GREEN INFRASTRUCTURE EVALUATION AND ALTERNATIVES ANALYSIS

STH 32/LAKE DRIVE ROADWAY IMPROVEMENT PROJECT
EDGEWOOD AVENUE TO KENSINGTON BOULEVARD

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2/1/2022

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List of Abbreviations

WisDOT	Wisconsin Department of Transportation
MMSD	Milwaukee Metropolitan Sewerage District
BMP	Best Management Practices
GI	Green Infrastructure
ROI	Return on Investment
TSS	Total Suspended Solids
TMDL	Total Maximum Daily Loads
GIPP	Green Infrastructure Partnership Program

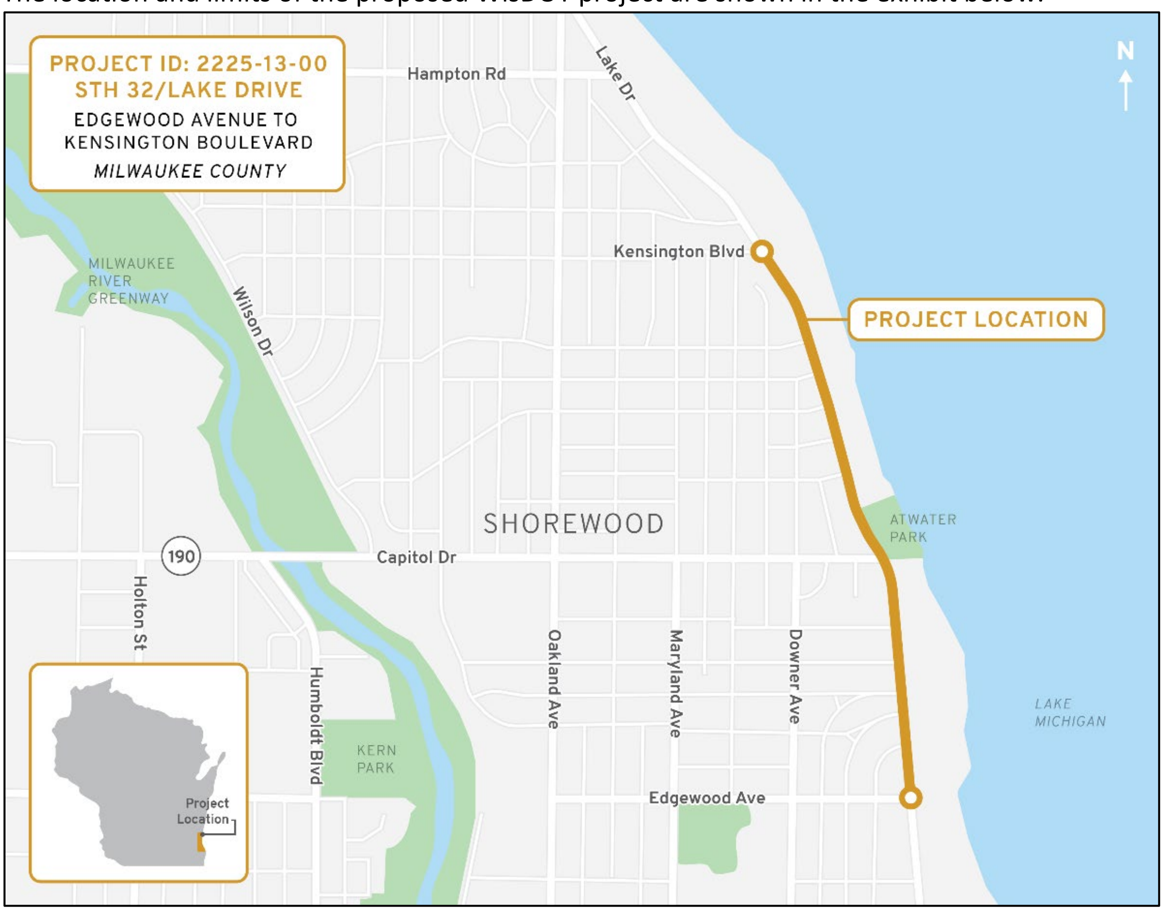
Section 1: Introduction and Objectives

1.0 WisDOT Project Background and Scope

The Wisconsin Department of Transportation (WisDOT) is planning a pavement replacement project on Lake Drive/STH 32 from Kensington Boulevard to Edgewood Avenue in the Village of Shorewood. As part of the pavement replacement project WisDOT will be evaluating the roadway corridor for elements such as pavement condition, roadway cross section, user safety, and municipal utilities. The WisDOT project planning and development is currently underway with a tentative construction start in 2026.

Within the Village limits, Lake Drive is an urban four-lane undivided roadway with curb and gutter. The typical roadway cross section is 44' in width from curb face to curb face. This includes two 11' wide travel lanes and two 11' wide outside lanes typically striped for shared on-street parking/bicycle lanes. The terrace width varies, and each side of the roadway has a 6' wide sidewalk. Within the project limits the roadway corridor is approximately 1.3 miles in length, has an average daily traffic of 14,000 vehicles/day, and has a posted speed limit of 30 mph. Some sections of the corridor have combined sewer while other sections have storm sewer and sanitary sewer mains.

The location and limits of the proposed WisDOT project are shown in the exhibit below.



1.1 Green Infrastructure Evaluation and Alternatives Analysis Objectives

As a green community, the Village of Shorewood is focused on protecting the region's natural resources and creating a sustainable environment for its residents. To meet these objectives the Village has a history of identifying and evaluating sustainable infrastructure development and green practices associated with public improvement projects throughout the Village. The purpose and scope of this report is to identify green infrastructure (GI) alternatives and the feasibility of including these practices into the reconstruction of the Lake Drive roadway corridor.

The following list summarizes the objectives of this Green Infrastructure Feasibility Study.

1. Identify and evaluate green infrastructure opportunities and Best Management Practices (BMPs) within the Lake Drive right-of-way between Edgewood Avenue and Kensington Boulevard.
2. Develop probable construction cost estimates for the identified and feasible green infrastructure opportunities.
3. Determine potential grant funding opportunities for the identified green infrastructure practices.

Section 2: Existing Sewer Infrastructure

2.0 Combined Sewer Area

A combined sewer area is located on Lake Drive from Shorewood Boulevard to Edgewood Avenue. All the drainage that is directed into the combined sewer system is ultimately treated at the Jones Island wastewater treatment facility. As this runoff is already subject to treatment prior to discharge back into waters of the state, there is little benefit and little to no return on investment (ROI) to pretreatment of this runoff with green infrastructure practices. **The combined sewer drainage basin within the project limits was not considered for the implementation of green infrastructure practices and is not included in this analysis or report.** Refer to Appendix A for maps of the Lake Drive sewer system and limits of the combined sewer area.

2.1 Existing Storm Sewer Area

Storm sewers are located on Lake Drive from Kensington Boulevard to Shorewood Boulevard. Per the Village GIS website, most of the Lake Drive runoff discharges to Lake Michigan via a 60" storm sewer pipe located south of the Wood Place intersection (between the 4120 and 4130 Lake Drive properties). A lesser amount of the Lake Drive runoff discharges to Lake Michigan via a 24"x48" storm sewer pipe located south of the Kensington Boulevard intersection (between the 4480 and 4496 Lake Drive properties). As these storm sewer systems discharge directly to Lake Michigan, there is a benefit to treating this runoff at its source and prior to discharge**. The storm sewer drainage basins within the project limits were considered for the implementation of green infrastructure practices and are the focus of this analysis and report.** These storm sewer drainage basin areas are approximately 23.6 acres based on an analysis of the GIS contour mapping information. Refer to Appendix A for maps of the Lake Drive sewer system and limits of the storm sewer area.

