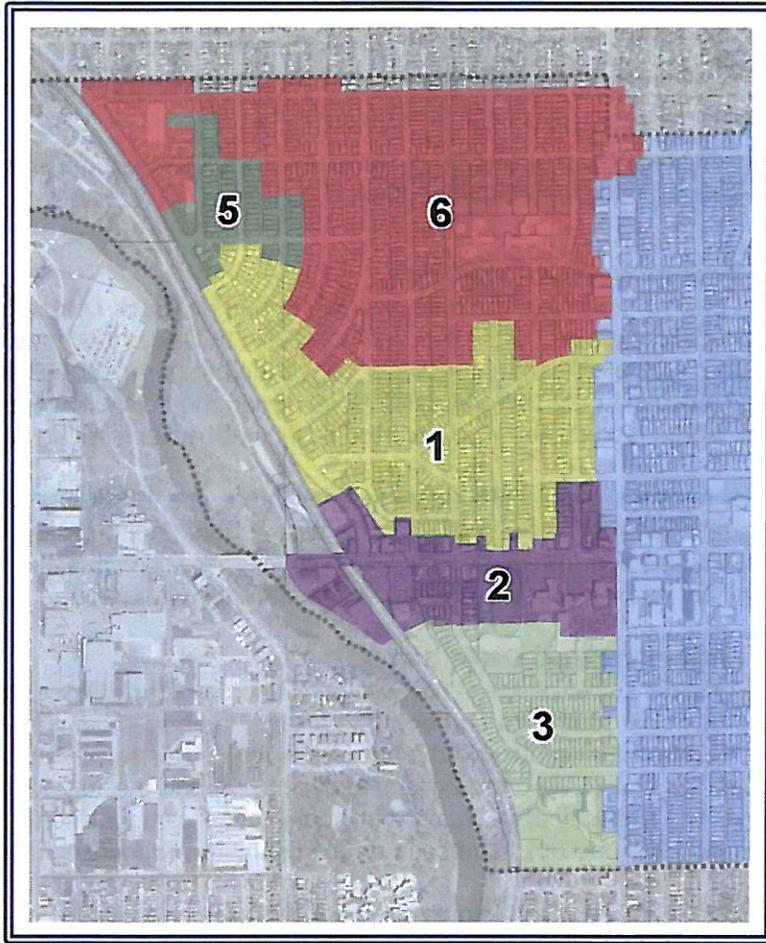


### 3- Separated Sewer Area Solutions

Recent flow metering by MMSD has identified Basins 1 and 6 as exceeding the peak hourly flow limits set forth in the MMSD 202 Facilities Plan. This finding indicates that both basins suffer from higher than average I-I.



**Separated Sewer Area of Shorewood – Sewershed ID Numbers**

Basins 1 and 6, not surprisingly, also happen to be the locations of the most frequent and severe basement backups during wet weather. Both sewersheds also suffer from inadequate street drainage that can pond on streets and intersections, creating hazardous conditions, and potentially increasing the clear water contribution to the already overloaded sanitary sewer system. The Village’s separate sewer improvement program focuses on sewersheds SH5001 and SH5006, and provides storm sewer projects that improve street drainage as well.

The most important feature of the Village’s approach to sewer improvements is the adoption of a goal of reducing I-I in separated area by 40% by 2035 and 80% long-term, for back-up protection for 4 inches of rain in 1 hour. This includes the rehabilitation and reconstruction of sewer laterals, as well as a comprehensive program to disconnect foundation drains from the sewer system.

### **Basin 1 Basement Backup Problem Definition**

Solution development in Basin 1 was assigned to **Strand Associates, Inc.** Both sanitary sewer improvements and drainage improvements in the area were included in the scope of work, which is presented herein.

- Focus on frequent backups on Larkin, Bartlett, and Newhall, south of Olive, north of Capitol
- Affecting approximately 150 properties in a **2 inch-1 hour** rain
- Surface depression centered at Kenmore and Newhall – directly affecting about 30 homes.
- Approximately 700 foot section of Newhall can collect up to 2.5 feet of rain during a 1 inch-1hour rain without overland flow.

### **Basin 2 Basement Backup Problem Definition**

The review of Basin 2 sewer performance was performed by **Clark Dietz, Inc.** Basin 2 is generally located along Capitol Drive, from Wilson Drive to Oakland Avenue. This is mainly a commercial strip, where residential properties consisting of apartment buildings. While severe surface flows have been reported on Capitol Drive during the heavy downpours of July 15 and 22, 2010, the Village records show no reported basement backups in this Basin on July 15, 2010.

On the heavier rains of July 22, 2010, one house with basement flooding was reported on Morris Boulevard at the intersection of Pinedale Court, just south of Capitol Drive. In general, the sewer system in Basin 2 has performed adequately in wet weather conditions and modeling of the system shows that no hydraulic improvements are currently warranted.

### **Basin 3 Basement Backup Problem Definition**

The review of Basin 3 sewer performance was performed by **Clark Dietz, Inc.** Basin 3 is generally located in the southwest corner of the Village, in an area bound by Oakland Avenue, Capitol Drive, Edgewood Avenue, and the Milwaukee River. This sewershed had about 3 reported backups on July 15, and 15 reported basement backups during the July 22, 2010 rain. There are 146 buildings in the sewershed, including the Middle School campus and the Public Works Campus. The reported backups have been on Morris Boulevard, between Newton and Beverly.

Historically, Basin 3 has not been known to be a high basement backup risk area, and the number of basement backups reported in July 2010 reflects the severity of rainfall rather than systemic deficiencies in sewer performance. In general, the sewer system in Basin 3 has performed adequately in wet weather conditions and extensive modeling of the system was undertaken to determine if hydraulic improvements are warranted.

### **Basin 4 Basement Backup Problem Definition**

Shorewood's Basin 4 refers to the area between Wilson Drive and the Milwaukee River. As such, there are no buildings and no sewers in this area. Basin 4 is not included for consideration in this Facility Plan.

### **Basin 5 Basement Backup Problem Definition**

The review of Basin 5 sewer performance was performed by **Clark Dietz, Inc.** Basin 5 is in the northwest side of Shorewood, tucked around the intersection of Congress and Woodruff. It is the smallest of Shorewood's separated service area sewersheds. Basin 5 had no reported basements backups on July 15, 2010 and 9 basement backups out of the total of 72 buildings on July 22, 2010.

Historically, Basin 5 has not been known to be a high basement backup risk area, and the number of basement backups reported in July 2010 reflects the severity of rainfall rather than systemic deficiencies in sewer performance. In general, the sewer system in Basin 5 has performed adequately in wet weather conditions and extensive modeling of the system was undertaken to determine if hydraulic improvements are warranted.

### **Basin 6 Basement Backup Problem Definition**

Solution development for Basin 6 was assigned to **Baxter & Woodman, Inc.** This sewershed is part of a system that extends into the Village of Whitefish Bay connecting to the Courtland Avenue MIS. The central part of the sewershed in Shorewood, close to the Whitefish Bay border has experienced frequent backups. This is a broken sewershed that has been found to have a peak hourly GPAD about 50 percent more than the assigned value of 21,000.

In addition to the present work, ATTACHMENT 1 presents the results of a study performed in 2000 (Basin 6 Sanitary Sewer Report) as a way to frame the Basin 6 issues that the Village has been grappling with over the last several years. Much work has been done on this issue, and the idea of somehow directing Basin 6 lows into Basin 5 (SH5005 at Congress) has been previously explored. The report is the first one of its kind to propose this alternative.

Even 10 years ago, the notion of reducing I-I in Basin 6 was front and center in discussing potential solutions. Specifically, the Village made its first attempt at recommending that foundation drains be disconnected in this area, as means to support the hydraulic improvements brought about by re-routing Basin 6 into Basin 5 instead of Whitefish Bay. ATTACHMENT 2 is a letter report outlining the foundation drain disconnection strategies that could achieve sizeable basement backup risk reduction in the area.

Basement backups are most common in the central portion of the sewershed, roughly an area bound by Glendale Ave., Marlborough, Lake Bluff, and Larkin Avenues. Rainfalls of 2 inches or more in one hour affect about 175 properties.

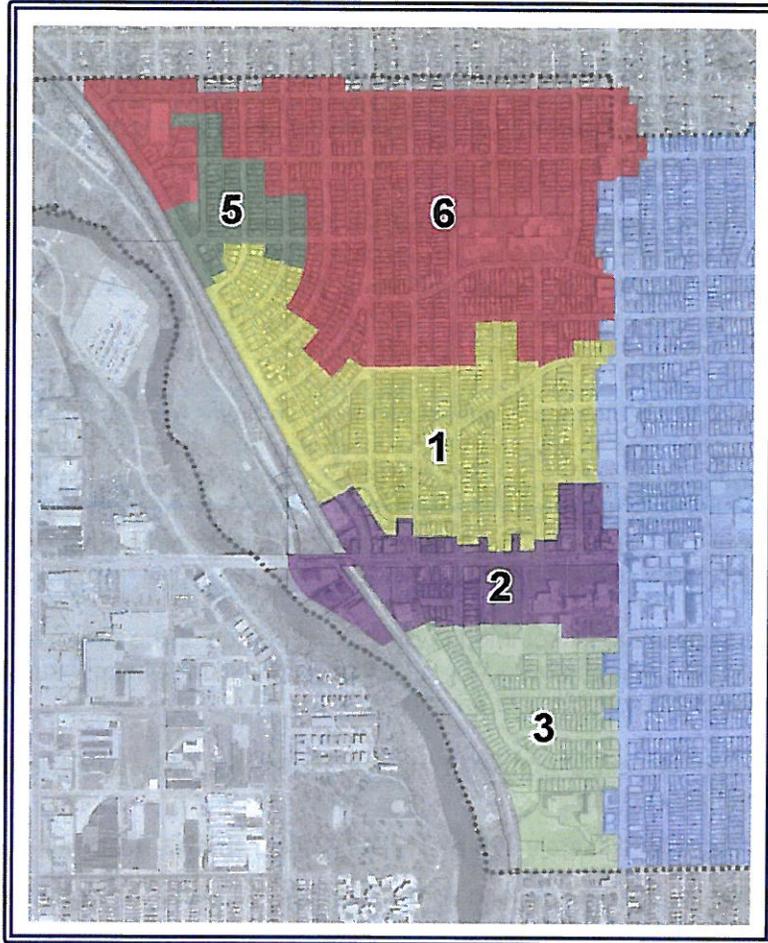
- Focus on the central portion of the sewer area, bound by Glendale Ave., Marlborough, Lake Bluff, and Larkin.
- Affecting approximately 175 properties in the **2 inch-1 hour** rain
- Surface depression on Glendale Avenue between Marlborough and Ardmore – directly affecting about 40 homes
- Approximately 600 foot section of Glendale Avenue can collect up to 3 feet of rain without overland flow

### ***3.1 - Sewershed SH5001, AKA Basin 1***

This is a broken sewershed that has been found to have a peak hourly “gallons per acre per day” (gpad) about twice the assigned value of 22,000 gpad. Clearly, there is a severe inflow and infiltration problem, thought to be predominantly an inflow problem due to the high frequency (backups reported annually) of system surcharging in common rainfall amounts (1 inch or more).

Solution development in Basin 1 was assigned to Strand Associates, Inc.<sup>®</sup> Both sanitary sewer improvements and drainage improvements in the area were included in the scope of work, which is presented herein.

Sewershed SH5001 (Basin 1) is bounded by North Oakland Avenue to the east, East Capitol Drive to the south, and North Wilson Drive to the west. The north boundary is approximately parallel to East Lawnwood Place and extends northwesterly at East Lawnwood Place toward East Congress Street. In general, Basin 1 topography slopes west toward the Milwaukee River. Basin 1 sanitary and storm sewers discharge on the west boundary of Basin 1 to the MMSD Metropolitan Interceptor Sewer (MIS) and Milwaukee River, respectively.



**Location of SH5001 - Basin 1 – Shown in Yellow**

The Village aims to provide basement backup protection for 2 inches of rain in 1 hour. Under existing condition operation, 32 of the 84 total manholes in Basin 1 do not meet the freeboard criteria for a 2-inch, 1-hour storm. For evaluation and comparison purposes, the level of protection (LOP) is assumed to be met if there is freeboard in the sanitary sewer manholes of 7 feet or greater. Freeboard can be defined as the difference between the manhole rim elevation (ground surface) and the level of the water in the manhole. The freeboard value of 7 feet was provided by the Village and determined based on home elevations and average basement depths obtained by others.

### 3.1.1 - Solution Alternatives and Proposed Response

This section discusses alternatives analyzed to address sanitary and storm sewer inefficiencies in Basin 1 (Table 3.1.4-1). Each sanitary sewer alternative includes a description of proposed improvements, a summary of the results, and whether the freeboard criterion was met. The storm sewer alternative includes a description and summary of the impacts on surface flooding. Each alternative was modeled using a 2-inch, 1-hour storm event.

Temporary underground storage of sanitary flows was considered as a part of the study. The location considered was the triangular piece of land east of the North Woodburn Street and East Olive Street intersection. Underground storage would provide additional capacity in the system during wet weather events; however, because of nonmonetary reasons (e.g., odor nuisances and operation and maintenance requirements) underground storage was not evaluated in detail. Additional maintenance items include cleaning the storage tank after use with high pressure water, exercising pumps, and removal of accumulated grit and trash. Underground storage also requires a pump station to remove contents after rain events and cleaning.

#### Basin 1 Alternative Descriptions

Name	Description
Alternative 1	Rerouting of North Bartlett Avenue, North Larkin Street, and North Newhall Street sanitary sewers, removal of basin interconnection points, and minor sanitary sewer improvements on North Morris Boulevard and East Elmdale Court.
Alternative 2	Alternative 1 plus the upsizing of downstream East Olive Street sanitary sewers.
Alternative 3	Addition of a wet weather pump station on North Larkin Street and upsizing of downstream East Olive Street sanitary sewers.
Alternative 4	Upsizing sanitary sewer in existing route and downstream East Olive Street sanitary sewers.
Alternative 5	Relief sanitary sewer.
Storm Sewer	Storm sewer on Newhall Street.

### 3.1.2 - Alternative 1 – Rerouted Sanitary Sewers on Bartlett, Larkin, Newhall

This alternative includes the following components:

- Disconnection of MH 118 (North Woodburn Street/East Lawnwood Place Intersection) and MH 105 (North Morris Boulevard/East Lawnwood Place Intersection), removing sanitary sewer basin interconnection points between Basin 1 and 6 at those locations.
- Disconnection of MH 110 (North Morris Boulevard/East Kenmore Place Intersection) to the north and addition of sanitary piping to connect MH 110 and MH 113 on Kenmore Place.
- Addition of sanitary piping to connect MH 108 and MH 114 at the East Elmdale Court/North Woodburn Street intersection.
- Reconstruction of and lower elevation of sanitary sewer on East Olive Street from North Bartlett Avenue to North Larkin Street and upsize pipe to 12-inch diameter.
- Reconstruction of sanitary sewer on East Olive Street from North Larkin Street to North Morris Boulevard.

