



APPENDIX F
Local Surface Water Management
Plan



CITY OF SHOREWOOD

Surface Water Management Plan

September 2018

Prepared For
City of Shorewood
5755 Country Club Road
Shorewood, MN 55331



WSB Project No. 02925-360

**SURFACE
WATER
MANAGEMENT
PLAN**

**CITY OF SHOREWOOD,
MINNESOTA**

September 2018

WSB Project No. 02925-360



I hereby certify that this plan, specification or report was prepared by me or under my direct supervision and that I am a duly Registered Professional Engineer under the laws of the State of Minnesota.



Bill Alms, PE

Lic. No. 54301

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BMP – Best Management Practice
CIP – Capital Improvement Projects
City – City of Shorewood
DNR – Department of Natural Resources
FEMA – Federal Emergency Management Agency
FHA – Federal Housing Administration
FIRM – Flood Insurance Rate Maps
GIS – Geographic Information System
HHPLS – Hydrologic, Hydraulic, and Pollutant Loading Study
HWL – High Water Level
LGU – Local Government Unit
LID – Low Impact Development
LMCD – Lake Minnetonka Conservation District
MCBS – Minnesota County Biological Survey
MCM – Minimum Control Measure
McRAM – Minnehaha Creek Routine Assessment Method
MCBS – Minnesota County Biological Survey
MCWD – Minnehaha Creek Watershed District
MLCCS – Minnesota Land Cover Classification System
MnDOT – Minnesota Department of Transportation
MOU – Memorandum of Understanding
MPCA – Minnesota Pollution Control Agency
MS4 – Municipal Separate Storm Sewer Systems
NOAA – National Oceanic Atmospheric Administration
NPDES – National Pollutant Discharge Elimination System
NURP – Nationwide Urban Runoff Program
NWI – National Wetland Inventory
OHWL – Ordinary High Water Level
PAHs – Polycyclic Aromatic Hydrocarbons
RPBCWD – Riley Purgatory Bluff Creek Watershed District
SMP – Storm Water Management Programs
SMS – Storm Water Management Studies
SWAMP – Stormwater Asset Management Program
SWMP – Surface Water Management Plan (also called the Plan)
SWPPP – Storm Water Pollution Prevention Plan
TMDL – Total Maximum Daily Load
WCA – Wetland Conservation Act

1. EXECUTIVE SUMMARY

1.1. Surface Water Management Plan Purposes

This Local Surface Water Management Plan (LSWMP, SWMP, the Plan) for the City of Shorewood (City) has been developed to meet local watershed management planning requirements of the Metropolitan Surface Water Management Act and Board of Water and Soil Resources Rules 8410. It has also been developed to be in conformance with the requirements of the local watershed districts, Metropolitan Council requirements, and applicable State and Federal laws. This document and its referenced literature is intended to provide a comprehensive inventory of pertinent water resource related information that affects the City and management of those resources.

1.2. Executive Summary

The Shorewood Surface Water Management Plan is divided into six sections:

- **Section 1 Executive Summary** provides background information and summarizes the contents of the plan.
- **Section 2 Land and Water Resource Inventory** includes a general description and summary of data related to precipitation, geology, topography, flood problem areas, water quality, land use, public utilities services, unique features, scenic areas, and pollutant source locations within the City among others.
- **Section 3 Agency Cooperation** describes the City's ordinances and other governmental controls and programs that affect water resources.
- **Section 4 Assessment of Problems and Issues** presents the existing and potential water resource related concerns within the City as well as corrective actions.
- **Section 5 Goals and Policies** outlines the City's goals and policies pertaining to water management.
- **Section 6 Implementation Program** outlines a prioritized listing of the studies, programs, and capital improvements that have been identified as necessary to respond to the water resource needs within the City.

The following appendices are included in the back of the plan:

- **Appendix A: Figures**
A number of figures were developed to assist in summarizing the information provided in the plan. A list of the figures included in the appendix can be found in the Table of Contents.
- **Appendix B: Water Resource Related Agreements**
This section contains copies of agreements that the City has entered into with other agencies regarding water resource management. More information on current City water resource related agreements can be found in **Section 1.3**.
- **Appendix C: Stormwater System Modeling Information**
A summary of the stormwater model that was developed for the City is included in this appendix. This includes drainage areas, high water levels, and peak discharge rates.
- **Appendix D: Federal Emergency Management Agency (FEMA) Flood Insurance Study**
This appendix contains the list of FEMA Flood Insurance Rate Maps (FIRM) applicable to the City, as well as additional information on how to obtain the most up-to-date data.
- **Appendix E: Municipal Separate Storm Sewer Systems (MS4) Permit Application and Storm Water Pollution Prevention Plan (SWPPP) Documents**
A copy of the City's MS4 permit information is included in this appendix.

- **Appendix F: Minnehaha Creek Routine Assessment Method (McRAM) Data**
In 2000, the Minnehaha Creek Watershed District (MCWD) completed a McRAM assessment of most of the City's wetlands. The results of this effort are summarized in this appendix.
- **Appendix G: P8 Water Quality Modeling Results**
A water quality model has been prepared for the City. This report provides the modeled water quality results for inflow and outflow to stormwater basins within the City.
- **Appendix H: Problem Area Summary**
A summary of the water resource problem areas within the City is provided here. These include past problem areas that have been addressed and areas that were noted as a private nuisance drainage concern by the City. A figure of the private nuisance drainage concerns is included in the Appendix as well.
- **Appendix I: Ordinances**
The City's water resource related ordinances are included in this appendix. The most up-to-date ordinances are available on the City's [website](#).
- **Appendix J: Phosphorus Removal Study**
A cursory look at potential methods for phosphorus removal is presented in this appendix.
- **Appendix K: Water Quality Data**
Selected water quality data from outside agencies is provided in this appendix.
- **Appendix L: Publicly Owned Stormwater BMP Inventory**
Inventory of stormwater BMPs owned by the City with location information.

Additional material is referenced within this report and is available from the Engineering Department.

This document is expected to be a ten-year Water Resource Management Plan, after which time this plan should be updated in conjunction with the City's Comprehensive Plan. However, if significant changes to the plan are deemed necessary prior to that date the City may revise this plan in its entirety.

1.3. Water Resource Related Agreements

The City currently has multiple water resource related agreements with the MCWD and RPBCWD. Before 2018, all local government unit (LGU) responsibilities within the City for the Wetland Conservation Act (WCA) were handled by MCWD. In 2018, a resolution was passed by the City which defers the authority and administrative responsibilities to implement the WCA as the LGU to the RPBCWD within the legal boundaries of the RPBCWD. MCWD will continue to act as the LGU for WCA matters within their legal boundary. In 2009, a Memorandum of Understanding (MOU) was adopted by the City which memorializes the City and the MCWD's roles in implementing water resource protection and management with the City. In 2018, a MOU was adopted which stated the City and the MCWD would work together to solve several large-scale water related issues within the City. A copy of each of these water resource related agreements can be found in **Appendix B**.

2. LAND AND WATER RESOURCE INVENTORY

In conformance with the Metropolitan Surface Water Management Act and as required in Minnesota Rules Section 8410.0060, this section of the plan provides a general description and summary of the climate, geology, surficial topography, surface and ground water resource data, soils, land use, public utilities services, water-based recreation, fish and wildlife habitat, unique features, scenic areas, and pollutant sources. This section also identifies where detailed information can be obtained for many of these areas of concern.

2.1. Location

The City of Shorewood is 13.3 square miles and located in southwestern Hennepin County (**Figure 1, Appendix A**). More than half of the City is covered in water. Lake Minnetonka borders the City to the north and west. The City is also bordered by Tonka Bay, Excelsior, Greenwood, and Deephaven to the north. Minnetonka borders the City to the east and Victoria and Chanhassen create the southern border. The City lies within two major watershed districts, MCWD and RPBCWD (**Figure 2, Appendix A**).

2.2. Climate and Precipitation

2.2.1. Climate

The climate within the Minneapolis/St. Paul metropolitan area is described as a humid continental climate with moderate precipitation, wide daily temperature variations, warm humid summers, and cold winters. The total average annual precipitation is approximately 31 inches, of which approximately one-third occurs in the months of June, July, and August. The annual snowfall average is about 54 inches, which is equivalent to approximately 5.4 inches of water. Average monthly temperature and precipitation are shown in **Table 2-1**.

2.2.2. Precipitation

In 2013, the National Oceanic Atmospheric Administration (NOAA) published the Atlas 14 Precipitation-Frequency document which showed an increase in rainfall intensity from the previously referenced Technical Paper 40 precipitation values. The City uses the Atlas 14 precipitation data for design purposes. A rainfall event having a 99% chance of occurrence in a given year over a 24-hour period is approximately 2.9 inches. A rainfall event having a 1% chance of occurrence in a given year over a 24-hour period is approximately 7.83 inches. The 1%, 10-day snowmelt runoff is 7.2 inches. Additional climatological information for the area can be obtained from the [National Weather Service website](#) or from the [State Climatologist website](#).

2.3. Geology and Topographic Information

2.3.1. Geology

The bedrock geology of the area mainly consists of St. Peter Sandstone, Prairie du Chien Group, St. Lawrence and Franconia Formations, and Jordan Sandstone. The City lies within the glacial till deposits left after the retreat of the Des Moines lobe and Grantsburg sub-lobe. The material making up this area is loamy, clayey till underlain with stratified sediment from the Superior lobe. Most of the lakes (including Lake Minnetonka) are in depressions created by the melting of buried glacial ice remnants.

Water tables in Shorewood are the Prairie du Chien-Jordan, Franconia-Ironton-Galesville, and Mt. Simon-Hinckley aquifers. The water table is located approximately 700-800 feet above sea

level.

Additional information on City geology may be found in the Water Resource Reference Library at City Hall.

Table 2-1 Average Monthly Temperature and Precipitation Data for City

| Months | Average Temp (F°) | Precipitation (inches) | Snowfall (inches) |
|---------------|--------------------------|-------------------------------|--------------------------|
| January | 15.6 | 0.9 | 12.2 |
| February | 20.8 | 0.77 | 7.7 |
| March | 32.8 | 1.89 | 10.3 |
| April | 47.5 | 2.66 | 2.4 |
| May | 59.1 | 3.36 | 0 |
| June | 68.8 | 4.25 | 0 |
| July | 73.8 | 4.04 | 0 |
| August | 71.2 | 4.3 | 0 |
| September | 62 | 3.08 | 0 |
| October | 48.9 | 2.43 | 0.6 |
| November | 33.7 | 1.77 | 9.3 |
| December | 19.7 | 1.16 | 11.9 |
| | | | |
| Totals | 46.2 | 30.61 | 54.4 |

Source: Midwestern Regional Climate Center, Minneapolis/St. Paul Airport (2017)

2.3.2. Topography

The landscape within the City is generally described as irregular, rolling hills interspersed with level and/or wet depressions. The specific drainage patterns, which depict topography for areas within the City, are shown on the subwatershed delineation map (**Figure 3, Appendix A**). As can be observed from the subwatershed delineation map, the City is divided into many small watersheds. The subwatershed delineations used City topographic mapping, storm sewer as-builts, aerial photos, and field investigations. There are a number of landlocked depressions within the City which are recognized by the MCWD. However, as a result of recent investigations, existing outlets have been discovered for some of these basins previously identified as landlocked.

The lowest point within the City is approximately 890 feet above sea level. The high point in the City is approximately 1,060 feet above sea level. One-foot topographic information for all areas within the City has been completed and is the source by which these watersheds were delineated.

2.4. Surface Water Resource Data

Available surface water resource data within the City is summarized in this section. Detailed information has been included either in the appendices of this report or has been identified by reference and is available in the Water Resource Library at Shorewood City Hall and from the MCWD or RPBCWD.

The hydrologic system of the City consists of wetlands, streams, and major water bodies as outlined below.

2.4.1. Wetlands

The general locations of wetlands within the City are shown in **Figure 4, Appendix A**. This figure shows the location of wetlands identified by the National Wetland Inventory (NWI) and also shows the DNR Public Waters. These wetlands provide habitat to many species of plants and animals.

In 2003, the MCWD completed a functional assessment of the wetlands within the City. The results of this assessment are included in **Appendix F**. The location of the wetlands classified in the MCWD assessment are shown in **Figure 5, Appendix A**.

2.4.2. Major Bodies of Water

There are several major water bodies that convey and store water within and through the City including Lake Minnetonka, Christmas Lake, Silver Lake, Lake William, Mary Lake, Galpin Lake, Como, Lake Virginia, and Footprint Lake (**Figure 4, Appendix A**). More information about these water bodies is included in various portions of this section.

2.4.3. Hydrologic Modeling (Water Quantity)

Stormwater in the City is directed to the storm sewer system which discharges water to the various ponds and lakes within the City. The City is divided into approximately 16 distinct watersheds. These areas are shown on **Figure 3, Appendix A**. **Figure 18, Appendix A** shows the storm sewer system and the stormwater ponds within the City, both public and private. **Appendix L** includes an inventory of publicly owned stormwater Best Management Practices (BMPs).

The hydrologic/hydraulic modeling effort quantifies the 1-year and 100-year rainfall events, peak discharge rates, storage requirements, other pertinent hydrologic/hydraulic information for stormwater retention areas, and trunk stormwater conveyance systems within the City. The hydrologic/hydraulic modeling results are included as **Appendix C**. The City plans to update the existing hydrologic/hydraulic model to Atlas 14 precipitation data and updated land use within the next few years. RPBCWD has expressed interest in partnering with the City when the City-wide model is updated to gain additional detail on the hydrodynamics and hydraulics within the Silver Lake subwatershed.

Additional information regarding hydrologic modeling within the City can be found in the following documents:

- Comprehensive Storm Water Study; OSM, 1975.
- Hydrologic Analysis of Glen Road – County Road 19 subwatershed; Eugene Hickok & Associates, 1988.
- Draft Feasibility Report in Storm Water Improvements and Appurtenant Work for Glen Road and County Road 19; OSM, 1997.
- Gideons Bay / Glen Road Stormwater Management Plan; WSB, 2001.
- CSAH 19/Smithtown Road/Country Club Road Hydraulic Report; WSB, 2002.

The MCWD also has a hydrology and hydraulics model which provides information on regional flood elevations and hydraulics for the City to use as reference. The 100-year high water level (HWL) for Lake Minnetonka is 931.5 as determined by the MCWD. This water body was not analyzed as part of the City's modeling efforts.

The RPBCWD has a hydrology and hydraulics model which provides information on regional flood elevations for the Silver Lake portion of the City, and is used as a resource by the City. The Ordinary High Water Level (OHWL) for Silver Lake is 898.1 as determined by the DNR.

2.5. Water Resource Problem Areas

As the City continues to be developed and redeveloped, drainage issues become more and more pressing. The western half of the City has minimal vacant land available for new stormwater control and treatment. Therefore, drainage issues will likely guide proposed capital improvement projects and the City will look for innovative ways to add stormwater storage. The problem areas to be addressed by the City are shown on **Figure 6, Appendix A**.

As a result of two heavy rainfall events in the fall of 2005, the City compiled a list of 51 reported problem areas. A supplemental report added another 12 areas the following year. The majority of the areas were determined to be areas of nuisance flooding. Most of the areas that represented potential safety problems have been addressed by the City. These reports are included in **Appendix H** along with a figure showing the location of unresolved private nuisance water resource problem areas identified by these reports.

2.6. Water Quality Data

2.6.1. Overview

Water quality data for the City has been obtained from the Minnesota Pollution Control Agency (MPCA) [Environmental Data Access website](#).

This database is utilized by participating agencies to compile water quality testing data and is almost entirely used for the storage of water quality parameters.

Figure 7, Appendix A shows the location of monitoring sites listed on the MPCA website. Average water quality information for each is summarized in **Table 2-2**.

Table 2-2 Water Quality Summary for Shorewood Lakes

| | Mean Total Phosphorus (ppb) | Mean Chlorophyll a (ppb) | Secchi Disk (meters) | Carlson Trophic Status |
|----------------------------------|-----------------------------|--------------------------|----------------------|------------------------|
| Lake Minnetonka (Upper Lake) | 26 | 10 | 3 | Eutrophic |
| Lake Minnetonka (St. Albans Bay) | 32 | 3.5 | 4 | Mesotrophic |
| Christmas Lake | 13 | 2 | 64 | Mesotrophic |
| Galpin Lake | NA | NA | 1.4 | Hypereutrophic |
| Silver Lake | 112 | 49 | 1.7 | Hypereutrophic |

There are currently three water bodies within the City that are considered impaired by the MPCA: Lake Minnetonka, Silver Lake, and Christmas Lake. The City discharges water to Lake Minnewashta and Lake Virginia, which are impaired waters located outside the City. Detailed information for the impairments of these waterbodies can be found in **Section 4**.

2.6.2. Water Quality Modeling Data

The MCWD completed a water quality model in 2003 as part of their Hydrologic, Hydraulic, and Pollutant Loading Study (HHPLS). This study represents the most up to date water quality information available for the City. Prior to this, a water quality model had been developed for the City. This information includes annual and seasonal pollutant loading calculations for the subwatersheds within the City. The results of the previous modeling effort are not included in this report, but are available in the City's Water Resource Library.

2.6.3. Stormwater Asset Management Program (SWAMP)

The City uses WSB's SWAMP to monitor stormwater BMPs throughout the City for water quality concerns. The program gives each BMP a score based on its estimated total suspended solids and total phosphorus removal efficiencies using survey data. The City uses SWAMP to determine which BMPs require maintenance and will be the most effective use of resources to restore.

2.7. Flood Insurance Studies/Floodplain Management

FEMA FIRM maps have been compiled for the City and is included in **Appendix D** of this plan. These FIRM maps were updated in 2016 by FEMA. **Figure 8, Appendix A** shows the extent of the FEMA floodplain within the City boundary. The City of Shorewood Floodplain Management Ordinance is included in **Appendix I**. This ordinance states that structures cannot be built within the 100-year floodplain as defined on the FEMA FIRM maps.

The City has adopted Floodplain Management Regulations to reduce risk to public health, property, and general welfare. A copy of these regulations can be found on the [City's website](#). These regulations prohibit uses or activities within the floodplain or floodway that include structures or fill or that obstruct flood flows or cause increased flood elevations.

2.8. Shoreland Management

A Shoreland Management Ordinance has been developed by the City and is included in **Appendix I**. This ordinance requires building setbacks to be 50-150 feet, depending on the water body classification, and can be found on the [City's website](#).

2.9. Private Development Stormwater Maintenance

Stormwater management ponds constructed on private development are required to be covered by drainage and utility easements that are dedicated to the City. Developers are required to submit an operations and maintenance plan for proposed stormwater BMPs. Current and future landowners are required to maintain the stormwater BMPs including but not limited to removing trash and debris, inspecting inlets and outlets, removing sediment buildup and stabilizing and restoring eroded areas. In the event the landowner fails to maintain the stormwater BMP in good working condition acceptable to the City, the City may enter the property and correct any deficiencies. The City will start an inventory of private stormwater management facilities following the approval of this Plan.

2.10. Groundwater Appropriations

Within the City, municipal wells serve the City's water needs. Each of these wells has a groundwater appropriation permit from the DNR. **Figure 9, Appendix A** shows the locations of all sites within the City covered by a DNR Water Appropriations Permit. If private residents install a well within the RPBCWD boundary, the resident would be required to obtain a groundwater appropriation permit from the RPBCWD in addition to the groundwater appropriation permit from the DNR.

2.11. Groundwater Resource Data

The City is underlain by the Mt. Simon-Hinckley aquifer, the western edge of the Prairie du Chien-Jordan aquifer, and the Franconia-Ironton-Galesville aquifer. The depth of these aquifers is approximately 750, 875, and 850 feet above sea level, respectively.

Based on the Geologic Atlas of Hennepin County, the groundwater system has a low sensitivity to pollution with very highly sensitive areas near Lake Minnetonka.

The City's Wellhead Protection Plan discusses possible connections between surface water and groundwater in the City. Tritium is an element associated with nuclear bomb testing in the 1950s and 60s and is used as a tracer of surface water and groundwater interactions. Tritium is not a health concern but trace amounts of tritium in the drinking water for the City indicates a likely surface water connection to groundwater. Further discussion on the interaction between the surface water and groundwater can be found in Part II of the Wellhead Protection Plan which can be found at City Hall.

Additional groundwater resource information for the City may be found in the Water Resources Library at City Hall in the Hennepin County Geologic Atlas (1989). The Minnesota Geological Survey is in the process of updating Hennepin County's Geologic Atlas. The City will update its groundwater resource data with the new Hennepin County Geologic Atlas information as necessary.

2.12. Wellhead Protection Plan

The Minnesota Department of Health completed Part I of Shorewood's Wellhead Protection Plan in October in 2011. In 2015, Part II of the Wellhead Protection Plan was submitted and approved by the Metropolitan Council. A copy of the Wellhead Protection Plan can be found at City Hall. The City is currently drafting a Wellhead Protection Implementation Plan which will be put in place once completed. **Figure 10, Appendix A** shows the location of wellhead protection areas as well as drinking water supply vulnerability.

2.13. Soils Information

The City consists mostly of Hayden-Cordova-Peaty muck association and Lester-Peaty muck association. These soils developed from glacial till and range from well-drained (Hayden and Lester) to poorly-drained (Cordova and Peaty Muck).

Using the Hennepin County Geologic Atlas, the hydrologic soil classification map for the City was developed and is shown on **Figure 11, Appendix A**. The soils for the City have been classified into four hydrologic soil groups defined as follows:

Group A – These soils have high infiltration rates even when thoroughly wetted. The infiltration rates range from 0.3 to 0.5 inches per hour. These soils consist chiefly of deep, well drained to excessively drained sands and gravel. These soils have a high rate of water transmission, therefore resulting in a low runoff potential.

Group B – These soils have moderate infiltration rates ranging from 0.15 to 0.30 inches per hour when thoroughly wetted. These soils consist of deep moderately well to well drained soils with moderately fine to moderately coarse textures.

Group C – These soils have slow infiltration rates ranging from 0.05 to 0.15 inches per hour when thoroughly wetted.

Group D – These soils have very slow infiltration rates ranging from 0 to 0.05 inches per hour when thoroughly wetted. These soils are typically clay soils with high swelling potential, soils with a high permanent water table, soils with a clay layer at or near the surface, or shallow soils over nearly impervious material.

Additional information on the geology and soil for this area can be obtained in the Hennepin

County Geologic Atlas.

2.14. Land Use and Public Utilities Services

The City's land use practices generally include residential, commercial, public, semi-public, and water. Land use information is available from the City. **Figure 12, Appendix A** shows the Minnesota Land Cover Classification System (MLCCS) land cover for the City. **Figures 13 and 14, Appendix A** show the existing and future land use map for the City, respectively. **Figure 17, Appendix A** shows Shorewood's City-owned parcels. The following municipal facilities are considered City owned facilities that contribute pollutants to stormwater discharges and are inspected quarterly:

- City Dump Site
- Organic Material Storage
- Public Works and Park Maintenance Storage

There is very little developable vacant land within the City, so no-large scale changes are expected in land use or drainage patterns. For this reason, **Figure 3, Appendix A** is considered both the current and future drainage patterns map for the City. When the City's hydrologic/hydraulic model is updated for Atlas 14 precipitation, if changes to the drainage patterns are found an updated drainage routing map will be made. Additionally, when the hydrologic/hydraulic model is updated to Atlas 14 precipitation, updates to the list of potential drainage problem areas will be made if necessary.

The following definitions of redevelopment and single-family home development apply to the entire Plan. Redevelopment is defined as any development on one or more lots where the land use is being altered or a structure is being torn down and rebuilt. Single-family home redevelopment is defined as a subsection of redevelopment where a residential home is being torn down and rebuilt.

There are opportunities for redevelopment within the City. The over 100-acre Minnetonka Country Club property is in the process of being redeveloped into a residential development, which will include 142 units of low density residential. Additional information on the redevelopment of the Minnetonka County Club can be found on the City's [website](#). The five-acre Xcel Energy site located south of the Lake Minnetonka LRT and east of County Road 19, if redeveloped, may be suitable for higher density housing or some sort of mixed use development. Additional information on this redevelopment opportunity can be found in the City's 2040 Comprehensive Plan. Similarly, and likely sooner, the northwest quadrant of the intersection of Smithtown Road and County Road 19 (Smithtown Crossing) is viewed as being an excellent redevelopment site. Again, a mixed-use approach to that area should be used. Additional information on the Smithtown Crossing redevelopment potential can be found in the Smithtown Crossing Redevelopment Study from 2012.

2.15. Public Areas for Water Based Recreation and Access

Lake Minnetonka is the major water body that borders the City to the north. This lake offers water-based recreation for fishing, boating, and swimming. Other lakes within the City include Christmas Lake, Silver Lake, and Galpin Lake. Galpin Lake extends into the City of Excelsior. Christmas Lake has boat access and has been stocked with rainbow trout by the DNR consistently for the last several years.

Smaller lakes and wetlands include Spray Island Marsh and other unnamed wetlands and lakes. The variety of water bodies within the City offer a great abundance of water-based recreation opportunities.

2.16. Fish and Wildlife Habitat and Unique Features

The abundance of lakes and wetlands in the City provide much fish and wildlife habitat. Lakes within the City contain walleye, northern pike, sunfish, trout, perch, bass, and bluegill. Christmas Lake is one of the few lakes in the Metropolitan Area that can support a two-story fishery, which means it can support both cold and warm-water species of fish.

Rare plant and animal species are present within the City. Red-shouldered hawks, blanding's turtles, fox snakes, least darter, and the pugnose shiner have all been observed in or around the City of Shorewood. No formal biological studies or State Management Plans have been completed within the City of Shorewood. **Figure 15, Appendix A** shows the MCWD key conservations areas, Minnesota County Biological Survey (MCBS) moderate biodiversity areas, and areas within City limits that are in the Metropolitan Conservation Corridor.

A portion of Silver Lake supports wild rice along the southern half of the eastern shore. Silver Lake is one of the only urban lakes in Minnesota that can support wild rice

Unique features and scenic areas include State-designated Scientific and Natural Areas, designated scenic areas, areas containing rare and endangered species, biologically diverse areas, and historic areas.

The City has a number of natural areas, water bodies, and city/regional parks. Areas of interest include Lake Minnetonka, Christmas Lake, and Crescent Beach. The City has no Scientific and Natural Areas or wild and scenic rivers as defined by the State, although the City has designated the Gideon Glen wetland as a conservation area. Restoration of this site has provided educational opportunities for the public.

2.17. Pollutant Source Locations

Pollutant sources have been identified by the MPCA and the location of these sites are shown in **Figure 16, Appendix A**. These pollutants include tanks and spills, leak sites, spill emergency response, and information from the MPCA Master Entity System.

Additional information on the pollution sources within the City is available in the City's Water Resource Library.

2.18. NPDES Phase II

The MPCA implemented the National Pollutant Discharge Elimination System (NPDES) Phase II Stormwater Program in March 2003. Phase II requires MS4s in Census Bureau defined urbanized areas to obtain an NPDES Phase II permit. Permits for construction sites greater than one acre will also be required as part of the Phase II. The City has submitted its SWPPP and Notice of Intent in conformance with the MPCA guidelines. The application that was sent to the MPCA is included in **Appendix E**. An inventory of city owned facilities is also included in **Appendix E**.

2.19. Key Conservation Areas

The MCWD has identified several Key Conservation Areas and the locations of these areas are shown on **Figure 15, Appendix A**.

A small portion of the area north of Lake Virginia (the upland portion) has been developed; however, a Conservation Easement has been obtained for the remainder of the area.

Further detail on the City's efforts to protect and conserve the hydrologic and ecologic values of these areas is presented in **Section 5**.

3. AGENCY COOPERATION

There are a number of other local, state, and federal agencies that have rules and regulations related to stormwater management. Through this strategy, the City recognizes these other agencies' role in this endeavor and will cooperate and coordinate with these agencies as necessary.

This Plan is in conformance with but does not restate all other agency rules that are applicable to water quality and natural resource protection. The other agency rules and policies include rules, policies, and guidelines associated with the following organizations:

- [Minnesota Department of Health](#)
- [Minnesota Pollution Control Agency](#)
- [Board of Water and Soil Resources](#) and the [Wetland Conservation Act](#)
- [Minnesota Department of Natural Resources](#)
- [US Army Corps of Engineers](#)
- [Minnesota Department of Agriculture](#)
- [US Fish and Wildlife Service](#)
- [Minnehaha Creek Watershed District](#)
- [Riley Purgatory Bluff Creek Watershed District](#)
- [Lake Minnetonka Conservation District](#)

While these other agency rules, policies, and guidelines are not all restated in this Plan, they are applicable to projects, programs, and planning within the City. Projects within each watershed district must meet requirements from the necessary watershed district in addition to any City requirements. The Minnesota Stormwater Manual, which is a document intended to be frequently updated, is incorporated by reference into this Plan and can be found on their [website](#).

3.1. Personal Contacts

To implement this Plan, a coordinated water resource management approach must be used. This approach utilizes the services of staff personnel within the City and surrounding communities, as well as staff associated with the various Watershed Districts having jurisdiction over areas within the City.

The primary implementation responsibility will lie with the appropriate staff members at the City. Assistance from the surrounding municipalities and Watershed Districts will also be anticipated. Outlined below are the names, addresses, telephone numbers, and website address for personnel having responsibilities for overseeing or implementing various aspects of the Plan.

City of Shorewood
Alyson Fauske, PE
City Engineer
5755 Country Club Road
Shorewood, MN 55331-892
(952) 960-7910

www.ci.shorewood.mn.us

Minnehaha Creek Watershed District
Becky Christopher
Lead Planner
15320 Minnetonka Blvd
Minnetonka, MN 55345
(952) 641-4512
www.minnehahacreek.org

Riley Purgatory Bluff Creek Watershed District
Dr. Claire Bleser
Administrator
18681 Lake Drive East
Chanhassen, MN 55317
(952) 687-1348
<http://www.rpbcwd.org/>

3.2. Minnehaha Creek Watershed Coordination Plan

MCWD requests that local government units establish a coordination plan that the LGU and MCWD can implement at a staff level to achieve common goals. Some of these goals include:

- Maintaining awareness of needs and opportunities between the City and MCWD
- Implementing programs and projects that meet the needs of all partners, align financially, and are a part of the overall watershed planning effort.

Improving coordination between land use planning at the City and watershed planning at MCWD will result in better projects that meet agency goals and are a more efficient use of public funds. Coordination and collaboration between entities is key to constructing cost effective BMPs to manage water quality concerns and preserve the City's natural resources in the future.

The following is a summary of the coordination plan, which will be adjusted and expanded as deemed appropriate by the City and MCWD during project implementation. It is anticipated that the City Administrator, Public Works Director, and Planning Director will be the primary contacts for the coordination plan.

- Annual meeting – City staff members will meet during the summer to review NPDES MS4 reports and activity from the previous year. Staff will also discuss draft Capital Improvement Plans for each entity for the upcoming year. It is anticipated that the City Administrator, Public Works Director, and Planning Director will be the primary contacts for the annual meeting.
- Land Use Planning – City Planning staff will continue to route requests for land use approvals including, but not limited to, subdivisions and site plan reviews which fall under MCWD jurisdiction will be forwarded to MCWD staff for comment. Coordination will occur in the beginning stages of the project during the concept plan review.

The City's ten-year Capital Improvement Plan (CIP) is a flexible schedule of projects and public improvements that the City wishes to do over the next ten years. The 2018-2027 CIP is the most recent version of the CIP and can be found on the City's [website](#). The CIP is updated annually to ensure consistency of changing demands and funds available. Projects are prioritized by the current level of need for the project, and available funds but to address the growing number of drainage concerns within the City, the CIP in the near future will be guided by addressing drainage concerns primarily.

The City will send the MCWD the CIP when it is updated annually and ask the MCWD for planning assistance and aid in finding funding sources to help finance the projects on the CIP. The CIP would include future feasibility studies and capital improvement projects that the City is hoping to implement in the future. The City will send the MCWD any small area plans, major land use changes or policy changes such as zoning and ordinance updates to receive feedback from the MCWD on how water quality treatment could be incorporated into these items. The city will include the MCWD early on in project initiation, even if projects are unfunded at the time, to utilize the technical planning assistance offered by the MCWD and to look for opportunities to incorporate water quality improvements into otherwise non-water related projects.

- Regulatory Activities –The MCWD has rules covering stormwater management, erosion control, shoreline and streambank stabilization, floodplain alteration and wetland protection among others. MCWD will be responsible for implementation and enforcement of their own rules. In cases where there are analogous City requirements, then the more restrictive rules are understood to govern. Enforcement of the rules will be the responsibility of the governing entity.

The City will include the MCWD early on in City projects including holding pre-application meetings to discuss proposed project plans. The City will also continue to refer developers to the MCWD early on in project planning to ensure the MCWD has adequate time to be value added for development plans. Planning staff will require documentation of appropriate MCWD construction and land alteration permits for those projects located within District boundaries as a condition to City approval. Approved MCWD permits will be stored with other project documentation for future reference. Staff will consider additional coordination for erosion control inspection and enforcement and discuss opportunities at future annual meetings.

- Wetland Conservation Act Enforcement – MCWD acts as the LGU for WCA applications within the MCWD boundary. The City will continue to forward any concerns regarding wetlands in the MCWD boundary to MCWD as they arise.
- Funding – The City seeks support from MCWD in terms of grant funding for water quality projects. The City requests that MCWD staff continue to provide information about upcoming grants and other funding opportunities.
- Data Sharing – City staff members and MCWD staff will coordinate to share any new or relevant data with one another on an annual basis to ensure consistency between entities. This data could be related to any newly completed studies water quality monitoring, BMP performance monitoring, and other activities.
- Public Improvement Projects – City staff members will provide yearly updates on plans for public improvement projects. This will be coordinated as part of the annual meeting while discussing the draft Capital Improvement Plan. Maintenance activities for stormwater infrastructure will be provided to MCWD as part of the MS4 recording process and City inspection reports.
- Public Outreach and Education – The City will continue to provide surface water management updates to the public through the annual newsletter, City mailings and the City website. The City will encourage programs aimed at fostering responsible water quality management practices by its residents, including educating residents on the proper use of fertilizer and the importance of cleaning up after their pets. The City will help promote the MCWD's educational workshops and events to private homeowners and developers. The MCWD's educational workshops cover topics such as winter maintenance training, installing turf alternatives, and informational sessions on the

Master Water Steward program. The City will coordinate with the MCWD on other educational efforts when possible to avoid duplicating efforts.

- Future Project Coordination – The City wishes to continue to coordinate with the MCWD on future projects. In 2018, a MOU was adopted which states the City and the MCWD will work together to solve large-scale drainage issues within the western half of the City. These drainage issues include Shorewood Oaks Development, Strawberry Lane, Grant Lorenz Channel, Alexander Lane Pond and Church Road Ponding. The City plans to partner with the MCWD on Freeman Park drainage area projects to reduce the risk of flooding including reconstructing the Freeman Park outlet, stabilizing the Grant Lorenz Channel and other smaller projects. The City of Excelsior and the City of Shorewood plan to partner on a Grant Street/Park Street drainage improvement project in the future with collaboration from the MCWD. The City will continue to look for opportunities to collaborate with the MCWD on future drainage improvement projects.

Street reconstruction projects are planned for most upcoming years in the City. Some street reconstruction projects include storm sewer replacement. The City will send the MCWD where future street reconstruction projects are planned when they are added to the CIP so the MCWD can provide recommendations and technical planning assistance for how water quality improvements could be incorporated into larger City projects.

- Overall Goals – Both entities wish to maintain healthy water quality and water quantity throughout the City. Prioritization of these characteristics may differ between the two entities but City staff and MCWD staff will continue to have an open dialogue about how to best meet both water quality and water quantity goals.

3.3. Riley Purgatory Bluff Creek Watershed Coordination Plan

The RPBCWD has developed a suite of rules that include floodplain management and drainage alterations, erosion and sediment control, wetland and creek buffers, shoreline and streambank stabilization, waterbody crossings and structures, appropriation of public surface waters, appropriation of groundwater, and stormwater management for the communities within its jurisdiction. RPBCWD will be responsible for implementation and enforcement of the different rules and how it plans or not as the case may be to take on these rules.

In cases where there are analogous City requirements, then the more restrictive rules are understood to govern. Enforcement of the rules will be the responsibility of the governing entity.

The RPBCWD assumes that it will continue to implement its regulatory program in Shorewood until at least such a time as the City amends its LSWMP, updates its official controls, and submits the amendment to the RPBCWD for a determination that it will provide water resources protection equal to or better than the RPBCWD's rules. At that point, the RPBCWD and Shorewood could enter an agreement recognizing that the City will exercise sole regulatory authority for the relevant RPBCWD rule areas. The RPBCWD will continue to implement those rules it is required to implement by statute or that are within the watershed district's sole jurisdiction.

The City will continue to work and collaborate with RPBCWD on projects and initiatives that improve the water quality and quantity conditions in the Silver Lake subwatershed. The City would like to partner with the RPBCWD on water quality monitoring within the Silver Lake subwatershed as well as monitoring erosion concerns along Silver Lake. Planning staff will require documentation of appropriate RPBCWD construction and land alteration permits for those projects located within District boundaries as a condition to City approval. City staff and the RPBCWD will continue to share any new or relevant data with one another to ensure consistency between the two entities. The City and the RPBCWD will collaborate on any new issues that

emerge in the Silver Lake subwatershed as necessary.

RPBCWD acts as the LGU for WCA applications within the RPBCWD boundary. The City will continue to forward any concerns regarding wetlands in the RPBCWD boundary to RPBCWD as they arise.

4. PROBLEMS AND CORRECTIVE ACTIONS

Outlined below is an assessment of the known existing and potential water resource-related problems. These problems have been identified based on an analysis of the land and water resource data collected as part of this plan preparation and through information provided by the City. Any existing or potential problems within the topic area has been described and future corrective actions have been incorporated into an implementation plan. The problems/corrective actions noted with an asterisk(*) are completely or partially on City-owned property, including drainage and utility easements.

4.1. Lake and stream water quality problems

Problem 4.1.1

Impaired waters to which the City discharges and the impairments for each are listed in **Table 4-1**.

Table 4-1 Impaired Waterbodies to which Shorewood Discharges

| Waterbody/Watercourse (AUID) | Year Added to List | Affected Use | Pollutant/Stressor | TMDL Status |
|--|--------------------|---------------------|-------------------------|-------------|
| Lake Minnetonka (ID – 27-0133-02 and 27-0133-05) | 1998 | Aquatic Consumption | Mercury in Fish Tissue | Complete |
| Christmas Lake (ID – 27-0137-00) | 1998 | Aquatic Consumption | Mercury in Fish Tissue | Complete |
| Lake Virginia (ID – 10-0015-00) | 2004 | Aquatic Recreation | Nutrient/Eutrophication | Complete |
| Lake Virginia (ID – 10-0015-00) | 2006 | Aquatic Consumption | Mercury in Fish Tissue | Complete |
| Silver Lake (ID – 27-0136-00) | 2016 | Aquatic Recreation | Nutrient/Eutrophication | Underway |
| Lake Minnewashta* (ID – 10-0009-00) | 2004 | Aquatic Consumption | Mercury in Fish Tissue | Complete |

*Lake Minnewashta is located outside of Shorewood but receives runoff from the City

Corrective Action 4.1.1

The City shall work with the MCWD and the RPBCWD to develop and implement any necessary Total Maximum Daily Loads (TMDLs) for the impaired waters within its boundaries.

Additional information about the TMDL process can be found at the [MPCA website](#).

Problem 4.1.2*

Stormwater pond maintenance for improved water quality treatment, flood control, and aesthetics is needed at Manor Park Pond.

Corrective Action 4.1.2*

The City, in cooperation with MCWD, will complete a feasibility study to identify methods to improve Manor Park Pond as funds are available.

Problem 4.1.3

The MCWD identified a small stream in the upper Christmas Lake subwatershed that is not listed as impaired for nutrients but has a total phosphorus concentration significantly higher than state river eutrophication standards.

Corrective Action 4.1.3

The City will work with MCWD to look into potential projects to reduce the total phosphorus concentration of the stream by improving the water quality of the runoff entering the stream.

Problem 4.1.4

The MCWD has identified an established zebra mussel population in the following waterbodies within City limits:

- Christmas Lake
- Lake Virginia

Corrective Action 4.1.4

The City will work with MCWD to continue to educate its residents on the importance of proper boat maintenance and boat draining to reduce the spread of invasive species.

Problem 4.1.5

Silver Lake has been identified as an impaired water for nutrients/eutrophication due to a high phosphorus load.

Corrective Action 4.1.5

The City will work with RPBCWD to implement projects to reduce the phosphorus load concentration entering the lake.

4.2. Flooding and stormwater rate control concerns

Problem 4.2.1*

The portion of the City west of Mary Lake is mostly developed with minimal vacant land available for additional stormwater storage and treatment. There are drainage problems throughout the western half of the City due to the minimal amount of storage availability.

Corrective Action 4.2.1*

The City will work with the MCWD to manage flooding and rate control issues experienced within the City. Regional maintenance of stormwater will be preferred over individual, private BMPs. Drainage issues will likely guide proposed capital improvement projects in the City.

Problem 4.2.2*

Drainage problems have been reported in the areas listed below and are shown on **Figure 6, Appendix A**. Areas marked with ** are included below based on modeling done by the RPBCWD in 2016; these locations were not reported to the City by residents.

- 4770 Lakeway Terrace
- 5615 and 5635 Harding Lane
- 24645 and 24735 Glen Road
- 6060 Strawberry Lane
- 26370 Peach Circle
- 6120 Riviera Lane
- 23350 Academy Road
- 5830 Echo Road
- 27125 Beverly Drive
- 19305, 19310, 19315, 19320, 19325, 19345, 19365, 19375, 19385, 19395, 19405, 19415, and 19425 Vine Ridge Road**
- 5670, 5705, and 5791 Vine Hill Road**
- 19210 Covington Court**
- 5900 and 18924 Covington Road**

- 5700, 5720, 5729 and 5730 Covington Circle**

Corrective Action 4.2.2*

The City will work with the MCWD and the RPBCWD to manage flooding and rate control concerns experienced within the City. Several of the drainage issue areas listed above will be addressed during the City's planned street reconstruction projects. The City will complete hydraulic and hydrologic analyses and feasibility reports for each of the flooding and drainage problem areas noted above that do not currently have identified solutions.

Problem 4.2.3

A number of landlocked subwatersheds are located within the City. These areas are shown on **Figure 6, Appendix A**.

Corrective Action 4.2.3

Mary Lake currently threatens homes located on the east end of the lake, near Clover Lane and Elder Turn. The City will determine the best option for constructing an outlet from this area.

For other landlocked areas, the City will require redevelopment plans within these subwatersheds to utilize strategies that minimize downstream flooding and additional runoff volumes.

Problem 4.2.4*

A large portion of the City drains near Freeman Park through several residential backyards causing flooding issues for these properties during large storm events. The current outlet for Freeman Park was constructed too low and is submerged during large storm events.

Corrective Action 4.2.4*

The City will determine the best option for an outlet improvement project for Freeman Park to decrease the risk to the residential properties near the park. The City plans to partner with the MCWD on Freeman Park drainage area projects to reduce the risk of flooding and provide water quality improvements.

Problem 4.2.5

Basement flooding in the Shorewood Oaks development due to private drantile connections to the public storm sewer. During large storm events, the stormwater surcharge can take place causing backflow through the private drantile.

Corrective Action 4.2.5

The City will disconnect private drantile and/or install backflow preventers to eliminate the risk of backing up drantile connections.

Problem 4.2.6*

The Strawberry Lane area is prone to standing water adjacent to the roadway due to the flat terrain.

Corrective Action 4.2.6*

The City will look into different alternatives to provide a piped outlet from the Strawberry Lane area to address the existing drainage issue. All alternatives required additional stormwater storage, either by expanding an existing pond or creating a new pond.

Problem 4.2.7

Stormwater pond located in a development at Alexander Lane is not draining as intended and holds standing water longer than designed.

Corrective Action 4.2.7

The City will connect the pond outlet pipe to the proposed storm sewer under Strawberry Lane to

reduce the drawdown time of the stormwater pond.

Problem 4.2.8*

Reported standing water occurring along Church Road during large storm events due to the area being landlocked.

Corrective Action 4.2.8*

The City will construct a ditch running southwest parallel to the Lake Minnetonka LRT Regional Trail towards existing dual culverts.

Problem 4.2.9

There are several private nuisance water resource related problem areas throughout the City.

Corrective Action 4.2.9

The City has determined that these private nuisance water resource related problem areas are not caused by City-owned property and would be best solved by the residents involved. In 2006 and 2007, studies were completed looking into the cause and solution for these residential problems. The associated report for this study and a figure showing the location of these drainage issues can be found in **Appendix H**.

4.3. Impacts on water quantity or quality management practices on recreational opportunities.

Problem 4.3.1

The City has not experienced any impacts to recreational opportunities as the result of water quantity or quality impacts.

Corrective Action 4.3.1

No corrective action needed.

4.4. Impacts of stormwater quality on fish and wildlife resources.

Problem 4.4.1

The City recognizes that there is currently not enough water quality monitoring data available to determine the effects of stormwater quality on area lakes.

Corrective Action 4.4.1

Consider implementing a water quality monitoring program in cooperation with MCWD. The City will collaborate with the RPBCWD on water quality monitoring within the Silver Lake subwatershed.

4.5. Impacts of erosion and sedimentation on water resources.

Problem 4.5.1*

Erosion problems have been reported at Footprint Lake and the Waterford Place drainage way.

Corrective Action 4.5.1*

The City will monitor conditions of these areas and consider maintenance and improvement options if needed.

Problem 4.5.2*

High velocities in the Grant Lorenz channel have caused erosion and frequent sediment transport to downstream waters. Additionally, high water levels in the channels during large storm events cause damage to adjacent properties.

Corrective Action 4.5.2*

The City will work with MCWD to stabilize and provide drainage improvements to the Grant Lorenz channel. The project is expected to entail realignment, ensuring adequate capacity and stabilizing the channel.

Problem 4.5.3

The MCWD has requested that shoreline conditions on Christmas Lake, specifically the eastern shore, be monitored and maintained. Shoreline restoration practices need to be implemented to prevent erosion.

Corrective Action 4.5.3

The City will undertake efforts to educate and provide technical assistance to private property owners to identify maintenance and improvement options, if desired.

Problem 4.5.4

The RPBCWD has identified erosion concerns along the edge of Silver Lake in Shorewood and Chanhassen.

Corrective Action 4.5.4

The City will work with RPBCWD and the City of Chanhassen on a slope stabilization project on Silver Lake.

4.6. Adequacy of existing regulations to address adverse impacts on water resources.

Problem 4.6.1

The City has regulatory controls in place to manage and mitigate adverse impacts on public waters and wetlands in addition to the regulatory controls in place by the MCWD and the RPBCWD. However, additional ordinances or ordinance updates may be necessary to keep regulatory controls relevant to emerging impacts on public waters or wetlands.

Corrective Action 4.6.1

Continue to implement the SWPPP. The City will continue to implement BMPs as well as review and revise existing ordinances, as necessary.

4.7. Identification of potential problems which are anticipated to occur in the next 20 years based on growth projections and planned urbanization.

Problem 4.7.1

The City is almost entirely developed; however, the City recognizes that increased development in the future may increase the volume of runoff directed to the current stormwater storage and conveyance systems within the City. The City anticipates the stormwater runoff generated from newly developing areas will be treated prior to being discharged from the City to areas of concern.

Corrective Action 4.7.1

Implement the City's SWMP, including rate control, stormwater treatment and infiltration requirements. If and when areas redevelop, these controls will be required based on the Goals and Policies of **Section 5**. New developments and redevelopments will also be required to be in compliance with MCWD and RPBCWD rules and requirements.

Problem 4.7.2*

Determining the performance of existing stormwater facilities throughout the City.

Corrective Action 4.7.2*

Included in the City's SWPPP are established BMPs aimed at storm sewer inspection and maintenance training programs. The City is to annually inspect twenty percent of all MS4 outlets each year and all structural pollution control devices. The City will also conduct annual inspections of all stockpile, storage, and material handling areas. The City will evaluate records to determine if inspection frequency should be increased or decreased. More information on the City's stormwater maintenance and inspection program can be found in the SWPPP located in **Appendix E**.

Problem 4.7.3*

Determining the need for pond sediment removal projects.

Corrective Action 4.7.3*

The City will implement WSB's SWAMP to monitor stormwater BMPs for water quality concerns. The program estimates total suspended solids and total phosphorus removal efficiencies based on survey information. The City will use SWAMP to determine which BMPs require maintenance and will be the most effective use of City resources.

Problem 4.7.4*

Increasing prevalence of polycyclic aromatic hydrocarbons (PAHs) in stormwater ponds from runoff of roads and other surfaces.

Corrective Action 4.7.4*

The City will identify stormwater ponds that are contaminated and follow protocol for disposal of dredged material. The City also bans the use of materials that contain PAHs for paved surfaces for future development and redevelopment.

Problem 4.7.5*

Increasing prevalence of chloride in surface and groundwater in the Twin Cities from road salt runoff from roadways and other impervious surfaces.

Corrective Action 4.7.5*

Although the City does not use salt as a deicer, the City will work to implement preventative measures to reduce the chloride runoff before it reaches surface and/or groundwater. Measures will include education and outreach for salt applicators (commercial or private), promote winter best practices, partnering with the watershed districts for training, and other initiatives noted in the Twin Cities Metropolitan Area Chloride Management Plan.

4.8. Impact of land use practices and development on water resource issues.

Problem 4.8.1

The MCWD has identified several Key Conservation Areas. The areas are shown in **Figure 15, Appendix A**.

Corrective Action 4.8.1

The City will work with MCWD to appropriately protect these areas where possible. A small portion of upland area has been developed north of Lake Virginia.

4.9. Availability and adequacy of existing technical information to manage water resources.

Problem 4.9.1

The existing HydroCAD model for the City is not using the most current precipitation data available.

Corrective Action 4.9.1

The City will update the existing HydroCAD model to Atlas 14 conditions along with updating any out of date subwatershed delineations and updating pond live storage information based on LiDAR data or record plans. Any new problem areas identified by the updated model will be added to the existing list of problem areas included in this Plan.

Problem 4.9.2

The development of this SWMP has provided additional technical information to the City related to stormwater management.

Corrective Action 4.9.2

The City will continue to update the hydrologic/hydraulic model and Geographic Information System (GIS) database as new development and redevelopment occur. This activity is included in the City's Storm Water Pollution Prevention Plan as Minimum Control Measure (MCM) 3-Illicit Discharge. Costs for implementing MCMs are included in **Table 6-1**.

5. ESTABLISHMENT OF GOALS AND POLICIES

The City has developed a number of goals, strategies, and policies for the management of stormwater within the City. These goals and policies have been developed to complement any county, regional, or state goals and policies. The goals of the City are as follows:

1. Minimize public capital expenditures needed to correct flooding and water quality problems.
2. Identify and plan for means to effectively protect and improve surface and groundwater quality.
3. Prevent erosion of soil into surface water systems.
4. Promote groundwater recharge.
5. Protect and enhance fish and wildlife habitat and water recreational facilities.
6. Secure the other benefits associated with the proper management of surface and ground water.

In order to achieve the City's goals for managing stormwater, four strategies were developed. These strategies will assist the City in targeting its main audiences for the purposes of stormwater management as follows:

Strategies

Cooperation with other agencies: This strategy recognizes that the City is not alone in managing stormwater within its boundaries. There are a number of other local, state, and federal agencies that also have rules and regulations related to stormwater management. Through this strategy, the City has recognized these other agencies' role in this endeavor and will cooperate and coordinate with these agencies as deemed necessary by the City.

Education: This strategy includes educating various groups within the City about proper stormwater management. Education of residents, City staff, City Council, business owners, and developers is included in this strategy to assist in meeting the City's goals.

Regulation: Much of stormwater management comes in the form of regulations put on new or redevelopment within the City. These regulations will also assist the City in achieving their water management goals. Policies related to the management of stormwater are included in the regulation strategy.

Internal operations: The final strategy relates to the internal operations of the City. By outlining policies related to how the City's operations will treat and manage stormwater, the City can work to achieve its stormwater management goals.

The City has identified target audiences for the policies outlined in each strategy. The target audiences and strategies are as follows:

| AUDIENCE | STRATEGY |
|--|-----------------------------------|
| Public (Residents and Business Owners) | Education, Regulation |
| City Staff and City Council | Cooperation, Education, Operation |
| Developers | Education, Regulation |
| Review Agencies | Cooperation |

Based on the target audience and the strategy, the City has developed a number of policies. These policies are outlined below.

5.1. Cooperation with Other Agencies

There are a number of other local, state, and federal agencies that have rules and regulations related to stormwater management. Through this strategy, the City recognizes these other agencies' role in this endeavor and will cooperate and coordinate with these agencies as necessary. A list of the other agencies the City will work with can be found in **Section 3** of this plan.

5.2. Education

The purpose of the education strategy in meeting the City's goals is to foster responsible water quality management practices by educating residents, business owners, City staff, City Council, and developers about proper stormwater management. If these targeted audiences recognize their role in responsible stormwater management in their homes, businesses, and practices, it is another way for the City to meet its goals. This education strategy has also been designed to be in conformance with the NPDES requirements.

| STRATEGY: EDUCATION | | |
|----------------------------|---|--|
| No. | Policy | Target Audience |
| 1. | The City will continue to implement its public education program as part of the NPDES Phase II program. | Residents, Business Owners, Developers, City Staff and Council |
| 2. | The City will develop and update its website for water resource management information. | Residents, Business Owners, Developers |
| 3. | The City will develop and distribute an annual newsletter and include information in other City mailings aimed at fostering responsible water quality management practices. Topics may include, but not be limited to: <ul style="list-style-type: none"> ● Wetland buffers ● Groundwater quality and protection ● Controlling invasive species ● Water conservation and the water cycle ● Proper hazardous waste disposal ● Yard waste management ● Pet waste disposal ● Illicit discharge | Residents, Business Owners, Developers |
| 4. | The City will collaborate with MCWD, RPBCWD, and Lake Minnetonka Conservation District (LMCD) in stormwater management education efforts. | Residents, Business Owners, Developers |
| 5. | The City will provide annual training opportunities to City staff regarding housekeeping and construction BMPs and the NPDES permit requirement. | City Staff |

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| STRATEGY: EDUCATION | | |
|----------------------------|---|--|
| No. | Policy | Target Audience |
| 6. | The City will conduct pre-construction meetings with contractors to review erosion control methods and inspections for projects that disturb one acre or more for City projects. | City Staff, Contractors, Residents |
| 7. | The City will encourage programs aimed at fostering responsible water quality management practices by its residents, including educating residents on the proper use of fertilizer. Information on the City's Public Education Program is included in the City's NPDES Storm Water Pollution Prevention Plan at City Hall. | Business Owners, Residents |
| 8. | The City will submit a public notice 30 days in advance and hold an annual public meeting to review the SWPPP, SWMP, and BMPs. | Residents, Developers, Business Owners |
| 9. | The City will maintain a phone line and website to report construction site erosion control concerns and waste disposal infractions. The phone number is (952) 474-3236. | Residents, Developers, Business Owners |
| 10. | The City will work with landowners through public education efforts to reduce the amount of animal or pet waste entering local water bodies. | Residents, Developers, Business Owners |
| 11. | Prepare and distribute information on pertinent water management issues to residents a minimum of one time per year and as required as part of the NPDES Phase II program. This information will be incorporated into the City's newsletters and will provide an opportunity for residents to participate in watershed management activities. A copy of the description of the program to be implemented by the City is in the NPDES SWPPP at City Hall. | Residents, Developers, Business Owners |

5.3. Regulation

The policies developed in this strategy outline specific stormwater management elements that are required to be implemented through the development and/or permitting process. The regulation strategy is targeted at the public, developers, City staff, and City Council. The policies below are City regulations. Developers will need to determine if they trigger either MCWD or RPBCWD regulations as well based on site location and proposed site changes.

| STRATEGY: REGULATION | | |
|----------------------------------|---|---|
| No. | Policy | Target Audience |
| Overall Regulation Policy | | |
| 1. | The MCWD is responsible for implementing all of their rules within the City, when applicable. The RPBCWD is responsible for implementing all of their rules within the City, when applicable. In addition, the City will verify adherence to policies outlined in this section. | Developers, MCWD, RPBCWD, City Staff |

| STRATEGY: REGULATION | | |
|-----------------------------|--|--------------------------------------|
| No. | Policy | Target Audience |
| 2. | For all regulations listed in Section 5.3 the following terms are defined as follows: <ul style="list-style-type: none"> – Redevelopment: Any development on one or more lots where the land use is being altered or a structure is being torn down and rebuilt. – Single-family home redevelopment: A subsection of redevelopment where a residential home is being torn down and rebuilt. | Developers, MCWD, RPBCWD, City Staff |
| 3. | Regulations listed in Section 5.3 are enforced for all new development or redevelopment projects where a building or grading permit is required. | Developers, City Staff |
| Rate Control | | |
| 1. | Future discharge rates from new development and redevelopment will not exceed existing discharge rates. | Developers |
| 2. | Design calculations for the 1%, 10%, and 99% chance storm events must be submitted for review and approval. Discharge rates must be based on pre-development conditions allowing for no increase compared to existing rates. | Developers |
| 3. | The design of major stormwater storage facilities shall accommodate a critical duration event with a 1% chance of occurrence. | Developers |
| 4. | The design of new storm sewer systems shall be based on a critical duration rainfall event having a 10% chance of occurring in any given year for local storm sewer. | Developers |
| 5. | For collection systems not designed to meet rate control standards (i.e., catch basins) a clogging factor of 50% will be utilized in sizing intake structures. | Developers |
| 6. | No orifice having a diameter less than eight inches (8") is allowed in the design of rate control structures within the City. | Developers |
| 7. | An emergency spillway (emergency outlet) from ponding areas shall be installed a minimum of one foot (1') below the lowest building opening and shall be designed to have a capacity to overflow water at an elevation below the lowest building opening at a rate not less than three times the 100-year peak discharge rate from the basin or the anticipated 100-year peak inflow rate to the basin, whichever is higher. | Developers |
| 8. | As part of any new development or redevelopment within the City, on-site retention and treatment for stormwater runoff will be required to conform to the policies outlined in this plan unless an approved off-site regional facility is available to accommodate this runoff. | Developers |

| Flood Control | | |
|----------------------|---|------------|
| 1. | The 100-year high surface water elevation will be derived from the City's hydrologic/hydraulic model in Appendix C and information from the FEMA Flood Insurance Study. For Silver Lake and the Silver Lake branch of Purgatory Creek, the 100-year high water elevation developed by the Riley Purgatory Bluff Creek Watershed District will be used as shown also in Appendix C . | Developers |
| 2. | Any new or redevelopment building construction within the City will maintain a minimum building opening elevation three feet (3') above the projected 100-year high water elevation for the area. If this three-foot building opening freeboard requirement is considered a hardship, the standard could be lowered to two feet (2') if the following can be demonstrated: <ul style="list-style-type: none"> • That, within the two-foot freeboard area, stormwater storage is available which is equal to or exceeds 50% of the stormwater storage currently available in the basin below the 100-year elevation. • That a 25% obstruction of the basin outlet over a 24-hour period would not result in more than one-foot (1') of additional bounce in the basin. • An adequate overflow route from the basin is available that will provide assurance that one foot of freeboard will be maintained for the proposed low building opening. | Developers |
| 3. | Any new development or redevelopment in the City must set minimum basement floor elevations to an elevation that meets the following criteria: <ul style="list-style-type: none"> • The basement floor will be four feet (4') above the currently-observed groundwater elevations in the area (Federal Housing Administration (FHA) policy). • The basement floor elevation will be two feet (2') above the elevation of any known historic high ground water elevations for the area. Information on historic high groundwater elevations can be derived from any reasonable sources, including piezometer data, soil boring data, etc. • For areas outside of the RPBCWD boundaries, the basement floor elevation will be one foot (1') above the 100-year high-water elevation for the area unless it can be demonstrated that this standard creates a hardship, and that the basement floor will be one foot (1') above the highest anticipated groundwater elevation that could result from high surface water elevations elevating groundwater elevations in the area during the 100-year critical duration rainfall event. The impact of high surface water elevation on groundwater elevations in the vicinity of the structure can take into consideration the site's distance from the floodplain areas, the soils, the normal water elevation of surface depressions in the areas, the static groundwater table, and historic water elevations in the area. • For areas within the RPBCWD boundaries, the low floor elevation must be a minimum of two feet (2') above the calculated 100-year | Developers |

CITY OF SHOREWOOD SURFACE WATER MANAGEMENT PLAN

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| | flood frequency elevation. | |
| 4. | No structure (temporary or permanent), fill (including fill for roads and levees), deposit, obstruction, storage of materials or equipment, or other uses may be allowed as a conditional use that will cause any increase in the stage of the 100-year flood or cause an increase in flood damages in the reach or reaches affected. | Developers |
| 5. | The City may allow an outlet to land locked basins, provided that the discharge rate from these basins not exceed the 10-day, 100-year average daily run-off rate and that it can be demonstrated that this discharge will not significantly impact the downstream flood profile. | Developers |
| 6. | The City will require compensatory storage equal to storage losses resulting from floodplain fill as part of any new development. This compensatory storage must be provided in a suitable location so as not to increase the 100-year floodplain elevation for the area. | Developers |
| 7. | The City will revise its subdivision ordinance to direct the developer to provide the MCWD or RPBCWD with a copy of the preliminary plat, if applicable. | Developers, MCWD, RPBCWD |
| <i>Water Quality Treatment</i> | | |
| 1. | <p>Treatment of stormwater to Nationwide Urban Runoff Program (NURP) guidelines is required prior to stormwater discharge to a lake, stream, or wetland and prior to discharge from the site as part of development. A single-family home development or redevelopment is exempt from meeting the NURP standards below. The NURP guidelines for the design of stormwater treatment basins are as follows:</p> <ul style="list-style-type: none"> a. A permanent pool ("dead storage") volume below the principal spillway (normal outlet) which shall be greater than or equal to the runoff from a 2.5-inch storm over the entire contributing drainage area assuming full development. b. A permanent pool average depth (basin volume/basin area) which shall be greater than or equal to four feet (4'), with a maximum depth of less than or equal to ten feet (10'). c. Basin side slopes above the normal water level should be no steeper than 3:1, and preferably flatter. A basin shelf with a minimum width of ten feet (10') and depth of one foot (1') below the normal water level is recommended to enhance wildlife habitat, reduce potential safety hazards, and improve access for long-term maintenance. d. To prevent short-circuiting, the distance between major inlets and outlets shall be maximized. | Developers |
| 2. | New stormwater management ponds that are constructed as part of private development shall be covered by drainage and utility easements that are dedicated to the City. | Developers |

CITY OF SHOREWOOD SURFACE WATER MANAGEMENT PLAN

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|---|---|------------------|-----------------------|------------------|--------------------------------|----------------------|----------------------------------|-----------------|---------------------------|-----------|---------------------------|------------|
| 3. | An operations and maintenance plan must be submitted for all new stormwater BMPs. | Developers | | | | | | | | | | |
| 4. | The City will cooperate with the MPCA and other outside organizations to develop TMDL plans for the listed impaired waters that receive stormwater from the City. | City Staff, MPCA | | | | | | | | | | |
| 5. | The City will require the inclusion of skimmers in the construction of new pond outlets, and add skimmers to the existing system whenever feasible and practical to prevent floatables from being discharged downstream. Skimmer structures will have a minimum four-inch (4") overlap and the maximum one-year storm event discharge velocity should not exceed half a foot (0.5') per second. The use of skimmer structures other than wood baffles will be encouraged unless the baffle structure is properly designed. | Developers | | | | | | | | | | |
| 6. | The City will include provisions for coarse sedimentation and skimming floatable materials prior to stormwater discharge to lakes and DNR-protected wetlands. Skimmers will be designed to skim the one-year storm event. This requirement will apply in all cases except where it is deemed not feasible or not practical to do so. Considerations for variance to this policy will only be made in cases where the direct drainage area is limited in size and the probability that a significant pollutant discharge from the area to areas outside the City would be extremely unlikely. The use of skimmer structures other than wood baffles will be encouraged unless the baffle structure is properly designed. | Developers | | | | | | | | | | |
| 7. | <p>The City has adopted the RPBCWD water quality goals for Silver Lake. These goals are as follows:</p> <table border="0" style="margin-left: 40px;"> <tr> <td>Water Quality:</td> <td>TSS_{sd}=83</td> </tr> <tr> <td>Recreation Goal:</td> <td>Canoeing and aesthetic viewing</td> </tr> <tr> <td>Aquatic Communities:</td> <td>Preserve lake's wildlife habitat</td> </tr> <tr> <td>Water Quantity:</td> <td>Manage for regional flood</td> </tr> <tr> <td>Wildlife:</td> <td>Protect existing wildlife</td> </tr> </table> <p>These goals and information about the lake is included in the <i>Silver Lake Use Attainability Analysis</i> (May 2003) which is available in the City's Water Resource Library.</p> | Water Quality: | TSS _{sd} =83 | Recreation Goal: | Canoeing and aesthetic viewing | Aquatic Communities: | Preserve lake's wildlife habitat | Water Quantity: | Manage for regional flood | Wildlife: | Protect existing wildlife | City Staff |
| Water Quality: | TSS _{sd} =83 | | | | | | | | | | | |
| Recreation Goal: | Canoeing and aesthetic viewing | | | | | | | | | | | |
| Aquatic Communities: | Preserve lake's wildlife habitat | | | | | | | | | | | |
| Water Quantity: | Manage for regional flood | | | | | | | | | | | |
| Wildlife: | Protect existing wildlife | | | | | | | | | | | |
| <i>Infiltration/Volume Control</i> | | | | | | | | | | | | |
| 1. | Abstraction via infiltration, evapotranspiration, capture, and/or reuse of one inch of rainfall over the net new impervious of the site or on a regional basis upon development or redevelopment is required for projects that increase stormwater runoff volume, provided that past and existing land use practices do not have a significant potential to contaminate the stormwater runoff and that the soil characteristics are suitable for infiltration. If the soil characteristics are not suitable for infiltration, the same volume will be required to be treated through filtration practices. | Developers | | | | | | | | | | |

CITY OF SHOREWOOD SURFACE WATER MANAGEMENT PLAN

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| 2. | New development and redevelopment shall consider and incorporate to the extent practical and feasible low impact development (LID) techniques. The LID techniques must be reviewed and approved by the City as part of the plan review process. A maintenance plan for these features will be submitted to the City for review and approval. | Developers |
| 3. | The amount of allowable impervious surfaces within new development will be regulated according to the City's ordinances. | Developers |
| 4. | The City intends to use both designated and non-designated areas to store stormwater runoff in the 100-year event. These areas include general depressions, low points, and streets where structures and/or property are not damaged and any inundation will only be temporary in nature. | City Staff, MPCA |
| Wetlands | | |
| 1. | Wetlands will be protected within the City boundaries to assure that the value of wetlands in relation to their surface water quantity benefits are not significantly impacted by development. | Developers, Residents |
| 2. | The City will encourage land owners to maintain wetlands and open space areas for the benefit of wildlife. The City will utilize the Planning Commission and Land Conservation and Environment Committee members to promote this objective. | Developers, Residents |
| 3. | MCWD and RPBCWD act as LGU for the City within their respective boundaries. The Districts will manage wetlands in conformance with Minnesota Rules Chapter 8420 as developed by the Board of Water and Soil Resources. Any redevelopment in the City of Shorewood involving wetland alterations will be subject to the MCWD or RPBCWD procedures for such activities, as applicable, including regulation, monitoring, and control. | Developers, Residents |

5.4. Internal Operations

The City's internal operations can have a significant impact on stormwater management. This strategy is targeted primarily at the City with some areas targeted at the public and/or another agency. These policies are aimed at operation and maintenance activities associated with water resource management within the City.

Many of these policies are policies that are already in place through the previous SWMP. Other policies have been developed as part of the City's MS4 permit and the subsequent SWPPP.

| STRATEGY: INTERNAL OPERATIONS | | |
|--------------------------------------|--|-------------------------|
| | Policy | Source/Rationale |
| 1. | The City will sweep the streets at least once annually and record the results. Areas that need more frequent sweeping will be swept as needed. | City Staff |

CITY OF SHOREWOOD SURFACE WATER MANAGEMENT PLAN

| STRATEGY: INTERNAL OPERATIONS | | |
|--------------------------------------|--|-------------------------|
| | Policy | Source/Rationale |
| | | |
| 2. | The City will inspect 20% of its stormwater treatment basins, structural pollution control devices, outfalls, and ponds every year on a rotating basis. Maintenance will be conducted as necessary. The costs for this activity are included in No. 33 of Table 6-1 . | City Staff |
| 3. | The City prefers to use regional detention and treatment areas rather than site specific detention areas where feasible. The City recognizes that development of these areas will likely be incorporated into development activity and not initiated independently by the City. | City Staff |
| 4. | The City requires as-builts of all ponding areas and designated emergency overflows. | City Staff, Developers |
| 5. | The City will develop a stormwater management ordinance. | City Staff |
| 6. | The City will maintain and update its storm sewer map, including storm sewer pipes, outfalls, ponds, conveyances, and water bodies on an annual basis. The costs for this activity are included in No. 45 of Table 6-1 . | City Staff |
| 7. | The City will conduct visual inspections of stormwater discharges on City-owned land annually and record results of inspections in conformance with the City's MS4 SWPPP. | City Staff |
| 8. | The City will contact the MPCA State Duty Officer at 1-800-422-0798 to report any hazardous material spills or discharges in conformance with the City's MS4 SWPPP. | City Staff |
| 9. | The City will have an annual coordination meeting with MCWD to discuss activity from the previous year and upcoming proposed projects within MCWD jurisdiction. | City Staff, MCWD |
| 10. | The City will annually inspect and maintain any exposed stockpiles and storage areas on City property to prevent erosion and discharge into the storm sewer system or water body in conformance with the City's MS4 SWPPP. | City Staff |
| 11. | The City will maintain and submit annual inspection reports, maintenance reports, and other needed documentation in conformance with the NPDES permit and the MCWD requirements. This will include annually reporting of the progress towards meeting the MCWD goals for reduction in annual phosphorus loading: Lake Minnetonka Watershed – 50 pounds Lake Virginia Watershed – 4 pounds Christmas Lake Watershed – 3 pounds | City Staff, MCWD |

CITY OF SHOREWOOD SURFACE WATER MANAGEMENT PLAN

| STRATEGY: INTERNAL OPERATIONS | | |
|--------------------------------------|--|--------------------------|
| | Policy | Source/Rationale |
| 12. | The City staff will review and adjust as necessary mowing, fertilizing, and herbicide application practices to reduce organic and pollutant discharges to the storm sewer and water bodies. The cost for this activity is included in No. 56 on Table 6-1. | City Staff |
| 13. | The City will review road salt application practices and consider alternative products as they become available. The cost for this activity is included in No. 57 on Table 6-1. | City Staff |
| 14. | The City will participate, to the extent deemed necessary by the City, in TMDL studies that affect land use within its borders as these studies are completed. The costs for this activity are included in No. 52 of Table 6-1. | City Staff |
| 15. | The City will encourage homeowners with properties adjacent to water resources to establish a vegetative buffer strip at the shoreline. This strip should consist of native vegetation to limit erosion and nutrient transport across the buffer strip. | Residents |
| 16. | The City will implement its NPDES SWPPP. The SWPPP is incorporated by reference and is available in the Water Resource Library at City Hall. | City Staff |
| 17. | The City will work with the MCWD and RPBCWD to assure adequate inspection, maintenance and repair of all ditches under their jurisdiction within the City. | City Staff, MCWD, RPBCWD |
| 18. | The City prefers the development of municipal drainage systems whenever possible to private drainage systems. Design of drainage systems shall attempt to accommodate existing drainage systems including tile lines. Existing drainage systems will be protected and drainage perpetuated. | City Staff, Developers |
| 19. | The City will adopt the MCWD goal to reduce phosphorus loading by 50 pounds annually within the City by a combination of existing stormwater treatment ponds that have been constructed, exploring other options for additional ponds that will exceed treatment standards, and implementing a fall street sweeping program. The City will report annually to the MCWD about the effectiveness of these BMPs and the progress made by each to reduce phosphorus loading. | City Staff, MCWD |
| 20. | The City will work with the MCWD to monitor shoreline conditions on Christmas Lake. The costs for this activity are included in No. 41 of Table 6-1. | Residents, MCWD |

CITY OF SHOREWOOD SURFACE WATER MANAGEMENT PLAN

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| 21. | <p>The City will work with the RPBCWD to monitor shoreline conditions on Silver Lake.</p> <p>The costs for this activity are included in No. 42 of Table 6-1.</p> | Residents, RPBCWD |
| 22. | <p>Although the City is fully developed, the City will continue to look for opportunities to acquire additional open space and enhance existing open space. The City will incorporate into future park and open space improvement plans, water quality protections consistent with MCWD rules. These activities will be guided by the City's overall Comprehensive Plan which will adopt the Surface Water Management Plan by reference.</p> | City Staff |
| 23. | <p>In addition to zoning requirements, buffer requirements may place additional restrictions on properties. The MCWD is responsible for reviewing and enforcing wetland buffer requirements.</p> | City Staff, MCWD |

6. IMPLEMENTATION PROGRAM

6.1. Implementation Priorities

Based on the information developed in **Sections 4 and 5**, the City has developed a SWMP that reflects the needs and concerns of the City Council, City staff, citizens, and the funding capabilities of the City. A prioritized listing of the studies, programs, and capital improvements that have been identified as necessary to respond to the water resource needs within the City is outlined on the following tables. The City anticipates implementing at least to some extent the regulatory programs, studies, or improvements identified within this plan within the next ten years.

The City has developed a method to prioritize capital improvement projects. A three-tiered approach has been adopted that prioritizes projects as “High”, “Medium”, or “Low”. Prioritized projects are shown on **Figure 6, Appendix A**. This method is based on the following criteria:

High Priority: Projects meet one or more of the following criteria:

- Projects with the highest benefit relative to project cost.
- Projects that should be completed soon to meet regulatory or permit requirements.
- Projects that are needed to address significant public safety concerns.
- Projects that are needed to finish or upgrade the construction of the City’s stormwater infrastructure system to meet long-term improvement plans.
- Projects that should be constructed now so as to be in conjunction with other projects that will result in a reduction in cost or impact to the public.
- Projects for which funding is now available or will be available in the next few years.

Medium Priority: Projects meet one or more of the following criteria:

- Projects with a high benefit relative to project cost.
- Projects that must be completed soon, but not immediately to meet regulatory or permit requirements.
- Projects that are needed to address public safety concerns.
- Projects that are needed to finish or upgrade the construction of the City’s stormwater infrastructure system to meet long term improvement plans, but timing for construction should be delayed to accommodate other planning or project work.
- Projects that should be constructed soon and/or scheduled so as to be in conjunction with other projects that will result in a reduction in cost or impact to the public.

Low Priority: These projects meet the criteria listed above, but are not urgent, have lower Benefit to Cost Ratios, can be delayed until other work can be done at the same time, or must be delayed until funds become available.

Table 6 contains Storm Water Capital Improvement Projects (CIP), Storm Water Management Programs (SMP), and Storm Water Management Studies (SMS). The costs associated with these items reflect year 2017 costs and do not take into account inflation. These tables are for

planning and budgeting purposes and are considered rough estimates. It is anticipated that these cost estimates will be reviewed annually and updated as needed.

The City's ten-year Capital Improvement Plan (CIP) is a flexible schedule of projects and public improvements the City wishes to implement over the next 10 years. The 2018-2027 CIP is the most recent version of the CIP and can be found on the City's [website](#). The CIP includes park improvement projects, infrastructure improvement projects, water and sanitary sewer improvements and trail improvement projects. Storm sewer improvements are typically coordinated with the street reconstruction project in the same area. The CIP is reviewed and updated annually to remain representative of the City's demands and funds. Projects are prioritized by current level of need for the project, the overlap of different department projects and the funds available for each of the different departments.

6.2. Financial Considerations

Implementation of the proposed regulatory controls, programs and improvements that are identified in this plan will have a financial impact on the City. To establish how significant this impact will be, a review of the means and ability of the City to fund these controls, programs and improvements is necessary. Toward this end, please find outlined below a listing of various sources of revenue that the City will endeavor to implement the water resource management efforts outlined in this plan.

For the next ten years, the capital improvement projects are estimated to cost over \$7,000,000. The stormwater management program costs are estimated at about \$2,500,000. The official controls are estimated to cost approximately \$113,000. The stormwater studies are estimated to cost about \$120,000. Over this ten-year period, these projects, programs, and studies are estimated to cost about \$11,000,000 altogether. Any projects, studies, and programs and the associated funding are subject to City Council approval.

The City intends to maintain its existing storm sewer system by using funds collected under the existing Storm Water Utility Fee. For this reason, there are no anticipated impacts on the City's General Fund. Levy limits are not anticipated to impact this fund either. Monetary impacts on households will be limited to the same level it is currently impacting households.

The greatest barrier the City faces toward implementing these programs, studies and projects is a lack of funding. Since the proposed expenditures exceed the projected revenue, the City has identified projects for which it will pursue grants to fund the work. In lieu of additional funding, the City Council will prioritize the activities that are undertaken based on which projects provide the most benefit to the City.

| DESCRIPTION OF FUNDING SOURCE | REVENUE GENERATED |
|---|---|
| 1. Revenue generated by City's Storm Water Utility estimated for 2018 | \$352,000/year |
| 2. Project paybacks | Variable |
| 3. Special assessments for local improvements made under the authority granted by Minnesota Statutes Chapter 429 (Ad Valorem Financing) | Variable depending on activities undertaken |
| 4. Revenue generated by Watershed Management Special Tax Districts provided for under Minnesota Statutes Chapter 473.882 | Variable depending on activities undertaken |

| DESCRIPTION OF FUNDING SOURCE | REVENUE GENERATED |
|--|---|
| 5. For projects being completed by or in cooperation with a Watershed District or Watershed Management Organization, project funds could be obtained from watershed district levies associated with their administrative funds, construction funds, preliminary funds, repair and maintenance funds or survey and data acquisition funds, as provided for in Minnesota Statutes Chapter 103D.905 | Variable depending on activities undertaken |
| 6. Grant monies that may be secured from various local, regional, County, State, or Federal agencies. This would include the County, Minnesota Department of Transportation (MnDOT), MPCA, the DNR and others. | Variable depending on activities undertaken |
| 7. Other Sources: These may be other sources of funding for stormwater activities such as tax increment financing, state aid, etc. The City will continue to explore additional revenue sources as they become available. | Variable depending on activities undertaken |
| 8. Tax abatement | Variable |

6.3. Amendment Procedures

It is the intention of the City to have this Plan reviewed and approved by the MCWD and the RPBCWD. Once approved, no significant changes to this plan can be facilitated without the approval of the proposed revisions by the watershed districts within the City that are affected by the change.

Significant changes to the local plan shall be made known to the following parties:

1. City Council
2. City Administrator, Director of Public Works, and City Engineer
3. Affected watershed districts within the City
4. Metropolitan Council
5. Public within the City through a public hearing process

Following notification of the above parties, they shall have 60 days to comment on the proposed revisions. The Metropolitan Council shall have 45 days to comment on the revisions. Failure to respond within 60 days constitutes approval. Upon receipt of approvals from the affected Watershed Districts within the City, any proposed amendments will be considered approved.

Minor changes to the Plan shall be defined as changes that do not modify the goals, policies, or commitments expressly defined in this plan by the City. Adjustment to subwatershed boundaries will be considered minor changes provided that the change will have no significant impact on the rate or quality in which stormwater runoff is discharged from the City boundaries. Minor changes to this plan can be made by the staff at the City without outside review. It is the intention of the City that this Plan be updated ten years after the adoption of this Plan unless significant changes to the plan are deemed necessary prior to that date.

The City is required to complete these amendments within two years of the adoption of a watershed plan, in accordance with Chapter 8410.0160.

SECTION 6

| TABLE 6.1 | | | | | | | | | | | | | | | |
|--|--|--|----------|---|------------------------------------|-------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|--|
| SURFACE WATER MANAGEMENT IMPLEMENTATION PLAN | | | | | | | | | | | | | | | |
| No. | Project Description | 10 Year Total Cost Estimate ^{1,3} | Priority | Possible Funding Sources ² | Proposed Cost By Year ¹ | | | | | | | | | | Comments |
| | | | | | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | |
| Capital Improvement Projects (CIP) | | | | | | | | | | | | | | | |
| 1 | Storm sewer improvements paired with Street CIP items. | \$4,500,000 | High | Storm Water Utility Fund | | \$1,050,000 | \$100,000 | \$700,000 | \$700,000 | \$750,000 | \$300,000 | \$300,000 | \$300,000 | \$300,000 | To be implemented when street reconstruction projects are constructed. |
| 2 | Harding Lane Drainage: Involves installation of tile lines, catch basin structure and culvert. | \$97,000 | High | MCWD Grants/ Storm Water Utility Fund | | | | | | | \$97,000 | | | | |
| 3 | Lake Mary Outlet: Currently Lake Mary is landlocked. This project provides an emergency overflow to reduce flooding potential. | \$505,000 | High | MCWD Grants/ Storm Water Utility Fund | | | | | | | | \$505,000 | | | |
| 4 | Nelsine Dr Drainage: Involves installation of tile lines, catch basin structure and culvert. | \$16,000 | High | Storm Water Utility Fund | | | | | | \$16,000 | | | | | |
| 5 | 5925 Grant Drainage: Involves installation of tile lines, catch basin structure and culvert. | \$49,000 | High | Storm Water Utility Fund | | | | | | | | \$49,000 | | | |
| 6 | Amlee Road Drainage: Part of street reconstruction project | \$115,498 | High | Storm Water Utility Fund | | | | | \$115,498 | | | | | | |
| 7 | Manitou Lane Drainage: Part of street reconstruction project | \$61,749 | High | Storm Water Utility Fund | | | | | \$61,749 | | | | | | |
| 8 | Glen Road East Drainage: Part of street reconstruction project | \$178,126 | High | Storm Water Utility Fund | | | | | \$178,126 | | | | | | |
| 9 | Rivera Lane Drainage: Part of street reconstruction project | \$139,396 | High | Storm Water Utility Fund | \$139,396 | | | | | | | | | | |
| 10 | Shorewood Lane Drainage: Part of street reconstruction project | \$150,257 | High | Storm Water Utility Fund | \$150,257 | | | | | | | | | | |
| 11 | Mann Lane Drainage: Part of street reconstruction project | \$83,006 | High | Storm Water Utility Fund | \$83,006 | | | | | | | | | | |
| 12 | Maple Street Road Drainage: Part of the street reconstruction | \$32,451 | High | Storm Water Utility Fund | \$32,451 | | | | | | | | | | |
| 13 | Update the City's existing HydroCAD model to Atlas-14 conditions. | \$9,500 | High | RPBCWD Grants/ Storm Water Utility Fund | \$9,500 | | | | | | | | | | |
| 14 | Grant Lorenz Channel: Work with MCWD on a project to stabilize the channel. Project may include realignment, ensuring adequate capacity and stabilization of the channel | \$725,000 | High | MCWD Grants/ Storm Water Utility Fund | | | \$725,000 | | | | | | | | |
| 15 | Freeman Park Outlet Improvement: Work with MCWD to replace the outlet structure from Freeman Park. | \$10,000 | High | MCWD Grants/ Storm Water Utility Fund | | | \$10,000 | | | | | | | | |
| 16 | Freeman Park Drainage Area: Work with MCWD to reduce drainage issues in the Freeman Park area. This project may include a stormwater management feature immediately downstream of the Freeman Park outlet. | \$194,500 | High | MCWD Grants/ Storm Water Utility Fund | | | \$194,500 | | | | | | | | Cost does not include land acquisition expense |
| 17 | Shorewood Oaks Drainage Issues: Disconnect private drain tile and/or install backflow preventers | \$45,000 | Medium | MCWD Grants/ Storm Water Utility Fund | | | | | | | | | | \$45,000 | |
| 18 | Strawberry Lane Drainage: Route storm sewer to a proposed retention pond via a drainage easement. | \$242,000 | Medium | MCWD Grants/ Storm Water Utility Fund | | | | | | | | | \$242,000 | | |
| 19 | Church Road Ponding: Construct Ditch parallel to the Lake Minnetonka LRT Regional Trail to provide outlet for landlocked area. | \$29,000 | Medium | MCWD Grants/ Storm Water Utility Fund | | | | | | | \$29,000 | | | | |

SECTION 6

| No. | Project Description | 10 Year Total Cost Estimate ^{1,3} | Priority | Possible Funding Sources ² | Proposed Cost By Year ¹ | | | | | | | | | | Comments | |
|-----|--|--|----------|--|------------------------------------|------|------|------|----------|----------|------|----------|------|------|----------|---|
| | | | | | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | | |
| 20 | <u>Alexander Lane Pond</u> : Connect pond outlet pipe to proposed storm sewer under Strawberry Lane to reduce drawdown time of pond. | \$43,000 | Medium | MCWD Grants/ Storm Water Utility Fund | | | | | | | | \$43,000 | | | | |
| 21 | <u>23350 Academy Ave. Storm</u> : Involves installation of tile lines, catch basin structure and culvert. | \$55,000 | Medium | Storm Water Utility Fund | | | | | \$55,000 | | | | | | | |
| 22 | <u>Undertake projects to restore potential wetlands outlined in the MCWD Functional Assessment Report</u> | \$50,000 | Medium | MCWD Grants/ Developers | | | | | | \$50,000 | | | | | | |
| 23 | <u>Galpin Lake Road Trail Drainage</u> : Involved creating drainage along newly constructed trails. | \$230,000 | Low | Storm Water Utility Fund | \$230,000 | | | | | | | | | | | |
| 24 | <u>Rampart Ct. Drainage</u> : Involves installation of tile lines, catch basin structure and culvert. | \$11,880 | Low | Storm Water Utility Fund | | | | | \$11,880 | | | | | | | |
| 25 | <u>Work with RPBCWD on a project to reduce the phosphorus loading rate into Silver Lake.</u> | \$811,000 | Low | RPBCWD Grant/ Storm Water Utility Fund | | | | | | | | | | | | This project is not currently in RPBCWD's 10-year implementation table but this description is used as a place holder in case RPBCWD decides to move forward with this project sooner than planned. |
| 26 | <u>Work with RPBCWD on a slope stabilization project on Silver Lake.</u> | \$52,000 | Low | RPBCWD Grant/ Storm Water Utility Fund | | | | | | | | | | | | This project is not currently in RPBCWD's 10-year implementation table but this description is used as a place holder in case RPBCWD decides to move forward with this project sooner than planned. |

SECTION 6

| No. | Project Description | 10 Year Total Cost Estimate ^{1,3} | Priority | Possible Funding Sources ² | Proposed Cost By Year ¹ | | | | | | | | | | Comments |
|----------------------------------|--|--|----------|---------------------------------------|------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|----------|
| | | | | | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | |
| Operation and Maintenance | | | | | | | | | | | | | | | |
| 27 | <u>Sponsor City Spring Clean Up Day</u> | \$80,000 | | Stormwater Utility Revenue | \$8,000 | \$8,000 | \$8,000 | \$8,000 | \$8,000 | \$8,000 | \$8,000 | \$8,000 | \$8,000 | \$8,000 | |
| 28 | <u>Conduct inspections and clean up of illicit discharges and illegal dumping within the City</u> | \$77,000 | | Stormwater Utility Revenue | \$7,700 | \$7,700 | \$7,700 | \$7,700 | \$7,700 | \$7,700 | \$7,700 | \$7,700 | \$7,700 | \$7,700 | |
| 29 | <u>Conduct erosion control inspections of construction sites</u> | \$55,000 | | Stormwater Utility Revenue | \$5,500 | \$5,500 | \$5,500 | \$5,500 | \$5,500 | \$5,500 | \$5,500 | \$5,500 | \$5,500 | \$5,500 | |
| 30 | <u>Review construction plans for conformance to City stormwater management policies. MCWD and RPBCWD are responsible for implementing all of their rules within the City, when applicable.</u> | \$75,000 | | Stormwater Utility Revenue | \$7,500 | \$7,500 | \$7,500 | \$7,500 | \$7,500 | \$7,500 | \$7,500 | \$7,500 | \$7,500 | \$7,500 | |
| 31 | <u>Conduct pre-construction meetings with contractors to review erosion control methods and inspections.</u> | \$20,000 | | Stormwater Utility Revenue | \$2,000 | \$2,000 | \$2,000 | \$2,000 | \$2,000 | \$2,000 | \$2,000 | \$2,000 | \$2,000 | \$2,000 | |
| 32 | <u>Plan review and inspection of long term operation and maintenance of BMPs.</u> | \$70,000 | | Stormwater Utility Revenue | \$7,000 | \$7,000 | \$7,000 | \$7,000 | \$7,000 | \$7,000 | \$7,000 | \$7,000 | \$7,000 | \$7,000 | |
| 33 | <u>Inspect 20% of storm sewer system including outfalls, ponds, and structural pollution control devices</u> | \$80,000 | | Stormwater Utility Revenue | \$8,000 | \$8,000 | \$8,000 | \$8,000 | \$8,000 | \$8,000 | \$8,000 | \$8,000 | \$8,000 | \$8,000 | |
| 34 | <u>Inspect all identified structural pollution control devices and BMPs once per year.</u> | \$10,000 | | Stormwater Utility Revenue | \$1,000 | \$1,000 | \$1,000 | \$1,000 | \$1,000 | \$1,000 | \$1,000 | \$1,000 | \$1,000 | \$1,000 | |
| 35 | <u>Sweep streets each spring</u> | \$250,000 | | Stormwater Utility Revenue | \$25,000 | \$25,000 | \$25,000 | \$25,000 | \$25,000 | \$25,000 | \$25,000 | \$25,000 | \$25,000 | \$25,000 | |
| 36 | <u>Sweep streets in strategic areas each fall</u> | \$250,000 | | Stormwater Utility Revenue | \$25,000 | \$25,000 | \$25,000 | \$25,000 | \$25,000 | \$25,000 | \$25,000 | \$25,000 | \$25,000 | \$25,000 | |
| 37 | <u>Conduct annual pond surveys to schedule and prioritize the necessary maintenance projects. This effort will be assisted by the SWAMP Application.</u> | \$150,000 | | Stormwater Utility Revenue | \$15,000 | \$15,000 | \$15,000 | \$15,000 | \$15,000 | \$15,000 | \$15,000 | \$15,000 | \$15,000 | \$15,000 | |
| 38 | <u>The City will perform yearly cleanout of ponds identified for maintenance with the SWAMP program.</u> | \$1,500,000 | | Stormwater Utility Revenue | \$150,000 | \$150,000 | \$150,000 | \$150,000 | \$150,000 | \$150,000 | \$150,000 | \$150,000 | \$150,000 | \$150,000 | |
| 39 | <u>Annual maintenance on the Stormwater Asset Management Program (SWAMP).</u> | \$20,000 | | Stormwater Utility Revenue | \$2,000 | \$2,000 | \$2,000 | \$2,000 | \$2,000 | \$2,000 | \$2,000 | \$2,000 | \$2,000 | \$2,000 | |
| 40 | <u>Monitor erosion control problems at Footprint Lake and Waterford Place drainage way</u> | \$10,000 | | Stormwater Utility Revenue | \$1,000 | \$1,000 | \$1,000 | \$1,000 | \$1,000 | \$1,000 | \$1,000 | \$1,000 | \$1,000 | \$1,000 | |
| 41 | <u>Work with MCWD to monitor shoreline conditions on Christmas Lake and educate private property owners on maintenance and improvement options.</u> | \$10,000 | | Stormwater Utility Revenue | \$1,000 | \$1,000 | \$1,000 | \$1,000 | \$1,000 | \$1,000 | \$1,000 | \$1,000 | \$1,000 | \$1,000 | |
| 42 | <u>Work with RPBCWD to monitor shoreline conditions on Silver Lake and educate private property owners on maintenance and improvement options.</u> | \$10,000 | | Stormwater Utility Revenue | \$1,000 | \$1,000 | \$1,000 | \$1,000 | \$1,000 | \$1,000 | \$1,000 | \$1,000 | \$1,000 | \$1,000 | |

SECTION 6

| No. | Project Description | 10 Year Total Cost Estimate ^{1,3} | Priority | Possible Funding Sources ² | Proposed Cost By Year ¹ | | | | | | | | | | Comments |
|--------------------------|--|--|----------|---------------------------------------|------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|----------|
| | | | | | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | |
| Official Controls | | | | | | | | | | | | | | | |
| 43 | <u>Prepare and distribute annual newsletter and distribute information in City mailing regarding surface water management</u> | \$4,000 | | Stormwater Utility Revenue | \$400 | \$400 | \$400 | \$400 | \$400 | \$400 | \$400 | \$400 | \$400 | \$400 | |
| 44 | <u>Maintain and update website for surface water management education per NPDES permit</u> | \$3,000 | | Stormwater Utility Revenue | \$300 | \$300 | \$300 | \$300 | \$300 | \$300 | \$300 | \$300 | \$300 | \$300 | |
| 45 | <u>Maintain and update GIS database, storm sewer map, and hydrologic model</u> | \$65,000 | | Stormwater Utility Revenue | \$6,500 | \$6,500 | \$6,500 | \$6,500 | \$6,500 | \$6,500 | \$6,500 | \$6,500 | \$6,500 | \$6,500 | |
| 46 | <u>Hold annual public meetings to educate residents and business owners on surface water management</u> | \$4,000 | | Stormwater Utility Revenue | \$400 | \$400 | \$400 | \$400 | \$400 | \$400 | \$400 | \$400 | \$400 | \$400 | |
| 47 | <u>Provide annual training workshops to educate City staff about surface water management</u> | \$8,000 | | Stormwater Utility Revenue | \$800 | \$800 | \$800 | \$800 | \$800 | \$800 | \$800 | \$800 | \$800 | \$800 | |
| 48 | <u>Submit a public notice 30 days in advance of holding annual public meeting to review SWPPP, Surface Water Management Plan and BMPs.</u> | \$4,000 | | Stormwater Utility Revenue | \$400 | \$400 | \$400 | \$400 | \$400 | \$400 | \$400 | \$400 | \$400 | \$400 | |
| 49 | <u>Prepare and submit annual SWPPP report and MCWD report</u> | \$5,000 | | Stormwater Utility Revenue | \$500 | \$500 | \$500 | \$500 | \$500 | \$500 | \$500 | \$500 | \$500 | \$500 | |
| 50 | <u>Hold annual public meetings to review SWPPP, Surface Water Management Plan and BMPs. Collect and consider public input.</u> | \$15,000 | | Stormwater Utility Revenue | \$1,500 | \$1,500 | \$1,500 | \$1,500 | \$1,500 | \$1,500 | \$1,500 | \$1,500 | \$1,500 | \$1,500 | |
| 51 | <u>Maintain and submit annual inspection reports, maintenance records, and other documentation in conformance with the NPDES permit</u> | \$5,000 | | Stormwater Utility Revenue | \$500 | \$500 | \$500 | \$500 | \$500 | \$500 | \$500 | \$500 | \$500 | \$500 | |

SECTION 6

| No. | Project Description | 10 Year Total Cost Estimate ^{1,3} | Priority | Possible Funding Sources ² | Proposed Cost By Year ¹ | | | | | | | | | | Comments |
|--------------------------|---|--|----------|--|------------------------------------|-------------|-------------|-------------|-------------|-------------|-----------|-------------|-----------|-----------|---|
| | | | | | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | |
| Monitor and Study | | | | | | | | | | | | | | | |
| 52 | <u>Coordinate with MCWD and/or RPBCWD in the development and implementation of TMDLs</u> | \$30,000 | High | MCWD Grants / Storm Water Utility Fund / Clean Water Legacy Fund | \$10,000 | \$10,000 | \$10,000 | | | | | | | | |
| 53 | <u>Complete a wetland functions and values assessment for wetlands within the RPBCWD</u> | \$50,000 | High | RPBCWD Grant | | | | | \$50,000 | | | | | | |
| 54 | <u>Complete phosphorus loading study of street sweepings to calibrate the phosphorus load reductions for the MCWD</u> | \$10,000 | High | MCWD Grants/ Storm Water Utility Fund | | | | \$10,000 | | | | | | | |
| 55 | <u>Review planning and zoning policies and ordinances and update as needed to comply with Surface Water Management Plan, MCWD rules and RPBCWD rules.</u> | \$10,000 | Medium | MCWD Grants/ Storm Water Utility Fund | \$1,000 | \$1,000 | \$1,000 | \$1,000 | \$1,000 | \$1,000 | \$1,000 | \$1,000 | \$1,000 | \$1,000 | |
| 56 | <u>Review mowing, fertilizing, and herbicide application practices and review alternative products (as available)</u> | \$10,000 | Medium | Storm Water Utility Fund | | \$2,000 | | \$2,000 | | \$2,000 | | \$2,000 | | \$2,000 | |
| 57 | <u>Review road salt application practices and review alternative products (as available). Implement projects or other management actions based on the Minnesota Pollution Control Agency's Twin Cities Metro Chloride TMDL when applicable.</u> | \$25,000 | Medium | RPBCWD Grants/ Storm Water Utility Fund | \$2,500 | \$2,500 | \$2,500 | \$2,500 | \$2,500 | \$2,500 | \$2,500 | \$2,500 | \$2,500 | \$2,500 | The City currently does not salt roads. |
| | TOTAL | \$11,350,363 | | | \$291,500 | \$1,343,500 | \$1,116,500 | \$1,198,000 | \$1,453,753 | \$1,099,500 | \$707,500 | \$1,180,500 | \$823,500 | \$628,500 | |

¹ Cost estimates are preliminary and subject to review and revision as engineer's reports are completed and more information becomes available. Table reflects 2018 costs and does not account for inflation. Costs generally include labor, equipment, materials, and all other costs necessary to complete each activity. Some of the costs outlined above may be included in other operational costs budgeted by the City.

² Funding for stormwater program activities projected to come from following sources - Surface Water Management Fund, Developers Agreements, Grant Funds, General Operating Fund, or Special Assessments.

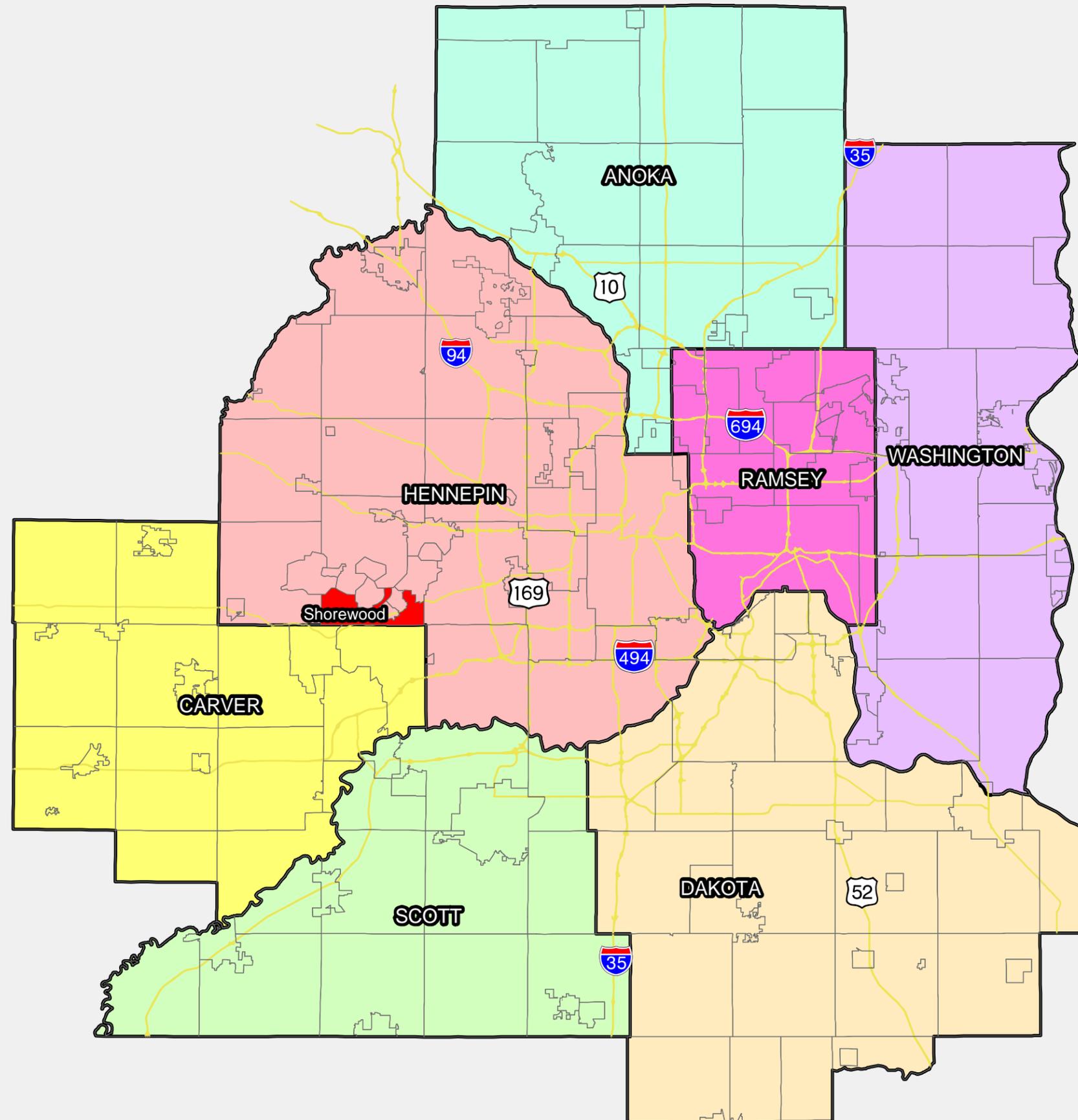
³ Staff time is not included in the cost shown.

