

Village of Wilmette Separate Storm Sewer System Stormwater Management Report January 2015



VILLAGE OF WILMETTE
STORMWATER
ACTION PLAN

Prepared for:
Village of Wilmette
1200 Wilmette Avenue
Wilmette, IL 60091



Prepared by:
Christopher B. Burke Engineering, Ltd.
9575 W. Higgins Road, Suite 600
Rosemont, IL 60018



TABLE OF CONTENTS

Table of Contents	i
List of Tables.....	iii
List of Figures	iii
List of Exhibits.....	iii
List of Abbreviations, Acronyms and Definitions	iv
List of Appendices.....	iv
Chapter 1 Project Overview.....	4
1.1 Introduction	4
1.2 Purpose and Scope	5
Chapter 2 Study Development.....	5
2.1 Data Collection.....	5
2.1.1 Village Staff and Public Involvement.....	5
2.1.2 Storm Sewer Data Collection	6
2.1.3 Storm Sewer Flow and Rain Gage Data.....	6
2.1.4 Floodplain Maps	6
Chapter 3 Description of Existing Drainage System	7
3.1 Stormwater Pump Station.....	8
3.1.1 Description of Pump Station Electrical Equipment	8
3.2 Existing Storm Sewer Network and Limitations	9
3.3 Storm and Sanitary Sewer Relations, Inflow and Infiltration.....	10
Chapter 4 Hydrologic and Hydraulic Model Development.....	11
4.1 Subbasin Delineation	11
4.2 Land Use	11
4.3 Data Entry	11
4.4 Existing Condition Modeling Calibration	12
Chapter 5 Existing Condition Model	15
5.1 Critical Duration and Design Storms	15
5.2 Model Results	16
5.2.1 Flood Depths.....	16
5.2.2 Estimated Number of Structures Impacted by Flooding.....	16

5.2.3	Identification of System Bottlenecks	17
Chapter 6	Proposed Improvements.....	19
6.1	Near Term Drainage Improvements	19
6.1.1	High Capacity Inlets.....	19
6.1.2	Coordination with Glenview	20
6.1.3	Residential Structure Flood Proofing	21
6.1.4	Green Infrastructure Improvements.....	21
6.1.5	Green Infrastructure Ordinance Requirements	23
6.1.6	Green Infrastructure Limitations	23
6.2	Long Term Capital Drainage Improvements.....	24
6.2.1	Engineer’s Estimate of Probable Cost Analysis and Assumptions	24
6.3	Alternative 1 – Relief Storm Sewer System.....	25
6.3.1	Alternative 1 - Project Benefits, Costs and Considerations.....	27
6.4	Alternative 2 – Centralized Storage at Community Playfield	28
6.4.1	Alternative 2 - Project Benefits, Costs and Considerations.....	29
6.5	Alternative 3 – Neighborhood Stormwater Storage	30
6.5.1	Alternative 3 - Project Benefits, Costs and Considerations.....	31
Chapter 7	Comparison of Proposed Alternatives and Summary of Benefits.....	33
7.1	Unquantified Benefits	34
Chapter 8	Funding of Large Term Capital Projects.....	34
8.1	Pay-As-You-Go Capital Funding.....	34
8.2	Municipal Bond	34
8.3	Special Service Area (SSA)	34
8.4	Stormwater Utility Fee.....	35
8.5	Outside Funding Sources	35
8.5.1	Federal Emergency Management Agency (FEMA).....	35
8.5.2	Metropolitan Water Reclamation District of Greater Chicago (MWRDGC)	36
Chapter 9	Separate Storm Sewer System Facts, Specifics and Realities	36

LIST OF TABLES

Table 1. Residential Structures Impacted by Flooding – Existing Conditions	1
Table 2. Summary of Benefits and Costs.....	3
Table 3. Design Storm Statistics	15
Table 4. Estimated Number of Structures Impacted by Flooding (Existing Conditions)	17
Table 5. Estimated Number of Structures Impacted by Flooding (Alternative 1).....	27
Table 6. Estimated Number of Structures Impacted by Flooding (Alternative 2).....	29
Table 7. Estimated Number of Structures Impacted by Flooding (Alternative 3).....	31
Table 8. Summary of Benefits and Costs.....	33

LIST OF FIGURES

Figure 1. Village of Wilmette Existing Trunk Storm Sewers and Topography.....	4
Figure 2. GIS Database Village of Wilmette Existing Storm Sewer Network	5
Figure 3. Cook County FEMA FIRM – Wilmette Study Area	6
Figure 4. Pump Station Drainage Schematic	9
Figure 5. Flow Monitoring Locations.....	12
Figure 6. XP-SWMM Calibration Results	13
Figure 7. April 2013 Inundation Areas and XP-SWMM Analysis - Verification of Results.....	14
Figure 8. High Capacity Inlets.....	20
Figure 9. Potential Diversion Area to Glenview.....	20
Figure 10. Window Well Elevation	21
Figure 11. Green Road	21
Figure 12. Green Road	22
Figure 13. Downspout Disconnection	22
Figure 14. Rain Barrel.....	22
Figure 15. Typical Storm Sewer Construction	24
Figure 16. Alternative 1 XP-SWMM Model Results for 100-year Storm Event - Street Flooding Duration .	27
Figure 17. Underground Storage Example	28
Figure 18. Alternative 2 XP-SWMM Model Results for 100-year Storm Event - Street Flooding Duration .	29
Figure 19. Alternative 3 XP-SWMM Model Results for 100-year Storm Event - Street Flooding Duration .	31
Figure 20. North Branch Chicago River Schematic.....	37

LIST OF EXHIBITS

Exhibit 1 – Flood Questionnaire Map 1
Exhibit 2 – Flood Questionnaire Map 2
Exhibit 3 – FIRM Panel 234
Exhibit 4 – FIRM Panel 253
Exhibit 5 – Existing Condition Storm Sewer Network
Exhibit 6 – Existing Topography
Exhibit 7 – 10-Year Existing Inundation Map

- Exhibit 8 – 100-Year Existing Inundation Map
- Exhibit 9 – Study Areas
- Exhibit 10 – Alternative 1
- Exhibit 11 – Alternative 2
- Exhibit 12 – Alternative 3
- Exhibit 13 – Alternative 3 Inundation Area
- Exhibit 14 – Subbasin Map

LIST OF ABBREVIATIONS, ACRONYMS AND DEFINITIONS

Acre – Feet (ac-ft) – Flood volumes are typically quantified in acre-feet. One acre-foot is the equivalent of an acre of land that is flooded one foot deep.

Hydraulic Grade Line (HGL) – The HGL is the surface or profile of water flowing in a storm sewer flowing partially full. If a pipe is under pressure, the hydraulic grade line is the elevation that the water rises to on the ground surface.

Level of Service – For this study, the level of service or capacity of a storm sewer refers to the point at which the systems begins to surcharge, which means stormwater begins to collect in the streets because the receiving storm sewer is at capacity.

RCBC – Reinforced Concrete Box Culvert

RCP – Reinforced Concrete Pipe

Tailwater – The water surface downstream of an outlet pipe. Flow from the outlet pipe can decrease if the tailwater level exceeds the normal of the outlet.

XP-SWMM – An XP-Software Stormwater and Wastewater Management Model (XP-SWMM) is a dynamic modeling program that determines the hydrologic response (runoff mode) from a storm event and routes the runoff through a storm sewer network (hydraulic mode).

Zone AE – Special Flood Hazard Area – FEMA defines Zone AE as a SFHA subject to inundation by the 1% annual chance flood with a defined elevation. The 1% annual chance flood is the 100-year flood, or base flood, or the flood that has a 1% chance of being equaled or exceeded in any given year. The Base Flood Elevation (BFE) is the water surface elevation of the 1% annual chance flood.

Zone X – Other Flood Areas – A Zone X is defined as an area of 0.2% chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile, and areas protected by levees from 1% annual chance flood.

LIST OF APPENDICIES

- Appendix 1 – Flood Inundation Depths (Tables)
- Appendix 2 – Reduction of Flood Inundation Depths (Tables)
- Appendix 3 – Cost Estimates
- Appendix 4 – CD with XP-SWMM models and GIS database

EXECUTIVE SUMMARY

This Stormwater Management Report for the Separate Storm Sewer System was initiated by the Village of Wilmette (Village) as part of the ongoing Stormwater Action Plan to address flooding within the Village. The study area includes approximately 1,720 acres west of Ridge Road that is served by the Village's separate storm sewer system. Portions of this area have experienced extensive flooding in the recent past during intense storm events. The methodology for analyzing the separate storm sewer system included a comprehensive survey of the storm sewer system, resident meetings, hydrologic and hydraulic modeling of the existing drainage system, identification of system limitations and development of proposed drainage improvements. The proposed drainage improvements included near-term drainage improvements that can be incorporated into the Village's current infrastructure projects, green infrastructure and long term capital improvement projects.

The separate storm sewer system on the west side of the Village is comprised of lateral and trunk storm sewers that drain to the stormwater pump station at Lake Avenue east of Harms Road. The stormwater pump station pumps the stormwater up to an elevation where it can drain by gravity through large storm sewers to the North Branch of the Chicago River. The area served by the separate storm sewer system is heavily developed into single family homes and is relatively flat with little elevation difference. There are widespread low areas that collect water once the capacity of the drainage system is exceeded. When this occurs, water collects in the streets and there are no stormwater storage areas or safe overland flow routes to safely store or convey the water away from the residential neighborhoods.

Based on the detailed hydrologic and hydraulic modeling for the study area, the existing drainage system has approximately a 2-year level of service before street flooding begins. The model results indicate that under existing conditions the maximum street flooding depths for the 10-year through 100-year return interval design storm event range from 2.3 feet to 3.3 feet, respectively and flooding is widespread for these events. Approximately 700 residential structures are impacted by flooding for the 100-year return interval design storm event. A summary of residential structures impacted by flooding is provided in **Table 1**.

Return Interval Storm	Number of Structures
10-year	120
25-year	280
50-year	480
100-year	700

Table 1. Residential Structures Impacted by Flooding – Existing Conditions

Analysis of the existing conditions model results shows that the limiting component in the drainage system is the trunk line and lateral storm sewer system that feed the pump station. This drainage system has a lower capacity than the pump station and the outflow storm sewers from the pump station. Based on this conclusion, the development of proposed drainage improvement alternatives focused on improvements to the trunk line and lateral storm sewer system that feed the pump station. The Village has indicated that the desired level of service for drainage improvements is a 10-year level of service (10-year hydraulic

grade line below street level).

The proposed drainage improvements consist of near-term improvements such as installation of high capacity inlets that are less prone to clogging and green infrastructure. These improvements will not have a measureable reduction in flooding during severe storm events. Three alternatives for long term capital improvement projects were developed with the goal of providing a 10-year level of service. These improvements are summarized as follows:

Alternative 1 – Relief Storm Sewer System: This alternative includes the construction of a relief storm sewer system to increase conveyance in the storm sewer system to a level that matches the pump station capacity. Under this alternative, the storm sewer would provide a 10-year level of service for separate storm sewer system and the number of structures impacted during a 100-year return interval storm event would be reduced from 700 to 370. The engineer's estimate of probable cost for this alternative is **\$75,000,000**.

Alternative 2 – Centralized Storage at Community Playfield: This alternative includes the construction a 55 acre-ft underground stormwater storage facility at Community Playfield. A relief storm sewer system would be constructed to convey water to the underground stormwater storage facility. This alternative would provide a 10-year level of service for the separate storm sewer system and reduce the number of structures impacted during a 100-year return interval storm event from 700 to 490. The engineer's estimate of probable cost for this alternative is **\$70,000,000**.

Alternative 3 – Neighborhood Stormwater Storage: This alternative includes the construction of underground stormwater storage at Thornwood Park (10 acre-ft), Community Recreation Center (10 acre-ft) and Centennial Park (12 acre-ft). The proposed stormwater storage would provide a 10-year level of service for those areas immediately adjacent to the parks, which includes many of the most frequently flooded areas within the Village. This alternative would reduce the number of structures impacted during a 100-year return interval storm event from 700 to 570. The engineer's estimate of probable cost for this alternative is **\$44,000,000**.

A summary of the benefits and costs of each proposed project is included in **Table 2**. Additional benefits that have not been quantified include a reduction of inflow and infiltration to the sanitary sewer system, duration of street flooding, basement seepage and yard flooding as well as improved access during storm events and increased property values.

	Design Storm	Existing	Alternative 1	Alternative 2	Alternative 3
			Relief Storm Sewer System	Centralized Stormwater Storage at Community Playfield	Neighborhood Stormwater Storage
Benefits	Number of Structures Impacted by Flooding (% Reduction)				
	10-year	120	0 (100%)	0 (100%)	50 (58%)
	25-year	280	60 (79%)	90 (67%)	160 (43%)
	50-year	480	190 (60%)	240 (50%)	320 (33%)
	100-year	700	370 (47%)	490 (30%)	570 (19%)
	Street Flooding Depth in feet (Minimum - Maximum)				
	10-year	0.3 - 2.2	0.0	0.0	0.0 - 2.2
	25-year	0.5 - 2.7	0.0 - 1.7	0.1 - 1.8	0.3 - 2.6
	50-year	0.6 - 3.0	0.0 - 2.2	0.5 - 2.3	0.5 - 2.9
	100-year	0.6 - 3.3	0.0 - 2.6	0.6 - 2.7	0.6 - 3.2
Costs	Total Cost	--	\$75 Million	\$70 million	\$44 million
	Cost per Structure Protected for 100-year Event	--	\$227,273	\$333,333	\$338,462

Table 2. Summary of Benefits and Costs

CHAPTER 1 PROJECT OVERVIEW

1.1 INTRODUCTION

The Village of Wilmette (Village) has historically experienced widespread street and structure flooding resulting from a wide range of storm events with varying degrees of intensity and duration. To effectively address the stormwater and flooding issues, the Village has embarked on an ongoing Stormwater Action Plan. As part of this plan, the Village has retained Christopher B. Burke Engineering, Ltd. (CBBEL) to develop this Stormwater Management Report (SMR). This SMR presents the results of an extensive stormwater management investigation of the separate storm sewer system within the Village located west of Ridge Road. This study focuses exclusively on stormwater management issues and flooding within the western portion of the Village. The western portion of the Village consists of a separate storm sewer for handling stormwater runoff (**Figure 1**).

The Village is dedicated to addressing the management of stormwater quantity and quality. Stormwater management falls under the Village's Municipal Services Committee (MSC) with necessary approval for stormwater infrastructure projects granted by the Board of Trustees. The Village encourages progressive engineering design to manage stormwater quantity while enforcing pollution prevention to improve stormwater quality. This SMR addresses existing and anticipated problems related to stormwater runoff and localized flooding to reflect the updated priorities for stormwater management in the Village.

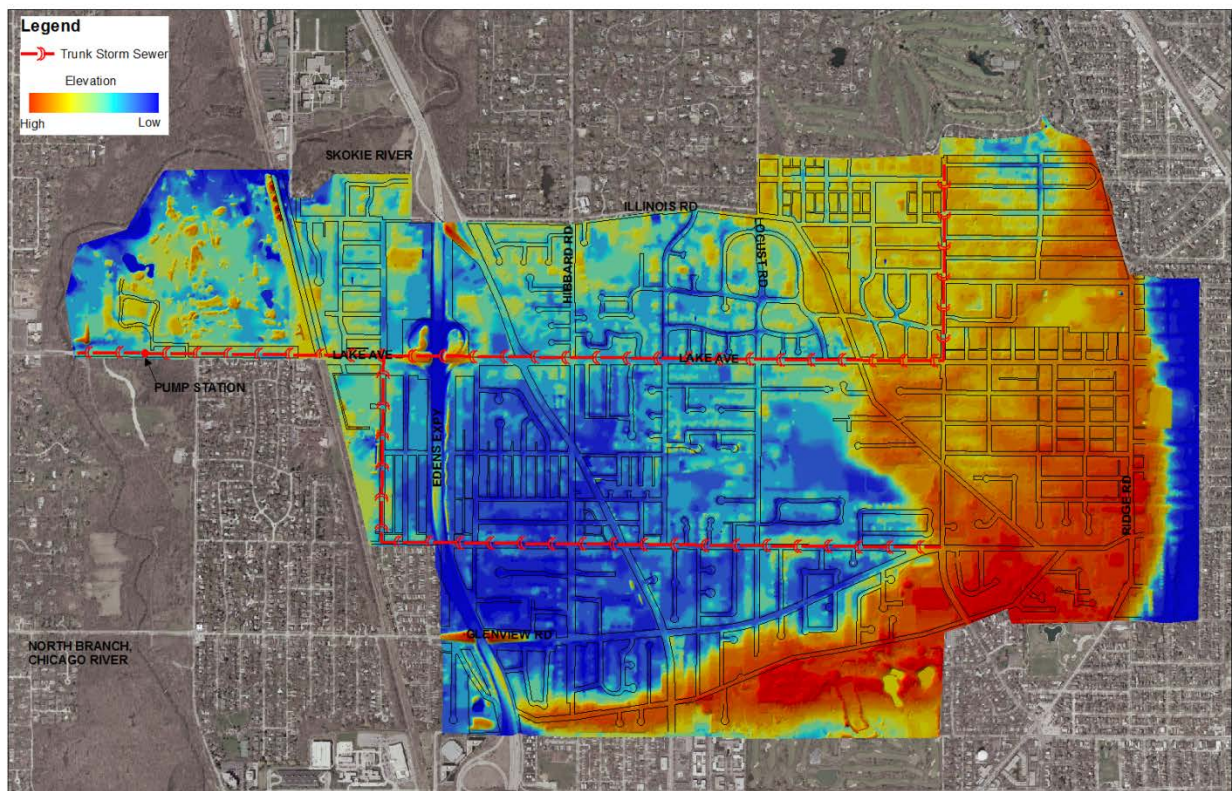


Figure 1. Village of Wilmette Existing Trunk Storm Sewers and Topography

1.2 PURPOSE AND SCOPE

The purpose of this SMR is to present the findings of detailed analyses, provide justification for capital improvement projects in a prioritized manner and provide recommended improvement projects that will:

- Reduce existing flood/drainage problems,
- Prevent an increase in existing flood/drainage problems as redevelopment occurs,
- Prevent or minimize future flood damages,
- Help preserve the natural and beneficial function of the drainage system, and
- Help preserve and enhance stormwater quality.

This SMR includes detailed hydrologic and hydraulic modeling of the western portion of the Village to identify flood damage areas and existing bottlenecks or problems in the stormwater conveyance system. The detailed modeling was used to identify optimal locations and sizes for capital drainage improvement projects and stormwater quantity/quality Best Management Practices (BMPs) to reduce flooding and damages. The scope of the SMR includes the development of a digital storm sewer database developed in a Geographic Information System (GIS) database for the Village. The GIS database will serve as the central location for all of the information collected and developed as part or a result of this SMR. This SMR database has been developed with the intended use as a tool in the decision-making process for future capital improvements. The compilation of the GIS database is one of the main products resulting from the SMR (Figure 2).

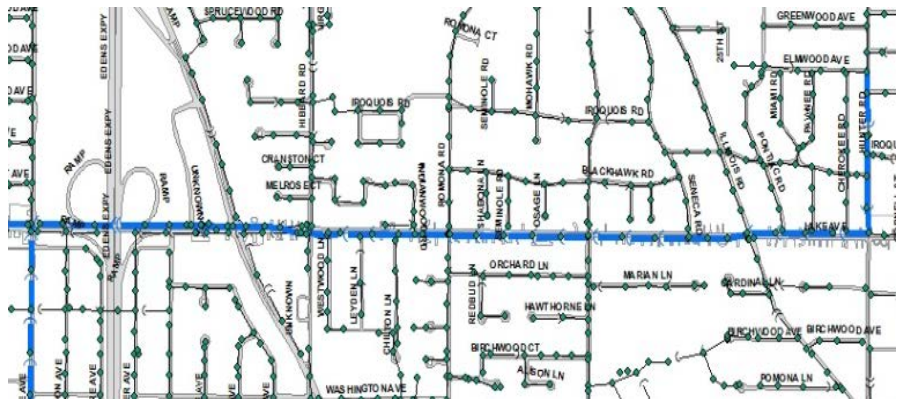


Figure 2. GIS Database Village of Wilmette Existing Storm Sewer Network

CHAPTER 2 STUDY DEVELOPMENT

2.1 DATA COLLECTION

2.1.1 Village Staff and Public Involvement

Participation from Village staff, decision-makers and the public was essential to understanding the flooding and drainage issues throughout the Village. This input is necessary to craft solutions to effectively address flooding problems. The extent and nature of known existing stormwater conditions and concerns in the Village were identified through various means including: discussions with the Village Engineering staff, Public Works staff, Trustees and a series of public meetings. Three resident open houses were held on March 13th, 19th and 20th 2014. There were approximately 168 residents that signed in at the open

houses and there were 134 flood questionnaires returned. The results of the flood questionnaires can be seen in **Exhibits 1 and 2**. Public notice was also posted to promote residents to review, identify and explain problem areas on maps and exhibits throughout the Village. CBBEL also reviewed specific accounts, videos and photographs of flooding from Village staff and residents, as well as reviewed applicable Village plans, codes, GIS data, previous studies and construction documents. The information shown on **Exhibits 1 and 2** is a representation of the information compiled from the residents that provided information at the open houses. It is noted that flooding is widespread and not limited to only the information obtained from resident questionnaires. As noted throughout this SMR, detailed consideration has been taken to quantify the full extent of the flooding problems.

2.1.2 Storm Sewer Data Collection

Storm sewer data including sewer location, alignment, elevation, size and condition was collected during a survey of the Village's entire storm sewer system west of Ridge Road in the Spring of 2014 by RJN and CBBEL staff. This survey included gathering information on more than 1,500 manholes and pipes throughout the western portion of the Village and was used to develop a GIS database of the Village's storm sewer network.

2.1.3 Storm Sewer Flow and Rain Gage Data

Flow monitoring data was collected in two locations along the trunk storm sewer lines on Lake Avenue and Wilmette Avenue by RJN and provided to CBBEL. Corresponding precipitation data collected by RJN was also provided to CBBEL. Further discussion of this flow and precipitation data is provided in forthcoming sections of this report.

2.1.4 Floodplain Maps

According to the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) panels 234 and 253, for Cook County and Incorporated areas, effective August 19, 2008; portions of the western Village north of Lake Avenue contain Zone AE Special Flood Hazard Areas (SFHA) and Zone X (Other Flood Areas) associated with the North Branch of the Chicago River (**Exhibits 3 and 4**).

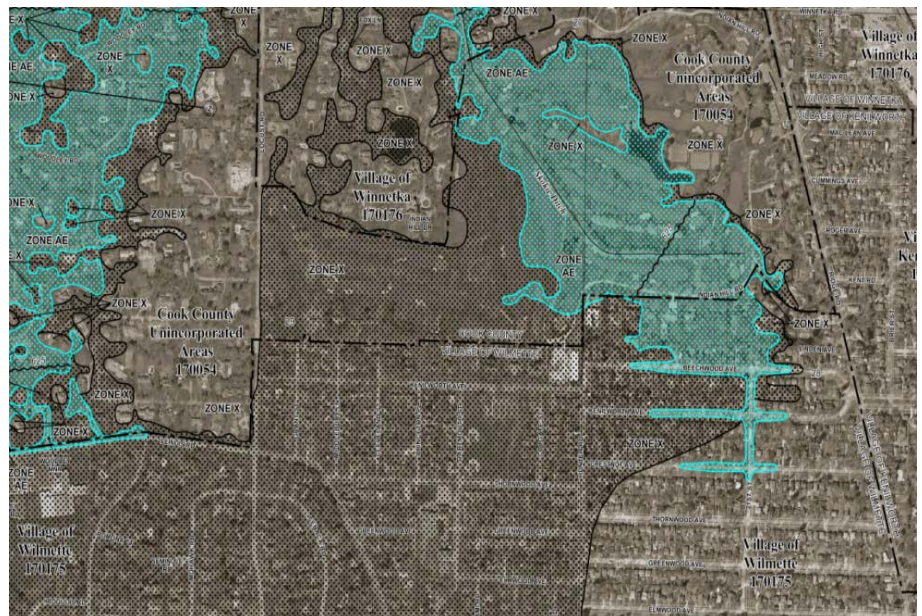


Figure 3. Cook County FEMA FIRM – Wilmette Study Area

FEMA defines Zone AE as a SFHA subject to inundation by the 1% annual chance flood with a defined elevation. The 1% annual chance flood is the 100-year flood, or base flood, or the flood that has a 1% chance of being equaled or exceeded in any given year. The Base Flood Elevation (BFE) is the water surface elevation of the 1% annual chance flood. Zone X is an area of 0.2% chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile, and areas protected by levees from 1% annual chance flood.

The Village is largely protected from overbank flooding along the North Branch Chicago River by high ground within the Wilmette Golf Club and other areas south of Winnetka Road. The Zone AE SFHA shown on the FIRM for the areas west of Hibbard Road is limited to non-residential areas.

The Zone AE SFHA associated with the Kenilworth Gardens neighborhood (areas east of Hibbard) is the result of overbank flooding from the headwaters of the Skokie Ditch that flows through Indian Hill Club (**Figure 3**). A drainage divide exists on Indian Hill Club property where stormwater drains both northwest to the Village of Winnetka (Skokie Ditch) and east through the Village of Kenilworth to Lake Michigan. The portion of the Skokie Ditch draining northwest through the Village of Winnetka is susceptible to tailwater effects from the drainage system in the Village of Winnetka. The Skokie Ditch drains to a pump station at Crow Island Park (south of Willow Road) in the Village of Winnetka before ultimately draining to the Cook County Forest Preserve property (northwest corner of Hibbard and Winnetka Roads) where it is pumped again into the Skokie River.

The relatively higher ground along the northern edge of the Village boundary in Kenilworth Gardens borders the Indian Hill Club and acts as a drainage barrier in the upper portion of the headwaters to the Skokie Ditch. During the 10-year storm event, the higher ground along this divide creates a bowl and prevents interflow between the Indian Hill Club and the Kenilworth Gardens area. During storm events greater than the 10-year, stormwater can flow between the houses along this divide into and out of Indian Hill Club.

CHAPTER 3 DESCRIPTION OF EXISTING DRAINAGE SYSTEM

The storm sewer network draining the western portion of the Village is a separate storm sewer system and generally drains west from Ridge Road to the North Branch Chicago River (River) where stormwater is pumped to the River at the Lake Avenue Stormwater Pump Station (Pump Station). The existing storm sewer network draining to the Pump Station consists of a series of lateral storm sewers and two trunk sewers along Lake Avenue and Wilmette Avenue (**Exhibit 5**). A trunk sewer in this analysis is defined by a storm sewer greater than 48-inches in diameter and a lateral storm sewer is defined by a storm sewer that is 48-inches in diameter or less. The two trunk sewers combine into a single 102-inch diameter trunk sewer at the intersection of Lake Avenue and Laramie Avenue. The single 102-inch diameter trunk sewer continues west along Lake Avenue to the Pump Station. At the Pump Station, the stormwater is lifted from an elevation of approximately 602 feet to elevation 614 feet where it drains by gravity to the River through the storm sewer outlet pipes. There are two storm sewer outlet pipes, a 6-foot x 10-foot Reinforce Concrete Box Culvert (RCBC) and an 84-inch diameter reinforced concrete pipe (RCP) that drain from the Pump Station to the River.