- Reconstruction of sanitary sewer on East Olive Street from North Morris Boulevard to North Woodburn Street and upsize pipe to 15-inch diameter.
- Reconstruction of sanitary sewers on North Bartlett Avenue, North Newhall Street, and North Larkin Street so that all flow is toward East Olive Street. Abandon east-west sanitary pipes between North Bartlett Avenue and North Newhall Street (on East Kenmore Place) and between North Newhall Street and North Larkin Street (easement between residential properties).

This alternative provides a more hydraulically advantageous flow pattern that can more efficiently convey sanitary flows compared to the existing sanitary piping configuration. Replacement of deteriorated clay sanitary sewer pipes also provides an opportunity for private sanitary lateral improvements, reconstruction of deteriorated streets, and placement of a storm sewer lateral collection system to occur simultaneously. These items are important for future overall infiltration/inflow (I/I) reduction efforts and goals. Figure 3.1.4a-1 shows an overview of the proposed improvements and the analysis of Alternative 1. The peak flow to the MIS was determined to be 9.5 cubic feet per second (cfs) per model output.

### **3.1.3 - Alternative 2 - Rerouted Sanitary Sewers on Bartlett, Larkin, Newhall, and Olive**

In order to meet the outlined freeboard criteria, further improvements to Alternative 1 are required. Therefore, this alternative includes the following components:

- Disconnection of MH 118 (North Woodburn Street/East Lawnwood Place Intersection) and MH 105 (North Morris Boulevard/East Lawnwood Place Intersection), removing sanitary sewer basin interconnection points between Basin 1 and 6 at those locations.
- Disconnection of MH 110 (North Morris Boulevard/East Kenmore Place Intersection) to the north and addition of sanitary piping to connect MH 110 and MH 113 on East Kenmore Place.
- Addition of sanitary piping to connect MH 108 and MH 114 at the East Elmdale Court/North Woodburn Street intersection.
- Reconstruction of and lower elevation of sanitary sewer on East Olive Street from North Bartlett Avenue to North Larkin Street and upsize pipe to 12-inch diameter.
- Reconstruction of sanitary sewer from MH 103 (East Olive Street/North Larkin Street Intersection) to MH 112x (East Olive Street between North Woodburn Street and North Morris Boulevard) and upsize pipe to 15-inch diameter.
- Reconstruction of sanitary sewer on East Olive Street from MH 112x to MH 10022 (West of North Wilson Drive) and upsize pipe to 18-inch diameter.
- Reconstruction of sanitary sewers on North Bartlett Avenue, North Newhall Street, and North Larkin Street so that all flow is toward East Olive Street. Abandon east-west sanitary pipes between North Bartlett Avenue and North Newhall Street (on East Kenmore Place) and between North Newhall Street and North Larkin Street (easement between residential properties).

Figure 3.1.4b-1 shows an overview of Alternative 2 proposed improvements. The peak flow to the MIS was determined to be 11.2 cfs per model output.

This alternative offers many similar benefits as discussed in Alternative 1 while achieving the freeboard criteria in Basin 1. All manholes within Basin 1 meet the desired freeboard criteria except several manholes on and adjacent to North Wilson Drive. Improvements proposed as part of Alternative 2 result in reduced freeboard conditions for the manholes near North Wilson Drive.

Based on comments from Village staff, basement backups in this area are rare. This area is currently being evaluated as part of an I/I investigation to better understand sanitary sewer flows.

### **3.1.4 - Alternative 3 - Local Pumping Station**

This alternative includes the following components:

- Disconnection of MH 118 (North Woodburn Street/East Lawnwood Place Intersection) and MH 105 (North Morris Boulevard/East Lawnwood Place Intersection), removing sanitary sewer interconnection between Basin 1 and 6 at those locations.
- Upsizing of sanitary piping from MH 91 (East Kenmore Place/North Newhall Street Intersection) to MH 98 (North Larkin Street - south of North Larkin Street/East Olive Street Intersection) from 8-inch diameter to 10-inch diameter.
- Addition of diversion structure and wet weather pump station at MH 98 (North Larkin Street-south of North Larkin Street/East Olive Street Intersection).
- Addition of wet weather pump station piping from MH 98 to MH 121 (East Olive Street/North Woodburn Street Intersection) and connection of pump station piping to MH 121.
- Reconstruction of sanitary sewer from MH 112x (East Olive Street between North Woodburn Street and North Morris Boulevard) to MH 121 and upsize pipe to 15-inch diameter.
- Reconstruction of sanitary sewer on East Olive Street from MH 121 to MH 10022 (West of North Wilson Drive) and upsize pipe to 18-inch diameter.

This alternative provides minimal opportunity for private sanitary sewer lateral improvements or replacement of deteriorated clay sanitary sewer pipes. Both of these items are important for overall I/I reduction efforts and goals and can be further evaluated with the Basin 1 I/I study.

Unlike the gravity sewer alternatives, the wet weather pump station alternative will have maintenance and operating costs. Since the pump station requires electricity and will not operate in the event of a power outage, a portable generator would be required for emergency situations. The pump station will provide relief to the sanitary sewers on and east of North Larkin Street, but upsizing the sanitary sewer piping on East Olive Street will be required for freeboard criteria to be met throughout Basin 1.

Figure 3.1.4c-1 shows an overview of Alternative 3 proposed improvements. The peak flow to the MIS was determined to be 11 cfs per model output.

All manholes within Basin 1 meet the desired freeboard criteria except several manholes on and adjacent to North Wilson Drive. Improvements proposed as part of Alternative 3 result in improved freeboard conditions for the manholes near North Wilson Drive but still do not appear to meet the freeboard criteria. Based on comments from Village staff, basement backups in this area are rare. This area is currently being evaluated as part of an I/I investigation to better understand sanitary sewer flows.

### **3.1.5 - Alternative 4 - Sanitary Sewer Upgrades Along Existing Alignment**

This alternative includes the following components:

- Disconnection of MH 118 (North Woodburn Street/East Lawnwood Place Intersection) and MH 105 (North Morris Boulevard/East Lawnwood Place Intersection), thereby removing interconnection between Basins 1 and 6 at those locations.

- Upsizing of sanitary piping from MH 91 (East Kenmore Place/North Newhall Street Intersection) to MH 98 (North Larkin Street- south of North Larkin Street/East Olive Street Intersection) from 8-inch diameter to 10-inch diameter.
- Reconstruction of sanitary sewer from MH 98 to MH 103 (North Larkin Street/East Olive Street Intersection) upsize pipe to 15-inch diameter.
- Reconstruction of sanitary sewer on East Olive Street from MH 103 to MH 10022 (West of North Wilson Drive) and upsize pipe to 18-inch diameter.

This alternative results in less disruption to the existing neighborhood than Alternatives 1 and 2 while still achieving the desired freeboard criteria in Basin 1. One segment of the sanitary sewer work lies in an easement area between North Newhall Street and North Larkin Street. Because of the proximity of houses and garages, replacement of the sanitary sewer using traditional open-cut construction methods would be extremely difficult. Usage of a trenchless technology, such as pipe bursting, is recommended. This alternative provides reduced opportunity for private sanitary sewer lateral improvements or replacement of deteriorated clay sanitary sewer pipes. Both of these items are important for overall I/I reduction efforts and goals and can be further evaluated with the Basin 1 I/I study.

Figure 3.1.4d-1 shows an overview of Alternative 4 proposed improvements. The peak flow to the MIS was determined to be 10.9 cfs per model output.

All manholes within Basin 1 meet the desired freeboard criteria except several manholes on and adjacent to North Wilson Drive. Improvements proposed as part of Alternative 4 result in improved freeboard conditions for the manholes near North Wilson Drive, but still do not appear to meet the freeboard criteria. Based on comments from Village staff, basement backups in this area are rare. This area is currently being evaluated as part of an I/I investigation to better understand sanitary sewer flows.

### **3.1.6 – Temporary Flood Control Relief Point**

The temporary flood control relief point at Olive and Woodburn will convey flows directly to an existing 72-inch storm sewer along Olive Street, which subsequently discharges to the Milwaukee River. The intent is that the temporary flood control relief point will only operate during rainfall events larger than 2 inches in 1 hour.

The impacts on the receiving waterbody, the Milwaukee River, are mitigated by the fact that the overflow occurs under extreme wet weather conditions and only after a considerable period of very high flows within the sanitary sewer system. Though technically a sanitary sewer overflow, the discharge to Milwaukee River is expected to be largely consisting of I-I flow within our sanitary sewer system. In addition, the duration of the overflow is expected to correspond to the peak rainfall condition (i.e., peak inflow) and thus result in limited bypass volume. All bypasses will be electronically monitored and reported for maximum control over the proposed control relief point.

The relief, coupled with the proposed sanitary sewer will provide additional hydraulic grade line relief while I/I reduction efforts are taking place in Basin 1. The long-term goal is that, once the I/I program is fully implemented, the relief point can be abandoned.

### **3.1.7 - North Newhall Street Storm Sewer Improvements**

Surface flooding at the intersection of North Newhall Street and East Kenmore Place has been observed during heavy rainfall events. The existing storm sewers at the intersection of North Newhall Street and East Kenmore Place are over capacity during a 2-inch, 1-hour storm. Diverting a portion of the stormwater from North Newhall Street to the East Capitol Drive storm sewer will provide relief to the North Newhall Street/East Kenmore Place intersection. North Newhall Street storm sewer improvements include the upsizing of approximately 700 feet of storm sewer piping to 24-inch diameter from the North Newhall Street/East Kenmore Place intersection to the North Newhall Street/East Capitol Drive intersection.

The direction of the storm sewer piping will be reversed to flow south and connect to the southernmost storm sewer on East Capitol Drive. Results of the analysis show that street flooding near the North Newhall Street/East Kenmore Place intersection is resolved with these improvements for a 2-inch, 1-hour storm event. It is anticipated that inlets will be incorporated at intersections and at intermediate spacing along North Newhall Street. Sustainable design elements will also be considered during design. Figure 3.1.4f-1 shows an overview of the storm sewer improvements.

### **3.1.8 - North Newhall Storm Sewer Water Quality Impacts**

No additional water quality measures are proposed since the storm sewers would not add new imperviousness to existing storm discharges to the Milwaukee River at the capitol Drive outfall. Instead, the proposed storm sewer provides a second pipe system as a complement to the existing pipe system that drains Newhall Street. As a result, the Village does anticipate increased pollutant loads and no additional Best Management Practices are proposed at this time.

### **3.1.9 - Opinion of Estimated Cost**

Opinions of estimated cost (OEC) were prepared for each alternative and include a 15 percent allowance for technical services and a 25 percent construction contingency factor.

Roadway repairs on East Olive Street and North Larkin Street were quantified and estimated under the asphalt street reconstruct item because of the poor condition of the existing street. Both East Olive Street and North Larkin Street are identified to be reconstructed in 2018 according to the 2010-2020 Street Replacement Program. Because of the condition trench restoration would leave East Olive Street and North Larkin Street in after sanitary sewer and lateral replacements, it is suggested that both streets be reconstructed as part of the sanitary improvements. Also, any reconstructed street would include the addition of an 8-inch storm lateral collection system.

Roadway repairs on North Bartlett Avenue and North Newhall Street were quantified and estimated under the trench restoration item. These streets are in acceptable condition. Both North Bartlett Avenue and North Newhall Street are identified to be chip sealed in 2015 in accordance with the 2010 to 2020 Street Maintenance Program. Trench restoration of the sanitary sewer trunk line and laterals should be adequate until the next scheduled maintenance in 2015.

Table 3.1.5-1 shows a summary of the OEC for each alternative described above. A detailed summary of the OEC for each alternative is shown in Table 3.1.5-2.

### Summary of Opinion of Estimated Cost

Name	Total Project Cost
Alt. 1 – Rerouted Sewers	\$3,875,000
Alt. 2 - Rerouted sewers, extended	\$4,628,000
Alt. 3 – Lift Station	\$2,504,000
Alt. 4 – Improvements on existing route	\$1,850,000
North Newhall Storm Sewer Improvements	\$240,000

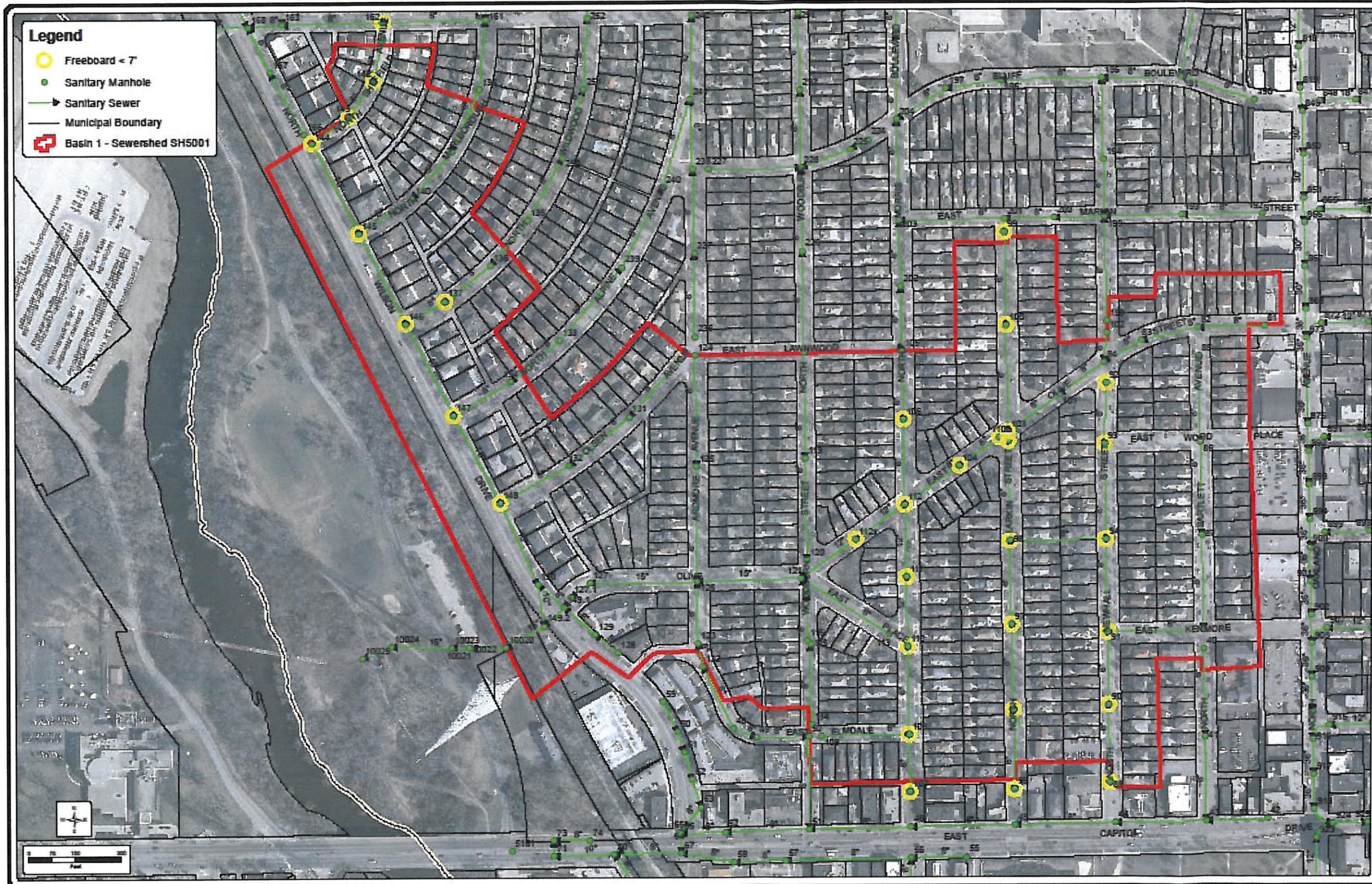
#### 3.1.10 - Recommended Solutions

Alternative 4 achieves the desired LOP of at least 7 feet of manhole freeboard at the lowest OEC and does not require any emergency power. It has the second best ranking in terms of potential neighborhood disruption. However, it does not appear to offer the same options for private I/I removal as Alternatives 1 and 2. The Basin 1 I/I study currently being undertaken will identify opportunities for public and private I/I reduction. In addition, the North Newhall Street storm sewer improvements will be incorporated into Alternative 4.