APPENDIX A

Figures



Shorewood
Surface Water
Management Plan
Figure 1: City Location



| | |
|---|-------------------|
|  | City Boundaries |
|  | City of Shorewood |

N
0 7 Miles
1 inch = 7 miles

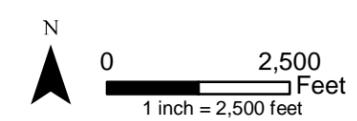



CITY OF SHOREWOOD

Shorewood Surface Water Management Plan Figure 2: Watershed Districts



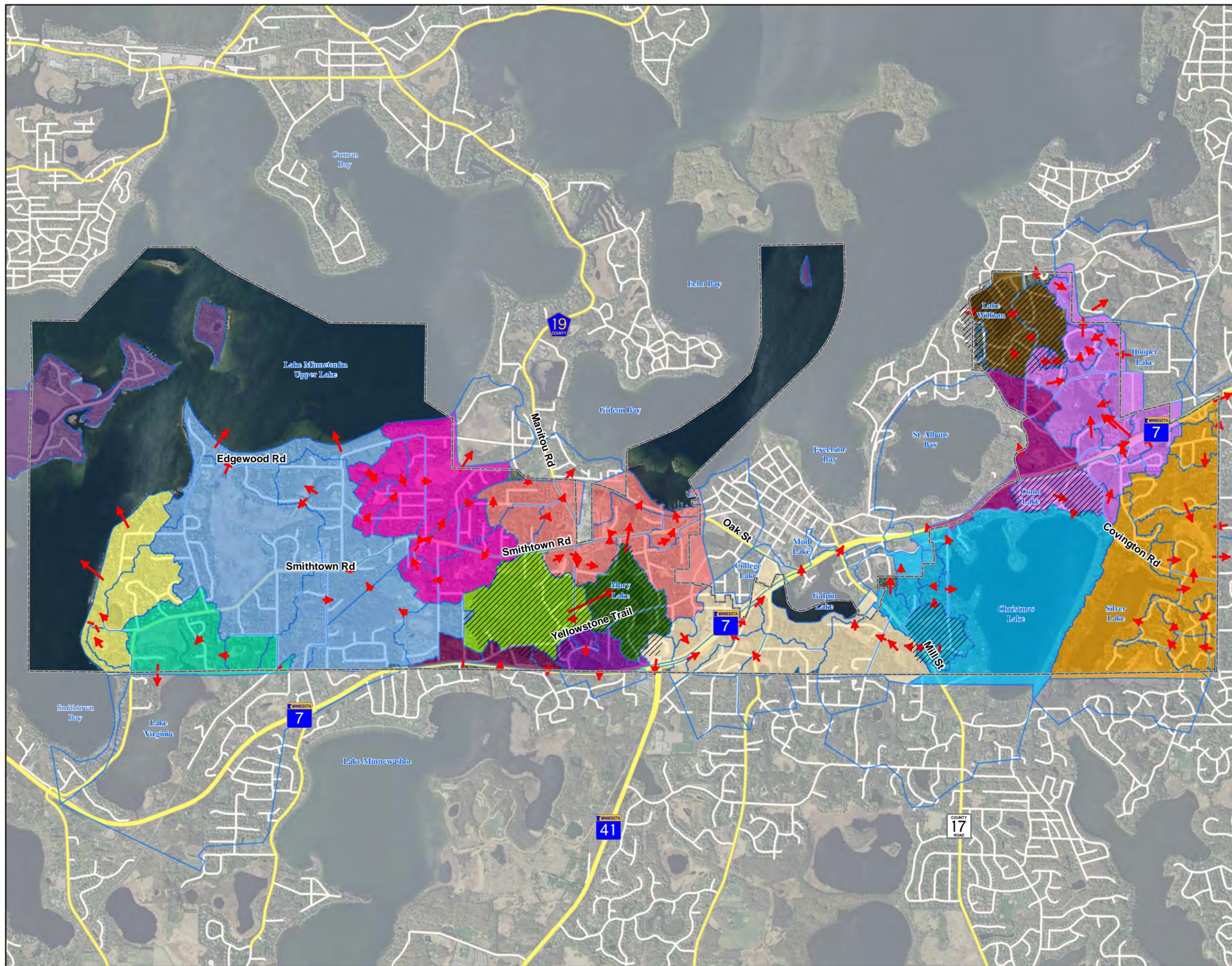
- City Boundary
- Minnehaha Creek Watershed District
- Riley Purgatory Bluff Creek Watershed District





CITY OF SHOREWOOD

Shorewood Surface Water Management Plan Figure 3: Drainage Map



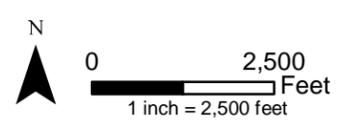
City Boundary
— City Boundary

Direction of Flow
→ Direction of Flow

Subwatersheds

- Outside City Limits
- Carson Bay
- Central Area
- Christmas Lake
- Gideon Bay
- Galpin Lake
- Lake Minnetonka
- Lake Mary
- Lake Minnewashta
- Lake Virginia
- Lake William
- North-Central Area
- Purgatory Creek
- St. Albans Bay
- South-Central Area
- West Area
- West-Central Area

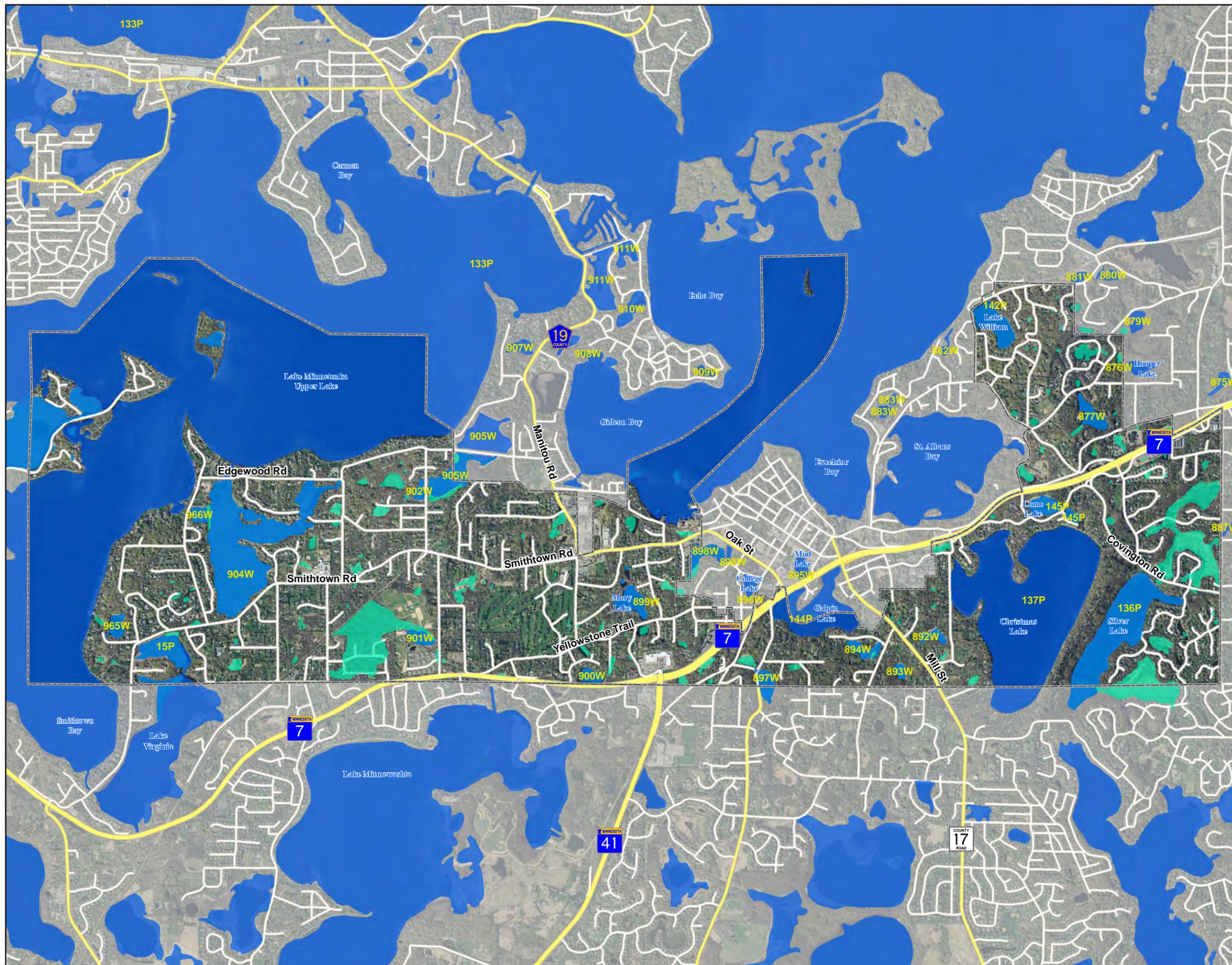
— Landlocked Basins as Identified by MCWD





CITY OF SHOREWOOD

Shorewood Surface Water Management Plan Figure 4: Wetlands and DNR Public Waters



| | |
|--|----------------------------|
| | City Boundary |
| | DNR Public Waters/Wetlands |
| | NWI Wetland |

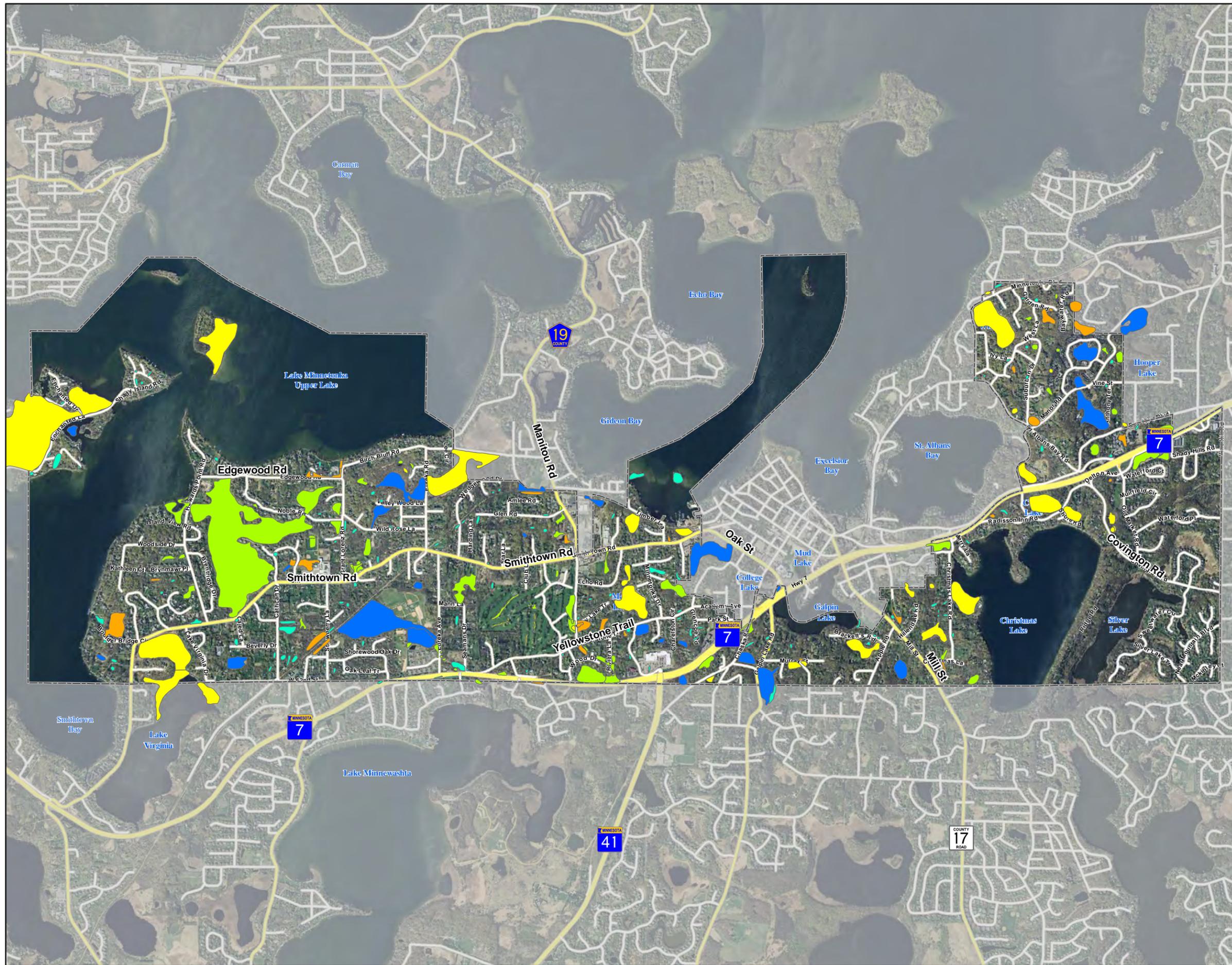
N
0 2,500 Feet
1 inch = 2,500 feet





CITY OF SHOREWOOD

Shorewood Surface Water Management Plan Figure 5: MCWD Wetland Assessment Map



| | |
|--------------------------------------|----------------|
| | City Boundary |
| MCWD Wetland Management Class | |
| | Manage 1 |
| | Manage 2 |
| | Manage 3 |
| | Not Classified |
| | Preserve |

N

0 2,500 Feet

1 inch = 2,500 feet

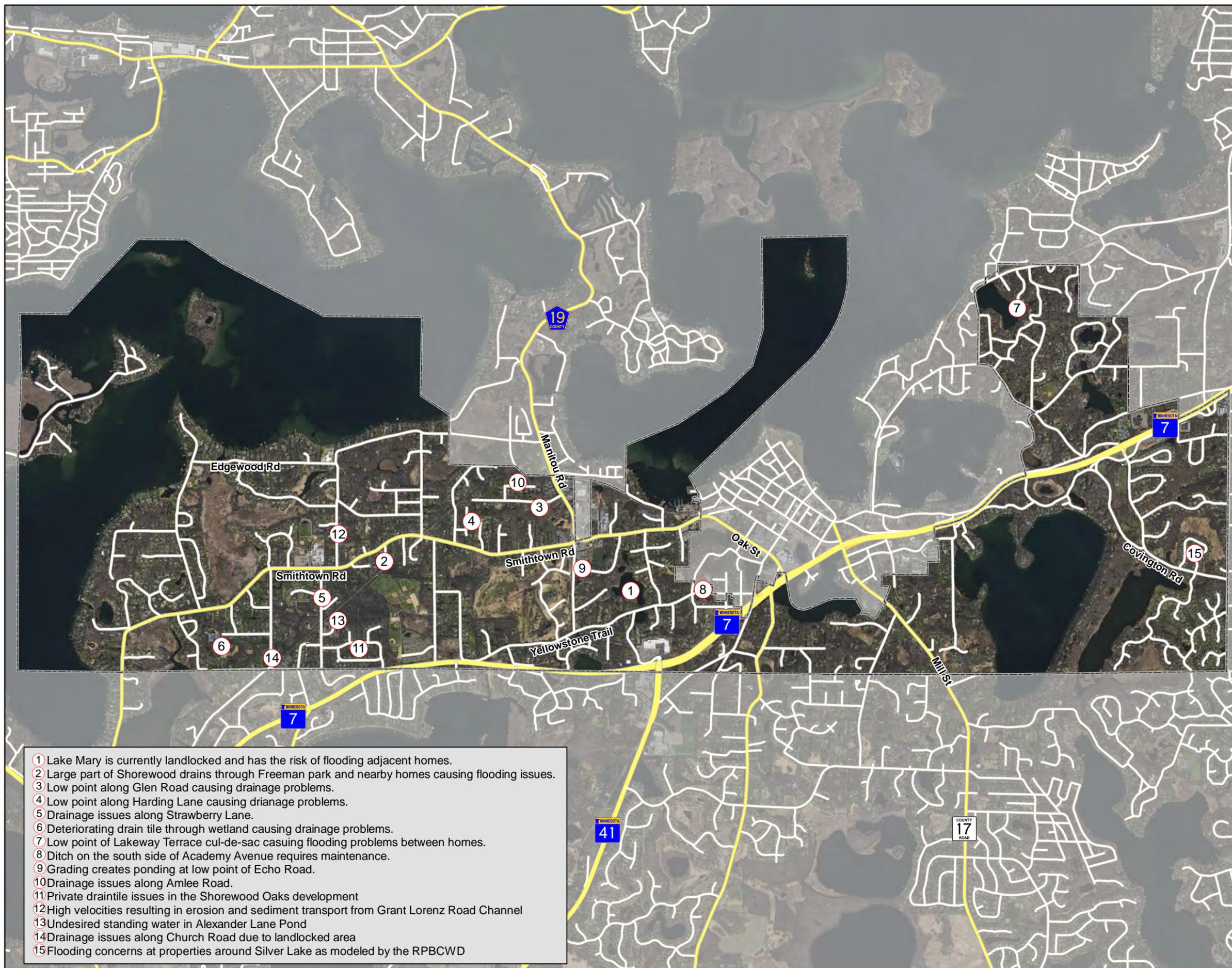




CITY OF SHOREWOOD

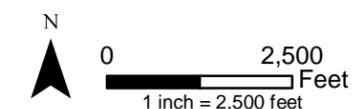
Shorewood Surface Water Management Plan

Figure 6: Water Resource Problem Areas



City Boundary

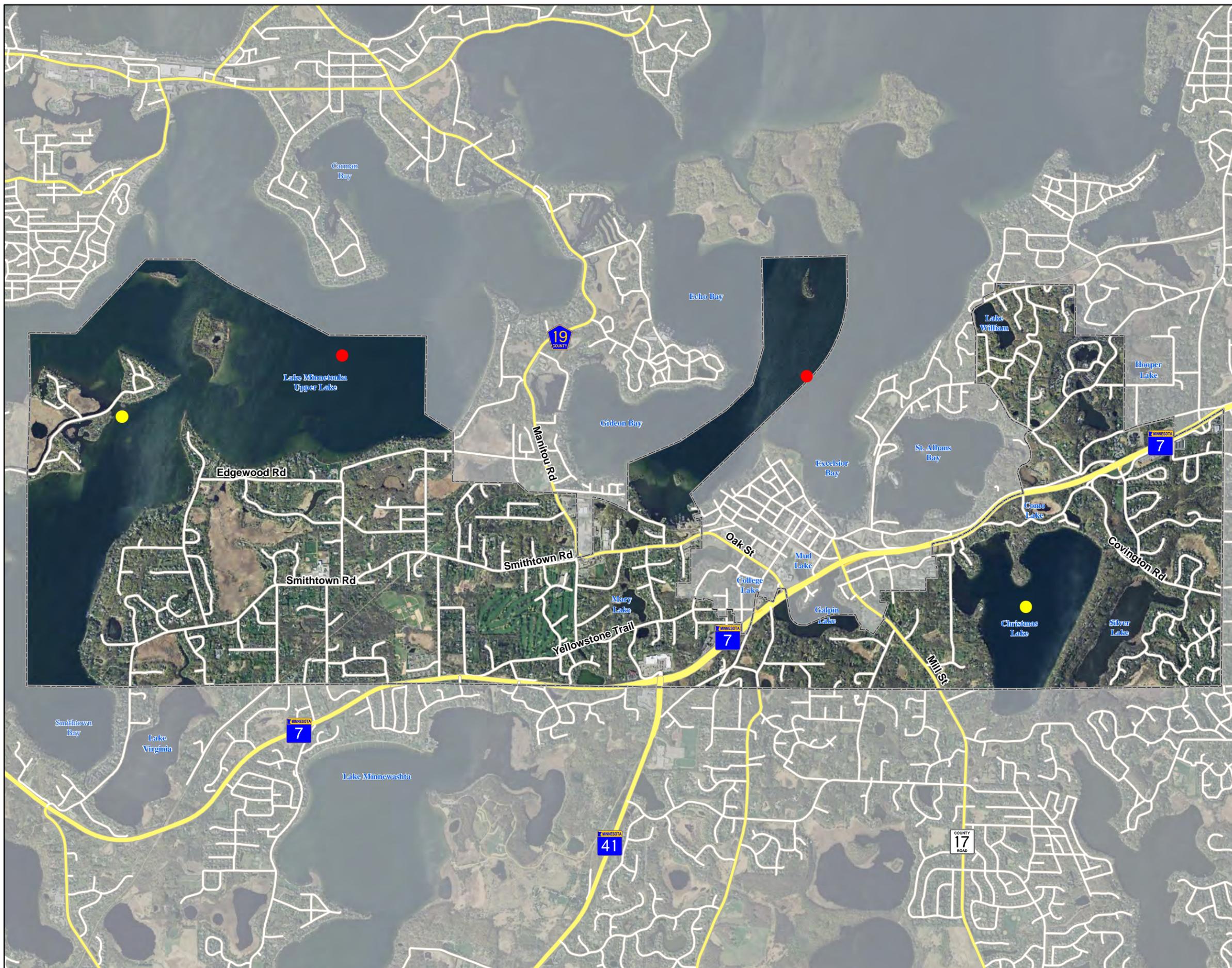
- ① Lake Mary is currently landlocked and has the risk of flooding adjacent homes.
- ② Large part of Shorewood drains through Freeman park and nearby homes causing flooding issues.
- ③ Low point along Glen Road causing drainage problems.
- ④ Low point along Harding Lane causing drainage problems.
- ⑤ Drainage issues along Strawberry Lane.
- ⑥ Deteriorating drain tile through wetland causing drainage problems.
- ⑦ Low point of Lakeway Terrace cul-de-sac causing flooding problems between homes.
- ⑧ Ditch on the south side of Academy Avenue requires maintenance.
- ⑨ Grading creates ponding at low point of Echo Road.
- ⑩ Drainage issues along Amlee Road.
- ⑪ Private drain tile issues in the Shorewood Oaks development
- ⑫ High velocities resulting in erosion and sediment transport from Grant Lorenz Road Channel
- ⑬ Undesired standing water in Alexander Lane Pond
- ⑭ Drainage issues along Church Road due to landlocked area
- ⑮ Flooding concerns at properties around Silver Lake as modeled by the RPBCWD



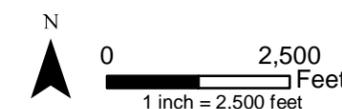


CITY OF SHOREWOOD

Shorewood Surface Water Management Plan Figure 7: MPCA Water Quality Monitoring Locations



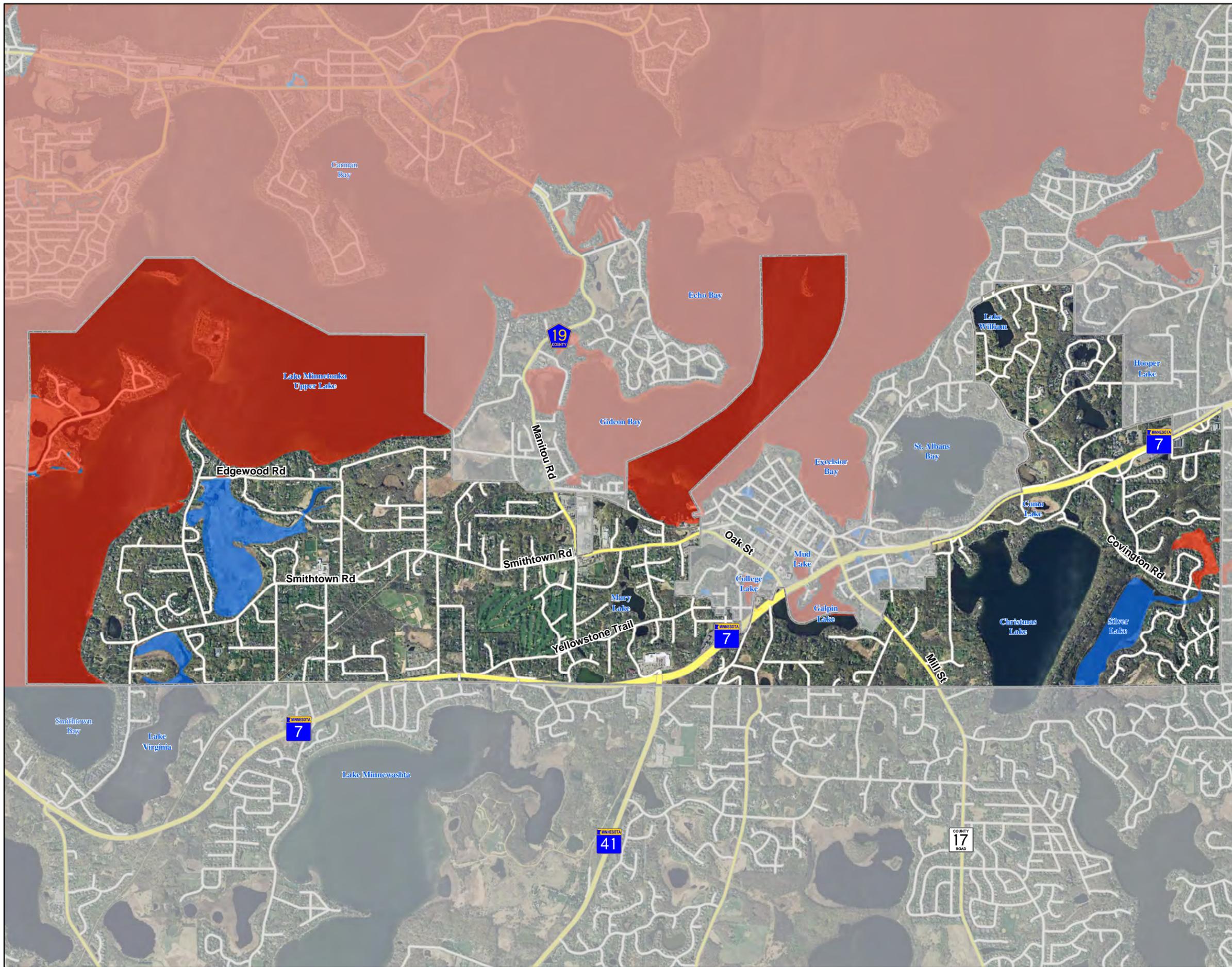
| | |
|------------------------------------|---------------|
| | City Boundary |
| Owner of Monitoring Station | |
| | MPCA |
| | USEPA |





CITY OF SHOREWOOD

Shorewood Surface Water Management Plan Figure 8: FEMA Floodplain Map



| | |
|------------------------------|---------------------|
| | City Boundary |
| Floodplain Boundaries | |
| | 100-Year Floodplain |
| | 500-Year Floodplain |

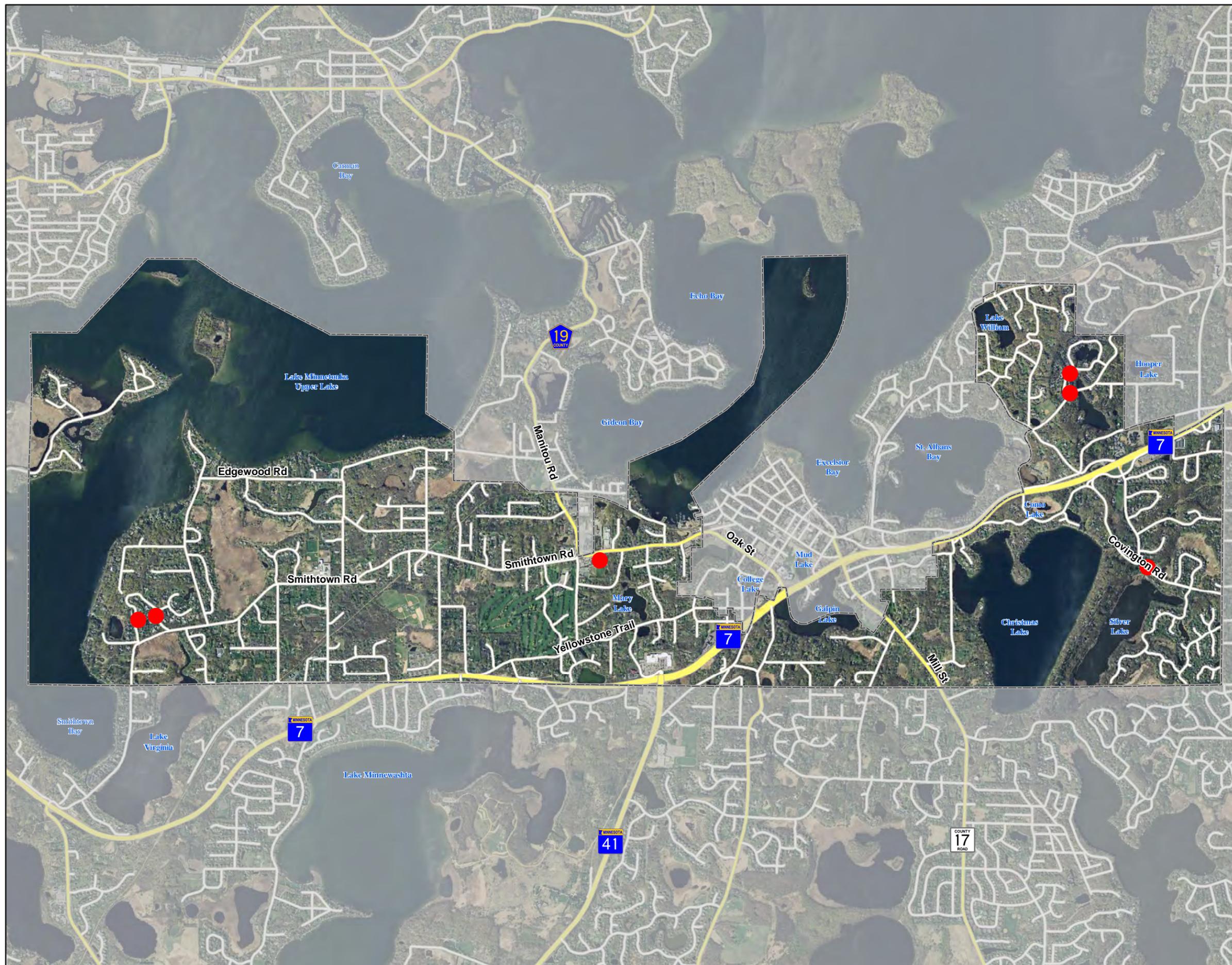
N
0 2,500 Feet
1 inch = 2,500 feet



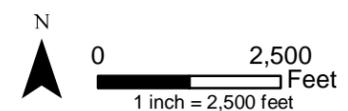


CITY OF SHOREWOOD

Shorewood Surface Water Management Plan Figure 9: Groundwater Appropriations



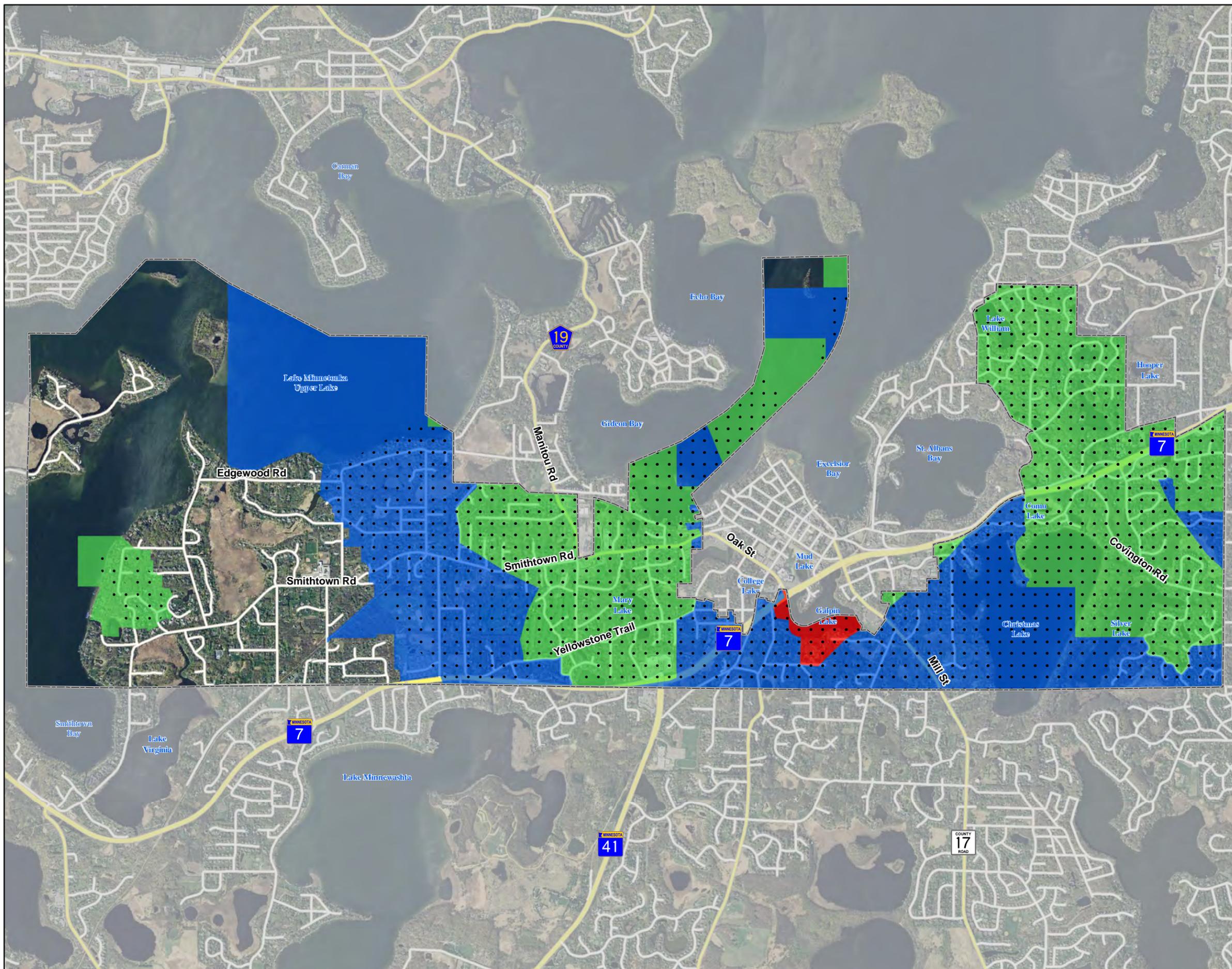
| | |
|--|--|
| | City Boundary |
| | MN DNR Permitted Water Appropriation Locations |



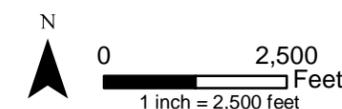


CITY OF SHOREWOOD

Shorewood Surface Water Management Plan Figure 10: Drinking Water Supply Management Areas



| | |
|--|--------------------------|
| | City Boundary |
| | Wellhead Protection Area |
| Drinking Water Supply Vulnerability | |
| | High |
| | Moderate |
| | Low |

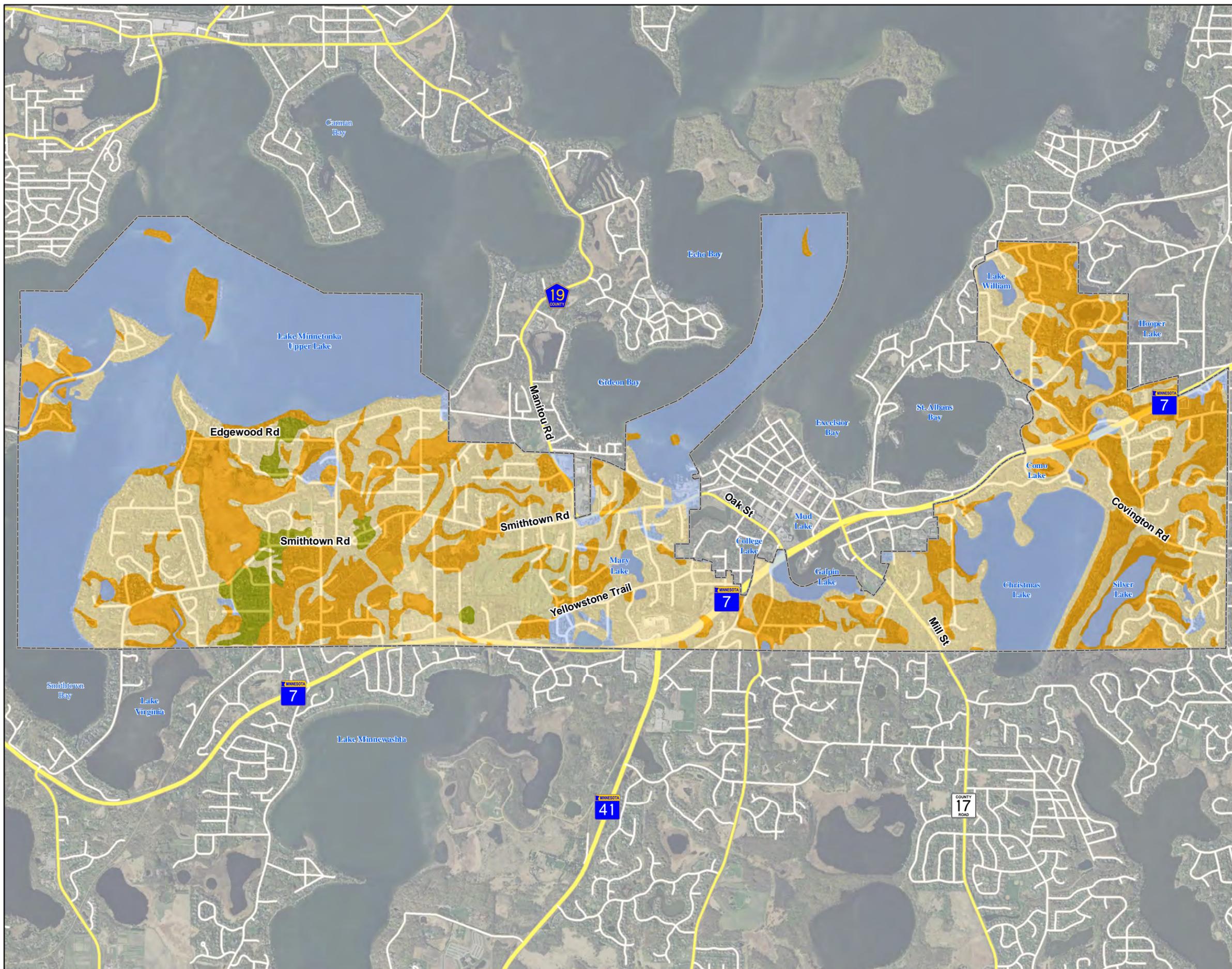




CITY OF SHOREWOOD

Shorewood Surface Water Management Plan

Figure 11: Hydrologic Soils Classification Map



-  City Boundary
- Hydrologic Group**
-  HSG B: These soils have moderate infiltration rates ranging from 0.15 to 0.30 inches per hour when thoroughly wetted. These soils consist of deep moderately well to well drained soils with moderately fine to moderately coarse textures.
-  HSG C: These soils have slow infiltration rates ranging from 0.05 to 0.15 inches per hour when thoroughly wetted
-  HSG D: These soils have very slow infiltration rates ranging from 0 to 0.05 inches per hour when thoroughly wetted. These soils are typically clay soils with high swelling potential, soils with high permanent water table, soils with clay layer at or near the surface, or shallow soils over nearly impervious material.
-  Water

N



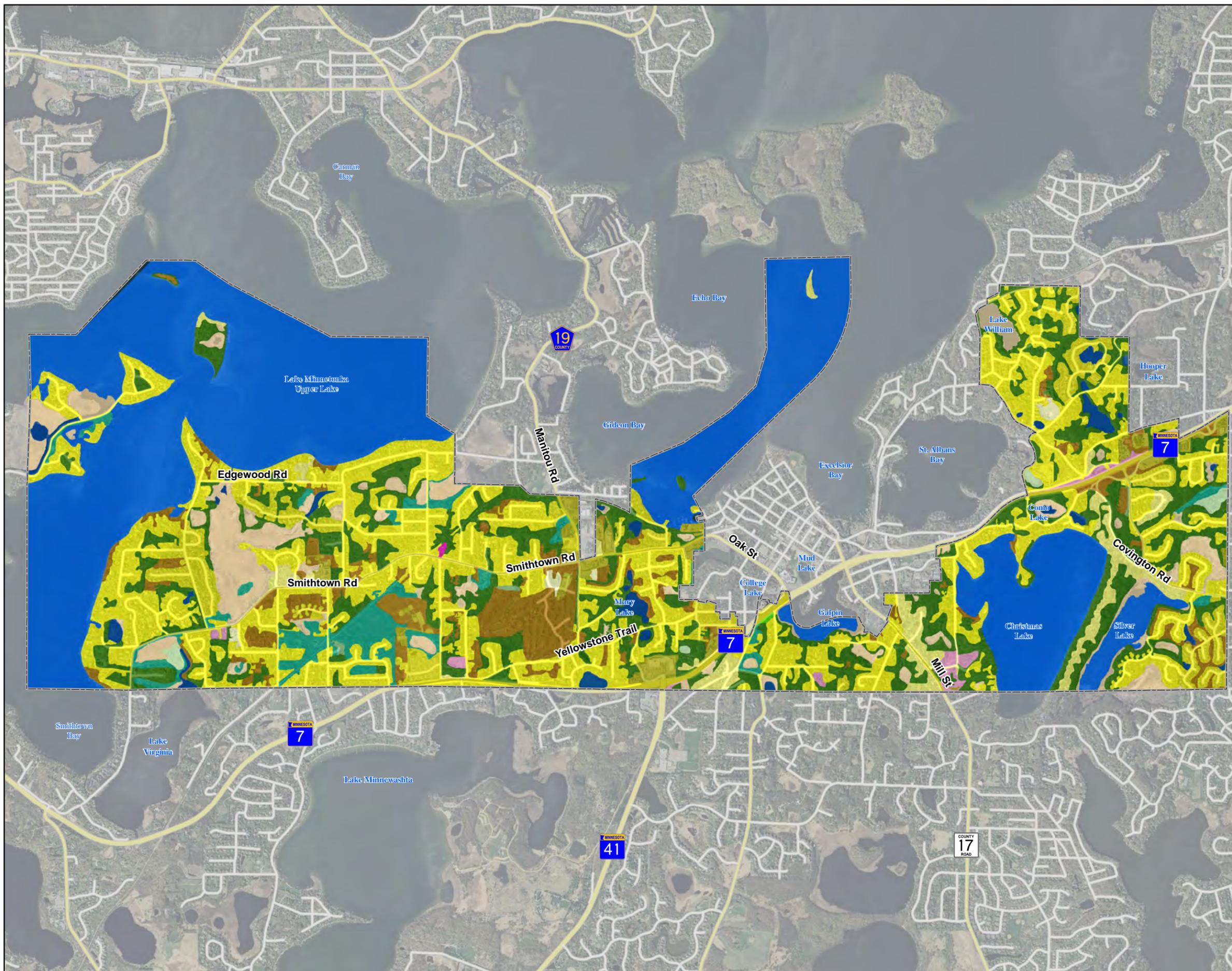
0 2,500 Feet

1 inch = 2,500 feet





Shorewood
Surface Water
Management Plan
**Figure 12: Minnesota Land
Cover Classification System**



| City Boundary | |
|--------------------------|-----------------------------|
| [White outline] | City Boundary |
| Landcover Classification | |
| [Light yellow] | 5-10% Impervious |
| [Yellow] | 11-25% Impervious |
| [Light green] | 26-50% Impervious |
| [Yellow-green] | 51-75% Impervious |
| [Green] | 76-100% Impervious |
| [Brown] | Short Grasses |
| [Light green] | Agricultural Land |
| [Green] | Tree Plantation |
| [Dark green] | Forest |
| [Teal] | Wetland Forest |
| [Light green] | Wetland Shrubs |
| [Pink] | Tall Grasses |
| [Light brown] | Wetland Emergent Vegetation |
| [Magenta] | Dry Tall Grasses |
| [Blue] | Open Water |
| [Dark blue] | Wetland Open Water |

N

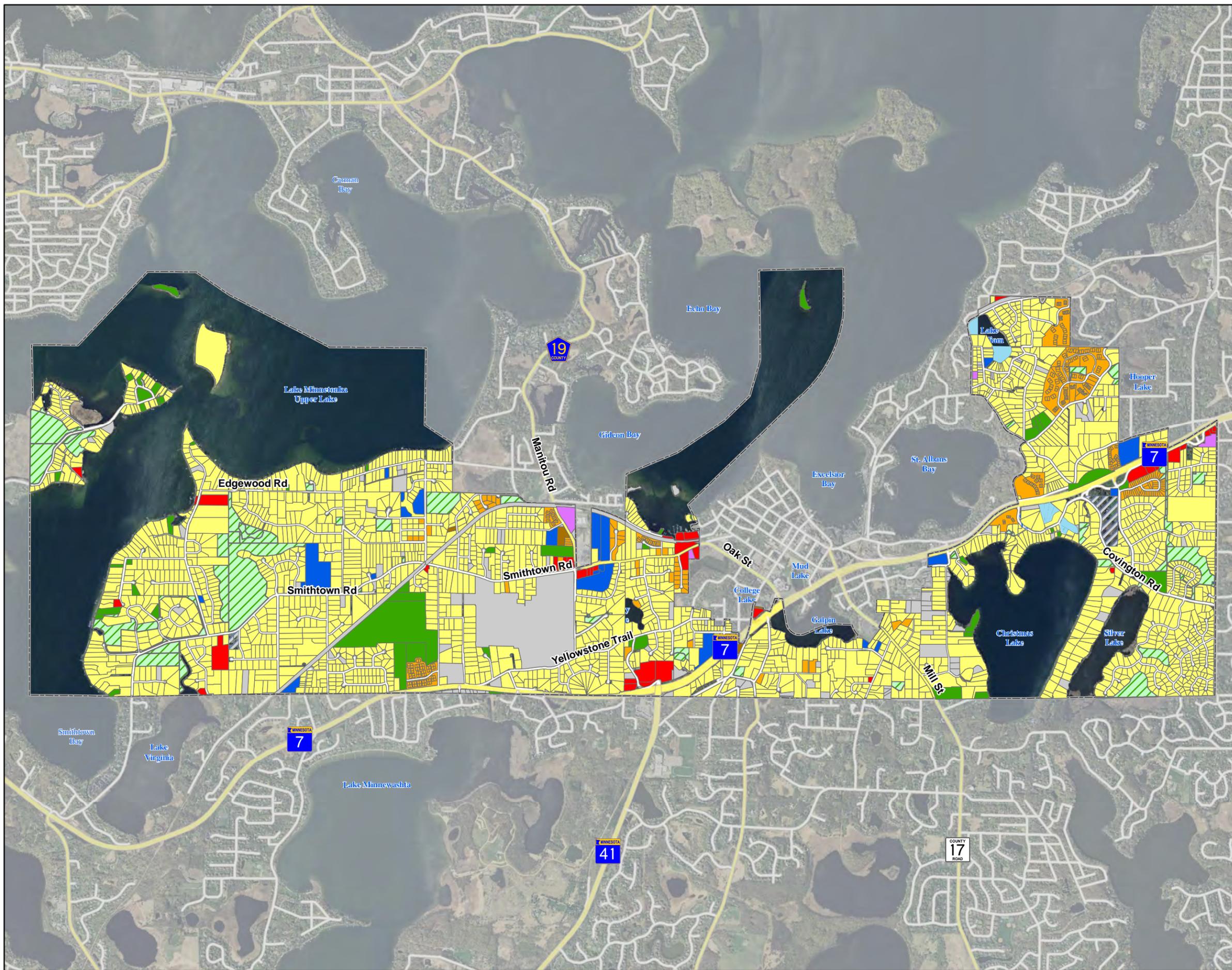
0 2,500 Feet

1 inch = 2,500 feet



CITY OF SHOREWOOD

Shorewood Surface Water Management Plan Figure 13: Existing Land Use



| | |
|-----------------|----------------------------|
| | City Boundary |
| Land Use | |
| | Low Density Residential |
| | Medium Density Residential |
| | High Density Residential |
| | Commercial |
| | Industrial |
| | Public/Institutional |
| | Open Space |
| | Parks |
| | Cemetery |
| | Vacant Land/Undeveloped |
| | Lakes and Wetlands |

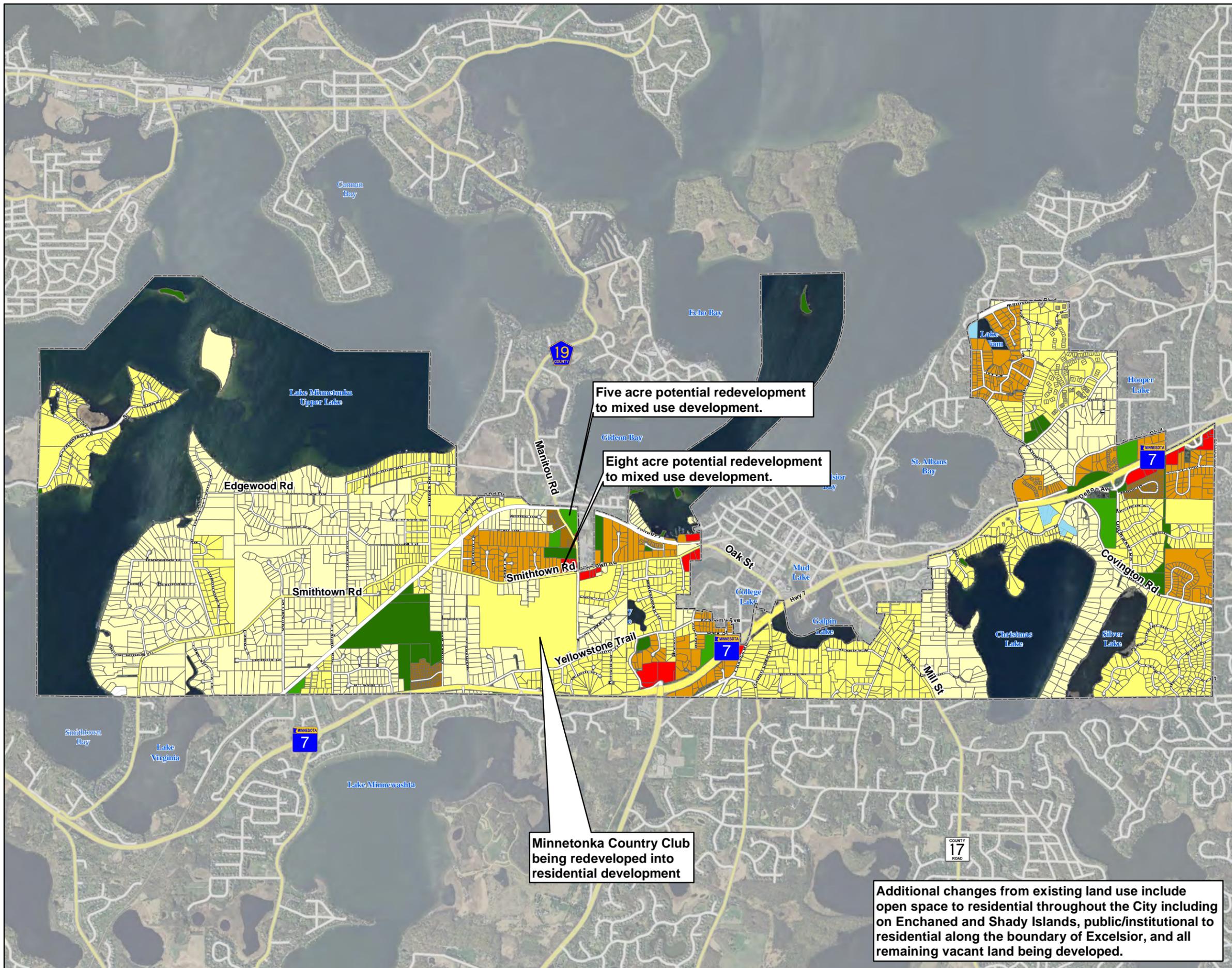
N

0 2,500 Feet
1 inch = 2,500 feet



CITY OF SHOREWOOD

Shorewood Surface Water Management Plan Figure 14: Future Land Use



City Boundary

Land Use

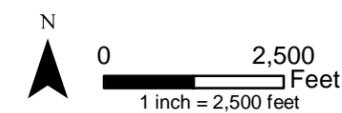
- Lowest Density Residential
- Low Density Residential
- Low to Medium Density Residential
- Medium Density Residential
- Commercial
- Semi-Public
- Public
- Open Water
- ROW

Five acre potential redevelopment to mixed use development.

Eight acre potential redevelopment to mixed use development.

Minnetonka Country Club being redeveloped into residential development

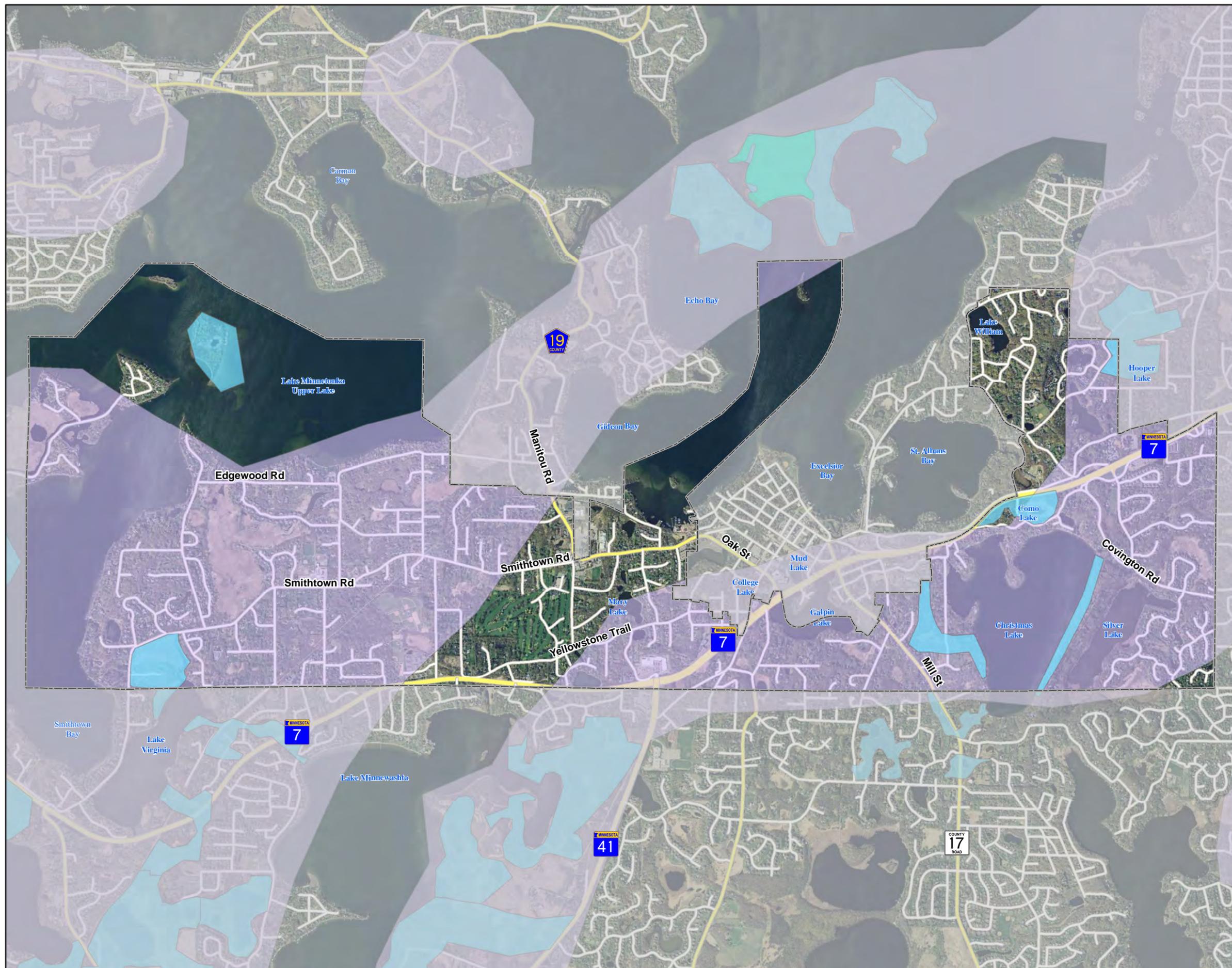
Additional changes from existing land use include open space to residential throughout the City including on Enchanted and Shady Islands, public/institutional to residential along the boundary of Excelsior, and all remaining vacant land being developed.





CITY OF SHOREWOOD

Shorewood Surface Water Management Plan Figure 15: Biological Significance and Conservation Corridor Map



-  City Boundary
-  MCWD Key Conservation Areas
-  MCBS Moderate Biodiversity Area
-  Metropolitan Conservation Corridor

N



0 2,500 Feet



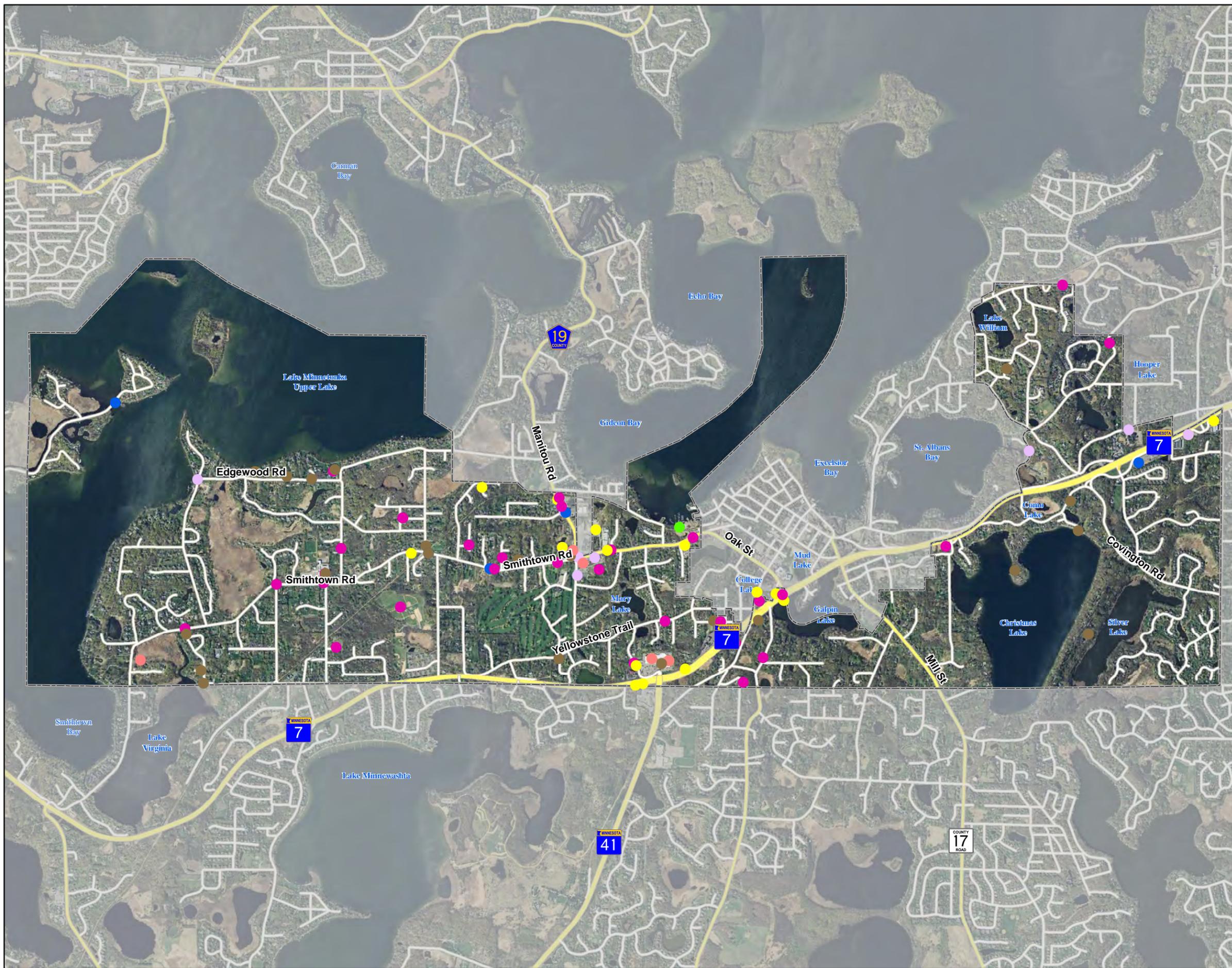
1 inch = 2,500 feet





CITY OF SHOREWOOD

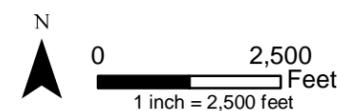
Shorewood Surface Water Management Plan Figure 16: Pollutant Source Location Map



City Boundary

MPCA Pollutant Source

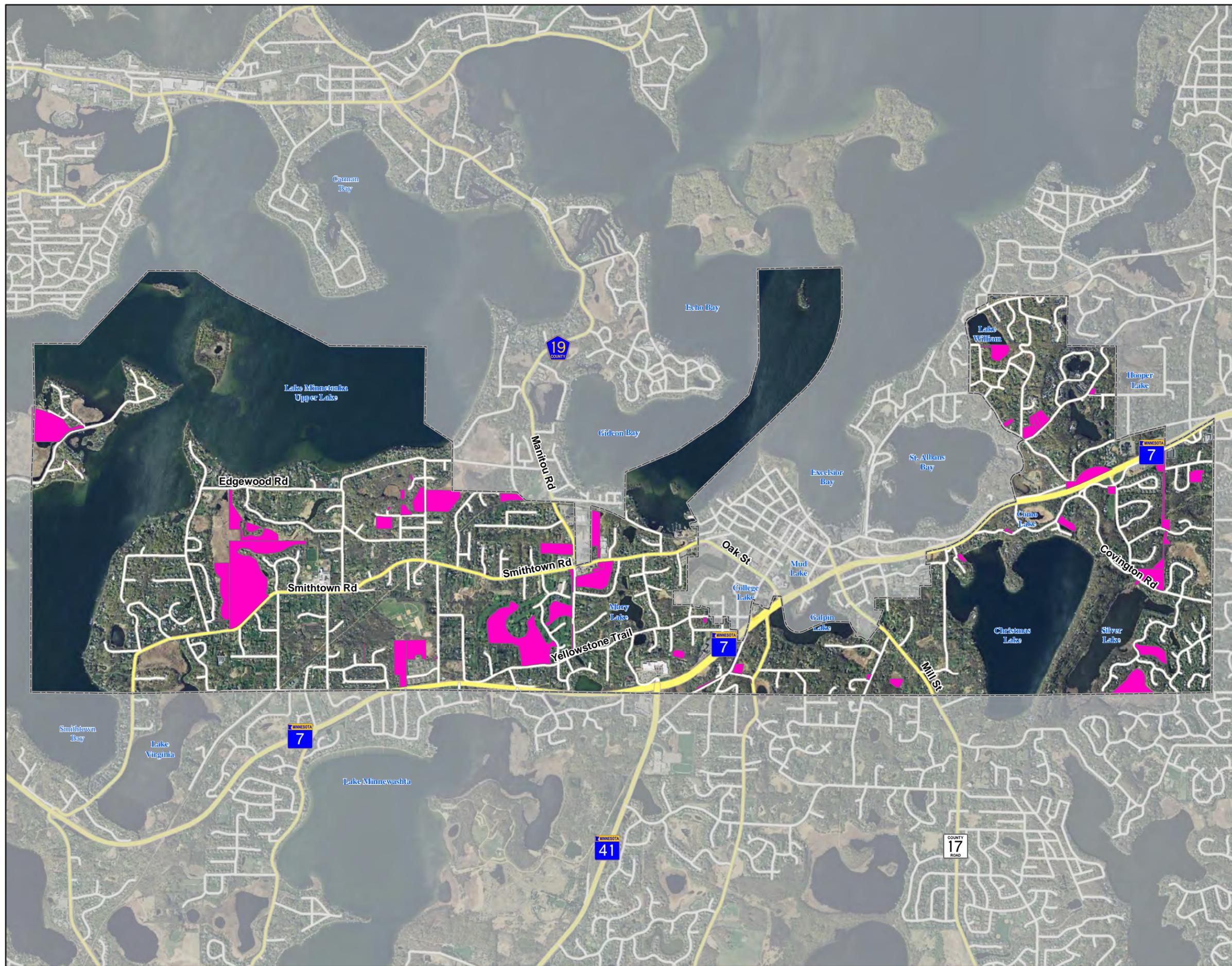
- Aboveground Tanks
- Brownfields
- Construction Stormwater
- Hazardous Waste
- Industrial Stormwater
- Multiple Programs
- Petroleum Remediation
- Solid Waste
- Underground Tanks
- Wastewater





CITY OF SHOREWOOD

Shorewood Surface Water Management Plan
Figure 17: Shorewood's City-Owned Parcels



| | |
|--|--------------------|
| | City Boundary |
| | City-Owned Parcels |

N

0 2,500 Feet

1 inch = 2,500 feet



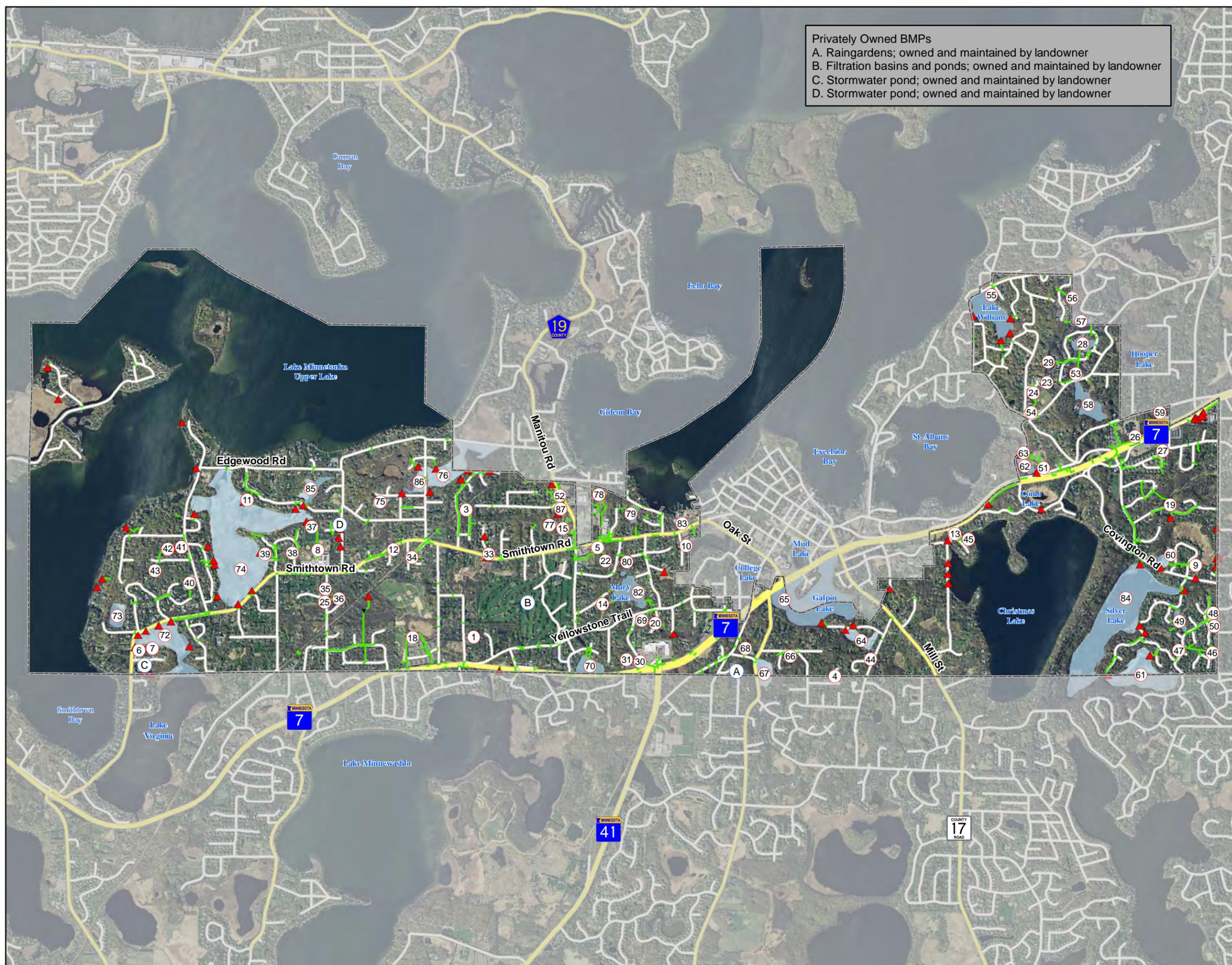
CITY OF SHOREWOOD

Shorewood Surface Water Management Plan

Figure 18: Storm Sewer and Stormwater BMPs

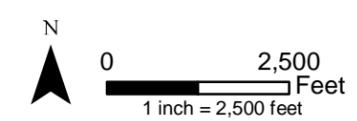
Privately Owned BMPs

- A. Raingardens; owned and maintained by landowner
- B. Filtration basins and ponds; owned and maintained by landowner
- C. Stormwater pond; owned and maintained by landowner
- D. Stormwater pond; owned and maintained by landowner



- City Boundary
- Outfalls
- Storm Sewer
- Pond Inventory*

*Numbers Coincide with City-Owned Stormwater Basin Identifiers



APPENDIX B

Water Resource Related Agreements

CITY OF SHOREWOOD

RESOLUTION NO. 18-082

**A RESOLUTION REGARDING THE ADMINISTRATION OF THE MINNESOTA
WETLAND CONSERVATION ACT AND OTHER DUTIES**

WHEREAS, the Minnesota Wetland Conservation Act of 1991 (WCA) requires local government units (LGUs) to implement the rules and regulations promulgated by the Board of Water and Soil Resources (BWSR) pertaining to wetland draining, filling and excavation; and

WHEREAS, Minnesota Rules, chapter 8420 have been adopted by BWSR in accordance with the rulemaking provisions of Minnesota Statutes, chapter 14, for the purpose of implementing WCA; and

WHEREAS, Minnesota Rules 8420.0200, Subpart 1, Item E allows a county, city, or town to delegate implementation of chapter 8420 and the Act to another governmental entity by the passage of resolutions by both parties; and

WHEREAS, both parties must provide notice to BWSR, the Department of Natural Resources, and the Soil and Water Conservation District of the delegation, including a copy of the resolution and a description of the applicable geographic area, within 15 business days of adoption of the resolution.

NOW, THEREFORE, BE IT RESOLVED by the City Council of the City of Shorewood defers the authority and administrative responsibility to implement the WCA as the LGU to the Riley Purgatory Bluff Creek Watershed District for those areas within the legal boundaries the Riley Purgatory Bluff Creek Watershed District as of this date in accordance with Minnesota Rules, Chapter 8420;

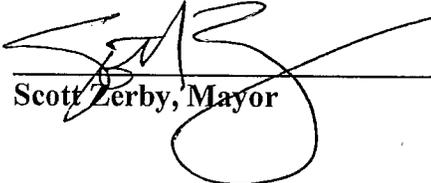
AND FURTHER, that the Riley Purgatory Bluff Creek Watershed District may review certain Public Waters work projects within the Riley Purgatory Bluff Creek Watershed District as allowed by their General Permit through the Minnesota Department of Natural Resources.

ADOPTED BY THE CITY COUNCIL OF THE CITY OF SHOREWOOD this 27th day of August, 2018.

ATTEST:



Sandie Thone, City Clerk



Scott Zerby, Mayor

MEMORANDUM of UNDERSTANDING

Between the Minnehaha Creek Watershed District and the City of Shorewood for Local Water Planning and Regulation

This Memorandum of Understanding (MOU) is made by and between the Minnehaha Creek Watershed District, a watershed district with purposes and powers as set forth at Minnesota Statutes Chapters 103B and 103D ("MCWD"), and the City of Shorewood, a body corporate and politic and a statutory city in the State of Minnesota ("City").

Recitals and Statement of Purpose

WHEREAS in 2007, the MCWD revised its comprehensive watershed management plan under Minnesota Statutes § 103B.231, which details the existing physical environment, land use and development in the watershed and establishes a plan to regulate water resource use and management to protect water resources, improve water quality, prevent flooding and otherwise achieve the goals of Minnesota Statutes Chapters 103B and 103D;

WHEREAS the MCWD's comprehensive watershed management plan incorporates the Rules adopted by the MCWD to protect water resources, improve water quality, prevent flooding and otherwise achieve the goals of Minnesota Statutes Chapters 103B and 103D;

WHEREAS the City has developed a local water management plan under Minnesota Statutes §103B.235 that describes the existing and proposed physical environment and land use within the City and sets forth an implementation plan for bringing local water management into conformance with the MCWD's comprehensive watershed management plan;

WHEREAS on January 8, 2009, the MCWD Board of Managers conditionally approved the City's local water management plan by adoption of Resolution 09-005, which resolution is attached and incorporated herein;

WHEREAS the City wishes to continue to authorize MCWD permitting authority with respect to all areas regulated by the MCWD including the Minnesota Wetland Conservation Act;

WHEREAS MCWD approval of a local plan requires a finding that the official controls of the local government are at least as protective of water resources as the MCWD Rules;

WHEREAS the finding by the MCWD Board of Managers in this regard rests on the City's authorization of the MCWD's continued exercise of regulatory authority within the City in accordance with Minnesota Statutes §103B.211, subdivision 1(a)(3);

WHEREAS the MCWD and City desire to memorialize their respective roles in implementing water resource protection and management within the City;

NOW THEREFORE it is mutually agreed by and between the parties that they enter into this MOU in order to document the understanding of the parties as to the roles and responsibilities of each party.

1.0 Responsibilities of the City

1.1 The City may exercise all present and future authority it otherwise may possess to issue permits for and regulate activities affecting water resources within the City.

1.2 The City will meet at least annually with the MCWD to review the implementation of the City's local water management plan.

1.3 Annually, by the date specified for the City's submittal of its annual report under its NPDES municipal stormwater permit, the City will submit to the MCWD a concise but specific report describing:

- a. Progress on the local water management plan implementation program.
- b. Progress on meeting phosphorus load reduction requirements of the WMP.
- c. Any adjustments to the implementation and/or capital improvement program in the local water management plan.
- d. A listing, with further specific information as the MCWD may request, of grading and structural alterations approved or occurring within city boundaries since the last annual report (both private and public alterations) that could measurably affect hydraulic and hydrologic model outcomes.

The City may incorporate its annual report into its NPDES MS4 annual report, provided it addresses the above items with specificity.

2.0 Responsibilities of the MCWD

2.1 The MCWD will continue to apply and enforce its Rules, as they may be amended from time to time, within the City.

2.2 The MCWD will meet with the City at least annually to review the implementation of the City's local water management plan, addressing at a minimum the following topics:

1. Maintenance of up-to-date water quality measures, such as concentrations of Phosphorus, in the City's local water management plan;
2. The City's progress toward Implementation Program/CIP items;
3. Utilizing street sweeping to meet MCWD Phosphorus Loading Reduction goals, and specifically the progress of the City toward testing phosphorus concentrations in sweepings and utilizing that knowledge for effective sweeping.

2.3 The MCWD retains all authority that it may possess under Minnesota Statutes Chapters 103B and 103D or any other provision of law, except as explicitly reposed in the City under this

MOU, including but not limited to authority set forth at Minnesota Statutes §§103B.211, subdivision 1(a); 103D.335 and 103D.341.

3.0 General

3.1 The MOU is effective on the date that it has been executed by both parties, will remain in effect for five years, and will be extended automatically for five-year terms unless terminated by agreement of the parties. Notwithstanding, the City will continue to be subject to applicable statutes and rules requiring that it revise its local water management plan in response to MCWD revisions of the WMP.

3.2 This MOU may be amended only by a writing signed by both parties.

3.3 This MOU does not affect the rights and duties of the parties under the March 24, 2008 Joint Powers Agreement signed by the MCWD and the City of Shorewood, which remains in force and effect according to its terms.

IN WITNESS WHEREOF, the parties hereto have executed this Memorandum of Understanding.

CITY OF SHOREWOOD

MINNEHAHA CREEK WATERSHED DISTRICT

By *Laura Surgeon*
acting Mayor

By *James B. Colkins*
President, Board of Managers

By *[Signature]*
City Manager

Date:

Date: *2-12-09*

APPROVED AS TO FORM AND EXECUTION

APPROVED AS TO FORM AND EXECUTION

By *Mary Deetzi*
Its Attorney

By *[Signature]*
Its Attorney

MEMORANDUM of UNDERSTANDING

This Memorandum of Understanding (MOU) is made between the City of Shorewood, a Minnesota municipal corporation ("City"), and the Minnehaha Creek Watershed District ("District"), a watershed district and political subdivision with powers at Minnesota Statutes Chapters 103B and 103D.

Recitals and Statement of Purpose

WHEREAS the City has identified drainage, groundwater and flooding concerns within certain defined catchments identified as:

- Shorewood Oaks Development
- Strawberry Lane
- Grant Lorenz Channel
- Alexander Lane Pond
- Church Road Ponding

and evaluated solutions to those concerns at a conceptual level as summarized in the "Freeman Park Feasibility Study" (April 5, 2017) ("Study");

WHEREAS the City would like to address these concerns through a systematic approach that integrates multiple goals for road improvements; parks, trails and open space; and management of water as a community asset;

WHEREAS in its Watershed Management Plan (2018), the District outlines its commitment to serving as a resource to its communities through early coordination and planning of land use and water resource matters, including technical assistance, regulatory process facilitation and shared efforts to secure funding;

WHEREAS in addition to addressing drainage, groundwater and flooding concerns, collaboration between the City and District may create the opportunity for water quality, habitat and other water resource benefits;

WHEREAS the City and District wish to formalize a mutual commitment to integrating efforts and aligning resources in order to plan wisely, make sound public investments in infrastructure, and protect and improve natural systems so as to foster a vibrant and healthy community;

THEREFORE this MOU establishes a cooperative framework to examine and pursue work within the area defined by the Study that integrates and cost-effectively achieves the above City and District goals.

Terms of Understanding

1. The City will lead further development of the engineering basis for a plan to address the identified areas of drainage, groundwater and flooding concern, including the evaluation of alternatives and costs.
2. The District, through its staff and engineer, will provide independent technical evaluation of the concerns; proposed solutions; and opportunities to integrate elements for water quality, habitat or other water resource benefits.

3. To facilitate technical review and collaboration, the City and District each will make relevant data available to each other on request. City data including but are not limited to technical data supporting the Study; City stormwater conveyance maps and system component specifications; City capital improvement programs for roads, trails and parks; and information on City land interests including ownership and rights under easements and covenants. District data include, but are not limited to, District hydraulic & hydrologic models and data sets and other District water quality and water resource data for relevant surface waters. Data sharing is subject to the ordinary licensing protocols of each party.

4. After initial mutual review of relevant data, the City and District will identify data gaps. The City will address gaps related to drainage, groundwater and related water quantity matters, as well as those related to City road, trails and parks improvements. The District will address gaps related to water quality and water resource matters other than quantity.

5. The City and District, through the working group formed under paragraph 8 below, will collaborate to identify and prioritize potential strategies and projects to address identified drainage, groundwater and flooding concerns while also advancing public natural resource, water quality, parks and trails, and infrastructure goals.

6. The strategies identified in paragraph 5 will be incorporated into an Area Plan developed by the City for the study area identified in Exhibit A. Through the collaborative analysis, the Plan will include a prioritized, phased City investment strategy that integrates City infrastructure priorities for road improvements, trails, park improvements and water resource improvements for volume, rate, and load reduction and ecological enhancements.

7. The Area Plan developed by the City will include a funding plan for the City investments identified. There are no funding commitments by MCWD at this time beyond the technical services provided herein. MCWD funding may be available for strategies with a water resources or ecological benefit through a MCWD grant program to be developed in 2018 or considered by the Board of Managers as part of its annual Capital Improvement Program. Formal request for funding are prioritized annually. MCWD will identify applicable outside funding opportunities as they relate to the integration of water resource improvement strategies and assist the City in seeking those funds.

8. As each potential project or other capital work is developed, the City and District will:

a. Facilitate conceptual review by their respective regulatory staff to provide for early identification of potential regulatory criteria or obstacles. The District also will assist the City in understanding the potential regulatory requirements of other water resource agencies. Notwithstanding the foregoing, any project that is pursued as a result of coordination under this MOU will remain subject to the ordinary permit requirements and procedures of each party, as applicable.

b. Explore internal and external sources of funding for such work.

9. With the District's assistance, the City will coordinate outreach and engagement of the neighborhood and the broader interested public with respect to the work under this MOU, and will be responsible for

process facilitation including public notice, meeting space and similar administrative matters. The parties will co-lead public sessions.

10. The City and District each will designate a staff member and an engineering representative to serve as working group members to advance this MOU. These representatives will maintain contact and coordination in order to achieve progress under this MOU. Each staff member will draw on others within his or her organization as is appropriate to contribute to progress, and will coordinate briefing and action by his or her decision making body when appropriate.

11. This MOU is a statement of mutual interest and cooperation. Nothing herein is legally binding. At such time as the District and City proceed to implement a specific capital project or program, or to formalize other coordination in a binding manner, they will enter into a written agreement that establishes legally binding roles, responsibilities and financial obligations.

12. Each party will bear the costs of its participation in the activities described herein.

13. This MOU is effective when fully executed by the parties and expires two years thereafter. Either party may terminate this MOU on 30 days' advance written notice to the other party.

CITY of SHOREWOOD

By: Sotzgar

Date: 3/1/18

MINNHAHA CREEK WATERSHED DISTRICT

By: K. Rogness

Date: 3/8/18

RESOLUTION

COPY

RESOLUTION NUMBER: 18-020

TITLE: **Authorization to execute memorandum of understanding with the City of Shorewood to coordinate planning of water resources and City capital improvement planning**

WHEREAS, in 2014, the Board of Managers established the Balanced Urban Ecology Policy which emphasizes the importance of integrated land use and water planning in order to maximize water resource and community benefits;

WHEREAS the 2017 Strategic Alignment Plan identifies the following organizational strategies to achieve the District's mission of protecting and improving land and water resources:

- Develop high impact capital projects integrated with non-water initiatives through multijurisdictional partnerships
- Change the land-use and water policy environment to increase early, value added partnership with private development, public infrastructure, and public policy/planning;

WHEREAS in its Watershed Management Plan (2018), the District outlines its commitment to serving as a resource to its communities through early coordination and planning of land use and water resource matters, including technical assistance, regulatory process facilitation and shared efforts to secure funding;

WHEREAS the City of Shorewood has initiated early coordination with the District to take a systematic approach to addressing identified drainage, groundwater and flooding concerns in the western portion of the City that integrates multiple goals for road improvements, parks, trails and open space management; and management of water as a community asset;

WHEREAS in addition to addressing drainage, groundwater and flooding concerns, collaboration between the City and District may create the opportunity for water quality, habitat and other water resource benefits;

WHEREAS the City and District wish to formalize a mutual commitment to integrating efforts and aligning resources in order to plan wisely, make sound public investments in infrastructure, and protect and improve natural systems so as to foster a vibrant and healthy community;

WHEREAS this MOU does not establish legally binding terms on the District and City, but establishes a cooperative framework to examine and pursue work within the area defined by the study that integrates and cost-effectively achieves the above City and District goals;

WHEREAS the City of Shorewood authorized the Memorandum of Understanding at its meeting on February 26.

NOW THEREFORE BE IT RESOLVED that the Minnehaha Creek Board of Managers authorizes the District Administrator to enter into a memorandum of understanding with the City of Shorewood to coordinate the planning and programming of water resource, road, infrastructure and park investments.

Resolution Number 18-020 moved by Manager Olson, seconded by Manager Becker.
Motion to adopt the resolution 7 ayes, 0 nays, 0 abstentions. Date: March 8, 2018.

K. Rogness
Secretary Date: 3/8/18

**DRAFT for discussion purposes only and subject to Board approval and the availability of funds.
Resolutions are not final until approved by the Board and signed by the Board Secretary.**

APPENDIX C

Stormwater System Modeling Information

Storm Water System Modeling Information

NOTE: The City's storm water model does not match the MCWD model. The MCWD model is on more of a global scale, whereas the City's model is split into several subwatersheds. The City will defer to the MCWD, when appropriate; however, the City will retain its existing model for areas where the MCWD model does not reflect localized subwatershed characteristics.

HYDROLOGIC INFORMATION FOR THE CITY OF SHOREWOOD

SUBWATERSHED NAME

Indicates area shown on the Subwatershed Delineation Map. The letter generally indicates a group of subwatersheds that connect to a common outlet or lake. The abbreviations used in the following tables and the watershed to which they correspond are:

| | |
|-------------|--|
| GB | Subwatershed tributary to Gideon Bay |
| LMAR | Subwatershed tributary to Lake Mary |
| C | Subwatershed tributary to Central area |
| SC | Subwatershed tributary to South-Central area |
| LMIN | Subwatershed tributary to Lake Minnewashta |
| NC | Subwatershed tributary to North-Central area |
| WC | Subwatershed tributary to West-Central area |
| LV | Subwatershed tributary to Lake Virginia |
| W | Subwatershed tributary to West area |
| PC | Subwatershed tributary to Purgatory Creek |
| CB | Subwatershed tributary to Carson Bay |
| LW | Subwatershed tributary to Lake William |
| SAB | Subwatershed tributary to St. Albans Bay |
| CL | Subwatershed tributary to Christmas Lake |
| GL | Subwatershed tributary to Galpin Lake |
| I | Subwatershed tributary to Lake Minnetonka |

SUBWATERSHED DRAINAGE AREA

The area that drains directly to a particular pond or major drainageway. The subwatershed boundaries are typically determined using available contour mapping. The boundaries should be considered approximate due to the limited availability or accuracy of the contour mapping and the possibility of alteration by new construction or storm sewer projects.

TIME OF CONCENTRATION (T_c)

The longest travel time for a particle of water to reach a discharge point in a watershed.

CURVE NUMBER (CN)

The runoff curve number accounts for many major factors in hydrologic modeling. The major factors that determine the curve number are the hydrologic soil group, the type of cover present in the watershed, land use in the watershed, and antecedent moisture conditions. Other factors affecting the curve number are whether impervious surface areas outlet directly to the drainage system or whether the flow spreads over pervious areas before entering the drainage system. Highly developed urban areas with a greater percentage of impervious surface area are characterized with higher curve numbers. Rural area with land uses of rural residential and agricultural typically will have lower curve numbers. Curve numbers have a typical range of 40 to 98.

PEAK RUN-OFF RATE

This is the rate water is shed from a particular drainage area. It is equivalent to the inflow rate of a storm water treatment basin.

RUNOFF VOLUME

This is the volume of water that is shed from a particular drainage area. The volume of water for a particular watershed is dependent on the subwatershed CN and storm event precipitation.

POND NWL

The normal water level of the pond is the lowest controlling elevation. It is usually taken as the invert of the outlet structure or the pump control elevation and is the elevation that the pond will drain down to after a rainfall event. The NWL does not reflect the lowest elevation that may be attained naturally by infiltration, evaporation or transpiration.

POND HWL

The highest water level achieved in a pond as predicted by the hydrologic/hydraulic model for a 100-year event. The model assumes that the pond elevation is equal to the NWL at the beginning of the storm event. The HWL is affected by the accuracy of the data such as drainage area, storage capacity, outlet description and condition, and runoff factors. All of these factors should be reviewed when HWL is considered critical.

RECOMMENDED 100 YEAR HWL

The highest water level predicted for a pond based on the 100-year event hydrologic/hydraulic model data results. This elevation is recommended for ponding areas and is not representative of actual conditions without full implementation of the model parameters.

PEAK OUTFLOW FROM POND

The maximum discharge rate from a pond through the outlet. This normally occurs when the pond is at the HWL and it assumes the full efficiency of the outlet structure. The peak outflow rate for subwatersheds without ponding areas is based on the flowing full capacity of the discharge pipe from that subwatershed.

POND OUTLET

The diameter of pipe or type of structure which provides an outlet from a subwatershed or storm water storage basin.

REQUIRED STORAGE

The volume of water required to be retained in order to reduce the peak runoff rate to the peak outflow from the pond. This volume of water is stored in a storm water retention basin between the NWL and the HWL.

AVAILABLE STORAGE

The storm water storage which is currently available within a subwatershed in the form of natural wetlands and depressions. These storage values are estimates taken from topography mapping provided by the City, U.S. Geological Survey Quad Maps, or available plans for proposed ponds.

APPROXIMATE OVERFLOW ELEVATION

The elevation at which the pond would overland overflow if the storage capacity is exceeded. This approximate elevation was determined from contour mapping.

EXISTING LOW BUILDING ELEVATION

This elevation was determined from the "House-Print" on the contour mapping and does not indicate low-floor or basement elevations. These elevations should be considered approximate due to possible inaccuracies in the mapping and buildings that have been constructed after the mapping was completed.

1-YEAR EVENT

A rainfall event that has a 100% chance of occurrence in a given year. The information in this table was obtained from a hydrologic/hydraulic model that utilized the Soil Conservation Service TR-20 Hydrograph Routing procedure. The 1-year event assumed a 2.4 inch, Type II distribution, 24-hour duration rainfall event.

100-YEAR EVENT

A rainfall event that has a 1% chance of occurrence in a given year. The information in this table was obtained from a hydrologic/hydraulic model that utilized the Soil Conservation Service TR20 Hydrograph Routing Procedure. The 100-year event assumed a 6.0 inch, Type II distribution, 24-hour duration rainfall event.

**CITY OF SHOREWOOD
COMPREHENSIVE WATER RESOURCES MANAGEMENT PLAN
STORMWATER MODEL RESULTS
1-YEAR EVENT**

| SUB-WATERSHED NUMBER | AREA (ac) | Tc (min) | CN | PEAK RUNOFF RATE (cfs) | RUNOFF VOLUME (ac-ft) | POND NWL (elev.) | POND HWL (elev.) | PEAK OUTFLOW FROM POND (cfs) | POND OUTLET (c) | REQUIRED STORAGE (ac-ft) | AVAILABLE STORAGE (ac-ft) (b) | APPROXIMATE OVERFLOW ELEVATION (a) | EXISTING LOW BUILDING ELEVATION (a) | COMMENTS |
|----------------------|-----------|----------|----|------------------------|-----------------------|------------------|------------------|------------------------------|-----------------------|--------------------------|-------------------------------|------------------------------------|-------------------------------------|----------|
| PC 1 | 4.9 | 16 | 75 | 3.0 | 0.2 | 943.2 | 943.5 | 0.3 | 12" RCP - (E) | 0.1 | 1.9 | 947 | 949 | |
| PC 2 | 10.3 | 20 | 74 | 4.9 | 0.5 | 922.1 | 922.8 | 1.2 | 12" RCP - (E) | 0.2 | 11.8 | 930.8 | 932 | |
| PC 3 | 18.1 | 23 | 75 | 9.1 | 0.9 | 910.1 | 910.9 | 0.1 | 12" RCP - (E) | 1.2 | 3.8 | 912.1 | 914 | |
| PC 4 | 19.3 | 21 | 76 | 10.9 | 1.0 | 904 | 904.4 | 3.4 | 5' Weir - (P) | 0.3 | 0.8 | 905 | 912 | |
| PC 5 | 20.2 | 23 | 78 | 13.1 | 1.2 | 898.6 | 899.3 | 1.1 | 12" RCP - (E) | 1.6 | 13.7 | 902.7 | 906 | |
| PC 6 | 183 | 25 | 78 | 115.0 | 11.0 | 894.8 | 895.5 | 2.0 | 15" RCP - (E) | 16.8 | 250 | 904 | 904 | |
| PC 7 | 16.3 | 15 | 73 | 8.7 | 0.7 | 889 | 890.7 | 7.1 | 24" CMP - (P) | 0.1 | 4.7 | 897.2 | 899 | |
| PC 8 | 11.8 | 15 | 76 | 8.3 | 0.6 | 893.7 | 894 | 0.2 | 12" RCP - (E) | 0.5 | 12.8 | 898.3 | 901 | |
| PC 9 | 26.9 | 18 | 75 | 15.4 | 1.3 | 933.5 | 934.2 | 1.6 | 15" RCP - (P) | 0.6 | 8.4 | 938.5 | 939 | |
| PC 10 | 65.9 | 21 | 74 | 31.1 | 3.0 | 910.8 | 911.6 | 13.7 | 36" RCP - (E) | 0.7 | 55 | 920.8 | 922 | |
| PC 11 | 64.3 | 29 | 76 | 31.3 | 3.4 | 888 | 890.2 | 39.3 | 72" x 54" RCP-A - (E) | 4.6 | 21 | 892.4 | 897 | |
| PC 12 | 3 | 15 | 87 | 4.5 | 0.3 | 963.9 | 964.8 | 2.5 | 15' weir - (P) | 0.1 | 0.7 | 968.3 | 971 | |
| PC 13 | 10 | 15 | 87 | 14.9 | 1.0 | | | | | | | 983 | 986 | |
| CB 1 | 7.5 | 15 | 73 | 4.0 | 0.3 | 1000.5 | 1000.7 | 0.1 | 15' Weir - (E) | 0.3 | 16 | 1007 | N/A | |
| CB 2 | 24.9 | 30 | 75 | 10.8 | 1.2 | 984.7 | 985.2 | 2.0 | 18" RCP - (E) | 0.5 | 9 | 989.8 | 1009 | |
| CB 3 | 15.2 | 15 | 80 | 14.6 | 1.0 | 978 | 978.6 | 0.8 | 18" RCP - (E) | 0.6 | 6.7 | 984.8 | 987 | |
| CB 4 | 38 | 20 | 82 | 35.2 | 2.9 | 976 | 977.7 | 8.1 | 18" RCP - (E) | 1.2 | 36.2 (985) | 987.8 | 991 | |
| CB 5 | 13.3 | 25 | 75 | 6.5 | 0.7 | 975.9 | 976.3 | 0.9 | 21" RCP - (E) | 0.3 | 9 | 987.8 | 984 | |
| CB 6 | 10.5 | 15 | 76 | 7.4 | 0.6 | 978.6 | 978.8 | 0.2 | 12" RCP - (P) | 0.4 | 9.7 | 995.7 | 984 | |
| CB 7 | 26.3 | 28 | 71 | 7.8 | 1.0 | 967.8 | 968.4 | 1.2 | 15" RCP - (P) | 0.4 | 23 | 984.5 | 982 | |
| CB 8 | 48.8 | 20 | 71 | 17.0 | 1.8 | 955.2 | 955.8 | 1.5 | 18" RCP - (P) | 6.8 | 67 | 961.4 | 969 | |
| CB 9 | 14.3 | 19 | 71 | 5.0 | 0.5 | 970 | 970.6 | 1.0 | 21" CMP - (E) | 0.2 | 1.1 | 974 | 973.5 | |
| CB 10 | 6.1 | 15 | 75 | 3.9 | 0.3 | 953.7 | 954.5 | 1.6 | 18" RCP - (E) | 0.9 | 11.3 (961.4) | 974 | 973.5 | |
| CB 11 | 1.5 | 10 | 68 | 0.5 | 0.0 | 979.8 | 980.1 | 0.4 | 12" RCP - (E) | 0.1 | 0.5 | 991 | 982 | |
| CB 12 | 17.2 | 20 | 73 | 7.4 | 0.7 | 955.1 | 955.8 | 1.9 | 15" CMP - (P) | 1.1 | 17 | 963.5 | 973 | |
| CB 13 | 3.4 | 15 | 81 | 3.5 | 0.3 | 953.1 | 954 | 1.9 | 18" RCP - (P) | 0.5 | 2.1 | 963.5 | 956 | |
| CB 14 | 23 | 34 | 76 | 9.9 | 1.2 | 952.5 | 953.4 | 2.3 | 21" CMP - (E) | 3.9 | 20.2 | 963.5 | 957 | |
| CB 15 | 4.9 | 16 | 70 | 1.8 | 0.2 | 943.9 | 944.1 | 0.2 | 12" RCP - (E) | 0.1 | 5.8 | 952.9 | 953 | |
| CB 16 | 16.5 | 20 | 78 | 11.1 | 1.0 | | | | | | | | 947 | |
| CB 17 | 4.57 | 20 | 71 | 1.6 | 0.2 | 984.8 | 985.1 | 0.5 | 12" RCP - (P) | 0.0 | 0.8 | 987 | 990 | |
| LW 1 | 39.3 | 21 | 72 | 15.2 | 1.6 | 933 | 934 | 4.9 | 27" RCP - (E) | 0.4 | 2.2 | 938 | 943 | |
| LW 2 | 71.7 | 34 | 76 | 30.9 | 3.8 | 931.5 | 931.8 | 0.2 | 15" CMP - (P) | 5.2 | 88 | 936 | 939 | |
| SAB 1 | 15.1 | 30 | 70 | 3.7 | 0.5 | 970.4 | 970.7 | 0.4 | 15" CMP - (P) | 0.2 | 6.5 | 977.3 | 981 | |
| SAB 2 | 16.9 | 28 | 73 | 6.3 | 0.7 | 986.5 | 986.7 | 0.2 | 9" RCP - (E) | 0.6 | 4 | 992 | 988 | |
| SAB 3 | 38.7 | 24 | 73 | 15.8 | 1.7 | 935.4 | 935.8 | 0.3 | 12" CMP - (E) | 1.4 | 7.4 | 937.4 | 946 | |
| SAB 4 | 21.3 | 19 | 79 | 16.4 | 1.4 | 944 | 945.9 | 13.2 | 36" CMP - (P) | 0.2 | - | 942 | 956 | |
| CL 1 | 10.6 | 20 | 74 | 5.1 | 0.5 | 932.8 | 934.1 | 2.6 | 15" CMP - (E) | 0.1 | 1.2 | 936.7 | 941 | |
| CL 1A | 47 | 30 | 74 | 18.5 | 2.2 | 947 | 947.3 | 0.5 | 12" RCP - (P) | 1.8 | 12.4 | 949 | 952 | |
| CL 1B | 11.1 | 20 | 74 | 5.3 | 0.5 | 938.5 | 938.9 | 0.6 | 18" RCP - (P) | 0.2 | 1.3 | 940 | 940 | |
| CL 2 | 50 | 16 | 74 | 28.2 | 2.3 | 933 | 933.2 | 0.1 | 18" RCP - (P) | 2.2 | 44 | 937.2 | 938 | |
| CL 3 | 356.6 | 60 | 90 | 272.9 | 42.9 | 932.8 | 933 | 2.3 | 36" CMP - (E) | 51.3 | 1045 | 936.7 | 938 | |
| CL 4 | 8.2 | 15 | 69 | 2.7 | 0.3 | 930.4 | 931.3 | 2.2 | 42" CMP - (E) | 1.0 | 18 | 937.9 | N/A | |
| CL 5 | 15.9 | 21 | 72 | 6.1 | 0.6 | 951 | 952.3 | 3.3 | 15" CMP - (E) | 0.1 | 0.7 | 953.5 | 957 | |
| CL 6 | 23.7 | 20 | 77 | 14.7 | 1.3 | 946 | 946.6 | 1.8 | 24" RCP - (E) | 1.0 | 3.7 | 948 | 948 | |

**CITY OF SHOREWOOD
COMPREHENSIVE WATER RESOURCES MANAGEMENT PLAN
STORMWATER MODEL RESULTS
1-YEAR EVENT**

| SUB-WATERSHED NUMBER | AREA (ac) | Tc (min) | CN | PEAK RUNOFF RATE (cfs) | RUNOFF VOLUME (ac-ft) | POND NWL (elev.) | POND HWL (elev.) | PEAK OUTFLOW FROM POND (cfs) | POND OUTLET (c) | REQUIRED STORAGE (ac-ft) | AVAILABLE STORAGE (ac-ft) (b) | APPROXIMATE OVERFLOW ELEVATION (a) | EXISTING LOW BUILDING ELEVATION (a) | COMMENTS |
|----------------------|-----------|----------|----|------------------------|-----------------------|------------------|------------------|------------------------------|------------------------|--------------------------|-------------------------------|------------------------------------|-------------------------------------|----------|
| GL 1 | 32.6 | 30 | 73 | 11.6 | 1.4 | 951.3 | 955.1 | 7.5 | 15" CMP - (E) | 0.2 | 0.2 | 955.1 | 959 | |
| GL 2 | 49.1 | 18 | 76 | 30.7 | 2.6 | 943.5 | 944.7 | 1.7 | 15" CMP - (E) | 4.4 | 18.6 | 947.8 | 947 | |
| GL 3 | 36 | 21 | 75 | 18.6 | 1.8 | 964.6 | 965.3 | 0.8 | 12" CMP - (E) | 2.9 | 10.7 | 967.1 | 977 | |
| GL 4 | 25.9 | 18 | 77 | 17.7 | 1.5 | 957.5 | 958.7 | 5.6 | 24" VCP - (E) | 1.8 | 14.8 | 962.7 | 966 | |
| GL 5 | 5.8 | 20 | 75 | 3.0 | 0.3 | 989.9 | 990 | 0.0 | 18" CMP - (E) | 0.3 | 1.7 | 988 | 990 | |
| GL 6 | 28.2 | 42 | 79 | 13.7 | 1.8 | 945 | 946.7 | 8.3 | 30" CMP - (E) | 0.8 | 6.1 | 950.5 | 953 | |
| GL 7 | 43.8 | 17 | 75 | 26.1 | 2.2 | 943.3 | 943.7 | 1.5 | 2-24" RCP - (E) | 21.5 | 300 | 950 | 949 | |
| GL 9 | 8.5 | 15 | 70 | 3.2 | 0.3 | 982.9 | 983.5 | 0.9 | 15' Weir - (P) | 0.8 | 12.2 | 991.2 | 992 | |
| GL 10 | 46.8 | 80 | 77 | 11.9 | 2.7 | | | | | | | 950 | 951 | |
| GB 1 | 20.4 | 25 | 74 | 9.3 | 0.9 | 953 | 953.6 | 0.8 | 15" CMP-(P) | 0.5 | 1.6 | 955.3 | 955 | |
| GB 2 | 27.5 | 28 | 78 | 16.5 | 1.7 | 945 | 946.2 | 2.4 | 10" ORIFICE-(E) | 0.8 | 2.6 | 948 | 951 | |
| GB 3 | 34.9 | 37 | 72 | 9.7 | 1.4 | 933 | 933.8 | 2.1 | 21" RCP-(P) | 0.5 | 4.9 | 939.6 | 937 | |
| GB 4 | 11.9 | 15 | 74 | 7.5 | 0.6 | | | | | | | | 950 | |
| GB 5 | 13.3 | 21 | 65 | 2.0 | 0.3 | 967.4 | 968.1 | 1.9 | 18" RCP-(E) | 0.0 | 0.5 | 971.7 | 985 | |
| GB 6 | 24.3 | 18 | 77 | 17.7 | 1.4 | 957.8 | 959.6 | 10.8 | 24" RCP-(E) | 0.3 | 19.5 | 972.8 | 967 | |
| GB 7 | 29.4 | 30 | 75 | 13.0 | 1.5 | 932.3 | 933.2 | 2.4 | 15" CMP-(E) | 1.6 | 17.1 | 938 | 942 | |
| GB 8 | 74.7 | 18 | 76 | 50.1 | 4.0 | | | | | | | | 974 | |
| GB 9 | 14.3 | 25 | 76 | 7.8 | 0.8 | 930.1 | 930.3 | 0.3 | 36"-STEEL-(E) | 0.6 | 16.9 | 939.1 | 936.4 | |
| GB 10 | 36.5 | 20 | 77 | 25.1 | 2.1 | | | | | | | | 933 | |
| LMAR 1 | 32.7 | 28 | 76 | 16.5 | 1.7 | 955 | 955.4 | 0.7 | 12" CMP-(P) | 1.2 | 5.3 | 963.9 | 957 | |
| LMAR 2 | 61.8 | 20 | 77 | 42.5 | 3.5 | 953.1 | 953.4 | 0.4 | 15" RCP-(P) | 4.3 | 54.8 | 958 | 957 | |
| C 1 | 137.1 | 37 | 69 | 26.5 | 4.3 | 958 | 958.3 | 0.4 | 21" RCP-(P) | 4.2 | 30.4 | 966.4 | 960 | |
| C 2 | 10.1 | 17 | 72 | 4.8 | 0.4 | 960 | 960.2 | 0.1 | 12" RCP-(P) | 0.3 | 2.3 | 961.7 | 968 | |
| SC 1 | 6.2 | 15 | 78 | 5.5 | 0.4 | 974.8 | 975 | 0.2 | 12" RCP-(E) | 0.2 | 2.2 | 979.6 | 977 | |
| SC 2 | 37.7 | 25 | 78 | 24.4 | 2.3 | 960.6 | 961.1 | 1.1 | 15" RCP-(P) | 3.3 | 25.7 | 964.5 | 966 | |
| LMIN 1 | 16.7 | 30 | 75 | 7.4 | 0.8 | 977.2 | 978.3 | 5.5 | 24" RCP-(E) | 0.1 | 17.6 | 984.7 | 991 | |
| LMIN 2 | 18 | 20 | 74 | 9.5 | 0.8 | 948.6 | 950 | 9.4 | 27" RCP-(E) | 0.0 | 12.5 | 963.6 | 964.5 | |
| LMIN 3 | 6.7 | 20 | 73 | 3.2 | 0.3 | 960.6 | 961.2 | 0.8 | 18" CMP-(E) | 0.1 | 0.9 | 963.6 | 966 | |
| LMIN 4 | 16.4 | 20 | 89 | 23.3 | 1.9 | 985 | 986.6 | 8.8 | 36" RCP-(E) | 0.7 | 2.2 | 990 | 994 | |
| NC 1 | 16.5 | 21 | 79 | 12.9 | 1.1 | 981.7 | 983.5 | 4.1 | 15" CMP-(E) | 0.3 | 1.3 | 984.7 | 985.2 | |
| NC 2 | 39.4 | 47 | 75 | 12.5 | 2.0 | 979 | 979.3 | 5.5 | 12" RCP-(E) | 0.9 | 2.9 | 980.3 | 980 | |
| NC 3 | 18.5 | 21 | 72 | 7.7 | 0.7 | 966.3 | 969.3 | 6.0 | 27" RCP-(E) | 0.4 | 0.5 | 970 | 973 | |
| NC 4 | 27.9 | 30 | 73 | 10.1 | 1.2 | 950.2 | 951.8 | 11.3 | 36"-STEEL-(E) | 0.2 | 0.9 | 956.2 | 961 | |
| NC 5 | 20 | 30 | 75 | 8.8 | 1.0 | 948 | 949.2 | 5.2 | 24"-STEEL-(E) | 0.2 | 1.7 | 952.3 | 955 | |
| NC 6 | 6.4 | 15 | 70 | 2.6 | 0.2 | 953.5 | 953.7 | 0.1 | 10" ORIFICE-(E) | 0.1 | 0.9 | 954.8 | 965 | |
| NC 7 | 12.6 | 15 | 75 | 8.7 | 0.6 | 941.3 | 941.4 | 1.1 | 24" CMP-(E) | 0.2 | 1.4 | 941.3 | 944 | |
| NC 8 | 6.6 | 15 | 73 | 3.8 | 0.3 | 937.9 | 938 | 0.1 | 12" CMP-(P) | 0.2 | 10.9 | 944.7 | 945 | |
| NC 9 | 24.8 | 21 | 74 | 12.7 | 1.1 | 932 | 932.2 | 0.1 | 15" CMP-(P) | 1.2 | 13.5 | 934.5 | 940 | |
| NC 10 | 47.6 | 43 | 75 | 16.2 | 2.4 | 930.5 | 931.1 | 0.7 | 15" CMP-(E) | 2.6 | 7 | 931.9 | 939 | |
| NC 11 | 86.1 | 40 | 75 | 30.9 | 4.3 | - | - | - | - | - | - | - | 932 | |
| WC 1 | 49.6 | 29 | 72 | 16.5 | 2.0 | 975.5 | 975.6 | 4.2 | 15" & 12" CMP-(E) | 0.6 | 2.9 | 976 | 983 | |
| WC 2 | 106.6 | 60 | 76 | 31.1 | 5.6 | 959.5 | 963.8 | 16.0 | "ORIF. TO 48" RCP-(E) | 1.5 | 68 | 971.4 | 974 | |
| WC 3 | 44.5 | 62 | 77 | 13.9 | 2.5 | 950 | 951.9 | 26.7 | 2-36" CMP-(E) | 0.7 | 3 | 955.9 | 966.2 | |
| WC 4 | 106.5 | 95 | 75 | 20.2 | 5.3 | 930 | 931.3 | 42.8 | 4-54"x31" RCPA-(E) | 1.6 | 5.2 | 932 | 934 | |
| WC 5 | 50.8 | 175 | 78 | 7.8 | 3.1 | 965 | 967.2 | 2.9 | 9" ORIFICE-(E) | 1.1 | 5.6 | 970.1 | 972.5 | |
| WC 6 | 316.4 | 52 | 77 | 112.0 | 17.9 | 929.4 | 929.8 | 1.7 | -18" CMP & 24" CMP-(E) | 34.3 | 191.4 | 931.1 | 932 | |
| WC 7 | 69.3 | 20 | 66 | 12.9 | 1.7 | | | | | | | | 932 | |

**CITY OF SHOREWOOD
 COMPREHENSIVE WATER RESOURCES MANAGEMENT PLAN
 STORMWATER MODEL RESULTS
 1-YEAR EVENT**

| SUB-WATERSHED NUMBER | AREA (ac) | Tc (min) | CN | PEAK RUNOFF RATE (cfs) | RUNOFF VOLUME (ac-ft) | POND NWL (elev.) | POND HWL (elev.) | PEAK OUTFLOW FROM POND (cfs) | POND OUTLET (c) | REQUIRED STORAGE (ac-ft) | AVAILABLE STORAGE (ac-ft) (b) | APPROXIMATE OVERFLOW ELEVATION (a) | EXISTING LOW BUILDING ELEVATION (a) | COMMENTS |
|----------------------|-----------|----------|----|------------------------|-----------------------|------------------|------------------|------------------------------|-----------------|--------------------------|-------------------------------|------------------------------------|-------------------------------------|----------|
| LV 1 | 22.1 | 15 | 75 | 15.2 | 1.1 | 949.5 | 949.8 | 5.0 | 27" RCP-(P) | 0.3 | 11.7 | 953.7 | 954 | |
| LV 2 | 116.6 | 69 | 75 | 28.0 | 5.8 | | | | | | | | 936 | |
| W 1 | 62.1 | 43 | 70 | 12.2 | 2.1 | 932.2 | 932.6 | 0.3 | 12" CMP-(P) | 2.0 | 13.2 | 934.5 | 938 | |
| W 2 | 21.6 | 20 | 65 | 3.4 | 0.5 | 930.2 | 930.3 | 0.0 | 12" CMP-(P) | 0.5 | 3.6 | 931.1 | 938 | |
| W 3 | 64.9 | 20 | 68 | 16.8 | 1.9 | - | - | - | - | - | - | - | 933 | |
| I 1 | 69.3 | 20 | 72 | 28.8 | 2.8 | - | - | - | - | - | - | - | - | |
| I 2 | 20.0 | 20 | 76 | 12.2 | 1.1 | - | - | - | - | - | - | - | - | |
| I 3 | 2.0 | 20 | 72 | 0.8 | 0.1 | - | - | - | - | - | - | - | - | |

- a) Elevations obtained from the Cities digital topographic 1' contour mapping.
- b) Available storage values calculated to the lowest elevation of either the overflow elevation or the low building elevation.
- c) It is recommended the existing outlet elevations be surveyed.