3.1 STORMWATER PUMP STATION

CBBEL visited the Pump Station with Village staff and conducted an extensive review of the plans and data for the Pump Station dating back to the original 1929 design plans. The Pump Station has a total of 5 pumps with space for a 6th future pump. The flow rates for each pump are as follows:

- Pump 1 – 14,000 gallon per minute (gpm)
- Pump 2 – 54,000 gpm
- Pump 3 – 54,000 gpm
- Pump 4 – 70,000 gpm
- Pump 5 – 70,000 gpm

Pump 1 is a low flow pump rated 14,000 gpm (31.2 cfs) at approximately 20 ft. Total Dynamic Head (TDH) which activates “ON” at 3.5 feet of water in the wet well and turns “OFF” at 1.8 feet of water in the wet well. It is driven by a 100 Horsepower (Hp) electric motor.

Pump Nos. 2 and 3 are each driven by 250 Hp electric motors and each are capable of pumping 54,000 gpm (120 cfs) at approximately 14 ft. TDH. Pump No. 3 turns “ON” at 4.43 feet of water in the wet well and turns “OFF” at 4.00 feet of water in the wet well. Pump No. 2 turns “ON” at 6.68 feet of water in the wet well and turns “OFF” at 4.72 feet of water in the wet well. Pump No. 3 has a variable frequency drive (VFD) which allows it to vary the speed of the pump and thus vary the pump output capacity from 14,000 gpm to 54,000 gpm.

Pump Nos. 4 and 5 are rated at approximately 70,000 gpm (155 cfs) at approximately 18 feet TDH and are driven by two 600 Hp motors. Pump No. 4 turns “ON” at 9.5 feet of water in the wet well and turns “OFF” at 2.8 feet of water in the wet well. Pump No. 5 turns “ON” at 10.5 feet of water and turns “OFF” at 9.0 feet of water.

CBBEL converted the “ON” and “OFF” elevations to the project datum and reviewed the pump performance rating curve in detail for each pump. The rated pumping capacity of the five pumps in the Pump Station is **585 cfs**. The rated capacity of each pump is represented by the midpoint of an operating range or pump performance curve. The pump performance curve has been determined for a range of TDH elevations. TDH is a function of the water level in the pump station wet well versus the tailwater elevation in the discharge chambers that drain by storm sewers to the River. The maximum Pump Station flowrates vary inversely with the TDH for the system.

The Pump Station has a very small wet well compared to a typical stormwater pump station of this size. The inflow storm sewer system serves the dual purpose of a wet well and conveyance system into the Pump Station.

3.1.1 Description of Pump Station Electrical Equipment

The station has two separate switchgears. Switchgear one serves Pumps 1, 2 and 5 and switchgear two serves Pumps 2, 3 and 6 (potentially). Each gear is served by two separate 12kV electrical feeds from ComEd with an automatic “tie breaker” switch which is normally open. When one of the feeders fails, the

switch automatically closes to allow the remaining functioning feeder to serve both switchgears and serve all pumps. There is an 800 kW standby diesel generator that is capable of running Pump Nos. 1, 2 and 3 during a power outage.

3.2 EXISTING STORM SEWER NETWORK AND LIMITATIONS

The western portion of the Village is topographically flat in most areas with the exception of higher ground along Ridge Road. This flat topography has the effect of allowing widespread but shallow surface storage of water in pockets throughout the Village. There is also very little elevation difference between the surface storage pockets, with the lowest ground elevation ranging from 619-622 feet. Flooding of the storage areas generally begins in the streets and rear yards once the storm sewer system has reached capacity during a storm event. The low areas of streets and rear yards are separated by typically higher ground around and associated with residential structures, block by block. The low areas within the interior portion of the Village east of the River and west of Ridge Road form a bowl. The bowl is drained by the storm sewer network and pumped into the River (**Exhibit 6**). Stormwater must travel from the furthest points on the west side of the Village, over 3 miles (northeast corner of the study area), west to the Pump Station. Almost all of the stormwater in the Village's separate storm sewer network is pumped through the Pump Station to the River (**Figure 4**).

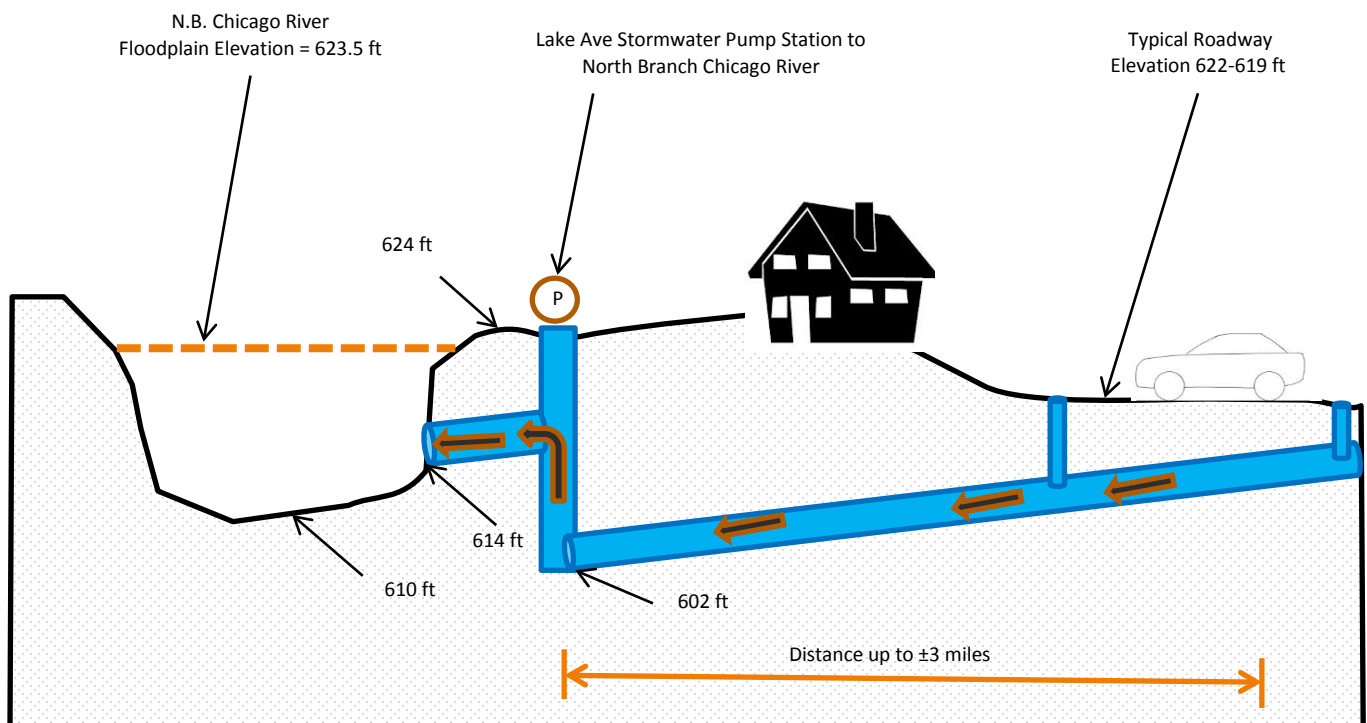


Figure 4. Pump Station Drainage Schematic

The land use within the separate storm sewer area is composed of high density residential areas with small lot sizes and minimal open space. This portion of the Village was primarily developed in the 1930s through 1950s, prior to modern stormwater management practices. As such, there is limited stormwater

storage, no overland flow routes and the storm sewer system was not designed based on current rainfall standards. In addition, the older residential structures were not constructed sufficiently high in comparison to the streets, leading to flooding of the residential structures once the flood depth in the street exceeds a certain depth. The flooding can be a result of water entering basement window sills, stair wells, first floor openings, footing drains or excessive seepage from severely saturated ground adjacent to the home.

These conditions result in the significant flooding experienced by the Village during severe storm events. They also contribute to the difficulties in retrofitting the existing system to reduce the risk of future flooding. There are very few open places where excess runoff can be directed and stored.

3.3 STORM AND SANITARY SEWER RELATIONS, INFLOW AND INFILTRATION

The western portion of the Village is drained by a separated storm sewer system where stormwater is separated from sanitary flow. Inflow and infiltration (I & I) are terms used to describe the ways that groundwater and stormwater enter into dedicated wastewater or sanitary sewer systems. Dedicated wastewater or sanitary sewers are pipes located in the street or on easements that are designed strictly to transport wastewater from sanitary fixtures inside homes or places of business to a wastewater treatment plant.

Inflow is stormwater that enters into sanitary sewer systems at points of direct connection to the system including footing/foundation drains, roof drains, downspouts, drains from window wells, outdoor basement stairwells, drains from driveways, groundwater/basement sump pumps, etc. These sources are typically improperly or illegally connected to sanitary sewer systems. Excessive standing water on the streets and yards from severe rainfall events can exacerbate the inflow in the sanitary system.

Infiltration is shallow groundwater from saturated soils that enters sanitary sewer systems through cracks and/or leaks in the sanitary sewer pipes. Cracks or leaks in sanitary sewer pipes or sanitary manholes may be caused by age related deterioration, loose joints, poor design, installation or maintenance errors, damage or root infiltration. Groundwater can enter these cracks or leaks when the soil above the sewer systems becomes saturated from excess runoff standing for prolonged periods. Infiltration can also be compounded when separated sanitary and storm sewer lines have been constructed in the same trench, separated by as little as one foot. During extreme rainfall events, the storm sewer system can become surcharged and pressurized. The pressurized storm sewer has the ability to push water out of the storm sewers and into neighboring sanitary lines.

When I & I enters the sanitary sewer it takes up space that is required for the wastewater and can cause an overloaded sanitary sewer system to back up during significant rain events. The capacity of the Village's existing storm sewer system and identification of proposed improvements to alleviate the potential to contribute to I & I will be examined in detail in the following chapters of this report.

CHAPTER 4 HYDROLOGIC AND HYDRAULIC MODEL DEVELOPMENT

An XP-Software Stormwater and Wastewater Management Model (XP-SWMM) was created of the Village's entire separate storm sewer network. The XP-SWMM software is a dynamic modeling program that determines the hydrologic response (runoff mode) from a storm event and routes the runoff through a storm sewer network (hydraulic mode). The XP-SWMM software was chosen for the analyses for its ability to simulate overland flows and surface storage combined with a storm sewer network to identify localized flooding problems.

4.1 SUBBASIN DELINEATION

The surveyed storm sewer network was combined with the Cook County 1-foot aerial topography in the GIS database. The approximately 1,720 acre western portion of the Village served by the separate storm sewer system was subdivided into 152 subbasins ranging in size from 2 acres to 50 acres based on storm sewer data, land use and aerial topography (**Exhibit 15**). Specific detail was used in areas where drainage boundaries were required to capture known drainage problems identified by Village staff and residents on a block by block basis.

4.2 LAND USE

Hydrologic parameters including area, Runoff Curve Number (RCN) and Time of Concentration (Tc) were calculated using the National Resource Conservation Service (NRCS) TR-55 methodology based on topography and land use using current aerial photography for each of the subbasins. The directly connected impervious areas in each subbasin were identified using digital shapefiles and assigned appropriately. The land use was characterized using a combined land use cover shapefile created from shapefiles provided by Cook County and a hydrologic soil group shapefile. The RCN value calculated for non-directly connected impervious areas of each subbasin was based on the ratio of impervious to pervious area in the subbasin for a particular hydrologic soil group.

4.3 DATA ENTRY

CBBEL entered the hydrologic parameters, trunk and lateral storm sewers (survey) and Pump Station data including rating curves as well as "ON" and "OFF" set points into the XP-SWMM software. In addition to the storm sewer network, overland flow paths and depressional storage areas were entered into the model using Cook County 1- foot aerial topography. CBBEL also entered a wide range of tailwater elevations including conditions representing the River at a 100-year flood elevation (worst case scenario).

4.4 EXISTING CONDITION MODELING CALIBRATION

The purpose of the XP-SWMM analysis is to simulate the existing storm sewer system, overland flow system, storage areas and the interactions between these components in order to identify system bottlenecks and evaluate proposed drainage system improvements. Prior to completing these analyses, it is important that the model be calibrated to known storm events. For this study, storm sewer flow monitoring was completed by RJN in two locations, 1) the trunk sewer along Lake Avenue and 2) the trunk sewer along Laramie Avenue, over a three month period (Figure 5). The collected data for two storm events were used in the calibration process.



Figure 5. Flow Monitoring Locations

This data was combined with measured precipitation rainfall data for two storm events that occurred over that time period. The May 2014 storm event produced 1.37 inches over a 1 hour period (approximately a 2-year design storm) and the June 2014 storm event produced 1.98 inches over a 12 hour period (approximately a 9-month design storm). These two storm events represent the largest of the storm events measured during the three month flow monitoring period.

The precipitation data for the two storm events was entered into the XP-SWMM analysis and executed for the existing storm sewer network. The simulated flow from the two trunk sewers in the XP-SWMM

analysis was compared to the flow measured during the flow monitoring process. As part of the calibration process, the RCNs and T_c were modified until both the peak and timing of the output hydrographs from the XP-SWMM analysis reasonably matched the measured hydrographs (**Figure 6**). This was done by reducing RCNs by approximately 12% throughout the study area.

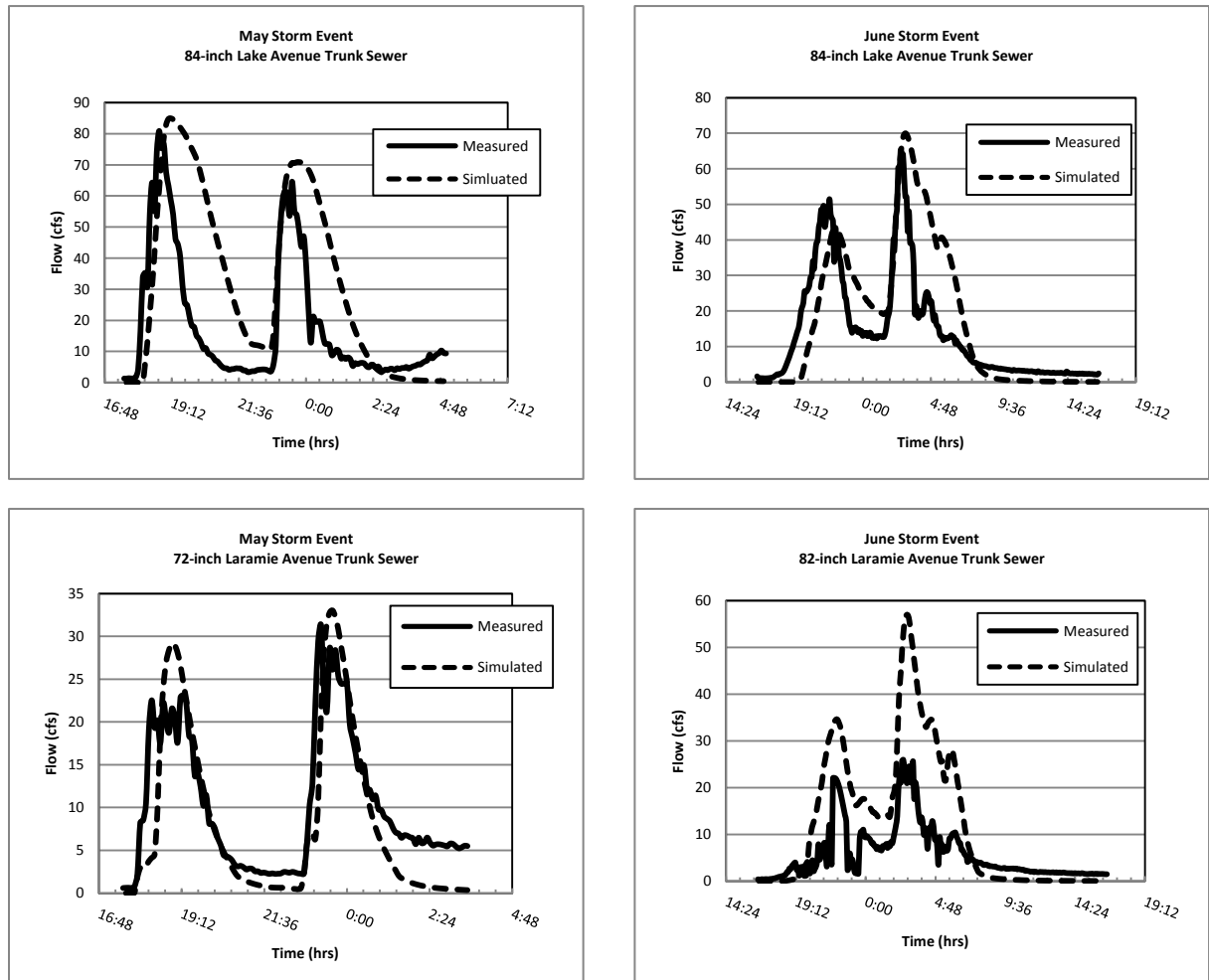


Figure 6. XP-SWMM Calibration Results

Following calibration of the existing condition model, the April 2013 storm event (5.56 inches over 24 hour; approximately 25-year design storm) was executed to provide verification of the model calibration. The simulated water surface elevations from the existing condition XP-SWMM analysis were compared to high water marks and debris lines provided by residents and Village staff. A few examples of locations where the calibration was verified are shown in **Figure 7**.

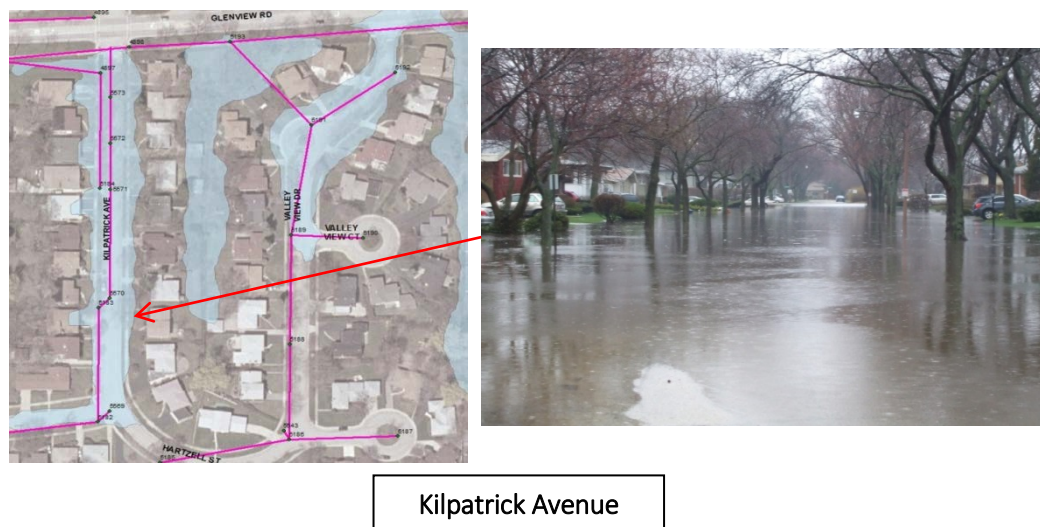
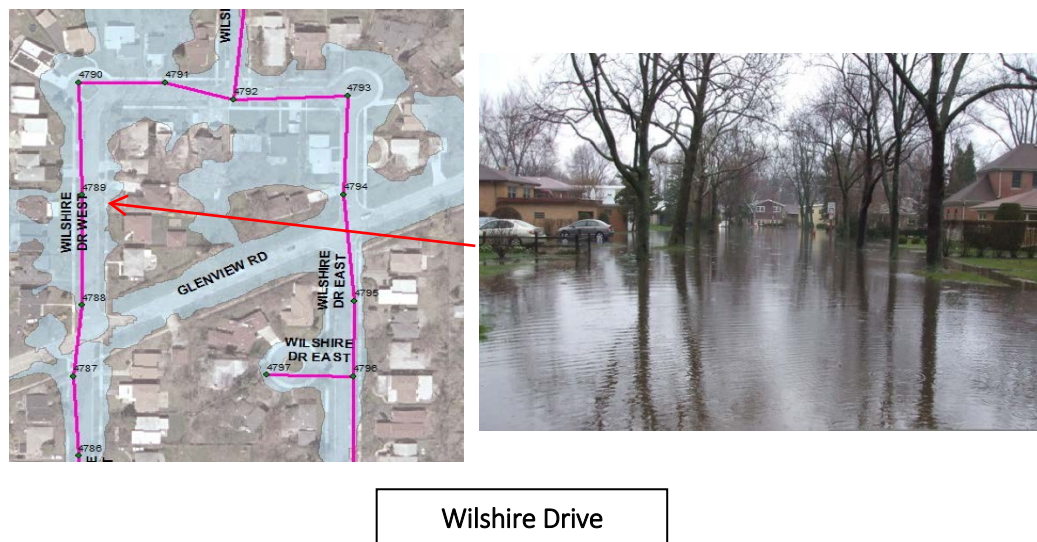
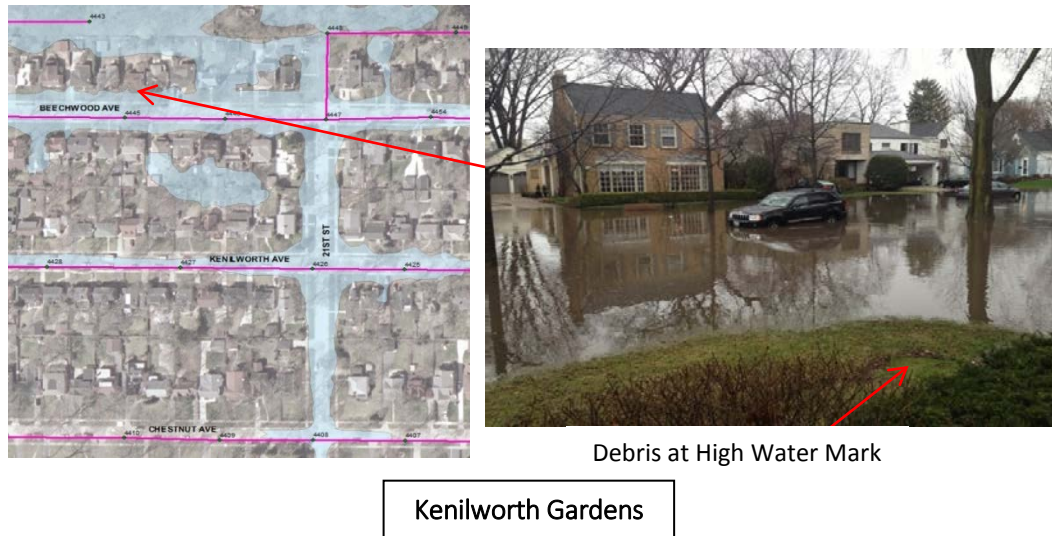


Figure 7. April 2013 Inundation Areas and XP-SWMM Analysis - Verification of Results

CHAPTER 5 EXISTING CONDITION MODEL

5.1 CRITICAL DURATION AND DESIGN STORMS

Following the calibration process a critical duration analysis was completed using the XP-SWMM model. The critical duration was determined for the Village's separate storm sewer system utilizing rainfall depths published in the Rainfall Frequency Atlas of the Midwest, by the Midwestern Climate Center and the Illinois State Water Survey (Bulletin 71) and Huff rainfall distributions. The critical duration refers to the duration of a storm that produces maximum water surface elevations, flood depths or flow rates. For example, the 100-year critical duration analysis included executing the XP-SWMM model for the 1-hour through 48-hour duration storm events. The storm event producing the highest flood elevation is the critical duration storm event, and all proposed improvements are then designed for the critical duration storm. The **3-hour duration design storm is the critical duration** for the Village's separate storm sewer network. Upon completion of the critical duration analysis, the XP-SWMM model was run for the 1-year through 100-year return interval 3-hour duration storm events.

The term "10-year storm" is used to define a rainfall event recurrence interval that statistically has the same 10% chance of occurring in any given year. **Table 3** shows the recurrence and statistical probability of a storm happening in a given year.

Recurrence Interval in Years	Probability of Occurrence in any Given Year	Percent Chance of Occurrence in any Given Year
100	1 in 100	1
10	1 in 10	10
5	1 in 5	20
2	1 in 2	50

Table 3. Design Storm Statistics

The rainfall depths published in Bulletin 71 for design storms are the design standards used throughout northeast Illinois to design stormwater infrastructure and are referenced in most local and county ordinances. The rainfall data used in the statistical analysis to develop the rainfall depths is based on measured rainfall data collected from 1901-1980 and does not include more recent storm events. Based on rainfall data collected by the Village over the last 30 years (since 1985), the measured intensity of 51 storm events has exceeded the 2-year design frequency and 21 of those storms events has exceeded the 10-year design frequency, compared to Bulletin 71 information. This recent trend of measured rainfall data suggests that higher intensity storm events are occurring more frequently and this trend is anticipated to continue. Based on a study conducted by CBBEL, when recent rainfall data (1985-2013) is included in the statistical analysis for design storm return intervals, rainfall depths used for design are shown to increase. Future stormwater analyses may utilize higher rainfall depths.

5.2 MODEL RESULTS

A distinction has been made to define **the level of service** or capacity of the existing storm sewer system. Throughout this study, the level of service or capacity of a storm sewer refers to the point at which the systems begins to surcharge, which means stormwater begins to collect in the streets because the receiving storm sewer is at capacity. Using this criteria, CBBEL determined that the majority of the storm sewers throughout the western portion of the Village have a 2-year level of service or 2-year capacity. Therefore, the Village's existing storm sewer system can convey runoff from less than 2 inches of rain over a 3-hour period before the storm sewer begins to surcharge and stormwater begins to collect on the streets in the lowest areas.

CBBEL used the critical duration water surface elevations from the calibrated XP-SWMM analysis to create existing condition inundation maps for the 10-year and 100-year design storms (**Exhibits 7 and 8**). The inundation maps were combined with Village flood response maps and flood questionnaire responses from the open houses to identify areas of concern throughout the Village (**Exhibit 9**).