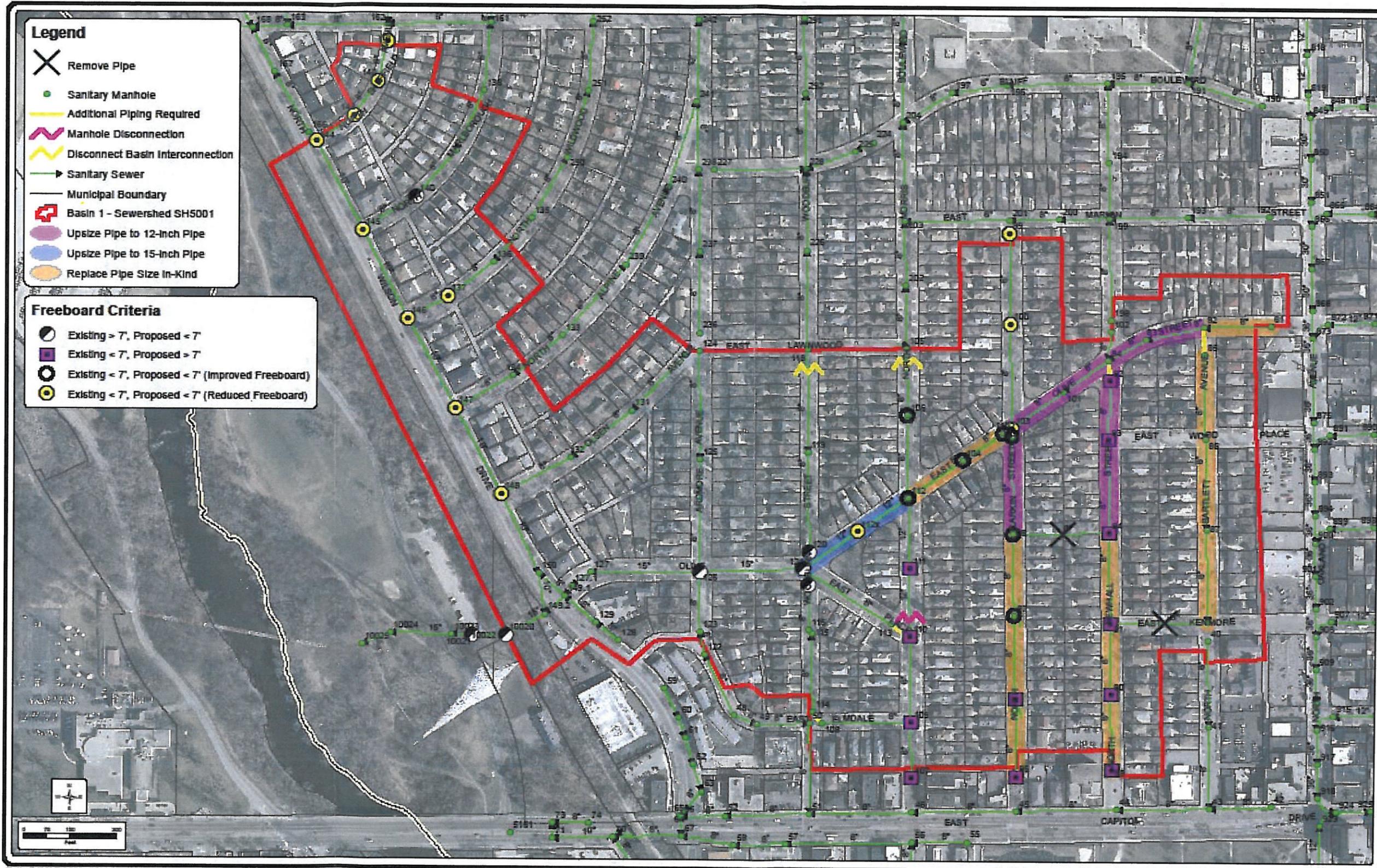
#### Alternative Evaluation Matrix

Alternative	RANKING				
	Achieves Desired LOP?	Relative Disruption to Neighborhood (1 = Least Disruption)	Impact on Private I/I Reduction Goals (1 = Most Opportunity)	Requires Emergency Power?	Cost
1	N	3	2	N	3
2	Y	4	1	N	4
3	Y	1	4	Y	2
4	Y	2	3	N	1

- Impact on Private I/I Reduction Goals* - This is a relative ranking that compares the alternatives in terms of providing opportunities for the reduction of private I/I in the basin. For example, complete street reconstruction provides an opportunity for the installation of storm lateral connections, and new sewer installation provides an opportunity for sanitary lateral reconstruction (1 = Alternative provides the most private I/I reduction opportunity).



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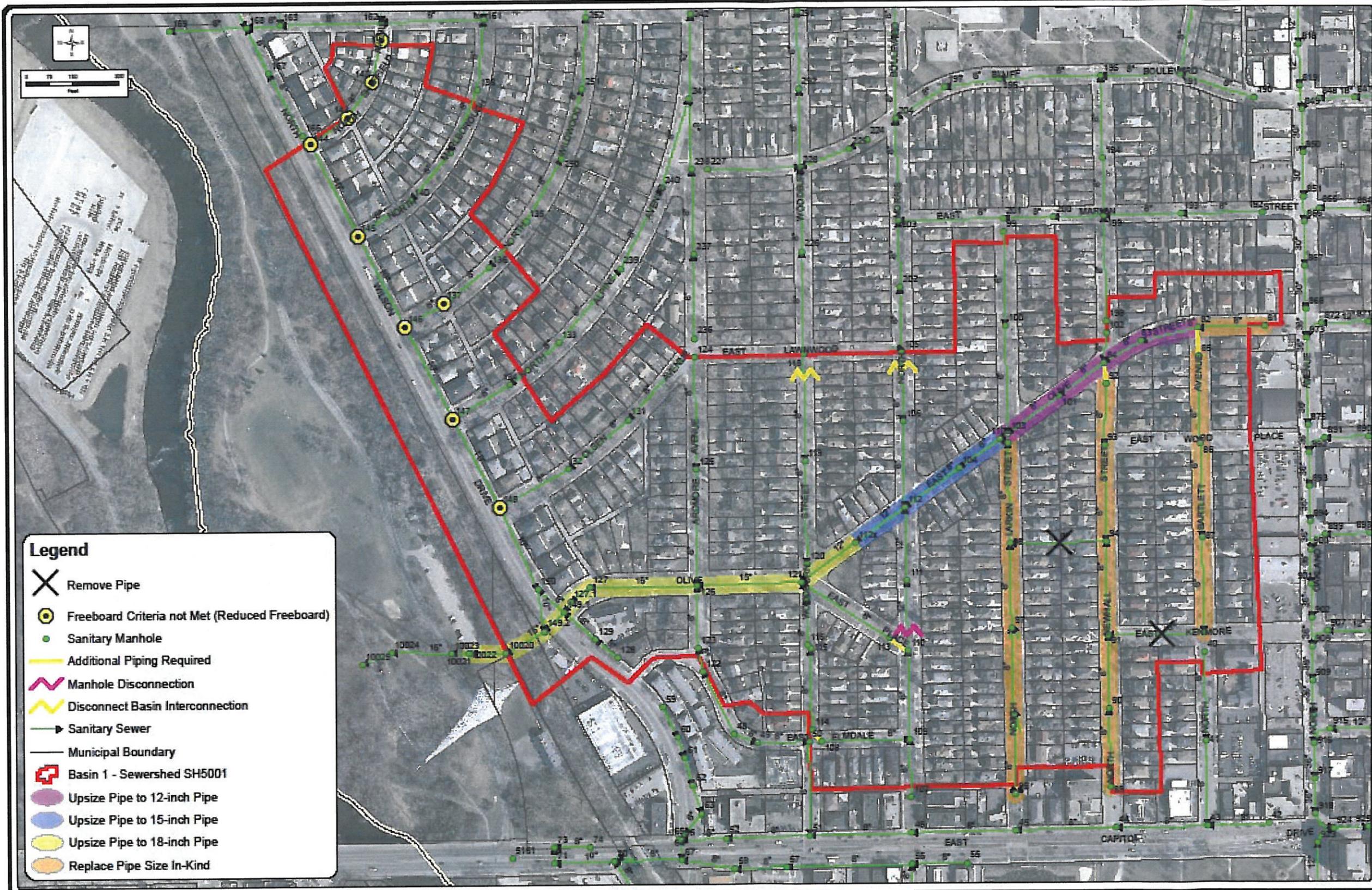


**BASIN 1 - ALTERNATIVE 1 - FACILITIES PLAN PRELIMINARY RECOMMENDATION  
2-INCH, 1-HOUR RAINFALL EVENT - ANALYSIS RESULTS**  
VILLAGE OF SHOREWOOD  
MILWAUKEE COUNTY, WISCONSIN



FIGURE 3.1.4a-1  
3646.002

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**Legend**

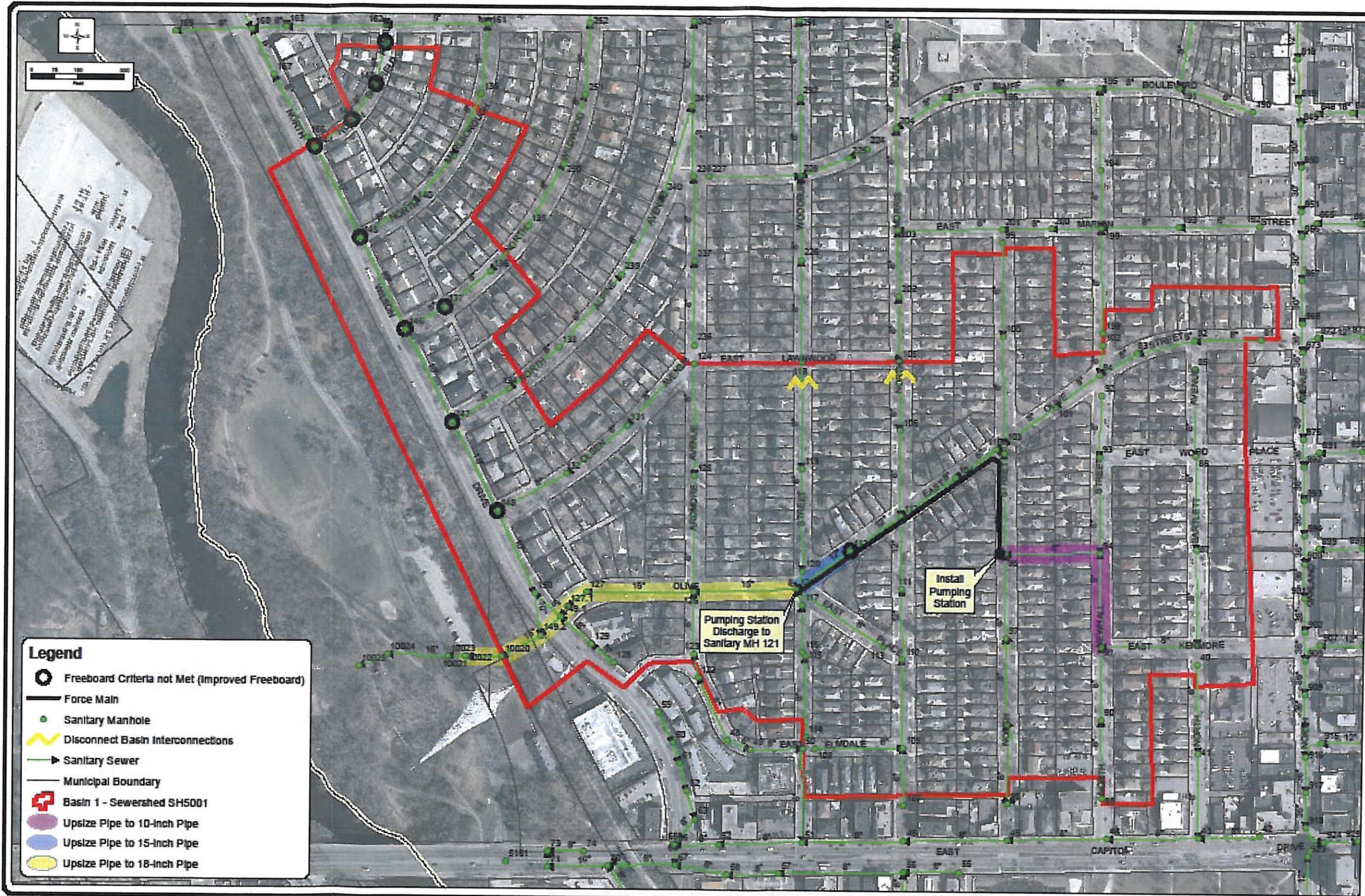
- ✕ Remove Pipe
- ⊙ Freeboard Criteria not Met (Reduced Freeboard)
- Sanitary Manhole
- Additional Piping Required
- ~ Manhole Disconnection
- ~ Disconnect Basin Interconnection
- Sanitary Sewer
- Municipal Boundary
- ⊕ Basin 1 - Sewershed SH5001
- Upsize Pipe to 12-inch Pipe
- Upsize Pipe to 15-inch Pipe
- Upsize Pipe to 18-inch Pipe
- Replace Pipe Size In-Kind

