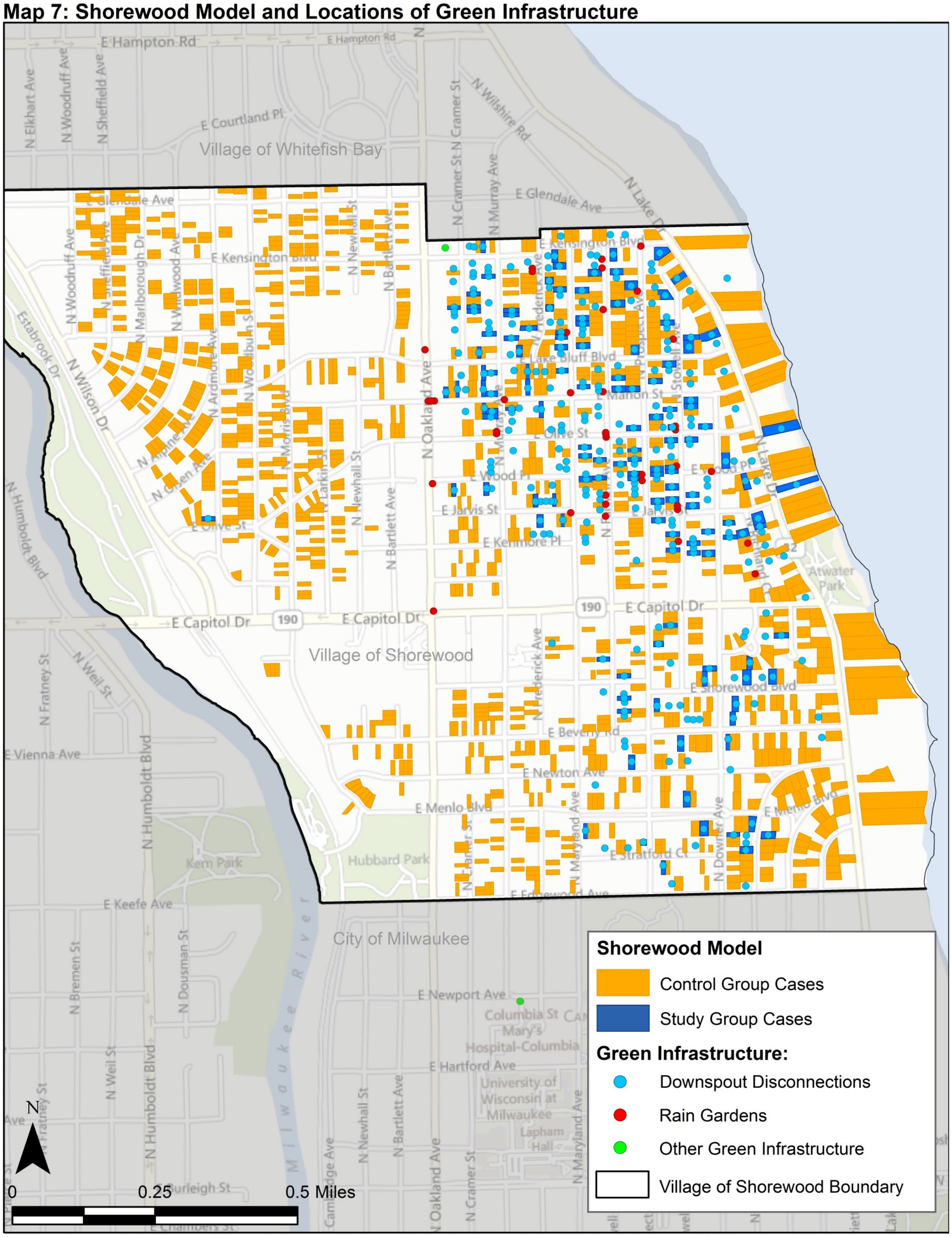
The Shorewood Regression Model

The Shorewood model investigates the impact of two kinds of green infrastructure on residential properties within the Village of Shorewood; the Downspout Disconnection Program and associated rain gardens. Although this model initially began as an investigation into the Downspout Disconnection program, a significant number of rain gardens were co-located with the properties participating in the downspout program, therefore the model was developed to measure both types of GI. Map 7 shows the locations of properties participating in the Downspout program along with rain gardens in the Village of Shorewood.

