City of Inver Grove Heights
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THIRD GENERATION Water Resources Management Plan

For:

City of Inver Grove Heights

December 8, 2014

WSB Project No. 1702-25

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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.

Jacob Newhall, P.E. Reg. No. 49170

Third Generation Water Resources Management Plan
City of Inver Grove Heights

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1.0 Executive Summary

1.0 Location and History

The City of Inver Grove Heights (City) is located in northern Dakota County, about 10 miles south of downtown St. Paul. The City covers 19,205 acres, or 30 square miles, and has a current population of about 34,000. The City is expected to have a population of approximately 40,000 by 2020. **Figure 1** in **Appendix A** shows the location of the City in the seven-county Twin Cities Metropolitan Area.

The City of Inver Grove Heights traces its beginnings to 1852, when pioneers staked claims in an area known as Inver Grove. Attracted by the area's access to the Mississippi River, these settlers from Ireland and Germany quickly established a community. Those of Irish decent clustered their farms along what is now known as Rich Valley Boulevard, which had been built by Captain William B. Dodd's military crews from Fort Snelling. Settlers from Germany laid claim to the wooded farmland in the northwest portion of the community, clearing and cultivating fields among the area lakes. Other settlers from France and England built homes along the Mississippi River.

By April of 1858, the Township of Inver Grove Heights was incorporated and the first Board of Supervisors was elected. From 1858 until 1880, hundreds of settlers were attracted to the township that was named after an Irish fishing village ("Inver") and commemorating the homeland of the German settlers ("Grove"). By 1880 the area consisted of more than 240 individual farms, four churches, and four school districts.

In 1886 the Chicago Great Western Railroad was built in the township adjacent to the river attracting hotels, taverns, butcher shops, and a railroad repair center; this area became known as the "Village." The Town Board built a town hall and jail and had jurisdiction over the schools in the area. The original town hall was replaced by a second village hall that was constructed on Doane Trail in the 1930s as part of a W.P.A. project. The current City Hall complex was constructed in the 1980s.

As commercial and industrial expansion took place in the late 1880s, people living in the one square mile area adjacent to the railroad separated themselves from the surrounding area by incorporating as the Village of Inver Grove in 1909. The two entities existed side by side for more than 56 years. After considerable debate, voters chose to create the City of Inver Grove Heights in 1965 by combining the village and the township into one government entity.

1.1 Purpose & Scope

The purpose of this Water Resources Management Plan (WRMP) is identical to the purpose given in Minnesota Statute 103B.201 for metropolitan water management programs. According to statute, the purposes of these water management programs are to:

- Protect, preserve, and use natural surface and groundwater storage and retention systems;
- Minimize public capital expenditures needed to correct flooding and water quality problems;
- Identify and plan for means to effectively protect and improve surface and groundwater quality;
- Establish more uniform local policies and official controls for surface and groundwater management;
- Prevent erosion of soil into surface water systems;

- Promote groundwater recharge;
- Protect and enhance fish and wildlife habitat and water recreational facilities; and
- Secure the other benefits associated with proper management of surface and ground water.

This WRMP will guide the City of Inver Grove Heights in protecting, preserving, and managing its surface water resources and stormwater system. This plan meets the requirements of Minnesota Statutes 103B.235, Minnesota Rules Chapter 8410, and the watershed organizations with jurisdiction in the City—the Lower Mississippi River Watershed Management Organization (LMRWMO) and the Eagan-Inver Grove Heights WMO.. **Figure 1-2** in **Appendix A** shows the coverage of the LMRWMO and the Eagan-Inver Grove Heights WMO in the City.

1.2 Water Resource Management Related Agreements

The City of Inver Grove Heights has entered into the following water resource management related agreements:

1. Joint Powers Agreement establishing the Lower Mississippi River Watershed Management Organization (LMRWMO)—the original joint powers agreement between the seven member cities (including Inver Grove Heights) went into effect in 1985. The revised and restated joint powers agreement was developed and signed in 2001, after LMRWMO adoption of the second generation watershed management plan. The 3rd Generation LMRWMO watershed management plan was completed in August of 2011. The joint powers agreement for the LMRWMO was amended in 2014 to include additional area in Mendota Heights.

2. Joint Powers Agreement establishing the Eagan-Inver Grove Heights Watershed Management Organization. This agreement went into effect on January 7, 2014.

3. Joint Powers Agreement with the City of Eagan regarding the Southern Lakes water tower, which includes discussions about storm sewers.

1.3 Plan Organization and Summary of Problems/Issues, Goals, and Potential Solutions

The Inver Grove Heights Water Resources Management Plan (WRMP) sets the course for the City's management of the water resources and stormwater within the City. The WRMP provides data and other background information, outlines the applicable regulations, assesses city-wide and specific issues, sets goals and policies for the City and its resources, and lists implementation tasks to achieve the goals. The WRMP also provides information regarding the funding of the implementation program. The WRMP is organized into six major sections, summarized as follows:

Section 1.0 Executive Summary
Section 1 provides information about the City's location and history, and summarizes the highlights of the WRMP, including the WRMP purpose and scope, goals, policies and implementation tasks.

Section 2.0 Land and Water Resource Inventory
Section 2 provides technical information describing the surface and subsurface conditions of the City. The first part of Section 2 (Section 2.0) presents the city-wide inventory, including land use, public utilities, climate and precipitation, topography, soils, geology, groundwater, MDNR public waters, wetlands, surface water resource monitoring information, water body classification, floodplain information, unique features and scenic areas, pollutant sources, and major basins and

overall drainage patterns. The second part of Section 2 (Section 2.1) presents an inventory of the 22 major drainage basins in the City, including information about watersheds, watershed area, land use, and other notable information. This information is presented in Sections 2.1.1 through 2.1.22:

2.1.1 110th Street Drainage Basin	2.1.12 Northwest Drainage Basin
2.1.2 Albavar Path Drainage Basin	2.1.13 Old Village Drainage Basin
2.1.3 Arbor Pointe Drainage Basin	2.1.14 Pine Bend Drainage Basin
2.1.4 Argenta Trail Drainage Basin	2.1.15 Rich Valley Drainage Basin
2.1.5 Babcock Trail Drainage Basin	2.1.16 Rosemount Drainage Basin
2.1.6 Barnes Avenue Drainage Basin	2.1.17 Simley Lake Drainage Basin
2.1.7 Eagan Drainage Basin	2.1.18 Skyline Village Drainage Basin
2.1.8 Highway 110-494 Drainage Basin	2.1.19 South Grove Drainage Basin
2.1.9 Inver Grove Trail Drainage Basin	2.1.20 South Marcott Lakes Drainage Basin
2.1.10 Jefferson Trail Drainage Basin	2.1.21 Sunfish Lake Drainage Basin
2.1.11 Mississippi River Drainage Basin	2.1.22 Valley Park Drainage Basin

Section 2 includes a number of maps, such as city-wide maps of land use, MDNR public waters, wetlands, and drainage basins, and maps showing the drainage patterns for each major drainage basin. This section also includes a number of tables, such as precipitation information, the City's lakes and their classification, water quality information, and tables for each drainage basin summarizing the watershed data and hydrologic modeling results.

Section 3.0 Goals and Policies

Section 3 presents the WRMP's purpose; background goals, policies, and other information from the City's 2030 Comprehensive Plan (completed March 2010), the Northwest Area Guiding Documents and Ordinances; the City's goals and policies; and the regulatory framework and agency responsibilities. The WRMP goals and policies are organized to cover nine major topics:

3.3.1 Water quality of lakes and ponds

Goal:

Water bodies designated as lakes by the City (see ***Table 2-8****) will be managed to meet the City's water quality criteria or for non-degradation of water quality, with allowance for natural variability.*

The WRMP includes policies that reference the City's lake classification system, which is presented in Section 2. Specific policies call for the City to: recruit volunteers to collect water quality data for the City lakes; use the monitoring data to determine appropriate lake management actions; address future total maximum daily load (TMDL) requirements; and to require or seek opportunities to provide pretreatment of stormwater runoff.

3.3.2 Stormwater runoff quality, rates, and volumes

Goal 1:
Operate, manage, and maintain the City's stormwater system to ensure proper functioning of the system and to meet the requirements of the City's NPDES Phase II MS4 Permit and other agency requirements.

Under this goal, the WRMP includes policies pertaining to the City's NPDES Phase II MS4 Permit and SWPPP, including the City's preparation of a loading assessment and nondegradation report.

Goal 2:
Improve the quality of stormwater runoff reaching the Mississippi River by reducing nonpoint source pollution (including sediment) carried as stormwater runoff.

Goal 3:
Minimize flood damage to residential, business, commercial and public structures and property, and protect against increased flooding caused by land disturbing activities and other projects.

Goal 4:
Reduce volumes of stormwater runoff and the amount of impervious surfaces in the developed parts of the City.

Goal 5:
In the Northwest Area—limit the rates and volumes, and increase the treatment of stormwater runoff, by managing stormwater runoff as close to its source as possible and mimicking the system's natural hydrology.

Under these goals, the WRMP includes policies requiring implementation of best management practices (BMPs) to reduce total suspended solids and total phosphorus by 85% and 55%, respectively; requiring submittal of stormwater management plans for land alteration and development activities; requiring infiltration of the first 1 inch of runoff from new impervious surfaces; requiring implementation of low impact development techniques in the Northwest Area and considering their implementation in other parts of the City; requiring developers follow the City's stormwater guidance document for the Northwest Area; requiring the placement of skimming devices at pond outlets, requiring post-development peak discharge rates to not exceed existing discharge rates for the 2-year, 10-year, and 100-year events; requiring 10-year "level of service" and 100-year level of protection for the City's stormwater system; describing the City's response to citizen-identified drainage issues; and requiring WMO review and approval of projects with intercommunity impacts. There should be no increase in volume for the 5-year, 24 hour event. For additional information regarding Low Impact Development (LID) required design concepts please refer to the Northwest Area Stormwater Manual on the City's website.

3.3.3 Floodplain management

Goal:
Minimize flood damage to residential, business, commercial, and public structures and property, and protect against increased flooding caused by land disturbing activities and other projects.

Under this goal, the WRMP includes policies calling for the City to implement and enforce its ordinances to prevent/minimize flood damages, including lowest floor elevation requirements (with special requirements for landlocked basins); removal of structures in the Mississippi River floodplain in the Old Village/Concord Boulevard neighborhoods; and to consider recruiting volunteers to monitor water levels on City lakes.

3.3.4 Erosion and sediment control

Goal 1:
Prevent erosion and sedimentation to the greatest extent possible.

Goal 2:
Regulate land-disturbing activities to protect against erosion and sedimentation.

Goal 3:
Implement soil protection and sedimentation controls to maintain health, safety, and welfare.

Goal 4:
Enforce erosion and sediment controls consistent with ordinances, SWPPP, and MS4 Program.

Under these goals, the WRMP includes policies regarding the City's general requirements for preparation and submittal of erosion and sediment control plans, calling for City inspection of projects; and calling for the City to collect a cash surety. The City's existing Erosion Control Ordinances will be updated consistent with the SWPPP Application for Reauthorization.

3.3.5 Wetland management

Goal 1:
Preserve wetlands for water retention, recharge, soil conservation, wildlife habitat, aesthetics, and natural enhancement of water quality.

Goal 2:
Achieve no net loss of wetlands, in conformance with the Minnesota Wetland Conservation Act (WCA) and associated rules (Minnesota Rules 8420).

Under these goals, the WRMP includes policies regarding the City's role as the Local Government Unit (LGU) responsible for administering the Wetland Conservation Act; and calling for the City to complete a phased wetland inventory and assessment, implement wetland management standards in the Northwest Area and consider implementing such standards in other areas of the City, and finalize the development of the City's wetlands ordinance.

3.3.6 Recreation, habitat and shoreland management

Goal:
Protect and enhance fish and wildlife habitat and recreation opportunities, and maintain shoreland integrity.

Under this goal, the WRMP includes policies calling for the City to continue enforcing its shoreland ordinance and Critical Area Plan, implement natural resource management standards in the Northwest Area and consider implementing such standards in other areas of the City, maintain existing public access to City lakes and seek to obtain easements for passive access to lakes where there is currently no access (i.e., during development or redevelopment), consider performing natural resource inventories, and consider identifying disturbed shoreland areas.

3.3.7 Education and public involvement

Goal 1:
Increase public support of the City's stormwater and water resource related efforts.

Goal 2:
Inform the public about the City's water resources and stormwater system, including their use, protection, and management.

Goal 3:
Raise public awareness regarding the steps they can take to reduce pollutants in stormwater runoff.

Goal 4:
Involve the public in stormwater management programs and decision-making.

Goal 5:
Perform public education and outreach, and invite public participation and involvement consistent with the City's NPDES Phase II MS4 Permit.

Under these goals, the WRMP includes policies calling for the City to implement the education and public involvement-related BMPs identified in the City's SWPPP for its NPDES Phase II MS4 permit, consider recruiting and training volunteers for monitoring and other activities, and to incorporate public involvement and public education efforts into all of the City's significant proposed projects.

3.3.8 Groundwater

Goal 1:
Protect the quality and quantity of the City's groundwater resources and aquifer recharge areas.

The City is developing a wellhead protection plan (started in 2012). Once completed and adopted, the City will implement this document. This includes encouraging groundwater recharge and protection of groundwater recharge areas, and continued implementation of its SSTS ordinance.

Goal 2:
The City will continue to participate in the Southeast Metro Groundwater Group.

3.3.9 Funding

Goal 1:
Achieve appropriate funding level through the City's stormwater utility to fund the costs of the City's stormwater system.

The City established a Stormwater Utility Ordinance in 2007 without any fee structure adopted. In 2011, a fee schedule was approved and billings began in 2012.

Adequate funding is essential for the City to implement its WRMP policies. Under this goal, the WRMP includes policies calling for the City to continue to review and update stormwater utility. As appropriate, the City will request cost sharing and/or grant assistance from the LMRWMO for intercommunity water resource projects; and seek LMRWMO assistance in determining cost allocations for intercommunity projects.

Goal 2:
Pursue grant funding to assist in funding stormwater improvement projects. This may include working with Dakota County Soil and Water Conservation District as well as other programs.

Section 4.0 Assessment of Problems and Issues
This section presents and discusses the status of problems and issues in the City, in the following topic areas: water quality, stormwater runoff rates and volumes, erosion and sediment control, and adequacy of existing programs. Within each topic area (except adequacy of existing programs), general issues are discussed first, followed by more specific issues. The unresolved or ongoing location-specific issues discussed in this section are shown on **Figure 4-1**.

Water quality
Under this topic, the WRMP discusses general stormwater runoff quality issues (e.g., nonpoint source runoff and phosphorus loadings), impaired waters and TMDL issues (e.g., reaches of the Mississippi River on the impaired waters list, and MPCA impaired waters listing criteria according to ecoregion), and specific water quality issues.

Stormwater runoff rates and volumes
Under this topic, the WRMP discusses general issues (e.g., impacts of land development on stormwater rates and volumes, landlocked basin issues, flooding damages, and floodplain management) and specific issues (e.g., intercommunity issues—Seidls Lake, Dawn Way and 59th Street, Trailer Court Pond (MnDOT), Babcock Trail, Argenta Trail Drainage Basin, and Eagan Drainage Basin); and local city issues— Dixie Avenue/Dickman Trail Stormwater Improvements, 78th St/Concord Blvd Stormwater Improvements, 64th St/Doffing Ave Storm Sewer Improvements, Concord Blvd/77th St/Dickman Trail Storm Sewer Improvements, properties in the floodplain of the Mississippi River in the Old Village/Concord Boulevard neighborhoods, provision for future discharge from Babcock Trail and Valley Park drainage basins into the South Grove drainage basins, Marcott Lakes high water levels, and citizen-identified drainage issues.

Erosion and sediment control
Under this topic, the WRMP discusses the general causes and impacts of erosion and sedimentation, specific examples of erosion and sedimentation problems in the City, the City's implementation and enforcement of its ordinances and approval processes pertaining to erosion and sediment control, and the NPDES construction permit.

Adequacy of existing programs
This section discusses the adequacy of the City's ordinances and official controls (including a description of the City's stormwater guidance document for the Northwest Area (*Inver Grove Heights Stormwater Manual Northwest Area (December 2006)*), the LMRWMO classification system, the City's education and public involvement program, maintenance of the City's stormwater system, groundwater protection, and the City's capital improvement and implementation programs.

In 2014, the City and Barr Engineering initiated a Special Studies Report to review and update modeling, mapping, and subwatershed information to account for development and other changes. The City intends to continue to update the stormwater maps and modeling as development occurs (maintain a current, frequently updated model).

Section 5.0 Implementation Program
Section 5 describes the significant components of the City's WRMP implementation program, including its NPDES Phase II MS4 permit, operation and maintenance of its stormwater system, education and public involvement, funding, design standards, ordinance implementation and official controls, implementation priorities, and WRMP update and amendment procedures.

The implementation program is presented at the end of Section 5 in **Table 5-1**. The implementation program includes a project description, cost estimate, potential funding sources, and proposed year of implementation for every year from 2014-2023.

Section 6.0 References

Appendix A – Figures

Appendix B – Inver Grove Heights Storm Water Pollution Prevention Program (SWPPP) Application for Reauthorization and MS4 General Permit

2.0 Land and Water Resource Inventory

2.0 City-wide Inventory

This section provides city-wide land and water resource information, including land use, public utilities, climate and precipitation, topography, soils, geology and groundwater, MDNR public waters, wetlands, water resources monitoring information, lakes/water body classification systems, unique features and scenic areas, pollutant sources, and major drainage basins and drainage patterns.

2.0.1 Land Use

Figure 2-1 shows existing land use in Inver Grove Heights (from the City's 2030 Comprehensive Plan). The land use map shows the land use in the City as residential, with concentrated areas of commercial development in the area of the Highway 52 and I-494 intersection, in the 110 and Mendota Road area, and at various locations along Cahill Avenue; business and industrial areas along the river, adjacent to the South St. Paul airport, and in the southern part of the City along, and west of, Highway 52; and large amounts of undeveloped land in the southern and western parts of the City. **Figure 2-2** shows the anticipated future land use in the City and **Figure 2-3** shows the proposed land use in the Northwest Area of the City. The land use maps show that most of the land use changes are projected to occur in the Northwest Area of the City, within the Metropolitan Urban Services Area (MUSA) boundary, in the form of new development. Smaller land use changes, most in the form of redevelopment, are anticipated in the older/northern parts of the City.

Inver Grove Heights is affected by the state Critical Areas Act and the federally designated Mississippi National River and Recreation Area (MNRRA). The Minnesota State Legislature enacted the Critical Areas Act in 1973 and an executive order (79-19) was signed in 1976 declaring the Mississippi River corridor a Critical Area. The executive order states the following purposes for the Critical Area designation:

1. To protect and preserve a unique and valuable state and regional resource for the benefit of the health, safety and welfare of the citizens for the state, region, and nation;

2. To prevent and mitigate irreversible damage to this state, regional and national resource;

3. To preserve and enhance its natural, aesthetic, cultural, and historical value for the public use;

4. To protect and preserve the river as an essential element in the national, state and regional transportation, sewer and water and recreational systems; and

5. To protect and preserve the biological and ecological functions of the corridor.

The Critical Area includes 72 miles of the river, extending from the cities of Dayton and Ramsey to just south of Hastings. The boundary of the Critical Area can generally be described as from the river bluff down to the river, with the corridor width varying.

In 1976, four corridor districts were established, corresponding to the following different types of land use along the Mississippi River: rural open space district, urban developed district, urban open space district, and urban diversified district. Each district has its own set of guidelines. Three of these districts—rural open space district, urban developed district and urban diversified district—are within Inver Grove Heights. The Critical Area Act requires that each city having jurisdiction over land within the Critical Area develop a Critical Area Plan. Executive Order 79-19 includes the rules and guidelines that each city must incorporate in its Critical Area Plan.

In 1988, the U.S. Congress designated the Mississippi River corridor as the Mississippi National River and Recreation Area (MNRRA), a unit of the national park system. The boundaries of the MNRRA corridor are the same as the Critical Area corridor. MNRRA was established to:

1. Protect, preserve, and enhance the significant values of the Mississippi River corridor through the Twin Cities metropolitan area;

2. Encourage coordination of federal, state, and local programs; and

3. Provide a management framework to assist the state of Minnesota and local governments in the development and implementation of integrated resource management programs and ensure orderly public and private development in the area.

The Mississippi River Coordinating Commission and the National Park Service adopted the MNRRA *Comprehensive Management Plan* in 1995. This plan adopts and incorporates by reference the state Critical Area Program, Shoreland Management Program, and other applicable state and regional land use management programs. The MNRRA comprehensive plan also identifies voluntary policies that are additional to the Critical Area requirements, for the purpose of protecting and enhancing river resources. The earlier Critical Area requirements are referred to as Tier 1 criteria, whereas the additional voluntary guidelines in the MNRRA comprehensive plan are referred to as Tier 2 criteria. Although a city's conformance with Tier 2 criteria is not mandatory, conformance to Tier 2 criteria is necessary to receive federal grants for land acquisition and development.

The City of Inver Grove Heights' comprehensive plan conforms to Tier 1 criteria and calls for the city to consider meeting Tier 2 criteria to take advantage of the additional funding sources.

2.0.2 Public Utilities

The Metropolitan Urban Service Area (MUSA) is the area delineated by the Metropolitan Council in their *Regional Blueprint*, where urbanization is expected to occur, and where metropolitan service systems (particularly sanitary sewer and major highways/interchanges) will be provided to accommodate growth. The future land use map (**Figure 2-2**) shows the MUSA boundary in Inver Grove Heights. About 53% of the land in the City of Inver Grove Heights lies within the MUSA.

Inver Grove Heights obtains its municipal water supplies from groundwater aquifers. Areas of large lot development (outside the MUSA) within the City are served by private individual wells and subsurface sewage treatment systems (SSTS). There are currently 1,461 SSTS in the City and this number is expected to increase to approximately 1,600 based on 2030 land use.

2.0.3 Climate and Precipitation

Because of its location near the center of the North American continent, Inver Grove Heights (and Minnesota) has a continental climate, meaning it experiences a wide variation in climate conditions (e.g., droughts and floods, heat and cold).

The mean annual temperature for Inver Grove Heights is 46.2°F, as measured at the Minneapolis/ St. Paul (MSP) airport station (1981-2010). Mean monthly temperatures vary from15.6°F in January to 73.8°F in July (1981-2000).Extreme temperatures recorded were a high of 108°F on July 14, 1936 and a low of -34°F on January 1, 1936 and January 19, 1970. For the period 1948-2005, the average date for latest occurrence of freezing temperatures ranges from April 29 at MSP to May 7 at the Rosemount station, while the average date for the first autumn frost is October 7 at MSP and September 29 at Rosemount. The average frost-free period (growing season) is 148 days at Rosemount and 161 days at MSP.

Table 2-1 summarizes precipitation data for the MSP airport station. Average total annual precipitation (1981-2010) is 29.8 inches. Monthly precipitation totals have ranged from a low of 0.09 inches in 2007, to a high of 9.34 inches in 2012. The mean monthly precipitation (2000-2013) varies from 4.423 inches in June to 0.6 inches in January. From May to September, the growing season months, the average rainfall (2000-2023) is 18.8 inches, or about 63 percent of the average annual precipitation. Average annual lake evaporation is about 31 inches.

Average annual snowfall (2000-2013) is 56.3 inches at the MSP airport station. Extreme snowfall records range from 98.6 inches during the 1983-1984 season to 14.2 inches during the 1930-1931 season.

The amount, rate, and type of precipitation are important in determining flood levels and stormwater runoff rates, all of which impact water resources. In urbanized watersheds, shorter duration events tend to play a larger role in predicting high water levels on basins. Shorter duration events are generally used by hydrologists to study local issues (sizing catch basins, storm sewer pipes, etc.). Longer duration events are generally used by hydrologists to study regional issues, such as predicting high water levels for regional basins and basins that have no outlets (landlocked), or have small outlets relative to their watershed size.

Snowmelt and rainstorms that occur with snowmelt in early spring are significant in this region. The volumes of runoff generated, although they occur over a long period, can have significant impacts where the contributing drainage area to a lake or pond is large and the outlet is small (or there is no outlet).

Average weather imposes little strain on the typical stormwater drainage system. Extremes of precipitation and snowmelt are important for design of flood control systems. The National Weather Service has data on extreme precipitation events that can be used to aid in the design of flood control systems. Extremes of snowmelt most often affect major rivers, the design of large stormwater storage areas, and landlocked basins, while extremes of precipitation most often affect the design of conveyance facilities.

In contrast with stormwater drainage facilities, stormwater quality treatment systems are designed based on the smaller, more frequent storms. These more frequent storms account for the majority of the annual pollutant loadings from urban watersheds.

Atlas 14 was published in 2013 and is the most up to date precipitation frequency and duration information (previously the TP-40 and TP-49 issued by the National Weather Bureau was used) The 2-year Atlas 14 rainfall event occurring over a 24-hour period produces approximately 2.8 inches. The 10-year Atlas 14 rainfall event occurring over a 24-hour period produces approximately 4.2 inches. The 100-year Atlas 14 rainfall event occurring over a 24-hour period produces approximately 7.4 inches. The City recognizes the 100-year, 10-day runoff to be 10.9 inches (refer to the Northwest Area AUAR and guiding documents). This data was obtained from the Atlas 14 website produced by the National Oceanic and Atmospheric Administration (NOAA) and **Figure 2-1** (A) of the *National Engineering Handbook*, Section 4, Hydrology, Soil Conservation Service, August 1972. Additional precipitation information for the area can be obtained from the National Oceanic and Atmospheric Administration (NOAA) website at http://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html?bkmrk=mn.

- 2-year event = 50% chance of occurring in any given year
- 100-year event = 1% chance of occurring in any given year

Table 2-2 lists many of the precipitation and runoff events used for design purposes.
Even with wide variations in climate conditions, climatologists have found four significant climate trends in the Upper Midwest (*Minnesota Weather Almanac,* Seeley, 2006):

- Warmer winters
- Higher minimum temperatures
- Higher dew points
- Changes in precipitation trends – more rainfall is coming from heavy thunderstorm events and increased snowfall

According to the Soil and Water Conservation Society's (SWCS) 2003 report on climate change, total precipitation amounts in the United States (and in the Great Lakes region) are trending upward, as are storm intensities. Precipitation records in the Twin Cities area show the annual average precipitation has increased, as shown in the following example:

- Minneapolis-St. Paul Airport station – the average annual precipitation has increased from 29.41 inches (1971-2000 average) to 29.83 inches, a 1.4% increase (data from the Climatology Working Group website: http://climate.umn.edu/).

As noted by the SWCS, increased storm intensities result in increased soil erosion and increased runoff. The MPCA's global warming website (http://www.pca.state.mn.us/hot/globalwarming.html) states that increased flooding could also result from more intense precipitation events.

Climate information can be obtained from a number of sources, such as the following websites:

- For climate information about the Twin Cities metropolitan area: http://climate.umn.edu/doc/twin_cities/twin_cities.htm
- For a wide range of Minnesota climate information: http://climate.umn.edu/
- For other Minnesota climate information: http://www.dnr.state.mn.us/climate/index.html

2.0.4 Topography

The City's topography is a result of its glacial history. The most recent glaciation took place about 12,000 years ago (the Pleistocene era). As the glaciers moved across the land, they cut and moved large amounts of material, sometimes carrying it for long distances. As the glaciers retreated, this material (called glacial drift) was left behind and reworked by the resulting glacial meltwater. Three geologic features/landforms are present in Inver Grove Heights: 1) glacial moraine; 2) outwash plain; and 3) fluvial landforms.

Glacial moraines (i.e. termination points of a glacial advance) cover large areas of Inver Grove Heights. This landform, also called knob and kettle topography, is characterized by rolling to hilly terrain interspersed with poorly drained depressions that form many deep ponds and lakes.

An area of outwash plain extends into south/southwest Inver Grove Heights from central Dakota County. Outwash plains were created as water from the melting glaciers reworked the debris carried by the glaciers. Outwash plains contain some of the richest gravel deposits in the metropolitan area.

Fluvial landforms are formed from river and stream flows. In Inver Grove Heights, this landform is found in the Mississippi River valley. The valley is characterized by a broad river bottom floodplain and steep side slopes in southern Inver Grove Heights.

The Mississippi River bluffs and the ravines that cut through them form the main areas of steep slope. Two other major areas of steep topography include the Marcott chain of lakes area and the area lying between Highway 52 and Cahill Avenue (North and South Valley Parks lie within this area). A large area of land with slopes exceeding 12 percent lies north of Cliff Road and west of Rich Valley Road. Steep slopes are also found around the ponds and depressions throughout much of the City. Flat and relatively flat areas can be found along the Mississippi River floodplain.

The bluffs, ravines, and other steep slopes are usually wooded or overgrown with underbrush. These steep-sloped areas are not suitable for development. However, they are important because of the wildlife they support and their natural beauty. Erosion can be a problem in areas of steep slope. The highest elevation in Inver Grove Heights is 1,040 feet above sea level, in the southwestern part of the City, along 105th Street West, between Rich Valley Boulevard and Akron Avenue. The lowest elevation is approximately 688 feet above sea level, at the extreme southeast corner of the City in the Mississippi River floodplain.

Dakota County has 2-foot contour interval topographic mapping available for the entire county. This mapping was used for the hydrologic analyses performed as part of this plan. There are also 10-foot contour interval topographic maps available from the U.S. Geological Survey.

2.0.5 Soils

Soil composition, slope and land management practices determine the effect of soils on stream and lake water quality. Soil composition and slope are important factors affecting the rate and volume of stormwater runoff. The shape and stability of aggregates of soil particles—expressed as soil structure—influence the permeability, infiltration rate, and erodibility of soils. Slope is important in determining stormwater runoff rates and, hence, the soil's susceptibility to erosion.

Infiltration capacities of soils affect the amount of direct runoff resulting from rainfall. Soils with high infiltration rates have a lower potential for runoff. Conversely, soils with low infiltration rates produce high runoff volumes and high peak discharge rates.

Four general soil hydrologic groups have been established by the Natural Resources Conservation Service (NRCS—formerly the Soil Conservation Service). These groups are:

- **Group A** Low runoff potential—high infiltration rate
- **Group B** Moderate infiltration rate
- **Group C** Slow infiltration rate
- **Group D** High runoff potential—very slow infiltration rate

The hydrologic grouping symbols (A-D) are combined with land use and used to estimate the amount of runoff that will occur over a given area for a particular rainfall amount. The Dakota County soil survey lists the hydrologic soil groups in its tables, but does not map the soils according to these groupings.

Urbanization changes the character of soil—typically resulting in decreased infiltration rates. As land is developed for urban use, much of the soil is covered with impervious surfaces, and soils in the remaining areas are significantly disturbed and altered. Development often results in consolidation of the soil and tends to reduce infiltration capacity of otherwise permeable soils, resulting in significantly greater amounts of runoff. Grading, plantings, and tended lawns tend to dominate the landscape in urbanized areas and may become more important factors in runoff generation than the original soil type. The topography of the City, characterized by numerous small depressions and steep slopes, also causes stormwater to runoff quickly with less time available for infiltration.

With the exception of the Mississippi River floodplain, the soils in the City generally consist of well-drained soils formed in loamy and sandy glacial till and outwash. The subsoils in the City are generally sand. In the undeveloped areas in the southern and northwestern parts of the City the soils are generally Kingsley-Mahtomedi soils and Waukegan-Wadena-Hawick soils. In the southern part of the City, the Kingsley-Mahtomedi soils are prominent, while the Waukegan-Wadena-Hawick soils run in a band from northwest to southeast through the Marcott chain of lakes area. The northwestern part of the City also contains large areas of Otterholt silt loam. Most of the soil along the Mississippi River is “alluvium,” which is either a silty, sandy, or loamy soil on nearly level floodplains or fill material on wet substratum. The Dakota County soil survey maps indicate soils that are nearly level to very gently sloping, generally poorly-drained and located in floodplain areas.