Section 3: Storm Water Treatment Objectives

3.0 Water Quality

Within the limits of the existing storm sewer area, storm water runoff from the Lake Drive roadway corridor is conveyed into the storm sewer system and ultimately discharged into Lake Michigan. Without treatment, pollutants carried in the storm water runoff will be deposited into Lake Michigan thereby degrading the water quality and wildlife habitats. Therefore, providing storm water quality treatment prior to discharge to Lake Michigan is an important component of the treatment objectives. Costs incurred for sustainable development as part of this project will have a direct benefit in improving the water quality of the storm sewer discharge into Lake Michigan. The ROI is greatest for treatment practices that directly relate to improving water quality and will therefore be the focus of the proposed GI alternatives.

3.1 Peak Discharge Rate/Water Quantity

The storm sewer from Kensington Boulevard to Shorewood Boulevard discharges into Lake Michigan. Since this body of water is so massive the peak discharge rate (or the limiting thereof) does not have a tangible impact on the receiving waterbody. Due to the substantial watershed area draining to the Lake Drive storm sewer system, providing storage to collect the drainage and reduce the peak discharge rate would take an impractical volume of storage and associated cost to have any meaningful impact. It is not feasible to physically fit a large scale storage system within the roadway corridor as there is not any available open space at-grade within the terrace or below grade within the network of existing utility infrastructure. Green infrastructure practices intended to provide storm water storage and reduce the peak discharge rate are not feasible or warranted within the context of this project.

3.2 Infiltration

There are no large open spaces within the roadway corridor to promote infiltration practices. In addition, as Lake Drive is in proximity to the Lake Michigan bluff, infiltration is not desirable as the resulting groundwater seepage could promote bluff erosion. Existing soils are clay and due to their low infiltration rates are not generally suitable for infiltration practices. For these reasons, infiltration practices are not feasible green infrastructure alternatives within the scope of this project. BMP's such as pervious pavement, biofiltration basin/bioswale would rely on an underdrain system connected to the Village storm sewer for discharge rather than infiltration.

Section 4: Green Infrastructure Alternatives Analysis

4.0 Reduce Total Impervious Area

In a reconstruction/redevelopment project, a simple and cost effective way to improve all aspects of storm water management is to reduce the overall impervious area. This results in less runoff being generated, more rain absorbed into the ground, and overall improved water quality. The existing typical roadway section is 44' in width from face of curb to face of curb. If a parking lane was eliminated on one side of the road the minimum typical roadway section with bicycle accommodations would be 40' in width (includes 5' bicycle lane, 11' driving lane, 11' driving lane, 5' bicycle lane, 8' parking lane), reducing the total pavement width by 4 feet. For the entire 1.3 mile length of roadway in the project, reducing the pavement section by 4' in width reduces the total impervious area by approximately 27,000 sq. ft. or 0.6 acres. While beneficial from a storm water perspective , the alteration to the roadway cross section impacts the functionality of the roadway. Because WisDOT is focused on maintaining the existing 44' roadway width, this alternative was not considered as a feasible green infrastructure alternative on this project.

4.1 Catch Basins with Sumps

Sumped catch basins are a traditional BMP for treating storm water by removing total suspended solids (TSS) and other pollutants and increasing water quality prior to storm water runoff discharging from the storm sewer system. For a roadway project that is generally limited to the roadway right-of-way and has very limited open space, sumped catch basins are the most feasible and cost-effective option. For maintenance the Village typically cleans the catch basin structures once every two years on average.

It is our understanding that the existing storm catch basin and inlet structures along the Lake Drive corridor are scheduled to be replaced as part of the WisDOT project. The existing structures consist of a mix of sumped (catch basin) and non-sumped (inlet) structures in various structure sizes. These existing structures can be uniformly replaced with new sumped catch basins to increase the capture rate of sediments and pollutants and further improve water quality. The new catch basins were modeled with 24-inch-deep sumps in accordance with the Shorewood Guide for Green Infrastructure standards. Additionally, since catch basins with larger sump surface areas can capture more pollutants, different sizes of catch basins were analyzed to determine their effectiveness. Finally, the proposed storm sewer improvements were compared against the existing conditions to determine the net improvement in water quality treatment. The result of this analysis is provided below.

Catch Basin Size	Particulate Solids Reduction with control (lbs)	% TSS Removal	Additional Solids Removal / % TSS Reduction Compared to Existing Conditions	Total Phosphorus Reduction (lbs) with control	Total Phosphorous % Removal	Additional Phosphorus Removal / % P Removal Compared to Existing Conditions
Existing Conditions	1,105	12.88%	N/A	2.84	9.10%	N/A
2'x3' Catch Basins	1,319	15.37%	214 lbs / 2.5%	3.38	10.86%	0.54 lbs / 1.8%
48" Diameter Catch Basins	1,715	19.99%	610 lbs / 7.1%	4.40	14.13%	1.56 lbs / 5.0%
60" Diameter Catch Basins	1,987	23.16%	882 lbs / 10.3%	5.10	16.38%	2.26 lbs / 7.3%

Table 4.1 – Catch Basins

For a WisDOT project, typically catch basins of standard dimensions of 2’x3’ and/or 48” diameter catch basins would be implemented as part of the base project scope. The cost premium for larger catch basin structures would be required to be funded entirely by the Village. As shown in the table above, there is a diminishing return as the size of the catch basins continues to increase. Additional costs associated with the larger structures and the physical limitations of the larger structures fitting within the existing utility infrastructure places practical limitations on the upper limits of the structure size.

Catch basins with sumps are an inexpensive green infrastructure practice. Refer to Table 5.0 for a breakdown of Village costs and Table 5.1 for the Village ROI in relation to the different catch basin structure sizes. It is recommended that 48” diameter catch basins with 2-foot sump depths are installed as part of the WisDOT roadway project for the best balance of cost and performance. If additional BMP treatments as discussed later in this report are selected to be included with the project, they shall be installed in conjunction with catch basins and have been modeled and analyzed in this report as such. **Catch basins with sumps are a practical and feasible BMP to include as a green infrastructure option in this project.**

4.2 Permeable Pavement

Permeable pavement in the form of permeable pavers is a BMP that is currently utilized in various areas of the Village, most notably as part of the Green Alley Program. Permeable pavement has openings/pores that allows storm water to infiltrate through the pavement into an underground filtration system that improves water quality prior to releasing the drainage into the storm sewer system. Maintenance can be expected with these systems with a minimum surface cleaning frequency of twice per year using industry recommended methods such as regenerative air or vacuum sweeping.