It is important to note that the Shorewood model is different from the other models, in terms of methodology. Instead of using panel data (which looks at assessed value of all parcels over a specific time period), this model uses cross-sectional data of sale prices of various parcels between 2000-2011. In other words, whereas the prior models looked at changes in assessed value for all parcels in each year to observe how those values change over time, this data set investigates the sale price of one parcel in one year and another sale price of a different property in another year, and so on. In short, the data is more limited, and a causal inference is somewhat less justified. Also, instead of the key dependent variable being assessed values determined by municipal officials, the Shorewood model uses actual sale prices. Lastly, this model differs from the others in that two distinct GI types are distinguished in the model: downspout disconnection and rain gardens.

[52] More information on the Shorewood Waters Project is available online at www.villageofshorewood.org/index.asp?Type=B_BASIC&SEC=%7B336C822C-C451-4E04-9130-C51C1B574F6C%7D

Map 7: Shorewood Model and Locations of Green Infrastructure



Source: MMSD, Village of Shorewood, Milwaukee County Automated Mapping and Land Information System, UWM Center for Economic Development, and ESRI.

The Village of Shorewood provided its official assessment data for this project. It included all data on assessments for the past decade as well as sales transactions going back several decades. Unlike the City of Milwaukee, properties in Shorewood are not assessed via mass appraisal on an annual basis; rather they are assessed intermittently either on an as needed basis or once every seven years to be in compliance with State laws. An "as needed" basis means that a property undergoes the reassessment process based on any of the following: 1) point of sale or change in ownership, 2) when a permit is pulled (usually for major renovation) to account for any adjustments based on physical changes to the property, 3) when requested by the property owner, or 4) based on Wisconsin state law. All properties are required by the State of Wisconsin to undergo a reassessment at minimum once every ten years; therefore if a property is not reassessed based on a sale, permit, or request within the past ten year cycle, then it needs to be reassessed or revaluated based on statute. Shorewood usually performs walk-through assessments to ensure compliance with State law once every seven years.

Based on the MMSD and Village data, there were 323 properties with registered downspout disconnections in Shorewood. All but one are located east of Oakland Avenue in Shorewood. Most of the registrations were listed as having occurred between 2003 and 2008, therefore CED limited the sample to include properties sold between 2000 and 2011. Not all of these properties, however, had undergone a sale during this time period. Of the 323 downspout disconnection properties, CED identified 137 properties that had undergone at least one sale, and in total identified 200 property sales (observations) involving the downspout properties. Of these properties, CED noticed that 19 had associated rain gardens, therefore CED created a separate variable within the model to analyze the impact of rain gardens.

For the comparables, CED selected properties that were not participating in the downspout program, nor had any other GI associated with it. This included a total of 1,020 properties that had at least one sale between 2000 and 2011, for a total of 1,549 comparable observations (including multiple sales for same properties). In addition, CED identified 7 that had associated rain gardens; these two were identified within the model.

Model Results

Full cross-sectional regression results are listed in Table 9. Overall, the model performs well with a relatively high Adjusted R2 value of 0.7435, meaning that the independent variables combined explain roughly 74 percent of the variation in the dependent variable.

The results reveal that no significant impact of rain gardens was captured by the model. At the same time, a negative impact was discovered in terms of downspout disconnection, contrary to the earlier findings about positive GI effects. The model suggests that single-family homes in Shorewood that have a downspout disconnection will have, on average, a sale price that is 5.4 percent lower in any given year. For example, a single family home in Shorewood with downspout disconnection is estimated to have sold for $13,200 less in 2011 than a property without downspout disconnection (holding all other factors constant).[53]

The lower sale prices may not necessarily be due to the downspout disconnection itself, and CED cautions against inferring a causal impact of downspout connection on sale prices in

Shorewood. ***That is, it cannot be definitively asserted that downspout disconnection results in a 5 percent decrease in sale prices*.**