Note: The Outlet designation (E) is an existing outlet, (P) is a proposed outlet.

SUBWATERSHED LABELS

PC = subwatershed tributary to Purgatory Creek
 CB = subwatershed tributary to Carson Bay
 LW = subwatershed tributary to Lake William
 SAB = subwatershed tributary to St. Albans Bay
 CL = subwatershed tributary to Christmas Lake

GL = subwatershed tributary to Galpin Lake
 GB = subwatershed tributary to Gideon Bay
 LMAR = subwatershed tributary to Lake Mary
 C = subwatershed tributary to Central area
 SC = subwatershed tributary to South-Central area

LMIN = subwatershed tributary to Lake Minnewashta
 NC = subwatershed tributary to North-Central area
 WC = subwatershed tributary to West-Central area
 LV = subwatershed tributary to Lake Virginia
 W = subwatershed tributary to West area
 I = subwatershed tributary to Lake Minnetonka

**CITY OF SHOREWOOD
COMPREHENSIVE WATER RESOURCES MANAGEMENT PLAN
STORMWATER MODEL RESULTS
100-YEAR EVENT**

| SUB-WATERSHED NUMBER | AREA (ac) | Tc (min) | CN | PEAK RUNOFF RATE (cfs) | RUNOFF VOLUME (ac-ft) | POND NWL (elev.) | POND HWL (elev.) | RECOMMENDED 100 YR HWL (elev.) | PEAK OUTFLOW FROM POND (cfs) | POND OUTLET (d) | REQUIRED STORAGE (ac-ft) | AVAILABLE STORAGE (ac-ft) (c) | APPROXIMATE OVERFLOW ELEVATION (b) | EXISTING LOW BUILDING ELEVATION (b) | COMMENTS |
|----------------------|-----------|----------|----|------------------------|-----------------------|------------------|------------------|--------------------------------|------------------------------|-----------------------|--------------------------|-------------------------------|------------------------------------|-------------------------------------|---|
| PC 1 | 4.9 | 16 | 75 | 18.5 | 1.3 | 943.2 | 944.5 | 945 | 3.4 | 12" RCP - (E) | 0.6 | 1.9 | 947 | 949 | The subwatershed modeling utilized City as-built #15 for the basin outlet. Recommend routine maintenance of basin/outlet. |
| PC 2 | 10.3 | 20 | 74 | 33.0 | 2.7 | 922.1 | 924.7 | 926 | 3.7 | 12" RCP - (E) | 1.3 | 11.8 | 930.8 | 932 | The subwatershed modeling utilized City as-built #14 for the basin outlet. Recommend routine maintenance of basin/outlet and periodic inspection of overflow elevation/route. |
| PC 3 | 18.1 | 23 | 75 | 55.4 | 4.8 | 910.1 | 911.7 | 912.5 | 7.1 | 12" RCP - (E) | 2.8 | 3.8 | 912.1 | 914 | The subwatershed modeling utilized City as-built #16 for the basin outlet. Recommend routine maintenance of basin/outlet and periodic inspection of overflow elevation/route. |
| PC 4 | 19.3 | 21 | 76 | 63.9 | 5.3 | 904 | 905.9 | 906 | 35.5 | 5' Weir - (P) | 1.6 | 0.8 | 905 | 912 | The basin outlet was modeled w/ 5' weir set @ the overland flow elevation. Research did not identify a control structure or pipe outlet for this basin. |
| PC 5 | 20.2 | 23 | 78 | 67.4 | 5.9 | 898.6 | 902.3 a | 903 | 5.9 a | 12" RCP - (E) | 11.7 a | 13.7 | 902.7 | 906 | The subwatershed modeling utilized City as-built #33 for the basin outlet. Recommend routine maintenance of basin/outlet. |
| PC 6 | 183 | 25 | 78 | 595.0 | 53.2 | 894.8 | 899.2 a | 900 | 10.6 a | 15" RCP - (E) | 111.3 a | 250 | 904 | 904 | The subwatershed modeling utilized City as-built #16 for the Silver Lake outlet. Recommend routine maintenance of outlet and periodic inspection of overflow route. |
| PC 7 | 16.3 | 15 | 73 | 59.5 | 4.1 | 889 | 894.7 | 896 | 14.2 | 21" CMP - (E) | 1.4 | 4.7 | 897.2 | 899 | The Covington Road culvert could not be field verified for size and invert elevation due to being submerged. Utilized culvert size identified in Riley-Purgatory-Bluff Creek stormwater plan. Recommend survey of culvert crossing Covington Road for invert size verification. |
| PC 8 | 11.8 | 15 | 76 | 47.2 | 3.2 | 893.7 | 894.7 | 895 | 1.7 | 12" RCP - (E) | 2.1 | 12.8 | 898.3 | 901 | The subwatershed modeling utilized City as-built #17 for the basin outlet. Recommend routine maintenance of basin, outlet, and overland overflow route. |
| PC 9 | 26.9 | 18 | 75 | 95.3 | 7.2 | 933.5 | 936.7 | 937 | 10.4 | 15" RCP - (P) | 3.6 | 8.4 | 938.5 | 939 | The basin outlet requires field verification for elevation, type, length, and size. The current model reflects approximate elevations for this basin. |
| PC 10 | 65.9 | 21 | 74 | 204.8 | 17.0 | 910.8 | 915.5 | 916 | 32.9 | 36" RCP - (E) | 7.8 | 55 | 920.8 | 922 | The basin outlet requires field verification for elevation, type, length, and size. The current model reflects approximate elevations for this basin. DRAFT |
| PC 11 | 64.3 | 29 | 76 | 184.1 | 17.7 | 888 | 894 | 894 | 171.2 | 72" x 54" RCP-A - (E) | 41.1 | 21 | 892.4 | 897 | This subwatershed discharges east to Minnetonka. Recommend a survey of the outlet as a response to conflicting data contained in as-builts, previous City plan, and R-P-B Creek plan. |
| PC 12 | 3 | 15 | 87 | 15.6 | 1.1 | 963.9 | 966.4 | 967 | 5.3 | 12" RCP - (P) | 0.3 | 0.7 | 968.3 | 971 | The field inspection of the depression indicated no existing outlet. The depression will discharge east into Minnetonka. |
| PC 13 | 10 | 15 | 87 | 52.0 | 3.7 | | | | | | | | 985 | 986 | The basin outlet requires additional research, field inspection, and survey to define the in-place outlet. This discharge from this subwatershed is directed to the TH 7 system flowing into Minnetonka. |
| CB 1 | 7.5 | 15 | 73 | 27.4 | 1.9 | 1000.5 | 1001.3 a | 1002 | 1.2 a | 15' Weir - (E) | 1.4 a | 16 | 1007 | N/A | Recommend field inspection and survey of culvert. The basin currently is located in an undeveloped/underdeveloped area with no structures identified on the city topography. |
| CB 2 | 24.9 | 30 | 75 | 67.7 | 6.6 | 984.7 | 986.7 | 987 | 6.8 | 18" RCP - (E) | 3.5 | 9 | 989.8 | 1009 | The basins for this subwatershed area located @ Broms Blvd and Old Market Road. The discharge is conveyed north into the TH 7 stormsewer. The basin outlet data was taken from City as-built #46. |
| CB 3 | 15.2 | 15 | 80 | 67.7 | 4.7 | 978 | 980.9 | 982 | 4.1 | 18" RCP - (E) | 2.7 | 6.7 | 984.8 | 987 | The basin outlet data was obtained from City as-built #57,58. The flow is directed north into the TH 7 storm sewer discharging into CB 4 north of TH 7. |
| CB 4 | 38 | 20 | 82 | 153.1 | 12.3 | 976 | 980.7 | 981.5 | 10.0 | 18" RCP - (E) | 12.2 | 36.2 (985) | 987.8 | 991 | The outlet from this depression requires further analysis. Recommend a survey, field inspection, and research to define the basin outlet. The model utilized a system defined in the previous city plan. |
| CB 5 | 13.3 | 25 | 75 | 39.6 | 3.5 | 975.9 | 978.1 | 980 | 12.4 | 21" RCP - (E) | 1.4 | 9 | 987.8 | 984 | Field inspection identified existing culvert. Recommended a survey of the culvert to define the model data. The research of this area did not provide system data. |
| CB 6 | 10.5 | 15 | 76 | 42.0 | 2.9 | 978.6 | 979.6 | 980 | 2.2 | 12" RCP - (P) | 1.7 | 9.7 | 995.7 | 984 | The research and field inspection of this basin indicated that no outlet presently exists. (8-11-1999) The basin can bounce approximately 5' before approaching structures based on the City topography. The proposed outlet for this basin would be approximately 15 to 20' deep crossing Excelsior Blvd based on the contour mapping. |
| CB 7 | 26.3 | 28 | 71 | 65.1 | 6.2 | 967.8 | 971.6 | 972 | 8.4 | 15" RCP - (P) | 3.0 | 23 | 984.5 | 982 | The research and field inspection of this basin indicated that no outlet presently exists. (8-11-1999) The basin can bounce approximately 16' before approaching structures, and 12' prior to any driveways based on the City topography. The proposed outlet pipe for this basin would have approximately 17' of cover. This basin receives runoff from the City of Deephaven. |

**CITY OF SHOREWOOD
COMPREHENSIVE WATER RESOURCES MANAGEMENT PLAN
STORMWATER MODEL RESULTS
100-YEAR EVENT**

| SUB-WATERSHED NUMBER | AREA (ac) | Tc (min) | CN | PEAK RUNOFF RATE (cfs) | RUNOFF VOLUME (ac-ft) | POND NWL (elev.) | POND HWL (elev.) | RECOMMENDED 100 YR HWL (elev.) | PEAK OUTFLOW FROM POND (cfs) | POND OUTLET (d) | REQUIRED STORAGE (ac-ft) | AVAILABLE STORAGE (ac-ft) (c) | APPROXIMATE OVERFLOW ELEVATION (b) | EXISTING LOW BUILDING ELEVATION (b) | COMMENTS |
|----------------------|-----------|----------|----|------------------------|-----------------------|------------------|------------------|--------------------------------|------------------------------|-----------------|--------------------------|-------------------------------|------------------------------------|-------------------------------------|---|
| CB 8 | 48.8 | 20 | 71 | 141.3 | 11.5 | 955.2 | 959.7 a | 960.5 | 6.5 a | 18" RCP - (P) | 47.5 a | 67 | 961.4 | 969 | The field inspection of the basin was unable to locate an existing outlet. Recommend survey inspection to define outlet. The research of previous City plan utilized an 18" outlet. The basin is proposed to discharge north across Manor Road to CB 10. |
| CB 9 | 14.3 | 19 | 71 | 42.9 | 3.4 | 970 | 973.9 | 974 | 12.4 | 21" CMP - (E) | 1.2 | 1.1 | 974 | 973.5 | The basin outlet field inspection indicated a 21" CMP discharges to CB 10. Recommend a survey of the outlet to obtain culvert data. |
| CB 10 | 6.1 | 15 | 75 | 23.7 | 1.6 | 953.7 | 957.3 a | 959 | 9.3 a | 18" RCP - (E) | 4.8 a | 11.3(961.4) | 974 | 973.5 | The outlet data for basin utilized City as-built #1. Recommend inspection and routine maintenance of outlet. |
| CB 11 | 1.5 | 10 | 68 | 4.8 | 0.3 | 979.8 | 981.2 | 981.5 | 3.6 | 12" RCP - (E) | 0.3 | 0.5 | 991 | 982 | The outlet data for basin utilized City as-built #1. Recommend inspection and routine maintenance of outlet. The low building elevation and overflow route require a survey to determine available stormwater storage. |
| CB 12 | 17.2 | 20 | 73 | 53.4 | 4.3 | 955.1 | 961.8 | 962 | 8.2 | 15" CMP - (P) | 13.0 | 17 | 963.5 | 973 | The basin receives flow from Hooper Lake within the City of Deephaven. Additional study is required to quantify flow rates and runoff volumes tributary to City. The overflow elevation from this basin is ultimately controlled by the CB-14 overflow elevation; the field inspection did not identify an in-place culvert under Manor Road to the northeast into CB 13. Recommend additional inspection of basin for existing outlet. |
| CB 13 | 3.4 | 15 | 81 | 15.5 | 1.1 | 953.1 | 958.4 a | 958.5 | 4.9 a | 18" RCP - (P) | 4.7 a | 2.1 | 963.5 | 956 | The field inspection did not identify an existing outlet across Regent Walk from basin to CB 14. Recommend additional inspection of basin for existing outlet. Research of City as-builts did not produce outlet data. The ultimate overflow from basin is controlled downstream at CB 14. |
| CB 14 | 23 | 34 | 76 | 59.2 | 6.3 | 952.5 | 956.6 a | 957 | 12.8 a | 21" CMP - (E) | 18.4 a | 20.2 | 963.5 | 957 | The field inspection identified a 21" CMP serving as the outlet from basin. Recommend a survey of the outlet. The discharge is directed north across the City border into Deephaven. |
| CB 15 | 4.9 | 16 | 70 | 15.7 | 1.1 | 943.9 | 945.1 | 946 | 2.8 | 12" RCP - (E) | 0.5 | 5.8 | 952.9 | 953 | The field inspection identified a 12" RCP outlet. Recommend a survey of the culvert. Discharge is east into Deephaven. Basin serve a small watershed with approximately 6 of bounce available. |
| CB 16 | 16.5 | 20 | 78 | 59.8 | 4.8 | | | | | | | | | 947 | This subwatershed discharges east into Deephaven. The stormwater storage is provided within the wetlands/basins on the NE city limits. Additional analysis of the basin is required of data outside the city to establish basin criteria. |
| CB 17 | 4.57 | 20 | 71 | 13.2 | 1.1 | 984.8 | 986.3 | 987 | 3.7 | 12" RCP - (P) | 0.4 | 0.8 | 987 | 990 | The rearyard depression is proposed to discharge east to CB 11. Additional analysis/study is recommended to assess routing feasibility. |
| LW 1 | 39.3 | 21 | 72 | 114.2 | 9.5 | 933 | 938.9 | 939 | 36.6 | 27" RCP - (E) | 3.2 | 2.2 | 938 | 943 | This subwatershed contains several small basins proposed to ultimately discharge to Lake William. The stormwater storage for this subwatershed utilized the largest basin immediately east of Lake William. The field inspection indicated no existing outlet is in place (8-11-199). Future development could reroute conveyance to the Carson Bay watershed. |
| LW 2 | 71.7 | 34 | 76 | 184.5 | 19.7 | 931.5 | 933.6 a | 935 | 3.0 a | 15" CMP - (P) | 39.7 a | 88 | 936 | 939 | The field inspection did not identify an existing outlet. Recommend a survey to obtain outlet data. Discharge from Lake William is conveyed west across City border. |
| SAB 1 | 15.1 | 30 | 70 | 34.6 | 3.4 | 970.4 | 972.4 | 974 | 6.9 | 15" CMP - (P) | 1.5 | 6.5 | 977.3 | 981 | The field inspection did not identify an existing outlet. The proposed outlet alignment to the west across the city border could create difficulties in obtaining easements. Additional analysis/study is recommended as part of feasibility study. |
| SAB 2 | 16.9 | 28 | 73 | 44.8 | 4.2 | 986.5 | 987.8 a | 988 | 1.4 a | 9" RCP - (E) | 3.4 a | 4 | 992 | 988 | The basin is located within a park. The field inspection indicated a 9" RCP discharges southwest across the city limits. Recommend a survey of the outlet, existing low buildings, and overflow route for additional analysis. |
| SAB 3 | 38.7 | 24 | 73 | 109.8 | 9.7 | 935.4 | 937.6 a | 938 | 5.8 a | 12" CMP - (E) | 7.8 a | 7.4 | 937.4 | 946 | The field inspection identified an existing 12" CMP culvert serving this subwatershed. The current model indicates overtopping of Manor Road during the 100 yr event. The stormwater runoff is directed across the City limits. |
| SAB 4 | 21.3 | 19 | 79 | 82.0 | 6.4 | - | - | - | - | 36" CMP - (P) | - | - | 942 | 956 | This subwatershed consists of area south of TH 7 and MndOT RW tributary to St. Albans bay. Additional research/field inspection is required to identify the existing storm sewer to St. Albans Bay. |
| CL 1 | 10.6 | 20 | 74 | 34.0 | 2.7 | 932.8 | 937.1 | 937.5 | 14.1 | 15" CMP - (E) | 1.5 | 1.2 | 936.7 | 941 | The field inspection indicated an existing 15" CMP outlet. Recommend a survey of culvert, low building, and overflow elevations. The discharge from this depression east across Christmas Lake Road. |
| CL 1A | 47 | 30 | 74 | 123.7 | 12.1 | 947 | 948.6 a | 949 | 4.0 a | 12" RCP - (P) | 9.5 a | 12.4 | 949 | 952 | The existing basin currently discharges overland to CL 1. Recommend installation of culvert under driveway to define NWL for this depression. |

**CITY OF SHOREWOOD
 COMPREHENSIVE WATER RESOURCES MANAGEMENT PLAN
 STORMWATER MODEL RESULTS
 100-YEAR EVENT**

| SUB-WATERSHED NUMBER | AREA (ac) | Tc (min) | CN | PEAK RUNOFF RATE (cfs) | RUNOFF VOLUME (ac-ft) | POND NWL (elev.) | POND HWL (elev.) | RECOMMENDED 100 YR HWL (elev.) | PEAK OUTFLOW FROM POND (cfs) | POND OUTLET (d) | REQUIRED STORAGE (ac-ft) | AVAILABLE STORAGE (ac-ft) (c) | APPROXIMATE OVERFLOW ELEVATION (b) | EXISTING LOW BUILDING ELEVATION (b) | COMMENTS |
|----------------------|-----------|----------|----|------------------------|-----------------------|------------------|------------------|--------------------------------|------------------------------|-----------------|--------------------------|-------------------------------|------------------------------------|-------------------------------------|---|
| CL 1B | 11.1 | 20 | 74 | 35.6 | 2.9 | 938.5 | 940.1 | 940 | 6.5 | 18" RCP - (P) | 1.3 | 1.3 | 940 | 940 | The existing basin currently discharges over to CL 1. Installation of a culvert will maximize the available storage within the basin, create additional stormwater storage, and improve treatment. |
| CL 2 | 50 | 16 | 74 | 183.1 | 12.9 | 933 | 934.3 a | 935 | 3.9 a | 18" RCP - (P) | 14.0 a | 44 | 937.2 | 938 | The field inspection of Como Lake basin and east basin identified a culvert between the two basins. No culvert was identified to Christmas Lake. The proposed culvert alignment would convey runoff from the East basin to Christmas Lake. Additional study is recommended as part of feasibility study. |
| CL 3 | 356.6 | 60 | 90 | 878.4 | 141.1 | 932.8 | 933.9 a | 934 | 15.8 a | 36" CMP - (E) | 275.9 a | 1045 | 936.7 | 938 | The Christmas Lake outlet was inspected and appeared in fair condition. Recommend routine outlet maintenance/debris removal. The Basin receives runoff from Chanhassen. |
| CL 4 | 8.2 | 15 | 69 | 26.1 | 1.8 | 930.4 | 932.9 | 934 | 14.0 | 42" CMP - (E) | 4.4 | 18 | 937.9 | N/A | The outlet from the basin is directed north across TH 7 ultimately to St. Albans Bay. The outlet is recommended for survey. MnDOT as-builts or survey data is required for model input. MnDOT is in the process of TH 7 design immediately west of this outlet in the city of Excelsior (8-11-1999) |
| CL 5 | 15.9 | 21 | 72 | 46.2 | 3.9 | 951 | 954 | 954.5 | 22.4 | 15" CMP - (E) | 1.1 | 0.7 | 953.5 | 957 | The discharge is directed north to the City of Excelsior and ultimately flows into St. Albans Bay. The downstream system is being evaluated by MnDOT as part of the TH 7 improvements (8-11-1999). Analysis outside the City limits would be required to obtain downstream system capacity. Recommend survey or as-builts from Excelsior for storm system. |
| CL 6 | 23.7 | 20 | 77 | 83.4 | 6.7 | 946 | 948.4 | 948.5 | 17.1 | 24" RCP - (E) | 4.6 | 3.7 | 948 | 948 | The basin discharges north to the City of Excelsior. The outlet requires additional analysis/data from the City of Excelsior. The storm sewer system is tributary to the TH 7 storm sewer flowing north to St. Albans Bay. Recommend survey or as-builts from Excelsior of system. |
| GL 1 | 32.6 | 30 | 73 | 83.0 | 8.2 | 951.3 | 957.9 | 958 | 76.8 | 15" CMP - (E) | 0.6 | 0.2 | 955.1 | 959 | The subwatershed is modeled with available stormwater storage adjacent to the road due to no control structure in place at the wetland/basin perched 9' above the culvert crossing Apple Road. Recommend installation of control structure at wetland to maximize wetland storage. Approximately 5' of bounce available in upstream wetland to serve approximately 75% of subwatershed area. Recommend survey of existing culvert crossing Apple Road. |
| GL 2 | 49.1 | 18 | 76 | 179.3 | 13.5 | 943.5 | 947.9 a | 948 | 7.5 a | 15" CMP - (E) | 26.4 a | 18.6 | 947.8 | 947 | Field inspection of existing culvert indicated system was in good condition. Recommend installation of skimmer at culvert inlet. Downstream channel requires inspection for erosion/maintenance. Basin receives flow from Chanhassen. |
| GL 3 | 36 | 21 | 75 | 115.5 | 9.6 | 964.6 | 967.4 | 968 | 10.6 | 12" CMP - (E) | 12.5 | 10.7 | 967.1 | 977 | Field inspection indicated culvert was in good condition. Recommend installation of skimmer at culvert inlet and riprap on downstream end. Basin receives runoff from Chanhassen. |
| GL 4 | 25.9 | 18 | 77 | 97.4 | 7.3 | 957.5 | 962.3 | 963 | 24.8 | 24" VCP - (E) | 11.6 | 14.8 | 962.7 | 966 | Field inspection indicated culvert inlet was in poor condition. The inlet was failing and contained debris. (8-11-1999) Recommend repair of apron inlet and installation of skimmer. Recommend riprap on downstream end of storm sewer system within GL 6. Additional stormwater storage is available north of Murray Street and south of Chaska Road. The additional storage was not utilized in the stormwater model. (8-11-1999). Basin receives runoff from Chanhassen. |
| GL 5 | 5.8 | 20 | 75 | 19.2 | 1.6 | 987 | 987.6 | 988 | 0.5 | 18" CMP - (E) | 1.1 | 1.7 | 988 | 990 | The existing culvert outlet was inspected and appeared in good condition. The wetland overland flows on the south side of TH 7 northeast to GL 6. The City topography indicates overland flow will occur across private property prior to conveyance down the TH 7 ditch. Recommend the ditch be graded to allow flow from the wetland. This activity could be conducted as part of the TH 7 & TH 41 improvement project (8-11-1999). |
| GL 6 | 28.2 | 42 | 79 | 69.3 | 8.4 | 945 | 951.7 | 952 | 23.8 | 30" CMP - (E) | 8.8 | 6.1 | 950.5 | 953 | This subwatershed consists of three wetlands/depressions located between TH 7 and Chaska Road. The stormwater storage for this area utilized the two northwest wetlands/depressions. The storm sewer outlet routing requires verification due to conflicting data. Recommend installation of a control structure/outlet for the southwest |

**CITY OF SHOREWOOD
COMPREHENSIVE WATER RESOURCES MANAGEMENT PLAN
STORMWATER MODEL RESULTS
100-YEAR EVENT**

| SUB-WATERSHED NUMBER | AREA (ac) | Tc (min) | CN | PEAK RUNOFF RATE (cfs) | RUNOFF VOLUME (ac-ft) | POND NWL (elev.) | POND HWL (elev.) | RECOMMENDED 100 YR HWL (elev.) | PEAK OUTFLOW FROM POND (cfs) | POND OUTLET (d) | REQUIRED STORAGE (ac-ft) | AVAILABLE STORAGE (ac-ft) (c) | APPROXIMATE OVERFLOW ELEVATION (b) | EXISTING LOW BUILDING ELEVATION (b) | COMMENTS |
|----------------------|-----------|----------|----|------------------------|-----------------------|------------------|------------------|--------------------------------|------------------------------|-----------------|--------------------------|-------------------------------|------------------------------------|-------------------------------------|--|
| GL 7 | 43.8 | 17 | 75 | 160.3 | 11.7 | 943.3 | 946.8 a | 946 | 20.7 a | 2-24" RCP (E) | 120.4 a | 300 | 950 | 949 | The Galpin Lake outlets require additional research/survey/field inspection due to conflicting data. MnDOT is undertaking a project on TH 7 involving the outlet systems (8-11-1999). The City of Excelsior and MnDOT system modifications should be incorporated in the model. The table drainage area reflects the City of Shorewood stormwater runoff to Galpin Lake. The stormwater model incorporates drainage areas from outside the city borders. |
| GL 9 | 8.5 | 15 | 70 | 28.0 | 1.9 | 982.9 | 986.4 | 987 | 4.9 | 15' Weir - (P) | 5.0 | 12.2 | 991.2 | 992 | The GL 9 basin is currently landlocked based on available research. The proposed outlet will convey runoff northeast to GL 10 and ultimately into Excelsior. |
| GL 10 | 46.8 | 80 | 77 | 68.1 | 13.2 | | | | | | | | 950 | 951 | The stormwater runoff is directed north to the City of Excelsior. The downstream system is being evaluated by MnDOT and Excelsior as part of the TH-7 improvements (8-11-1999). Analysis outside the City limits would be required to obtain direction of flow either to St. Albans Bay or Galpin Lake. Discrepancies in the downstream storm sewer system data outside city limits requires additional analysis. The model currently routes GL 10 to Galpin Lake (8-11-1999). |
| GB 1 | 16.4 | 20 | 74 | 61.1 | 5.3 | 953 | 955.5 | 955.5 | 6.0 | 15" CMP-(P) | 2.9 | 1.6 | 955.3 | 955 | No existing Outlet. Additional storage available in perched wetlands. Recommend survey of low building and overland overflow elevations. |
| GB 2 | 27.5 | 28 | 78 | 86.8 | 8.0 | 945 | 949 | 949 | 28.5 | 10" ORIFICE-(E) | 3.7 | 2.6 | 948 | 951 | Existing Outlet utilized in model. Overland overflow elevation is approx. 3' below existing buildings based on 1' contours. |
| GB 3 | 34.9 | 37 | 72 | 75.7 | 8.5 | 933 | 936.9 | 937 | 17.7 | 21" RCP-(P) | 3.7 | 4.9 | 939.6 | 937 | Discharges north to Tonka Bay. Recommend survey of low building and overflow elevations. |
| GB 4 | 11.9 | 15 | 74 | 47.2 | 3.1 | | | | | | | | 950 | | Subwatershed discharges to Tonka Bay w/ no storage identified within city limits. |
| GB 5 | 13.3 | 21 | 65 | 31.7 | 2.5 | 967.4 | 971.6 | 972 | 15.7 | 18" RCP-(E) | 0.4 | 0.5 | 971.7 | 985 | Exist. Outlet maximizes existing stormwater storage. HWL approaches Country Club Road overflow elev. based on 1' contour mapping. |
| GB 6 | 24.3 | 18 | 77 | 96.4 | 6.9 | 957.8 | 962.2 | 963 | 27.8 | 24" RCP-(E) | 3.0 | 19.5 | 972.8 | 967 | Field verified 24" CMP outlet. Recommend inlet maintenance/skimmer and survey of pipe invert. |
| GB 7 | 29.4 | 30 | 75 | 81.0 | 7.8 | 932.3 | 937.3 a | 937 | 10.7 a | 15"-CMP-(E) | 14.6 a | 17.1 | 938 | 942 | Recommend survey of existing outlet invert and overflow elevations. Recommend verification of easment over drainage route. |
| GB 8 | 74.7 | 18 | 76 | 287.9 | 20.6 | | | | | | | | | 974 | Discharges east into Excelsior. No basin outlet or overflow elevation identified within the city limits. |
| GB 9 | 14.3 | 25 | 76 | 45.6 | 3.9 | 930.1 | 931 | 932 | 4.1 | 36"-STEEL-(E) | 2.2 | 16.9 | 939.1 | 936.4 | Field inspection of outlet indicated the exist. Pipe was in good condition. Recommend limited dredging at pipe inlet as part of maintenance plan. |
| GB 10 | 36.5 | 20 | 77 | 136.4 | 10.3 | | | | | | | | 933 | | Direct discharge runoff from subwatershed within City. |
| LMAR 1 | 32.7 | 28 | 76 | 97.3 | 9.0 | 955 | 957.4 | 957.5 | 3.6 | 12" CMP-(P) | 6.1 | 5.3 | 963.9 | 957 | No outlet identified for Lake Linden from research or field inspection. Recommend outlet construction to Lake Mary. |
| LMAR 2 | 61.8 | 20 | 77 | 230.9 | 17.5 | 953.1 | 954.9 | 955 | 6.0 | 15" RCP-(P) | 24.8 | 54.8 | 958 | 957 | No outlet was identified from as-builts or field inspection for Lake Mary. Current model routes discharge to GB 7, routing option to GB 8. |
| C 1 | 137.1 | 37 | 69 | 266.2 | 30.1 | 958 | 960.3 a | 959.8 | 9.9 a | 21" RCP-(P) | 35.9 a | 30.4 | 966.4 | 960 | Central district is proposed to discharge to Lake Mary. No outlet was identified from research or field inspection. Recommend pipe alignment on south side of existing trail to the east in order to provide an outlet from subwatershed C2 and large depression in LMAR 2. |
| C 2 | 10.1 | 17 | 72 | 35.4 | 2.5 | 960 | 961.1 | 961.5 | 2.0 | 12" RCP-(P) | 1.4 | 2.3 | 961.7 | 968 | Currently modeled to subwatershed C1. Stormwater storage is provided by two wetlands east of Country Club Road. No outlet was identified from research or field inspection. |
| SC 1 | 6.2 | 15 | 78 | 27.6 | 1.8 | 974.8 | 975.8 | 976 | 2.6 | 12" RCP-(E) | 1.0 | 2.2 | 979.6 | 977 | Field inspection identified a 12" RCP outlet from basin, and was unable to verify the pipe discharge location/condition. Recommend survey of outlet, and installation of skimmer. |
| SC 2 | 37.7 | 25 | 78 | 127.3 | 11.0 | 960.6 | 962.8 | 963 | 7.4 | 15" RCP-(P) | 14.5 | 25.7 | 964.5 | 968 | No existing outlet was identified from research or field inspection. This basin is assumed to be currently land locked. Recommend further study/analysis of outlet from this basin. |
| LMIN 1 | 28 | 20 | 75 | 46.0 | 4.5 | 977.2 | 980.7 | 981 | 21.4 | 24" RCP-(E) | 1.0 | 17.6 | 984.7 | 991 | The outlet culvert was receiving maintenance by MnDot during the field inspection. Recommend survey of culvert. |
| LMIN 2 | 16.7 | 30 | 74 | 61.5 | 4.7 | 948.6 | 955.2 | 955.6 | 43.5 | 27" RCP-(E) | 0.5 | 12.5 | 963.6 | 964.5 | The field inspection indicated the apron of this culvert required maintenance/attachment. Recommend removal of sediment at the culvert inlet and repair. This subwatershed could serve as the primary discharge location for the LMIN watershed in the future. |

**CITY OF SHOREWOOD
COMPREHENSIVE WATER RESOURCES MANAGEMENT PLAN
STORMWATER MODEL RESULTS
100-YEAR EVENT**

| SUB-WATERSHED NUMBER | AREA (ac) | Tc (min) | CN | PEAK RUNOFF RATE (cfs) | RUNOFF VOLUME (ac-ft) | POND NWL (elev.) | POND HWL (elev.) | RECOMMENDED 100 YR HWL (elev.) | PEAK OUTFLOW FROM POND (cfs) | POND OUTLET (d) | REQUIRED STORAGE (ac-ft) | AVAILABLE STORAGE (ac-ft) (c) | APPROXIMATE OVERFLOW ELEVATION (b) | EXISTING LOW BUILDING ELEVATION (b) | COMMENTS |
|----------------------|-----------|----------|----|------------------------|-----------------------|------------------|------------------|--------------------------------|------------------------------|-------------------------|--------------------------|-------------------------------|------------------------------------|-------------------------------------|--|
| LMIN 3 | 6.7 | 20 | 73 | 22.2 | 1.7 | 960.6 | 963.9 | 964 | 11.0 | 18" CMP-(E) | 0.5 | 0.9 | 963.6 | 966 | The field inspection indicated the culvert inlet was in good condition. Recommend MnDOT excavate accumulated sediment/vegetation at the culvert inlet. |
| LMIN 4 | 16.4 | 20 | 89 | 76.8 | 6.3 | 985 | 990.2 | 990 | 24.0 | 36" RCP-(E) | 2.3 | 2.2 | 990 | 994 | This subwatershed has been incorporated as part of the TH7 & TH41 project (1999) into the LMIN watershed. |
| NC 1 | 16.5 | 21 | 79 | 63.5 | 4.9 | 981.7 | 985.2 | 985.2 | 37.1 | 15" CMP-(E) | 1.5 | 1.3 | 984.7 | 985.2 | The existing culvert requires maintenance/cleaning based on the field inspection. It is recommended that the feasibility of rerouting the discharge from NC 1 & NC 2 be analyzed to determine if rerouting to either NC 4 or NC 5 is feasible. Survey of existing culvert overflow elevation is recommended. |
| NC 2 | 39.4 | 47 | 75 | 79.9 | 10.5 | 979 | 980.9 | 981 | 7.0 | 12" RCP-(E) | 9.3 | 2.9 | 980.3 | 980 | The existing culvert and overflow elevation requires a survey. The existing basin routing is recommended for additional analysis to determine the feasibility of alternate conveyance routes. |
| NC 3 | 18.5 | 21 | 72 | 57.7 | 4.5 | 966.3 | 970.6 | 971 | 61.6 | 27" RCP-(E) | 0.6 | 0.5 | 970 | 973 | The subwatershed could provide additional storage in upstream depression based on 1' contour mapping. It is recommended that the conveyance route be verified for alignment within existing easements. The basin outlet is a two-stage structure, and was in good condition based on the field inspection. |
| NC 4 | 27.9 | 30 | 73 | 72.1 | 7.0 | 950.2 | 956.9 | 957 | 103.4 | 36" STEEL-(E) | 1.5 | 0.9 | 956.2 | 961 | The field inspection of the in-place culvert indicated maintenance/cleaning of the culvert and downstream channel is required. The in-place culvert was partially submerged and appeared in fair condition. This culvert crossing currently provides conveyance of NC 1, 2 & 3 and is recommended for a survey and feasibility study based on upstream conveyance alternatives for the NC watershed. |
| NC 5 | 20 | 30 | 75 | 55.1 | 5.3 | 948 | 951.9 | 952 | 24.9 | 24"-STEEL-(E) | 1.4 | 1.7 | 952.3 | 955 | The field inspection of the in-place culvert indicated no obstructions at the inlet or outlet. The culvert appeared in good condition. Recommend routine maintenance/clearing of upstream conveyance route to inlet. |
| NC 6 | 6.4 | 15 | 70 | 22.2 | 1.6 | 953.5 | 954.6 | 955 | 2.1 | 10" ORIFICE-(E) | 0.7 | 0.9 | 954.8 | 965 | The in-place culvert inlet was in good condition based on the field inspection. The culvert outlet was not located for inspection. The inlet location is outside the road right of way. The City should consider if current inlet location requires an easement or relocation to within the right of way. |
| NC 7 | 12.6 | 15 | 75 | 51.5 | 3.4 | 941.3 | 941.8 | 942 | 12.3 | 24" CMP-(E) | 1.4 | 1.4 | 941.3 | 944 | The basin currently overland flows to the 24" CMP culvert under Valleywood Lane. This conveyance route appears to cross private property. It is recommended that the City construct the conveyance to this culvert within the right of way or verify easements over the existing overflow alignment. |
| NC 8 | 6.6 | 15 | 73 | 25.4 | 1.7 | 937.9 | 938.5 | 939 | 1.4 | 12" CMP-(E) | 1.0 | 10.9 | 944.7 | 945 | The basin has an available bounce of approximately 6' prior to overland flow to NC 9. Installation of the proposed outlet would require easements based on the topographic mapping. Recommend a survey of the low building and overflow elevation, and outlet alignment for this basin. |
| NC 9 | 24.8 | 21 | 74 | 82.5 | 6.4 | 932 | 933.4 a | 932 | 2.5 a | 15" CMP-(P) | 7.5 a | 13.5 | 934.5 | 940 | It is recommended that the outlet alignment be surveyed for placement within easements. Additional stormwater storage is available in perched basins within this subwatershed. |
| NC 10 | 47.6 | 43 | 75 | 102.9 | 12.7 | 930.5 | 932.9 a | 933 | 16.7 a | 15" CMP-(E) | 11.0 a | 7 | 931.9 | 939 | The field inspection of the existing culvert indicated that maintenance/cleaning of sediment and vegetation at the inlet and outlet is required. The in-place culvert contains minimal cover within the road. It is recommended that a skimmer be installed in conjunction with culvert replacement. This basin could be utilized for rate control in the event that Eureka Road overtopping elevation is increased. |
| NC 11 | 86.1 | 40 | 75 | 195.7 | 22.9 | - | - | - | - | - | - | - | - | 932 | This subwatershed discharges east across city limits into Tonka Bay. |
| WC 1 | 49.6 | 29 | 72 | 127.0 | 12.0 | 975.5 | 976.5 | 977 | 16.9 | 15" & 12" CMP-(E) | 5.9 | 2.9 | 976 | 983 | The outlet culverts from this subwatershed are in good condition based on the field inspection (1999) it is recommended that a skimmer be installed at the basin outlet. |
| WC 2 | 106.6 | 60 | 76 | 187.1 | 29.3 | 959.5 | 966.8 | 967 | 21.8 | 8" ORIF. TO 48" RCP-(E) | 19.8 | 68 | 971.4 | 974 | The outlet from this basin is a special structure shown on City as-built #20. The 48" outlet pipe was filled to a depth of approximately 2' based on the field inspection. The 18" submerged outlet was not inspected during the field visit. It is recommended that the 48" outlet and 18" inlet be cleared of accumulated sediment. The in-place manhole control structure is recommended for inspection of accumulated sediment. In addition, upstream conveyance channels require sediment removal based on the field inspection and should be included in the City's CIP. |

**CITY OF SHOREWOOD
COMPREHENSIVE WATER RESOURCES MANAGEMENT PLAN
STORMWATER MODEL RESULTS
100-YEAR EVENT**

| SUB-WATERSHED NUMBER | AREA (ac) | T _c (min) | CN | PEAK RUNOFF RATE (cfs) | RUNOFF VOLUME (ac-ft) | POND NWL (elev.) | POND HWL (elev.) | RECOMMENDED 100 YR HWL (elev.) | PEAK OUTFLOW FROM POND (cfs) | POND OUTLET (d) | REQUIRED STORAGE (ac-ft) | AVAILABLE STORAGE (ac-ft) (c) | APPROXIMATE OVERFLOW ELEVATION (b) | EXISTING LOW BUILDING ELEVATION (b) | COMMENTS |
|----------------------|-----------|----------------------|----|------------------------|-----------------------|------------------|------------------|--------------------------------|------------------------------|-----------------------|--------------------------|-------------------------------|------------------------------------|-------------------------------------|--|
| WC 3 | 44.5 | 62 | 77 | 78.7 | 12.6 | 950 | 954.9 | 955.5 | 92.7 | 2-36" CMP (E) | 1.7 | 3 | 955.9 | 956.2 | The in-place 2-36" CMP culvert inlets were in good condition based on the field inspection. The conveyance channel upstream contained several fallen trees and sediment bars. It is recommended that the conveyance channel within this subwatershed be cleaned as part of the City CIP. |
| WC 4 | 106.5 | 95 | 75 | 128.2 | 28.4 | 930 | 932.6 | 933 | 145.4 | 4-54"x31" RCPA-(E) | 10.0 | 5.2 | 932 | 934 | The field inspection of the basin outlet indicated that the culverts were in good condition. (1999) It is recommended that sediment accumulation on the downstream of the culverts be removed. |
| WC 5 | 50.8 | 175 | 78 | 42.2 | 14.8 | 965 | 970.7 | 971 | 20.2 | 9" ORIFICE (E) | 6.8 | 5.6 | 970.1 | 972.5 | The field inspection of the outlet did not locate the system inlet. It is recommended that a skimmer be installed at the inlet. The city as-built #54 did not indicate the inlet being submerged. The field inspection indicated that a 9" pvc outlet was installed contrary to the as-built. Additional stormwater storage is available within this subwatershed in the form of wetlands. |
| WC 6 | 316.4 | 52 | 77 | 635.1 | 89.4 | 929.4 | 931.5 a | 931.5 | 36.29 32.3 a | 2-24" RCP | | | 930.9 931.1 | 932 | The outlets from this basin appeared in fair condition based on the field inspection. It is recommended that a skimmer be installed upstream of culvert inlets. The accumulation of vegetation/debris was present at the inlets at inspection. (1999) |
| WC 7 | 69.3 | 20 | 66 | 177.2 | 13.7 | | | | | 18" CMP & 24" CMP (E) | 204.2 a | 191.4 | | 932 | This subwatershed represents the City's direct discharge to Lake Minnetonka. |
| LV 1 | 22.1 | 15 | 75 | 90.3 | 5.9 | 949.5 | 951 | 952 | 19.3 | 27" RCP (P) | 2.1 | 11.7 | 953.7 | 954 | The wetland currently overland overflows west to LV 2. It is recommended that a survey of the low building and overflow elevation be conducted. The proposed outlet alignment location requires easement verification. Based on the topographic mapping, one structure could be at risk of impact if the current overflow elevation is not decreased. |
| LV 2 | 116.8 | 69 | 75 | 178.7 | 31.1 | | | | | | | | | 936 | This subwatershed consists of the direct tributary area to Lake Virginia. The proposed conveyance route from LV 1 should be contained within an easement. |
| W 1 | 62.1 | 43 | 70 | 112.9 | 14.1 | 932.2 | 934.8 a | 934.5 | 6.7 a | 12" CMP (P) | 14.5 a | 13.2 | 934.5 | 938 | The field inspection indicated overland flow across a driveway entrance is the existing outlet for this basin. It is proposed that an outlet be installed to define and establish an NWL for this basin. |
| W 2 | 21.6 | 20 | 65 | 52.9 | 4.1 | 930.2 | 931.4 a | 931.5 | 4.9 a | 12" CMP (P) | 4.2 a | 3.6 | 931.1 | 938 | This subwatershed is tributary to two depressions which currently overland flow to Lake Minnetonka once the stormwater storage is exceeded. The proposed outlet could allow backflow from the Lake. It is recommended that the outlet configuration be designed to prevent backflow. |
| W 3 | 64.9 | 20 | 68 | 179.7 | 13.8 | - | - | - | - | - | - | - | - | 933 | This subwatershed is directly tributary to Lake Minnetonka. |
| I 1 | 69.3 | 20 | 72 | 212.1 | 16.8 | - | - | - | - | - | - | - | - | - | Enchanted Island tributary to Lake Minnetonka |
| I 2 | 20.0 | 20 | 76 | 69.4 | 5.5 | - | - | - | - | - | - | - | - | - | Spray Island tributary to Lake Minnetonka |
| I 3 | 2.0 | 20 | 72 | 6.1 | 0.5 | - | - | - | - | - | - | - | - | - | Gile Island tributary to Lake Minnetonka |

- a) The critical event is the 100 year-10 day snowmelt.
- b) Elevations obtained from the Cities digital topographic 1' contour mapping.
- c) Available storage values calculated to the lowest elevation of either the overflow elevation or the low building elevation.
- d) It is recommended the existing outlet elevations be surveyed.

Note: The Outlet designation (E) is an existing outlet, (P) is a proposed outlet.

SUBWATERSHED LABELS

PC = subwatershed tributary to Purgatory Creek
 CB = subwatershed tributary to Carson Bay
 LW = subwatershed tributary to Lake William
 SAB = subwatershed tributary to St. Albans Bay
 subwatershed tributary to Christmas Lake

GL = subwatershed tributary to Galpin Lake
 GB = subwatershed tributary to Gideon Bay
 LMAR = subwatershed tributary to Lake Mary
 C = subwatershed tributary to Central area
 SC = subwatershed tributary to South-Central area

LMIN = subwatershed tributary to Lake Minnewashta
 NC = subwatershed tributary to North-Central area
 WC = subwatershed tributary to West-Central area
 LV = subwatershed tributary to Lake Virginia
 W = subwatershed tributary to West area
 I = subwatershed tributary to Lake Minnetonka

APPENDIX D

FEMA Flood Insurance Maps

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The community map repository should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations (BFEs)** and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) Report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS Report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' National Geodetic Vertical Datum of 1929 (NGVD 29). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study Report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study Report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study Report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 15. The **horizontal datum** was NAD 27, GRS 1980 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the National Geodetic Vertical Datum of 1929. These flood elevations must be compared to structure and ground elevations referenced to the same vertical datum. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at <http://www.ngs.noaa.gov> or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, NNGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at (301) 713-3242, or visit its website at <http://www.ngs.noaa.gov>.

Base map information shown on this FIRM was provided in digital format by the Minnesota Department of Natural Resources. This information was photogrammetrically compiled at a scale of 1:12,000 from aerial photography dated 2010 or later.

The **profile baselines** depicted on this map represent the hydraulic modeling baselines that match the flood profiles in the FIS report. As a result of improved topographic data, the **profile baseline**, in some cases, may deviate significantly from the channel centerline or appear outside the SFHA.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

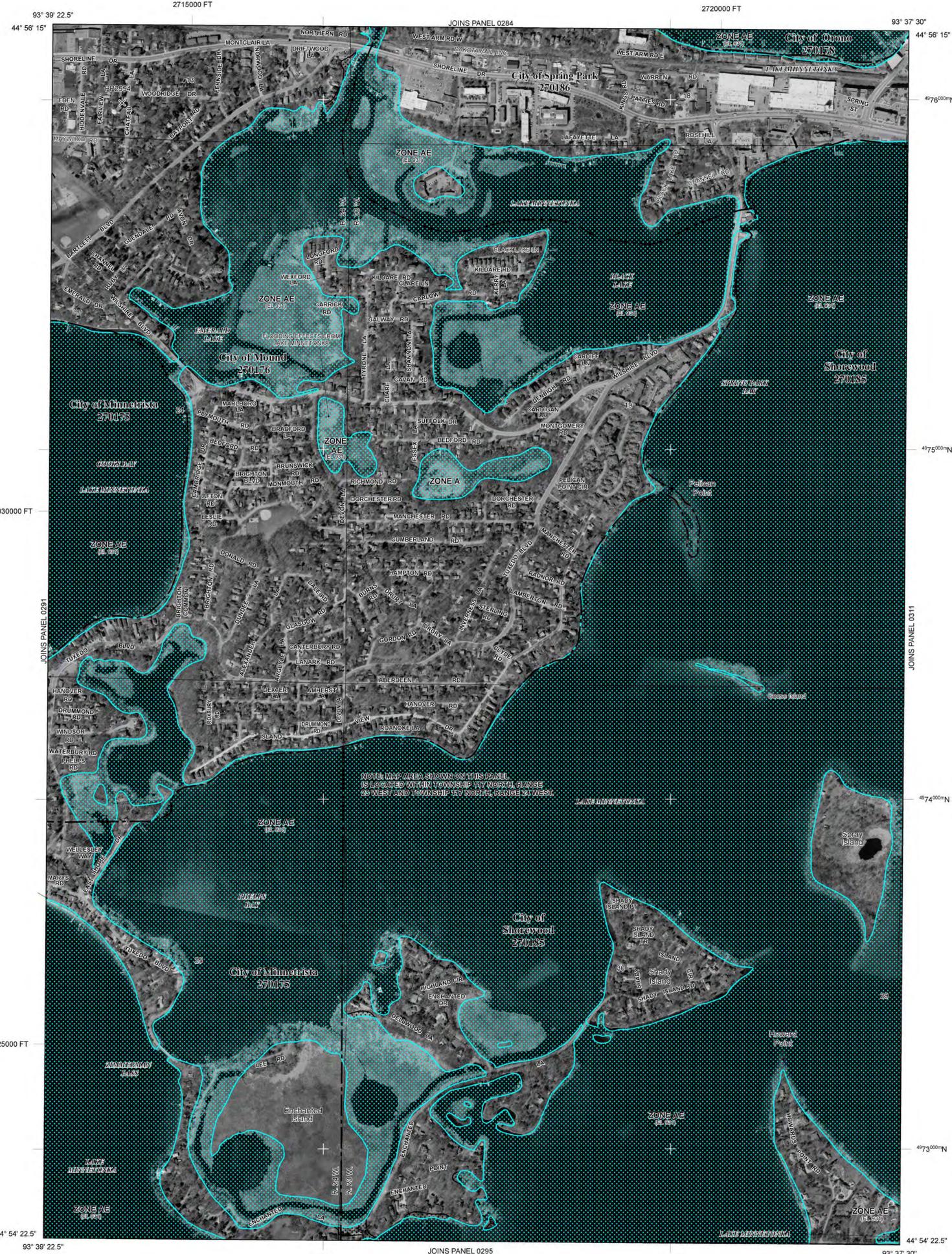
Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

For information on available products associated with this FIRM visit the **Map Service Center (MSC)** website at <http://msc.fema.gov>. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the MSC website.

 ADMINISTRATIVE FLOODWAY

*Administrative floodway designated in accordance with local regulations for management of these areas

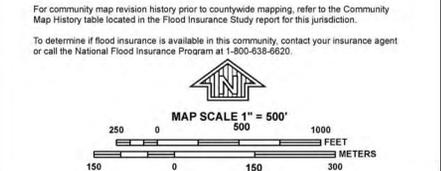
 MODELED NODE LABEL



NOTE: MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNSHIP 147 NORTH, RANGE 20 WEST AND TOWNSHIP 147 NORTH, RANGE 21 WEST

LEGEND

-  SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD
The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.
- ZONE A** No Base Flood Elevations determined.
- ZONE AE** Base Flood Elevations determined.
- ZONE AH** Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
- ZONE AO** Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
- ZONE AR** Special Flood Hazard Areas formerly protected from the 1% annual chance flood by a flood control system that was subsequently identified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
- ZONE A99** Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
- ZONE VE** Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
- ZONE V** Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.
-  FLOODWAY AREAS IN ZONE AE
The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.
-  OTHER FLOOD AREAS
- ZONE X** Areas of 0.2% annual 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.
- OTHER AREAS**
- ZONE D** Areas determined to be outside the 0.2% annual chance floodplain.
- ZONE E** Areas in which flood hazards are undetermined, but possible.
-  COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS
-  OTHERWISE PROTECTED AREAS (OPAs)
CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.
-  1% Annual Chance Floodplain Boundary
-  0.2% Annual Chance Floodplain Boundary
-  Floodway boundary
-  Zone D boundary
-  CBRS and OPA boundary
-  Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths, or flood velocities.
-  Base Flood Elevation line and value; elevation in feet*
(EL 987)
-  Cross section line
-  Transect line
- 45° 02' 08", 93° 02' 12" Geographic coordinates referenced to the North American Datum of 1983 (NAD 83) Western Hemisphere
- 5000-foot ticks: Minnesota State Plane coordinate system, South Zone (FIPSZONE 2203), Lambert Conformal Conic projection
- 1000-meter Universal Transverse Mercator grid values, zone 15
-  Bench mark (see explanation in Notes to Users section of this FIRM panel)
-  M1.5 River Mile
-  MAP REPOSITORIES
Refer to Map Repositories list on Map Index
- EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
September 2, 2004
- EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
November 4, 2016 - to add Special Flood Hazard Areas, to change Base Flood Elevations, to change floodway, to change Special Flood Hazard Areas, to decrease Base Flood Elevations, to incorporate previously issued Letters of Map Revisions, to increase Base Flood Elevations, to reflect updated topographic information, to update corporate limits, to update map format



NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0292F

FIRM
FLOOD INSURANCE RATE MAP
HENNEPIN COUNTY,
MINNESOTA
(ALL JURISDICTIONS)

PANEL 292 OF 500
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

| COMMUNITY | NUMBER | PANEL | SUFFIX |
|----------------------|--------|-------|--------|
| MINNETRISTA, CITY OF | 270175 | 0292 | F |
| MOUND, CITY OF | 270176 | 0292 | F |
| ORONO, CITY OF | 270178 | 0292 | F |
| SHOREWOOD, CITY OF | 270186 | 0292 | F |
| SPRING PARK, CITY OF | 270188 | 0292 | F |

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

 **MAP NUMBER**
27053C0292F
MAP REVISED
NOVEMBER 4, 2016
Federal Emergency Management Agency

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations (BFEs)** and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) Report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS Report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' National Geodetic Vertical Datum of 1929 (NGVD 29). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study Report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study Report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study Report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 15. The **horizontal datum** was NAD 27, GRS 1980 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the National Geodetic Vertical Datum of 1929. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at <http://www.ngs.noaa.gov> or contact the National Geodetic Survey at the following address:

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The **profile baselines** depicted on this map represent the hydraulic modeling baselines that match the flood profiles in the FIS report. As a result of improved topographic data, the **profile baseline**, in some cases, may deviate significantly from the channel centerline or appear outside the SFHA.

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 ADMINISTRATIVE FLOODWAY

* Administrative floodway designated in accordance with local regulations for management of these areas

 MODELED NODE LABEL

LEGEND

- SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD**
The 1% annual chance flood (100-year flood), also known as the base flood, is the flood area that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.
- ZONE A** No Base Flood Elevations determined.
 - ZONE AE** Base Flood Elevations determined.
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 - ZONE AR** Special Flood Hazard Areas formerly protected from the 1% annual chance flood by a flood control system that was subsequently deteriorated. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
 - ZONE A99** Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
 - ZONE V** Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
 - ZONE VE** Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

 FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

 OTHER FLOOD AREAS

ZONE X Areas of 0.2% annual 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.

OTHER AREAS

ZONE X Areas determined to be outside the 0.2% annual chance floodplain.

ZONE D Areas in which flood hazards are undetermined, but possible.

 COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

 OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

 1% Annual Chance Floodplain Boundary

 0.2% Annual Chance Floodplain Boundary

 Floodway Boundary

 Zone D Boundary

 CBRS and OPA Boundary

 Boundary Dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths, or flood velocities.

 Base Flood Elevation line and value; elevation in feet*

 Base Flood Elevation value where uniform within zone; elevation in feet*

*Referenced to the National Geodetic Vertical Datum of 1929

 Cross section line

 Transect line

 Geographic coordinates referenced to the North American Datum of 1983 (NAD 83) Western Hemisphere

 5000-foot ticks: Minnesota State Plane coordinate system, South Zone (FIPSZONE 2203), Lambert Conformal Conic projection

 1000-meter Universal Transverse Mercator grid values, zone 15

 Bench mark (see explanation in Notes to Users section of this FIRM panel)

 M1.5 River Mile

 MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
September 2, 2004

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

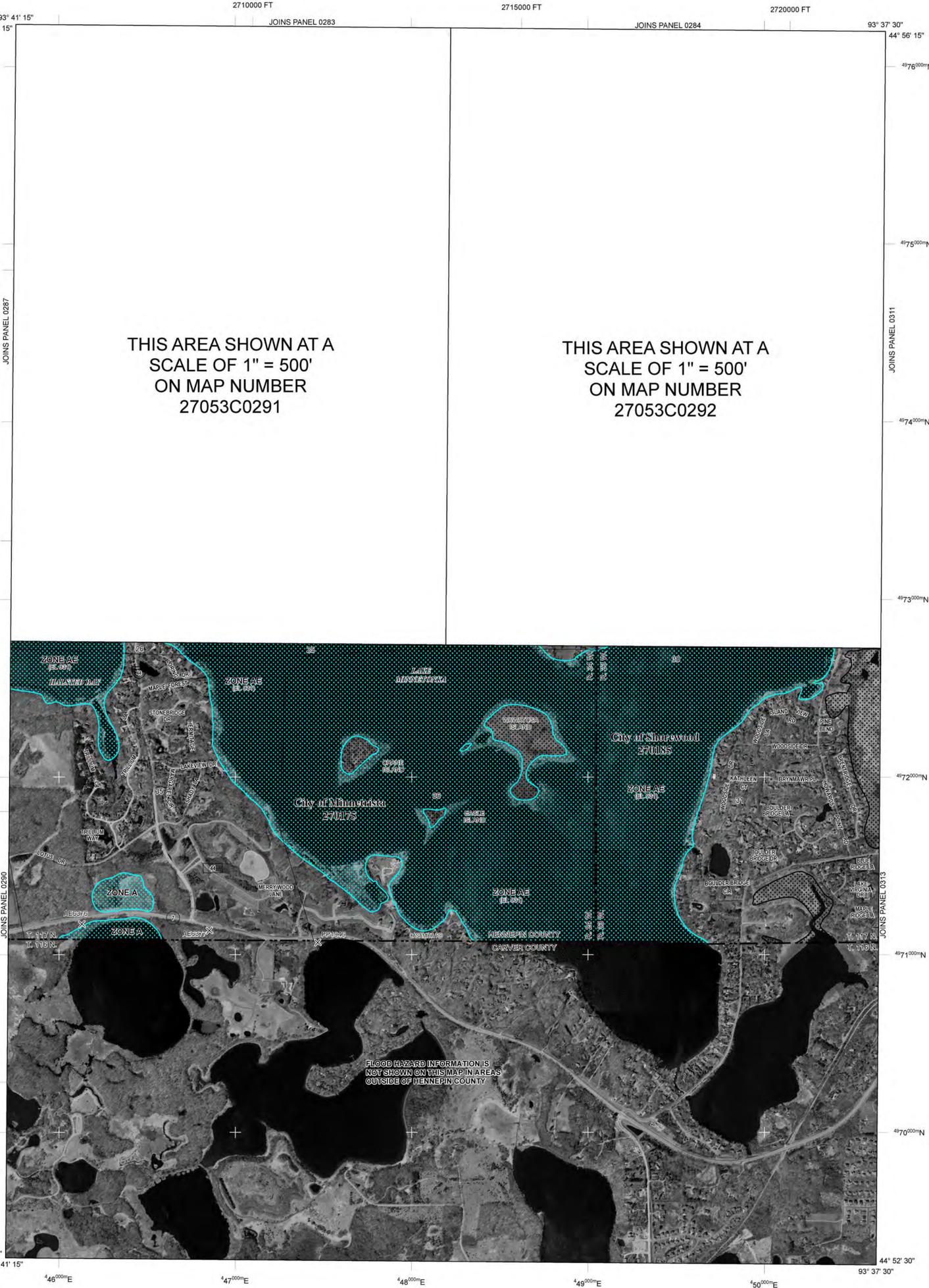
November 4, 2016 - to add Special Flood Hazard Areas, to change Base Flood Elevations, to change floodway, to change Special Flood Hazard Areas, to decrease Base Flood Elevations, to incorporate previously issued Letters of Map Revisions, to increase Base Flood Elevations, to reflect updated topographic information, to update corporate limits, to update map format

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

 MAP SCALE 1" = 1000'

500 0 1000 2000 FEET
300 0 300 600 METERS



NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0295F

FIRM
FLOOD INSURANCE RATE MAP
HENNEPIN COUNTY, MINNESOTA
(ALL JURISDICTIONS)

PANEL 295 OF 500
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

| COMMUNITY | NUMBER | PANEL | SUFFIX |
|----------------------|--------|-------|--------|
| MINNETRISTA, CITY OF | 27017S | 0295 | F |
| SHOREWOOD, CITY OF | 27018S | 0295 | F |

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

 **MAP NUMBER 27053C0295F**
MAP REVISED NOVEMBER 4, 2016
Federal Emergency Management Agency

NOTES TO USERS

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Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study Report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study Report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 15. The **horizontal datum** was NAD 27, GRS 1980 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the National Geodetic Vertical Datum of 1929. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at <http://www.ngs.noaa.gov> or contact the National Geodetic Survey at the following address:

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 ADMINISTRATIVE FLOODWAY

* Administrative floodway designated in accordance with local regulations for management of these areas

 MODELED NODE LABEL

LEGEND

-  SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD
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- ZONE A99** Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
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- ZONE VE** Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.
-  FLOODWAY AREAS IN ZONE AE
The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.
-  OTHER FLOOD AREAS
- ZONE X** Areas of 0.2% annual 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.
- OTHER AREAS**
- ZONE D** Areas determined to be outside the 0.2% annual chance floodplain.
- ZONE D** Areas in which flood hazards are undetermined, but possible.
-  COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS
-  OTHERWISE PROTECTED AREAS (OPAs)
CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.
-  1% Annual Chance Floodplain Boundary
-  0.2% Annual Chance Floodplain Boundary
-  Floodway boundary
-  Zone D boundary
-  CBRS and OPA boundary
-  Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths, or flood velocities.
-  Base Flood Elevation line and value; elevation in feet*
(EL 987)
-  Base Flood Elevation value where uniform within zone; elevation in feet*

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 Cross section line

 Transect line

45° 02' 08", 93° 02' 12"
Geographic coordinates referenced to the North American Datum of 1983 (NAD 83) Western Hemisphere

3100000 FT
5000-foot ticks: Minnesota State Plane coordinate system, South Zone (FIPSZONE 2203), Lambert Conformal Conic projection

1000-meter Universal Transverse Mercator grid values, zone 15
DX5510 X
Bench mark (see explanation in Notes to Users section of this FIRM panel)

M1.5
River Mile

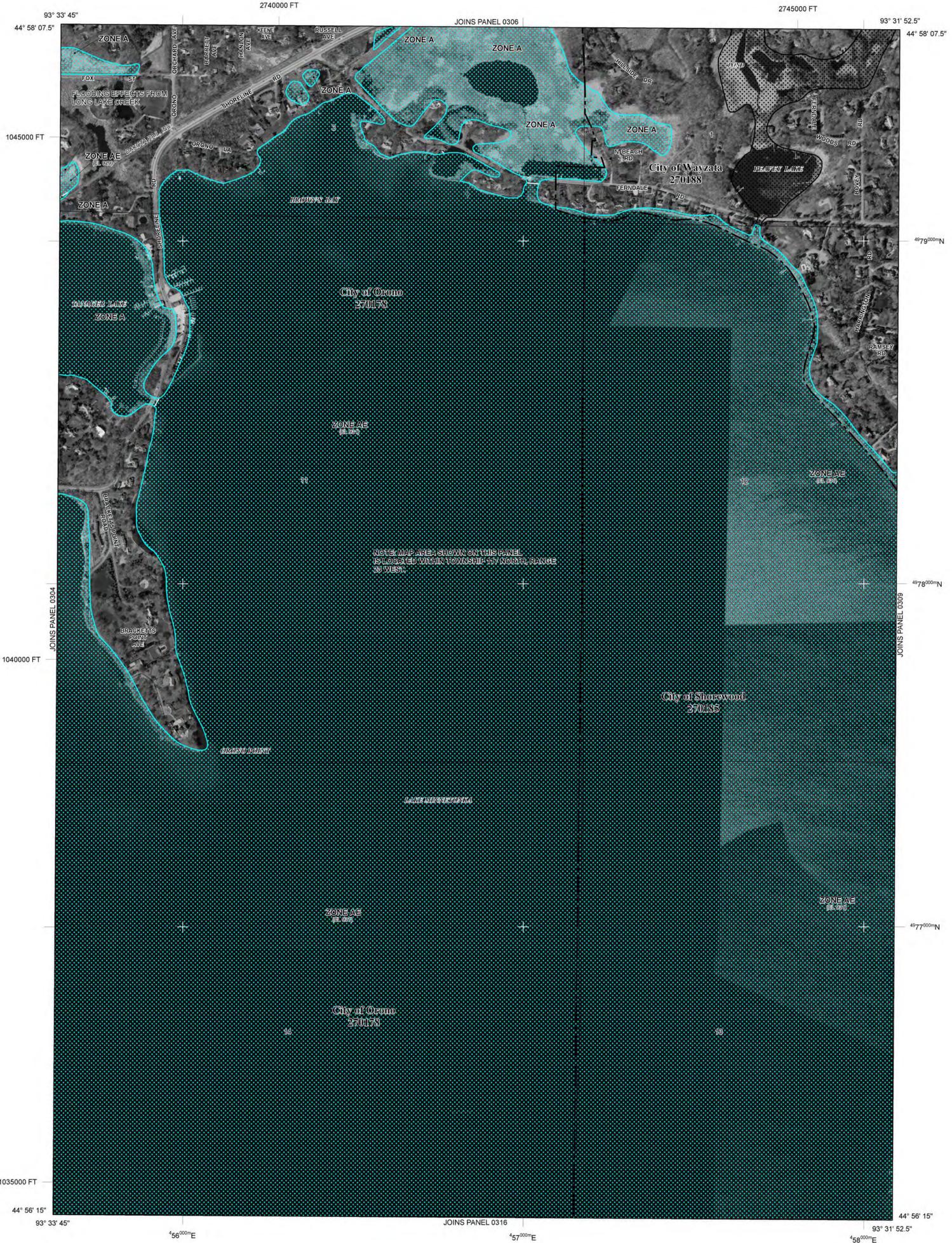
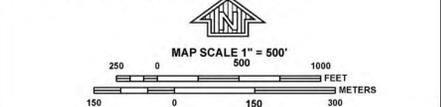
MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
September 2, 2004

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
November 4, 2016 - to add Special Flood Hazard Areas, to change Base Flood Elevations, to change floodway, to change Special Flood Hazard Areas, to decrease Base Flood Elevations, to incorporate previously issued Letters of Map Revisions, to increase Base Flood Elevations, to reflect updated topographic information, to update corporate limits, to update map format

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NFIP

PANEL 0308F

FIRM

FLOOD INSURANCE RATE MAP

HENNEPIN COUNTY, MINNESOTA (ALL JURISDICTIONS)

PANEL 308 OF 500
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

| COMMUNITY | NUMBER | PANEL | SUFFIX |
|--------------------|--------|-------|--------|
| ORONO, CITY OF | 270178 | 0308 | F |
| SHOREWOOD, CITY OF | 270185 | 0308 | F |
| WAYZATA, CITY OF | 270188 | 0308 | F |

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 **MAP NUMBER 27053C0308F**
MAP REVISED NOVEMBER 4, 2016
Federal Emergency Management Agency

NOTES TO USERS

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The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 15. The **horizontal datum** was NAD 27, GRS 1980 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the National Geodetic Vertical Datum of 1929. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at <http://www.ngs.noaa.gov> or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, NNGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at (301) 713-3242, or visit its website at <http://www.ngs.noaa.gov>.

Base map information shown on this FIRM was provided in digital format by the Minnesota Department of Natural Resources. This information was photogrammetrically compiled at a scale of 1:12,000 from aerial photography dated 2010 or later.

The **profile baselines** depicted on this map represent the hydraulic modeling baselines that match the flood profiles in the FIS report. As a result of improved topographic data, the **profile baseline**, in some cases, may deviate significantly from the channel centerline or appear outside the SFHA.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

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 ADMINISTRATIVE FLOODWAY

* Administrative floodway designated in accordance with local regulations for management of these areas

 MODELED NODE LABEL

LEGEND

-  SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD
The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.
- ZONE A** No Base Flood Elevations determined.
- ZONE AE** Base Flood Elevations determined.
- ZONE AH** Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
- ZONE AO** Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
- ZONE AR** Special Flood Hazard Areas formerly protected from the 1% annual chance flood by a flood control system that was subsequently destroyed. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
- ZONE A99** Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
- ZONE V** Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
- ZONE VE** Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.
-  FLOODWAY AREAS IN ZONE AE
The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.
-  OTHER FLOOD AREAS
- ZONE X** Areas of 0.2% annual 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.
- OTHER AREAS**
- ZONE X** Areas determined to be outside the 0.2% annual chance floodplain.
- ZONE D** Areas in which flood hazards are undetermined, but possible.
-  COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS
-  OTHERWISE PROTECTED AREAS (OPAs)
CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.
-  1% Annual Chance Floodplain Boundary
-  0.2% Annual Chance Floodplain Boundary
-  Floodway boundary
-  Zone D boundary
-  CBRS and OPA boundary
-  Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths, or flood velocities.
-  Base Flood Elevation line and value; elevation in feet*
-  Base Flood Elevation value where uniform within zone; elevation in feet*

*Referenced to the National Geodetic Vertical Datum of 1929

 Cross section line

 Transect line

45° 02' 08", 93° 02' 12"

3100000 FT

5000-foot ticks: Minnesota State Plane coordinate system, South Zone (FIPSZONE 2203), Lambert Conformal Conic projection

1000-meter Universal Transverse Mercator grid values, zone 15

 DX5510 X Bench mark (see explanation in Notes to Users section of this FIRM panel)

 M1.5 River Mile

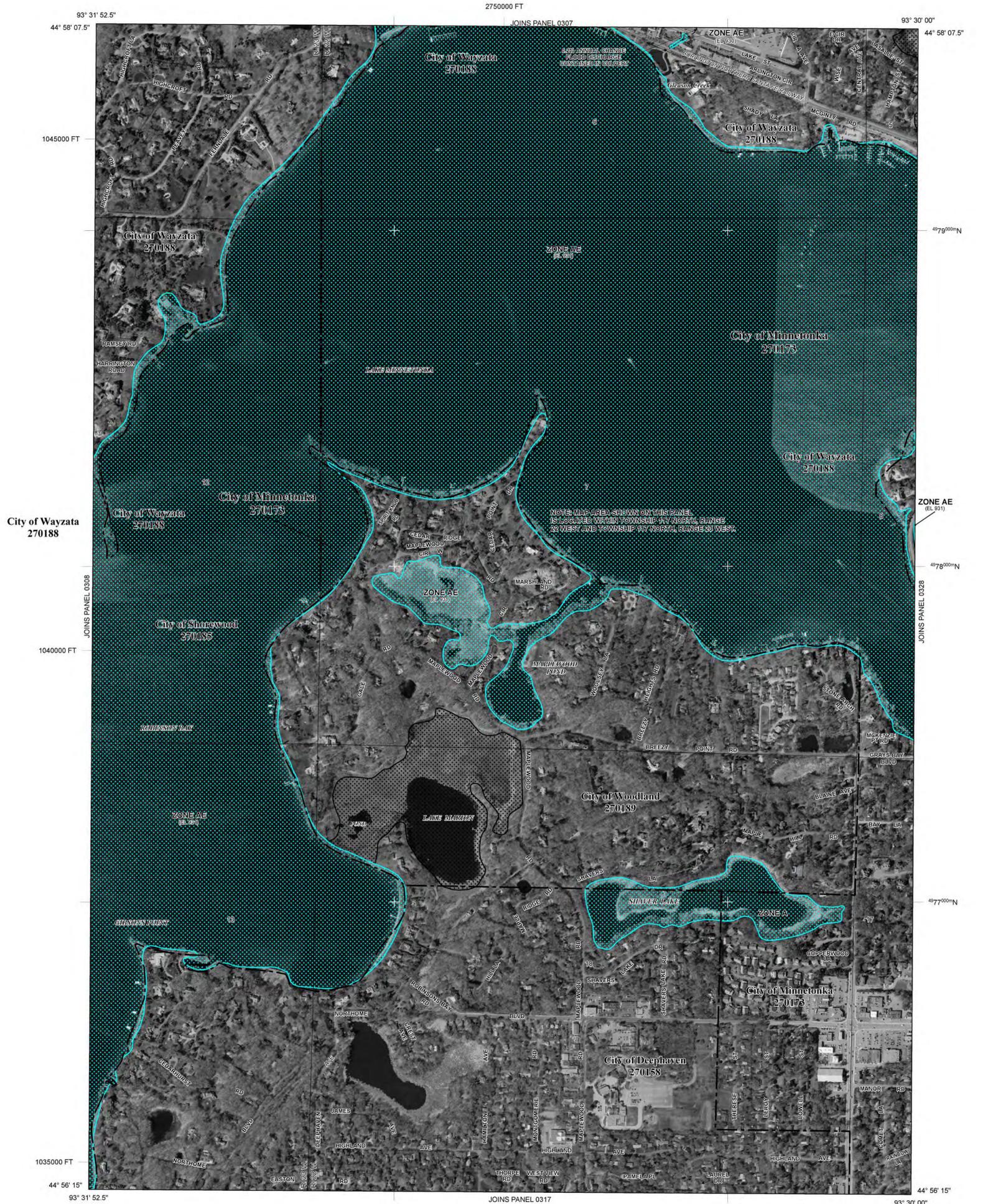
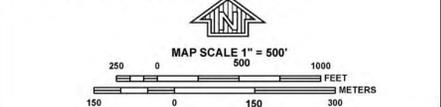
 MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
September 2, 2004

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
November 4, 2016 - to add Special Flood Hazard Areas, to change Base Flood Elevations, to change floodway, to change Special Flood Hazard Areas, to decrease Base Flood Elevations, to incorporate previously issued Letters of Map Revisions, to increase Base Flood Elevations, to reflect updated topographic information, to update corporate limits, to update map format

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.



NFIP

PANEL 0309F

FIRM

FLOOD INSURANCE RATE MAP

HENNEPIN COUNTY, MINNESOTA

(ALL JURISDICTIONS)

PANEL 309 OF 500

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

| COMMUNITY | NUMBER | PANEL | SUFFIX |
|---------------------|--------|-------|--------|
| DEEPHAVEN, CITY OF | 270158 | 0309 | F |
| MINNETONKA, CITY OF | 270173 | 0309 | F |
| SHOREWOOD, CITY OF | 270185 | 0309 | F |
| WAYZATA, CITY OF | 270188 | 0309 | F |
| WOODLAND, CITY OF | 270189 | 0309 | F |

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MAP NUMBER 27053C0309F

MAP REVISED NOVEMBER 4, 2016

Federal Emergency Management Agency

NOTES TO USERS

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To obtain more detailed information in areas where **Base Flood Elevations (BFEs)** and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) Report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS Report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' National Geodetic Vertical Datum of 1929 (NGVD 29). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study Report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study Report for this jurisdiction.

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 ADMINISTRATIVE FLOODWAY

* Administrative floodway designated in accordance with local regulations for management of these areas

 MODELED NODE LABEL

LEGEND

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- ZONE VE** Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.
-  FLOODWAY AREAS IN ZONE AE
The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.
-  OTHER FLOOD AREAS
- ZONE X** Areas of 0.2% annual 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.
- OTHER AREAS**
- ZONE X** Areas determined to be outside the 0.2% annual chance floodplain.
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-  OTHERWISE PROTECTED AREAS (OPAs)
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-  Floodway boundary
-  Zone D boundary
-  CBRS and OPA boundary
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-  Base Flood Elevation line and value; elevation in feet*
-  Base Flood Elevation value where uniform within zone; elevation in feet*

*Referenced to the National Geodetic Vertical Datum of 1929

 Cross section line

 Transect line

45° 02' 08", 93° 02' 12" Geographic coordinates referenced to the North American Datum of 1983 (NAD 83) Western Hemisphere

3100000 FT 5000-foot ticks: Minnesota State Plane coordinate system, South Zone (FIPSZONE 2203), Lambert Conformal Conic projection

1000-meter Universal Transverse Mercator grid values, zone 15

 Bench mark (see explanation in Notes to Users section of this FIRM panel)

 M1.5 River Mile

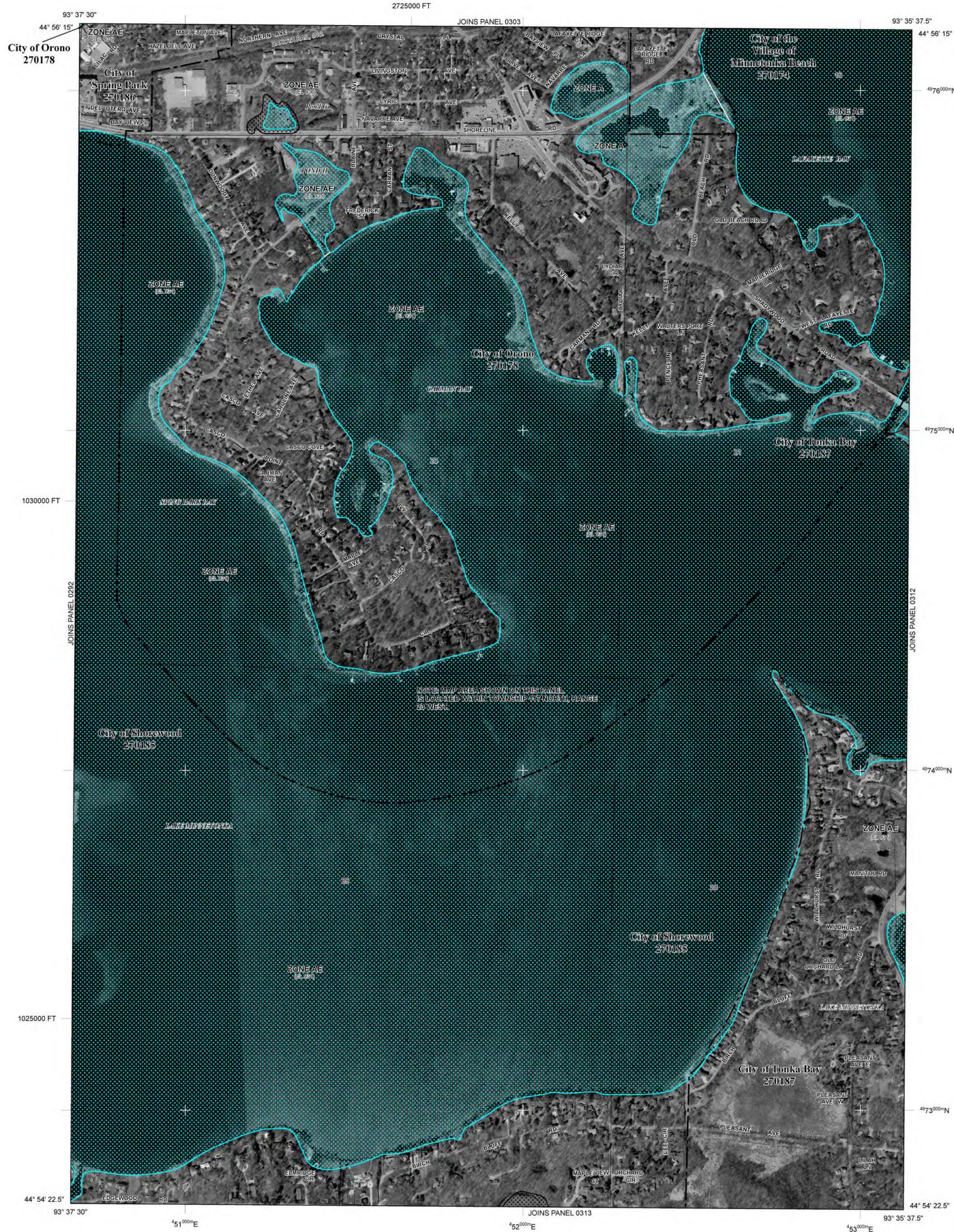
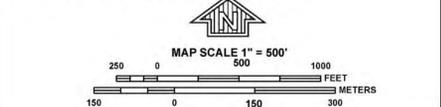
 MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
September 2, 2004

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
November 4, 2016 - to add Special Flood Hazard Areas, to change Base Flood Elevations, to change floodway, to change Special Flood Hazard Areas, to decrease Base Flood Elevations, to incorporate previously issued Letters of Map Revisions, to increase Base Flood Elevations, to reflect updated topographic information, to update corporate limits, to update map format

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NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0311F

FIRM

FLOOD INSURANCE RATE MAP

HENNEPIN COUNTY, MINNESOTA (ALL JURISDICTIONS)

PANEL 311 OF 500
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

| COMMUNITY | NUMBER | PANEL | SUFFIX |
|--|--------|-------|--------|
| THE VILLAGE OF MINNETONKA BEACH, CITY OF | 270174 | 0311 | F |
| ORONO, CITY OF | 270178 | 0311 | F |
| SHOREWOOD, CITY OF | 270185 | 0311 | F |
| SPRING PARK, CITY OF | 270186 | 0311 | F |
| TONKA BAY, CITY OF | 270187 | 0311 | F |

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 **MAP NUMBER 27053C0311F**
MAP REVISED NOVEMBER 4, 2016
Federal Emergency Management Agency

NOTES TO USERS

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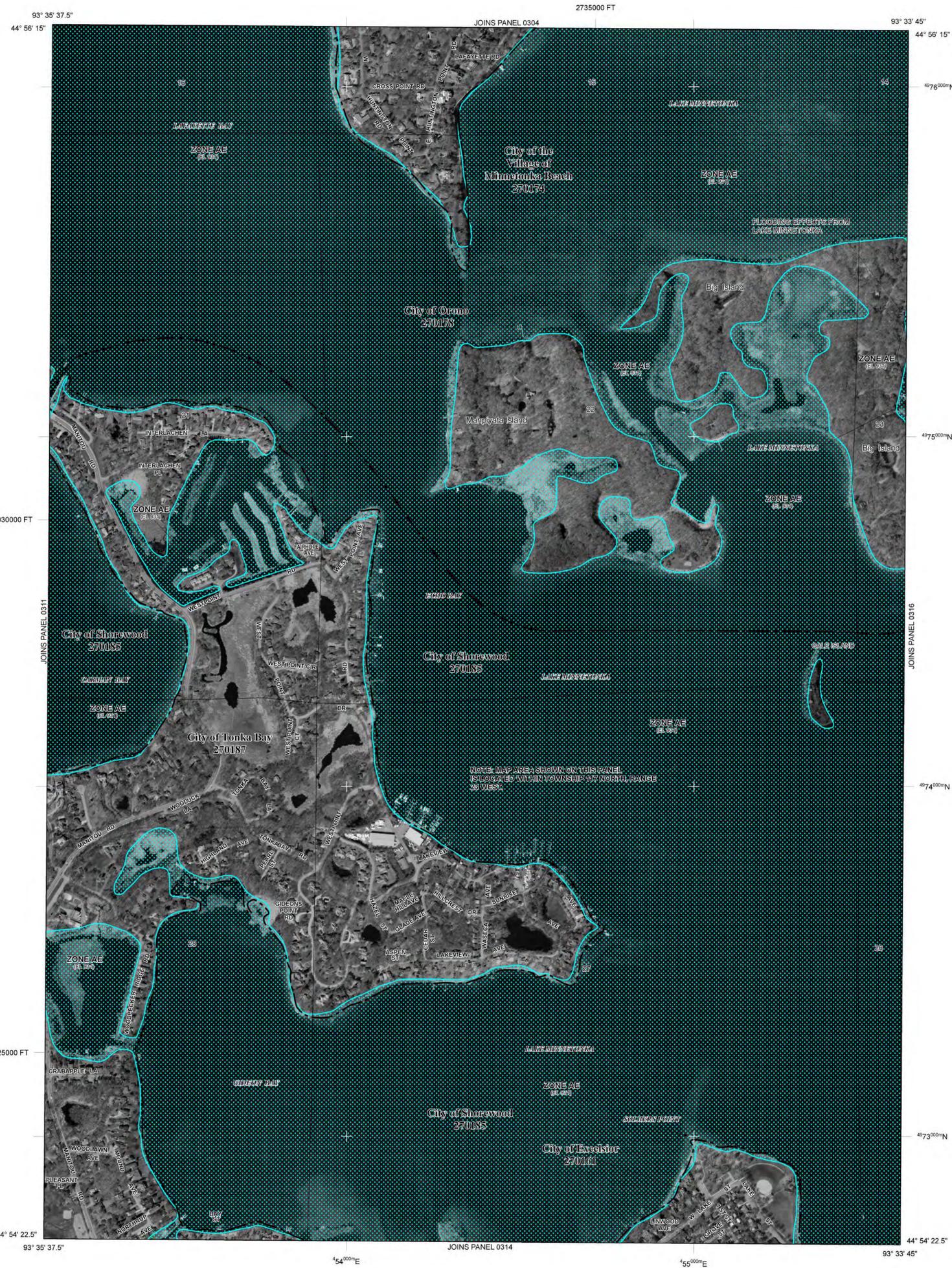
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 ADMINISTRATIVE FLOODWAY

*Administrative floodway designated in accordance with local regulations for management of these areas

 MODELED NODE LABEL



LEGEND

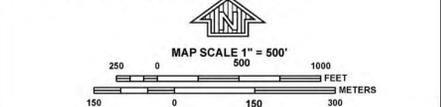
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- ZONE A99** Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
- ZONE VE** Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
- ZONE V** Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.
-  FLOODWAY AREAS IN ZONE AE
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- ZONE X** Areas of 0.2% annual 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.
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September 2, 2004
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November 4, 2016 - to add Special Flood Hazard Areas, to change Base Flood Elevations, to change floodway, to change Special Flood Hazard Areas, to decrease Base Flood Elevations, to incorporate previously issued Letters of Map Revisions, to increase Base Flood Elevations, to reflect updated topographic information, to update corporate limits, to update map format

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NFIP
NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0312F

FIRM
FLOOD INSURANCE RATE MAP
HENNEPIN COUNTY,
MINNESOTA
(ALL JURISDICTIONS)

PANEL 312 OF 500
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

| COMMUNITY | NUMBER | PANEL | SUFFIX |
|--|--------|-------|--------|
| THE VILLAGE OF MINNETONKA BEACH, CITY OF | 270174 | 0312 | F |
| EXCELSIOR, CITY OF | 270181 | 0312 | F |
| ORONO, CITY OF | 270178 | 0312 | F |
| SHOREWOOD, CITY OF | 270185 | 0312 | F |
| TONKA BAY, CITY OF | 270187 | 0312 | F |

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 **MAP NUMBER**
27053C0312F
MAP REVISED
NOVEMBER 4, 2016
Federal Emergency Management Agency

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The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 15. The **horizontal datum** was NAD 27, GRS 1980 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the National Geodetic Vertical Datum of 1929. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at <http://www.ngs.noaa.gov> or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, NNGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at (301) 713-3242, or visit its website at <http://www.ngs.noaa.gov>.

Base map information shown on this FIRM was provided in digital format by the Minnesota Department of Natural Resources. This information was photogrammetrically compiled at a scale of 1:12,000 from aerial photography dated 2010 or later.

The **profile baselines** depicted on this map represent the hydraulic modeling baselines that match the flood profiles in the FIS report. As a result of improved topographic data, the **profile baseline**, in some cases, may deviate significantly from the channel centerline or appear outside the SFHA.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

For information on available products associated with this FIRM visit the **Map Service Center (MSC)** website at <http://msc.fema.gov>. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the MSC website.

 ADMINISTRATIVE FLOODWAY

* Administrative floodway designated in accordance with local regulations for management of these areas

 MODELED NODE LABEL

LEGEND

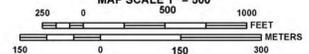
-  SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD
The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.
- ZONE A** No Base Flood Elevations determined.
- ZONE AE** Base Flood Elevations determined.
- ZONE AH** Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
- ZONE AO** Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
- ZONE AR** Special Flood Hazard Areas formerly protected from the 1% annual chance flood by a flood control system that was subsequently identified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
- ZONE A99** Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
- ZONE V** Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
- ZONE VE** Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.
-  FLOODWAY AREAS IN ZONE AE
The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.
-  OTHER FLOOD AREAS
- ZONE X** Areas of 0.2% annual 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.
- OTHER AREAS**
- ZONE D** Areas determined to be outside the 0.2% annual chance floodplain.
- ZONE E** Areas in which flood hazards are undetermined, but possible.
-  COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS
-  OTHERWISE PROTECTED AREAS (OPAs)
CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.
-  1% Annual Chance Floodplain Boundary
-  0.2% Annual Chance Floodplain Boundary
-  Floodway boundary
-  Zone D boundary
-  CBRS and OPA boundary
-  Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths, or flood velocities.
-  Base Flood Elevation line and value; elevation in feet*
(EL 987)
- *Referenced to the National Geodetic Vertical Datum of 1929
-  Cross section line
-  Transect line
- 45° 02' 08", 93° 02' 12" Geographic coordinates referenced to the North American Datum of 1983 (NAD 83) Western Hemisphere
- 3100000 FT 5000-foot ticks: Minnesota State Plane coordinate system, South Zone (FIPS ZONE 2203), Lambert Conformal Conic projection
- 1000-meter Universal Transverse Mercator grid values, zone 15
-  Bench mark (see explanation in Notes to Users section of this FIRM panel)
-  M1.5 River Mile
-  MAP REPOSITORIES
Refer to Map Repositories list on Map Index
- EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
September 2, 2004
- EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
November 4, 2016 - to add Special Flood Hazard Areas, to change Base Flood Elevations, to change floodway, to change Special Flood Hazard Areas, to decrease Base Flood Elevations, to incorporate previously issued Letters of Map Revisions, to increase Base Flood Elevations, to reflect updated topographic information, to update corporate limits, to update map format

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.



MAP SCALE 1" = 500'



NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0314F

FIRM
FLOOD INSURANCE RATE MAP
HENNEPIN COUNTY,
MINNESOTA
(ALL JURISDICTIONS)

PANEL 314 OF 500
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

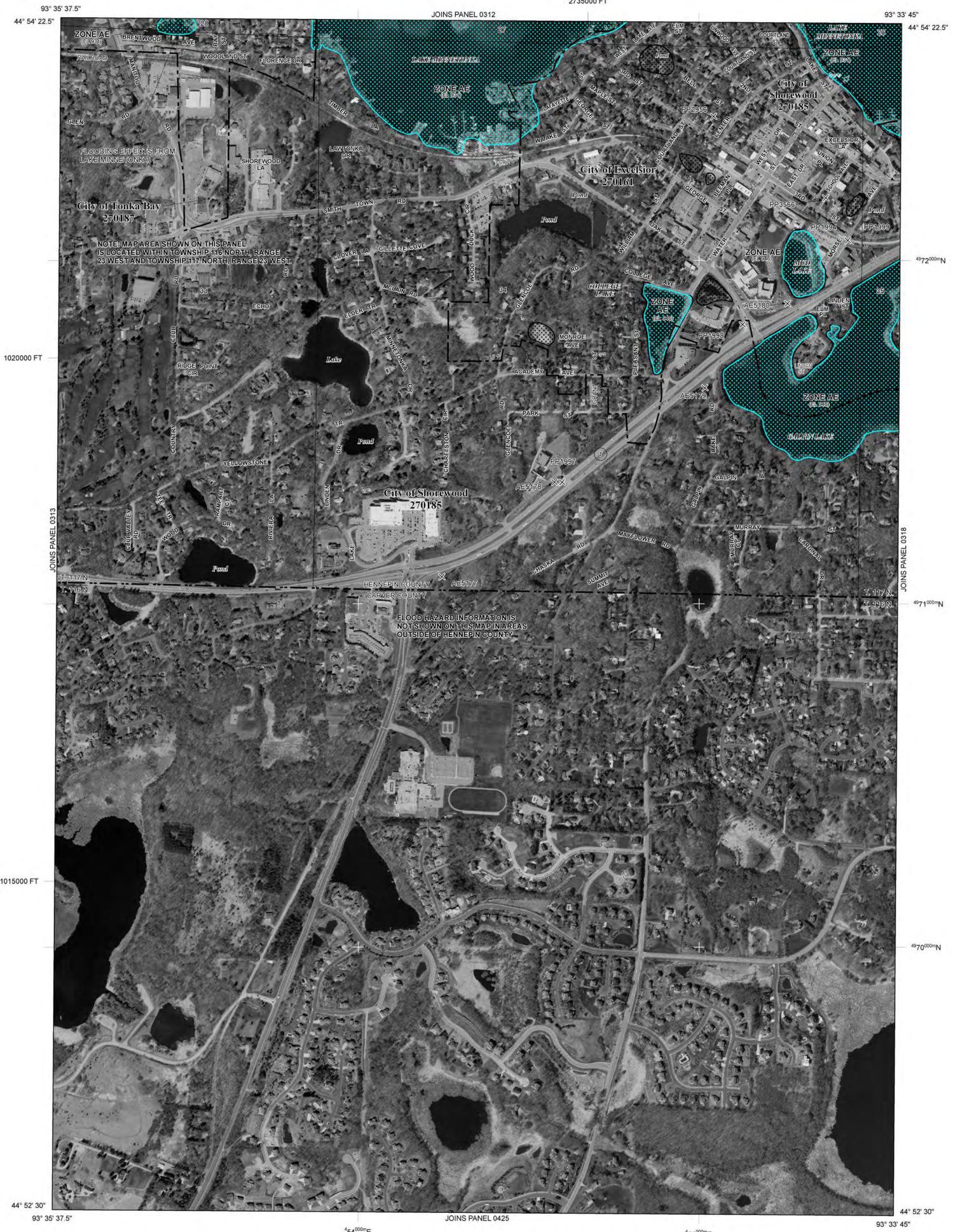
CONTAINS:

| COMMUNITY | NUMBER | PANEL | SUFFIX |
|--------------------|--------|-------|--------|
| EXCELSIOR, CITY OF | 270161 | 0314 | F |
| SHOREWOOD, CITY OF | 270185 | 0314 | F |
| TONKA BAY, CITY OF | 270187 | 0314 | F |

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MAP NUMBER
27053C0314F
MAP REVISED
NOVEMBER 4, 2016
Federal Emergency Management Agency



93° 35' 37.5"

44° 54' 22.5"

2735000 FT

93° 33' 45"

44° 54' 22.5"

1020000 FT

2450000 FT

44° 52' 30"

93° 35' 37.5"

4540000 E

4550000 E

93° 33' 45"

44° 52' 30"

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The community map repository should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations (BFEs)** and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) Report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS Report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' National Geodetic Vertical Datum of 1929 (NGVD 29). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study Report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study Report for this jurisdiction.