**BASIN 1 - ALTERNATIVE 2 - FPPR PLUS DOWNSTREAM SEWER IMPROVEMENTS  
2-INCH, 1-HOUR RAINFALL EVENT - ANALYSIS RESULTS**  
VILLAGE OF SHOREWOOD  
MILWAUKEE COUNTY, WISCONSIN



FIGURE 3.1.4b-1  
3646.002

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**Legend**

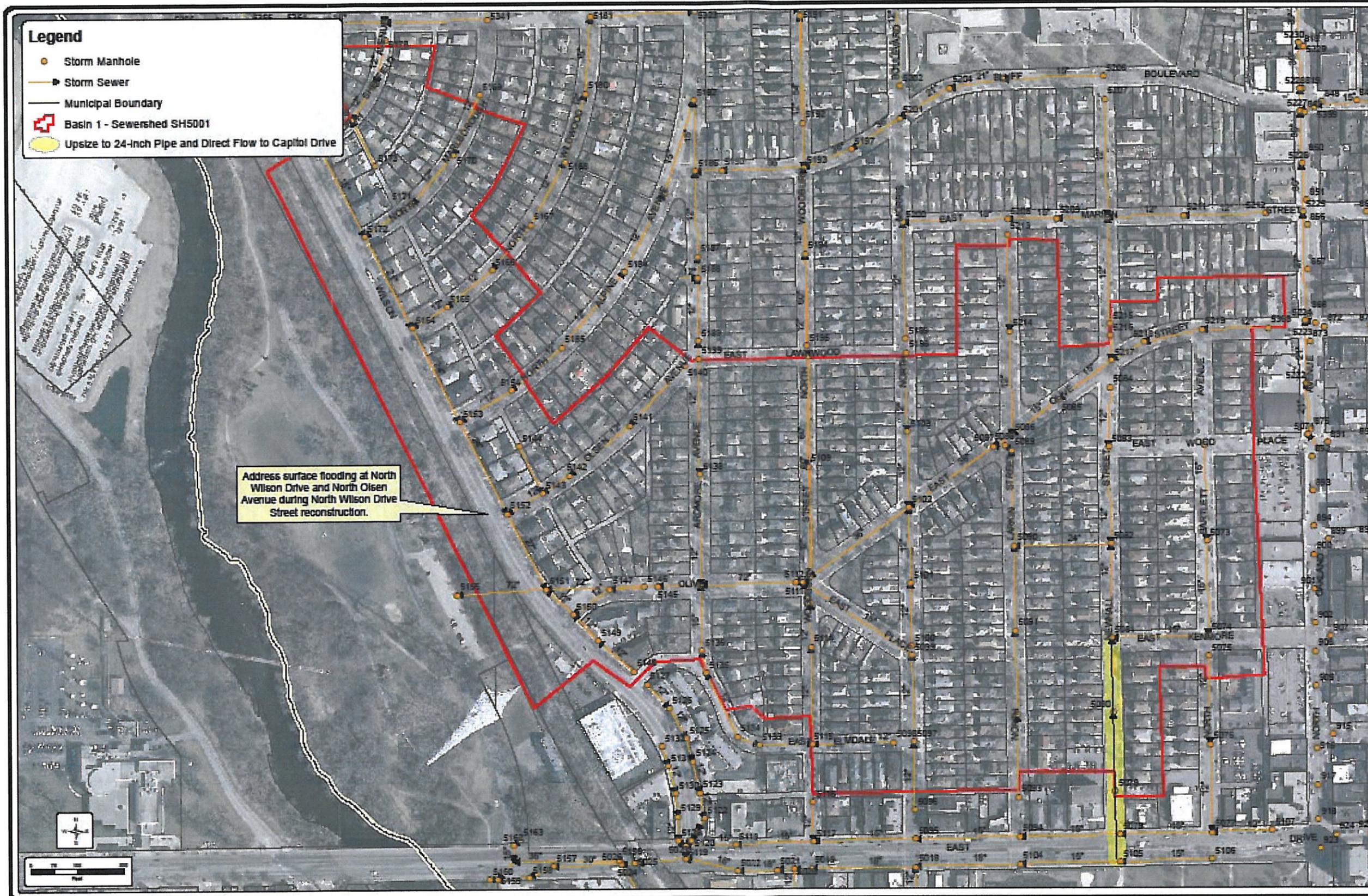
- Freeboard Criteria not Met (Improved Freeboard)
- Force Main
- Sanitary Manhole
- Disconnect Basin Interconnections
- Sanitary Sewer
- Municipal Boundary
- Basin 1 - Sewershed SH5001
- Upsize Pipe to 10-inch Pipe
- Upsize Pipe to 15-inch Pipe
- Upsize Pipe to 18-inch Pipe

**BASIN 1 - ALTERNATIVE 3 - LOCAL PUMPING STATION  
2-INCH, 1-HOUR RAINFALL EVENT - ANALYSIS RESULTS**  
VILLAGE OF SHOREWOOD  
MILWAUKEE COUNTY, WISCONSIN



FIGURE 3.1.4c-1  
3646.002

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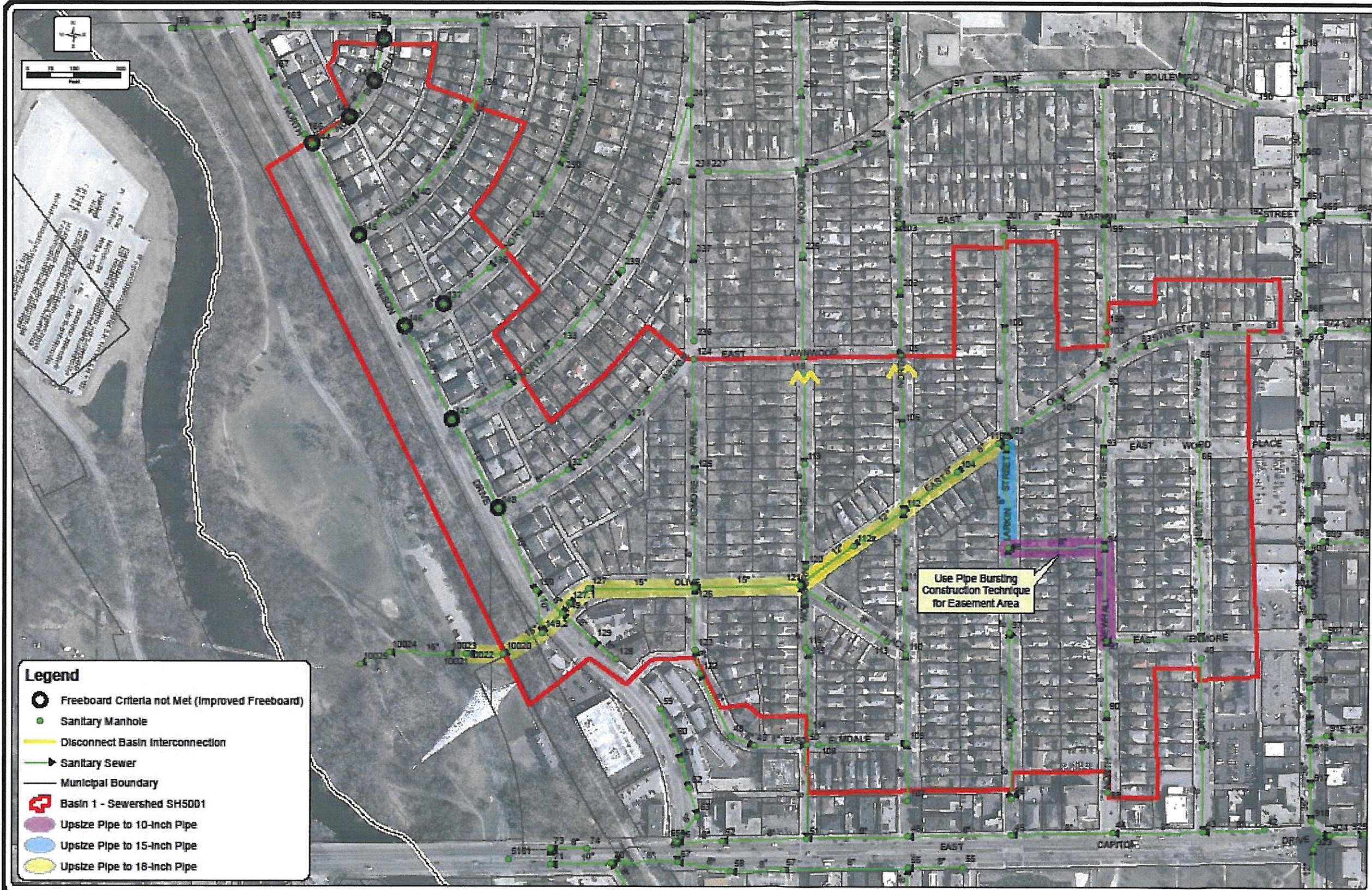


**NORTH NEWHALL STREET STORM SEWER  
2-INCH, 1-HOUR RAINFALL EVENT - ANALYSIS RESULTS**  
VILLAGE OF SHOREWOOD  
MILWAUKEE COUNTY, WISCONSIN



**FIGURE 3.1.4F-1**  
3646.002

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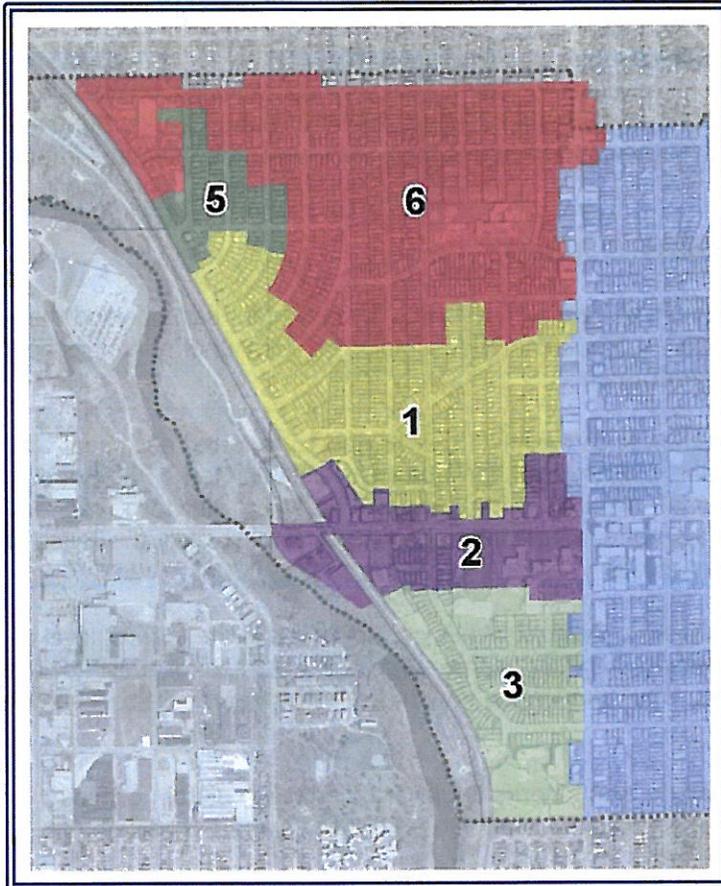
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**BASIN 1 - ALTERNATIVE 4 - SEWER UPGRADES - EXISTING ROUTE  
2-INCH, 1-HOUR RAINFALL EVENT - ANALYSIS RESULTS**  
VILLAGE OF SHOREWOOD  
MILWAUKEE COUNTY, WISCONSIN



**FIGURE 3.1.4d-1**  
3646.002

### 3.2 - Sewershed SH5002, AKA Basin 2



Separated Sewer Area of Shorewood – Sewershed ID Numbers

The review of Basin 2 sewer performance was performed by **Clark Dietz, Inc.** Basin 2 is generally located along Capitol Drive, from Wilson Drive to Oakland Avenue. This is mainly a commercial strip, where residential properties consisting of apartment buildings. While severe surface flows have been reported on Capitol Drive during the heavy downpours of July 15 and 22, 2010, the Village records show no reported basement backups in this Basin on July 15, 2010.

Basin 2 is 57.3 acres in size, has 28 buildings, mainly the commercial properties along Capitol Drive. Previous information on this basin indicates low inflow and infiltration potential. In general, the sewer system in Basin 2 has performed adequately in wet weather conditions and modeling of the system shows that no hydraulic improvements are currently warranted.

During the heavier rains of July 22, 2010, one house with basement flooding was reported on Morris Boulevard at the intersection of Pinedale Court, just south of Capitol Drive. This problem is related to the performance of Basin 3 sewers on Morris Boulevard and will be considered as part of the evaluation of Basin 3 solutions.

#### 3.2.1 – Recommended Response

Other than routine maintenance and rehabilitation of the sewer system, no specific interventions (i.e., replacement or upsizing of existing sewers) are recommended for Basin 2 sewers.

### ***3.3 - Sewershed SH5003, AKA Basin 3***

Basin 3 is located at the southwest corner of the Village and is characterized by relatively steep slopes in topography as well as sewer pipes. This feature helps with flows, and the connection to the 42 inch MIS interceptor occurs at the intersection of Morris Boulevard and Menlo.

Basin 3 covers 53.7 acres and has 146 buildings including 14 apartment buildings on Oakland Avenue and institutional buildings owned by the Village (Department of Public Works, Hubbard Park Lodge) and the School District (Shorewood Middle School, Shorewood Community Fitness Center).

#### **3.3.1 – Hydraulic Evaluation of Basin 3 Sewers**

Historically, Basin 3 has not been known to be a high risk area for basement backups and the number of basement backups reported in July 2010 reflects more the severity of rainfall rather than systemic deficiencies in sewer performance.

This sewershed had about 3 reported backups on July 15, 2010 and 15 reported basement backups during the July 22, 2010 rain. The reported backups are mainly on Morris Boulevard, between Newton and Beverly, and other distributed backups on Beverly and Newton. This behavior indicates that Basin 3 has low to moderate infiltration which is most likely the cause of aging infrastructure, both public and private.

Hydraulic modeling shows that rainfalls exceeding 2 inches per hour (this is the current level of protection standard for solutions in this facility Plan) some surcharging start to manifest itself at the intersection of Morris and Menlo. This surcharging may reach levels that create backup risks in this area.