Rather, homes with downspout disconnection in the Shorewood sample sell for roughly 5 percent less than those without downspout disconnection (holding all other factors constant). There are several major reasons for this distinction. First, downspout disconnection is an invisible green infrastructure improvement, and invisible infrastructure improvements theoretically should not increase nor decrease sale prices. As CED used a cross -sectional data set, a causal inference between downspout disconnection and property value declines cannot easily be inferred over the decade, particularly when that decade included a major housing market disruption. Next, some selection bias may be at work; for some reason, homeowners with lower property values (for example, possibly due to flooding issues or aging infrastructure) are choosing to disconnect their downspouts with greater frequency than those with higher property values. And finally, as this is measuring only properties that are registered in the downspout disconnection program, there may be some contamination within the control group as it may contain properties that have disconnected downspouts but are not registered with the Village or MMSD.

Like each of the other models, the coefficients indicate correlation and direction for the variables and help demonstrate the validity of the model. For example, as expected, the total assessed value of a property increases with an increase in building area, an increase in the number of bathrooms or half baths, additional living space such as finished rec rooms or enclosed porches, and working fireplaces. Surprisingly, this model indicates that an increasing lot size has a negative association with the sales price; this may reflect a quirk within the sales data, that some of the smaller lot (and presumably lesser expensive properties) were exhibiting a higher increase in sales price than larger lots over the given time period.

Proximity to Lake Michigan exhibited a unique pattern. The initial variable measured straight distance and indicated that proximity had a negative impact on sales price; however, when the variable was squared to enhance the impact, it indicated that there was indeed a net positive impact based on proximity. Additionally, proximity to streams (the Milwaukee River) also has a positive correlation with sales price. Together, this indicates that property sales within the Village tend to be higher towards the Lake and the River than in the middle of the Village (along Oakland Avenue). This reflects the actual sales data as well as housing stock in general (tend to be more affordable units closer to Oakland Avenue, including condos or duplexes).

Proximity to parks showed a positive correlation while proximity to brownfields was negative, as expected. Additionally, there was a positive correlation with the percent of high school graduates. Although percentage of population with at least a bachelor's degree was also measured, this variable did not show significance, but this may be due to the high number of UW-Milwaukee undergraduate students living in Shorewood who have yet to receive their degrees.

[53] The average sale price of a Shorewood single family home in 2011 was $337,753

Table 9. Full Hedonic Model for Analyzing the Influence of Green Infrastructure on Sale Price of Single-Family Residential Properties in the Village of Shorewood

Variables	Coefficient	(Std. Error)	Sig. (P <|z|)
Green Infrastructure (Downspout Disconnect)	-0.054	(0.020)	0.009**
Green Infrastructure (Rain Garden)	-0.077	(0.051)	0.133
Building Area (sq. ft.)	2.19E-04	(0.000)	0.000**
Parcel Area (sq. ft.)	-0.026	(0.055)	0.633
Age	0.023	(0.003)	0.000**
Age2	-1.54E-04	(0.000)	0.000**
Bedrooms	0.196	(0.035)	0.000**
Bedrooms2	-0.022	(0.004)	0.000**
Full Bathrooms	0.057	(0.011)	0.000**
Half Bathrooms	0.072	(0.012)	0.000**
Fireplace Openings	0.069	(0.010)	0.000**
Enclosed Porch (sq. ft.)	2.24E-04	(0.000)	0.039**
Rec Room (sq. ft.)	1.18E-04	(0.000)	0.000**
Distance to Lake Michigan	-2.64E-04	(0.000)	0.000**
Distance to Lake Michigan2	4.27E-08	(0.000)	0.000**
Distance to Closest River/Stream	2.96E-05	(0.000)	0.292
Distance to Nearest Freeway Ramp	1.66E-05	(0.000)	0.252
Distance to Nearest Bus Stop	-3.27E-06	(0.000)	0.858
# Brownfields within 500 ft.	-0.026	(0.012)	0.040**
Distance to Nearest Park	1.78E-05	(0.000)	0.245
% Pop. In Poverty	-0.266	(0.402)	0.509
% Pop. Black	2.816	(2.548)	0.269
% HS Grad. Rate	3.383	(1.330)	0.011**
Median Household Income (log)	-0.005	(0.014)	0.733
Population Density	0.003	(0.004)	0.522
2001	0.039	(0.033)	0.252
2002	0.117	(0.034)	0.001**
2003	0.121	(0.034)	0.000**
2004	0.192	(0.035)	0.000**
2005	0.203	(0.036)	0.000**
2006	0.218	(0.037)	0.000**
2007	0.216	(0.038)	0.000**
2008	0.174	(0.040)	0.000**
2009	0.160	(0.047)	0.001**
2010	0.121	(0.040)	0.003**
Constant	7.502	(1.359)	0.000**

NOTES: The table lists cross-sectional regression coefficients on the sale price of residential single-family homes in the village of Shorewood. The dependent variable is adjusted sale price (logged). N = 1,745; adjusted $R^2 = 0.7435$.