For the reconstruction of the Lake Drive roadway corridor, permeable pavers could potentially be incorporated into the parking lanes within the existing storm sewer area to capture and treat the runoff from the roadway pavement. The parking lanes are currently used as shared parking and bicycle lanes. If pervious pavers are selected, to avoid placing pavers in the bicycle path, the pavers would be limited to 5’ in width adjacent to the curb flange to maintain a 4’ wide lane for bicycle traffic between the edge of pavers and edge of traveled roadway lane. Since the permeable pavement section is deeper than a traditional pavement section, a detailed utility review would need to be completed to verify that there are no conflicts with utilities that may have been buried at a shallow depth under the roadway. As the terrace and residential lawn areas would continue to direct drainage into the roadway curb and gutter, sumped catch basins would be used in conjunction with permeable pavement. On the east side of the road, the permeable pavement could begin at the start of the parking lane adjacent to Atwater Park and continue to the north to Kensington Blvd. On the west side of the road, the permeable pavement could begin at the start of the parking lane mid-block between Capitol Drive and Jarvis Street and continue to Kensington Blvd. Refer to Appendix B for an exhibit with the potential locations for permeable pavement. The results of such an installation are provided below.

GI Practice	Particulate Solids Reduction (lbs)	TSS % Removal	Total Phosphorus Reduction (lbs)	Total Phosphorous % Removal
48" Diameter Catch Basins	1,362	21.9%	3.64	15.5%
Permeable Pavers -Parking Lanes north of Capitol to Kensington	1,420	60.1%	3.32	43.4%
Total	3,243	37.80%	8.92	28.63%
Additional Removals Compared to Existing Conditions	2,138 lbs	24.9%	6.08 lbs	19.5%

Table 4.2 – Permeable Pavement

In accordance with the SMA agreement with WisDOT, there is a 15% cost sharing requirement by the Village of Shorewood for a traditional concrete pavement structure in the parking lanes. The cost to the Village to replace a portion of the concrete pavement with pervious pavers is the cost of the pavers and associated stone storage base material less the 15% shared cost that the Village would have had to contribute for a traditional concrete pavement structure. While the cost is higher than other GI practices, the permeable pavers can capture and treat a more significant volume of storm water runoff from the roadway, providing the highest total TSS and phosphorous removal compared to the other GI practices. Refer to Table 5.0 for a breakdown of Village costs and Table 5.1 for the Village ROI for the permeable pavement alternative.

Permeable pavers provide a unique design element and an added aesthetic to the roadway. This treatment practice is visible to the public which promotes understanding and enthusiasm for green infrastructure. The construction typically fits within the scope of the current project so additional accommodations (roadway closures, construction staging, etc.) are not required to include this GI practice. Combined with the increase in water quality performance, permeable pavers are a feasible option as a green infrastructure alternative for this project. **If additional storm water treatment is desired beyond that provided by catch basins, pervious pavers are recommended as a supplemental GI practice.**

4.3 Biofiltration Basin / Bioswale

A biofiltration basin is a BMP that has been used in several areas in the Village. It is a vegetated/landscaped area designed to collect and filter storm water runoff. Storm water directed to the device soaks into the landscaped area and infiltrates through an underground filter media and storage layers. An underdrain at the bottom collects the treated storm water and discharges it into the storm sewer system. The basin is typically planted with native plants and grasses with deep root structures that absorb some pollutants in the runoff and help to treat the storm water. Examples of biofiltration basins/bioswales in a similar application can be found on Wilson Drive between Congress Street and Alpine Avenue. A series of bioswales are installed in the terrace to capture and treat runoff from the roadway. The larger the sizes of the overall biofiltration basins or bioswales, the more effective it can provide storm water treatment.

For roadway projects, bioswales tend to be incorporated into roadway medians and/or terrace areas if there is adequate open space and width. Multiple biofiltration cells are typically installed in a series to capture runoff along the length of a roadway corridor without overloading each individual biofiltration cell. For this project, there are no proposed medians and the terrace on each side of the road has very limited open space, being consistently planted with mature trees. As a frame of reference, the bioswales on Wilson Drive range in size from 1,500 sq. ft. to 2,500 sq. ft. Screening the corridor for Ash tree removals did not present opportunities to create large areas of open space. In accordance with Village policy guidance on the removal of ash trees, ash trees with a condition rating of less than 50% and all European and Green Ash trees, regardless of condition, with a diameter of less than 24 inches will be replaced. Within the corridor many trees are ash trees, but the condition rating of all ash trees is 0.5 or greater. Anticipated tree removals for the smaller Green and European Ash trees (<24 inches) are intermittent. In addition, there is an extensive network of existing underground utilities within the terrace including gas, electric, water, telephone, cable, and fiber optic. These utilities would be impacted with the construction of biofiltration basins in the roadway terrace. Additional tree removals beyond the current Village policy along with multiple utility relocations would need to be considered to create potential opportunities for bioswales within the corridor.

While space is limited within the right-of-way, there is Village owned land adjacent to the roadway corridor at Atwater Park. A small biofiltration basin could be installed at the entrance, refer to Appendix C for a potential location for the basin. For a small basin such as this, the quantity of allowable storm water runoff into the basin would be limited to not overload it, and the treatment benefits would similarly be limited. This BMP would be used in conjunction with sumped catch basins. The anticipated water quality benefits are provided below.

GI Practice	Particulate Solids Reduction (lbs)	TSS % Removal	Total Phosphorus Reduction (lbs)	Total Phosphorous % Removal
48" Diameter Catch Basins	1,648	20.0%	4.23	14.1%
Biofiltration Basin @ Atwater Park	188	58.3%	0.47	41.1%
Total	1,836	21.40%	4.70	15.09%
Additional Removals Compared to Existing Conditions	731 lbs	8.5%	1.86 lbs	6.0%

Table 4.3 – Biofiltration Basin

While a biofiltration basin can add an aesthetic element to an environment as a landscaped area with native plants and grasses, due to the limited space in Atwater Park, removing any open gathering space in favor of a storm water treatment area may be met with disapproval by the users of the park. At this location, the basin would be placed in proximity to the bluff. Although it would be lined to prevent infiltration, any failure of the basin could negatively impact the bluff. Furthermore, as a publicly owned park, Atwater Park is considered by WisDOT as a Section 4(f) property which cannot be impacted as part of a transportation project. Any work within Atwater Park would be required to be a separate standalone project designed and constructed by the Village. For these reasons **biofiltration basins/swales are not a feasible green infrastructure option** to include in the project.

4.4 Underground Detention

An underground detention system is essentially a buried oversized pipe or storage chamber that contains a permanent pool of water. Storm water runoff enters the storage chamber and suspended solids, debris, and pollutants settle to the bottom of the storage chamber, thereby increasing the water quality of all discharged storm water. Over time the sediment accumulates at the bottom of the detention system and needs to be cleaned out. Underground detention can be used in conjunction with catch basins, where catch basins provide pretreatment prior to the runoff reaching the underground detention basin.

With the volume of runoff generated from the roadway corridor, especially for larger storm events, a significant amount of storage is required. To study potential improvements to water quality, a system 300’ in length consisting of 84” diameter piping (containing a 4’ permanent pool of water) was considered and modeled. This BMP would be used in conjunction with sumped catch basins. The anticipated water quality benefits are provided below.