Further rain causes the risk to propagate along Morris Boulevard, and reach as far north as Beverly and Pinedale court. The model is therefore able to predict the spread of backup risk from south to north on Morris Boulevard.

We note that the rainfalls needed to create these backup risks are beyond the targeted 2 inches per hour level and that from a hydraulic stand point, the sewer system in basin 3 currently meets the Village's overall design level of protection against basement backups.

#### **3.3.2 – Recommended Response**

Other than routine maintenance and rehabilitation of the sewer system, no specific interventions (i.e., replacement or upsizing of existing sewers) are recommended for Basin 3 sewers.

### ***3.4 - Sewershed SH5005, AKA Basin 5***

Basin 5 is Shorewood's smallest separated sewershed. It is completely surrounded by Basin 6 and cover 19.4 acres. With 72 connections that include four apartment buildings on Wilson Drive, Basin 5 has historically avoided the basement backup problems unless rains exceed several inches in intensity.

#### **3.4.1 – Hydraulic Evaluation of Basin 5 Sewers**

No basement backups were reported during the July 15 rainfall and nine reports of basement backups were filed during the July 21 rainfall. With its small and hydraulically simple layout and its direct connection to the MIS at Congress, Basin 5 not only has low wet weather I-I, but also has the hydraulic efficiency to protect against basement backups.

A hydraulic model of the Basin 5 was created and analyzed for capacity problems, which were not present. The Congress street collector is a direct connection to the MIS, and the wet weather inflow characteristics indicate a slow and gradual buildup of flows during rain. Overall, no pipe improvements are recommended for this basin.

#### **3.4.2 – Recommended Response**

Other than routine maintenance and rehabilitation of the sewer system, no specific interventions (i.e., replacement or upsizing of existing sewers) are recommended for Basin 3 sewers.

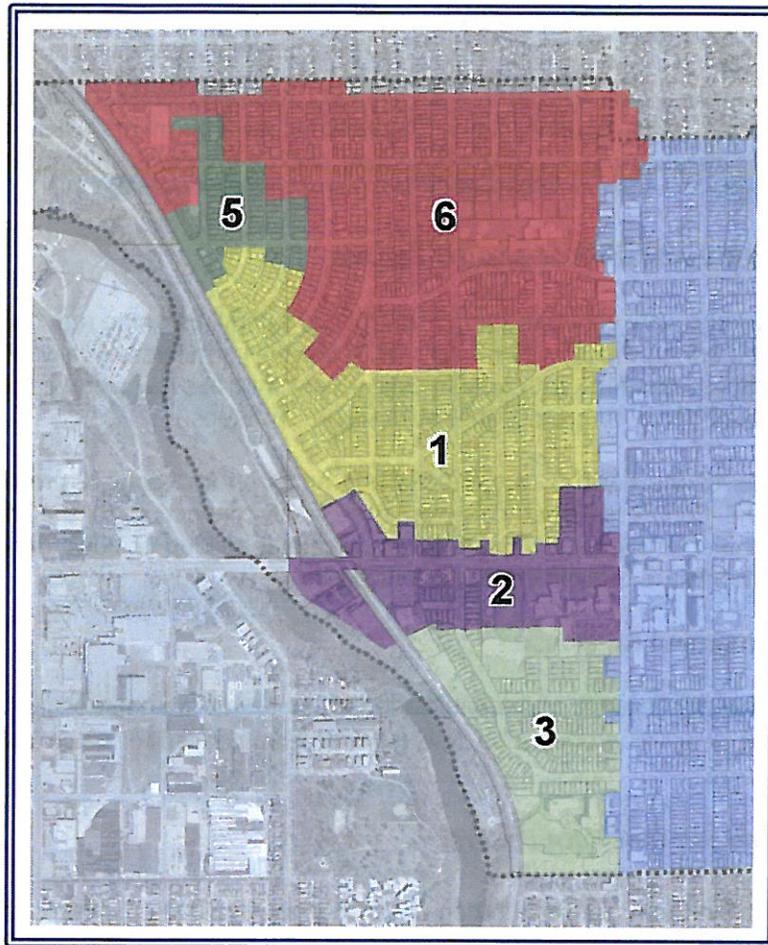
### ***3.5 - Sewershed SH5006, AKA Basin 6***

Basement backups in the northwest portion of the Village have been a chronic problem for many years. Basin 6 was found to have a peak hourly flow 50% more than the 21,000 gallons per acre per day assigned to this basin by Milwaukee Metropolitan Sewerage District (MMSD).

Basin 6 of the sanitary sewer system in Shorewood is bounded by Wilson Drive to the west, Oakland Avenue to the east, Glendale Avenue to the north, and Olive Street to the south. Portions of Whitefish Bay also drain through Shorewood before flowing back into Whitefish Bay. Basin 6 consists of nearly 650 single family residential homes and duplexes. Lake Bluff Elementary School is also located in Basin 6, with 520 students and staff in attendance, as well as 13 commercial businesses along Oakland Avenue.

The sanitary sewers in Basin 6 generally flow north to Glendale Avenue, and then west on Glendale Avenue to Marlborough Drive. From there sewage flows north into the Village of Whitefish Bay to Courtland Avenue and west on Courtland to the MMSD metropolitan interceptor sewer (MIS) near Courtland Avenue and west of Wilson Drive. The terrain in Basin 6 generally slopes from southeast to northwest toward Whitefish Bay. A ridge line runs southeast to northwest just east of Wilson Drive.

The storm sewers in Basin 6 drain to a large diameter storm sewer on Woodburn Avenue. The Woodburn Avenue storm sewer drains south to Olive Street and west to Wilson Drive toward the Milwaukee River. Street flooding was experienced during the heavy rain events of July 2010, especially along Glendale Avenue between Wildwood Avenue and Woodburn Street.



**Location of SH5006 - Basin 6 – Shown in Orange**

### **3.5.1 - Solution Alternatives and Proposed Response**

The Comprehensive Facility Plan includes extensive hydraulic modeling. Whitefish Bay's sanitary sewer Basin 3 was also included in the model. The criteria used for hydraulic modeling included simulating a 2-inch one hour rain to emulate a 10-year occurrence rain event or one having a 10% chance of occurring in any one year. A 3-inch one hour rain event was used to check the reaction of the sewer system during a 100-year occurrence rain event (1% chance of occurring in any one year). Basement backup risk was defined by comparing sewer hydraulic grade lines to basement floor elevations. Basement floor elevations were delineated by using an average basement depth of 7 feet below the street elevation or 7-feet of "freeboard". Surcharge conditions in the sanitary sewer system were then compared to the street elevation to determine potential basement backup risk. Similarly the storm sewer system was assessed based on the depth of hydraulic grade line or street ponding.

Basement backups are most common in the central portion of Basin 6 in an area bounded by Glendale, Marlborough, Lake Bluff, and Larkin Avenues. Rainfalls of 2-inches or more in one hour currently affect about 175 properties. The hydraulic model shows that during a 2-inch rain event

sanitary sewers currently become surcharged along Glendale Avenue, between Glendale Avenue and Kensington Boulevard, south of Kensington along Morris Avenue, and north of Glendale Avenue into the Village of Whitefish Bay. Simulating a 3-inch rain the hydraulic model shows more pronounced surcharging of the sanitary sewer system in the areas above and also extending outward into the system. Storm sewer surcharging and street ponding is also prevalent in these same areas.

### 3.5.2 - Alternative 1 - Congress Street Sanitary Sewer Route

The improvements include new sanitary sewers on Glendale Avenue, Kensington Boulevard, Congress Street, Sheffield Avenue, and Marlborough Drive. The proposed sanitary sewer on Glendale Avenue would parallel the existing sewer and intercept flows from Whitefish Bay west to Marlborough Drive, and return that flow north back into Whitefish Bay. A new sanitary sewer on Kensington Boulevard would intercept flows from the south and route them west and south in a gravity sewer to the MIS along Estabrook Parkway.

Sanitary sewers from 25-feet to 32-feet deep would be required along Marlborough Drive, Sheffield Avenue, Congress Street, and crossing Wilson Drive, for a distance of nearly 3,000 feet. Sanitary sewers in excess of 25-feet deep are very difficult to construct. Depending on the soil conditions, the width of the sewer trench can become very wide requiring special trench shoring. The width of the sewer trench would most likely extend from curb to curb and impact other underground utilities such as storm sewers, water mains, and gas mains. Street trees can also be affected by the trench width and heavy equipment necessary for deep trenches may damage tree limbs above the trench line. Deeper trenches usually mean more groundwater to deal with during construction as well as more surface restoration including pavement, curbs, sidewalks, and lawns. Access to driveways along the route is usually cut off for long periods of time. All these issues add up to a long and slow construction process for the deeper sections of sewer.



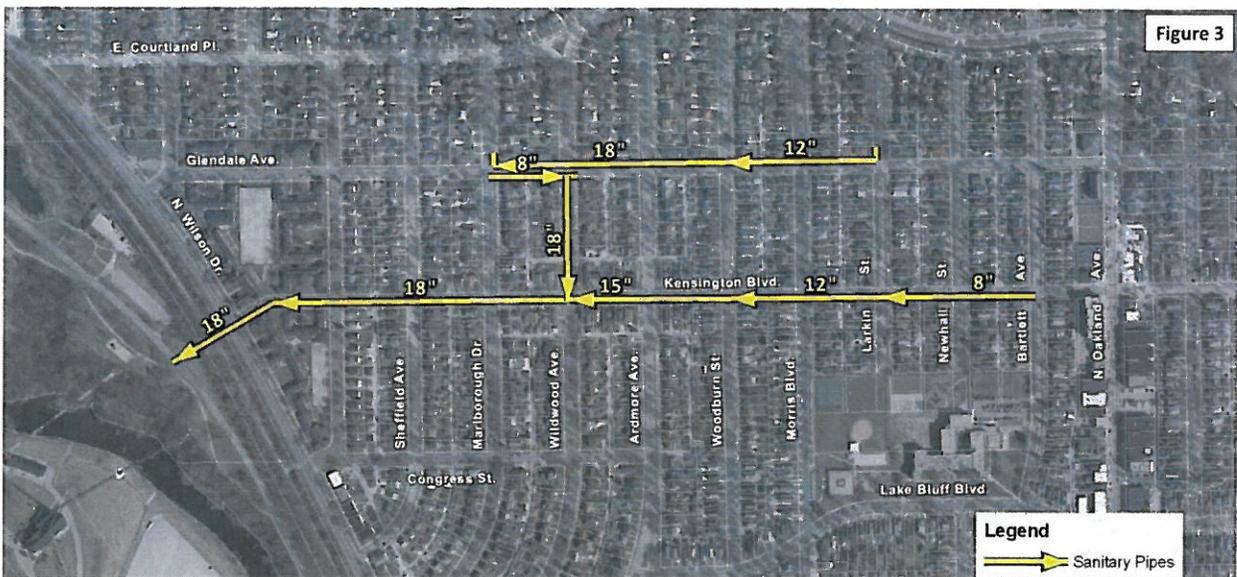
Alternative 1 - Congress Sanitary Sewer Route

### 3.5.3 - Alternative 2 - Kensington Boulevard Sanitary Sewer Route

We looked at an alternate route for the sanitary sewer improvements. A sanitary sewer would extend along Kensington Drive from Bartlett Avenue to a new MIS connection at Estabrook Parkway. A new connection to the MIS would be required between the existing Courtland and Congress connections. Sanitary sewers on Glendale Avenue serving homes in Shorewood that flow north into Whitefish Bay would need to be rerouted south to the Kensington Drive sanitary sewer.

The advantages to this alternate sewer route are that it shortens the route by 1,000 feet and shortens the length of sewer in deep excavations by more than 1,000 feet. This alternate route also makes trenchless construction methods more viable as the deep sewer sections are all along Kensington Drive between Wildwood Avenue and Wilson Drive. Trenchless construction methods involve tunneling a pipe below the ground surface by use of a boring machine. Pits are excavated at both ends and a new pipe is pushed into the hole created by the boring machine. Surface disruption is limited to the entrance and exit pits at manholes.

The narrow streets, multitude of existing utilities, street trees, and other existing improvements make trenchless pipeline construction methods a practical solution for installation at depths of greater than 25-feet. Soil testing and additional analysis will be required to determine if trenchless construction methods would be cost-effective.



**Alternative 2 - Kensington Boulevard Sanitary Sewer Route**

### 3.5.4 - Alternative 3 – Congress Street Lift Station

Another potential solution that was studied in the past is the use of a wastewater lift station to transmit flows from the sewershed over the hill to the MIS along Estabrook Parkway. The lift station would be designed to accommodate a flow of up to 3,000 gallons per minute. The lift station would consist of a below ground concrete wet well, three 25 Hp submersible sewage

pumps, a valve vault, electrical controls, alarm system, and stand-by emergency generator. The electrical control panels and emergency generator would need to be located above ground. The lift station would pump wastewater in a 16-inch force main along Wildwood Avenue and Congress Street to Marlborough Drive. An 18-inch gravity sewer would be extended west along Congress Street to the MIS along Estabrook Parkway.



**Alternative 3 – Congress Street Lift Station**

**3.5.5 - Alternative 4 - Courtland Place Parallel Sewer**

This alternative was also previously investigated and would include a parallel sanitary sewer on Courtland Place to the MIS. The parallel sewer could be constructed at shallower depths than the other alternatives, but would require the replacement of a new concrete street in Whitefish Bay.



**Alternative 4 - Courtland Place Parallel Sewer**

### **3.5.6 - Alternative 5 - Sewage Grinder Pump Alternative**

Another potential solution is to install a grinder pump in every house such that wastewater from each home is pumped to “overhead plumbing” above the basement floor and discharged to the gravity sanitary sewer system. The installation of a pumping unit at each house would eliminate basement backups as sewage could not backup into the house through the pump check valve. This would require the installation of a grinder pump unit in nearly every home. The alternative would eliminate the chronic basement backups in this area, but would not address the overflow of sewage into the streets or the removal of clear water from the sanitary sewer system, which are long term goals of the community and sewerage district.

### **3.5.7 – Temporary Flood Control Relief Points**

The alternative improvements modeled and discussed earlier were developed under the criteria of preventing basement backups in Basin 6 during a 2-inch rainstorm. I/I reduction improvements, especially on private property will take several years to complete. Until private property improvements are completed, some level of basement backup protection will be provided for rainstorms exceeding 2-inches by constructing two (2) temporary flood control relief points.