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 ADMINISTRATIVE FLOODWAY

* Administrative floodway designated in accordance with local regulations for management of these areas

 MODELED NODE LABEL

LEGEND

-  SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD
The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.
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- ZONE VE** Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.
-  FLOODWAY AREAS IN ZONE AE
The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.
-  OTHER FLOOD AREAS
- ZONE X** Areas of 0.2% annual 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.
- OTHER AREAS**
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- ZONE D** Areas in which flood hazards are undetermined, but possible.
-  COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS
-  OTHERWISE PROTECTED AREAS (OPAs)
CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.
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-  0.2% Annual Chance Floodplain Boundary
-  Floodway boundary
-  Zone D boundary
-  CBRS and OPA boundary
-  Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths, or flood velocities.
-  Base Flood Elevation line and value; elevation in feet*
-  Base Flood Elevation value where uniform within zone; elevation in feet*

*Referenced to the National Geodetic Vertical Datum of 1929

 Cross section line

 Transect line

45° 02' 08" 93° 02' 12" Geographic coordinates referenced to the North American Datum of 1983 (NAD 83) Western Hemisphere

3100000 FT 5000-foot ticks: Minnesota State Plane coordinate system, South Zone (FIPSZONE 2203), Lambert Conformal Conic projection

4978000m N 1000-meter Universal Transverse Mercator grid values, zone 15

DX5510 X Bench mark (see explanation in Notes to Users section of this FIRM panel)

M1.5 River Mile

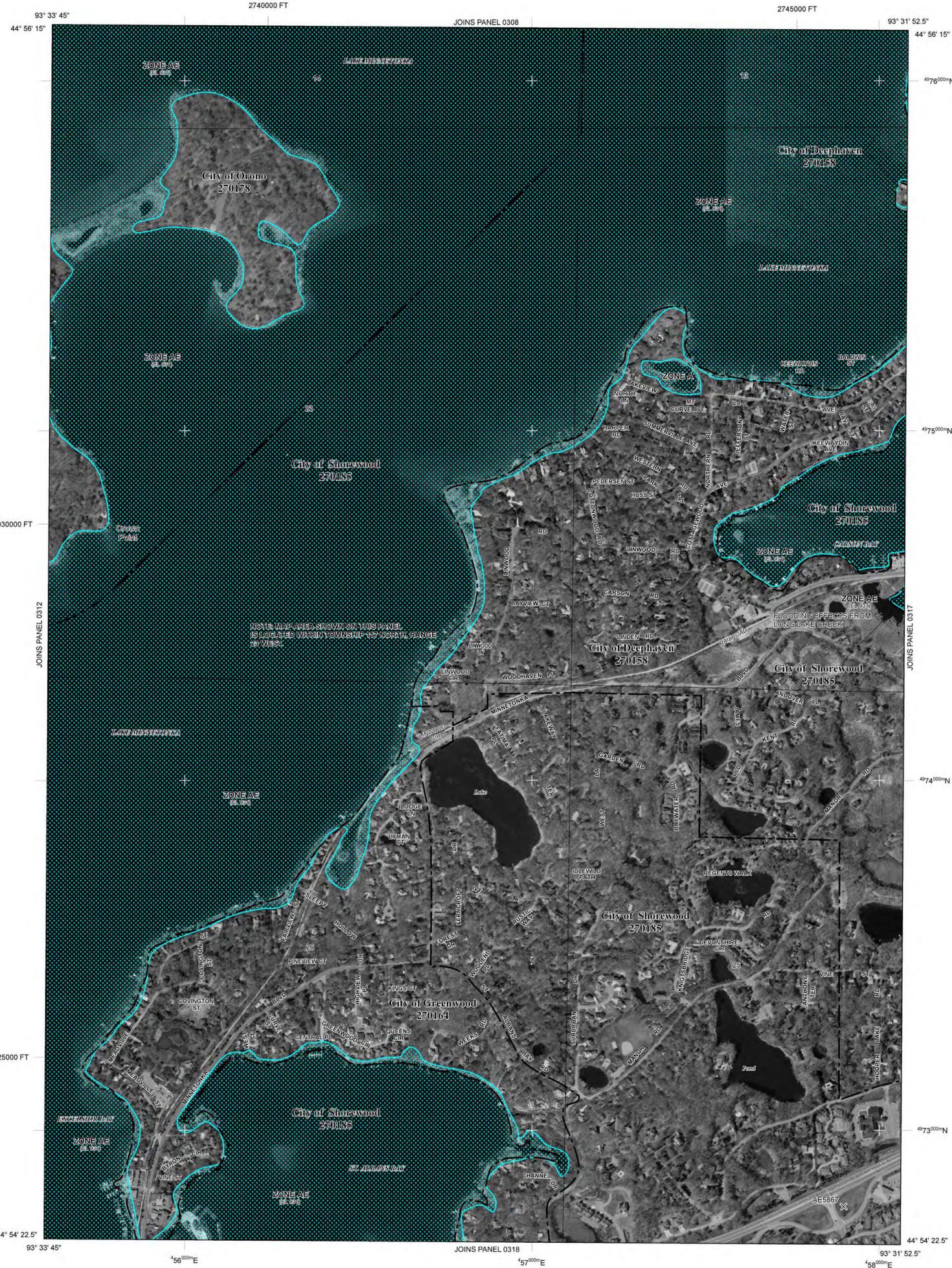
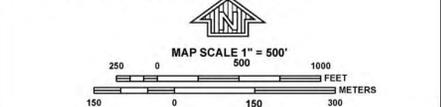
MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
September 2, 2004

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
November 4, 2016 - to add Special Flood Hazard Areas, to change Base Flood Elevations, to change floodway, to change Special Flood Hazard Areas, to decrease Base Flood Elevations, to incorporate previously issued Letters of Map Revisions, to increase Base Flood Elevations, to reflect updated topographic information, to update corporate limits, to update map format

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

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NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0316F

FIRM

FLOOD INSURANCE RATE MAP

HENNEPIN COUNTY, MINNESOTA (ALL JURISDICTIONS)

PANEL 316 OF 500
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

| COMMUNITY | NUMBER | PANEL | SUFFIX |
|--------------------|--------|-------|--------|
| DEEPAVEN, CITY OF | 270158 | 0316 | F |
| GREENWOOD, CITY OF | 270164 | 0316 | F |
| ORONO, CITY OF | 270178 | 0316 | F |
| SHOREWOOD, CITY OF | 270185 | 0316 | F |

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

 MAP NUMBER 27053C0316F
MAP REVISED NOVEMBER 4, 2016
Federal Emergency Management Agency

NOTES TO USERS

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Coastal Base Flood Elevations shown on this map apply only landward of 0.0' National Geodetic Vertical Datum of 1929 (NGVD 29). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study Report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

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The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 15. The **horizontal datum** was NAD 27, GRS 1980 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

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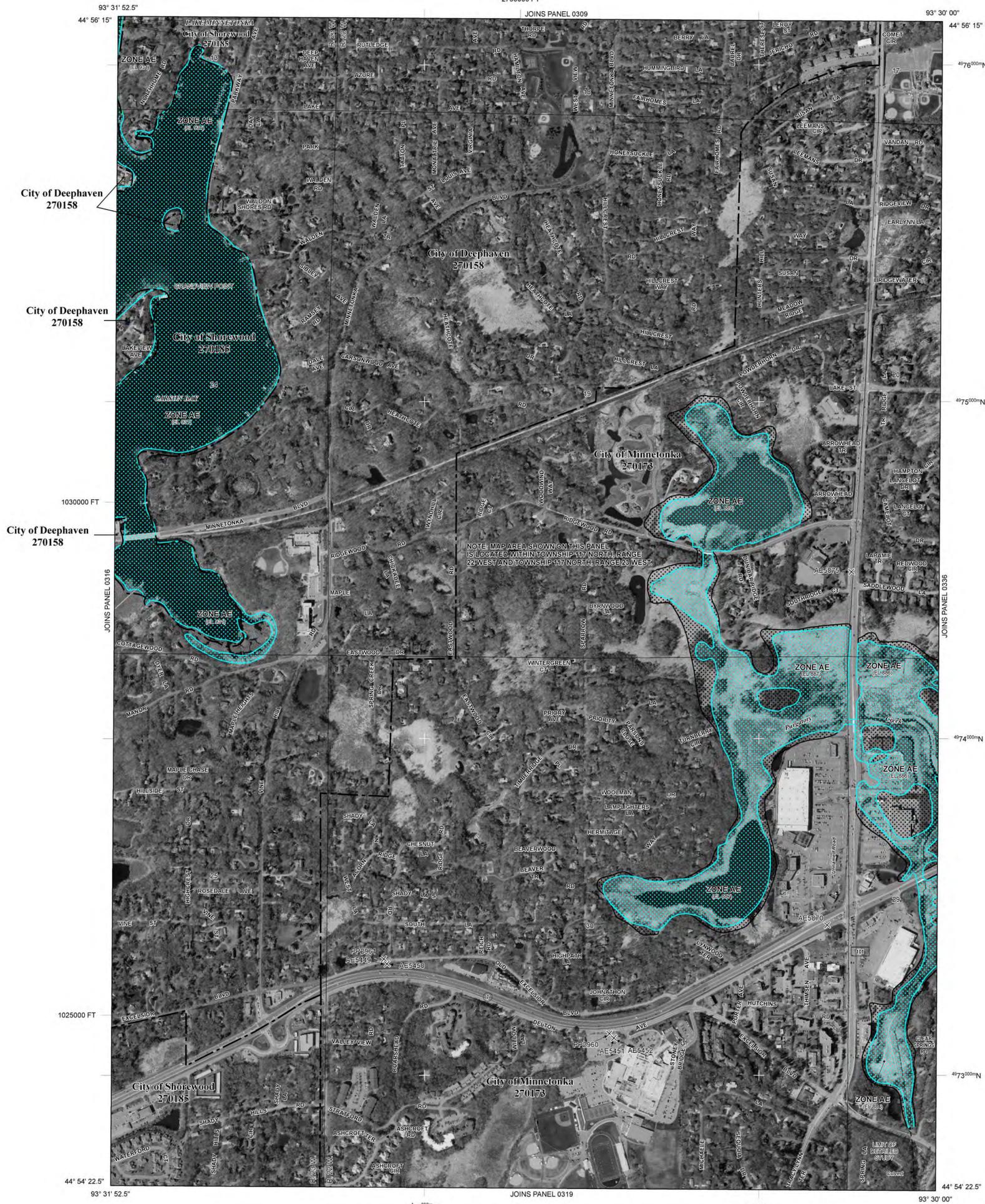
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 ADMINISTRATIVE FLOODWAY

*Administrative floodway designated in accordance with local regulations for management of these areas

 MODELED NODE LABEL

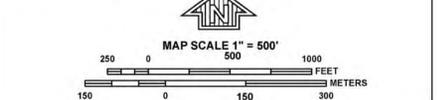
2750000 FT



LEGEND

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- ZONE VE** Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.
-  FLOODWAY AREAS IN ZONE AE
The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.
-  OTHER FLOOD AREAS
- ZONE X** Areas of 0.2% annual 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.
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-  Base Flood Elevation line and value; elevation in feet*
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-  Transect line
-  Geographic coordinates referenced to the North American Datum of 1983 (NAD 83) Western Hemisphere
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-  1000-meter Universal Transverse Mercator grid values, zone 15
-  Bench mark (see explanation in Notes to Users section of this FIRM panel)
-  M1.5
MAP REPOSITORIES
Refer to Map Repositories list on Map Index
-  EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
September 2, 2004
-  EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
November 4, 2016 - to add Special Flood Hazard Areas, to change Base Flood Elevations, to change floodway, to change Special Flood Hazard Areas, to decrease Base Flood Elevations, to incorporate previously issued Letters of Map Revisions, to increase Base Flood Elevations, to reflect updated topographic information, to update corporate limits, to update map format

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NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0317F

FIRM
FLOOD INSURANCE RATE MAP
HENNEPIN COUNTY,
MINNETONKA,
(ALL JURISDICTIONS)

PANEL 317 OF 500
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

| COMMUNITY | NUMBER | PANEL | SUFFIX |
|---------------------|--------|-------|--------|
| DEEPAVEN, CITY OF | 270158 | 0317 | F |
| MINNETONKA, CITY OF | 270173 | 0317 | F |
| SHOREWOOD, CITY OF | 270185 | 0317 | F |

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 **MAP NUMBER**
27053C0317F
MAP REVISED
NOVEMBER 4, 2016
Federal Emergency Management Agency

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Flood elevations on this map are referenced to the National Geodetic Vertical Datum of 1929. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at <http://www.ngs.noaa.gov> or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, NNGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at (301) 713-3242, or visit its website at <http://www.ngs.noaa.gov>.

Base map information shown on this FIRM was provided in digital format by the Minnesota Department of Natural Resources. This information was photogrammetrically compiled at a scale of 1:12,000 from aerial photography dated 2010 or later.

The **profile baselines** depicted on this map represent the hydraulic modeling baselines that match the flood profiles in the FIS report. As a result of improved topographic data, the **profile baseline**, in some cases, may deviate significantly from the channel centerline or appear outside the SFHA.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

For information on available products associated with this FIRM visit the **Map Service Center (MSC)** website at <http://msc.fema.gov>. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the MSC website.

 ADMINISTRATIVE FLOODWAY

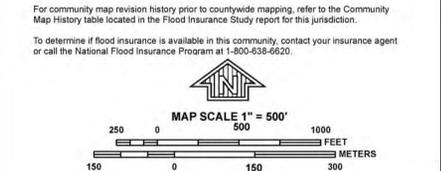
* Administrative floodway designated in accordance with local regulations for management of these areas

 MODELED NODE LABEL



LEGEND

- SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD**
The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.
- ZONE A** No Base Flood Elevations determined.
 - ZONE AE** Base Flood Elevations determined.
 - ZONE AH** Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
 - ZONE AO** Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
 - ZONE AR** Special Flood Hazard Areas formerly protected from the 1% annual chance flood by a flood control system that was subsequently deteriorated. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
 - ZONE A99** Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
 - ZONE V** Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
 - ZONE VE** Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.
- FLOODWAY AREAS IN ZONE AE**
The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.
- OTHER FLOOD AREAS**
 - ZONE X** Areas of 0.2% annual 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.
 - OTHER AREAS**
 - ZONE D** Areas determined to be outside the 0.2% annual chance floodplain. Areas in which flood hazards are undetermined, but possible.
 - COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS**
 - OTHERWISE PROTECTED AREAS (OPAs)**
 - CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.
 - 1% Annual Chance Floodplain Boundary
 - 0.2% Annual Chance Floodplain Boundary
 - Floodway boundary
 - Zone D boundary
 - CBRS and OPA boundary
 - Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths, or flood velocities.
 - Base Flood Elevation line and value; elevation in feet*
 - Base Flood Elevation value where uniform within zone; elevation in feet*
- *Referenced to the National Geodetic Vertical Datum of 1929
-  Cross section line
 -  Transect line
 - 45° 02' 08", 93° 02' 12" Geographic coordinates referenced to the North American Datum of 1983 (NAD 83) Western Hemisphere
 - 3100000 FT 5000-foot ticks: Minnesota State Plane coordinate system, South Zone (FIPSZONE 2203), Lambert Conformal Conic projection
 - 1000-meter Universal Transverse Mercator grid values, zone 15
 - DX5510 X Bench mark (see explanation in Notes to Users section of this FIRM panel)
 - M1.5 River Mile
- MAP REPOSITORIES**
Refer to Map Repositories list on Map Index
- EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP**
September 2, 2004
- EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL**
November 4, 2016 - to add Special Flood Hazard Areas, to change Base Flood Elevations, to change floodway, to change Special Flood Hazard Areas, to decrease Base Flood Elevations, to incorporate previously issued Letters of Map Revisions, to increase Base Flood Elevations, to reflect updated topographic information, to update corporate limits, to update map format



NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0318F

FIRM
FLOOD INSURANCE RATE MAP
HENNEPIN COUNTY, MINNESOTA
(ALL JURISDICTIONS)

PANEL 318 OF 500
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

| COMMUNITY | NUMBER | PANEL | SUFFIX |
|--------------------|--------|-------|--------|
| EXCELSIOR, CITY OF | 270161 | 0318 | F |
| GREENWOOD, CITY OF | 270164 | 0318 | F |
| SHOREWOOD, CITY OF | 270185 | 0318 | F |

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.



MAP NUMBER
27053C0318F
MAP REVISED
NOVEMBER 4, 2016
Federal Emergency Management Agency

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations (BFEs)** and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) Report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS Report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' National Geodetic Vertical Datum of 1929 (NGVD 29). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study Report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study Report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study Report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 15. The **horizontal datum** was NAD 27, GRS 1980 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

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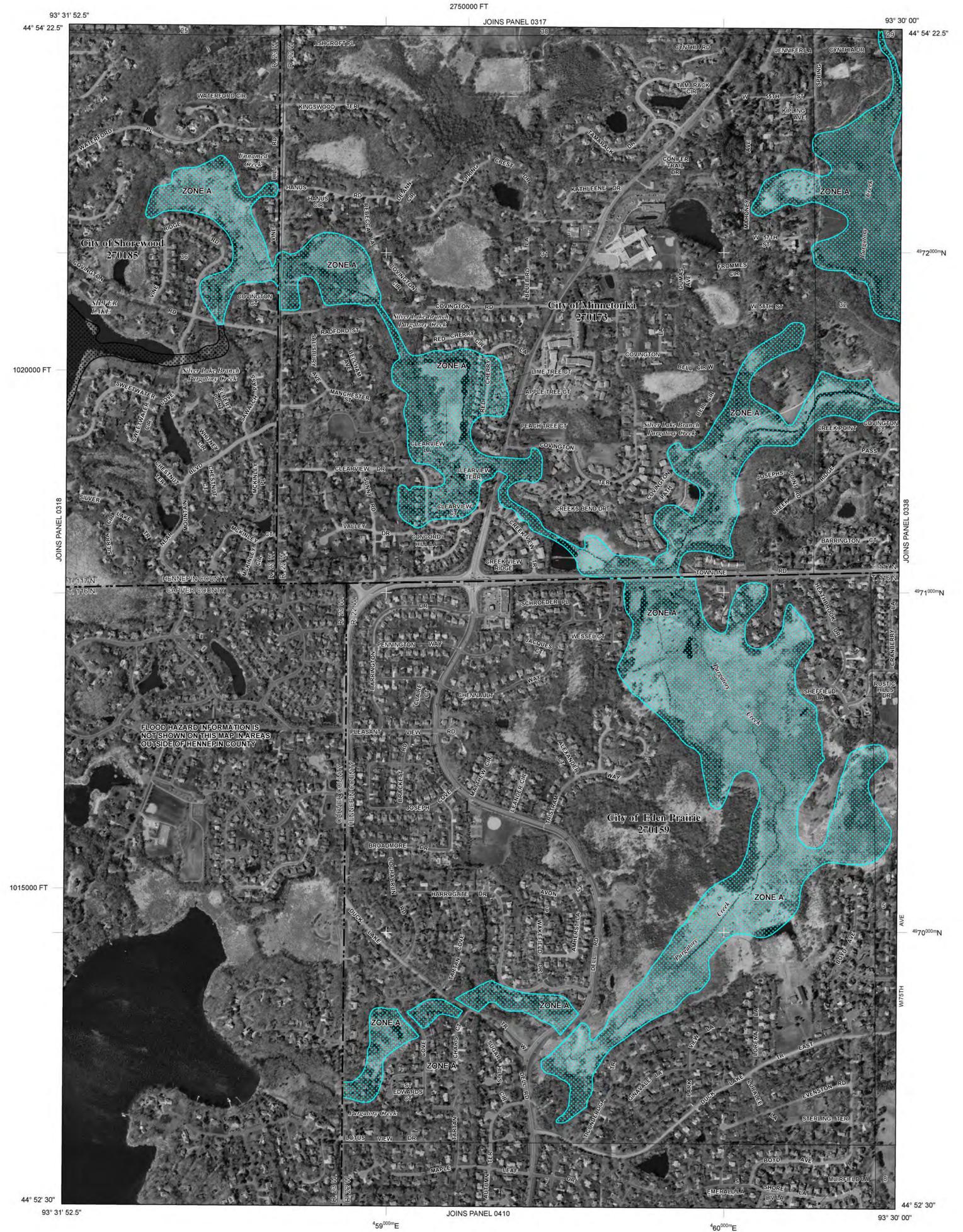
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 ADMINISTRATIVE FLOODWAY

* Administrative floodway designated in accordance with local regulations for management of these areas

 MODELED NODE LABEL



LEGEND

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- ZONE D** Areas determined to be outside the 0.2% annual chance floodplain.
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-  OTHERWISE PROTECTED AREAS (OPAs)
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-  0.2% Annual Chance Floodplain Boundary
-  Floodway boundary
-  Zone D boundary
-  CBRS and OPA boundary
-  Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths, or flood velocities.
-  Base Flood Elevation line and value; elevation in feet*
(EL. 987)

*Referenced to the National Geodetic Vertical Datum of 1929

 Cross section line

 Transect line

45° 02' 08" 93° 02' 12"

3100000 FT
5000-foot ticks: Minnesota State Plane coordinate system, South Zone (FIPSZONE 2203), Lambert Conformal Conic projection
1000-meter Universal Transverse Mercator grid values, zone 15
DX5510 X
M1.5
River Mile

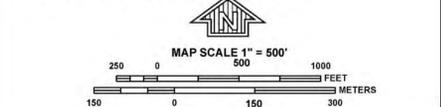
MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
September 2, 2004

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
November 4, 2016 - to add Special Flood Hazard Areas, to change Base Flood Elevations, to change floodway, to change Special Flood Hazard Areas, to decrease Base Flood Elevations, to incorporate previously issued Letters of Map Revisions, to increase Base Flood Elevations, to reflect updated topographic information, to update corporate limits, to update map format

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.



NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0319F

FIRM
FLOOD INSURANCE RATE MAP
HENNEPIN COUNTY,
MINNESOTA
(ALL JURISDICTIONS)

PANEL 319 OF 500
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

| COMMUNITY | NUMBER | PANEL | SUFFIX |
|-----------------------------|--------|-------|--------|
| EDEN PRAIRIE, CITY OF | 270159 | 0319 | F |
| CITY OF MINNETONKA, CITY OF | 270173 | 0319 | F |
| SHOREWOOD, CITY OF | 270185 | 0319 | F |

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

 **MAP NUMBER 27053C0319F**
MAP REVISED NOVEMBER 4, 2016
Federal Emergency Management Agency

APPENDIX E

NPDES Phase II Information and City Facility Inventory



Minnesota Pollution Control Agency

520 Lafayette Road North
St. Paul, MN 55155-4194

MS4 SWPPP Application for Reauthorization

for the NPDES/SDS General Small Municipal Separate Storm Sewer System (MS4) Permit MNR040000 reissued with an effective date of August 1, 2013
Stormwater Pollution Prevention Program (SWPPP) Document

Doc Type: Permit Application

Instructions: This application is for authorization to discharge stormwater associated with Municipal Separate Storm Sewer Systems (MS4s) under the National Pollutant Discharge Elimination System/State Disposal System (NPDES/SDS) Permit Program. **No fee** is required with the submittal of this application. Please refer to "Example" for detailed instructions found on the Minnesota Pollution Control Agency (MPCA) MS4 website at <http://www.pca.state.mn.us/ms4>.

Submittal: This MS4 SWPPP Application for Reauthorization form must be submitted electronically via e-mail to the MPCA at ms4permitprogram.pca@state.mn.us from the person that is duly authorized to certify this form. All questions with an asterisk (*) are required fields. All applications will be returned if required fields are not completed.

Questions: Contact Claudia Hochstein at 651-757-2881 or claudia.hochstein@state.mn.us, Dan Miller at 651-757-2246 or daniel.miller@state.mn.us, or call toll-free at 800-657-3864.

General Contact Information (*Required fields)

MS4 Owner (with ownership or operational responsibility, or control of the MS4)

*MS4 permittee name: City of Shorewood *County: Hennepin
(city, county, municipality, government agency or other entity)
*Mailing address: 5755 Country Club Road
*City: Shorewood *State: MN *Zip code: 55331
*Phone (including area code): (952) 960-7900 *E-mail: lbrown@shorewoodpw.com

MS4 General contact (with Stormwater Pollution Prevention Program [SWPPP] implementation responsibility)

*Last name: Brown *First name: Larry
(department head, MS4 coordinator, consultant, etc.)
*Title: Public Works Director
*Mailing address: 5755 Country Club Road
*City: Shorewood *State: MN *Zip code: 55331
*Phone (including area code): (952) 960-7900 *E-mail: lbrown@shorewoodpw.com

Preparer information (complete if SWPPP application is prepared by a party other than MS4 General contact)

Last name: Carlson First name: Jesse
(department head, MS4 coordinator, consultant, etc.)
Title: Water Resources Project Manager (WSB & Associates, Inc.)
Mailing address: 477 Temperance Street
City: St. Paul State: MN Zip code: 554101
Phone (including area code): (651) 286-8464 E-mail: JCarlson@wsbeng.com

Verification

- I seek to continue discharging stormwater associated with a small MS4 after the effective date of this Permit, and shall submit this MS4 SWPPP Application for Reauthorization form, in accordance with the schedule in Appendix A, Table 1, with the SWPPP document completed in accordance with the Permit (Part II.D.). Yes
- I have read and understand the NPDES/SDS MS4 General Permit and certify that we intend to comply with all requirements of the Permit. Yes

Certification (All fields are required)

- Yes - I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted.

I certify that based on my inquiry of the person, or persons, who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete.

I am aware that there are significant penalties for submitting false information, including the possibility of civil and criminal penalties.

This certification is required by Minn. Stat. §§ 7001.0070 and 7001.0540. The authorized person with overall, MS4 legal responsibility must certify the application (principal executive officer or a ranking elected official).

By typing my name in the following box, I certify the above statements to be true and correct, to the best of my knowledge, and that this information can be used for the purpose of processing my application.

Name: Larry Brown
(This document has been electronically signed)

Title: Public Works Director Date (mm/dd/yyyy): 12/30/13

Mailing address: 5755 Country Club Road

City: Shorewood State: MN Zip code: 55331

Phone (including area code): (952) 960-7900 E-mail: lbrown@shorewoodpw.com

Note: *The application will not be processed without certification.*

Stormwater Pollution Prevention Program Document

I. Partnerships: (Part II.D.1)

- A. List the **regulated small MS4(s)** with which you have established a partnership in order to satisfy one or more requirements of this Permit. Indicate which Minimum Control Measure (MCM) requirements or other program components that each partnership helps to accomplish (List all that apply). Check the box below if you currently have no established partnerships with other regulated MS4s. If you have more than five partnerships, hit the tab key after the last line to generate a new row.

No partnerships with regulated small MS4s

| Name and description of partnership | MCM/Other permit requirements involved |
|-------------------------------------|--|
| | |
| | |

- B. If you have additional information that you would like to communicate about your partnerships with other regulated small MS4(s), provide it in the space below, or include an attachment to the SWPPP Document, with the following file naming convention: *MS4NameHere_Partnerships*.

Minnehaha Creek Watershed District (MCWD): Coordinates educational efforts to provide focused outreach to stakeholders including residents, local businesses and developers. Aquatic invasive species control is also a high priority and the City encourages residents to work with the Freshwater Center to promote a Watershed Association Initiative (WAI). The City and MCWD have established a Memorandum of Understanding and Joint Power Agreement. Refer to V.B.2 for further details. MCM 1, 2, 4, and 5

Riley-Purgatory Creek Watershed District (RPCWD): Coordinates educational efforts to provide opportunities for public participation and involvement by offering residents cost-share funding assistance for stormwater management best management practices to protect and conserve water resources. MCM 1, 2, 4, and 5

II. Description of Regulatory Mechanisms: (Part II.D.2)

Illicit discharges

- A. Do you have a regulatory mechanism(s) that effectively prohibits non-stormwater discharges into your small MS4, except those non-stormwater discharges authorized under the Permit (Part III.D.3.b.)? Yes No

1. If yes:

- a. Check which *type* of regulatory mechanism(s) your organization has (check all that apply):

Ordinance Contract language
 Policy/Standards Permits
 Rules
 Other, explain: _____

- b. Provide either a direct link to the mechanism selected above or attach it as an electronic document to this form; or if your regulatory mechanism is either an Ordinance or a Rule, you may provide a citation:

Citation:

City Ordinance Chapter 907 – Illicit Discharges into Stormwater System

Direct link:

[http://www.amlegal.com/nxt/gateway.dll/Minnesota/shorewood_mn/title900publicright-of-wayandproperty/chapter907illicitdischargeintostormwater?f=templates\\$fn=default.htm\\$3.0\\$vid=amlegal:shorewood_mn\\$anc=JD_Chapter907](http://www.amlegal.com/nxt/gateway.dll/Minnesota/shorewood_mn/title900publicright-of-wayandproperty/chapter907illicitdischargeintostormwater?f=templates$fn=default.htm$3.0$vid=amlegal:shorewood_mn$anc=JD_Chapter907)

Check here if attaching an electronic copy of your regulatory mechanism, with the following file naming convention: *MS4NameHere_IDDEReg*.

2. If no:

Describe the tasks and corresponding schedules that will be taken to assure that, within 12 months of the date permit coverage is extended, this permit requirement is met:

Construction site stormwater runoff control

A Do you have a regulatory mechanism(s) that establishes requirements for erosion and sediment controls and waste controls?

Yes No

1. If **yes**:

a. Check which *type* of regulatory mechanism(s) your organization has (check all that apply):

- Ordinance Contract language
 Policy/Standards Permits
 Rules
 Other, explain: _____

b. Provide either a direct link to the mechanism selected above or attach it as an electronic document to this form; or if your regulatory mechanism is either an Ordinance or a Rule, you may provide a citation:

Citation:

1. City of Shorewood Municipal Code: Chapter 1202 – Subdivision Regulations, Section 1202.04, Subdivision 2(d)(9) and Comprehensive Water Resources Management Plan (CWRMP) Erosion Control Policy 1 and 4.
2. Minnehaha Creek Watershed District: Erosion Control Rule
3. Riley-Purgatory Creek Watershed District: Watershed is currently in the process of updating district rules.

Direct link:

1. City of Shorewood:
[http://www.amlegal.com/nxt/gateway.dll/Minnesota/shorewood_mn/title1200zoningandsubdivisionregulations/chapter1202subdivisionregulations?f=templates\\$fn=default.htm\\$3.0\\$vid=amlegal:shorewood_mn\\$sanc=JD_1202.04](http://www.amlegal.com/nxt/gateway.dll/Minnesota/shorewood_mn/title1200zoningandsubdivisionregulations/chapter1202subdivisionregulations?f=templates$fn=default.htm$3.0$vid=amlegal:shorewood_mn$sanc=JD_1202.04)
2. Minnehaha Creek Watershed District: <http://www.minnehahacreek.org/permits/full-mc wd-rules/erosion-control-rule>
3. Riley-Purgatory Creek Watershed District: <http://www.rpbcwd.org/permits/>

Check here if attaching an electronic copy of your regulatory mechanism, with the following file naming convention: MS4NameHere_CSWreg.

B Is your regulatory mechanism at least as stringent as the MPCA general permit to Discharge Stormwater Associated with Construction Activity (as of the effective date of the MS4 Permit)? Yes No

If you answered **yes** to the above question, proceed to C.

If you answered **no** to either of the above permit requirements listed in A. or B., describe the tasks and corresponding schedules that will be taken to assure that, within 12 months of the date permit coverage is extended, these permit requirements are met:

C. Answer **yes** or **no** to indicate whether your regulatory mechanism(s) requires owners and operators of construction activity to develop site plans that incorporate the following erosion and sediment controls and waste controls as described in the Permit (Part III.D.4.a.(1)-(8)), and as listed below:

- | | |
|--|---|
| 1. Best Management Practices (BMPs) to minimize erosion. | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No |
| 2. BMPs to minimize the discharge of sediment and other pollutants. | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No |
| 3. BMPs for dewatering activities. | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No |
| 4. Site inspections and records of rainfall events | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No |
| 5. BMP maintenance | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No |
| 6. Management of solid and hazardous wastes on each project site. | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No |
| 7. Final stabilization upon the completion of construction activity, including the use of perennial vegetative cover on all exposed soils or other equivalent means. | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No |
| 8. Criteria for the use of temporary sediment basins. | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No |

If you answered **no** to any of the above permit requirements, describe the tasks and corresponding schedules that will be taken to assure that, within 12 months of the date permit coverage is extended, these permit requirements are met:

Post-construction stormwater management

A. Do you have a regulatory mechanism(s) to address post-construction stormwater management activities?

Yes No

1. If **yes**:

a. Check which *type* of regulatory mechanism(s) your organization has (check all that apply):

- Ordinance Contract language
 Policy/Standards Permits
 Rules
 Other, explain: _____

b. Provide either a direct link to the mechanism selected above or attach it as an electronic document to this form; or if your regulatory mechanism is either an Ordinance or a Rule, you may provide a citation:

Citation:

1. City of Shorewood Municipal Code: Chapter – Subdivision Regulations, Section 1202.04, Subdivision 3.n and Subdivision 8 – require compliance with watershed rules and CWRMP.
2. Minnehaha Creek Watershed District: Stormwater Management Rule
3. Riley-Purgatory Creek Watershed District: Watershed is currently in the process of updating their rules.

Direct link:

1. City of Shorewood:
[http://www.amlegal.com/nxt/gateway.dll/Minnesota/shorewood_mn/title1200zoningandsubdivisionregulations/chapter1202subdivisionregulations?f=templates\\$fn=default.htm\\$3.0](http://www.amlegal.com/nxt/gateway.dll/Minnesota/shorewood_mn/title1200zoningandsubdivisionregulations/chapter1202subdivisionregulations?f=templates$fn=default.htm$3.0)
2. Minnehaha Creek Watershed District:
<http://www.minnehahacreek.org/sites/minnehahacreek.org/files/pdfs/regulatory/Stormwater%20Management%20Rule.pdf>
3. Riley-Purgatory Creek Watershed District: <http://www.rpbcwd.org/permits/>

Check here if attaching an electronic copy of your regulatory mechanism, with the following file naming convention: MS4NameHere_PostCSWreg.

B Answer **yes** or **no** below to indicate whether you have a regulatory mechanism(s) in place that meets the following requirements as described in the Permit (Part III.D.5.a.):

1. **Site plan review:** Requirements that owners and/or operators of construction activity submit site plans with post-construction stormwater management BMPs to the permittee for review and approval, prior to start of construction activity. Yes No
2. **Conditions for post construction stormwater management:** Requires the use of any combination of BMPs, with highest preference given to Green Infrastructure techniques and practices (e.g., infiltration, evapotranspiration, reuse/harvesting, conservation design, urban forestry, green roofs, etc.), necessary to meet the following conditions on the site of a construction activity to the Maximum Extent Practicable (MEP):
 - a. For new development projects – no net increase from pre-project conditions (on an annual average basis) of: Yes No
 - 1) Stormwater discharge volume, unless precluded by the stormwater management limitations in the Permit (Part III.D.5.a(3)(a)).
 - 2) Stormwater discharges of Total Suspended Solids (TSS).
 - 3) Stormwater discharges of Total Phosphorus (TP).
 - b. For redevelopment projects – a net reduction from pre-project conditions (on an annual average basis) of: Yes No
 - 1) Stormwater discharge volume, unless precluded by the stormwater management limitations in the Permit (Part III.D.5.a(3)(a)).
 - 2) Stormwater discharges of TSS.
 - 3) Stormwater discharges of TP.
3. **Stormwater management limitations and exceptions:**
 - a. Limitations
 - 1) Prohibit the use of infiltration techniques to achieve the conditions for post-construction stormwater management in the Permit (Part III.D.5.a(2)) when the infiltration structural stormwater BMP will receive discharges from, or be constructed in areas: Yes No
 - a) Where industrial facilities are not authorized to infiltrate industrial stormwater under an NPDES/SDS Industrial Stormwater Permit issued by the MPCA.
 - b) Where vehicle fueling and maintenance occur.
 - c) With less than three (3) feet of separation distance from the bottom of the infiltration system to the elevation of the seasonally saturated soils or the top of bedrock.
 - d) Where high levels of contaminants in soil or groundwater will be mobilized by the infiltrating stormwater.
 - 2) Restrict the use of infiltration techniques to achieve the conditions for post-construction stormwater management in the Permit (Part III.D.5.a(2)), without higher engineering review, Yes No

sufficient to provide a functioning treatment system and prevent adverse impacts to groundwater, when the infiltration device will be constructed in areas:

- a) With predominately Hydrologic Soil Group D (clay) soils.
- b) Within 1,000 feet up-gradient, or 100 feet down-gradient of active karst features.
- c) Within a Drinking Water Supply Management Area (DWSMA) as defined in Minn. R. 4720.5100, subp. 13.
- d) Where soil infiltration rates are more than 8.3 inches per hour.

- 3) For linear projects where the lack of right-of-way precludes the installation of volume control practices that meet the conditions for post-construction stormwater management in the Permit (Part III.D.5.a(2)), the permittee's regulatory mechanism(s) may allow exceptions as described in the Permit (Part III.D.5.a(3)(b)). The permittee's regulatory mechanism(s) shall ensure that a reasonable attempt be made to obtain right-of-way during the project planning process. Yes No
4. **Mitigation provisions:** The permittee's regulatory mechanism(s) shall ensure that any stormwater discharges of TSS and/or TP not addressed on the site of the original construction activity are addressed through mitigation and, at a minimum, shall ensure the following requirements are met:
- a. Mitigation project areas are selected in the following order of preference: Yes No
 - 1) Locations that yield benefits to the same receiving water that receives runoff from the original construction activity.
 - 2) Locations within the same Minnesota Department of Natural Resource (DNR) catchment area as the original construction activity.
 - 3) Locations in the next adjacent DNR catchment area up-stream
 - 4) Locations anywhere within the permittee's jurisdiction.
 - b. Mitigation projects must involve the creation of new structural stormwater BMPs or the retrofit of existing structural stormwater BMPs, or the use of a properly designed regional structural stormwater BMP. Yes No
 - c. Routine maintenance of structural stormwater BMPs already required by this permit cannot be used to meet mitigation requirements of this part. Yes No
 - d. Mitigation projects shall be completed within 24 months after the start of the original construction activity. Yes No
 - e. The permittee shall determine, and document, who will be responsible for long-term maintenance on all mitigation projects of this part. Yes No
 - f. If the permittee receives payment from the owner and/or operator of a construction activity for mitigation purposes in lieu of the owner or operator of that construction activity meeting the conditions for post-construction stormwater management in Part III.D.5.a(2), the permittee shall apply any such payment received to a public stormwater project, and all projects must be in compliance with Part III.D.5.a(4)(a)-(e). Yes No
5. **Long-term maintenance of structural stormwater BMPs:** The permittee's regulatory mechanism(s) shall provide for the establishment of legal mechanisms between the permittee and owners or operators responsible for the long-term maintenance of structural stormwater BMPs not owned or operated by the permittee, that have been implemented to meet the conditions for post-construction stormwater management in the Permit (Part III.D.5.a(2)). This only includes structural stormwater BMPs constructed after the effective date of this permit and that are directly connected to the permittee's MS4, and that are in the permittee's jurisdiction. The legal mechanism shall include provisions that, at a minimum:
- a. Allow the permittee to conduct inspections of structural stormwater BMPs not owned or operated by the permittee, perform necessary maintenance, and assess costs for those structural stormwater BMPs when the permittee determines that the owner and/or operator of that structural stormwater BMP has not conducted maintenance. Yes No
 - b. Include conditions that are designed to preserve the permittee's right to ensure maintenance responsibility, for structural stormwater BMPs not owned or operated by the permittee, when those responsibilities are legally transferred to another party. Yes No
 - c. Include conditions that are designed to protect/preserve structural stormwater BMPs and site features that are implemented to comply with the Permit (Part III.D.5.a(2)). If site configurations or structural stormwater BMPs change, causing decreased structural stormwater BMP effectiveness, new or improved structural stormwater BMPs must be implemented to ensure the conditions for post-construction stormwater management in the Permit (Part III.D.5.a(2)) continue to be met. Yes No

If you answered **no** to any of the above permit requirements, describe the tasks and corresponding schedules that will be taken to assure that, within twelve (12) months of the date permit coverage is extended, these permit requirements are met:

B.3.a.2: The City will amend the ordinance to include restricting the use of infiltration techniques for post-construction stormwater management as described in the Permit (Part III.D.5.a(3)(a).2). These amendments will be placed on the City Councils meeting agenda for approval within 12 months following the date permit coverage is extended.

B.4.a.: The City will amend the ordinance to include order of preference for selecting mitigation project areas as described in the Permit (Part III.D.5.a(4)(a)). This will occur on the same schedule as B.3.a.2.

B.4.d.: The City will amend the ordinance to include the requirement to complete mitigation projects within 24 months after the start of the original construction activity as described in the Permit (Part III.D.5.a(4)(d)). This will occur on the same schedule as B.3.a.2.

B.4.f.: The City does not accept money in lieu of meeting the post-construction stormwater requirements. No revisions to the City Code will be made.

B.5.c.: The City will amend the ordinance to include conditions to address BMP modification in the future as described in the Permit (Part III.D.5.a(5)(c)). This will occur on the same schedule as B.3.a.2.

III. Enforcement Response Procedures (ERPs): (Part II.D.3)

A. Do you have existing ERPs that satisfy the requirements of the Permit (Part III.B.)? Yes No

1. If **yes**, attach them to this form as an electronic document, with the following file naming convention: *MS4NameHere_ERPs*.
2. If **no**, describe the tasks and corresponding schedules that will be taken to assure that, with twelve (12) months of the date permit coverage is extended, these permit requirements are met:

The City will develop draft ERPs within 12 months of receiving permit coverage. The draft ERPs will include requirements for site inspections, criteria for elevating enforcement, and enforcement tools. They will be developed for MCM 3, 4, and 5. Enforcement mechanisms considered may include:

- Notice of Violations
- Stop Work Orders
- Securities in the form of a performance bond, letter of credit, or cash deposit
- Misdemeanor
- Partnerships with the watersheds for enforcement of their maintenance agreement for post-construction stormwater BMPs.

The draft ERPs will be incorporated in the City Code, policy document, or a formal partnership with the watersheds within 12 months of receiving permit coverage.

B. Describe your ERPs:

The current ERPs are included in the following City Code: Chapter 907; Illicit Discharge Detection and Elimination.

The City Code includes the following enforcement mechanisms:

- Notice of Violation
- Responsible for costs associated with resolving illicit discharge

IV. Storm Sewer System Map and Inventory: (Part II.D.4.)

A. Describe how you manage your storm sewer system map and inventory:

The City's storm sewer inventory was completed in 2007, and is reviewed annually and revised to include new construction and reconstruction projects. The inventory will be revised in 2014 to include new MS4 permit definitions for outfalls and ponds.

B. Answer **yes** or **no** to indicate whether your storm sewer system map addresses the following requirements from the Permit (Part III.C.1.a-d), as listed below:

1. The permittee's entire small MS4 as a goal, but at a minimum, all pipes 12 inches or greater in diameter, including stormwater flow direction in those pipes. Yes No
2. Outfalls, including a unique identification (ID) number assigned by the permittee, and an associated geographic coordinate. Yes No

- 3. Structural stormwater BMPs that are part of the permittee's small MS4. Yes No
- 4. All receiving waters. Yes No

If you answered **no** to any of the above permit requirements, describe the tasks and corresponding schedules that will be taken to assure that, within 12 months of the date permit coverage is extended, these permit requirements are met:

- C. Answer **yes** or **no** to indicate whether you have completed the requirements of 2009 Minnesota Session Law, Ch. 172, Sec. 28: with the following inventories, according to the specifications of the Permit (Part III.C.2.a.-b.), including:
 - 1. All ponds within the permittee's jurisdiction that are constructed and operated for purposes of water quality treatment, stormwater detention, and flood control, and that are used for the collection of stormwater via constructed conveyances. Yes No
 - 2. All wetlands and lakes, within the permittee's jurisdiction, that collect stormwater via constructed conveyances. Yes No
- D. Answer **yes** or **no** to indicate whether you have completed the following information for each feature inventoried.
 - 1. A unique identification (ID) number assigned by the permittee. Yes No
 - 2. A geographic coordinate. Yes No
 - 3. Type of feature (e.g., pond, wetland, or lake). This may be determined by using best professional judgment. Yes No

If you have answered **yes** to all above requirements, and you have already submitted the Pond Inventory Form to the MPCA, then you do not need to resubmit the inventory form below.

If you answered **no** to any of the above permit requirements, describe the tasks and corresponding schedules that will be taken to assure that, within 12 months of the date permit coverage is extended, these permit requirements are met:

D.1. The City GIS specialist will update the storm sewer map to include a geographic coordinate for each stormwater feature inventoried and identify the type of feature.

- E. Answer **yes** or **no** to indicate if you are attaching your pond, wetland and lake inventory to the MPCA on the form provided on the MPCA website at: <http://www.pca.state.mn.us/ms4>, according to the specifications of Permit (Part III.C.2.b.(1)-(3)). Attach with the following file naming convention: *MS4NameHere_inventory*. Yes No

If you answered **no**, the inventory form must be submitted to the MPCA MS4 Permit Program within 12 months of the date permit coverage is extended.

V. Minimum Control Measures (MCMs) (Part II.D.5)

A. MCM1: Public education and outreach

- 1. The Permit requires that, within 12 months of the date permit coverage is extended, existing permittees revise their education and outreach program that focuses on illicit discharge recognition and reporting, as well as other specifically selected stormwater-related issue(s) of high priority to the permittee during this permit term. Describe your **current** educational program, including **any high-priority topics included**:

The City's stormwater educational program focuses on target audiences including local residents, businesses and developers to encourage adoption of best management practices that improve water quality and protection of natural resources. Grant applications are accepted through the Minnehaha Creek Watershed District and the Riley-Purgatory Watershed District. The main vehicle for publicizing stormwater public education and outreach is through the use of the city's webpage and newsletters. Additionally, the City uses printed brochures for additional public education and outreach.

- 2. List the categories of BMPs that address your public education and outreach program, including the distribution of educational materials and a program implementation plan. Use the first table for categories of BMPs that you have established and the second table for categories of BMPs that you plan to implement over the course of the permit term.

Include the measurable goals with appropriate timeframes that each BMP category will be implemented and completed. In addition, provide interim milestones and the frequency of action in which the permittee will implement and/or maintain the BMPs. Refer to the U.S. Environmental Protection Agency's (EPA) *Measurable Goals Guidance for Phase II Small MS4s* (<http://www.epa.gov/npdcs/pubs/measurablegoals.pdf>).

If you have more than five categories, hit the tab key after the last line to generate a new row.

| Established BMP categories | Measurable goals and timeframes |
|---------------------------------------|---|
| <i>Printed Brochures at City Hall</i> | <i>Three different stormwater related brochures will be available at the City Hall. City staff will annually record the number of</i> |

| | |
|---|---|
| | <i>brochures distributed, review the appropriateness of the existing brochures, and provide new brochures for existing topics or high priority topics of interest (at the discretion of City staff). This BMP will be completed a minimum of once a year throughout the MS4 permit cycle (July 31, 2018).</i> |
| <i>City Newsletter</i> | <i>The City distributes 10 articles to approximately 7,500 residents per month during each year of the MS4 permit cycle (July 31, 2018).</i> |
| <i>Resident Guide</i> | <i>The City produces a Resident Guide that discusses stormwater related topics for annual distribution to an audience of approximately 7,500 residents. This BMP will continue to be implemented throughout the MS4 permit cycle (July 31, 2018).</i> |
| <i>Public Works Webpage</i> | <i>Stormwater educational materials are provided on the City's webpage (http://www.ci.shorewood.mn.us/pages/pworks/water.html) under the Sewer and Water section of the Public Works Department. City staff track hits on the website and update the content and appropriateness of all materials on the webpage once per calendar year during the MS4 permit cycle (July 31, 2018).</i> |
| <i>MCWD NEMO and University of Minnesota Extension</i> | <i>The City will continue to coordinate with the University of Minnesota Extension and the MCWD to provide stormwater education in the City that is also focused on elected officials through the NEMO program. Typically once per permit cycle.</i> |
| <i>Minnehaha Creek Watershed District Workshops</i> | <i>The City partners with MCWD to host an erosion and sediment control workshop to educate contractors or developers. Other workshops include aquatic invasive species control and encouragement of residents to work with the Fresh water Center on a Watershed Association Initiative (WAI).</i> |
| BMP categories to be implemented | Measurable goals and timeframes |
| <i>Annual SWPPP Assessment & Annual Reporting</i> | <i>City staff will conduct an annual SWPPP assessment in preparation of each annual report. Proposed SWPPP modifications are subject to Part II.G of the MS4 permit. The final annual report will be posted on the Sewer and Water webpage. City staff will submit the annual report to the MPCA prior to June 30th for the previous calendar year.</i> |
| <i>Water Resources Webpage updates (high priority topics)</i> | <i>The City's water resources webpage (http://www.ci.shorewood.mn.us/pages/pworks/water.html) will be updated with high priority topics, such as Illicit discharge recognition/reporting and information related to the Minnehaha Creek Watershed District Lakes TMDL, specifically for Phosphorus impairments in Lake Virginia. Periodic webpage updates will be completed throughout each year of the MS4 permit cycle (July 31, 2018).</i> |

3. Provide the name or the position title of the individual(s) who is responsible for implementing and/or coordinating this MCM:

Director of Public Works

B. MCM2: Public participation and involvement

1. The Permit (Part III.D.2.a.) requires that, within 12 months of the date permit coverage is extended, existing permittees shall revise their current program, as necessary, and continue to implement a public participation/involvement program to solicit public input on the SWPPP. Describe your current program:

City staff solicits public input during the annual SWPPP annual meeting and collaborates with Minnehaha Creek Watershed District to provide workshops on relevant stormwater topics that include parking lot or turf grass maintenance.

2. List the categories of BMPs that address your public participation/involvement program, including solicitation and documentation of public input on the SWPPP. Use the first table for categories of BMPs that you have established and the second table for categories of BMPs that you plan to implement over the course of the permit term.

Include the measurable goals with appropriate timeframes that each BMP category will be implemented and completed. In addition, provide interim milestones and the frequency of action in which the permittee will implement and/or maintain the BMPs. Refer to the EPA's *Measurable Goals Guidance for Phase II Small MS4s* (<http://www.epa.gov/npdes/pubs/measurablegoals.pdf>). **If you have more than five categories**, hit the tab key after the last line to generate a new row.

| Established BMP categories | Measurable goals and timeframes |
|--|---|
| <i>Annual Public Meeting</i> | <p><i>Present the draft MS4 annual report and solicit public input regarding the adequacy of the City's SWPPP. Public input received (oral and written) will be recorded in meeting minutes and evaluated by the City's MS4 General Contact. City responses (if relevant) will be made in writing to each commenter. Hold one meeting per calendar year (between January and June for the previous year) of the MS4 permit cycle.</i></p> |
| <i>Grant Programs</i> | <p><i>The City has partnered with Minnehaha Creek Watershed District, Riley-Purgatory Creek Watershed District and Blue Thumb to provide matching funds that encourage Shorewood residents, local business and organizations to improve water quality and natural resources within their respective watersheds. Programs currently available include:</i></p> <p><u><i>Minnehaha Creek Watershed District</i></u></p> <ul style="list-style-type: none"> <i>• The Non-Homeowner/Homeowner Stormwater Best Management Practices Program pays for practices that reduce runoff going to lakes, streams and wetlands. Financial assistance/cost-share is offered for installing rain gardens, permeable pavement, green roofs, tree trenches and infiltration basins and trenches.</i> <i>• The Shoreline/Streambank Stabilization Cost-Share Program offers cost-share for projects that help protect valuable water resources within the watershed.</i> <p><u><i>Riley-Purgatory Creek Watershed District</i></u></p> <ul style="list-style-type: none"> <i>• The Cost-Share Program provides funding assistance for the design and construction, restoration or implementation of stormwater management best management practices (BMPs) that protect and conserve water resources within the RPCWD. Eligible funding varies according to the type of project and focuses on three categories:</i> <ul style="list-style-type: none"> <i>○ Local Government and Commercial Facility BMP Projects</i> <i>○ Lake Association, Homeowners Association, Nonprofit Organization BMP Projects</i> <i>○ Single-Family Residential BMP Projects</i> <p><i>The City will continue to partner with watershed organizations and districts to offer grant programs that improve water quality to residents, business owners and local governments throughout the MS4 permit cycle (July 31, 2018).</i></p> |
| <i>Resident Participation</i> | <p><i>The City of Shorewood encourages residents in their SWPPP to help maintain or improve water quality on their residential lots by marnating a health lawn with minimal fertilizers, redirect downspouts from paved areas, keep storm sewer drains free of debris, properly dispose of wastes.</i></p> |
| BMP categories to be implemented | Measurable goals and timeframes |
| <i>Online Availability of the Stormwater Pollution Prevention Program (SWPPP) document</i> | <p><i>The City will make the SWPPP and 2013 annual report available on the Public Works Department webpage within 12 months from the date the MS4 permit coverage is extended to the City.</i></p> |
| <i>Coordination Meeting</i> | <p><i>Propose regular meetings with the MCWD to ensure the internal procedures from communication between the City and MCWD regarding the stormwater program continues seamlessly as responsibilities are shared. On-going</i></p> |
| <i>Develop Stormwater Organizational Chart</i> | <p><i>The City will develop a stormwater organizational chart detailing the roles and responsibilities of City staff in implementing the SWPPP.</i></p> |

3. Do you have a process for receiving and documenting citizen input? Yes No

If you answered **no** to the above permit requirement, describe the tasks and corresponding schedules that will be taken to

assure that, within 12 months of the date permit coverage is extended, this permit requirement is met:

Within 12 months of permit coverage the city will evaluate how they currently receive citizen input and develop this into a standard operating procedure (SOP).

- Provide the name or the position title of the individual(s) who is responsible for implementing and/or coordinating this MCM:

Director of Public Works

C. MCM 3: Illicit discharge detection and elimination

- The Permit (Part III.D.3.) requires that, within 12 months of the date permit coverage is extended, existing permittees revise their current program as necessary, and continue to implement and enforce a program to detect and eliminate illicit discharges into the small MS4. Describe your current program:

The City's IDDE ordinance #455 (Chapter 907 - Illicit Discharge into Stormwater System) was adopted in 2008 and the IDDE program was developed in 2009. Implementation and IDDE inspections began in January 1, 2009. The City currently uses an IDDE database to record inspection results and provides annual training to Public Works staff. City staff intends to maintain their "Water and Sanitary Sewer" section of the Public Works webpage to provide city contact information for the public to report potential non-stormwater discharges, spills, and connections throughout the MS4 Permit cycle (July 31, 2018).

- Does your Illicit Discharge Detection and Elimination Program meet the following requirements, as found in the Permit (Part III.D.3.c.-g.)?

- a. Incorporation of illicit discharge detection into all inspection and maintenance activities conducted under the Permit (Part III.D.6.e.-f.) Where feasible, illicit discharge inspections shall be conducted during dry-weather conditions (e.g., periods of 72 or more hours of no precipitation). Yes No
- b. Detecting and tracking the source of illicit discharges using visual inspections. The permittee may also include use of mobile cameras, collecting and analyzing water samples, and/or other detailed procedures that may be effective investigative tools. Yes No
- c. Training of all field staff, in accordance with the requirements of the Permit (Part III.D.6.g.(2)), in illicit discharge recognition (including conditions which could cause illicit discharges), and reporting illicit discharges for further investigation. Yes No
- d. Identification of priority areas likely to have illicit discharges, including at a minimum, evaluating land use associated with business/industrial activities, areas where illicit discharges have been identified in the past, and areas with storage of large quantities of significant materials that could result in an illicit discharge. Yes No
- e. Procedures for the timely response to known, suspected, and reported illicit discharges. Yes No
- f. Procedures for investigating, locating, and eliminating the source of illicit discharges. Yes No
- g. Procedures for responding to spills, including emergency response procedures to prevent spills from entering the small MS4. The procedures shall also include the immediate notification of the Minnesota Department of Public Safety Duty Officer, if the source of the illicit discharge is a spill or leak as defined in Minn. Stat. § 115.061. Yes No
- h. When the source of the illicit discharge is found, the permittee shall use the ERPs required by the Permit (Part III.B.) to eliminate the illicit discharge and require any needed corrective action(s). Yes No

If you answered **no** to any of the above permit requirements, describe the tasks and corresponding schedules that will be taken to assure that, within 12 months of the date permit coverage is extended, these permit requirements are met:

The City's IDDE program will be revised to include a map of high priority areas (based on current landuse, history of discharges, and active NPDES Industrial Stormwater permits) and internal procedures for emergency and non-emergency response to reported spills, illicit discharges, and connections. Draft revisions will be completed in 2014 and implemented within 12 months from the date MS4 permit coverage is extended to the City.

- List the categories of BMPs that address your illicit discharge, detection and elimination program. Use the first table for categories of BMPs that you have established and the second table for categories of BMPs that you plan to implement over the course of the permit term.

Include the measurable goals with appropriate timeframes that each BMP category will be implemented and completed. In addition, provide interim milestones and the frequency of action in which the permittee will implement and/or maintain the BMPs. Refer to the EPA's *Measurable Goals Guidance for Phase II Small MS4s* (<http://www.epa.gov/npdes/pubs/measurablegoals.pdf>).

If you have more than five categories, hit the tab key after the last line to generate a new row.

| Established BMP categories | Measurable goals and timeframes |
|----------------------------|--|
| <i>IDDE Inspections</i> | <i>The City will continue to annually conduct IDDE inspections</i> |

| | |
|---|--|
| | <i>concurrently with stormsewer, outfall, and ponds inspections per the IDDE inspection program.</i> |
| <i>Televising Sewer Lines</i> | <i>The City televises sewer lines when necessary to diagnose blockages using a robotic camera and digitally records and documents visual images of nearly 6 miles of sanitary sewer collection pipe interiors.</i> |
| <i>Training</i> | <i>Continue to host a minimum of one staff training event per year to discuss illicit discharge recognition and reporting. City staff will develop an annual training schedule, record the employee names, topics covered, and date of each event, annually through the end of the MS4 permit cycle (July 31, 2018).</i> |
| BMP categories to be implemented | Measurable goals and timeframes |
| <i>IDDE Priority Inspection Map</i> | <i>Develop IDDE inspection map in 2014. Utilize map for inspections within 12 months from the date MS4 permit coverage is extended.</i> |
| <i>Written Procedures for Emergency Response</i> | <i>Draft written procedures for emergency and non-emergency response to non-stormwater spills, discharges, and connections in 2014. Implement final written procedures within 12 months from the date MS4 permit coverage is extended.</i> |
| <i>Public Works "Sewer and Water" Webpage updates</i> | <i>The City will update the "Report a Problem" section of the Public Works webpage to include city contact information for construction site non-compliance. The Water Resources webpage will also be updated with construction site erosion and sediment control related public education. This update will occur within 12 months from the date MS4 permit coverage is extended.</i> |

4. Do you have procedures for record-keeping within your Illicit Discharge Detection and Elimination (IDDE) program as specified within the Permit (Part III.D.3.h.)? Yes No

If you answered **no**, indicate how you will develop procedures for record-keeping of your Illicit Discharge, Detection and Elimination Program, within 12 months of the date permit coverage is extended:

C.4., The City will develop written procedures for receiving, documenting and storing citizen input as described in the permit (Part III.D.3.h). The procedure may include incorporating a link on the website and will include a record of all complaints received and follow-up activity that was performed. Procedures will be in place within 12 months following the date permit coverage is extended.

5. Provide the name or the position title of the individual(s) who is responsible for implementing and/or coordinating this MCM:

Public Works Director

D. MCM 4: Construction site stormwater runoff control

1. The Permit (Part III.D.4) requires that, within 12 months of the date permit coverage is extended, existing permittees shall revise their current program, as necessary, and continue to implement and enforce a construction site stormwater runoff control program. Describe your current program:

The City requires an erosion control permit. City ordinance Chapter 1202 - Subdivision Regulations defines requirements for construction stormwater permit approval.

Additionally the City partners with the Minnehaha Creek Watershed District and to assist with permitting. The City has an MOU with the Minnehaha Creek Watershed District (MCWD) where MCWD has the primary role in reviewing and permitting projects requiring construction site runoff control for areas within the MCWD boundaries.

Riley Purgatory Bluff Creek Watershed District (RPBCWD) is in the process of developing regulatory rules and can be found on their website. It is anticipated that the RPBCWD will adopt their rules within a year. Once the rules are adopted the City will either establish a partnership with RPBCWD for completing reviews and permitting projects requiring construction site runoff control or revise their ordinances to meet the requirements of the Construction Site General Permit.

City Engineering and Building Department staff conduct erosion control site plan reviews and perform regular site inspections on all permitted residential and commercial sites, and serve as the City's point of contact for public complaints of potential non-compliance. The City Engineer provides plan review and inspections of development projects. The City also collaborates with the Minnehaha Creek Watershed District and the Riley-Purgatory Creek Watershed District to manage construction site stormwater runoff within the respective watershed boundaries.

Stop Work Orders, Suspension or Revocation of Permit, and Misdemeanors are the enforcement tools used for non-compliance.

2. Does your program address the following BMPs for construction stormwater erosion and sediment control as required in the Permit (Part III.D.4.b.):
- a. Have you established written procedures for site plan reviews that you conduct prior to the start of construction activity? Yes No
 - b. Does the site plan review procedure include notification to owners and operators proposing construction activity that they need to apply for and obtain coverage under the MPCA's general permit to *Discharge Stormwater Associated with Construction Activity No. MN R100001*? Yes No
 - c. Does your program include written procedures for receipt and consideration of reports of noncompliance or other stormwater related information on construction activity submitted by the public to the permittee? Yes No
 - d. Have you included written procedures for the following aspects of site inspections to determine compliance with your regulatory mechanism(s):
 - 1) Does your program include procedures for identifying priority sites for inspection? Yes No
 - 2) Does your program identify a frequency at which you will conduct construction site inspections? Yes No
 - 3) Does your program identify the names of individual(s) or position titles of those responsible for conducting construction site inspections? Yes No
 - 4) Does your program include a checklist or other written means to document construction site inspections when determining compliance? Yes No
 - e. Does your program document and retain construction project name, location, total acreage to be disturbed, and owner/operator information? Yes No
 - f. Does your program document stormwater-related comments and/or supporting information used to determine project approval or denial? Yes No
 - g. Does your program retain construction site inspection checklists or other written materials used to document site inspections? Yes No

If you answered **no** to any of the above permit requirements, describe the tasks and corresponding schedules that will be taken to assure that, within 12 months of the date permit coverage is extended, these permit requirements are met.

The City intends to review the existing procedures for site inspections, and revise (as needed) to include definitions for identifying priority sites, frequency of City inspections, and protocols for the receipt and consideration of non-compliance. Draft revisions will be completed in early 2014 and formally adopted for implementation within 12 months of the date MS4 permit coverage is extended to the City. City staff will also add contact information on the City website (Departments/Public Works/"Report a Problem") for the public to provide complaints regarding non-compliance of construction sites.

3. List the categories of BMPs that address your construction site stormwater runoff control program. Use the first table for categories of BMPs that you have established and the second table for categories of BMPs that you plan to implement over the course of the permit term.

Include the measurable goals with appropriate timeframes that each BMP category will be implemented and completed. In addition, provide interim milestones and the frequency of action in which the permittee will implement and/or maintain the BMPs. Refer to the EPA's *Measurable Goals Guidance for Phase II Small MS4s* (<http://www.epa.gov/npdes/pubs/measurablegoals.pdf>). **If you have more than five categories**, hit the tab key after the last line to generate a new row.

| Established BMP categories | Measurable goals and timeframes |
|-------------------------------------|--|
| <i>City Erosion Control Permit</i> | <i>Continue to implement as defined by City Code Chapter 1202 Subdivision Regulations</i> |
| <i>Training</i> | <i>Building or Engineering Department staff (a minimum of one staff member) will maintain valid certification in NPDES Construction Stormwater Permit related training per NPDES-CSW training requirements.</i> |
| BMP categories to be implemented | Measurable goals and timeframes |
| <i>Public Works Webpage updates</i> | <i>The City will update the "Report a Problem" section of the Public Works webpage to include city contact information for construction site non-compliance. The Water Resources webpage will also be updated with construction site erosion and sediment control related public education. This update will occur within 12 months from the date MS4 permit coverage is extended.</i> |

| | |
|---|---|
| <i>Review Building Dept. inspection checklist</i> | <i>The City will update the existing Erosion and sediment control checklist to meet current NPDES Construction Stormwater Permit requirements and develop a standardize form that can be used in conjunction with MCWD. This update will occur in 2014 and be implemented within 12 months from the date MS4 permit coverage is extended.</i> |
|---|---|

| | |
|--|---|
| <i>Revise Building Dept. plan review checklist</i> | <i>Revise the Building and Engineering Department's plan review checklist for single family dwellings to include specific erosion and sediment control standards.</i> |
|--|---|

4. Provide the name or the position title of the individual(s) who is responsible for implementing and/or coordinating this MCM:

Director of Public Works

E. MCM 5: Post-construction stormwater management

- 1.

The Permit (Part III.D.5.) requires that, within 12 months of the date permit coverage is extended, existing permittees shall revise their current program, as necessary, and continue to implement and enforce a post-construction stormwater management program. Describe your current program:

Permit applications require a plan submittal consisting of the design standards used for permanent facilities. The Post-Construction Stormwater Management program is primarily described in Subdivision Regulations, Section 1202.04, Subdivision 3.n and Subdivision 8. The City code requires that applicant's comply with the goals and policies of the City of Shorewood's approved Comprehensive Water Resources Management Plan and the Watershed Rules.

2. Have you established written procedures for site plan reviews that you will conduct prior to the start of construction activity? Yes No

3. Answer **yes** or **no** to indicate whether you have the following listed procedures for documentation of post-construction stormwater management according to the specifications of Permit (Part III.D.5.c.):

a. Any supporting documentation that you use to determine compliance with the Permit (Part III.D.5.a), including the project name, location, owner and operator of the construction activity, any checklists used for conducting site plan reviews, and any calculations used to determine compliance? Yes No

b. All supporting documentation associated with mitigation projects that you authorize? Yes No

c. Payments received and used in accordance with Permit (Part III.D.5.a.(4)(f))? Yes No

d. All legal mechanisms drafted in accordance with the Permit (Part III.D.5.a.(5)), including date(s) of the agreement(s) and names of all responsible parties involved? Yes No

If you answered **no** to any of the above permit requirements, describe the steps that will be taken to assure that, within 12 months of the date permit coverage is extended, these permit requirements are met.

E.3.b-c., The City will develop written procedures for documentation of post-construction stormwater management for documentation of mitigation projects, payments, and legal mechanisms as described in the Permit (Part III.D.5.c.). Procedures will be in place within 12 months following the date permit coverage is extended.

4. List the categories of BMPs that address your post-construction stormwater management program. Use the first table for categories of BMPs that you have established and the second table for categories of BMPs that you plan to implement over the course of the permit term.

Include the measurable goals with appropriate timeframes that each BMP category will be implemented and completed. In addition, provide interim milestones and the frequency of action in which the permittee will implement and/or maintain the BMPs. Refer to the EPA's *Measurable Goals Guidance for Phase II Small MS4s* (<http://www.epa.gov/npdes/pubs/measurablegoals.pdf>). **If you have more than five categories**, hit the tab key after the last line to generate a new row.

| Established BMP categories | Measurable goals and timeframes |
|---|---|
| <i>City Stormwater Management Permits</i> | <i>The City will continue to review and issue stormwater permits (for land disturbance of 5,000 square feet and larger) in collaboration with the Minnehaha Creek Watershed District through the end of the MS4 permit cycle (July 31, 2018).</i> |

| BMP categories to be implemented | Measurable goals and timeframes |
|---|--|
| <i>Ordinance Updates</i> | <i>City Code 1202 will be evaluated and revised if needed to include MS4 regulatory standards. If changes are deemed necessary the final ordinance language will be formally</i> |

5. Provide the name or the position title of the individual(s) who is responsible for implementing and/or coordinating this MCM:

Director of Public Works

F. MCM 6: Pollution prevention/good housekeeping for municipal operations

1. The Permit (Part III.D.6.) requires that, within 12 months of the date permit coverage is extended, existing permittees shall revise their current program, as necessary, and continue to implement an operations and maintenance program that prevents or reduces the discharge of pollutants from the permittee owned/operated facilities and operations to the small MS4. Describe your current program:

The City's Public Works Department is primarily responsible for all MCM 6 activities. Current Public Works activities include inspections and maintenance of the storm sewer system, street sweeping, and employee training. In 2014, the City intends to expand the employee training opportunities, refine all record keeping procedures of inspections and maintenance, and written procedures for IDDE.

2. Do you have a facilities inventory as outlined in the Permit (Part III.D.6.a.)? Yes No

3. If you answered **no** to the above permit requirement in question 2, describe the tasks and corresponding schedules that will be taken to assure that, within 12 months of the date permit coverage is extended, this permit requirement is met:

City staff will prepare a facility inventory within 12 months of the date permit coverage is extended to the City.

4. List the categories of BMPs that address your pollution prevention/good housekeeping for municipal operations program. Use the first table for categories of BMPs that you have established and the second table for categories of BMPs that you plan to implement over the course of the permit term.

Include the measurable goals with appropriate timeframes that each BMP category will be implemented and completed. In addition, provide interim milestones and the frequency of action in which the permittee will implement and/or maintain the BMPs. For an explanation of measurable goals, refer to the EPA's *Measurable Goals Guidance for Phase II Small MS4s* (<http://www.epa.gov/npdes/pubs/measurablegoals.pdf>).

If you have more than five categories, hit the tab key after the last line to generate a new row.

| Established BMP categories | Measurable goals and timeframes |
|--|--|
| Street Sweeping | The City will continue to conduct street sweeping operations of all public streets a minimum of twice annually (record the sweeping route and date per occurrence). Review and revise (as needed) street sweeping operations (including schedule, equipment, and disposal), stormwater quality priority areas, and routes annually through the end of the MS4 permit cycle (July 31, 2018). |
| Structural Pollution Control Device (SPCD) Inspections | Continue to inspect 100% of all SPCD's each year of the MS4 permit cycle (July 31, 2018) |
| Inspect MS4 Outfalls and Ponds | Continue to inspect 20% of all MS4 outfalls each year, until 100% of all MS4 Outfalls and Ponds have been inspected within the MS4 permit cycle (until July 31, 2018). |
| Review Inspection Reports | Annually, review all pond, outfall, and SPCD inspection records to determine if maintenance, repair, or replacement is needed. Include a description of the findings and any maintenance, repair, or replacement as a result of the inspection findings. Evaluate each SPCD's inspection frequency and adjust as needed per MS4 Permit Part III.D.6.e (1.). Evaluate and update inspection records annually through the end of the MS4 permit cycle (July 31, 2018). |
| Training | Continue to host a minimum of one staff training event per year to discuss stormwater related topics. City staff will develop an annual training schedule, record the employee names, topics covered, and date of each event, annually through the end of the MS4 permit cycle (July 31, 2018). |

| BMP categories to be implemented | Measurable goals and timeframes |
|---|--|
| Pond Sediment Excavation and Removal Projects | The City will develop a reporting component for pond sediment removal projects within 12 months from the date MS4 permit |

| | |
|--|---|
| | coverage is extended to the City. Reporting will consist of documenting the date, pond ID, project limits/construction plans, volume of sediment removed, test results (if any), and disposal location. Will report annually as projects are completed. |
| Stockpiles, Storage and Material Handling Area Inspections | Conduct written inspections of all stockpile, storage and material handling areas as per the facilities inventoried in 2014. Reporting done annually starting in 2015. |

5. Does discharge from your MS4 affect a Source Water Protection Area (Permit Part III.D.6.c.)? Yes No
- a. If **no**, continue to 6.
- b. If **yes**, the Minnesota Department of Health (MDH) is in the process of mapping the following items. Maps are available at <http://www.health.state.mn.us/divs/eh/water/swp/maps/index.htm>. Is a map including the following items available for your MS4:
- 1) Wells and source waters for drinking water supply management areas identified as vulnerable under Minn. R. 4720.5205, 4720.5210, and 4720.5330? Yes No
- 2) Source water protection areas for surface intakes identified in the source water assessments conducted by or for the Minnesota Department of Health under the federal Safe Drinking Water Act, U.S.C. §§ 300j – 13? Yes No
- c. Have you developed and implemented BMPs to protect any of the above drinking water sources? Yes No
6. Have you developed procedures and a schedule for the purpose of determining the TSS and TP treatment effectiveness of all permittee owned/operated ponds constructed and used for the collection and treatment of stormwater, according to the Permit (Part III.D.6.d.)? Yes No
7. Do you have inspection procedures that meet the requirements of the Permit (Part III.D.6.e.(1)-(3)) for structural stormwater BMPs, ponds and outfalls, and stockpile, storage and material handling areas? Yes No
8. Have you developed and implemented a stormwater management training program commensurate with each employee's job duties that:
- a. Addresses the importance of protecting water quality? Yes No
- b. Covers the requirements of the permit relevant to the duties of the employee? Yes No
- c. Includes a schedule that establishes initial training for new and/or seasonal employees and recurring training intervals for existing employees to address changes in procedures, practices, techniques, or requirements? Yes No
9. Do you keep documentation of inspections, maintenance, and training as required by the Permit (Part III.D.6.h.(1)-(5))? Yes No

If you answered **no** to any of the above permit requirements listed in **Questions 5 – 9**, then describe the tasks and corresponding schedules that will be taken to assure that, within 12 months of the date permit coverage is extended, these permit requirements are met:

The City will update written procedures for conducting inspections of illicit discharge detection, outfalls, ponds and structural pollution control devices, develop BMPs to protect drinking water sources, draft inspection and record keeping procedures for stockpile, storage, and material handling areas, a reporting method for employee training events, and record keeping procedures for pond excavation projects within 12 months of the date permit coverage is extended to the City.

10. Provide the name or the position title of the individual(s) who is responsible for implementing and/or coordinating this MCM:

Director of Public Works

VI. Compliance Schedule for an Approved Total Maximum Daily Load (TMDL) with an Applicable Waste Load Allocation (WLA) (Part II.D.6.)

- A. Do you have an approved TMDL with a Waste Load Allocation (WLA) prior to the effective date of the Permit? Yes No
1. If **no**, continue to section VII.
2. If **yes**, fill out and attach the MS4 Permit TMDL Attachment Spreadsheet with the following naming convention: *MS4NameHere_TMDL*.

This form is found on the MPCA MS4 website: <http://www.pca.state.mn.us/ms4>.

VII. Alum or Ferric Chloride Phosphorus Treatment Systems (Part II.D.7.)

- A. Do you own and/or operate any Alum or Ferric Chloride Phosphorus Treatment Systems which are regulated by this Permit (Part III.F.)? Yes No
1. If **no**, this section requires no further information.
 2. If **yes**, you own and/or operate an Alum or Ferric Chloride Phosphorus Treatment System within your small MS4, then you must submit the Alum or Ferric Chloride Phosphorus Treatment Systems Form supplement to this document, with the following naming convention: *MS4NameHere_TreatmentSystem*.
This form is found on the MPCA MS4 website: <http://www.pca.state.mn.us/ms4>.

VIII. Add any Additional Comments to Describe Your Program

TMDL Wasteload Allocation Excel Spreadsheet PART II.D.6.a.-e.

Copy and paste from the Master List MS4 TMDL Spreadsheet for your MS4 to the space below.

| Permittee name | Preferred ID | TMDL project name* | Waterbody ID | Type of WLA* | Numeric WLA* | Unit* | Percent reduction | Flow condition* | Waterbody name | Pollutant of concern* | Date approved |
|----------------|--------------|---|--------------|--------------|--------------|---------|-------------------|-----------------|----------------|-----------------------|---------------|
| Shorewood City | MS400122 | Minnehaha Creek Watershed District Lakes TMDL | 10-0015 | Individual | 0.05 | lbs/day | 16% | N/A | Lake Virginia | Phosphorus | 4/25/2011 |

JOINT POWERS AGREEMENT

Between the City of Shorewood and the Minnehaha Creek Watershed District

This Agreement is made this 24th day of March, 2008, by and between the City of Shorewood, a body corporate and politic and a statutory city in the State of Minnesota ("City") and the Minnehaha Creek Watershed District, a watershed district with purposes and powers as set forth in Minnesota Statutes Chapters 103B and 103D ("MCWD"). This Agreement is executed under authority of Minnesota Statutes §471.59, which permits two or more governmental units to jointly and cooperatively exercise any power common to each of them.

Recitals and Statement of Purpose

WHEREAS, a majority of the City of Shorewood lies in the Minnehaha Creek Watershed District, and the MCWD serves as the Local Governmental Unit responsible for administering the Wetland Conservation Act within that area;

WHEREAS, the remainder of the City of Shorewood lies in the Riley Purgatory Bluff Creek Watershed District (RPBCWD), and the RPBCWD has affirmatively and voluntarily committed in writing to transfer all local permitting authority, including its responsibility for administering the Wetland Conservation Act, to the City of Shorewood effective December 31, 2007;

WHEREAS, the City has requested that the MCWD provide services as the Local Governmental Unit responsible for administering the Wetland Conservation Act for the entire City, including the area that lies within the RPBCWD;

WHEREAS, the RPBCWD previously held General Permit #1997-6113 from the Minnesota Department of Natural Resources, which allowed the RPBCWD to permit certain Public Waters work projects without requiring an individual permit, and the RPBCWD affirmatively and voluntarily requested the withdrawal of this General Permit, and the Department of Natural Resources granted this request on February 25, 2008, effectively immediately;

WHEREAS, the MCWD holds General Permit #2001-6009 from the Minnesota Department of Natural Resources, which allows the MCWD to permit certain Public Waters work projects without requiring an individual permit, and the City has requested that the MCWD exercise this authority for the entire City, including the area that lies within the RPBCWD;

NOW, THEREFORE it is mutually agreed by and between the parties as follows:

1.0 Wetland Conservation Act Administration

1.1 The MCWD will serve as the Local Government Unit responsible for administering the Wetland Conservation Act for the entire City, including the area that lies within the RPBCWD.

1.2 The MCWD will not charge the City for providing these services, but may charge fees to permit applicants, and otherwise exercise enforcement powers as authorized by law, including Minnesota Statutes Sections 103D.345, 103G.2242, and 103G.237.

2.0 Department of Natural Resources General Permit Administration

2.1 Upon approval in writing from the Department of Natural Resources, the MCWD will exercise its authority under General Permit 2001-6009 from the Department of Natural Resources for the entire City, including that area that lies within the RPBCWD to regulate riprap shoreline protection, intakes and storm sewer outfalls, retaining walls, excavation for navigation, excavation for wildlife enhancement, excavation for bioengineering, ice ridge removal, and bridges and culvert crossings, pursuant to the MCWD Rules, as they may be amended from time to time.

2.2 The MCWD will not charge the City for providing these services, but may charge fees to permit applicants, and otherwise exercise enforcement powers as authorized by law, including Minnesota Statutes Section 103D.345.

3.0 Indemnification

Each party hereby holds the other party harmless, and agrees to defend and indemnify the other party from and against any and all suits, actions, causes of actions, proceedings, claims, costs and damages arising out of the indemnifying party's action or inaction, except to the extent resulting from an action or inaction of another party or third party for which the other party or third party independently would be subject to liability.

4.0 Termination

4.1 This Agreement may be terminated at any time for any reason by either party upon providing 90 days advance notice in writing.

4.2 The MCWD will terminate the exercise of authority under General Permit 2001-6009 for the area of the City that lies within the RPBCWD in the event that the RPBCWD obtains a new General Permit from the Department of Natural Resources, and communicates in writing to the City and the MCWD that it desires to resume the exercise of such authority within the City.

4.3 In the event of the termination of this Agreement, the parties pledge to cooperate in developing a transition plan to address pending permit applications and ongoing enforcement responsibilities.

5.0 Amendment

This Agreement may be amended only by a writing signed by both of the parties.

6.0 Notices

Any written communication required under this Agreement shall be addressed to the other party as follows, except that any party may change its address for notice by so notifying the other parties in writing:

To MCWD:

Administrator
Minnehaha Creek Watershed District
18202 Minnetonka Boulevard
Deephaven, MN 55391

To City:

Administrator
City of Shorewood
5755 Country Club Road
Shorewood, MN 55331

7.0 Reservation of Powers

Nothing in this Agreement shall limit either party's lawful exercise of its regulatory authority.

IN WITNESS WHEREOF, intending to be legally bound, the parties hereto execute and deliver this Agreement.

MINNEHAHA CREEK WATERSHED DISTRICT

By: James B. Callen's
Its: PRESIDENT

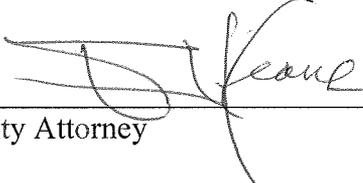
Approved as to Form and Execution:


District Counsel

CITY OF SHOREWOOD

By: Christine Lizee
Its: Mayor

Approved as to Form and Execution:


City Attorney

CITY OF SHOREWOOD

RESOLUTION NO. 08-022

**A RESOLUTION ADOPTING THE PERMANENT RULES OF THE WETLAND
CONSERVATION ACT**

WHEREAS, The Minnesota Wetland Conservation Act of 1991 (WCA) requires local government units (LGUs) to implement this law by adopting the rules and regulations promulgated by the Board of Water and Soil Resources (BWSR) pertaining to wetland draining and filling; and,

WHEREAS, the BWSR is requesting LGUs adopting the permanent rules of the WCA to notify them of the LGU decision regarding adoption; and,

WHEREAS, the LGU is responsible for making WCA determinations for landowners; and,

WHEREAS, the Minnehaha Creek Watershed District accepts LGU authority within their watershed boundaries; and,

NOW, THEREFORE BE IT RESOLVED:

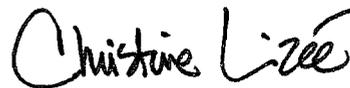
The City hereby delegates the responsibility as the LGU to Minnehaha Creek Watershed District for WCA within the legal boundaries of the Riley Purgatory Bluff Creek Watershed District within the City of Shorewood as of May 1, 2008, within the guidelines as set forth by the WCA and rules.

BE IT FURTHER RESOLVED:

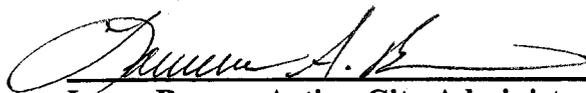
This is subject to approval of the agreement between the City and the Minnehaha Creek Watershed District.

ADOPTED by the City Council of the City of Shorewood this 10th day of March, 2008.

ATTEST:



Christine Lizée, Mayor



Larry Brown, Acting City Administrator/Clerk

MEMORANDUM of UNDERSTANDING

Between the Minnehaha Creek Watershed District and the City of Shorewood for Local Water Planning and Regulation

This Memorandum of Understanding (MOU) is made by and between the Minnehaha Creek Watershed District, a watershed district with purposes and powers as set forth at Minnesota Statutes Chapters 103B and 103D ("MCWD"), and the City of Shorewood, a body corporate and politic and a statutory city in the State of Minnesota ("City").

Recitals and Statement of Purpose

WHEREAS in 2007, the MCWD revised its comprehensive watershed management plan under Minnesota Statutes § 103B.231, which details the existing physical environment, land use and development in the watershed and establishes a plan to regulate water resource use and management to protect water resources, improve water quality, prevent flooding and otherwise achieve the goals of Minnesota Statutes Chapters 103B and 103D;

WHEREAS the MCWD's comprehensive watershed management plan incorporates the Rules adopted by the MCWD to protect water resources, improve water quality, prevent flooding and otherwise achieve the goals of Minnesota Statutes Chapters 103B and 103D;

WHEREAS the City has developed a local water management plan under Minnesota Statutes §103B.235 that describes the existing and proposed physical environment and land use within the City and sets forth an implementation plan for bringing local water management into conformance with the MCWD's comprehensive watershed management plan;

WHEREAS on January 8, 2009, the MCWD Board of Managers conditionally approved the City's local water management plan by adoption of Resolution 09-005, which resolution is attached and incorporated herein;

WHEREAS the City wishes to continue to authorize MCWD permitting authority with respect to all areas regulated by the MCWD including the Minnesota Wetland Conservation Act;

WHEREAS MCWD approval of a local plan requires a finding that the official controls of the local government are at least as protective of water resources as the MCWD Rules;

WHEREAS the finding by the MCWD Board of Managers in this regard rests on the City's authorization of the MCWD's continued exercise of regulatory authority within the City in accordance with Minnesota Statutes §103B.211, subdivision 1(a)(3);

WHEREAS the MCWD and City desire to memorialize their respective roles in implementing water resource protection and management within the City;

NOW THEREFORE it is mutually agreed by and between the parties that they enter into this MOU in order to document the understanding of the parties as to the roles and responsibilities of each party.

1.0 Responsibilities of the City

1.1 The City may exercise all present and future authority it otherwise may possess to issue permits for and regulate activities affecting water resources within the City.

1.2 The City will meet at least annually with the MCWD to review the implementation of the City's local water management plan.

1.3 Annually, by the date specified for the City's submittal of its annual report under its NPDES municipal stormwater permit, the City will submit to the MCWD a concise but specific report describing:

- a. Progress on the local water management plan implementation program.
- b. Progress on meeting phosphorus load reduction requirements of the WMP.
- c. Any adjustments to the implementation and/or capital improvement program in the local water management plan.
- d. A listing, with further specific information as the MCWD may request, of grading and structural alterations approved or occurring within city boundaries since the last annual report (both private and public alterations) that could measurably affect hydraulic and hydrologic model outcomes.

The City may incorporate its annual report into its NPDES MS4 annual report, provided it addresses the above items with specificity.

2.0 Responsibilities of the MCWD

2.1 The MCWD will continue to apply and enforce its Rules, as they may be amended from time to time, within the City.

2.2 The MCWD will meet with the City at least annually to review the implementation of the City's local water management plan, addressing at a minimum the following topics:

1. Maintenance of up-to-date water quality measures, such as concentrations of Phosphorus, in the City's local water management plan;
2. The City's progress toward Implementation Program/CIP items;
3. Utilizing street sweeping to meet MCWD Phosphorus Loading Reduction goals, and specifically the progress of the City toward testing phosphorus concentrations in sweepings and utilizing that knowledge for effective sweeping.

2.3 The MCWD retains all authority that it may possess under Minnesota Statutes Chapters 103B and 103D or any other provision of law, except as explicitly reposed in the City under this

MOU, including but not limited to authority set forth at Minnesota Statutes §§103B.211, subdivision 1(a); 103D.335 and 103D.341.

3.0 General

3.1 The MOU is effective on the date that it has been executed by both parties, will remain in effect for five years, and will be extended automatically for five-year terms unless terminated by agreement of the parties. Notwithstanding, the City will continue to be subject to applicable statutes and rules requiring that it revise its local water management plan in response to MCWD revisions of the WMP.

3.2 This MOU may be amended only by a writing signed by both parties.

3.3 This MOU does not affect the rights and duties of the parties under the March 24, 2008 Joint Powers Agreement signed by the MCWD and the City of Shorewood, which remains in force and effect according to its terms.

IN WITNESS WHEREOF, the parties hereto have executed this Memorandum of Understanding.

CITY OF SHOREWOOD

MINNEHAHA CREEK WATERSHED DISTRICT

By *Laura Surgeon*
acting Mayor

By *James B. Colkins*
President, Board of Managers

By *[Signature]*
City Manager

Date:

Date: *2-12-09*

APPROVED AS TO FORM AND EXECUTION

APPROVED AS TO FORM AND EXECUTION

By *Mary Deetzi*
Its Attorney

By *[Signature]*
Its Attorney

APPENDIX F

MCWD Wetland Functional Assessment Summary

**Minnehaha Creek Watershed District - Functional Assessment of Wetlands
Wetland Management Classification**

| Wetland ID Number | Circular 39 Classification | Vegetative Diversity | Wildlife Habitat Quality | Fishery Habitat Quality | Aesthetic Quality |
|--------------------------|-----------------------------------|-----------------------------|---------------------------------|--------------------------------|--------------------------|
| D-117-23-26-001 | Type 2 | Moderate | Moderate | Low | Low |
| D-117-23-25-005 | Type 2 | Low | Moderate | Moderate | Moderate |
| D-117-23-25-003 | Type 2 | Not Applicable | Not Applicable | Not Assessed | Not Applicable |
| D-117-23-25-004 | Type 5 | Low | Not Applicable | Low | Low |
| E-117-23-30-001 | Type 3, Type 2, | High | High | Moderate | Moderate |
| D-117-23-25-001 | Type 2 | Low | Moderate | Low | Low |
| E-117-23-25-022 | Type 5, Type 4 | Moderate | Moderate | Low | Exceptional |
| D-117-23-25-038 | Type 3, Type 5 | Moderate | Moderate | Moderate | Low |
| D-117-23-25-043 | Type 3 | Moderate | Moderate | Low | Low |
| D-117-23-25-037 | Type 2 | Low | Low | Moderate | Low |
| E-117-23-25-011 | Type 5 | Moderate | Moderate | Low | Low |
| D-117-23-26-008 | Type 2 | Not Applicable | Not Applicable | Not Assessed | Not Applicable |
| E-117-23-25-021 | Type 3 | High | Moderate | Low | Moderate |
| E-117-23-25-020 | Type 5 | Moderate | Moderate | Low | Exceptional |
| E-117-23-30-002 | Type 4 | Low | Moderate | Exceptional | Moderate |
| E-117-23-25-019 | Type 5 | Low | Moderate | Moderate | Moderate |
| E-117-23-25-016 | Type 5 | Moderate | Moderate | Low | Exceptional |
| E-117-23-26-004 | Type 5 | Moderate | Moderate | Exceptional | High |
| E-117-23-25-017 | Type 3, Type 2 | Low | Moderate | Moderate | Moderate |
| E-117-23-25-018 | Type 5 | Low | Low | Low | Moderate |
| E-117-23-30-004 | Type 1 | Moderate | High | Low | Moderate |
| D-117-23-25-024 | Type 2, Type 3 | Low | Moderate | Low | Moderate |
| D-117-23-25-027 | Type 2 | Low | Moderate | Low | Moderate |
| D-117-23-30-007 | Type 3 | Low | Moderate | Low | Low |
| D-117-23-25-023 | Type 5 | Low | Low | Low | Low |
| E-117-23-25-015 | Type 3 | Low | Moderate | Moderate | Moderate |
| D-117-23-25-023 | Type 5 | Low | Low | Low | Low |
| D-117-23-30-014 | Type 3 | Low | Moderate | Low | Low |
| D-117-23-25-023 | Type 5 | Low | Low | Low | Low |
| D-117-23-29-002 | Type 3 | Not Applicable | Not Applicable | Not Assessed | Not Applicable |

**Minnehaha Creek Watershed District - Functional Assessment of Wetlands
Wetland Management Classification**

| Wetland ID Number | Circular 39 Classification | Vegetative Diversity | Wildlife Habitat Quality | Fishery Habitat Quality | Aesthetic Quality |
|--------------------------|-----------------------------------|-----------------------------|---------------------------------|--------------------------------|--------------------------|
| E-117-23-25-023 | Type 6, Type 3 | Exceptional | Exceptional | Low | Moderate |
| D-117-23-29-002 | Type 3 | Not Applicable | Not Applicable | Not Assessed | Not Applicable |
| D-117-23-32-042 | Type 3 | Low | Moderate | Low | High |
| E-117-23-32-001 | Type 3 | Low | Moderate | Low | Moderate |
| D-117-23-32-039 | Type 3 | Low | Moderate | Low | Moderate |
| D-117-23-25-028 | Type 5 | Low | Low | Low | Low |
| D-117-23-33-036 | Type 3, Type 4 | Moderate | Moderate | Low | High |
| D-117-23-32-043 | Type 4 | Low | Moderate | Moderate | Moderate |
| D-117-23-33-005 | Type 3 | Low | Moderate | Low | Moderate |
| D-117-23-32-039 | Type 3 | Low | Moderate | Low | Moderate |
| E-117-23-33-002 | Type 4 | Moderate | Moderate | Low | Moderate |
| E-117-23-36-001 | Type 5, Type 4 | Moderate | Moderate | Exceptional | Exceptional |
| D-117-23-32-002 | Type 3 | Low | Moderate | Low | High |
| D-117-23-32-037 | Type 1, Type 2 | Low | Moderate | Low | Moderate |
| D-117-23-32-043 | Type 4 | Low | Moderate | Moderate | Moderate |
| D-117-23-32-002 | Type 3 | Low | Moderate | Low | High |
| E-117-23-33-001 | Type 4 | Low | Moderate | Low | Moderate |
| E-117-23-36-002 | Type 5 | Moderate | Moderate | Exceptional | Exceptional |
| D-117-23-33-011 | Type 4 | Low | Moderate | Low | Moderate |
| D-117-23-34-032 | Type 5, Type 4 | Moderate | Moderate | Exceptional | Exceptional |
| E-117-23-36-003 | Type 8 | Exceptional | High | Low | High |
| D-117-23-35-009 | Type 3, Type 5 | Low | Low | Low | Low |
| D-117-23-32-037 | Type 1, Type 2 | Low | Moderate | Low | Moderate |
| D-117-23-36-004 | Type 2 | Moderate | Moderate | Low | High |
| E-117-23-34-001 | Type 4 | Moderate | Moderate | Exceptional | Exceptional |
| D-117-23-36-004 | Type 2 | Moderate | Moderate | Low | High |
| D-117-23-33-006 | Type 3 | Low | High | Low | Low |
| D-117-23-33-017 | Type 2 | Low | Moderate | Low | Moderate |
| D-117-23-32-035 | Type 4 | Low | Moderate | Low | Moderate |
| D-117-23-32-035 | Type 4 | Low | Moderate | Low | Moderate |

**Minnehaha Creek Watershed District - Functional Assessment of Wetlands
Wetland Management Classification**

| Wetland ID Number | Circular 39 Classification | Vegetative Diversity | Wildlife Habitat Quality | Fishery Habitat Quality | Aesthetic Quality |
|-------------------|----------------------------|----------------------|--------------------------|-------------------------|-------------------|
| D-117-23-34-002 | Type 7, Type 2 | Not Applicable | Not Applicable | Not Assessed | Not Applicable |
| D-117-23-32-041 | Type 4 | Low | Moderate | Low | Moderate |
| D-117-23-34-001 | Type 7, Type 2 | Not Applicable | Not Applicable | Not Assessed | Not Applicable |
| D-117-23-35-005 | Type 3, Type 1 | Low | Moderate | Low | Moderate |
| D-117-23-33-016 | Type 4 | Low | Moderate | Low | Moderate |
| E-117-23-31-007 | Type 4 | Low | Moderate | Low | Moderate |
| D-117-23-33-033 | Type 1 | Moderate | Moderate | Low | Moderate |
| D-117-23-32-032 | Type 2, Type 4 | Low | Moderate | Low | Moderate |
| D-117-23-32-033 | Type 2 | Low | Moderate | Low | Moderate |
| D-117-23-32-009 | Type 1, Type 2 | Low | Low | Low | Moderate |
| D-117-23-32-009 | Type 1, Type 2 | Low | Low | Low | Moderate |
| D-117-23-32-002 | Type 3 | Low | Moderate | Low | High |
| D-117-23-32-009 | Type 1, Type 2 | Low | Low | Low | Moderate |
| D-117-23-32-009 | Type 1, Type 2 | Low | Low | Low | Moderate |
| D-117-23-33-001 | Type 4 | Moderate | Moderate | Exceptional | Moderate |
| E-117-23-33-003 | Type 4 | Low | Moderate | Low | Moderate |
| D-117-23-33-031 | Type 3 | Low | Moderate | Low | Moderate |
| E-117-23-31-001 | Type 3 | Low | Moderate | Low | Moderate |
| D-117-23-34-009 | Type 2 | Low | Moderate | Low | Moderate |
| D-117-23-32-012 | Type 2 | Low | High | Low | Moderate |
| E-117-23-35-001 | Type 5 | Moderate | Moderate | Exceptional | Exceptional |
| E-117-23-31-002 | Type 5 | Low | Moderate | Low | Moderate |
| D-117-23-35-011 | Type 3, Type 4 | Moderate | Moderate | Exceptional | Exceptional |
| D-117-23-35-012 | Type 3 | Moderate | Moderate | Exceptional | Exceptional |
| E-117-23-34-007 | Type 5 | Exceptional | Moderate | Exceptional | Exceptional |
| E-117-23-34-006 | Type 4 | Moderate | Moderate | Moderate | Exceptional |
| D-117-23-33-052 | Type 4 | Low | Moderate | Low | Moderate |
| D-117-23-33-044 | Type 4 | Low | Moderate | Low | Moderate |
| D-117-23-32-040 | Type 3 | Low | Moderate | Low | High |
| E-117-23-35-002 | Type 4, Type 5, | Low | Low | Low | Low |

**Minnehaha Creek Watershed District - Functional Assessment of Wetlands
Wetland Management Classification**

| Wetland ID Number | Circular 39 Classification | Vegetative Diversity | Wildlife Habitat Quality | Fishery Habitat Quality | Aesthetic Quality |
|-------------------|----------------------------|----------------------|--------------------------|-------------------------|-------------------|
| D-117-23-33-049 | Type 4 | Low | Moderate | Low | Moderate |
| E-117-23-31-003 | Type 5 | Low | Moderate | Low | Moderate |
| D-117-23-33-050 | Type 4 | Low | Moderate | Low | Moderate |
| D-117-23-32-030 | Type 4 | Low | Moderate | Low | Low |
| D-117-23-33-048 | Type 3 | Low | Moderate | Low | Moderate |
| D-117-23-33-021 | Type 2 | Low | Moderate | Low | Moderate |
| D-117-23-34-011 | Type 2 | Moderate | Moderate | Low | Moderate |
| D-117-23-33-044 | Type 4 | Low | Moderate | Low | Moderate |
| D-117-23-33-020 | Type 2 | Low | Moderate | Low | Moderate |
| D-117-23-33-051 | Type 4 | Low | Moderate | Low | Moderate |
| D-117-23-33-047 | Type 4 | Low | Moderate | Low | Moderate |
| D-117-23-33-020 | Type 2 | Low | Moderate | Low | Moderate |
| E-117-23-35-003 | Type 3, Type 6 | Moderate | Moderate | Exceptional | Exceptional |
| D-117-23-34-025 | Type 4 | Moderate | Moderate | Low | Moderate |
| D-117-23-34-012 | Type 3 | Low | Low | Low | Low |
| D-117-23-33-043 | Type 4 | Exceptional | Moderate | Low | Moderate |
| D-117-23-32-040 | Type 3 | Low | Moderate | Low | High |
| D-117-23-32-020 | Type 2 | Not Applicable | Not Applicable | Not Assessed | Not Applicable |
| D-117-23-33-022 | Type 2 | Low | Moderate | Low | Moderate |
| D-117-23-33-027 | Type 2 | Exceptional | Moderate | Low | Moderate |
| D-117-23-34-026 | Type 1 | Low | High | Low | Moderate |
| D-117-23-35-020 | Type 3, Type 1 | Moderate | Moderate | Moderate | Exceptional |
| D-117-23-34-027 | Type 3, Type 6 | Moderate | Moderate | Low | Exceptional |
| D-117-23-32-041 | Type 4 | Low | Moderate | Low | Moderate |
| D-117-23-33-046 | Type 2 | Low | Moderate | Low | Moderate |
| D-117-23-33-041 | Type 5 | Low | Moderate | Low | Moderate |
| D-117-23-33-023 | Type 4 | Low | Moderate | Low | Moderate |
| D-117-23-34-015 | Type 1 | Moderate | Moderate | Low | Moderate |
| D-117-23-33-040 | Type 2 | Low | Moderate | Low | Moderate |
| D-117-23-35-017 | Type 2, Type 3 | Moderate | Moderate | Low | Moderate |

**Minnehaha Creek Watershed District - Functional Assessment of Wetlands
Wetland Management Classification**

| Wetland ID Number | Circular 39 Classification | Vegetative Diversity | Wildlife Habitat Quality | Fishery Habitat Quality | Aesthetic Quality |
|--------------------------|-----------------------------------|-----------------------------|---------------------------------|--------------------------------|--------------------------|
| E-117-23-31-005 | Type 3 | Low | High | Low | Moderate |
| D-117-23-34-018 | Type 3 | Moderate | Moderate | Moderate | Exceptional |
| D-117-23-32-026 | Type 2 | Low | High | Low | Low |
| D-117-23-33-029 | Type 6 | Low | Moderate | Low | Moderate |
| D-117-23-33-023 | Type 4 | Low | Moderate | Low | Moderate |
| D-117-23-33-023 | Type 4 | Low | Moderate | Low | Moderate |
| D-117-23-34-020 | Type 3 | Moderate | Moderate | Low | Moderate |
| D-117-23-33-029 | Type 6 | Low | Moderate | Low | Moderate |
| D-117-23-34-034 | Type 2 | Low | Moderate | Low | Moderate |
| E-117-23-35-004 | Type 3 | Low | Moderate | Low | Exceptional |
| D-117-23-34-017 | Type 7, Type 4 | Moderate | Moderate | Moderate | Exceptional |
| D-117-23-34-017 | Type 7, Type 4 | Moderate | Moderate | Moderate | Exceptional |
| D-117-23-35-015 | Type 3 | Not Applicable | Not Applicable | Not Assessed | Not Applicable |
| D-117-23-33-023 | Type 4 | Low | Moderate | Low | Moderate |
| D-117-23-33-042 | Type 5 | Low | Low | Low | Moderate |
| D-117-23-33-045 | Type 2 | Low | Moderate | Low | Moderate |
| D-117-23-33-026 | Type 2 | Low | Moderate | Low | Moderate |
| D-117-23-34-021 | Type 2, Type 6 | High | Moderate | Low | Moderate |
| D-117-23-34-019 | Type 2, Type 1 | Moderate | Moderate | Low | Moderate |
| D-117-23-35-018 | Type 3 | Moderate | Moderate | Moderate | Moderate |
| E-117-23-31-008 | Type 3 | Moderate | High | Exceptional | High |
| D-117-23-32-018 | Type 2 | Not Applicable | Not Applicable | Not Assessed | Not Applicable |
| D-117-23-34-033 | Type 4, Type 3 | Moderate | Moderate | Moderate | Exceptional |
| E-117-23-26-006 | Type 5 | Moderate | Moderate | Exceptional | Exceptional |

APPENDIX G

P8 Water Quality Modeling Results

P8 WATER QUALITY MODELING RESULTS

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I. DESCRIPTION OF P8 WATER QUALITY MODEL

In an effort to provide the City with additional information on existing and future water quality, an urban water quality model was developed. The computer program used to model water quality within the City of Shorewood is the "Program for Predicting Polluting Particle Passage through Pits, Puddles, and Ponds" referred to as the P8 Urban Catchment Model developed by Dr. William W. Walker, Jr.