The Dakota County soil survey contains maps showing generalized and detailed soils information. The following generalized soil and land descriptions are taken from the county soil maps.

Kingsley-Mahtomedi soils are generally loamy and sandy soils, which are well drained and moderately coarse textured. These soils are generally found on gently sloping to very steep land, much of it urban, and are also found on uplands. These soils are 40 percent Kingsley, 12 percent Mahtomedi, and 40 percent minor soils. Kingsley soils typically consist of an eight-inch thick surface layer of black sandy loam, followed by a four-inch thick subsurface layer of brown loamy sand, followed by a 26-inch thick subsoil. The subsoil is dark brown and reddish brown sandy loam in the upper part, and dark brown sandy loam in the lower part. The underlying material is dark brown sandy loam with layers of loamy sand. Mahtomedi soils typically consist of a five-inch thick surface layer of very dark grayish brown loamy sand, followed by a 30-inch thick subsoil of dark brown and dark yellowish brown gravelly coarse sand. The underlying material to a depth of about 60 inches is yellowish brown stratified sand and coarse sand. Both of these soils are suitable for subsurface sewage treatment systems (SSTS). Erosion, complex slopes, and susceptibility to drought make Kingsley-Mahtomedi soils generally poorly suited to crop cultivation.

Waukegan-Wadena-Hawick soils are generally silty, loamy, and sandy soils, which are well drained to excessively drained soils found on level to very steep land on outwash plains and terraces. These soils are 36 percent Waukegan, 22 percent Wadena, eight percent Hawick soils, and 34 percent minor soils. Waukegan soils are similar to Kingsley soils; they are well drained silt loams with a bottom layer of gravelly sand. Wadena soils are also well drained loams, sandy loams and loamy sands, while Hawick soils are sandy loams, loamy sands and gravelly sands. These soils are suitable for subsurface sewage treatment systems (SSTS), although Wadena and Hawick soils should be tested to assure the soil will filter the effluent. Waukegan-Wadena-Hawick soils are well suited for crop cultivation, as well as road and building construction.

Otterholt silt loam is a well-drained soil found on side slopes and broad hillcrests on end moraines. Irregular in shape, the individual soil areas range in size from less than five acres to 30 acres. The soil consists of a two-inch thick very dark grayish brown surface layer, followed by a nine-inch thick subsurface layer of brown silt sand, followed by a 24-inch thick subsoil of dark yellowish brown silt loam. The underlying material to a depth of about 60 inches is reddish brown sandy loam to dark brown loam. In some areas, the silt mantle is less than 30 inches thick. Building foundations and footings on Otterholt soils should be designed to accommodate soil shrinking and swelling. The moderate permeability of these soils restricts its use for SSTS. Although it erodes easily, Otterholt soils are well suited to agricultural crops.

More information about soils can be obtained from the Dakota County soil survey.

2.0.6 Geology and Groundwater

2.0.6.1 Geology

The geology of Inver Grove Heights consists of three major units: 1) Quaternary or surface geology—includes all of the (primarily glacial) deposits above the bedrock formations; 2) Paleozoic or bedrock geology—includes several layers of limestone, dolomite, sandstone, and shales; and 3) Proterozoic or basement geology—includes basalts and crystalline igneous rocks. This sequence is depicted in the generalized regional stratigraphic column shown on **Figure 2-4**. The stratigraphic column shows the vertical relationship of the units, their approximate thickness and their water-bearing capabilities.

The subcropping bedrock units in the City are the Decorah shale, the Platteville and Glenwood formations, the St. Peter sandstone, the Prairie du Chien dolomite, the Jordan sandstone, and the Tunnel City Group. Subcropping bedrock is the first bedrock encountered below the overlying soils. The youngest subcropping bedrock units, such as the Decorah shale, occur in the far northern part of the City, while the older subcropping bedrock units, such as the Jordan sandstone and Tunnel City Group, occur in the southern part of the City. All of these bedrock units are sedimentary rocks deposited by shallow seas during Paleozoic Era, approximately 225 to 600 million years ago. The bedrock formations form part of a gently sloping bowl-like structure centered under the Minneapolis-St. Paul metropolitan area, known as the Twin Cities Basin. The Dakota County geologic atlas contains more information about the subcropping bedrock units.

The quaternary (surface) geology in the City consists of glacial deposits of varying thickness covering most of the bedrock in the City. The thickest deposit lies over the extensive buried bedrock valley located in southern Inver Grove Heights. The bedrock valley was carved during the Pleistocene era by advancing and retreating glaciers and by erosion from streams inhabiting the valley during inter-glacial periods. Later, this valley was buried under thick deposits of stream and glacial sand and gravel. The deposits that buried the bedrock valley are approximately 400 feet thick, even 500 feet thick or more in places, while the glacial deposits in the northern and eastern parts of the City are less than 50 feet thick, with exposed bedrock along the cliffs of the Mississippi River banks.

2.0.6.2 Groundwater Resources

Two types of aquifers are present in Inver Grove Heights: surficial (quaternary) aquifers and bedrock aquifers. The following paragraphs provide general information about the aquifers in the City; for more information, the reader is referred to the Dakota County geologic atlas and the *Dakota County Groundwater Protection Plan*.

2.0.6.2.1 Surficial (Quaternary) Aquifers

Surficial (quaternary) aquifers are water-bearing layers of sediment, usually sand and gravel, which lie close to the ground surface. The highest yielding surficial aquifers are generally located in buried bedrock valleys. Many domestic and some irrigation wells in the City draw water from these aquifers. Many private drinking water wells were constructed in surficial aquifers, especially those constructed prior to the first state Well Code in 1974. Since the surficial aquifers are more susceptible to pollution, they are not used for municipal or public supply wells. In some locations, the aquifer could provide sufficient water yield for some non-potable industrial uses.

Recharge to the surficial aquifers is primarily through the downward percolation of local precipitation. Some surficial aquifers may also be recharged during periods of high stream stage. Surficial aquifers may discharge to local lakes, streams or to the underlying bedrock.

A large number of ponds and lakes are scattered throughout the southern part of the City and recharge the groundwater. Many of these water bodies are landlocked and their only outlet is to the groundwater. Some of the landlocked lakes are probably perched above the regional level of the shallow groundwater in the watershed.

2.0.6.2.2 Bedrock Aquifers

Five major bedrock aquifers are available for water supply in the City. The major bedrock aquifers are, in order of use and development: (1) Prairie du Chien-Jordan, (2) Mt. Simon-Hinckley, (3) Tunnel City Wonewoc, (4) St. Peter, and (5) Platteville. The aquifer used most often for water supply in the City is the Prairie du Chien-Jordan aquifer. The Prairie du Chien-Jordan aquifer is high yielding, more easily tapped than deeper aquifers, has very good water quality and is continuous through most of the City.

The groundwater level in the Prairie du Chien-Jordan aquifer varies from about 700 feet to more than 800 feet above mean sea level as shown in the county geologic atlas. The aquifer is recharged in areas where thin permeable drift overlies the limestone layers. Some recharge of this aquifer occurs locally from percolation through the overlying glacial deposits or St. Peter sandstone. However, hydrogeologic considerations suggest this recharge would be a minimal contribution to the aquifer flow. Regional recharge of the Prairie du Chien-Jordan aquifer occurs to the south, in Freeborn and Mower Counties. Groundwater movement in the aquifer is generally from south to north, toward the Minnesota and Mississippi Rivers. The drift-filled bedrock valley in the southern portion of the City cuts deeply into the Prairie du Chien-Jordan aquifer, creating a direct connection between the aquifer and the surficial groundwater in the glacial drift. Hence, any contamination percolating through the glacial drift in the bedrock valley may enter the bedrock aquifer system.

The aquifer with the highest water quality and highest possible yields is the Mt. Simon-Hinckley aquifer, but it is more expensive to use than the Prairie du Chien-Jordan because of its greater depth and there are limitations to its use. Minnesota statutes limit appropriations from the Mt. Simon-Hinckley aquifer to potable water uses, where there are no feasible or practical alternatives, and where a water conservation plan is incorporated with the appropriations permit. The water level of the Mt. Simon-Hinckley has been nearly constant, at about 700 feet above mean sea level. Recharge of the Mt. Simon-Hinckley takes place far north of the City, where the bedrock is closer to the surface, and occurs by percolation through the overlying drift and bedrock. Groundwater movement in the aquifer is generally to the southeast. The local direction of groundwater flow in the Twin Cities area tends to be toward the western suburbs, due to pumping of the aquifer.

The City of Inver Grove Heights obtains its municipal water from the Prairie du Chien-Jordan and the Mt. Simon-Hinckley aquifers.

2.0.7 MDNR Public Waters

Figure 2-5 shows the MDNR public waters within Inver Grove Heights. Other than the Mississippi River, which borders the City, there are no public water courses (streams or ditches) in the City. The MDNR designates certain water resources as public waters to indicate those lakes, wetlands, and watercourses over which the MDNR has regulatory jurisdiction. By statute, the definition of public waters includes “public waters” and “public waters wetlands.”

Public waters are all water basins and watercourses that meet the criteria set forth in Minnesota Statutes, Section 103G.005, subd. 15 that are identified on Public Water Inventory maps and lists authorized by Minnesota Statutes, Section 103G.201. **Public waters wetlands** include all type 3, type 4, and type 5 wetlands (as defined in U.S. Fish and Wildlife Service Circular No. 39, 1971 edition) that are 10 acres or more in size in unincorporated areas or 2 ½ acres or more in size in incorporated areas (see Minnesota Statutes Section 103G.005, subd. 15a and 17b).

The MDNR uses county-scale maps to show the general location of the public waters and public waters wetlands (lakes, wetlands, and watercourses) under its regulatory jurisdiction. These maps are commonly known as Public Waters Inventory (PWI) maps. The regulatory “boundary” of these waters and wetlands is called the ordinary high water level (OHWL). PWI maps are available on a county-by-county basis. Additionally, county-by-county lists of these waters are available in tabular form. The PWI maps and lists are available on the MDNR’s website (http://www.dnr.state.mn.us/waters/watermgmt_section/pwi/maps.html).

2.0.8 NPDES Permit

Under the U.S. Environmental Protection Agency’s (EPA) Storm Water Phase II National Pollutant Discharge Elimination System (NPDES) Rules, small municipal separate storm sewer systems (“MS4s”) serving populations under 100,000 that are located in urbanized areas are required to obtain a NPDES Phase II Storm Water permit under the Clean Water Act. MS4s must develop, implement, and enforce a Storm Water Pollution Prevention Program (SWPPP) designed to minimize the discharge of pollutants from the MS4, to protect water quality, and to satisfy the appropriate water quality requirements of the Clean Water Act. The MPCA identified the City of Inver Grove Heights as a MS4 based on the 2000 census.

The City applied for and received a NPDES Phase II MS4 Permit in 2003 and applied for reissuance in 2006. In 2013, the City Applied for MS4 Permit reauthorization. City’s permit was extended by MPCA on March 17, 2014. The City is required to meet the permit requirements outlined in the City’s reauthorization document and general permit. As part of the permit, the City prepared and adopted a SWPPP. The SWPPP outlines the appropriate best management practices (BMPs) for the City of Inver Grove Heights to control or reduce the pollutants in stormwater runoff to the maximum extent practicable. The City will accomplish this through the implementation of the BMPs outlined within its SWPPP. These BMPs could be a combination of education, maintenance, control techniques, system design and engineering methods, ordinances, policies, enforcement response procedures, standard operating procedures, and other such provisions that are appropriate to meet the requirements of the NDPES Phase II permit. BMPs have been prepared to address each of the six minimum control measures as outlined in the rules:

1. Public education and outreach on stormwater impacts
2. Public participation/involvement
3. Illicit discharge detection and elimination
4. Construction site stormwater runoff control
5. Post-construction stormwater management in new development and redevelopment
6. Pollution prevention/good housekeeping for municipal operations

For each of these six minimum control measures, the City identified appropriate BMPs, along with measurable goals, an implementation schedule, and the persons responsible to complete each measure.

The MPCA revised the NPDES permit program in 2006 to require 30 of the permitted MS4s to complete a nondegradation review. Inver Grove Heights is one of these 30 MS4s and completed its nondegradation review in 2008 (*Nondegradation Review, January 2008,* City of Inver Grove Heights, prepared by Bonestroo). Inver Grove Heights' nondegradation review consisted of a loading assessment and the City's nondegradation report. The City's nondegradation report focused on mitigation through implementation of infiltration design guidelines, with an emphasis on controls over new development and redevelopment. Inver Grove Heights modified its SWPPP to include a new BMP summary sheet regarding implementation and annual reporting of this infiltration design guidance.

The SWPPP BMP implementation program is incorporated into the City's overall stormwater implementation program (**Table 5-1**).

Prior to June 30 of each year of the five-year permit cycle, the City must hold an annual public meeting. At this meeting, the City distributes educational materials and presents an overview of the MS4 program and the City's SWPPP. The City also receives oral and written statements and considers them for inclusion into the SWPPP.

Also prior to June 30, the City must submit an annual report to the MPCA. This annual report summarizes the following:

1. **Status of Compliance with Permit Conditions**. The annual report contains an assessment of the appropriateness of the BMPs and the City's progress toward achieving the identified measurable goals for each of the minimum control measures. This assessment is based on results collected and analyzed, inspection findings, and public input received during the reporting period.

2. **Work Plan**. The annual report lists the stormwater activities that are planned to be undertaken in the next reporting cycle.

3. **Modifications to the SWPPP**. The annual report identifies any changes to BMPs or measurable goals for any of the minimum control measures.

4. **Notice of Coordinated Activities.** A notice is included in the annual report for any portions of the permit for which a government entity or organization outside of the MS4 is being utilized to fulfill any BMP contained in the SWPPP.

The City's SWPPP Application for Reauthorization from 2013 as well as the City's General Permit is included in **Appendix B**

2.0.9 Wetlands

The City of Inver Grove Heights contains a large number of wetlands—over 630, according to the National Wetlands Inventory (NWI) (U.S. Fish & Wildlife Service) mapping. Because of the large number of wetlands in Inver Grove Heights, the City is implementing a phased approach to completing wetland inventories and assessments in the City, focusing on the areas where the information is most needed. Two inventories and assessment have already been completed; these are described in the following paragraphs.

2.0.9.1 Wetland Inventory and Assessment

The City completed wetland inventories and assessments in two large parts of the City: the Northwest Expansion Area (now referred to as the Northwest Area) and the Southwest Study Area. The results of these inventories are shown on **Figure 2-6**. For areas outside of the two study areas, **Figure 2-6** also shows the wetlands identified on the NWI mapping.

Bonestroo, Rosene, Anderlik & Associates completed the studies and used the same methodology for both study areas, which included the following steps:

1. Preliminary identification of wetland sites—Preliminary wetland locations were identified from NWI mapping and plotted on 1997 (Northwest Area) and 2000 (Southwest Study Area) digital orthographic quad data from the U.S. Geological Survey. Infrared aerial photographs from the MDNR served as an additional source of information.

2. Field assessment and determination of community type—the field assessment involved a qualitative evaluation of each wetland site, which included identifying plant species and determining the wetland's predominant hydrology. These two criteria were used to determine the wetland community type (e.g. sedge meadow, wet meadow, shallow marsh) for each wetland site. The field data were entered into a Microsoft Access database, which allowed the data to be used for the Minnesota Routine Assessment Method (MNRAM), Version 2.0. MNRAM is a field evaluation tool that assesses and assigns value to many qualitative wetland functions. For these wetland studies, the following criteria were evaluated in MNRAM:

    a. Floristic quality
    b. Wildlife habitat value
    c. Aesthetic/recreational/educational/cultural value
    d. Stormwater susceptibility, based on the community type and community quality and the State of Minnesota Storm-Water Advisory Group's publication *Storm-Water and Wetlands: Planning and Evaluation Guidelines for Addressing Potential Impacts of Urban Storm-Water and Snow-Melt Runoff on Wetlands* (1997).

3. Wetland ranking—Wetland quality was determined using the following modified MNRAM criteria:
    a. Levels of native plant diversity
    b. Exotic/invasive species infestations
    c. Adjacent land uses
    d. Other disturbance indicators

   Using MNRAM, a qualitative value (low, medium, high, or exceptional) was assigned for each wetland function. These qualitative values were given a numeric score and combined with a stormwater susceptibility score to arrive at an overall wetland rank. Wetlands were ranked from I – IV, with I being the highest quality. The following equation shows the wetland ranking system:

   Wetland Rank[4] = Floral Diversity[1] + Wildlife Habitat[2] + Stormwater Susceptibility[3]

   Notes:
   [1]Score based on modified MNRAM methodology:
   Exceptional or High = 4; Medium High = 3; Medium = 2; Low or Medium Low = 1
   [2]Score based on modified MNRAM methodology:
   Exceptional = 4; High = 3; Medium High = 2.5; Medium = 2; Medium Low = 1.5; Low = 1
   [3]Based on modified Storm-Water Advisory Group guidance:
   Highly susceptible = 4; Moderately = 3; Slightly = 2; Least = 1
   [4]Wetland ranking based on total score:

Rank	Total Score	Description
I	10.25 – 12	Exceptional
II	7.25 – 10.20	High
III	4.75 – 7.2	Medium
IV	3 – 4.70	Low

Northwest Area

The Northwest Area covers approximately 3,140 acres (or 16%) of the City. As part of the natural resource inventory completed for the Northwest Area, 184 wetlands were assessed (*Inver Grove Heights Northwest Area Natural Resource Inventory and Management Plan*, (NRI) 2003). The field work for the inventory was completed in 1999.

In the Northwest Area, the wetland rank was converted to an "NRI Rank" so that uplands and wetlands could be ranked on a single scale:

Wetland Rank	**NRI Rank**
I	Exceptional
II	High
III	Medium
IV	Low

The wetlands (and natural areas) were then placed into management classifications (Manage 1, Manage 2, Manage 3, Manage 4) by a process that considered both the NRI Rank and "local value criteria." The local value criteria take into account the value of a site from a local perspective, with input provided by an advisory committee (the Local Advisory Committee). A flowchart in the NRI document shows how the natural resources (wetlands and uplands) were placed into the management classifications.

The results of the wetland inventory, assessment, and management classification in the Northwest Expansion Area are summarized in **Tables 2-3** and **2-4** and shown on **Figure 2-6**.

Southwest Study Area
The Southwest Study Area covers about 2,900 acres (or 15%) of the City. 75 wetlands were assessed in the Southwest Study Area (*Review Draft, Wetland Inventory and Assessment, Southwest Study Area,* 2002). The field work for the inventory was completed in 2001.

The results of the wetland inventory, assessment, and ranking for the Southwest Study Area are summarized in **Tables 2-5** and **2-6** and shown on **Figure 2-6**. Eleven potential wetland sites were assigned identification numbers but no data were collected. Two of the sites were determined to be non-wetlands, one site was an artificial/created pond, and the remaining eight sites are located on Xcel Energy property. Data were not collected on the Xcel Energy sites because it is unlikely the property will be developed for other land use and unlikely they will be available for stormwater management.

2.0.9.2 Wetland Management Standards—Northwest Area

The Northwest Area NRI developed wetland management standards and recommendations based on the wetland management classification. The recommended wetland management standards are shown in **Table 2-7**. The Northwest Expansion Area Alternative Urban Areawide Review (AUAR, 2005) calls for the implementation of these standards and recommendations in the study area.

The recommended wetland management standards in **Table 2-7** are intended to work as follows:

- Buffer strips filter sediments and can reduce local runoff
- Structural setbacks attempt to minimize encroachment on the buffer and excessive transport of nutrients/water into a wetland
- Pretreatment manages the amount of nutrients (primarily targeting phosphorus) that enters a basin. Inherent in the methods used for phosphorus removal is the removal of sediment from runoff.
- Stormwater quantity/storm bounce controls keep the duration of elevated water levels in a wetland within limits that will not damage the wetland type.

Additional wetland management recommendations from the NRI include:

- Installation of permanent signs/markers to locate the edges of buffers
- Monitoring of grading within buffer strip areas during construction
- Regular inspection of erosion and sediment controls during construction
- Review of standards and recommendations with MDNR prior to development proposed to occur near a MDNR public water

2.0.9.3 Wetland Ordinance

The City is currently developing a new wetland ordinance as part of a larger effort to update the City's water resource-related ordinances. The City's current stormwater management ordinance (Title 9, Chapter 5) contains a number of provisions that apply to wetlands. Inver Grove Heights is the local government unit responsible for administering the Wetland Conservation Act and rules in the City.

The new wetland ordinance will require the classification of wetlands for both development and redevelopment projects that are greater than one acre in size. This is in accordance with section 5.5.3 Policy B of the LMRWMO Plan. The City will use a wetland classification system as described in the LMRWMO Plan section 5.5.3 Policy C and D.

2.0.10 Water Resources Monitoring Information

The City has a large number of lakes and ponds, but little water quality data has been collected. The following paragraphs present the water quality information for the following significant water bodies in the City: Simley Lake, Marcott/Rosenberger Lake, Marcott/Ohmans Lake, Dickman Lake, Hornbean Lake, Golf Course Pond, Schmitt Lake, Seidls Lake, and an unnamed/Marcott Lakes water body (DNR #19-263W).

Simley Lake

Between 1995 and 2002, Simley Lake water quality was sampled through the Metropolitan Council's Citizen Assisted Monitoring Program (CAMP). A volunteer collected the water quality samples. The following table summarizes the "lake water quality summary information" for Simley Lake found on the MPCA's website.

Water Quality Summary – Simley Lake

Water Quality Constituent	Average (Range)	Number of Observations
Total Phosphorus	42 ug/L (10 – 103 ug/L)	72
Chlorophyll-a	19.6 ug/L (1 – 110 ug/L)	85
Secchi Disc	1.2 m (0 – 4 m)	72

The MDNR conducted a fisheries survey on July 15, 2002. The survey noted that Simley Lake is part of the MDNR's children's fishing pond program. The MDNR stocks the lake annually with bluegills and black crappie. The survey found a small number of other game fish present (i.e. walleye, northern pike and largemouth bass).

Marcott Lakes/Rosenberger Lake

Between 1995 and 2002, Marcott Lakes/Rosenberger Lake water quality was sampled through the Metropolitan Council's Citizen Assisted Monitoring Program (CAMP). A volunteer collected the water quality samples. The following table summarizes the "lake water quality summary information" for Marcott Lakes/Rosenberger Lake found on the MPCA's website.

Water Quality Summary – Marcott Lakes/Rosenberger Lake

Water Quality Constituent	Average (Range)	Number of Observations
Total Phosphorus	21 ug/L (10 – 37 ug/L)	49
Chlorophyll-a	4.2 ug/L (1 – 21 ug/L)	58
Secchi Disc	2.6 m (1 – 4 m)	49

The MDNR conducted a fisheries survey on June 13, 1991. The survey found abundant numbers of small-sized black bullhead and bluegill. The survey noted that the simple species complex and the abundance of black bullhead in the lake indicate frequent winter kill events.

Marcott Lakes/Ohmans Lake

The MPCA's Website has water quality data for Marcott Lakes/Ohmans Lake for 1988-89, through the Citizen Lake Monitoring Program; 1996, through the MN Lakes LCMR study; 1997, through the MPCA's Lake Monitoring Program Project; and 2013, through CAMP. The 2013 monitoring did not include total phosphorous or Chlorophyll-a sampling, but did include dissolved oxygen (DO) and pH levels. . The following table summarizes the water quality information.

Water Quality Summary – Marcott Lakes/Ohmans Lake

Water Quality Constituent	Average (Range)	Number of Observations
Total Phosphorus (1996, 1997)	48 ug/L (20 – 133 ug/L)	3
Chlorophyll-a (1988-89; 1996, 1997)	5 ug/L (2 – 6 ug/L)	3
Secchi Disc (all years)	4.2 m (1.4 – 5.8)	62
DO (2013)	8.6 mg/L (1.2 – 14.2 mg/L)	5
pH (2013)	7.9 (6.9 – 8.5)	4

Dickman Lake

"Lake water quality summary information" is available for Dickman Lake on the MPCA's website, although the years of sampling are not provided. The following table summarizes the water quality information.

Water Quality Summary – Dickman Lake

Water Quality Constituent	Average (Range)	Number of Observations
Total Phosphorus	120 ug/L (103 – 136 ug/L)	2
Chlorophyll-a	72.6 ug/L (59 – 86 ug/L)	2
Secchi Disc	0.8 m (N/A)	1

Hornbean Lake

Between 1994 and 2005, the City of Sunfish Lake (through WSB & Associates, Inc.) collected water quality samples on Hornbean Lake. From 2006 to 2010, water quality samples were collected by a Sunfish Lake resident volunteer, as part of the Metropolitan Council's Citizen Assisted Monitoring Program (CAMP). The following table summarizes the historical water sampling program for Hornbean Lake:

Historical Water Quality Sampling – Hornbean Lake

Year	Water Quality Constituents Sampled1	Number of Sampling Events
1994	**TP, Chl-a, TKN, TFe**	**4**
1995	**TP, Chl-a, TKN, TFe**	**1 (winter)**
1997	**TP, Ortho-P, Chl-a, SD, TKN, TFe**	**3**
2002	**TP, Ortho-P, Chl-a, SD, TSS, TKN**	**3**
2005	**TP, Ortho-P, Chl-a, SD, TKN**	**3**
2006	**TP, Chl-a, TKN, SD, Phe-a**	**11**
2007	**TP, Chl-a, TKN, SD, Phe-a**	**8**
2008	**TP, Chl-a, TKN, SD, Phe-a**	**7**
2009	**TP, Chl-a, TKN, SD, Phe-a**	**4**
2010	**TP, Chl-a, TKN, SD, Phe-a**	**2**

[1] TP = Total phosphorus; Ortho-P = Ortho-Phosphorus; Chl-a = Chlorophyll-a; SD = Secchi disc transparency, TSS = Total suspended solids; TKN = total Kjeldahl nitrogen; TFe = Total iron; Phe-a = Pheophytin a

The following table summarizes the 2005-2010 water quality data:

2005-2010 Water Quality Summary – Hornbean Lake

Water Quality Constituent	2005-2010 Average (Range)
Total Phosphorus	49 ug/L (19 – 103 ug/L)
Chlorophyll-a	18 ug/L (2.6 – 87 ug/L)
Secchi Disc	1.8 m/5.9 ft (0.3 – 4.0 m/1.0 – 13.1 ft)

Golf Course Pond

"Lake water quality summary information" is available for Golf Course Pond on the MPCA's website, although the years of sampling are not provided. The only water quality data available are Secchi disc transparencies. The average Secchi disc transparency is 0.3 meters, based on nine observations.

Schmitt Lake

No water quality data is available for Schmitt Lake.

Seidls Lake

Seidls Lake is a 14-acre water body located in both South St. Paul and Inver Grove Heights. The lake has a maximum depth of 17 feet. The lake is surrounded by parkland in both cities, which is heavily wooded with steep topography. There is an observation platform on Seidls Lake, but no public access or beach. Seidls Lake has no surface water outlet (it is "landlocked").

Between 1995 and 2012, Seidls Lake water quality was sampled through the Metropolitan Council's Citizen Assisted Monitoring Program (CAMP). A volunteer collected the water quality samples. The following table summarizes the "lake water quality summary information" for Seidls Lake found on the MPCA's website.

Water Quality Summary – Seidls Lake

Water Quality Constituent	Average (Range)	Number of Observations
Total Phosphorus	66 ug/L (10 – 368 ug/L)	185
Chlorophyll-a	26.0 ug/L (1 – 130 ug/L)	185
Secchi Disc	1.3 m (0.25 – 3 m)	381

Unnamed/Marcott Lakes (DNR #19-263W)

In 1995, a volunteer sampled the water quality of this unnamed part of the Marcott chain of lakes as part of the Metropolitan Council's Citizen Assisted Monitoring Program (CAMP). The following table summarizes the "lake water quality summary information" for this water body found on the MPCA's website.

Water Quality Summary – Unnamed/Marcott Lakes (DNR #19-263W)

Water Quality Constituent	Average (Range)	Number of Observations
Total Phosphorus	54 ug/L (15 – 150 ug/L)	9
Chlorophyll-a	34.2 ug/L (4 – 74 ug/L)	9
Secchi Disc	0.9 m (0 – 1 m)	9

2.0.11 Lakes/Water Body Classification System (LMRWMO)

2.0.11.1 Lake Classification – Lower Mississippi River WMO

The LMRWMO has adopted a water body classification system similar to that of the MPCA. The City's waterbody classification system is consistent with the LMRWMO classification system.

Table 2.9 will be used to help classify water bodies as deep lakes, shallow lakes, wetlands, and ponds. The pond column has been added to the MPCA's table by the City to provide a classification for water bodies that may be considered ponds. The classification system determines whether a water body should be managed as a deep lake, shallow lake, wetland, or pond and takes into account the rank and desired level of protection.

The LMRWMO designated certain water bodies as "intercommunity water resources." The LMRWMO is responsible for classifying, setting goals, monitoring water quality, tracking water quality trends, and implementing lake management actions for intercommunity water resources. In Inver Grove Heights, the intercommunity resources and their classifications are:

Water Body	**DNR Number**	**City Classification**
Schmitt Lake	19-52P	NCHF Shallow[1]
Dickman Lake	19-46P	NCHF Shallow [1]
Bohrer Pond	19-34P	NCHF Shallow [1]
Hornbean Lake (also lies in the City of Sunfish Lake)	19-47P	NCHF Shallow
Golf Course Pond	19-49P	NCHF Shallow
Seidls Pond/Lake (also lies in the City of South St. Paul)	19-95W	NCHF Shallow
Trailer Court Pond	Not DNR public water	NCHF Shallow

[1] Little or no water quality data is available. Water quality monitoring data is needed to verify this classification.
[2] Action Level = Secchi disc reading, as set by the LMRWMO. Depending on the relationship between the most recent water quality data and the action level, and the long-term water quality trend, the LMRWMO recommends implementing different lake water quality management actions.
[3] LMRWMO set the action level based on classification.

2.0.11.2 City System for Classifying Water Bodies

The City of Inver Grove Heights manages lakes differently than wetlands, so it is important to differentiate between the two. The City used the MPCA's "Guidance Manual for Assessing the Quality of Minnesota Surface Waters for the Determination of Impairment" (October 2005) to categorize water bodies as lakes or wetlands. According to the guidance document, a water body is a lake if it meets all of the following requirements:

- Listed in MDNR Bulletin 25
- Not listed as a wetland (i.e., DNR public waters number ends in "W") in the MDNR Public Waters Inventory
- 10 acres or larger
- Hydraulic residence time of at least 14 days

For the purposes of this plan, the City will consider a water body to be a lake if it is:

1. A DNR-listed public water, but not listed as a wetland (i.e., DNR number is 19-xxxx-P, not "W"); and
2. 10 acres or larger in water surface area

Table 2-8 lists the City-designated lakes in Inver Grove Heights. The table also shows the City's lake classification for each water body, which is based on the MPCA's impaired waters listing criteria and whether the lake is deep/shallow and the lake lies within the North Central Hardwood Forest (NCHF) or

Western Corn Belt Plains (WCBP) ecoregion (see **Section 4.1.2**). The depth and/or littoral area of a number of the lakes are not known, in those instances the classification is based on an assumed depth and/or littoral area. The City's classification system is as follows:

If the lake is located in the following ecoregion:	And, it meets the MPCA's definition for:	Then, it is given the following City classification:
NCHF	Deep	NCHF Deep
	Shallow	NCHF Shallow
WCBP	Deep	WCBP Deep
	Shallow	WCBP Shallow

The following water quality criteria apply to the City's lake classifications, and are based on the MPCA's impaired waters listing criteria or proposed listing criteria.