5.2.1 Flood Depths

CBBEL determined street elevations using spot shot elevations derived from the Cook County 1-foot aerial topography and survey data. The aerial topography was developed using LIDAR or Light Detection and Ranging. CBBEL used the LIDAR to determine the lowest street elevation for each of the study areas shown on **Exhibit 9**. This elevation is the minimum or lowest elevation in each area and is not uniform, but represents the worst case scenario in a particular area. This elevation is taken at the lowest point or sag in the street along the cutter flow line, not at an intersection or the crown of the street. This elevation was used to calculate the flood depths by subtracting the lowest elevation in each area from the simulated elevations developed in the XP-SWMM analyses for each design storm. This flood depth represents the maximum flood depth or worst case scenario for a particular area or neighborhood. The color coded areas of concern shown on **Exhibit 9** correspond to the colors shown in the subsequent summary tables of inundation depths for each design storm included in **Appendix 1**.

5.2.2 Estimated Number of Structures Impacted by Flooding

A desktop GIS analysis was used to determine the number of structures impacted by flooding through overland flow entering the structure. A structure is considered impacted by flooding when the water surface elevation of the surrounding water exceeds the lowest entry elevation of a structure and the water enters the structure through a window well, low opening, front door, etc. The elevation of the structures in this analysis was determined using the Village parcel boundary layer overlaid onto the Cook County 1-foot aerial topography (LIDAR). The highest elevation within with each parcel was assigned to that particular parcel. This elevation minus 1 foot was compared to the XP-SWMM results to determine if the structure on the property was impacted by flooding for a particular design storm. The house elevation was generally a foot below the highest elevation on the lot. Therefore if the water level got to this elevation (a foot below the highest lot elevation) the structure was considered impacted. This methodology was confirmed by reviewing multiple properties within the study areas. **Table 4** summarizes the approximate number structures impacted by flooding using this method for the 10-, 25-, 50-, and 100-

year existing conditions.

It should be noted that this represents an estimate of the number of structures impacted by overland flow. If this analysis were to be completed based on a comparison between the flood elevation and the lowest property elevation, the number of properties impacted would be significantly higher compared to the number of structures impacted.

Return Interval Storm	Number of Structures
10-year	120
25-year	280
50-year	480
100-year	700

Table 4. Estimated Number of Structures Impacted by Flooding (Existing Conditions)

5.2.3 Identification of System Bottlenecks

Using the XP-SWMM model, CBBEL completed a comprehensive analysis of the existing drainage system. This included a simulation of the Pump Station in detail under a number of different tailwater conditions or downstream receiving water surface elevations in the River.

As a conservative assumption, the existing conditions XP-SWMM model was executed assuming a 100-year tailwater condition from the River. The approximate existing condition flowrates in the inflow and outflow storm sewers at the Pump Station from this analysis are as follows:

Inflow Storm Sewer – 102-inch diameter storm sewer

- Full flow capacity = 300 cfs
- XP-SWMM Model Results:
 - Flowrate during 2-year event (surcharged conditions upstream) = 274 cfs
 - This is due to lateral sewer network restricting flow draining into the trunk line.
- Flowrate during 10-year event (significant street flooding) = 290 cfs
- Flowrate during 100-year event (severe street flooding) = 295 cfs

Outflow Storm Sewer – 84-inch diameter storm sewer and 6-foot x 10-foot box culvert

- Combined full flow capacity under maximum River tailwater conditions = 980 cfs
- XP-SWMM Model Results
 - Combined flowrate during 10-year event = 290 cfs
 - Combined flowrate during 100-year storm event = 295 cfs

Pump Station Flow

- Pump Station rated capacity = 585 cfs
 - Maximum Pump Station capacity has been evaluated under a wide range of TDH conditions. For the purpose of this analysis, the maximum capacity was limited to 585 cfs, which is a conservative assumption.

- XP-SWMM Model Results
 - Pump rate during 10-year event = 290 cfs (3 pumps running)
 - Pump rate during 100-year event = 295 cfs (3 pumps running)
 - The 10-year and 100-year flowrates are nearly identical as the Pump Station will only pump what is conveyed to it via the inflow pipes.

Based on the information above, the inflow storm sewer to the Pump Station is the limiting element in the trunk storm sewer system. The maximum rated capacity of the existing Pump Station is not utilized before capacity in the inflow storm sewer system is reached and upstream flooding begins. This is due to the limiting capacity of the 102-inch trunk sewer along Lake Avenue and the undersized lateral storm sewers draining to the trunk throughout the Village. According to the CBBEL calibrated XP-SWMM analysis, the maximum flowrate at the pump station under existing conditions is approximately 290 cfs (50% of existing rated capacity) for the 10-year storm event. The results of the XP-SWMM model show that three pumps are utilized during the 10-year storm event. An additional analysis was completed to simulate the effect of utilizing the maximum rated capacity (all five pumps) of the Pump Station during the 10-year storm event. Under this scenario, the upstream water surface elevations did not show a reduction. This confirms that the inflow storm sewer capacity is the limiting element in the system.

Village staff has indicated that all five pumps have been running simultaneously during large storms in the past; however, the fifth pump does not stay on for extended periods of time. The short operation of the fifth pump is due to the limited inflow storm sewer capacity and lack of wet well storage at the Pump Station. The inflow storm sewer performs as both conveyance to the station and an in-line wet well and is a restriction within the system. The inflow storm sewer can be pumped down quickly given the capacity of the pumps in relation to the capacity and storage of the inflow storm sewer. This is verified by the limited operation time of the fifth pump as recorded during the April 2013 storm event, when the pump was quickly cycled off and on twice during the storm event. Village staff has indicated that during storms such as the April 2013 storm event, pump operations are monitored to prevent damage to the pumps. The following conclusions were drawn from the existing condition analysis:

- The separate storm sewer system capacity is the limiting factor. The lateral sewer network restricts flow draining into the trunk storm sewer throughout the Village and the trunk sewer restricts the flow draining to the pump station.
- The existing storm sewer system was designed and constructed prior to modern stormwater management practices and current design standards.
- The Pump Station can only pump the water that is delivered to it by the storm sewer network.
- The Pump Station does not have a typical wet well. The inflow storm sewer system serves the dual purpose of a wet well and conveyance system into the Pump Station.
- The rated capacity of the pump station is 585 cfs, which is based on the midpoint of the operating range on the pump performance curves provided by the Village. The pump flowrate is a function of the water level in the pump station wet well versus the tailwater elevation in the discharge chambers that drain to the River. The hydrologic and hydraulic modeling was completed assuming a 100-year tailwater condition in the River.
- The Village operates the Pump Station manually during large storm events such as the April 2013 storm event. Given the limited capacity of the existing inflow storm sewer system, the manual

operation would not affect flooding within the Village. During this storm event, the fifth pump was cycled on and off approximately two times as a result of the limited storage and conveyance capacity of the existing storm sewer system.

- Under existing conditions, the inflow storm sewer is the limiting element in the system. The existing inflow storm sewer has a capacity of approximately 300 cfs. Approximately 50% of the rated capacity of the Pump Station is currently utilized during the 10-year storm event. Additional inflow to the Pump Station is required to more efficiently utilize the capacity of the existing pumps.

A detailed review of the XP-SWMM model results was completed paying particular attention to the Hydraulic Grade Line (HGL) in the storm sewer system during different storm events. Increases in the HGL at model nodes were noted and used to identify restrictions within the storm sewer system. The proposed drainage improvements were designed based on the restrictions identified in the existing conditions XP-SWMM model results.

CHAPTER 6 PROPOSED IMPROVEMENTS

At the August 2014 Municipal Services Committee meeting, CBBEL provided an existing condition update to this stormwater management study and was directed by Village staff to develop proposed drainage improvements that would allow the separate storm sewer system to provide a 10-year level of service. **The proposed 10-year level of service goal would reduce the water surface elevations in the storm sewer network below the street elevations for the 10-year critical duration design storm event.**

The proposed drainage improvements to achieve this goal include both near term and long term capital improvement projects. Near term drainage improvements include the addition of high capacity inlets, incorporation of green infrastructure and cooperative projects working with adjacent communities. The long term capital improvements proposed include significant improvements to the drainage system.

6.1 NEAR TERM DRAINAGE IMPROVEMENTS

6.1.1 High Capacity Inlets

CBBEL identified potential locations for high capacity storm sewer inlets in western portions of the Village as an early occurring part of the Stormwater Action Plan. High capacity inlets will allow more water into the storm sewer system and reduce the frequency of clogging from debris and leaves (**Figure 8**). When the existing storm sewer system becomes surcharged, the new inlets will not provide a benefit. However, in locations where potential future storm sewer improvements are likely, the inlets will allow full utilization of the storm sewer system. The addition of high capacity inlets have the potential to be incorporated into the Village's road program.

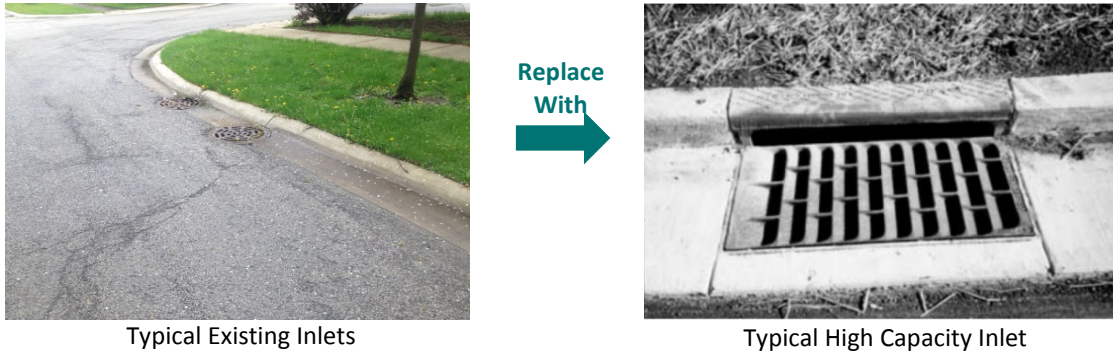


Figure 8. High Capacity Inlets

6.1.2 Coordination with Glenview

Similar to the Village of Wilmette and many other communities in the North Branch Chicago River Watershed, the Village of Glenview (Glenview) experiences frequent flooding. In 2014, Glenview began construction of Phase I for Flood Mitigation Improvements (East of Harms Project) which included two pump stations to reduce flooding for the areas located east of the North Branch Chicago River in Glenview. Phase II of the project includes a new storm sewer within Glenview to convey water more efficiently to the new pump station. It is our understanding that this study included a small (approximately 25 acres) portion of the Village of Wilmette as tributary area to the proposed improvements identified in the study (Figure 9) and the proposed pump stations associated with the improvements have been sized to accommodate the runoff from this area.

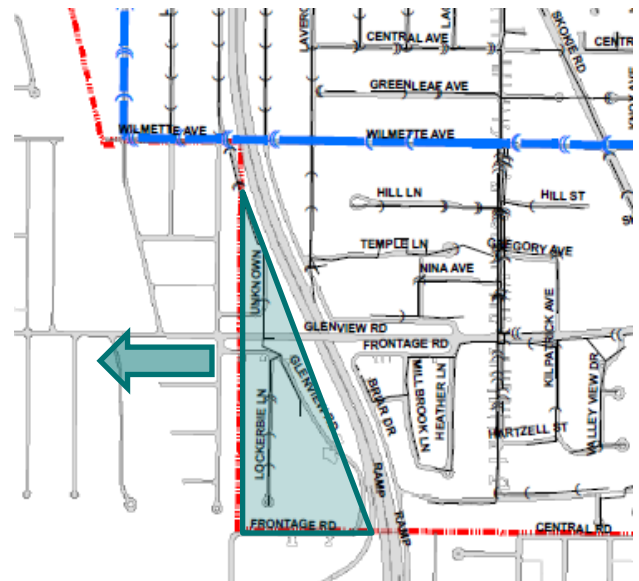


Figure 9. Potential Diversion Area to Glenview

CBBEL analyzed on a concept level utilizing the proposed Glenview pump stations for an outlet for this portion of the Village's storm sewer system. This area is currently drained by storm sewers to the Village of Wilmette Pump Station. Based on our preliminary discussions with the Village of Glenview and review of the storm sewer inverts, this area could be diverted to the Phase II storm sewer system and into the Glenview pump stations at the North Branch of the Chicago River. This would provide flood reduction benefits for this specific area, but would not result in flood reduction benefits for the remainder of Wilmette as the area is too small to significantly impact the capacity of Wilmette's trunk sewer system. The Glenview Phase II storm sewer system is currently in design, and the potential to divert runoff from this 25 acres portion of the Village will require coordination with Glenview.

6.1.3 Residential Structure Flood Proofing

In addition to the previous short term drainage improvements that could be completed by the Village, residents can flood-proof their homes. Flood-proofing of residential structures is the single most effective measure that can be completed to protect homes from flooding. A few of these measures include:

- Sanitary backflow valve: Valve that allows water to flow in one direction, but automatically closes when the direction of flow is reversed. When the HGL in the sanitary sewer line exceeds the adjacent basement floor elevation, the check valve will engage preventing sanitary backup into the basement.
- Sump pump with battery backup: In the event of an electrical outage during a flood, a battery backup to provide power to the sump pump is recommended to prevent basement flooding.
- Directing downspouts away from structures: Downspouts that outlet near a structure allows stormwater to infiltrate and collect against the foundation resulting in seepage and/or additional strain on the sump pump. Directing downspouts away from the structure is a simple flood-proofing measure to help reduce the amount of water against the foundation.
- Raising window wells or other low entry points: Raising the window wells and low entry points increases the level of flood protection around a home by blocking overland flood access into the structure (Figure 10).



Figure 10. Window Well Elevation

Completing these flood-proofing measures in homes that are susceptible to flooding can provide a level of freeboard above the street flooding elevation that will significantly improve the effectiveness of the long term capital improvement projects to be discussed later in the report. The Village currently has a program that provides a list of engineering firms to residents with a set fee schedule for site visits and flooding assessments. It is recommended that this program be continued and utilized to the maximum extent possible by residents.

6.1.4 Green Infrastructure Improvements

Over the last 20 years many communities throughout our region have increased implementation of green infrastructure by adding green infrastructure to their toolkit of approaches for the management of stormwater. Green infrastructure techniques include using vegetation to control stormwater, restoring wetlands to retain floodwater, installing permeable pavement to mimic natural hydrology, and using or capturing and re-using stormwater more efficiently on site.



Figure 11. Green Road



Figure 12. Green Road

By attempting to mimic natural hydrologic functions, such as infiltration and evaporation, these approaches prevent stormwater from flowing into surface waters or storm sewer systems already under great stress using natural features. Green infrastructure is typically used to compliment or assist traditional stormwater management practices and is not meant to replace engineered grey stormwater management practices.

Although green infrastructure practices cannot single-handedly mitigate the flooding during extreme storm events, they provide a reduction in stormwater runoff

volumes and improve water quality. Green infrastructure should be an integral part of stormwater management strategies given the cost-effectiveness of green approaches across a variety of categories. On a national scale, policies that favor or stimulate the wider adoption of green infrastructure strategies have been gaining notoriety while providing opportunity and available financial resources.

CBBEL has identified numerous areas where green infrastructure could be implemented throughout the Village. Recommendations of types and locations are as follows:

- Green Roads
 - Future Village projects as warranted (Figure 12)
- Island rain gardens (examples of locations)
 - Valley View Drive
 - Thelin Court
 - Cove Lane
 - Greenleaf Avenue and Laurel Lane
 - Wilshire Drive, 4 locations
 - Romona Road – south of Wilmette Avenue
 - Other locations as appropriate
- Rain barrels and downspout disconnection
 - Program for downspout disconnection and rain barrel assistance (Figures 13 and 14)
 - Limited to private property
- Permeable pavement
 - Pilot program in business districts or alleys



Figure 13. Downspout Disconnection



Figure 14. Rain Barrel

6.1.5 Green Infrastructure Ordinance Requirements

Under the new Cook County Watershed Management Ordinance (WMO), infiltration of the first 1 inch of rainfall is required for new commercial developments greater than 0.5 acres in size and single family residential development greater than 1.0 acre in size. The Village, as an authorized community under the WMO, enforces these requirements for new development within the Village. The Village also requires that downspouts for new residential homes be discharged to pervious surfaces to promote infiltration rather than connected directly to the storm sewer system. This is a beneficial green infrastructure requirement that reduces the flowrate from roof runoff into the storm sewer system. Other municipalities like Elmhurst and Barrington have implemented more stringent requirements such as requiring all new residential structures to store a portion of the runoff from the impervious area in a stormwater storage facility on the lot (rain garden or underground storage system). The Village may wish to consider a similar requirement which would reduce the peak runoff rate from residential redevelopment.

6.1.6 Green Infrastructure Limitations

Green infrastructure systems have a growing record of reducing runoff from smaller and more frequent rain events. However these systems do not target low-frequency high-volume rainfall events. Care should be taken to realize that while green infrastructure can be used to compliment a stormwater management system for frequent storm events, flooding will continue throughout the Village from high-volume rainfall events due to the undersized storm sewer system.

It is important to understand the magnitude of the flooding problem in the Village, the capacity of the existing storm sewer network and the relation of limitations of green infrastructure. In typical urban flood problem areas, the storage volumes required to reduce the flood depths to an acceptable level are significant. **Flood reduction throughout the western portion of the Village will require ± 50 acre-ft of storage.** Flood volumes are typically quantified in acre-feet. One acre-foot is the equivalent of an acre of land that is flooded one foot deep. Comparing 50 acre-feet of volume to volumes provided by green infrastructure, limitations of green infrastructure can be quantified:

- Capacity limitations
 - A single 0.15 acre lot in the Village would generate up to 15,000 gallons of runoff during the April 2013 storm event:
 - 235 rain barrels (55 gallons each) per property are required to store this water
 - Runoff from roof only = 110 rain barrels
 - 1 acre-ft of flood storage equals:
 - 5,925 rain barrels (55 gallons each)
 - 8,250 feet of green alleys (0.08 acre-feet per 660 ft block)
 - 2,520 feet of roadway with pervious pavement

The construction of green infrastructure techniques like green streets and rain gardens also has a heavy reliance on soil type for infiltration. Soil amendments to achieve proper infiltration rates to meet performance stands can increase construction costs. Roadway jurisdictions and requirements can also limit the use and increase construction cost of green streets. Vegetation used in rain gardens and bio

retention areas also requires establishment and maintenance.

To quantify the effect of green infrastructure throughout the Village, CBBEL performed XP-SWMM analysis using the MWRDGC volume control methodology to determine the impact of implementing rain gardens throughout the Village. RCN values were reduced by implementing a two foot deep, 10-foot x 20-foot rain garden on every residential property in each subbasin within the watershed. The XP-SWMM results indicate less than a 0.2 foot reduction in water surface elevation for the 10-year design storm event. This reduction is only realized under this hypothetical simulation if every residential property throughout the Village constructed a rain garden.

6.2 LONG TERM CAPITAL DRAINAGE IMPROVEMENTS

CBBEL identified **three** long term capital improvement projects that include increasing storm sewer sizes, adding relief storm sewers and incorporating stormwater storage to reduce flooding from the 10-year design storm below the street elevation. These long term improvements were analyzed with the XP-SWMM model to determine the effect on peak water surface elevations throughout the entire western portion of the Village and to verify that the proposed drainage projects did not negatively impact downstream areas. A delineation of the proposed condition 10-, 25-, 50-, and 100-year flood inundation areas for each alternative was created to quantify the structures removed, reduction of street flooding and overall reduction in flood depths throughout the Village.

6.2.1 Engineer's Estimate of Probable Cost Analysis and Assumptions

A conceptual engineer's estimate of probable cost for each of the proposed drainage improvement alternatives has been prepared. There are many unknowns including soil conditions, utility conflicts and right-of-way limits that will affect the ultimate design and cost of the improvements. Because of this, the engineer's estimate of probable cost includes a 20% contingency. Permitting, design and construction engineering for each project has also been included in the estimates as a percentage of the total cost of the project.



Figure 15. Typical Storm Sewer

In preparation of the conceptual engineer's estimate of probable cost, CBBEL has completed a unit price analysis utilizing recently submitted bid prices from three awarded CBBEL projects in various municipalities in the Chicagoland area to develop applicable unit prices for the proposed improvements in the western Village. These three projects were used to develop estimated unit prices as they are similar in scope and size to the improvements identified for this SMR. The three projects include the following:

- Village of Elmwood Park's Thatcher Avenue Storm Sewer
 - Bid in May of 2014
 - 3 bidders
 - Awarded for \$5.9 million

- Village of River Forest's Northside Stormwater Management Project
 - Bid in September of 2014
 - 6 bidders
 - Awarded for \$900,000
- Village of Winnetka's Forest Glen and Greenwood Avenue Stormwater Improvements
 - Bid in October of 2014
 - 6 bidders
 - Awarded for \$6.3 million

CBBEL calculated the quantities for the improvements based on the assumptions below:

- The patching width is the proposed pipe outside diameter plus 3.5 feet on each side of the storm sewer.
- Roadways with proposed storm sewers \geq 60-inch in diameter are shown to be completely reconstructed. If the proposed storm sewers are $<$ 60-inch in diameter then, patching and resurfacing was assumed.
- All estimates are based on 2014 unit prices.

6.3 ALTERNATIVE 1 – RELIEF STORM SEWER SYSTEM

Alternative 1 consists of a relief storm sewer system designed to match the existing Pump Station capacity and includes new trunk and lateral storm sewers. Alternative 1 reduces the water surface elevation from the 10-year design storm event below the street elevations throughout the entire western portion of the Village. The proposed storm sewer layout is shown on **Exhibit 10**.

Working downstream to upstream, Alternative 1 includes a proposed 10-foot x 7-foot reinforced concrete box culvert from the existing Pump Station on the west side of the Village to connect with large diameter storm sewer pipe on Washington Avenue, Romona Road, Lake Avenue, and Hunter Road. Upsized lateral storm sewers are also proposed to tie into the new trunk line storm sewers. The following factors apply to Alternative 1:

- All existing storm sewers would be left in place.
- Relief storm sewer system would connect to the existing storm sewer system.
- Construction areas are primarily limited to roadways, Village owned property and the Wilmette Golf Course.
- The storm sewers consist of large diameter pipes over long distances.
- Includes the addition of a 6th Variable Frequency Drive (VFD) pump and discharge piping to provide backup and redundancy at the Pump Station.
 - The 6th pump is for redundancy and efficiency purposes only.
 - Increased Pump Station flexibility.
 - Replacement of the cast iron flap check valves located in the discharge chamber with resilient rubber check valves.

The proposed trunk and lateral storm sewers would better utilize the existing pumping capacity of the Pump Station. The XP-SWMM model was revised to simulate Alternative 1. The model results indicate

that Alternative 1 provides a 10-year level of service and does **not** require the installation of a new pump. The maximum inflow rate to the Pump Station under Alternative 1 is approximately 480 cfs for the 10-year event. Four pumps would be utilized during the 10-year storm event, which is 82% of the available rated capacity of the Pump Station. For the 100-year storm event, the maximum inflow rate to the Pump Station would be 585 cfs and all five pumps would be utilized. Under the maximum anticipated 100-year tailwater conditions, the existing Pump Station can meet this inflow flowrate with the existing five pumps. Alternative 1 was evaluated under a wide range of tailwater conditions, including the River at a 100-year flood elevation. Under all scenarios, the headwater elevation in the pump station would not exceed the allowable High Water Elevation (HWE) within the Pump Station of 615.9 ft during the 100-year flood event.

The additional storm sewer conveyance under Alternative 1 will provide additional flow to the Pump Station to more efficiently use the existing pump capacity and maintain consistent pumping rates. While the capacity of the inflow storm sewer will be increased under Alternative 1, it will not provide 100-year conveyance capacity to the Pump Station. The inflow storm sewer system will continue to limit conveyance to the Pump Station for storm events greater than the 10-year design storm. A 100-year storm event in the Village would not flood the Pump Station as it would only be required to pump the water that is conveyed to it while the additional runoff would remain in the upstream low-lying areas throughout the Village.

Alternative 1 will more efficiently utilize the existing pumping capacity and will therefore increase the flowrate to the River. CBBEL completed a hydrologic and hydraulic analysis for the North Branch Chicago River Watershed to determine if the increased pump flowrate would result in peak water surface elevation increases in the River during flood events. The HEC-HMS hydrologic and unsteady HEC-RAS hydraulic models developed as part of the Detailed Watershed Plan (DWP) in 2011 by HDR, Inc., for the Metropolitan Water Reclamation District of Greater Chicago (MWRDGC) were used to complete this analysis. The analysis showed that the increased pump flowrate for the 100-year storm event does not increase downstream water surface elevations more than 0.09 feet (less than 1 inch), which occurs several miles downstream of Wilmette. There would be no increase in River flood elevations within the Village of Glenview, which is immediately downstream of Wilmette.

CBBEL recommends installing a sixth pump (70,000 gpm) in the available empty chamber within the Pump Station as part of Alternative 1. This will allow for one pump to be out of service for maintenance at all times while maintaining the existing firm capacity (585 cfs) of the Pump Station. The firm capacity of the Pump Station is the capacity that is available at any time assuming the largest pump is out of service. The sixth pump should be a Variable Frequency Drive (VFD) pump to accommodate the limited wet well capacity of the inflow storm sewer system. It is envisioned that the sixth pump with VFD would be operated once the capacity of the first three pumps is exceeded, and the fourth or fifth pump would become the backup pump. Operation of the backup pump would be hardwired to occur only if one of the other pumps were out of service or in an emergency situation. Operation of all six pumps would not significantly reduce flooding in the Village in events up to and exceeding the 100-year storm event, as the inflow storm sewer system would still be the limiting element of the system. If the Village wished to operate all six pumps at the same time in the future, further analysis would be required to demonstrate there would be no downstream increases in River water surface elevations.

6.3.1 Alternative 1 - Project Benefits, Costs and Considerations

A delineation of the proposed condition 10-, 25-, 50-, and 100-year flood inundation area was created to quantify the structures removed, reduction in street flooding and overall reduction in flood depths throughout the Village for Alternative 1. **Table 5** summarizes the approximate number of structures impacted by flooding for Alternative 1 using the GIS desktop analysis of parcels as previously described (maximum elevation minus 1- foot compared to simulated elevations) for the 10-, 25-, 50-, and 100-year proposed conditions. The 10-year proposed condition inundation area for Alternative 1 shows no street flooding through the western portion of the Village. The flood depths and reductions for each design storm throughout the Village are shown in the tables included in **Appendices 1 and 2**. In addition to reduction of structure flooding, Alternative 1 reduces the depth and duration of street inundation throughout the Village for larger storm events (**Figure 16**).