The P8 urban water quality model predicts the generation and transportation of stormwater run-off pollutants within the City. This model can estimate pollutant loadings, concentrations and removal efficiencies for basins subject to single or continuous rainfall events. The model will simulate the performance of a variety of treatment devices including swales, buffer strips, detention ponds, flow splitters, infiltration basins and general devices.

The initial calibration of this model corresponds to values measured under the Nationwide Urban Run-off Program or NURP. Specific calibration of this model for the City of Shorewood will require water quality monitoring data for selected areas in the City. Without calibration of the model to site specific data, predictions for specific parameter concentrations, flows, and loadings will be less reliable. However, the relative predictions concerning the removal efficiency of a basin by particle size will be unaffected by calibration.

The methodology used to model the City of Shorewood is described as follows. The Stormwater Treatment basins were assumed to provide a minimum of 4 feet of depth below the invert of the basin outlet and existing line pool storage between the basin outlet and the high water level. The storage volume of the treatment basin between the NWL and HWL was obtained from the TR-20 modeling effort for the 100-year storm event. The dimensions of the treatment basins as well as the peak discharge rates from these basins are shown in the P8 Input Tables.

Some preliminary calibration to regional standards has been completed for this P8 Water Quality Model. The data used to calibrate this model was run-off data collected from the City of Minneapolis. The original parameters that the P8 Model estimates are total suspended solids (TSS), total kjeldahl nitrogen (TKN), total phosphorous (TP), copper (CU), lead (PB), and zinc (ZN). In addition to these parameters, when calibrated to run-off data from the City of Minneapolis, the following water quality parameters were added to the calibrated model, hydrocarbons (HC), chemical oxygen demand (COD) and biological oxygen demand (BOD).

Again, it must be noted that the concentrations of individual water quality parameters estimated by P8 Water Quality Computer Model may vary significantly with concentrations obtained in the field. This inconsistency is due to the extreme variation in water quality parameter concentrations observed from individual subwatersheds. However, the estimated removal efficiency of treatment

basins should be comparable to the removal efficiencies determined from field investigations. This is a result of removal efficiencies being estimated by the total removal of suspended solids. The removal efficiency of a stormwater treatment basin is determined by the particle size distribution and settling velocity of the total suspended solids found in the stormwater run-off received by the basin. The following particle classes are based primarily upon calibration of run-off concentrations and settling velocity measured under the Nation-Wide Urban Run-off Program:

| PARTICLE CLASS | DESCRIPTION | PERCENT OF TSS | SETTLING VELOCITY (FT/HR) |
|----------------|-----------------|----------------|---------------------------|
| P 0% | Dissolved | 0 | 0 |
| P 10% | 10th Percentile | 20 | 0.03 |
| P 30% | 30th Percentile | 20 | 0.3 |
| P 50% | 50th Percentile | 20 | 1.5 |
| P 80% | 80th Percentile | 40 | 15 |

The first class permits consideration of the dissolved fractions of stormwater run-off quality components.

The storm event used to model water quality is a 1-inch, 24-hour, Type II storm.

II. INTERPRETATION OF P8 WATER QUALITY MODEL RESULTS

The P8 water quality modeling results are summarized on the following table. This table contains the estimated minimum, mean, and maximum concentrations of water quality parameters found in both the inflow to a stormwater treatment basin and the outflow. This table is a summary of all stormwater treatment basins modeled in the City of Shorewood. Minimum is defined as the treatment basin within the City of Shorewood which contains the lowest concentration of these water quality parameters and its inflow, and outflow, as well as, the treatment basin with the lowest removal efficiency of these parameters. Mean is the average concentration of water quality parameters found in the inflow, the outflow and the average treatment efficiency of basins within the City of Shorewood. Maximum is defined as the highest concentration of water quality parameters found in the inflow and outflow. The maximum removal efficiency is that pond in Shorewood which removes the greatest percentage of the water quality parameters from stormwater run-off.

The treatment efficiency of a pond will be somewhat dependent upon the quality of water entering the stormwater treatment basin. A stormwater treatment basin which receives a large volume of stormwater from watersheds which have treated runoff prior to discharge into the downstream pond

will show a reduced treatment or pollutant removal efficiency when compared to treatment basins that only receive untreated runoff..

Included in this Appendix is a breakdown of the treatment efficiencies, as well as, the concentrations of water quality parameters for each stormwater treatment basin proposed for the City of Shorewood. These tables, as well as the P8 input, are contained in **Sections III, IV, V, VI and VII of this Appendix.**

**City of Shorewood
Comprehensive Water Resources Management Plan
P8 Water Quality Monitoring Results**

| | | WATER QUALITY PARAMETERS | | | | | | | | | | | | | |
|--|---------|--------------------------|--------|--------|--------|---------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| | | P 0% | P 10% | P 30% | P 50% | P 80% | TSS | TP | TKN | Cu | Pb | Zn | HC | COD | BOD |
| Concentration In the inflow (PPM) | Minimum | 0.121 | 0.783 | 0.193 | 0.129 | 0.229 | 1.136 | 0.035 | 0.195 | 0.002 | 0.002 | 0.011 | 0.069 | 2.873 | 0.402 |
| | Mean | 0.948 | 14.957 | 14.219 | 13.830 | 27.197 | 47.620 | 0.324 | 1.544 | 0.016 | 0.038 | 0.089 | 1.283 | 60.771 | 8.890 |
| | Maximum | 1.000 | 17.185 | 17.185 | 17.185 | 34.370 | 85.924 | 0.479 | 2.197 | 0.023 | 0.064 | 0.126 | 2.183 | 99.983 | 14.742 |
| Concentration In the outflow (PPM) | Minimum | 0.111 | 0.552 | 0.081 | 0.012 | 0.002 | 0.242 | 0.007 | 0.040 | 0.000 | 0.000 | 0.002 | 0.014 | 0.669 | 0.092 |
| | Mean | 0.796 | 10.083 | 7.583 | 6.250 | 10.684 | 37.389 | 0.283 | 1.366 | 0.014 | 0.030 | 0.079 | 1.039 | 50.655 | 7.380 |
| | Maximum | 1.003 | 16.860 | 16.860 | 16.860 | 33.721 | 84.301 | 0.473 | 2.174 | 0.023 | 0.063 | 0.125 | 2.147 | 98.125 | 14.468 |
| Removal Efficiency of Pond (%) | Minimum | 0.175 | 0.500 | 0.168 | 0.031 | 0.004 | 14.200 | 2.800 | 2.200 | 2.200 | 10.700 | 2.200 | 10.700 | 5.700 | 6.000 |
| | Mean | 0.691 | 38.382 | 54.922 | 65.097 | 73.011 | 78.589 | 43.297 | 36.033 | 36.033 | 67.141 | 36.033 | 67.141 | 65.317 | 66.375 |
| | Maximum | 1.000 | 94.900 | 99.200 | 99.900 | 100.000 | 98.800 | 64.800 | 54.500 | 54.500 | 87.200 | 54.500 | 87.200 | 95.800 | 95.900 |

**City of Shorewood
Comprehensive Water Resources Management Plan
Christmas Lake and Galpin Lake
Watersheds-P8 Results-Model Input**

| Subwatershed Identification | Index Number | Area (acres) | Impervious Fraction | Pervious CN | Treatment Device Number | Infiltration Rate (in/hour) | Flows to Number | Area of Pond (acres) | | | Storage at HWL (acre feet) | Peak Discharge Rate (cfs) |
|-----------------------------|--------------|--------------|---------------------|-------------|-------------------------|-----------------------------|-----------------|----------------------|-------|-------|----------------------------|---------------------------|
| | | | | | | | | Bottom | NWL | HWL | | |
| CL1 | 1 | 10.6 | 0.243 | 68 | 1 | | 3 | 0.3 | 1.0 | 3.3 | 30.0 | 14.1 |
| CL1A | 22 | 47 | 0.240 | 68 | 22 | | 3 | 3.5 | 4.1 | 6.9 | 19.9 | 4.0 |
| CL1B | 23 | 11.1 | 0.240 | 68 | 23 | | 3 | 0.2 | 0.4 | 1.3 | 1.3 | 6.5 |
| CL2 | 2 | 50 | 0.353 | 61 | 2 | | 3 | 8.6 | 9.8 | 11.1 | 44.9 | 3.9 |
| CL3 | 3 | 356.6 | 0.670 | 61 | 3 | | 4 | 239.0 | 254.0 | 269.0 | 1016.0 | 15.8 |
| CL4 | 4 | 8.2 | 0.225 | 61 | 4 | | out | --- | 0.8 | 4.0 | 18.3 | 14.0 |
| CL5 | 5 | 15.9 | 0.300 | 61 | 5 | | 6 | --- | 0.4 | 1.3 | 1.8 | 22.4 |
| CL6 | 6 | 23.7 | 0.434 | 61 | 6 | | out | --- | --- | --- | --- | --- |
| CL7* | 7 | 267.9 | 0.250 | 61 | 7 | | out | --- | --- | --- | --- | --- |
| GL1 | 8 | 32.6 | 0.327 | 61 | 8 | | 9 | 0.5 | 0.8 | 0.9 | 0.5 | 76.8 |
| GL2 | 9 | 49.1 | 0.230 | 61 | 9 | | out | 1.0 | 2.2 | 9.3 | 27.2 | 7.5 |
| GL3 | 10 | 36 | 0.283 | 61 | 10 | | 11 | 2.3 | 3.8 | 4.8 | 11.3 | 10.6 |
| GL4 | 11 | 25.9 | 0.434 | 61 | 11 | | 13 | 0.5 | 1.0 | 3.8 | 10.9 | 24.8 |
| GL5 | 12 | 5.8 | 0.380 | 68 | 12 | | 13 | 0.9 | 2.6 | 3.8 | 9.9 | 0.5 |
| GL6 | 13 | 28.2 | 0.488 | 61 | 13 | | out | --- | 0.2 | 1.4 | 4.9 | 22.5 |
| GL7 | 14 | 43.8 | 0.380 | 61 | 14 | | out | --- | --- | --- | --- | --- |
| GL9 | 16 | 8.5 | 0.250 | 61 | 16 | | 17 | 0.7 | 1.1 | 1.9 | 12.2 | 4.9 |
| GL10 | 17 | 46.8 | 0.434 | 61 | 17 | | out | --- | --- | --- | --- | --- |
| GL11* | 18 | 49.7 | 0.407 | 61 | 18 | | 11 | --- | --- | --- | --- | --- |
| GL12* | 19 | 34.1 | 0.380 | 61 | 19 | | 10 | --- | --- | --- | --- | --- |
| GL13* | 20 | 34 | 0.407 | 61 | 20 | | 9 | --- | --- | --- | --- | --- |
| GL14* | 21 | 19.6 | 0.327 | 61 | 21 | | 8 | --- | --- | --- | --- | --- |

* CL 7 represents the area in Chanhassen tributary to Christmas Lake. Subwatershed parameters were assumed.

Note: Storage is the flood pool available to 100 year HWL. Peak Discharge is the 100 year basin outflow.

* Subwatershed areas outside City boundaries tributary to City of Shorewood.

**City of Shorewood
Comprehensive Water Resources Management Plan
Christmas Lake and Galpin Lake
Watersheds-P8 Results**

PERCENT REMOVAL EFFICIENCY OF TREATMENT DEVICE
FOR EACH PARTICLE CLASS

| Device Number | Subwatershed Number | 1 | 2 | 3 | 4 | 5 |
|---------------|---------------------|-------|--------|--------|--------|--------|
| | | P 0% | P 10% | P 30% | P 50% | P 80% |
| 1 | CB1 | 0.175 | 0.818 | 0.247 | 0.061 | 0.009 |
| 2 | CB2 | 0.529 | 3.792 | 1.401 | 0.541 | 0.104 |
| 3 | CB3 | 0.669 | 5.45 | 2.17 | 1.077 | 0.248 |
| 4 | CB4 | 0.839 | 10.392 | 4.599 | 1.313 | 0.273 |
| 5 | CB5 | 1 | 15.508 | 9.76 | 3.769 | 0.893 |
| 6 | CB6 | 0.468 | 2.606 | 0.889 | 0.249 | 0.04 |
| 7 | CB7 | 0.917 | 8.393 | 4.118 | 1.914 | 0.426 |
| 8 | CB8 | 0.419 | 2.455 | 0.307 | 0.037 | 0.004 |
| 9 | CB9 | 1 | 13.114 | 5.053 | 1.241 | 0.245 |
| 10 | CB10 | 0.434 | 2.618 | 0.326 | 0.04 | 0.005 |
| 11 | CB11 | 0.998 | 11.091 | 2.239 | 0.249 | 0.025 |
| 12 | CB12 | 1 | 4.131 | 0.442 | 0.078 | 0.015 |
| 13 | CB13 | 1 | 4.018 | 0.416 | 0.074 | 0.014 |
| 14 | CB14 | 0.43 | 2.069 | 0.224 | 0.033 | 0.005 |
| 15 | CB15 | 0.646 | 4.404 | 1.89 | 0.875 | 0.19 |
| 16 | CB16 | 1 | 16.849 | 16.849 | 16.849 | 33.698 |
| 17 | CB17 | 0.999 | 15.503 | 9.329 | 3.378 | 0.802 |
| 18 | LW1 | 0.999 | 14.668 | 10.971 | 6.91 | 2.562 |
| 19 | LW2 | 0.208 | 1.235 | 0.168 | 0.031 | 0.004 |
| 20 | SAB1 | 0.54 | 3.639 | 1.445 | 0.619 | 0.123 |
| 21 | SAB2 | 0.433 | 2.563 | 0.691 | 0.169 | 0.026 |
| 22 | SAB3 | 0.429 | 2.805 | 0.673 | 0.165 | 0.025 |
| 23 | SAB4 | 1 | 16.849 | 16.849 | 16.849 | 33.698 |
| 25 | OVERALL | 0.441 | 3.503 | 1.98 | 1.761 | 3.4 |

**City of Shorewood
Comprehensive Water Resources Management Plan
Christmas Lake and Galpin Lake
Watersheds-P8 Results**

PERCENT REMOVAL EFFICIENCY OF TREATMENT DEVICE
FOR EACH WATER QUALITY COMPONENT

| Device Number | Subwatershed Number | TSS | TP | TKN | Cu | Pb | Zn | HC | COD | BOD |
|---------------|---------------------|------|------|------|------|------|------|------|------|------|
| 1 | CL1 | 83.7 | 27.3 | 20.1 | 20.1 | 54.8 | 20.1 | 54.8 | 67.8 | 69 |
| 2 | CL2 | 97.2 | 63.2 | 53.2 | 53.2 | 85.8 | 53.2 | 85.8 | 92.1 | 92.6 |
| 3 | CL3 | 97.5 | 62.7 | 52.6 | 52.6 | 85.7 | 52.6 | 85.7 | 92.5 | 93 |
| 4 | CL4 | 38.9 | 7 | 4.9 | 4.9 | 19.4 | 4.9 | 19.4 | 19.4 | 20.7 |
| 5 | CL5 | 78.3 | 42.6 | 35.9 | 35.9 | 69.2 | 35.9 | 69.2 | 56.7 | 58.9 |
| 6 | CL6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7 | CL7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 8 | GL1 | 74.1 | 38.3 | 32.2 | 32.2 | 65.5 | 32.2 | 65.5 | 52.1 | 54 |
| 9 | GL2 | 85 | 46.3 | 37.9 | 37.9 | 71.6 | 37.9 | 71.6 | 71 | 72.4 |
| 10 | GL3 | 94.4 | 60.1 | 50.6 | 50.6 | 83.4 | 50.6 | 83.4 | 86.7 | 87.5 |
| 11 | GL4 | 72.8 | 34.2 | 28 | 28 | 62 | 28 | 62 | 52 | 53.7 |
| 12 | GL5 | 98.5 | 64.6 | 54.4 | 54.4 | 87 | 54.4 | 87 | 95.2 | 95.4 |
| 13 | GL6 | 42.9 | 12.6 | 9.9 | 9.9 | 32.4 | 9.9 | 32.4 | 21.6 | 22.9 |
| 14 | GL7 | 98.1 | 64.2 | 54.1 | 54.1 | 86.7 | 54.1 | 86.7 | 94.1 | 94.4 |
| 16 | GL9 | 96.9 | 62.9 | 53 | 53 | 85.6 | 53 | 85.6 | 92.1 | 92.5 |
| 17 | GL10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 18 | GL11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 19 | GL12 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 20 | GL13 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 21 | GL14 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 22 | CL1A | 96.8 | 62.7 | 52.8 | 52.8 | 85.5 | 52.8 | 85.5 | 91.6 | 92.1 |
| 23 | CL1B | 88.5 | 53.7 | 45.2 | 45.2 | 78.1 | 45.2 | 78.1 | 77.5 | 78.3 |
| 25 | OVERALL | 88.6 | 56.4 | 47.5 | 47.5 | 78.3 | 47.5 | 78.3 | 81.8 | 82.5 |

**City of Shorewood
Comprehensive Water Resources Management Plan
Christmas Lake and Galpin Lake
Watersheds-P8 Results**

CONCENTRATION (PPM) PRESENT IN THE INFLOW OF EACH TREATMENT DEVICE
FOR EACH PARTICLE CLASS

| Device Number | Subwatershed Number | 1 | 2 | 3 | 4 | 5 |
|---------------|---------------------|-------|--------|--------|--------|--------|
| | | P 0% | P 10% | P 30% | P 50% | P 80% |
| 1 | CL1 | 0.784 | 5.117 | 3.332 | 2.788 | 5.272 |
| 2 | CL2 | 1 | 16.849 | 16.849 | 16.849 | 33.699 |
| 3 | CL3 | 0.938 | 15.328 | 15.2 | 15.175 | 30.337 |
| 4 | CL4 | 0.121 | 0.783 | 0.193 | 0.129 | 0.229 |
| 5 | CL5 | 1 | 16.849 | 16.849 | 16.849 | 33.699 |
| 6 | CL6 | 1 | 15.505 | 12.913 | 11.84 | 23.088 |
| 7 | CL7 | 1 | 16.849 | 16.849 | 16.849 | 33.699 |
| 8 | GL1 | 1 | 16.849 | 16.849 | 16.849 | 33.698 |
| 9 | GL2 | 0.998 | 15.261 | 12.47 | 10.844 | 20.582 |
| 10 | GL3 | 1 | 16.848 | 16.848 | 16.848 | 33.696 |
| 11 | GL4 | 0.794 | 11.125 | 10.033 | 9.783 | 19.427 |
| 12 | GL5 | 1 | 16.829 | 16.829 | 16.829 | 33.659 |
| 13 | GL6 | 0.789 | 9.597 | 6.242 | 4.398 | 6.807 |
| 14 | GL7 | 1 | 16.849 | 16.849 | 16.849 | 33.699 |
| 16 | GL9 | 1 | 16.849 | 16.849 | 16.849 | 33.699 |
| 17 | GL10 | 0.925 | 15.379 | 15.293 | 15.267 | 30.509 |
| 18 | GL11 | 1 | 16.849 | 16.849 | 16.849 | 33.699 |
| 19 | GL12 | 1 | 16.849 | 16.849 | 16.849 | 33.699 |
| 20 | GL13 | 1 | 16.849 | 16.849 | 16.849 | 33.698 |
| 21 | GL14 | 1 | 16.849 | 16.849 | 16.849 | 33.699 |
| 22 | CL1A | 1 | 16.811 | 16.811 | 16.811 | 33.621 |
| 23 | CL1B | 1 | 16.811 | 16.811 | 16.811 | 33.621 |
| 25 | OVERALL | 1 | 16.848 | 16.848 | 16.848 | 33.696 |

**City of Shorewood
Comprehensive Water Resources Management Plan
Christmas Lake and Galpin Lake
Watersheds-P8 Results**

CONCENTRATION (PPM) PRESENT IN THE INFLOW OF EACH TREATMENT DEVICE
FOR EACH WATER QUALITY COMPONENT

| Device Number | Subwatershed Number | TSS | TP | TKN | Cu | Pb | Zn | HC | COD | BOD |
|---------------|---------------------|--------|-------|-------|-------|-------|-------|-------|--------|--------|
| 1 | CB1 | 1.136 | 0.035 | 0.195 | 0.002 | 0.002 | 0.011 | 0.069 | 2.873 | 0.402 |
| 2 | CB2 | 5.839 | 0.12 | 0.645 | 0.007 | 0.008 | 0.037 | 0.264 | 13.365 | 1.878 |
| 3 | CB3 | 8.945 | 0.161 | 0.851 | 0.009 | 0.011 | 0.049 | 0.369 | 19.488 | 2.746 |
| 4 | CB4 | 16.577 | 0.235 | 1.197 | 0.013 | 0.017 | 0.069 | 0.583 | 36.48 | 5.15 |
| 5 | CB5 | 29.93 | 0.339 | 1.657 | 0.017 | 0.027 | 0.095 | 0.923 | 58.888 | 8.448 |
| 6 | CB6 | 3.785 | 0.098 | 0.539 | 0.006 | 0.006 | 0.031 | 0.202 | 9.17 | 1.286 |
| 7 | CB7 | 14.851 | 0.236 | 1.226 | 0.013 | 0.017 | 0.07 | 0.563 | 30.947 | 4.395 |
| 8 | CB8 | 2.803 | 0.084 | 0.469 | 0.005 | 0.005 | 0.027 | 0.168 | 7.827 | 1.072 |
| 9 | CB9 | 19.653 | 0.28 | 1.426 | 0.015 | 0.02 | 0.082 | 0.692 | 44.734 | 6.28 |
| 10 | CB10 | 2.989 | 0.088 | 0.488 | 0.005 | 0.005 | 0.028 | 0.176 | 8.326 | 1.14 |
| 11 | CB11 | 13.604 | 0.243 | 1.284 | 0.013 | 0.016 | 0.074 | 0.556 | 35.039 | 4.825 |
| 12 | CB12 | 4.665 | 0.188 | 1.072 | 0.011 | 0.01 | 0.061 | 0.355 | 13.554 | 1.859 |
| 13 | CB13 | 4.523 | 0.187 | 1.068 | 0.011 | 0.01 | 0.061 | 0.352 | 13.21 | 1.812 |
| 14 | CB14 | 2.332 | 0.083 | 0.468 | 0.005 | 0.005 | 0.027 | 0.16 | 6.677 | 0.915 |
| 15 | CB15 | 7.359 | 0.147 | 0.792 | 0.008 | 0.01 | 0.045 | 0.327 | 16.073 | 2.272 |
| 16 | CB16 | 84.245 | 0.473 | 2.173 | 0.023 | 0.063 | 0.125 | 2.145 | 98.06 | 14.458 |
| 17 | CB17 | 29.012 | 0.334 | 1.636 | 0.017 | 0.026 | 0.094 | 0.903 | 58.07 | 8.311 |
| 18 | LW1 | 35.111 | 0.361 | 1.74 | 0.018 | 0.031 | 0.1 | 1.04 | 60.851 | 8.817 |
| 19 | LW2 | 1.438 | 0.042 | 0.234 | 0.002 | 0.002 | 0.013 | 0.084 | 3.957 | 0.543 |
| 20 | SAB1 | 5.826 | 0.121 | 0.655 | 0.007 | 0.008 | 0.038 | 0.266 | 13.069 | 1.842 |
| 21 | SAB2 | 3.449 | 0.09 | 0.498 | 0.005 | 0.005 | 0.029 | 0.186 | 8.701 | 1.211 |
| 22 | SAB3 | 3.667 | 0.091 | 0.499 | 0.005 | 0.006 | 0.029 | 0.19 | 9.336 | 1.295 |
| 23 | SAB4 | 84.245 | 0.473 | 2.173 | 0.023 | 0.063 | 0.125 | 2.145 | 98.06 | 14.458 |

**City of Shorewood
Comprehensive Water Resources Management Plan
Christmas Lake and Galpin Lake
Watersheds-P8 Results**

CONCENTRATION (PPM) PRESENT IN THE OUTFLOW OF EACH TREATMENT DEVICE
FOR EACH PARTICLE CLASS

| Device Number | Subwatershed Number | 1 | 2 | 3 | 4 | 5 |
|---------------|---------------------|-------|--------|--------|--------|--------|
| | | P 0% | P 10% | P 30% | P 50% | P 80% |
| 1 | CB1 | 1 | 16.612 | 16.612 | 16.612 | 33.225 |
| 2 | CB2 | 0.83 | 13.174 | 13.056 | 13.018 | 26.013 |
| 3 | CB3 | 1 | 16.849 | 16.849 | 16.849 | 33.699 |
| 4 | CB4 | 0.839 | 11.908 | 10.746 | 10.347 | 20.098 |
| 5 | CB5 | 1 | 16.849 | 16.849 | 16.849 | 33.699 |
| 6 | CB6 | 1 | 16.849 | 16.849 | 16.849 | 33.699 |
| 7 | CB7 | 1 | 16.849 | 16.849 | 16.849 | 33.699 |
| 8 | CB8 | 0.872 | 11.442 | 7.421 | 5.031 | 7.99 |
| 9 | CB9 | 1 | 16.849 | 16.849 | 16.849 | 33.699 |
| 10 | CB10 | 0.472 | 3.546 | 1.101 | 0.623 | 1.046 |
| 11 | CB11 | 0.999 | 15.729 | 10.592 | 5.642 | 6.329 |
| 12 | CB12 | 1 | 16.849 | 16.849 | 16.849 | 33.699 |
| 13 | CB13 | 1 | 6.333 | 3.297 | 2.998 | 5.879 |
| 14 | CB14 | 0.539 | 4.299 | 2.024 | 1.73 | 3.38 |
| 15 | CB15 | 1 | 16.849 | 16.849 | 16.849 | 33.699 |
| 16 | CB16 | 1 | 16.849 | 16.849 | 16.849 | 33.699 |
| 17 | CB17 | 1 | 16.849 | 16.849 | 16.849 | 33.699 |
| 18 | LW1 | 1 | 16.849 | 16.849 | 16.849 | 33.699 |
| 19 | LW2 | 1 | 16.221 | 15.157 | 13.987 | 24.733 |
| 20 | SAB1 | 1 | 16.849 | 16.849 | 16.849 | 33.699 |
| 21 | SAB2 | 1 | 16.847 | 16.847 | 16.847 | 33.695 |
| 22 | SAB3 | 1 | 16.849 | 16.849 | 16.849 | 33.699 |
| 23 | SAB4 | 1 | 16.849 | 16.849 | 16.849 | 33.699 |
| 25 | OVERALL | 1 | 16.831 | 16.831 | 16.831 | 33.662 |

**City of Shorewood
Comprehensive Water Resources Management Plan
Christmas Lake and Galpin Lake
Watersheds-P8 Results**

CONCENTRATION (PPM) PRESENT IN THE OUTFLOW OF EACH TREATMENT DEVICE
FOR EACH WATER QUALITY COMPONENT

| Device Number | Subwatershed Number | TSS | TP | TKN | Cu | Pb | Zn | HC | COD | BOD |
|---------------|---------------------|--------|-------|-------|-------|-------|-------|-------|--------|--------|
| 1 | CL1 | 2.67 | 0.111 | 0.636 | 0.007 | 0.006 | 0.036 | 0.209 | 7.418 | 1.029 |
| 2 | CL2 | 1.344 | 0.036 | 0.2 | 0.002 | 0.002 | 0.11 | 0.074 | 3.556 | 0.49 |
| 3 | CL3 | 0.773 | 0.023 | 0.129 | 0.001 | 0.001 | 0.007 | 0.046 | 2.149 | 0.294 |
| 4 | CL4 | 0.814 | 0.024 | 0.135 | 0.001 | 0.001 | 0.008 | 0.048 | 2.248 | 0.308 |
| 5 | CL5 | 18.277 | 0.271 | 1.393 | 0.015 | 0.019 | 0.08 | 0.661 | 42.43 | 5.937 |
| 6 | CL6 | 63.346 | 0.409 | 1.926 | 0.02 | 0.049 | 0.11 | 1.675 | 80.436 | 11.759 |
| 7 | CL7 | 84.246 | 0.473 | 2.173 | 0.023 | 0.063 | 0.125 | 2.146 | 98.062 | 14.459 |
| 8 | GL1 | 21.755 | 0.291 | 1.469 | 0.015 | 0.022 | 0.084 | 0.739 | 46.795 | 6.624 |
| 9 | GL2 | 8.8 | 0.196 | 1.061 | 0.011 | 0.012 | 0.061 | 0.42 | 22.058 | 3.064 |
| 10 | GL3 | 4.312 | 0.108 | 0.596 | 0.006 | 0.007 | 0.034 | 0.225 | 11.076 | 1.534 |
| 11 | GL4 | 13.68 | 0.205 | 1.054 | 0.011 | 0.015 | 0.06 | 0.499 | 29.259 | 4.144 |
| 12 | GL5 | 0.896 | 0.024 | 0.136 | 0.001 | 0.001 | 0.008 | 0.05 | 2.25 | 0.311 |
| 13 | GL6 | 15.433 | 0.22 | 1.121 | 0.012 | 0.016 | 0.064 | 0.545 | 32.797 | 4.656 |
| 14 | GL7 | 0.242 | 0.007 | 0.04 | 0 | 0 | 0.002 | 0.014 | 0.669 | 0.092 |
| 16 | GL9 | 1.9 | 0.045 | 0.246 | 0.003 | 0.003 | 0.014 | 0.095 | 4.573 | 0.639 |
| 17 | GL10 | 76.447 | 0.432 | 1.991 | 0.021 | 0.057 | 0.114 | 1.951 | 89.207 | 13.15 |
| 18 | GL11 | 84.245 | 0.473 | 2.173 | 0.023 | 0.063 | 0.125 | 2.145 | 98.06 | 14.458 |
| 19 | GL12 | 84.244 | 0.473 | 2.173 | 0.023 | 0.063 | 0.125 | 2.145 | 98.059 | 14.458 |
| 20 | GL13 | 84.245 | 0.473 | 2.173 | 0.023 | 0.063 | 0.125 | 2.145 | 98.06 | 14.458 |
| 21 | GL14 | 84.245 | 0.473 | 2.173 | 0.023 | 0.063 | 0.125 | 2.145 | 98.06 | 14.458 |
| 22 | CL1A | 2.692 | 0.127 | 0.731 | 0.008 | 0.007 | 0.042 | 0.234 | 7.76 | 1.075 |
| 23 | CL1B | 9.703 | 0.212 | 1.148 | 0.012 | 0.013 | 0.066 | 0.457 | 21.99 | 3.117 |
| 25 | OVERALL | 9.976 | 0.106 | 0.536 | 0.006 | 0.009 | 0.031 | 0.317 | 16.217 | 2.326 |

**City of Shorewood
Comprehensive Water Resources Management Plan
Carson Bay, Lake William, and St. Albans Bay
Watersheds-P8 Results**

| Subwatershed Identification | Index Number | Area (acres) | Impervious Fraction | Pervious CN | Treatment Device Number | Infiltration Rate (in/hour) | Flows to Number | Area of Pond (acres) | | | Storage at HWL (acre-feet) | Peak Discharge Rate (cfs) |
|-----------------------------|--------------|--------------|---------------------|-------------|-------------------------|-----------------------------|-----------------|----------------------|------|------|----------------------------|---------------------------|
| | | | | | | | | Bottom | NWL | HWL | | |
| CB 1 | 1 | 7.5 | 0.188 | 71 | 1 | | 2 | 0.1 | 1.4 | 3.5 | 16 | 1.2 |
| CB 2 | 2 | 24.9 | 0.215 | 71 | 2 | | 4 | 0.5 | 0.8 | 3.2 | 7.9 | 6.8 |
| CB 3 | 3 | 15.2 | 0.515 | 61 | 3 | | 4 | 0.5 | 0.7 | 1.4 | 7 | 4.1 |
| CB 4 | 4 | 38.0 | 0.569 | 61 | 4 | | 8 | --- | 0.3 | 4.3 | 2.7 | 10 |
| CB 5 | 5 | 13.3 | 0.300 | 66 | 5 | | 8 | --- | 0.1 | 3.0 | 9 | 12.4 |
| CB 6 | 6 | 10.5 | 0.407 | 61 | 6 | | 8 | 0.2 | 1.1 | 2.5 | 9.7 | 2.2 |
| CB 7* | 7 | 26.3 | 0.325 | 61 | 7 | | 8 | 0.2 | 0.4 | 2.4 | 17.2 | 8.4 |
| CB 8 | 8 | 48.8 | 0.325 | 61 | 8 | | 10 | 8.1 | 9.6 | 11.9 | 67.6 | 6.5 |
| CB 9 | 9 | 14.3 | 0.325 | 61 | 9 | | 10 | --- | 0.3 | 1.9 | 7.1 | 12.4 |
| CB 10 | 10 | 6.1 | 0.380 | 61 | 10 | | 14 | 0.6 | 1.0 | 1.9 | 11.3 | 9.3 |
| CB 11 | 11 | 1.5 | 0.200 | 61 | 11 | | 14 | --- | 0.2 | 0.2 | 0.1 | 3.6 |
| CB 12* | 12 | 17.2 | 0.300 | 61 | 12 | | 13 | --- | 1.4 | 2.4 | 12.7 | 8.2 |
| CB 13 | 13 | 3.4 | 0.321 | 71 | 13 | | 14 | --- | 0.3 | 1.5 | 4.8 | 5.9 |
| CB 14 | 14 | 23.0 | 0.407 | 61 | 14 | | out | 2.4 | 3.8 | 5.5 | 23.1 | 25.2 |
| CB 15 | 15 | 4.9 | 0.407 | 61 | 15 | | out | 0.1 | 0.3 | 1.1 | 5.8 | 2.8 |
| CB 16 | 16 | 16.5 | 0.461 | 61 | 16 | | out | --- | --- | --- | --- | --- |
| CB 17 | 17 | 4.6 | 0.325 | 61 | 17 | | 11 | --- | 0.0 | 0.8 | 0.8 | 4.9 |
| LW 1 | 18 | 39.3 | 0.300 | 61 | 18 | | 19 | 0.1 | 0.1 | 1.1 | 3.3 | 36.6 |
| LW 2 | 19 | 71.7 | 0.407 | 61 | 19 | | out | 15.8 | 17.9 | 20.3 | 87.9 | 3 |
| SAB 1 | 20 | 15.1 | 0.250 | 61 | 20 | | out | . | 0.6 | 1.3 | 6.5 | 6.9 |
| SAB 2 | 21 | 16.9 | 0.300 | 67 | 21 | | out | 0.5 | 1.2 | 4.0 | 6.6 | 1.4 |
| SAB 3 | 22 | 38.7 | 0.407 | 61 | 22 | | out | 2.2 | 3.3 | 3.8 | 7.4 | 5.8 |
| SAB 4 | 23 | 21.3 | 0.488 | 61 | 23 | | out | --- | --- | --- | --- | --- |

* CB 7 and CB 12 account for the areas in Deephaven that drain into Shorewood.

Note: Storage is the flood pool available to 100 year HWL. Peak Discharge is the 100 year basin outflow.

City of Shorewood
Comprehensive Water Resources Management Plan
Carson Bay, Lake William, and St. Albans Bay
Watersheds-P8 Results

PERCENT REMOVAL EFFICIENCY OF TREATMENT DEVICE
 FOR EACH PARTICLE CLASS

| Device Number | Subwatershed Number | 1 | 2 | 3 | 4 | 5 |
|---------------|---------------------|------|-------|-------|-------|-------|
| | | P:0% | P:10% | P:30% | P:50% | P:80% |
| 1 | CB1 | 0 | 94.2 | 98.5 | 99.6 | 100 |
| 2 | CB2 | 0 | 69.2 | 89.3 | 95.8 | 99.6 |
| 3 | CB3 | 0 | 65 | 87.1 | 93.6 | 99.3 |
| 4 | CB4 | 0 | 12.7 | 57.2 | 87.3 | 98.6 |
| 5 | CB5 | 0 | 8 | 42.1 | 77.6 | 97.3 |
| 6 | CB6 | 0 | 83.7 | 94.7 | 98.5 | 99.9 |
| 7 | CB7 | 0 | 49.8 | 75.6 | 88.6 | 98.7 |
| 8 | CB8 | 0 | 73.8 | 95.9 | 99.3 | 100 |
| 9 | CB9 | 0 | 22.2 | 70 | 92.6 | 99.3 |
| 10 | CB10 | 0 | 24.9 | 70.4 | 93.6 | 99.6 |
| 11 | CB11 | 0 | 29.5 | 78.8 | 95.6 | 99.6 |
| 12 | CB12 | 0 | 75.5 | 97.4 | 99.5 | 100 |
| 13 | CB13 | 0 | 36.5 | 87.4 | 97.5 | 99.8 |
| 14 | CB14 | 0 | 49.3 | 88.9 | 98.1 | 99.9 |
| 15 | CB15 | 0 | 72.7 | 88.8 | 94.8 | 99.4 |
| 16 | CB16 | 0 | 0 | 0 | 0 | 0 |
| 17 | CB17 | 0 | 8 | 44.6 | 79.9 | 97.6 |
| 18 | LW1 | 0 | 12.9 | 34.8 | 59 | 92.4 |
| 19 | LW2 | 0 | 85.9 | 98.9 | 99.8 | 100 |
| 20 | SAB1 | 0 | 76.6 | 91.4 | 96.3 | 99.6 |
| 21 | SAB2 | 0 | 83.1 | 95.9 | 99 | 99.9 |
| 22 | SAB3 | 0 | 80 | 96 | 99 | 99.9 |
| 23 | SAB4 | 0 | 0 | 0 | 0 | 0 |
| 25 | OVERALL | 0 | 75.4 | 88.2 | 89.5 | 89.9 |

**City of Shorewood
Comprehensive Water Resources Management Plan
Carson Bay, Lake William, and St. Albans Bay
Watersheds-P8 Results**

PERCENT REMOVAL EFFICIENCY OF TREATMENT DEVICE
FOR EACH WATER QUALITY COMPONENT

| Device Number | Subwatershed Number | TSS | TP | TKN | Cu | Pb | Zn | HC | COD | BOD |
|---------------|---------------------|------|------|------|------|------|------|------|------|------|
| 1 | CB1 | 98.5 | 64.3 | 54.1 | 54.1 | 86.8 | 54.1 | 86.8 | 95.3 | 95.4 |
| 2 | CB2 | 90.7 | 54.9 | 45.9 | 45.9 | 79.4 | 45.9 | 79.4 | 80.9 | 81.8 |
| 3 | CB3 | 88.8 | 54.3 | 45.7 | 45.7 | 78.5 | 45.7 | 78.5 | 78.3 | 79.3 |
| 4 | CB4 | 68.8 | 30.6 | 25.1 | 25.1 | 58.5 | 25.1 | 58.5 | 43.9 | 46 |
| 5 | CB5 | 64.5 | 28.2 | 23.8 | 23.8 | 57 | 23.8 | 57 | 39.9 | 41.6 |
| 6 | CB6 | 95.3 | 61.2 | 51.5 | 51.5 | 84.2 | 51.5 | 84.2 | 89.4 | 89.9 |
| 7 | CB7 | 82.3 | 47.3 | 39.8 | 39.8 | 72.7 | 39.8 | 72.7 | 68.1 | 69.3 |
| 8 | CB8 | 89.5 | 44.4 | 35 | 35 | 68.7 | 35 | 68.7 | 79.8 | 80.7 |
| 9 | CB9 | 76.7 | 40.8 | 34.4 | 34.4 | 67.7 | 34.4 | 67.7 | 54.4 | 56.6 |
| 10 | CB10 | 52 | 12.9 | 9.3 | 9.3 | 28.4 | 9.3 | 28.4 | 33.7 | 35.2 |
| 11 | CB11 | 64.5 | 31.9 | 25.6 | 25.6 | 50 | 25.6 | 50 | 45.9 | 48.3 |
| 12 | CB12 | 94.5 | 60.2 | 50.7 | 50.7 | 83.5 | 50.7 | 83.5 | 86.2 | 87.1 |
| 13 | CB13 | 75.6 | 21.2 | 15.4 | 15.4 | 47.2 | 15.4 | 47.2 | 53.2 | 55.2 |
| 14 | CB14 | 78.6 | 25.6 | 19 | 19 | 51.6 | 19 | 51.6 | 60.6 | 62.1 |
| 15 | CB15 | 91 | 56.6 | 47.7 | 47.7 | 80.4 | 47.7 | 80.4 | 82.5 | 83.2 |
| 16 | CB16 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 17 | CB17 | 65.6 | 29.3 | 24.7 | 24.7 | 57.9 | 24.7 | 57.9 | 40.8 | 42.5 |
| 18 | LW1 | 58.3 | 23.6 | 19.8 | 19.8 | 51.5 | 19.8 | 51.5 | 37.9 | 39 |
| 19 | LW2 | 96.4 | 60.3 | 50.2 | 50.2 | 83.2 | 50.2 | 83.2 | 90.7 | 91.3 |
| 20 | SAB1 | 92.7 | 58.4 | 49.2 | 49.2 | 81.9 | 49.2 | 81.9 | 85.1 | 85.7 |
| 21 | SAB2 | 95.6 | 61.4 | 51.7 | 51.7 | 84.4 | 51.7 | 84.4 | 89.4 | 90 |
| 22 | SAB3 | 95 | 60.8 | 51.2 | 51.2 | 83.9 | 51.2 | 83.9 | 88 | 88.7 |
| 23 | SAB4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 25 | OVERALL | 86.6 | 55.9 | 47.1 | 47.1 | 76.5 | 47.1 | 76.5 | 81.2 | 81.8 |

**City of Shorewood
Comprehensive Water Resources Management Plan
Carson Bay, Lake William, and St. Albans Bay
Watersheds-P8 Results**

CONCENTRATION (PPM) PRESENT IN THE INFLOW OF EACH TREATMENT DEVICE
FOR EACH PARTICLE CLASS

| Device Number | Subwatershed Number | 1 | 2 | 3 | 4 | 5 |
|---------------|---------------------|-------|--------|--------|--------|--------|
| | | P.0% | P.10% | P.30% | P.50% | P.80% |
| 1 | CB1 | 1 | 16.612 | 16.612 | 16.612 | 33.225 |
| 2 | CB2 | 0.83 | 13.174 | 13.056 | 13.018 | 26.013 |
| 3 | CB3 | 1 | 16.849 | 16.849 | 16.849 | 33.699 |
| 4 | CB4 | 0.839 | 11.908 | 10.746 | 10.347 | 20.098 |
| 5 | CB5 | 1 | 16.849 | 16.849 | 16.849 | 33.699 |
| 6 | CB6 | 1 | 16.849 | 16.849 | 16.849 | 33.699 |
| 7 | CB7 | 1 | 16.849 | 16.849 | 16.849 | 33.699 |
| 8 | CB8 | 0.872 | 11.442 | 7.421 | 5.031 | 7.99 |
| 9 | CB9 | 1 | 16.849 | 16.849 | 16.849 | 33.699 |
| 10 | CB10 | 0.472 | 3.546 | 1.101 | 0.623 | 1.046 |
| 11 | CB11 | 0.999 | 15.729 | 10.592 | 5.642 | 6.329 |
| 12 | CB12 | 1 | 16.849 | 16.849 | 16.849 | 33.699 |
| 13 | CB13 | 1 | 6.333 | 3.297 | 2.998 | 5.879 |
| 14 | CB14 | 0.539 | 4.299 | 2.024 | 1.73 | 3.38 |
| 15 | CB15 | 1 | 16.849 | 16.849 | 16.849 | 33.699 |
| 16 | CB16 | 1 | 16.849 | 16.849 | 16.849 | 33.699 |
| 17 | CB17 | 1 | 16.849 | 16.849 | 16.849 | 33.699 |
| 18 | LW1 | 1 | 16.849 | 16.849 | 16.849 | 33.699 |
| 19 | LW2 | 1 | 16.221 | 15.157 | 13.987 | 24.733 |
| 20 | SAB1 | 1 | 16.849 | 16.849 | 16.849 | 33.699 |
| 21 | SAB2 | 1 | 16.847 | 16.847 | 16.847 | 33.695 |
| 22 | SAB3 | 1 | 16.849 | 16.849 | 16.849 | 33.699 |
| 23 | SAB4 | 1 | 16.849 | 16.849 | 16.849 | 33.699 |
| 25 | OVERALL | 1 | 16.831 | 16.831 | 16.831 | 33.662 |

**City of Shorewood
Comprehensive Water Resources Management Plan
Carson Bay, Lake William, and St. Albans Bay
Watersheds-P8 Results**

CONCENTRATION (PPM) PRESENT IN THE INFLOW OF EACH TREATMENT DEVICE
FOR EACH WATER QUALITY COMPONENT

| Device Number | Subwatershed Number | TSS | TP | TKN | Cu | Pb | Zn | HC | COD | BOD |
|---------------|---------------------|--------|-------|-------|-------|-------|-------|-------|--------|--------|
| 1 | CB1 | 1.136 | 0.035 | 0.195 | 0.002 | 0.002 | 0.011 | 0.069 | 2.873 | 0.402 |
| 2 | CB2 | 5.839 | 0.12 | 0.645 | 0.007 | 0.008 | 0.037 | 0.264 | 13.365 | 1.878 |
| 3 | CB3 | 8.945 | 0.161 | 0.851 | 0.009 | 0.011 | 0.049 | 0.369 | 19.488 | 2.746 |
| 4 | CB4 | 16.577 | 0.235 | 1.197 | 0.013 | 0.017 | 0.069 | 0.583 | 36.48 | 5.15 |
| 5 | CB5 | 29.93 | 0.339 | 1.657 | 0.017 | 0.027 | 0.095 | 0.923 | 58.888 | 8.448 |
| 6 | CB6 | 3.785 | 0.098 | 0.539 | 0.006 | 0.006 | 0.031 | 0.202 | 9.17 | 1.286 |
| 7 | CB7 | 14.851 | 0.236 | 1.226 | 0.013 | 0.017 | 0.07 | 0.563 | 30.947 | 4.395 |
| 8 | CB8 | 2.803 | 0.084 | 0.469 | 0.005 | 0.005 | 0.027 | 0.168 | 7.827 | 1.072 |
| 9 | CB9 | 19.653 | 0.28 | 1.426 | 0.015 | 0.02 | 0.082 | 0.692 | 44.734 | 6.28 |
| 10 | CB10 | 2.989 | 0.088 | 0.488 | 0.005 | 0.005 | 0.028 | 0.176 | 8.326 | 1.14 |
| 11 | CB11 | 13.604 | 0.243 | 1.284 | 0.013 | 0.016 | 0.074 | 0.556 | 35.039 | 4.825 |
| 12 | CB12 | 4.665 | 0.188 | 1.072 | 0.011 | 0.01 | 0.061 | 0.355 | 13.554 | 1.859 |
| 13 | CB13 | 4.523 | 0.187 | 1.068 | 0.011 | 0.01 | 0.061 | 0.352 | 13.21 | 1.812 |
| 14 | CB14 | 2.332 | 0.083 | 0.468 | 0.005 | 0.005 | 0.027 | 0.16 | 6.677 | 0.915 |
| 15 | CB15 | 7.359 | 0.147 | 0.792 | 0.008 | 0.01 | 0.045 | 0.327 | 16.073 | 2.272 |
| 16 | CB16 | 84.245 | 0.473 | 2.173 | 0.023 | 0.063 | 0.125 | 2.145 | 98.06 | 14.458 |
| 17 | CB17 | 29.012 | 0.334 | 1.636 | 0.017 | 0.026 | 0.094 | 0.903 | 58.07 | 8.311 |
| 18 | LW1 | 35.111 | 0.361 | 1.74 | 0.018 | 0.031 | 0.1 | 1.04 | 60.851 | 8.817 |
| 19 | LW2 | 1.438 | 0.042 | 0.234 | 0.002 | 0.002 | 0.013 | 0.084 | 3.957 | 0.543 |
| 20 | SAB1 | 5.826 | 0.121 | 0.655 | 0.007 | 0.008 | 0.038 | 0.266 | 13.069 | 1.842 |
| 21 | SAB2 | 3.449 | 0.09 | 0.498 | 0.005 | 0.005 | 0.029 | 0.186 | 8.701 | 1.211 |
| 22 | SAB3 | 3.667 | 0.091 | 0.499 | 0.005 | 0.006 | 0.029 | 0.19 | 9.336 | 1.295 |
| 23 | SAB4 | 84.245 | 0.473 | 2.173 | 0.023 | 0.063 | 0.125 | 2.145 | 98.06 | 14.458 |
| 25 | OVERALL | 10.644 | 0.115 | 0.597 | 0.006 | 0.01 | 0.034 | 0.35 | 15.777 | 2.268 |

**City of Shorewood
Comprehensive Water Resources Management Plan
Carson Bay, Lake William, and St. Albans Bay
Watersheds-P8 Results**

CONCENTRATION (PPM) PRESENT IN THE OUTFLOW OF EACH TREATMENT DEVICE
FOR EACH PARTICLE CLASS

| Device Number | Subwatershed Number | 1 | 2 | 3 | 4 | 5 |
|---------------|---------------------|-------|--------|--------|--------|--------|
| | | P 0% | P 10% | P 30% | P 50% | P 80% |
| 1 | CB1 | 0.175 | 0.818 | 0.247 | 0.061 | 0.009 |
| 2 | CB2 | 0.529 | 3.792 | 1.401 | 0.541 | 0.104 |
| 3 | CB3 | 0.669 | 5.45 | 2.17 | 1.077 | 0.248 |
| 4 | CB4 | 0.839 | 10.392 | 4.599 | 1.313 | 0.273 |
| 5 | CB5 | 1 | 15.508 | 9.76 | 3.769 | 0.893 |
| 6 | CB6 | 0.468 | 2.606 | 0.889 | 0.249 | 0.04 |
| 7 | CB7 | 0.917 | 8.393 | 4.118 | 1.914 | 0.426 |
| 8 | CB8 | 0.419 | 2.455 | 0.307 | 0.037 | 0.004 |
| 9 | CB9 | 1 | 13.114 | 5.053 | 1.241 | 0.245 |
| 10 | CB10 | 0.434 | 2.618 | 0.326 | 0.04 | 0.005 |
| 11 | CB11 | 0.998 | 11.091 | 2.239 | 0.249 | 0.025 |
| 12 | CB12 | 1 | 4.131 | 0.442 | 0.078 | 0.015 |
| 13 | CB13 | 1 | 4.018 | 0.416 | 0.074 | 0.014 |
| 14 | CB14 | 0.43 | 2.069 | 0.224 | 0.033 | 0.005 |
| 15 | CB15 | 0.646 | 4.404 | 1.89 | 0.875 | 0.19 |
| 16 | CB16 | 1 | 16.849 | 16.849 | 16.849 | 33.698 |
| 17 | CB17 | 0.999 | 15.503 | 9.329 | 3.378 | 0.802 |
| 18 | LW1 | 0.999 | 14.668 | 10.971 | 6.91 | 2.562 |
| 19 | LW2 | 0.208 | 1.235 | 0.168 | 0.031 | 0.004 |
| 20 | SAB1 | 0.54 | 3.639 | 1.445 | 0.619 | 0.123 |
| 21 | SAB2 | 0.433 | 2.563 | 0.691 | 0.169 | 0.026 |
| 22 | SAB3 | 0.429 | 2.805 | 0.673 | 0.165 | 0.025 |
| 23 | SAB4 | 1 | 16.849 | 16.849 | 16.849 | 33.698 |
| 25 | OVERALL | 0.441 | 3.503 | 1.98 | 1.761 | 3.4 |

**City of Shorewood
Comprehensive Water Resources Management Plan
Carson Bay, Lake William, and St. Albans Bay
Watersheds-P8 Results**

CONCENTRATION (PPM) PRESENT IN THE OUTFLOW OF EACH TREATMENT DEVICE
FOR EACH WATER QUALITY COMPONENT

| Device Number | Subwatershed Number | TSS | TP | TKN | Cu | Pb | Zn | HC | COD | BOD |
|---------------|---------------------|--------|-------|-------|-------|-------|-------|-------|--------|--------|
| 1 | CB1 | 83.062 | 0.468 | 2.156 | 0.023 | 0.062 | 0.124 | 2.119 | 96.706 | 14.259 |
| 2 | CB2 | 65.262 | 0.376 | 1.739 | 0.018 | 0.049 | 0.1 | 1.676 | 76.318 | 11.248 |
| 3 | CB3 | 84.246 | 0.473 | 2.173 | 0.023 | 0.063 | 0.125 | 2.146 | 98.062 | 14.459 |
| 4 | CB4 | 53.099 | 0.338 | 1.598 | 0.017 | 0.041 | 0.092 | 1.404 | 65.011 | 9.54 |
| 5 | CB5 | 84.246 | 0.473 | 2.173 | 0.023 | 0.063 | 0.125 | 2.146 | 98.062 | 14.459 |
| 6 | CB6 | 84.246 | 0.473 | 2.173 | 0.023 | 0.063 | 0.125 | 2.146 | 98.062 | 14.459 |
| 7 | CB7 | 84.246 | 0.473 | 2.173 | 0.023 | 0.063 | 0.125 | 2.146 | 98.062 | 14.459 |
| 8 | CB8 | 31.885 | 0.287 | 1.411 | 0.015 | 0.027 | 0.081 | 0.935 | 49.543 | 7.146 |
| 9 | CB9 | 84.246 | 0.473 | 2.173 | 0.023 | 0.063 | 0.125 | 2.146 | 98.062 | 14.459 |
| 10 | CB10 | 6.316 | 0.108 | 0.58 | 0.006 | 0.008 | 0.033 | 0.26 | 12.834 | 1.799 |
| 11 | CB11 | 38.292 | 0.357 | 1.726 | 0.018 | 0.033 | 0.099 | 1.111 | 64.789 | 9.344 |
| 12 | CB12 | 84.246 | 0.473 | 2.173 | 0.023 | 0.063 | 0.125 | 2.146 | 98.062 | 14.459 |
| 13 | CB13 | 18.506 | 0.238 | 1.263 | 0.013 | 0.02 | 0.072 | 0.666 | 28.232 | 4.048 |
| 14 | CB14 | 11.432 | 0.136 | 0.711 | 0.007 | 0.012 | 0.041 | 0.392 | 18.15 | 2.59 |
| 15 | CB15 | 84.246 | 0.473 | 2.173 | 0.023 | 0.063 | 0.125 | 2.146 | 98.062 | 14.459 |
| 16 | CB16 | 84.246 | 0.473 | 2.173 | 0.023 | 0.063 | 0.125 | 2.146 | 98.062 | 14.459 |
| 17 | CB17 | 84.246 | 0.473 | 2.173 | 0.023 | 0.063 | 0.125 | 2.146 | 98.062 | 14.459 |
| 18 | LW1 | 84.246 | 0.473 | 2.173 | 0.023 | 0.063 | 0.125 | 2.146 | 98.062 | 14.459 |
| 19 | LW2 | 70.098 | 0.441 | 2.049 | 0.021 | 0.054 | 0.117 | 1.827 | 87.348 | 12.834 |
| 20 | SAB1 | 84.246 | 0.473 | 2.173 | 0.023 | 0.063 | 0.125 | 2.146 | 98.062 | 14.459 |
| 21 | SAB2 | 84.237 | 0.473 | 2.173 | 0.023 | 0.063 | 0.125 | 2.145 | 98.052 | 14.457 |
| 22 | SAB3 | 84.246 | 0.473 | 2.173 | 0.023 | 0.063 | 0.125 | 2.146 | 98.062 | 14.459 |
| 23 | SAB4 | 84.246 | 0.473 | 2.173 | 0.023 | 0.063 | 0.125 | 2.146 | 98.062 | 14.459 |
| 25 | OVERALL | 84.156 | 0.472 | 2.172 | 0.023 | 0.063 | 0.125 | 2.144 | 97.959 | 14.443 |

**City of Shorewood
Comprehensive Water Resources Management Plan
Purgatory Creek Watersheds-P8 Results**

| Subwatershed Identification | Index Number | Area (acres) | Impervious Fraction | Pervious CN | Treatment Device Number | Infiltration Rate (in/hour) | Flows to Number | Area of Pond (acres) | | | Storage at HWL (acre-feet) | Peak Discharge Rate (cfs) |
|-----------------------------|--------------|--------------|---------------------|-------------|-------------------------|-----------------------------|-----------------|----------------------|------|------|----------------------------|---------------------------|
| | | | | | | | | Bottom | NWL | HWL | | |
| PC1 | 1 | 4.9 | 0.380 | 61 | 1 | | 4 | 0.2 | 0.4 | 0.6 | 1.9 | 6.9 |
| PC2 | 2 | 10.3 | 0.353 | 61 | 2 | | 3 | 0.1 | 0.2 | 3.9 | 11.8 | 8.7 |
| PC3 | 3 | 18.1 | 0.380 | 61 | 3 | | 5 | --- | 1.0 | 2.2 | 3.9 | 6.1 |
| PC4 | 4 | 19.3 | 0.318 | 66 | 4 | | 5 | 0.5 | 0.8 | 0.9 | 0.9 | 2.9 |
| PC5 | 5 | 20.2 | 0.311 | 67 | 5 | | 6 | 0.5 | 1.0 | 5.9 | 15.3 | 7.5 |
| PC6 | 6 | 183 | 0.380 | 61 | 6 | | 7 | 21.6 | 24.0 | 27.0 | 127.5 | 12.4 |
| PC7 | 7 | 16.3 | 0.327 | 61 | 7 | | 11 | --- | 0.0 | 2.9 | 11.7 | 54.3 |
| PC8 | 8 | 11.8 | 0.100 | 68 | 8 | | 11 | 0.4 | 1.6 | 5.9 | 50.7 | 13.6 |
| PC9 | 9 | 26.9 | 0.380 | 61 | 9 | | 10 | 0.1 | 0.7 | 2.1 | 4.9 | 6.5 |
| PC10 | 10 | 65.9 | 0.353 | 61 | 10 | | 11 | 0.2 | 0.5 | 13.7 | 65.0 | 94.1 |
| PC11 | 11 | 64.3 | 0.407 | 61 | 11 | | out | 0.5 | 1.0 | 13.5 | 28.7 | 101.0 |
| PC12 | 12 | 3.0 | 0.380 | 61 | 12 | | out | --- | --- | --- | --- | --- |
| PC13 | 13 | 10.0 | 0.380 | 68 | 13 | | out | --- | --- | --- | --- | --- |
| PC14* | 14 | 245.7 | 0.407 | 61 | 14 | | 11 | --- | --- | --- | --- | --- |
| PC15* | 15 | 104.2 | 0.461 | 61 | 15 | | 6 | --- | --- | --- | --- | --- |

* Subwatershed PC 14 represents the area in Minnetonka that contributes stormwater to Shorewood. Likewise, subwatershed PC 15 represents the area in Chanhassen that is tributary to Silver Lake.

Note: Storage is the flood pool available to 100 year HWL. Peak Discharge is the 100 year basin outflow.

**City of Shorewood
Comprehensive Water Resources Management Plan
Purgatory Creek Watersheds-P8 Results**

PERCENT REMOVAL EFFICIENCY OF TREATMENT DEVICE
FOR EACH PARTICLE CLASS

| Device Number | Subwatershed Number | 1 | 2 | 3 | 4 | 5 |
|---------------|---------------------|------|-------|-------|-------|-------|
| | | P 0% | P 10% | P 30% | P 50% | P 80% |
| 1 | PC1 | 0 | 80.7 | 93.3 | 97 | 99.7 |
| 2 | PC2 | 0 | 54.7 | 80.3 | 92.5 | 99.3 |
| 3 | PC3 | 0 | 32.2 | 81.1 | 95.9 | 99.6 |
| 4 | PC4 | 0 | 64.3 | 82.8 | 92.9 | 99.3 |
| 5 | PC5 | 0 | 49.7 | 82.5 | 95.9 | 99.7 |
| 6 | PC6 | 0 | 76.9 | 97.5 | 99.5 | 100 |
| 7 | PC7 | 0 | 3.4 | 25.6 | 63.4 | 94.7 |
| 8 | PC8 | 0 | 94.9 | 99.1 | 99.8 | 100 |
| 9 | PC9 | 0 | 58 | 82 | 94.4 | 99.5 |
| 10 | PC10 | 0 | 24.1 | 57.1 | 84 | 98.2 |
| 11 | PC11 | 0 | 8.1 | 40.2 | 76.1 | 97.1 |
| 12 | PC12 | 0 | 0 | 0 | 0 | 0 |
| 13 | PC13 | 0 | 0 | 0 | 0 | 0 |
| 14 | PC14 | 0 | 0 | 0 | 0 | 0 |
| 15 | PC15 | 0 | 0 | 0 | 0 | 0 |
| 25 | OVERALL | 0 | 45.3 | 71.1 | 88.3 | 97.2 |

**City of Shorewood
Comprehensive Water Resources Management Plan
Purgatory Creek Watersheds-P8 Results**

PERCENT REMOVAL EFFICIENCY OF TREATMENT DEVICE
FOR EACH WATER QUALITY COMPONENT

| Device Number | Subwatershed Number | TSS | TP | TKN | Cu | Pb | Zn | HC | COD | BOD |
|---------------|---------------------|------|------|------|------|------|------|------|------|------|
| 1 | PC1 | 94.1 | 60.3 | 50.9 | 50.9 | 83.3 | 50.9 | 83.3 | 87.5 | 88.1 |
| 2 | PC2 | 85.2 | 50.3 | 42.3 | 42.3 | 75.3 | 42.3 | 75.3 | 71.9 | 73.1 |
| 3 | PC3 | 79.6 | 40.8 | 33.4 | 33.4 | 67.5 | 33.4 | 67.5 | 59.1 | 61.3 |
| 4 | PC4 | 87.5 | 51.1 | 42.6 | 42.6 | 76.3 | 42.6 | 76.3 | 76.6 | 77.5 |
| 5 | PC5 | 78.8 | 33.1 | 25.6 | 25.6 | 58.9 | 25.6 | 58.9 | 62.4 | 63.9 |
| 6 | PC6 | 94.6 | 57.7 | 48 | 48 | 82.1 | 48 | 82.1 | 86.4 | 87.3 |
| 7 | PC7 | 32.9 | 5 | 3.6 | 3.6 | 18.4 | 3.6 | 18.4 | 13.4 | 14.4 |
| 8 | PC8 | 98.8 | 64.8 | 54.5 | 54.5 | 87.2 | 54.5 | 87.2 | 95.8 | 95.9 |
| 9 | PC9 | 86.7 | 51.8 | 43.6 | 43.6 | 76.6 | 43.6 | 76.6 | 74.1 | 75.2 |
| 10 | PC10 | 70.5 | 32.5 | 26.7 | 26.7 | 60.1 | 26.7 | 60.1 | 49.3 | 50.9 |
| 11 | PC11 | 59.6 | 22 | 17.8 | 17.8 | 49.4 | 17.8 | 49.4 | 34.8 | 36.4 |
| 12 | PC12 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 13 | PC13 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 14 | PC14 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 15 | PC15 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 25 | OVERALL | 79.9 | 45.2 | 38.1 | 38.1 | 70.5 | 38.1 | 70.5 | 64.8 | 65.9 |

**City of Shorewood
Comprehensive Water Resources Management Plan
Purgatory Creek Watersheds-P8 Results**

CONCENTRATION (PPM) PRESENT IN THE INFLOW OF EACH TREATMENT DEVICE
FOR EACH PARTICLE CLASS

| Device Number | Subwatershed Number | 1 | 2 | 3 | 4 | 5 |
|---------------|---------------------|-------|--------|--------|--------|--------|
| | | P 0% | P 10% | P 30% | P 50% | P 80% |
| 1 | PC1 | 1 | 17.185 | 17.185 | 17.185 | 34.37 |
| 2 | PC2 | 1 | 16.849 | 16.849 | 16.849 | 33.699 |
| 3 | PC3 | 0.961 | 13.637 | 12.171 | 11.458 | 22.132 |
| 4 | PC4 | 0.872 | 13.659 | 13.252 | 13.105 | 26 |
| 5 | PC5 | 0.89 | 9.771 | 5.998 | 4.785 | 8.663 |
| 6 | PC6 | 0.962 | 14.768 | 14.105 | 13.957 | 27.851 |
| 7 | PC7 | 0.422 | 3.064 | 0.958 | 0.682 | 1.24 |
| 8 | PC8 | 1 | 16.74 | 16.74 | 16.74 | 33.48 |
| 9 | PC9 | 1 | 16.849 | 16.849 | 16.849 | 33.699 |
| 10 | PC10 | 0.97 | 13.861 | 12.633 | 11.995 | 23.465 |
| 11 | PC11 | 0.716 | 9.482 | 7.856 | 7.253 | 13.927 |
| 12 | PC12 | 1 | 16.849 | 16.849 | 16.849 | 33.699 |
| 13 | PC13 | 1 | 16.829 | 16.829 | 16.829 | 33.659 |
| 14 | PC14 | 1 | 16.849 | 16.849 | 16.849 | 33.699 |
| 15 | PC15 | 1 | 16.849 | 16.849 | 16.849 | 33.699 |
| 25 | OVERALL | 1 | 16.851 | 16.851 | 16.851 | 33.701 |

**City of Shorewood
Comprehensive Water Resources Management Plan
Purgatory Creek Watersheds-P8 Results**

CONCENTRATION (PPM) PRESENT IN THE INFLOW OF EACH TREATMENT DEVICE
FOR EACH WATER QUALITY COMPONENT

| Device Number | Subwatershed Number | TSS | TP | TKN | Cu | Pb | Zn | HC | COD | BOD |
|---------------|---------------------|--------|-------|-------|-------|-------|-------|-------|--------|--------|
| 1 | PC1 | 85.924 | 0.479 | 2.197 | 0.023 | 0.064 | 0.126 | 2.183 | 99.983 | 14.742 |
| 2 | PC2 | 84.246 | 0.473 | 2.173 | 0.023 | 0.063 | 0.125 | 2.146 | 98.062 | 14.459 |
| 3 | PC3 | 59.398 | 0.384 | 1.817 | 0.019 | 0.046 | 0.104 | 1.577 | 73.54 | 10.786 |
| 4 | PC4 | 66.016 | 0.387 | 1.797 | 0.019 | 0.05 | 0.103 | 1.703 | 78.001 | 11.485 |
| 5 | PC5 | 29.217 | 0.269 | 1.348 | 0.014 | 0.026 | 0.077 | 0.88 | 43.492 | 6.267 |
| 6 | PC6 | 70.682 | 0.419 | 1.952 | 0.02 | 0.054 | 0.112 | 1.831 | 83.82 | 12.333 |
| 7 | PC7 | 5.944 | 0.096 | 0.518 | 0.005 | 0.007 | 0.03 | 0.239 | 11.403 | 1.601 |
| 8 | PC8 | 83.7 | 0.471 | 2.165 | 0.023 | 0.063 | 0.124 | 2.133 | 97.436 | 14.366 |
| 9 | PC9 | 84.246 | 0.473 | 2.173 | 0.023 | 0.063 | 0.125 | 2.146 | 98.062 | 14.459 |
| 10 | PC10 | 61.954 | 0.393 | 1.855 | 0.019 | 0.048 | 0.106 | 1.636 | 75.827 | 11.132 |
| 11 | PC11 | 38.518 | 0.267 | 1.277 | 0.013 | 0.031 | 0.073 | 1.046 | 49.199 | 7.191 |
| 12 | PC12 | 84.246 | 0.473 | 2.173 | 0.023 | 0.063 | 0.125 | 2.146 | 98.062 | 14.459 |
| 13 | PC13 | 84.147 | 0.472 | 2.172 | 0.023 | 0.063 | 0.125 | 2.143 | 97.948 | 14.442 |
| 14 | PC14 | 84.246 | 0.473 | 2.173 | 0.023 | 0.063 | 0.125 | 2.146 | 98.062 | 14.459 |
| 15 | PC15 | 84.246 | 0.473 | 2.173 | 0.023 | 0.063 | 0.125 | 2.146 | 98.062 | 14.459 |
| 25 | OVERALL | 84.253 | 0.473 | 2.173 | 0.023 | 0.063 | 0.125 | 2.146 | 98.069 | 14.46 |

**City of Shorewood
Comprehensive Water Resources Management Plan
Purgatory Creek Watersheds-P8 Results**

CONCENTRATION (PPM) PRESENT IN THE OUTFLOW OF EACH TREATMENT DEVICE
FOR EACH PARTICLE CLASS

| Device Number | Subwatershed Number | 1 | 2 | 3 | 4 | 5 |
|---------------|---------------------|-------|--------|--------|--------|--------|
| | | P 0% | P 10% | P 30% | P 50% | P 80% |
| 1 | PC1 | 0.44 | 2.929 | 1.153 | 0.514 | 0.105 |
| 2 | PC2 | 0.886 | 7.56 | 3.323 | 1.261 | 0.251 |
| 3 | PC3 | 0.961 | 9.239 | 2.303 | 0.469 | 0.089 |
| 4 | PC4 | 0.709 | 4.86 | 2.292 | 0.942 | 0.181 |
| 5 | PC5 | 0.784 | 4.866 | 1.05 | 0.197 | 0.028 |
| 6 | PC6 | 0.4 | 2.543 | 0.357 | 0.07 | 0.012 |
| 7 | PC7 | 0.42 | 2.958 | 0.714 | 0.249 | 0.066 |
| 8 | PC8 | 0.111 | 0.552 | 0.152 | 0.037 | 0.006 |
| 9 | PC9 | 0.902 | 7.058 | 3.035 | 0.945 | 0.169 |
| 10 | PC10 | 0.956 | 10.51 | 5.42 | 1.916 | 0.413 |
| 11 | PC11 | 0.708 | 8.698 | 4.696 | 1.734 | 0.411 |
| 12 | PC12 | 0.999 | 16.848 | 16.848 | 16.848 | 33.697 |
| 13 | PC13 | 1 | 16.829 | 16.829 | 16.829 | 33.658 |
| 14 | PC14 | 1 | 16.849 | 16.849 | 16.849 | 33.698 |
| 15 | PC15 | 1 | 16.849 | 16.849 | 16.849 | 33.698 |
| 25 | OVERALL | 0.713 | 8.827 | 4.888 | 1.973 | 0.938 |

**City of Shorewood
Comprehensive Water Resources Management Plan
Purgatory Creek Watersheds-P8 Results**

CONCENTRATION (PPM) PRESENT IN THE OUTFLOW OF EACH TREATMENT DEVICE
FOR EACH WATER QUALITY COMPONENT

| Device Number | Subwatershed Number | TSS | TP | TKN | Cu | Pb | Zn | Hg | COD | BOD |
|---------------|---------------------|--------|-------|-------|-------|-------|-------|-------|--------|--------|
| 1 | PC1 | 4.701 | 0.099 | 0.533 | 0.006 | 0.006 | 0.031 | 0.216 | 10.529 | 1.484 |
| 2 | PC2 | 12.394 | 0.217 | 1.142 | 0.012 | 0.015 | 0.065 | 0.5 | 27.152 | 3.838 |
| 3 | PC3 | 12.101 | 0.228 | 1.21 | 0.013 | 0.015 | 0.069 | 0.512 | 30.114 | 4.172 |
| 4 | PC4 | 8.275 | 0.163 | 0.875 | 0.009 | 0.011 | 0.05 | 0.364 | 17.95 | 2.546 |
| 5 | PC5 | 6.14 | 0.163 | 0.9 | 0.009 | 0.01 | 0.052 | 0.334 | 16.058 | 2.222 |
| 6 | PC6 | 2.982 | 0.082 | 0.455 | 0.005 | 0.005 | 0.026 | 0.167 | 8.124 | 1.114 |
| 7 | PC7 | 3.987 | 0.091 | 0.498 | 0.005 | 0.006 | 0.029 | 0.195 | 9.87 | 1.369 |
| 8 | PC8 | 0.747 | 0.022 | 0.124 | 0.001 | 0.001 | 0.007 | 0.044 | 1.906 | 0.266 |
| 9 | PC9 | 11.208 | 0.212 | 1.131 | 0.012 | 0.014 | 0.065 | 0.478 | 25.212 | 3.56 |
| 10 | PC10 | 18.259 | 0.263 | 1.346 | 0.014 | 0.019 | 0.077 | 0.65 | 38.414 | 5.462 |
| 11 | PC11 | 15.539 | 0.207 | 1.043 | 0.011 | 0.015 | 0.06 | 0.527 | 32.044 | 4.565 |
| 12 | PC12 | 84.242 | 0.473 | 2.172 | 0.023 | 0.063 | 0.125 | 2.145 | 98.055 | 14.458 |
| 13 | PC13 | 84.145 | 0.472 | 2.171 | 0.023 | 0.063 | 0.124 | 2.143 | 97.946 | 14.441 |
| 14 | PC14 | 84.246 | 0.473 | 2.173 | 0.023 | 0.063 | 0.125 | 2.146 | 98.062 | 14.459 |
| 15 | PC15 | 84.245 | 0.473 | 2.173 | 0.023 | 0.063 | 0.125 | 2.145 | 98.06 | 14.458 |
| 25 | OVERALL | 16.626 | 0.211 | 1.061 | 0.011 | 0.016 | 0.061 | 0.552 | 33.088 | 4.721 |

City of Shorewood
Comprehensive Water Resources Management Plan
West, Lake Virginia, West-Central, Lake Minnewashta, South-Central, Central,
and Lake Mary Watersheds-P8 Results

| Subwatershed Identification | Index Number | Area (acres) | Impervious Fraction | Pervious CN | Treatment Device Number | Infiltration Rate (in/hour) | Flows to Number | Area of Pond (acres) | | | Storage at HWL (acre-feet) | Peak Discharge Rate (cfs) |
|-----------------------------|--------------|--------------|---------------------|-------------|-------------------------|-----------------------------|-----------------|----------------------|------|-------|----------------------------|---------------------------|
| | | | | | | | | Bottom | NWL | HWL | | |
| W1 | 1 | 62.1 | 0.250 | 61 | 1 | | 3 | 1.0 | 4.5 | 6.5 | 13.2 | 16.9 |
| W2 | 2 | 21.6 | 0.120 | 61 | 2 | | 3 | 1.0 | 3.0 | 4.2 | 3.6 | 21.8 |
| (1) W3 | 3 | 64.9 | 0.200 | 61 | 3 | | out | --- | --- | --- | --- | --- |
| LV1 | 4 | 22.1 | 0.200 | 71 | 4 | | 5 | 0.5 | 0.7 | 4.7 | 11.3 | 19.3 |
| (1) LV2 | 5 | 116.6 | 0.235 | 70 | 5 | | out | --- | --- | --- | --- | --- |
| WC1 | 6 | 49.6 | 0.200 | 71 | 6 | | 7 | 3.0 | 5.0 | 6.4 | 3.5 | 16.9 |
| WC2 | 7 | 106.6 | 0.250 | 74 | 7 | | 8 | --- | 0.0 | 1.5 | 4.1 | 18.5 |
| WC3 | 8 | 44.5 | 0.120 | 74 | 8 | | 9 | --- | 0.0 | 1.0 | 1.5 | 92.7 |
| WC4 | 9 | 106.5 | 0.220 | 69 | 9 | | 11 | 0.5 | 1.0 | 10.2 | 5.2 | 145.4 |
| WC5 | 10 | 50.8 | 0.160 | 74 | 10 | | 8 | 0.0 | 0.0 | 9.5 | 5.6 | 5.4 |
| WC6 | 11 | 316.4 | 0.226 | 70 | 11 | | out | 59.7 | 77.7 | 113.7 | 164.6 | 20.2 |
| (1) WC7 | 12 | 69.3 | 0.147 | 60 | 12 | | out | --- | --- | --- | --- | --- |
| C1 | 13 | 137.1 | 0.225 | 61 | 13 | | 16 | 2.0 | 10.1 | 20.3 | 30.4 | 9.9 |
| C2 | 14 | 10.1 | 0.300 | 67 | 14 | | 13 | --- | 1.0 | 1.7 | 2.3 | 2.0 |
| LMAR 1 | 15 | 32.7 | 0.250 | 61 | 15 | | 16 | 2.0 | 2.3 | 3.2 | 24.8 | 3.6 |
| LMAR 2 | 16 | 61.8 | 0.334 | 61 | 16 | | out | 6.9 | 11.7 | 16.4 | 54.8 | 6.0 |
| SC1 | 17 | 6.2 | 0.310 | 68 | 17 | | 18 | --- | 0.7 | 1.5 | 5.9 | 2.8 |
| SC2 | 18 | 37.7 | 0.310 | 61 | 18 | | out | 4.9 | 5.8 | 8.1 | 56.5 | 7.4 |
| (2) SC3 | 19 | 28.0 | 0.327 | 61 | 19 | | 18 | --- | --- | --- | --- | --- |
| LMIN1 | 20 | 26.0 | 0.253 | 68 | 20 | | out | --- | 0.0 | 7.4 | 26.9 | 42.5 |
| LMIN2 | 21 | 16.7 | 0.353 | 61 | 21 | | out | --- | 0.0 | 0.7 | 2.5 | 59.5 |
| LMIN3 | 22 | 6.7 | 0.327 | 61 | 22 | | out | --- | 0.1 | 0.2 | 0.5 | 11.0 |
| LMIN4 | 23 | 18.4 | 0.320 | 61 | 23 | | out | --- | 0.0 | 3.5 | 2.3 | 24.0 |

Note: Storage is the flood pool available to 100 year HWL. Peak Discharge is the 100 year basin outflow.

City of Shorewood
Comprehensive Water Resources Management Plan
West, Lake Virginia, West-Central, Lake Minnewashta, South-Central, Central,
and Lake Mary Watersheds-P8 Results

PERCENT REMOVAL EFFICIENCY OF TREATMENT DEVICE
FOR EACH PARTICLE CLASS

| Device Number | Subwatershed Number | 1 | 2 | 3 | 4 | 5 |
|---------------|---------------------|------|-------|-------|-------|-------|
| | | P 0% | P 10% | P 30% | P 50% | P 80% |
| 1 | W1 | 0 | 85.9 | 97.4 | 99.5 | 100 |
| 2 | W2 | 0 | 94 | 99.2 | 99.8 | 100 |
| 3 | W3 | 0 | 0 | 0 | 0 | 0 |
| 4 | LV1 | 0 | 49.5 | 81 | 95.5 | 99.6 |
| 5 | LV2 | 0 | 0 | 0 | 0 | 0 |
| 6 | WC1 | 0 | 87 | 96.7 | 99.4 | 99.9 |
| 7 | WC2 | 0 | 3.4 | 25.2 | 62.6 | 94.5 |
| 8 | WC3 | 0 | 0.5 | 4.3 | 18.2 | 69.7 |
| 9 | WC4 | 0 | 26 | 66.1 | 90 | 99 |
| 10 | WC5 | 0 | 7.5 | 44.6 | 80.1 | 97.6 |
| 11 | WC6 | 0 | 88.6 | 99.2 | 99.9 | 100 |
| 12 | WC7 | 0 | 0 | 0 | 0 | 0 |
| 13 | C1 | 0 | 86.7 | 97.7 | 99.5 | 100 |
| 14 | C2 | 0 | 70.3 | 96.5 | 99.4 | 99.9 |
| 15 | LMAR1 | 0 | 82.4 | 96.7 | 99.1 | 99.9 |
| 16 | LMAR2 | 0 | 80 | 97.8 | 99.6 | 100 |
| 17 | SC1 | 0 | 68.7 | 96.2 | 99.3 | 99.9 |
| 18 | SC2 | 0 | 81.7 | 97.2 | 99.4 | 100 |
| 19 | SC3 | 0 | 0 | 0 | 0 | 0 |
| 20 | LMIN1 | 0 | 1.3 | 11.7 | 39 | 86.1 |
| 21 | LMIN2 | 0 | 0.6 | 5.7 | 20.7 | 68.9 |
| 22 | LMIN3 | 0 | 11.9 | 51.4 | 83.7 | 98.1 |
| 23 | LMIN4 | 0 | 5.1 | 34.8 | 72.8 | 96.4 |
| 25 | OVERALL | 0 | 69.8 | 78.5 | 80.9 | 83.4 |

City of Shorewood
Comprehensive Water Resources Management Plan
West, Lake Virginia, West-Central, Lake Minnewashta, South-Central, Central,
and Lake Mary Watersheds-P8 Results

PERCENT REMOVAL EFFICIENCY OF TREATMENT DEVICE
FOR EACH WATER QUALITY COMPONENT

| Device Number | Subwatershed Number | TSS | TP | TKN | Cu | Pb | Zn | HC | COD | BOD |
|---------------|---------------------|------|------|------|------|------|------|------|------|------|
| 1 | W1 | 96.5 | 62.5 | 52.6 | 52.6 | 85.3 | 52.6 | 85.3 | 91.1 | 91.6 |
| 2 | W2 | 98.6 | 64.7 | 54.5 | 54.5 | 87.1 | 54.5 | 87.1 | 95.4 | 95.6 |
| 3 | W3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 4 | LV1 | 85 | 49.4 | 41.5 | 41.5 | 74.9 | 41.5 | 74.9 | 69.9 | 71.4 |
| 5 | LV2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6 | WC1 | 96.6 | 61.9 | 52 | 52 | 85 | 52 | 85 | 91.4 | 91.8 |
| 7 | WC2 | 55.5 | 18.2 | 14.9 | 14.9 | 47.4 | 14.9 | 47.4 | 31.4 | 32.5 |
| 8 | WC3 | 14.2 | 2.8 | 2.2 | 2.2 | 10.7 | 2.2 | 10.7 | 5.7 | 6 |
| 9 | WC4 | 66.3 | 31.9 | 25.8 | 25.8 | 53.5 | 25.8 | 53.5 | 46.1 | 48.1 |
| 10 | WC5 | 65.5 | 28.1 | 23.4 | 23.4 | 57 | 23.4 | 57 | 40.5 | 42.2 |
| 11 | WC6 | 96.6 | 53.1 | 42.7 | 42.7 | 78.8 | 42.7 | 78.8 | 91 | 91.4 |
| 12 | WC7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 13 | C1 | 96.7 | 60.9 | 50.9 | 50.9 | 84.5 | 50.9 | 84.5 | 91.4 | 91.8 |
| 14 | C2 | 93.2 | 58.8 | 49.5 | 49.5 | 82.4 | 49.5 | 82.4 | 83.5 | 84.7 |
| 15 | LMAR1 | 95.6 | 61.5 | 51.8 | 51.8 | 84.5 | 51.8 | 84.5 | 89.3 | 89.9 |
| 16 | LMAR2 | 94.8 | 49.9 | 39.8 | 39.8 | 77.4 | 39.8 | 77.4 | 86.7 | 87.4 |
| 17 | SC1 | 92.8 | 58.4 | 49.1 | 49.1 | 82 | 49.1 | 82 | 82.7 | 83.9 |
| 18 | SC2 | 95.6 | 59.8 | 50 | 50 | 83.6 | 50 | 83.6 | 88.9 | 89.5 |
| 19 | SC3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 20 | LMIN1 | 44.9 | 11.5 | 9.7 | 9.7 | 39.6 | 9.7 | 39.6 | 24.4 | 25 |
| 21 | LMIN2 | 33 | 6 | 5 | 5 | 29.1 | 5 | 29.1 | 17.5 | 17.8 |
| 22 | LMIN3 | 68.6 | 32.5 | 27.3 | 27.3 | 60.6 | 27.3 | 60.6 | 44.5 | 46.3 |
| 23 | LMIN4 | 61.1 | 24.9 | 21 | 21 | 54 | 21 | 54 | 36.4 | 37.8 |
| 25 | OVERALL | 79.2 | 50.3 | 42.3 | 42.3 | 69.8 | 42.3 | 69.8 | 74.3 | 74.7 |

City of Shorewood
Comprehensive Water Resources Management Plan
West, Lake Virginia, West-Central, Lake Minnewashta, South-Central, Central,
and Lake Mary Watersheds-P8 Results

CONCENTRATION (PPM) PRESENT IN THE INFLOW OF EACH TREATMENT DEVICE
FOR EACH PARTICLE CLASS

| Device Number | Subwatershed Number | 1 | 2 | 3 | 4 | 5 |
|---------------|---------------------|-------|--------|--------|--------|--------|
| | | P-0% | P-10% | P-30% | P-50% | P-80% |
| 1 | W1 | 1 | 16.849 | 16.849 | 16.849 | 33.699 |
| 2 | W2 | 1 | 16.849 | 16.849 | 16.849 | 33.698 |
| 3 | W3 | 0.638 | 8.171 | 7.264 | 7.08 | 14.073 |
| 4 | LV1 | 1 | 16.338 | 16.338 | 16.338 | 32.677 |
| 5 | LV2 | 1 | 15.425 | 14.7 | 14.366 | 28.546 |
| 6 | WC1 | 1 | 16.338 | 16.338 | 16.338 | 32.677 |
| 7 | WC2 | 0.899 | 12.164 | 11.743 | 11.628 | 23.208 |
| 8 | WC3 | 0.926 | 12.406 | 9.342 | 5.277 | 4.364 |
| 9 | WC4 | 0.948 | 13.665 | 11.293 | 8.078 | 11.062 |
| 10 | WC5 | 1 | 15.042 | 15.042 | 15.042 | 30.084 |
| 11 | WC6 | 0.968 | 13.233 | 9.984 | 8.424 | 16.066 |
| 12 | WC7 | 1 | 16.849 | 16.849 | 16.849 | 33.699 |
| 13 | C1 | 1 | 15.789 | 15.395 | 15.352 | 30.686 |
| 14 | C2 | 1 | 16.847 | 16.847 | 16.847 | 33.695 |
| 15 | LMAR1 | 1 | 16.849 | 16.849 | 16.849 | 33.699 |
| 16 | LMAR2 | 0.596 | 6.872 | 5.815 | 5.605 | 11.104 |
| 17 | SC1 | 1 | 16.822 | 16.822 | 16.822 | 33.644 |
| 18 | SC2 | 1 | 15.869 | 15.478 | 15.435 | 30.851 |
| 19 | SC3 | 1 | 16.849 | 16.849 | 16.849 | 33.699 |
| 20 | LMIN1 | 1 | 16.813 | 16.813 | 16.813 | 33.626 |
| 21 | LMIN2 | 1 | 16.849 | 16.849 | 16.849 | 33.699 |
| 22 | LMIN3 | 1 | 16.849 | 16.849 | 16.849 | 33.698 |
| 23 | LMIN4 | 1 | 16.849 | 16.849 | 16.849 | 33.699 |
| 25 | OVERALL | 1 | 16.548 | 16.548 | 16.548 | 33.096 |

**City of Shorewood
Comprehensive Water Resources Management Plan
West, Lake Virginia, West-Central, Lake Minnewashta, South-Central, Central,
and Lake Mary Watersheds-P8 Results**

CONCENTRATION (PPM) PRESENT IN THE INFLOW OF EACH TREATMENT DEVICE
FOR EACH WATER QUALITY COMPONENT

| Device Number | Subwatershed Number | TSS | TP | TKN | Cu | Pb | Zn | HC | COD | BOD |
|---------------|---------------------|--------|-------|-------|-------|-------|-------|-------|--------|--------|
| 1 | W1 | 84.246 | 0.473 | 2.173 | 0.023 | 0.063 | 0.125 | 2.146 | 98.062 | 14.459 |
| 2 | W2 | 84.246 | 0.473 | 2.173 | 0.023 | 0.063 | 0.125 | 2.146 | 98.062 | 14.459 |
| 3 | W3 | 36.588 | 0.241 | 1.153 | 0.012 | 0.029 | 0.066 | 0.983 | 44.729 | 6.56 |
| 4 | LV1 | 81.692 | 0.463 | 2.136 | 0.022 | 0.061 | 0.122 | 2.088 | 95.136 | 14.027 |
| 5 | LV2 | 73.036 | 0.435 | 2.027 | 0.021 | 0.056 | 0.116 | 1.893 | 87.056 | 12.808 |
| 6 | WC1 | 81.692 | 0.463 | 2.136 | 0.022 | 0.061 | 0.122 | 2.088 | 95.136 | 14.027 |
| 7 | WC2 | 58.743 | 0.364 | 1.716 | 0.018 | 0.045 | 0.098 | 1.546 | 69.593 | 10.245 |
| 8 | WC3 | 31.389 | 0.315 | 1.538 | 0.016 | 0.028 | 0.088 | 0.938 | 52.626 | 7.631 |
| 9 | WC4 | 44.098 | 0.356 | 1.703 | 0.018 | 0.036 | 0.098 | 1.229 | 64.063 | 9.346 |
| 10 | WC5 | 75.209 | 0.439 | 2.043 | 0.021 | 0.057 | 0.117 | 1.942 | 87.711 | 12.933 |
| 11 | WC6 | 47.708 | 0.35 | 1.689 | 0.018 | 0.039 | 0.097 | 1.316 | 64.46 | 9.377 |
| 12 | WC7 | 84.246 | 0.473 | 2.173 | 0.023 | 0.063 | 0.125 | 2.146 | 98.062 | 14.459 |
| 13 | C1 | 77.222 | 0.448 | 2.077 | 0.022 | 0.058 | 0.119 | 1.987 | 90.735 | 13.363 |
| 14 | C2 | 84.237 | 0.473 | 2.173 | 0.023 | 0.063 | 0.125 | 2.145 | 98.052 | 14.457 |
| 15 | LMAR1 | 84.246 | 0.473 | 2.173 | 0.023 | 0.063 | 0.125 | 2.146 | 98.062 | 14.459 |
| 16 | LMAR2 | 29.396 | 0.208 | 1.012 | 0.011 | 0.024 | 0.058 | 0.81 | 36.722 | 5.374 |
| 17 | SC1 | 84.11 | 0.472 | 2.171 | 0.023 | 0.063 | 0.124 | 2.142 | 97.906 | 14.436 |
| 18 | SC2 | 77.633 | 0.449 | 2.083 | 0.022 | 0.059 | 0.119 | 1.997 | 91.201 | 13.432 |
| 19 | SC3 | 84.246 | 0.473 | 2.173 | 0.023 | 0.063 | 0.125 | 2.146 | 98.062 | 14.459 |
| 20 | LMIN1 | 84.066 | 0.472 | 2.171 | 0.023 | 0.063 | 0.124 | 2.141 | 97.856 | 14.428 |
| 21 | LMIN2 | 84.246 | 0.473 | 2.173 | 0.023 | 0.063 | 0.125 | 2.146 | 98.062 | 14.459 |
| 22 | LMIN3 | 84.246 | 0.473 | 2.173 | 0.023 | 0.063 | 0.125 | 2.146 | 98.062 | 14.459 |
| 23 | LMIN4 | 84.246 | 0.473 | 2.173 | 0.023 | 0.063 | 0.125 | 2.146 | 98.062 | 14.459 |
| 25 | OVERALL | 82.739 | 0.467 | 2.151 | 0.023 | 0.062 | 0.123 | 2.112 | 96.335 | 14.204 |

City of Shorewood
Comprehensive Water Resources Management Plan
West, Lake Virginia, West-Central, Lake Minnewashta, South-Central, Central,
and Lake Mary Watersheds-P8 Results

CONCENTRATION (PPM) PRESENT IN THE OUTFLOW OF EACH TREATMENT DEVICE
FOR EACH PARTICLE CLASS

| Device Number | Subwatershed Number | 1 | 2 | 3 | 4 | 5 |
|---------------|---------------------|-------|--------|--------|--------|--------|
| | | P.0% | P.10% | P.30% | P.50% | P.80% |
| 1 | W1 | 0.422 | 2.175 | 0.44 | 0.09 | 0.013 |
| 2 | W2 | 0.124 | 0.625 | 0.142 | 0.032 | 0.005 |
| 3 | W3 | 0.638 | 8.171 | 7.264 | 7.08 | 14.073 |
| 4 | LV1 | 0.998 | 8.249 | 3.103 | 0.729 | 0.14 |
| 5 | LV2 | 1 | 15.425 | 14.7 | 14.366 | 28.546 |
| 6 | WC1 | 0.618 | 2.131 | 0.536 | 0.1 | 0.016 |
| 7 | WC2 | 0.899 | 11.752 | 8.78 | 4.35 | 1.278 |
| 8 | WC3 | 0.926 | 12.336 | 8.931 | 4.316 | 1.319 |
| 9 | WC4 | 0.939 | 10.104 | 3.825 | 0.81 | 0.108 |
| 10 | WC5 | 0.99 | 13.781 | 8.257 | 2.968 | 0.725 |
| 11 | WC6 | 0.175 | 0.827 | 0.081 | 0.012 | 0.002 |
| 12 | WC7 | 1 | 16.849 | 16.849 | 16.849 | 33.698 |
| 13 | C1 | 0.419 | 1.939 | 0.361 | 0.07 | 0.011 |
| 14 | C2 | 1 | 4.999 | 0.586 | 0.108 | 0.021 |
| 15 | LMAR1 | 0.313 | 2.126 | 0.555 | 0.154 | 0.024 |
| 16 | LMAR2 | 0.234 | 1.11 | 0.129 | 0.022 | 0.004 |
| 17 | SC1 | 0.999 | 5.258 | 0.635 | 0.12 | 0.024 |
| 18 | SC2 | 0.341 | 2.12 | 0.432 | 0.098 | 0.014 |
| 19 | SC3 | 1 | 16.849 | 16.849 | 16.849 | 33.698 |
| 20 | LMIN1 | 1 | 16.589 | 14.84 | 10.259 | 4.664 |
| 21 | LMIN2 | 1.003 | 16.797 | 15.947 | 13.411 | 10.52 |
| 22 | LMIN3 | 1 | 14.853 | 8.186 | 2.753 | 0.641 |
| 23 | LMIN4 | 1 | 15.992 | 10.979 | 4.587 | 1.215 |
| 25 | OVERALL | 0.399 | 4.551 | 3.575 | 3.173 | 5.516 |

**City of Shorewood
Comprehensive Water Resources Management Plan
West, Lake Virginia, West-Central, Lake Minnewashta, South-Central, Central,
and Lake Mary Watersheds-P8 Results**

CONCENTRATION (PPM) PRESENT IN THE OUTFLOW OF EACH TREATMENT DEVICE
FOR EACH WATER QUALITY COMPONENT

| Device Number | Subwatershed Number | TSS | TP | TKN | Cu | Pb | Zn | HC | COD | BOD |
|---------------|---------------------|--------|-------|-------|-------|-------|-------|-------|--------|--------|
| 1 | W1 | 2.717 | 0.084 | 0.47 | 0.005 | 0.005 | 0.027 | 0.167 | 7.254 | 1.003 |
| 2 | W2 | 0.803 | 0.025 | 0.138 | 0.001 | 0.001 | 0.008 | 0.049 | 2.111 | 0.293 |
| 3 | W3 | 36.588 | 0.241 | 1.153 | 0.012 | 0.029 | 0.066 | 0.983 | 44.729 | 6.56 |
| 4 | LV1 | 12.221 | 0.234 | 1.248 | 0.013 | 0.015 | 0.072 | 0.524 | 28.586 | 4.015 |
| 5 | LV2 | 73.036 | 0.435 | 2.027 | 0.021 | 0.056 | 0.116 | 1.893 | 87.055 | 12.808 |
| 6 | WC1 | 2.783 | 0.116 | 0.66 | 0.007 | 0.006 | 0.038 | 0.217 | 7.564 | 1.055 |
| 7 | WC2 | 26.16 | 0.298 | 1.46 | 0.015 | 0.024 | 0.084 | 0.813 | 47.747 | 6.914 |
| 8 | WC3 | 26.902 | 0.306 | 1.503 | 0.016 | 0.025 | 0.086 | 0.837 | 49.587 | 7.169 |
| 9 | WC4 | 14.847 | 0.241 | 1.255 | 0.013 | 0.017 | 0.072 | 0.569 | 34.515 | 4.844 |
| 10 | WC5 | 25.731 | 0.313 | 1.551 | 0.016 | 0.024 | 0.089 | 0.827 | 51.724 | 7.403 |
| 11 | WC6 | 0.922 | 0.034 | 0.19 | 0.002 | 0.002 | 0.011 | 0.064 | 2.661 | 0.364 |
| 12 | WC7 | 84.245 | 0.473 | 2.173 | 0.023 | 0.063 | 0.125 | 2.145 | 98.061 | 14.458 |
| 13 | C1 | 2.38 | 0.081 | 0.459 | 0.005 | 0.005 | 0.026 | 0.158 | 6.489 | 0.897 |
| 14 | C2 | 5.715 | 0.195 | 1.097 | 0.011 | 0.011 | 0.063 | 0.379 | 16.148 | 2.214 |
| 15 | LMAR1 | 2.859 | 0.068 | 0.369 | 0.004 | 0.004 | 0.021 | 0.143 | 7.132 | 0.991 |
| 16 | LMAR2 | 1.265 | 0.045 | 0.255 | 0.003 | 0.003 | 0.015 | 0.087 | 3.602 | 0.494 |
| 17 | SC1 | 6.037 | 0.197 | 1.104 | 0.012 | 0.011 | 0.063 | 0.386 | 16.928 | 2.321 |
| 18 | SC2 | 2.666 | 0.071 | 0.391 | 0.004 | 0.004 | 0.022 | 0.145 | 6.975 | 0.964 |
| 19 | SC3 | 84.245 | 0.473 | 2.173 | 0.023 | 0.063 | 0.125 | 2.145 | 98.06 | 14.458 |
| 20 | LMIN1 | 46.351 | 0.418 | 1.96 | 0.021 | 0.038 | 0.112 | 1.293 | 74.022 | 10.829 |
| 21 | LMIN2 | 56.675 | 0.446 | 2.071 | 0.022 | 0.045 | 0.119 | 1.526 | 81.222 | 11.928 |
| 22 | LMIN3 | 26.434 | 0.319 | 1.579 | 0.017 | 0.025 | 0.091 | 0.845 | 54.437 | 7.759 |
| 23 | LMIN4 | 32.772 | 0.355 | 1.717 | 0.018 | 0.029 | 0.098 | 0.987 | 62.364 | 8.987 |
| 25 | OVERALL | 16.815 | 0.134 | 0.654 | 0.007 | 0.014 | 0.038 | 0.478 | 22.599 | 3.294 |

**City of Shorewood
Comprehensive Water Resources Management Plan
Gideon Bay, North-Central, and Lake Minnetonka
Watersheds-P8 Results**

| Subwatershed Identification | Index Number | Area (acres) | Impervious Fraction | Pervious GN | Treatment Device Number | Infiltration Rate (in/hour) | Flows to Number | Area of Pond (acres) | | | Storage at HWL (acre-feet) | Peak Discharge Rate (cfs) |
|-----------------------------|--------------|--------------|---------------------|-------------|-------------------------|-----------------------------|-----------------|----------------------|-----|-----|----------------------------|---------------------------|
| | | | | | | | | Bottom | NWL | HWL | | |
| GB 1 | 1 | 16.4 | 0.353 | 61 | 1 | | 2 | --- | 0.5 | 1.8 | 2.9 | 6.0 |
| GB 2 | 2 | 27.5 | 0.460 | 61 | 2 | | 4 | 0.20 | 0.4 | 1.3 | 2.6 | 28.5 |
| GB 3 | 3 | 34.9 | 0.300 | 61 | 3 | | out | --- | 0.4 | 1.2 | 1.7 | 17.7 |
| GB 4 | 4 | 11.9 | 0.535 | 61 | 4 | | out | --- | --- | --- | --- | --- |
| GB 5 | 5 | 13.3 | 0.120 | 61 | 5 | | 6 | --- | 0.0 | 1.0 | 0.59 | 15.7 |
| GB 6 | 6 | 24.3 | 0.120 | 68 | 6 | | 7 | --- | 0.1 | 2.7 | 6.6 | 27.8 |
| GB 7 | 7 | 29.4 | 0.380 | 61 | 7 | | out | --- | 0.7 | 4.3 | 15 | 10.7 |
| GB 8 | 8 | 74.7 | 0.407 | 61 | 8 | | out | --- | --- | --- | --- | --- |
| GB 9 | 9 | 14.3 | 0.407 | 61 | 9 | | out | 0.50 | 1.6 | 3.3 | 9.7 | 4.1 |
| GB 10 | 10 | 36.5 | 0.434 | 61 | 10 | | out | --- | --- | --- | --- | --- |
| NC 1 | 11 | 16.5 | 0.300 | 71 | 11 | | 12 | --- | 0.0 | 0.8 | 1.01 | 37.1 |
| NC 2 | 12 | 39.4 | 0.240 | 71 | 12 | | 13 | --- | 0.5 | 4.0 | 9.8 | 7.0 |
| NC 3 | 13 | 18.5 | 0.300 | 61 | 13 | | 14 | 0.05 | 0.1 | 0.2 | 0.52 | 61.6 |
| NC 4 | 14 | 27.9 | 0.210 | 68 | 14 | | 21 | 0.01 | 0.0 | 0.5 | 0.9 | 103.4 |
| NC 5 | 15 | 20.0 | 0.310 | 65 | 15 | | 21 | 0.08 | 0.1 | 1.3 | 3.13 | 24.8 |
| NC 6 | 16 | 6.4 | 0.250 | 61 | 16 | | 17 | --- | 0.6 | 0.8 | 1 | 2.1 |
| NC 7 | 17 | 12.6 | 0.310 | 66 | 17 | | 20 | 0.80 | 2.7 | 3.2 | 2.4 | 12.3 |
| NC 8 | 18 | 6.6 | 0.327 | 61 | 18 | | 19 | 0.58 | 1.1 | 2.0 | 10.9 | 1.4 |
| NC 9 | 19 | 24.8 | 0.353 | 61 | 19 | | 20 | 3.70 | 5.0 | 5.3 | 16.4 | 2.5 |
| NC 10 | 20 | 47.6 | 0.380 | 61 | 20 | | out | 2.00 | 3.3 | 6.0 | 7 | 16.7 |
| I1 | 21 | 69.3 | 0.300 | 72 | 21 | | out | --- | --- | --- | --- | --- |
| I2 | 22 | 20.0 | 0.300 | 72 | 22 | | out | --- | --- | --- | --- | --- |
| I3 | 23 | 2.0 | 0.300 | 72 | 23 | | out | --- | --- | --- | --- | --- |

Note: Storage is the flood pool available to 100 year HWL. Peak Discharge is the 100 year basin outflow.