The impacts on the receiving waterbody, the Milwaukee River, are mitigated by the fact that the overflow occurs under extreme wet weather conditions and only after a considerable period of very high flows within the sanitary sewer system. Though technically a sanitary sewer overflow, the discharge to Milwaukee River is expected to be largely consisting of I-I flow within our sanitary sewer system. In addition, the duration of the overflow is expected to correspond to the peak rainfall condition (i.e., peak inflow) and thus result in limited bypass volume. All bypasses will be electronically monitored and reported for maximum control over the proposed control relief point.

#### **Location 1: Morris near Lake Bluff and Marion**

This area is located at the upper reaches of the sewer system and again the potential for basement backups in this area is due to the existing pipe size and slope. To address this subarea the sanitary sewer on Morris between Lake Bluff and Marion could be upsized from 8-inch to 10-inch.

Also, an temporary flood control relief pipe will be installed on Lake Bluff between the Morris sanitary sewer and the Woodburn storm sewer to provide additional basement backup protection on Morris. The overflow rate required would be very small at approximately 90 gpm, which is 0.1% of the 90,000 gpm flow in the large diameter Woodburn storm sewer during a 3-inch rainstorm.

#### **Location 2: Glendale between Wildwood and Ardmore**

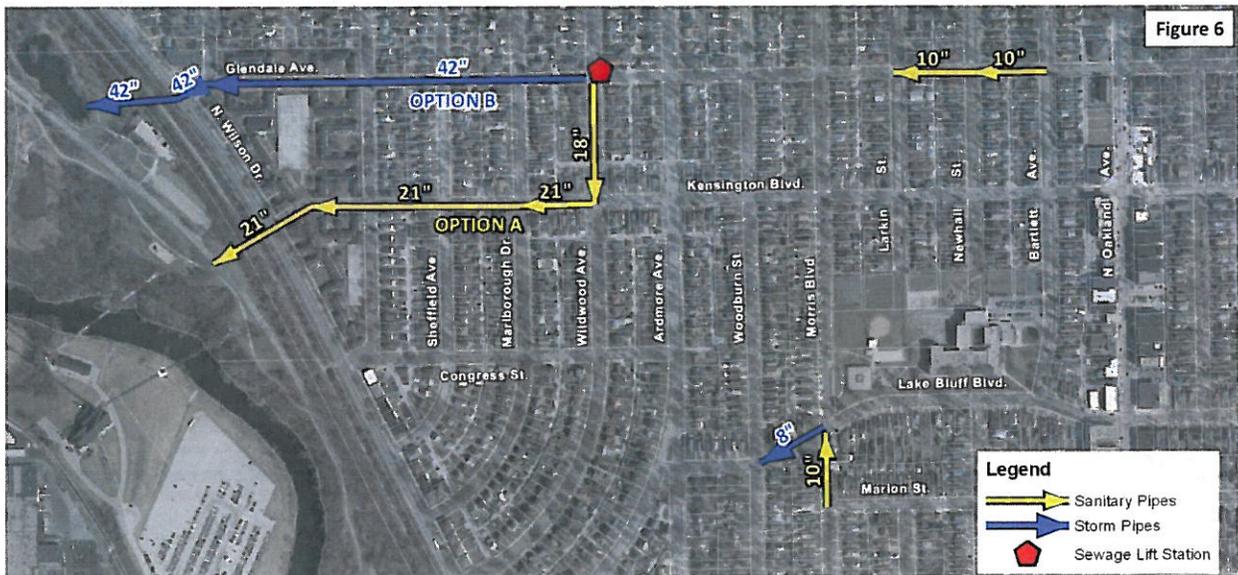
This area is located at the junction where multiple sanitary sewers converge coupled with the fact that this is the low area in the neighborhood. In order to address potential basement backups for rainstorms exceeding 2-inches in this subarea, we identified three alternatives:

1. A gravity flood control relief point can be built at Kensington and Wildwood. The sanitary sewer on Kensington between the MIS and Wildwood will be upsized from 18-inch to 21-

inch. This alternative is very cost effective since a new pipe is already proposed to be installed along Kensington. The increase in materials cost for 21-inch pipe versus 18-inch is relatively small. This is the least cost alternative, but would require the approval of MMSD.

2. An excess flow pumping station could be installed near the intersection of Glendale Avenue and Wildwood Avenue to handle flood control relief in the area. The pumping station would be set to turn on below the basement elevations in this area, and pump excess flows at a rate of 2,000 gallons per minute into the storm sewer system. In order to accommodate the additional flows, the proposed storm sewers west of Wildwood on Glendale would need to be upsized from 30-inch to 42-inch. This is the most costly alternative and would require operation and maintenance of mechanical equipment.
3. Grinder pumps could be installed at 8 homes along Glendale to provide basement backup protection. This alternative would require plumbing work in private homes to install the grinder pumps

The preferred and selected alternative is the gravity flood control relief point at Kensington and Wildwood.



Temporary Flood Control Relief Points

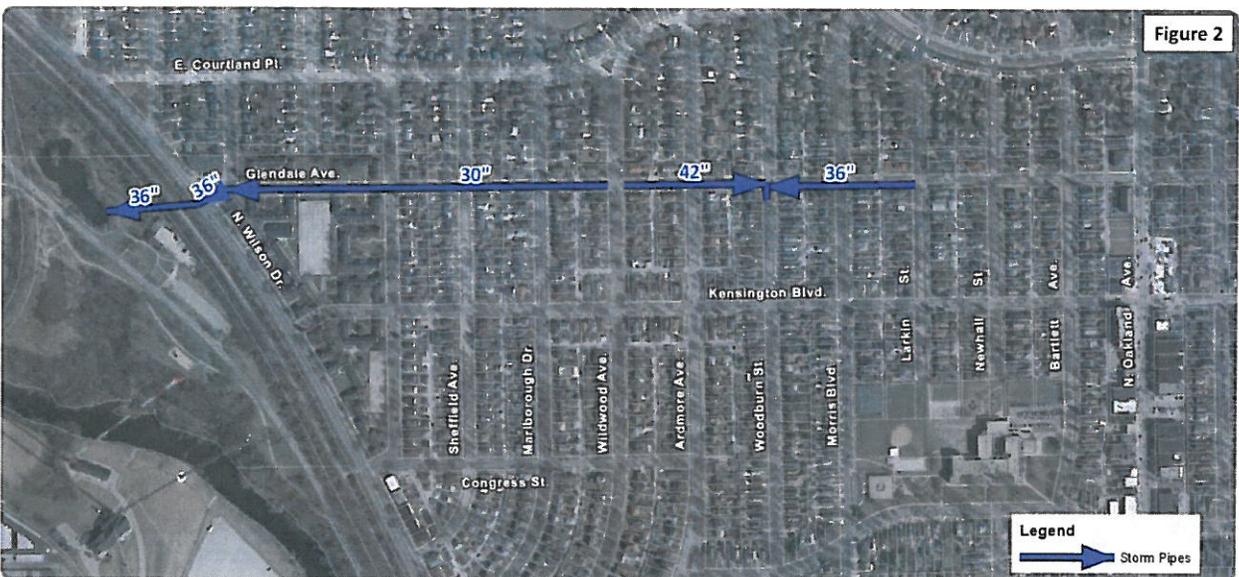
### 3.5.8 – Glendale Avenue Storm Sewer Improvements

The storm sewer improvements recommended for Basin 6 include new storm sewer pipes on Glendale Avenue. A storm sewer is proposed to extend west on Glendale Avenue from Wildwood Avenue draining to a pond in Estabrook Park, which flows to the Milwaukee River. Storm sewers are also proposed to extend east and west on Glendale Avenue from Woodburn Street. New curb inlets would be installed at each intersection.

We investigated two other alternatives to the Glendale Avenue storm sewer improvements:

1. One potential alternative we looked at was the installation of large diameter pipes on Glendale thereby creating an underground storm water detention basin. Excess flows would be stored in the pipes and discharged at a slower rate such that the downstream storm sewers could handle it. When we modeled this alternative the effect on lowering the hydraulic grade line was more localized than anticipated. The cost of this alternative is rather high at nearly \$10 per cubic foot of storage. Therefore, this alternative was not considered to be cost-effective.
2. The second alternative investigated included the installation of a large diameter pipe on Glendale taking all the flow on Glendale west to Estabrook Park. This would require the construction of a very large storm sewer to accommodate the anticipated flows.

In either case, we propose that large curb inlets be installed in the lower areas of Glendale Avenue, which would be 5 to 10-feet long. Large curb inlets allow much more water to enter the storm sewer system than the typical 2 or 3-foot curb inlet and grate.



**Glendale Avenue Storm Sewer Construction**

### 3.5.9 - Glendale Avenue Storm Sewer Water Quality Impacts

No additional water quality measures are proposed since the storm sewers would not add new imperviousness to existing storm discharges to the Milwaukee River at the Glendale Avenue outfall. Instead, the proposed storm sewer provides a second pipe system as a complement to the existing pipe system that drains Glendale Avenue. As a result, the Village does anticipate increased pollutant loads and no additional Best Management Practices are proposed at this time.

### 3.5.10 - Opinion of Estimated Cost

<b>Cost Summary</b>	<u>Trench Restoration Only</u>	<u>Street Reconstruction</u>
A. Congress Route:	\$6.5 Million	\$7.9 Million
B. Kensington Route:	\$5.2 Million	\$6.6 Million
C. Congress Lift Station:	\$5.2 Million	\$6.9 Million
D. Courtland Route:	\$5.8 Million	\$7.3 Million
E. Sewage Grinder Pump Alternative:	\$7.5 Million	
F. Temporary Flood Control Relief:		
1. Glendale Relief:	\$200,000	\$400,000
2. Morris Relief :	\$200,000	\$400,000
3. Glendale / Wildwood Relief:		
a. Upsize Sanitary Sewer:	\$60,000	
b. Excess Flow Pumping Station:	\$600,000	
c. Grinder Pumps:	\$100,000	
G. Sustainable Storm Water Trench	\$600,000	

### 3.5.11 - Recommended Solutions

Excessive I/I in the existing sanitary system has caused surcharging which backed up into basements through sanitary laterals. Basement backups in the northwest portion of the Village have been a chronic problem for many years. Street flooding has also been problematic along Glendale Avenue between Wildwood Avenue and Woodburn Street. The proposed hydraulic improvements to the sanitary and storm sewer systems have been entered into the XP-SWMM hydraulic model to determine their response to various rainfall events. The results show that the proposed improvements will alleviate basement backup risk and street flooding. The Village is also in the process of implementing I/I reduction improvements throughout Basin 6 from both public and private sources.

The improvements listed in the Facility Plan would address the needs shown. Due to the length and depth of sanitary sewers this alternative is somewhat more costly than other alternatives. The Facility Plan approach to the proposed storm sewer improvements is a cost-effective solution to the street flooding experienced in Basin 6. Other sanitary sewer alternatives were considered such as the Courtland Alternate Sewer Route, the Grinder Pump Alternative, and the underground storage system for storm water. The cost of these alternatives proved to be more than the other alternatives, with potential disadvantages.

We looked at the cost to install a wastewater lift station to transmit wastewater flows to the MIS as was proposed a number of years ago. The construction cost of this alternative was the same as the cost for gravity sewers. Lift stations, however, have much higher operating and

maintenance costs than gravity sewers. To account for this, we performed a present worth cost analysis which looks at the total cost of a project, including construction, operations, and maintenance costs over a 20-year period. When the power costs, equipment replacement, and operations labor is factored in to the lift station alternative, the 20-year cost of the gravity sewer alternative is less than the lift station alternative.

The Kensington alternate sanitary sewer route builds on the original Facility Plan approach and adjusts the alignment to eliminate approximately 1,000 feet of sewer with a new connection point to the MIS at Kensington. Moving the connection point saves the cost of two blocks of new pipe. Also, as the deeper portions of sanitary sewer are all on Kensington, tunneling a new sewer through the hill becomes more cost-effective. Rerouting sanitary sewers on Wildwood instead of Marlborough and Sheffield results in shallower sewer depths and less cost. The cost savings of the Kensington alternate sanitary sewer route over the Facility Plan sanitary sewer route is roughly \$1.3 Million. For these reasons, the Kensington alternate sanitary sewer route is the selected alternative.

With regard to relief sewers and temporary flood control relief alternatives for rainstorms exceeding 2-inches, upsized sanitary sewers on Glendale and Morris will provide additional basement backup protection.

An overflow sewer from the Morris sanitary sewer discharging to the Woodburn storm sewer is also needed to alleviate high flows for a short period of time during heavy rainfall events. The selected alternative will include these improvements.

The area near the intersection of Glendale Avenue and Wildwood Avenue can be addressed by upsizing a portion of the Kensington sanitary sewer. The selected alternative will also include these improvements.



**1 Basin 6 Recommended Solution**

The storm water drainage improvements for Basin 6 as shown in the selected plan are as were

proposed in the Facility Plan. The drainage improvements include larger storm sewers on Glendale Avenue extending east and west from Woodburn Street. The improvements include a storm sewer extending west on Glendale Avenue from Wildwood Avenue draining to a pond in Estabrook Park. New curb inlets would be installed at each intersection and a sump pump drainage system would be installed behind the curb to accommodate future basement footing drain disconnections. Sustainable water quality enhancements will be designed for reconstructed streets. Soil conditions will be explored along the street reconstruction routes to determine the feasibility of installing sustainable storm water storage trenches to reduce surface water flows.

Existing public utilities along Glendale Avenue include a sanitary sewer, two storm sewers, and a water main. The proposed improvements include an additional sanitary sewer and replacement of one of the storm sewers with a larger pipe. In order to maintain the required 8-foot separation between water mains and sewers, the water main will most likely need to be relocated. The Kensington and Wildwood Street pavements are in poor condition and are due for replacement in 2012. The Glendale street pavement is in good condition, but the scope of the proposed improvements along Glendale will damage the majority of the pavement. For these reasons we recommend that the Village consider reconstructing the Kensington, Wildwood, and Glendale pavements in lieu of trench patching. The cost estimates for each alternative have been adjusted accordingly.

The project will be phased by splitting the Kensington and Glendale work into two projects. The Kensington sanitary sewer could be built as Phase 1, extending from the MIS to Bartlett. This will provide some relief for the sanitary sewer along Glendale as the Kensington sanitary sewer would intercept flows from the south.

The existing Glendale sanitary sewer will continue to discharge through Whitefish Bay. If the project were to be split into phases, relief of the surface flooding along Glendale would not be completed until Phase 2. Due to the multiple pipes proposed on Glendale, it makes sense to do the storm sewer work and the sanitary sewer work together on that street. Phase 2 would consist of new storm sewers on Glendale and new sanitary sewers on Glendale and Wildwood, completing the project.