** $p < 0.05$, * $p < 0.10$

SUMMARY

Based on the data, CED developed panel regression models for three of the areas (Menomonee Valley, The Brewery, and Lincoln Creek) and one cross-sectional regression model Shorewood) to assess the impact that GI had on surrounding property values.

All models performed well, although Lincoln Creek performs the best and shows that GI has had a strong and significant impact on the surrounding property values. Because the entire infrastructure redevelopment within Lincoln Creek was focused on green infrastructure, this model looks to be free and clear of problems that have arisen with assigning impact to GI within The Brewery and the Menomonee Valley. Within the Menomonee Valley and The Brewery, other infrastructure (roads, sewer and water lines) was occurring at the same time that the green infrastructure was being developed, therefore the "GI Impact" likely also reflects the impact of all infrastructure development.

Shorewood, using a different methodology, indicated an inconclusive impact of the downspout disconnection program on residential properties and that the rain gardens program likely has had no impact on property values. Problems stem from the data itself, including sampling and selection bias, as well as shortcomings of the cross-sectional regression methodology which indicates that a causal inference between the 5 percent decrease in sales price and the downspout disconnection program cannot be made with any degree of certainty.

In both the Menomonee Valley and The Brewery, tax increment financing plays a key positive role in the impact on assessments and on the return on investment. Both models demonstrate that the improvements have had a strong positive impact on property assessments, and incorporating GI as part of a TIF development ensures timely payoff for the overall investment.

In Lincoln Creek, the model indicates the GI improvements had a strong positive impact on the surrounding properties. Under these circumstances (with no additional infrastructure and no TIF), the GI could be considered a tool for neighborhood improvement.

Menomonee Valley:

- The panel regression model indicated significantly positive impacts, but concurrent redevelopment efforts in the four TIF districts make it impossible to isolate the impact of the GI from the other infrastructure improvements, and therefore the results of the model indicate the impact of all concurrent infrastructure.
- The cleanup and redevelopment played a significant role in increasing the property values, of which the GI played an instrumental part in improving the quality of the development.
- The investment in GI infrastructure offset any additional costs for other infrastructure that would have been required to address non-point source runoff or potential flooding.

- Overall, properties in the study group outperformed those in the control group in terms of total assessed value and average assessed value.
- Given the outcomes of the increases in assessed values and the structure of the TIF, it is likely that the $835,000 investment in GI by MMSD would likely be paid off in 3 years based on the total assessment value of $270.8M and a mill rate of $1.48, (an estimated annual return of about ***$400,800)***.

The Brewery:

- The panel regression model indicated significantly positive impacts, but concurrent redevelopment efforts in the TIF make it impossible to separate the impact of the GI from the other infrastructure improvements, and therefore the results of the model indicate the impact of all concurrent infrastructure.
- The TIF and redevelopment planning and execution is playing a significant role in increasing the property values.
- Given its LEED Platinum Certification, the GI improvements were an essential part of the redevelopment efforts and it is unlikely that the increases in assessed values would have been as high without the certification status.
- Overall, properties in the study group outperformed those in the control group in terms of total assessed value and average assessed value.
- Given the outcomes of the increases in assessed values and the structure of the TIF, it is likely that the $1,038,000 investment in GI by MMSD would likely be paid off in 17 years based on the total assessment value of $43.1M and a mill rate of $1.44, (an estimated annual return of about ***$62,000)***. This likely will occur faster given that ongoing development will continue to add to the tax base of the study area.