GI Practice	Particulate Solids Reduction (lbs)	TSS % Removal	Total Phosphorus Reduction (lbs)	Total Phosphorous % Removal
48” Diameter Catch Basins	1,844	21.5%	4.40	14.13%
Underground Detention - 300’ of 84” Pipe	899	31.9%	2.65	20.5%
Total	2,743	31.97%	7.05	22.62%
Additional Removals Compared to Existing Conditions	1,638 lbs	19.1%	4.21 lbs	13.5%

Table 4.4 – Underground Detention

Underground detention systems are costly and are generally only used in heavily urban sites that have no available open space for other BMPs. These systems are generally installed within larger development sites, under parking lots, and other areas where they will not impact underground utilities or infrastructure. They are not commonly installed under roadways especially within extensively developed corridors. While the ROI for an underground detention system looks favorable when compared to other BMP practices, there are many hidden costs that are not captured in this calculation. The large size required for the underground detention system creates crossing conflicts with existing water and sewer utility laterals. The lateral piping and the associated utility mains would need to be relayed deeper to avoid the new detention system. The extensive area of excavation to install the system requires a complete roadway shutdown, creating additional expenses for temporary traffic control, detours, and deterioration of adjacent roadways that do not typically experience such high traffic volumes. The extent of these impacts would require further detailed investigation and therefore the associated costs are not currently reflected in these estimates. Adding up these additional impacts would result in a much less favorable ROI for underground detention. Since there is an extensive network of existing utility infrastructure it is not feasible to relocate existing utilities to physically fit such a large-scale underground storage system within the roadway corridor. For these reasons **underground detention is not a feasible green infrastructure option** to include in the project.

4.5 Proprietary Devices/Others

There are several commercially available structural storm water treatment devices by various manufacturers that can enhance pollutant removal rates within a storm sewer system. These devices are typically substituted for catch basins and vary in their method of treatment but may use filters, media filled cartridges, skimmers, whirlpools, etc. to collect and capture pollutants within the structure. These devices require more intensive maintenance and user knowledge than standard catch basin structures and have not seen widescale adoption. Due to the plethora of options that fall into this category as well as the additional cost and maintenance requirements, these devices were not considered as a green infrastructure alternative on this project.

Storm water tree pits work similarly to biofiltration basins. Runoff can be directed into the tree pits which then absorb and filter the runoff prior to discharge back into the storm sewer system. Typically, multiple tree pits are connected in series to form a continuous underground trench storage area to collect and treat storm water. An underdrain at the bottom of the system directs the filtered storm water back into the storm sewer system. To achieve the required treatment area and storage volume needed to handle the storm water runoff from the roadway, multiple interconnected tree pits are needed. As discussed previously, with the Lake Drive terrace already continuously planted with mature trees that are close together, there is not adequate space to provide this interconnected network of storm water tree pits. Additionally, there are a multitude of existing underground utilities that run under the terrace including gas, electric, water, telephone, cable, and fiber optic. These utilities would be impacted with the construction of storm water tree pits. For these reasons, **this treatment practice was not considered as a feasible green infrastructure alternative on this project.**

Section 5: Opinion of Probable Construction Cost

5.0 Cost Summary

GI Practice	Quantity	Unit Price	Total Cost	Total Cost Funded by Village of Shorewood
Catch Basins 2x3-ft	25 each	$1,800 /ea.	$45,000	$0
Catch Basins 48” Diameter	25 each	$2,200 /ea.	$55,000	$0
Catch Basins 60” Diameter	25 each	$3,400 /ea.	$85,000	$30,000 (Cost premium to install 60” catch basins = 60” catch basin cost – 48” catch basin cost)
Permeable Pavement	34,000 s.f. pavers + 5,000 c.y. permeable paver storage stone + 6,500 l.f. of underdrain	$10 /s.f. + $65 /c.y. + $25/l.f.	$827,500	$787,750 (Cost premium to install permeable pavers instead of concrete paving in parking lanes = Permeable paver system cost – 15% Village cost sharing for concrete pavement installation)
Biofiltration Basin	1,200 s.f.	$30 /s.f.	$36,000	$36,000
Underground Detention	300 l.f.	$700 /l.f.	$210,000	$210,000

Table 5.0 – Cost Summary

Refer to Appendix D for detailed cost estimate information.

5.1 Return on Investment -Removal Efficiencies by Cost

GI Practice	Total Cost by Village (20-yr life)	Annual TSS Removal (lb)	Annual $/lb of TSS Removal (20-yr life)	Annual Phosphorous Removal (lb)	Annual $/lb of Phosphorous Removal (20-yr life)
Catch Basins 2x3-ft	$0	1,319	N/A	3.38	N/A
Catch Basins 48" Diameter	$0	1,715	N/A	4.40	N/A
Catch Basins 60" Diameter	$30,000	272	$6 / lb	0.7	$2,200 / lb
Permeable Pavement	$787,750	1,420	$28 / lb	3.32	$11,900 / lb
Biofiltration Basin	$36,000	188	$10 / lb	0.5	$3,600 / lb
Underground Detention	$210,000	899	$12 / lb	2.65	$4,000 / lb

Table 5.1 – ROI Summary

The total cost by Village is the initial cost of construction. Potential grant funding and annual maintenance costs have not been considered. A 20-year design life has been assumed for all BMP device to determine the annual cost per pound of pollutant removal.

Section 6: Potential Funding Mechanisms

Potential funding mechanisms are listed below. These programs are typically competitive grant programs with project selection based on their compatibility with grant program goals and objectives. Depending on the green infrastructure practices selected for the project as well as other project specific criteria, the project may be eligible for funding from the programs listed below. Treatment practices such as sumped catch basins are not eligible for funding, while green infrastructure such as a pervious paver system generally have a higher likelihood of obtaining funding. The prospect of grant funding should be evaluated by the Village staff based on past green infrastructure project experiences within the community. While the project may be eligible to submit an application for the funding programs listed below, no grant funding is guaranteed.

6.0 Green Infrastructure Partnership Program

The Green Infrastructure Partnership Program (GIPP) is funding provided by Milwaukee Metropolitan Sewerage District (MMSD) to create new green infrastructure practices including rain gardens, bioswales/biofiltration basins, green roofs, and a variety of other practices that help capture and treat storm water runoff. The program offers incentive funding on a cost per-gallon captured basis.

Applications are competitively scored based on an established set of criteria focused on the applicant's ability and commitment to implement, maintain, and promote the project. As the receiving waterbody for this project is such a large watershed in Lake Michigan, project related water quality improvements will be less impactful than in a smaller watershed like the Milwaukee River. Because of this, the project will score lower and have a reduced likelihood of being selected for this grant.

6.1 Green Solution Program

The Green Solutions program is funding provided by MMSD as a financial incentive to municipalities served to implement green infrastructure practices and achieve TMDL compliance. Funding is provided on an annual basis to the Village of Shorewood rather than on a project-by-project basis.

6.2 Urban Nonpoint Source & Storm Water Management Grant Program

The Urban Nonpoint Source & Storm Water (UNPS&SW) Management Grant Program provided by the Wisconsin Department of Natural Resources offers competitive grants to local governments for the control of pollution from urban sources that is carried by storm water runoff. The grant funding is geared towards TMDL (Total Maximum Daily Loads) compliance. The total state reimbursement amount cannot exceed $150,000 for construction and engineering.