### **3.5.12 - Improvement Benefits in Whitefish Bay**

The Village of Shorewood has led an effort to address sewer backup problems in Basin 6 in conjunction with the Village of Whitefish bay, the City of Milwaukee, and MMSD. To that end, regular meetings were scheduled and held during the preparation of this facility Plan with these governments and agencies. A total of four (4) meetings were held so far since August of 2010 with Whitefish bay officials consisting of the Village Engineer, the Assistant Village Engineer, and the Village Manager. MMSD staff was also present at all meetings, facilitating discussion and offering insight into MMSD facilities and operations pertinent to the solution components under discussion.

The progress of the solution alternatives as it affected each neighbor of Shorewood was transmitted to that community and subsequent meetings provided the opportunity for discussion and exchange of ideas with regards to the solutions under consideration.

Specifically, the issues of sewer backups in Whitefish bay are of utmost concern to that community and the benefits brought about by Shorewood's Basin 6 projects are a welcome

contribution to Whitefish Bay's own efforts to stem the widespread basement backup potential in the neighboring areas.

Basement backups in Whitefish Bay were reported along Courtland, Glendale, Marlborough, Wildwood, Woodburn, Morris, Larkin, Newhall, and Bartlett. The hydraulic model shows the anticipated surcharging in the existing sanitary sewer system during a simulated 2-inch rainfall event (10-year frequency storm) and a 3-inch (100-year frequency storm).

### **2-Inch Rain Benefits:**

The proposed improvements address the chronic basement backups and provide street flooding providing protection for the 2-inch rain event.

1. The proposed improvements will benefit residents, both in Shorewood and in Whitefish Bay. Based on the hydraulic model of the proposed improvements basement backup risk in Shorewood would be reduced from 115 potentially affected properties to zero during a 2-inch rain event.
2. The hydraulic model shows that the proposed improvements would reduce basement backup risk in Whitefish Bay from 150 potentially affected properties to 110 properties during a 2-inch rain event. The depth of inundation or hydraulic grade line in the sanitary sewers would also drop roughly 2-feet in Shorewood and 1-foot in Whitefish Bay during a 2-inch rain event.

### **3-Inch Rain Benefits:**

The addition of relief sewers and overflow pipes will provide additional benefit for up to a 3-inch rain event until such time as I/I reduction improvements from both public and private sources are completed.

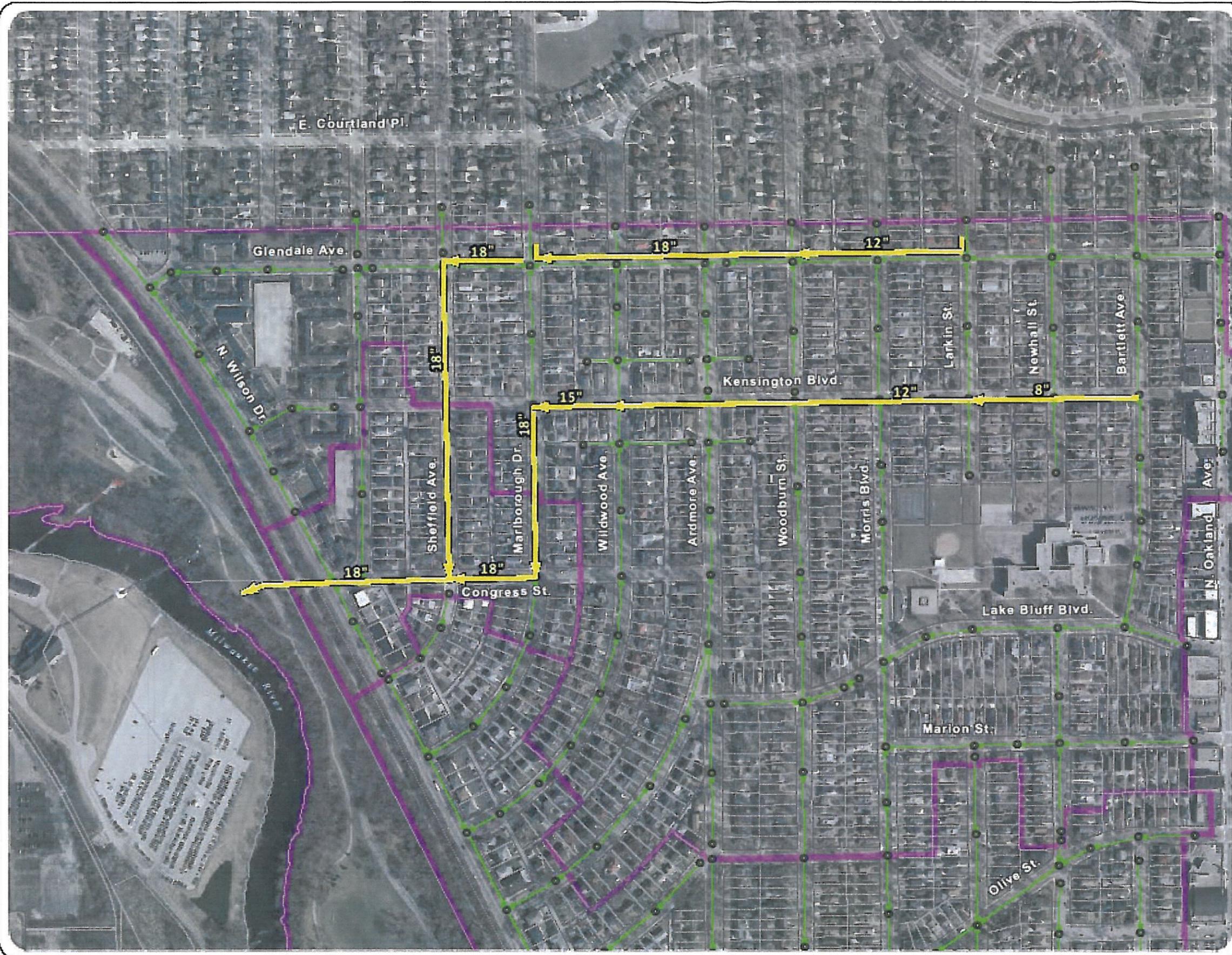
1. Surcharging of sanitary sewers and basement backup risk in Basin 6 of Shorewood will be eliminated after the selected alternative is implemented. Based on the hydraulic model of the proposed improvements basement backup risk for Shorewood residents during a 3-inch rain event will be reduced from 350 potentially affected properties to zero.
2. The hydraulic model shows that the proposed improvements will reduce basement backup risk in Whitefish Bay from 300 potentially affected properties to 200 potentially affected properties. The hydraulic grade line in the sanitary sewers would also drop by approximately 4-feet in both Shorewood and Whitefish Bay during a 3-inch rain event.

As noted above, basement backup risk will be reduced by 1/3 for residents in Whitefish Bay, especially near Glendale Avenue and along Courtland Place. A drop will be noted in the hydraulic grade line of the sanitary sewer system after the proposed improvements are completed in Shorewood.

However, the occurrence of basement backups will not decrease substantially north of Courtland Place in Whitefish Bay until additional improvements in Whitefish Bay are completed. The sizes of the local sewers in that area reduce upstream flows creating a bottleneck during large rain events. The proposed improvements will provide additional downstream capacity and a

corresponding reduction in basement backup risk will be noted after Whitefish Bay makes improvements in their sanitary sewer system.

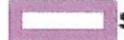
The Villages of Shorewood and Whitefish Bay understand that the current efforts in Shorewood's Basin 6 provide basement backup risk reduction in Whitefish Bay. Accordingly, Staff in both Villages have demonstrated their willingness to draft a cost share agreement that reflects the relative benefits of the proposed projects in each Village.



0 87.5 175 350 Feet

March 24, 2011

**Legend**

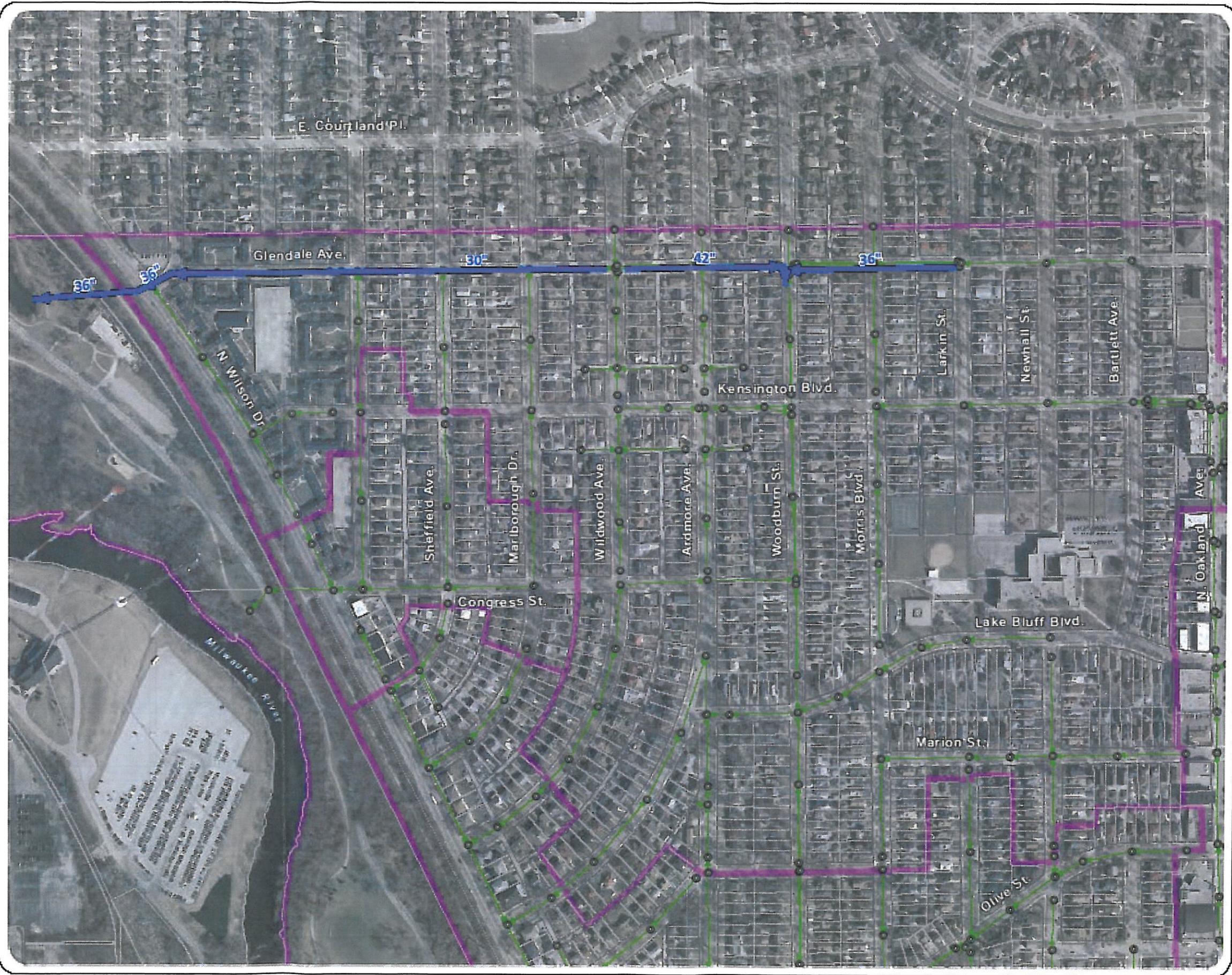
- Proposed Improvements**
-  Sanitary Pipes
- Existing Sanitary Sewer**
-  Sanitary Pipes
-  Sanitary Manholes
-  Sewer Shed Basins

**VILLAGE OF SHOREWOOD, WISCONSIN**

**BASIN 6  
PRELIMINARY DESIGN  
MEMO**

**FIGURE 1  
FACILITY PLAN  
ALTERNATIVE**





0 87.5 175 350 Feet

March 24, 2011

**Legend**

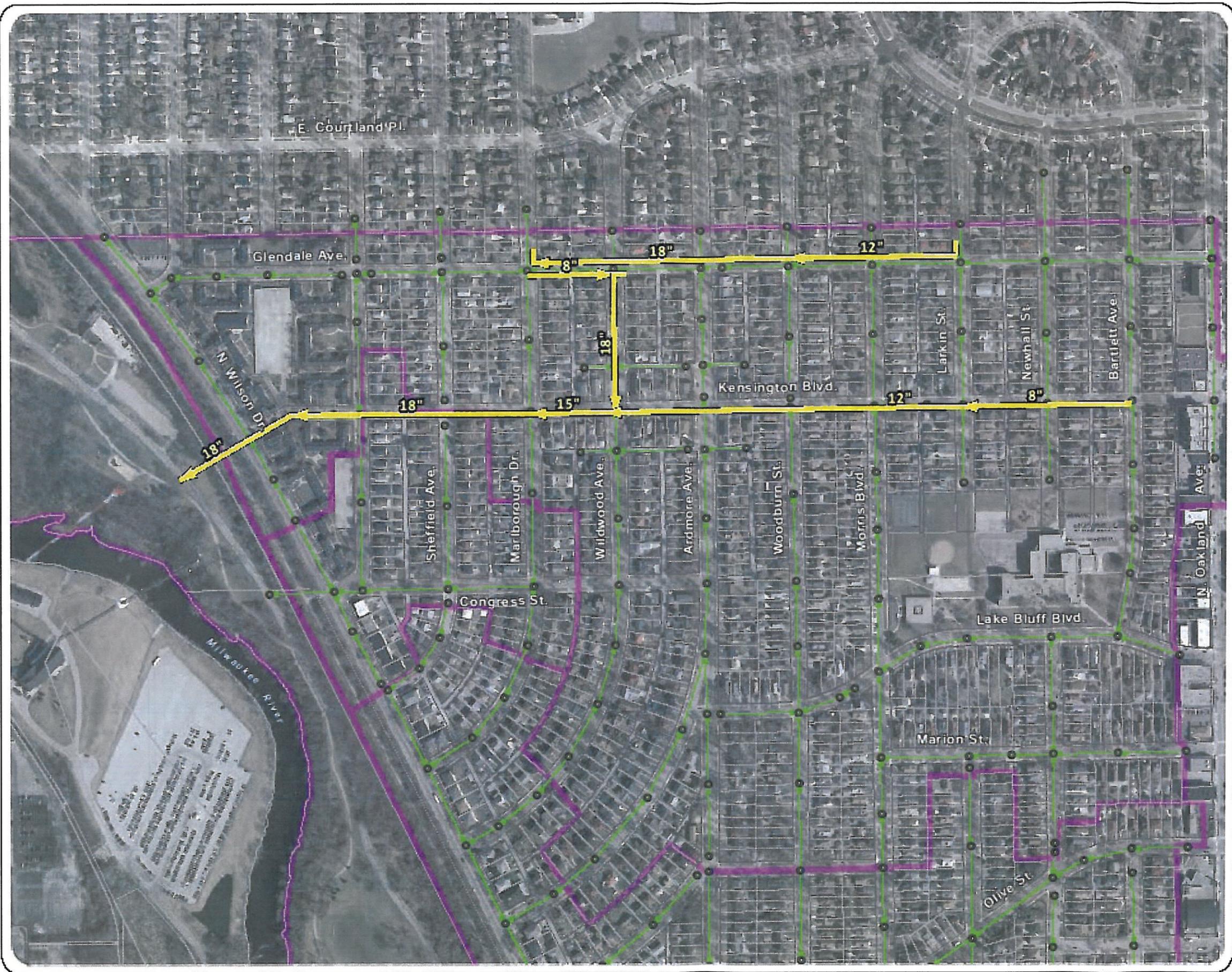
- Proposed Improvements
- Storm Pipes
- Existing Storm Sewer
- Storm Pipes
- Storm Structures
- ▭ Sewer Shed Basins