City of Shorewood
Comprehensive Water Resources Management Plan
Gideon Bay, North-Central, and Lake Minnetonka
Watersheds-P8 Results

PERCENT REMOVAL EFFICIENCY OF TREATMENT DEVICE
 FOR EACH PARTICLE CLASS

| Device Number | Subwatershed Number | 1 | 2 | 3 | 4 | 5 |
|---------------|---------------------|------|-------|-------|-------|-------|
| | | P 0% | P 10% | P 30% | P 50% | P 80% |
| 1 | GB1 | 0 | 38.3 | 84.9 | 97 | 99.7 |
| 2 | GB2 | 0 | 32.6 | 66.5 | 88.7 | 98.9 |
| 3 | GB3 | 0 | 50.8 | 92.9 | 99.7 | 100 |
| 4 | GB4 | 0 | 0 | 0 | 0 | 0 |
| 5 | GB5 | 0 | 2 | 14.4 | 41.3 | 86.4 |
| 6 | GB6 | 0 | 8.7 | 44.1 | 79.6 | 97.7 |
| 7 | GB7 | 0 | 37.6 | 84.3 | 97 | 99.7 |
| 8 | GB8 | 0 | 0 | 0 | 0 | 0 |
| 9 | GB9 | 0 | 84.4 | 94.3 | 97.5 | 99.7 |
| 10 | GB10 | 0 | 0 | 0 | 0 | 0 |
| 11 | NC1 | 0 | 2.8 | 22.2 | 58.3 | 93.3 |
| 12 | NC2 | 0 | 29.7 | 78.7 | 95.5 | 99.6 |
| 13 | NC3 | 0 | 5.2 | 19.2 | 49.3 | 90.6 |
| 14 | NC4 | 0 | 0.8 | 5.6 | 22.1 | 73.8 |
| 15 | NC5 | 0 | 23 | 51 | 71.1 | 95.3 |
| 16 | NC6 | 0 | 58.5 | 93.8 | 98.8 | 99.9 |
| 17 | NC7 | 0 | 89.6 | 96.8 | 98.8 | 99.9 |
| 18 | NC8 | 0 | 88.6 | 97.1 | 99 | 99.9 |
| 19 | NC9 | 0 | 87 | 98.3 | 99.6 | 100 |
| 20 | NC10 | 0 | 68.7 | 93 | 98.5 | 99.9 |
| 21 | NC11 | 0 | 0 | 0 | 0 | 0 |
| 22 | I1 | 0 | 0 | 0 | 0 | 0 |
| 23 | I2 | 0 | 0 | 0 | 0 | 0 |
| 24 | I3 | 0 | 0 | 0 | 0 | 0 |
| 25 | OVERALL | 0 | 25.8 | 40.9 | 46.6 | 50.4 |

**City of Shorewood
Comprehensive Water Resources Management Plan
Gideon Bay, North-Central, and Lake Minnetonka
Watersheds-P8 Results**

PERCENT REMOVAL EFFICIENCY OF TREATMENT DEVICE
FOR EACH WATER QUALITY COMPONENT

| Device Number | Subwatershed Number | TSS | TP | TKN | Cu | Pb | Zn | HC | COD | BOD |
|---------------|---------------------|------|------|------|------|------|------|------|------|------|
| 1 | GB1 | 83.9 | 48.7 | 41 | 41 | 74.1 | 41 | 74.1 | 65.7 | 67.8 |
| 2 | GB2 | 74.7 | 36.3 | 29.7 | 29.7 | 63.3 | 29.7 | 63.3 | 55 | 56.6 |
| 3 | GB3 | 88.7 | 53.8 | 45.3 | 45.3 | 78.3 | 45.3 | 78.3 | 73.6 | 75.4 |
| 4 | GB4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5 | GB5 | 46.1 | 12.8 | 10.7 | 10.7 | 40.7 | 10.7 | 40.7 | 25.5 | 26.2 |
| 6 | GB6 | 60.7 | 27.4 | 22.9 | 22.9 | 52.4 | 22.9 | 52.4 | 36.6 | 38.4 |
| 7 | GB7 | 80.9 | 44.5 | 36.9 | 36.9 | 69.6 | 36.9 | 69.6 | 61.9 | 64.1 |
| 8 | GB8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 9 | GB9 | 95.1 | 61 | 51.4 | 51.4 | 84 | 51.4 | 84 | 89.5 | 89.9 |
| 10 | GB10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 11 | NC1 | 54 | 18.3 | 15.4 | 15.4 | 47.6 | 15.4 | 47.6 | 30.6 | 31.6 |
| 12 | NC2 | 77.1 | 41.8 | 34.7 | 34.7 | 66.1 | 34.7 | 66.1 | 56.3 | 58.6 |
| 13 | NC3 | 37.7 | 8.9 | 6.9 | 6.9 | 28.5 | 6.9 | 28.5 | 18.3 | 19.2 |
| 14 | NC4 | 22.3 | 3.5 | 2.7 | 2.7 | 17 | 2.7 | 17 | 9.2 | 9.6 |
| 15 | NC5 | 67.1 | 32.1 | 27 | 27 | 59.3 | 27 | 59.3 | 47.9 | 49.2 |
| 16 | NC6 | 90.2 | 55.5 | 46.7 | 46.7 | 79.7 | 46.7 | 79.7 | 77.3 | 78.8 |
| 17 | NC7 | 96.8 | 56.7 | 46.3 | 46.3 | 82.1 | 46.3 | 82.1 | 91.9 | 92.2 |
| 18 | NC8 | 96.9 | 62.9 | 53 | 53 | 85.6 | 53 | 85.6 | 92.3 | 92.6 |
| 19 | NC9 | 96.9 | 61.9 | 51.9 | 51.9 | 85.1 | 51.9 | 85.1 | 91.7 | 92.2 |
| 20 | NC10 | 91.7 | 54.4 | 45.1 | 45.1 | 79.5 | 45.1 | 79.5 | 81.4 | 82.5 |
| 21 | NC11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 22 | I1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 23 | I2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 24 | I3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 25 | OVERALL | 42.8 | 25 | 21 | 21 | 37.8 | 21 | 37.8 | 35.6 | 36.2 |

**City of Shorewood
Comprehensive Water Resources Management Plan
Gideon Bay, North-Central, and Lake Minnetonka
Watersheds-P8 Results**

CONCENTRATION (PPM) PRESENT IN THE INFLOW OF EACH TREATMENT DEVICE
FOR EACH PARTICLE CLASS

| Device Number | Subwatershed Number | 1 | 2 | 3 | 4 | 5 |
|---------------|---------------------|-------|--------|--------|--------|--------|
| | | P.0% | P.10% | P.30% | P.50% | P.80% |
| 1 | GB 1 | 1 | 16.849 | 16.849 | 16.849 | 33.699 |
| 2 | GB 2 | 1 | 14.822 | 12.358 | 11.719 | 23.149 |
| 3 | GB 3 | 1 | 16.849 | 16.849 | 16.849 | 33.698 |
| 4 | GB 4 | 0.994 | 11.065 | 6.19 | 3.966 | 6.062 |
| 5 | GB 5 | 1 | 16.849 | 16.849 | 16.849 | 33.699 |
| 6 | GB 6 | 1 | 16.685 | 15.946 | 14.349 | 23.335 |
| 7 | GB 7 | 1 | 16.383 | 14.563 | 12.838 | 24.143 |
| 8 | GB 8 | 1 | 16.849 | 16.849 | 16.849 | 33.699 |
| 9 | GB 9 | 1 | 16.849 | 16.849 | 16.849 | 33.698 |
| 10 | GB 10 | 1 | 16.849 | 16.849 | 16.849 | 33.698 |
| 11 | NC 1 | 1 | 16.547 | 16.547 | 16.547 | 33.095 |
| 12 | NC 2 | 1 | 16.318 | 15.221 | 13.175 | 22.391 |
| 13 | NC 3 | 1 | 12.942 | 6.961 | 5.04 | 9.288 |
| 14 | NC 4 | 1 | 13.283 | 8.136 | 5.757 | 8.227 |
| 15 | NC 5 | 1 | 16.849 | 16.849 | 16.849 | 33.699 |
| 16 | NC 6 | 1 | 16.849 | 16.849 | 16.849 | 33.698 |
| 17 | NC 7 | 1 | 13.986 | 12.257 | 12.013 | 23.918 |
| 18 | NC 8 | 1 | 16.849 | 16.849 | 16.849 | 33.698 |
| 19 | NC 9 | 0.848 | 13.796 | 13.613 | 13.552 | 27.04 |
| 20 | NC 10 | 0.624 | 9.379 | 8.969 | 8.871 | 17.671 |
| 21 | NC 11 | 1 | 15.004 | 12.348 | 10.742 | 17.966 |
| 22 | I1 | 1 | 16.849 | 16.849 | 16.849 | 33.699 |
| 23 | I2 | 1 | 16.849 | 16.849 | 16.849 | 33.699 |
| 24 | I3 | 1 | 16.849 | 16.849 | 16.849 | 33.699 |
| 25 | OVERALL | 1 | 16.823 | 16.823 | 16.823 | 33.646 |

**City of Shorewood
Comprehensive Water Resources Management Plan
Gideon Bay, North-Central, and Lake Minnetonka
Watersheds-P8 Results**

CONCENTRATION (PPM) PRESENT IN THE INFLOW OF EACH TREATMENT DEVICE
FOR EACH WATER QUALITY COMPONENT

| Device Number | Subwatershed Number | TSS | TP | TKN | Cu | Pb | Zn | Hg | COD | BOD |
|---------------|---------------------|--------|-------|-------|-------|-------|-------|-------|--------|--------|
| 1 | GB 1 | 84.246 | 0.473 | 2.173 | 0.023 | 0.063 | 0.125 | 2.146 | 98.062 | 14.459 |
| 2 | GB 2 | 62.048 | 0.4 | 1.894 | 0.02 | 0.048 | 0.109 | 1.646 | 77.847 | 11.383 |
| 3 | GB 3 | 84.246 | 0.473 | 2.173 | 0.023 | 0.063 | 0.125 | 2.146 | 98.062 | 14.459 |
| 4 | GB 4 | 27.284 | 0.29 | 1.464 | 0.015 | 0.025 | 0.084 | 0.862 | 45.454 | 6.511 |
| 5 | GB 5 | 84.246 | 0.473 | 2.173 | 0.023 | 0.063 | 0.125 | 2.146 | 98.062 | 14.459 |
| 6 | GB 6 | 70.315 | 0.451 | 2.088 | 0.022 | 0.054 | 0.12 | 1.832 | 88.973 | 13.084 |
| 7 | GB 7 | 67.927 | 0.431 | 2.011 | 0.021 | 0.052 | 0.115 | 1.778 | 86.058 | 12.615 |
| 8 | GB 8 | 84.246 | 0.473 | 2.173 | 0.023 | 0.063 | 0.125 | 2.146 | 98.062 | 14.459 |
| 9 | GB 9 | 84.246 | 0.473 | 2.173 | 0.023 | 0.063 | 0.125 | 2.146 | 98.062 | 14.459 |
| 10 | GB 10 | 84.246 | 0.473 | 2.173 | 0.023 | 0.063 | 0.125 | 2.146 | 98.062 | 14.459 |
| 11 | NC 1 | 82.737 | 0.467 | 2.151 | 0.023 | 0.062 | 0.123 | 2.112 | 96.333 | 14.204 |
| 12 | NC 2 | 67.106 | 0.437 | 2.033 | 0.021 | 0.052 | 0.117 | 1.76 | 85.844 | 12.609 |
| 13 | NC 3 | 34.231 | 0.314 | 1.559 | 0.016 | 0.03 | 0.089 | 1.02 | 54.096 | 7.744 |
| 14 | NC 4 | 35.403 | 0.328 | 1.612 | 0.017 | 0.031 | 0.092 | 1.046 | 56.254 | 8.092 |
| 15 | NC 5 | 84.246 | 0.473 | 2.173 | 0.023 | 0.063 | 0.125 | 2.146 | 98.062 | 14.459 |
| 16 | NC 6 | 84.246 | 0.473 | 2.173 | 0.023 | 0.063 | 0.125 | 2.146 | 98.062 | 14.459 |
| 17 | NC 7 | 62.173 | 0.396 | 1.878 | 0.02 | 0.048 | 0.108 | 1.649 | 76.041 | 11.146 |
| 18 | NC 8 | 84.246 | 0.473 | 2.173 | 0.023 | 0.063 | 0.125 | 2.146 | 98.062 | 14.459 |
| 19 | NC 9 | 68 | 0.389 | 1.797 | 0.019 | 0.051 | 0.103 | 1.742 | 79.649 | 11.737 |
| 20 | NC 10 | 44.89 | 0.268 | 1.252 | 0.013 | 0.034 | 0.072 | 1.166 | 53.261 | 7.837 |
| 21 | NC 11 | 56.06 | 0.395 | 1.874 | 0.02 | 0.044 | 0.107 | 1.511 | 74.725 | 10.911 |
| 22 | I1 | 84.246 | 0.473 | 2.173 | 0.023 | 0.063 | 0.125 | 2.146 | 98.062 | 14.459 |
| 23 | I2 | 84.246 | 0.473 | 2.173 | 0.023 | 0.063 | 0.125 | 2.146 | 98.062 | 14.459 |
| 24 | I3 | 84.246 | 0.473 | 2.173 | 0.023 | 0.063 | 0.125 | 2.146 | 98.062 | 14.459 |
| 25 | OVERALL | 84.115 | 0.472 | 2.171 | 0.023 | 0.063 | 0.124 | 2.143 | 97.911 | 14.436 |

**City of Shorewood
Comprehensive Water Resources Management Plan
Gideon Bay, North-Central, and Lake Minnetonka
Watersheds-P8 Results**

CONCENTRATION (PPM) PRESENT IN THE OUTFLOW OF EACH TREATMENT DEVICE
FOR EACH PARTICLE CLASS

| Device Number | Subwatershed Number | 1 | 2 | 3 | 4 | 5 |
|---------------|---------------------|-------|--------|--------|--------|--------|
| | | P.0% | P.10% | P.30% | P.50% | P.80% |
| 1 | GB1 | 1 | 10.392 | 2.545 | 0.508 | 0.097 |
| 2 | GB2 | 0.992 | 9.978 | 4.143 | 1.329 | 0.257 |
| 3 | GB3 | 1 | 8.251 | 1.532 | 0.324 | 0.061 |
| 4 | GB4 | 0.994 | 11.066 | 6.19 | 3.966 | 6.062 |
| 5 | GB5 | 1.001 | 16.546 | 14.447 | 9.913 | 4.589 |
| 6 | GB6 | 1 | 15.232 | 8.918 | 2.933 | 0.546 |
| 7 | GB7 | 1 | 10.225 | 2.282 | 0.38 | 0.064 |
| 8 | GB8 | 1 | 16.849 | 16.849 | 16.849 | 33.698 |
| 9 | GB9 | 0.406 | 2.383 | 0.966 | 0.424 | 0.087 |
| 10 | GB10 | 1 | 16.849 | 16.849 | 16.849 | 33.698 |
| 11 | NC1 | 1 | 16.08 | 12.874 | 6.894 | 2.215 |
| 12 | NC2 | 1 | 11.47 | 3.236 | 0.591 | 0.092 |
| 13 | NC3 | 1 | 12.264 | 5.626 | 2.557 | 0.875 |
| 14 | NC4 | 1 | 13.177 | 7.685 | 4.489 | 2.159 |
| 15 | NC5 | 0.998 | 12.973 | 8.255 | 4.875 | 1.593 |
| 16 | NC6 | 0.999 | 6.996 | 1.045 | 0.205 | 0.041 |
| 17 | NC7 | 0.262 | 1.218 | 0.395 | 0.139 | 0.024 |
| 18 | NC8 | 0.232 | 1.411 | 0.484 | 0.176 | 0.031 |
| 19 | NC9 | 0.184 | 1.116 | 0.233 | 0.052 | 0.007 |
| 20 | NC10 | 0.419 | 2.769 | 0.626 | 0.133 | 0.02 |
| 21 | NC11 | 1 | 15.004 | 12.348 | 10.742 | 17.966 |
| 22 | I1 | 1 | 16.849 | 16.849 | 16.849 | 33.698 |
| 23 | I2 | 1 | 16.849 | 16.849 | 16.849 | 33.698 |
| 24 | I3 | 1 | 16.86 | 16.86 | 16.86 | 33.721 |
| 25 | OVERALL | 0.892 | 12.583 | 10.31 | 9.359 | 17.357 |

**City of Shorewood
Comprehensive Water Resources Management Plan
Gideon Bay, North-Central, and Lake Minnetonka
Watersheds-P8 Results**

CONCENTRATION (PPM) PRESENT IN THE OUTFLOW OF EACH TREATMENT DEVICE
FOR EACH WATER QUALITY COMPONENT

| Device Number | Subwatershed Number | TSS | TP | TKN | Cu | Pb | Zn | HC | COD | BOD |
|---------------|---------------------|--------|-------|-------|-------|-------|-------|-------|--------|--------|
| 1 | GB1 | 13.542 | 0.243 | 1.282 | 0.013 | 0.016 | 0.074 | 0.555 | 33.675 | 4.662 |
| 2 | GB2 | 15.708 | 0.254 | 1.323 | 0.014 | 0.018 | 0.076 | 0.601 | 35.027 | 4.936 |
| 3 | GB3 | 10.169 | 0.222 | 1.203 | 0.013 | 0.014 | 0.069 | 0.479 | 26.415 | 3.637 |
| 4 | GB4 | 27.285 | 0.29 | 1.464 | 0.015 | 0.025 | 0.084 | 0.862 | 45.455 | 6.511 |
| 5 | GB5 | 45.495 | 0.413 | 1.943 | 0.02 | 0.037 | 0.111 | 1.274 | 73.185 | 10.693 |
| 6 | GB6 | 27.629 | 0.327 | 1.61 | 0.017 | 0.026 | 0.092 | 0.872 | 56.415 | 8.062 |
| 7 | GB7 | 12.951 | 0.239 | 1.269 | 0.013 | 0.016 | 0.073 | 0.541 | 32.804 | 4.53 |
| 8 | GB8 | 84.245 | 0.473 | 2.173 | 0.023 | 0.063 | 0.125 | 2.145 | 98.061 | 14.458 |
| 9 | GB9 | 3.86 | 0.088 | 0.48 | 0.005 | 0.006 | 0.028 | 0.188 | 8.678 | 1.225 |
| 10 | GB10 | 84.245 | 0.473 | 2.173 | 0.023 | 0.063 | 0.125 | 2.145 | 98.061 | 14.458 |
| 11 | NC1 | 38.063 | 0.382 | 1.82 | 0.019 | 0.032 | 0.104 | 1.106 | 66.834 | 9.713 |
| 12 | NC2 | 15.389 | 0.254 | 1.327 | 0.014 | 0.018 | 0.076 | 0.596 | 37.532 | 5.215 |
| 13 | NC3 | 21.322 | 0.286 | 1.45 | 0.015 | 0.021 | 0.083 | 0.73 | 44.219 | 6.259 |
| 14 | NC4 | 27.51 | 0.317 | 1.568 | 0.016 | 0.026 | 0.09 | 0.869 | 51.113 | 7.317 |
| 15 | NC5 | 27.696 | 0.321 | 1.585 | 0.017 | 0.026 | 0.091 | 0.873 | 51.131 | 7.348 |
| 16 | NC6 | 8.287 | 0.21 | 1.157 | 0.012 | 0.013 | 0.066 | 0.436 | 22.281 | 3.058 |
| 17 | NC7 | 1.776 | 0.053 | 0.293 | 0.003 | 0.003 | 0.017 | 0.105 | 4.343 | 0.609 |
| 18 | NC8 | 2.101 | 0.05 | 0.273 | 0.003 | 0.003 | 0.016 | 0.105 | 4.962 | 0.696 |
| 19 | NC9 | 1.409 | 0.038 | 0.21 | 0.002 | 0.002 | 0.012 | 0.078 | 3.684 | 0.509 |
| 20 | NC10 | 3.548 | 0.089 | 0.487 | 0.005 | 0.005 | 0.028 | 0.185 | 9.143 | 1.266 |
| 21 | NC11 | 56.059 | 0.395 | 1.874 | 0.02 | 0.044 | 0.107 | 1.511 | 74.724 | 10.911 |
| 22 | I1 | 84.245 | 0.473 | 2.173 | 0.023 | 0.063 | 0.125 | 2.145 | 98.061 | 14.458 |
| 23 | I2 | 84.245 | 0.473 | 2.173 | 0.023 | 0.063 | 0.125 | 2.145 | 98.06 | 14.458 |
| 24 | I3 | 84.301 | 0.473 | 2.174 | 0.023 | 0.063 | 0.125 | 2.147 | 98.125 | 14.468 |
| 25 | OVERALL | 49.608 | 0.342 | 1.63 | 0.017 | 0.039 | 0.093 | 1.339 | 64.243 | 9.383 |

APPENDIX H

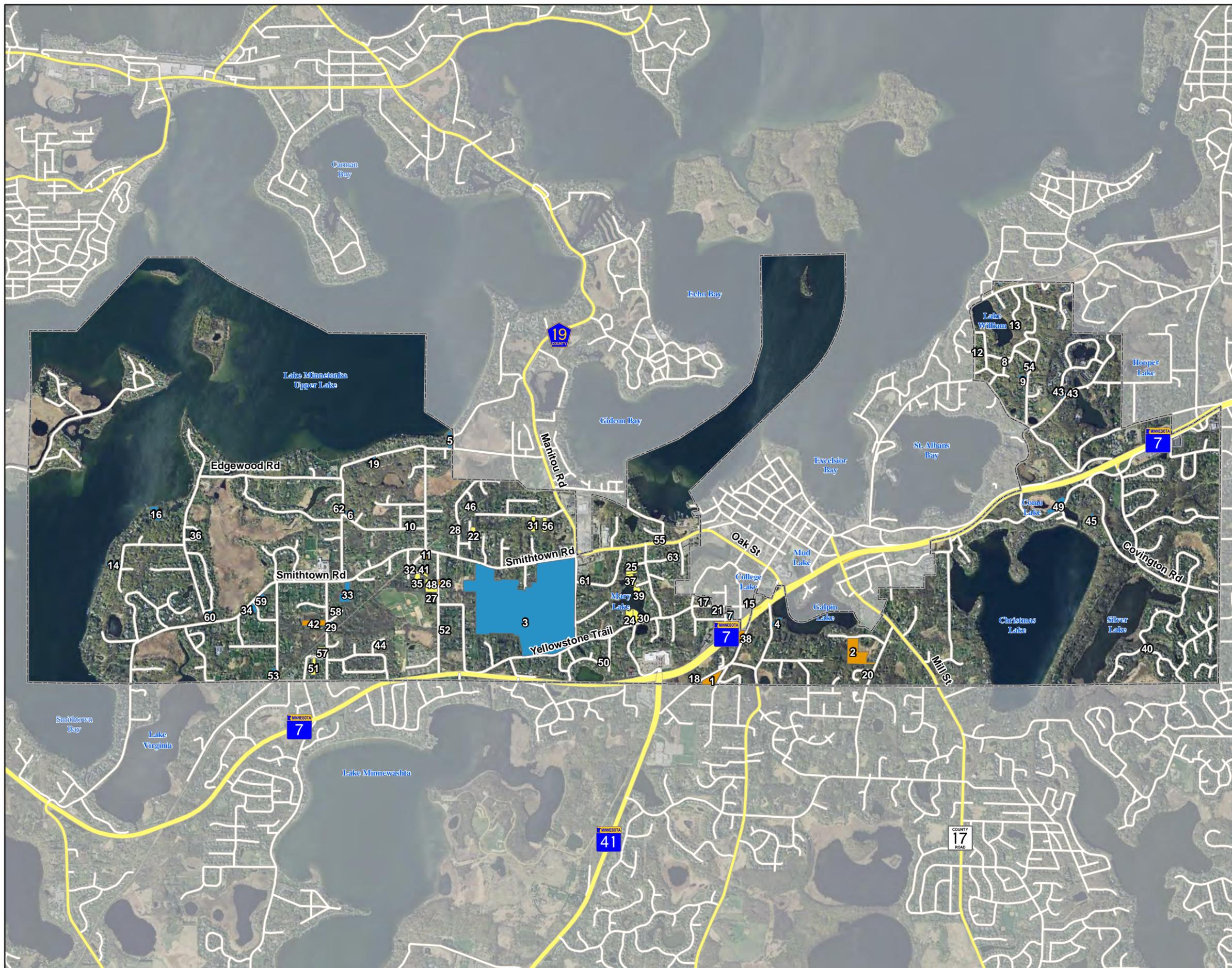
Problem Area Summary



CITY OF SHOREWOOD

Shorewood Surface Water Management Plan

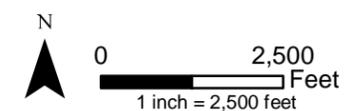
Problem Areas Identified in 2006 and 2007 Drainage Analysis



City Boundary

Problem Areas from 2006/2007 Study

- Project Completed
- To be Corrected by Residents/Owners
- To be Corrected by the City



**ANALYSIS OF DRAINAGE PROBLEM AREAS
WITHIN THE CITY OF SHOREWOOD**

**PREPARED FOR THE
CITY OF SHOREWOOD, MINNESOTA**

January 23, 2006

Prepared By:

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Minneapolis, MN 55416
(763) 541-4800
(763) 541-1700 (Fax)**

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**APPENDIX A - Opinion Of Probable Cost For Selected Problem Areas
(Category 1-5)**

**APPENDIX B - Recommended Maintenance Activities
(On-going or One-time projects)**

CERTIFICATION

I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly licensed professional engineer under the laws of the State of Minnesota.

Steven Gurney, P.E.

Date: January, 2006

Reg. No. 40497

I. INTRODUCTION

On September 4th, 2005 a strong thunderstorm developed over the City of Shorewood. In the course of approximately three hours, close to six inches of rain fell within the City. During this time, large hail also was observed, stripping leaves from trees and adding to the general debris that was present within the storm sewer system.

The City experienced a second storm on October 4th, 2005. This storm produced approximately 4.5 inches of rain within a four hour period.

The City requested WSB & Associates, Inc. look at the various drainage problem areas. The preliminary findings of this investigation are outlined within this report.

To aid the City in planning for projects that will reduce the number of flood problem areas, we have ranked the problem areas based on a modified classification system. In order to maintain some consistency with the City's system previously established, we used the same categories with limited modifications. The criteria outlined in the Capital Improvement Program (1997 – 2001) were modified as follows:

- Split "Private Nuisance" areas into two categories, one in which the City may share in the responsibility for the project and one that is entirely the responsibility of the private property owner and / or their neighbors.
- Added a new category consisting of areas where no additional work is recommended.

The various categories are outlined below:

1) PUBLIC SAFETY AND HEALTH

Primary attention will be paid to those projects that impact the public health or safety. These projects would include ice problems on the road, erosion that is causing a hazardous structural problem (i.e. undermining a road), or storm water that is causing a significant health problem (such as flooding the sanitary system).

2) SUBSTANTIAL FINANCIAL IMPACT TO THE CITY

This category will include those projects that, while not endangering the public health, will still have a negative impact on the residents as a whole. Projects in this category include minor infrastructure replacement that cannot be funded cost effectively by other means. Other potential projects include erosion causing property damage and minor structure replacement.

3) PUBLIC NUISANCE

This category includes those projects that cannot be considered a substantial hazard, are not likely to cause a financial loss to the City, but are a public nuisance. These projects include standing water in the roadway, unwanted flooding in public parks, and minor erosion projects.

4) PRIVATE NUISANCE WITH LIMITED CITY RESPONSIBILITY

This category includes projects that are a nuisance to a single residence or small group of residences that the City Council deems that the City has some responsibility to help correct. These projects include those instances where a large drainage area is causing a problem to a small area or where a substantial portion of the runoff is generated within the City's Right-of-Way.

In order for the City to participate, the homeowner(s) must be willing to provide a right-of-entry to City crews and provide Drainage and Utility Easement over improvements without cost.

5) PRIVATE NUISANCE WITH NO CITY RESPONSIBILITY

This category includes projects that are a nuisance to a single residence or small group of residences that the City Council deems that the City has no responsibility to help correct. These projects include those instances where a limited drainage area, consisting of private property, is causing a problem to a small area. The nuisance problem will involve little or no runoff that is generated from City Right-of-Way.

6) NO FURTHER ACTION REQUIRED

This category includes projects that are under way, or have been addressed through various means, such as individual homeowners correcting the problem himself or herself or City crews fixing the problem.

The problem areas are all evaluated and a category assigned so that the City Council can begin to prioritize the problem areas.

Tables 1-6 contain a list of the problem areas for each category along with a preliminary ranking of the areas within in each category. This ranking, along with the preliminary cost estimates, can be used by the City Council to determine the priority for fixing the problem areas.

II. DISCUSSION OF PROBLEM AREAS

Following the September 4th storm, the City received several drainage complaints. Since that time, we have investigated each of the various areas to visit with concerned residents, gather additional information, take pictures, and where possible, observe the problems.

The results of this preliminary investigation are presented in the following pages. Each problem area has a brief description of the complaint expressed by the property owner followed by a summary of the hydrologic characteristics of the subwatershed tributary to the site.

Next, possible alternatives that may be considered to address the problems at the subject site are outlined. A preliminary cost estimate for each alternative is also provided.

Following that is a recommendation by WSB as to how the City should proceed. Several of the areas are within private property and do not necessarily require much additional investigation by City Staff or their consultants. However, there are several areas that, because of their proximity to or the amount of public property involved in the tributary area, will require further review.

Unless otherwise noted, the hydrologic information is based on a cursory review of the subwatershed tributary to the problem area. The Soil Conservation Service's TR-20 method was used to estimate flow rates from the subwatershed directly tributary to the problem area.

Problem Area Number 1 – 6180 Murray Hill Road

Description of Problem:

The owner of 6180 Murray Hill Road has experienced flooding as a result of the September 4th storm. The house is located at the base of a steep hill. At the top of the hill, two city streets, Murray Hill Road and Summit Drive, intersect at a “T” intersection. Runoff from Summit Drive is conveyed down the surface of the road, which is at an approximate 12.5% slope. It has been observed by City crews that the runoff from this road is flowing with such velocity that it does not stay on the road surface. Rather, it drops down the steep slope and flows towards the residence at 6180 Murray Hill Road. This is evident by the accumulation of sediment at the base of the hill. The resident has stated that they had flooding of their basement during the storm event.

Hydrologic Information:

- Tributary Area: 2.3 ac
- Impervious Surface: 20%
- Peak 10-year Flow Rate: 5.8 cfs
- Peak 100-year Flow Rate: 10.2 cfs

Possible Alternatives:

The following alternatives are available to correct the drainage problem at this site:

1. Installation of storm sewer and catch basins on Summit Drive. It is anticipated that the construction costs associated with this work will be approximately \$31,000.
2. Regrading of Murray Hill Road and / or areas behind the west curb to provide conveyance for on the street surface, rather than down the steep bank. It is anticipated that the construction costs associated with this work will be approximately \$2,300.
3. Grading of the yard to provide a swale that will intercept runoff coming down the steep slope and convey it to the wetland behind the residence. It is anticipated that the construction costs associated with this work will be approximately \$2,900.

Recommendation:

It is recommended that this problem area be categorized as a “Private Nuisance with Limited Public Responsibility” area (Category 4) since a portion of the runoff comes from City Right-of-Way.

It is also recommended that additional analysis be undertaken to determine the depth of flow at this intersection so that the height of the constructed berm can be verified.

Problem Area Number 2 – 6100 Apple Road

Description of Problem:

This residence is located at the bottom of a ravine, with the house cut back into the hill. The homeowner has attempted to redirect runoff around his house by constructing a drain tile system comprised of six inch HDPE and pea rock french drain system. During the heavy rains of September, the system was overwhelmed and several areas were eroded, depositing the pea rock on the downstream lawn.

Hydrologic Information:

- Tributary Area: 5.1 ac
- Impervious Surface: 5%
- Peak 10-year Flow Rate: 7.7 cfs
- Peak 100-year Flow Rate: 15 cfs

Possible Alternatives:

The homeowner could construct a new pipe with more capacity. Due to the proximity of the house, it is not recommended that additional ponding be provided uphill unless an emergency overflow route can be established. In order to accomplish this, the homeowner may have to coordinate the work with his neighbors. It is anticipated that the construction costs associated with this work will be approximately \$16,000.

Recommendation:

It is recommended that this problem area be categorized as a “Private Nuisance with No City Responsibility” area (Category 5).

A letter will be sent to the resident recommending that he contact his neighbors to discuss alternatives and that they work together to provide a solution to the problem. No further analysis will be undertaken by WSB on this problem area unless directed by the City to do so.

Problem Area Number 3 – Minnetonka Country Club

Description of Problem:

Discussion during the heavy storm events of September, the Country Club experienced flooding that resulted in the course being shut down for a few days. While much of the course was flooded initially, the extended duration of the flooding in the southeast corner of the course has the groundskeeper concerned. A field review of the area shows that the outlet pipe that conveys runoff from this area is an 8-inch PVC line.

Hydrologic Information:

- Tributary Area: 147.2 ac*
- Impervious Surface: 12%*
- Peak 10-year Flow Rate: 141 cfs**
- Peak 100-year Flow Rate: 267 cfs**

*Based on a model developed as part of CSMP

**Considerable storage volume available on golf course. Peak rates represent runoff to golf course.

Possible Alternatives:

The following alternatives are available to correct the drainage problem at this site:

1. Provide a larger pipe with more capacity to convey runoff from the southeast corner of the golf course.
2. Provide additional ponding within golf course, within areas that will not impact play.
3. Raise impacted greens above high-water level.
4. Combination of the above. The above alternatives could be constructed in phases or as one large project. Since the scope of this project could vary significantly, separate cost opinions have not been developed for the individual alternatives. Rather, a cost range has been provided to aid in planning and budgeting purposes. It is anticipated that the construction costs associated with this work will be approximately \$120,000 to \$533,000.

Recommendation:

It is recommended that this problem area be categorized as a “Private Nuisance with Limited Public Responsibility” area (Category 4) since there are areas off-site including City Right-of-Way that contributes runoff to the golf course.

Since this is a large area containing lots of open space, and there is potential for a comprehensive storm water management plan for this area, it is recommended that further analysis be undertaken to develop a comprehensive system that will provide treatment and rate control for the watershed as a whole.

Problem Area Number 4 – 5925 Galpin Lake Road

Description of Problem:

This residence is a new home constructed on a previously vacant lot. The homeowner is concerned with the amount of runoff that is conveyed through his property from the road.

Hydrologic Information:

- *No hydrologic analysis completed since this problem has already been addressed.*

Possible Alternatives:

The homeowner has redirected the runoff conveyed through his property by constructing a berm adjacent to the road surface. The berm will contain runoff within the road surface. It is then conveyed downstream to a low point, where it will discharge to Galpin Lake.

Recommendation:

It is recommended that this problem area be categorized as a “No Further Action Required” area (Category 6) since the problem has been addressed through the building permitting process.

A letter informing the homeowner of this will be mailed, but no further analysis of this site will be made without direction from the City.

Problem Area Number 5 – 25360 Birch Bluff Road

Description of Problem:

The culvert at the driveway entrance to this property is damaged and in need of replacement. The CMP is deteriorated along the bottom of the culvert and both ends of the culvert are partially collapsed. This has resulted in greater flow velocities and erosion at both ends of the culvert.

The culvert is located on the drainage ditch that conveys runoff from a large portion of the City directly to Lake Minnetonka at Crescent Beach.

Hydrologic Information:

- Tributary Area: 86.1 ac (direct), 306.4 ac (total tributary area)*
- Impervious Surface: 30%**
- Peak 10-year Flow Rate: 8 cfs***
- Peak 100-year Flow Rate: 14 cfs***

* Based on subwatershed delineated in CSMP.

** The amount of impervious surface is estimated from the Curve Numbers previously established during preparation of the City's CSMP.

*** Flow rates based on full flow capacity of existing culvert (10-year) and peak flow rate without overtopping of driveway (100-year). Additional rate control is provided by upstream culvert at Pleasant Place.

Possible Alternatives:

The following alternatives are available to correct the drainage problem at this site:

1. Do nothing.
2. Replace culvert. It is anticipated that the construction costs associated with this work will be approximately \$15,000.

Recommendation:

It is recommended that this problem area be categorized as a "Public Safety and Health" area (Category 1) since the drainage ditch is an integral part of the City's storm water conveyance system.

The City will replace this culvert in the spring.

Problem Area Number 6 – 26220 Wild Rose Lane

Description of Problem:

During the heavy rainfalls of September, the resident experienced basement flooding. The water in the basement was approximately 2 – 2 ½ feet deep. The backyard of the residence contains an in-ground swimming pool that is located at the base of a steep hill. To gain access to the pool from the house, there is an egress door located below ground, as well as a lookout window. The runoff seems to have entered through these openings as evident by the debris line on the lookout window.

Hydrologic Information:

- Tributary Area: 1.5 ac
- Impervious Surface: 15%
- Peak 10-year Flow Rate: 3.9 cfs
- Peak 100-year Flow Rate: 6.9 cfs

Possible Alternatives:

The following alternatives are available to reduce the risk of flooding at the basement of this residence in the future:

1. Seal the low-building openings. It is anticipated the construction costs associated with this work will be approximately \$12,500.
2. Provide a drainage swale around the back of the lot to convey runoff around the home. It is anticipated the construction costs associated with this work will be approximately \$6,000.

Recommendation:

It is recommended that this problem area be categorized as a “Private Nuisance with No City Responsibility” area (Category 5).

A letter will be sent to the resident recommending that they contact their neighbors to discuss alternatives and that they work together to provide a solution to the problem. No further analysis will be undertaken by WSB on this problem area unless directed by the City to do so.

Since this property has experienced flooding of the basement, it is further recommended that this be given a higher priority if the City does decide to get involved in private drainage problems.

Problem Area Number 7 – 5925 Grant Street

Description of Problem:

This residence is located at the lowest point of a subwatershed that includes a portion of the City of Excelsior. A series of culverts are located in the roadway ditch in the front of the yard. To alleviate standing water in the low backyard area, a 4-inch PVC drain tile was installed to convey runoff from this lowpoint to the storm sewer located in the street Right-of-Way. The inlet to this drain tile consists of a small hole dug into the yard supported by landscape bricks. A screened grate was placed over the bricks.

During the September rainfall event, this area flooded resulting in water in the basement of the residence. It was observed that the landscape bricks that supported the grate had collapsed, partially blocking the drain tile line.

The storm sewer system crosses below Park Street and discharges to a drainage ditch located within the City's Right-of-Way. At the end of the ditch, adjacent to the TH-7 Right-of-Way, a resident has constructed a horseshoe shaped berm in an attempt to block runoff from flowing across his property. The height of this berm is approximately 3–4 feet high. Based on review of the City's 1-foot contour information, it appears that there is approximately 7 feet of fall from the outlet of the storm sewer system to the top of this berm. Therefore, it is unlikely that the berm is creating any tailwater impacts on the Grant Street storm sewer system. The City has an existing sewer easement across the property containing the berm. It is recommended that the City instruct the homeowner at 5965 Grant Street to remove the berm.

Hydrologic Information:

- Tributary Area: 1.7 ac* (direct), 8.9 ac total (tributary to Park St. storm sewer)
 - Impervious Surface: 9% (direct), 25% (total area)
 - Peak 10-year Flow Rate: 19.7 cfs
 - Peak 100-year Flow Rate: 34.3 cfs
- *Area within City of Excelsior has been estimated based on field visit.

Possible Alternatives:

Constructing a larger storm sewer system with additional capacity would reduce the flooding potential in this area. It is anticipated the construction costs associated with this work will be approximately \$42,000.

Recommendation:

It is recommended that this problem area be categorized as a “Private Nuisance with Limited Public Responsibility” area (Category 4) since the runoff involves City Right-of-Way and a portion of the storm sewer system is a City owned system.

It is recommended that additional analysis be undertaken to design a comprehensive system in this area.

Problem Area Number 8 – 20955 Ivy Lane

Description of Problem:

The resident is complaining of small “sink holes” in her yard. It appears that these eroded areas are a result of the gutter downspouts from the garage area, which are directed toward the areas that have eroded. The resident was requesting that fill be placed in these areas since it is adjacent to a City drainage ditch.

Hydrologic Information:

- *No hydrologic analysis completed since the erosion is located on private property.*

Recommendation:

It is recommended that this problem area be categorized as a “No Further Action Required” area (Category 6).

A letter informing the homeowner of this will be mailed, but no further analysis of this site will be made without direction from the City.

Problem Area Number 9 – 4980 Suburban Drive

Description of Problem:

The owner has experienced a wet basement. He believes this is due to the neighbor's gutter downspouts being directed toward his foundation. In addition, during the October rainfall event the homeowner observed that runoff from the neighbor's yards has conveyed down a small hill in his backyard and across his driveway, resulting in erosion to the gravel driveway. The eroded material is then deposited in a low area adjacent to this property.

Hydrologic Information:

- Tributary Area: 0.5 ac
- Impervious Surface: 37%
- Peak 10-year Flow Rate: 1.6 cfs
- Peak 100-year Flow Rate: 2.6 cfs

Possible Alternatives:

The following alternatives are available to reduce the potential for further erosion in this area:

1. Installation of a small private drainage system to convey runoff under the driveway. It is anticipated that the construction costs associated with this work will be approximately \$6,500.
2. Construction of a berm to contain runoff within the yard or spread it out so that localized erosion is not experienced. It is anticipated that the construction costs associated with this work will be approximately \$4,300.
3. Paving driveway. It is anticipated that the construction costs associated with this work will be approximately \$7,800.

Recommendation:

It is recommended that this problem area be categorized as a "Private Nuisance with No City Responsibility" area (Category 5).

A letter will be sent to the resident recommending that he contact his neighbors to discuss alternatives and that they work together to provide a solution to the problem. No further analysis will be undertaken by WSB on this problem area unless directed by the City to do so.

Problem Area Number 10 – 25720 / 25722 Wild Rose Lane

Description of Problem:

The property owner has experienced erosion of his driveway. A review of the site showed that the driveway culvert at this location was almost completely plugged. Runoff from the roadway that would have been conveyed under the driveway by this culvert instead ran down the driveway thereby causing erosion.

The property owner has since regraded the front yard and driveway to block street runoff from entering his property. In addition, the City has built up a small bituminous curb over the driveway that will convey runoff past the driveway and into a low area west of the property.

Hydrologic Information:

- *No hydrologic analysis completed since the property owner was fixing this area.*

Recommendation:

It is recommended that this problem area be categorized as a “No Further Action Required” area (Category 6) since the property owner has addressed the problem.

A letter informing the homeowner of this will be mailed, but no further analysis of this site will be made without direction from the City.

Problem Area Number 11 – 25575 Smithtown Road (Lake South Auto)

Description of Problem:

During the September rainfall event, the business owner reported flooding of his shop area. A catch basin is located in the Smithtown Road ditch, immediately east of the paved area in front of the shop. Runoff intercepted by this catch basin is conveyed under Smithtown Road by a storm sewer system that discharges to the Regional Trail ditch.

The primary structure for this property has experienced flooding on several occasions. During the last events approximately 8 inches of water covered the finished floor of the building. In addition, runoff inundated the low point of Smithtown Way Roadway, located approximately 75 feet west of Smithtown Road, and the intersection of Smithtown Road and Smithtown Way.

Further observations by the City during the October rainfall event indicated that runoff was being trapped by the curb that has been placed around the edge of the parking lot, by the owner, in front of the business. In addition, it has been observed that the capacity of the catch basin immediately east of the driveway is exceeded.

Hydrologic Information:

- Tributary Area: 7.4 ac
- Impervious Surface: 19%
- Peak 10-year Flow Rate: 14.9 cfs
- Peak 100-year Flow Rate: 26.7 cfs

Possible Alternatives:

1. The Public Works Department has swapped out the inlet grate for the catch basin located immediately east of the subject driveway to increase the capacity of the drainage inlet.
2. If the increased capacity of the inlet grate remains inadequate, modifications to the driveway will be required to redirect runoff to the mainline structures. It is anticipated that the construction costs associated with this work will be approximately \$19,000.

Recommendation:

It is recommended that this problem area be categorized as a “Public Nuisance” (Category 3.)

Problem Area Number 12 – 21165 Minnetonka Boulevard

Description of Problem:

This home was recently constructed on a subdivided lot. As a requirement of the construction, the homeowner constructed a private drainage system within the City Right-of-Way. Runoff from a small depression located on his lot is conveyed to the storm sewer system through a flared end section (FES) located on the property. The system discharges to the roadside ditch located downstream along Minnetonka Boulevard. The storm sewer system appears to have replaced a series of culverts in two downstream driveways. To replace these culverts, catch basins were added at the driveways that connect to the private drainage system.

The homeowner originally contacted the City to express concern that the system was clogging with debris. He also expressed concern that an upstream culvert was clogged and redirecting runoff through his front yard rather than along the roadside ditch. He also expressed concern with the amount of standing water that was in the depression on his property. The homeowner indicated that he plans to place fill in the depression to eliminate standing water below the FES.

Subsequent conversations with the property owner indicate that, at times, stormwater runoff was actually flowing into the depression through the FES. Based on this, it appears that the storm sewer system may have surcharged and back-flowed into the depression area. Once the peak subsided, the water did drain out of the depression to the elevation of the FES.

Hydrologic Information:

- Tributary Area: 6.0 ac
- Impervious Surface: 25%
- Peak 10-year Flow Rate: 13.3 cfs
- Peak 100-year Flow Rate: 23.2 cfs

Possible Alternatives:

To reduce the risk of clogging, City crews have replaced the standard CB grates with beehive-type grates. In addition, the trash guard on the FES at the downstream discharge point to the Minnetonka Boulevard ditch was removed. This trash guard had trapped debris within the FES. City crews also removed a portion of the damaged culvert upstream of the property, which should reduce the potential for runoff being conveyed across the front yard of the 21165 Minnetonka Boulevard.

In order to reduce the potential for runoff backflowing into the depression area located on the property, the homeowner may wish to consider the following options:

1. Installation of a flap gate within the storm sewer line between the FES and the catch basin. It is anticipated that the construction costs associated with this work will be approximately \$4,000.
2. Construction of a parallel storm sewer system to convey runoff from Minnetonka Boulevard. The system could be installed over the top of the previously installed system

to convey the runoff collected by the catch basins adjacent to Minnetonka Boulevard. It is anticipated that the construction costs associated with this work will be approximately \$12,000.

3. Do nothing. The backflow is a temporary inconvenience that, with proper grading of the depression area, could be reduced to occurring only during large intensity storms. The emergency overflow elevation for this depression area is approximately two feet lower than the low building opening of the new home at 21165 Minnetonka Boulevard. Provided that overflow elevation is maintained, it is likely that adequate freeboard will be provided for this property.
4. Other, homeowner-initiated solution.

Recommendation:

It is recommended that this problem area be categorized as a “Private Nuisance With No City Responsibility” area (Category 5). This situation would normally be categorized as a “Private Nuisance With Limited City Responsibility” area (Category 4), but since this private storm sewer system was required to develop the lot, it should remain a private system.

A letter will be sent to the residents recommending that they contact their engineer to discuss the operation of the storm sewer system and potential solutions to the back flow condition.

No further analysis will be undertaken by WSB on this problem area unless directed by the City to do so.

Problem Area Number 13 – 4770 Lakeway Terrace

Description of Problem:

This property is located near the low point of the Lakeway Terrace cul-de-sac. The property owner is complaining that during the recent storms, runoff was conveyed over his landscaped berm and through his side yard to Lake William. There is a storm sewer system in the street that conveys runoff from a drainage ditch as well as runoff from the road surface. Catch basins are located at the street low point. The catch basin on the west side of Lakeway Terrace has a beehive casting that appears to be slightly silted in. During the September storm event, it is possible that this casting became plugged with debris, as there were a lot of leaves dropped from trees as a result of hail.

A review of City records did not yield any specific information as to a drainage and utility easement, although, typically, there is a 10-foot easement provided along each side of the common lot line.

Hydrologic Information:

- Tributary Area: 3.4 ac
- Impervious Surface: 14%
- Peak 10-year Flow Rate: 7.8 cfs
- Peak 100-year Flow Rate: 14.0 cfs

Possible Alternatives:

The following alternatives are available to reduce the potential for runoff being conveyed through this property:

1. Install a different casting that will allow debris to enter the CB. A stool grate such as the Neena HR-4341-A casting is recommended. It is anticipated that the construction costs associated with this work will be approximately \$900.
2. The road grade could be lowered on the east edge of the roadway. This would convey runoff back to the drainage ditch. There are drawbacks to this proposed system, as it would impact an existing force main and lift station located in the Right-of-Way in this location. It is anticipated that the construction costs associated with this work will be approximately \$12,000.
3. Construction of a higher berm along the property would allow additional runoff to pond on the road surface in this area before being conveyed across the property. This construction would result in the disturbance to front yards that are currently in good condition. It is anticipated that the construction costs associated with this work will be approximately \$1,700.
4. Do nothing. The remainder of the overflow route does appear to be well graded away from structures; therefore, flooding potential is minimized. It does not appear that the

runoff conveyed along the lot line of this property would result in a flooding risk to the adjacent homes.

Recommendation:

It is recommended that this problem area be categorized as a “Private Nuisance With Limited City Responsibility” area (Category 4).

It will be recommended that the City look at future improvements in this area that may reduce the potential for runoff being conveyed along the common lot line.

Problem Area Number 14 – 28070 Woodside Road

Description of Problem:

This property has experienced partial erosion of the timber retaining wall that has been constructed along the bluff overlooking Lake Minnetonka. In order to convey runoff from the backyard to the lake, a downspout consisting of two CMP flumes have been installed. The entrance to these flumes consists of grouted riprap to provide a smooth transition.

Based on a field visit, it appears that runoff from the adjacent property to the north is conveyed to this downspout. During the site visit, it was observed that the grass surface had been bent over, indicating that runoff had come from that property and been conveyed to the downspout. Based on a review of the grading plan for the adjoining property, the construction of the new house does not appear to have significantly altered the drainage patterns that existed prior to the construction of the new house.

Hydrologic Information:

- Tributary Area: 1.1 ac
- Impervious Surface: 16%
- Peak 10-year Flow Rate:
- Peak 100-year Flow Rate:

Possible Alternatives:

The property owner has already fixed the eroded areas. The following alternatives are available to reduce the potential for future erosion in this area:

1. Reconstruct the entrance to the downspout by building up the grouted riprap area adjacent to the entrance to the culverts. This would reduce the chance of water flowing over the bluff and eroding the material supporting the downspouts. It is anticipated that the construction costs associated with this work will be approximately \$1,700.
2. Constructing a new drain on the north property that would reduce the amount of runoff being conveyed to the downspout. In order to convey this runoff to the lake, a separate pipe would have to be constructed through the bluff, which would require a variance from the Bluff Preservation Ordinance. Alternatively, the drain system could connect into the existing downspout at a lower elevation. It is anticipated that the construction costs associated with this work will be approximately \$5,000.
3. Do nothing. The storm events that caused the erosion were large storm events that exceeded the 10-year storm event, which is the typical design storm event for this type of system.

Recommendation:

It is recommended that this problem area be categorized as a “Private Nuisance With No City Responsibility” area (Category 5.)

A letter will be sent to the resident recommending that she contact her neighbors to discuss alternatives and that they work together to provide a solution to the problem. No further analysis will be undertaken by WSB on this problem area unless directed by the City to do so.

Problem Area Number 15 – 800 Water Street (Frontier Electric)

Description of Problem:

The Frontier Electric shop building was flooded during the September storm event. The property is actually located within the City of Excelsior. The property owner contends that increased runoff from the City of Shorewood has resulted in his shop being flooded. These improvements include the reconstruction of the parking lot at the Shorewood Mall, as well as the construction of the new townhomes located immediately east of the mall.

Subsequent inspection of the catch basins within the mall parking lot indicates that the runoff from the parking lot is conveyed to the storm sewer system that was constructed as part of the TH-7/41 improvements. This was verified during a subsequent rainfall event where no runoff was observed being conveyed to the TH-7 ditch east of the mall. There is an emergency overflow pipe that would convey runoff to the east should that ditch in front of the mall fill up. However, the area tributary to this ditch is relatively small, and it is not likely that runoff would be conveyed to the east.

Hydrologic Information:

The hydrologic analysis completed in conjunction with the Mn/DOT project to reconstruct the TH-7/41 intersection indicated that the tributary area to the Frontier Electric building was actually reduced.

Possible Alternatives:

In addition to the work that was previously done during the reconstruction of TH-7/41, work is has been completed by other government entities.

Mn/DOT has regraded the TH-7 ditch and improved the entrance to the culvert adjacent to the shop building. In addition, it is our understanding that the City of Excelsior will be removing the pipe adjacent to the shop, providing an open channel conveyance system that will be less likely to cause flooding of the shop building. It is anticipated that this work will be completed in 2006.

Recommendations:

It is recommended that this problem area be categorized as a “No Further Action Required” area (Category 6) since it is being addressed by other government entities.

A letter informing the property owner of this will be mailed, but no further analysis of this site will be made without direction from the City.

Problem Area Number 16 – 27780 Island View Road

Description of Problem:

The homeowner expressed concern about standing water in his yard adjacent to his neighbor's property. The problem has been noticed since the neighbor installed a new pool. The property owner believes that a drain tile may have been damaged as part of the construction of the pool.

Hydrologic Information:

- Tributary Area: 1.6 ac
- Impervious Surface: 4%
- Peak 10-year Flow Rate: 3.0 cfs
- Peak 100-year Flow Rate: 5.7 cfs

Possible Alternatives:

The following alternatives are available to correct the standing water problem at this site:

1. Construct a small drain system to the lake. The effectiveness of this system may be limited because the system would have to operate under hydraulic head since there is limited fill between the yard and the lake. It is anticipated that the construction costs associated with this work will be approximately \$7,800.
2. Because the area of standing water is relatively small, a rain garden could be constructed at the site low point consisting of wet tolerant trees or shrubs. It is anticipated that the construction costs associated with this work will be approximately \$4,500.
3. Do nothing. Since the problem does not pose an immediate potential for flooding, doing nothing would be an appropriate option at this site.

Recommendation:

It is recommended that this problem area be categorized as a "Private Nuisance With No City Responsibility" area (Category 5).

A letter will be sent to the resident recommending that he contact his neighbors to discuss alternatives and that they work together to provide a solution to the problem. No further analysis will be undertaken by WSB on this problem area unless directed by the City to do so.

Problem Area Number 17 – 23350 Academy Avenue

Description of Problem:

The elevation of this house and the garage are below the elevation of the street adjacent to the property. During the September storm event, runoff was observed flowing onto the property. The house was flooded. A catch basin is located on the south side of the road, but this catch basin appears to have been plugged. Runoff then overtopped the road. It appears that the majority of the ditch on the south side of the road has been silted in over time and is in need of maintenance.

Hydrologic Information:

- Tributary Area: 1.2 ac
- Impervious Surface: 18%
- Peak 10-year Flow Rate: 2.9 cfs
- Peak 100-year Flow Rate: 5.1 cfs

Possible Alternatives:

The following alternatives are available to correct the flooding problem at this site:

1. Installation of a beehive manhole will reduce potential for clogging. It is anticipated that the construction costs associated with this work will be approximately \$900.
2. Excavation of a new ditch along the south side of the street would reduce the potential for runoff overtopping the road. It is anticipated that the construction costs associated with this work will be approximately \$1,400.
3. Regrading the road to provide positive drainage away from the house may not be possible due to the steep grades of driveways across the street. However, installation of curb and gutter along this stretch of road, combined with some lowering of the road, may reduce the potential for runoff being conveyed toward the house. It is anticipated that the construction costs associated with this work will be approximately \$53,000.

Recommendation:

It is recommended that this problem area be categorized as a “Private Nuisance with Limited Public Responsibility” area (Category 4) since a portion of the runoff comes from City Right-of-Way.

It is also recommended that additional analysis be undertaken to determine the most cost effective alternative to reduce flooding potential.

Problem Area Number 18 – 6180 Chaska Road

Description of Problem:

Runoff from Chaska Road washed out a landscape berm on the west edge of this property. Runoff was conveyed through the side yard and into an egress window, flooding the basement. A small drain system with small catch basin inlets located in the side yard did not convey the runoff at the high rate generated by the September storm.

Hydrologic Information:

- Tributary Area: 1.3 ac*
- Impervious Surface: 7%
- Peak 10-year Flow Rate: 2.5 cfs
- Peak 100-year Flow Rate: 4.8 cfs

* Area is estimated from CSMP Subwatershed Boundaries since the City's 1-foot contour information does not extend into Chanhassen.

Possible Alternatives:

The homeowner is considering the following alternatives to correct the drainage problem at this site:

1. Construction of a more defined swale to provide an overflow route through the side yard of this residence. In addition, increase the height of the grading around the egress windows. It is anticipated that the construction costs associated with this work will be approximately \$3,200.

Recommendation:

It is recommended that this problem area be categorized as a "Private Nuisance With Limited City Responsibility" area (Category 4.)

It will be recommended that the City look at future improvements to reduce the potential for flooding at this property.

Problem Area Number 19 – 26025 Birch Bluff Road

Description of Problem:

Runoff from the road has eroded the area around the driveway.

Hydrologic Information:

- *No hydrologic analysis was completed since the problem has been addressed.*

Possible Alternatives:

City crews have already corrected this erosion problem by building up a bituminous curb along the edge of the road and backfilling the eroded area. It is anticipated that this work has addressed the erosion problem.

Recommendation:

It is recommended that this problem area be categorized as a “No Further Action Required” area (Category 6) since the City maintenance crews have fixed this area.

A letter informing the homeowner of this will be mailed, but no further analysis of this site will be made without direction from the City.

Problem Area Number 20 – 22015 Stratford Place

Description of Problem:

During the large September rainfall event, runoff from the drainage channel adjacent to this property may have scoured away part of the bank on the north side of the channel. Continued high flows in this drainage channel may result in additional erosion of the channel, thereby threatening the foundation of the house. During the site visit, it was noted that the 36-inch culvert under Stratford Place was almost completely clogged at the inlet. The City removed the debris at this site.

Hydrologic Information:

- Tributary Area: 45 ac*
- Impervious Surface: 25%**
- Peak 10-year Flow Rate: 66.2 cfs
- Peak 100-year Flow Rate: 116.6 cfs

* The majority of the subwatershed is in the City of Chanhassen. Tributary area outside the City limits is estimated from subwatershed boundaries established during development of the City's CSMP.

** The amount of impervious surface is estimated since the majority of watershed is in the City of Chanhassen.

Possible Alternatives:

It is recommended that the City of Chanhassen be contacted to discuss repairs in this area since the majority of the area tributary to this problem is within their boundary. The following alternatives are available to correct the erosion problem at this site:

1. Extend the culvert under Stratford Place. A manhole could be added beyond the storm sewer extended up through the channel to collect runoff prior to the point where it begins to erode the bank of the existing home. The length of the storm sewer is approximately 100 feet. It is anticipated that the construction costs associated with this work will be approximately \$27,000.
2. Armoring along the channel bank to protect the foundation of the house along with installation of riprap adjacent to Apple Road is recommended. It is possible that the riprap could be placed only in selected portions of the channel that are posing a threat to the stability of the roadbed. It is anticipated that the construction costs associated with this work will be approximately \$18,000.

Recommendation:

It is recommended that this problem area be categorized as a "Public Safety and Health" area (Category 1) since further erosion may threaten both the City's roadway and the private residence.

Problem Area Number 21 – 5915 Grant Street

Description of Problem:

The property owner experienced flooding in her yard. This residence is adjacent to 5925 Grant Street. The description of the problem, hydrologic information, and possible alternatives are the same for this property as those outlined in *Problem Area Number 7*.

Recommendation:

It is recommended that this problem area be categorized as a “Private Nuisance with Limited Public Responsibility” area (Category 4) since the runoff involves City Right-of-Way and a portion of the storm sewer system is a City owned system.

It is recommended that additional analysis be undertaken to design a comprehensive system in this area.

Problem Area Number 22 – 5635 Harding Lane

Description of Problem:

Runoff from adjacent homes is conveyed through the backyard of this property. The runoff is conveyed by overland flow on the property. The catch basin is located on the north property line of this property, but it does not appear that the catch basin fully intercepts all runoff conveyed through the backyards. There is a drainage and utility easement on the back 50 feet of the lot. This does not appear to coincide with the primary flow path. This problem area was previously studied in 2003 and a draft version of the report was presented to the City for review. The project was tabled since there was not a consensus with the impacted property owners at that time.

Hydrologic Information:

- Tributary Area: 2.8 ac*
- Impervious Surface: 30%*
- Peak 10-year Flow Rate: 6.0 cfs
- Peak 100-year Flow Rate: 12.2 cfs

* Based on model previously developed as part of the 2003 Harding Lane Comprehensive Stormwater Management Plan.

Possible Alternatives:

The following alternatives are available to correct the drainage problem at this site:

1. The backyard area could be regraded so that the drainage swale is moved further away from the walkout opening. It is anticipated that the construction costs associated with this work will be approximately \$9,000.
2. Construction of a catch basin and storm sewer upstream of the project would intercept more water before it is conveyed onto this property. This system would be connected to the existing catch basin. It is anticipated that the construction costs associated with this work will be approximately \$13,000.
3. The construction of the improvements suggested in the 2003 study could address problems within the whole Harding Lane area. Adjusted for inflation, these costs are anticipated to be approximately \$87,000.

Recommendation:

It is recommended that this problem area be categorized as a “Private Nuisance with No City Responsibility” area (Category 5.)

A letter will be sent to the resident recommending that they contact their neighbors to discuss alternatives and that they work together to provide a solution to the problem. No further analysis will be undertaken by WSB on this problem area unless directed by the City to do so.

Problem Area Number 23 – 5615 Harding Lane

Description of Problem:

This is a property immediately north of 5635 Harding Lane. The runoff that is not intercepted by the catch basin located in the side yard of this property and 5635 Harding Lane is conveyed through this backyard. A retaining wall has been partially eroded and the runoff ponds in the homeowners garage. The hydrologic information and possible alternatives are the same for this area as those outlined for ***Problem Area Number 22***.

Recommendation:

It is recommended that this problem area be categorized as a “Private Nuisance with No City Responsibility” area (Category 5.)

A letter will be sent to the resident recommending that they contact their neighbors to discuss alternatives and that they work together to provide a solution to the problem. No further analysis will be undertaken by WSB on this problem area unless directed by the City to do so.

Since this property has experienced flooding of the garage, it is further recommended that this be given a higher priority if the City does decide to get involved in private drainage problems.

Problem Area Number 24 – 23980 Yellowstone Trail

Description of Problem:

This property is concerned about the current high water level of Mary Lake. Trees are being flooded on this property. A review of the Minnesota Department of Natural Resources website indicates that no Ordinary High Water Level has been determined for this lake.

Hydrologic Information:

- Tributary Area: 61.8 ac
- Impervious Surface: 43%
- Peak 10-year Flow Rate: 133 cfs*
- Peak 100-year Flow Rate: 231 cfs*

*Basin is actually land-locked. Flow rates represent peak runoff rates to the basin.

Possible Alternatives:

The following alternatives are available to correct the nuisance flooding problem at this site:

1. Construction of an outlet for this basin. The proposed storm sewer improvements for Minnetonka Drive could easily be modified to include an outlet for this basin. This outlet pipe would be relatively small and would function as an emergency overflow. It is anticipated that this pipe could be set at an elevation two feet lower than the existing overflow elevation. It is anticipated that the construction costs associated with this work will be approximately \$207,000.
2. Pump down the basin. The City did this for a period of time this fall. The costs associated with this option would vary depending on the amount of time the pump would run, and the number of occasions that the pump would have to be brought to this location.
3. Do nothing. The emergency overflow elevation of Mary Lake is approximately 957.1 and the lowest floor elevation of the adjacent elevations is 957.5. This provides 0.4 inches of freeboard, which is less than ideal, but would provide some buffer so that if the City were not able to pump, the water would overflow from the lake before flooding the residence at 23955 Clover Lane.

Recommendation:

It is recommended that this problem area be categorized as a “Private Nuisance with Limited Public Responsibility” area (Category 4) since a portion of the runoff comes from City Right-of-Way.

It is also recommended that an outlet from Mary Lake be constructed as part of the Minnetonka Drive storm sewer improvement project.

Problem Area Number 25 – 23955 Clover Lane

Description of Problem:

This property is also located on Mary Lake. The description of the problem, hydrologic information and possible alternatives are the same as those outlined for ***Problem Area Number 24***.

Recommendation:

It is recommended that this problem area be categorized as a “Private Nuisance with Limited Public Responsibility” area (Category 4) since a portion of the runoff comes from City Right-of-Way.

It is also recommended that an outlet from Mary Lake be constructed as part of the Minnetonka Drive storm sewer improvement project.

Since this residence has the lowest low floor elevation, the property owner should consider obtaining sand bags to protect his building in the event that the water level rises and the City is not able to pump.

Problem Area Number 26 – 5815 Eureka Road

Description of Problem:

A new house was constructed south of this property and it has blocked the drainage from the subject property. An old drain tile existed prior to construction of the new house, but it was damaged during construction of the new house. The drain tile conveyed runoff to an existing drainage ditch located south of the new house construction. New drain tile was installed, but this does not appear to be functioning properly. During the heavy rainfall events, water has ponded in the low area in the southwest corner of this property. During the October storm event, it was observed that runoff overtopped to Eureka Road and was conveyed to the west through the backyards. (See *Problem Area Number 35 and Problem Area Number 48.*)

Hydrologic Information:

- Tributary Area: 2.9 ac
- Impervious Surface: 5%
- Peak 10-year Flow Rate: 5.7 cfs
- Peak 100-year Flow Rate: 10.7 cfs

Possible Alternatives:

The following alternatives are available to correct the drainage problem at this site:

1. We have been working with the home builder to fix the drainage problem at this site. This is being accomplished through the building permit process. The solution proposed by the builder is to excavate a small pond area to replace the depression area in the southwest corner of the lot. It is anticipated that the construction costs associated with this work will be approximately \$1,000. The builder has placed \$1,500 in an escrow account to cover this work once the area dries out in the spring.

Recommendation:

It is recommended that this problem area be categorized as a “Public Safety and Health” area (Category 1) since the overtopping of Eureka Road, if it occurs in the winter, could result in ice on the road.

The City is working with the builder to construct these improvements to minimize the potential for flooding across Eureka Road. This situation would typically be categorized as a private drainage matter, but, because of the hazard potential, is moved to Category 1.

Problem Area Number 27 – 5840 Eureka Road

Description of Problem:

This property has experienced a wet basement after the two large rainfall events this fall. The property owner contends that this is a result of a new culvert that was installed under Eureka Road, which conveys runoff to the drainage swale located along the south edge of this property. This swale discharges to the wetland located west of this property.

The homeowner believes that removal of debris at the outlet of this wetland would eliminate his problem. A cursory review indicates that the elevation of the outlet is approximately six feet below the existing ground elevation adjacent to his house. Since the basement is depressed approximately two feet, it appears that this is a groundwater related problem rather than a surface water runoff problem. It is unlikely that removing the debris, which is approximately six to twelve inches deep at the outlet, would greatly decrease the water level at the wetland.

Hydrologic Information:

- Tributary Area: 39.4 ac (direct), 55.9 ac (direct and indirect)
- Impervious Surface: 38%
- Peak 10-year Flow Rate: 6.4 cfs*
- Peak 100-year Flow Rate: 7.0 cfs*

* Flow rates based on existing CSMP model for culvert located upstream of this property.

Possible Alternatives:

In order to address flooding at this site, a new outlet for this basin would have to be constructed at a lower elevation. Storm sewer improvements for this area would involve constructing a trunk storm sewer system that would be deeper than the existing conveyance system of culverts, pipes, and ditches. This new trunk sewer would discharge to the large wetland complex downstream of Eureka Road. There will most likely be some amount of wetland mitigation required as a result of lowering the water level of this basin.

Recommendation:

It is recommended that this problem area be categorized as a “No Further Action Required” area (Category 6) since the problem appears to be related to a ground water level.

A letter informing the homeowner of this will be mailed, but no further analysis of this site will be made without direction from the City.

Problem Area Number 28 – 5600 Wedgewood Drive

Description of Problem:

There has been standing water at the Regional Trail and that it is higher than usual. It is creating an annoying odor. The homeowner is also concerned about the potential for his house flooding. An emergency overflow elevation for this area is approximately two feet lower than that ground adjacent to the house. This overflow elevation is located approximately 300 feet west of Wedgewood Lane.

Hydrologic Information:

- Tributary Area: 1.1 ac
- Impervious Surface: 14%
- Peak 10-year Flow Rate: 2.5 cfs
- Peak 100-year Flow Rate: 4.5 cfs

Possible Alternatives:

The following alternatives are available to correct the drainage problem at this site:

1. Do nothing. The house is not in danger of flooding from surface waters since there is an adequate overflow section.
2. Provide outlet through existing overflow route. A positive outlet could be established by dredging the ditch deeper through the existing overflow area to the west. This work could be done by the Hennepin County Regional Trail Authority since the area is within their Right-of-Way. It would result in significant tree loss. The area with the standing water has been identified as a wetland, so eliminating all standing water would require mitigation to replace the lost wetland. It is anticipated that the construction costs associated with this work will be approximately \$18,000.
3. Construct an outlet to the Wedgewood Drive storm sewer that is being proposed for construction in 2006. It is anticipated that the construction costs associated with this work will be approximately \$156,000. This cost could be reduced if the outlet is constructed as part of the up-coming Wedgewood Drive road reconstruction project.

Recommendation:

It is recommended that this problem area be categorized as a “Private Nuisance with No City Responsibility” area (Category 5).

No further analysis will be undertaken by WSB on this problem area unless directed by the City to do so.

Since the area in question also involves the Hennepin County Regional Trail Authority, the City has contacted them in an effort to assist with the solutions to the standing water. However, this effort would result in the loss of many trees. The removal of these trees would not require replacement if the work is done as part of a City project.

Problem Area Number 29 – 26395 Peach Circle

Description of Problem:

The property owner at this location is concerned with the amount of standing water located adjacent to the Hennepin County Regional Trail. The water backed up during the recent storm events and flooded their backyard. They have also had flooding in the basement that was due to a failed sump pump. The emergency overflow elevation for this area is approximately one foot lower than that ground adjacent to the house. This overflow elevation is located approximately 600 feet east of Strawberry Lane.

Hydrologic Information:

- Tributary Area: 2.7 ac
- Impervious Surface: 10%
- Peak 10-year Flow Rate: 5.6 cfs
- Peak 100-year Flow Rate: 10.4 cfs

Possible Alternatives:

The following alternatives are available to correct the drainage problem at this site:

1. Do nothing. The house is not in danger of flooding from surface waters since the overflow section is lower than the low building opening of the residence. However, more freeboard would be preferred.
2. Provide a positive outlet through the existing overflow route. This outlet could be established through the existing overflow area by dredging the ditch deeper. This work could be done by the Hennepin County Regional Trail Authority since the area is within their Right-of-Way. It would result in significant tree loss. These trees would not have to be replaced, but replacement would result in a project that is more acceptable to surrounding residents. It is anticipated that the construction costs associated with this work will be approximately \$28,000, excluding tree replacement.

Recommendation:

It is recommended that this problem area be categorized as a “Private Nuisance with No City Responsibility” area (Category 5.)

No further analysis will be undertaken by WSB on this problem area unless directed by the City to do so.

Since the area in question also involves the Hennepin County Regional Trail Authority, the City has contacted them in an effort to assist with the solutions to the standing water.

Problem Area Number 30 – 23930 Yellowstone Trail

Description of Problem:

This property is immediately east of 23980 Yellowstone Trail. The description of the problem, hydrologic information and possible alternatives are the same as those outlined in ***Problem Area Number 24***.

It is recommended that this problem area be categorized as a “Private Nuisance with Limited Public Responsibility” area (Category 4) since a portion of the runoff comes from City Right-of-Way.

It is also recommended that an outlet from Mary Lake be constructed as part of the Minnetonka Drive storm sewer improvement project.

Problem Area Number 31 – 24735 Glen Road

Description of Problem:

During recent storm events, the backyard area has filled up with water. When I visited the area on the 13th of October, the water had receded. The property owner claims to have lost \$25,000 worth of landscaping improvements in the past at this property. This area has been studied as part of the Glen Road Problem Area Report, which was originally completed by WSB & Associates, Inc. in October of 2001. This project was not completed due to resistance by several property owners. Since that time, there have been storm sewer improvements constructed as part of the CSAH-19 Project. Based on these improvements, the previously proposed plan no longer is valid. However, the hydrology of this problem area is essentially unchanged in the vicinity.

Hydrologic Information:

- Tributary Area: 16.4 ac*
- Impervious Surface: 26%*
- Peak 10-year Flow Rate: 34.9 cfs**
- Peak 100-year Flow Rate: 61.1 cfs**

*Based on model developed for CSMP

**Peak runoff rate represents runoff to low point at problem area.

Possible Alternatives:

There is an outlet for this area proposed as part of the Amlee Road Reconstruction. The outlet will be constructed in the northeast corner of the lot and at an elevation low enough to convey runoff from the lower area at the back of the property. This outlet could be extended to the south to convey runoff from the low point if desired by the property owner. However, an easement will be required over all pipes within this property. It is anticipated that the construction costs associated with this work will be approximately \$82,000.

Recommendation:

It is recommended that this problem area be categorized as a “Private Nuisance with No City Responsibility” area (Category 5.) However, since this area has been an ongoing problem area, the City is in the process of designing plans for the construction of an outlet for this problem area, provided easements can be obtained.

Problem Area Number 32 – 5770 Smithtown Way

Description of Problem:

The property owner contacted the City concerned about a “river” running through her yard. The “river” was caused by runoff from a designed drainage swale that outlets a wetland area behind this development. The swale flowing through conveys runoff around the houses, down the common lot line, and into a rock-lined channel where it is then conveyed the Smithtown Road storm sewer. The property owner claims that the increased runoff is a result of the construction on the new house at 5835 Eureka Road.

Hydrologic Information:

- Tributary Area: 18.5 ac (direct), 74.4 ac (direct and indirect)
- Impervious Surface: 38%
- Peak 10-year Flow Rate: 36.5 cfs*
- Peak 100-year Flow Rate: 59.1 cfs*

* Flow rate on based existing CSMP model for downstream outlet at pond adjacent to Smithtown Way.

Possible Alternatives:

There is no alternative identified for this problem area as the system appears to be functioning as designed. All runoff is being contained in the drainage and utility easements. A review of these easements indicates that they are located along the back lot line for a width of approximately 51 feet at the west edge of the property.

Recommendation:

It is recommended that this problem area be categorized as a “No Further Action Required” area (Category 6) since the runoff conveyed through this property is contained within the existing drainage and utility easement.

No further analysis will be undertaken by WSB on this problem area unless directed by the City to do so.

Problem Area Number 33 – 26275 Smithtown Road

Description of Problem:

The property owner called concerned that the culverts under Smithtown Road were partially plugged. During a visit to this area, it was observed that the entrance to one culvert was mostly plugged with debris. The other culvert had sufficient capacity to convey the runoff under Smithtown Road. A review of the City's one foot contour information indicates that Smithtown Road would overtop before the house at 26275 Smithtown Road would become inundated.

Hydrologic Information:

- Tributary Area: 44.5 ac (direct), 251.5 ac (total tributary area)
- Impervious Surface: 43%
- Peak 10-year Flow Rate: 63.4 cfs*
- Peak 100-year Flow Rate: 92.6 cfs*

*Flow rates based on CSMP model. Road will not overtop during 100-year event.

Possible Alternatives:

No further work is required at this area, except regular maintenance to clean debris from the culvert entrances.

Recommendation:

It is recommended that this problem area be categorized as a "No Further Action Required" area (Category 6.)

A letter informing the homeowner of this will be mailed, but no further analysis of this site will be made without direction from the City.

Problem Area Number 34 – 5900 Afton Road

Description of Problem:

The property owner has expressed concern about the amount of runoff that is conveyed through his backyard from his neighbor's property. The grading adjacent to the structure is adequate, with positive drainage away from the foundation. The runoff is conveyed through a small swale located approximately at the location of the homeowner's fence. The runoff is generated from a small tributary area, comprised of a portion of two neighboring lots.

In addition to this concern, the property owner also expressed concern about several small maintenance items associated with the storm sewer for Smithtown Road. These include the following:

- a) There is a sinkhole adjacent to a catch basin immediately west of Afton Road. This is located in the south ditch of Smithtown Road.
- b) There is standing water on Afton Road after large rainfall events.
- c) There are additional sinkholes in the south ditch, east of Afton Road. This suggests there may be damage to the bands connecting the culvert.

Hydrologic Information:

- Tributary Area: 0.5 ac
- Impervious Surface: 14%
- Peak 10-year Flow Rate: 1.3 cfs
- Peak 100-year Flow Rate: 2.3 cfs

Possible Alternatives:

The homeowner may wish to consider regarding his lot to provide a more defined conveyance route for runoff through his backyard, further from his foundation.

In order to address the maintenance concerns along Smithtown Road, it is recommended that the catch basin and culverts be repaired and the sinkholes backfilled. To reduce the potential for standing water on Afton Road, it is recommended that the grassed areas adjacent to the street be lowered so that the road is higher than that ditch.

Recommendation:

It is recommended that this problem area be categorized as a "Private Nuisance With No City Responsibility" area (Category 5).

A letter will be sent to the resident recommending that he contact his neighbors to discuss alternatives and that they work together to provide a solution to the problem. No further analysis will be undertaken by WSB on this problem area unless directed by the City to do so.

The maintenance items associated with this problem area will be added to the maintenance list that has been developed while discussing drainage concerns with residents and by observing problems during site visits.

Problem Area Number 35 – 5790 Smithtown Way

Description of Problem:

The homeowner has a concern about the amount of runoff flowing through her backyard. She believes the problem is created by the construction of the new house 5835 Eureka Road.

A review of the City's records indicates that there is a drainage and utility easement located in the backyard of this property.

During the large October rainfall event, it was noted that the low spot at 5815 Eureka Road (See ***Problem Area Number 26***) had standing water that backed up and over-topped Eureka Road. This water was conveyed through the backyards to this property. However, it does appear that the runoff was contained within the drainage and utility easement.

Hydrologic Information:

- Tributary Area: 1.5 ac
- Impervious Surface: 24%
- Peak 10-year Flow Rate: 4.0 cfs
- Peak 100-year Flow Rate: 6.8 cfs

Possible Alternatives:

This problem area does not require any additional work as the runoff is conveyed within drainage and utility easements.

The standing water and subsequent over-topping of Eureka Road is being addressed through the building permit process as discussed in the report for ***Problem Area Number 26***.

Recommendation:

It is recommended that this problem area be categorized as a "No Further Action Required" area (Category 6.)

A letter informing the homeowner of this will be mailed, but no further analysis of this site will be made without direction from the City.

The City will be working with the house builder to reduce the potential for runoff over-topping Eureka Road.

Problem Area Number 36 – 27475 Pine Bend

Description of Problem:

The property owner called complaining of a “river” running through her backyard. This appears to be an ongoing problem. The basement of the property is wet, but this appears to be caused by a high ground water table. The City did install a catch basin and grade a small swale along the property line to convey water away from the property. This was done in either 2001 or 2002.

Hydrologic Information:

- Tributary Area: 8.4 ac
- Impervious Surface: 13%
- Peak 10-year Flow Rate: 13.0 cfs
- Peak 100-year Flow Rate: 24.2 cfs

Possible Alternatives:

The following alternatives are available to correct the flooding problem at this site:

1. Do nothing. This problem does not appear to be related to surface water runoff as there is an existing swale to convey surface water flows through the property. The catch basin that was installed consisted of a perforated riser, which would lower the ground water table if the soils adjacent to the house were porous enough to convey water.
2. Construct a storm sewer system from west of Howards Point Road through the property. Although the swale is located on a private property, it does convey runoff from several lots upstream. It is possible to construct a system at a lower elevation, but this would result in the removal of several mature trees.
3. Since this is a ground water issue, the homeowner may wish to consider a more comprehensive foundation drain tile system and sump pump.

Recommendation:

It is recommended that this problem area be categorized as a “No Further Action Required” area (Category 6) since the problem appears to be related to a high ground water level.

A letter informing the homeowner of this will be mailed, but no further analysis of this site will be made without direction from the City.

Problem Area Number 37 – 23950 Elder Turn

Description of Problem:

The property owner is concerned with the high water level in Mary Lake. This residence is south of the property at 23955 Clover Lane. The description of the problem, hydrologic information, and possible alternatives are the same for this property as those outlined for ***Problem Area Number 25***.

Recommendation:

It is recommended that this problem area be categorized as a “Private Nuisance with Limited Public Responsibility” area (Category 4) since a portion of the runoff comes from City Right-of-Way.

It is also recommended that an outlet from Mary Lake be constructed as part of the Minnetonka Drive storm sewer improvement project.

Problem Area Number 38 – 23075 State Highway 7 (Control House)

Description of Problem:

The owner of this commercial property initially contacted the City with a concern about a partially blocked culvert located in the roadside ditch downstream of this property. After review of property boundaries, it was determined that the constriction and the ditch block downstream were a result of an abandoned right-of-way. Mn/DOT maintenance crews have removed the old culvert and restored disturbed areas in the ditch downstream of the Control House. No record drawing information was available to verify the location of storm sewer in this area. However, there is a large pipe that discharges to the ditch north of the Control House driveway. The alignment of this culvert is not known at this time.

After the constriction was removed, the property owner again contacted the City to express concern over the amount of gravel that had eroded upstream and deposited on his driveway.

Hydrologic Information:

- Tributary Area: 0.4 ac
- Impervious Surface: 35%
- Peak 10-year Flow Rate: 1.2 cfs
- Peak 100-year Flow Rate: 2.1 cfs

Possible Alternatives:

The following alternatives are available to reduce the potential for eroded materials being deposited on the driveway of the Control House property:

1. Construct storm sewer along Chaska Road. This would allow runoff to be conveyed in the storm sewer pipe rather than on the roadway shoulder. This would reduce the potential of gravel from the shoulder being eroded downstream. It is anticipated that the construction costs associated with this work will be approximately \$18,000.
2. Construct catch basin over existing storm sewer. This would convey runoff, and sediment, from the road under the driveway. Additional investigation would have to be done to determine exactly where the storm sewer is located in this area. It is anticipated that the construction costs associated with this work will be approximately \$2,500.

Recommendation:

It is recommended that this problem area be categorized as a “Private Nuisance with Limited Public Responsibility” area (Category 4) since a portion of the runoff comes from City Right-of-Way.

It is recommended that additional investigation be undertaken as to the exact location of the storm sewer outletting into the Chaska Road ditch adjacent to the Control House. This investigation will be necessary to determine the most effective storm sewer option available to minimize the amount of sediment deposited on the driveway entrance to the Control House.

Problem Area Number 39 – 23895 / 23905 Elder Turn

Description of Problem:

This property is located across the street from the property located at 23950 Elder Turn (***Problem Area Number 37.***) The description of the problem, the hydrologic information, and possible alternatives are the same for this property as those outlined for ***Problem Area Number 25.***

Recommendation:

It is recommended that this problem area be categorized as a “Private Nuisance with Limited Public Responsibility” area (Category 4) since a portion of the runoff comes from City Right-of-Way.

It is also recommended that an outlet from Mary Lake be constructed as part of the Minnetonka Drive storm sewer improvement.

Problem Area Number 40 – 19660 Silver Lake Trail

Description of Problem:

The property owner contacted the City concerned about the high water level in the wetland behind her house. She had also reported that the road was washed out, but it was determined that what she meant was only that the water had overtopped the road.

Hydrologic Information:

- Tributary Area: 20.2 ac (direct), 72.8 ac (total tributary area)*
- Impervious Surface: 35%
- Peak 10-year Flow Rate: 5.0 cfs**
- Peak 100-year Flow Rate: 5.8 cfs**

*Based on model developed for CSMP

** Estimated flow rates based on capacity of culvert under Sweetwater Curve.

Possible Alternatives:

This area is located on private property. Therefore, no work will be done by the City on this property. However, if the homeowner wishes to regrade the lot, they could do so. Any fill in excess of 100 cubic yards would require a Conditional Use Permit from the City.

Recommendation:

It is recommended that this problem area be categorized as a “No Further Action Required” area (Category 6.)

A letter informing the homeowner of this will be mailed, but no further analysis of this site will be made without direction from the City.

Problem Area Number 41 – 5775 Smithtown Way

Description of Problem:

This property is adjacent to 5790 Smithtown Way. The description of the problem, hydrologic information, and possible alternatives are the same for this property as those outlined for ***Problem Area Number 35***.

The homeowner has a concern about the amount of runoff flowing through her backyard. She believes the problem is created by the construction of the new house 5835 Eureka Road.

A review of the City’s records indicates that there is a drainage and utility easement located in the backyard of this property.

During the large October rainfall event, it was noted that the low spot at 5815 Eureka Road (See ***Problem Area Number 26***) had standing water that backed up and over-topped Eureka Road. This water was conveyed through the backyards to this property. However, it does appear that the runoff was contained within the drainage and utility easement.

Recommendation:

It is recommended that this problem area be categorized as a “No Further Action Required” area (Category 6.)

A letter informing the homeowner of this will be mailed, but no further analysis of this site will be made without direction from the City.

The City will be working with the house builder to address the potential for runoff over-topping Eureka Road.

Problem Area Number 42 – 5970 Strawberry Lane

Description of Problem:

This property owner is concerned about standing water in the neighbor's yard and along his common lotline. He would like his neighbor to the north to install a culvert under his driveway so that runoff will be conveyed to the existing wetland north of the neighbor's property.

Hydrologic Information:

- Tributary Area: 4.7 ac
- Impervious Surface: 19%
- Peak 10-year Flow Rate: 9.5 cfs
- Peak 100-year Flow Rate: 17.0 cfs

Possible Alternatives:

The following alternatives are available to reduce the potential for nuisance flooding at this site:

1. Do nothing. There is an emergency overflow located at the west end of the property that would allow runoff to overflow to a pond in back of the property prior to flooding the structure located at 5970 Strawberry Lane.
2. Installation of a culvert in the neighbor's property. This could be done, but it appears there would be a minimal amount of hydraulic head over the culvert to convey water to the north. It appears the area most likely would remain wet after large storm events unless the culvert could be installed at a lower elevation and the adjacent ground graded to drain toward the culvert. Since this is a relatively large area that is very flat, this does not appear to be a very practical solution. It is anticipated that the construction costs associated with this work will be approximately \$4,000.

Recommendation:

It is recommended that this problem area be categorized as a "Private Nuisance with No City Responsibility" area (Category 5.)

A letter will be sent to the resident recommending that he contact his neighbors to discuss alternatives and that they work together to provide a solution to the problem. No further analysis will be undertaken by WSB on this problem area unless directed by the City to do so.

**Problem Area Number 43 – 20458/ 20456 / 20454 / 20452 / 20450 Knightsbridge Road
(Amesbury Townhomes)**

Description of Problem:

This problem area is immediately downstream of an existing wetland. During the storm events, the wetland filled up until it reached its over-topping elevation. Once this happened, the runoff that normally would have been contained within the basin was conveyed down the hill through the drainage swale adjacent to the townhomes and into a culvert located under Knightsbridge Road. The capacity of this storm sewer system does not appear to be adequate to convey the runoff rate from the area. Therefore, the townhomes were flooded. A subdivision of existing lots in the upstream reach of this subwatershed was under construction when the flooding occurred.

Hydrologic Information:

- Tributary Area: 6.5 ac (reduced to 5.6 ac with new construction upstream)
- Impervious Surface: 17% (based on proposed conditions)
- Peak 10-year Flow Rate: 12.6 cfs*
- Peak 100-year Flow Rate: 22.4 cfs*

*Peak rates based on proposed conditions

Possible Alternatives:

The following alternatives are available to reduce the potential for flooding at this site:

1. Provide a positive outlet from the wetland located on the common lot line. By providing a positive outlet, the storage in this basin can be used to reduce peak rates. A possible secondary benefit would be that the outlet pipe could be constructed so that the runoff is conveyed in the pipe rather than through the overland swale adjacent to the townhomes. Increasing the size of the wetland and/or constructing a berm across the natural overflow outlet could create additional storage. This work would have to be coordinated with the Minnehaha Creek Watershed District so that the requirements of the Wetland Conservation Act are met. It is anticipated that the construction costs associated with this work will be approximately \$12,000.
2. A larger pipe could replace the 18-inch RCP with greater conveyance capacity. Consideration should be given to providing a larger pipe that is less susceptible to plugging by debris. It is anticipated that the construction costs associated with this work will be approximately \$56,000.
3. Do nothing. The Homeowner's Association could monitor the wetland level and pump the water down to provide some storage for larger runoff events. It should be noted that this might not eliminate flooding potential, depending on the amount of pumping that can be achieved between storm events.

Recommendation:

It is recommended that this problem area be categorized as a “Private Nuisance with No City Responsibility” area (Category 5.)

A letter will be sent to the Homeowners Association recommending that they contact their residents to discuss alternatives and that they work together to provide a solution to the problem. No further analysis will be undertaken by WSB on this problem area unless directed by the City to do so.

Problem Area Number 44 – 6045 Burlwood Court

Description of Problem:

This property owner called to complain about standing water located between her house and the neighbor to the west. They are also concerned about a bad odor, presumably from standing water. During the November 8, 2005 site visit, no standing water was observed.

Hydrologic Information:

- Tributary Area: 1.7 ac
- Impervious Surface: 13%
- Peak 10-year Flow Rate: 3.7 cfs
- Peak 100-year Flow Rate: 6.8 cfs

Possible Alternatives:

The following alternatives are available that may reduce the potential for standing water in this area:

1. Do nothing. There does not appear to be flood potential. Based on the City's one foot contour information, the emergency overflow to Burlwood Court is approximately 975. The homes adjacent to this low point have a low building opening of greater than 976 (6065 Burlwood Court) or 979.5 (6045 Burlwood Court), which provides approximately one foot of freeboard.
2. Construction of an outlet to the Burlwood Court storm sewer would minimize standing water at this location. It is anticipated that the construction costs associated with this work will be approximately \$11,000.

Recommendation:

It is recommended that this problem area be categorized as a "Private Nuisance with No City Responsibility" area (Category 5.)

Problem Area Number 45 – 5480 Carrie Lane

Description of Problem:

This property owner contacted the City for assistance after experiencing minor erosion on her property after the heavy rainfall event in September. The property owner wanted to use salvaged landscape rock that had washed off the entrance area to Carrie Lane. Carrie Lane is a private road. Therefore, the City is not responsible for maintenance of this road.

Hydrologic Information:

- *No hydrologic information was gathered nor an analysis made as this is a private matter.*

Possible Alternatives:

The homeowner desired to use the salvaged material, although it was recommended that larger rip-rap or other channel stabilization measures may be necessary due to the high velocity of runoff coming through the culvert under their driveway. Since this was a private system entirely on private property, it was determined that the homeowner could proceed at their own risk.

Recommendation:

It is recommended that this problem area be categorized as a “No Further Action Required” area (Category 6.)

A letter informing the homeowner of this will be mailed, but no further analysis of this site will be made without direction from the City.

Problem Area Number 46 – 5480 Teal Circle

Description of Problem:

This property owner contacted the City concerned that a neighbor had dammed up the channel with concrete blocks, and the blocks were causing erosion to the channel banks. The resident also expressed concern that increased runoff due to a pond south of the Hennepin County Regional Trail being filled in over time with sediment.

Hydrologic Information:

- Tributary Area: 20 ac
- Impervious Surface: 30%
- Peak 10-year Flow Rate: 19.2 cfs*
- Peak 100-year Flow Rate: 24.8 cfs*

* Peak flow rates based on model developed for CSMP.

Possible Alternatives:

City crews removed the concrete blocks on November 2, 2005. Dredging of the pond could be accomplished when the Harding Lane improvements are constructed (see *Problem Area 22.*)

Recommendation:

It is recommended that this problem area be categorized as a “No Further Action Required” area (Category 6.)

A letter informing the homeowner of this will be mailed, but no further analysis of this site will be made without direction from the City.

Problem Area Number 47 – 6060 Strawberry Lane

Description of Problem:

This property owner has standing water in his yard and he would like to grade the road ditch towards the Regional Trail to provide a positive outlet for standing water in his front yard. It appears the previous homeowner had placed fill in a portion of the ditch. He does not want to lose trees in his back yard. Therefore, he is not receptive to having the Regional Trail Authority provide a ditch along their trail corridor.

An outlet culvert is located under Strawberry Lane that conveys runoff in the south ditch of the Regional Trail from the west side of Strawberry Lane to the east side. This water then is conveyed into Freeman Park.

Hydrologic Information:

- Tributary Area: 0.3 ac*
- Impervious Surface: 30%
- Peak 10-year Flow Rate: 1.0 cfs
- Peak 100-year Flow Rate: 1.6 cfs

*Hydrologic information listed is for area directly tributary to road side ditch. The total area tributary to the Regional Trail ditch is significantly larger.

Possible Alternatives:

1. In order to minimize the amount of standing water that is present within this property, the old drainage ditch could be dredged out along the Regional Trail. In lieu of this, the property owner mentioned that he would dig out a small channel to drain the water out. The property owner also asked permission to dig out the road ditch adjacent to his property. It is anticipated that the construction costs associated with this work will be approximately \$1,000.

Recommendation:

It is recommended that this problem area be categorized as a “Private Nuisance with No City Responsibility” area (Category 5.)

A letter will be sent to the resident recommending that he contact his neighbors to discuss alternatives and that they work together to provide a solution to the problem. No further analysis will be undertaken by WSB on this problem area unless directed by the City to do so.

The letter will also indicate to the property owner that the maintenance of the ditch adjacent to Strawberry Lane within his property limits would be acceptable, provided the ditch was cleaned out but not lined with rock.

Problem Area Number 48 – 5820 Eureka Road

Description of Problem:

This property is located across the street from 5815 Eureka Road. The description of the problem, hydrologic information, and possible alternatives are the same as those outlined for *Problem Area Number 26*.

Recommendation:

It is recommended that this problem area be categorized as a “No Further Action Required” area (Category 6.)

No further analysis will be undertaken by WSB on this problem area unless directed by the City to do so.

The City is working with the builder to construct improvements at 5815 Eureka Road, which will minimize the potential for flooding across Eureka Road.

Problem Area Number 49 – 20480 Radisson Road

Description of Problem:

The resident contacted the City to express concern about the amount of runoff from Radisson Road. It appears that the runoff was conveyed over his driveway and across his lawn, where it may have displaced a portion of a keystone block retaining wall. The wall is approximately six to seven feet high and does not appear to have any tiebacks. This lack of tiebacks may have contributed to the displacement of the wall.

Hydrologic Information:

- Tributary Area: 0.4 ac
- Impervious Surface: 23%
- Peak 10-year Flow Rate: 1.2 cfs
- Peak 100-year Flow Rate: 2.0 cfs

Possible Alternatives:

The following alternatives are available to correct the drainage problem at this site:

1. Install curb and gutter along Radisson Road when the street is reconstructed. It is anticipated that the construction costs associated with this work will be approximately \$17,000.

Recommendation:

It is recommended that this problem area be categorized as a “Private Nuisance with Limited Public Responsibility” area (Category 4) since a portion of the runoff comes from City Right-of-Way.

The area below the retaining wall is a good location for a storm water treatment pond. If the City desires to upgrade Radisson Road with curb and gutter in the future, consideration should be given to obtaining an easement in this area for a storm water treatment pond.

Problem Area Number 50 – 6120 Riviera Lane

Description of Problem:

The property owner contacted the City to express concern over standing water at the end of his driveway. This area is in the low point of Riviera Road, adjacent to a wetland. The standing water is caused by the crown of the road trapping water in this area.

Hydrologic Information:

- Tributary Area: 4.4 ac
- Impervious Surface: 13%
- Peak 10-year Flow Rate: 6.8 cfs
- Peak 100-year Flow Rate: 12.7 cfs

Possible Alternatives:

The following alternatives are available to reduce the nuisance flooding in this area:

1. Regrade Riviera Lane road surface. It is anticipated that the construction costs associated with this work will be approximately \$14,000. Substantial cost savings would be realized if this work was to be completed as a part of the reconstruction of the Riviera Lane road surface.

Recommendation:

It is recommended that this problem area be categorized as a “Public Nuisance” area (Category 3.) The project is not cost-effective unless it is done as part of an overall reconstruction of Riviera Lane. Therefore, it is recommended that the project not be undertaken until the City reconstructs the road surface at Riviera Lane.

A letter will be sent to the property owner informing them of this, but no further analysis will be made without direction from the City.

Problem Area Number 51 – 26505 Maple Avenue

Description of Problem:

The property owner contacted the City to express concern about standing water in their yard. Their property is an inside lot with no direct access to the street, with the exception of their driveway through Maple Avenue.

Hydrologic Information:

- Tributary Area: 2.0 ac*
- Impervious Surface: 15%
- Peak 10-year Flow Rate: 5.1 cfs
- Peak 100-year Flow Rate: 9.2 cfs

*Hydrologic information listed is for area directly tributary to low spot between houses. The entire area is low and has a larger total tributary area.

Possible Alternatives:

Since this a low land-locked area, the only alternative would be to construct a large trunk storm sewer to provide a positive outlet for this property. The trunk sewer could also serve as a conveyance system for ***Problem Area Number 47 and Problem Area Number 29***. It is anticipated that the construction costs associated with this system will be approximately \$215,000.

Recommendation:

It is recommended that this problem area be categorized as a “Private Nuisance with No City Responsibility” area (Category 5.)

A letter will be sent to the resident recommending that he contact his neighbors to discuss alternatives and that they work together to provide a solution to the problem. No further analysis will be undertaken by WSB on this problem area unless directed by the City to do so.

III. SUMMARY AND RECOMMENDATIONS

Generally, the City's drainage issues can be classified as nuisance flooding, with a few exceptions. *Tables 1 – 6* summarize the problem areas by each of the six categories outlined at the beginning of this report. Of the 51 problem areas, only three are recommended for immediate correction. These are the areas listed under Category 1, which may pose a threat to public safety if left unchecked.

Table 1 outlines the problem areas that may impact the public health or safety (Category 1). It is anticipated that flooding risks at the two areas can be reduced through construction projects with an estimated cost of \$29,000 to \$44,000.

Table 2 is provided as a place holder should any new areas be discovered in which the problem area will have a negative impact on the residents as a whole (Category 2.)

Table 3 shows the problem areas that are a public nuisance (Category 3.) It is anticipated that flooding risks at the two areas can be reduced through construction projects with an estimated cost of \$22,000 to \$33,000. The flooding problem at Lake South Auto has already been addressed and the other area is a nuisance problem that does not pose an immediate threat to any buildings. Therefore, it is recommended that these projects be deferred until a time the projects could be combined with other work in the vicinity.

Table 4 outlines the problem areas that either involve a site where the problem is caused, at least partially, by runoff generated within the City's Right-of-Way, or where a large drainage area is causing a problem to a small area, limiting a single resident to easily solve the problem by themselves (Category 4.) It is anticipated that that flooding risks at these areas can be reduced through construction projects with an estimated cost of \$216,300 to \$916,200. It should be noted that costs vary greatly dependent upon the scope and solutions of the projects noted. Design projects would have to be undertaken to determine a more specific detail of the costs.

Of the areas within this category, it is recommended that the areas identified as a flooding threat to any buildings should be considered first.

Table 5 outlines the problem areas that either involve a site where the problem is caused by runoff generated from private property or where a small area is involved (Category 5.) It is anticipated that that flooding risks at these areas can be reduced through construction projects with an estimated cost ranging from \$345,400 to \$703,100. Of these areas, it is recommended that the areas identified as a flooding threat to any buildings should be considered first. These areas are highlighted on the table, and represent a cost of \$69,000.