City Classification	Water Quality Constituent & Criteria		
	Total Phosphorus ug/L (ppb)	Chlorophyll-a ug/L (ppb)	Secchi Disc meters
NCHF Deep[1]	<40	<15	≥1.2
NCHF Shallow[2]	<60	<20	≥1.0
WCBP Deep[1]	<70	<24	≥1.0
WCBP Shallow[2]	<90	<30	≥0.7

[1]Current listing criteria, taken from *Guidance Manual for Assessing the Quality of Minnesota Surface Waters for the Determination of Impairment, 305(b) Report and 303(d) List* (MPCA, October 2005).
[2]Proposed listing criteria, taken from *Minnesota Lake Water Quality Assessment Report: Developing Nutrient Criteria, Third Edition* (MPCA, September 2005).

The following paragraphs present general information about the City-designated lakes.

Bohrer Pond (DNR #19-34P)
Bohrer Pond is a 20-acre lake located in northeaster Inver Grove Heights in watershed IP-01, adjacent to the South St. Paul airport. The depth of Bohrer Pond is unknown. Bohrer Pond is an LMRWMO-designated intercommunity resource. There are small areas of parkland on the southwest and northwest sides of the lake, but there is no public access on the lake. Land use in the watershed includes the South St. Paul airport, and industrial, commercial, and high and low density residential land uses. Most of the watershed is developed.

McGroarty Pond (DNR #19-35P)
McGroarty Pond is a 16-acre lake located in northern Inver Grove Heights in watershed ID-86, southwest of the intersection of Upper 55th Street and Highway 52. The depth of McGroarty Pond is unknown. There is a small area of parkland on the east side of the lake, but there is no public access on the lake. Land use in the watershed includes highway and low density residential land uses. There is a small amount of undeveloped land in the watershed.

Unnamed (DNR #19-36P)
This unnamed water body is a 17-acre lake located in northwestern Inver Grove Heights in watersheds FP-3, 4, 7, 1. Argenta Trail West bisects the water body. The depth of the waterbody is unknown. There is no adjacent parkland and no public access on the lake. Land use in the watershed includes a small amount of low density residential and agricultural land uses. There are large areas of undeveloped land in the watershed.

Simley Lake (DNR #19-37P)
Simley Lake is an 11-acre lake located in central Inver Grove Heights in watershed DP-21, at the intersection of Cahill Avenue East and 80th Street East. Simley Lake has a maximum depth of 17 feet. There is a small city park, comprised of the island in the middle of the lake. Access to the park is limited to a pedestrian trail to the island. There is no public access on the lake. Land use in the watershed includes a high school, commercial land use, and residential land uses. Most of the watershed is developed.

Unnamed (DNR #19-38P)
This unnamed water body is an 11-acre lake located in central Inver Grove Heights in watershed DP-32, at the intersection of Cahill Avenue East and College Trail East. The depth of this water body is unknown. There is a small amount of parkland at the far eastern shore of the lake, which extends south along the west side of Cahill Avenue. There is no public access on the lake. Land use in the watershed includes a high school, and low density residential land uses. Most of the watershed is developed.

Marcott Lakes/Rosenberger Lake (DNR #19-41P)
Rosenberger Lake is one of the lakes that make up the Marcott Lakes chain. It is a 25-acre lake located in west central Inver Grove Heights, in watershed EP-080a, near the southeast intersection of T.H. 55 and South Robert Trail. The maximum depth of Rosenberger Lake is 26 feet. There is no adjoining park land nor public access to this lake (or to any of the Marcott chain of lakes). Land use in the watershed is currently a mixture of low density residential, highway, and undeveloped land.

Marcott Lakes/Ohmans Lake (DNR-#19-42P)
Ohmans Lake is the south end of the Marcott Lakes chain. It is a 32-acre lake located in west central Inver Grove Heights, in watershed SML-C-3 and SML-C-1, south of T.H. 55 and between Barnes Avenue East and South Robert Trail. The maximum depth of Ohmans Lake is 33 feet. The lake is made up of three interconnected basins. There is no adjoining park land nor public access to this lake (or to any of the Marcott chain of lakes). Land use in the watershed is mostly undeveloped land, with a small amount of low density residential land.

Unnamed (DNR #19-43P)
This unnamed water body is a 14-acre lake located in southwest Inver Grove Heights in watershed RV-M-7, at the intersection of 96th Street East and Rich Valley Boulevard. The depth of this water body is unknown. There is no parkland and no public access on the lake. Land use in the watershed includes a low density residential land and undeveloped land.

Dickman Lake (DNR #19-46P)
Dickman Lake is a 24-acre lake located in northwestern Inver Grove Heights, in watershed EP-016a, just east of Robert Trail South. The depth of Dickman Lake is unknown. There are no parks or public access on the lake. The lake’s tributary area includes a small portion of the City of Sunfish Lake, between I-494 and Robert Trail. Dickman Lake is an LMRWMO-designated intercommunity resource. Existing land use in the watershed includes low density residential, park land, and undeveloped land.

Hornbean Lake (DNR #19-47P)
Hornbean Lake is a 20-acre lake located in northwestern Inver Grove Heights that straddles the Sunfish Lake/Inver Grove Heights border, just north of I-494. Based on water quality sampling data, the maximum depth of Hornbean Lake is estimated to be about 12 feet. Hornbean Lake is an LMRWMO-designated intercommunity resource. The lake is located in watersheds QP-1, 2, 3, and 4. Existing land use in the watershed includes low density residential, highway and undeveloped land. The lake receives direct runoff from I-494. There are no parks or public access on the lake in either city.

Golf Course Pond (DNR #19-49P)
This 15-acre lake is located in far northern Inver Grove Heights, north of I-494, in watershed T-11, near the intersection of Mendota Road and Babcock Trail. The depth of Golf Course Pond is unknown. Because its tributary area includes land in West St. Paul, Golf Course Pond is an LMRWMO-designated intercommunity resource. Although there is no adjacent parkland or public access to the lake, Southview Country Club is adjacent to the lake. Other land uses in the watershed include mostly low density residential, with a small amount of medium density residential.

Schmitt Lake (DNR #19-52P)
Schmitt Lake is a 56-acre lake is located in far northern Inver Grove Heights, just south of I-494, in watershed S-11, near the intersection of I-494 and Robert Trail South. The depth of Schmitt Lake is unknown. Because its tributary watershed includes land in Sunfish Lake and West St. Paul, Schmitt Lake is an LMRWMO-designated intercommunity resource. There is a small area of parkland on the southwest side of the lake and the parkland extends far south, but there is no public access on the lake. Land use in the watershed includes highway, commercial, and high and low density residential land.

Unnamed (DNR #19-54P)
This unnamed water body is a 15-acre lake that straddles the Eagan/Inver Grove Heights border in northwestern Inver Grove Heights/northeastern Eagan. The depth of this lake is unknown. There is no adjacent parkland and no public access on the lake. Land use in the watershed includes mostly undeveloped land.

2.0.12 Floodplain Information

The Federal Emergency Management Agency (FEMA) revised previous floodplain maps from 1980 or older and required the City to adopt new FEMA floodplain maps by December 2, 2011. The City, as required, adopted the new floodplain maps. These maps are important as they are used as part of the Flood Insurance Program and the maps are used to determine location of the floodplain. The floodplain maps, together with the City's floodplain ordinance, allow the City to take part in the federal government's flood insurance program. Homeowners within FEMA designated floodplains are required to purchase flood insurance. In some cases, homes within FEMA-designated floodplains on the FEMA floodplain maps may actually not be in the floodplain. In order to waive the mandatory flood insurance requirements for their homes, residents must remove their homes from the FEMA-designated floodplain by obtaining Letters of Map Amendment (LOMA). The City of Inver Grove Heights floodplain ordinance applies to those areas covered by the FIS.

2.0.13 Unique Features and Scenic Areas (Natural Communities and Rare Species)

Northwest Area Natural Resource Inventory
The City completed a natural resource inventory and assessment in the 3,140-acre Northwest Area of the City. The inventory included an evaluation of both upland and wetland sites. The upland evaluation identified 43 upland sites. The field work for the inventory was completed in 1999. The results of the upland evaluation are shown on **Figure 2-7**. (See **Section 2.0.9** for a description of the wetland evaluation in the Northwest Area.)

Bonestroo, Rosene, Anderlik & Associates completed the natural resource inventory and used the following methodology for evaluating the upland sites:

1. Preliminary assessment of upland sites—The boundaries of natural areas and natural communities were delineated using infrared aerial photographs from the MDNR. National

Wetland Inventory maps, DNR County Biological Survey databases/maps, etc. served as additional sources of natural resource information.

2. Field assessment and determination of community type—The field assessment involved a qualitative evaluation of each upland site. The field survey included identification of major plant species in the canopy, subcanopy, shrub, and ground cover of forest and woodland natural communities. In non-forested areas, such as prairies, the field survey identified dominant grasses and forbs (other non-woody plants). The field survey focused on collecting data on disturbance indicators or natural communities, such as exotic/invasive species and erosion. The natural community type (e.g. oak woodland-brushland, dry oak forest) was determined for each upland site using the methodology outlined in the 1993 MDNR publication *Minnesota's Native Vegetation, A Key to Natural Communities*. Some sites, dominated by non-native vegetation, could not be classified using the Key. These sites were given common descriptive names, such as "old field" and "conifer plantation." 20 old fields and five conifer plantations were documented during the study.

3. Upland ranking—Each upland natural area was assigned a qualitative rank, ranging from A (highest ecological quality) to D (lowest ecological quality). Standard ecological criteria used to evaluate the health of natural communities were used to determine the quality rankings and included:
   a. Degree of native species diversity
   b. Age of trees
   c. Amount of disturbance, including invasion by non-native plant species

   "A" quality communities most closely resemble intact natural areas, whereas "D" quality communities have been highly altered from the "intact" standard. In urban/urbanizing landscapes, "A" quality communities are rare.

   The upland ecological rankings are described below:

Rank	Description
A	Exceptional Quality—approaches pre-settlement condition
B	Good Quality—minimal disturbance
C	Fair Quality—significant disturbance – restorable
D	Poor Quality—high level of disturbance – unrestorable
NA	Ranking system does not apply (includes "old fields" & "conifer plantations")

   The upland rankings were then converted to "NRI Rankings" so that uplands and wetlands could be ranked on a single scale:

Upland Rank	**NRI Rank**
A, AB	Exceptional
B, BC	High
C, CD	Medium
D, NA	Low

The upland areas (and wetlands) were then placed into management classifications (Manage 1, Manage 2, Manage 3, Manage 4) by a process that considered both the NRI Rank and "local value criteria." The local value criteria take into account the value of a site from a local perspective, with input provided by an advisory committee (the Local Advisory Committee). A flowchart in the NRI document shows how the natural resources (wetlands and uplands) were placed into the management classifications.

The results of the upland inventory, assessment, and management classification in the Northwest Area are summarized in **Tables 2-10** and **2-11** and shown on **Figure 2-7**.

The Northwest Area NRI developed upland management standards and recommendations based on the upland management classification. The recommended upland management standards are shown in **Table 2-12**. The Northwest Expansion Area Alternative Urban Areawide Review (AUAR, 2005) calls for the implementation of these standards and recommendations in the study area.

The recommended upland management standards in **Table 2-12** seek to:

- Avoid impacting remaining quality natural areas
- Minimize the effects of impacts, when they must occur
- Mitigate impacts by encouraging reintroduction of appropriate locally occurring native species and the processes inherent to a community type

MDNR Natural Heritage/County Biological Survey Information

Through its Natural Heritage and Nongame Research Program, the DNR collects, manages, and interprets information about nongame animals, native plants and plant communities. The program is closely tied with the DNR's Minnesota County Biological Survey, which identifies and locates rare natural resources. The Natural Heritage and Nongame Research Program develops and maintains lists of the rare natural features in Minnesota, including Minnesota's list of endangered, threatened, and special concern species; Minnesota's list of natural communities; and important animal aggregation sites. This information is included in Minnesota's Natural Heritage Information System, which is maintained by the DNR, through its Natural Heritage and Nongame Research Program, and can be obtained from the DNR for a fee.

The DNR's Native Plant Communities and Rare Species of The Minnesota River Valley Counties (2007) also identifies natural communities and rare species. The Dakota County survey map identifies where evidence indicates the presence of rare plants and animals. The survey map does not list the specific species or their exact locations; this information can be obtained through the DNR Natural Heritage and Nongame Research Program. The Dakota County survey shows the presence of rare animals in two locations along the Mississippi River in Inver Grove Heights. The survey also identifies eight rare plant locations within Inver Grove Heights, near the Mississippi River or along the river bluffs. These surveys are evidence of the biological importance of the Mississippi River corridor.

The survey also identifies the original vegetation in the City as river bottom forest (elm, ash, cottonwood, boxelder, silver maple, willow, aspen, and hackberry) along the Mississippi River, and as a mixture of oak openings and barrens (scattered trees and groves of oaks of scrubby form with some brush and thickets), upland deciduous forest (oak, elm, basswood, ash, maple, Hornbean, aspen, and birch trees), and brush prairie (grass and brush of oak and aspen).

The county biological survey also shows that the Mississippi National River and Recreation Area (MNRRA) is located along the entire reach of the river within Inver Grove Heights (see **Section 2.0.1** for more information about MNRRA). The survey also shows the location of the Katherine Ordway Natural History Study Area adjacent to the Mississippi River, in southeast Inver Grove Heights.

2.0.14 Pollutant Sources

Figure 2-8 shows the approximate location of pollutant sources in Inver Grove Heights, as obtained from Dakota County. The information includes the following MPCA data: Master Entity System (MES) sites, MES spill sites information, registered tank locations, leaking underground storage tank (LUST) sites, hazardous waste generator sites, and dump sites. The MPCA or Dakota County should be contacted for details about specific sites, since many of the sites have been cleaned up or are in the clean-up process.

The City's Hazardous Materials Emergency Response Plan establishes a procedure for the mitigation of hazardous material incidents (i.e., a spill, leak, or release of a hazardous material). The City's fire department is responsible for the implementation of the response plan.

Figure 2-9 shows the commercial, industrial, and high density residential areas (highly impervious areas) that drain to the Mississippi River without treatment. These areas are concentrated in the older, northeast portion of the City, which developed before stormwater treatment practices were required.

2.0.15 Major Basins/Overall Drainage Patterns

The City of Inver Grove Heights lies almost entirely within the LMRWMO and is therefore considered tributary to the Mississippi River. Although portions of northern and eastern Inver Grove Heights drain readily to the Mississippi River, there are numerous basins in the City with no surface water outlet (landlocked basins), especially in the western and southern parts of the City. The only way water from these landlocked basins reaches the river is by groundwater flow.

The basins that drain to Eagan lie within the Eagan-Inver Grove Heights WMO and are tributary to the Minnesota River. The basins that drain into Rosemount lie within the LMRWMO. **Figure 1-2** shows the coverage of the LMRWMO and the Eagan-Inver Grove Heights WMO in the City.

The City was divided into 22 major drainage basins, which are shown on **Figure 2-10** and listed below (all of the drainage basins are located in LMRWMO unless otherwise noted):

110th Street Drainage Basin	Northwest Drainage Basin
Albavar Path Drainage Basin	Old Village Drainage Basin
Arbor Pointe Drainage Basin	Pine Bend Drainage Basin
Argenta Trail Drainage Basin	Rich Valley Drainage Basin
Babcock Trail Drainage Basin	Rosemount Drainage Basin
Barnes Avenue Drainage Basin	Simley Lake Drainage Basin
Eagan Drainage Basin	Skyline Village Drainage Basin
Highway 110-494 Drainage Basin	South Grove Drainage Basin
Inver Grove Trail Drainage Basin	South Marcott Lakes Drainage Basin
Jefferson Trail Drainage Basin	Sunfish Lake Drainage Basin
Mississippi River Drainage Basin	Valley Park Drainage Basin

Watersheds in each drainage basin were named according to the following naming convention:

1. For the Barnes Avenue, Inver Grove Trail, Pine Bend, Rich Valley, and South Marcott Lakes (landlocked) drainage basins, the watershed naming convention is:
    a. A two- or three-letter prefix (e.g. "BA" or "IGT") representing the name of the drainage basin.

b. A letter representing the subbasins, starting with “A” and progressing alphabetically (A, B, C, etc.). For example, Pine Bend subbasins are PB-A, PB-B, etc.
c. A unique number representing the individual watershed (e.g., PB-A-3).

2. For the 110th Street drainage basin, the watershed naming convention is:
   a. The prefix “110,” followed by
   b. A unique number representing the individual watershed (e.g., 110-53)

3. For all other drainage basins, the watershed naming convention is:
   a. A one- or two-letter prefix (e.g. “T” or “EP”) based on the naming convention used in the City’s previous WRMP.
   b. A unique number representing the individual watershed (e.g., EP-80a, T-11).

2.1 Basin Inventories

Sections 2.1.1 through **2.1.22** present an inventory of the 22 major drainage basins in the City (see **Figure 2-10**). Basins are listed alphabetically. For each basin, the following information is provided (if available and/or applicable):

1. Statistics – watershed prefix/prefixes, total drainage basin area, number of subbasins (if applicable), and number of watersheds

2. Location within the City

3. Description of existing and future land use

4. Significant water bodies in the drainage basin

5. Description of drainage patterns

6. Discussion of past major studies/modeling efforts—the City has conducted various hydrologic models, including XP SWMM, Barr Watershed Model, and Meyer Model analyses. **Figure 2-11** shows the types of models used throughout the City. The models utilized rainfall information from TP-40 and other available rainfall and snowmelt data. Atlas 14 was published by NOAA in 2013 and therefore was not used in the hydrologic models completed prior to 2013.

7. Tabulated modeling results

8. Figures showing watershed divides and drainage patterns. Some figures also show flood elevations and landlocked status if detailed snowmelt modeling was completed for the drainage basins shown in the figure.

Barnes Avenue, Inver Grove Trail, Pine Bend, Rich Valley, and South Marcott Lakes Drainage Basins

As part of the planning process for the Water Resources Management Plan, the City performed hydrologic modeling in the landlocked drainage basins where development is currently occurring or is believed to be imminent—Barnes Avenue, Inver Grove Trail, Pine Bend, Rich Valley, and South Marcott Lakes. The City used the XP SWMM model to determine the 100-year and 10-year 10-day snowmelt conditions in these landlocked drainage basins. The City chose to complete snowmelt modeling in these drainage basins because flood levels on landlocked basins are more sensitive to runoff volumes than to runoff rates. As development occurs or is imminent in these drainage basins, additional rainfall event based modeling will be performed.

The snowmelt modeling results were used to determine the "landlocked status" of the individual watersheds in the drainage basins. **Figure 2-12** explains the landlocked status terminology that is described below and shown on **Figure 2-17B**, **Figure 2-19B**, **Figure 2-21B**, and **Figure 2-22B**.

Landlocked Status Terminology

Not Landlocked:

1. Outflows (piped or overland) occur in the 100-year 10-day snowmelt event
2. Flood storage between normal and primary overflow elevations is less than the runoff volume from the 1-year 24-hour storm for the directly tributary watershed (not including runoff from tributary watersheds)

A "Not Landlocked" watershed is one that cannot be classified as "Semi-Landlocked," "Landlocked," or "Terminal Landlocked." A "Not Landlocked" watershed has outflow during the 100-year 10-day snowmelt event, and may also have outflow during other rainfall events and snowmelt events of higher frequency. Flood storage between the normal water level and the pipe outlet, or lowest surface overflow if no pipe is present, is less than the runoff volume from a 1-year 24-hour storm. Therefore, it is not a "Semi-Landlocked" watershed.

Semi-Landlocked:

1. Outflows (piped or overland) occur in the 100-year 10-day snowmelt event
2. Flood storage between normal and primary overflow elevations is greater than the runoff volume from the 1-year 24-hour storm for the directly tributary area (not including runoff from tributary watersheds) (i.e., outflows occur only occasionally)

"Semi-Landlocked" watersheds are not completely landlocked, but also cannot be classified as "Not Landlocked." For a "Semi-Landlocked" watershed, water flows out of the watershed, but only during certain storm events. More specifically, there is flow out of the watershed during the 100-year 10-day snowmelt event, but the flood storage between the normal and primary overflow elevations is greater than the runoff volume from 1-year 24-hour storm.

Landlocked:

1. No outflows occur in the 100-year 10-day snowmelt event

"Landlocked" watersheds are those which were found to have no outflow during the 100-year 10-day snowmelt event. Some "Landlocked" watersheds are "Terminal Landlocked" watersheds.

Terminal Landlocked:

1. The landlocked watershed(s) in a subbasin that is the most downstream, hydrologically speaking. This is typically the lowest basin in the subbasin, and is determined using engineering judgment. Not all landlocked watersheds are terminal landlocked watersheds
2. There is only one terminal landlocked area per subbasin, but it may be covered by two or more watersheds due to equalization of ponded water

A "Terminal Landlocked" watershed is a subset of "Landlocked" watersheds. A "Terminal Landlocked" watershed is the most downstream watersheds in a subbasin, and is often the lowest basin in the subbasin. There may be one or more "Landlocked" watersheds upstream of a "Terminal Landlocked" watershed, and by definition water from this "Landlocked" watershed will not reach the "Terminal Landlocked" watershed during the 100-year 10-day snowmelt, but the "Terminal Landlocked" watershed is technically downstream of the "Landlocked" watershed, if upstream "Landlocked" watershed were to overflow during a larger, less probable rainfall or snowmelt event.

Overflow Type:

Primary Overflow (Pipe)—Watershed has a pipe outlet as the primary overflow and there is flow in the pipe in the 100-year event
Primary Overflow (Overland)—Watershed has no pipe outlet, but there is an overland surface outlet in the 100-year event

Secondary Overflow (Overland)—The next-lowest overflow elevation, above the primary overflow, likely to flow to a different watershed than the primary overflow

The tabulated model results for these drainage basins do not show information about the pipe size and type because this information was not included in the XP-SWMM snowmelt model. The main goal of the modeling was to calculate the flood elevations and the runoff volumes stored in the lakes, ponds, wetlands, and low-lying areas. Since most of the watersheds in these drainage basins are landlocked, the outlet sizes are relatively unimportant because the flood elevations and runoff volumes are independent of the timing and distribution of the modeled storm event. It was important to model the outlet elevations (the upstream, or highest elevation) and destination watershed. The model used a simplified/assumed outlet size.

2.1.1 110th Street Drainage Basin

Prefix: "110"
Drainage Basin Area: 2,615 ac
Total Number of Watersheds: 206

The 110th Street Drainage Basin covers a large area in the southern portion of the City. Low density residential developments or undeveloped land dominate in this drainage basin. Most of the eastern portion of the drainage basin is covered by the Pine Bend Landfill and other industrial/extractive sites. Much of the central section is agricultural land use.

The watersheds in this drainage basin, as seen on **Figure 2-13**, were delineated as part of the preliminary efforts for the 10-day snowmelt modeling completed for this WRMP, although they were not modeled. This area was also not modeled for the 1994 Plan since it was classified as a Type III area, which means Barr Watershed Modeling was not conducted, but some qualitative computations were performed. For this reason, this area is shown as having "No Hydrologic Modeling Results" in **Figure 2-11**. **Table 2-13** does not report modeling data for the 110th Street drainage basin; however the drainage area is listed for each watershed.

Some recent developments within this drainage basin are the Pine Bend Landfill, Pine Valley Estates 2nd Addition, and the Southern Lakes 3rd, 4th, and 5th Additions, which are in both the 110th Street and Eagan Drainage Basins.

2.1.2 Albavar Path Drainage Basin

Prefix: “ALB”
Drainage Basin Area: 154 ac
Total Number of Watersheds: 20

Albavar Path is a small drainage basin located in the southwest corner of the City, and is surrounded by the 110th Street, Eagan, and Rosemount Drainage Basins (**Figure 2-13**). The land uses in this basin are low density residential and undeveloped land. The City’s future land use map shows a potential park/preserve between the Albavar Path Drainage Basin and the Rosemount Drainage Basin (see **Figure 2-2**). **Table 2-14** lists the drainage area for each watershed; no hydrologic modeling is available for the Albavar Path Drainage Basin.

2.1.3 Arbor Pointe Drainage Basin

Prefix: “DP”, “KP”, “ARB”
Drainage Basin Area: 1,018 ac
Total Number of Watersheds: 81

The Arbor Pointe Drainage Basin, shown on **Figure 2-14**, is located in the center of the City, along Highway 55 and Highway 52. The land use in this drainage basin is very mixed, ranging from low density residential and golf course to commercial and major highway.

Some recent developments within this drainage basin are Park Point, Woodview Pond, Hidden Forest, the Birch Boulevard Improvements, Monument Ridge, Arbor Pointe 1st through 10th Additions, Arbor Crest, Arbor Knoll, Ashwood Ponds 1st and 2nd Additions, Birchwood Ponds 2nd Addition, Fairway Hills, Fairway Village and Fairway Village South, and Orchard Meadows and Orchard Meadows West and North.

The majority of the Arbor Pointe Drainage Basin lies over a perched water table, and many of the pre-development ponds were landlocked. In the mid to late 1990s, Rottlund Company developed the area bound by Concord Boulevard, Courthouse Boulevard, College Trail and T.H. 52, and in the process, created a drainage system that connected most of the ponds with small diameter pipe that terminates at pond DP-29B. Twin 5-cfs pumps were installed in DP-29B to drain the water from the Arbor Pointe Drainage Basin. The pumps discharge into the storm sewer system in watershed JP-2. In order to ensure the pumping system operates off-peak, the pumps were installed with float mechanisms. The floats are set such that one pump will begin pumping when the water in DP-29B reaches elevation 859.5 and the second will begin pumping at elevation 860.0. The pumps will continue pumping until the pond has been drawn down to elevation 859.0. A Barr Watershed Model of the Arbor Pointe drainage system is used to determine potential impacts of development on the existing drainage system. The modeling data and results for Arbor Pointe are in **Table 2-15**.

<u>KP-29</u>

Proposed developments in the KP-29 watershed prompted the City to perform a feasibility study for providing an outlet for the naturally landlocked basin. The study determined that a gravity outlet was not feasible and that pumping to the Arbor Pointe (DP-29B) watershed was the only feasible option for a pumped outlet. The study recommended restricting the peak discharges from KP-29 to 2.6 cfs or less, if the system is operated on-demand, to avoid flooding problems in KP-17 and DP-29B. The City has already obtained the recommended drainage easement around KP-29 to elevation 914.0.

2.1.4 Argenta Trail Drainage Basin

Prefix: “F”, “EA”
Drainage Basin Area: 228 ac
Total Number of Watersheds: 19

The Argenta Trail Drainage Basin, shown on **Figure 2-15**, is located in the northwest corner of the City, west of the Northwest Drainage Basin, south of the Sunfish Lake Drainage Basin, and south of Highway 494. There is one City-designated lake in this drainage basin. This water body is unnamed, but has a DNR identification number 19-36P. The land use is predominantly agricultural and undeveloped, although there is a cluster of low density residential on the west edge of the drainage basin, west of Argenta Trail West, near the City-designated lake. The City’s future land use map shows single family residential throughout the drainage basin, except for a park to be shared with the Northwest Drainage Basin. The modeling data and results for Argenta Trail are in **Table 2-16**.

Figure 2-11 shows the Argenta Trail drainage basin as having XP-SWMM hydrologic modeling results. The watersheds in this drainage basin, along with those in the Northwest drainage basin, were modeled by EOR in 2006 as part of the Northwest Area Stormwater study project. The hydrologic results from this modeling effort are shown in **Table 2-16**. Also, the watersheds in this drainage basin were originally modeled in the Barr Watershed Model, however, the XP-SWMM modeling results supersede the Barr Watershed Model results, since they are more current and were based on newer data and watershed divides.

The Eagan *Stormwater Management Plan* (draft, 2006) shows a proposed four-inch diameter orifice outlet from watershed/pond F-022 (designated FP-13 in the Eagan plan) to watershed/pond F-018 (designated FP-9 in the Eagan plan). In subsequent discussions, City of Inver Grove Heights and City of Eagan staff agreed that flows from F-022 (in the Argenta Trail Drainage Basin) will drain to F-025 (in the Eagan Drainage Basin).

2.1.5 Babcock Trail Drainage Basin

Prefix: “BP”, “BAB”, “CP”
Drainage Basin Area: 808 ac
Total Number of Watersheds: 64

The Babcock Trail Drainage Basin, shown on **Figure 2-16**, is located in the north central part of the City, along the Highway 52 corridor south of 494. There is one City-designated lake in this drainage basin: McGroarty Pond (DNR #19-35P). The major land use in this drainage basin is low density residential, with multiple institutional lots, and some park and medium density residential. Planned land use in this drainage basin includes large commercial lots in previously undeveloped land along the east side of Highway 52.

Some recent developments in this drainage basin include Valley Park Heights and Cobblestone Oaks 2nd Addition, which is also partially in the Valley Park Drainage Basin. Available hydrologic modeling results for this drainage basin can be found in **Table 2-17**.

2.1.6 Barnes Avenue Drainage Basin

Prefix: "BA"
Drainage Basin Area: 439 ac
Total Number of Watersheds: 42

Subbasins	Subbasin Area (ac)	Number of Watersheds
BA-A	68.4	6
BA-B	64.3	6
BA-C	29.9	7
BA-D	8.6	2
BA-E	45.7	4
BA-F	91.6	4
BA-G	103.6	10
BA-H	27.7	3

The Barnes Avenue drainage basin is centrally located in the City, surrounded by the South Marcott Lakes, 100th Street, Pine Bend, and Arbor Pointe drainage basins. As seen on **Figures 2-17A** and **2-17B**, Highway 52 serves as the eastern border for the Barnes Avenue drainage basin, 96th Street East runs east-west through the middle of the entire basin, and its namesake, Barnes Avenue, passes through the basin on the west end.

Land use in this drainage basin is composed mostly of single-family residential, surrounded by undeveloped land. There is also a passive parkland area in the Marcott Woods development, south of 96th Street East and between Baxter Trail and Benjamin Trail.

The basin drains generally towards a landlocked area in the middle of the basin, south of 96th Street, although the northeast corner of the basin near the intersection of T.H. 52 and County Road 56 drains to the south along Highway 52 to another landlocked watershed.

The Barnes Avenue Drainage Basin, along with the South Marcott Lakes, Inver Grove Trail, Pine Bend, and Rich Valley drainage basins, were modeled for the 100-year and 10-year 10-day snowmelt events in XP-SWMM for this Plan. The modeling data and results for Barnes Avenue are in **Table 2-18**.

Some recent developments were accounted for in the modeling effort for this drainage basin, even though they were not in place at the time of the topographic data acquisition. Development plans were obtained from the City, and changes were made in the watershed divides, drainage patterns, and overflow elevations and pipe outlet elevations (if applicable) for the models. These developments are Marcott Woods, and Marcott Woods 2nd Addition.

2.1.7 Eagan Drainage Basin

Prefix: "EAG", "EG", "F", "W"
Drainage Basin Area: 849 ac
Total Number of Watersheds: 65

The Eagan Drainage Basin consists of subwatersheds along the Inver Grove Heights-Eagan municipal boundary that drain to the City of Eagan. The drainage basin is shown on **Figures 2-13** and **2-15**.

There is one City-designated lake in the Eagan Drainage Basin, an unnamed lake with a DNR identification number of 19-54P. The predominant land use is undeveloped and single family housing, with some commercial, medium density residential, parkland, and institutional.

Some recent developments in this drainage basin include Annistone Ranch, which lies in the Eagan, Jefferson Trail, and Northwest Drainage Basins, and Southern Lakes and its 3rd, 4th, and 5th Additions. The Southern Lakes developments are in both the 110th Street and Eagan Drainage Basins. The modeling data and results for the Eagan Drainage Basin are in **Tables 2-19A** and **2-19B**. **Table 2-19C** shows the drainage areas for the watersheds without modeling results to report.

The Eagan *Stormwater Management Plan* (draft, 2006) shows a proposed 12-inch diameter outlet from watershed F-018 (designated FP-9 in Eagan plan) discharging to watershed F-025 (designated FP-8 in Eagan plan). The City of Inver Grove Heights and City of Eagan staff agrees on this drainage pattern. However, the flood elevations for watershed F-025 reported in **Table 2-19A** in this plan may need to be revisited, as they do not include the impact of flows from watershed F-018.