Return Interval Storm	Number of Structures		% Reduction
	Existing Conditions	Alternative 1	
10-year	120	0	100
25-year	280	60	79
50-year	480	190	63
100-year	700	370	47

Table 5. Estimated Number of Structures Impacted by Flooding (Alternative 1)

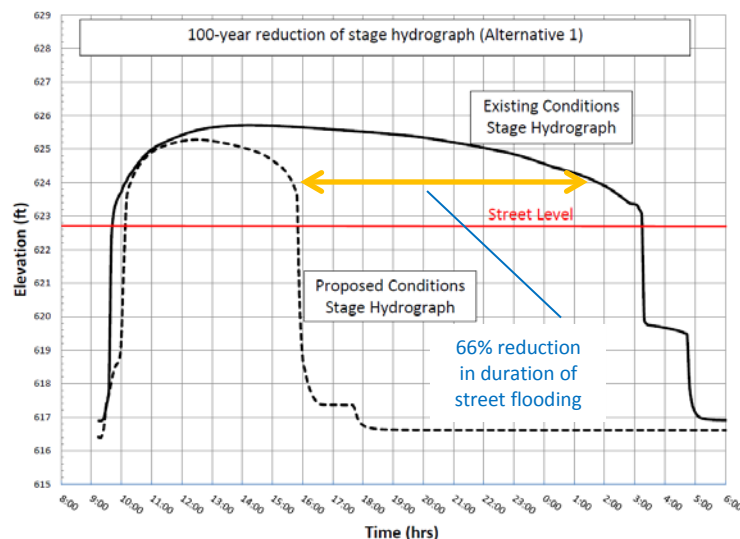


Figure 16. Alternative 1 XP-SWMM Model Results for 100-year Storm Event - Street Flooding Duration

The cost for Alternative 1, including engineering, permitting, and construction costs is approximately **\$75,000,000**. This includes the addition of a 6th pump that is proposed to be installed in the existing Pump Station. The engineer's estimate of probable cost is included in **Appendix 3**. This cost does not include maintenance cost for the proposed system. Maintenance costs would be minimal and can be included in the Village's ongoing maintenance program for current infrastructure. Other cost and considerations for Alternative 1 include:

- Long term project duration
- Significant traffic disruption
- Utility conflicts
- Golf course disruption
- Permitting
 - Illinois Department of Transportation (IDOT)
 - Cook County
 - Illinois Environmental Protection Agency (IEPA)
 - Concurrence from:
 - MWRDGC
 - Illinois Department of Natural Resources – Office of Water Resources (IDNR-OWR)

6.4 ALTERNATIVE 2 – CENTRALIZED STORAGE AT COMMUNITY PLAYFIELD

Alternative 2 consists of a large underground storage facility and relief storm sewers. Alternative 2 would reduce the water surface elevation from the 10-year design storm event below the street elevations throughout the entire western portion of the Village. The proposed storage area and storm sewer layout is shown on **Exhibit 11**. Alternative 2 includes storm sewer replacement along Hunter Road, and proposed large diameter storm sewer on Lake Avenue, Locust Road, and Glenview Road. Upsized lateral storm sewers are also proposed to tie into the new trunk line storm sewers. A 55 acre-foot underground storage basin with pump is proposed at Community Playfield. The 55 acre-foot (18 million gallons) underground storage basin stores water in the system to reduce flowrates. The following factors apply to Alternative 2:



Figure 17. Underground Storage Example

- The 55 acre-foot storage basin requires a 6 acre footprint which would not include construction staging areas.
- A pump station is required to dewater the proposed storage basin.
- The alternative does not protect against back to back storm events when the storage basin is full
- Includes the addition of a 6th Variable Frequency Drive (VFD) pump and discharge piping to provide backup and redundancy at the Pump Station.
 - The 6th pump is for redundancy and efficiency purposes only.
 - Increased Pump Station flexibility.
 - Replacement of the cast iron flap check valves located in the discharge chamber with resilient rubber check valves
- Does not increase flowrates to the River.
- Upgrades to the trunk and laterals are required in addition to the underground storage basin.

- Alternative 2 does not protect against back to back storm events when the storage basin is full.
- Provides a smaller benefit than Alternative 1 during storm events greater than the 10-year return interval.

6.4.1 Alternative 2 - Project Benefits, Costs and Considerations

A delineation of the proposed condition 10-, 25-, 50-, and 100-year flood inundation area was created to quantify the structures removed, reduction in street flooding and overall reduction in flood depths throughout the Village for Alternative 2. **Table 6** summarizes the approximate number of structures impacted by flooding for Alternative 2 using the GIS desktop analysis of parcels as previously described (maximum elevation minus 1- foot compared to simulated elevations) for the 10-, 25-, 50-, and 100-year proposed conditions. The 10-year, proposed condition inundation area for Alternative 2 shows no street flooding through the western portion of the Village. The flood depths and reductions for each design storm throughout the Village are shown in the tables included in **Appendices 1 and 2**. In addition to reduction of structure flooding, Alternative 2 reduces the depth and duration of street inundation throughout the Village for larger storm events however; this reduction is less than the reduction for Alternative 1. An example of the proposed condition stage hydrograph reduction is shown in **Figure 18**.

Return Interval Storm	Number of Structures		% Reduction
	Existing Conditions	Alternative 2	
10-year	120	0	100
25-year	280	90	68
50-year	480	240	50
100-year	700	490	30

Table 6. Estimated Number of Structures Impacted by Flooding (Alternative 2)

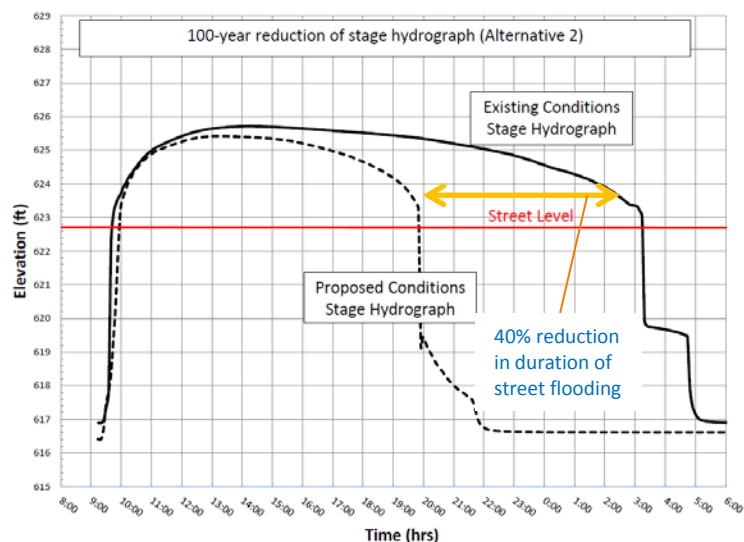


Figure 18. Alternative 2 XP-SWMM Model Results for 100-year Storm Event - Street Flooding Duration

The cost for Alternative 2, including engineering, permitting, and construction costs is approximately **\$70,000,000**. This includes the addition of a 6th pump that is proposed to be installed in the existing Pump Station. The engineer's estimate of probable cost is included in **Appendix 3**. This cost does not include maintenance cost of the proposed system. Maintenance and operation cost would be minimal and can be included in the Village's ongoing maintenance program for current infrastructure. Other cost and considerations for Alternative 2 include:

- Long term project duration
- Significant traffic disruption
- Utility conflicts
- Significant park disruption
 - Park District approval
- Permitting
 - Illinois Department of Transportation (IDOT)
 - Cook County
 - Illinois Environmental Protection Agency (IEPA)
 - Concurrence from
 - MWRDGC
 - Illinois Department of Natural Resources – Office of Water Resources (IDNR-OWR)

6.5 ALTERNATIVE 3 – NEIGHBORHOOD STORMWATER STORAGE

Alternative 3 consist of stormwater storage located at 3 parks in neighborhoods adjacent to significant flood risk areas. Alternative 3 provides a 10-year level of service for the adjacent neighborhoods but it does not provide a 10-year level of service for the entire western side of the Village. A few of the storm sewer improvements in Alternative 3 include sewer replacement along Hunter Road, Wilmette Avenue, Glenview Road, and Lavergne Avenue. The proposed storm sewers tie into three underground storage basins at three parks located at Thornwood Park, Centennial Park and Hibbard Park at the Community Recreation Center. The storm sewer improvements and storage basins associated with Alternative 3 are shown on **Exhibit 12**. The underground storage basins are proposed to be constructed under the existing baseball fields at these parks with replacement of the baseball fields included as part of the proposed improvements. The following factors apply to Alternative 3:

- **Alternative 3 does not provide a 10-year level of service for all residents**
- The three underground storage basins impact three different parks.
 - Thornwood Park – 10 acre-ft, 3 acre footprint
 - Centennial Park – 12 acre-ft, 3 acre footprint
 - To be located outside of the existing naturalized storage area at this location.
 - Community Recreation Center – 10 acre-feet, 2 acre footprint
- Pump stations would likely be required to dewater the underground storage basins.
- Alternative 3 does not protect against back to back storm events when the storage basins are full.
- Includes the addition of a 6th Variable Frequency Drive (VFD) pump and discharge piping to provide backup and redundancy at the Pump Station.

- Replacement of the cast iron flap check valves located in the discharge chamber with resilient rubber check valves.
- Does not increase flowrates to the River.
- Less trunk and lateral storm sewers are required.
- Project can be more easily phased and financed.
- Provides a smaller benefit than Alternatives 1 and 2 for storm events greater than the 10-year storm event when.

6.5.1 Alternative 3 - Project Benefits, Costs and Considerations

A delineation of the proposed condition 10-, 25-, 50-, and 100-year flood inundation area was created to quantify the structures removed, reduction in street flooding and overall reduction in flood depths throughout the Village for Alternative 3. **Table 7** summarizes the approximate number of structures impacted by flooding for Alternative 3 using the GIS desktop analysis of parcels as previously described (maximum elevation minus 1- foot compared to simulated elevations) for the 10-, 25-, 50-, and 100-year proposed conditions.

Return Interval Storm	Number of Structures		% Reduction
	Existing Conditions	Alternative 3	
10-year	120	50	58
25-year	280	160	43
50-year	480	320	33
100-year	700	570	19

Table 7. Estimated Number of Structures Impacted by Flooding (Alternative 3)

The 10-year proposed condition inundation area for Alternative 3 shows street flooding would remain in portions of the western Village however overall reductions from Alternative 3 are seen throughout. **Exhibit 13** compares the existing and proposed condition inundation areas for the 10-year design storm. The flood depths and reductions for each design storm throughout the Village are shown in the tables included in **Appendices 1 and 2**. In addition to reduction of structure flooding, Alternative 3 reduces the depth and duration of street inundation throughout the Village for larger storm events however;

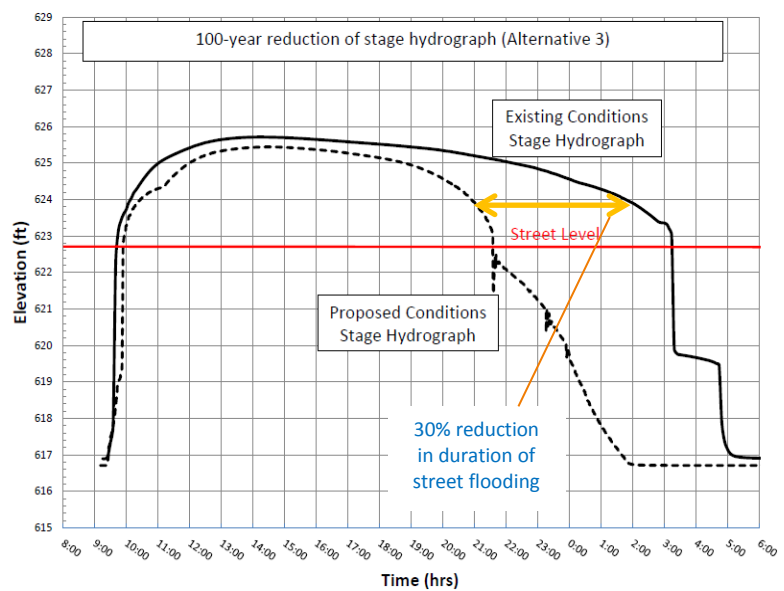


Figure 19. Alternative 3 XP-SWMM Model Results for 100-year Storm Event - Street Flooding Duration

this reduction is less than the reduction for Alternatives 1 and 2. An example of the proposed condition stage hydrograph reduction is shown in (Figure 19).

The cost for Alternative 3, including engineering, permitting, and construction costs is approximately **\$44,000,000**. This includes the addition of a 6th pump that is proposed to be installed in the existing Pump Station. This cost does not include maintenance cost of the proposed improvements. Maintenance and operation cost would be minimal and can be included in the Village's ongoing maintenance program for current infrastructure. The engineer's estimate of probable cost is included in **Appendix 3**. Other cost and considerations for Alternative 3 include:

- Multiple and significant park disruption
 - Park District approval
- Does not provide 10-year level of service for all areas
- Roadway disruption
- Utility conflicts
- Permitting
 - Illinois Department of Transportation (IDOT)
 - Cook County
 - Illinois Environmental Protection Agency (IEPA)
 - Concurrence from
 - MWRDGC
 - Illinois Department of Natural Resources – Office of Water Resources (IDNR-OWR)

CHAPTER 7 COMPARISON OF PROPOSED ALTERNATIVES AND SUMMARY OF BENEFITS

A summary of the benefits and costs of each long term capital project are included in **Table 8**.

	Design Storm	Existing	Alternative 1	Alternative 2	Alternative 3
			Relief Storm Sewer System	Centralized Stormwater Storage at Community Playfield	Neighborhood Stormwater Storage
Benefits	Number of Structures Impacted by Flooding (% Reduction)				
	10-year	120	0 (100%)	0 (100%)	50 (58%)
	25-year	280	60 (79%)	90 (67%)	160 (43%)
	50-year	480	190 (60%)	240 (50%)	320 (33%)
	100-year	700	370 (47%)	490 (30%)	570 (19%)
	Street Flooding Depth in feet (Minimum - Maximum)				
	10-year	0.3 - 2.2	0.0	0.0	0.0 - 2.2
	25-year	0.5 - 2.7	0.0 - 1.7	0.1 - 1.8	0.3 - 2.6
	50-year	0.6 - 3.0	0.0 - 2.2	0.5 - 2.3	0.5 - 2.9
	100-year	0.6 - 3.3	0.0 - 2.6	0.6 - 2.7	0.6 - 3.2
Costs	Total Cost	--	\$75 Million	\$70 million	\$44 million
	Cost per Structure Protected for 100-year Event	--	\$227,273	\$333,333	\$338,462

Table 8. Summary of Benefits and Costs

Table 8 shows that while Alternative 1 has the highest total cost, it provides the greatest benefit in reduction of structures impacted by flooding for storm events greater than the 10-year return interval storm event. It also has the lowest cost per structure protected for the 100-year storm event. Alternative 2 is slightly less expensive than Alternative 1 but provides smaller benefits for storm events greater than the 10-year storm event. Alternative 3 is the least expensive alternative but does not provide a 10-year level of service to all areas and provides the smallest flood reduction benefits of the three alternatives.

It is anticipated that the reduction in impacted structures could be significantly increased under all alternatives through flood-proofing of residential structures by homeowners and this is encouraged.

7.1 UNQUANTIFIED BENEFITS

In addition to the benefits quantified in **Table 8** the long term capital projects provide many benefits that cannot readily be quantified. These benefits include:

- Reduction in:
 - Street flooding: improved access during storm events would be realized by reducing the frequency, depth and duration that street flooding occurs.
 - Yard flooding
 - Infiltration and inflow into the sanitary sewer system: When storm sewers cannot handle the inflow, the storm sewer becomes surcharged and pressurized. The pressurized storm sewer has the ability to push water out of the storm sewers and into neighboring sanitary lines. The standing water in the streets and yards from the surcharged conditions also contributes to I&I. The alternatives outlined in this report could reduce the pressure or surcharged condition within the stormwater system.
 - Basement seepage
- Increased property values

CHAPTER 8 FUNDING OF LARGE TERM CAPITAL PROJECTS

The long term capital improvement projects require significant capital expenditures. The following funding sources have been used in other communities to fund infrastructure projects.

8.1 PAY-AS-YOU-GO CAPITAL FUNDING

The Village could dedicate a portion of the Capital Planning Budget each year to construct a portion of the selected project. The phasing and portion of the project constructed each year would depend on the budget that can be allocated to the stormwater improvements.

8.2 MUNICIPAL BOND

A municipal bond is a bond issued by a local government, or their agencies. The Village could issue bonds to cover all or part of the project. This would allow a greater portion of the project to be completed in a short period of time.

8.3 SPECIAL SERVICE AREA (SSA)

A Special Service Area (SSA) is a taxing mechanism that can be used to fund a wide range of special or additional services and/or physical improvements in a defined geographic area within the Village. The Village could develop a SSA that places a levy on the properties within the Separate Storm Sewer area. The revenues from the SSA could be used to fund drainage projects and repay Municipal Bonds.

8.4 STORMWATER UTILITY FEE

The concept of the stormwater utility fee is to collect from both residents and businesses within the entire Village based on the amount of impervious area on the property. The impervious area is directly related to the amount of stormwater runoff contributing to the storm sewer system. An equivalent residential unit (ERU) is the basis for the amount paid to the utility fee on a monthly basis and can be included on tax bills or water bills. Impervious areas for businesses and industries in the Village should be calculated to determine the number of ERUs within a specific non-residential parcel. The Stormwater Utility could be used to fund drainage projects and repay Municipal Bonds. The utility fee per ERU would be set based on the cost of the project, length of time for repayment and additional reserves needed for maintenance, etc. Other communities in the area have recently been successful in establishing a stormwater utility fee to help fund water resource related projects, including: Rolling Meadows, Downers Grove, Highland Park, and Winnetka.

8.5 OUTSIDE FUNDING SOURCES

Federal, State and County funding of stormwater projects has been successfully used by communities. However, these outside funding sources are limited and the competition for the resources is fierce. The application process can be rigorous and take months or years to complete. Given the flooding problems and potential improvement projects, the following two outside funding sources have the highest likelihood of success.

8.5.1 [Federal Emergency Management Agency \(FEMA\)](#)

To be eligible for FEMA funding, the Village or County must have an approved Hazard Mitigation Plan. It is our understanding the Cook County completed this plan in November 2014.

8.5.1.1 [Hazard Mitigation Grant Program \(HMGP\)](#)

This program provides grants to states and local governments to implement long term hazard mitigation measures after a major disaster declaration. The program will pay for 75% of mitigation projects that meet a minimum benefit/cost ratio of 1.0. In the event that a major disaster for the State is declared in the future, it is our recommendation that the Village apply for this grant. The funding available is only a portion of the total losses for a particular disaster, which makes this a very competitive grant with an application process that can take up to 24 months.

8.5.1.2 [Flood Mitigation Assistance \(FMA\)](#)

This nationwide FEMA program provides funds for projects to reduce or eliminate risk of flood damage to buildings that are insured under the National Flood Insurance Program (NFIP) on an annual basis. Unlike the HMGP program, this is a nationwide competition that focuses on Repetitive Loss properties as defined under the National Flood Insurance Program (NFIP). The program will pay for a percentage of mitigation projects that meet a minimum benefit/cost ratio of 1.0. The competition for this grant is nation-wide and is very competitive.

8.5.2 Metropolitan Water Reclamation District of Greater Chicago (MWRDGC)

MWRDGC has limited cost-sharing funding opportunities for watershed-scale projects. Projects have recently been funded by MWRDGC in Elmwood Park, Winnetka and Glenview. Based on our November 2014 meeting with MWRDGC staff, a large regional storage or trunk sewer project could qualify for cost sharing, however the funds available are small in comparison to the scale of the required drainage projects. The cost sharing program is extremely competitive and requires a benefit/cost analysis.

CHAPTER 9 SEPARATE STORM SEWER SYSTEM FACTS, SPECIFICS AND REALITIES

The final chapter of this Stormwater Management Report (SMR) of the western portion of the Village is intended to highlight facts, answer common questions and dispel myths about the Village's separate storm sewer network. The following statements have been provided to help the general public understand why flooding occurs in western Wilmette and understand what the Village is doing to address the issues through the Stormwater Action Plan and the proposed improvements outlined in this SMR.

9.1.1 Is the Village drained by a combined sewer?

No, the Village west of Ridge Road is drained by a separate storm sewer system that conveys only stormwater. The east side of the Village is drained by a combined sewer, which conveys storm and sanitary water in the same sewer.

9.1.2 Will my street continue to flood if the project is constructed?

A large scale capital project will reduce frequency, depth and duration of street flooding. However, given the flat topography of the Village, during the most extreme storm events there will likely still be street flooding.

9.1.3 What are the benefits of spending Millions of dollars on a capital improvement project?

The benefits of a large scale capital improvement project include reduction in the frequency, depth and duration of flooding of streets, yards and homes. It will also reduce the likelihood of inflow and infiltration to the sanitary sewer.

9.1.4 Can the Village solve the flooding problems in western Wilmette using only green infrastructure, i.e. rain barrels and rain gardens?

While we strongly recommend the implementation of green infrastructure, it will not significantly reduce flooding by itself.

9.1.5 What are the limitations of the existing system's capacity of sewers and pumps? Can the Village install a larger pump at the Lake Avenue Pump Station to pump the water out faster?

The limiting factor in the existing drainage system is the trunk and lateral storm sewers that drain to the Pump Station. Installation of a larger pump will result in no reduction in flooding.

9.1.6 If water comes up through my floor drain during a flood event, how will these capital improvements reduce that risk? Is it valuable to install a back-flow preventer?

Yes, we recommend that all residents flood proof their homes to the maximum extent practicable. Flood proofing measurements include back-flow valves on sanitary laterals, raising low entry points where water could enter homes, installing sump pumps with battery back-up and disconnecting downspouts.

9.1.7 Why can't the Village just open the sluice gate at Lake Michigan?

The sluice gate at the North Shore Channel can be used to lower water levels in the North Shore Channel during flood events. The separate storm sewer system is pumped to the North Branch Chicago River, which is not impacted at this location by opening the sluice gate (**Figure 20**).

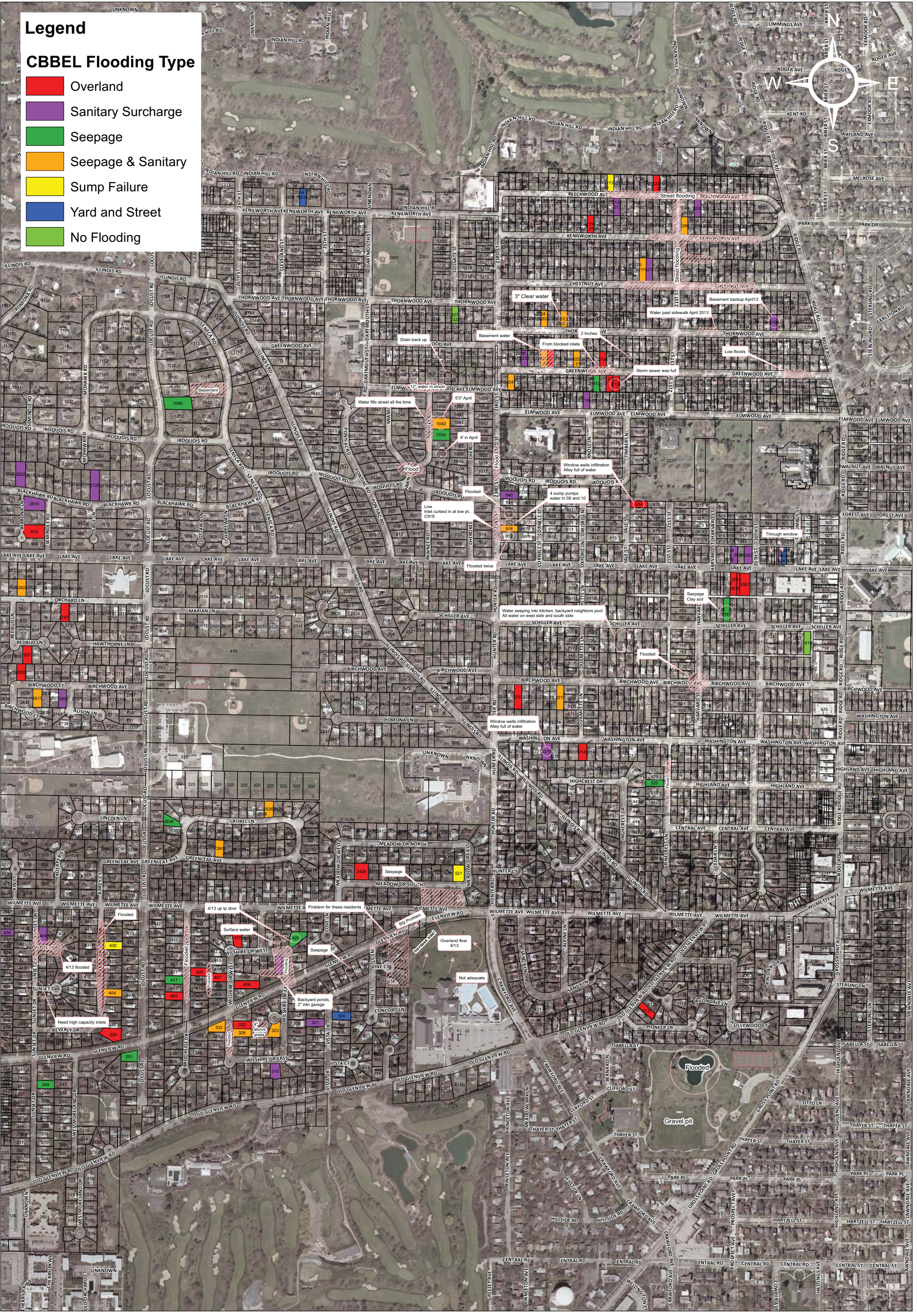


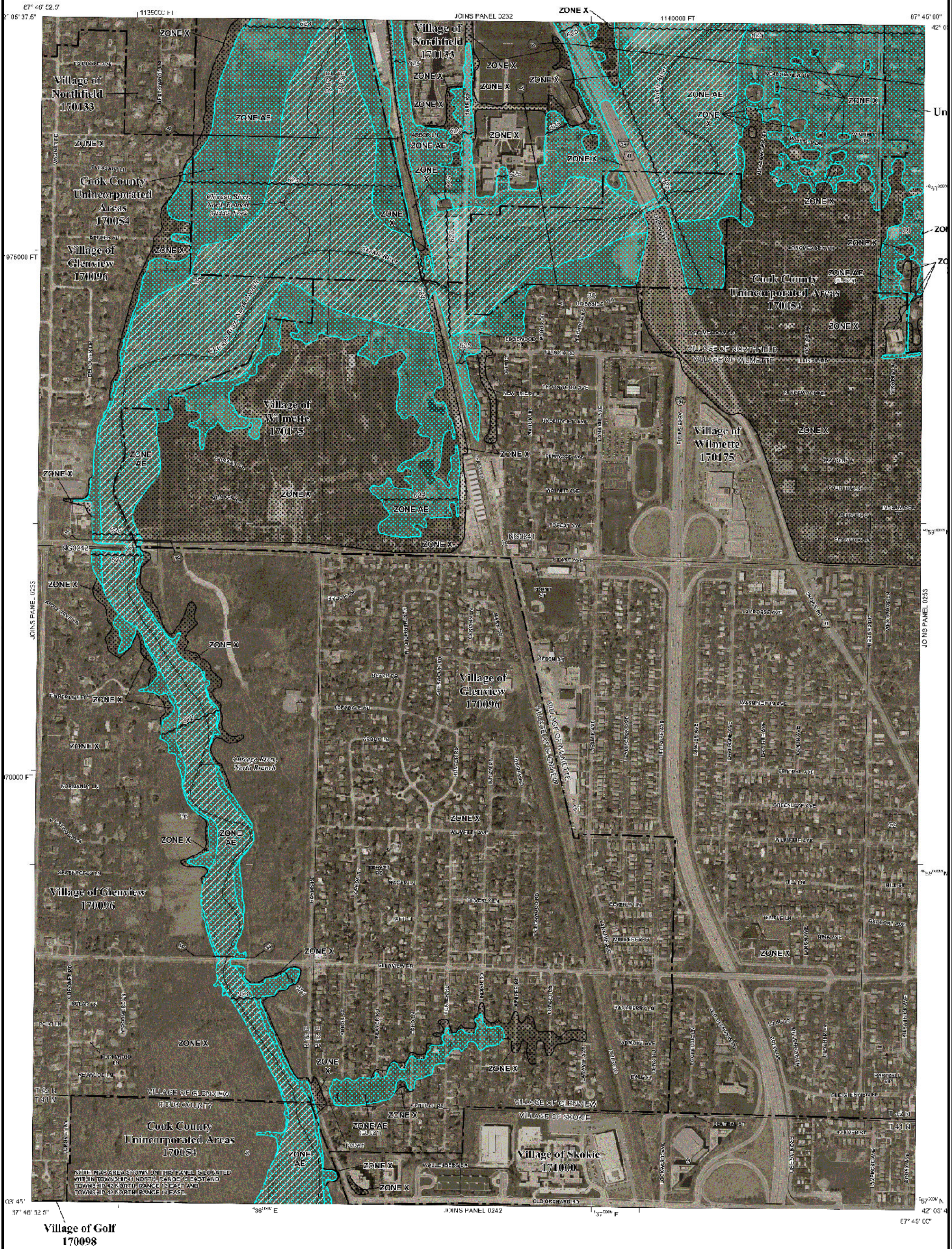
Figure 20. North Branch Chicago River Schematic