Table 6 outlines the problem areas that, after our investigation, were deemed to not be problems (Category 6.) These areas either were entirely private issues on a single property, maintenance issues addressed by City crews, or problems being addressed through the City's building permit process. There were five areas in which a resident perceived "flooding," but after further review, it was determined that the runoff was contained to portions of their property, our adjacent properties, that were covered by Drainage and Utility Easements. No further work is recommended for these areas, other than sending a letter to the resident explaining our findings.

In order to address the problem areas summarized in *Tables 1 – 4*, the estimated costs range is between \$267,300 and \$993,200.

Funding:

Currently, the City has in place a stormwater fee. As design alternatives are considered, utilization of the stormwater fees, in conjunction with special assessments for benefiting areas, will need to be considered.

TABLES

Table 5

**Summary of Problem Areas Categorized as
"Private Nuisance with No City Responsibility" Areas
(Category 5)**

| PA # | Name | Address | Opinion of Probable Cost | Notes |
|---------------|---------------------|----------------------|---------------------------------|--|
| 6 | Ketti & Mike Histon | 26220 Wild Rose Ln | \$6,000 to \$13,000 | House flooded |
| 43 | Amesbury Townhomes | Tom Maple | \$12,000 to \$56,000 | Townhouses flooded |
| 31 | Diane Buranen | 24735 Glen Rd | \$65,000 to \$82,000 | Long-term problem |
| 22 | Pat Brown | 5635 Harding Ln | \$8,900 to \$87,000 | Long-term problem |
| 23 | Adam McArthur | 5615 Harding Ln | see note | Combined with PA 22 |
| 2 | Kim Culp | 6100 Apple Rd | \$12,000 to \$16,000 | |
| 9 | Greg Johnson | 4980 Suburban Dr | \$4,000 to \$8,000 | |
| 12 | Nathan Shanklin | 21165 Mtka Blvd | \$4,000 to \$12,000 | |
| 14 | Ann Levenworth | 28070 Woodside Rd | \$1,700 to \$5,000 | |
| 16 | Larry Reid | 27780 Island View Rd | \$4,500 to \$7,800 | |
| 28 | Greg Sochko | 5600 Wedgewood Dr | \$18,500 to \$156,000 | More cost effective if done with overall project when Wedgewood is reconstructed |
| 29 | Kizilos-Clift | 26395 Peach Circle | \$22,000 to \$27,000 | |
| 34 | Bob Castellano | 5900 Afton Rd | \$1,700 to \$2,100 | |
| 42 | Brian Lieffers | 5970 Strawberry Lane | \$3,300 to \$4,200 | |
| 44 | Ellen Jordano | 6045 Burlwood Ct | \$9,000 to \$11,000 | |
| 47 | Don Johnson | 6060 Strawberry Lane | \$800 to \$1,000 | |
| 51 | Eileen Koehnen | 26505 Maple Ave | \$172,000 to \$215,000 | |
| Totals | | | \$345,400 to \$703,100 | |

NOTE: Projects are listed in recommended order of priority. Highlighted areas represent the areas that experienced flooding of buildings.

Table 6

**Summary of Problem Areas Categorized as
"No Further Action Required" Areas
(Category 6)**

| PA # | Name | Address | Opinion of Probable Cost | Notes |
|-------------|-------------------|---------------------------|---------------------------------|--|
| 4 | Jim Cradit | 5925 Galpin Lake Rd | N/A | Problem addressed through building permit process |
| 8 | Kathy Kucera | 20955 Ivy Lane | N/A | Private matter on individual lot |
| 10 | Mike Messina | 25720 & 25722 Wildrose Ln | N/A | Property owner has addressed problem |
| 15 | Frontier Electric | 800 Water Street | N/A | Problem addressed through other governmental entities |
| 19 | Craig Johnson | 26025 Birch Bluff Rd | N/A | Problem addressed by City crews |
| 27 | John Majestic | 5840 Eureka Rd | N/A | This appears to be related to a high groundwater level |
| 32 | Barb Richman | 5770 Smithtown Way | N/A | Not really a problem - runoff contained within Drainage & Utility Easement |
| 33 | Glen Gillund | 26275 Smithtown Rd | N/A | Problem addressed by City crews |
| 35 | Shelly McGinnis | 5790 Smithtown Way | N/A | Not really a problem - runoff contained within Drainage & Utility Easement |
| 36 | Ann Seymour | 27475 Pine Bend | N/A | Previously addressed by City - appears to be related to a high groundwater level |
| 40 | Melena Gross | 19660 Silver Lake Tr | N/A | Not really a problem - wetland contained within Drainage & Utility Easement |
| 41 | Darcy Bertagnoli | 5775 Smithtown Way | N/A | Not really a problem - runoff contained within Drainage & Utility Easement |
| 45 | Carol McClure | 5480 Carrie Ln | N/A | Private matter on individual lot |
| 46 | Pat Arnst | 5480 Teal Circle | N/A | Problem addressed by City crews |
| 48 | Mark McClure | 5820 Eureka Rd | N/A | Problem will be addressed through building permit process |
| | | | | |
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APPENDIX A

Appendix A

Opinion of Probable Cost

Problem Area 1 - 6180 Murray Hill Road

A preliminary opinion of probable cost is given below. Costs are for the construction of improvements only and do not include easements and / or land acquisition costs. It is anticipated that the benefited property owners will donate easements. Costs for engineering and administration are also not included. Costs may vary significantly based on final scope of project. Actual costs will be determined when survey and feasibility reports are completed.

Preliminary Opinion of Probable Cost - Option 1 (Storm Sewer)

| Item No. | Description | Quantity | Unit | Unit Cost | Total |
|--------------------|---|----------|------|------------|--------------------|
| 1 | Mobilization | 1 | LS | \$5,000.00 | \$5,000.00 |
| 2 | Remove Bituminous Pavement | 200 | SY | \$5.00 | \$1,000.00 |
| 3 | Salvage and Reinstall Base Course Aggregate | 35 | CY | \$12.00 | \$420.00 |
| 4 | Excavation | 20 | CY | \$15.00 | \$300.00 |
| 5 | Storm Sewer (15" RCP) | 120 | LF | \$40.00 | \$4,800.00 |
| 6 | Catch Basins and Manholes | 5 | EA | \$1,250.00 | \$6,250.00 |
| 7 | Bituminous Pavement | 45 | TN | \$150.00 | \$6,750.00 |
| Subtotal | | | | | \$24,520.00 |
| +25% Contingencies | | | | | \$6,130.00 |
| Total | | | | | \$30,650.00 |

Preliminary Opinion of Probable Cost - Option 2 (Construct Berm on West Edge of Road)

| Item No. | Description | Quantity | Unit | Unit Cost | Total |
|--------------------|--------------------------|----------|------|-----------|-------------------|
| 1 | Mobilization | 1 | LS | \$750.00 | \$750.00 |
| 2 | Imported Borrow Material | 45 | CY | \$15.00 | \$675.00 |
| 3 | Turf Establishment | 200 | SY | \$2.00 | \$400.00 |
| Subtotal | | | | | \$1,825.00 |
| +25% Contingencies | | | | | \$456.00 |
| Total | | | | | \$2,281.00 |

Preliminary Opinion of Probable Cost - Option 3 (Excavate a Drainage Swale Below Hill)

| Item No. | Description | Quantity | Unit | Unit Cost | Total |
|--------------------|--------------------|----------|------|------------|-------------------|
| 1 | Mobilization | 1 | LS | \$1,250.00 | \$1,250.00 |
| 2 | Excavation | 75 | CY | \$8.00 | \$600.00 |
| 3 | Turf Establishment | 250 | SY | \$2.00 | \$500.00 |
| Subtotal | | | | | \$2,350.00 |
| +25% Contingencies | | | | | \$588.00 |
| Total | | | | | \$2,938.00 |

Appendix A

Opinion of Probable Cost

Problem Area 2 - 6100 Apple Road

A preliminary opinion of probable cost is given below. Costs are for the construction of improvements only and do not include easements and / or land acquisition costs. It is anticipated that the benefited property owners will donate easements. Costs for engineering and administration are also not included. Costs may vary significantly based on final scope of project. Actual costs will be determined when survey and feasibility reports are completed.

Preliminary Opinion of Probable Cost - Option 1 (Storm Sewer)

| Item No. | Description | Quantity | Unit | Unit Cost | Total |
|--------------------|---------------------------|----------|------|------------|--------------------|
| 1 | Mobilization | 1 | LS | \$2,500.00 | \$2,500.00 |
| 2 | Storm Sewer (15" HDPE) | 250 | LF | \$25.00 | \$6,250.00 |
| 3 | Catch Basins and Manholes | 4 | EA | \$750.00 | \$3,000.00 |
| 4 | Restoration | 1 | LS | \$750.00 | \$750.00 |
| Subtotal | | | | | \$12,500.00 |
| +25% Contingencies | | | | | \$3,125.00 |
| Total | | | | | \$15,625.00 |

Appendix A

Opinion of Probable Cost

Problem Area 3 - Minnetonka Country Club

A preliminary opinion of probable cost is given below. Costs are for the construction of improvements only and do not include easements and / or land acquisition costs. It is anticipated that the benefited property owners will donate easements. Costs for engineering and administration are also not included. Costs may vary significantly based on final scope of project. Actual costs will be determined when survey and feasibility reports are completed.

Preliminary Opinion of Probable Cost

| Item No. | Description | Quantity | Unit | Unit Cost | Total |
|--------------------|---------------------------|----------|------|-------------|---------------------|
| 1 | Mobilization | 1 | LS | \$25,000.00 | \$25,000.00 |
| 2 | Excavation | 15000 | CY | \$12.00 | \$180,000.00 |
| 3 | Storm Sewer (12" RCP) | 600 | LF | \$35.00 | \$21,000.00 |
| 4 | Storm Sewer (15" RCP) | 300 | LF | \$40.00 | \$12,000.00 |
| 5 | Storm Sewer (27" RCP) | 2000 | LF | \$85.00 | \$170,000.00 |
| 6 | Catch Basins and Manholes | 9 | EA | \$1,250.00 | \$11,250.00 |
| 7 | Turf Establishment | 5 | Ac | \$1,500.00 | \$7,500.00 |
| Subtotal | | | | | \$426,750.00 |
| +25% Contingencies | | | | | \$106,688.00 |
| Total | | | | | \$533,438.00 |

Appendix A

Opinion of Probable Cost

Problem Area 5 - 25360 Birch Bluff Road

A preliminary opinion of probable cost is given below. Costs are for the construction of improvements only and do not include easements and / or land acquisition costs. It is anticipated that the benefited property owners will donate easements. Costs for engineering and administration are also not included. Costs may vary significantly based on final scope of project. Actual costs will be determined when survey and feasibility reports are completed.

Preliminary Opinion of Probable Cost

| Item No. | Description | Quantity | Unit | Unit Cost | Total |
|----------|----------------------------------|----------|------|--------------------|--------------------|
| 1 | Mobilization | 1 | LS | \$2,500.00 | \$2,500.00 |
| 2 | Remove Existing Culvert | 1 | LS | \$800.00 | \$800.00 |
| 3 | Furnish and Install 30" RCP-A | 30 | LF | \$100.00 | \$3,000.00 |
| 4 | Pipe Bedding | 20 | TN | \$15.00 | \$300.00 |
| 5 | Pavement Removal & Restoration | 50 | SY | \$100.00 | \$5,000.00 |
| 6 | Sediment Removal at Edge of Lake | 1 | LS | \$500.00 | \$500.00 |
| | | | | Subtotal | \$12,100.00 |
| | | | | +25% Contingencies | \$3,025.00 |
| | | | | Total | \$15,125.00 |

Appendix A

Opinion of Probable Cost

Problem Area 6 - 26220 Wild Rose Lane

A preliminary opinion of probable cost is given below. Costs are for the construction of improvements only and do not include easements and / or land acquisition costs. It is anticipated that the benefited property owners will donate easements. Costs for engineering and administration are also not included. Costs may vary significantly based on final scope of project. Actual costs will be determined when survey and feasibility reports are completed.

Preliminary Opinion of Probable Cost - Option 1 (Seal low building openings)

| Item No. | Description | Quantity | Unit | Unit Cost | Total |
|--------------------|--------------------------------------|----------|------|------------|--------------------|
| 1 | Mobilization | 1 | LS | \$2,500.00 | \$2,500.00 |
| 2 | Seal walkout door and lookout window | 1 | LS | \$7,500.00 | \$7,500.00 |
| Subtotal | | | | | \$10,000.00 |
| +25% Contingencies | | | | | \$2,500.00 |
| Total | | | | | \$12,500.00 |

Preliminary Opinion of Probable Cost - Option 2 (Excavate swale)

| Item No. | Description | Quantity | Unit | Unit Cost | Total |
|--------------------|--------------|----------|------|------------|-------------------|
| 1 | Mobilization | 1 | LS | \$2,500.00 | \$2,500.00 |
| 2 | Excavation | 130 | CY | \$14.00 | \$1,820.00 |
| 3 | Restoration | 1 | LS | \$750.00 | \$750.00 |
| Subtotal | | | | | \$5,070.00 |
| +25% Contingencies | | | | | \$1,268.00 |
| Total | | | | | \$6,338.00 |

Appendix A

Opinion of Probable Cost

Problem Area 7 - 5925 Grant Street

A preliminary opinion of probable cost is given below. Costs are for the construction of improvements only and do not include easements and / or land acquisition costs. It is anticipated that the benefited property owners will donate easements. Costs for engineering and administration are also not included. Costs may vary significantly based on final scope of project. Actual costs will be determined when survey and feasibility reports are completed.

Preliminary Opinion of Probable Cost

| Item No. | Description | Quantity | Unit | Unit Cost | Total |
|--------------------|---|----------|------|------------|--------------------|
| 1 | Mobilization | 1 | LS | \$3,500.00 | \$3,500.00 |
| 2 | Remove Bituminous Pavement | 200 | SY | \$5.00 | \$1,000.00 |
| 3 | Storm Sewer (12" RCP) | 80 | LF | \$35.00 | \$2,800.00 |
| 4 | Storm Sewer (15" RCP) | 90 | LF | \$40.00 | \$3,600.00 |
| 5 | Storm Sewer (27" RCP) | 70 | LF | \$85.00 | \$5,950.00 |
| 6 | Catch Basins and Manholes | 5 | EA | \$1,250.00 | \$6,250.00 |
| 7 | Salvage and Reinstall Base Course Aggregate | 35 | CY | \$12.00 | \$420.00 |
| 8 | Bituminous Pavement | 45 | TN | \$150.00 | \$6,750.00 |
| 9 | Turf Establishment | 1500 | SY | \$2.00 | \$3,000.00 |
| Subtotal | | | | | \$33,270.00 |
| +25% Contingencies | | | | | \$8,318.00 |
| Total | | | | | \$41,588.00 |

Appendix A

Opinion of Probable Cost

Problem Area 9 - 4980 Suburban Drive

A preliminary opinion of probable cost is given below. Costs are for the construction of improvements only and do not include easements and / or land acquisition costs. It is anticipated that the benefited property owners will donate easements. Costs for engineering and administration are also not included. Costs may vary significantly based on final scope of project. Actual costs will be determined when survey and feasibility reports are completed.

Preliminary Opinion of Probable Cost - Option 1 (Storm Sewer)

| Item No. | Description | Quantity | Unit | Unit Cost | Total |
|--------------------|---------------------------|----------|------|------------|-------------------|
| 1 | Mobilization | 1 | LS | \$2,500.00 | \$2,500.00 |
| 2 | Storm Sewer (8" HDPE) | 60 | LF | \$12.00 | \$720.00 |
| 3 | Catch Basins and Manholes | 2 | EA | \$750.00 | \$1,500.00 |
| 4 | Restoration | 1 | LS | \$500.00 | \$500.00 |
| Subtotal | | | | | \$5,220.00 |
| +25% Contingencies | | | | | \$1,305.00 |
| Total | | | | | \$6,525.00 |

Preliminary Opinion of Probable Cost - Option 2 (Construct berm)

| Item No. | Description | Quantity | Unit | Unit Cost | Total |
|--------------------|--------------------------|----------|------|------------|-------------------|
| 1 | Mobilization | 1 | LS | \$2,500.00 | \$2,500.00 |
| 2 | Imported Borrow Material | 30 | CY | \$25.00 | \$750.00 |
| 3 | Restoration | 1 | LS | \$200.00 | \$200.00 |
| Subtotal | | | | | \$3,450.00 |
| +25% Contingencies | | | | | \$863.00 |
| Total | | | | | \$4,313.00 |

Preliminary Opinion of Probable Cost - Option 3 (Pave Driveway)

| Item No. | Description | Quantity | Unit | Unit Cost | Total |
|--------------------|---------------------|----------|------|-----------|-------------------|
| 1 | Mobilization | 1 | LS | \$800.00 | \$800.00 |
| 2 | Subgrade Prep | 1 | LS | \$200.00 | \$200.00 |
| 3 | Bituminous Pavement | 35 | TN | \$150.00 | \$5,250.00 |
| Subtotal | | | | | \$6,250.00 |
| +25% Contingencies | | | | | \$1,563.00 |
| Total | | | | | \$7,813.00 |

Appendix A

Opinion of Probable Cost

Problem Area 11 - 25575 Smithtown Road (Lake South Auto)

A preliminary opinion of probable cost is given below. Costs are for the construction of improvements only and do not include easements and / or land acquisition costs. It is anticipated that the benefited property owners will donate easements. Costs for engineering and administration are also not included. Costs may vary significantly based on final scope of project. Actual costs will be determined when survey and feasibility reports are completed.

Preliminary Opinion of Probable Cost

| Item No. | Description | Quantity | Unit | Unit Cost | Total |
|----------|---|----------|------|--------------------|--------------------|
| 1 | Mobilization | 1 | LS | \$5,000.00 | \$5,000.00 |
| 2 | Remove Bituminous Pavement | 150 | SY | \$5.00 | \$750.00 |
| 3 | Salvage and Reinstall Base Course Aggregate | 25 | CY | \$12.00 | \$300.00 |
| 4 | Excavation | 50 | CY | \$15.00 | \$750.00 |
| 5 | Bituminous Pavement | 35 | TN | \$150.00 | \$5,250.00 |
| 6 | Restoration | 1 | LS | \$3,500.00 | \$3,500.00 |
| | | | | Subtotal | \$15,550.00 |
| | | | | +25% Contingencies | \$3,888.00 |
| | | | | Total | \$19,438.00 |

Appendix A

Opinion of Probable Cost

Problem Area 12 - 21165 Minnetonka Blvd.

A preliminary opinion of probable cost is given below. Costs are for the construction of improvements only and do not include easements and / or land acquisition costs. It is anticipated that the benefited property owners will donate easements. Costs for engineering and administration are also not included. Costs may vary significantly based on final scope of project. Actual costs will be determined when survey and feasibility reports are completed.

Preliminary Opinion of Probable Cost - Option 1 (Install Flap Gate)

| Item No. | Description | Quantity | Unit | Unit Cost | Total |
|--------------------|------------------------|----------|------|------------|-------------------|
| 1 | Mobilization | 1 | LS | \$1,200.00 | \$1,200.00 |
| 2 | Manhole with Flap Gate | 1 | EA | \$1,800.00 | \$1,800.00 |
| 3 | Restoration | 1 | LS | \$250.00 | \$250.00 |
| Subtotal | | | | | \$3,250.00 |
| +25% Contingencies | | | | | \$813.00 |
| Total | | | | | \$4,063.00 |

Preliminary Opinion of Probable Cost - Option 2 (Construct Parallel Storm Sewer)

| Item No. | Description | Quantity | Unit | Unit Cost | Total |
|--------------------|---------------------------|----------|------|------------|--------------------|
| 1 | Mobilization | 1 | LS | \$2,500.00 | \$2,500.00 |
| 2 | Storm Sewer (12" HDPE) | 210 | LF | \$24.00 | \$5,040.00 |
| 3 | Catch Basins and Manholes | 2 | EA | \$750.00 | \$1,500.00 |
| 4 | Restoration | 1 | LS | \$500.00 | \$500.00 |
| Subtotal | | | | | \$9,540.00 |
| +25% Contingencies | | | | | \$2,385.00 |
| Total | | | | | \$11,925.00 |

Appendix A

Opinion of Probable Cost

Problem Area 13 - 4770 Lakeway Terrace

A preliminary opinion of probable cost is given below. Costs are for the construction of improvements only and do not include easements and / or land acquisition costs. It is anticipated that the benefited property owners will donate easements. Costs for engineering and administration are also not included. Costs may vary significantly based on final scope of project. Actual costs will be determined when survey and feasibility reports are completed.

Preliminary Opinion of Probable Cost - Option 1 (Install New Casting)

| Item No. | Description | Quantity | Unit | Unit Cost | Total |
|--------------------|-------------|----------|------|-----------|-----------------|
| 1 | New Casting | 1 | LS | \$750.00 | \$750.00 |
| Subtotal | | | | | \$750.00 |
| +25% Contingencies | | | | | \$188.00 |
| Total | | | | | \$938.00 |

Preliminary Opinion of Probable Cost - Option 2 (Tip Road Surface To Drain to the East)

| Item No. | Description | Quantity | Unit | Unit Cost | Total |
|--------------------|---|----------|------|------------|--------------------|
| 1 | Mobilization | 1 | LS | \$2,500.00 | \$2,500.00 |
| 2 | Remove Bituminous Pavement | 100 | SY | \$5.00 | \$500.00 |
| 3 | Salvage and Reinstall Base Course Aggregate | 20 | CY | \$12.00 | \$240.00 |
| 4 | Excavation | 10 | CY | \$15.00 | \$150.00 |
| 5 | Bituminous Pavement | 25 | TN | \$150.00 | \$3,750.00 |
| 6 | Insulation of Lift Station and Forcemain | 1 | LS | \$2,500.00 | \$2,500.00 |
| Subtotal | | | | | \$9,640.00 |
| +25% Contingencies | | | | | \$2,410.00 |
| Total | | | | | \$12,050.00 |

Preliminary Opinion of Probable Cost - Option 3 (Construct Berm on West Edge of Road)

| Item No. | Description | Quantity | Unit | Unit Cost | Total |
|--------------------|--------------------------|----------|------|-----------|-------------------|
| 1 | Mobilization | 1 | LS | \$800.00 | \$800.00 |
| 2 | Imported Borrow Material | 25 | CY | \$15.00 | \$375.00 |
| 3 | Turf Establishment | 100 | SY | \$2.00 | \$200.00 |
| Subtotal | | | | | \$1,375.00 |
| +25% Contingencies | | | | | \$344.00 |
| Total | | | | | \$1,719.00 |

Appendix A

Opinion of Probable Cost

Problem Area 14 - 28070 Woodside Rd.

A preliminary opinion of probable cost is given below. Costs are for the construction of improvements only and do not include easements and / or land acquisition costs. It is anticipated that the benefited property owners will donate easements. Costs for engineering and administration are also not included. Costs may vary significantly based on final scope of project. Actual costs will be determined when survey and feasibility reports are completed.

Preliminary Opinion of Probable Cost - Option 1 (Raise Area Adjacent to Downspout Entrance)

| Item No. | Description | Quantity | Unit | Unit Cost | Total |
|--------------------|----------------|----------|------|-----------|-------------------|
| 1 | Mobilization | 1 | LS | \$300.00 | \$300.00 |
| 2 | Grouted Riprap | 8 | CY | \$95.00 | \$760.00 |
| 3 | Restoration | 1 | LS | \$300.00 | \$300.00 |
| Subtotal | | | | | \$1,360.00 |
| +25% Contingencies | | | | | \$340.00 |
| Total | | | | | \$1,700.00 |

Preliminary Opinion of Probable Cost - Option 2 (Construct New Storm Sewer)

| Item No. | Description | Quantity | Unit | Unit Cost | Total |
|--------------------|---------------------------|----------|------|-----------|-------------------|
| 1 | Mobilization | 1 | LS | \$800.00 | \$800.00 |
| 2 | Storm Sewer (12" HDPE) | 80 | LF | \$24.00 | \$1,920.00 |
| 3 | Catch Basins and Manholes | 1 | EA | \$750.00 | \$750.00 |
| 4 | Restoration | 1 | LS | \$500.00 | \$500.00 |
| Subtotal | | | | | \$3,970.00 |
| +25% Contingencies | | | | | \$993.00 |
| Total | | | | | \$4,963.00 |

Appendix A

Opinion of Probable Cost

Problem Area 16 - 27780 Island View Rd.

A preliminary opinion of probable cost is given below. Costs are for the construction of improvements only and do not include easements and / or land acquisition costs. It is anticipated that the benefited property owners will donate easements. Costs for engineering and administration are also not included. Costs may vary significantly based on final scope of project. Actual costs will be determined when survey and feasibility reports are completed.

Preliminary Opinion of Probable Cost - Option 1 (Construct New Draintile System)

| Item No. | Description | Quantity | Unit | Unit Cost | Total |
|--------------------|---------------------------|----------|------|-----------|-------------------|
| 1 | Mobilization | 1 | LS | \$500.00 | \$500.00 |
| 2 | Storm Sewer (8" HDPE) | 300 | LF | \$15.00 | \$4,500.00 |
| 3 | Catch Basins and Manholes | 3 | EA | \$250.00 | \$750.00 |
| 4 | Restoration | 1 | LS | \$500.00 | \$500.00 |
| Subtotal | | | | | \$6,250.00 |
| +25% Contingencies | | | | | \$1,563.00 |
| Total | | | | | \$7,813.00 |

Preliminary Opinion of Probable Cost - Option 2 (Construct Rain Garden)

| Item No. | Description | Quantity | Unit | Unit Cost | Total |
|--------------------|---------------------|----------|------|-----------|-------------------|
| 1 | Mobilization | 1 | LS | \$300.00 | \$300.00 |
| 2 | Wet-tolerant plants | 12 | EA | \$250.00 | \$3,000.00 |
| 3 | Restoration | 1 | LS | \$300.00 | \$300.00 |
| Subtotal | | | | | \$3,600.00 |
| +25% Contingencies | | | | | \$900.00 |
| Total | | | | | \$4,500.00 |

Appendix A

Opinion of Probable Cost

Problem Area 17 - 23350 Academy Lane

A preliminary opinion of probable cost is given below. Costs are for the construction of improvements only and do not include easements and / or land acquisition costs. It is anticipated that the benefited property owners will donate easements. Costs for engineering and administration are also not included. Costs may vary significantly based on final scope of project. Actual costs will be determined when survey and feasibility reports are completed.

Preliminary Opinion of Probable Cost - Option 1 (Install New Casting)

| Item No. | Description | Quantity | Unit | Unit Cost | Total |
|----------|-------------|----------|------|--------------------|-----------------|
| 1 | New Casting | 1 | LS | \$750.00 | \$750.00 |
| | | | | Subtotal | \$750.00 |
| | | | | +25% Contingencies | \$188.00 |
| | | | | Total | \$938.00 |

Preliminary Opinion of Probable Cost - Option 2 (Excavate Ditch on South Side of Road)

| Item No. | Description | Quantity | Unit | Unit Cost | Total |
|----------|--------------------|----------|------|--------------------|-------------------|
| 1 | Mobilization | 1 | LS | \$800.00 | \$800.00 |
| 2 | Excavation | 15 | CY | \$15.00 | \$225.00 |
| 3 | Turf Establishment | 40 | SY | \$2.00 | \$80.00 |
| | | | | Subtotal | \$1,105.00 |
| | | | | +25% Contingencies | \$276.00 |
| | | | | Total | \$1,381.00 |

Preliminary Opinion of Probable Cost - Option 3 (Lower Road and Install Curb & Gutter)

| Item No. | Description | Quantity | Unit | Unit Cost | Total |
|----------|---|----------|------|--------------------|--------------------|
| 1 | Mobilization | 1 | LS | \$2,500.00 | \$2,500.00 |
| 2 | Remove Bituminous Pavement | 800 | SY | \$5.00 | \$4,000.00 |
| 3 | Salvage and Reinstall Base Course Aggregate | 140 | CY | \$12.00 | \$1,680.00 |
| 4 | Excavation | 80 | CY | \$15.00 | \$1,200.00 |
| 5 | Curb & Gutter | 800 | LF | \$8.00 | \$6,400.00 |
| 5 | Bituminous Pavement | 180 | TN | \$150.00 | \$27,000.00 |
| | | | | Subtotal | \$42,780.00 |
| | | | | +25% Contingencies | \$10,695.00 |
| | | | | Total | \$53,475.00 |

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Opinion of Probable Cost

Problem Area 18 - 6180 Chaska Road

A preliminary opinion of probable cost is given below. Costs are for the construction of improvements only and do not include easements and / or land acquisition costs. It is anticipated that the benefited property owners will donate easements. Costs for engineering and administration are also not included. Costs may vary significantly based on final scope of project. Actual costs will be determined when survey and feasibility reports are completed.

Preliminary Opinion of Probable Cost

| Item No. | Description | Quantity | Unit | Unit Cost | Total |
|----------|--------------------|----------|------|--------------------|-------------------|
| 1 | Mobilization | 1 | LS | \$800.00 | \$800.00 |
| 2 | Excavation | 100 | CY | \$15.00 | \$1,500.00 |
| 3 | Turf Establishment | 120 | SY | \$2.00 | \$240.00 |
| | | | | Subtotal | \$2,540.00 |
| | | | | +25% Contingencies | \$635.00 |
| | | | | Total | \$3,175.00 |

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Opinion of Probable Cost

Problem Area 20 - 22015 Stratford Road

A preliminary opinion of probable cost is given below. Costs are for the construction of improvements only and do not include easements and / or land acquisition costs. It is anticipated that the benefited property owners will donate easements. Costs for engineering and administration are also not included. Costs may vary significantly based on final scope of project. Actual costs will be determined when survey and feasibility reports are completed.

Preliminary Opinion of Probable Cost - Option 1

| Item No. | Description | Quantity | Unit | Unit Cost | Total |
|--------------------|-------------------------------|----------|------|------------|--------------------|
| 1 | Mobilization | 1 | LS | \$5,000.00 | \$5,000.00 |
| 2 | Clearing and Grubbing | 1 | LS | \$2,000.00 | \$2,000.00 |
| 3 | 36" RCP | 100 | LF | \$90.00 | \$9,000.00 |
| 4 | Furnish and Install Manhole | 6 | LF | \$500.00 | \$3,000.00 |
| 5 | Salvage and Reinstall 36" FES | 1 | EA | \$2,500.00 | \$2,500.00 |
| Subtotal | | | | | \$21,500.00 |
| +25% Contingencies | | | | | \$5,375.00 |
| Total | | | | | \$26,875.00 |

Preliminary Opinion of Probable Cost - Option 2

| Item No. | Description | Quantity | Unit | Unit Cost | Total |
|--------------------|---------------------------|----------|------|------------|--------------------|
| 1 | Mobilization | 1 | LS | \$5,000.00 | \$5,000.00 |
| 2 | Clearing and Grubbing | 1 | LS | \$2,800.00 | \$2,800.00 |
| 3 | Furnish and Place Riprap | 75 | CY | \$80.00 | \$6,000.00 |
| 4 | Type IV Geotextile Fabric | 100 | SY | \$2.00 | \$200.00 |
| Subtotal | | | | | \$14,000.00 |
| +25% Contingencies | | | | | \$3,500.00 |
| Total | | | | | \$17,500.00 |

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Opinion of Probable Cost

Problem Area 22 - 5635 Harding Lane

A preliminary opinion of probable cost is given below. Costs are for the construction of improvements only and do not include easements and / or land acquisition costs. It is anticipated that the benefited property owners will donate easements. Costs for engineering and administration are also not included. Costs may vary significantly based on final scope of project. Actual costs will be determined when survey and feasibility reports are completed.

Preliminary Opinion of Probable Cost - Option 1 (Re-grade Back Yard Area)

| Item No. | Description | Quantity | Unit | Unit Cost | Total |
|--------------------|-----------------------|----------|------|------------|-------------------|
| 1 | Mobilization | 1 | LS | \$1,500.00 | \$1,500.00 |
| 2 | Clearing and Grubbing | 0.3 | Ac | \$1,200.00 | \$360.00 |
| 3 | Excavation | 350 | CY | \$14.00 | \$4,900.00 |
| 4 | Restoration | 1 | LS | \$400.00 | \$400.00 |
| Subtotal | | | | | \$7,160.00 |
| +25% Contingencies | | | | | \$1,790.00 |
| Total | | | | | \$8,950.00 |

Preliminary Opinion of Probable Cost - Option 2 (Construct New Storm Sewer)

| Item No. | Description | Quantity | Unit | Unit Cost | Total |
|--------------------|---------------------------|----------|------|------------|--------------------|
| 1 | Mobilization | 1 | LS | \$1,200.00 | \$1,200.00 |
| 2 | Storm Sewer (12" HDPE) | 200 | LF | \$24.00 | \$4,800.00 |
| 3 | Catch Basins and Manholes | 2 | EA | \$2,000.00 | \$4,000.00 |
| 4 | Restoration | 1 | LS | \$250.00 | \$250.00 |
| Subtotal | | | | | \$10,250.00 |
| +25% Contingencies | | | | | \$2,563.00 |
| Total | | | | | \$12,813.00 |

Preliminary Opinion of Probable Cost - Option 3 (Construct Previously Proposed Improvements)

Adjusting for inflation, it is anticipated that the construction costs associated with this option will be **\$87,000**.

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Opinion of Probable Cost

Problem Area 24 - 23980 Yellowstone Trail

A preliminary opinion of probable cost is given below. Costs are for the construction of improvements only and do not include easements and / or land acquisition costs. It is anticipated that the benefited property owners will donate easements. Costs for engineering and administration are also not included. Costs may vary significantly based on final scope of project. Actual costs will be determined when survey and feasibility reports are completed.

Preliminary Opinion of Probable Cost

| Item No. | Description | Quantity | Unit | Unit Cost | Total |
|--------------------|----------------------------|----------|------|-------------|---------------------|
| 1 | Mobilization | 1 | LS | \$15,000.00 | \$15,000.00 |
| 2 | Remove Bituminous Pavement | 640 | SY | \$5.00 | \$3,200.00 |
| 3 | Storm Sewer (12" RCP) | 970 | LF | \$35.00 | \$33,950.00 |
| 4 | Catch Basins and Manholes | 9 | EA | \$1,250.00 | \$11,250.00 |
| 5 | Base Course Aggregate | 110 | CY | \$8.00 | \$880.00 |
| 6 | Bituminous Pavement | 500 | TN | \$150.00 | \$75,000.00 |
| 7 | Curb & Gutter | 1940 | LF | \$12.00 | \$23,280.00 |
| 8 | Turf Establishment | 1620 | SY | \$2.00 | \$3,240.00 |
| Subtotal | | | | | \$165,800.00 |
| +25% Contingencies | | | | | \$41,450.00 |
| Total | | | | | \$207,250.00 |

Appendix A

Opinion of Probable Cost

Problem Area 26 - 5815 Eureka Road

A preliminary opinion of probable cost is given below. Costs are for the construction of improvements only and do not include easements and / or land acquisition costs. It is anticipated that the benefited property owners will donate easements. Costs for engineering and administration are also not included. Costs may vary significantly based on final scope of project. Actual costs will be determined when survey and feasibility reports are completed.

Preliminary Opinion of Probable Cost

| Item No. | Description | Quantity | Unit | Unit Cost | Total |
|----------|--------------------------------------|----------|------|--------------------|-------------------|
| 1 | Mobilization | 1 | LS | \$300.00 | \$300.00 |
| 2 | Excavation | 15 | CY | \$10.00 | \$150.00 |
| 3 | Furnish and Place Field Stone Riprap | 5 | CY | \$80.00 | \$400.00 |
| 4 | Type IV Geotextile Fabric | 40 | SY | \$2.00 | \$80.00 |
| | | | | Subtotal | \$930.00 |
| | | | | +25% Contingencies | \$233.00 |
| | | | | Total | \$1,163.00 |

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Opinion of Probable Cost

Problem Area 28 - 5600 Wedgewood Drive

A preliminary opinion of probable cost is given below. Costs are for the construction of improvements only and do not include easements and / or land acquisition costs. It is anticipated that the benefited property owners will donate easements. Costs for engineering and administration are also not included. Costs may vary significantly based on final scope of project. Actual costs will be determined when survey and feasibility reports are completed.

Preliminary Opinion of Probable Cost - Option 1 (Re-grade Ditch to Provide Positive Outlet to West)

| Item No. | Description | Quantity | Unit | Unit Cost | Total |
|--------------------|--------------------|----------|------|-------------|--------------------|
| 1 | Mobilization | 1 | LS | \$1,500.00 | \$1,500.00 |
| 2 | Excavation | 500 | CY | \$10.00 | \$5,000.00 |
| 3 | Restoration | 1 | LS | \$300.00 | \$300.00 |
| 4 | Wetland Mitigation | 0.3 | AC | \$25,000.00 | \$7,500.00 |
| Subtotal | | | | | \$14,300.00 |
| +25% Contingencies | | | | | \$3,575.00 |
| Total | | | | | \$17,875.00 |

Preliminary Opinion of Probable Cost - Option 2 (Construct New Storm Sewer)

| Item No. | Description | Quantity | Unit | Unit Cost | Total |
|--------------------|----------------------------|----------|------|-------------|---------------------|
| 1 | Mobilization | 1 | LS | \$15,000.00 | \$15,000.00 |
| 2 | Remove Bituminous Pavement | 1600 | SY | \$5.00 | \$8,000.00 |
| 3 | Storm Sewer (12" RCP) | 850 | LF | \$35.00 | \$29,750.00 |
| 4 | Catch Basins and Manholes | 4 | EA | \$1,250.00 | \$5,000.00 |
| 5 | Base Course Aggregate | 275 | CY | \$8.00 | \$2,200.00 |
| 6 | Bituminous Pavement | 360 | TN | \$150.00 | \$54,000.00 |
| 7 | Turf Establishment | 1800 | SY | \$2.00 | \$3,600.00 |
| 8 | Wetland Mitigation | 0.3 | AC | \$25,000.00 | \$7,500.00 |
| Subtotal | | | | | \$125,050.00 |
| +25% Contingencies | | | | | \$31,263.00 |
| Total | | | | | \$156,313.00 |

Appendix A

Opinion of Probable Cost

Problem Area 29 - 26395 Peach Circle

A preliminary opinion of probable cost is given below. Costs are for the construction of improvements only and do not include easements and / or land acquisition costs. It is anticipated that the benefited property owners will donate easements. Costs for engineering and administration are also not included. Costs may vary significantly based on final scope of project. Actual costs will be determined when survey and feasibility reports are completed.

Preliminary Opinion of Probable Cost

| Item No. | Description | Quantity | Unit | Unit Cost | Total |
|--------------------|--------------|----------|------|------------|--------------------|
| 1 | Mobilization | 1 | LS | \$4,500.00 | \$4,500.00 |
| 2 | Excavation | 1700 | CY | \$10.00 | \$17,000.00 |
| 3 | Restoration | 1 | LS | \$300.00 | \$300.00 |
| Subtotal | | | | | \$21,800.00 |
| +25% Contingencies | | | | | \$5,450.00 |
| Total | | | | | \$27,250.00 |

Appendix A

Opinion of Probable Cost

Problem Area 31 - 24735 Glen Road

A preliminary opinion of probable cost is given below. Costs are for the construction of improvements only and do not include easements and / or land acquisition costs. It is anticipated that the benefited property owners will donate easements. Costs for engineering and administration are also not included. Costs may vary significantly based on final scope of project. Actual costs will be determined when survey and feasibility reports are completed.

Preliminary Opinion of Probable Cost

| Item No. | Description | Quantity | Unit | Unit Cost | Total |
|----------|---|----------|------|--------------------|--------------------|
| 1 | Mobilization | 1 | LS | \$2,500.00 | \$2,500.00 |
| 2 | Storm Sewer (15" HDPE - directional bore) | 400 | LF | \$100.00 | \$40,000.00 |
| 3 | Storm Sewer (27" RCP) | 200 | LF | \$85.00 | \$17,000.00 |
| 4 | Catch Basins and Manholes | 4 | EA | \$750.00 | \$3,000.00 |
| 5 | Cleanout Existing Pipe at Railroad | 1 | LS | \$500.00 | \$500.00 |
| 6 | Restoration | 1 | LS | \$2,500.00 | \$2,500.00 |
| | | | | Subtotal | \$65,500.00 |
| | | | | +25% Contingencies | \$16,375.00 |
| | | | | Total | \$81,875.00 |

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Opinion of Probable Cost

Problem Area 34 - 5900 Afton Rd

A preliminary opinion of probable cost is given below. Costs are for the construction of improvements only and do not include easements and / or land acquisition costs. It is anticipated that the benefited property owners will donate easements. Costs for engineering and administration are also not included. Costs may vary significantly based on final scope of project. Actual costs will be determined when survey and feasibility reports are completed.

Preliminary Opinion of Probable Cost

| Item No. | Description | Quantity | Unit | Unit Cost | Total |
|--------------------|--------------|----------|------|-----------|-------------------|
| 1 | Mobilization | 1 | LS | \$300.00 | \$300.00 |
| 2 | Excavation | 70 | CY | \$15.00 | \$1,050.00 |
| 3 | Restoration | 1 | LS | \$300.00 | \$300.00 |
| Subtotal | | | | | \$1,650.00 |
| +25% Contingencies | | | | | \$413.00 |
| Total | | | | | \$2,063.00 |

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Opinion of Probable Cost

Problem Area 38 - 23075 State Hwy 7

A preliminary opinion of probable cost is given below. Costs are for the construction of improvements only and do not include easements and / or land acquisition costs. It is anticipated that the benefited property owners will donate easements. Costs for engineering and administration are also not included. Costs may vary significantly based on final scope of project. Actual costs will be determined when survey and feasibility reports are completed.

Preliminary Opinion of Probable Cost - Option 1 (Construct New Storm Sewer)

| Item No. | Description | Quantity | Unit | Unit Cost | Total |
|--------------------|----------------------------|----------|------|------------|--------------------|
| 1 | Mobilization | 1 | LS | \$1,200.00 | \$1,200.00 |
| 2 | Remove Bituminous Pavement | 81 | SY | \$5.00 | \$405.00 |
| 3 | Storm Sewer (15" RCP) | 200 | LF | \$40.00 | \$8,000.00 |
| 4 | Catch Basins and Manholes | 2 | EA | \$1,250.00 | \$2,500.00 |
| 5 | Base Course Aggregate | 15 | CY | \$8.00 | \$120.00 |
| 6 | Bituminous Pavement | 15 | TN | \$150.00 | \$2,250.00 |
| 8 | Turf Establishment | 25 | SY | \$2.00 | \$50.00 |
| Subtotal | | | | | \$14,525.00 |
| +25% Contingencies | | | | | \$3,631.00 |
| Total | | | | | \$18,156.00 |

Preliminary Opinion of Probable Cost - Option 2 (Construct Manhole Over Existing Storm Sewer)

| Item No. | Description | Quantity | Unit | Unit Cost | Total |
|--------------------|--------------|----------|------|------------|-------------------|
| 1 | Mobilization | 1 | LS | \$500.00 | \$500.00 |
| 2 | Manhole | 1 | EA | \$1,250.00 | \$1,250.00 |
| 3 | Restoration | 1 | LS | \$250.00 | \$250.00 |
| Subtotal | | | | | \$2,000.00 |
| +25% Contingencies | | | | | \$500.00 |
| Total | | | | | \$2,500.00 |

Appendix A

Opinion of Probable Cost

Problem Area 42 - 5970 Strawberry Lane

A preliminary opinion of probable cost is given below. Costs are for the construction of improvements only and do not include easements and / or land acquisition costs. It is anticipated that the benefited property owners will donate easements. Costs for engineering and administration are also not included. Costs may vary significantly based on final scope of project. Actual costs will be determined when survey and feasibility reports are completed.

Preliminary Opinion of Probable Cost

| Item No. | Description | Quantity | Unit | Unit Cost | Total |
|--------------------|---|----------|------|------------|-------------------|
| 1 | Mobilization | 1 | LS | \$1,200.00 | \$1,200.00 |
| 2 | Remove Bituminous Pavement | 40 | SY | \$5.00 | \$200.00 |
| 3 | Storm Sewer (15" CMP) | 30 | LF | \$25.00 | \$750.00 |
| 4 | Salvage and Reinstall Base Course Aggregate | 8 | CY | \$12.00 | \$96.00 |
| 5 | Bituminous Pavement | 5 | TN | \$150.00 | \$750.00 |
| 6 | Turf Establishment | 15 | SY | \$2.00 | \$30.00 |
| 7 | Excavate to Provide Positive Drainage | 25 | CY | \$12.00 | \$300.00 |
| Subtotal | | | | | \$3,326.00 |
| +25% Contingencies | | | | | \$832.00 |
| Total | | | | | \$4,158.00 |

Appendix A

Opinion of Probable Cost

Problem Area 43 - Amesbury Townhomes

A preliminary opinion of probable cost is given below. Costs are for the construction of improvements only and do not include easements and / or land acquisition costs. It is anticipated that the benefited property owners will donate easements. Costs for engineering and administration are also not included. Costs may vary significantly based on final scope of project. Actual costs will be determined when survey and feasibility reports are completed.

Preliminary Opinion of Probable Cost - Option 1 (Increase Storage and Construct New Storm Sewer Upstream)

| Item No. | Description | Quantity | Unit | Unit Cost | Total |
|--------------------|---------------------------|----------|------|-----------|--------------------|
| 1 | Mobilization | 1 | LS | \$800.00 | \$800.00 |
| 2 | Storm Sewer (12" HDPE) | 210 | LF | \$24.00 | \$5,040.00 |
| 3 | Catch Basins and Manholes | 3 | EA | \$750.00 | \$2,250.00 |
| 4 | Common Borrow | 100 | CY | \$8.00 | \$800.00 |
| 5 | Restoration | 1 | LS | \$500.00 | \$500.00 |
| Subtotal | | | | | \$9,390.00 |
| +25% Contingencies | | | | | \$2,348.00 |
| Total | | | | | \$11,738.00 |

Preliminary Opinion of Probable Cost - Option 2 (Construct New Storm Sewer Downstream of Knightsbridge)

| Item No. | Description | Quantity | Unit | Unit Cost | Total |
|--------------------|---------------------------|----------|------|------------|--------------------|
| 1 | Mobilization | 1 | LS | \$800.00 | \$800.00 |
| 2 | Storm Sewer (48" RCP) | 370 | LF | \$110.00 | \$40,700.00 |
| 3 | Catch Basins and Manholes | 2 | EA | \$1,250.00 | \$2,500.00 |
| 4 | Restoration | 1 | LS | \$500.00 | \$500.00 |
| Subtotal | | | | | \$44,500.00 |
| +25% Contingencies | | | | | \$11,125.00 |
| Total | | | | | \$55,625.00 |

Appendix A

Opinion of Probable Cost

Problem Area 44 - 6045 Burlwood Ct

A preliminary opinion of probable cost is given below. Costs are for the construction of improvements only and do not include easements and / or land acquisition costs. It is anticipated that the benefited property owners will donate easements. Costs for engineering and administration are also not included. Costs may vary significantly based on final scope of project. Actual costs will be determined when survey and feasibility reports are completed.

Preliminary Opinion of Probable Cost

| Item No. | Description | Quantity | Unit | Unit Cost | Total |
|--------------------|---|----------|------|------------|--------------------|
| 1 | Mobilization | 1 | LS | \$5,000.00 | \$5,000.00 |
| 2 | Remove Bituminous Pavement | 60 | SY | \$5.00 | \$300.00 |
| 3 | Storm Sewer (12" RCP) | 40 | LF | \$35.00 | \$1,400.00 |
| 5 | Salvage and Reinstall Base Course Aggregate | 8 | CY | \$12.00 | \$96.00 |
| 6 | Bituminous Pavement | 13 | TN | \$150.00 | \$1,950.00 |
| 7 | Curb & Gutter | 20 | LF | \$12.00 | \$240.00 |
| 8 | Turf Establishment | 30 | SY | \$2.00 | \$60.00 |
| Subtotal | | | | | \$9,046.00 |
| +25% Contingencies | | | | | \$2,262.00 |
| Total | | | | | \$11,308.00 |

Appendix A

Opinion of Probable Cost

Problem Area 47 - 6060 Strawberry Ln

A preliminary opinion of probable cost is given below. Costs are for the construction of improvements only and do not include easements and / or land acquisition costs. It is anticipated that the benefited property owners will donate easements. Costs for engineering and administration are also not included. Costs may vary significantly based on final scope of project. Actual costs will be determined when survey and feasibility reports are completed.

Preliminary Opinion of Probable Cost

| Item No. | Description | Quantity | Unit | Unit Cost | Total |
|--------------------|--------------|----------|------|-----------|-------------------|
| 1 | Mobilization | 1 | LS | \$300.00 | \$300.00 |
| 2 | Excavation | 15 | CY | \$15.00 | \$225.00 |
| 3 | Restoration | 1 | LS | \$300.00 | \$300.00 |
| Subtotal | | | | | \$825.00 |
| +25% Contingencies | | | | | \$206.00 |
| Total | | | | | \$1,031.00 |

Appendix A

Opinion of Probable Cost

Problem Area 49 - 20480 Radisson Road

A preliminary opinion of probable cost is given below. Costs are for the construction of improvements only and do not include easements and / or land acquisition costs. It is anticipated that the benefited property owners will donate easements. Costs for engineering and administration are also not included. Costs may vary significantly based on final scope of project. Actual costs will be determined when survey and feasibility reports are completed.

Preliminary Opinion of Probable Cost

| Item No. | Description | Quantity | Unit | Unit Cost | Total |
|--------------------|---|----------|------|------------|--------------------|
| 1 | Mobilization | 1 | LS | \$2,500.00 | \$2,500.00 |
| 2 | Remove Bituminous Pavement | 200 | SY | \$5.00 | \$1,000.00 |
| 3 | Salvage and Reinstall Base Course Aggregate | 35 | CY | \$12.00 | \$420.00 |
| 4 | Excavation | 20 | CY | \$15.00 | \$300.00 |
| 5 | Bituminous Pavement | 45 | TN | \$150.00 | \$6,750.00 |
| 5 | Curb & Gutter | 200 | LF | \$12.00 | \$2,400.00 |
| Subtotal | | | | | \$13,370.00 |
| +25% Contingencies | | | | | \$3,343.00 |
| Total | | | | | \$16,713.00 |

Appendix A

Opinion of Probable Cost

Problem Area 50 - 6120 Riviera Lane

A preliminary opinion of probable cost is given below. Costs are for the construction of improvements only and do not include easements and / or land acquisition costs. It is anticipated that the benefited property owners will donate easements. Costs for engineering and administration are also not included. Costs may vary significantly based on final scope of project. Actual costs will be determined when survey and feasibility reports are completed.

Preliminary Opinion of Probable Cost

| Item No. | Description | Quantity | Unit | Unit Cost | Total |
|--------------------|---|----------|------|------------|--------------------|
| 1 | Mobilization | 1 | LS | \$2,500.00 | \$2,500.00 |
| 2 | Remove Bituminous Pavement | 200 | SY | \$5.00 | \$1,000.00 |
| 3 | Salvage and Reinstall Base Course Aggregate | 35 | CY | \$12.00 | \$420.00 |
| 4 | Excavation | 20 | CY | \$15.00 | \$300.00 |
| 5 | Bituminous Pavement | 45 | TN | \$150.00 | \$6,750.00 |
| Subtotal | | | | | \$10,970.00 |
| +25% Contingencies | | | | | \$2,743.00 |
| Total | | | | | \$13,713.00 |

Appendix A

Opinion of Probable Cost

Problem Area 51 - 26505 Maple Ave

A preliminary opinion of probable cost is given below. Costs are for the construction of improvements only and do not include easements and / or land acquisition costs. It is anticipated that the benefited property owners will donate easements. Costs for engineering and administration are also not included. Costs may vary significantly based on final scope of project. Actual costs will be determined when survey and feasibility reports are completed.

Preliminary Opinion of Probable Cost

| Item No. | Description | Quantity | Unit | Unit Cost | Total |
|--------------------|---|----------|------|------------|---------------------|
| 1 | Mobilization | 1 | LS | \$3,500.00 | \$3,500.00 |
| 2 | Remove Bituminous Pavement | 80 | SY | \$5.00 | \$400.00 |
| 3 | Storm Sewer (12" RCP) | 600 | LF | \$35.00 | \$21,000.00 |
| 4 | Storm Sewer (15" RCP) | 600 | LF | \$40.00 | \$24,000.00 |
| 5 | Storm Sewer (18" RCP) | 1900 | LF | \$50.00 | \$95,000.00 |
| 6 | Catch Basins and Manholes | 10 | EA | \$1,250.00 | \$12,500.00 |
| 7 | Salvage and Reinstall Base Course Aggregate | 20 | CY | \$12.00 | \$240.00 |
| 8 | Bituminous Pavement | 20 | TN | \$150.00 | \$3,000.00 |
| 9 | Turf Establishment | 6200 | SY | \$2.00 | \$12,400.00 |
| Subtotal | | | | | \$172,040.00 |
| +25% Contingencies | | | | | \$43,010.00 |
| Total | | | | | \$215,050.00 |

APPENDIX B

Appendix B

List of Recommended Maintenance Items

| Number | Address | Maintenance Activity Required | Additional Comments |
|--------|----------------------|--|--|
| 7 | 5925 Grant St | Remove obstructions from pipe entrances | Home owner should be responsible for system on their property |
| 12 | 21165 Mtka Blvd | Remove obstructions from pipe entrances | |
| 13 | 4770 Lakeway Terrace | Replace beehive casting with higher capacity grate | One-time activity |
| 15 | 800 Water Street | Remove silt from FES at TH 7/41 intersection | |
| 17 | 23350 Academy | Remove silt from CB grate/replace with beehive grate | |
| 24 | 23980 Yellowstone Tr | Continue monitoring water level | Additional pumping may be necessary |
| 33 | 26275 Smithtown Rd | Remove obstructions from pipe entrances | |
| 34 | 5900 Afton Rd | a. Repair sink hole adjacent to CB west of Afton Rd. | One-time activity |
| | | b. Re-grade turf areas adjacent to Afton Rd | Provide positive drainage from road surface; one-time activity |
| | | c. Repair sink holes at culverts east of Afton Rd | One-time activity |
| 46 | 5480 Teal Circle | Remove obstructions from ditch | |
| 49 | 20480 Radisson Road | Place temporary bituminous curb at end of driveway | |

SUPPLEMENTAL REPORT
ANALYSIS OF DRAINAGE PROBLEM AREAS
WITHIN THE CITY OF SHOREWOOD

PREPARED FOR THE
CITY OF SHOREWOOD, MINNESOTA

January 22, 2007

Prepared By:

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**APPENDIX A - Opinion Of Probable Cost For Selected Problem Areas
(Category 3 and 5)**

CERTIFICATION

I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly licensed professional engineer under the laws of the State of Minnesota.



Steven Gurney, P.E.

Date: January 22, 2007

Reg. No. 40497

I. INTRODUCTION

On January 23, 2006, a report entitled “Analysis of Drainage Problem Areas within the City of Shorewood” was approved by the Shorewood City Council. Since that time, other property owners have contacted the City requesting that their property be added to the list.

The history behind the original report is not reiterated here; however, the various categories previously established during the preparation of that report are outlined below:

1) PUBLIC SAFETY AND HEALTH

Primary attention will be paid to those projects that impact the public health or safety. These projects would include ice problems on the road, erosion that is causing a hazardous structural problem (i.e. undermining a road), or storm water that is causing a significant health problem (such as flooding the sanitary system).

2) SUBSTANTIAL FINANCIAL IMPACT TO THE CITY

This category will include those projects that, while not endangering the public health, will still have a negative impact on the residents as a whole. Projects in this category include minor infrastructure replacement that cannot be funded cost effectively by other means. Other potential projects include erosion causing property damage and minor structure replacement.

3) PUBLIC NUISANCE

This category includes those projects that cannot be considered a substantial hazard, are not likely to cause a financial loss to the City, but are a public nuisance. These projects include standing water in the roadway, unwanted flooding in public parks, and minor erosion projects.

4) PRIVATE NUISANCE WITH LIMITED CITY RESPONSIBILITY

This category includes projects that are a nuisance to a single residence or small group of residences that the City Council deems that the City has some responsibility to help correct. These projects include those instances where a large drainage area is causing a problem to a small area or where a substantial portion of the runoff is generated within the City’s Right-of-Way.

In order for the City to participate, the homeowner(s) must be willing to provide a right-of-entry to City crews and provide Drainage and Utility Easement over improvements without cost.

5) PRIVATE NUISANCE WITH NO CITY RESPONSIBILITY

This category includes projects that are a nuisance to a single residence or small group of residences that the City Council deems that the City has no responsibility to help correct. These projects include those instances where a limited drainage area, consisting of

private property, is causing a problem to a small area. The nuisance problem will involve little or no runoff that is generated from City Right-of-Way.

6) NO FURTHER ACTION REQUIRED

This category includes projects that are under way, or have been addressed through various means, such as individual homeowners correcting the problem himself or herself or City crews fixing the problem.

The problem areas are all evaluated and a category assigned so that the City Council can begin to prioritize the problem areas.

With the exception of three areas, the new problem areas are areas that either the City has no responsibility for or no further action is required. Therefore, Tables 1-6, created as part of the original report, are not updated here. The new problem areas can simply be added to the bottom of the lists as there is no prioritization needed for these new areas.

II. DISCUSSION OF PROBLEM AREAS

Since the original report was approved by the City Council, the City received additional drainage complaints. Since that time, we have investigated each of the various areas to visit with concerned residents, gather additional information, take pictures, and where possible, observe the problems.

The results of this preliminary investigation are presented in the following pages. Each problem area has a brief description of the complaint expressed by the property owner followed by a summary of the hydrologic characteristics of the subwatershed tributary to the site.

Next, possible alternatives that may be considered to address the problems at the subject site are outlined. A preliminary cost estimate for each alternative is also provided.

Following that is a recommendation by WSB as to how the City should proceed. Most of the areas are within private property and do not require much additional investigation by City Staff or their consultants. However, there are several areas that, because of their proximity to or the amount of public property involved in the tributary area, will require further review.

Unless otherwise noted, the hydrologic information is based on a cursory review of the subwatershed tributary to the problem area. The Soil Conservation Service's TR-20 method was used to estimate flow rates from the subwatershed directly tributary to the problem area.

Problem Area Number 52 – 5985 Eureka Rd

Description of Problem:

The property owner contacted the City concerned about the amount of water flowing through their property. They indicated that the water was so high during the September 2005 storm that it overtopped Eureka Road. A review of the City's contour information indicates that this property contains a drainage way that conveys runoff from areas east of the property. Typically, road culverts are designed to convey runoff from a storm event up to a 10-year storm event. After that, the runoff is allowed to overtop the road unless doing so would threaten to flood an upstream property. The contours also show that the house is at least one foot higher than the low point in the road, so runoff will overtop the road before flooding the house. It appears that the culvert is functioning as designed.

Hydrologic Information:

- Tributary Area: 13.4 ac
- Impervious Surface: 10%
- Peak 10-year Flow Rate: 26 cfs
- Peak 100-year Flow Rate: 48 cfs

Possible Alternatives:

There is no alternative identified for this area as the system seems to be functioning properly, and there is no danger of the house being flooded by surface water runoff. Should the property owner decide to place fill in their yard, caution must be exercised that the grading does not block runoff from other properties. Any fill greater than 50 cubic yards will require a permit.

Recommendation:

It is recommended that this problem area be categorized as a "No Further Action Required" area (Category 6) since the system appears to be functioning as designed.

Problem Area Number 53 – 6180 Cathcart Dr

Description of Problem:

The property owner contacted City Hall concerned about water being back up on her property. The property owner had placed fill on the property and placed silt fence along the edges, as required. Across the street, a small pond had been recently excavated. During the grading of this pond, the outlet of the culvert under the road had been partially obstructed with riprap. The riprap was re-positioned so the water would drain from the yard at 6180 Cathcart. In addition, the silt fence placed on the property was blocking a small amount of additional water. Sediment removal, consistent with usual maintenance of silt fence will address this condition.

Hydrologic Information:

- *No hydrologic analysis completed since the problem has been addressed.*

Possible Alternatives:

There is no alternative identified for this area as the system seems to be functioning properly, provided regular maintenance is performed on the remaining silt fence. Once turf is established, the silt fence can be removed.

Recommendation:

It is recommended that this problem area be categorized as a “No Further Action Required” area (Category 6) since the problem appears to have been addressed.

Problem Area Number 54 – 4940 Suburban Dr

Description of Problem:

The property owner contacted City Hall complaining that runoff from the road had flooded her property. After further discussion, it was clarified that the only problem was actually just standing water on a small portion of the yard. The property owner indicated that they were in the process of constructing an in-ground swimming pool, and they were concerned about what could be done with runoff from their driveway area. The proposed plan will essentially maintain the existing flow patterns through his portion of the property; however, the runoff will be conveyed in a pipe rather than via an overland swale. The change is acceptable, provided the concentrated runoff is allowed to dissipate at the edge of the property.

Hydrologic Information:

- Tributary Area: 0.88 ac
- Impervious Surface: 32%
- Peak 10-year Flow Rate: 2.4 cfs
- Peak 100-year Flow Rate: 3.9 cfs

Possible Alternatives:

There is no alternative identified for this area as the system seems to be functioning properly, provided existing runoff patterns are not drastically altered during construction of the in-ground pool, as required by the building permit.

Recommendation:

It is recommended that this problem area be categorized as a “No Further Action Required” area (Category 6) since this will be addressed during the building permit process.

Problem Area Number 55 – 5590 Timber Lane

Description of Problem:

The property owner contacted City Hall complaining that his yard was soggy and did not drain properly. The property owner indicated that he would like to place fill in the yard to eliminate some of the low areas. A review of the City's contour information indicates that a low point is present in the northeast corner of the property. The property owner indicated that he would like to place fill in the yard to eliminate the low spot. He also asked if the culvert in the southeast corner of his property could be cleaned out. This culvert is in the County right-of-way. During the summer, the ditch downstream of the culvert was jetted out, which should improve the performance of the culvert.

Hydrologic Information:

- Tributary Area: 0.88 ac
- Impervious Surface: 32%
- Peak 10-year Flow Rate: 2.4 cfs
- Peak 100-year Flow Rate: 3.9 cfs

Possible Alternatives:

There is no alternative identified for this area since there is no danger of the house being flooded by surface water runoff. Should the property owner decide to place fill in their yard, a permit would be required for fill greater than 50 cubic yards. The costs for this work will be \$1,700 to \$5,000 depending on the amount of fill used.

Recommendation:

It is recommended that this problem area be categorized as a "Private Nuisance with No City Responsibility" area (Category 5) since the poor drainage through the low area is an existing condition not caused by any action of the City.

Problem Area Number 56 – 24645 Glen Road

Description of Problem:

The property owner contacted City Hall complaining about standing water on her property. The property owner indicated that she thought the recent wetland restoration work done on the Gideon Glen site created this condition. A review of the City's contour information indicates that the low area on her property is several feet higher than the Gideon Glen wetland. The house itself is approximately 6 inches above the overflow elevation of the low area. While this is less than the minimum standard of 1 foot that would be applied for new construction, the small drainage area tributary to this low point will not likely result in flooding of the house.

The Minnehaha Creek Watershed District also reviewed the site and concurred that the problem was not related to their work in the wetland. The standing water was most likely caused by snow melting before the ground was thawed, which would have allowed it to infiltrate into the ground.

Hydrologic Information:

- Tributary Area: 0.60 ac
- Impervious Surface: 40%
- Peak 10-year Flow Rate: 1.8 cfs
- Peak 100-year Flow Rate: 2.9 cfs

Possible Alternatives:

There is no alternative identified for this area since there is no danger of the house being flooded by surface water runoff. Should the property owner decide to pump the standing water from her yard, it is anticipated that the costs for this work will be \$100 to \$500 depending on the duration of pumping.

Recommendation:

It is recommended that this problem area be categorized as a "Private Nuisance with No City Responsibility" area (Category 5) since the standing water in low area is caused by an existing condition which was not created by any action of the City.

Problem Area Number 57 – 6080 Strawberry Lane

Description of Problem:

The property owner contacted City Hall concerned about standing water in her back yard. It appears this was created when the builder of the new house behind her pumped out the into the common backyard low area. This new house is part of the same development. A review of the grading plan for the development indicates that a drainage swale was to have been excavated that will convey runoff from the common back yards to the ditch adjacent to the HCRRRA trial.

The developer has been made aware of this, and the swale will be constructed prior to releasing the letter of credit associated with the grading work.

Hydrologic Information:

- *No hydrologic analysis completed since the problem will be addressed through the building permit process.*

Possible Alternatives:

There is no alternative identified for this area as the problem will be addressed as part of the building permit process and / or approval of the development.

Recommendation:

It is recommended that this problem area be categorized as a “No Further Action Required” area (Category 6) since the problem will be addressed by other avenues.

Problem Area Number 58 – 26370 Peach Circle

Description of Problem:

The property owner contacted City Hall concerned about standing water in the street. The source of the water is the sump pump discharge from 26395 Peach Circle (see **Problem Area 29**) that is directed to Peach Circle. A catch basin is located in the cul-de-sac, near the east lot line of this property. The storm sewer then conveys runoff to a stormwater treatment pond at the back of the property. The only apparent outlet for this pond is the overland overflow. Based on a review of the City's 1-foot contours, it appears the overflow is approximately 1.5 feet lower than the elevation of the lowest building opening on adjacent structures.

Due to the relatively flat grade of the road and areas of settlement on the road surface, there is standing water present immediately after rainfall events, or when the sump pump is discharging. The property owner also expressed dissatisfaction with the pond on his property, which appears to have been built as part of this subdivision.

Hydrologic Information:

- Tributary Area: 1.74 ac
- Impervious Surface: 36%
- Peak 10-year Flow Rate: 4.9 cfs
- Peak 100-year Flow Rate: 8.0 cfs

Possible Alternatives:

The following alternatives are available to reduce the nuisance flooding in this area:

1. Re-grade the Peach Circle road surface and install curb & gutter along with additional storm sewer. It is anticipated that the construction costs associated with this work will be approximately \$71,000. Substantial cost savings would be realized if this work was to be completed as a part of the reconstruction of the Peach Circle road surface.
2. An interim fix that could be constructed to reduce the standing water on Peach Circle would be to install a draitile along the south edge of the road, and connect to the catch basin in the cul-de-sac. A bituminous patch could then be placed on the street to restore the crown.

Recommendation:

It is recommended that this problem area be categorized as a "Public Nuisance" area (Category 3.) The project is not cost-effective unless it is done as part of an overall reconstruction of Peach Circle. Therefore, it is recommended that the project not be undertaken until the City reconstructs the road surface at Peach Circle. Prior to beginning work, the easements over the storm sewer and pond should be verified and, if not in place, secured before proceeding.

Problem Area Number 59 – 5875 Afton Road

Description of Problem:

The property owner contacted the City concerned about water flowing through his yard. The runoff appears to be contained in a designed drainage swale that conveys runoff through the property.

Hydrologic Information:

- Tributary Area: 34.4 ac
- Impervious Surface: 35%
- Peak 10-year Flow Rate: 67.9 cfs*
- Peak 100-year Flow Rate: 113.3 cfs*

* Flow rate on runoff from entire tributary area, neglecting upstream ponding.

Possible Alternatives:

There is no alternative identified for this problem area as the system appears to be functioning as designed. All runoff is being contained in the drainage and utility easements.

Recommendation:

It is recommended that this problem area be categorized as a “No Further Action Required” area (Category 6) since the runoff conveyed through this property is contained within the existing drainage and utility easement.

Problem Area Number 60 – 5935 Howard’s Point Road

Description of Problem:

The property owner contacted the City concerned about standing water on his property. A review of the City’s one-foot contours confirms that there is a depression on the south half of this lot. The adjacent low point, at the intersection of Howard’s Point Road and Smithtown Road, is approximately two feet below the apparent low building opening of the house on this property.

Hydrologic Information:

- Tributary Area: 1.5 ac
- Impervious Surface: 17%
- Peak 10-year Flow Rate: 2.7 cfs
- Peak 100-year Flow Rate: 4.6 cfs

Possible Alternatives:

There is no alternative identified for this area since there is no danger of the house being flooded by surface water runoff. Should the property owner decide to place fill in their yard, a permit would be require for fill greater than 50 cubic yards. The costs for this work will be \$1,700 to \$5,000 depending on the amount of fill used.

Recommendation:

It is recommended that this problem area be categorized as a “No Further Action Required” area (Category 6) since there is adequate freeboard above the overflow section that will convey runoff away from the property before surface waters would flood the house.

Problem Area Number 61 – 5830 Echo Road

Description of Problem:

The property owner contacted the City concerned that the culvert located on the west edge of the property was not function properly. A review of the site indicates that the culvert is functioning as intended. There is a spot on the road that will hold water. It appears that over time the edges of the lawns are higher than the edge of the road. This traps water on the road surface this can be fixed by minor grading along the edge of the road.

Hydrologic Information:

- Tributary Area: 1.5 ac
- Impervious Surface: 17%
- Peak 10-year Flow Rate: 2.7 cfs
- Peak 100-year Flow Rate: 4.6 cfs

Possible Alternatives:

The standing water in this area can be fixed by minor grading along the edge of the road. However, it is likely that, over time, the edges of the road would again block the runoff from leaving the road surface. In order to address this, a storm sewer and catch basin s could be installed to convey runoff directly to the nearby ditch. The cost for this work is estimated to be approximately \$30,000. Substantial cost savings could be realized if the storm sewer improvements are incorporated into the site plan for a new City Hall when that project is initiated.

Recommendation:

It is recommended that this problem area be categorized as a “Public Nuisance” area (Category 3.) The installation of a storm sewer system in this area is not cost-effective unless it is done as part of the overall reconstruction of the area for a new City Hall building. However, it is recommended that limited grading be done by the City’s Public Works crews to allow runoff to leave the road surface.

Problem Area Number 62 – 5520 Grant Lorenz Road

Description of Problem:

The property owner contacted the City concerned that the open channel that conveys runoff through his property has become choked with sediment. He also contends that the alleged sediment deposition has blocked the flow of runoff through his property, thereby creating wetland conditions.

A comparison of the City's one-foot contours from 1966 and 1999 do not show an increase in elevation within this property, or the nearby surrounding properties. This would most likely indicate that sediment deposition, if any, was very limited. In fact, the majority of this parcel appears to be slightly lower based on the 1999 survey compared to the 1966 survey. This is most likely due to the presence of peaty soils that tend to compress naturally over time.

Hydrologic Information:

- Tributary Area: 53 ac (direct), 305 ac (direct and indirect)*
- Impervious Surface: 19%
- Peak 10-year Flow Rate: 75 cfs
- Peak 100-year Flow Rate: 150 cfs

* Tributary area is approximated from larger tributary area (subwatershed WC 4) as identified in CSMP.

Possible Alternatives:

There is no alternative identified for this problem area as the system appears to be functioning as originally intended. The property owner could raise the low area by importing fill. This would require a conditional use permit, as well as permit from the MCWD. The property owner is responsible for preparing a wetland delineation report to determine the exact limits of wetlands on the property.

Recommendation:

It is recommended that this problem area be categorized as a "No Further Action Required" area (Category 6) since the system appears to be functioning as originally intended.

Problem Area Number 63 – 23610 Gillette Curve

Description of Problem:

The property owner contacted City Hall concerned about standing water in the street. This is caused by the small bituminous hump placed at the end of the property owner's driveway. If this were not in place, the runoff would be conveyed down the driveway and into the garage that is approximately one foot lower than the edge of the street. The area of standing water is relatively small (approximately two feet by four feet.)

Hydrologic Information:

- Tributary Area: 1.09 ac
- Impervious Surface: 32%
- Peak 10-year Flow Rate: 2.1 cfs
- Peak 100-year Flow Rate: 3.5 cfs

Possible Alternatives:

To reduce the nuisance flooding in this area, it is recommended that Gillette Curve be re-graded and curb & gutter installed along with additional storm sewer. It is anticipated that the construction costs associated with this work will be approximately \$32,000 to \$150,000. Substantial cost savings would be realized if this work was to be completed as a part of the reconstruction of the Gillette Curve road surface.

Recommendation:

It is recommended that this problem area be categorized as a "Public Nuisance" area (Category 3.) The project is not cost-effective unless it is done as part of an overall reconstruction of Gillette Curve. Therefore, it is recommended that the project not be undertaken until the City reconstructs the road surface at Gillette Curve. Prior to beginning work, the easements over the storm sewer and pond should be verified and, if not in place, secured before proceeding.

III. SUMMARY AND RECOMMENDATIONS

Generally, the City's drainage issues outlined in this Supplemental Report can be classified as nuisance flooding, with a few exceptions. Of the 12 problem areas, nine are identified as "Private Nuisance with No City Responsibility" (Category 5) or "No Further Action Required" (category 6.)

The three exceptions are areas classified as "Public Nuisance "(Category 3.) In all three cases, the nuisance is a small area of standing water on the road, smaller than 500 square feet in size. Based on this, it is recommended that no major construction be undertaken at these areas until the roads are reconstructed. In the meantime, it may be possible to make temporary fixes that will address the standing water until it can be permanently addressed as part of a larger project.

In order to address the three problem areas as separate projects, the estimated costs range is between \$107,000 and \$251,000. The narratives in the report mention that, due to economy of scale, significant savings may be realized by doing these projects as part of a larger road reconstruction project.

Funding:

Currently, the City has in place a stormwater fee. As design alternatives are considered, utilization of the stormwater fees, in conjunction with special assessments for benefiting areas, will need to be considered.

APPENDIX A

APPENDIX I

Ordinances

CITY OF SHOREWOOD

ORDINANCE NO. 534

**AN ORDINANCE AMENDING THE SHOREWOOD CITY CODE TO REPLACE
EXISTING CHAPTER 1101 IN ITS ENTIRETY WITH A REVISED CHAPTER 1101
(FLOODPLAIN MANAGEMENT REGULATIONS)**

Section 1. Chapter 1101 (Floodplain Management Regulations) of the Shorewood City Code is hereby deleted in its entirety and replaced with:

CHAPTER 1101

FLOODPLAIN MANAGEMENT REGULATIONS

Section

- 1101.01 STATUTORY AUTHORIZATION, FINDINGS OF FACT AND PURPOSE
- 1101.02 GENERAL PROVISIONS
- 1101.03 ESTABLISHMENT OF ZONING DISTRICTS
- 1101.04 FLOODWAY DISTRICT (FW)
- 1101.05 FLOOD FRINGE DISTRICT (FF)
- 1101.06 GENERAL FLOODPLAIN DISTRICT (GF)
- 1101.07 LAND DEVELOPMENT STANDARDS
- 1101.08 PUBLIC UTILITIES, RAILROADS, ROADS, AND BRIDGES
- 1101.09 MANUFACTURED HOMES AND PLACEMENT OF RECREATIONAL VEHICLES
- 1101.10 ADMINISTRATION
- 1101.11 NONCONFORMITIES
- 1101.12 PENALTIES AND ENFORCEMENT
- 1101.13 AMENDMENTS

1101.01 STATUTORY AUTHORIZATION, FINDINGS OF FACT AND PURPOSE

Subd. 1. *Statutory Authorization:* The legislature of the State of Minnesota has, in Minnesota Statutes Chapter 103F and Chapter 462 delegated the responsibility to local government units to adopt regulations designed to minimize flood losses. Therefore, the City Council of Shorewood, Minnesota, does ordain as follows.

Subd. 2. *Purpose:*

- a. This chapter regulates development in the flood hazard areas of the City of Shorewood. These flood hazard areas are subject to periodic inundation, which may result in loss of life and property, health and safety hazards, disruption of commerce and governmental services, extraordinary public expenditures for flood protection and relief, and impairment of the tax base. It is the purpose of this

chapter to promote the public health, safety, and general welfare by minimizing these losses and disruptions.

- b. National Flood Insurance Program Compliance. This chapter is adopted to comply with the rules and regulations of the National Flood Insurance Program codified as 44 Code of Federal Regulations Parts 59 -78, as amended, so as to maintain the community's eligibility in the National Flood Insurance Program.
- c. This chapter is also intended to preserve the natural characteristics and functions of watercourses and floodplains in order to moderate flood and stormwater impacts, improve water quality, reduce soil erosion, protect aquatic and riparian habitat, provide recreational opportunities, provide aesthetic benefits and enhance community and economic development.

1101.02 GENERAL PROVISIONS

Subd. 1. *How to Use This Chapter:* This chapter adopts the floodplain maps applicable to the City of Shorewood and includes three floodplain districts: Floodway, Flood Fringe, and General Floodplain.

- a. Where Floodway and Flood Fringe districts are delineated on the floodplain maps, the standards in Sections 4 or 5 will apply, depending on the location of a property.
- b. Locations where Floodway and Flood Fringe districts are not delineated on the floodplain maps are considered to fall within the General Floodplain district. Within the General Floodplain district, the Floodway District standards in Section 4 apply unless the floodway boundary is determined, according to the process outlined in Section 6. Once the floodway boundary is determined, the Flood Fringe District standards in Section 5 may apply outside the floodway.

Subd. 2. *Lands to Which Chapter Applies:*

- a. This chapter applies to all lands within the jurisdiction of Shorewood shown on the floodplain maps and/or the attachments to the maps as being located within the boundaries of the Floodway, Flood Fringe, or General Floodplain Districts.
- b. The Floodway, Flood Fringe and General Floodplain Districts are overlay districts that are superimposed on all existing zoning districts on the Shorewood Zoning Districts map referenced in Chapter 1201 of this code. The standards imposed in the overlay districts are in addition to any other requirements in Chapter 1201 of this Code. In case of a conflict, the more restrictive standards will apply.

Subd. 3. *Incorporation of Maps by Reference:* The following maps together with all attached material are hereby adopted by reference and declared to be a part of this chapter. The attached material includes the Flood Insurance Study for Hennepin County, Minnesota, and Incorporated Areas, dated November 4, 2016 and the Flood Insurance Rate Map panels enumerated below, dated November 4, 2016, all prepared by the Federal Emergency Management Agency. These materials are on file in the Shorewood City Offices.

Effective Flood Insurance Rate Map panels:

| | | | |
|-------------|-------------|-------------|-------------|
| 27053C0292F | 27053C0309F | 27053C0313F | 27053C0317F |
| 27053C0295F | 27053C0311F | 27053C0314F | 27053C0318F |
| 27053C0308F | 27053C0312F | 27053C0316F | 27053C0319F |

- Subd. 4 *Regulatory Flood Protection Elevation:* The regulatory flood protection elevation (RFPE) is an elevation no lower than one foot above the elevation of the regional flood plus any increases in flood elevation caused by encroachments on the floodplain that result from designation of a floodway.
- Subd. 5. *Interpretation:* The boundaries of the floodplain districts are determined by scaling distances on the Flood Insurance Rate Map.
- a. Where a conflict exists between the floodplain limits illustrated on the flood plain map and floodplain elevations discover in actual field conditions, the flood elevations shall be the governing factor. The Zoning Administrator must interpret the boundary location based on the ground elevations that existed on the site on the date of the first National Flood Insurance Program map showing the area within the regulatory floodplain, and other available technical data.
 - b. Persons contesting the location of the district boundaries will be given a reasonable opportunity to present their case to the City Council, serving as the Board of Adjustments and Appeals and to submit technical evidence.
- Subd. 6. *Abrogation and Greater Restrictions:* It is not intended by this chapter to repeal, abrogate, or impair any existing easements, covenants, or other private agreements. However, where this chapter imposes greater restrictions, the provisions of this chapter prevail. All other ordinances inconsistent with this chapter are hereby repealed to the extent of the inconsistency only.
- Subd. 7. *Warning and Disclaimer of Liability:* This chapter does not imply that areas outside the floodplain districts or land uses permitted within such districts will be free from flooding or flood damages. This chapter does not create liability on the part of the City of Shorewood or its officers or employees for any flood damages that result from reliance on this chapter or any administrative decision lawfully made hereunder.
- Subd. 8 *Severability:* If any section, clause, provision, or portion of this chapter is adjudged unconstitutional or invalid by a court of law, the remainder of this chapter shall not be affected and shall remain in full force.
- Subd. 9 *Definitions:* Unless specifically defined below, words or phrases used in this chapter must be interpreted according to common usage and so as to give this chapter its most reasonable application.

ACCESSORY USE OR STRUCTURE. A use or structure on the same lot with, and of a nature customarily incidental and subordinate to, the principal use or structure.

BASE FLOOD ELEVATION. The elevation of the “regional flood.” The term “base flood elevation” is used in the flood insurance survey.

BASEMENT. Any area of a structure, including crawl spaces, having its floor or base subgrade (below ground level) on all four sides, regardless of the depth of excavation below ground level.

CONDITIONAL USE. A specific type of structure or land use listed in the official control that may be allowed but only after an in-depth review procedure and with appropriate conditions or restrictions as provided in the official zoning controls or building codes and upon a finding that:

- (1) Certain conditions as detailed in the zoning code exist.
- (2) The structure and/or land use conform to the comprehensive land use plan if one exists and are compatible with the existing neighborhood.

CRITICAL FACILITIES. Facilities necessary to a community's public health and safety, those that store or produce highly volatile, toxic or water-reactive materials, and those that house occupants that may be insufficiently mobile to avoid loss of life or injury. Examples of critical facilities include hospitals, correctional facilities, schools, daycare facilities, nursing homes, fire and police stations, wastewater treatment facilities, public electric utilities, water plants, fuel storage facilities, and waste handling and storage facilities.

DEVELOPMENT. Any manmade change to improved or unimproved real estate, including buildings or other structures, mining, dredging, filling, grading, paving, excavation or drilling operations, or storage of equipment or materials.

EQUAL DEGREE OF ENCROACHMENT. A method of determining the location of floodway boundaries so that floodplain lands on both sides of a stream are capable of conveying a proportionate share of flood flows.

FLOOD. A temporary increase in the flow or stage of a stream or in the stage of a wetland or lake that results in the inundation of normally dry areas.

FLOOD FREQUENCY. The frequency for which it is expected that a specific flood stage or discharge may be equaled or exceeded.

FLOOD FRINGE. The portion of the Special Flood Hazard Area (one percent annual chance flood) located outside of the floodway. Flood fringe is synonymous with the term "floodway fringe" used in the Flood Insurance Study for Hennepin County, Minnesota

FLOOD PRONE AREA. Any land susceptible to being inundated by water from any source (see "Flood").

FLOODPLAIN. The beds proper and the areas adjoining a wetland, lake or watercourse which have been or hereafter may be covered by the regional flood.

FLOODPROOFING. A combination of structural provisions, changes, or adjustments to properties and structures subject to flooding, primarily for the reduction or elimination of flood damages.

FLOODWAY. The bed of a wetland or lake and the channel of a watercourse and those portions of the adjoining floodplain which are reasonably required to carry or store the regional flood discharge.

LOWEST FLOOR. The lowest floor of the lowest enclosed area (including basement). An unfinished or flood resistant enclosure, used solely for parking of vehicles, building access, or storage in an area other than a basement area, is not considered a building's lowest floor; provided, that such enclosure is not built so as to render the structure in violation of the applicable non-elevation design requirements of 44 Code of Federal Regulations, Part 60.3.

MANUFACTURED HOME. A structure, transportable in one or more sections, which is built on a permanent chassis and is designed for use with or without a permanent foundation when attached to the required utilities. The term "manufactured home" does not include the term "recreational vehicle".

NEW CONSTRUCTION. Structures, including additions and improvements, and placement of manufactured homes, for which the start of construction commenced on or after the effective date of this chapter.

OBSTRUCTION. Any dam, wall, wharf, embankment, levee, dike, pile, abutment, projection, excavation, channel modification, culvert, building, wire, fence, stockpile, refuse, fill, structure, or matter in, along, across, or projecting into any channel, watercourse, or regulatory floodplain which may impede, retard, or change the direction of the flow of water, either in itself or by catching or collecting debris carried by such water.

ONE HUNDRED YEAR FLOODPLAIN. Lands inundated by the "Regional Flood" (see definition).

PRINCIPAL USE OR STRUCTURE. All uses or structures that are not accessory uses or structures.

REACH. A hydraulic engineering term to describe a longitudinal segment of a stream or river influenced by a natural or man-made obstruction. In an urban area, the segment of a stream or river between two consecutive bridge crossings would most typically constitute a reach.

RECREATIONAL VEHICLE. A vehicle that is built on a single chassis, is 400 square feet or less when measured at the largest horizontal projection, is designed to be self-propelled or permanently towable by a light duty truck, and is designed primarily not for use as a permanent dwelling but as temporary living quarters for recreational, camping,

travel, or seasonal use. For the purposes of this chapter, the term recreational vehicle is synonymous with the term “travel trailer/travel vehicle”.

REGIONAL FLOOD. A flood which is representative of large floods known to have occurred generally in Minnesota and reasonably characteristic of what can be expected to occur on an average frequency in the magnitude of the 1% chance or 100-year recurrence interval. Regional flood is synonymous with the term "base flood" used in a flood insurance study.

REGULATORY FLOOD PROTECTION ELEVATION (RFPE) An elevation not less than one foot above the elevation of the regional flood plus any increases in flood elevation caused by encroachments on the floodplain that result from designation of a floodway.

REPETITIVE LOSS. Flood related damages sustained by a structure on two separate occasions during a ten year period for which the cost of repairs at the time of each such flood event on the average equals or exceeds 25% of the market value of the structure before the damage occurred.

SPECIAL FLOOD HAZARD AREA. A term used for flood insurance purposes synonymous with “One Hundred Year Floodplain”.

START OF CONSTRUCTION. Includes substantial improvement, and means the actual start of construction, repair, reconstruction, rehabilitation, addition, placement or other improvement that occurred before the permit’s expiration date. The actual start is either the first placement of permanent construction of a structure on a site, such as the pouring of slab or footings, the installation of piles, the construction of columns, or any work beyond the stage of excavation; or the placement of a manufactured home on a foundation. Permanent construction does not include land preparation, such as clearing, grading and filling; nor does it include the installation of streets and/or walkways; nor does it include excavation for a basement, footings, piers, foundations, or the erection of temporary forms; nor does it include the installation on the property of accessory buildings, such as garages or sheds not occupied as dwelling units or not part of the main structure. For a substantial improvement, the actual start of construction means the first alteration of any wall, ceiling, floor, or other structural part of a building, whether or not that alteration affects the external dimensions of the building.

STRUCTURE. Anything constructed or erected on the ground or attached to the ground or on-site utilities, including, but not limited to, buildings, factories, sheds, detached garages, cabins, manufactured homes, recreational vehicles not meeting the exemption criteria specified in Section 1101.09 Subd. 2. of this chapter and other similar items.

SUBSTANTIAL DAMAGE. Damage of any origin sustained by a structure where the cost of restoring the structure to its before damaged condition would equal or exceed 50 percent of the market value of the structure before the damage occurred.

SUBSTANTIAL IMPROVEMENT. Within any consecutive 365-day period, any reconstruction, rehabilitation (including normal maintenance and repair), repair after damage, addition, or other improvement of a structure, the cost of which equals or exceeds 50 percent of the market value of the structure before the “start of construction” of the improvement. This term includes structures that have incurred “substantial damage,” regardless of the actual repair work performed. The term does not, however, include either:

- (1) Any project for improvement of a structure to correct existing violations of state or local health, sanitary, or safety code specifications which have been identified by the local code enforcement official and which are the minimum necessary to assure safe living conditions.
- (2) Any alteration of a “historic structure,” provided that the alteration will not preclude the structure’s continued designation as a “historic structure.” For the purpose of this chapter, “historic structure” is as defined in 44 Code of Federal Regulations, Part 59.1.

Subd.10. *Annexations:* The Flood Insurance Rate Map panels adopted by reference into Section 1101.02 Subd. 3. above may include floodplain areas that lie outside of the corporate boundaries of the City of Shorewood at the time of adoption of this chapter. If any of these floodplain land areas are annexed into the City of Shorewood after the date of adoption of this chapter, the newly annexed floodplain lands will be subject to the provisions of this chapter immediately upon the date of annexation.

Subd. 11. *Detachments.* The Flood Insurance Rate Map panels adopted by reference into Section 1101.02 Subd. 3. above will include floodplain areas that lie inside the corporate boundaries of municipalities at the time of adoption of this chapter. If any of these floodplain land areas are detached from a municipality and come under the jurisdiction of Shorewood after the date of adoption of this chapter, the newly detached floodplain lands will be subject to the provisions of this chapter immediately upon the date of detachment.

1101.03 ESTABLISHMENT OF FLOODPLAIN DISTRICTS

Subd. 1. *Districts:*

- a. Floodway District. The Floodway District includes those areas within Zones AE that have a floodway delineated as shown on the Flood Insurance Rate Map adopted in Section 1102.02 Subd. 3., as well as portions of other lakes, wetlands, and basins within Zones AE (that do not have a floodway delineated) that are located at or below the ordinary high water level as defined in Minnesota Statutes, Section 103G.005, subdivision 14.
- b. Flood Fringe District. The Flood Fringe District includes areas within Zones AE that have a floodway delineated on the Flood Insurance Rate Map adopted in Section 1102.02 Subd. 3., but are located outside of the floodway. For other lakes, wetlands and other basins within Zones AE that do not have a floodway delineated, the Flood Fringe District also includes those areas below the 1% annual

chance (100-year) flood elevation but above the ordinary high water level as defined in Minnesota Statutes, Section 103G.005, subdivision 14.

- c. General Floodplain District. The General Floodplain District includes those areas within Zone A as shown on the Flood Insurance Rate Map adopted in Section 1102.02 Subd. 3.

Subd. 2. *Applicability:* Within the floodplain districts established in this chapter, the use, size, type and location of development must comply with the terms of this chapter and other applicable regulations. In no cases shall floodplain development adversely affect the efficiency or unduly restrict the capacity of the channels or floodways of any tributaries to the main stream, drainage ditches, or any other drainage facilities or systems. All uses not listed as permitted uses or conditional uses in Sections 1101.04, 1101.5, and 1101.06, are prohibited. In addition, critical facilities, as defined in Section 1101.02 (Critical Facilities), are prohibited in all floodplain districts.

1101.04 FLOODWAY DISTRICT (FW)

Subd. 1. *Permitted Uses:* The following uses, subject to the standards set forth in Section 1101.04 Subd. 2., are permitted uses if otherwise allowed in the underlying zoning district or any applicable overlay district:

- a. Open space uses, including but not limited to private and public golf courses, tennis courts, driving ranges, archery ranges, picnic grounds, boat launching ramps, swimming areas, parks, wildlife and nature preserves, fishing areas, and single or multiple purpose recreational trails.
- b. Residential lawns, gardens, parking areas, and play areas.
- c. Railroads, streets, bridges, utility transmission lines and pipelines, provided that the Department of Natural Resources' Area Hydrologist is notified at least ten days prior to issuance of any permit.

Subd. 2. *Standards for Floodway Permitted Uses:*

- a. The use must have a low flood damage potential.
- b. The use must not obstruct flood flows or cause any increase in flood elevations and must not involve structures, obstructions, or storage of materials or equipment.
- c. Any facility that will be used by employees or the general public must be designed with a flood warning system that provides adequate time for evacuation if the area is inundated to a depth and velocity such that the depth (in feet) multiplied by the velocity (in feet per second) would exceed a product of four upon occurrence of the regional (1% chance) flood.

Subd. 3. *Conditional Uses:* The following uses may be allowed as conditional uses following the standards and procedures set forth in Section 1101.10 Subd.4. of this chapter and further

subject to the standards set forth in Section 1101.04 Subd. 4., if otherwise allowed in the underlying zoning district or any applicable overlay district.

- a. Structures accessory to the uses listed in Sections 1101.04 Subd. 1. a.-c. above and the uses listed in b.-c. below.
- b. Extraction and storage of sand, gravel, and other materials.
- c. Marinas, boat rentals, docks, piers, wharves, and water control structures.
- d. Storage yards for equipment, machinery, or materials.
- e. Placement of fill or construction of fences that obstruct flood flows.
- f. General farming, pasture, grazing, outdoor plant nurseries, horticulture, truck farming, forestry, sod farming, and wild crop harvesting.

Subd. 4. *Standards for Floodway Conditional Uses:*

- a. All Uses. A conditional use must not cause any increase in the stage of the 1% chance or regional flood or cause an increase in flood damages in the reach or reaches affected.
- b. Fill; Storage of Materials and Equipment:
 - (1) The storage or processing of materials that are, in time of flooding, flammable, explosive, or potentially injurious to human, animal, or plant life is prohibited.
 - (2) Fill, dredge spoil, and other similar materials deposited or stored in the floodplain must be protected from erosion by vegetative cover, mulching, riprap or other acceptable method. Permanent sand and gravel operations and similar uses must be covered by a long-term site development plan.
 - (3) Temporary placement of fill, other materials, or equipment which would cause an increase to the stage of the 1% percent chance or regional flood may only be allowed if the City Council has approved a plan that assures removal of the materials from the floodway based upon the flood warning time available.
- c. Accessory Structures. Accessory structures, as identified in Section 1101.04 Subd. 3.a., may be permitted, provided that:
 - (1) Structures are not intended for human habitation;
 - (2) Structures will have a low flood damage potential;
 - (3) Structures will be constructed and placed so as to offer a minimal obstruction to the flow of flood waters;
 - (4) Service utilities, such as electrical and heating equipment, within these structures must be elevated to or above the regulatory flood protection elevation or properly floodproofed;
 - (5) Structures must be elevated on fill or structurally dry floodproofed in accordance with the FP1 or FP2 floodproofing classifications in the State

Building Code. All floodproofed structures must be adequately anchored to prevent flotation, collapse or lateral movement and designed to equalize hydrostatic flood forces on exterior walls.

- (6) As an alternative, an accessory structure may be internally/wet floodproofed to the FP3 or FP4 floodproofing classifications in the State Building Code, provided the accessory structure constitutes a minimal investment and does not exceed 576 square feet in size. Designs for meeting this requirement must either be certified by a registered professional engineer or meet or exceed the following criteria:
 - (a) To allow for the equalization of hydrostatic pressure, there must be a minimum of two “automatic” openings in the outside walls of the structure, with a total net area of not less than one square inch for every square foot of enclosed area subject to flooding; and
 - (b) There must be openings on at least two sides of the structure and the bottom of all openings must be no higher than one foot above the lowest adjacent grade to the structure. Using human intervention to open a garage door prior to flooding will not satisfy this requirement for automatic openings.
- d. Structural works for flood control that will change the course, current or cross section of protected wetlands or public waters are subject to the provisions of Minnesota Statutes, Section 103G.245.
- e. A levee, dike or floodwall constructed in the floodway must not cause an increase to the 1% chance or regional flood. The technical analysis must assume equal conveyance or storage loss on both sides of a stream.
- f. Floodway developments must not adversely affect the hydraulic capacity of the channel and adjoining floodplain of any tributary watercourse or drainage system.

1101.05 FLOOD FRINGE DISTRICT (FF)

Subd. 1 *Permitted Uses:* Permitted uses are those uses of land or structures allowed in the underlying zoning district(s) that comply with the standards in Subd. 2. below. If no pre-existing, underlying zoning districts exist, then any residential or nonresidential structure or use of a structure or land is a permitted use provided it does not constitute a public nuisance.

Subd. 2. *Standards for Flood Fringe Permitted Uses:*

- a. All structures, including accessory structures, must be elevated on fill so that the lowest floor, as defined, is at or above the regulatory flood protection elevation. The finished fill elevation for structures must be no lower than one foot below the regulatory flood protection elevation and the fill must extend at the same elevation at least 15 feet beyond the outside limits of the structure.
- b. Accessory Structures. As an alternative to the fill requirements of a. above, structures accessory to the uses identified in Subd. 1. above may be permitted to be

internally/wet floodproofed to the FP3 or FP4 floodproofing classifications in the State Building Code, provided that:

- (1) The accessory structure constitutes a minimal investment, does not exceed 576 square feet in size, and is only used for parking and storage.
 - (2) All portions of floodproofed accessory structures below the Regulatory Flood Protection Elevation must be:
 - (a) Adequately anchored to prevent flotation, collapse or lateral movement and designed to equalize hydrostatic flood forces on exterior walls,
 - (b) Be constructed with materials resistant to flood damage, and
 - (c) Must have all service utilities be water-tight or elevated to above the regulatory flood protection elevation
 - (3) Designs for meeting this requirement must either be certified by a registered professional engineer or meet or exceed the following criteria:
 - (a) To allow for the equalization of hydrostatic pressure, there must be a minimum of two “automatic” openings in the outside walls of the structure, with a total net area of not less than one square inch for every square foot of enclosed area subject to flooding; and
 - (b) There must be openings on at least two sides of the structure and the bottom of all openings must be no higher than one foot above the lowest adjacent grade to the structure. Using human intervention to open a garage door prior to flooding will not satisfy this requirement for automatic openings.
- c. The cumulative placement of fill or similar material on a parcel must not exceed 1,000 cubic yards, unless the fill is specifically intended to elevate a structure in accordance with Subd. 2.a. of this section, or if allowed as a conditional use under Subd. 3.c. below.
- d. The storage of any materials or equipment must be elevated on fill to the regulatory flood protection elevation.
- e. All service utilities, including ductwork, must be elevated or water-tight to prevent infiltration of floodwaters.
- f. The storage or processing of materials that are, in time of flooding, flammable, explosive, or potentially injurious to human, animal, or plant life is prohibited.
- g. All fill must be properly compacted and the slopes must be properly protected by the use of riprap, vegetative cover or other acceptable method.
- h. All new principal structures must have vehicular access at or above an elevation not more than two feet below the regulatory flood protection elevation, or must have a flood warning /emergency evacuation plan acceptable to the City Council.
- i. Accessory uses such as yards, railroad tracks, and parking lots may be at an elevation lower than the regulatory flood protection elevation. However, any

facilities used by employees or the general public must be designed with a flood warning system that provides adequate time for evacuation if the area is inundated to a depth and velocity such that the depth (in feet) multiplied by the velocity (in feet per second) would exceed a product of four upon occurrence of the regional (1% chance) flood.

- j. Manufactured homes and recreational vehicles must meet the standards of Section 1100.09 of this chapter.

Subd. 3. *Conditional Uses:* The following uses and activities may be allowed as conditional uses, if allowed in the underlying zoning district(s) or any applicable overlay district, following the procedures in Section 1101.10 Subd. 4. of this chapter.

- a. Any structure that is not elevated on fill or floodproofed in accordance with Subd. 2.a. and 2.b of this section.
- b. Storage of any material or equipment below the regulatory flood protection elevation.
- c. The cumulative placement of more than 1,000 cubic yards of fill when the fill is not being used to elevate a structure in accordance with Subd. 2.a. of this section.
- d. The use of methods to elevate structures above the regulatory flood protection elevation, including stilts, pilings, parallel walls, or above-grade, enclosed areas such as crawl spaces or tuck under garages, shall meet the standards in Subd. 4.f. of this section.

Subd. 4. *Standards for Flood Fringe Conditional Uses:*

- a. The standards listed in Subd. 2.d. through 2.j. apply to all conditional uses.
- b. Basements, as defined by Section 1101.02 Subd. 9. of this chapter, are subject to the following:
 - (1) Residential basement construction is not allowed below the regulatory flood protection elevation.
 - (2) Nonresidential basements may be allowed below the regulatory flood protection elevation provided the basement is structurally dry floodproofed in accordance with Subd. 4.c. below.
- c. All areas of nonresidential structures, including basements, to be placed below the regulatory flood protection elevation must be floodproofed in accordance with the structurally dry floodproofing classifications in the State Building Code. Structurally dry floodproofing must meet the FP1 or FP2 floodproofing classification in the State Building Code, which requires making the structure watertight with the walls substantially impermeable to the passage of water and with structural components capable of resisting hydrostatic and hydrodynamic loads and the effects of buoyancy.
- d. The placement of more than 1,000 cubic yards of fill or other similar material on a parcel (other than for the purpose of elevating a structure to the regulatory flood

protection elevation) must comply with an approved erosion/sedimentation control plan.

- (1) The plan must clearly specify methods to be used to stabilize the fill on site for a flood event at a minimum of the regional (1% chance) flood event.
 - (2) The plan must be prepared and certified by a registered professional engineer or other qualified individual acceptable to the City Council.
 - (3) The plan may incorporate alternative procedures for removal of the material from the floodplain if adequate flood warning time exists.
- e. Storage of materials and equipment below the regulatory flood protection elevation must comply with an approved emergency plan providing for removal of such materials within the time available after a flood warning.
- f. Alternative elevation methods other than the use of fill may be utilized to elevate a structure's lowest floor above the regulatory flood protection elevation. The base or floor of an enclosed area shall be considered above-grade and not a structure's basement or lowest floor if: 1) the enclosed area is above-grade on at least one side of the structure; 2) it is designed to internally flood and is constructed with flood resistant materials; and 3) it is used solely for parking of vehicles, building access or storage. The above-noted alternative elevation methods are subject to the following additional standards:
- (1) Design and Certification - The structure's design and as-built condition must be certified by a registered professional engineer as being in compliance with the general design standards of the State Building Code and, specifically, that all electrical, heating, ventilation, plumbing and air conditioning equipment and other service facilities must be at or above the regulatory flood protection elevation or be designed to prevent flood water from entering or accumulating within these components during times of flooding.
 - (2) Specific Standards for Above-grade, Enclosed Areas - Above-grade, fully enclosed areas such as crawl spaces or tuck under garages must be designed to internally flood and the design plans must stipulate:
 - (a) The minimum area of openings in the walls where internal flooding is to be used as a floodproofing technique. There shall be a minimum of two openings on at least two sides of the structure and the bottom of all openings shall be no higher than one foot above grade. The automatic openings shall have a minimum net area of not less than one square inch for every square foot of enclosed area subject to flooding unless a registered professional engineer or architect certifies that a smaller net area would suffice. The automatic openings may be equipped with screens, louvers, valves, or other coverings or devices provided that they permit the automatic entry and exit of flood waters without any form of human intervention; and

- (b) That the enclosed area will be designed of flood resistant materials in accordance with the FP3 or FP4 classifications in the State Building Code and shall be used solely for building access, parking of vehicles or storage.