For watershed W-002, the Eagan *Stormwater Management Plan* (draft, 2006) shows a lower 100-year flood elevation than reported in **Table 2-19A**. However, the City of Eagan's model does not reflect more recent information regarding additional watersheds that are tributary to W-002. Watershed W-002 is designated GP-8 in the Eagan plan.

The flood levels shown in **Table 2-19B** may need to be revised. The results shown are from a HydroCAD modeling effort performed for the Southern Lakes development, and only the 24-hour rainfall event was modeled. Also, the HydroCAD model assumed a four-inch diameter orifice at Elevation 908.3 for watershed EAG-640. Subsequent City of Eagan as-builts show a 12-inch diameter outlet at Elevation 909.3 (EAG-640 is designated LP-30 in the Eagan *Stormwater Management Plan* (draft, 2006). Outflows from the Southern Lakes development drain into the City of Eagan. The Eagan plan shows higher flood levels (based on the 100-year 10-day snowmelt event) for two of the ponds in Inver Grove Heights, but the City of Eagan's hydrologic model was based on larger, less detailed watersheds than the Southern Lakes development model.

2.1.8 Highway 110-494 Drainage Basin

Prefixes: "A", "H", "IP", "P", "S," "T", "Bish"
Drainage Basin Area: 3,038 ac
Total Number of Watersheds: 101

The Highway 110-494, shown on **Figure 2-18**, drainage basin is located in the far northern part of Inver Grove Heights. The basin extends north, west, and east from the City boundaries. The basin generally drains from the outer portions of the basin inward to the MnDOT drainage system in I-494. The basin extends into the neighboring cities of Sunfish Lake, South Saint Paul, and West Saint Paul. The major water bodies in the basin include Schmitt Lake, Golf Course Pond, and Seidls Lake. Of these, Schmitt Lake (19-52P) and Golf Course Pond (19-49P) are City-designated lakes.

Land use in the Highway 110-494 drainage basin is largely low density residential and commercial. Highways 494 and 52 cross through the center of the basin, creating a large amount of major highway land use. There is a large golf course in the northwest quadrant of the drainage basin, and clusters of multi-family and attached housing near the major highways.

The City's future land use map shows an increase of commercial land use, especially in the southeast quadrant of the Highway 494/52 intersection. Some recent developments in this drainage basin include Gramercy Park, Lafayette 1st and 2nd Additions, and Lafayette East.

In 1989, the LMRWMO completed the *Drainage Plan for the Highway 110-494 Watershed* (Barr 1989). The Drainage Plan included hydrologic modeling (using the Barr Watershed Model) of the Trailer Court Pond (T23) watershed. The modeling data and results for the Highway 110-494 drainage basin are in **Table 2-20**.

Approximately 1,700 acres (56%) of the Highway 110-494 drainage basin, including the Schmitt Lake watershed, drains to Trailer Court Pond prior to discharging into the MnDOT storm sewer system in I-494. The critical runoff event for Trailer Court Pond is the 4-day event, which indicates runoff volume, as well as timing, is critical when analyzing the pond. The Trailer Court Pond model formed the foundation for all subsequent hydrologic modeling within the Highway 110-494 Drainage Basin.

<u>Akron Avenue</u>
Extensive flooding occurred in the northwestern portion of the basin at the intersection of Akron Avenue and Highway 110 because of commercial development along Robert Street near Mendota Road. MnDOT helped to alleviate the flooding problems by installing twin 54-inch diameter metal culverts under Highway 110 at the intersection with Akron Ave. In 1990, the City of Inver Grove Heights followed the MnDOT project with the construction of two storm sewer systems – one was constructed under Akron Avenue and the second was constructed along the property lines of the existing businesses. Both systems discharge to the new MnDOT culverts.

<u>Bishop Heights and Fine Developments</u>
Bishop Heights, a commercial development in the southeast quadrant of I-494 and T.H. 52, drains to two historically landlocked basins within the Trailer Court Pond watershed, T18 and T19. The development drains to a stormwater pond east of the movie theater (Bish-D) and flows from the pond are split evenly between T18 and T19. Ponds T18 and T19 remained landlocked after the development was completed.

Pond T19 is located on the Gertens Property, east of Blaine Avenue. The pond will continue to function as a landlocked basin as long as it can continue to infiltrate stormwater and maintain a normal water elevation. A private storm sewer system, owned by Gertens, connects to the City of Inver Grove Heights storm sewer in Blaine Avenue, which then discharges into T19. The two systems are connected at two locations, the lowest of which is at elevation 874.04. If Pond T19 should ever rise above that elevation, water would backflow through the Gertens system and would drain into the irrigation water storage pond located east of the Gertens storefront (T19E), which drains to the Trailer Court Pond. In essence, the Gertens system provides a safe, high overflow for T19. The public use of this private system was formalized in a 2005 easement agreement.

The Fine development in the T18 watershed filled the natural basin and the basin was replaced with a stormwater pond. The new T18 discharges into the T.H. 52 right-of-way and eventually drains to Trailer Court Pond. The new pond was designed to accommodate the split flows from Bish-D.

In order to discharge into the MnDOT right-of-way, MnDOT required the developer and the City of Inver Grove Heights to create an XP-SWMM model of the T23 watershed. The XP-SWMM model used Barr Watershed Model hydrology for all areas west of T.H. 52 and XP-SWMM-generated hydrology for all areas east of T.H. 52. The model was used to show the flooding impacts at T17 and Trailer Court Pond. Based on the model, MnDOT issued a drainage permit restricting 100-year discharges from T18 to 12 cfs or less.

Seidls Lake

Seidls Lake is a landlocked, 6.5 acre lake that lies in a deep valley northwest of the intersection of I-494 and Highway 52, and straddles the border of Inver Grove Heights and South St. Paul. The lake has a 412-acre watershed that receives stormwater runoff from Inver Grove Heights, South St. Paul and West St. Paul. The watershed is near full development and the land use within the watershed consists primarily of single family residential, golf course, open space, and commercial uses.

The water surface elevation typically ranges between Elevations 800 and 805 although fluctuations to Elevation 814 are not uncommon. The natural overflow of the lake is to the southwest at approximately Elevation 874 and the lowest home adjacent to the lake is on the northern point of the lake at approximately Elevation 844.

Seidls Lake Park, in both Inver Grove Heights and South St. Paul, surrounds a majority of the lake. The park is a popular recreation destination for members of the nearby neighborhoods and communities. The primary access to the park is on the north side of the lake in South St. Paul. A bituminous path starts at 4th Street, runs along the eastern edge of the lake, and dead-ends on the south side of the lake. A second path access from the south is expected to be constructed in the future.

In 2001, as part of the Lafayette Addition on Seidls Lake development proposal, the City performed a long-term hydrologic study of Seidls Lake. The study concluded that the development would result in a slight increase in flood elevations on the lake.

Development, along with recent wet years in the Twin Cities, has resulted in water levels in Seidls Lake to be higher than desirable for an extended time. The high water inundates the trail, making the park unusable for the local citizens. The City of Inver Grove Heights and the City of South St. Paul recognize the importance of the park to their communities and the problem that high water creates. The two cities requested that the LMRWMO perform a feasibility study for providing a pumped outlet from Seidls Lake.

The Seidls Lake Outlet Feasibility Study (Barr 2004) looked at providing Seidls Lake with a pumped outlet and discharging the water into either Inver Grove Heights or South St. Paul. Because any pumped discharges into the City of Inver Grove Heights would drain to Trailer Court Pond, which is sensitive to any additional stormwater volume, the study recommended discharging the water into the South St. Paul storm sewer system.

Gertens

On October 4th and 5th, 2005, between 6.4 and 8.6 inches of rain fell in the Highway 110-494 Drainage Basin. The event caused the Gertens irrigation water storage pond (T19E) to overtop. The flood water eroded the embankment to failure and washed all of the sediment into Trailer Court Pond. MnDOT required Gertens to dredge the sediment from the pond and to redesign their storage pond and outlet structure. The XP-SWMM model of the Trailer Court Pond watershed was appended to include a detailed study of the Gertens site. The results of the study included recommendations for pond storage, outlet design and an overflow swale from the pond.

2.1.9 Inver Grove Trail Drainage Basin

Prefix: "IGT"
Drainage Basin Area: 426 ac
Total Number of Watersheds: 35

Subbasin	Subbasin Area (ac)	Number of Watersheds
IGT-A	101.2	6
IGT-B	43.7	4
IGT-C	112.1	9
IGT-D	73.4	5
IGT-E	95.1	11

The Inver Grove Trail drainage basin is situated in the east-central portion of the City, with only the Mississippi River drainage basin separating it from the river (see **Figures 2-19A & B**). This drainage basin consists of the area between Old Concord Boulevard East, which borders the basin on the west, and Inver Grove Trail, which borders the basin on the east, in addition to some land west of Old Concord Boulevard East.

Stormwater runoff in this drainage basin generally drains to a landlocked basin. As seen on Figure 2-19B, 14 of the 35 watersheds are landlocked. There are multiple ponds located throughout the Inver Grove Trail drainage basin. One of them, IGT-E-9, which was previously called KP-34, has been studied in the past due to flooding problems.

Land use is predominantly undeveloped and some single family residential. There are also a few lots designated as mixed use residential, agriculture, and farmstead. The residential land use in the basin is generally split by Old Concord Boulevard East, with single family residential attached west of the road, and single family residential attached east of the road.

Two recent developments were accounted for in the modeling effort for this drainage basin, even though they were not in place at the time of the topographic data acquisition. Development plans for Cobblestone Oaks and Legend Estates were obtained from the City, and changes were made in the watershed divides, drainage patterns, and overflow elevations and pipe outlet elevations (if applicable) for the models. Both of these developments drain to constructed stormwater ponds. The modeling data and results for Inver Grove Trail are in **Table 2-21**.

2.1.10 Jefferson Trail Drainage Basin

Prefix: "JEF", "GP"
Drainage Basin Area: 107 ac
Total Number of Watersheds: 4

The Jefferson Trail Drainage Basin, shown on **Figure 2-15**, is a small basin situated between the Northwest Drainage Basin and the Eagan Drainage Basin, near the Eagan City border. This drainage basin is primarily medium density residential. There is also some low density residential, undeveloped, and industrial and utility land use. Planned land use shows little to no change. Drainage is generally towards the south, into one of three small ponds in the basin.

One recent development in this drainage basin is the Annistone Ranch housing development. This development is located such that it drains to the Northwest, Jefferson Trail, and Eagan Drainage Basins. The modeling data and results for Jefferson Trail are in **Table 2-22**.

2.1.11 Mississippi River Drainage Basin

Prefix: "MIS"
Drainage Basin Area: 950 ac
Total Number of Watersheds: 74

The Mississippi River Drainage Basin, shown on **Figure 2-20**, is located along the bank of the river along most of the City's eastern border, is composed of watersheds that drain towards the river. The land use is predominantly undeveloped land, especially in the southern two-thirds of the drainage basin. In the north, low density residential is the main land use, with some medium density residential in the northern-most tip of the drainage basin.

One recent development in this drainage basin is Hatchard Estates, but since this drainage basin was not recently modeled with the 100-year 10-day snowmelt event, no changes had to be made to drainage divides. The modeling data and results for the Mississippi River Drainage Basin are in **Table 2-23**.

This drainage basin is generally split in half; the south half drains directly east to the Mississippi River, while the north half does not. This split also characterizes the hydrologic modeling status of the watersheds in the drainage basin. The watersheds in the northern half were in the Type I area where Barr Watershed Modeling was performed for the 1994 Plan (these results are still valid), and the watersheds in the southern half were not modeled for the first generation Plan, nor were they modeled for this second generation Plan, since they drain directly to the river. **Table 2-23** and **Figure 2-11** reflect this information.

2.1.12 Northwest Drainage Basin

Prefix: "BP", "EP", "QP", "SP"
Drainage Basin Area: 2856 ac
Total Number of Watersheds: 192

The Northwest Drainage Basin, shown on **Figure 2-15**, is a large area located on either side of Robert Trail/Highway 3 mostly north of Highway 55. The main land use in this drainage basin is undeveloped land. Other major land uses include low density residential, park, and golf course. There are two City-designated lakes within this drainage basin: the northern portion of the Marcott Lakes chain, called Marcott Lakes/Rosenberger Lake (DNR #19-41P), and Dickman Lake (DNR #19-46P), both of which are landlocked.

Some recent developments in this drainage basin are Wildwood Ranch, Annistone Ranch, which is also partially in the Jefferson Trail and Eagan Drainage Basins, Marianna Ranch, which is also partially in the Rich Valley Drainage Basin, and Orchard Trail, which is along the border of both the Northwest Drainage Basin and the South Marcott Lakes Drainage Basin.

Figure 2-11 shows the Northwest drainage basin as having XP-SWMM hydrologic modeling results. The watersheds in this drainage basin, along with those in the Argenta Trail drainage basin, were modeled by EOR in 2006 as part of the Northwest Area Stormwater Manual project. The hydrologic results from this modeling effort are shown in **Table 2-24**. Also, the watersheds in this drainage basin were originally modeled in the Barr Watershed Model, however, the XP-SWMM modeling results supersede the Barr Watershed Model results, since they are more current and were based on newer data and watershed divides.

For the 10-day snowmelt event, a substantial volume of water passes through an 18-inch culvert under Ann Marie Trail East from the Northwest Drainage Basin (watershed EP-80a) to the South Marcott Lakes Drainage Basin (SML-B-1). See **Figure 2-16A** for the location of this outflow. The volume of outflow is 122.1 ac-ft for the 100 year event, and 68.7 ac-ft for the 10-year event. See **Section 2.1.20** for an explanation on how this additional volume was accounted for in the South Marcott Lakes Drainage Basin.

The City developed a stormwater guidance document specifically for the Northwest Area—*Inver Grove Heights Stormwater Manual Northwest Area* (December 2006), which covers area in the Northwest Drainage Basin. See **Sections 4.3.1** of this plan for more information about the stormwater manual.

2.1.13 Old Village Drainage Basin

Prefix: "OLD"
Drainage Basin Area: 473 ac
Total Number of Watersheds: 5

The Old Village Drainage Basin, shown on **Figure 2-16**, is located in the northeast tip of the City, bordering the Mississippi River, the City of South St. Paul, and the South Grove Drainage Basin. The general drainage pattern is east, towards the river. The major land uses in this drainage basin are low density residential, extractive, and park. The modeling data and results for the Old Village Drainage Basin are in **Table 2-25**.

2.1.14 Pine Bend Drainage Basin

Prefix: "PB"
Drainage Basin Area: 803 ac
Total Number of Watersheds: 71

Subbasin	Subbasin Area (ac)	Number of Watersheds
PB-A	108.0	8
PB-B	153.5	15
PB-C	95.5	6
PB-D	27.7	3
PB-E	26.1	2
PB-F	151.5	13
PB-G	81.9	13
PB-H	25.2	1
PB-I	80.8	8
PB-J	17.4	1
PB-K	23.6	1

The Pine Bend Drainage Basin (**Figures 2-21A & B**) is located in the southeast corner of the City, situated between the Mississippi River Drainage Basin and the 110th Street Drainage Basin. The major land uses in this drainage basin are undeveloped, extractive, and low density residential. There is no overall drainage pattern in this drainage basin.

This drainage basin was modeled using XP SWMM. Two recent developments were accounted for in the modeling effort, even though they were not in place at the time of the topographic data acquisition. Development plans for the Chesley Addition and Ferrel Gas were obtained from the City, and changes were made to the watershed divides, drainage patterns, and overflow elevations and pipe outlet elevations (if applicable) for the models. The modeling data and results for the Pine Bend Drainage Basin are in **Table 2-26**.

2.1.15 Rich Valley Drainage Basin

Prefix: "RV"
Drainage Basin Area: 1681 ac
Total Number of Watersheds: 155

Subbasin	Subbasin Area (ac)	Number of Watersheds
RV-A	140.0	9
RV-B	29.3	4
RV-C	163.9	14
RV-D	84.4	6
RV-E	47.7	2
RV-F	128.4	16
RV-G	179.6	21
RV-H	59.0	2
RV-I	82.3	11
RV-J	48.0	5
RV-K	58.6	5
RV-L	228.7	22
RV-M	175.4	18
RV-N	126.6	9
RV-O	129.3	11

The Rich Valley Drainage Basin (**Figures 2-22A & B**) is located on the western edge and southern half of the City. This drainage basin was modeled as part of the landlocked basins snowmelt modeling done for this WRMP.

Some recent developments were accounted for in the modeling effort for this drainage basin, even though they were not in place at the time of the topographic data acquisition. Development plans were obtained from the City, and changes were made to the watershed divides, drainage patterns, and overflow elevations and pipe outlet elevations (if applicable) for the models. These developments are Forest Ridge East, Inver Hills 7th, 8th, and 9th Additions, Ves Valley Estates, Coventry Pass 5th, 6th, and 7th Additions, and Marianna Ranch, which is also partially in the Northwest Drainage Basin. The modeling data and results for the Rich Valley Drainage Basin are in **Table 2-27**.

There is one unnamed water body that is a City-designated lake (DNR #19-43P).

2.1.16 Rosemount Drainage Basin

Prefix: "ROS"
Drainage Basin Area: 844 ac
Total Number of Watersheds: 90

The Rosemount Drainage Basin is made up of the area straddling the Inver Grove Heights/ Rosemount border (**Figure 2-13**). The major land uses in this drainage basin are undeveloped and low density residential. There are also portions of industrial and utility land uses on the east side of the drainage basin.

As with the 110th Street drainage basin directly to its north, this area was also not modeled for the 1994 Plan, since it was classified as a Type III area, which means Barr Watershed Modeling was not conducted, but some qualitative computations were performed. For this reason, this area is shown as having "No Hydrologic Modeling Results" in **Figure 2-11**. **Table 2-28** lists the drainage areas for each drainage area.

2.1.17 Simley Lake Drainage Basin

Prefix: "DP", "SIM"
Drainage Basin Area: 560 ac
Total Number of Watersheds: 24

The Simley Lake Drainage Basin, shown on **Figure 2-14**, is oriented in an east-west fashion in the central part of the City. Named after one of its largest water bodies, Simley Lake, this drainage basin is composed of mostly low density residential and institutional land uses. Simley Lake is one of two City-designated lakes in this drainage basin (DNR #19-37P), an unnamed lake (DNR #19-38P) being the other.

One recent development within the Simley Lake Drainage Basin is Whistletree Woods, located at the eastern end of the drainage basin.

The City installed a 12-inch-diameter piped outlet to Simley Lake as part of the Cahill Avenue reconstruction project. Prior to the installation of the outlet, Simley Lake was frequently subjected to long-term flooding problems, which killed riparian vegetation, caused shoreline erosion problems, and inundated the City park on the north end of the lake.

The outlet drains Simley Lake to DP-28, a landlocked basin located in a deep, forested depression. There is a 18-inch diameter high overflow outlet pipe from DP-28—when water in DP-28 exceeds Elevation 865, water will gravity flow from DP-28 to DP-29B (which has a pumped outlet). The modeling data and results for the Simley Lake Drainage Basin are in **Table 2-29**.

2.1.18 Skyline Village Drainage Basin

Prefix: "JP"
Drainage Basin Area: 377 ac
Total Number of Watersheds: 8

The Skyline Village Drainage Basin, located in northeast Inver Grove Heights and shown on **Figure 2-16**, is mostly made up of low density residential. Other land uses in the drainage basin include medium density residential, park, and institutional.

Drainage from Skyline Village discharges to the Mississippi River at JP-5. Historically, water had drained through a storm sewer system that discharged into a ravine downstream of Concord Boulevard. In 1990, the City addressed erosion problems in the ravine by extending the storm sewer to the river. The City connected to the (then) existing 66-inch diameter outlet pipe and extended a new 66-inch-diameter pipe to the east side of the railroad tracks. At the railroad tracks the pipeline transitions to twin 42-inch-diameter polyethylene pipes that discharge into an energy dissipation structure before draining into the Mississippi River.

One recent development in the Skyline Village Drainage Basin was the 2nd Addition to Concord Commons. It is near the south end of the drainage basin, near the Inver Grove Trail Drainage Basin. The development plans were obtained for this project, but it was found to be completely within the

Skyline Village Drainage Basin and therefore not modeled in the snowmelt model for this Plan. The modeling data and results for the Skyline Village Drainage Basin are in **Table 2-30**.

2.1.19 South Grove Drainage Basin

Prefix: "IP", None
Drainage Basin Area: 1053 ac
Total Number of Watersheds: 93

The South Grove Drainage Basin, shown on **Figure 2-16**, generally drains from northwest to southeast. The majority of the basin drains through the ravine east of Dawn Avenue before discharging into the Mississippi River. The basin is primarily single family residential with some commercial developments in the northwest, and the Fleming Field airport in South St. Paul. Bohrer Pond (DNR #19-34P), a City-designated lake, is the major water body in the basin. The modeling data and results for the South Grove Drainage Basin are in **Table 2-31**.

From 2006 through 2011 annual street reconstruction projects were completed by the City that included a 10-year design storm sewer system as well as 48 roadside rain gardens and a bio retention basin, the majority of which is within the South Grove Drainage Basin.

70th Street

70th Street, a four-lane Dakota County road, bisects the drainage basin and forms the southern boundary of the Fleming Field airport. Dakota County and the City of Inver Grove Heights collaborated on a street and drainage improvement project for 70th Street, between Cahill Avenue and Concord Boulevard. Prior to the project (which was completed in 2005), 70th Street was a four-lane rural road section that experienced frequent flooding at its intersection with Clayton Avenue, and the drainage system primarily utilized the drainage swale that runs through the back yards of the neighborhoods along 71st Street and eventually discharges into the ravine east of Dawn Avenue.

The City developed an XP-SWMM model of the 70th Street watershed to aid in the design of an improved drainage system. The new system conveys storm flows from the 10-year design storm in storm sewer pipe installed under 70th Street and Dawn Avenue and discharges into the Dawn Avenue Ravine. The system utilizes the drainage swale to convey flows from events that exceed the 10-year design storm.

As part of the project, the ravine east of Dawn Avenue was re-graded and fortified with riprap to prevent erosion. The backyard drainage swale along 71st Street was also re-graded to create an efficient slope and cross section for conveying storm flows. In addition, two stubs were installed in the storm sewer system to accommodate future connections from the Valley Park and Babcock Trail drainage basins, and from Bohrer Pond.

Bohrer Pond

Bohrer Pond is a 20 acre landlocked basin located on the boundary of Inver Grove Heights and South St. Paul, on the west side of the Fleming Field Airport. The Bohrer Pond watershed spans 509 acres, with 128 acres in South St. Paul and 381 acres in Inver Grove Heights. The natural overflow of Bohrer Pond is to the south at approximately 816 feet above mean sea level (MSL), which is much higher than the lowest point on Cloman Way at Elevation 806.8 MSL and the lowest home adjacent to the pond at Elevation 808.3 (Barr 1978). Approximately 144 homes in the Bohrer Pond watershed exist below Elevation 816 MSL. Several townhouse associations reside on the southern end of the pond. The associations have experienced repeated long-term flooding of streets and shoreline erosion due to high water levels on Bohrer Pond.

Providing an outlet to Bohrer Pond was first mentioned in a 1974 stormwater drainage report to the City (Ellison-Pihlstrom, 1974). In 1978, a feasibility study for providing an outlet was prepared; however there was not a feasible option for discharging the water. The 70th Street Reconstruction Project created a new opportunity for discharging water from Bohrer Pond. At the request of the homeowners' associations located on the south side of the pond, the City Council initiated a feasibility study for constructing an outlet from Bohrer Pond.

The Bohrer Pond Gravity Outlet Feasibility Study (Barr 2005) used the XP-SWMM model created for the 70th Street project and connected in the Bohrer Pond watershed. The study evaluated the feasibility of a pumped outlet and a gravity outlet from Bohrer Pond and recommended constructing the gravity outlet. The recommended outlet was a 36-inch diameter gravity outlet connected to the stub in the 70th Street system. The recommended outlet system also included a back-flow prevention valve so flows from 70th Street could not back flow into Bohrer Pond. The City completed construction of the recommended outlet in October 2005.

In addition to the outlet control structure constructed in 2005, a shoreland restoration project was completed in conjunction with Dakota County Soil and Water Conservation District in 2011. Also the Bohrer Pond Northwest Sedimentation Basin Improvement Project restored the basin capacity and storage volume and added a sheet-pile weir to control flow and retain floatables. The Bridgewood Sedimentation Basin Improvement Project (to be completed in 2014) consists of a stormwater basin to retain and treat stormwater from Bridgewood Apartment Impervious Surface.

2.1.20 South Marcott Lakes Drainage Basin

Prefix: "SML"
Drainage Basin Area: 697 ac
Total Number of Watersheds: 52

Subbasin	Subbasin Area (ac)	Number of Watersheds
SML-A	64.0	10
SML-B	148.9	4
SML-C	165.3	6
SML-D	48.1	7
SML-E	39.0	3
SML-F	47.3	6
SML-G	106.5	10
SML-H	78.2	6

The South Marcott Lakes Drainage Basin (**Figures 2-17A & B**) is located in the central part of the City. The predominant land uses are undeveloped land, with some low density residential lots around the fringes of the drainage basin. There are also agricultural and farmstead lots within the drainage basin.

One recent development was accounted for in the modeling effort for this drainage basin, even though it was not in place at the time of the topographic data acquisition. Development plans for Orchard Trail were obtained from the City, and changes were made to the watershed divides, drainage patterns, and overflow elevations and pipe outlet elevations (if applicable) for the models.

For the 10-day snowmelt event, a substantial volume of water passes through an 18-inch culvert under Ann Marie Trail East from the Northwest Drainage Basin (watershed EP-80a) to the South Marcott Lakes Drainage Basin (SML-B-1). See **Figure 2-16A** for the location of this inflow. The volume of inflow is 122.1 ac-ft for the 100 year event, and 68.7 ac-ft for the 10-year event. The modeling results account for this additional inflow and can be seen in **Table 2-32**.

There is one City-designated lake within this drainage basin, Marcott Lakes/Ohmans Lake (DNR #19-42P).

2.1.21 Sunfish Lake Drainage Basin

Prefix: "HB", "MHc", "Q", "QP", "PR"
Drainage Basin Area: 517 ac
Total Number of Watersheds: 28

The Sunfish Lake Drainage Basin, shown on **Figure 2-15**, is made up of the portion of the City of Inver Grove Heights and the City of Sunfish Lake that drains to Hornbean Lake, which straddles the municipal boundary.

The main land uses in the Sunfish Lake Drainage Basin are single family residential, agriculture, and undeveloped. Hornbean Lake is the major water body, and is the only City-designated lake in this drainage basin. Hornbean Lake is designated by the DNR as #19-47P.

The Sunfish Lake Drainage Basin is at the far upstream end of the LMRWMO's Interstate Valley Creek major subwatershed, which includes land in the cities of Inver Grove Heights, Lilydale, Mendota Heights, Sunfish Lake, and West St. Paul. As described in **Section 4.0.3**., the LMRWMO's water quality feasibility study (Barr, 2004) identified one feasible water quality improvement best management practice (BMP) in the City—the deepening of an existing pond located southwest of Hornbean Lake, adjacent to Interstate 494. This BMP would require the involvement/approval of MnDOT because MnDOT constructed the pond. Before moving forward with implementation of the BMP, the LMRWMO feasibility study noted that a final design would need to be prepared, and the cost allocation would need to be developed.

The watersheds in this drainage basin have a range of modeling result states, as seen in **Figure 2-11**. Some have been modeled only with XP-SWMM, while others have been modeled only with P8, which is from the modeling efforts done for the Lower Mississippi River Water Management Organization Water Quality Study. The hydrologic modeling results for the watersheds in the Sunfish Lake drainage basin can be seen in **Table 2-33**.

2.1.22 Valley Park Drainage Basin

Prefix: "CP", "VAL"
Drainage Basin Area: 427 ac
Total Number of Watersheds: 20

The Valley Park Drainage Basin, shown on **Figure 2-16**, is located in the northern half of the City, bordered by the South Grove, Skyline Village, Simley Lake, and Babcock Trail Drainage Basins. The land use in the Valley Park Drainage Basin is dominated by park/recreational/preserve, including North Valley Park and South Valley Park, and single family residential. There are some parcels of commercial, institutional, and undeveloped land.

Some recent developments in the Valley Park Drainage Basin include Summit Ridge Addition, Traverse Point Addition, Pinnacle Addition, Brittany Park 2nd Addition, and Cobblestone Oaks 2nd Addition, which also lies partially in the Babcock Trail Drainage Basin. Hydrologic modeling results for the basin can be found in **Table 2-34**.