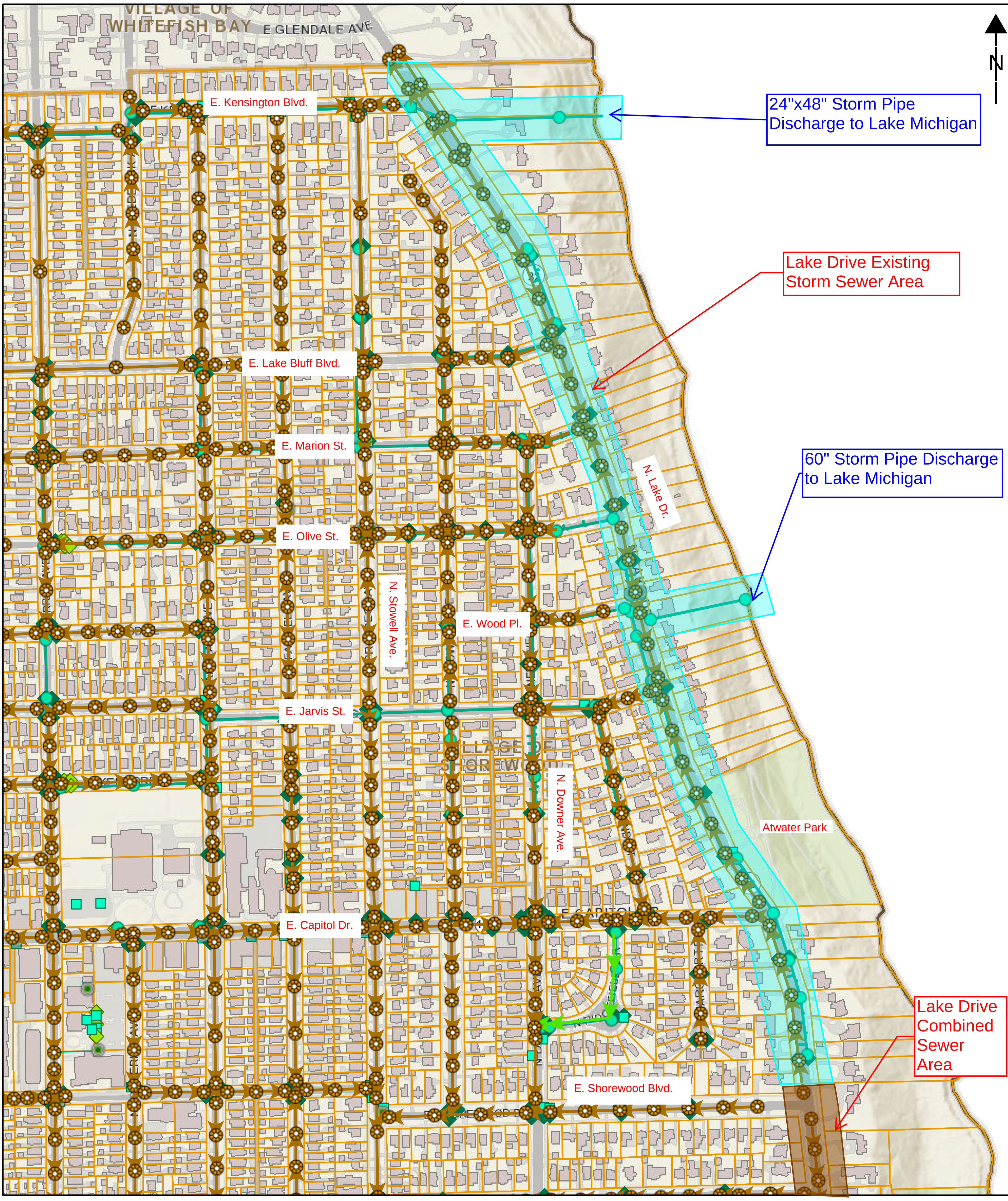
6.3 Fund for Lake Michigan

The mission of the Fund for Lake Michigan is to improve the health of Lake Michigan, its shoreline and river systems, for the benefit of the people and communities that depend on it for water, recreation, and commerce. As such, Fund for Lake Michigan grants are targeted to the Lake Michigan shoreline, near shore areas, and watersheds within the Lake Michigan basin in Wisconsin. Priority is given to on-the-ground projects in southeastern Wisconsin that have near-term, direct, and quantifiable impacts on water quality in the Lake Michigan watershed. Past project experience has indicated that state-of-the art, large scale, and innovative projects involving restoration, development, and water treatment practices are most likely to obtain funding. As a roadway reconstruction project, the scope and scale of this project is likely not notable enough to be selected for funding from this program.

Appendix A

Lake Drive Sewer System Maps

Lake Drive Sewer System



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Scale 2 Street Labels

Scale 2 Muni Labels

Combined Sewer Manholes

Sewer Pipes

Combined Waste Water

Sanitary Sewer

Storm MHs

Standard

Sump

Curb Inlets

Standard Inlet

Catchbasin with Sump

Green Inlet

Storm Pipes

Storm Pipes

Storm Leads

Underdrains

Property Information

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0 0.07 0.15 0.3 km

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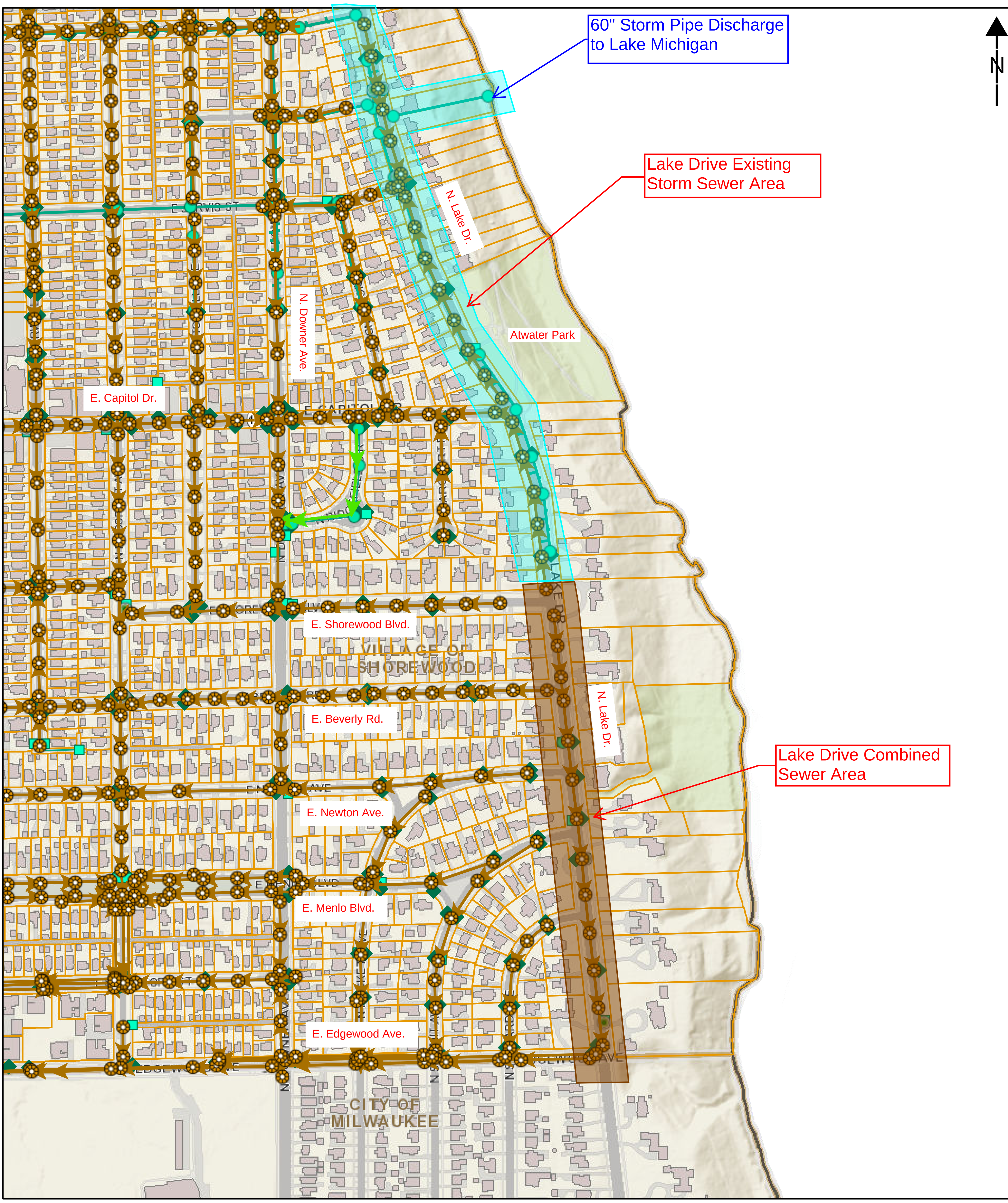
Milwaukee County Land Information Office