Lincoln Creek:

- The panel regression model indicated significantly positive impacts of GI on surrounding property values. The model demonstrates the impact of the GI improvement in its most 'pure' form, given that no additional infrastructure was concurrent to the GI.
- The results of this study specifically highlight the impact that the GI has had on existing properties. Given the lack of developable land within the area, no new development is anticipated with two major exceptions. Properties within the vicinity have recently begun undergoing redevelopment (Westlawn) or are being planned for redevelopment (Growing Power's Vertical Farm) and further increases in assessed values are likely to occur.
- Overall, properties in the study group outperformed those in the control group in terms of total assessed value and average assessed value.
- Given the history of flooding in the area, it is unlikely that the study area properties would have performed as well without the GI intervention .
- Based on the model, CED estimates that the total property values were $18.3M higher in any given year based on the new GI or about $19,200 for the average property .
- Given MMSD's average mill rate of $1.48 over the time period, it is estimated that the amount of property tax revenue generated is about ***$176,400***. At this rate, the

initial capital investment of $10.95M will be paid off in 65 years. This does not take into account the impacts that the GI had on properties outside of the 600 foot distance nor does it consider that property values will likely continue to rise based on additional redevelopment projects within the vicinity (Westlawn and Growing Power)

Shorewood Downspout Disconnection Program and Rain Gardens:

- The Shorewood model differed from the other three models; this model uses cross-sectional data of sale prices of various parcels. Although a valid modeling approach, this is not as robust as the panel regression models.
- Based on the model, rain gardens had no significant impact on property values
- Based on the model, downspout disconnection was associated with a negative impact on property values (approximately 5.4 percent lower sales price)**:** it cannot, however, be definitively asserted that downspout disconnection results in a 5.4 percent decrease in sales price. Rather homes with downspout disconnections tend to sell for roughly 5.4 percent less than those without. Factors at play may include:
    - Cross-sectional data is less comprehensive.
    - Downspout disconnection is an invisible infrastructure.
    - Selection bias: homeowners with lower property values or with flooding problems may be choosing to disconnect their downspouts with greater frequency than those whose values were higher.
    - Sampling bias or contamination may be present as the control group may have included properties that have disconnected downspouts not registered with the Village of MMSD.

Appendix A: Property Assessments, the Mass Appraisal Process, and Equalization

City of Milwaukee: Residential and Commercial Properties

In the City of Milwaukee, the City Assessor's Office is responsible for estimating the market value of all locally assessable property in the City of Milwaukee and producing the assessment data on an annual basis. Commercial and residential properties in the city of Milwaukee are assessed using a ***mass appraisal*** process. Mass appraisal is a standardized procedure for collecting data and appraising property to ensure that all properties within a municipality are valued uniformly and equitably. It is the process of valuing a group of properties as of a given date, using common data, employing standardized methods, and conducting statistical tests to ensure uniformity and equity in the valuations.

Assessors use mass appraisal procedures and techniques when determining the fair cash value of properties in their municipalities. Milwaukee assesses properties to their full market value, which is the most probable price (cash or equivalent) which a property would bring in a competitive and open market with the seller and buyer both acting prudently. It should be noted that market value is neither the highest nor the lowest price paid, but the 'most probable price'. In general, there are three unique market value approaches:

> The ***income approach*** to value is based on the assumption that potential buyers will pay no more for the subject property than it would cost them to purchase an equally desirable substitute investment that offers the same return and risk as the subject property. It considers the subject property as an investment and, to that end; its value is based on the rent it will produce for the owner.
>
> The ***cost approach*** to value is based on the assumption that potential buyers will pay no more for the subject property than it would cost them to purchase an equally desirable substitute parcel of vacant land and construct an equally desirable substitute improvement. In this approach, the appraiser calculates the cost new of the improvements, subtracts from it accrued depreciation to arrive at an estimate of the improvement's value, and then adds the value of the land as if vacant to arrive at an estimate of the subject property's total value.
>
> The ***sales comparison approach*** to value is based on the assumption that potential buyers will pay no more for the subject property than it would cost them to purchase an equally desirable substitute improved property already existing in the market place. In this approach, the appraiser locates sales of comparable improved properties and adjusts the selling prices to reflect the subject property's total value. The adjustments are the quantification of characteristics in properties that cause prices paid to vary. The appraiser considers and compares all possible differences between the comparable properties and the subject property that could affect value. Objectively verifiable market evidence should be used to determine these items. Items, which are identified as having an influence on value in the market place, are then quantified by the use of their contributory values. These contributory values

then become the adjustments which are added to, or subtracted from, the selling price of the comparable property.