Table 2-1. Precipitation Summary—Minneapolis/St. Paul Airport Station
Averages: - 1981-2010 Extremes: 1891-2013

Total Precipitation, Inches					Snow, inches	
Month	**Mean**	**High—Yr**	**Low—Yr**	**1-Day Max**	**Mean**	**High—Yr**
Jan	0.90	3.63 1967	0.05 1892	1.21 1/24/1967	12.2	46.4 1982
Feb	0.77	3.25 1922	0.03 1894	1.90 2/4/1930	7.7	26.5 1962
Mar	1.89	4.75 1965	0.09 1910	1.62 3/1/1965	10.3	46.1 1965
Apr	2.66	7.00 2001	0.16 1987	2.58 4/6/2006	2.4	21.8 1983
May	3.36	10.33 1906	0.21 1934	3.16 5/21/1906	0.0	3.0 1946
Jun	4.25	9.82 1990	0.22 1988	2.95 6/21/2002	0.0	0.0
Jul	4.04	17.90 1987	0.11 1936	9.15 7/23/1987	0.0	0.0
Aug	4.30	9.32 2007	0.20 1925	7.28 8/30/1977	0.0	0.0
Sep	3.08	7.77 1903	0.30 2012	4.96 9/12/1903	0.0	1.7 1942
Oct	2.43	6.42 1911	0.01 1952	4.61 10/4/2005	0.6	8.2 1991
Nov	1.77	5.29 1991	0.02 1939	2.52 11/11/1940	9.3	46.9 1991
Dec	1.16	4.27 1982	0.00 1943	1.50 12/14/1891	11.9	33.6 2010
Annual	30.61	40.15 1911	11.54 1910	9.15 7/23/1987	54.4	101.5 1983

University of Minnesota Climatology

Table 2-2. Selected Precipitation and Runoff Events

Type of Event and Frequency	Duration	Amount (Inches)
Rainfall		
1-year	24-hour	2.4
2-year		2.8
5-year		3.5
10-year	24-hour	4.2
25-year		5.3
50-year		6.3
100-year		7.4
25 year	10-day	7.8
50-year		8.8
100-year		10.0
Runoff (snowmelt)		
10-year	10-day	4.7
25-year		5.7
50-year		6.4
100-year		7.1

Source: National Oceanic and Atmospheric Association – Atlas 14, *Hydrology Guide for Minnesota* (USDA Soil Conservation Service)

Table 2-3. Wetland Management Classification Summary – Northwest Area

Community Type	Management Class	No. of Occurrences
Seasonally Flooded Basin	1	1
	2	1
Sedge Meadow	1	3
	2	1
	3	2
Wet Meadow	1	7
	2	8
	3	19
	4	20
Alder Thicket	1	1
Shrub-Carr	1	1
	2	1
	3	1
Hardwood Swamp	1	4
	3	7
	4	6
Shallow Marsh	1	8
	2	7
	3	15
	4	15
Shallow Open Water	1	2
	2	2
	3	10
	4	10
Deep Marsh	1	6
	2	4
	3	10
	4	9
Other	1	1
	4	2
Total		184

Table 2-4. Summary of Wetland Natural Areas – Northwest Area

Community Type	No. of Occurrences	Acres	Percent of Wetland Natural Communities
Seasonally Flooded Basin	2	1.1	0.4
Sedge Meadow	6	10.7	4.0
Wet Meadow	54	68.7	25.7
Alder Thicket	1	3.5	1.3
Shrub-Carr	3	6.0	2.2
Hardwood Swamp	17	14.8	5.6
Shallow Marsh	45	52.4	19.7
Shallow Open Water	24	51.5	19.3
Deep Marsh	29	49.5	18.6
Other	3	8.6	3.2
Total	184	266.8	100.0

Table 2-5. Wetland Ranking Summary – Southwest Study Area

Community Type	Wetland Rank	No. of Occurrences
Seasonally Flooded Basin	II	1
	III	1
	IV	8
Wet Meadow	II	1
	III	1.5
	IV	5
Bottomland Hardwood	III	1.5
	IV	6
Shallow Marsh	II	4
	III	7
	IV	13
Shallow Open Water	II	7
	III	1
	IV	3
Deep Marsh	II	5
	III	1
	IV	4
Open Bog	I	1
Reed Canary Grass Monotype	IV	4
Total		75

Table 2-6. Summary of Wetland Natural Areas – Southwest Study Area

Community Type	No. of Occurrences
Seasonally Flooded Basin	10
Wet Meadow	7.5
Bottomland Hardwood	7.5
Shallow Marsh	24
Shallow Open Water	11
Deep Marsh	10
Open Bog	1
Reed Canary Grass Monotype	4
Total	75

Table 2-7. Recommended Wetland Management Standards – Northwest Area

Management Classification	Buffer Strip (feet)		Structural Setback from Edge of Buffer (feet)	Stormwater Phosphorus Pretreatment Requirement	Stormwater Quantity Requirement
	Slopes <15%	Slopes ≥15%			
Manage 1	60	90	10	Limit loadings to 2X predevelopment[1] loadings (0.28 lbs./ac/yr)[2]	Storm Bounce – Maintain High Water Level (HWL) at or below existing conditions for 100-year storm
Manage 2	30	45	10	Limit concentration to 150 parts per billion (ppb)[3]	Storm Bounce – Maintain HWL bounce at or below existing conditions plus 0.5 feet for a 100-year storm
Manage 3	20	30	10	Limit concentration to predevelopment concentrations (200 ppb)	No requirement
Manage 4	15	20	10	No Requirement – enhancement recommended[4]	No requirement

[1] Existing refers to hydrologic conditions at the time this inventory was conducted (2000)

[2] A multi-cell pond configuration with the lower cell being a constructed wetland or infiltration basin is recommended to achieve these levels of removal

[3] Multi-cell pond with vegetative buffers between cells are recommended to achieve these levels of removal

[4] Enhance wildlife habitat and enhance nutrient removal efficiency to protect Manage 1, 2, or 3 downstream water bodies

Table 2-8. Inver Grove Heights Lakes and City Lake Classification

DNR Number	Lake Name	Watershed Name	Water Surface Area (acres)	Ecoregion	Shallow/Deep	City Lake Classification
19-34P	Bohrer Pond	IP-01	20.2	NCHF[2]	Shallow[4]	NCHF Shallow
19-35P	McGroarty Pond	BP-8	16.1	NCHF	Shallow[4]	NCHF Shallow
19-36P	Unnamed[1]	FP-3,4,7,1	17.2	NCHF	Shallow[4]	NCHF Shallow
19-37P	Simley Lake	DP-21	14.8	NCHF	Shallow[5]	NCHF Shallow
19-38P	Unnamed	DP-32	10.7	NCHF	Shallow[4]	NCHF Shallow
19-41P	Marcott Lakes/ Rosenberger Lake	EP-080a	25.4	WCBP[3]	Deep	WCBP Deep
19-42P	Marcott Lakes/ Ohmans Lake	SML-C-3, SML-C-1	32.2	WCBP	Deep	WCBP Deep
19-43P	Unnamed	RV-M-7	14.0	WCBP	Shallow[4]	WCBP Shallow
19-46P	Dickman Lake	EP-016a	24.4	NCHF	Shallow[4]	NCHF Shallow
19-47P	Hornbean Lake	QP-1,2,3,4	20.3	NCHF	Shallow	NCHF Shallow
19-49P	Golf Course Pond	T-11	15.0	NCHF	Shallow[4]	NCHF Shallow
19-52P	Schmitt Lake	S-11	56.2	NCHF	Shallow[4]	NCHF Shallow
19-54P	Unnamed[1]	FP-8	14.5	NCHF	Shallow[4]	NCHF Shallow

[1]In Eagan-Inver Grove Heights WMO; all other lakes are located in Lower Mississippi River WMO

[2]NCHF = North Central Hardwood Forest

[3]WCBP = Western Corn Belt Plains

[4]Assumed, no depth information available

[5]Although maximum depth is >15 feet, it is assumed that at least 80% of the lake is littoral (<15 feet deep)

Table 2-9: Factors Used to Classify Deep Lakes, Shallow Lakes, Wetlands, and Ponds

Factor	Deep Lakes	Shallow Lakes	Wetlands	Ponds
Public Waters Inventory Code	Typically coded as "L or LP" in PWI	May be coded as either "L, LP or LW" in PWI	Typically coded as "LW" in PWI	May be coded as either "L, LP or LW" in PWI
Depth, max.	Typically > 15 feet	Typically < 15 feet	Typically <7 feet	Typically <10 feet
Littoral area	Typically < 80%	Typically >80%	Typically 100%	Typically 100%
Area (min.)	> 10 acres (Bulletin 25)	> 10 acres (Bulletin 25)	No minimum	No minimum
Thermal stratification (summer)	Stratification common but dependent upon depth	Typically do not stratify	Typically do not stratify	Typically do not stratify
Fetch	Significant fetch depending on size & shape	Fetch is variable depending on size & shape	Rarely has a significant fetch	Rarely has a significant fetch
Substrate	Consolidated sand/silt/gravel	Consolidated to mucky	Mucky to unconsolidated	Variable
Shoreline features	Generally wave formed, often sand, gravel or rock	Generally wave formed, often sand, gravel or rock	Generally dominated by emergents	Generally dominated by emergents
Emergent vegetation & relative amount of open water	Shoreline may have ring of emergents; vast majority of basin open water	Emergents common, may cover much of fringe of lake; basin often has high percentage of open water	Emergents often dominate much of basin; often minimal open water	Emergents common, may cover much of fringe of pond; basin often has high percentage of open water

Factor	Deep Lakes	Shallow Lakes	Wetlands	Ponds
Submergent vegetation	Common in littoral fringe, extent dependent on transparency	Abundant in clear lakes; however may be lacking in algal-dominated turbid lakes	Common unless dominated by an emergent like cattail	Common unless dominated by an emergent like cattail
Dissolved Oxygen	Aerobic epilimnion; hypolimnion often anoxic by midsummer	Aerobic epilimnion but wide diurnal flux possible	Diurnal flux & anaerobic conditions common	Variable
Fishery	Typically managed for a sport/game fishery. May be stocked. DNR fishery assessments typically available	May or may not be managed for a sport fishery. If so, fishery assessment should be available. Winter aeration often used to minimize winterkill potential	Typically not managed for a sport fishery. Little or no DNR fishery information. Seldom aerated. May be managed to remove fish & promote waterfowl	Typically not managed for a sport fishery
Uses	Wide range of uses including boating, swimming, skiing, fishing; boat ramps & beaches common	Boating, fishing, waterfowl production, hunting, aesthetics; limited swimming; may have boat ramp, beaches uncommon	Waterfowl & wildlife production, hunting, aesthetics. Unimproved boat ramp if any. No beaches	Typically manmade basins. Important for flood protection and runoff pollutant removal. May provide passive recreational opportunities

Table 2-10. Upland Management Classification Summary – Northwest Area

Community Type	Management Class	No. of Occurrences
Dry Prairie (hill subtype)	3	2
Dry Prairie (sand-gravel subtype)	2	1
Dry Oak Savanna	3	1
Oak Woodland-Brushland	4	6
	3	18
	2	1
	1	1
Oak Forest, Dry	4	1
	2	1
Oak Forest, Mesic	3	2
	1	2
Lowland Hardwood Forest	4	4
	3	3
Total		43

Table 2-11. Summary of Upland Natural Areas – Northwest Area

Natural Community Type	State Rarity Rank*	Number of Occurrences	Acres	Percent of Upland Natural Communities**
Dry Prairie	2	3	5.0	1.1
Dry Oak Savanna	1	1	2.4	0.5
Oak Woodland Brushland	4	26	340.8	75.5
Dry Oak Forest	3	2	50.0	11.1
Mesic Oak Forest	2	4	28.5	6.3
Lowland Hardwood Forest	4	7	24.8	5.5
Total		43	451.5	100.0

* State Rarity Rank, as developed by MN DNR staff reflects extent and condition of natural community types in Minnesota. Natural community types with a rank of "1" are considered critically endangered in MN, while those ranked "5" are considered secure under present conditions.

** Calculated as a percent of land area by area

Table 2-12. Recommended Upland Management Standards – Northwest Area

Management Classification	Management Activities
Manage 1	• Community type structure should remain intact, i.e., canopy, subcanopy, ground layer • Permanent alteration under 10,000 sf and no greater than 50 feet from building pad • Buffer plantings composed of species native to Inver Grove Heights • Where impacts occur, replant with native species typical of community type in Inver Grove Heights • In areas of development, planning tools such as clustered housing should be used • Maintain current corridors, and if possible, create connectivity with other natural communities • Treated diseased trees in natural communities (i.e., oak wilt, Dutch elm disease) on a case-by-case basis, taking into account the surrounding ecosystem • Manage Natural Communities and associated buffers to maintain or improve their composition, structure, and function • Provide neighborhood residents with information regarding the significance of natural areas near their home
Manage 2	• Community type structure should be maintained • Avoid impacts to only poorest quality portions of site; no permanent alteration greater than 75 feet from building pad • Where impacts occur, replant with native species typical of community type in city • In areas of development, landscape with local origin native plants • Maintain or create connectivity between natural areas • Manage natural areas to maintain or improve their composition, structure, and function
Manage 3	• Protect hardwood canopy trees, especially trees representative of the forest type • Minimize total area of disturbance; no permanent alteration greater than 100 feet from building • Avoid impacts to better quality portion of natural areas on site • Landscape with species native to Inver Grove Heights • Maintain or create connectivity between natural areas
Manage 4	• Minimize loss of canopy trees in forest areas, especially trees representative of the forest type • Avoid impacts to better quality portions of the site with no permanent alteration greater than 150 feet from buildings • Where impacts occur, replant with native species typical to community type in city • In areas of development, landscape with local origin native plants • Maintain or create connectivity between natural areas

Table 2-13. Hydrologic Data – 110th Street Drainage Basin

Watershed	Area	Watershed	Area	Watershed	Area	Watershed	Area	Watershed	Area
110-1597	5.9	110-651	2.1	110-706	3.5	110-773	28.2	110-860	3.7
110-563	5.2	110-652	15.6	110-707	10.2	110-775	19.3	110-862	1.8
110-564	28.4	110-653	23.1	110-708	4.8	110-776	8.7	110-864	1.6
110-573	16.9	110-655	2.2	110-709	22.8	110-780	3.2	110-866	77.8
110-574	15.9	110-656	3.4	110-711	2.7	110-782	5.4	110-867	11.6
110-576	18.7	110-657	8.9	110-712	20.9	110-784	5.5	110-869	8.7
110-584	3.3	110-658	7.6	110-713	43.9	110-786	1.7	110-870	2.8
110-585	4.2	110-659	5.7	110-714	14.9	110-789	8.0	110-872	14.1
110-587	16.9	110-662	43.9	110-715	3.4	110-790	5.1	110-873	52.4
110-588	7.6	110-663	14.4	110-716	0.7	110-791	6.3	110-876	1.8
110-589	10.2	110-666	22.2	110-717	3.3	110-792	3.6	110-878	4.3
110-590	14.1	110-667	1.9	110-718	10.5	110-793	9.6	110-881	4.6
110-592	6.2	110-668	9.6	110-720	4.4	110-796	1.6	110-882	3.8
110-594	4.5	110-669	29.5	110-722	14.4	110-797	2.6	110-883	3.7
110-596	5.6	110-670	5.5	110-724	3.7	110-799	4.1	110-889	2.8
110-602	7.5	110-671	19.8	110-725	2.2	110-800	4.5	110-890	5.3
110-604	2.9	110-673	2.4	110-726	20.8	110-801	15.6	110-892	8.6
110-607	25.0	110-674	6.2	110-728	13.1	110-805	15.5	110-894	4.6
110-610	30.8	110-675	1.8	110-730	7.4	110-807	17.6	110-897	57.0
110-611	5.7	110-676	1.6	110-731	1.2	110-809	11.7	110-898	11.9
110-613	3.0	110-677	27.8	110-733	38.1	110-811	32.5	110-899	7.8
110-614	8.2	110-678	11.3	110-734	5.0	110-813	1.6	110-901	13.3
110-615	20.6	110-679	3.4	110-735	12.2	110-814	31.6	110-902	9.9
110-617	3.9	110-680	4.6	110-736	47.7	110-816	10.4	110-920	1.8
110-618	30.8	110-683	5.9	110-737	1.8	110-824	8.0	110-921	10.5
110-621	16.4	110-685	7.9	110-739	15.8	110-826	6.0	110-927	7.7
110-622	37.7	110-686	3.4	110-745	32.6	110-829	1.8	110-928	14.0
110-623	3.7	110-687	2.4	110-747	21.8	110-831	4.1	110-929	41.3
110-625	2.2	110-688	7.7	110-748	6.3	110-832	48.5	110-930	12.5
110-629	6.0	110-689	51.8	110-750	23.0	110-833	23.0	110-933	15.7
110-630	8.8	110-691	11.7	110-751	4.8	110-835	30.8	110-936	11.8
110-631	12.8	110-692	4.8	110-752	1.8	110-836	15.1	110-937	28.8
110-633	4.9	110-693	9.0	110-753	1.6	110-837	5.1	110-941	11.4
110-641	3.4	110-694	2.0	110-754	3.4	110-841	3.0	110-942	2.3
110-642	2.2	110-695	15.7	110-755	13.7	110-843	5.1	110-949	8.3
110-643	22.4	110-698	8.4	110-757	127.8	110-845	6.3	110-987	2.3
110-644	7.5	110-699	23.0	110-759	4.8	110-847	9.3		
110-645	4.1	110-700	9.5	110-760	4.9	110-851	14.3		
110-646	8.5	110-702	12.3	110-761	15.1	110-852	25.0		
110-647	7.8	110-704	16.7	110-763	2.2	110-857	9.3		
110-648	5.8	110-705	5.5	110-765	14.1	110-858	22.8		
110-650	8.2	110-706	3.5	110-771	11.8	110-859	14.5		

Table 2-14. Hydrologic Data – Albavar Path Drainage Basin

Watershed	Area
ALB-795	4.0
ALB-798	1.9
ALB-803	11.1
ALB-808	3.7
ALB-810	14.4
ALB-818	5.7
ALB-820	7.7
ALB-822	4.1
ALB-823	1.6
ALB-827	18.4
ALB-834	28.6
ALB-838	8.6
ALB-839	2.6
ALB-846	15.7
ALB-855	2.6
ALB-868	2.1
ALB-874	2.1
ALB-885	10.1
ALB-887	6.9
ALB-888	2.7

Table 2-15. Hydrologic Modeling Data and Results – Arbor Pointe Drainage Basin

Watershed Data					10-Year Event Results			100-Year Event Results		
Watershed/ Pond ID	**Area (acres)**	**Outlet**	**Normal Water Level**	**Critical Runoff Event**	**Computed 10-yr Flood**	**Peak Pond Outflow Q_{10}**	**Stored Vol**	**Computed 100-yr Fl**	**Peak Pond Outflow Q_{100}**	**Stored Vol.**
DP-49	15.9	4" OUTLET W/ 6' WEIR AT 918.4	913.9	2 day	916.1	1	2.2	917.5	0.7	3.7
DP-48	26.2	18" w/6' Weir at 911.0 and 24" Outlet Downstream of Weir	908.5	1 hr	911.6	22.3	2.4	912.3	37	3.8
DP-46A	9.0	24"	915.3	1 hr	916.8 (1/2 hr)	8.7	0.1	918	18.1	0.2
DP-46	17.1	6" w/4' Weir at 907.5	902.0	2 day	906.2 (2 day)	1.8	10.2	907.9	5.8	15.2
DP-36A	8.5	12"@915.5/20' WEIR@917.9		1 hr	917	3	0.7	918	9	1.2
DP-36	35.4	9" w/6' Weir at 888.0 and 24" Outlet Downstream of Weir	883.0	1 hr	887.4 (2 hr)	7	3.1	889.4	33.6	4.7
DP-43A	9.0	4"w/Ex. Overflow at 909.0	904.0	1 hr	905.1 (10-day snowmelt)	0.4	0.8	905.6	0.7	1.2
DP-43	12.2	4" w/Ex. Overflow at 905.0	900.0	10-day snowmelt	902.1	0.8	1.5	903	1	2.6
DP-57A	2.6	4" w/Ex. Overflow at 891.0	888.5	10-day snowmelt	890.8	0.8	0.7	891	1.2	0.7
DP-57B	17.2	6"	887.0	10-day snowmelt	888.4 (10-day snowmelt)	1	3.8	889	1.4	5.3
DP-58	25.5	4"	883.0	2 day	886.0 (10-day snowmelt)	0.9	2.6	888	1.3	4.4
DP-34	6.0	4"	914.0	10-day snowmelt	914.4	0.2	0.8	914.6	0.3	1.2
DP-35	38.4	9"	881.0	12 hr	883.8 (2 day)	3.2	4.8	885.4	4.2	8.5
KP-19C	4.9	Ex. Swale at 919	918.0	1 hr	919.0 (10-day snowmelt)	0.4	0.6	919	3.7	0.6
KP-19B	2.9	Ex. Swale at 913	913.0	1 hr	913.2 (1/2 hr)	3.8	0.1	913.3	7.1	0.2

Table 2-15. Hydrologic Modeling Data and Results – Arbor Pointe Drainage Basin

Watershed Data					10-Year Event Results			100-Year Event Results		
Watershed/ Pond ID	Area (acres)	Outlet	Normal Water Level	Critical Runoff Event	Computed 10-yr Flood	Peak Pond Outflow Q_{10}	Stored Vol	Computed 100-yr Fl	Peak Pond Outflow Q_{100}	Stored Vol.
KP-19A	8.0	4"	895.0	10-day snowmelt	896.8	0.6	1.4	897.7	0.9	2.3
DP-66	36.9	4"	881.5	4 day	884.3 (2 Day)	1	7.7	886.3	1.2	13.2
DP-67C	16.4	Ex.Weir Overflow	880.1	1 hr	880.3	7.8	1	880.5	14.8	1.9
DP-67A	8.5	4"	890.5	2 day	892	0.5	1.4	892.9	0.8	2.3
DP-67B	8.5	Ex. Swale	879.4	12 hr	879.8 (2 hr)	3.8	1.5	880.1	9	2.5
DP-60A	10.5	4"	990.9	2 day	902.1 (10-day snowmelt)	0.4	1.2	902.8	0.6	2
KP-27A	4.4			1 hr		6.8 (1/2 hr)			37	
KP-27B	28.8	12"	911.0	6 hr	913.4 (2 hr)	5	3.8	915.4	8.6	6.7
DP-51A	4.0			1/2 hr		31.7			31.7	
DP-51B	4.7			1/2 hr		20.1			32.1	
KP-30[1]	6.6	Natural Overflow	915.0	10-day snowmelt	915	0.7	1.3	915	1.4	1.3
KP-29EST[1]	11.3	Landlocked w/ Natural Overflow	921.0	10-day snowmelt	921	0.5	2.2	921.1	2.4	2.2
KP-29TSC[1]	8.1	24" CMP (assumed)	917.0	1-hr	919.7	17.5	0.5	920.4	22.6	0.8
KP-29WET[1]	8.9	12" CMP	908.7	1-hr	910.5	2.9	0.6	911.8	4.7	1.2
KP-29So[1]	5.8	24" RCP (assumed)		1-hr		12.5				
KP-29[1]	11.2	Landlocked	907	10-day snowmelt				911.5		
KP-17	26.6	6"	919.0	12 hr	921.6 (2 day)	1.9	3	923.3	2.6	5.4
DP-51	8.9	15"	903.0	2 day	905	6.5	3.9	906.3	9.6	6.7
DP-60B	14.0	12"	884.5	2 day	887.2	5.2	5.4	889	7.5	9.6
DP-60C	14.2	21" w/8' Weir at 874.0	871.8	2 day	874.3	18.1	5.2	874.9	34	6.4
DP-30	10.5	4"	885.0	10-day snowmelt	885.8	0.4	1.3	886.1	0.5	1.9
DP-29A	16.0	4"	915.5	2 day	916.7 (10-day snowmelt)	0.5	1.9	917.4	0.7	3.1
DP-60D	7.0	30"	866.5	2 day	868.7 (2 day)	18.2	3.7	870	32	5.8

Table 2-15. Hydrologic Modeling Data and Results – Arbor Pointe Drainage Basin

Watershed Data					10-Year Event Results			100-Year Event Results		
Watershed/ Pond ID	Area (acres)	Outlet	Normal Water Level	Critical Runoff Event	Computed 10-yr Flood	Peak Pond Outflow Q_{10}	Stored Vol	Computed 100-yr Fl	Peak Pond Outflow Q_{100}	Stored Vol.
DP-64	45.8	15" Ex.	904.0	1 hr.	905.6	5.2	3.4	906.9	8.5	6.7
DP-29B	33.7	10 cfs Pump	859.0	10-day snowmelt	866.6 (10-day snowmelt)	10	31.1	872.6	10	81.1
DP-12	44.9									
DP-12-A	1.8									
DP-12-B	11.2									
DP-12-C	13.1									
DP-12-D	11.5									
DP-12-E	4.6									
DP-12-F	1.6									
DP-12-G	19.5									
DP-14-A	16.0									
DP-14-B	13.4									
DP-16	39.5									
DP-17	16.9									
DP-7A	12.8									
DP-40	63.6									
DP-44	9.8									
DP-44-A	7.0									
DP-44-B	8.7									
DP-45	14.3									
DP-45-A	6.4									
DP-45-B	10.7									
DP-47	9.9									
KP-14	4.8									
KP-18[2]	17.4							917.0	0.0	
KP-22	7.1									
KP-26[3]	4.9	18" RCP	953.9					958.0		

[1]Watershed is tributary to KP-29 (Short Pond). KP-29 has a high overflow pipe at elevation 915.4 that would discharge into the Cahill Avenue storm sewer system and drain south to PB-B-3. Flood elevations were determined as part of 2008 development study for Short Dance Studio.

[2]Flood elevation information transferred from 1994 Plan.

[3]Information taken from record drawings for Hidden Forest development.

Table 2-16. Hydrologic Modeling Data and Results – Argenta Trail Drainage Basin

Watershed/ Pond ID	Watershed Area (ac)	Basin Bottom Elevation	100 year 10-day Snowmelt (7.2", no infiltration)		5-year 24-hour Rainfall Max. Elevation	100-year 24-hour Rainfall Max. Elevation
			Maximum Elevation	Bounce (ft)		
EA-011	17.0	927	935.1	8.1		
F-001	27.4	883	894.4	11.4	886.0	888.3
F-003	2.9	951	953.1	2.1	952.4	953.2
F-004	10.9					
F-005	5.3	897	903.8	6.8	899.1	901.3
F-006	5.1	909	917.2	8.2	912.5	915.1
F-008a	9.8	933	936.7	3.7	933.9	934.6
F-008b	3.5					
F-010	10.1	895	903.8	8.8	898.8	901.4
F-011a	10.8	921	927.2	6.2	923.4	925.4
F-011b	11.7	929	931.2	2.2	930.5	931.1
F-011c	16.1					
F-013	10.6					
F-015	4.2	899	903.8	4.8	899.7	901.4
F-016	11.1	899	905.3	6.3	901.2	903.0
F-017	8.8	892.1	905.3	13.2	897.7	903.0
F-019	28.9	891.4	895.7	4.2	893.7	894.9
F-020	3.4	889	891.4	2.4	891.5	891.8
F-022 [1]	30.6	891	892.4	0.6	892.2	892.3

Source: City of Inver Grove Heights – Northwest Area Surface Water Modeling Report, Emmons & Olivier Resources, Inc., August 2006

[1] The Eagan Stormwater Management Plan shows a proposed 4" diameter orifice outlet from F-022 (FP-13 in the Eagan plan) to F-018 (FP-9 in the Eagan plan). In subsequent discussions, City of Inver Grove Heights and City of Eagan staff agreed that flows from F-022 will drain to F-025.

Table 2-17. Hydrologic Modeling Data and Results – Babcock Trail Drainage Basin

Watershed Data					10-Year Event Results			100-Year Event Results		
Watershed/ Pond ID	Area (acres)	Outlet	Normal Water Level	Critical Runoff Event	Computed 10-yr Flood	Peak Pond Outflow Q_{10}	Stored Vol	Computed 100-yr Fl	Peak Pond Outflow Q_{100}	Stored Vol.
BP-5-B	17.8									
BP-5-A	2.7									
BP-8	49.8		903.7		904.8			906.2		27
BP-8A	7.7									
BP-8B	11.7									
BP-9	13.5		891		892.8	7.3		893.9	12	8.5
BP-11	26.5		898		900.4	5.2		902	7.3	13
BP-11A	6.2									
BP-11B	1.8									
BP-11C	4.3									
BP-11D	4.4									
BP-11E	4.0									
BP-11F	7.0									
BP-11G	5.7									
BP-11H	1.7									
BP-12	47.1		810		818			823.8		134
BP-12A	20.9									
BP-12B	4.0									
BP-12C	5.4									
BP-12D	19.3									
BP-12E	4.2									
BP-15	30.3		860		862	7		863	11	5
BP-15A	4.9									
BP-16	48.9		806		808	8		813.1	11	23
BP-17	84.5		763		799			813.1		330
BP-21	37.3		905.0		906.8	3.8		907.6	5.3	34.0
BP-21A	13.3									
BP-22	38.4		905.0		907.0	5.0		908.6	6.0	17.0
BP-22A	4.9									
BP-22B	2.2									
BP-22C	6.3									
BP-23	21.6		901.5		902.2			903.1		11.0
BP-23A	3.9									
BP-26	9.9		901.0		902.2	1.9		903.2	3.5	5.3
BP-26A	10.8									
BP-26B	1.8									
BP-26C	4.8									
BP-26D	13.6									

Table 2-17. Hydrologic Modeling Data and Results – Babcock Trail Drainage Basin

Watershed Data					10-Year Event Results			100-Year Event Results		
Watershed/ Pond ID	Area (acres)	Outlet	Normal Water Level	Critical Runoff Event	Computed 10-yr Flood	Peak Pond Outflow Q_{10}	Stored Vol	Computed 100-yr Fl	Peak Pond Outflow Q_{100}	Stored Vol.
BP-26E	4.2									
BP-27	4.5		901.5		901.8	6.3		902.0	11.0	0.2
BP-30	31.9		895.0		896.3	6.0		897.3	11.0	5.2
BP-37	4.8									
BP-50	9.9		926.0		936.6			939.6		21.0
BP-50A	3.5									
BP-50B	2.9									
BP-50C	3.0									
BP-50D	15.0									
BP-50E	5.4									
BP-51	15.8		917.5		922.9	7.7		926.7	10.0	5.8
BP-51B	10.9									
BP-51C	10.1									
BP-52	32.4		930.1		941.5			944.0		11.0
BP-52A	7.8									
BP-52B	7.4									
BP-52C	2.5									
BP-52D	3.3									
BP-52E	5.7									
BP-52F	32.4									
IP-01K1	7.0									
T-20	13.5									

Note: Watershed areas listed in table represent watershed divides shown on **Figure 2-15**. All other information in table has been transferred from the 1994 WRMP where watershed divides differ from this Plan.