**VILLAGE OF SHOREWOOD, WISCONSIN**

**BASIN 6  
PRELIMINARY DESIGN  
MEMO**

**FIGURE 2  
FACILITY PLAN  
ALTERNATIVE**





0 87.5 175 350  
Feet

March 24, 2011

**Legend**

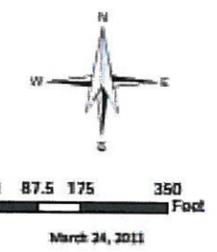
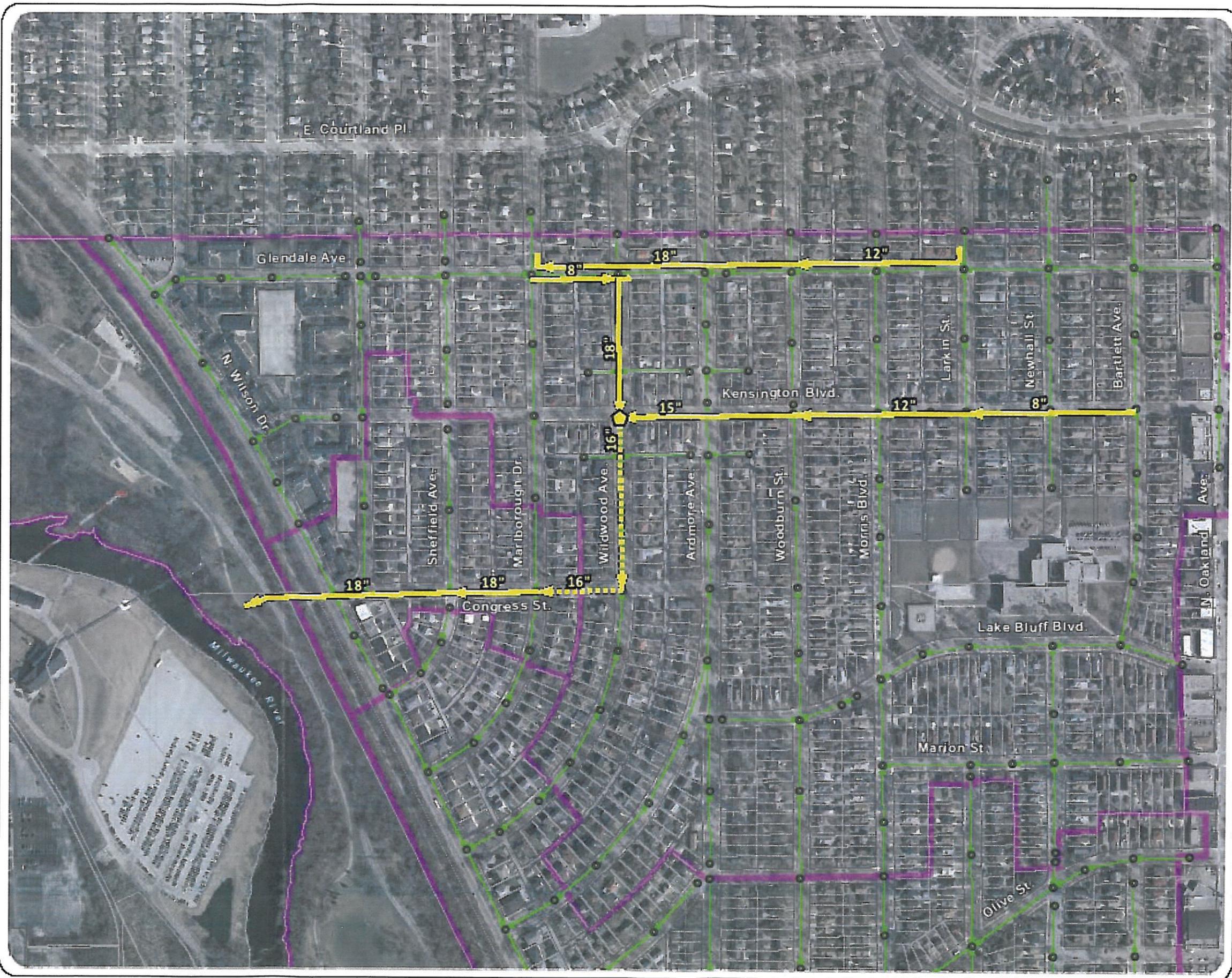
- Proposed Improvements
- Sanitary Pipes
- Existing Sanitary Sewer
- Sanitary Pipes
- Sanitary Manholes
- Sewer Shed Basins

**VILLAGE OF SHOREWOOD, WISCONSIN**

**BASIN 6  
PRELIMINARY DESIGN  
MEMO**

**FIGURE 3  
KENSINGTON  
ALTERNATE ROUTE**





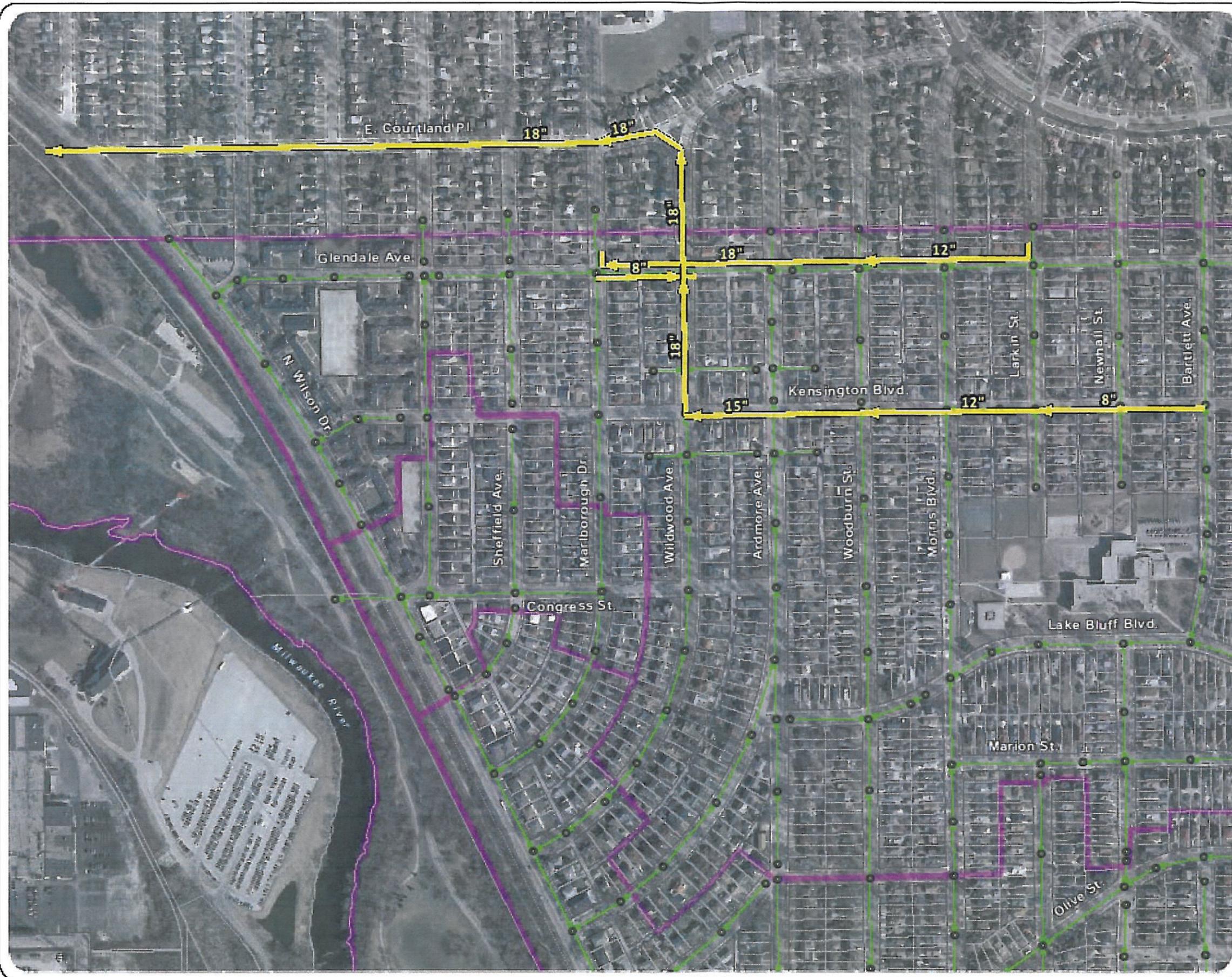
- Legend**
- Proposed Improvements
    - Sanitary Pipes
    - Sanitary Force Main
    - Sewage Lift Station
  - Existing Sanitary Sewer
    - Sanitary Pipes
    - Sanitary Manholes
    - Sewer Shed Basins

**VILLAGE OF SHOREWOOD, WISCONSIN**

**BASIN 6  
PRELIMINARY DESIGN  
MEMO**

**FIGURE 4  
LIFT STATION  
ALTERNATIVE**





0 87.5 175 350 Feet

March 24, 2011

**Legend**

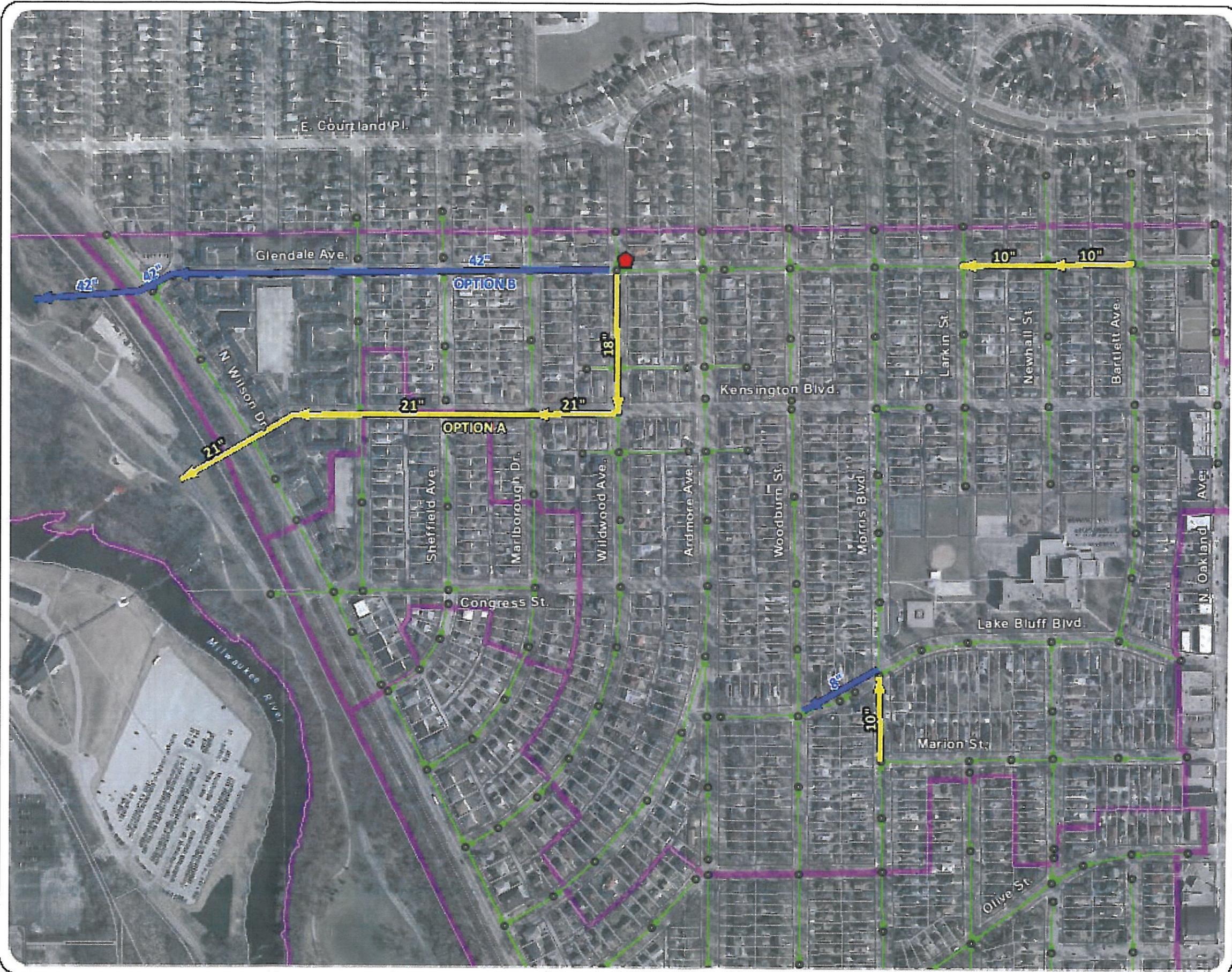
- Proposed Improvements
  - Sanitary Pipes
- Existing Sanitary Sewer
  - Sanitary Pipes
- Sanitary Manholes
- Sewer Shed Basins

**VILLAGE OF SHOREWOOD, WISCONSIN**

**BASIN 6  
PRELIMINARY DESIGN  
MEMO**

**FIGURE 5  
COURTLAND ALTERNATE  
ROUTE**





0 87.5 175 350  
Foot  
March 24, 2011

**Legend**

- Proposed Improvements
  - Storm Pipes
  - Sanitary Pipes
- Existing Sanitary Sewer
  - Sanitary Pipes
  - Sanitary Manholes
  - Sewer Shed Basins
- Sewage Lift Station

**VILLAGE OF SHOREWOOD, WISCONSIN**

**BASIN 6  
PRELIMINARY DESIGN  
MEMO**

**FIGURE 6  
RELIEF SEWER/  
OVERFLOW  
ALTERNATE ROUTE**