The model that the City of Milwaukee uses for its mass appraisal process is based on the income approach. If there is an appeal, the city reviews the assessment using all three traditional approaches to value: sales comparison, cost and income.

It should be noted, however, that the assessed value is not the same as the estimated fair market value of a property. The assessed value is the dollar value placed on a property as an estimate of market value, while the estimated fair market value is calculated by dividing the property's total assessed value by the average assessment ratio. Wisconsin relies upon the estimated fair market value for the purposes of apportioning tax levies among the different municipalities, for the distribution of shared revenues. In Wisconsin, the Department of Revenue (DOR) equates the total property in all municipalities to an estimate of fair market value each year to ensure a uniform distribution of shared taxes across all municipalities in the State; this process is referred to as *equalization*. Using equalization, the assessor's role is to ensure that each property contributes their fair share of tax. Theoretically, if an assessment is done correctly, the fair market value should approximate the current market value of a property, and Wisconsin law requires that the total assessed value of a municipality and the total estimated fair market value be within 10 percent of each other. This helps to maintain transparency and acts to protect homeowners and taxpayers.

The City of Milwaukee assesses two major classes of real property, commercial and residential.[1] All manufacturing properties are assessed by the DOR. The City of Milwaukee assesses all properties on an annual basis. Given that there are over 160,000 parcels within the City of Milwaukee, and thousands of sales transactions annually, Milwaukee's annual assessment is driven by modeling rather than walk-through assessments. Although it is, ultimately, the consummated sales of buyers and sellers that are used in determining assessed values, other factors do impact assessments such as condition or locational (neighborhood quality) data. Due to the role that location and neighborhood quality plays on property values, the City of Milwaukee has classified over 130 unique assessment neighborhoods. Similar types of properties within each neighborhood class are assessed using similar metrics. When developing each of the models, CED omitted any properties from the control group that matched the assessment neighborhood from the study group to avoid problems that could arise from selection bias.

State of Wisconsin: Manufacturing Properties

Assessments for manufacturing and industrial properties tend to include assessments of both the real estate (physical building and land) but also the 'real property' such as manufacturing equipment associated with the building. In Wisconsin, the state Department of Revenue (DOR)[2] conducts assessments on manufacturing (industrial) properties, given the unique nature of industrial properties, and the properties are compared on a statewide basis. The

[1] The City of Milwaukee also assesses all personal property related to commercial businesses, while the DOR assesses all personal property related to manufacturing businesses.

[2] Wisconsin Department of Revenue *Guide to Wisconsin Manufacturing Property Assessment.* Available online at www.dor.state.wi.us/pubs/slf/pb065.pdf

DOR determines the market value of manufacturing property from a review of the manufacturing property report forms (M-forms) that are filed by manufacturing companies each year and also from field reviews of manufacturing properties and manufacturing company records (every 5 years), and includes a physical inspection of real and personal property. The field audit allows the Department of Revenue to update property records to reflect changes in the manufacturers building, land improvements. The field audit also includes a reappraisal of the real property. The field audit many include an inspection of accounting records.

Although the field inspections occur every 5 years, all properties are revalued on an annual basis. Under law, the State of Wisconsin is required to assess all manufacturing properties at full market value, or what a property would ordinarily sell for at arms-length sale on the open market. By Statute, the DOR relies on a sales comparison approach (to the extent possible) before considering either of the other two valuation methods. But due to the limited number of comparable sales of manufacturing in any given year, the DOR uses a combination of approaches. Appeals of assessments are handled by the State Board of Assessors. Like the City of Milwaukee, the State of Wisconsin relies upon assessing manufacturing property at market value