Shorewood, WI

Lake Drive Sewer System



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Scale 2 Street Labels

Scale 2 Muni Labels

Combined Sewer Manholes

Sewer Pipes

Combined Waste Water

Sanitary Sewer

Storm MHs

Standard

Sump

Curb Inlets

Standard Inlet

Catchbasin with Sump

Storm Pipes

Storm Pipes

Storm Leads

Underdrains

Property Information

1:5,000

0 0.05 0.1 0.2 mi

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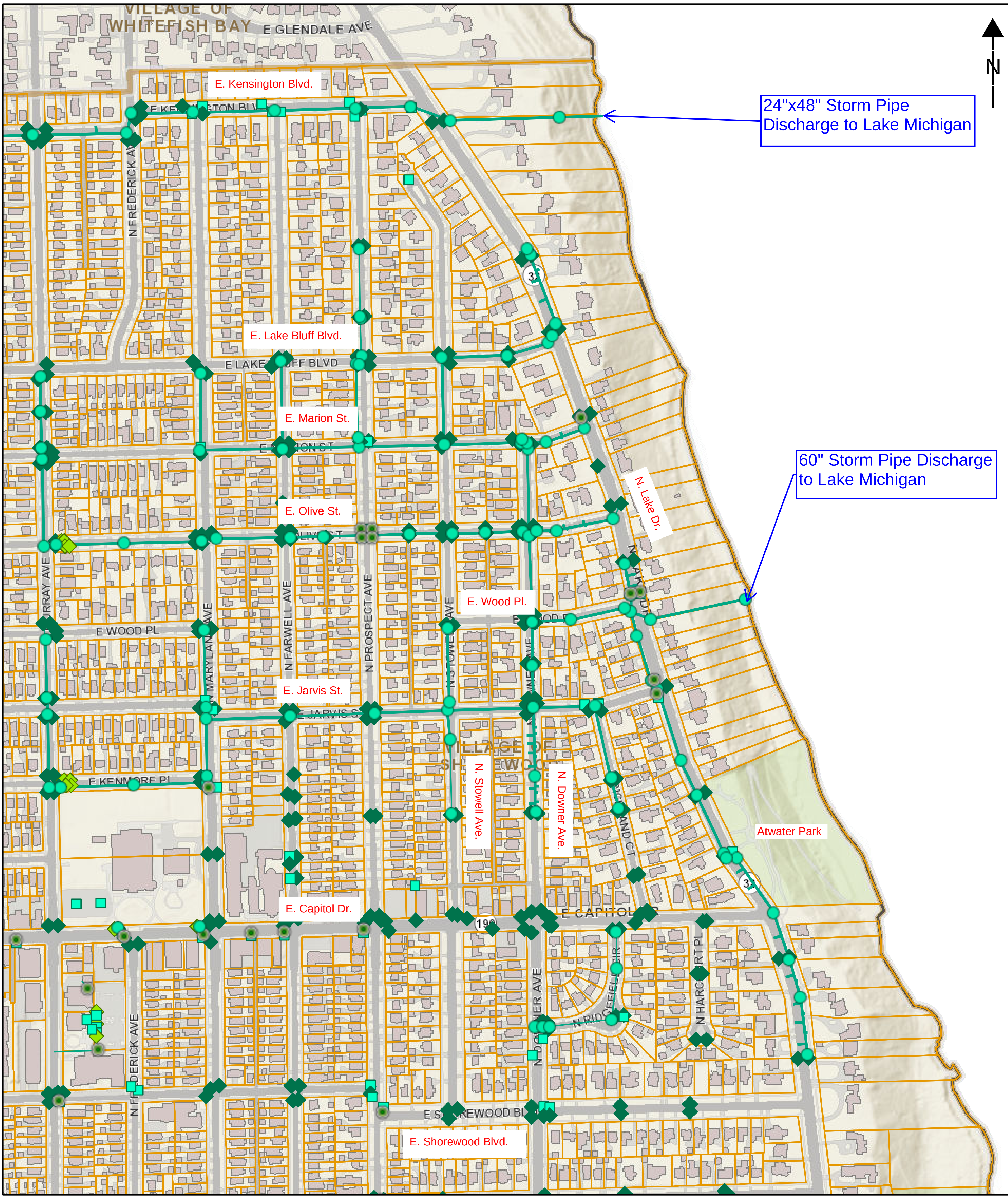
Milwaukee County Land Information Office