Legend

CBBEL Flooding Type

- Overland
- Sanitary Surcharge
- Seepage
- Seepage & Sanitary
- Sump Failure
- Yard and Street
- No Flooding





		DSGN.	MJB	CHKD.	DRB
<div><div>CB</div><div>CHRISTOPHER B. BURKE ENGINEERING LTD. 9575 West Higgins Road, Suite 600 Rosemont, Illinois 60018 (847) 823-0500</div></div>	CLIENT	VILLAGE OF WILMETTE			PROJECT NO. 13-0605
	TITLE	COOK COUNTY FIRM PANEL 234 OF 832 - MAP REVISED AUGUST 19, 2008			DATE 1/15/15
					EXH 3



		DSGN.	MJB	CHKD.	DRB
<div><div></div><div>CB</div></div> <div>CHRISTOPHER B. BURKE ENGINEERING LTD. 9575 West Higgins Road, Suite 600 Rosemont, Illinois 60018 (847) 823-0500</div>	CLIENT	VILLAGE OF WILMETTE		PROJECT NO. 13-0605	
	TITLE	COOK COUNTY FIRM PANEL 253 OF 832 - MAP REVISED AUGUST 19, 2008		DATE 1/15/15	
				EXH 4	

Legend

Trunk Storm Sewer

Elevation

High Low

Elevation

Low

ILLINOIS RD

LOCUST RD



RIDGE RD

PUMP STATION

LAKE AVE

EDENS EXPY

LAKEVIEW RD

NORTH BRANCH CHICAGO RIVER



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Rosemont, Illinois 60018
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CLIENT:

VILLAGE OF WILMETTE

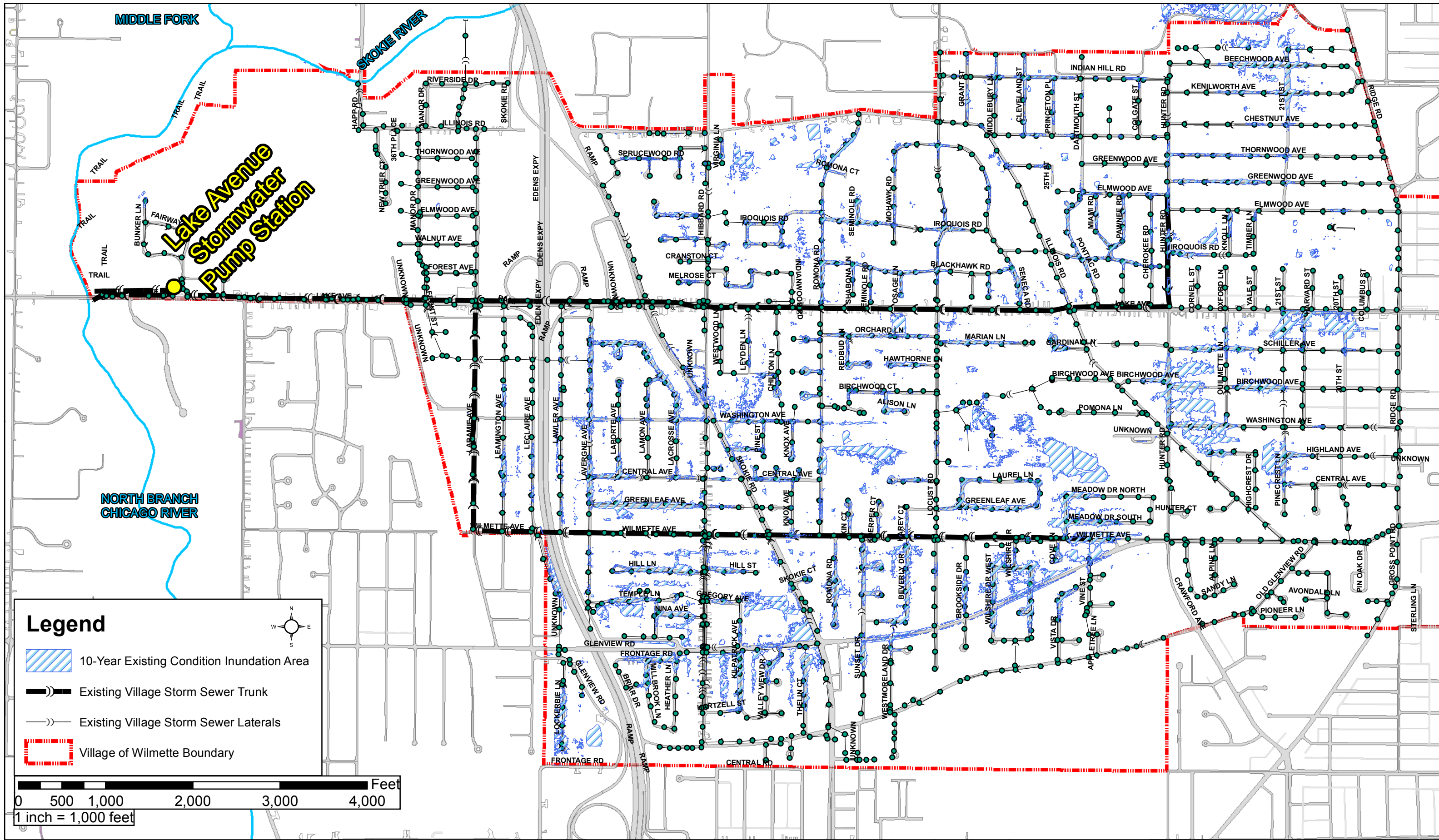
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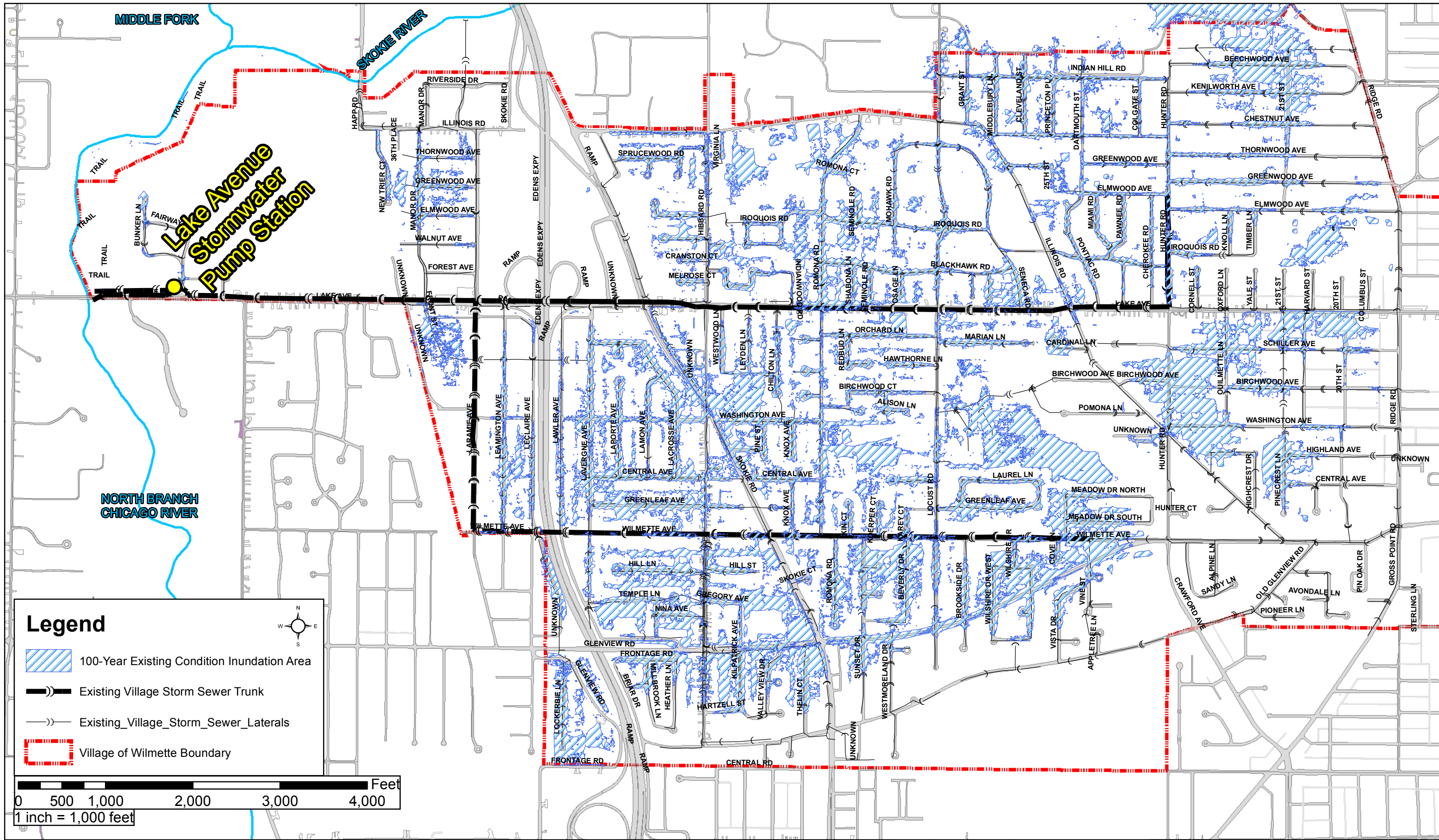


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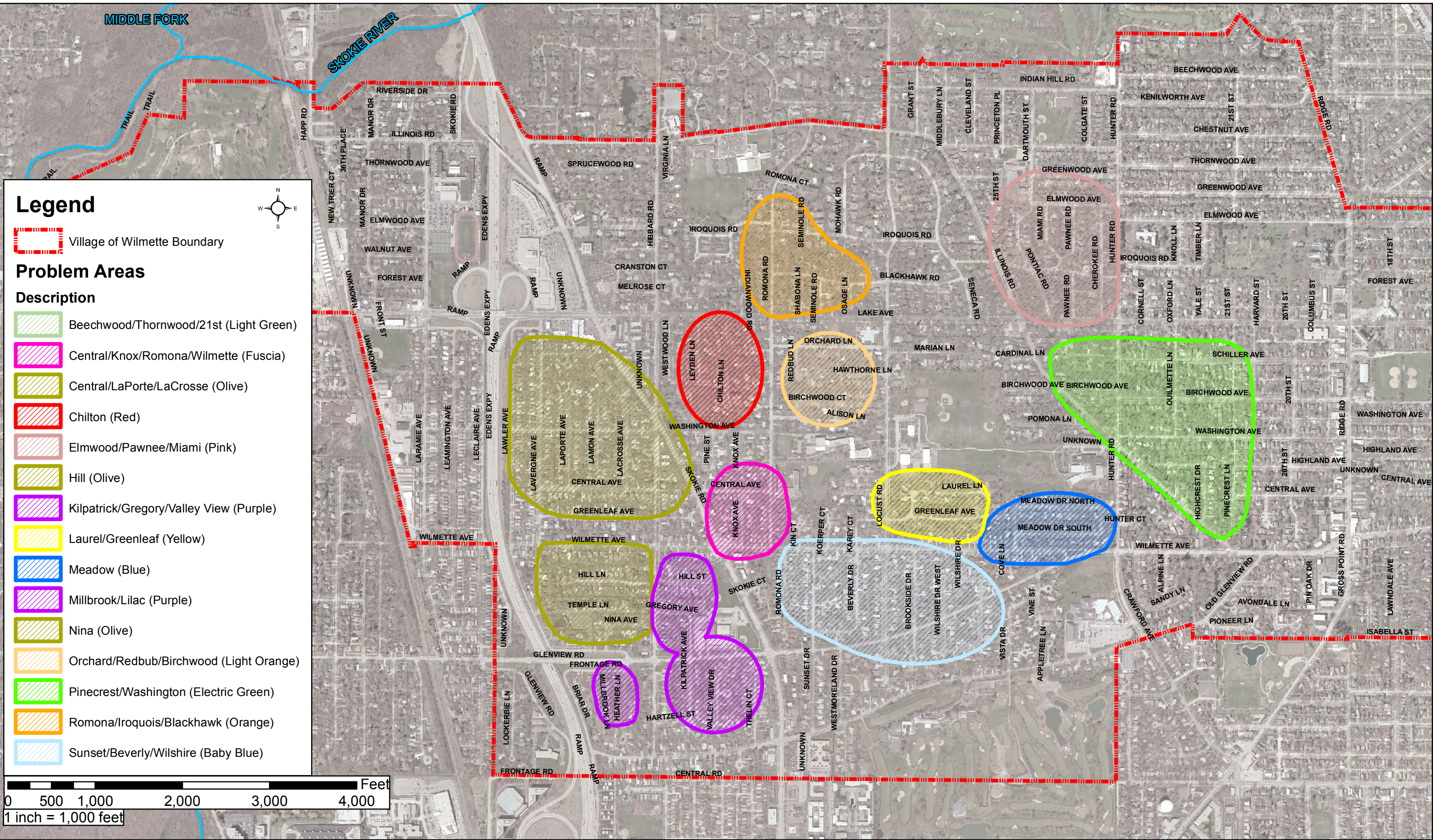
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- Existing Village Storm Sewer Trunk
- Existing Village Storm Sewer Laterals
- Village of Wilmette Boundary

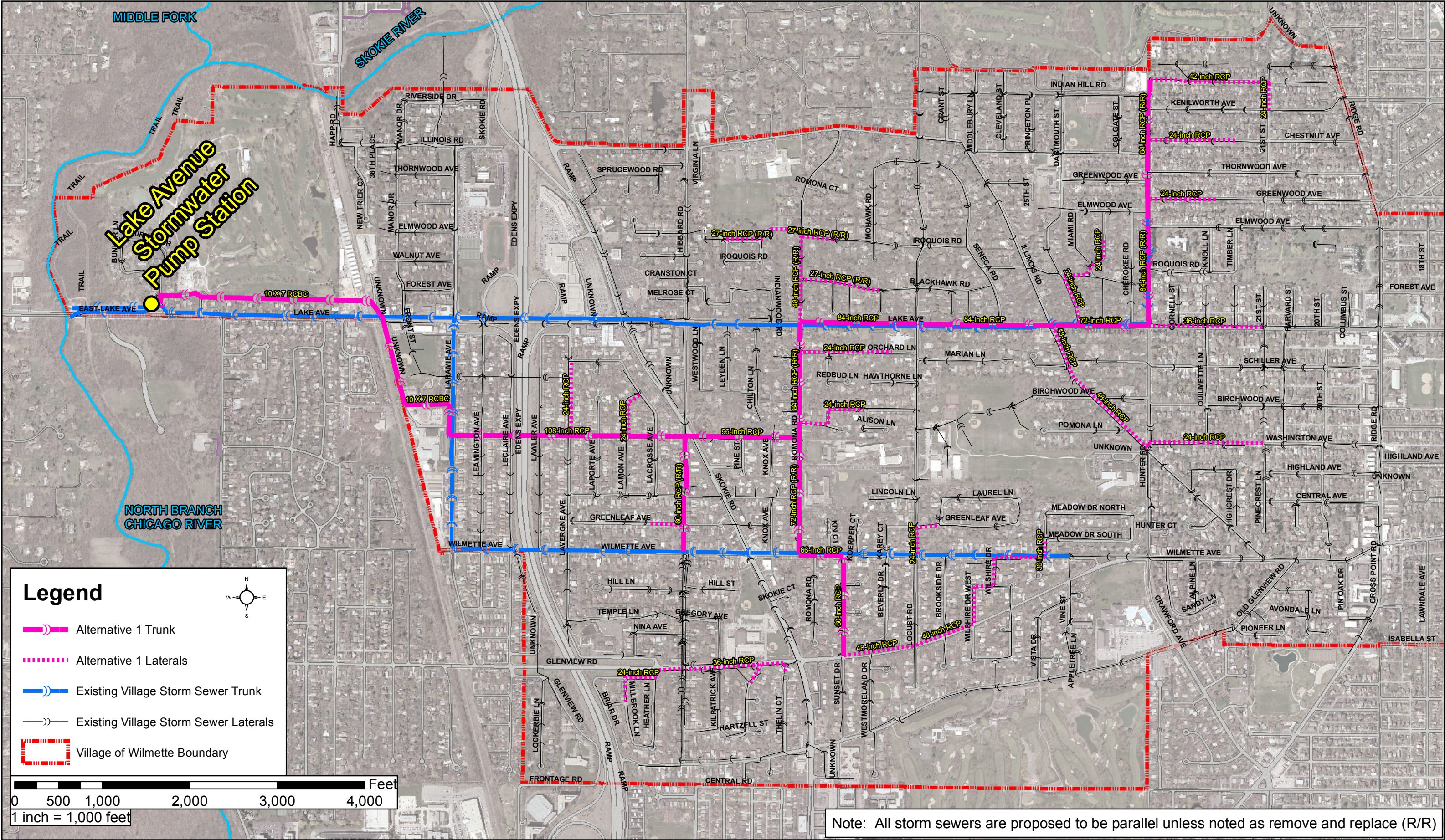
0 500 1,000 2,000 3,000 4,000 Feet

1 inch = 1,000 feet



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- Alternative 1 Trunk
- Alternative 1 Laterals
- Existing Village Storm Sewer Trunk
- Existing Village Storm Sewer Laterals
- Village of Wilmette Boundary

Note: All storm sewers are proposed to be parallel unless noted as remove and replace (R/R)

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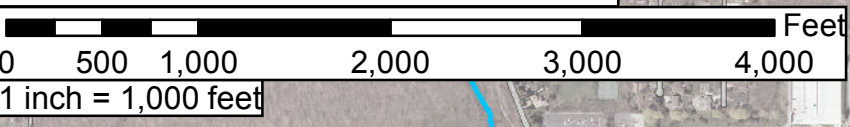
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**ALTERNATIVE 1
RELIEF STORM SEWER SYSTEM**

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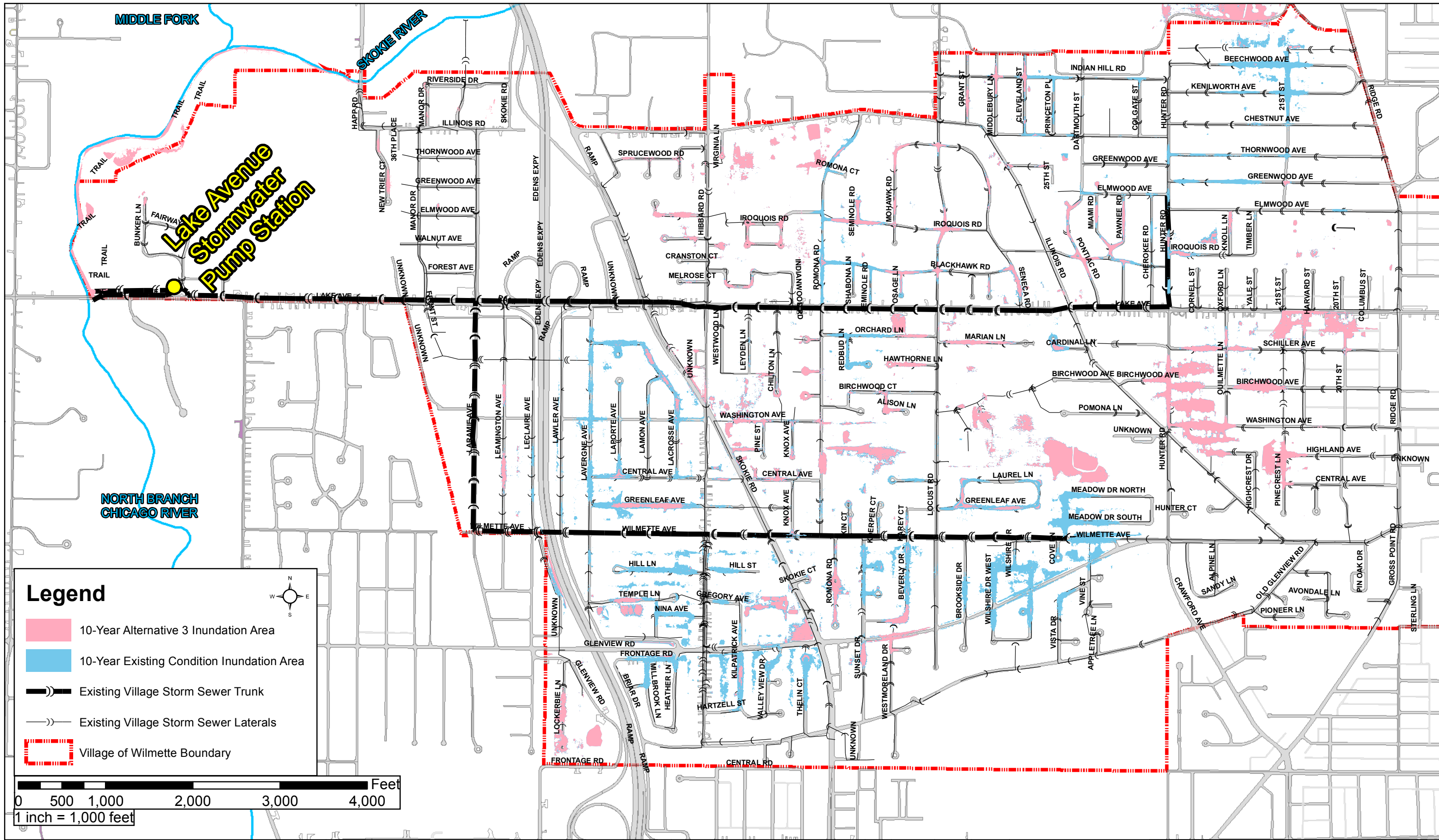
Lake Avenue
Stormwater
Pump Station

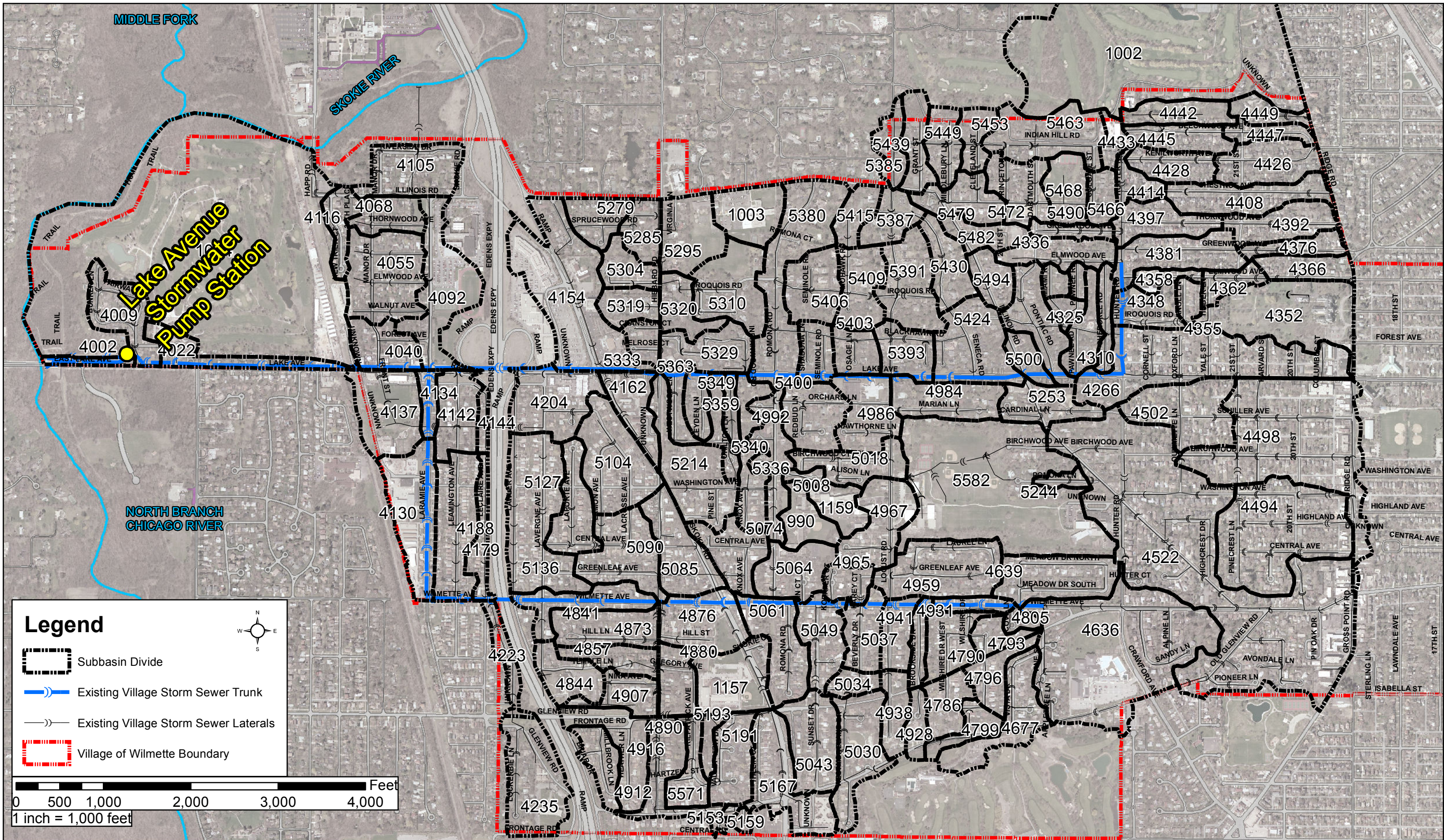
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- Community Park Underground Storage
- Alternative 2 Trunk
- Alternative 2 Laterals
- Existing Village Storm Sewer Trunk
- Existing Village Storm Sewer Laterals
- Village of Wilmette Boundary