Table 2-17A. Hydrologic Modeling Data and Results – Babcock Trail Drainage Basins Included in the Northwest Area Study

Watershed/ Pond ID	Watershed Area (ac)	Basin Bottom Elevation	100 year 10-day Snowmelt (7.2", no infiltration)		Rainfall Events	
			Maximum Elevation	Bounce (ft)	5-year 24-hour Rainfall Max. Elevation	100-year 24-hour Rainfall Max. Elevation
BP-002	31.4	933	940.9	7.9	937.1	938.4
BP-004	39.0	911	912.4	1.4	911.7	912.2
BP-005	47.9	911	912.2	1.2	911.4	912.0
BP-032	11.3	891	900.4	9.4	892.9	894.9
BP-033a	28.3	913	924.1	11.1	918.1	920.2
BP-033b	9.6	929	941.8	12.8	932.3	934.9
BP-033c	5.6					
BP-033d	13.7	943	953.6	10.6	946.1	948.8
BP-034	11.0	913	918.1	5.1	914.6	915.6
BP-035	12.2	917	927.2	10.2	918.3	920.3
BP-036	13.5	923	926.8	3.8	927.1	929.7
BP-038a	11.0	887	896.5	9.5	890.0	891.8
BP-038b	15.6	901	912.9	11.9	907.2	909.4
BP-038c	7.5	919	927.0	8.0	921.2	922.8
BP-039a	15.1	909	915.6	6.6	910.6	911.7
BP-039b	6.2	927	933.1	6.1	929.0	930.8
BP-039c	3.3	933	937.1	4.1	935.8	937.1
BP-039d	3.8	945	952.1	7.1	947.4	948.9
BP-039e	10.9	909	922.8	13.8	914.5	916.9
BP-039f	4.2	933	939.2	6.2	936.3	938.1
BP-048a	4.2	927	931.3	4.3	927.2	928.1
BP-048b	9.3	925	931.1	6.1	925.3	926.8
BP-048c	7.5	943	946.8	3.8	943.3	944.2
BP-048d	13.5	943	948.1	5.1	943.1	944.0
BP-048e	12.0	939	945.5	6.5	941.1	942.5
BP-049a	16.6	925	930.3	5.3	925.5	927.0
BP-049b	7.3	943	947.9	4.9	943.8	945.0

Source: City of Inver Grove Heights – Northwest Area Surface Water Modeling Report, Emmons & Olivier Resources, Inc., August 2006

Table 2-18. Modeling Data and Results – 10-Day Snowmelt – Barnes Avenue Drainage Basin

Watershed/ Pond ID	Drainage Area (ac)	Normal Water Level (ft)	100-year 10-day Snowmelt Results: High Water Level (ft)	100-year 10-day Snowmelt Results: Maximum Storage Volume (ac-ft)	10-year 10-day Snowmelt Results: High Water Level (ft)	10-year 10-day Snowmelt Results: Maximum Storage Volume (ac-ft)
BA-A-1	4.6	934.0	940.8	1.3	940.7	1.3
BA-A-2	4.9	925.2	934.1	1.1	934.0	1.0
BA-A-3	3.7	938.8	948.1	1.9	946.4	1.2
BA-A-4	14.7	860.9	864.9	1.2	864.9	1.2
BA-A-5	24.7	853.5	864.7	22.1	861.7	13.6
BA-A-6	15.8	875.2	881.1	8.1	879.5	5.3
BA-B-1	8.3	916.6	918.4	0.3	918.4	0.3
BA-B-2	16.8	857.9	865.3	9.8	864.8	8.8
BA-B-3	4.2	854.7	862.1	2.1	861.1	1.4
BA-B-4	12.2	842.7	848.8	2.7	848.7	2.6
BA-B-5	7.5	877.6	884.3	3.8	882.8	2.5
BA-B-6	15.4	889.4	895.8	7.9	894.0	5.2
BA-C-1	7.1	942.0	943.2	0.0	943.2	0.0
BA-C-2	2.5	962.2	965.0	1.3	964.2	0.8
BA-C-3	3.6	933.2	933.6	0.0	933.6	0.0
BA-C-4	3.1	935.1	936.5	0.0	936.5	0.0
BA-C-5	4.2	919.3	928.2	2.9	926.5	1.7
BA-C-6	4.8	930.5	934.6	0.0	934.6	0.0
BA-C-7	4.7	918.8	928.2	13.0	926.2	9.4
BA-D-1	2.3	963.0	970.7	1.2	969.4	0.8
BA-D-2	6.3	961.5	964.9	3.2	963.8	2.1
BA-E-1	15.3	885.0	885.3	0.0	885.2	0.0
BA-E-2	12.0	911.4	916.4	2.2	916.4	2.2
BA-E-3	14.6	816.0	820.4	0.1	820.3	0.1
BA-E-4	3.9	854.9	861.8	2.0	860.5	1.3
BA-F-1	7.1	824.1	826.7	0.04	826.1	0.0
BA-F-2	50.8	781.4	795.0	18.3	790.4	7.3
BA-F-3	18.0	775.1	795.0	108.6	790.4	73.0
BA-F-4	15.7	829.0	829.4	0.0	829.3	0.0
BA-G-1	57.8	779.2	795.0	22.5	790.4	10.1
BA-G-10	13.9	836.1	838.6	1.3	838.6	1.2
BA-G-2	2.2	803.9	805.6	0.0	805.6	0.0
BA-G-3	5.3	839.3	845.1	0.1	845.1	0.1
BA-G-4	4.1	797.5	804.3	2.4	804.3	2.3
BA-G-5	3.9	815.0	815.2	0.0	815.2	0.0
BA-G-6	0.6	815.1	816.5	0.0	816.4	0.0
BA-G-7	2.6	821.2	826.5	0.6	826.5	0.6
BA-G-8	6.3	809.5	810.9	0.0	810.8	0.0

BA-G-9	7.1	825.1	832.9	3.6	831.0	2.4
BA-H-1	10.0	852.4	855.8	0.4	855.8	0.4
BA-H-2	6.7	843.2	847.2	0.2	847.1	0.2
BA-H-3	10.9	837.9	847.2	4.0	847.1	4.0

Table 2-19A. Hydrologic Modeling Data and Results – Eagan Drainage Basin

Watershed/ Pond ID	Watershed Area (ac)	Basin Bottom Elevation	100 year 10-day Snowmelt (7.2", no infiltration)		5-year 24-hour Rainfall Max. Elevation	100-year 24-hour Rainfall Max. Elevation
			Maximum Elevation	Bounce (ft)		
EG-003a	4.0	895	901.5	6.5	896.8	898.3
F-002	6.7	873	892.1	19.1	876.5	878.4
F-012	9.0	893	893.1	0.1	893.2	893.2
F-014	16.0	877	881.9	4.9	879.2	880.2
F-018[1]	72.9	887	889.2	2.2	--	889.0
F-021	3.8	883	888.6	5.6	884.5	885.7
F-023	2.9	877	886.3	9.3	880.0	882.1
F-024	15.6	851	856.3	5.3	851.7	853.1
F-025[2]	72.1	875	879.7	4.7	875.7	877.0
W-002[3]	48.6	879	889.5	10.5	884.0	885.8
W-004a	31.5	849	861.8	12.8	853.8	856.1
W-004b	3.4	887	893.3	6.3	890.7	892.5
W-006	52.7	827	835.2	8.2	832.1	835.0

Source: City of Inver Grove Heights – Northwest Area Surface Water Modeling Report, Emmons & Olivier Resources, Inc., August 2006

[1] "Basin Bottom Elevation" is the proposed outlet elevation. Maximum elevations shown are from the City of Eagan Stormwater Management Plan, which shows a proposed 12" outlet from F-018 (FP-9 in Eagan plan) discharging to F-025 (FP-8 in Eagan plan). See also footnote 1 of Table 2-16. At the peak flood elevation of 889.2, the peak outflow rate is 11.1 cfs. The 5-year 24-hour rainfall maximum elevation is not available in the Eagan plan. Emmons & Olivier Resources, Inc. (EOR) results show the following flood elevations: 888.2, 883.7, and 886.1 for the 100-year 10-day snowmelt, 5-year 24-hour rainfall, and 100-year 24-hour rainfall, respectively, which were based on a basin bottom elevation of 879. EOR's results are based on F-018 draining south into Eagan (watershed G-3 in the Eagan plan). The Eagan plan does not separate out watershed F-012; it is included with watershed F-018.

[2] These flood elevations may need to be revisited, as they do not include flows from F-018 (see footnote 1). However, the peak flood elevation shown here for the 100-year 10-day snowmelt is higher than shown in the Eagan Stormwater Management Plan (878.4), so the peak flood elevation shown here will be used in the interim.

[3] City of Eagan Stormwater Management Plan shows the critical 100-year flood elevation to be 883.8 with a peak outflow of 6.4 cfs (100-year 24-hour rainfall). However, the City of Eagan's model does not reflect more recent information regarding additional watersheds that are tributary to W-002. W-002 is GP-8 in the Eagan Stormwater Management Plan.

Table 2-19B. Hydrologic Modeling Data and Results – Eagan Drainage Basin

Watershed Data			10-Year Event Results[1]		100-Year Event Results[1]	
Watershed/ Pond ID	Watershed Area (ac)	Normal Water Level	Computed 10-yr Flood Level	Peak Pond Outflow Q_{10} (cfs)	Computed 100-yr Flood Level	Peak Pond Outflow Q_{100} (cfs)
EAG-639	55.1	918.5	919.5	1.1	920.8 [2]	1.4
EAG-640	39.2	908.3 [3]	909.8	0 - check	912.6 [4]	11.0
EAG-696	13.0	918.0	921.2	4.8	922.6	5.8
EAG-697	13.5	962.5	963.1	1.4	963.7	3.1
EAG-710	3.4	919.0	920.2	18.6	920.8	35.6
EAG-723	15.6	928.0	930.3	7.2	930.9	8.8
EAG-632	41.0	942.2	NA	NA	947.3	0.0
EAG-637	21.4	959.0	960.7	17	962.5	41
EAG-638	3.6	NA	NA	NA	NA	NA
EAG-665	9.4	952.5	953.0	0.0	953.2	1.0

[1] Flood levels are from HydroCAD modeling results performed for the Southern Lakes development. Only the 24-hour rainfall event was modeled; actual peak flood levels and outflows may be higher.

[2] City of Eagan Stormwater Management Plan shows a flood level of 924.8 and an outflow of 3.9 cfs for the 100-year 10-day snowmelt event, and a flood level of 923.8 and an outflow of 3.4 cfs for the 100-year 24-hour rainfall event. However, the City of Eagan's hydrologic model was based on larger, less detailed watersheds than the Southern Lakes development model. For example, Eagan's model included watershed EAG-632 as part of watershed EAG-639 (i.e., the effects of EAG-632, including ponding, were not modeled separately). EAG-639 is LP-67 in Eagan Stormwater Management Plan.

[3] "Normal Water Level" is the elevation used in the HydroCAD modeling performed for the Southern Lakes development. The HydroCAD model assumed a 4" orifice at 908.3. Subsequent City of Eagan as-builts show a 12" outlet at 909.3 (normal water level). EAG-640 is LP-30 in Eagan Stormwater Management Plan.

[4] City of Eagan Stormwater Management Plan shows a flood level of 914.7 and an outflow of 39.3 cfs for the 100-year 10-day snowmelt event, and a flood level of 913.5 and an outflow of 3.5 cfs for the 100-year 24-hour rainfall event. However, see also footnote 2.

Table 2-19C. Hydrologic Modeling Data and Results – Eagan Drainage Basin

Watershed/ Pond ID	Watershed Area (ac)		Watershed/ Pond ID	Watershed Area (ac)
EAG-1009	1.6		EAG-756	3.5
EAG-312	13.0		EAG-758	15.2
EAG-326	36.6		EAG-766	20.6
EAG-524	1.7		EAG-768	4.2
EAG-527	5.9		EAG-772	8.6
EAG-544	7.3		EAG-774	9.1
EAG-545	8.4		EAG-794	10.0
EAG-546	7.4		EAG-804	14.2
EAG-558	2.3		EAG-812	2.5
EAG-565	1.6		EAG-817	7.3
EAG-572	8.4		EAG-825	4.1
EAG-575	6.2		EAG-828	2.2
EAG-586	3.9		EAG-830	4.8
EAG-593	1.9		EAG-844	2.0
EAG-599	5.1		EAG-854	1.0
EAG-606	30.7		EAG-856	2.0
EAG-654	2.0		EAG-863	3.0
EAG-684	5.2		EAG-865	1.7
EAG-738	4.2		EAG-875	8.8
EAG-742	5.4		EAG-891	8.1
EAG-743	26.7		EAG-913	3.2
EAG-744	8.3		EAG-915	26.2
EAG-746	6.6		EG-003b	3.6

Table 2-20. Hydrologic Modeling Data and Results – Highway 110-494 Drainage Basin

Watershed Data					10-Year Event Results			100-Year Event Results		
Watershed/ Pond ID	Area (acres)	Outlet	Normal Water Level	Critical Runoff Event	Computed 10-yr Flood	Peak Pond Outflow Q_{10}	Stored Vol	Computed 100-yr Fl	Peak Pond Outflow Q_{100}	Stored Vol.
S-7	4.1	18" RCP	945.5	1 hr	946.4	2	0.41	946.7	4	0.6
S-9	41.5	36" RCP	939.0	2-day	941.7	29	13.9	943.2	43	22.2
S-8	32.4	48" CMP	852.2	1 hr	953.1	13	3.5	953.7	20	5.6
S-11	218.5	5.2' weir	937.2	10-day snowmelt	938.8	19	92.1	939.6	24	139.8
SL-19	26.4	18" CMP	1006.4	1 hr	1008.3	7	0.82	1009.1	27	2.1
SL-20	21.3	swale	101.8	1 hr	1003.9	4	1.6	1004.2	20	3
SL-23	6.2	18" CMP	1012.0	1 hr	1011.6	9	0.07	1012.3	21	0.1
SL-17	9.9	48" RCP	996.0	1/2 hr	998.2	25	0.07	999	51	0.1
SL-16	4.3	24" CMP	1002.0	1/2 hr	1003.8	11	0.03	1004.3	22	0.1
SL-2	12.0	30" CMP	961.1	1/2 hr	964	24	0.05	965.9	46	0.2
SL-15B	25.0	36" RCP	956.5	1 hr	960.1	46	0.7	961.8	68	1.5
SL-11	40.0	36" CMP	980.0	1 hr	980.8	8	1.7	981.9	18	4.0
SL-13	8.0	36" CMP	968.0	1 hr	971	32	2.1	972.3	50	3.7
SL-8	15.4	36" CMP	966.0	1 hr	966.8	7	0.8	967.8	17	1.8
SL-7	6.5	swale	972.0	10-day snowmelt	976.3	0	2.2	976.8	1	3.0
SL-6	52.3	21" RCP	945.0	2-day	950.5	17	46	953	20	77.1
SL-14a	3.4	24" RCP	956.8	1 hr	957.9	7	0.17	858.5	13	0.4
SL-14b	3.4			N/A		N/A			N/A	
SL-4	5.9	24" RCP	946.6	1 hr	948.2	9	0.25	949.1	19	0.6
SL-3	4.2	18" RCP	943.5	1 hr	944.1	1	0.24	944.3	2	0.5
SL-1	6.2	36" RCP	942.3	1 hr	944.1	31	0.9	945.2	66	2.2
SL-18	2.9	18" CMP	957.5	1/2 hr	958.4	8	0.02	959.1	15	0.4
A-16	13.1			1/2 hr		37			62	
A-17	12.2			1/2 hr		87			132	
A-21	16.5	swale	0.0	10-day snowmelt	0.1	0.1	5.2	0.1	0.1	7.8
A-1	45.0		340.1	1 hr	341.4	4	3.1	342.2	5.5	6.5
A-2	12.9		338.9	1 hr	339.4	6	1.2	339.7	8	2.1
A-3	15.4			1/2 hr		66			117	
A-4	9.5		334.9	24 hr	335.7	4	2.1	336.2	7	3.7
A-5	11.6			24 hr		30			7	
A-6	1.9			1/2 hr		34			61	
A-7	32.4		296.4	1 hr	298.6	13	4.3	300.8	18	8.6
A-8	4.0			1/2 hr		12			21	
A-9	13.4			1/2 hr		50			85	
A-10	14.3			1/2 hr		59			92	
A-11	7.6			1/2 hr		35			53	
A-12	18.3			1/2 hr		157			239	
A-13	9.1	12"	990.1	1 hr	992.8	6	2.1	994.3	8	4
A-14	11.7			1/2 hr		242			372	
A-15	9.4			1/2 hr		54			80	
A-18	14.4			1/2 hr		263			399	
A-19	8.7			1/2 hr		241			368	
A-20-1	1.9			1/2 hr		247			380	
A-20-2	7.0	UG storage w/ weir	983.3	1 hr	990.4	16	0.4	994.5	27	0.6

Table 2-20. Hydrologic Modeling Data and Results – Highway 110-494 Drainage Basin

Watershed Data					10-Year Event Results			100-Year Event Results		
Watershed/ Pond ID	**Area (acres)**	**Outlet**	**Normal Water Level**	**Critical Runoff Event**	**Computed 10-yr Flood**	**Peak Pond Outflow Q_{10}**	**Stored Vol**	**Computed 100-yr Fl**	**Peak Pond Outflow Q_{100}**	**Stored Vol.**
A-20-3	5.2			1/2 hr		264			404	
A-20-4	4.0			1/2 hr		34			53	
A-20-5	0.9			1/2 hr		6			9	
A-20-6	2.0			1/2 hr		270			413	
A-20-7	1.5			1/2 hr		43			66	
A-20-8	4.7			1/2 hr		69			105	
A-20-9	15.8			1/2 hr		60			92	
T-1	54.4	54" RCP	894.0	1 hr	896.7	42.1	3.9	897.7	118.9	5.8
T-2	22.7	42" RCP	904.1	1/2 hr	909.8	86.5	0.6	911.4	106.2	1.2
T-3	13.1	2-88x54" RCPA	890.0	1 hr	892.5 (1/2 hr)	134.5	0.8	893.4	223.7	1.4
T-4	9.2	24" RCP	893.0	1 hr	894.8	7.8	0.7	895.6	11.2	1.3
T-5	5.3	78" RCP	886.5	1 hr	890.8 (1/2 hr)	127.8	0.8	892.7	183	2.9
T-6	16.8	landlocked	279.2	10-day snowmelt	285.1	0	5.5	286.4	0	8.3
T-7	6.9	landlocked	273.6	10-day snowmelt	276.6	0	2.3	277.6	0	3.4
T-8	21.1	Weir/24" CMP	967.2	1 hr	969.6 (2 hr)	166	2.3	970.9	37.8	3.6
T-9	15.6	Weir at 962	962.0	1 hr	962.4 (1/2 hr)	49.9	0.3	962.6	79.9	0.4
T-10	11.2	42"	0.0	1/2 hr	3	41.8	0.2	3.1	80.1	0.2
T-11	84.9	8" orifice/18" culvert at 941.6	941.6	2 day	943	7.1	21.3	943.8	12.4	33.3
T-12	72.3	no outlet/ road overflow at 925.8	924.0	4 day	926 (10-day snowmelt)	6.8	13.9	926.2	17.7	15.5
T-13-1	6.3	Centex Pond #1	903.0	1 hr	904 (2 hr)	2.9	0.5	904.4	7.9	0.8
T-13-2	10.3	Centex Pond #2	888.0	1 hr	889.1 (2 hr)	4.5	0.9	889.7	10.7	1.3
T-13	162.8	21" RCP	886.0	4 day	891.6 (10-day snowmelt)	26.3	60.6	895.6	37.7	106.7
H-1	57.1	12" RCP	840.0	10-day snowmelt	841.1	0.4	13.6	841.6	0.6	20.4
T-14	42.2	21" RCP	839.0	4 day	845.3 (10-day snowmelt)	27.3	10.7	850.1	37.2	19.2
T-15	6.0	24" RCP	921.4	1/2 hr	923.2 (1 hr)	12.3	0.1	924.3	19.8	0.1
T-16	33.7	54" RCP	909.8	1/2 hr	914.8	106.3	0.7	916.3	143.2	1.4
BISH-2	7.1			1/2 hr		24.9			38.0	
BISH-D	28.0	21"/24" to T18; 18"/24" to T19	890.5	1 hr	894.6	34.9	2.9	897	44.3	5.1
T-18[1]	32.8	10”	890.0	12 hr				895.5	27	12.2
T-18A[1,2]	5.2	11”	886.0	12 hr				890.5	17	4.0
T-17	46.1	48" RCP	866.0	1 hr	872.5	117	3	874.7	150.9	6.6
T-19	34.9	Backflow through 12" @874.04	868.1	10-day snowmelt	873.6	0.1	12.3	874.1	0.1	19.4
T-19ES	4.2	24" RCP	855.4	1-hr	856	3.9	0.5	856.3	6.1	0.7

Table 2-20. Hydrologic Modeling Data and Results – Highway 110-494 Drainage Basin

Watershed Data					10-Year Event Results			100-Year Event Results		
Watershed/ Pond ID	Area (acres)	Outlet	Normal Water Level	Critical Runoff Event	Computed 10-yr Flood	Peak Pond Outflow Q_{10}	Stored Vol	Computed 100-yr Fl	Peak Pond Outflow Q_{100}	Stored Vol.
T-19E	19.7	24" CPEP at 838.96. 48" dia drop structure @848.6 assumed.	851.7	1 hr	850.5	51.8	0.5	853.3	60.4	1.3
T-21	8.7			1/2 hr		53.6			80.1	
T-22	37.9	landlocked (2cfs outlet)	0.0	2 day	1.1 (12 hr)	2	10.2	1.1	2	18.1
T-23	30.0	42" Submerged to 27" RCP	810.7	4 day	817.8 (2 day)	32.2	20.8	824.1	42.9	50
IP-01A	8.9									
IP-01B	10.5									
IP-01K2	4.1									
IP-01K3	10.4									
H-2	19.5									
H-3	22.4									
H-4	8.9									
H-5	13.0									
H-6	120.9									
H-7	13.2									
H-8	40.1									
H-9	32.0									
H-10	307.3									
H-11	238.4									
P-1[3]	27.3	8" pipe	282.0	10-day				285.0	3.7	3.6
P-2[3]	74.4	15" RCP	933.5	1-hr				939.7	13.9	11.6
P-3[3]	65.9		900.75	10-day				903.1	15.4	14.5
P-4[3]	8.5								66	
P-5[3]	15.6		888.0	1-hr				889.3	2.9	1.9
P-6[3]	226.8	Landlocked	804.8	10-day				831.0	0.0	248.2

[1]Based on 2003 development proposal for Southeast Quadrant LLC Retail

[2]Outflows from this watershed are restricted by MnDOT drainage permit D-04-6590

[3]Data and results from Seidls Lake Outlet Feasibility Study (Barr 2004)

Table 2-21. Modeling Data and Results – 10-Day Snowmelt – Inver Grove Trail Drainage Basin

			100-year 10-day Snowmelt Results		10-year 10-day Snowmelt Results	
Watershed/ Pond ID	Drainage Area (ac)	Normal Water Level (ft)	High Water Level (ft)	Maximum Storage Volume (ac-ft)	High Water Level (ft)	Maximum Storage Volume (ac-ft)
IGT-A-1	11.7	898.8	901.2	0.2	901.2	0.2
IGT-A-2	18.2	899.2	904.8	9.3	903.1	6.1
IGT-A-3	1.5	902.1	902.3	0.0	902.2	0.0
IGT-A-4	18.2	899.2	910.4	3.6	910.4	3.6
IGT-A-5	50.0	887.6	897.2	38.6	895.7	25.1
IGT-A-6	1.6	892.4	897.2	1.5	895.7	0.7
IGT-B-1	1.9	897.2	901.3	1.0	900.5	0.6
IGT-B-2	10.1	885.4	892.1	5.2	890.6	3.4
IGT-B-3	22.0	891.1	894.2	11.2	893.3	7.4
IGT-B-4	9.7	882.2	891.7	4.9	890.2	3.3
IGT-C-1	5.5	894.8	895.0	0.0	895.0	0.0
IGT-C-2	16.6	863.5	869.5	14.0	867.7	8.9
IGT-C-3	10.6	870.4	872.9	3.4	872.8	3.2
IGT-C-4	11.0	857.2	863.4	15.8	859.5	4.7
IGT-C-5	24.0	860.0	869.5	11.5	867.7	8.2
IGT-C-6	9.8	850.5	855.1	1.0	853.2	0.4
IGT-C-7	25.6	846.1	855.1	21.0	853.2	14.1
IGT-C-8	4.9	847.6	855.1	1.7	853.6	1.1
IGT-C-9	4.2	859.7	864.5	0.8	864.5	0.8
IGT-D-1	7.2	888.1	888.4	0.3	888.4	0.3
IGT-D-2	15.1	882.7	883.7	1.8	883.7	1.7
IGT-D-3	42.7	857.7	865.9	38.3	863.7	25.4
IGT-D-4	5.8	868.2	875.2	0.1	875.1	0.1
IGT-D-5	2.6	864.9	875.0	1.3	873.4	0.9
IGT-E-1	6.2	922.2	928.6	1.2	928.5	1.2
IGT-E-10	5.4	852.5	860.4	2.8	858.8	1.8
IGT-E-11	4.1	850.6	861.6	6.3	859.3	3.3
IGT-E-2	8.4	898.8	905.4	2.7	905.3	2.7
IGT-E-3	2.0	909.4	912.7	0.4	912.7	0.4
IGT-E-4	25.1	855.7	868.1	19.9	863.7	10.9
IGT-E-5	2.0	894.4	896.6	0.4	896.6	0.4
IGT-E-6	7.2	872.2	880.3	1.1	880.2	1.1
IGT-E-7	3.2	863.4	871.6	1.9	871.5	1.9
IGT-E-8	2.1	850.1	861.6	1.4	859.3	0.7
IGT-E-9	29.6	853.1	858.7	18.0	857.2	10.9

Table 2-22. Hydrologic Modeling Data and Results – Jefferson Trail Drainage Basin

Watershed Data					10-Year Event Results			100-Year Event Results		
Watershed/ Pond ID	**Area (acres)**	**Outlet**	**Normal Water Level**	**Critical Runoff Event**	**Computed 10-yr Flood**	**Peak Pond Outflow Q_{10}**	**Stored Vol**	**Computed 100-yr Fl**	**Peak Pond Outflow Q_{100}**	**Stored Vol.**
GP-1	27.7		846.0	10-day Snowmelt	856.3	0.0		855.2	0.0	22
GP-2-A	29.		846.4	10-day Snowmelt	856.3	0.0	29.6	862.3	0.0	48
GP-2-B	9.8			1-hr						
GP-3	39.9	12”	860.9	1-hr	862.7	3.7	3.2	864.4	6.9	6.2

Note: Water elevations and storage volumes transferred from 1994 WRMP.

Table 2-23. Hydrologic Data – Mississippi River Drainage Basin

Watershed	Area		Watershed	Area		Watershed	Area		Watershed	Area
MIS-1601	1.5		MIS-381	4.6		MIS-500[1]	9.8		MIS-634	1.6
MIS-276	6.9		MIS-385	3.6		MIS-503	15.3		MIS-635	2.6
MIS-277	42.8		MIS-387	4.3		MIS-509	2.5		MIS-636	3.3
MIS-297	2.5		MIS-395	8.6		MIS-510	1.8		MIS-649	2.3
MIS-300	6.0		MIS-404	4.4		MIS-514	11.9		MIS-664	63.5
MIS-304	4.3		MIS-411	8.4		MIS-516	15.4		MIS-690	6.5
MIS-308	13.7		MIS-426	1.0		MIS-521	15.7		MIS-703	3.3
MIS-310	24.6		MIS-427	3.6		MIS-528	3.1		MIS-729	25.6
MIS-311	9.6		MIS-429	11.2		MIS-549	27.8		MIS-741	13.2
MIS-317	18.6		MIS-430	14.2		MIS-550	11.2		MIS-778	29.7
MIS-331	5.2		MIS-431	13.3		MIS-556	4.2		MIS-787	5.4
MIS-334	33.0		MIS-445	4.4		MIS-562	3.2		MIS-788	3.0
MIS-345	9.2		MIS-447	4.6		MIS-571	24.6		MIS-806	12.2
MIS-356	15.5		MIS-457	30.5		MIS-580	8.7		MIS-821	52.8
MIS-362	18.1		MIS-479	3.3		MIS-597	6.1		MIS-861	42.9
MIS-365	10.4		MIS-483	4.4		MIS-601	15.9		MIS-906	25.2
MIS-369	6.0		MIS-487	4.2		MIS-605	5.2		MIS-940	6.3
MIS-373	16.5		MIS-495	2.2		MIS-619	3.2			
MIS-378	20.3		MIS-497	17.5		MIS-620	1.8			

[1]In 1994 WRMP, MIS-500 was labeled KP-36 and was located in the Inver Grove Trail Drainage Basin

Table 2-24. Hydrologic Modeling Data and Results – Northwest Drainage Basin

Watershed/ Pond ID	Watershed Area (ac)	Basin Bottom Elevation	100 year 10-day Snowmelt (7.2", no infiltration)		Rainfall Events	
			Maximum Elevation	Bounce (ft)	5-year 24-hour Rainfall Max. Elevation	100-year 24-hour Rainfall Max. Elevation
BP-002	31.4	933	940.9	7.9	937.1	938.4
BP-004	39.0	911	912.4	1.4	911.7	912.2
BP-005	47.9	911	912.2	1.2	911.4	912.0
BP-032	11.3	891	900.4	9.4	892.9	894.9
BP-033a	28.3	913	924.1	11.1	918.1	920.2
BP-033b	9.6	929	941.8	12.8	932.3	934.9
BP-033c	5.6					
BP-033d	13.7	943	953.6	10.6	946.1	948.8
BP-034	11.0	913	918.1	5.1	914.6	915.6
BP-035	12.2	917	927.2	10.2	918.3	920.3
BP-036	13.5	923	926.8	3.8	927.1	929.7
BP-038a	11.0	887	896.5	9.5	890.0	891.8
BP-038b	15.6	901	912.9	11.9	907.2	909.4
BP-038c	7.5	919	927.0	8.0	921.2	922.8
BP-039a	15.1	909	915.6	6.6	910.6	911.7
BP-039b	6.2	927	933.1	6.1	929.0	930.8
BP-039c	3.3	933	937.1	4.1	935.8	937.1
BP-039d	3.8	945	952.1	7.1	947.4	948.9
BP-039e	10.9	909	922.8	13.8	914.5	916.9
BP-039f	4.2	933	939.2	6.2	936.3	938.1
BP-048a	4.2	927	931.3	4.3	927.2	928.1
BP-048b	9.3	925	931.1	6.1	925.3	926.8
BP-048c	7.5	943	946.8	3.8	943.3	944.2
BP-048d	13.5	943	948.1	5.1	943.1	944.0
BP-048e	12.0	939	945.5	6.5	941.1	942.5
BP-049a	16.6	925	930.3	5.3	925.5	927.0
BP-049b	7.3	943	947.9	4.9	943.8	945.0
DP-006	6.1	937	944.7	7.7	938.8	940.1
EP-005a	31.9	924.9	925.7	0.8	925.2	925.5
EP-005b	54.3	912	915.2	3.2	915.3	915.5
EP-005c	6.8	924	932.0	8.0	927.0	928.8
EP-005d	6.8	953	957.7	4.7	954.4	955.3
EP-009	16.1	889	899.4	10.4	894.4	897.7
EP-010a	10.5	877	899.0	22.0	885.5	889.5
EP-010b	30.6	898	907.3	9.3	901.1	904.0
EP-011	13.9	883	899.0	16.0	886.1	888.9
EP-012a	11.4					
EP-012b	5.0					
EP-013	43.0	851	865.8	14.8	854.7	857.0
EP-016a	97.0	903	907.3	4.3	904.0	904.9
EP-016b	15.7	901	909.1	8.1	903.3	905.5

Table 2-24. Hydrologic Modeling Data and Results – Northwest Drainage Basin

Watershed/ Pond ID	Watershed Area (ac)	Basin Bottom Elevation	100 year 10-day Snowmelt (7.2", no infiltration)		Rainfall Events	
			Maximum Elevation	Bounce (ft)	5-year 24-hour Rainfall Max. Elevation	100-year 24-hour Rainfall Max. Elevation
EP-016c	10.0	907	913.4	6.4	909.5	911.0
EP-016d	41.8	907	912.4	5.4	912.2	915.2
EP-016e	2.5					
EP-016f	5.0	945	950.4	5.4	946.1	947.2
EP-016g	9.0	925	934.9	9.9	928.6	930.5
EP-018	12.4	935	935.3	0.3	935.2	935.4
EP-025a	22.0	879	882.2	3.2	882.4	884.8
EP-025b	10.6	897	903.8	6.8	898.0	899.6
EP-027a	55.4	846.3	860.1	13.8	850.7	853.7
EP-027b	32.0					
EP-027c	22.4	888	893.0	5.0	889.4	890.6
EP-027d	7.1	923	930.3	7.3	925.0	926.5
EP-027e	7.9	941	947.1	6.1	943.0	944.4
EP-027f	6.0	849	854.5	5.5	850.2	851.3
EP-027g	2.8	903	907.0	4.0	904.1	905.0
EP-031a	25.0	875	888.5	13.5	878.5	881.7
EP-031b	13.5	901	902.4	1.4	901.3	901.7
EP-031c	8.2					
EP-032	11.7	891	899.9	8.9	893.2	895.2
EP-034	38.1	848.3	866.1	17.8	855.8	858.9
EP-035a	15.6					
EP-035b	4.3	853	864.6	11.6	855.5	857.1
EP-035c	5.2					
EP-035d	5.5					
EP-036a	20.2	858.3	869.1	10.8	864.2	865.5
EP-038a	8.4	867	872.1	5.1	870.1	871.5
EP-038b	7.9	867	875.3	8.3	869.8	871.9
EP-039	36.5	847	857.8	10.8	848.6	851.9
EP-044	40.0	885	895.0	10.0	886.7	889.6
EP-045	25.8	879	886.3	7.3	879.8	881.3
EP-049a	25.6	840	850.7	10.7	843.2	845.4
EP-049b	8.3	859	870.4	11.4	861.9	863.9
EP-049c	25.6	899	912.7	13.7	902.9	906.2
EP-049d	16.2					
EP-049e	4.6	903	907.1	4.1	904.3	905.1
EP-049f	28.0	873	883.0	10.0	875.8	878.3
EP-049g	8.8	877	883.1	6.1	878.8	881.1
EP-057a	12.2	919	923.1	4.1	919.7	920.6
EP-057b	7.4	939	946.2	7.2	941.8	943.2
EP-058a	45.5	877	887.7	10.7	878.0	880.5
EP-058b	3.7	921	926.3	5.3	923.2	924.4
EP-058c	3.1	929	935.9	6.9	932.0	933.3

Table 2-24. Hydrologic Modeling Data and Results – Northwest Drainage Basin

Watershed/ Pond ID	Watershed Area (ac)	Basin Bottom Elevation	100 year 10-day Snowmelt (7.2", no infiltration)		Rainfall Events	
			Maximum Elevation	Bounce (ft)	5-year 24-hour Rainfall Max. Elevation	100-year 24-hour Rainfall Max. Elevation
EP-059a	26.2	899	906.0	7.0	900.2	901.9
EP-059b	29.2					
EP-059c	10.9	933	939.1	6.1	934.6	936.3
EP-059d	1.1					
EP-059e	1.6					
EP-060a	26.6	855	863.1	8.1	863.1	863.3
EP-060b	22.2	897	905.8	8.8	900.0	902.0
EP-060c	2.5	929	933.2	4.2	930.4	931.4
EP-064	13.3	885	900.4	15.4	888.5	891.8
EP-066a	29.6					
EP-066b	18.5					
EP-066c	5.8					
EP-067a	49.8	859	862.3	3.3	859.5	860.1
EP-067b	5.7	879	884.4	5.4	880.4	881.6
EP-068a	15.3	857	862.8	5.8	858.3	859.4
EP-068c	5.1					
EP-071	48.8	841	854.9	13.9	845.4	848.0
EP-072	33.4	841	847.3	6.3	842.2	843.4
EP-073a	13.6	840	853.2	13.2	842.0	844.5
EP-073b	12.0					
EP-073c	9.4					
EP-073d	3.3					
EP-074a	27.2	825	833.7	8.7	826.8	828.7
EP-074b	7.1	837	842.1	5.1	839.8	841.3
EP-074c	4.4					
EP-074d	14.7					
EP-074e	12.6					
EP-074f	4.1					
EP-075	22.6	805	825.0	20.0	808.6	813.2
EP-076	15.3	893	893.2	0.2	893.2	893.4
EP-078	46.4	807	809.6	2.6	808.0	808.9
EP-079a	37.0	807	810.3	3.3	807.9	808.9
EP-079b	3.8					
EP-080a	129.9	801	803.5	2.5	801.4	802.1
EP-080b	17.6	901	903.1	2.1	902.1	903.0
EP-080c	22.2	905	910.6	5.6	905.8	906.9
EP-080d	9.7	901	902.6	1.6	902.7	903.2
EP-080e	4.3	893	898.9	5.9	895.3	896.2
EP-080f	19.7					
EP-102a	32.7	901	910.7	9.7	906.6	908.7
EP-102b	10.2	901	909.7	8.7	903.9	905.7
EP-102c	19.2	913	919.2	6.2	910.9	911.3

Table 2-24. Hydrologic Modeling Data and Results – Northwest Drainage Basin

Watershed/ Pond ID	Watershed Area (ac)	Basin Bottom Elevation	100 year 10-day Snowmelt (7.2", no infiltration)		Rainfall Events	
			Maximum Elevation	Bounce (ft)	5-year 24-hour Rainfall Max. Elevation	100-year 24-hour Rainfall Max. Elevation
EP-104	41.0	888.1	898.4	10.3	892.5	894.8
EP-106	13.6	859	869.3	10.3	862.2	864.7
EP-107a	46.1	855	861.3	6.3	856.8	858.1
EP-107b	47.4	847	866.7	19.7	858.7	861.6
EP-107c	11.4					
EP-107d	4.4					
EP-107e	2.1					
EP97-B	6.7					
EP97-C	6.7					
EP97-D	6.5					
EP97-E	3.0					
EP97-F	3.1					
QP-5	29.1	923.0	929.6	6.6	924.6	926.2
SP-10	3.9	907.0	909.1	2.1	909.1	909.2
SP-12	32.6	823.0	827.5	4.5	825.2	826.0
SP-13	2.6					
SP-14	20.3	873.0	883.3	10.3	875.6	878.1
SP-15	21.3	891.0	899.0	8.0	893.4	895.0
SP-16	14.6	863.0	869.5	6.5	864.8	866.2
SP-17	16.8	811.0	827.5	16.5	814.0	818.2
SP-18	1.8					
SP-2	16.1	871.0	881.1	10.1	877.5	881.0
SP-20	20.8	839.0	851.1	12.1	841.1	845.1
SP-21	19.4	857.0	861.1	4.1	861.0	861.2
SP-22	9.7	843.0	850.4	7.4	846.1	847.6
SP-23	6.5	861.0	865.3	4.3	864.1	865.1
SP-25	3.1	957.0	958.3	1.3	957.7	958.1
SP-27	21.6	831.0	839.2	8.2	833.7	835.6
SP-28	17.0	833.0	834.8	1.8	834.8	835.7
SP-29	5.3					
SP-3	34.0	915.0	919.2	4.2	918.7	919.4
SP-4	10.3					
SP-5	12.9					
SP-7	19.9	921.8	933.0	11.2	925.7	928.1
SP-8	52.7	835.0	848.7	13.7	839.3	842.5
SP-9	3.7	863.0	868.2	5.2	866.0	868.0
EP-068b[1]		861	870.4	9.4	866.1	867.9

Source: City of Inver Grove Heights – Northwest Area Surface Water Modeling Report, Emmons & Olivier Resources, Inc., August 2006

[1] Watershed not included in August 2006 report by Emmons & Olivier Resources, Inc.