Shorewood, WI

Lake Drive Existing Storm Sewer



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Scale 2 Street Labels

Scale 2 Muni Labels

Catchbasin with Sump

Green Inlet

Storm MHs

Standard

Sump

Curb Inlets

Standard Inlet

Storm Pipes

Storm Pipes

Storm Leads

Underdrains

Property Information

1:5,000

0 0.05 0.1 0.2 mi

0 0.07 0.15 0.3 km

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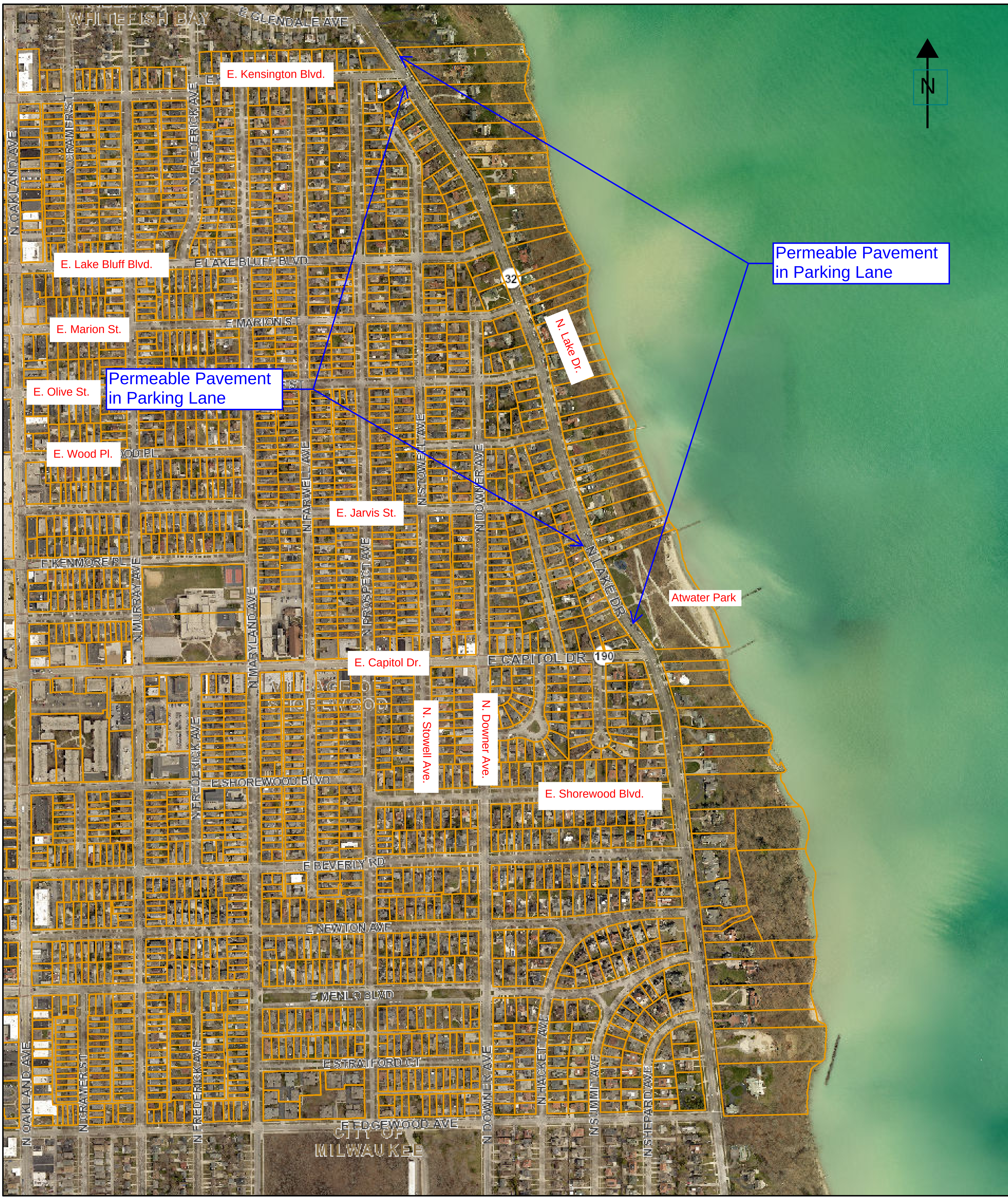
Milwaukee County Land Information Office

Shorewood, WI

Appendix B

Permeable Pavement Exhibit

Lake Drive Permeable Pavement



11/30/2021, 1:45:11 PM

Scale 3 Street Labels

Scale 3 Muni Labels

Property Information

1:7,000

0 0.07 0.15 0.3 mi

0 0.13 0.25 0.5 km

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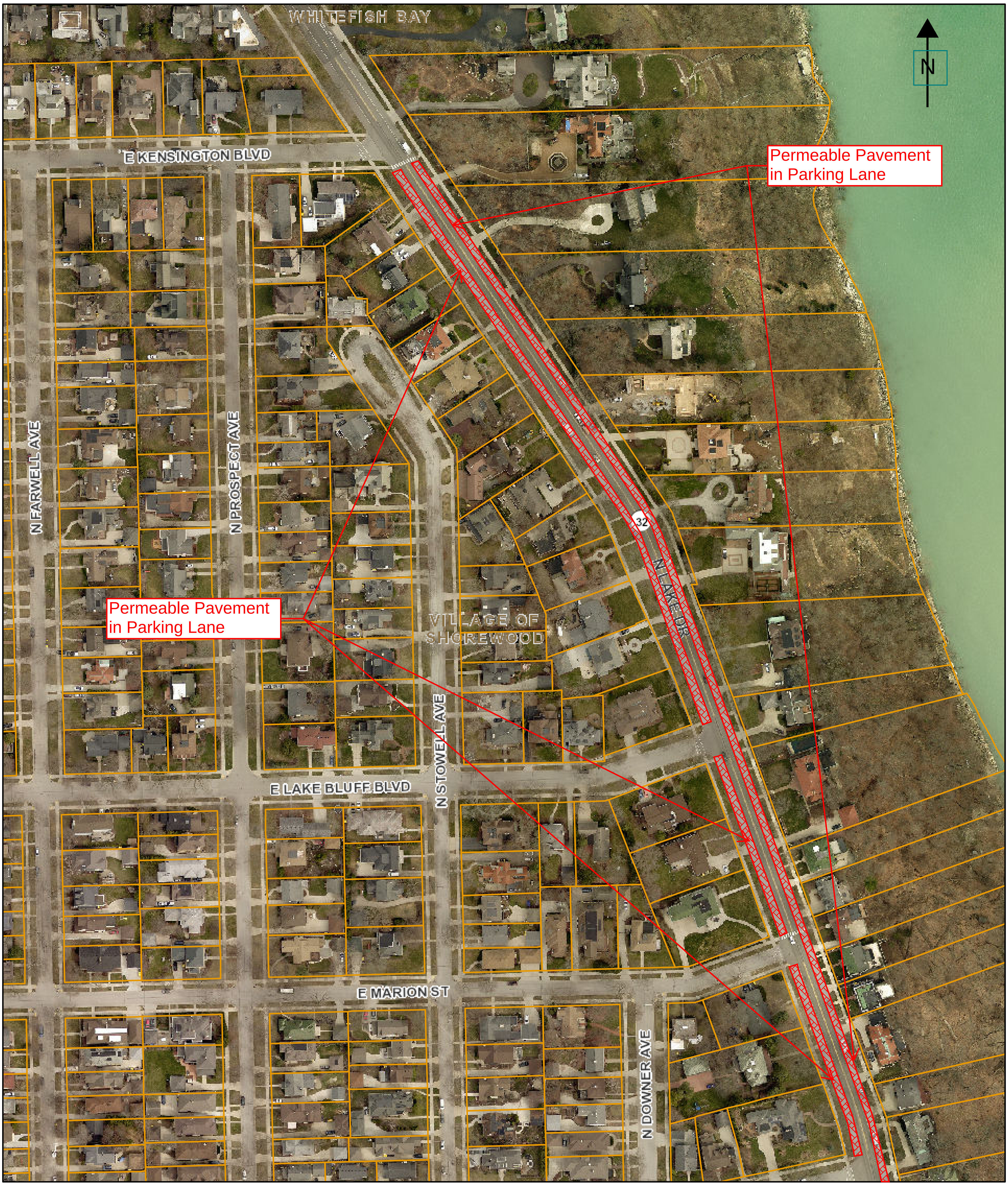
Lake Drive Permeable Pavement