1101.06 GENERAL FLOODPLAIN DISTRICT (GF)

Subd. 1. *Permitted Uses:*

- a. The uses listed in Section 1101.04 Subd. 1. of this chapter, Floodway District Permitted Uses, are permitted uses.
- b. All other uses are subject to the floodway/flood fringe evaluation criteria specified in Section 1101.06 Subd. 2. below. Section 1101.04 applies if the proposed use is determined to be in the Floodway District. Section 1101.05 applies if the proposed use is determined to be in the Flood Fringe District.

Subd. 2. *Procedures for Floodway and Flood Fringe Determinations:*

- a. Upon receipt of an application for a permit or other approval within the General Floodplain District, the Zoning Administrator must obtain, review and reasonably utilize any regional flood elevation and floodway data available from a federal, state, or other source.
- b. If regional flood elevation and floodway data are not readily available, the applicant must furnish additional information, as needed, to determine the regulatory flood protection elevation and whether the proposed use would fall within the Floodway or Flood Fringe District. Information must be consistent with accepted hydrological and hydraulic engineering standards and the standards in Subd. 2.c. below.
- c. The determination of floodway and flood fringe must include the following components, as applicable:
 - (1) Estimate the peak discharge of the regional (1% chance) flood.
 - (2) Calculate the water surface profile of the regional flood based upon a hydraulic analysis of the stream channel and overbank areas.
 - (3) Compute the floodway necessary to convey or store the regional flood without increasing flood stages more than one-half (0.5) foot. A lesser stage increase than 0.5 foot is required if, as a result of the stage increase, increased flood damages would result. An equal degree of encroachment on both sides of the stream within the reach must be assumed in computing floodway boundaries.
- d. The Zoning Administrator will review the submitted information and assess the technical evaluation and the recommended Floodway and/or Flood Fringe District boundary. The assessment must include the cumulative effects of previous floodway encroachments. The Zoning Administrator may seek technical assistance from a designated engineer or other expert person or agency, including the

Department of Natural Resources. Based on this assessment, the Zoning Administrator may approve or deny the application.

- e. Once the Floodway and Flood Fringe District boundaries have been determined, the Zoning Administrator must process the permit application consistent with the applicable provisions of Sections 1101.04 and 1101.05 of this chapter.

1101.07 LAND DEVELOPMENT STANDARDS

Subd. 1 *In General:* Recognizing that flood prone areas may exist outside of the designated floodplain districts, the requirements of this chapter apply to all land within the City of Shorewood.

Subd. 2. *Subdivisions:* No land may be subdivided which is unsuitable for reasons of flooding or inadequate drainage, water supply or sewage treatment facilities. Manufactured home parks and recreational vehicle parks or campgrounds are considered subdivisions under this chapter.

- a. All lots within the floodplain districts must be able to contain a building site outside of the Floodway District at or above the regulatory flood protection elevation.
- b. All subdivisions must have road access both to the subdivision and to the individual building sites no lower than two feet below the regulatory flood protection elevation, unless a flood warning emergency plan for the safe evacuation of all vehicles and people during the regional (1% chance) flood has been approved by the City Council. The plan must be prepared by a registered engineer or other qualified individual, and must demonstrate that adequate time and personnel exist to carry out the evacuation.
- c. For all subdivisions in the floodplain, the Floodway and Flood Fringe District boundaries, the regulatory flood protection elevation and the required elevation of all access roads must be clearly labeled on all required subdivision drawings and platting documents.
- d. In the General Floodplain District, applicants must provide the information required in Section 1101.06 Subd.2. of this chapter to determine the regional flood elevation, the Floodway and Flood Fringe District boundaries and the regulatory flood protection elevation for the subdivision site.
- e. If a subdivision proposal or other proposed new development is in a flood prone area, any such proposal must be reviewed to assure that:
 - (1) All such proposals are consistent with the need to minimize flood damage within the flood prone area,
 - (2) All public utilities and facilities, such as sewer, gas, electrical, and water systems are located and constructed to minimize or eliminate flood damage, and
 - (3) Adequate drainage is provided to reduce exposure of flood hazard.

- Subd. 3. *Building Sites.* If a proposed building site is in a flood prone area, all new construction and substantial improvements (including the placement of manufactured homes) must be:
- a. Designed (or modified) and adequately anchored to prevent floatation, collapse, or lateral movement of the structure resulting from hydrodynamic and hydrostatic loads, including the effects of buoyancy;
 - b. Constructed with materials and utility equipment resistant to flood damage;
 - c. Constructed by methods and practices that minimize flood damage; and
 - d. Constructed with electrical, heating, ventilation, plumbing, and air conditioning equipment and other service facilities that are designed and/or located so as to prevent water from entering or accumulating within the components during conditions of flooding.

1101.08 PUBLIC UTILITIES, RAILROADS, ROADS, AND BRIDGES

- Subd. 1. *Public Utilities:* All public utilities and facilities such as gas, electrical, sewer, and water supply systems to be located in the floodplain must be floodproofed in accordance with the State Building Code or elevated to the regulatory flood protection elevation.
- Subd. 2. *Public Transportation Facilities:* Railroad tracks, roads, and bridges to be located within the floodplain must comply with Sections 1101.04 and 1101.05 of this chapter. These transportation facilities must be elevated to the regulatory flood protection elevation where failure or interruption of these facilities would result in danger to the public health or safety or where such facilities are essential to the orderly functioning of the area. Minor or auxiliary roads or railroads may be constructed at a lower elevation where failure or interruption of transportation services would not endanger the public health or safety.
- Subd. 3. *On-site Water Supply and Sewage Treatment Systems:* Where public utilities are not provided: 1) On-site water supply systems must be designed to minimize or eliminate infiltration of flood waters into the systems and are subject to the provisions in Minnesota Rules Chapter 4725.4350, as amended; and 2) New or replacement on-site sewage treatment systems must be designed to minimize or eliminate infiltration of flood waters into the systems and discharges from the systems into flood waters, they must not be subject to impairment or contamination during times of flooding, and are subject to the provisions in Minnesota Rules Chapter 7080.2270, as amended.

1101.09 MANUFACTURED HOMES AND PLACEMENT OF RECREATIONAL VEHICLES.

- Subd. 1. *Manufactured Homes:* New manufactured home parks and expansions to existing manufactured home parks are prohibited in any floodplain district. For existing manufactured home parks or lots of record, the following requirements apply:
- a. Placement or replacement of manufactured home units is prohibited in the Floodway District.
 - b. If allowed in the Flood Fringe District, placement or replacement of manufactured home units is subject to the requirements of Section 1101.05 of this chapter. New

and replacement manufactured homes must be elevated in compliance with Section 1101.05 of this chapter and must be securely anchored to an adequately anchored foundation system that resists flotation, collapse and lateral movement. Methods of anchoring may include, but are not limited to, use of over-the-top or frame ties to ground anchors. This requirement is in addition to applicable state or local anchoring requirements for resisting wind forces.

Subd. 2.

Recreational Vehicles: New recreational vehicle parks or campgrounds and expansions to existing recreational vehicle parks or campgrounds are prohibited in any floodplain district. Placement of recreational vehicles in existing recreational vehicle parks or campgrounds in the floodplain must meet the exemption criteria below or be treated as new structures meeting the requirements of this chapter.

- a. Recreational vehicles are exempt from the provisions of this chapter if they are placed in any of the following areas and meet the criteria listed in Section 1101.09 Subd. 2.b.:
 - (1) Individual lots or parcels of record.
 - (2) Existing commercial recreational vehicle parks or campgrounds.
 - (3) Existing condominium-type associations.
- b. Criteria for Exempt Recreational Vehicles:
 - (1) The vehicle must have a current license required for highway use.
 - (2) The vehicle must be highway ready, meaning on wheels or the internal jacking system, attached to the site only by quick disconnect type utilities commonly used in campgrounds and recreational vehicle parks.
 - (3) No permanent structural type additions may be attached to the vehicle.
 - (4) The vehicle and associated use must be permissible in any pre-existing, underlying zoning district.
 - (5) Accessory structures are not permitted within the Floodway District. Any accessory structure in the Flood Fringe District must be constructed of flood-resistant materials and be securely anchored, meeting the requirements applicable to manufactured homes in Section 1101.09 Subd. 2.b.
 - (6) An accessory structure must constitute a minimal investment
- c. Recreational vehicles that are exempt in Section 1101.09 Subd. 2.b lose this exemption when development occurs on the site that exceeds a minimal investment for an accessory structure such as a garage or storage building. The recreational vehicle and all accessory structures will then be treated as new structures subject to the elevation and floodproofing requirements of Section 1101.05 of this chapter. No development or improvement on the parcel or attachment to the recreational vehicle is allowed that would hinder the removal of the vehicle should flooding occur.

1101.10 ADMINISTRATION

Subd. 1. *Zoning Administrator:* A Zoning Administrator or other official designated by the City Council must administer and enforce this chapter.

Subd. 2. *Permit Requirements:*

- a. Permit Required. A permit must be obtained from the Zoning Administrator prior to conducting the following activities:
 - (1) The erection, addition, modification, rehabilitation, or alteration of any building, structure, or portion thereof. Normal maintenance and repair also requires a permit if such work, separately or in conjunction with other planned work, constitutes a substantial improvement as defined in this chapter.
 - (2) The use or change of use of a building, structure, or land.
 - (3) The change or extension of a nonconforming use.
 - (4) The repair of a structure that has been damaged by flood, fire, tornado, or any other source.
 - (5) The placement of fill, excavation of materials, or the storage of materials or equipment within the floodplain.
 - (6) Relocation or alteration of a watercourse (including new or replacement culverts and bridges), unless a public waters work permit has been applied for.
 - (7) Any other type of “development” as defined in this chapter.
- b. Application for Permit. Permit applications must be submitted to the Zoning Administrator on forms provided by the Zoning Administrator. The permit application must include the following as applicable:
 - (1) A site plan showing all pertinent dimensions, existing or proposed buildings, structures, and significant natural features having an influence on the permit.
 - (2) Location of fill or storage of materials in relation to the stream channel.
 - (3) Copies of any required municipal, county, state or federal permits or approvals.
 - (4) Other relevant information requested by the Zoning Administrator as necessary to properly evaluate the permit application.
- c. Certificate of Zoning Compliance for a New, Altered, or Nonconforming Use. No building, land or structure may be occupied or used in any manner until a certificate of zoning compliance has been issued by the Zoning Administrator stating that the use of the building or land conforms to the requirements of this chapter.

- d. Certification. The applicant is required to submit certification by a registered professional engineer, registered architect, or registered land surveyor that the finished fill and building elevations were accomplished in compliance with the provisions of this chapter. Floodproofing measures must be certified by a registered professional engineer or registered architect.
- e. Record of First Floor Elevation. The Zoning Administrator must maintain a record of the elevation of the lowest floor (including basement) of all new structures and alterations or additions to existing structures in the floodplain. The Zoning Administrator must also maintain a record of the elevation to which structures and alterations or additions to structures are floodproofed.
- f. Notifications for Watercourse Alterations. Before authorizing any alteration or relocation of a river or stream, the Zoning Administrator must notify adjacent communities. If the applicant has applied for a permit to work in public waters pursuant to Minnesota Statutes, Section 103G.245, this will suffice as adequate notice. A copy of the notification must also be submitted to the Chicago Regional Office of the Federal Emergency Management Agency (FEMA).
- g. Notification to FEMA When Physical Changes Increase or Decrease Base Flood Elevations. As soon as is practicable, but not later than six months after the date such supporting information becomes available, the Zoning Administrator must notify the Chicago Regional Office of FEMA of the changes by submitting a copy of the relevant technical or scientific data.

Subd. 3. *Variances:*

- a. Variance Applications. An application for a variance to the provisions of this chapter will be processed and reviewed in accordance with applicable state statutes and Section 1201.05 of the Zoning Code.
- b. Adherence to State Floodplain Management Standards. A variance must not allow a use that is not allowed in that district, permit a lower degree of flood protection than the regulatory flood protection elevation for the particular area, or permit standards lower than those required by state law.
- c. Additional Variance Criteria. The following additional variance criteria of the Federal Emergency Management Agency must be satisfied:
 - (1) Variances must not be issued by a community within any designated regulatory floodway if any increase in flood levels during the base flood discharge would result.
 - (2) Variances may only be issued by a community upon (i) a showing of good and sufficient cause, (ii) a determination that failure to grant the variance would result in exceptional hardship to the applicant, and (iii) a determination that the granting of a variance will not result in increased flood heights, additional threats to public safety, extraordinary public expense, create nuisances, cause fraud on or victimization of the public, or conflict with existing local laws or ordinances.

- (3) Variances may only be issued upon a determination that the variance is the minimum necessary, considering the flood hazard, to afford relief.
- d. Flood Insurance Notice. The Zoning Administrator must notify the applicant for a variance that: 1) The issuance of a variance to construct a structure below the base flood level will result in increased premium rates for flood insurance up to amounts as high as \$25 for \$100 of insurance coverage; and 2) Such construction below the base or regional flood level increases risks to life and property. Such notification must be maintained with a record of all variance actions.
 - e. General Considerations. The community may consider the following factors in granting variances and imposing conditions on variances and conditional uses in floodplains:
 - (1) The potential danger to life and property due to increased flood heights or velocities caused by encroachments;
 - (2) The danger that materials may be swept onto other lands or downstream to the injury of others;
 - (3) The proposed water supply and sanitation systems, if any, and the ability of these systems to minimize the potential for disease, contamination and unsanitary conditions;
 - (4) The susceptibility of any proposed use and its contents to flood damage and the effect of such damage on the individual owner;
 - (5) The importance of the services to be provided by the proposed use to the community;
 - (6) The requirements of the facility for a waterfront location;
 - (7) The availability of viable alternative locations for the proposed use that are not subject to flooding;
 - (8) The compatibility of the proposed use with existing development and development anticipated in the foreseeable future;
 - (9) The relationship of the proposed use to the Comprehensive Land Use Plan and flood plain management program for the area;
 - (10) The safety of access to the property in times of flood for ordinary and emergency vehicles;
 - (11) The expected heights, velocity, duration, rate of rise and sediment transport of the flood waters expected at the site.
 - f. Submittal of Hearing Notices to the Department of Natural Resources (DNR). The Zoning Administrator must submit hearing notices for proposed variances to the DNR sufficiently in advance to provide at least ten days' notice of the hearing. The notice may be sent by electronic mail or U.S. Mail to the respective DNR area hydrologist.

- g. Submittal of Final Decisions to the DNR. A copy of all decisions granting variances must be forwarded to the DNR within ten days of such action. The notice may be sent by electronic mail or U.S. Mail to the respective DNR area hydrologist.
- h. Record-Keeping. The Zoning Administrator must maintain a record of all variance actions, including justification for their issuance, and must report such variances in an annual or biennial report to the Administrator of the National Flood Insurance Program, when requested by the Federal Emergency Management Agency.

Subd. 4. *Conditional Uses:*

- a. Administrative Review. An application for a conditional use permit under the provisions of this chapter will be processed and reviewed in accordance with Section 1204 of the Zoning Code.
- b. Factors Used in Decision-Making. In passing upon conditional use applications, the City Council must consider all relevant factors specified in other sections of this chapter, and those factors identified in Section 1101.10 Subd. 3.e. of this chapter.
- c. Conditions Attached to Conditional Use Permits. The City Council may attach such conditions to the granting of conditional use permits as it deems necessary to fulfill the purposes of this chapter. Such conditions may include, but are not limited to, the following:
 - (1) Modification of waste treatment and water supply facilities.
 - (2) Limitations on period of use, occupancy, and operation.
 - (3) Imposition of operational controls, sureties, and deed restrictions.
 - (4) Requirements for construction of channel modifications, compensatory storage, dikes, levees, and other protective measures.
 - (5) Floodproofing measures, in accordance with the State Building Code and this chapter. The applicant must submit a plan or document certified by a registered professional engineer or architect that the floodproofing measures are consistent with the regulatory flood protection elevation and associated flood factors for the particular area.
- d. Submittal of Hearing Notices to the Department of Natural Resources (DNR). The Zoning Administrator must submit hearing notices for proposed conditional uses to the DNR sufficiently in advance to provide at least ten days' notice of the hearing. The notice may be sent by electronic mail or U.S. Mail to the respective DNR area hydrologist.
- e. Submittal of Final Decisions to the DNR. A copy of all decisions granting conditional uses must be forwarded to the DNR within ten days of such action. The notice may be sent by electronic mail or U.S. Mail to the respective DNR area hydrologist.

1101.11

NONCONFORMITIES

Subd. 1

Continuance of Nonconformities: A use, structure, or occupancy of land which was lawful before the passage or amendment of this chapter but which is not in conformity with the provisions of this chapter may be continued subject to the following conditions. Historic structures, as defined in Section 1101.02 Subd. 9. of this chapter, are subject to the provisions of a. – f. below.

- a. A nonconforming use, structure, or occupancy must not be expanded, changed, enlarged, or altered in a way that increases its flood damage potential or degree of obstruction to flood flows except as provided in b. below. Expansion or enlargement of uses, structures or occupancies within the Floodway District is prohibited.
- b. Any addition or structural alteration to a nonconforming structure or nonconforming use that would result in increasing its flood damage potential must be protected to the regulatory flood protection elevation in accordance with any of the elevation on fill or floodproofing techniques (i.e., FP1 thru FP4 floodproofing classifications) allowable in the State Building Code, except as further restricted in c. – g. below.
- c. If the cost of all previous and proposed alterations and additions exceeds 50 percent of the market value of any nonconforming structure, that shall be considered substantial improvement, and the entire structure must meet the standards of Sections 1101.04 or 1101.05 of this chapter for new structures, depending upon whether the structure is in the Floodway or Flood Fringe District, respectively. The cost of all structural alterations and additions must include all costs such as construction materials and a reasonable cost placed on all manpower or labor.
- d. If any nonconforming use, or any use of a nonconforming structure, is discontinued for more than one year, any future use of the premises must conform to this chapter. The Assessor must notify the Zoning Administrator in writing of instances of nonconformities that have been discontinued for a period of more than one year.
- e. If any nonconformity is substantially damaged, as defined in Section 1101.02 Subd. 9. of this chapter, it may not be reconstructed except in conformity with the provisions of this chapter. The applicable provisions for establishing new uses or new structures in Section 1101.04 or 1101.05 will apply depending upon whether the use or structure is in the Floodway or Flood Fringe, respectively.
- f. If any nonconforming use or structure experiences a repetitive loss, as defined in Section 1101.02 Subd. 9. of this chapter, it must not be reconstructed except in conformity with the provisions of this chapter.
- g. Any substantial improvement, as defined in Section 1101.02 Subd. 9. of this chapter, to a nonconforming structure requires that the existing structure and any additions must meet the requirements of Section 1101.04 or 1101.05 of this

chapter for new structures, depending upon whether the structure is in the Floodway or Flood Fringe District.

1101.12 PENALTIES AND ENFORCEMENT

- Subd. 1. *Violation Constitutes a Misdemeanor:* Violation of the provisions of this chapter or failure to comply with any of its requirements (including violations of conditions and safeguards established in connection with grants of variances or conditional uses) constitute a misdemeanor and will be punishable as defined by law.
- Subd. 2. *Other Lawful Action:* Nothing in this chapter restricts the City of Shorewood from taking such other lawful action as is necessary to prevent or remedy any violation. If the responsible party does not appropriately respond to the Zoning Administrator within the specified period of time, each additional day that lapses will constitute an additional violation of this chapter and will be prosecuted accordingly.
- Subd. 3. *Enforcement:* Violations of the provisions of this chapter will be investigated and resolved in accordance with the provisions of Section 120.08 of the Zoning Code. In responding to a suspected ordinance violation, the Zoning Administrator and City Council may utilize the full array of enforcement actions available to it including but not limited to prosecution and fines, injunctions, after-the-fact permits, orders for corrective measures or a request to the National Flood Insurance Program for denial of flood insurance availability to the guilty party. The City of Shorewood must act in good faith to enforce these official controls and to correct ordinance violations to the extent possible so as not to jeopardize its eligibility in the National Flood Insurance Program.

1101.13 AMENDMENTS

- Subd. 1. *Floodplain Designation – Restrictions on Removal:* The floodplain designation on the floodplain maps must not be removed from floodplain areas unless it can be shown that the designation is in error or that the area has been filled to or above the elevation of the regulatory flood protection elevation and is contiguous to lands outside the floodplain. Special exceptions to this rule may be permitted by the Commissioner of the Department of Natural Resources (DNR) if the Commissioner determines that, through other measures, lands are adequately protected for the intended use.
- Subd. 2. *Amendments Require DNR Approval:* All amendments to this chapter must be submitted to and approved by the Commissioner of the Department of Natural Resources (DNR) prior to adoption. The Commissioner must approve the amendment prior to community approval.
- Subd. 3. *Map Revisions Require Ordinance Amendments.* The floodplain district regulations must be amended to incorporate any revisions by the Federal Emergency Management Agency to the floodplain maps adopted in Section 1101.02 Subd. 3. of this chapter.

Section 2. This Ordinance shall be in full force and effect upon publishing in the Official Newspaper of the City of Shorewood.

ADOPTED BY THE CITY COUNCIL OF THE CITY OF SHOREWOOD this 24th day of October 2016.

ATTEST:



Scott Zerby, Mayor



Jean Panchyshyn, City Clerk

CITY OF SHOREWOOD

ORDINANCE NO. 535

**AN ORDINANCE AMENDING THE SHOREWOOD ZONING CODE AS IT PERTAINS
TO SHORT-TERM RENTALS**

Section 1. City Code Section 1201.02 is hereby amended to add the following definitions:

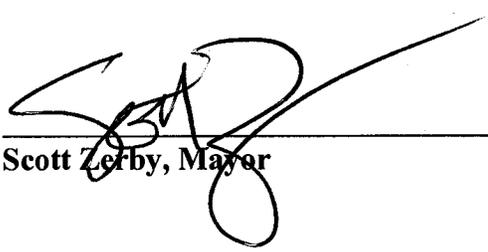
"HOTEL." An establishment, including a motel, resort, boarding house, lodging house, bed and breakfast, furnished apartment house, short-term rental unit not in a residential district, or other building, which is kept, used or advertised as, or held out to the public to be, a place where sleeping and/or housekeeping accommodations are supplied for pay to guests for transient occupancy."

"SHORT-TERM RENTAL UNIT." Any structure, any portion of any structure, rental dwelling or rental dwelling unit that is rented to a transient for less than thirty (30) consecutive days in a residential district or residential planned unit development district."

"TRANSIENT:" Any person who, at their own expense or at the expense of another, exercises occupancy or possession, or is entitled to occupancy or possession, by reason of any rental agreement, concession, permit, right of access, option to purchase, license, time sharing arrangement, or any other type of agreement for a period of less than thirty (30) consecutive calendar days."

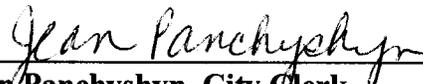
Section 2. This Ordinance shall be in full force and effect upon publication in the Official Newspaper of the City of Shorewood.

ADOPTED BY THE CITY COUNCIL OF THE CITY OF SHOREWOOD this 28th day of November, 2016.



Scott Zerby, Mayor

ATTEST:



Jean Panchyshyn, City Clerk

CHAPTER 907 ILLICIT DISCHARGE INTO STORMWATER SYSTEM

Section

- 907.01 Purpose/intent
- 907.02 Definitions
- 907.03 Applicability
- 907.04 Responsibility for administration
- 907.05 Severability
- 907.06 Prohibited discharges
- 907.07 Best management practices
- 907.08 Notification of spills
- 907.09 Enforcement
- 907.10 Appeal of notice of violation
- 907.11 Cost of abatement of the violation
- 907.12 Remedies not exclusive

907.01 PURPOSE/INTENT .

The purpose of this chapter is to reduce non-storm water discharges to the Municipal Separate Storm Sewer System (MS4) in order to comply with requirements of the National Pollutant Discharge Elimination System (NPDES) permit process. The objectives of this chapter are:

- (1) To minimize pollutants into the MS4.
- (2) To prohibit illicit connections and discharges to the MS4.
- (3) To establish legal authority to carry out compliance with this chapter.

(Ord. 455, passed 12-8-2008)

907.02 DEFINITIONS.

For the purpose of this chapter, the following definitions shall apply unless the context clearly indicates or requires a different meaning.

AUTHORIZED ENFORCEMENT AGENCY . The City of Shorewood designated to enforce this chapter.

BEST MANAGEMENT PRACTICES (BMPs). Pollution prevention practices, maintenance procedures, and other management practices to reduce the discharge of pollutants to storm water, receiving waters, or storm water conveyance systems. BMPs also include treatment practices, operating procedures, and practices to control site runoff, spillage or leaks, disposal, or drainage from raw materials storage.

HAZARDOUS MATERIALS. Those materials which because of their quantity, concentration, or physical, chemical, or infectious characteristics are a hazard to human health, safety and property when improperly disposed of.

ILLEGAL DISCHARGE. Any direct non-stormwater discharge to the storm drain system of pollutants or hazardous materials.

ILLICIT CONNECTIONS. Any drain or conveyance causing an illegal discharge to enter the storm drain system or connected to the storm drain system which has not been approved by an authorized enforcement agency.

NON-STORMWATER DISCHARGE. A discharge into the storm drain system that is not normal stormwater.

POLLUTANT. Paints, varnishes, and solvents; oil and other automotive fluids; hazardous substances, concrete washout, and wastes.

STORM DRAINAGE SYSTEM. Publicly-owned facilities by which stormwater is collected and/or conveyed, including but not limited to any roads with drainage systems, municipal streets, gutters, curbs, inlets, piped storm drains, pumping facilities, retention and detention basins, natural and human-made or altered drainage channels, reservoirs, and other drainage structures.

STORMWATER. Any surface flow, runoff, and drainage consisting of natural precipitation and resulting from such precipitation.

STORMWATER POLLUTION PREVENTION PLAN. A document which describes the best management practices and activities to be implemented by government to reduce pollutant discharges to stormwater, stormwater conveyance systems, and/or receiving waters.

(Ord. 455, passed 12-8-2008)

907.03 APPLICABILITY .

This chapter shall apply to all run-off entering the storm drain system.

(Ord. 455, passed 12-8-2008)

907.04 RESPONSIBILITY FOR ADMINISTRATION.

The city shall administer, implement, and enforce the provisions of this chapter. Any powers granted or duties imposed upon the city may be delegated in writing by the City Council to persons or entities including the Minnehaha Creek Watershed District.

(Ord. 455, passed 12-8-2008)

907.05 SEVERABILITY .

The provisions of this chapter are hereby declared to be severable. If any provision, clause, sentence, or paragraph of this chapter or the application thereof to any person, establishment, or circumstances shall be

held invalid, such invalidity shall not affect the other provisions or application of this chapter.

(Ord. 455, passed 12-8-2008)

907.06 PROHIBITED DISCHARGES.

No person shall discharge or cause to be discharged into the municipal storm drain system or watercourses any pollutants or hazardous materials that cause or contribute to a violation of applicable water quality standards.

(Ord. 455, passed 12-8-2008) Penalty, see § 104.01

907.07 BEST MANAGEMENT PRACTICES.

The city may adopt requirements identifying best management practices for any activity, operation, or facility which may cause or contribute to pollution or contamination of stormwater, the storm drain system, or waters within its borders.

(Ord. 455, passed 12-8-2008)

907.08 NOTIFICATION OF SPILLS.

Any person having information of any known or suspected illegal discharges shall notify the city.

(Ord. 455, passed 12-8-2008)

907.09 ENFORCEMENT .

Upon finding that a person has violated a prohibition of this chapter, the city may order compliance by written notice of violation to the responsible person. Such notice may require reasonable monitoring, analysis and remediation by a specified deadline.

(Ord. 455, passed 12-8-2008)

907.10 APPEAL OF NOTICE OF VIOLATION.

Subd. 1. Any person receiving a notice of violation may appeal the determination of the authorized enforcement agency. The notice of appeal must be received within ten days from the date of the notice of violation. Hearing on the appeal before the appropriate authority or his/her designee shall take place within 30 days from the date of receipt of the notice of appeal.

Subd. 2. The good citizens of Shorewood retain all legal rights guaranteed by the United States and Minnesota Constitution to pursue all appeals and rights to due process.

(Ord. 455, passed 12-8-2008)

907.11 COST OF ABATEMENT OF THE VIOLATION.

The property owner shall incur all costs to cease violating the provisions of this chapter.

(Ord. 455, passed 12-8-2008)

907.12 REMEDIES NOT EXCLUSIVE.

The remedies listed in this chapter are not exclusive of any other remedies available under any applicable federal, state or local law and it is within the discretion of the city to seek cumulative remedies.

(Ord. 455, passed 12-8-2008)

CHAPTER 1102

WETLAND DEVELOPMENTS

Section

- 1102.01 Purpose and intent
- 1102.02 Definitions
- 1102.03 Wetland Conservation Area and Map
- 1102.04 Conditions of development, restrictions
- 1102.05 Earth change plan
- 1102.06 Subdivision standards
- 1102.07 Land area within easements
- 1102.08 Artificial obstructions
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- 1102.10 Violation
- 1102.11 Vehicle restrictions

1102.01 PURPOSE AND INTENT .

Subd. 1. The City of Shorewood is a residential community located on the south shore of Lake Minnetonka and it includes within its boundaries the largest portion of Christmas Lake, Silver Lake, Lake Mary, a portion of Lake Virginia and Galpin Lake, together with numerous inlets, harbors, bays, wetlands, woods and valleys. The name of this city denotes its character--a city of shoreland, water and woods--natural assets its citizens hold in trust for future generations. It is in the public interest to protect these assets against haphazard, uncoordinated and unplanned development which may affect in some way lowlands, marshes, wetlands, swamps, lakes and watercourses within the city.

Subd. 2. Recognizing the obligation to protect these assets and natural resource gifts from destruction and pollution of all kinds, and in order to carry out a program of coordinated land and water management, the following standards, prohibitions, regulations and requirements are hereinafter set forth. In addition to the general purposes, the specific intent of this chapter is to:

- a. Reduce danger to health by protecting surface and ground water supplies from the impairment which results from incompatible land uses by providing safe and sanitary drainage;
- b. Permit and encourage planned development land uses which will not impede the flow of flood water or cause danger to life or property;
- c. Permit and encourage land uses compatible with the preservation of the natural vegetation and marshes which are a principal factor in the maintenance of constant rates of water flow through the year and which sustain many species of wildlife and plant growth;

d. Avoid fast runoff of surface waters from developed areas to prevent pollution materials such as animal feces, motor oils, paper, sand, salt and other debris, garbage and foreign materials from being carried directly into the nearest natural stream, lake or other public waters;

e. Prevent the development of structures in areas which will adversely affect the public passage and use of creeks, marshes, lowlands and watercourses within the city.

(1987 Code, § 1102.01)

1102.02 DEFINITIONS .

For the purpose of this chapter, the following definitions shall apply unless the context clearly indicates or requires a different meaning.

ARTIFICIAL OBSTRUCTION . Any dam, wall, wharf, embankment, levee, dike, pile, abutment, projection, excavation, bridge, conduit, pole, culvert, building, wire fences, fill, other structure or matter in, along, across or projecting into the protected wetland conservation area.

NATURAL OBSTRUCTION. Any rock, tree, gravel or analogous natural matter that is an obstruction and has been located within the wetland conservation area by a nonhuman cause.

SETBACK. The minimum horizontal distance between a building or structure and the nearest edge of a wetland buffer. Distances are to be measured at ground level from the most outwardly extended portion of any part of the structure.

WETLAND BUFFER . An area of vegetated ground cover, measuring 35 feet in depth, abutting a wetland conservation area as provided in § 1102.03 of this code or abutting a wetland which is protected by the Wetland Conservation Act of 1991 (hereinafter referred to as the WCA).

(1987 Code, § 1102.02) (Ord. 305, passed 8-28-1995)

1102.03 WETLAND CONSER VATION AREA AND MAP .

The wetland conservation area within the city, hereafter referred to as the protected area, is defined and established to be the shoreline of Lake Minnetonka, Galpin Lake, Christmas Lake, Lake Mary, Silver Lake, Lake Virginia and the low areas adjoining any watercourse and drainageway or body of water subject to meandering, flowing or overflow, including areas of marsh, wooded marsh, submerged marsh and inundation area as shown upon the wetlands map. The Map is made a part of this chapter and two copies thereof shall remain on file in the office of the City Administrator/Clerk for public inspection.

(1987 Code, § 1102.03)

1102.04 CONDITIONS OF DEVELOPMENT , RESTRICTIONS .

No filling, grading, dredging, excavation or construction shall be allowed within the wetland conservation area if the activity is incompatible with the policies expressed in this chapter and the preservation of those wetlands in their natural state, nor shall the shoreline of Lake Minnetonka, Galpin Lake, Christmas Lake, Lake Mary, Silver Lake and Lake Virginia be changed in any way by fill or excavation without an earth change plan being filed by the applicant to so do and a permit issued hereunder by the City Council for the change.

(1987 Code, § 1102.04) (Ord. 70, passed 3-12-1973)

1102.05 EARTH CHANGE PLAN .

Landowners or developers desiring to develop land or construct any dwelling or any other artificial obstruction or direct the flow of water from any underground water source, on land located within the wetland conservation area or change the shoreline of Lake Minnetonka, Galpin Lake, Christmas Lake, Lake Mary, Silver Lake and Lake Virginia within the city, shall first submit a plan of development, hereinafter referred to as “an earth change plan,” to the City Council which shall set forth proposed provisions for sediment control, water management, maintenance of landscaped features and any additional matters intended to improve or maintain the quality of the environment. The plan shall set forth proposed changes requested by the applicant and affirmatively disclose what, if any, change will be made in the natural condition of the earth, including loss or change of earth ground cover, destruction of trees, grade changes and its effect, if any, upon lakes, streams, watercourses and marshes, lowlands and wetlands in the area. The plan shall minimize tree removal, ground cover change, loss of natural vegetation and grade changes as much as possible and shall affirmatively provide for the relocation or replanting of as many trees as possible which are proposed to be removed. The purpose of the earth change plan shall be to eliminate as much as possible potential pollution, erosion and siltation.

(1987 Code, § 1102.05) (Ord. 217, passed 7-10-1989)

1102.06 SUBDIVISION STANDARDS.

No part of any land within the wetland conservation area shall be platted for residential use or any other use which will increase the danger to health, life, property or the public welfare. Whenever a portion of the conservation area is located within the area to be subdivided, an adequate easement in favor of the city over the lowlands shall be required for the purpose of improving and protecting the area from drainage and other purposes expressed in this chapter. Streets, driveways and culverts shall not be constructed or designed so as to restrict the flow of water and the same shall be approved by the City Council.

Subd. 1. No part of any land within the wetland conservation area shall be platted for residential use or any other use which will increase the danger to health, life, property or the public welfare. Whenever a portion of the conservation area is located within the area to be subdivided, an adequate easement in favor of the city over the lowlands shall be required for the purpose of improving and protecting the area from drainage and other purposes expressed in this chapter. Streets, driveways and culverts shall not be constructed or designed so as to restrict the flow of water and the same shall be approved by the City Council.

Subd. 2. For lots created after 28 August 1995, or for those lots where a wetland buffer strip and setback have been required as part of a subdivision development agreement, a buffer strip shall be maintained abutting all wetland conservation areas as provided in § 1102.03 of this code and abutting WCA wetlands.

a. It is the responsibility of the subdivider to delineate the exact boundaries of wetland conservation areas as provided in § 1102.03 of this code and the boundaries of WCA wetlands. Wetland delineations supplied by subdividers shall be certified by a qualified wetland delineator approved by the U.S. Army Corps of Engineers or the Minnesota Board of Water and Soil Resources.

b. Wetland buffer strips and structure setbacks shall apply to all parcels of land whether or not the wetland is on the same parcel as the development.

c. Buffer strip vegetation shall be preserved and maintained in its natural state.

d. For roadways that must be aligned either adjacent to or across wetlands and are subject to WCA replacement requirements, additional wetland filling to create a buffer strip shall not be required.

e. A survey monument is required at each lot line where it crosses a wetland buffer strip and as necessary to adequately determine the location of the wetland buffer strip. These monuments shall remain

in place after site grading of the lot has been completed.

f. Wetland buffer strips and structure setbacks shall be as follows:

(1) Wetland buffer strip: minimum 35 feet from wetland conservation area or WCA wetland;

(2) Structure setback: minimum 15 feet from wetland buffer strip (fences and play equipment may encroach into the structure setback area, but not into the wetland buffer strip).

(1987 Code, § 1102.06) (Ord. 305, passed 8-28-1995)

1102.07 LAND AREA WITHIN EASEMENTS .

Land area, if within the wetland conservation area designated as an easement, shall not be credited as part of the area complying with the land use density or building unit to land area ratio, or other similar requirements of the zoning ordinance. The exempt land area which is not to be developed and which is designated as an easement shall not be subject to special assessment to defray cost of municipal improvement projects, including and not limited to water, sanitary and storm sewer improvements.

(1987 Code, § 1102.07)

1102.08 ARTIFICIAL OBSTRUCTIONS .

If an artificial obstruction is found within the wetland conservation area, an order shall be issued to the owner of the parcel, following ten days written notice and hearing thereon, for removal within a reasonable time as may be prescribed by the condition and type of artificial obstruction. If the owner shall fail to remove the artificial obstruction, or if the owner cannot be found or determined, the city shall have the power to make or cause the removal to be made, the cost of which shall be borne by the owner or specially assessed against the lands in the same manner as prescribed by law for the levy of special assessments for municipal improvements, notwithstanding § 1102.07 herein. The special assessment shall be certified to the County Auditor for collection in the same manner as the ad valorem real property taxes of the city.

(1987 Code, § 1102.08)

1102.09 VARIANCES .

Subd. 1. Variances may be granted by the City Council upon application therefor in extraordinary cases, but only when the proposed use is determined to be in the public interest and no variance shall be granted which the Council determines will or has a tendency to:

a. Result in the placement of an artificial obstruction which will restrict the passage of storm and flood water in a manner as to increase the height of flooding, except obstructions approved by the Minnehaha Creek Watershed District in conjunction with sound flood plain management;

b. Result in incompatible land uses or which would be detrimental to the protection of surface and ground water supplies;

c. Be not in keeping with land use plans and planning objectives for the city or which will increase or cause danger to life or property;

d. Be inconsistent with the objectives of encouraging land uses compatible with the preservation of the natural land forms, vegetation and the marshes and wetlands within the city.

Subd. 2. No permit or variance shall be issued unless the applicant has submitted an earth change plan as required and set forth in § 1102.05 of this chapter.

Subd. 3. In granting any variance, the Council may attach the conditions as it deems necessary to insure compliance with the policy or intent of this chapter.

(1987 Code, § 1102.09)

1102.10 VIOLATION .

Any person violating any of the provisions of this chapter shall be guilty of a misdemeanor.

(1987 Code, § 1102.10) (Ord. 70, passed 3-12-1973) Penalty, see § 104.01

1102.11 VEHICLE RESTRICTIONS .

No person within a wetland conservation area shall:

Subd. 1. Drive or park a vehicle, except an authorized or emergency vehicle, on any turf or other area not designated for parking or travel;

Subd. 2. Wash, grease, dismantle, repair, change or deposit the oil of a vehicle anywhere within a wetland conservation area;

Subd. 3. Operate a motorized vehicle;

Subd. 4. Operate any watercraft within a wetland conservation area.

(1987 Code, § 1102.11) (Ord. 209, passed 5-9-1988)

1201.26 S, SHORELAND DISTRICT .

Subd. 1. Shoreland Districts. The shorelands within the city are designated as shoreland districts and the requirements set forth in this chapter shall govern development and other activities within these districts. The classification of the shoreland areas shall govern the use, alteration and development of these areas according to the classification as per M.S., Chapter 105, and Minnesota Regulations parts 6120.2500 - 6120.3900.

Subd. 2. District application. The S District shall be applied to and superimposed upon all zoning districts as contained herein as existing or amended by the text and map of this chapter. The regulations and requirements imposed by the S District shall be in addition to those established for districts which jointly apply. Under the joint application of districts, the more restrictive requirements shall apply.

Subd. 3. Boundaries. The boundaries of the Shoreland District are established within the following distances from the ordinary high water level of the surface water depending on the size of the surface water as indicated on the Shorewood Zoning Districts Map.

| Surface Water | Distance (Feet)* |
|--|------------------|
| Greater than 10 acres (Table 1) | 1,000 |
| Rivers and streams (draining an area greater than 2 square miles) | 300** |
| * The practical distance may be less whenever the waters involved are bounded by topographical divides | |

which extend landward from the waters for lessor distances and prevent flowage toward the surface water.

** The distance requirement shall be increased to the limit of the flood plain when the flood plain is greater than 300 feet.

Subd. 4. Shoreland classification.

a. The surface waters affected by this section and which require controlled development of their shoreland (shoreland district) are shown on the map designated as the official “Zoning Districts Map of the City of Shorewood” which is properly approved and made a part of the ordinance and filed with the Zoning Administrator.

b. Surface waters generally greater than ten acres and given an identification number by the State of Minnesota are defined in § 1201.02 and listed in Table 1 of this section. Other surface waters affected by this chapter, generally having less than ten acres, are classified as wetlands and thus regulated under the provisions of Shorewood Ordinance 70 (Chapter 1102 of the City Code).

TABLE 1
SURFACE WATER DISTRIBUTION

| DNR Identification Number | Name | Classification |
|---------------------------|-----------------|----------------|
| 27-133 | Lake Minnetonka | GD |
| 27-142 | Lake William | GD |
| 27-137 | Christmas Lake | RD |
| 27-144 | Galpin Lake | GD |
| 10-15 | Virginia Lake | RD |
| 27-145 | Como Lake | RD |
| 27-136 | Silver Lake | NE |
| – | Purgatory Creek | GD |

Subd. 5. Minimum lot and setback requirements.

a. The following chart sets forth the minimum area setbacks and other requirements of each respective classification:

| | NE Natural Environment | RD Recreational Development | GD General Development |
|--|------------------------|-----------------------------|------------------------|
| (1) Min. lot size above normal high water mark | | | |
| Abutting water | 40,000 sq. ft. | 20,000 sq. ft. | 15,000 sq. ft. |
| Nonabutting | 20,000 sq. ft. | 15,000 sq. ft. | 15,000 sq. ft. |
| (2) Lot width at lakeshore setback* | 125 ft. | 75 ft. | 75 ft. |
| (3) Setback from ordinary high water level* | 150 ft. | 75 ft. | 50 ft. |
| (4) Setback from public street* | | | |
| Abutting federal, state or county road | 50 ft. | 50 ft. | 50 ft. |
| Abutting town or public road | 30 ft. | 30 ft. | 30 ft. |
| (5) Max. impervious surface to area ratio | 25% | 25% | 25% |
| (6) Max. building height (feet) | 35 ft.** | 35 ft.** | 35 ft.** |

| | | | |
|--|-----------------------------|-----------------------------|-----------------------------|
| (7) Side yard setback (lots abutting water) | 30 ft. total/10 ft. min.*** | 30 ft. total/10 ft. min.*** | 30 ft. total/10 ft. min.*** |
| (8) Setback of roads, parking or impervious surface areas from ordinary high water level**** | 50 ft. | 50 ft. | 50 ft. |
| (9) Structure height (lowest floor) above high water elevation***** | 3 ft. | 3 ft. | 3 ft. |
| * Setback requirements from the ordinary high water level shall not apply to stairs, lifts, piers and docks. Where development exists on both sides of a proposed building site, building setbacks may be altered to more closely conform to adjacent building setbacks. | | | |
| **Building heights may be increased as provided in § 1201.03, Subdivision 4c. | | | |
| ***Subject to regulations and exceptions as provided in §§ 1201.10 through 1201.23. | | | |
| ****Where feasible and practical, all roads and parking areas shall meet the setback requirements established for structures in (3) above. Natural vegetation or other natural materials shall be required in order to screen parking areas when viewed from the water. Parking areas of more than four spaces shall be screened in accordance with a landscaping plan submitted and approved by the City Council. | | | |
| *****Does not include piers and docks. | | | |

b. Substandard lot. Any lot of record filed in the office of the Hennepin County Registrar of Deeds on or before the effective date of this chapter, which does not meet the area requirements of this chapter may be allowed as a building site subject to approval of a shoreland impact plan and provided:

- (1) The lot meets all standards of the applicable zoning use district;
- (2) The lot is in separate ownership from abutting lands;

(3) Except for lot area, all other sanitary and dimensional requirements of the Shoreland District are complied with insofar as practical (70% width and area requirements).

c. Placement of structures. Placement of structures shall comply with the provisions of Shorewood Ordinance 109 (Chapter 1101, Flood Control Regulations of the City Code).

d. Bluff impact zones Structures and accessory facilities, except stairways, lifts and landings, must not be placed within bluff impact zones.

Subd. 6. Development regulations.

a. Landowners or developers desiring to develop land or construct any dwelling or any other artificial obstruction on land located within any Shoreland District within the city shall first submit a conditional use permit application as regulated by § 1201.04 and a plan of development hereinafter referred to as “Shoreland Impact Plan,” which shall set forth proposed provisions for sediment control, water management, maintenance of landscaped features and any additional matters intended to improve or maintain the quality of the environment. Such a plan shall set forth proposed changes requested by the applicant and affirmatively disclose what, if any, change will be made in the natural condition of the earth, including loss or change of earth ground cover, destruction of trees, grade courses and marshes. The plan shall minimize tree removal, ground cover change, loss of natural vegetation and grade changes as much as possible and shall affirmatively provide for the relocation or replanting of as many trees as possible which are proposed to be removed. The purpose of the shoreland impact plan shall be to eliminate as much as possible potential pollution, erosion and siltation.

- (1) Exceptions.

(a) No conditional use permit or shoreland impact plan shall be required for the development of permitted accessory uses contained within the R-1A, R-1B, R-1C, R-2A, R-2B or R-2C Districts.

(b) No conditional use permit or shoreland impact plan shall be required for the development of permitted uses contained within the R-1A, R-1B, R-1C, R-2A, R-2B or R-2C Districts, provided that the uses are constructed on standard lots when abutting a shoreline and that all the uses are serviced with public sanitary sewer.

(c) The provisions otherwise set forth in this chapter and in other applicable local ordinances shall apply to all plats except Planned Unit Development.

(2) Subdivision. No land shall be subdivided which is determined by the city or the Commissioner of Natural Resources to be unsuitable by reason of flooding, inadequate drainage, soil and rock formations with severe limitations for development, severe erosion potential, unfavorable topography, inadequate water supply or sewage treatment capabilities or any other feature likely to be harmful to the health, safety or welfare of the future residents of the proposed subdivision or the community.

b. Sewage and waste disposal. Any premises used for human occupancy shall be provided with public sanitary sewer disposal.

c. Water supply. Any private supply of water for domestic purposes shall conform to Minnesota Department of Health Standards for water quality. Private wells shall be placed in areas not subject to flooding and up slope from any source of contamination. Wells already existing in areas subject to flooding shall be floodproofed in accordance with city standards.

d. Stairways, lifts and landings. Stairways and lifts are the preferred alternative to major topographic alterations for achieving access up and down bluffs and steep slopes to shore areas. Stairways and lifts must meet the following design requirements:

(1) Stairways and lifts must not exceed four feet in width;

(2) Landings for stairways and lifts must not exceed 32 square feet in area;

(3) Canopies or roofs are not allowed on stairways, lifts or landings;

(4) Stairways, lifts and landings may be either constructed above the ground on posts or pilings or placed into the ground, provided they are designed and built in a manner that ensures control of soil erosion;

(5) Stairways, lifts and landings must be located in the most visually inconspicuous portions of lots, as viewed from the surface of the public water assuming summer, leaf-on conditions, whenever practical;

(6) Facilities such as ramps, lifts or mobility paths for physically handicapped persons are also allowed for achieving access to shore areas, provided that the dimensional and performance standards of items (1) to (5) above are complied with in addition to the requirements of Minnesota Regulations, Chapter 1340.

Subd. 7. Shoreland alteration .

a. The removal of natural vegetation shall be restricted to prevent erosion into public waters, to consume nutrients in the soil and to preserve shoreland aesthetics.

(1) Clearcutting is prohibited within required setback areas and except as necessary for placing public roads, utilities, structures and parking areas.

(2) Natural vegetation shall be restored insofar as feasible after any construction project.

(3) Selective cutting of trees and underbrush is allowed as long as sufficient cover is left to make cars and structures visually inconspicuous when viewed from the water.

b. Grading and filling:

(1) Grading and filling within Shoreland Districts, or any alteration of the natural topography where the slope of land is toward a public water or watercourse leading to a public water must be approved by the Building Official and a permit obtained prior to the commencement of any work thereon. The permit may be granted subject to the conditions that:

(a) No more than one-third of the surface area of a lot shall be devoid of vegetative ground cover at any time;

(b) Temporary ground cover such as mulch shall be used and permanent cover such as sod shall be planted as soon as possible;

(c) Methods to prevent erosion and trap sediment shall be employed in accordance with the Shorewood Subdivision Ordinance (Chapter 1202 of this code);

(d) Fill shall not be placed in areas lower in elevation than the normal high water mark;

(e) Fill shall be stabilized according to accepted engineering standards;

(f) Fill shall not restrict a floodway or destroy the storage capacity of a flood plain;

(g) The maximum slope of the finished surface which slopes toward a water body or a watercourse leading to the water body shall be three units horizontal to one vertical;

(h) No grading or filling shall be permitted within shore and bluff impact zones;

(i) Plans to place fill or excavated material on steep slopes must be reviewed and approved by the City Engineer for continued slope stability and must not create finished slopes greater than three units horizontal to one vertical;

(j) Placement of natural rock riprap, including associated grading of the shortline and placement of a filter blanket, is permitted if the finished slope does not exceed three feet horizontal to one foot vertical, the landward extent of the riprap is within ten feet of the ordinary high water level and the height of the riprap above the ordinary high water level does not exceed three feet;

(2) Any work which will change or diminish the course, current or cross section of a public water must be approved by the Department of Natural Resources as per M.S. § 105.44 before the work is begun. This includes construction of channels and ditches, lagooning, dredging of lake bottom for the removal of muck, silt or weeds and filling the lake bed, including low lying marsh areas. Approval shall be construed to mean the issuance by the Commissioner of the Department of Natural Resources of a permit under the procedures of M.S. § 42 and other related statutes;

(3) Excavation on shorelands where the intended purpose is connection to a public water, such as boat slips, canals, lagoons and harbors, shall require a permit from the Building Official prior to commencement of construction. The permit shall be obtained only after the Commissioner of the Department of Natural Resources has approved the proposed connection to public waters. Approval will be given only if the proposed work is consistent with applicable state regulations for work in beds of public waters.

c. Steep slopes. The Zoning Administrator must evaluate possible soil erosion impacts and development visibility from public waters before issuing a permit for construction of roads, driveways, structures or other improvements on steep slopes. When determined necessary, conditions must be attached to issued permits to prevent erosion and to preserve existing vegetation screening of structures, vehicles and other facilities as viewed from the surface of public waters, assuming summer, leaf-on vegetation.

Subd. 8. Stormwater management. The following general and specific standards shall apply.

a. General standards.

(1) When possible, existing natural drainageways, wetlands and vegetated soil surfaces must be used to convey, store, filter and retain stormwater runoff before discharge to public waters.

(2) Development must be planned and conducted in a manner that will minimize the extent of disturbed areas, runoff velocities, erosion potential and reduce and delay runoff volumes. Disturbed areas must be stabilized and protected as soon as possible and facilities or methods used to retain sediment on the site.

(3) When development density, topographic features and soil and vegetation conditions are not sufficient to adequately handle stormwater runoff using natural features and vegetation, various types of constructed facilities such as diversions, settling basins, skimming devices, dikes, waterways and ponds may be used. Preference must be given to designs using surface drainage, vegetation and infiltration rather than buried pipes and man-made materials and facilities.

b. Specific standards.

(1) Impervious surface coverage of lots must not exceed 25% of the lot area, except as provided in § 1201.03 Subd. 2.u. of this code.

(2) When constructed facilities are used for stormwater management, documentation must be provided by a registered engineer licensed in the State of Minnesota that they are designed and installed consistent with the field office technical guide of the local soil and water conservation districts.

(3) New constructed stormwater outfalls to public waters must provide for filtering or settling of suspended solids and skimming of surface debris before discharge.

Subd. 9. Planned Unit Development. The Planned Unit Development provisions contained in § 1201.06 may be utilized within a Shoreland District, when consistent with the provisions of this section and provided that the following requirements are satisfactorily met:

a. Preliminary plans shall be approved by the Department of Natural Resources prior to city approval;

b. Sufficient open space is preserved through the use of restrictive deed covenants, public dedications and the like;

c. The following factors are carefully evaluated to insure that any increased density of development is consistent with the resource limitations of the public water:

(1) Suitability of the site for the proposed use;

(2) Physical and aesthetic impact of any increased density;

(3) Level of current development;

(4) Amount and ownership of undeveloped shoreland;

(5) Levels and types of water surface use and public access;

(6) Possible effects on overall public use;

d. Any commercial, recreational, community or religious facility allowed as part of the planned unit development conforms to all applicable federal and state regulations, including, but not limited to the following:

(1) Licensing provisions or procedures;

(2) Waste disposal regulations;

(3) Water supply regulations;

(4) Building codes;

(5) Safety regulations;

(6) Regulations concerning the appropriate use of public waters as defined in M.S., Chapter 105, as may be amended;

(7) Applicable regulations of the Minnesota Environmental Quality Board;

(8) Storm sewer;

e. The final P.U.D. plan shall not be modified or altered in any way without written approval from the Department of Natural Resources;

f. P.U.D.'s incorporating shoreline recreational facilities such as beaches, docks or boat launching facilities and the like shall be designed that the facilities are centralized for common utilization.

Subd. 10. Variance. Variances may be granted by the City Council upon application as required in § 1201.05 of this chapter in extraordinary cases, but only when the proposed use is determined to be in the public interest and no variance shall be granted which the Council determines will or has a tendency to:

a. Result in the placement of an artificial obstruction which will restrict the passage of storm and flood water in a manner as to increase the height of flooding, except obstructions approved by the U.S. Army Corps of Engineers in conjunction with sound flood plain management;

b. Result in compatible land uses or which would be detrimental to the protection of surface and ground water supplies;

c. Be not in keeping with land use plans and planning objectives for the city or which will increase or cause danger to life or property;

d. Be inconsistent with the objectives of encouraging land use compatible with the preservation of the natural land forms, vegetation and the marshes and wetlands within the city. No permit or variance shall be issued unless the applicant has submitted a Shoreland Impact Plan as required and set forth in this chapter. In granting any variance, the Council may attach the conditions as they deem necessary to insure compliance with the purpose and intent of this chapter.

Subd. 11. DNR notification procedure.

a. Copies of all notices of any public hearings to consider variances, amendments or conditional uses under this section shall be received by the Commissioner of the Department of Natural Resources at least ten days prior to the hearings.

b. A copy of amendments and final decisions granting variances or conditional uses under this section shall be received by the Commissioner of the Department of Natural Resources within ten days of final action or amendment.

Subd. 12. Effect of permit The granting of any permit, variance or subdivision approval under provisions of this section shall in no way affect the owner's capability to obtain the approval required by any other statute, ordinance or legislation of any state agency or subdivision thereof. Approval may be expressly given in conjunction with other permits applied for, but no approval shall be implied from the grant of the permits nor from the necessity to apply for a permit as described herein.

(1987 Code, § 1201.26) (Ord. 261, passed 11-30-1992; Am. Ord. 382, passed 3-25-2002; Am. Ord. 420, passed 2-13-2006)

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Shorewood, MN Code of Ordinances

1201.26 S, SHORELAND DISTRICT .

Subd. 1. Shoreland Districts. The shorelands within the city are designated as shoreland districts and the requirements set forth in this chapter shall govern development and other activities within these districts. The classification of the shoreland areas shall govern the use, alteration and development of these areas according to the classification as per M.S., Chapter 105, and Minnesota Regulations parts 6120.2500 - 6120.3900.

Subd. 2. District application. The S District shall be applied to and superimposed upon all zoning districts as contained herein as existing or amended by the text and map of this chapter. The regulations and requirements imposed by the S District shall be in addition to those established for districts which jointly apply. Under the joint application of districts, the more restrictive requirements shall apply.

Subd. 3. Boundaries. The boundaries of the Shoreland District are established within the following distances from the ordinary high water level of the surface water depending on the size of the surface water as indicated on the Shorewood Zoning Districts Map.

| | |
|---|------------------|
| Surface Water | Distance (Feet)* |
| Greater than 10 acres (Table 1) | 1,000 |
| Rivers and streams (draining an area greater than 2 square miles) | 300** |
| * The practical distance may be less whenever the waters involved are bounded by topographical divides which extend landward from the waters for lessor distances and prevent flowage toward the surface water. | |
| ** The distance requirement shall be increased to the limit of the flood plain when the flood plain is greater than 300 feet. | |

Subd. 4. Shoreland classification.

a. The surface waters affected by this section and which require controlled development of their shoreland (shoreland district) are shown on the map designated as the official “Zoning Districts Map of the City of Shorewood” which is properly approved and made a part of the ordinance and filed with the Zoning Administrator.

b. Surface waters generally greater than ten acres and given an identification number by the State of Minnesota are defined in § 1201.02 and listed in Table 1 of this section. Other surface waters affected by this chapter, generally having less than ten acres, are classified as wetlands and thus regulated under the provisions of Shorewood Ordinance 70 (Chapter 1102 of the City Code).

TABLE 1
SURFACE WATER DISTRIBUTION

| DNR Identification Number | Name | Classification |
|---------------------------|-----------------|----------------|
| 27-133 | Lake Minnetonka | GD |
| 27-142 | Lake William | GD |
| 27-137 | Christmas Lake | RD |
| | | |

| | | |
|--------|-----------------|----|
| 27-144 | Galpin Lake | GD |
| 10-15 | Virginia Lake | RD |
| 27-145 | Como Lake | RD |
| 27-136 | Silver Lake | NE |
| — | Purgatory Creek | GD |

Subd. 5. Minimum lot and setback requirements.

a. The following chart sets forth the minimum area setbacks and other requirements of each respective classification:

| | NE Natural Environment | RD Recreational Development | GD General Development |
|--|----------------------------------|----------------------------------|----------------------------------|
| (1) Min. lot size above normal high water mark Abutting water Nonabutting | 40,000 sq. ft. 20,000 sq. ft. | 20,000 sq. ft. 15,000 sq. ft. | 15,000 sq. ft. 15,000 sq. ft. |
| (2) Lot width at lakeshore setback* | 125 ft. | 75 ft. | 75 ft. |
| (3) Setback from ordinary high water level* | 150 ft. | 75 ft. | 50 ft. |
| (4) Setback from public street* Abutting federal, state or county road Abutting town or public road | 50 ft. 30 ft. | 50 ft. 30 ft. | 50 ft. 30 ft. |
| (5) Max. impervious surface to area ratio | 25% | 25% | 25% |
| (6) Max. building height (feet) | 35 ft.** | 35 ft.** | 35 ft.** |
| (7) Side yard setback (lots abutting water) | 30 ft. total/10 ft. min.*** | 30 ft. total/10 ft. min.*** | 30 ft. total/10 ft. min.*** |
| (8) Setback of roads, parking or impervious surface areas from ordinary high water level**** | 50 ft. | 50 ft. | 50 ft. |
| (9) Structure height (lowest floor) above high water elevation***** | 3 ft. | 3 ft. | 3 ft. |
| * Setback requirements from the ordinary high water level shall not apply to stairs, lifts, piers and docks. Where development exists on both sides of a proposed building site, building setbacks may be altered to more closely conform to adjacent building setbacks. | | | |
| **Building heights may be increased as provided in § 1201.03, Subdivision 4c. | | | |
| ***Subject to regulations and exceptions as provided in §§ 1201.10 through 1201.23. | | | |
| ****Where feasible and practical, all roads and parking areas shall meet the setback requirements established for structures in (3) above. Natural vegetation or other natural materials shall be required in order to screen parking areas when viewed from the water. Parking areas of more than four spaces shall be screened in accordance with a landscaping plan submitted and approved by the City Council. | | | |
| *****Does not include piers and docks. | | | |

b. Substandard lot. Any lot of record filed in the office of the Hennepin County Registrar of Deeds on or before the effective date of this chapter, which does not meet the area requirements of this chapter may be allowed as a building site subject to approval of a shoreland impact plan and provided:

- (1) The lot meets all standards of the applicable zoning use district;

(2) The lot is in separate ownership from abutting lands;

(3) Except for lot area, all other sanitary and dimensional requirements of the Shoreland District are complied with insofar as practical (70% width and area requirements).

c. Placement of structures. Placement of structures shall comply with the provisions of Shorewood Ordinance 109 (Chapter 1101, Flood Control Regulations of the City Code).

d. Bluff impact zones Structures and accessory facilities, except stairways, lifts and landings, must not be placed within bluff impact zones.

Subd. 6. Development regulations.

a. Landowners or developers desiring to develop land or construct any dwelling or any other artificial obstruction on land located within any Shoreland District within the city shall first submit a conditional use permit application as regulated by § 1201.04 and a plan of development hereinafter referred to as "Shoreland Impact Plan," which shall set forth proposed provisions for sediment control, water management, maintenance of landscaped features and any additional matters intended to improve or maintain the quality of the environment. Such a plan shall set forth proposed changes requested by the applicant and affirmatively disclose what, if any, change will be made in the natural condition of the earth, including loss or change of earth ground cover, destruction of trees, grade courses and marshes. The plan shall minimize tree removal, ground cover change, loss of natural vegetation and grade changes as much as possible and shall affirmatively provide for the relocation or replanting of as many trees as possible which are proposed to be removed. The purpose of the shoreland impact plan shall be to eliminate as much as possible potential pollution, erosion and siltation.

(1) Exceptions.

(a) No conditional use permit or shoreland impact plan shall be required for the development of permitted accessory uses contained within the R-1A, R-1B, R-1C, R-2A, R-2B or R-2C Districts.

(b) No conditional use permit or shoreland impact plan shall be required for the development of permitted uses contained within the R-1A, R-1B, R-1C, R-2A, R-2B or R-2C Districts, provided that the uses are constructed on standard lots when abutting a shoreline and that all the uses are serviced with public sanitary sewer.

(c) The provisions otherwise set forth in this chapter and in other applicable local ordinances shall apply to all plats except Planned Unit Development.

(2) Subdivision. No land shall be subdivided which is determined by the city or the Commissioner of Natural Resources to be unsuitable by reason of flooding, inadequate drainage, soil and rock formations with severe limitations for development, severe erosion potential, unfavorable topography, inadequate water supply or sewage treatment capabilities or any other feature likely to be harmful to the health, safety or welfare of the future residents of the proposed subdivision or the community.

b. Sewage and waste disposal. Any premises used for human occupancy shall be provided with public sanitary sewer disposal.

c. Water supply. Any private supply of water for domestic purposes shall conform to Minnesota Department of Health Standards for water quality. Private wells shall be placed in areas not subject to flooding and up slope from any source of contamination. Wells already existing in areas subject to flooding shall be floodproofed in accordance with city standards.

d. Stairways, lifts and landings. Stairways and lifts are the preferred alternative to major topographic alterations for achieving access up and down bluffs and steep slopes to shore areas. Stairways and lifts must meet the following design requirements:

(1) Stairways and lifts must not exceed four feet in width;

(2) Landings for stairways and lifts must not exceed 32 square feet in area;

(3) Canopies or roofs are not allowed on stairways, lifts or landings;

(4) Stairways, lifts and landings may be either constructed above the ground on posts or pilings or placed into the ground, provided they are designed and built in a manner that ensures control of soil erosion;

(5) Stairways, lifts and landings must be located in the most visually inconspicuous portions of lots, as viewed from the surface of the public water assuming summer, leaf-on conditions, whenever practical;

(6) Facilities such as ramps, lifts or mobility paths for physically handicapped persons are also allowed for achieving access to shore areas, provided that the dimensional and performance standards of items (1) to (5) above are complied with in addition to the requirements of Minnesota Regulations, Chapter 1340.

Subd. 7. Shoreland alteration .

a. The removal of natural vegetation shall be restricted to prevent erosion into public waters, to consume nutrients in the soil and to preserve shoreland aesthetics.

(1) Clearcutting is prohibited within required setback areas and except as necessary for placing public roads, utilities, structures and parking areas.

(2) Natural vegetation shall be restored insofar as feasible after any construction project.

(3) Selective cutting of trees and underbrush is allowed as long as sufficient cover is left to make cars and structures visually inconspicuous when viewed from the water.

b. Grading and filling:

(1) Grading and filling within Shoreland Districts, or any alteration of the natural topography where the slope of land is toward a public water or watercourse leading to a public water must be approved by the Building Official and a permit obtained prior to the commencement of any work thereon. The permit may be granted subject to the conditions that:

(a) No more than one-third of the surface area of a lot shall be devoid of vegetative ground cover at any time;

(b) Temporary ground cover such as mulch shall be used and permanent cover such as sod shall be planted as soon as possible;

(c) Methods to prevent erosion and trap sediment shall be employed in accordance with the Shorewood Subdivision Ordinance (Chapter 1202 of this code);

(d) Fill shall not be placed in areas lower in elevation than the normal high water mark;

(e) Fill shall be stabilized according to accepted engineering standards;

(f) Fill shall not restrict a floodway or destroy the storage capacity of a flood plain;

(g) The maximum slope of the finished surface which slopes toward a water body or a watercourse leading to the water body shall be three units horizontal to one vertical;

(h) No grading or filling shall be permitted within shore and bluff impact zones;

(i) Plans to place fill or excavated material on steep slopes must be reviewed and approved by the City Engineer for continued slope stability and must not create finished slopes greater than three units horizontal to one vertical;

(j) Placement of natural rock riprap, including associated grading of the shortline and placement of a filter blanket, is permitted if the finished slope does not exceed three feet horizontal to one foot vertical, the landward extent of the riprap is within ten feet of the ordinary high water level and the height of the riprap above the ordinary high water level does not exceed three feet;

(2) Any work which will change or diminish the course, current or cross section of a public water must be approved by the Department of Natural Resources as per M.S. § 105.44 before the work is begun. This includes construction of channels and ditches, lagooning, dredging of lake bottom for the removal of muck, silt or weeds and filling the lake bed, including low lying marsh areas. Approval shall be construed to mean the issuance by the Commissioner of the Department of Natural Resources of a permit under the procedures of M.S. § 42 and other related statutes;

(3) Excavation on shorelands where the intended purpose is connection to a public water, such as boat slips, canals, lagoons and harbors, shall require a permit from the Building Official prior to commencement of construction. The permit shall be obtained only after the Commissioner of the Department of Natural Resources has approved the proposed connection to public waters. Approval will be given only if the proposed work is consistent with applicable state regulations for work in beds of public waters.

c. Steep slopes. The Zoning Administrator must evaluate possible soil erosion impacts and development visibility from public waters before issuing a permit for construction of roads, driveways, structures or other improvements on steep slopes. When determined necessary, conditions must be attached to issued permits to prevent erosion and to preserve existing vegetation screening of structures, vehicles and other facilities as viewed from the surface of public waters, assuming summer, leaf-on vegetation.

Subd. 8. Stormwater management. The following general and specific standards shall apply.

a. General standards.

(1) When possible, existing natural drainageways, wetlands and vegetated soil surfaces must be used to convey, store, filter and retain stormwater runoff before discharge to public waters.

(2) Development must be planned and conducted in a manner that will minimize the extent of disturbed areas, runoff velocities, erosion potential and reduce and delay runoff volumes. Disturbed areas must be stabilized and protected as soon as possible and facilities or methods used to retain sediment on the site.

(3) When development density, topographic features and soil and vegetation conditions are not sufficient to adequately handle stormwater runoff using natural features and vegetation, various types of constructed facilities such as diversions, settling basins, skimming devices, dikes, waterways and ponds may be used. Preference must be given to designs using surface drainage, vegetation and infiltration rather than buried pipes and man-made materials and facilities.

b. Specific standards.

(1) Impervious surface coverage of lots must not exceed 25% of the lot area, except as provided in § 1201.03 Subd. 2.u. of this code.

(2) When constructed facilities are used for stormwater management, documentation must be provided by a registered engineer licensed in the State of Minnesota that they are designed and installed consistent with the field office technical guide of the local soil and water conservation districts.

(3) New constructed stormwater outfalls to public waters must provide for filtering or settling of suspended solids and skimming of surface debris before discharge.

Subd. 9. Planned Unit Development. The Planned Unit Development provisions contained in § 1201.06 may be utilized within a Shoreland District, when consistent with the provisions of this section and provided that the following requirements are satisfactorily met:

- a. Preliminary plans shall be approved by the Department of Natural Resources prior to city approval;
- b. Sufficient open space is preserved through the use of restrictive deed covenants, public dedications and the like;
- c. The following factors are carefully evaluated to insure that any increased density of development is consistent with the resource limitations of the public water:
 - (1) Suitability of the site for the proposed use;
 - (2) Physical and aesthetic impact of any increased density;
 - (3) Level of current development;
 - (4) Amount and ownership of undeveloped shoreland;
 - (5) Levels and types of water surface use and public access;
 - (6) Possible effects on overall public use;
- d. Any commercial, recreational, community or religious facility allowed as part of the planned unit development conforms to all applicable federal and state regulations, including, but not limited to the following:
 - (1) Licensing provisions or procedures;
 - (2) Waste disposal regulations;
 - (3) Water supply regulations;
 - (4) Building codes;
 - (5) Safety regulations;
 - (6) Regulations concerning the appropriate use of public waters as defined in M.S., Chapter 105, as may be amended;
 - (7) Applicable regulations of the Minnesota Environmental Quality Board;
 - (8) Storm sewer;
- e. The final P.U.D. plan shall not be modified or altered in any way without written approval from the Department of Natural Resources;
- f. P.U.D.'s incorporating shoreline recreational facilities such as beaches, docks or boat launching facilities and the like shall be designed that the facilities are centralized for common utilization.

Subd. 10. Variance. Variances may be granted by the City Council upon application as required in § 1201.05 of this chapter in extraordinary cases, but only when the proposed use is determined to be in the public interest and no variance shall be granted which the Council determines will or has a tendency to:

- a. Result in the placement of an artificial obstruction which will restrict the passage of storm and flood water in a manner as to increase the height of flooding, except obstructions approved by the U.S. Army Corps of Engineers in conjunction with sound flood plain management;
- b. Result in compatible land uses or which would be detrimental to the protection of surface and ground water supplies;
- c. Be not in keeping with land use plans and planning objectives for the city or which will increase or cause danger to life or property;

d. Be inconsistent with the objectives of encouraging land use compatible with the preservation of the natural land forms, vegetation and the marshes and wetlands within the city. No permit or variance shall be issued unless the applicant has submitted a Shoreland Impact Plan as required and set forth in this chapter. In granting any variance, the Council may attach the conditions as they deem necessary to insure compliance with the purpose and intent of this chapter.

Subd. 11. DNR notification procedure.

a. Copies of all notices of any public hearings to consider variances, amendments or conditional uses under this section shall be received by the Commissioner of the Department of Natural Resources at least ten days prior to the hearings.

b. A copy of amendments and final decisions granting variances or conditional uses under this section shall be received by the Commissioner of the Department of Natural Resources within ten days of final action or amendment.

Subd. 12. Effect of permit The granting of any permit, variance or subdivision approval under provisions of this section shall in no way affect the owner's capability to obtain the approval required by any other statute, ordinance or legislation of any state agency or subdivision thereof. Approval may be expressly given in conjunction with other permits applied for, but no approval shall be implied from the grant of the permits nor from the necessity to apply for a permit as described herein.

(1987 Code, § 1201.26) (Ord. 261, passed 11-30-1992; Am. Ord. 382, passed 3-25-2002; Am. Ord. 420, passed 2-13-2006)

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APPENDIX J

Phosphorus Removal Study

PHOSPHORUS LOAD REDUCTION STUDY
CITY OF SHOREWOOD

AUGUST 2008

Prepared by:

**WSB & Associates, Inc.
701 Xenia Avenue South, Suite 300
Minneapolis, MN 55416
(763) 541-4800
(763) 541-1700**

I hereby certify that this report was prepared by me or under my direct supervision and that I am a duly registered professional engineer under the laws of the State of Minnesota.



Steven G. Gurney, PE
Reg. No. 40497

Date

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I. INTRODUCTION AND PURPOSE

This report provides the results of a Phosphorus Loading Assessment that was completed for the City of Shorewood. This report provides the results of a very basic water quality modeling and stormwater treatment analysis for systems that are in place within the City of Shorewood. The report provides the results of the assessment which has been performed to estimate the changes in annual phosphorus loadings that may have occurred from 2000 to the present.

Section II provides a detailed outline of the procedures and methods that were used to perform the loading assessment and to estimate stormwater BMP treatment efficiencies. **Section III** presents and discusses the results of the loading assessment.

II. PROCEDURES AND METHODS FOLLOWED

This section of the report provides the procedures and methods followed for the loading assessment and analysis.

The loading assessment estimates the changes in annual phosphorus loads for areas that were redeveloped within the City of Shorewood between 2000 and 2007. This time frame was chosen to coincide with the MCWD studies. Likewise, areas that redeveloped prior to 2000, or have not redeveloped, are not included in this study.

A method based on land use has been applied to determine the change in phosphorus loadings as described in the Steps listed below. This method is similar to that outlined in the July 1, 2005, Technical Memorandum from Wenck Associates, Inc. entitled “Methodology for HHPLS-P-Load model Application to Development of Subwatershed Rules Under Performance-Based Management.”

The redeveloped areas evaluated as part of this study are identified in **Figure 1**. A detailed description of the procedures and methods used follows:

FIGURE 1

Step 1. Compare 2000 and 2007 land uses.

Information was gathered from past redevelopment reviews and from staff input regarding areas of the City in which stormwater improvements have been constructed since 2000.

Step 2. Estimate annual phosphorus loading based on land use.

The annual phosphorus loading used for this study for various land uses are summarized in **Table 1**.

Table 1

| Land Cover Type for Selection of Imperviousness | Annual TP Load (lb/ac) |
|--|-------------------------------|
| Undeveloped Land, or Pre-development | |
| Hydric soils – row cropland or close grown cropland | 0.259 |
| Upland soils – row cropland or close grown cropland | 0.109 |
| Forest, woodland, upland shrubland, savanna, grassland | 0.014 |
| Developed Land, or Post-Development | |
| Rural/Residential 4-10% Impervious | 0.300 |
| Residential Low/Residential 11-25% Impervious | 0.563 |
| Residential Medium/Residential 26-50% Impervious | 0.724 |
| Residential High/Residential 51-75% Impervious | 1.140 |
| Commercial 76-90% Impervious | 1.288 |

Step 3: Compute annual phosphorus load generated by land use.

The average phosphorus load generated from each land use in the pre- and post-development condition was computed based on the data gathered in **Step 1** and **Step 2**. Annual loading is calculated using the following equation on a per acre basis:

$$\text{Redevelopment Size} \times \text{Loading by Land Use} = \text{Total Phosphorus Load (lbs/year)}$$

Step 4: Define treatment practices and removal efficiencies employed in 2000 and present.

Treatment practices and BMPs that have been constructed since 2000 were identified and evaluated for this study. Identified below is a discussion of the BMPs considered for the analysis:

- **Stormwater Ponds**

This analysis considers that newly created ponds will retain 60% of TP loads prior to discharging downstream. This TP removal rate is supported by information presented in “Phosphorus Removal by Urban Runoff Detention Basins” (Walker). This document indicates that basins built to the NURP design standards that average four feet in depth provide TP removal efficiencies of 60% or greater. To be conservative, a 50% removal rate is used in this study, except where otherwise demonstrated during the design review of individual redevelopment projects.

- **Structural BMPs**

Significant structural BMPs within the City include:

1. The underground alum treatment system at Shorewood Mall, constructed in 2002 as part of the Cub Foods expansion. Further discussion of this system is presented in **Section III** of this study.
2. The grit chamber installed as part of the County Road 19 project. This structural BMP was one part of the treatment train for the Gideon Glen demonstration project.

- **Other BMPs**

In addition to storm water ponds, other BMPs may reduce volumes of runoff and pollutant loadings within the City. Some common BMPs that exist in the City are infiltration areas, sump catch basins, street sweeping, restrictions on phosphorus fertilizer, and vegetated buffers. These BMPs further reduce increases in annual runoff volumes and pollutant loading discharges that may have occurred between 2000 and 2007.

III. DISCUSSION/EVALUATION OF RESULTS

This section provides the results of the phosphorus load analysis that was completed as part of this study. This section also provides a description of possible methods to further reduce the phosphorus load on downstream waters. The information presented in this section was determined utilizing the methods outlined in **Section II** of the report.

Results

The Gideon Glen improvements resulted in a load reduction of 10.2 lbs. of phosphorus (see **Appendix A**).

As indicated previously, about half of this load reduction can be used to offset the City's goal of phosphorus reduction.

There were several other properties within the City of Shorewood that have been redeveloped since 2000, but were not included in this analysis at this time.

Parkview Crossing, Barrington Townhomes, the Shorewood Nursery, and the Excelsior Covenant Church are projects that provided treatment meeting the standards in place at the time of development. While there is also a load reduction associated with these projects, they are not included as part of the City's load reduction efforts conducted between 2000 and 2007.

Arbor Creek and Lake Virginia Woods were two subdivisions that were created from open space. While the NURP ponds constructed for these projects provide the required treatment for the site, there is a slight increase in the phosphorus loads from each site because open space was converted. Since the MCWD load reduction allocations for each City are already based on some areas of the City being redeveloped, these developments are ignored in this study.

Two other redevelopments are not included since they were constructed in landlocked basins and, therefore do not discharge downstream. These basins are identified as LMC-7 and LMC-8 in the MCWD Plan. Redevelopment in these basins includes the Bosworth Planned Unit Development and the Shorewood Mall Expansion that included the new Cub Foods building.

As part of the construction of the Cub Foods store, an alum injection system was installed in the underground chamber constructed beneath the parking lot. The underground system could be utilized to reduce the phosphorus load to Lake Minnewashta and ultimately Lake Virginia, if an outlet from these landlocked basins becomes necessary.

Potential Additional Load Reductions

There are several options available to further reduce the phosphorus loads to each watershed.

The following is a list of potential BMPs or operational procedures that could possibly be used to reduce the phosphorus load to downstream water bodies within MCWD.

1. **Street Sweeping**: A study completed by the Coon Creek Watershed District in June 2007 indicates that the average concentration of phosphorus in street sweepings is 215 mg per kg of sweepings (or 0.35 lbs per ton of sweepings). Based on the City's past records, approximately 400 tons are removed annually in the spring by sweeping.

If a second sweeping was added in the fall, it is estimated that an additional 200 tons will be removed. This represents an additional 70 pounds of phosphorus can be reduced annually. Based on 50 miles of City-maintained streets, the average phosphorus removal will be 1.4 pounds per mile. By strategically sweeping select areas of the City (i.e., those directly tributary to the lakes targeted) the City can easily meet its load reduction allocation.

Table 2 – Recommended Fall Sweeping Activities

| BMP | Road Miles to Be Swept | Estimated Load Reduction | Subwatershed |
|-----------------|-------------------------------|---------------------------------|---------------------|
| Street Sweeping | 32.1 mi | 45 lbs. | Lake Minnetonka |
| Street Sweeping | 2.9 mi | 4 lbs. | Lake Virginia |
| Street Sweeping | 2.1 mi | 3 lbs. | Christmas Lake |

Because fall sweepings collect mostly dead leaves and lawn clippings, it is likely that this reduction is under-estimated.

2. **Construction of Additional NURP Ponds**: Since the City is fully developed, there are limited opportunities to construct new stormwater treatment ponds. Should areas redevelop, the City will require new developments to install treatment facilities at that time.
3. **Use of Active Treatment Systems**: This option involves using a portable alum treatment unit to treat standing water in storm water ponds.
3. **Infiltration Basins**: Due to the nature of the soils in this area, this is not considered a good option; however, if a developer proposed this type of system, the City would allow it, provided treatment to NURP standards have been demonstrated.

4. **Water Reuse:** A water reuse system to reuse stormwater runoff as irrigation water in City parks may be a feasible system to reduce both runoff volume and annual phosphorus load to downstream waterbodies.

The above methods are presented to demonstrate that there are potential options available to reduce phosphorus loads to downstream water bodies.

IV. RECOMMENDATION

This report demonstrates that the City will be able to meet the phosphorus load reductions set forth by MCWD (57 pounds, overall, annually).

The report is based on several general assumptions, using data from a variety of other studies. Since this data may or may not relate to the City of Shorewood Storm Water Management Program, it is recommended that a complete Feasibility Report be undertaken to incorporate data that relates to the City of Shorewood.

Based on the results of the Feasibility Report, the most cost-effective methods for phosphorus removal can be implemented in the City of Shorewood. At this time, the City will begin a fall sweeping program that will be evaluated and adjusted to meet the phosphorus load reduction goals set by MCWD. The City will continue to look for other opportunities to provide phosphorus load reductions by other means.

APPENDIX A

Load Calculations for Gideon Glen Project in Shorewood



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Minneapolis, MN 55416
763-541-4800
www.wsbeng.com

Project Description _____
Project No. 1459-23 Designed By _____
Task Description _____ Checked By _____
Page _____ of _____

Gideon Glen
(Co. Rd. 19 pond - 2004/2005 construction)

Predevelopment Condition (15.8 ac Commercial)

$$15.8 \text{ ac} \times 1.288 \text{ lb/ac} = 20.4 \text{ lbs TP}$$

Post-development Condition (15.8 ac Commercial)
(only 1 ac added impervious)

neglect grit chamber

$$20.4 \text{ lbs TP} \\ \text{less } 50\% \text{ NDRP removal } 10.2 \text{ lbs TP}$$

$$10.2 \text{ lbs TP}$$

$$\text{Total Reduction per Site: } 10.2 \text{ lb TP}$$

APPENDIX K

Lake Water Quality Data

Christmas : IN SHOREWOOD (Lake)

Lake identification number: 27-0137-00

Overall Condition :

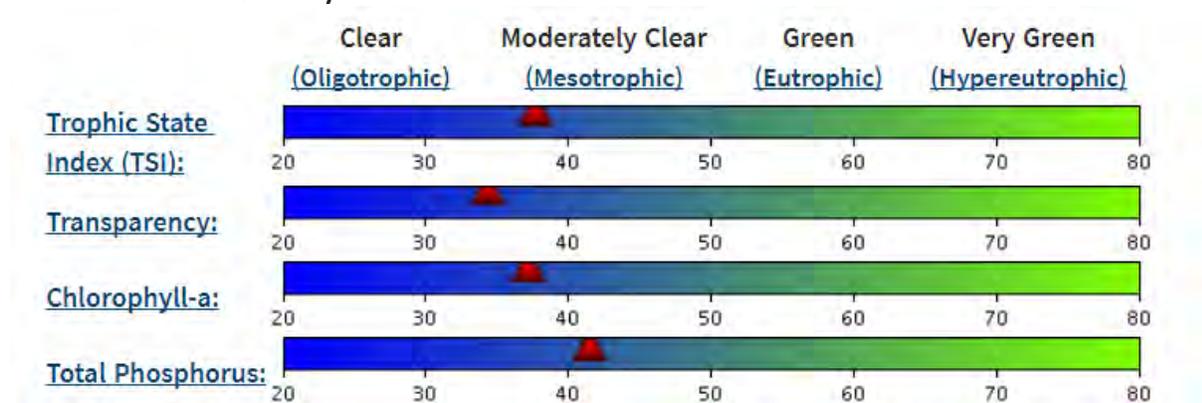
Suitable for swimming and wading, with good clarity and low algae levels throughout the open water season. Concentrations of mercury in fish tissue exceed the water quality standard; for specific fish consumption advice refer to the Minnesota Department of Health website at

<http://www.health.state.mn.us/divs/eh/fish/eating/sitespecific.html>

Physical Condition

| | |
|----------------------------|---|
| Major Watershed: | Mississippi River - Twin Cities |
| County: | Carver, Hennepin |
| Location: | IN SHOREWOOD |
| Surface Area: | 259.927494465 acres |
| Maximum Depth: | 87 feet |
| Ecoregion: | North Central Hardwood Forests |
| Use Classification: | 2B, 3C |

Lake Water Quality



Overall Trophic State Index for This Lake: 38

| Parameter | 10-Year average of all summer samples | Parameter TSI | Expected TSI range for lakes in same ecoregion | Number of samples |
|--------------------------------------|--|---------------|---|-------------------|
| Transparency (meters) | 6 | 34 | N/A | 74 |
| Chlorophyll-a (parts per billion) | 2 | 37 | N/A | 69 |
| Total Phosphorus (parts per billion) | 13 | 42 | N/A | 69 |

Water transparency is an excellent indicator of water quality, and the majority of these data are collected by volunteers. Join the MPCA's [Citizen Lake Monitoring Program](#) and help collect this important information for your lake.

Minn etonka -St. Albans Bay: 1 MI NE EXCELS'R (Lake)

Lake identification number: 27-0133-04

Overall Condition :

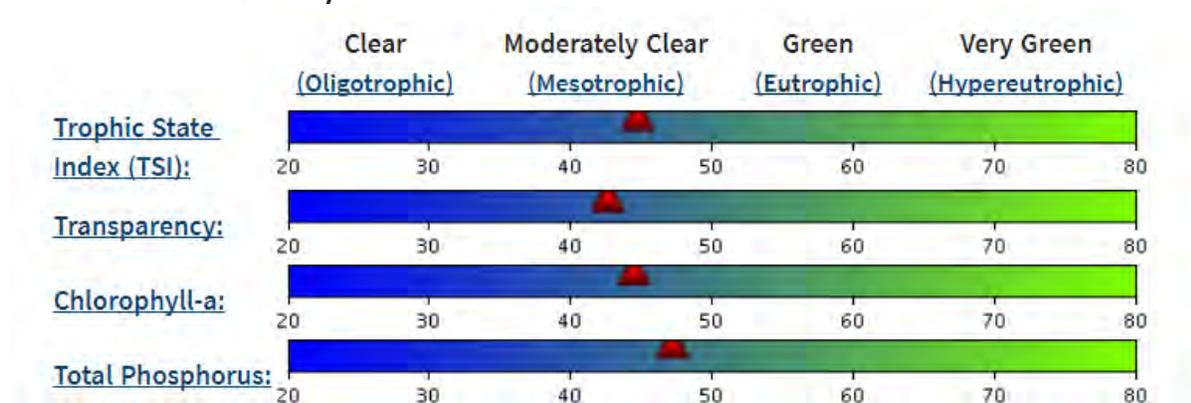
Suitable for swimming and wading, with good clarity and low algae levels throughout the open water season. Concentrations of mercury in fish tissue exceed the water quality standard; for specific fish consumption advice refer to the Minnesota Department of Health website at

<http://www.health.state.mn.us/divs/eh/fish/eating/sitespecific.html>

Physical Condition

| | |
|----------------------------|---|
| Major Watershed: | Mississippi River - Twin Cities |
| County: | Hennepin |
| Location: | 1 MI NE EXCELS'R |
| Surface Area: | 160.118043036 acres |
| Maximum Depth: | 84 feet |
| Ecoregion: | North Central Hardwood Forests |
| Use Classification: | 2B, 3C |

Lake Water Quality



Overall Trophic State Index for This Lake: 45

| Parameter | 10-Year average of all summer samples | Parameter TSI | Expected TSI range for lakes in same ecoregion | Number of samples |
|--------------------------------------|--|---------------|---|-------------------|
| Transparency (meters) | 3 | 43 | N/A | 53 |
| Chlorophyll-a (parts per billion) | 4 | 45 | N/A | 53 |
| Total Phosphorus (parts per billion) | 20 | 47 | N/A | 53 |

Water transparency is an excellent indicator of water quality, and the majority of these data are collected by volunteers. Join the MPCA's [Citizen Lake Monitoring Program](#) and help collect this important information for your lake.

Minn et on ka -Upp er Lake : 1.5 MI SE OF MOUND (Lake)

Lake identification number: 27-0133-05

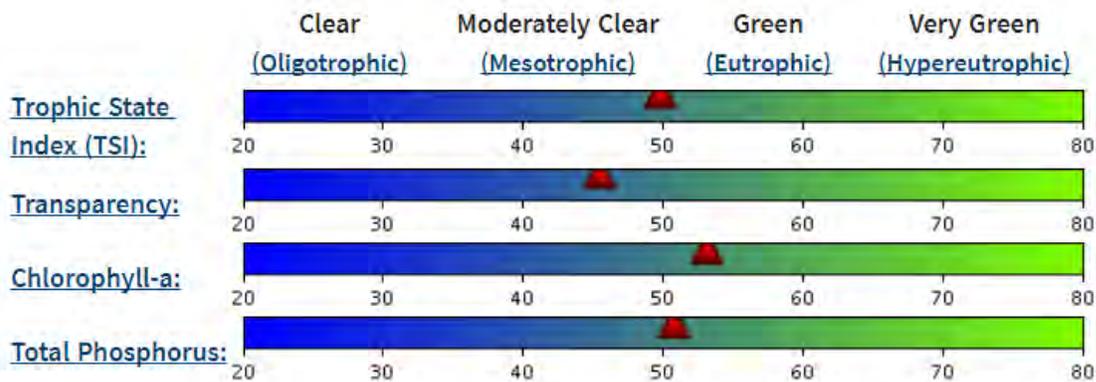
Overall Condition :

Suitable for swimming and wading, with good clarity and low algae levels throughout the open water season. Concentrations of mercury in fish tissue exceed the water quality standard; for specific fish consumption advice refer to the Minnesota Department of Health website at <http://www.health.state.mn.us/divs/eh/fish/eating/sitespecific.html>

Physical Condition

| | |
|----------------------------|---|
| Major Watershed: | Mississippi River - Twin Cities |
| County: | Carver, Hennepin |
| Location: | 1.5 MI SE OF MOUND |
| Surface Area: | 4229.1989427 acres |
| Maximum Depth: | 83 feet |
| Ecoregion: | North Central Hardwood Forests |
| Use Classification: | 2B, 3C |

Lake Water Quality



Overall Trophic State Index for This Lake: 50

| Parameter | 10-Year average of all summer samples | Parameter TSI | Expected TSI range for lakes in same ecoregion | Number of samples |
|--------------------------------------|---------------------------------------|---------------|--|-------------------|
| Transparency (meters) | 3 | 46 | N/A | 510 |
| Chlorophyll-a (parts per billion) | 10 | 53 | N/A | 86 |
| Total Phosphorus (parts per billion) | 26 | 51 | N/A | 86 |

Water transparency is an excellent indicator of water quality, and the majority of these data are collected by volunteers. Join the MPCA's [Citizen Lake Monitoring Program](#) and help collect this important information for your lake.

APPENDIX L

Publicly Owned Stormwater BMP Inventory



MS4 Pond, Wetland, and Lake Inventory Form

Municipal Separate Storm Sewer System (MS4) Program

Doc Type: Plans/Specifications/Maps

| Name of MS4 Permittee | Date form completed | Unique ID Number | Type of Feature (Pond, Wetland or Lake) | Feature Common Name (If Applicable) | Y Coordinate (Latitude) Decimal Degrees | X Coordinate (Longitude) Decimal Degrees |
|-----------------------|---------------------|------------------|---|-------------------------------------|---|--|
| City of Shorewood | 5/2/2016 | Basin-1 | Dry Pond | | 44.894 | -93.5997 |
| City of Shorewood | 5/2/2016 | Basin-3 | Dry Pond | | 44.9033 | -93.6005 |
| City of Shorewood | 5/2/2016 | Basin-4 | Dry Pond | | 44.8912 | -93.5626 |
| City of Shorewood | 5/2/2016 | Basin-5 | Infiltration Basin | | 44.9005 | -93.587 |
| City of Shorewood | 5/2/2016 | Basin-6 | Infiltration Basin | | 44.893 | -93.6341 |
| City of Shorewood | 5/2/2016 | Basin-7 | Infiltration Basin | | 44.8932 | -93.6328 |
| City of Shorewood | 5/2/2016 | Basin-8 | Infiltration Basin | | 44.9003 | -93.6158 |
| City of Shorewood | 5/2/2016 | Basin-9 | Other | | 44.8993 | -93.5255 |
| City of Shorewood | 5/2/2016 | Basin-10 | Other | | 44.9007 | -93.5779 |
| City of Shorewood | 5/2/2016 | Basin-11 | Other | | 44.904 | -93.623 |
| City of Shorewood | 5/2/2016 | Basin-12 | Wet Pond | | 44.9004 | -93.608 |
| City of Shorewood | 5/2/2016 | Basin-13 | Wet Pond | | 44.9016 | -93.5503 |
| City of Shorewood | 5/2/2016 | Basin-14 | Wet Pond | | 44.8965 | -93.5859 |
| City of Shorewood | 5/2/2016 | Basin-15 | Wet Pond | | 44.9019 | -93.5906 |
| City of Shorewood | 5/2/2016 | Basin-16 | Wet Pond | | 44.8915 | -93.6341 |
| City of Shorewood | 5/2/2016 | Basin-17 | Wet Pond | | 44.892 | -93.6336 |
| City of Shorewood | 5/2/2016 | Basin-18 | Wet Pond | | 44.8939 | -93.606 |
| City of Shorewood | 5/2/2016 | Basin-19 | Wet Pond | | 44.9038 | -93.5282 |
| City of Shorewood | 5/2/2016 | Basin-20 | Wet Pond | | 44.895 | -93.5811 |
| City of Shorewood | 5/2/2016 | Basin-21 | Wet Pond | | 44.9022 | -93.6136 |
| City of Shorewood | 5/2/2016 | Basin-22 | Wet Pond | | 44.8996 | -93.5862 |
| City of Shorewood | 5/2/2016 | Basin-23 | Wet Pond | | 44.9126 | -93.5409 |
| City of Shorewood | 5/2/2016 | Basin-24 | Wet Pond | | 44.9119 | -93.5421 |
| City of Shorewood | 5/2/2016 | Basin-25 | Wet Pond | | 44.8965 | -93.6151 |
| City of Shorewood | 5/2/2016 | Basin-26 | Wet Pond | | 44.9087 | -93.5318 |
| City of Shorewood | 5/2/2016 | Basin-27 | Wet Pond | | 44.908 | -93.529 |
| City of Shorewood | 5/2/2016 | Basin-28 | Wet Pond | | 44.9155 | -93.5372 |
| City of Shorewood | 5/2/2016 | Basin-29 | Wet Pond | | 44.9141 | -93.5407 |
| City of Shorewood | 5/2/2016 | Basin-30 | Wet Pond | | 44.8923 | -93.5832 |
| City of Shorewood | 5/2/2016 | Basin-31 | Wet Pond | | 44.8924 | -93.584 |
| City of Shorewood | 5/2/2016 | Basin-32 | Wet Pond | | 44.9014 | -93.5903 |
| City of Shorewood | 5/2/2016 | Basin-33 | Wet Pond | | 44.9001 | -93.5982 |
| City of Shorewood | 5/2/2016 | Basin-34 | Wet Pond | | 44.8998 | -93.6061 |
| City of Shorewood | 5/2/2016 | Basin-35 | Wet Pond | | 44.8972 | -93.615 |

| Name of MS4 Permittee | Date form completed | Unique ID Number | Type of Feature (Pond, Wetland or Lake) | Feature Common Name (If Applicable) | Y Coordinate (Latitude) Decimal Degrees | X Coordinate (Longitude) Decimal Degrees |
|-----------------------|---------------------|------------------|---|-------------------------------------|---|--|
| City of Shorewood | 5/2/2016 | Basin-36 | Wet Pond | | 44.8968 | -93.6138 |
| City of Shorewood | 5/2/2016 | Basin-37 | Wet Pond | | 44.902 | -93.6164 |
| City of Shorewood | 5/2/2016 | Basin-38 | Wet Pond | | 44.9001 | -93.6184 |
| City of Shorewood | 5/2/2016 | Basin-39 | Wet Pond | | 44.9 | -93.6212 |
| City of Shorewood | 5/2/2016 | Basin-40 | Wet Pond | | 44.8979 | -93.629 |
| City of Shorewood | 5/2/2016 | Basin-41 | Wet Pond | | 44.9005 | -93.63 |
| City of Shorewood | 5/2/2016 | Basin-42 | Wet Pond | | 44.9004 | -93.6312 |
| City of Shorewood | 5/2/2016 | Basin-43 | Wet Pond | | 44.8988 | -93.6325 |
| City of Shorewood | 5/2/2016 | Basin-44 | Wet Pond | | 44.8925 | -93.5589 |
| City of Shorewood | 5/2/2016 | Basin-45 | Wet Pond | | 44.9012 | -93.5493 |
| City of Shorewood | 5/2/2016 | Basin-46 | Wet Pond | | 44.893 | -93.5238 |
| City of Shorewood | 5/2/2016 | Basin-47 | Wet Pond | | 44.8931 | -93.5273 |
| City of Shorewood | 5/2/2016 | Basin-48 | Wet Pond | | 44.8959 | -93.5237 |
| City of Shorewood | 5/2/2016 | Basin-49 | Wet Pond | | 44.8953 | -93.5272 |
| City of Shorewood | 5/2/2016 | Basin-50 | Wet Pond | | 44.8954 | -93.5236 |
| City of Shorewood | 5/2/2016 | Basin-51 | Wet Pond | | 44.9064 | -93.5412 |
| City of Shorewood | 5/2/2016 | Basin-52 | Wet Pond | | 44.904 | -93.5909 |
| City of Shorewood | 5/2/2016 | Basin-53 | Wetland | | 44.9133 | -93.5379 |
| City of Shorewood | 5/2/2016 | Basin-54 | Wetland | | 44.9105 | -93.5425 |
| City of Shorewood | 5/2/2016 | Basin-55 | Wetland | | 44.9177 | -93.5466 |
| City of Shorewood | 5/2/2016 | Basin-56 | Wetland | | 44.9188 | -93.5383 |
| City of Shorewood | 5/2/2016 | Basin-57 | Wetland | | 44.9172 | -93.5374 |
| City of Shorewood | 5/2/2016 | Basin-58 | Wetland | | 44.9111 | -93.5366 |
| City of Shorewood | 5/2/2016 | Basin-59 | Wetland | | 44.9097 | -93.5293 |
| City of Shorewood | 5/2/2016 | Basin-60 | Wetland | | 44.8998 | -93.5288 |
| City of Shorewood | 5/2/2016 | Basin-61 | Wetland | | 44.8914 | -93.5308 |
| City of Shorewood | 5/2/2016 | Basin-62 | Wetland | | 44.9066 | -93.5431 |
| City of Shorewood | 5/2/2016 | Basin-63 | Wet Pond | | 44.9074 | -93.5433 |
| City of Shorewood | 5/2/2016 | Basin-64 | Wetland | | 44.894 | -93.5599 |
| City of Shorewood | 5/2/2016 | Basin-65 | Wetland | | 44.8968 | -93.5647 |
| City of Shorewood | 5/2/2016 | Basin-66 | Wetland | | 44.8927 | -93.5672 |
| City of Shorewood | 5/2/2016 | Basin-67 | Wetland | | 44.8915 | -93.5698 |
| City of Shorewood | 5/2/2016 | Basin-68 | Wetland | | 44.8932 | -93.5718 |
| City of Shorewood | 5/2/2016 | Basin-69 | Wetland | | 44.8953 | -93.5825 |
| City of Shorewood | 5/2/2016 | Basin-70 | Wetland | | 44.8919 | -93.5879 |
| City of Shorewood | 5/2/2016 | Basin-71 | Wet Pond | | 44.8942 | -93.6064 |
| City of Shorewood | 5/2/2016 | Basin-72 | Wetland | | 44.8932 | -93.6308 |
| City of Shorewood | 5/2/2016 | Basin-73 | Wetland | | 44.8955 | -93.6363 |
| City of Shorewood | 5/2/2016 | Basin-74 | Wetland | | 44.9013 | -93.6238 |
| City of Shorewood | 5/2/2016 | Basin-75 | Wetland | | 44.9039 | -93.6094 |

| Name of MS4 Permittee | Date form completed | Unique ID Number | Type of Feature (Pond, Wetland or Lake) | Feature Common Name (If Applicable) | Y Coordinate (Latitude) Decimal Degrees | X Coordinate (Longitude) Decimal Degrees |
|-----------------------|---------------------|------------------|---|-------------------------------------|---|--|
| City of Shorewood | 5/2/2016 | Basin-76 | Wetland | | 44.9066 | -93.6015 |
| City of Shorewood | 5/2/2016 | Basin-77 | Wetland | | 44.9022 | -93.5913 |
| City of Shorewood | 5/2/2016 | Basin-78 | Wet Pond | | 44.9044 | -93.5869 |
| City of Shorewood | 5/2/2016 | Basin-79 | Wetland | | 44.903 | -93.5835 |
| City of Shorewood | 5/2/2016 | Basin-80 | Wetland | | 44.8995 | -93.584 |
| City of Shorewood | 5/2/2016 | Basin-81 | Wetland | | 44.8987 | -93.5844 |
| City of Shorewood | 5/2/2016 | Basin-82 | Lake | Lake Mary | 44.8973 | -93.5836 |
| City of Shorewood | 5/2/2016 | Basin-83 | Wetland | | 44.9024 | -93.5783 |
| City of Shorewood | 5/2/2016 | Basin-84 | Wetland | | 44.8952 | -93.534 |
| City of Shorewood | 5/2/2016 | Basin-85 | Wetland | | 44.9048 | -93.6164 |
| City of Shorewood | 5/2/2016 | Basin-86 | Wetland | | 44.9053 | -93.6054 |
| City of Shorewood | 5/2/2016 | Basin-87 | Wetland | | 44.9034 | -93.5909 |