Table 2-25. Hydrologic Modeling Data and Results – Old Village Drainage Basin

Watershed Data					10-Year Event Results			100-Year Event Results		
Watershed/ Pond ID	Area (acres)	Outlet	Normal Water Level	Critical Runoff Event	Computed 10-yr Flood	Peak Outflow Q_{10}	Stored Vol	Computed 100-yr Fl	Peak Outflow Q_{100}	Stored Vol.
PP-1	322.2			1 hr		560	0.0		940	0.0
PP-2	123.0			1 hr		240	0.0		400	0.0
PP-3	41.8			1 hr		120	0.0		180	0.0
PP-4	55.1			1 hr		170	0.0		270	0.0
PP-5	23.0			1 hr		70	0.0		130	0.0

Note: All information in table was transferred from 1994 WRMP.

Table 2-26. Modeling Data and Results – 10-Day Snowmelt – Pine Bend Drainage Basin

			100-year 10-day Snowmelt Results		10-year 10-day Snowmelt Results	
Watershed/ Pond ID	Drainage Area (ac)	Normal Water Level (ft)	High Water Level (ft)	Maximum Storage Volume (ac-ft)	High Water Level (ft)	Maximum Storage Volume (ac-ft)
PB-A-1	34.0	883.6	888.5	17.3	887.1	11.4
PB-A-2	3.5	915.3	918.7	0.1	918.6	0.1
PB-A-3	26.0	889.4	894.3	15.9	892.8	10.2
PB-A-4	5.9	884.0	886.0	2.1	885.9	2.0
PB-A-5	2.3	882.4	886.9	0.4	886.9	0.4
PB-A-6	21.7	867.6	878.4	10.2	875.2	5.7
PB-A-7	7.0	863.0	878.4	18.4	875.2	9.6
PB-A-8	7.6	883.7	890.2	0.6	890.2	0.6
PB-B-10	22.3	809.7	814.3	28.7	812.4	16.3
PB-B-11	5.8	849.1	858.1	3.0	856.4	2.0
PB-B-12	6.1	848.9	852.9	1.0	852.9	1.0
PB-B-13	5.8	867.9	874.6	4.1	874.3	3.9
PB-B-14	11.5	892.8	896.8	1.9	896.7	1.8
PB-B-15	2.6	903.3	906.9	0.4	906.9	0.4
PB-B-2	4.2	915.3	920.0	0.6	920.0	0.6
PB-B-3[1]	14.2	865.5	876.7	22.5	873.2	14.2
PB-B-4	20.1	877.7	885.3	3.7	885.2	3.6
PB-B-5	16.2	845.3	859.0	8.3	856.6	5.4
PB-B-6	23.4	825.6	833.7	5.4	833.6	5.2
PB-B-7	5.5	811.7	821.6	2.8	819.7	1.9
PB-B-8	6.4	815.6	825.1	3.3	823.3	2.2
PB-B-9	13.5	822.4	829.7	0.6	829.6	0.5
PB-C-1	4.1	817.5	829.2	0.6	829.1	0.6
PB-C-2	16.7	787.5	795.3	26.5	791.5	12.5
PB-C-3	9.4	830.3	831.6	0.0	831.6	0.0
PB-C-4	19.4	795.2	798.5	8.9	798.3	8.4
PB-C-5	13.0	801.1	802.2	0.1	802.2	0.1
PB-C-6	32.8	796.5	807.7	16.7	805.4	11.0
PB-D-1	20.1	829.9	838.2	12.2	835.6	6.8
PB-D-2	2.8	853.3	857.8	1.1	857.6	1.0
PB-D-3	4.8	862.0	868.0	2.4	866.9	1.6
PB-E-1	18.4	834.2	845.6	7.6	843.4	4.7
PB-E-2	7.6	827.4	845.6	7.1	843.4	5.1
PB-F-1	22.0	757.2	772.6	65.0	768.6	41.3
PB-F-10	6.5	904.9	909.7	2.6	909.2	2.2
PB-F-11	11.5	898.6	899.0	0.0	899.0	0.0
PB-F-12	1.9	895.1	895.5	0.0	895.4	0.0
PB-F-13	2.2	896.6	896.8	0.0	896.8	0.0
PB-F-2	6.3	801.8	805.7	2.8	805.0	2.1
PB-F-3	1.5	793.5	795.5	0.2	795.5	0.2
PB-F-4	36.3	779.4	779.9	0.0	779.8	0.0
PB-F-5	16.3	846.6	849.2	0.5	849.1	0.5
PB-F-6	4.0	869.2	870.2	0.1	870.2	0.1
PB-F-7	18.9	872.4	872.9	0.0	872.8	0.0
PB-F-8	5.3	901.5	907.5	2.3	906.8	1.8
PB-F-9	18.7	889.6	900.7	10.6	898.9	6.3
PB-G-1	2.1	904.1	908.9	1.1	908.2	0.7
PB-G-10	1.56	926.0	928.4	0.3	928.4	0.3
PB-G-11	2.6	916.8	917.6	0.0	917.6	0.0

Table 2-26. Modeling Data and Results – 10-Day Snowmelt – Pine Bend Drainage Basin

			100-year 10-day Snowmelt Results		10-year 10-day Snowmelt Results	
Watershed/ Pond ID	**Drainage Area (ac)**	**Normal Water Level (ft)**	**High Water Level (ft)**	**Maximum Storage Volume (ac-ft)**	**High Water Level (ft)**	**Maximum Storage Volume (ac-ft)**
PB-G-12	13.5	897.1	900.6	0.5	900.5	0.5
PB-G-13	5.2	930.3	933.1	1.9	933.1	1.8
PB-G-2	36.5	878.2	885.9	42.7	883.7	26.7
PB-G-3	2.0	905.5	906.3	0.1	906.3	0.1
PB-G-4	1.3	913.2	916.7	0.4	916.7	0.4
PB-G-5	1.6	908.5	910.2	0.0	910.2	0.0
PB-G-6	9.1	910.7	914.2	2.3	914.1	2.2
PB-G-7	1.2	912.4	912.6	0.0	912.6	0.0
PB-G-8	3.5	926.7	928.3	0.2	928.3	0.2
PB-G-9	1.9	926.4	927.8	0.1	927.8	0.1
PB-H-1	25.2	891.2	895.4	12.9	894.1	8.5
PB-I-1	23.9	918.5	921.6	1.2	921.6	1.2
PB-I-2	9.8	919.8	924.5	1.1	924.4	1.0
PB-I-3	6.2	929.2	934.2	3.2	933.3	2.1
PB-I-4	7.5	926.5	934.1	3.8	932.9	2.5
PB-I-5	12.4	918.7	927.3	7.0	927.2	6.8
PB-I-6	3.4	927.9	930.2	0.2	930.2	0.2
PB-I-7	1.3	922.9	927.4	0.3	927.2	0.2
PB-I-8	16.3	922.8	927.4	0.1	927.2	0.1
PB-J-1	17.4	909.7	910.2	0.7	910.2	0.6
PB-K-1	23.6	916.0	921.1	0.7	921.1	0.7

[1]Refer to 2006 hydrologic study for Cahil Avenue Extension by Kimley-Horn and Associates, Inc. for rainfall event modeling results.

Table 2-27. Modeling Data and Results – 10-Day Snowmelt – Rich Valley Drainage Basin

			100-year 10-day Snowmelt Results		10-year 10-day Snowmelt Results	
Watershed/ Pond ID	Drainage Area (ac)	Normal Water Level (ft)	High Water Level (ft)	Maximum Storage Volume (ac-ft)	High Water Level (ft)	Maximum Storage Volume (ac-ft)
RV-A-1	16.5	827.6	834.5	8.4	833.3	5.6
RV-A-2	11.5	822.0	832.1	5.9	830.1	3.9
RV-A-3	13.7	793.4	808.4	7.0	805.7	4.6
RV-A-4	20.0	821.1	830.9	10.2	828.6	6.7
RV-A-5	18.9	800.3	806.2	3.6	806.2	3.6
RV-A-6	3.3	865.2	870.6	1.2	870.3	1.1
RV-A-7	24.0	796.0	796.6	0.1	796.3	0.1
RV-A-8	4.1	816.0	817.5	0.6	817.5	0.6
RV-A-9	27.9	791.7	796.6	35.0	794.8	21.7
RV-B-1	4.8	822.9	825.8	0.5	825.8	0.5
RV-B-2	12.9	792.2	799.4	13.6	797.2	8.7
RV-B-3	6.1	805.4	808.9	0.1	808.9	0.1
RV-B-4	5.6	826.9	832.4	0.8	832.4	0.8
RV-C-1	8.0	787.1	794.8	1.6	794.7	1.6
RV-C-10	5.2	853.9	856.8	0.5	856.8	0.5
RV-C-11	4.8	853.6	856.2	0.1	856.2	0.1
RV-C-12	20.0	823.4	827.8	2.5	827.8	2.5
RV-C-13	1.8	906.7	912.9	0.9	911.8	0.6
RV-C-14	17.4	853.9	863.8	8.9	861.9	5.8
RV-C-2	22.1	788.1	793.1	18.3	792.9	17.4
RV-C-3	4.1	810.6	814.5	0.3	814.4	0.3
RV-C-4	5.9	809.9	810.0	0.0	810.0	0.0
RV-C-5	7.7	825.3	825.4	0.0	825.4	0.0
RV-C-6	2.1	822.4	825.7	0.1	825.7	0.1
RV-C-7	18.0	804.0	812.1	19.5	815.8	34.6
RV-C-8	39.0	791.7	795.8	35.3	794.4	22.5
RV-C-9	7.8	837.2	843.1	1.0	843.1	1.1
RV-D-1	3.6	951.0	952.7	0.2	952.8	0.2
RV-D-2	2.5	963.7	965.4	0.3	965.5	0.3
RV-D-3	14.4	937.2	943.3	11.0	941.4	6.6
RV-D-4	2.9	939.9	943.3	1.6	941.4	0.6
RV-D-5	52.3	829.7	841.8	26.7	839.0	17.6
RV-D-6	8.8	852.4	856.5	4.5	855.3	3.0
RV-E-1	23.8	853.2	870.9	12.1	868.4	8.0
RV-E-2	23.9	857.2	869.1	12.2	866.9	8.0
RV-F-1	3.8	871.2	875.1	0.3	875.1	0.3
RV-F-10	10.2	848.2	860.2	7.2	858.3	4.7
RV-F-11	4.5	861.4	866.9	0.3	866.8	0.3
RV-F-12	0.7	874.9	881.7	0.3	880.2	0.2
RV-F-13	12.7	844.1	846.4	0.8	846.4	0.8
RV-F-14	9.5	823.0	825.2	4.9	824.5	3.2
RV-F-15	33.7	811.0	818.0	18.1	815.9	11.3
RV-F-16	5.5	818.3	824.1	1.9	824.0	1.9
RV-F-2	5.8	853.2	862.8	1.5	859.3	0.5
RV-F-3	10.5	862.6	874.9	4.6	874.0	3.5
RV-F-4	1.5	864.9	868.1	0.4	868.1	0.4
RV-F-5	5.1	860.0	865.2	1.0	865.1	1.1
RV-F-6	3.0	854.0	862.8	3.5	860.7	2.0

Table 2-27. Modeling Data and Results – 10-Day Snowmelt – Rich Valley Drainage Basin

			100-year 10-day Snowmelt Results		10-year 10-day Snowmelt Results	
Watershed/ Pond ID	Drainage Area (ac)	Normal Water Level (ft)	High Water Level (ft)	Maximum Storage Volume (ac-ft)	High Water Level (ft)	Maximum Storage Volume (ac-ft)
RV-F-7	7.8	846.1	862.8	8.9	858.3	5.2
RV-F-8	9.2	846.0	856.2	1.8	856.1	1.8
RV-F-9	5.0	836.6	845.5	5.4	846.8	6.9
RV-G-1	5.0	848.1	853.4	2.5	852.4	1.7
RV-G-10	8.3	818.2	826.1	5.0	824.0	2.8
RV-G-11	8.2	818.7	827.0	5.5	825.6	3.9
RV-G-12	4.8	841.5	845.8	0.5	845.8	0.5
RV-G-13	1.9	853.6	856.1	0.2	856.1	0.2
RV-G-14	4.6	817.4	833.3	7.7	833.1	7.5
RV-G-15	3.7	878.6	881.9	0.5	881.9	0.6
RV-G-16	8.1	857.5	860.9	1.0	860.9	1.0
RV-G-17	18.1	841.7	847.8	4.6	847.7	4.5
RV-G-18	16.4	824.5	841.2	22.1	841.2	22.2
RV-G-19	18.0	830.7	841.2	4.4	841.2	4.4
RV-G-2	20.4	817.1	827.3	19.0	824.2	10.0
RV-G-20	10.4	832.0	843.5	4.6	842.5	3.8
RV-G-21	12.6	938.0	944.8	0.4	944.8	0.4
RV-G-3	4.8	845.3	853.0	1.9	853.0	1.9
RV-G-4	8.9	849.9	856.0	4.5	854.6	3.0
RV-G-5	6.9	845.6	855.6	3.5	854.0	2.3
RV-G-6	2.7	875.2	880.6	0.8	880.5	0.8
RV-G-7	1.8	876.1	878.1	0.1	878.0	0.1
RV-G-8	2.1	877.6	882.5	0.7	882.5	0.7
RV-G-9	11.9	819.3	827.3	5.6	824.2	1.7
RV-H-1	3.1	884.2	886.3	0.3	886.2	0.3
RV-H-2	55.9	858.2	870.1	29.7	867.4	19.7
RV-I-1	6.3	866.0	869.7	3.1	869.0	2.1
RV-I-10	6.5	859.0	867.0	3.6	865.5	2.2
RV-I-11	2.1	869.9	873.3	1.0	872.5	0.7
RV-I-2	33.5	855.3	862.0	20.7	861.7	18.9
RV-I-3	2.5	859.7	864.0	0.7	864.0	0.7
RV-I-4	4.2	854.2	862.0	5.8	861.7	5.3
RV-I-5	4.6	884.0	885.0	0.1	885.1	0.1
RV-I-6	12.8	852.6	862.0	5.8	861.7	5.3
RV-I-7	2.5	868.0	868.1	0.0	868.3	0.0
RV-I-8	4.6	861.0	869.2	2.4	867.9	1.6
RV-I-9	2.5	862.0	872.6	1.0	872.0	0.8
RV-J-1	2.7	883.4	884.0	0.0	884.0	0.0
RV-J-2	8.7	859.1	862.9	1.6	862.9	1.6
RV-J-3	11.4	845.6	850.8	5.7	849.6	3.8
RV-J-4	6.3	847.4	852.3	0.2	849.8	0.0
RV-J-5	18.8	843.2	852.3	18.4	849.8	11.2
RV-K-1	11.1	865.0	868.5	1.3	868.5	1.3
RV-K-2	1.9	854.8	862.7	1.0	862.6	1.0
RV-K-3	5.1	846.3	856.5	3.2	856.5	3.1
RV-K-4	2.4	847.6	850.2	0.2	850.2	0.2
RV-K-5	38.1	793.7	801.4	24.4	799.2	14.2
RV-L-1	2.4	887.7	890.6	0.5	890.6	0.5
RV-L-10	3.2	867.1	868.0	0.1	868.0	0.1

Table 2-27. Modeling Data and Results – 10-Day Snowmelt – Rich Valley Drainage Basin

			100-year 10-day Snowmelt Results		10-year 10-day Snowmelt Results	
Watershed/ Pond ID	**Drainage Area (ac)**	**Normal Water Level (ft)**	**High Water Level (ft)**	**Maximum Storage Volume (ac-ft)**	**High Water Level (ft)**	**Maximum Storage Volume (ac-ft)**
RV-L-11	40.4	788.8	803.9	47.8	797.1	18.8
RV-L-12	3.9	885.7	887.6	0.2	887.6	0.2
RV-L-13	16.8	859.0	869.3	21.4	869.1	20.9
RV-L-14	8.9	854.5	860.6	7.1	860.5	7.0
RV-L-15	5.8	867.5	869.3	0.6	869.2	0.5
RV-L-16	20.1	870.5	872.5	1.4	872.4	1.3
RV-L-17	9.8	876.1	878.5	1.1	878.5	1.1
RV-L-18	12.5	879.3	881.3	1.2	881.2	1.2
RV-L-19	5.0	873.2	874.6	0.3	874.7	0.3
RV-L-2	10.1	874.1	883.3	7.7	883.0	7.0
RV-L-20	19.4	880.0	881.3	0.2	881.2	0.2
RV-L-21	2.5	891.4	893.4	0.4	893.4	0.4
RV-L-22	1.6	877.2	884.9	0.8	883.6	0.54
RV-L-3	1.9	883.1	883.6	0.0	883.6	0.0
RV-L-4	4.5	881.5	883.3	0.2	883.0	0.2
RV-L-5	2.5	885.0	887.4	0.7	887.4	0.7
RV-L-6	16.5	855.5	863.0	8.4	861.5	5.5
RV-L-7	9.6	855.6	860.0	1.9	859.7	1.6
RV-L-8	17.2	850.3	860.0	15.6	857.7	8.1
RV-L-9	14.3	849.8	853.7	2.5	853.6	2.5
RV-M-1	10.4	808.1	818.4	5.3	816.7	3.5
RV-M-10	19.2	810.8	826.5	13.2	824.1	8.9
RV-M-11	8.2	821.0	826.5	2.6	824.8	1.2
RV-M-12	8.8	816.9	826.5	1.8	824.8	1.2
RV-M-13	1.9	873.0	881.1	1.0	879.7	0.6
RV-M-14	2.6	872.4	877.9	1.3	876.8	0.9
RV-M-15	7.2	848.2	858.9	3.7	857.1	2.4
RV-M-16	7.6	863.8	871.4	3.9	870.0	2.6
RV-M-17	4.9	859.6	867.2	3.3	865.7	2.2
RV-M-18	1.7	890.1	890.7	0.0	890.7	0.0
RV-M-2	4.2	819.3	825.2	1.3	825.2	1.3
RV-M-3	12.8	810.7	821.2	10.1	819.7	7.4
RV-M-4	7.4	831.1	833.0	0.1	833.0	0.1
RV-M-5	16.3	836.9	843.6	1.7	843.6	1.7
RV-M-6	3.3	824.1	826.1	0.1	826.1	0.1
RV-M-7	47.3	788.2	790.8	33.3	789.9	21.5
RV-M-8	5.2	839.2	846.7	2.6	845.4	1.8
RV-M-9	6.6	817.4	826.5	5.5	824.8	3.6
RV-N-1	3.1	907.5	910.0	1.2	909.7	1.0
RV-N-2	36.1	816.1	823.1	4.7	820.5	1.7
RV-N-3	37.7	808.0	823.1	53.1	820.5	35.8
RV-N-4	17.1	817.0	823.1	5.8	820.5	2.3
RV-N-5	6.0	832.8	834.8	0.0	834.8	0.0
RV-N-6	7.0	876.7	878.4	0.9	878.4	1.0
RV-N-7	12.0	875.6	876.6	0.1	876.6	0.1
RV-N-8	4.6	855.5	862.0	2.7	862.0	2.7
RV-N-9	2.6	862.3	862.8	0.0	862.8	0.0
RV-O-1	8.8	853.6	864.0	4.5	862.5	3.0
RV-O-10	4.6	968.2	971.4	0.6	971.4	0.6

Table 2-27. Modeling Data and Results – 10-Day Snowmelt – Rich Valley Drainage Basin

			100-year 10-day Snowmelt Results		10-year 10-day Snowmelt Results	
Watershed/ Pond ID	Drainage Area (ac)	Normal Water Level (ft)	High Water Level (ft)	Maximum Storage Volume (ac-ft)	High Water Level (ft)	Maximum Storage Volume (ac-ft)
RV-O-11	13.5	936.0	941.9	0.9	941.9	0.2
RV-O-2	23.6	850.1	861.4	12.0	859.7	8.0
RV-O-3	16.2	842.0	858.4	12.2	856.7	9.7
RV-O-4	4.1	847.6	861.5	5.7	860.5	4.8
RV-O-5	9.0	855.6	861.5	1.4	860.5	1.0
RV-O-6	8.4	860.0	862.2	0.2	862.2	0.3
RV-O-7	20.4	851.9	869.6	23.0	866.1	14.8
RV-O-8	4.0	885.5	887.3	0.1	887.2	0.1
RV-O-9	16.9	888.3	897.2	6.5	897.1	6.3

Table 2-28. Hydrologic Data – Rosemount Drainage Basin

Watershed	Area	Watershed	Area	Watershed	Area	Watershed	Area
ROS-871	9.3	ROS-943	9.6	ROS-971	4.9	ROS-998	8.7
ROS-886	6.4	ROS-944	1.6	ROS-972	10.9	ROS-999	4.8
ROS-893	12.6	ROS-945	4.4	ROS-973	4.0	ROS-1000	15.1
ROS-896	13.1	ROS-946	7.2	ROS-974	10.2	ROS-1001	4.4
ROS-900	12.4	ROS-947	13.3	ROS-975	20.6	ROS-1002	1.9
ROS-903	16.1	ROS-948	3.4	ROS-976	8.1	ROS-1003	3.8
ROS-904	3.4	ROS-950	4.3	ROS-977	44.7	ROS-1004	9.5
ROS-905	4.5	ROS-951	9.2	ROS-978	3.4	ROS-1005	4.3
ROS-907	4.0	ROS-952	4.5	ROS-979	3.5	ROS-1006	2.1
ROS-908	3.1	ROS-954	10.8	ROS-980	7.9	ROS-1007	3.7
ROS-909	30.8	ROS-955	2.5	ROS-981	28.1	ROS-1610	3.2
ROS-910	3.8	ROS-957	17.0	ROS-983	23.5	ROS-1612	21.5
ROS-911	2.1	ROS-958	11.0	ROS-984	3.4	ROS-1613	7.1
ROS-912	3.2	ROS-959	26.9	ROS-985	1.6	ROS-1618-A	7.8
ROS-914	3.3	ROS-960	10.7	ROS-989	17.3	ROS-1618-B	11.4
ROS-917	3.7	ROS-961	19.2	ROS-990	3.3	ROS-1619	3.5
ROS-918	4.6	ROS-963	24.6	ROS-991	1.7	ROS-1620-A	10.1
ROS-922	6.3	ROS-964	6.0	ROS-992	12.3	ROS-1620-B	8.1
ROS-924	14.4	ROS-965	2.9	ROS-993	9.3	ROS-1621	8.6
ROS-925	5.5	ROS-966	37.5	ROS-994	5.7	ROS-1626-A	3.1
ROS-931	13.0	ROS-968	4.2	ROS-995	8.7	ROS-1626-B	14.5
ROS-934	8.1	ROS-969	17.1	ROS-996	6.0		
ROS-938	6.4	ROS-970	4.0	ROS-997	5.8		

Table 2-29. Hydrologic Modeling Data and Results – Simley Lake Drainage Basin

Watershed Data					10-Year Event Results			100-Year Event Results		
Watershed/ Pond ID	Area (acres)	Outlet	Normal Water Level	Critical Runoff Event	Computed 10-yr Flood	Peak Pond Outflow Q_{10}	Stored Vol	Computed 100-yr Fl	Peak Pond Outflow Q_{100}	Stored Vol.
DP-1[1]	4.6									
DP-2-A[1]	15.0	4"	936.1	10-day snowmelt	939.7	1	8.9	941.4	1.3	13.8
DP-2-B[1]	6.1									
DP-2-C[1]	3.5									
DP-2-D[1]	9.1									
DP-2-E[1]	5.6									
DP-2-F[1]	10.7									
DP-2-G[1]	2.8									
DP-6	72.5	24"	919.0	1 hr	921.1	14.9	4.9	922.8	27.4	9.5
DP-52	29.4	4"	912.5	10-day snowmelt	916.2	0.3	6.1	918	0.5	10
DP-7	45.1	12"	909.6	24 hr	913.1	6.1	8.1	916.1	12.8	16
DP-54	88.7	8"	903.5	10-day snowmelt	911.2	6.3	20.6	915.2	7.5	35.6
DP-55	32.0	6"	897.0	10-day snowmelt	910.9	4.7	27.9	913.1	7.4	34.3
DP-21	145.2	12"	887.5	10-day snowmelt	890	5.5	36.7	892.1	6.7	69.2
DP-19	23.0	36"	917.0	1 hr	917.9	5.9	2.6	918.2	36.8	3.6
DP-20	43.2	36"	908.0	1 hr	909.1	30.6	3	909.6	113.6	4.2
DP-32	39.7	4"	897.0	4 day	898.3	3	13.9	899.1	4.6	23.5
DP-28	39.0	18" High OF Pipe w/ Manual Valve	841.7	10-day snowmelt	851.4	7	16.1	862.6	7	51.1

[1] Watershed subdivided from watersheds shown in 1994 WRMP.

[2] High overflow pipe at elevation 865.0. Flood elevations taken from 1994 WRMP.