Note: All storm sewers are proposed to be parallel unless noted as remove and replace (R/R)





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9575 West Higgins Road, Suite 600
Rosemont, Illinois 60018
(847) 823-0500

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TITLE:

Separate Storm Sewer Area Subbasin Map

PROJ. NO. 13-0605

DATE: 11/25/2014

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EXH 14

Appendix 1 – Flood Inundation Depths (Tables)



Location	Location ID
Romona/Iroquois	D
Shabona/Seminole	
Romona/Blackhawk	
Chilton	E
Kilpatrick/Hartzell	M
Valley View Rear Yards	
Valley View	
Thelin	
Lilac/Milbrook	
Kilpatrick/Gregory	K
Lavergne N	
Central/Laporte	
Lacrosse	
Greenleaf E	
Nina	L
Hill	
Lavergne S	
Central/Knox	J
Romona/Wilmette	F
Birchwood/Kenneth/Alison	
Redbud/Orchard W	
Orchard/Locust/Hawthorne	G
Greenleaf/Locust/Laurel	
Brookside	I
Sunset	
Beverly	
Wilshire E	
Wilshire W	
Meadow	H
Washington/Pinecrest	C
Beechwood E	A
Beechwood W	
Kenilworth W	
Kenilworth E	
Chestnut W	
Chestnut E	
Thornwood W	
Thornwood E	
Greenwood	
Elmwood	B
Miami	
Pawnee	
Iroquois E	
Hunter S	

Lowest Ground Elevation	XP-SWMM ID
spot shot (LIDAR)	Node
622.31	5577
622.21	5400
621.38	5380
622.21	5356
619.83	5571
620.39	5193
621.09	5191
619.98	5167
621.12	4912
620.44	4880
621.18	5136
620.64	5127
620.78	5104
619.59	5090
620.02	4907
619.71	4873
620.41	4841
621.08	5074
622.03	5064
621.50	5018
621.99	4992
621.85	4986
621.21	4959
621.35	4931
621.11	5049
621.38	5034
621.11	4793
620.90	4790
621.57	4639
626.22	4522
622.79	4447
622.71	4445
623.74	4428
622.89	4426
624.67	4414
624.22	4408
624.63	4397
624.69	4392
624.11	4381
625.35	4336
623.63	4322
623.55	4318
623.50	4310
623.96	4303

Existing Conditions Water Surface Elevation (WSEL)	
10-year (ft)	
WSEL	Flooding Depth
623.0	0.7
622.8	0.6
622.9	1.5
621.8	0.0
621.4	1.5
621.8	1.4
622.0	0.9
622.3	2.3
621.6	0.5
621.4	1.0
622.2	1.0
621.6	0.9
622.1	1.3
621.3	1.7
621.1	1.1
621.1	1.4
620.8	0.4
621.9	0.8
622.4	0.3
622.7	1.2
623.2	1.2
623.3	1.5
622.4	1.1
622.5	1.2
622.1	1.0
622.8	1.4
622.6	1.5
622.6	1.7
623.4	1.9
628.4	2.2
624.4	1.6
624.4	1.7
624.6	0.9
624.4	1.5
624.7	0.0
624.5	0.3
625.2	0.6
625.2	0.5
625.6	1.5
625.5	0.2
624.8	1.2
624.8	1.3
624.8	1.3
624.6	0.6

Min	0.0
Max	2.3
Avg	1.1

Proposed Condition Water Surface Elevations and Reductions Alternative 1 "Trunk & Laterals"	
10-year (ft)	
WSEL	Flooding Depth
621.0	-1.3
621.1	-1.1
620.9	-0.4
620.7	-1.5
620.0	0.1
619.9	-0.5
620.0	-1.1
620.0	0.1
620.0	-1.2
620.4	0.0
617.6	-3.6
619.0	-1.7
618.3	-2.4
619.1	-0.4
619.8	-0.2
619.8	0.1
620.0	-0.4
619.8	-1.3
619.9	-2.1
620.7	-0.8
620.8	-1.2
621.1	-0.7
621.2	0.0
620.8	-0.5
620.2	-0.9
620.5	-0.8
621.2	0.1
620.9	0.0
621.4	-0.2
626.3	0.1
622.9	0.1
622.9	0.1
623.0	-0.8
622.9	0.0
622.8	-1.9
623.6	-0.6
623.6	-1.0
624.0	-0.7
623.2	-0.9
624.0	-1.3
623.0	-0.6
622.9	-0.7
622.9	-0.6
622.6	-1.4

Min	-3.6
Max	0.1
Avg	-0.8

Proposed Condition Water Surface Elevations and Reductions Alternative 2 "Storage at Community Park"	
10-year (ft)	
WSEL	Flooding Depth
619.1	-3.3
620.4	-1.8
618.7	-2.7
618.5	-3.7
618.8	-1.0
618.8	-1.6
618.8	-2.3
618.8	-1.2
619.6	-1.5
620.0	-0.5
619.9	-1.3
619.3	-1.4
620.7	-0.1
619.2	-0.4
619.1	-0.9
619.1	-0.6
620.0	-0.4
618.5	-2.6
620.8	-1.2
616.9	-4.6
618.8	-3.2
617.1	-4.8
620.1	-1.1
617.9	-3.5
618.2	-2.9
618.5	-2.9
619.4	-1.7
618.5	-2.4
621.7	0.1
623.9	-2.3
622.9	0.1
622.8	0.1
623.0	-0.8
623.0	0.1
622.4	-2.3
624.4	0.1
623.3	-1.3
623.7	-1.0
622.3	-1.8
623.7	-1.7
621.9	-1.8
621.7	-1.9
621.5	-2.0
620.9	-3.1

Min	-4.8
Max	0.1
Avg	-1.7

Proposed Condition Water Surface Elevations and Reductions Alternative 3 "Storage at Thornwood, Centennial and Hibbard Parks"	
10-year (ft)	
WSEL	Flooding Depth
622.5	0.2
621.8	-0.4
621.6	0.2
621.5	-0.7
620.3	0.5
620.2	-0.2
621.2	0.1
620.4	0.4
620.7	-0.4
620.4	-0.1
620.8	-0.4
620.9	0.3
621.5	0.7
620.7	1.1
619.9	-0.2
619.8	0.1
620.2	-0.2
621.8	0.7
622.0	0.0
622.6	1.1
621.6	-0.4
623.3	1.4
621.6	0.4
620.6	-0.8
621.0	-0.1
622.5	1.1
620.2	-0.9
619.9	-1.0
619.3	-2.2
628.4	2.2
622.5	-0.3
622.5	-0.2
622.6	-1.2
622.6	-0.3
622.4	-2.3
624.1	-0.1
623.5	-1.1
623.9	-0.8
622.8	-1.3
624.8	-0.6
624.5	0.9
624.5	0.9
624.2	0.7
622.7	-1.3

Min	-2.3
Max	2.2
Avg	-0.1

Note: For the purposes of reporting data, 10-year level of service was determined to be achieved for flooding depths of 0.1 feet or less.

Location	Location ID
Romona/Iroquois	D
Shabona/Seminole	
Romona/Blackhawk	
Chilton	E
Kilpatrick/Hartzell	M
Valley View Rear Yards	
Valley View	
Thelin	
Lilac/Milbrook	
Kilpatrick/Gregory	
Lavergne N	K
Central/Laporte	
Lacrosse	
Greenleaf E	
Nina	L
Hill	
Lavergne S	
Central/Knox	J
Romona/Wilmette	F
Birchwood/Kenneth/Alison	
Redbud/Orchard W	
Orchard/Locust/Hawthorne	G
Greenleaf/Locust/Laurel	
Brookside	I
Sunset	
Beverly	
Wilshire E	
Wilshire W	
Meadow	H
Washington/Pinecrest	C
Beechwood E	A
Beechwood W	
Kenilworth W	
Kenilworth E	
Chestnut W	
Chestnut E	
Thornwood W	
Thornwood E	
Greenwood	
Elmwood	
Miami	B
Pawnee	
Iroquois E	
Hunter S	

Lowest Ground Elevation	XP-SWMM ID
spot shot (LIDAR)	Node
622.31	5577
622.21	5400
621.38	5380
622.21	5356
619.83	5571
620.39	5193
621.09	5191
619.98	5167
621.12	4912
620.44	4880
621.18	5136
620.64	5127
620.78	5104
619.59	5090
620.02	4907
619.71	4873
620.41	4841
621.08	5074
622.03	5064
621.50	5018
621.99	4992
621.85	4986
621.21	4959
621.35	4931
621.11	5049
621.38	5034
621.11	4793
620.90	4790
621.57	4639
626.22	4522
622.79	4447
622.71	4445
623.74	4428
622.89	4426
624.67	4414
624.22	4408
624.63	4397
624.69	4392
624.11	4381
625.35	4336
623.63	4322
623.55	4318
623.50	4310
623.96	4303

Existing Conditions Water Surface Elevation (WSEL)	
25-year (ft)	
WSEL	Flooding Depth
623.4	1.1
623.4	1.2
623.4	2.0
622.9	0.7
621.7	1.8
622.1	1.7
622.3	1.2
622.7	2.7
621.8	0.7
621.8	1.3
622.4	1.3
621.9	1.3
622.4	1.6
621.7	2.1
621.5	1.4
621.4	1.7
621.3	0.9
622.2	1.1
622.7	0.7
623.0	1.5
623.5	1.5
623.6	1.8
622.7	1.5
622.9	1.6
622.4	1.3
622.9	1.6
622.9	1.8
622.9	2.0
623.7	2.1
628.8	2.6
624.9	2.2
624.9	2.2
625.0	1.2
624.9	2.1
625.3	0.6
624.9	0.7
625.1	0.7
625.2	0.5
626.0	1.9
625.9	0.5
625.3	1.7
625.3	1.8
625.3	1.8
625.2	1.2

Min	0.5
Max	2.7
Avg	1.5

Proposed Condition Water Surface Elevations and Reductions Alternative 1 "Trunk & Laterals"	
25-year (ft)	
WSEL	Flooding Depth
622.9	0.5
623.0	0.7
622.8	1.4
622.9	0.7
621.2	1.4
621.3	0.9
621.5	0.4
621.5	1.6
621.4	0.2
621.6	1.1
618.9	-2.2
620.7	0.1
620.7	0.0
620.6	1.1
621.1	1.0
620.9	1.2
621.0	0.6
621.4	0.4
621.4	-0.6
622.4	0.9
622.5	0.5
622.8	1.0
622.4	1.1
622.3	1.0
621.8	0.7
622.1	0.8
622.6	1.4
622.5	1.6
622.9	1.3
627.9	1.7
624.4	1.6
624.4	1.7
624.4	0.7
624.4	1.5
624.7	0.0
624.5	0.3
625.1	0.5
625.2	0.5
625.0	0.8
625.7	0.3
624.6	1.0
624.5	0.9
624.5	1.0
624.2	0.2

Min	-2.2
Max	1.7
Avg	0.8

Proposed Condition Water Surface Elevations and Reductions Alternative 2 "Storage at Community Park"	
25-year (ft)	
WSEL	Flooding Depth
622.9	0.6
623.0	0.8
622.8	1.5
622.7	0.5
621.6	1.8
621.6	1.3
621.7	0.6
621.8	1.8
621.5	0.4
621.5	1.1
621.7	0.5
621.2	0.6
621.9	1.2
621.0	1.5
621.2	1.2
621.1	1.4
621.1	0.7
621.6	0.6
622.5	0.4
622.8	1.3
622.3	0.3
623.0	1.2
622.6	1.4
622.5	1.2
622.1	0.9
622.2	0.9
622.5	1.3
622.5	1.6
623.1	1.5
627.7	1.4
624.5	1.7
624.5	1.8
624.6	0.9
624.5	1.6
624.7	0.1
624.5	0.3
625.1	0.5
625.2	0.5
625.0	0.9
625.7	0.4
624.4	0.8
624.4	0.8
624.5	1.0
624.9	0.9

Min	0.1
Max	1.8
Avg	1.0

Proposed Condition Water Surface Elevations and Reductions Alternative 3 "Storage at Thornwood, Centennial and Hibbard Parks"	
25-year (ft)	
WSEL	Flooding Depth
623.2	0.9
623.2	1.0
623.2	1.8
622.9	0.7
621.4	1.5
621.5	1.1
622.1	1.0
621.5	1.5
621.5	0.3
621.5	1.0
621.6	0.5
621.7	1.1
622.0	1.2
621.4	1.8
621.2	1.2
621.1	1.4
621.1	0.7
622.2	1.1
622.5	0.5
622.9	1.4
622.7	0.7
623.6	1.8
622.3	1.1
622.4	1.0
622.1	1.0
622.9	1.6
622.4	1.3
622.4	1.5
622.6	1.1
624.4	1.6
624.4	1.7
624.6	0.8
624.4	1.5
625.4	0.7
624.5	0.3
625.0	0.4
625.2	0.5
625.0	0.9
625.7	0.4
625.0	1.4
625.0	1.5
625.0	1.5
625.0	1.1

Min	0.3
Max	2.6
Avg	1.1

Note: For the purposes of reporting data, 10-year level of service was determined to be achieved for flooding depths of 0.1 feet or less.

Location	Location ID
Romona/Iroquois	D
Shabona/Seminole	
Romona/Blackhawk	
Chilton	E
Kilpatrick/Hartzell	M
Valley View Rear Yards	
Valley View	
Thelin	
Lilac/Milbrook	
Kilpatrick/Gregory	
Lavergne N	K
Central/Laporte	
Lacrosse	
Greenleaf E	
Nina	L
Hill	
Lavergne S	
Central/Knox	J
Romona/Wilmette	F
Birchwood/Kenneth/Alison	
Redbud/Orchard W	
Orchard/Locust/Hawthorne	G
Greenleaf/Locust/Laurel	
Sunset	I
Beverly	
Brookside	
Wilshire E	
Wilshire W	
Meadow	H
Washington/Pinecrest	C
Beechwood E	A
Beechwood W	
Kenilworth W	
Kenilworth E	
Chestnut W	
Chestnut E	
Thornwood W	
Thornwood E	
Greenwood	
Elmwood	B
Miami	
Pawnee	
Iroquois E	
Hunter S	

Lowest Ground Elevation	XP-SWMM ID
spot shot (LIDAR)	Node
622.31	5577
622.21	5400
621.38	5380
622.21	5356
619.83	5571
620.39	5193
621.09	5191
619.98	5167
621.12	4912
620.44	4880
621.18	5136
620.64	5127
620.78	5104
619.59	5090
620.02	4907
619.71	4873
620.41	4841
621.08	5074
622.03	5064
621.50	5018
621.99	4992
621.85	4986
621.21	4959
621.11	5049
621.38	5034
621.35	4931
621.11	4793
620.90	4790
621.57	4639
626.22	4522
622.79	4447
622.71	4445
623.74	4428
622.89	4426
624.67	4414
624.22	4408
624.63	4397
624.69	4392
624.11	4381
625.35	4336
623.63	4322
623.55	4318
623.50	4310
623.96	4303

Existing Conditions Water Surface Elevation (WSEL)	
50-year (ft)	
WSEL	Flooding Depth
623.7	1.4
623.7	1.5
623.7	2.3
623.1	0.9
621.9	2.1
622.4	2.0
622.4	1.3
623.0	3.0
622.1	1.0
622.0	1.6
622.6	1.4
622.1	1.5
622.7	1.9
622.0	2.4
621.7	1.6
621.6	1.9
621.6	1.2
622.4	1.3
622.9	0.9
623.2	1.7
623.7	1.7
623.7	1.9
622.9	1.7
622.6	1.5
623.0	1.7
623.2	1.8
623.1	2.0
623.1	2.2
623.9	2.3
629.2	2.9
625.3	2.5
625.3	2.6
625.3	1.6
625.3	2.4
625.6	1.0
625.3	1.1
625.7	1.0
625.3	0.6
626.2	2.1
625.9	0.5
625.7	2.1
625.7	2.2
625.7	2.2
625.7	1.7

Min	0.5
Max	3.0
Avg	1.7

Proposed Condition Water Surface Elevations and Reductions Alternative 1 "Trunk & Laterals"	
50-year (ft)	
WSEL	Flooding Depth
623.4	1.1
623.4	1.2
623.4	2.0
623.1	0.9
621.6	1.8
621.7	1.3
622.0	0.9
622.1	2.1
621.7	0.6
621.9	1.4
619.5	-1.7
621.3	0.6
621.5	0.7
621.1	1.5
621.4	1.4
621.3	1.6
621.4	1.0
621.9	0.8
621.9	-0.1
622.6	1.1
623.0	1.0
623.3	1.4
622.7	1.5
622.2	1.1
622.5	1.1
622.7	1.4
622.9	1.8
622.9	2.0
623.3	1.7
628.4	2.2
624.9	2.1
624.9	2.2
624.9	1.2
624.9	2.0
624.9	0.3
624.9	0.7
625.3	0.7
625.2	0.5
625.5	1.3
625.9	0.5
625.2	1.5
624.9	1.4
624.9	1.4
624.7	0.7

Min	-1.7
Max	2.2
Avg	1.2

Proposed Condition Water Surface Elevations and Reductions Alternative 2 "Storage at Community Park"	
50-year (ft)	
WSEL	Flooding Depth
623.4	1.1
623.4	1.2
623.4	2.0
622.9	0.7
621.9	2.1
622.1	1.7
622.1	1.0
622.2	2.2
621.9	0.8
621.9	1.5
622.1	0.9
621.8	1.2
622.3	1.5
621.6	2.0
621.6	1.6
621.5	1.8
621.5	1.1
622.0	0.9
622.8	0.7
623.1	1.6
622.9	0.9
623.4	1.6
622.6	1.4
622.4	1.3
622.6	1.2
622.8	1.5
622.9	1.7
622.9	2.0
623.5	2.0
628.3	2.1
625.0	2.3
625.0	2.3
625.0	1.3
625.0	2.2
625.1	0.5
625.0	0.8
625.4	0.7
625.2	0.5
625.5	1.4
625.9	0.5
625.2	1.5
624.9	1.4
625.0	1.5
625.0	1.1

Min	0.5
Max	2.3
Avg	1.4

Proposed Condition Water Surface Elevations and Reductions Alternative 3 "Storage at Thornwood, Centennial and Hibbard Parks"	
50-year (ft)	
WSEL	Flooding Depth
623.6	1.2
623.6	1.3
623.6	2.2
623.1	0.9
621.7	1.9
621.8	1.4
622.3	1.2
621.9	1.9
621.8	0.7
621.8	1.4
622.1	0.9
622.1	1.4
622.3	1.5
621.8	2.2
621.5	1.5
621.4	1.7
621.5	1.1
622.4	1.3
622.8	0.8
623.1	1.6
623.2	1.2
623.7	1.9
622.7	1.5
622.4	1.3
623.0	1.7
622.9	1.5
622.8	1.7
622.8	1.9
623.1	1.6
629.1	2.9
625.0	2.2
625.0	2.3
625.0	1.3
625.0	2.1
625.5	0.8
625.0	0.8
625.3	0.7
625.2	0.5
625.5	1.4
625.9	0.5
625.5	1.9
625.4	1.9
625.4	1.9
625.3	1.3

Min	0.5
Max	2.9
Avg	1.5

Note: For the purposes of reporting data, 10-year level of service was determined to be achieved for flooding depths of 0.1 feet or less.

Location	Location ID
Romona/Iroquois	D
Shabona/Seminole	
Romona/Blackhawk	
Chilton	E
Kilpatrick/Hartzell	M
Valley View Rear Yards	
Valley View	
Thelin	
Lilac/Milbrook	
Kilpatrick/Gregory	
Lavergne N	K
Central/Laporte	
Lacrosse	
Greenleaf E	
Nina	L
Hill	
Lavergne S	
Central/Knox	J
Romona/Wilmette	F
Birchwood/Kenneth/Alison	
Redbud/Orchard W	
Orchard/Locust/Hawthorne	G
Greenleaf/Locust/Laurel	
Brookside	I
Sunset	
Beverly	
Wilshire E	
Wilshire W	H
Meadow	
Washington/Pinecrest	C
Beechwood E	A
Beechwood W	
Kenilworth W	
Kenilworth E	
Chestnut W	
Chestnut E	
Thornwood W	
Thornwood E	
Greenwood	
Elmwood	B
Miami	
Pawnee	
Iroquois E	
Hunter S	

Lowest Ground Elevation	XP-SWMM ID
spot shot (LIDAR)	Node
622.31	5577
622.21	5400
621.38	5380
622.21	5356
619.83	5571
620.39	5193
621.09	5191
619.98	5167
621.12	4912
620.44	4880
621.18	5136
620.64	5127
620.78	5104
619.59	5090
620.02	4907
619.71	4873
620.41	4841
621.08	5074
622.03	5064
621.50	5018
621.99	4992
621.85	4986
621.21	4959
621.35	4931
621.11	5049
621.38	5034
621.11	4793
620.90	4790
621.57	4639
626.22	4522
622.79	4447
622.71	4445
623.74	4428
622.89	4426
624.67	4414
624.22	4408
624.63	4397
624.69	4392
624.11	4381
625.35	4336
623.63	4322
623.55	4318
623.50	4310
623.96	4303

Existing Conditions Water Surface Elevation (WSEL)	
100-year (ft)	
WSEL	Flooding Depth
623.9	1.6
623.9	1.7
623.9	2.6
623.3	1.0
622.2	2.4
622.5	2.1
622.5	1.4
623.2	3.3
622.3	1.2
622.3	1.8
622.7	1.6
622.5	1.8
622.8	2.0
622.3	2.7
621.9	1.8
621.8	2.0
621.8	1.4
622.6	1.5
623.1	1.0
623.3	1.8
623.8	1.8
623.8	2.0
623.1	1.9
623.4	2.1
622.9	1.8
623.2	1.8
623.3	2.4
624.1	2.6
629.5	3.3
625.7	2.9
625.7	3.0
625.7	2.0
625.7	2.8
625.8	1.2
625.7	1.5
625.8	1.2
625.7	1.0
626.4	2.3
626.0	0.6
626.0	2.4
626.0	2.4
626.0	2.5
626.0	2.0

Min	0.6
Max	3.3
Avg	2.0

Proposed Condition Water Surface Elevations and Reductions Alternative 1 "Trunk & Laterals"	
100-year (ft)	
WSEL	Flooding Depth
623.8	1.5
623.8	1.6
623.8	2.4
623.2	1.0
622.0	2.2
622.1	1.7
622.3	1.2
622.5	2.5
622.1	0.9
622.2	1.7
620.1	-1.0
621.7	1.1
622.0	1.2
621.6	2.0
621.7	1.7
621.6	1.8
621.7	1.3
622.2	1.1
622.3	0.3
622.9	1.4
623.4	1.4
623.6	1.8
623.0	1.8
623.1	1.7
622.6	1.4
622.8	1.5
623.2	2.1
623.2	2.3
623.6	2.0
628.8	2.6
625.3	2.5
625.3	2.6
625.3	1.5
625.3	2.4
625.3	0.6
625.3	1.1
625.4	0.8
625.3	0.6
625.9	1.8
625.9	0.6
625.5	1.9
625.4	1.8
625.4	1.9
625.1	1.2

Min	-1.0
Max	2.6
Avg	1.5

Proposed Condition Water Surface Elevations and Reductions Alternative 2 "Storage at Community Park"	
100-year (ft)	
WSEL	Flooding Depth
623.7	1.4
623.7	1.5
623.7	2.4
623.2	1.0
622.3	2.5
622.4	2.0
622.4	1.3
622.5	2.5
622.2	1.1
622.2	1.8
622.4	1.2
622.2	1.5
622.6	1.8
622.0	2.4
621.9	1.9
621.8	2.1
621.8	1.3
622.2	1.2
623.0	1.0
623.3	1.8
623.2	1.2
623.7	1.8
623.0	1.7
623.1	1.8
622.7	1.5
622.9	1.5
623.1	2.0
623.1	2.2
623.8	2.3
628.8	2.6
625.4	2.6
625.4	2.7
625.4	1.7
625.4	2.5
625.5	0.8
625.4	1.2
625.5	0.9
625.4	0.7
626.0	1.9
625.9	0.6
625.5	1.9
625.4	1.9
625.4	1.9
625.4	1.4

Min	0.6
Max	2.7
Avg	1.7

Proposed Condition Water Surface Elevations and Reductions Alternative 3 "Storage at Thornwood, Centennial and Hibbard Parks"	
100-year (ft)	
WSEL	Flooding Depth
623.9	1.6
623.9	1.7
623.9	2.5
623.3	1.0
622.1	2.3
622.2	1.8
622.4	1.3
622.3	2.3
622.1	1.0
622.1	1.7
622.4	1.2
622.3	1.7
622.6	1.8
622.3	2.7
621.8	1.7
621.7	2.0
621.7	1.3
622.6	1.5
623.0	1.0
623.3	1.8
623.6	1.6
623.8	1.9
623.0	1.8
623.3	1.9
622.8	1.7
623.1	1.8
623.1	2.0
623.1	2.2
623.5	2.0
629.5	3.2
625.4	2.7
625.4	2.7
625.4	1.7
625.4	2.6
625.6	0.9
625.4	1.2
625.7	1.0
625.4	0.8
626.0	1.9
625.9	0.6
625.8	2.1
625.8	2.2
625.8	2.3
625.8	1.8

Min	0.6
Max	3.2
Avg	1.8

Note: For the purposes of reporting data, 10-year level of service was determined to be achieved for flooding depths of 0.1 feet or less.