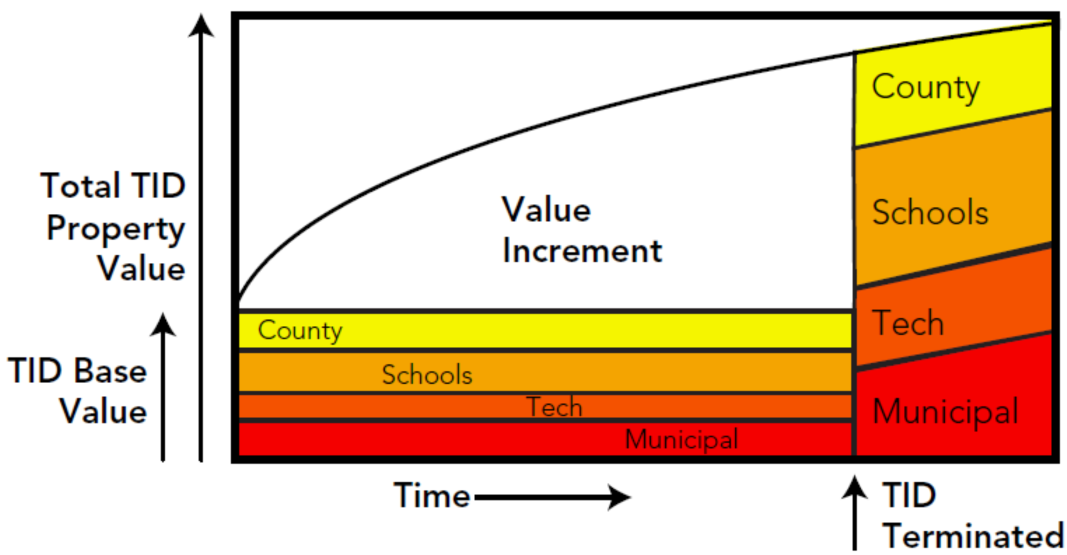
The DOR is required to assess all property at full market value which is what the property would sell for at arms-length sale. Given that manufacturing assessments are also based on market rates and revalued on an annual basis, which is the same method used by the City of Milwaukee for commercial and residential properties; this allows for the commercial and industrial properties (in both the Menomonee Valley and The Brewery) to be included in the same dataset and model without the need to adjust one type or the other. In addition to being assessed at or near full market value, all properties in Milwaukee are taxed at 100 percent of their assessed values (for example, mill rates are applied at the full 100 percent value of the property).

Appendix B: Tax Incremental Financing

Tax Incremental Financing (TIF) is a method for financing the costs of development, primarily for the costs associated with public infrastructure. It relies upon future gains in the taxes of surrounding properties to subsidize current improvements. As most public projects result in gains in the values of surrounding properties, generating additional property tax revenues, the purpose is to "capture" the increased value (tax increment) to pay for the public project. As TIF refers to the funding mechanism, Tax Increment Districts or TIDs refer to the specific geographic areas in which the redevelopment using TIF is to occur.

Generally, TIF is used to fund improvement projects in distressed, blighted, or underutilized areas, where redevelopment is unlikely to occur without this form of assistance. In Wisconsin, TIF is used to finance infrastructure projects or for site (brownfield) remediation. In theory, TIF authorization is supposed to be based on a determination that an area is "blighted" and that redevelopment would not take place "but for" the public investment. These requirements, however, tend not to restrict the locations of TIF districts, and in application, many TIDs are located in non-blighted greenfield areas. More on the description of the TIF funding for the Menomonee Valley and The Brewery is provided with the findings.

Value Growth and Tax Sharing in TIF



Source: Center on Wisconsin Strategies report "Efficient and Strategic TIF Use: A Guide for Wisconsin Municipalities". Available online at www.cows.org/_data/documents/1071.pdf

The chart above shows how tax increment financing keeps assessments for the TIF properties flat over the life of the TIF, which is typically between 20 and 30 years. Over time, as the development within the district occurs and the values of the properties increase, taxes that go towards the different taxing entities (local school districts, sewerage districts, and local, county, and state governments) remain flat, even if assessments fluctuate or increase. It is this value increment or the increase in TID property assessments that is used to pay off the costs of the infrastructure.

In Wisconsin, all TIDs must pass a “but for” test, meaning that a minimum of 50 percent of the real property within a TID must be blighted, in need of rehabilitation or conservation, or suitable for industrial sites or mixed use development. In cases that involve mixed use development, no more than 35 percent of the development may be used for residential uses. TID projects must be laid out in detail, with the total costs defined for each project and estimates for when the costs will be paid off provided. Property valuations must be certified for the base value of the TID, which is the assessment in the initial year of the TIF district.