11/30/2021, 1:48:50 PM

Scale 1 Street Labels

Scale 1 Muni Labels

Property Information

1:2,000

0 0.02 0.04 0.09 mi

0 0.04 0.07 0.14 km

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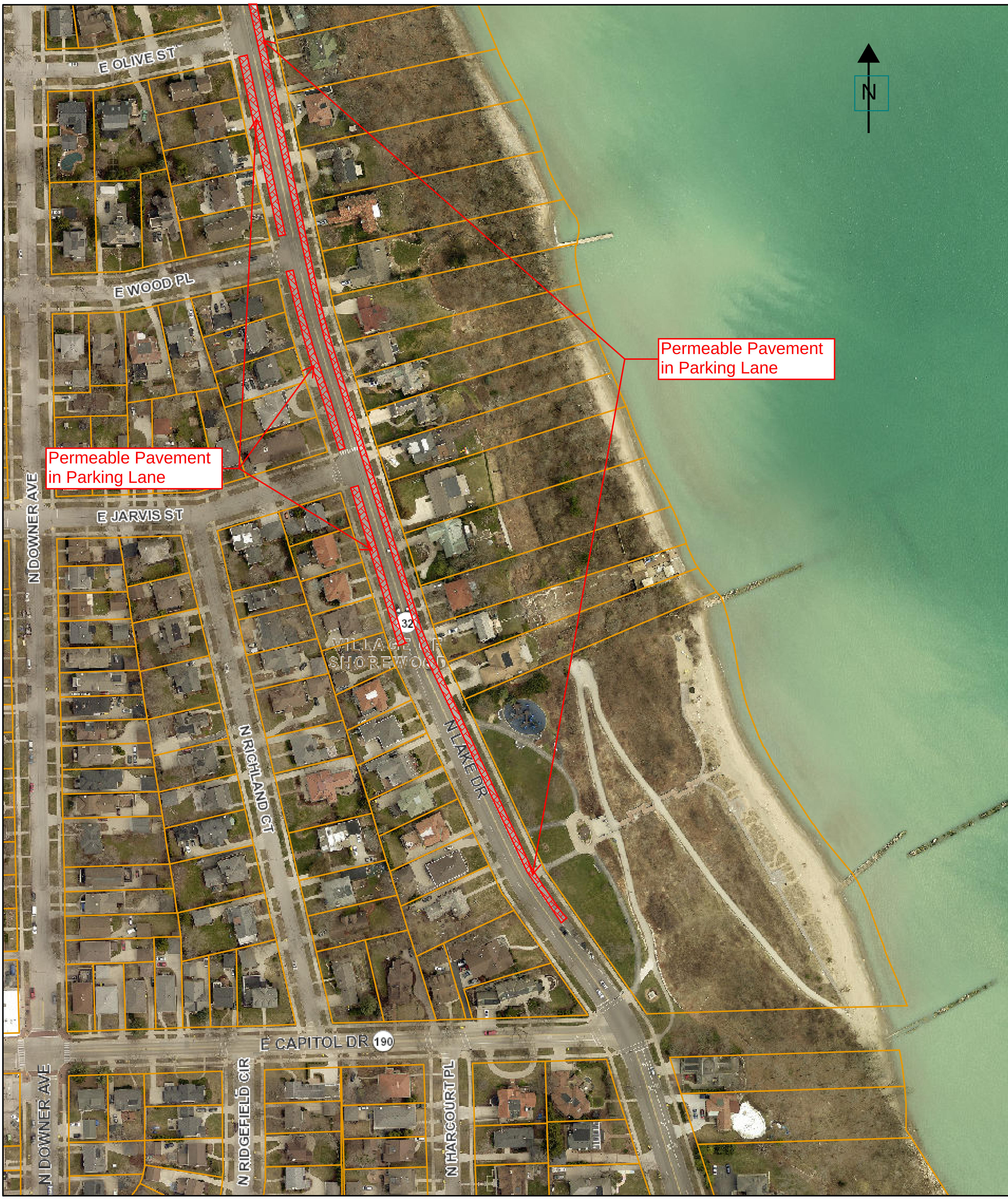
Lake Drive Permeable Pavement



11/30/2021, 1:47:40 PM

Scale 1 Street Labels

Scale 1 Muni Labels

Property Information

1:2,000

0 0.02 0.04 0.09 mi

0 0.04 0.07 0.14 km

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Shorewood, WI

Appendix C

Biofiltration Basin Exhibit

Lake Drive Biofiltration Basin

11/30/2021, 1:26:44 PM

Scale 0 Street Labels

Scale 0 Muni Labels

Combined Sewer Manholes

Sewer Pipes

Combined Waste Water

Storm MHs

Standard

Curb Inlets

Standard Inlet

Catchbasin with Sump

Storm Pipes

Storm Pipes

Storm Leads

Underdrains

Address Numbers

Property Information

1:500

0	0.01	0.01	0.02 mi
0	0.01	0.01	0.03 km

N

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Shorewood, WI

Appendix D

Estimate of Probable Construction Costs

GREEN INFRASTRUCTURE EVALUATION AND ALTERNATIVES ANALYSIS
STH 32/ LAKE DRIVE ROADWAY IMPROVEMENT PROJECT

ESTIMATE OF COSTS FOR GREEN INFRASTRUCTURE ALTERNATIVES
February 1st, 2022

Section 4.1: Catch Basins with Sumps							
Item No.	**Item**	**Unit**	**QTY**	**Unit Price**	**Total**	**WisDOT Cost**	**Village Cost**
611.1230	Catch Basins 2x3-FT	EACH	25	$1,800.00	$45,000.00	$45,000.00	$0.00
611.1004	Catch Basin 4-FT Diameter	EACH	25	$2,200.00	$55,000.00	$55,000.00	$0.00
611.1005	Catch Basin 5-FT Diameter	EACH	25	$3,400.00	$85,000.00	$55,000.00	$30,000.00

Section 4.2: Biofiltration Basin / Bioswale							
Item No.	**Item**	**Unit**	**QTY**	**Unit Price**	**Total**	**WisDOT Cost**	**Village Cost**
SPV	Biofiltration Basin at Atwater Park	SF	1,200	$30.00	$36,000.00	$0.00	$36,000.00

Section 4.3: Permeable Pavement							
Item No.	**Item**	**Unit**	**QTY**	**Unit Price**	**Total**	**WisDOT Cost**	**Village Cost**
Concrete Pavement Cost if used in parking lane areas rather than Permeable Pavers - 15% cost sharing by Village per SMA							
415.0080	Concrete Pavement 8-Inch	SY	3,800	$50.00	$190,000.00	$161,500.00	$28,500.00
305.0125	Base Aggregate Dense 1 1/4-Inch	TON	2,500	$30.00	$75,000.00	$63,750.00	$11,250.00
					TOTAL	$225,250.00	$39,750.00
Permeable Pavers Cost in the parking lanes - 100% cost by Village							
SPV	Permeable Pavers	SF	34,000	$10.00	$340,000.00	$0.00	$340,000.00
SPV	Permeable Pavers Storage Layer, No. 2 Stone	CY	5,000	$65.00	$325,000.00	$0.00	$325,000.00
612.0406	Pipe Underdrain Wrapped 6-Inch	LF	6,500	$25.00	$162,500.00	$0.00	$162,500.00
					TOTAL	$0.00	$827,500.00
	Total Cost Premium for the Village to Install Permeable Pavers instead of Concrete Pavement in Parking Lanes			= $827,500 - $39,750			$787,750.00

Section 4.4: Underground Detention							
Item No.	**Item**	**Unit**	**QTY**	**Unit Price**	**Total**	**WisDOT Cost**	**Village Cost**
521.6184	Culvert Pipe Corrugated Steel Aluminum Coated 84-Inch	LF	300	$700.00	$210,000.00	$0.00	$210,000.00