Appendix 2 - Reduction of Flood Inundation Depths (Tables)



Location	Location ID
Romona/Iroquois	D
Shabona/Seminole	
Romona/Blackhawk	
Chilton	E
Kilpatrick/Hartzell	M
Valley View Rear Yards	
Valley View	
Thelin	
Lilac/Millbrook	
Kilpatrick/Gregory	
Lavergne N	K
Central/Laporte	
Lacrosse	
Greenleaf E	
Nina	L
Hill	
Lavergne S	
Central/Knox	J
Romona/Wilmette	F
Birchwood/Kenneth/Alison	
Redbud/Orchard W	
Orchard/Locust/Hawthorne	G
Greenleaf/Locust/Laurel	
Brookside	I
Sunset	
Beverly	
Wilshire E	
Wilshire W	
Meadow	H
Washington/Pinecrest	C
Beechwood E	A
Beechwood W	
Kenilworth W	
Kenilworth E	
Chestnut W	
Chestnut E	
Thornwood W	
Thornwood E	
Greenwood	
Elmwood	B
Miami	
Pawnee	
Iroquois E	
Hunter S	

Lowest Ground Elevation	XP-SWMM ID
spot shot (LIDAR)	Node
622.31	5577
622.21	5400
621.38	5380
622.21	5356
619.83	5571
620.39	5193
621.09	5191
619.98	5167
621.12	4912
620.44	4880
621.18	5136
620.64	5127
620.78	5104
619.59	5090
620.02	4907
619.71	4873
620.41	4841
621.08	5074
622.03	5064
621.50	5018
621.99	4992
621.85	4986
621.21	4959
621.35	4931
621.11	5049
621.38	5034
621.11	4793
620.90	4790
621.57	4639
626.22	4522
622.79	4447
622.71	4445
623.74	4428
622.89	4426
624.67	4414
624.22	4408
624.63	4397
624.69	4392
624.11	4381
625.35	4336
623.63	4322
623.55	4318
623.50	4310
623.96	4303

Existing Conditions Water Surface Elevation (WSEL)	
10-year (ft)	
WSEL	Flooding Depth
623.0	0.7
622.8	0.6
622.9	1.5
621.8	0.0
621.4	1.5
621.8	1.4
622.0	0.9
622.3	2.3
621.6	0.5
621.4	1.0
622.2	1.0
621.6	0.9
622.1	1.3
621.3	1.7
621.1	1.1
621.1	1.4
620.8	0.4
621.9	0.8
622.4	0.3
622.7	1.2
623.2	1.2
623.3	1.5
622.4	1.1
622.5	1.2
622.1	1.0
622.8	1.4
622.6	1.5
622.6	1.7
623.4	1.9
628.4	2.2
624.4	1.6
624.4	1.7
624.6	0.9
624.4	1.5
624.7	0.0
624.5	0.3
625.2	0.6
625.2	0.5
625.6	1.5
625.5	0.2
624.8	1.2
624.8	1.3
624.8	1.3
624.6	0.6

Proposed Condition Water Surface Elevations and Reductions Alternative 1 "Trunk & Laterals"	
10-year (ft)	
WSEL	Reduction in 10yr WSEL
621.0	-2.1
621.1	-1.8
620.9	-1.9
620.7	-1.1
620.0	-1.4
619.9	-1.8
620.0	-2.0
620.0	-2.3
620.0	-1.7
620.4	-1.0
617.6	-4.6
619.0	-2.6
618.3	-3.7
619.1	-2.2
619.8	-1.3
619.8	-1.3
620.0	-0.7
619.8	-2.1
619.9	-2.5
620.7	-2.0
620.8	-2.4
621.1	-2.2
621.2	-1.2
620.8	-1.7
620.2	-1.9
620.5	-2.2
621.2	-1.4
620.9	-1.6
621.4	-2.1
626.3	-2.2
622.9	-1.6
622.9	-1.6
623.0	-1.7
622.9	-1.5
622.8	-1.9
623.6	-0.9
623.6	-1.6
624.0	-1.2
623.2	-2.4
624.0	-1.5
623.0	-1.9
622.9	-2.0
622.9	-1.9
622.6	-2.0

Proposed Condition Water Surface Elevations and Reductions Alternative 2 "Storage at Community Park"	
10-year (ft)	
WSEL	Reduction in 10yr WSEL
619.1	-4.0
620.4	-2.4
618.7	-4.1
618.5	-3.3
618.8	-2.5
618.8	-3.0
618.8	-3.2
618.8	-3.5
619.6	-2.0
620.0	-1.5
619.9	-2.3
619.3	-2.3
620.7	-1.4
619.2	-2.1
619.1	-2.0
619.1	-2.0
620.0	-0.8
618.5	-3.4
620.8	-1.6
616.9	-5.8
618.8	-4.4
617.1	-6.2
620.1	-2.3
617.9	-4.6
618.2	-3.9
618.5	-4.3
619.4	-3.2
618.5	-4.0
621.7	-1.7
623.9	-4.5
622.9	-1.5
622.8	-1.6
623.0	-1.6
623.0	-1.5
622.4	-2.3
624.4	-0.2
623.3	-1.9
623.7	-1.5
622.3	-3.3
623.7	-1.9
621.9	-3.0
621.7	-3.2
621.5	-3.3
620.9	-3.6

Proposed Condition Water Surface Elevations and Reductions Alternative 3 "Storage at Thornwood, Centennial and Hibbard Parks"	
10-year (ft)	
WSEL	Reduction in 10yr WSEL
622.5	-0.5
621.8	-1.1
621.6	-1.3
621.5	-0.3
620.3	-1.0
620.2	-1.6
621.2	-0.8
620.4	-1.9
620.7	-0.9
620.4	-1.1
620.8	-1.4
620.9	-0.7
621.5	-0.6
620.7	-0.6
619.9	-1.3
619.8	-1.3
620.2	-0.5
621.8	-0.1
622.0	-0.3
622.6	-0.1
621.6	-1.6
623.3	-0.1
621.6	-0.7
620.6	-1.9
621.0	-1.1
622.5	-0.3
620.2	-2.4
619.9	-2.7
619.3	-4.1
628.4	-0.1
622.5	-1.9
622.5	-2.0
622.6	-2.1
622.6	-1.9
622.4	-2.3
624.1	-0.4
623.5	-1.7
623.9	-1.3
622.8	-2.8
624.8	-0.7
624.5	-0.3
624.5	-0.3
624.2	-0.6
622.7	-1.9

Location	Location ID
Romona/Iroquois	D
Shabona/Seminole	
Romona/Blackhawk	
Chilton	E
Kilpatrick/Hartzell	M
Valley View Rear Yards	
Valley View	
Thelin	
Lilac/Millbrook	
Kilpatrick/Gregory	
Lavergne N	K
Central/Laporte	
Lacrosse	
Greenleaf E	
Nina	L
Hill	
Lavergne S	
Central/Knox	J
Romona/Wilmette	F
Birchwood/Kenneth/Alison	
Redbud/Orchard W	
Orchard/Locust/Hawthorne	G
Greenleaf/Locust/Laurel	
Brookside	I
Sunset	
Beverly	
Wilshire E	
Wilshire W	H
Meadow	
Washington/Pinecrest	C
Beechwood E	A
Beechwood W	
Kenilworth W	
Kenilworth E	
Chestnut W	
Chestnut E	
Thornwood W	
Thornwood E	
Greenwood	
Elmwood	B
Miami	
Pawnee	
Iroquois E	
Hunter S	

Lowest Ground Elevation	XP-SWMM ID
spot shot (LIDAR)	Node
622.31	5577
622.21	5400
621.38	5380
622.21	5356
619.83	5571
620.39	5193
621.09	5191
619.98	5167
621.12	4912
620.44	4880
621.18	5136
620.64	5127
620.78	5104
619.59	5090
620.02	4907
619.71	4873
620.41	4841
621.08	5074
622.03	5064
621.50	5018
621.99	4992
621.85	4986
621.21	4959
621.35	4931
621.11	5049
621.38	5034
621.11	4793
620.90	4790
621.57	4639
626.22	4522
622.79	4447
622.71	4445
623.74	4428
622.89	4426
624.67	4414
624.22	4408
624.63	4397
624.69	4392
624.11	4381
625.35	4336
623.63	4322
623.55	4318
623.50	4310
623.96	4303

Existing Conditions Water Surface Elevation (WSEL)	
25-year (ft)	
WSEL	Flooding Depth
623.4	1.1
623.4	1.2
623.4	2.0
622.9	0.7
621.7	1.8
622.1	1.7
622.3	1.2
622.7	2.7
621.8	0.7
621.8	1.3
622.4	1.3
621.9	1.3
622.4	1.6
621.7	2.1
621.5	1.4
621.4	1.7
621.3	0.9
622.2	1.1
622.7	0.7
623.0	1.5
623.5	1.5
623.6	1.8
622.7	1.5
622.9	1.6
622.4	1.3
622.9	1.6
622.9	1.8
622.9	2.0
623.7	2.1
628.8	2.6
624.9	2.2
624.9	2.2
625.0	1.2
624.9	2.1
625.3	0.6
624.9	0.7
625.4	0.7
625.2	0.5
626.0	1.9
625.9	0.5
625.3	1.7
625.3	1.8
625.3	1.8
625.2	1.2

Proposed Condition Water Surface Elevations and Reductions Alternative 1 "Trunk & Laterals"	
25-year (ft)	
WSEL	Reduction in 25yr WSEL
622.9	-0.5
623.0	-0.4
622.8	-0.6
622.9	-0.1
621.2	-0.4
621.3	-0.8
621.5	-0.8
621.5	-1.2
621.4	-0.5
621.6	-0.2
618.9	-3.5
620.7	-1.2
620.7	-1.7
620.6	-1.0
621.1	-0.4
620.9	-0.4
621.0	-0.3
621.4	-0.8
621.4	-1.2
622.4	-0.7
622.5	-1.0
622.8	-0.8
622.4	-0.3
622.3	-0.6
621.8	-0.7
622.1	-0.8
622.6	-0.3
622.5	-0.4
622.9	-0.8
627.9	-1.0
624.4	-0.6
624.4	-0.6
624.4	-0.6
624.4	-0.6
624.7	-0.6
624.5	-0.4
625.1	-0.2
625.2	0.0
625.0	-1.0
625.7	-0.2
624.6	-0.7
624.5	-0.8
624.5	-0.8
624.2	-1.0

Proposed Condition Water Surface Elevations and Reductions Alternative 2 "Storage at Community Park"	
25-year (ft)	
WSEL	Reduction in 25yr WSEL
622.9	-0.5
623.0	-0.3
622.8	-0.5
622.7	-0.2
621.6	-0.1
621.6	-0.4
621.7	-0.6
621.8	-0.9
621.5	-0.3
621.5	-0.2
621.7	-0.7
621.2	-0.7
621.9	-0.5
621.0	-0.6
621.2	-0.3
621.1	-0.3
621.1	-0.2
621.6	-0.6
622.5	-0.2
622.8	-0.2
622.3	-1.2
623.0	-0.6
622.6	-0.1
622.5	-0.4
622.1	-0.4
622.2	-0.7
622.5	-0.4
622.5	-0.4
623.1	-0.6
627.7	-1.2
624.5	-0.4
624.5	-0.4
624.6	-0.4
624.5	-0.4
624.7	-0.6
624.5	-0.4
625.1	-0.2
625.2	0.0
625.0	-1.0
625.7	-0.2
624.4	-0.9
624.4	-0.9
624.5	-0.8
624.9	-0.3

Proposed Condition Water Surface Elevations and Reductions Alternative 3 "Storage at Thornwood, Centennial and Hibbard Parks"	
25-year (ft)	
WSEL	Reduction in 25yr WSEL
623.2	-0.2
623.2	-0.2
623.2	-0.2
622.9	0.0
621.4	-0.3
621.5	-0.6
622.1	-0.2
621.5	-1.2
621.5	-0.4
621.5	-0.3
621.6	-0.8
621.7	-0.2
622.0	-0.4
621.4	-0.3
621.2	-0.3
621.1	-0.3
621.1	-0.2
622.2	0.0
622.5	-0.2
622.9	-0.1
622.7	-0.8
623.6	0.0
622.3	-0.4
622.4	-0.5
622.1	-0.3
622.9	0.0
622.4	-0.5
622.4	-0.5
622.6	-1.1
628.8	0.0
624.4	-0.5
624.4	-0.5
624.6	-0.4
624.4	-0.5
625.4	0.0
624.5	-0.4
625.0	-0.3
625.2	0.0
625.0	-1.0
625.7	-0.2
625.0	-0.3
625.0	-0.3
625.0	-0.3
625.0	-0.2

Location	Location ID
Romona/Iroquois	D
Shabona/Seminole	
Romona/Blackhawk	
Chilton	E
Kilpatrick/Hartzell	M
Valley View Rear Yards	
Valley View	
Thelin	
Lilac/Millbrook	
Kilpatrick/Gregory	K
Lavergne N	
Central/Laporte	
Lacrosse	
Greenleaf E	
Nina	L
Hill	
Lavergne S	
Central/Knox	J
Romona/Wilmette	F
Birchwood/Kenneth/Alison	
Redbud/Orchard W	
Orchard/Locust/Hawthorne	G
Greenleaf/Locust/Laurel	
Sunset	I
Beverly	
Brookside	
Wilshire E	
Wilshire W	
Meadow	H
Washington/Pinecrest	C
Beechwood E	A
Beechwood W	
Kenilworth W	
Kenilworth E	
Chestnut W	
Chestnut E	
Thornwood W	
Thornwood E	
Greenwood	
Elmwood	B
Miami	
Pawnee	
Iroquois E	
Hunter S	

Lowest Ground Elevation	XP-SWMM ID
spot shot (LIDAR)	Node
622.31	5577
622.21	5400
621.38	5380
622.21	5356
619.83	5571
620.39	5193
621.09	5191
619.98	5167
621.12	4912
620.44	4880
621.18	5136
620.64	5127
620.78	5104
619.59	5090
620.02	4907
619.71	4873
620.41	4841
621.08	5074
622.03	5064
621.50	5018
621.99	4992
621.85	4986
621.21	4959
621.11	5049
621.38	5034
621.35	4931
621.11	4793
620.90	4790
621.57	4639
626.22	4522
622.79	4447
622.71	4445
623.74	4428
622.89	4426
624.67	4414
624.22	4408
624.63	4397
624.69	4392
624.11	4381
625.35	4336
623.63	4322
623.55	4318
623.50	4310
623.96	4303

Existing Conditions Water Surface Elevation (WSEL)	
50-year (ft)	
WSEL	Flooding Depth
623.7	1.4
623.7	1.5
623.7	2.3
623.1	0.9
621.9	2.1
622.4	2.0
622.4	1.3
623.0	3.0
622.1	1.0
622.0	1.6
622.6	1.4
622.1	1.5
622.7	1.9
622.0	2.4
621.7	1.6
621.6	1.9
621.6	1.2
622.4	1.3
622.9	0.9
623.2	1.7
623.7	1.7
623.7	1.9
622.9	1.7
622.6	1.5
623.0	1.7
623.2	1.8
623.1	2.0
623.1	2.2
623.9	2.3
629.2	2.9
625.3	2.5
625.3	2.6
625.3	1.6
625.3	2.4
625.6	1.0
625.3	1.1
625.7	1.0
625.3	0.6
626.2	2.1
625.9	0.5
625.7	2.1
625.7	2.2
625.7	2.2
625.7	1.7

Proposed Condition Water Surface Elevations and Reductions Alternative 1 "Trunk & Laterals"	
50-year (ft)	
WSEL	Reduction in 50yr WSEL
623.4	-0.3
623.4	-0.3
623.4	-0.3
623.1	0.0
621.6	-0.3
621.7	-0.6
622.0	-0.4
622.1	-0.9
621.7	-0.3
621.9	-0.1
619.5	-3.1
621.3	-0.9
621.5	-1.1
621.1	-0.9
621.4	-0.2
621.3	-0.3
621.4	-0.2
621.9	-0.5
621.9	-1.0
622.6	-0.5
623.0	-0.7
623.3	-0.4
622.7	-0.2
622.2	-0.5
622.5	-0.5
622.7	-0.5
622.9	-0.2
622.9	-0.2
622.9	-0.2
623.3	-0.6
628.4	-0.8
624.9	-0.4
624.9	-0.4
624.9	-0.4
624.9	-0.4
624.9	-0.7
624.9	-0.4
625.3	-0.3
625.2	-0.1
625.5	-0.8
625.9	0.0
625.2	-0.5
624.9	-0.8
624.9	-0.8
624.7	-1.0

Proposed Condition Water Surface Elevations and Reductions Alternative 2 "Storage at Community Park"	
50-year (ft)	
WSEL	Reduction in 50yr WSEL
623.4	-0.3
623.4	-0.3
623.4	-0.3
622.9	-0.2
621.9	0.0
622.1	-0.3
622.1	-0.3
622.2	-0.8
621.9	-0.2
621.9	-0.1
622.1	-0.5
621.8	-0.3
622.3	-0.4
621.6	-0.4
621.6	0.0
621.5	-0.1
621.5	-0.1
622.0	-0.4
622.8	-0.1
623.1	-0.1
622.9	-0.7
623.4	-0.3
622.6	-0.3
622.4	-0.3
622.6	-0.5
622.8	-0.3
622.9	-0.2
622.9	-0.2
622.9	-0.2
623.5	-0.4
628.3	-0.9
625.0	-0.3
625.0	-0.3
625.0	-0.3
625.0	-0.3
625.1	-0.5
625.0	-0.3
625.4	-0.3
625.2	-0.1
625.5	-0.7
625.9	0.0
625.2	-0.5
624.9	-0.8
625.0	-0.7
625.0	-0.6

Proposed Condition Water Surface Elevations and Reductions Alternative 3 "Storage at Thornwood, Centennial and Hibbard Parks"	
50-year (ft)	
WSEL	Reduction in 50yr WSEL
623.6	-0.1
623.6	-0.1
623.6	-0.1
623.1	0.0
621.7	-0.2
621.8	-0.5
622.3	0.0
621.9	-1.1
621.8	-0.3
621.8	-0.2
622.1	-0.5
622.1	-0.1
622.3	-0.4
621.8	-0.2
621.5	-0.2
621.4	-0.2
621.5	-0.1
622.4	0.0
622.8	-0.1
623.1	0.0
623.2	-0.5
623.7	0.0
622.7	-0.2
622.4	-0.2
623.0	0.0
622.9	-0.3
622.8	-0.3
622.8	-0.3
623.1	-0.8
629.1	0.0
625.0	-0.3
625.0	-0.3
625.0	-0.3
625.0	-0.3
625.5	-0.1
625.0	-0.3
625.3	-0.4
625.2	-0.1
625.5	-0.7
625.9	0.0
625.5	-0.2
625.4	-0.3
625.4	-0.3
625.3	-0.4

Location	Location ID
Romona/Iroquois	D
Shabona/Seminole	
Romona/Blackhawk	
Chilton	E
Kilpatrick/Hartzell	M
Valley View Rear Yards	
Valley View	
Thelin	
Lilac/Millbrook	
Kilpatrick/Gregory	
Lavergne N	K
Central/Laporte	
Lacrosse	
Greenleaf E	
Nina	L
Hill	
Lavergne S	
Central/Knox	J
Romona/Wilmette	F
Birchwood/Kenneth/Alison	
Redbud/Orchard W	
Orchard/Locust/Hawthorne	G
Greenleaf/Locust/Laurel	
Brookside	I
Sunset	
Beverly	
Wilshire E	
Wilshire W	H
Meadow	
Washington/Pinecrest	C
Beechwood E	A
Beechwood W	
Kenilworth W	
Kenilworth E	
Chestnut W	
Chestnut E	
Thornwood W	
Thornwood E	
Greenwood	
Elmwood	B
Miami	
Pawnee	
Iroquois E	
Hunter S	

Lowest Ground Elevation	XP-SWMM ID
spot shot (LIDAR)	Node
622.31	5577
622.21	5400
621.38	5380
622.21	5356
619.83	5571
620.39	5193
621.09	5191
619.98	5167
621.12	4912
620.44	4880
621.18	5136
620.64	5127
620.78	5104
619.59	5090
620.02	4907
619.71	4873
620.41	4841
621.08	5074
622.03	5064
621.50	5018
621.99	4992
621.85	4986
621.21	4959
621.35	4931
621.11	5049
621.38	5034
621.11	4793
620.90	4790
621.57	4639
626.22	4522
622.79	4447
622.71	4445
623.74	4428
622.89	4426
624.67	4414
624.22	4408
624.63	4397
624.69	4392
624.11	4381
625.35	4336
623.63	4322
623.55	4318
623.50	4310
623.96	4303

Existing Conditions Water Surface Elevation (WSEL)	
100-year (ft)	
WSEL	Flooding Depth
623.9	1.6
623.9	1.7
623.9	2.6
623.3	1.0
622.2	2.4
622.5	2.1
622.5	1.4
623.2	3.3
622.3	1.2
622.3	1.8
622.7	1.6
622.5	1.8
622.8	2.0
622.3	2.7
621.9	1.8
621.8	2.0
621.8	1.4
622.6	1.5
623.1	1.0
623.3	1.8
623.8	1.8
623.8	2.0
623.1	1.9
623.4	2.1
622.9	1.8
623.2	1.8
623.3	2.2
623.3	2.4
624.1	2.6
629.5	3.3
625.7	2.9
625.7	3.0
625.7	2.0
625.7	2.8
625.8	1.2
625.7	1.5
625.8	1.2
625.7	1.0
626.4	2.3
626.0	0.6
626.0	2.4
626.0	2.4
626.0	2.5
626.0	2.0

Proposed Condition Water Surface Elevations and Reductions Alternative 1 "Trunk & Laterals"	
100-year (ft)	
WSEL	Reduction in 100yr WSEL
623.8	-0.2
623.8	-0.2
623.8	-0.2
623.2	0.0
622.0	-0.2
622.1	-0.3
622.3	-0.2
622.5	-0.8
622.1	-0.3
622.2	-0.1
620.1	-2.6
621.7	-0.8
622.0	-0.9
621.6	-0.7
621.7	-0.1
621.6	-0.2
621.7	-0.1
622.2	-0.3
622.3	-0.7
622.9	-0.4
623.4	-0.4
623.6	-0.2
623.0	-0.1
623.1	-0.4
622.6	-0.3
622.8	-0.3
623.2	-0.1
623.2	-0.1
623.6	-0.5
628.8	-0.6
625.3	-0.4
625.3	-0.4
625.3	-0.4
625.3	-0.4
625.3	-0.6
625.3	-0.4
625.4	-0.4
625.3	-0.4
625.9	-0.5
625.9	-0.1
625.5	-0.4
625.4	-0.6
625.4	-0.6
625.1	-0.9

Proposed Condition Water Surface Elevations and Reductions Alternative 2 "Storage at Community Park"	
100-year (ft)	
WSEL	Reduction in 100yr WSEL
623.7	-0.2
623.7	-0.2
623.7	-0.2
623.2	-0.1
622.3	0.0
622.4	-0.1
622.4	-0.1
622.5	-0.8
622.2	-0.1
622.2	-0.1
622.4	-0.3
622.2	-0.3
622.6	-0.2
622.0	-0.3
621.9	0.0
621.8	0.0
621.8	0.0
622.2	-0.3
623.0	-0.1
623.3	0.0
623.2	-0.6
623.7	-0.1
623.0	-0.2
623.1	-0.3
622.7	-0.2
622.9	-0.3
623.1	-0.1
623.1	-0.1
623.8	-0.3
628.8	-0.7
625.4	-0.3
625.4	-0.3
625.4	-0.3
625.4	-0.3
625.5	-0.3
625.4	-0.3
625.5	-0.3
625.4	-0.3
626.0	-0.5
625.9	-0.1
625.5	-0.4
625.4	-0.5
625.4	-0.5
625.4	-0.7

Proposed Condition Water Surface Elevations and Reductions Alternative 3 "Storage at Thornwood, Centennial and Hibbard Parks"	
100-year (ft)	
WSEL	Reduction in 100yr WSEL
623.9	-0.1
623.9	-0.1
623.9	-0.1
623.3	0.0
622.1	-0.1
622.2	-0.3
622.4	-0.1
622.3	-0.9
622.1	-0.2
622.1	-0.1
622.4	-0.4
622.3	-0.1
622.6	-0.2
622.3	-0.1
621.8	-0.1
621.7	-0.1
621.7	0.0
622.6	0.0
623.0	0.0
623.3	0.0
623.6	-0.1
623.8	0.0
623.0	-0.1
623.3	-0.1
622.8	-0.1
623.1	0.0
623.1	-0.2
623.1	-0.2
623.5	-0.6
629.5	0.0
625.4	-0.3
625.4	-0.3
625.4	-0.3
625.4	-0.3
625.6	-0.2
625.4	-0.3
625.7	-0.2
625.4	-0.3
626.0	-0.5
625.9	-0.1
625.8	-0.2
625.8	-0.2
625.8	-0.2
625.8	-0.3

Appendix 3 – Cost Estimates



Christopher B. Burke Engineering, Ltd.
9575 West Higgins Road, Suite 600
Rosemont, Illinois 60018
Project Number: 13-0605
Date: January 8, 2015

Village of Wilmette, Proposed Storm Sewer Improvements
ALTERNATIVE 1 - New Trunk and Lateral Storm Sewer Relief System