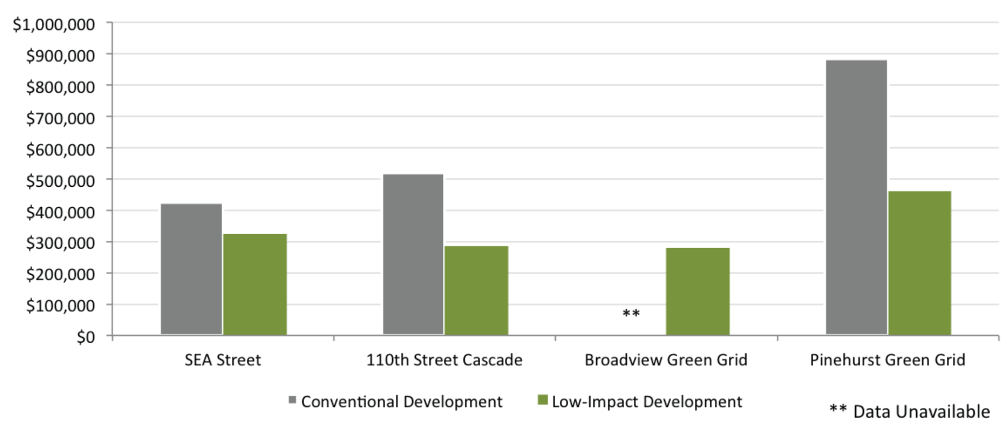
It should be noted that both the Menomonee Valley and The Brewery areas were significantly blighted prior to the redevelopment, both required a considerable amount of brownfield remediation, and both depended on TIF for redevelopment. Had it not been for TIF and a significant amount of planning and public incentives, neither of these sites would have undergone redevelopment and the assessments on the existing blighted properties would have remained low, generating little revenue for the local taxing authorities.

In the Menomonee Valley, there have been 4 major TIFs to finance infrastructure costs, each targeted to specific areas within the study area. In The Brewery, one TIF district has been created by the City of Milwaukee, but currently, not all of the authorized TIF funds have yet been realized (spent). Although most TIFs cover the full costs of public infrastructure, in both the Menomonee Valley and The Brewery, the costs of green infrastructure have been both public and private. In each case, CED focused on the investments and contributions that MMSD made in green infrastructure and discounted any private investment.

Appendix C: Grey versus Green Infrastructure Costs

- Episcopal High School in Baton Rouge, Louisiana had flooding issues in the school's quadrangle so they got an estimate for re-piping of $500,000. They instead had bioswales and a rain garden designed and constructed for $110,000 by BROWN+DANOS.
- Seattle Public Utilities (SPU) indicated that designs incorporating green infrastructure costs $217,253 LESS THAN conventional street in overall construction costs and yields a cost savings equal to $329/SF.
- SPU estimates that a local street converted to Street Edge Alternatives street design saves $100,000 per block (330 linear feet) compared to a traditional street design, while achieving the same level of porosity (35% impervious area)
- Chicago's Green Alley Program shows that investing in permeable pavements, downspout disconnection, rain barrels and tree plantings is approximately 3 to 6 times more effective in managing stormwater per $1,000 invested than conventional methods.
- The Arlington-Pascal Stormwater Improvements project chose a green infrastructure based solution because it saved $1 million, a 45% reduction compared to the conventional stormwater management option
- In Philadelphia, Pennsylvania, their city-wide implementation of GI at a 50% LID level through green infrastructure would provide a net benefit of $2,846.4 million. A 30-foot tunnel (grey option) would provide a net benefit of ONLY $122 million (Stratus 2009).

Figure 4. Cost Analysis of Seattle Public Utilities Natural Drainage System



Source: ECONorthwest, with data from Seattle Public Utilities 2002

Sources:
1. www.asla.org/uploadedFiles/CMS/Government_Affairs/Federal_Government_Affairs/Banking%20on%20Green%20HighRes.pdf
2. www.cnt.org/repository/gi-values-guide.pdf