ITEMS	UNIT	QUANTITY	UNIT PRICE	TOTAL COST
TREE ROOT PRUNING	EACH	50	\$145.00	\$7,250.00
TREE PRUNING (1 TO 10 INCH DIAMETER)	EACH	50	\$129.00	\$6,450.00
TREE PRUNING (OVER 10 INCH DIAMETER)	EACH	50	\$170.00	\$8,500.00
TREE PROTECTION	EACH	50	\$100.00	\$5,000.00
TOPSOIL FURNISH AND PLACE	SQ YD	13,000	\$7.00	\$91,000.00
SODDING, SPECIAL	SQ YD	13,000	\$11.00	\$143,000.00
REMOVAL AND DISPOSAL OF UNSUITABLE MATERIAL	CU YD	3,000	\$45.00	\$135,000.00
TRENCH BACKFILL, CA-7	CU YD	145,000	\$30.00	\$4,350,000.00
AGGREGATE SUBGRADE IMPROVEMENT	CU YD	3,000	\$54.00	\$162,000.00
AGGREGATE FOR TEMPORARY ACCESS	TON	500	\$22.00	\$11,000.00
BITUMINOUS MATERIALS (PRIME COAT)	GAL	14,000	\$3.00	\$42,000.00
AGGREGATE (PRIME COAT)	TON	300	\$15.00	\$4,500.00
LEVELING BINDER (MACHINE METHOD), N50	TON	4,500	\$88.00	\$396,000.00
HOT-MIX ASPHALT BINDER COURSE, IL-19.0, N50 6"	TON	19,500	\$76.00	\$1,482,000.00
HOT-MIX ASPHALT SURFACE COURSE, MIX "D", N50 2.5"	TON	8,000	\$89.00	\$712,000.00
HOT-MIX ASPHALT SURFACE COURSE, MIX "D", N50 1.5"	TON	9,000	\$89.00	\$801,000.00
AGGREGATE BASE COURSE, 10"	SQ YD	60,000	\$12.00	\$720,000.00
PORTLAND CEMENT CONCRETE SIDEWALK 5 INCH	SQ FT	2,500	\$6.00	\$15,000.00
SIDEWALK REMOVAL	SQ FT	2,500	\$2.00	\$5,000.00
DETECTABLE WARNINGS	SQ FT	1,000	\$43.00	\$43,000.00
PAVEMENT REMOVAL	SQ YD	60,000	\$13.50	\$810,000.00
HOT-MIX ASPHALT SURFACE REMOVAL, 2"	SQ YD	86,000	\$5.00	\$430,000.00
COMBINATION CONCRETE CURB AND GUTTER REMOVAL AND REPLACEMENT	FOOT	50,000	\$24.00	\$1,200,000.00
CLASS B PATCH, SPECIAL	SQ YD	1,200	\$90.00	\$108,000.00
CLASS D PATCH, SPECIAL	SQ YD	33,000	\$93.00	\$3,069,000.00
STORM SEWER REMOVAL, 8"	FOOT	50	\$10.00	\$500.00
STORM SEWER REMOVAL, 12"	FOOT	2,600	\$10.00	\$26,000.00
STORM SEWER REMOVAL, 15"	FOOT	1,020	\$10.00	\$10,200.00
STORM SEWER REMOVAL, 21"	FOOT	454	\$10.00	\$4,540.00
STORM SEWER REMOVAL, 24"	FOOT	150	\$10.00	\$1,500.00
STORM SEWER REMOVAL, 27"	FOOT	1,080	\$10.00	\$10,800.00
STORM SEWER REMOVAL, 30"	FOOT	1,370	\$20.00	\$27,400.00
STORM SEWER REMOVAL, 36"	FOOT	665	\$20.00	\$13,300.00
STORM SEWER REMOVAL, 48"	FOOT	604	\$20.00	\$12,080.00
STORM SEWER REMOVAL, 54"	FOOT	533	\$20.00	\$10,660.00
STORM SEWER REMOVAL, 60"	FOOT	137	\$20.00	\$2,740.00
STORM SEWERS, 24" RCP	FOOT	11,620	\$192.00	\$2,231,040.00
STORM SEWERS, 27" RCP	FOOT	1,800	\$205.00	\$369,000.00
STORM SEWERS, 30" RCP	FOOT	400	\$218.00	\$87,200.00
STORM SEWERS, 36" RCP	FOOT	2,785	\$252.00	\$701,820.00
STORM SEWERS, 42" RCP	FOOT	2,475	\$300.00	\$742,500.00
STORM SEWERS, 48" RCP	FOOT	4,460	\$328.00	\$1,462,880.00
STORM SEWERS, 60" RCP	FOOT	2,520	\$414.00	\$1,043,280.00
STORM SEWERS, 66" RCP	FOOT	480	\$468.00	\$224,640.00
STORM SEWERS, 72" RCP	FOOT	2,420	\$650.00	\$1,573,000.00
STORM SEWERS, 84" RCP	FOOT	6,920	\$1,000.00	\$6,920,000.00
STORM SEWERS, 96" RCP	FOOT	1,300	\$1,152.00	\$1,497,600.00
STORM SEWERS, 108" RCP	FOOT	2,650	\$1,500.00	\$3,975,000.00
STORM SEWERS, 108" RCP (AUGURED)	FOOT	350	\$5,500.00	\$1,925,000.00
PRECAST CONCRETE BOX CULVERTS 10' X 7'	FOOT	4,100	\$1,800.00	\$7,380,000.00
PRECAST CONCRETE BOX CULVERTS 10' X 7' (AUGURED)	FOOT	100	\$6,000.00	\$600,000.00
JUNCTION BOX	EACH	4	\$150,000.00	\$600,000.00
MANHOLES, TYPE A, WITH RISER	EACH	30	\$8,000.00	\$240,000.00
MANHOLES, TYPE A, 4'-DIAMETER, TYPE 1 FRAME, CLOSED LID	EACH	58	\$3,600.00	\$208,800.00
MANHOLES, TYPE A, 5'-DIAMETER, TYPE 1 FRAME, CLOSED LID	EACH	24	\$5,200.00	\$124,800.00
MANHOLES, TYPE A, 6'-DIAMETER, TYPE 1 FRAME, CLOSED LID	EACH	9	\$7,300.00	\$65,700.00
MANHOLES, TYPE A, 7'-DIAMETER, TYPE 1 FRAME, CLOSED LID	EACH	19	\$11,000.00	\$209,000.00
MANHOLES, TYPE A, 8'-DIAMETER, TYPE 1 FRAME, CLOSED LID	EACH	17	\$16,500.00	\$280,500.00
MANHOLES, TYPE A, 9'-DIAMETER, TYPE 1 FRAME, CLOSED LID	EACH	6	\$20,000.00	\$120,000.00
MANHOLES, TYPE A, 10'x10', TYPE 1 FRAME, CLOSED LID	EACH	5	\$48,000.00	\$240,000.00
PUMP STATION UPDATED - 6th PUMP	L. SUM	1	\$750,000.00	\$750,000.00
RELOCATE WATER SERVICE LINE, LONG SIDE	EACH	269	\$3,600.00	\$968,400.00
REMOVE AND REPLACE WATER MAIN	FOOT	12,850	\$240.00	\$3,084,000.00
RELOCATE SANITARY SEWER SERVICE LINE	EACH	219	\$1,900.00	\$416,100.00
REMOVE AND REPLACE SANITARY MAIN	FOOT	11,660	\$150.00	\$1,749,000.00
THERMOPLASTIC PAVEMENT MARKINGS	L. SUM	1	\$25,000.00	\$25,000.00
TRAFFIC CONTROL	L. SUM	1	\$750,000.00	\$750,000.00
CONSTRUCTION LAYOUT	L. SUM	1	\$200,000.00	\$200,000.00

SUBTOTAL = \$55,640,680.00
CONTINGENCY (20%) = \$11,128,136.00
CONSTRUCTION TOTAL = \$66,768,816.00

DESIGN ENGINEERING (6%) = \$4,006,128.96
CONSTRUCTION OBSERVATION (6%) = \$4,006,128.96
PERMITTING = \$250,000.00

TOTAL PROJECT COST INCLUDING ENGINEERING = \$75,031,073.92

NOTES:

1. THIS ESTIMATE DOES NOT INCLUDE ROW ACQUISTION, TEMPORARY OR CONSTRUCTION EASEMENTS, OR RELOCATING ANY EXISTING UTILITIES.
 2. THESE UNIT PRICES ARE BASED ON OUR DESIGN MEMO DATED DECEMBER 5, 2014 AND ARE 2014 CONSTRUCTION COSTS.
 3. PAVEMENT THICKNESS REMOVAL WAS ASSUMED TO BE 21".
 4. TRENCH BACKFILL IS INCLUDED IN THE COST OF THE WATER MAIN AND SANITARY MAIN REMOVAL AND REPLACEMENT.
- N:\wilmette\130605\Civil\Spreadsheets\Final Cost Estimates_011515.xlsx

CATEGORY	TOTAL COST
UNDERGROUND	\$37,987,480.00
PAVING	\$10,107,500.00
WM RELOCATION	\$4,196,400.00
SANITARY RELOCATION	\$2,309,100.00
MISCELLANEOUS	\$1,040,200.00
TOTAL	\$55,640,680.00

Christopher B. Burke Engineering, Ltd.
9575 West Higgins Road, Suite 600
Rosemont, Illinois 60018
Project Number: 13-0605
Date: January 8, 2015

Village of Wilmette, Proposed Storm Sewer Improvements
ALTERNATIVE 2 - Centralized Storage at Community Playfield

ITEMS	UNIT	QUANTITY	UNIT PRICE	TOTAL COST
TREE ROOT PRUNING	EACH	50	\$145.00	\$7,250.00
TREE PRUNING (1 TO 10 INCH DIAMETER)	EACH	50	\$129.00	\$6,450.00
TREE PRUNING (OVER 10 INCH DIAMETER)	EACH	50	\$170.00	\$8,500.00
TREE PROTECTION	EACH	50	\$100.00	\$5,000.00
EARTH EXCAVATION	CU YD	89,000	\$44.00	\$3,916,000.00
UNDERGROUND STORAGE TANK	AC-FT	55	\$300,000.00	\$16,500,000.00
TOPSOIL FURNISH AND PLACE	SQ YD	7,000	\$7.00	\$49,000.00
SODDING, SPECIAL	SQ YD	7,000	\$11.00	\$77,000.00
SYNTHETIC TURF SURFACE	SQ FT	205,000	\$6.00	\$1,230,000.00
STONE BASE COURSE FOR TURF SURFACE, CA-7, 14"	SQ YD	23,000	\$15.00	\$345,000.00
LIME SOIL STABILIZATION	TON	6,600	\$80.00	\$528,000.00
UNDERDRAINS FOR TURF SURFACE (1"x12")	FOOT	9,500	\$15.00	\$142,500.00
REMOVAL AND DISPOSAL OF UNSUITABLE MATERIAL	CU YD	1,000	\$45.00	\$45,000.00
TRENCH BACKFILL, CA-7	CU YD	87,700	\$30.00	\$2,631,000.00
AGGREGATE SUBGRADE IMPROVEMENT	CU YD	1,000	\$54.00	\$54,000.00
AGGREGATE FOR TEMPORARY ACCESS	TON	500	\$22.00	\$11,000.00
BITUMINOUS MATERIALS (PRIME COAT)	GAL	10,500	\$3.00	\$31,500.00
AGGREGATE (PRIME COAT)	TON	230	\$15.00	\$3,450.00
LEVELING BINDER (MACHINE METHOD), N50	TON	2,100	\$88.00	\$184,800.00
HOT-MIX ASPHALT BINDER COURSE, IL-19.0, N50 6"	TON	6,500	\$76.00	\$494,000.00
HOT-MIX ASPHALT SURFACE COURSE, MIX "D", N50 2.5"	TON	2,700	\$89.00	\$240,300.00
HOT-MIX ASPHALT SURFACE COURSE, MIX "D", N50 1.5"	TON	7,850	\$89.00	\$698,650.00
AGGREGATE BASE COURSE, 10"	SQ YD	27,000	\$12.00	\$324,000.00
PORTLAND CEMENT CONCRETE SIDEWALK 5 INCH	SQ FT	2,500	\$6.00	\$15,000.00
SIDEWALK REMOVAL	SQ FT	2,500	\$2.00	\$5,000.00
DETECTABLE WARNINGS	SQ FT	1,000	\$43.00	\$43,000.00
PAVEMENT REMOVAL	SQ YD	20,000	\$13.50	\$270,000.00
HOT-MIX ASPHALT SURFACE REMOVAL, 2"	SQ YD	90,000	\$5.00	\$450,000.00
COMBINATION CONCRETE CURB AND GUTTER REMOVAL AND REPLACEMENT	FOOT	33,500	\$24.00	\$804,000.00
CLASS B PATCH, SPECIAL	SQ YD	350	\$90.00	\$31,500.00
CLASS D PATCH, SPECIAL	SQ YD	31,200	\$93.00	\$2,901,600.00
STORM SEWER REMOVAL, 8"	FOOT	50	\$10.00	\$500.00
STORM SEWER REMOVAL, 12"	FOOT	29	\$10.00	\$290.00
STORM SEWER REMOVAL, 15"	FOOT	100	\$10.00	\$1,000.00
STORM SEWER REMOVAL, 21"	FOOT	144	\$10.00	\$1,440.00
STORM SEWER REMOVAL, 36"	FOOT	665	\$20.00	\$13,300.00
STORM SEWER REMOVAL, 48"	FOOT	635	\$20.00	\$12,700.00
STORM SEWER REMOVAL, 54"	FOOT	791	\$20.00	\$15,820.00
STORM SEWER REMOVAL, 60"	FOOT	503	\$20.00	\$10,060.00
STORM SEWERS, 24" RCP	FOOT	12,795	\$192.00	\$2,456,640.00
STORM SEWERS, 30" RCP	FOOT	2,225	\$218.00	\$485,050.00
STORM SEWERS, 36" RCP	FOOT	3,300	\$252.00	\$831,600.00
STORM SEWERS, 48" RCP	FOOT	5,940	\$328.00	\$1,948,320.00
STORM SEWERS, 60" RCP	FOOT	3,675	\$414.00	\$1,521,450.00
STORM SEWERS, 72" RCP	FOOT	2,460	\$650.00	\$1,599,000.00
STORM SEWERS, 78" RCP	FOOT	1,500	\$875.00	\$1,312,500.00
STORM SEWERS, 84" RCP	FOOT	685	\$1,000.00	\$685,000.00
MANHOLES, TYPE A, 4'-DIAMETER, TYPE 1 FRAME, CLOSED LID	EACH	55	\$3,600.00	\$198,000.00
MANHOLES, TYPE A, 5'-DIAMETER, TYPE 1 FRAME, CLOSED LID	EACH	27	\$5,200.00	\$140,400.00
MANHOLES, TYPE A, 6'-DIAMETER, TYPE 1 FRAME, CLOSED LID	EACH	18	\$7,300.00	\$131,400.00
MANHOLES, TYPE A, 7'-DIAMETER, TYPE 1 FRAME, CLOSED LID	EACH	19	\$11,000.00	\$209,000.00
MANHOLES, TYPE A, 8'-DIAMETER, TYPE 1 FRAME, CLOSED LID	EACH	9	\$16,500.00	\$148,500.00
MANHOLES, TYPE A, 9'-DIAMETER, TYPE 1 FRAME, CLOSED LID	EACH	5	\$20,000.00	\$100,000.00
MANHOLES, TYPE A, 10'x10', TYPE 1 FRAME, CLOSED LID	EACH	9	\$48,000.00	\$432,000.00
PUMP FOR UNDERGROUND STORAGE BASIN	L. SUM	1	\$750,000.00	\$750,000.00
PUMP STATION UPDATED - 6th PUMP	L. SUM	1	\$750,000.00	\$750,000.00
STABILIZED CONSTRUCTION ENTRANCE	L. SUM	1	\$15,000.00	\$15,000.00
RELOCATE WATER SERVICE LINE, LONG SIDE	EACH	197	\$3,600.00	\$709,200.00
REMOVE AND REPLACE WATER MAIN	FOOT	11,000	\$240.00	\$2,640,000.00
RELOCATE SANITARY SEWER SERVICE LINE	EACH	201	\$1,900.00	\$381,900.00
REMOVE AND REPLACE SANITARY MAIN	FOOT	5,840	\$150.00	\$876,000.00
SOIL EROSION/SEDIMENT CONTROL	L. SUM	1	\$250,000.00	\$250,000.00
THERMOPLASTIC PAVEMENT MARKINGS	L. SUM	1	\$25,000.00	\$25,000.00
TRAFFIC CONTROL	L. SUM	1	\$750,000.00	\$750,000.00
CONSTRUCTION LAYOUT	L. SUM	1	\$200,000.00	\$200,000.00

SUBTOTAL =	\$51,653,570.00
CONTINGENCY (20%) =	\$10,330,714.00
CONSTRUCTION TOTAL =	\$61,984,284.00
DESIGN ENGINEERING (6%) =	\$3,719,057.04
CONSTRUCTION OBSERVATION (6%) =	\$3,719,057.04
PERMITTING =	\$250,000.00
TOTAL PROJECT COST INCLUDING ENGINEERING =	\$69,672,398.08

- NOTES:
1. THIS ESTIMATE DOES NOT INCLUDE ROW ACQUISTION, TEMPORARY OR CONSTRUCTION EASEMENTS, OR RELOCATING ANY EXISTING UTILITIES.
 2. THESE UNIT PRICES ARE BASED ON OUR DESIGN MEMO DATED DECEMBER 5, 2014 AND ARE 2014 CONSTRUCTION COSTS.
 3. PAVEMENT THICKNESS REMOVAL WAS ASSUMED TO BE 21".
 4. TRENCH BACKFILL IS INCLUDED IN THE COST OF THE WATER MAIN AND SANITARY MAIN REMOVAL AND REPLACEMENT.

CATEGORY	TOTAL COST
UNDERGROUND	\$14,884,970.00
UNDERGROUND STORAGE	\$23,285,500.00
PAVING	\$6,568,800.00
WM RELOCATION	\$3,475,200.00
SANITARY RELOCATION	\$1,383,900.00
MISCELLANEOUS	\$1,305,200.00
TOTAL	\$50,903,570.00

Christopher B. Burke Engineering, Ltd.
9575 West Higgins Road, Suite 600
Rosemont, Illinois 60018
Project Number: 13-0605
Date: January 8, 2015

Village of Wilmette, Proposed Storm Sewer Improvements
ALTERNATIVE 3 - Neighborhood Stormwater Storage

ITEMS	UNIT	QUANTITY	UNIT PRICE	TOTAL COST
TREE ROOT PRUNING	EACH	50	\$145.00	\$7,250.00
TREE PRUNING (1 TO 10 INCH DIAMETER)	EACH	50	\$129.00	\$6,450.00
TREE PRUNING (OVER 10 INCH DIAMETER)	EACH	50	\$170.00	\$8,500.00
TREE PROTECTION	EACH	50	\$100.00	\$5,000.00
EARTH EXCAVATION (HAUL OFF-SITE)	CU YD	86,700	\$44.00	\$3,814,800.00
EXCAVATION RE-SPREAD (STAY ON-SITE)	CU YD	99,400	\$7.50	\$745,500.00
UNDERGROUND STORAGE TANK	AC-FT	32	\$300,000.00	\$9,600,000.00
TOPSOIL EXCAVATION AND PLACEMENT	SQ YD	41,200	\$6.15	\$253,380.00
TOPSOIL FURNISH AND PLACE	SQ YD	1,100	\$7.00	\$7,700.00
SODDING, SPECIAL	SQ YD	1,100	\$11.00	\$12,100.00
SEEDING	SQ YD	40,100	\$2.00	\$80,200.00
EROSION CONTROL BLANKET	SQ YD	40,100	\$2.00	\$80,200.00
REMOVAL AND DISPOSAL OF UNSUITABLE MATERIAL	CU YD	365	\$45.00	\$16,425.00
TRENCH BACKFILL, CA-7	CU YD	50,000	\$30.00	\$1,500,000.00
AGGREGATE SUBGRADE IMPROVEMENT	CU YD	365	\$54.00	\$19,710.00
AGGREGATE FOR TEMPORARY ACCESS	TON	100	\$22.00	\$2,200.00
BITUMINOUS MATERIALS (PRIME COAT)	GAL	5,200	\$3.00	\$15,600.00
AGGREGATE (PRIME COAT)	TON	130	\$15.00	\$1,950.00
LEVELING BINDER (MACHINE METHOD), N50	TON	625	\$88.00	\$55,000.00
HOT-MIX ASPHALT BINDER COURSE, IL-19.0, N50 6"	TON	2,600	\$76.00	\$197,600.00
HOT-MIX ASPHALT SURFACE COURSE, MIX "D", N50 2.5"	TON	1,100	\$89.00	\$97,900.00
HOT-MIX ASPHALT SURFACE COURSE, MIX "D", N50 1.5"	TON	3,700	\$89.00	\$329,300.00
AGGREGATE BASE COURSE, 10"	SQ YD	7,300	\$12.00	\$87,600.00
PORTLAND CEMENT CONCRETE PAVEMENT, 7"	SQ YD	2,400	\$64.00	\$153,600.00
SUBBASE GRANULAR MATERIAL, TYPE B, 6"	SQ YD	2,400	\$6.00	\$14,400.00
PORTLAND CEMENT CONCRETE SIDEWALK 5 INCH	SQ FT	1,000	\$6.00	\$6,000.00
SIDEWALK REMOVAL	SQ FT	1,000	\$2.00	\$2,000.00
DETECTABLE WARNINGS	SQ FT	750	\$43.00	\$32,250.00
PAVEMENT REMOVAL	SQ YD	7,300	\$13.50	\$98,550.00
HOT-MIX ASPHALT SURFACE REMOVAL, 2"	SQ YD	41,100	\$5.00	\$205,500.00
COMBINATION CONCRETE CURB AND GUTTER REMOVAL AND REPLACEMENT	FOOT	10,000	\$24.00	\$240,000.00
CLASS B PATCH, SPECIAL	SQ YD	1,500	\$90.00	\$135,000.00
CLASS D PATCH, SPECIAL	SQ YD	13,000	\$93.00	\$1,209,000.00
STORM SEWER REMOVAL, 8"	FOOT	50	\$10.00	\$500.00
STORM SEWER REMOVAL, 10"	FOOT	540	\$10.00	\$5,400.00
STORM SEWER REMOVAL, 12"	FOOT	3,676	\$10.00	\$36,760.00
STORM SEWER REMOVAL, 15"	FOOT	2,329	\$10.00	\$23,290.00
STORM SEWER REMOVAL, 18"	FOOT	2,642	\$10.00	\$26,420.00
STORM SEWER REMOVAL, 21"	FOOT	761	\$10.00	\$7,610.00
STORM SEWER REMOVAL, 24"	FOOT	449	\$20.00	\$8,980.00
STORM SEWER REMOVAL, 27"	FOOT	65	\$20.00	\$1,300.00
STORM SEWER REMOVAL, 30"	FOOT	615	\$20.00	\$12,300.00
STORM SEWER REMOVAL, 36"	FOOT	836	\$20.00	\$16,720.00
STORM SEWER REMOVAL, 48"	FOOT	1,006	\$20.00	\$20,120.00
STORM SEWER REMOVAL, 54"	FOOT	533	\$20.00	\$10,660.00
STORM SEWER REMOVAL, 60"	FOOT	137	\$20.00	\$2,740.00
STORM SEWERS, 12" RCP	FOOT	600	\$95.00	\$57,000.00
STORM SEWERS, 21" RCP	FOOT	160	\$120.00	\$19,200.00
STORM SEWERS, 24" RCP	FOOT	6,580	\$192.00	\$1,263,360.00
STORM SEWERS, 30" RCP	FOOT	800	\$218.00	\$174,400.00
STORM SEWERS, 36" RCP	FOOT	3,433	\$252.00	\$865,116.00
STORM SEWERS, 42" RCP	FOOT	970	\$300.00	\$291,000.00
STORM SEWERS, 48" RCP	FOOT	830	\$328.00	\$272,240.00
STORM SEWERS, 60" RCP	FOOT	1,340	\$414.00	\$554,760.00
STORM SEWERS, 45" x 29" RCEP	FOOT	200	\$250.00	\$50,000.00
STORM SEWERS, 76" x 48" RCEP	FOOT	675	\$400.00	\$270,000.00
PRECAST CONCRETE BOX CULVERTS 4' x 5'	FOOT	600	\$1,100.00	\$660,000.00
PRECAST CONCRETE BOX CULVERTS 3' x 6'	FOOT	450	\$1,100.00	\$495,000.00
MANHOLES, TYPE A, 4'-DIAMETER, TYPE 1 FRAME, CLOSED LID	EACH	10	\$3,600.00	\$36,000.00
MANHOLES, TYPE A, 5'-DIAMETER, TYPE 1 FRAME, CLOSED LID	EACH	10	\$5,200.00	\$52,000.00
MANHOLES, TYPE A, 6'-DIAMETER, TYPE 1 FRAME, CLOSED LID	EACH	12	\$7,300.00	\$87,600.00
MANHOLES, TYPE A, 7'-DIAMETER, TYPE 1 FRAME, CLOSED LID	EACH	7	\$11,000.00	\$77,000.00
MANHOLES, TYPE A, 8'-DIAMETER, TYPE 1 FRAME, CLOSED LID	EACH	6	\$16,500.00	\$99,000.00
MANHOLES, TYPE A, 9'-DIAMETER, TYPE 1 FRAME, CLOSED LID	EACH	2	\$20,000.00	\$40,000.00
MANHOLES, TYPE A, 10'x10', TYPE 1 FRAME, CLOSED LID	EACH	8	\$48,000.00	\$384,000.00
PUMP STATION UPDATED - 6th PUMP	L. SUM	1	\$750,000.00	\$750,000.00
PUMP FOR UNDERGROUND STORAGE BASINS	L. SUM	3	\$500,000.00	\$1,500,000.00
JUNCTION CHAMBER	EACH	2	\$150,000.00	\$300,000.00
4'x5' CONCRETE END SECTION	EACH	1	\$2,500.00	\$2,500.00
RIPRAP WITH FILTER FABRIC	SQ YD	20	\$125.00	\$2,500.00
BACKFLOW PREVENTER	EACH	2	\$500.00	\$1,000.00
UNDERDRAIN, 6" PVC	FOOT	500	\$12.00	\$6,000.00
BASEBALL FIELD REPLACEMENT	EACH	3	\$330,000.00	\$990,000.00
STABILIZED CONSTRUCTION ENTRANCE	L. SUM	4	\$10,000.00	\$40,000.00
RELOCATE WATER SERVICE LINE, LONG SIDE	EACH	113	\$3,600.00	\$406,800.00
REMOVE AND REPLACE WATER MAIN	FOOT	6,770	\$240.00	\$1,624,800.00
RELOCATE SANITARY SEWER SERVICE LINE	EACH	120	\$1,900.00	\$228,000.00
REMOVE AND REPLACE SANITARY MAIN	FOOT	100	\$150.00	\$15,000.00
SOIL EROSION/SEDIMENT CONTROL	L. SUM	1	\$500,000.00	\$500,000.00
THERMOPLASTIC PAVEMENT MARKINGS	L. SUM	1	\$10,000.00	\$10,000.00
TRAFFIC CONTROL	L. SUM	1	\$750,000.00	\$750,000.00
CONSTRUCTION LAYOUT	L. SUM	1	\$500,000.00	\$500,000.00

CATEGORY	TOTAL COST
UNDERGROUND	\$9,971,476.00
UNDERGROUND STORAGE	\$15,555,280.00
PAVING	\$2,889,335.00
WM RELOCATION	\$2,051,400.00
SANITARY RELOCATION	\$262,800.00
MISCELLANEOUS	\$1,857,450.00
TOTAL	\$32,587,741.00

SUBTOTAL = \$32,587,741.00
CONTINGENCY (20%) = \$6,517,548.20
CONSTRUCTION TOTAL = \$39,105,289.20

DESIGN ENGINEERING (6%) = \$2,346,317.35
CONSTRUCTION OBSERVATION (6%) = \$2,346,317.35
PERMITTING = \$250,000.00

TOTAL PROJECT COST INCLUDING ENGINEERING = \$44,047,923.90

NOTES:

- THIS ESTIMATE DOES NOT INCLUDE ROW ACQUISTION, TEMPORARY OR CONSTRUCTION EASEMENTS, OR RELOCATING ANY EXISTING UTILITIES.
- THESE UNIT PRICES ARE BASED ON OUR DESIGN MEMO DATED DECEMBER 5, 2014 AND ARE 2014 CONSTRUCTION COSTS.
- PAVEMENT THICKNESS REMOVAL WAS ASSUMED TO BE 21".
- TRENCH BACKFILL IS INCLUDED IN THE COST OF THE WATER MAIN AND SANITARY

Appendix 4 – CD with XP-SWMM models and GIS database