Table 2-30. Hydrologic Modeling Data and Results – Skyline Village Drainage Basin

Watershed Data					10-Year Event Results			100-Year Event Results		
Watershed/ Pond ID	Area (acres)	Outlet	Normal Water Level	Critical Runoff Event	Computed 10-yr Flood	Peak Pond Outflow Q_{10}	Stored Vol	Computed 100-yr Fl	Peak Pond Outflow Q_{100}	Stored Vol.
JP-1	107.4	18"	843.3	1 hr	846.7	14.9	5.4	849.4	20.1	12.8
JP-4	91.8			1/2 hr		197.9			351.1	
JP-3	56.0			1/2 hr		127.2			217.4	
JP-2	100.1			1 hr		367.1(1/2 hr)			686.5	
JP-5	38.0			1 hr		295.9			574.5	
JP-6	49.9					NA			NA	

Table 2-31. Hydrologic Modeling Data and Results – South Grove Drainage Basin

Watershed Data					10-Year Event Results			100-Year Event Results		
Watershed/ Pond ID	Area (acres)	Outlet	Normal Water Level	Critical Runoff Event	Computed 10-yr Flood	Peak Pond Outflow Q_{10}	Stored Vol	Computed 100-yr Fl	Peak Pond Outflow Q_{100}	Stored Vol.
IP-01	416.0	36" RCP	802.5	10-day snowmelt	804.9	19.1	60.8	807.3	25.6	113.8
IP-01K4	6.8			1/2 hr		18.6			32.8	
IP-01C	7.4			1 hr		13.6			22.5	
IP-01D	16.0			1/2 hr		37.7			66.2	
IP-01E	4.8			1/2 hr		16.4			29.6	
IP-01F	15.0			1/2 hr		41			68.1	
IP-01G	13.8			1/2 hr		23.6			44.2	
IP-01H	17.8			1/2 hr		28.2			52.6	
IP-01I	5.8			1/2 hr		15.6			27.3	
IP-01J	6.7			1/2 hr		18.3			35.3	
IP-01L	4.1			1/2 hr		14.1			25.4	
101	2.8	24" rcp		1/2hr		9.9			20.5	
102	1.0	24" rcp		1/2hr		11.9			22.6	
103	1.2	24" rcp		1/2hr		14.2			25.3	
104	1.6	18" rcp		1/2hr		17.5			30.0	
105	1.3	21" rcp		1/2hr		22.3			55.5	
106	1.2	21" rcp		1/2hr		26.1			58.3	
107	1.2	24" rcp		1/2hr		31.9			57.8	
10812	10.0	street flow		1/2hr		22.9			53.9	
108	18.0	36" rcp		1/2hr		83.1			111.9	
109	0.8	42" rcp		1/2hr		87.5			110.0	
110	3.5	48" rcp		1/2hr		91.6			117.8	
111	2.6	48" rcp		1/2hr		95.4			134.0	
112	3.0	54" rcp		1/2hr		113.4			167.5	
12421	29.0	street flow		1/2hr		52.9			105.8	
1122	17.0	street flow		1/2hr		11.9			42.9	
1181	9.0	15" rcp	816.9	1hr	817.7	10.6	0.4	818.3	21.6	0.7
1182	3.7	street flow		1/2hr		83.7			161.0	
1183	2.7	street flow				See 1182			See 1182	
1153	41.5	33" rcp		1/2hr		55.3			106.6	
113	6.7	54" rise x 88" span arch		1/2hr		121.5			182.8	
114	2.1	54" rise x 88" span arch		1/2hr		171.7			218.5	
1155	1.0	66" rcp		1/2hr		173.8			222.9	
116	22.6	18" rcp		1hr		24.0			37.5	
130	0.6	66" rcp		1/2hr		174.3			221.1	
117	0.7	66" rcp		1/2hr		173.9			219.4	
119	8.2	66" rcp		1/2hr		180.1			227.7	
120	5.5	66" rcp		1/2hr		187.8			247.6	
121	24.1	66" rcp		1hr		215.6			301.9	
122	2.6	66" rcp		1/2hr		211.9			279.6	
123	25.7	66" rcp		1/2hr		243.9			329.6	

Table 2-31. Hydrologic Modeling Data and Results – South Grove Drainage Basin

Watershed Data					10-Year Event Results			100-Year Event Results		
Watershed/ Pond ID	**Area (acres)**	**Outlet**	**Normal Water Level**	**Critical Runoff Event**	**Computed 10-yr Flood**	**Peak Pond Outflow Q_{10}**	**Stored Vol**	**Computed 100-yr Fl**	**Peak Pond Outflow Q_{100}**	**Stored Vol.**
12422	1.7	street flow		1/2hr		3.2			7.6	
12427	2.6	street flow		1/2hr		7.6			15.3	
12423	18.6	street flow		1/2hr		35.1			89.0	
12428	6.1	street flow		1/2hr		17.3			31.6	
12429	2.7	street flow		1/2hr		19.3			40.5	
124210	4.9	street flow		1/2hr		21.2			50.5	
12425	7.2	street flow		1/2hr		62.5			158.6	
12424	22.8	street flow		1/2hr		87.2			225.5	
12426	2.4	66" rcp		1hr		90.2			234.1	
12411	0.9	swale		1/2hr		94.7			304.3	
12412	1.0	swale		1/2hr		95.1			306.5	
12413	0.6	swale		1/2hr		96.3			307.9	
12414	1.1	swale		1/2hr		95.8			309.8	
12415	1.9	swale		1/2hr		93.1			326.2	
12416	0.5	swale		1/2hr		93.0			327.2	
12417	0.7	72" rcp		1hr		93.4			320.3	
124	0.4	90" rcp		1/2hr		387.9			829.4	
125	0.8	96" rcp		1/2hr		388.5			991.0	
126	0.9	channel		1/2hr		389.0			1334.5	
301	4.6	18" rcp		1hr		7.6			8.6	
302	4.2	18" rcp		1/2hr		7.8			33.1	
124211	28.2	street flow		1/2hr		53.1			103.5	
303	14.0	18" rcp		1/2hr		59.5			128.4	
304	1.4	18" rcp		1/2hr		15.3			21.2	
305	0.1	12" cmp		1/2hr		0.4			0.7	
306	4.1	24" cmp		1/2hr		15.7			28.9	
128	2.1	Swale		1hr		460.5			784.1	
129	8.3	72" deep x 96" wide box	753.4	1hr	760.2	507.8	0.5	777.5	498.6	17.1
127	1.4	swale		1/2hr		393.3			1659.1	
1185	3.1	swale		1/2hr		4.1			150.6	
1186	2.2	swale		1/2hr		7.1			152.4	
1187	2.4	36" rcp		1/2hr		9.9			157.1	
1184	3.9	swale		1/2hr		94.3			302.5	
201[1]	0.8									
202[1]	4.0									
203[1]	1.5									
204[1]	0.7									
205[1]	0.5									
IP-2[1]	59.1									
IP-4[1]	39.8									
IP-5[1]	11.0									

[1] Watershed not modeled.

Notes: Horton's method for runoff estimation was used to generate runoff estimates for the 70th Street drainage study rather than the SCS method. For this reason, watershed width and watershed slope are shown in this table (instead of time of concentration and SCS Curve Number). Only storm sewer drainage routes are provided in the table; overflow destinations are not shown.

Table 2-32. Modeling Data and Results – 10-Day Snowmelt – South Marcott Lakes Drainage Basin

			100-year 10-day Snowmelt Results		10-year 10-day Snowmelt Results	
Watershed/ Pond ID	Drainage Area (ac)	Normal Water Level (ft)	High Water Level (ft)	Maximum Storage Volume (ac-ft)	High Water Level (ft)	Maximum Storage Volume (ac-ft)
SML-A-1	6.2	885.9	888.1	1.8	888.1	1.7
SML-A-10	11.5	833.7	842.0	10.2	841.7	9.8
SML-A-2	5.3	881.5	886.2	4.3	884.4	2.1
SML-A-3	2.6	867.8	867.9	0.0	867.9	0.0
SML-A-4	6.6	868.7	872.8	2.8	872.3	2.2
SML-A-5	6.2	867.3	875.4	3.1	874.2	2.1
SML-A-6	7.9	864.7	867.9	2.5	867.8	2.4
SML-A-7	10.3	863.9	864.7	0.2	864.6	0.2
SML-A-8	6.0	859.5	862.3	0.1	862.2	0.1
SML-A-9	1.5	880.8	882.1	0.0	882.1	0.0
SML-B-1	36.6	794.0	794.6	2.4	794.6	2.0
SML-B-2	12.1	817.3	822.1	0.9	822.1	0.9
SML-B-3	12.9	783.8	786.7	2.0	786.6	1.8
SML-B-4	87.3	785.6	786.8	17.3	786.6	15.0
SML-C-1	34.5	775.9	784.0	37.6	781.1	21.5
SML-C-2	14.7	778.1	784.0	6.7	781.1	1.8
SML-C-3	99.8	775.8	784.0	249.1	781.1	153.7
SML-C-4	5.5	847.0	849.0	0.4	849.0	0.3
SML-C-5	4.8	866.8	868.4	0.3	868.3	0.3
SML-C-6	6.1	872.1	874.9	0.6	874.8	0.6
SML-D-1	2.9	903.2	907.9	1.5	906.4	0.8
SML-D-2	8.3	901.4	907.6	5.4	906.1	3.0
SML-D-3	9.0	888.0	897.2	1.9	897.1	1.8
SML-D-4	17.6	881.1	889.9	9.8	887.7	5.6
SML-D-5	2.8	880.9	889.9	6.1	887.7	3.7
SML-D-6	4.9	899.0	903.0	2.5	902.2	1.6
SML-D-7	2.7	898.7	902.3	1.4	901.4	0.9
SML-E-1	4.0	892.9	895.2	0.1	895.2	0.1
SML-E-2	31.8	876.0	880.2	18.2	879.0	12.0
SML-E-3	3.3	881.9	886.1	1.7	885.2	1.1
SML-F-1	3.9	921.3	929.0	2.0	928.3	1.3
SML-F-2	20.1	908.5	914.3	10.2	913.1	6.8
SML-F-3	4.4	909.3	909.4	0.0	909.5	0.0
SML-F-4	5.0	882.7	888.6	2.6	887.0	1.7
SML-F-5	5.5	889.2	890.5	0.2	890.4	0.2
SML-F-6	8.4	883.8	889.2	4.3	888.3	2.8
SML-G-1	6.0	881.8	889.1	4.7	889.0	4.6
SML-G-10	2.3	906.2	909.2	0.9	909.0	0.8
SML-G-2	3.0	886.9	888.3	0.2	888.3	0.1
SML-G-3	5.6	883.3	886.2	0.5	886.1	0.5
SML-G-4	23.7	794.2	805.3	14.5	804.5	12.4
SML-G-5	7.7	798.2	798.5	0.0	798.5	0.0
SML-G-6	30.0	783.7	793.4	34.3	789.3	15.9
SML-G-7	8.2	793.7	803.6	7.8	803.6	7.7
SML-G-8	12.6	851.9	855.5	1.3	855.5	1.3
SML-G-9	7.5	875.6	876.7	0.1	876.7	0.1
SML-H-1	19.1	849.8	850.3	0.0	850.2	0.0
SML-H-2	7.4	938.3	946.6	3.7	945.5	2.5
SML-H-3	26.6	841.9	842.5	0.0	842.4	0.0
SML-H-4	12.7	813.3	835.0	29.9	831.5	21.4
SML-H-5	9.9	820.2	835.0	8.7	831.5	4.9
SML-H-6	2.6	828.3	835.0	1.2	831.5	0.3

Table 2-33. Modeling Data and Results – 10-Day Snowmelt – Sunfish Lake Drainage Basin

Watershed/ Pond ID	Watershed Area (ac)	Basin Bottom Elevation	100 year 10-day Snowmelt (7.2", no infiltration)		5-year 24-hour Rainfall Max. Elevation	100-year 24-hour Rainfall Max. Elevation
			Maximum Elevation	Bounce (ft)		
HB-10	28.3					
HB-11	14.2					
HB-12	26.7					
HB-13	3.5					
HB-14	2.3					
HB-15	2.4					
HB-16	6.1					
HB-6	10.8					
HB-9	1.0					
HS-3	7.3					
HS-4	11.3					
PR-1	22.3					
PR-2	5.3					
PR-3	1.3					
Q-001	10.1	917.0	930.7	13.7	924.6	927.0
Q-002	3.6	921.0	927.1	6.1	924.2	926.1
Q-004a	7.0	927.0	929.1	2.1	927.8	929.1
Q-004b	6.6					
Q-005	9.6					
Q-006	21.2					
Q-007a	28.6	883.0	885.7	2.7	883.9	885.2
Q-008	11.2	881.0	885.7	4.7	881.4	881.8
Q-009	38.3	879.0	885.4	6.4	880.4	881.5
Q-010	4.7	885.0	889.1	4.1	886.1	886.9
Q-011	76.0	870.5	872.7	2.2	871.0	871.8
Q-012	6.3	893.0	895.2	2.2	893.6	894.5

Table 2-34. Hydrologic Modeling Data and Results – Valley Park Drainage Basin

Watershed Data					10-Year Event Results			100-Year Event Results		
Watershed/ Pond ID	**Area (acres)**	**Outlet**	**Normal Water Level**	**Critical Runoff Event**	**Computed 10-yr Flood**	**Peak Pond Outflow Q_{10}**	**Stored Vol**	**Computed 100-yr Fl**	**Peak Pond Outflow Q_{100}**	**Stored Vol.**
CD-1	35.5		913.0		915.3	17		916.3	24	7.9
CD-1A	5.8									
CP-10	22.5		842.3		849.2	3.2		852.4	4	10
CP-10C	12.0									
CP-10A	21.7									
CP-10B	5.5									
CP-13	83.9		825.8		836.1			839.9		56
CP-13A	6.0									
CP-13B	6.9									
CP-13C	9.2									
CP-2	2.7		923.0		924.0	7.8		925.0	15	1.5
CP-4	38.8		909.0		912.1	18		913.8	25	5.9
CP-4A	12.2									
CP-5	73.0		789.5		802.2			808.9		150
CP-5A	14.0									
CP-6A	1.4									
CP-6B	16.2									
CP-6	30.4		788.5		802.2			808.9		97
CP-6D	5.0									
CP-6C	24.2									

Note: Water elevations, storage volumes and peak flow rates transferred from 1994 WRMP

3.0 Goals and Policies

3.0 Purpose

The purpose of this Water Resources Management Plan is identical to the purpose given in Minnesota Statute 103B.201 for metropolitan water management programs. According to statute, the purposes of these water management programs are to:

- Protect, preserve, and use natural surface and groundwater storage and retention systems;
- Minimize public capital expenditures needed to correct flooding and water quality problems;
- Identify and plan for means to effectively protect and improve surface and groundwater quality;
- Establish more uniform local policies and official controls for surface and groundwater management;
- Prevent erosion of soil into surface water systems;
- Promote groundwater recharge;
- Protect and enhance fish and wildlife habitat and water recreational facilities; and
- Secure the other benefits associated with proper management of surface and ground water.

3.1 Background

The City of Inver Grove Heights' 2030 Comprehensive Plan (completed March, 2010) states that just as with the previous 2020 Comprehensive Plan, City residents identified unique topography, open spaces, and the Mississippi River frontage as important factors for the City to consider when defining a future vision for the City. Some of the environmental protection policies listed in the 2030 Comprehensive Plan are listed below, which either directly or indirectly impact the City's water resources (quoted from comprehensive plan):

Environmental Protection Policies:

1. Promote conservation of key natural resources.

2. Establish a balance between the protection of natural resources and future urban development.

Environmental Protection Policy Action Steps:

In order to enhance environmental protection, the City will:

1. Continue to carefully monitor development by requiring Environmental Assessment Worksheets and/or Environmental Impact Statements where they are needed in order to properly assess the effect the proposed development may have on a specific area.

2. Review and update existing development checklists to address environmental concerns related to development projects.

3. Consider reestablishing a program of periodically testing water bodies within the community in order to assess the long-range effects that urbanization has on these water bodies and

correspondingly, in order to undertake any necessary protective measures that may be pointed out through this monitoring system.

4. Continue monitoring private septic systems in order to safeguard against contamination of the underground water system and related health problems.

5. Continue to require appropriate erosion controls during construction.

6. Encourage efforts to preserve endangered and threatened wildlife species including preservation of natural habitat areas where feasible.

7. Cooperate with state and federal agencies to achieve compliance with water quality regulations.

8. Enforce federal, state and local wetland rules and regulations.

9. Continue implementing the Northwest Area zoning ordinances as a model for innovative storm water management and development patterns.

10. Encourage the use of Low Impact Development (LID) techniques that preserve and enhance our environment.

In addition to the 2030 Comprehensive Plan, the City completed a number of studies for the Northwest Area of the City, including:

1. Northwest Quadrant Study (Hoisington Koegler Group, Inc., 2001)

2. Northwest Quadrant Hydrologic & Hydraulic Analysis (Emmons & Olivier Resources, 2004)

3. Northwest Expansion Area AUAR (Bonestroo, Rosene, Anderlik & Associates, 2005)

4. Updated Northwest Expansion Area AUAR (Emmons & Olivier Resources, 2007); includes the Regional Basin Map for the Northwest Area (frequently updated, most current version available from the City).

Through these studies, the City developed new goals and policies for the northwest part of the City. The goals and policies are also embodied in the Northwest Area Planned Unit Overlay District (Subd. 39 of the Subdivision Ordinance). The subdivision ordinance also incorporates the *Inver Grove Heights Stormwater Manual Northwest Area* (2006).

As stated in the Northwest Area subdivision ordinance, the overlay district will encourage development which "…incorporates natural features as integral elements, promotes cluster development practices which preserve significant natural features by concentrating building locations, …and uses on-site retention of stormwater in existing landlocked basins preserved in open space areas." The subdivision ordinance also states:

- The amount of stormwater runoff from the Northwest Area will be reduced through minimizing the amount of impervious surface overage.
- The preservation of natural areas for infiltration will also maximize the ability to infiltrate stormwater without piping stormwater to a remote outlet (e.g. the Mississippi River).

- The area will have clustered housing and will permit mixtures of housing types to encourage greater preservation of natural areas/open space as long as requirements for stormwater management features are met.

Significant requirements in the subdivision ordinance for the Northwest Area, include:

- Until municipal sewer and water become available to properties in the Northwest Area, lots are required to have a minimum size of 10 acres.
- 20% of the net developable land must be preserved as natural area/open space.
- Post development runoff volume must match predevelopment runoff volume for the 5-year 24-hour event.
- Proposed developments must use infiltration rain gardens, vegetated swales, parking lot bioretention, infiltration basins/trenches, disconnection of impervious surfaces, green roofs, and other low impact development techniques.

3.2 Water Resource Management Plan Goals

3.2.1 Water Quality of Lakes and Ponds

Goal:
Water bodies designated as lakes by the City (see **Table 2-8**) will be managed to meet the City's water quality criteria or for non-degradation of water quality, with allowance for natural variability.

Policies

1. Land development and other projects within the tributary watershed will be designed to preserve or improve existing water quality so far as reasonably possible. To conform to this policy, the City will require implementation of best management practices during land development and other construction in the tributary watershed.

2. The City classified the City-designated "lakes" according to the City's lake classification system (see **Table 2-8**). The City will revise individual lake classifications based on new data.

3. The City will recruit volunteers, as needed and as available, to monitor the City's lakes, recognizing it may be difficult for volunteers to gain access to all of the lakes. Initially, the City will arrange for lakes to be monitored through the MPCA's Citizen Lake Monitoring Program (CLMP), which is a Secchi disc monitoring program. Depending on need and citizen interest, the City may arrange for lakes to be monitored through the Metropolitan Council's Citizen Assisted Monitoring Program (CAMP). For the LMRWMO-designated intercommunity water bodies, the City will seek funding from the LMRWMO for the monitoring efforts. The following water bodies are the City-designated lakes:

    - Bohrer Pond (LMRWMO-designated intercommunity water resource)
    - McGroarty Pond
    - Unnamed (DNR #19-36P) (Eagan-Inver Grove Heights WMO water body)Simley Lake
    - Unnamed (DNR #19-38P)
    - Marcott Lakes/Rosenberger Lake (DNR #19-41P)
    - Marcott Lakes/Ohmans Lake (DNR #19-42P)
    - Unnamed (DNR #19-43P)

- Dickman Lake (LMRWMO-designated intercommunity water resource)
- Hornbean Lake (LMRWMO-designated intercommunity water resource)
- Golf Course Pond (LMRWMO-designated intercommunity water resource)
- Schmitt Lake (LMRWMO-designated intercommunity water resource)
- Unnamed (DNR #19-54P) (Eagan-Inver Grove Heights WMO water body)

4. The City will share its water quality data with the LMRWMO and Eagan-Inver Grove Heights WMO.

5. Once sufficient data have been collected for the City-designated lakes, the City will determine the appropriate lake management actions needed (if any) to improve or maintain water quality.

6. The City will address future TMDL requirements. The City is currently listed on two TMDLs: Lower Mississippi River Fecal Coliform Bacteria TMDL and Fish Lake Nutrient TMDL. The City does not drain to the Vermillion River Basin (not a contributor to this portion of the Lower Mississippi River Fecal Coliform Bacteria TMDL as identified by the MPCA). The City does drain to Fish Lake in Eagan (impaired by Nutrients) but discharge from Inver Grove Heights is limited to 1 cfs and therefore Inver Grove Heights is not a contributor to this impairment.

7. For new stormwater discharge points/outfalls, the City will provide/require pretreatment of stormwater prior to its discharge to wetlands and other water resources.

8. For existing stormwater discharge points/outfalls, the City will seek opportunities to provide pretreatment of stormwater prior to its discharge to wetlands and water resources.

9. For existing inlets to the stormwater system that receive direct stormwater runoff (i.e., no pretreatment) from highly impervious land uses, the City will also seek opportunities to provide pretreatment of stormwater runoff.

3.2.2 Stormwater Runoff Quality, Rates and Volumes

Goal 1:
Operate, manage, and maintain the City's stormwater system to ensure proper functioning of the system and to meet the requirements of the City's NPDES Phase II MS4 Permit and other agency requirements.

Policies:

1. The City will implement the BMPs identified in its SWPPP for its NPDES Phase II MS4 Permit.

2. The City will inspect, operate, maintain, and repair its stormwater system, following a regular work schedule. The City's operation and maintenance program is closely tied with the City's implementation of its NPDES Phase II MS4 permit and SWPPP, which is described in **Section 2.0.8**.

3. The City will implement BMPs on City property and City projects in accordance with the NPDES General Construction Stormwater Permit and the City's NPDES Phase II MS4 Permit.

4. The City will address any future mandatory TMDL requirements.

5. The City will provide pretreatment of stormwater discharge to any new infiltration system to protect the functionality of the system. Pretreatment shall collect sediment, skim floatables, and be easily accessed for inspection and maintenance.

6. The City will encourage developers to comply with the MPCA's Industrial Stormwater Permit.

Goal 2:
Improve the quality of stormwater runoff reaching the Mississippi River by reducing nonpoint source pollution (including sediment) carried as stormwater runoff.

Goal 3:
Minimize flood damage to residential, business, commercial and public structures and property, and protect against increased flooding caused by land disturbing activities and other projects.

Goal 4:
Reduce volumes of stormwater runoff and the amount of impervious surfaces in the developed parts of the City.

Goal 5:
In the Northwest Area—limit the rates and volumes, and increase the treatment of stormwater runoff, by managing stormwater runoff as close to its source as possible and mimicking the system's natural hydrology.

Policies:

1. For development and redevelopment projects, the City will require implementation of best management practices (BMPs) for development projects that achieve removal rates equivalent to a pond designed to NURP standards (i.e., minimum 85% removal of total suspended solids and minimum 55% removal of total phosphorus). Special emphasis will be placed on the watersheds that drain (or will drain) to the Mississippi River. The City is aware that findings of TMDLs will supersede LMRWMO water quality standards. Where applicable, water quality performance standards are required to meet NPDES construction stormwater standards as required by the NPDES construction permit.

   Linear construction projects should meet this requirement where possible and feasible.

2. Through its Stormwater Management Ordinance, the City will continue to require submittal of stormwater management plans for land alteration and development activities. The stormwater management plans must meet the stormwater management design criteria given in the ordinance, including stormwater rate control and water quality treatment pond requirements. (The Stormwater Management Ordinance is currently being revised and will include updated stormwater management requirements.)

3. The City will require infiltration of the first 1 inch of runoff from new impervious surfaces <u>for new developments</u>, where there are A and B soils. Where there are conditions that limit

infiltration (see NPDES Permit for acceptable limitations), filtration of this volume will be required. For redevelopment projects, it is the City's goal to meet this requirement.

4. The City will require the placement of skimming devices at the outlet of all on-site detention basins to capture trash and floatable debris. The skimming devices are to provide treatment up to the critical duration 5-year storm event.

5. The City will require that post-development peak discharge rates shall not exceed existing discharge rates for the 2-year, 10-year, and 100-year (50 percent, 10 percent, and 1 percent probability) critical duration storm events. *(The City's revised Stormwater Management Ordinance, currently in draft form, includes this provision.)*

6. The City requires (through Subd. 39 of the City's Subdivision Ordinance) the incorporation of Low Impact Development (LID) design concepts into development projects located in the Northwest Area. The City will also consider requiring the incorporation of LID design concepts into development projects located in the other landlocked basins in the City (see **Section 2.1** for a description of these basins). In all other parts of Inver Grove Heights, the City will require consideration of LID design concepts in development projects. The primary goal of Low Impact Development is to mimic the pre-development site hydrology through storage, infiltration, evaporation, maintenance of natural drainage courses, and other methods (for more information, see *Low Impact Development Design Strategies, An Integrated Design Approach*, June 1999).

   Specific LID-related requirements and considerations for the Northwest Area (per the Subdivision Ordinance) include:

   - Post development runoff volume must match predevelopment runoff volume for the 5-year 24-hour event.
   - Proposed developments must use infiltration rain gardens, vegetated swales, parking lot bioretention, infiltration basins/trenches, disconnection of impervious surfaces, green roofs, and/or other LID techniques.
   - Mass grading should be avoided to reduce compaction of natural/open space areas.
   - Joint parking and shared driveway arrangements are encouraged.
   - Pervious materials may be used for parking lot surfaces and are encouraged for single-family residential driveways.
   - Parking lot curbing generally must be flat or have breaks at regular intervals to convey runoff into the stormwater system.
   - Residential downspouts and sump pumps must discharge to cisterns and/or permeable surfaces, while non-residential downspouts and sump pumps must meet this requirement if reasonably possible.
   - Narrower street widths are allowed, with restrictions.

7. The City will require developers to follow the City's stormwater guidance document for the Northwest Area—*Inver Grove Heights Stormwater Manual Northwest Area (December 2006)*. The City developed the stormwater manual to facilitate compliance with the standards set forth in the Planned Unit Development for the Northwest Area (Subd. 39 of the City's Subdivision Ordinance). The City's stormwater manual uses the Minnesota Stormwater Manual (released on December 2, 2005) as its foundation, tailoring it to the unique geomorphic and hydrologic characteristics and requirements of the Northwest Area. The City's stormwater manual includes the Best Management Practices (BMP) design guidance,

CADD drawings, construction and maintenance checklists and costing information provided in the Minnesota Stormwater Manual, plus additional information addressing typical constraints in the Northwest Area, guidance on the application of better site design (BSD) techniques, and a detailed example of the application of pretreatment and volume control standards to a typical development in the Northwest Area.

8. The City may not allow/require stormwater infiltration practices when soil conditions, groundwater supply issues, safety issues, snow removal, and other concerns would make such practices impractical.

9. The City will require project proposers to consider methods for reducing the amount of impervious surface on their sites. Methods to consider include:

   - Reducing road widths, such as allowing parking on only one side of a residential street.
   - Eliminating pavement in the center of cul-de-sacs.
   - Reducing sidewalk widths.
   - Allowing and providing for shared parking.
   - Creating a smaller building footprint (e.g., building two-story houses instead of one-story houses).
   - Installing semipermeable/permeable paving, where feasible (e.g., overflow parking lots).

10. Any intercommunity water resources planning conducted by the City will consider alternative solutions.

    - All drainage studies or feasibility studies conducted by the City that lead to projects in a subwatershed with an intercommunity drainage issue will consider the impact of the project on the drainage issue and will consider the total intercommunity project cost.
    - No solutions or partial solutions to intercommunity drainage issues will be implemented without prior completion of a feasibility study of the options and adoption of a preferred option by the WMO, except in emergencies.

11. To meet the City's best management practices standards, the City will either a) require construction of best management practices as part of the permitted project; or b) at the City's discretion, collect an appropriate fee from the project proposer as a contribution toward construction of a future regional best management practice within the same drainage basin.

12. When areas redevelop, the City will take advantage of the opportunity to improve stormwater runoff management and water quality.

13. Storm sewer systems will be designed to provide discharge capacity for the critical-duration 10-year frequency runoff event (level of service). The "level of service" is that part of the storm sewer system's total capacity needed to convey runoff without unusual hardship or significant interference with day-to-day public activities. By selecting a 10-year design frequency, the City accepts a 10-percent probability that some inconvenience will occur in any year. The City may allow variances to this standard in areas where a new storm sewer system would connect to an existing storm sewer system that does not have 10-year capacity. (The 10-year storm is the critical precipitation or runoff event which has approximately a 10-percent chance of occurring in any year.)

The portions of the system that convey outflows from ponding areas will be sized to convey the critical 10-year storm flow or the required 100-year outflow from upstream ponding areas, whichever is greater.

14. The level of protection along all trunk conveyors, streams, and open channels and around all wetlands, ponds, detention basins, and lakes will be based on the critical-duration 100-year runoff event (precipitation or snowmelt). (The 100-year event is the storm which has a 1-percent chance of occurring in any year.)

    The City deems a risk level of 10 percent too great when considering public safety or flood damages to improvements, so the City intends for its system to provide a 100-year "level of protection" from flooding. Thus, ponds are designed for 100-year events. Likewise, the secondary capacity provided by overflow channels and temporary storage in local depressions must be considered to determine if properties in local depressions will suffer flood damage from events greater than the 10-year event, up to the 100-year event. If damage or other unacceptable risk is predicted to occur, then portions of the conveyance system will be sized for a larger event, such that improvements in these areas are provided 100-year protection.

    Existing improvements which are not provided a 100-year level of protection will be evaluated on a case-by-case basis to determine whether the perceived risk warrants City action.

    Although storm sewer systems are designed for 10-year storm events, their performance must be analyzed for storms exceeding the design storm. When the design storm is exceeded, surcharging (pressurizing) of the system will likely occur. When pressures are high enough, low areas (typically where catch basins are located) become small detention ponds. In some circumstances, these low areas will function as pressure relief valves, which may result in the spraying or rushing out of water. If it becomes evident that street ponding could result structural damage, the City will look into alleviate the flooding and providing a safe overflow.

15. As development occurs or is imminent, the City will require the completion of additional hydrologic modeling to calculate the flood levels resulting from the 2-, 10-, and 100-year critical duration storm events. This modeling will update/complement the City's existing modeling efforts. The model to be used must either be approved or selected by the City prior to its use. The City will require the use of XP-SWMM in the Northwest Area, and may require the use of XP-SWMM in other areas of the City.

16. The City will ensure that proposed development, redevelopment, and/or infrastructure projects will not overtax the existing downstream stormwater drainage system.

17. The City will require the incorporation of emergency overflow structures (e.g., swales, spillways), where feasible, into pond outlet structure designs to prevent undesired flooding resulting from storms larger than the 100-year (1 percent) event or plugged outlet conditions.

18. The City when feasible, will use multi-stage outlets into pond designs to control flows from smaller, less frequent storms and help maintain base flows in downstream open channels.

19. As areas develop or redevelop, at the City's discretion, the City will secure easements extending up to at least the 100-year flood elevation over floodplains, detention areas, wetlands, ditches, and all other parts of the stormwater system.

20. The City establishes the following policies regarding landlocked basins:

    - The City will allow only the existing tributary area to discharge to a landlocked basin, unless provision has been made for an outlet from the basin or modeling has been completed that supports increasing the tributary area.
    - The City will consider both the water quality and flooding impacts of proposed outlets from landlocked basins on downstream water resources.
    - The City will take into consideration the effects of water level fluctuations on trees, vegetation, erosion, and property values. Steeply sloped shorelines that are subject to slope failure and shoreline damage should not be in contact with flood water for extended periods of time

21. The City will respond appropriately to citizen-identified drainage issues, depending on the type of drainage issue:

    a. If the drainage issue is limited to the resident's lot, it is the responsibility of the property owner to resolve the drainage problem, but City staff may provide recommendations to the property owner.
    b. If the drainage issue is the result of a larger scale problem that is not covered by the City's Code, Ordinances, or Policies, it is the involved property owners' responsibility to resolve the drainage problem.
    c. If the drainage issue is the result of a larger scale problem that is covered by the City's Code, Ordinances, or Policies, there are two levels of City involvement:

        i. Relatively minor issues that can be resolved/addressed quickly by City maintenance staff; or
        ii. Larger issues that can be resolved only through a public improvement project, which requires a longer process to implement

22. The City will submit to the appropriate WMO for review and approval any proposed changes to the City's WRMP and/or proposed City projects that will/may have an impact transcending municipal boundaries.

3.2.3 Floodplain Management

Goal:
Minimize flood damage to residential, business, commercial, and public structures and property, and protect against increased flooding caused by land disturbing activities and other projects.

Policy

1. The City will implement and enforce its flood plain management ordinance to prevent/minimize flood damages in the Mississippi River floodplain.

2. The City will implement and enforce its stormwater management ordinance to prevent/minimize flood damages in all other parts of the City. Through this ordinance, the City will restrict development along surface water overflow routes, or adjacent to localized depressions, when the level of protection afforded such development is less than 100-year.

The City is responsible for enforcing the City's lowest floor elevation requirements. The elevation of the lowest floor of a building on a lot adjacent to an inundation area (wetland, lake, pond, stream, or open channel) is defined as the lowest floor elevation. To minimize flooding problems, the City requires the lowest floor elevation for lots adjacent to an inundation area with an outlet or an open channel to be set at 2 feet above the critical 100-year flood level. Due to the uncertainty in determining the 100-year flood level on landlocked basins, the City requires the lowest floor elevation for lots adjacent to a landlocked basin to be established according to the relationship between the 100-year flood level and the basin's natural overflow (see **Figures 3-1** and **3-2**). The City may allow variances to these lowest floor elevation requirements in special cases where there is a low risk of damages, such as public open spaces, and/or low risk land uses (e.g., golf courses).

3. For landlocked basins throughout the City, the Northwest Standards are to be implemented. The City requires preservation of existing natural overflow paths and elevations, creation of emergency overflow routes and elevations, or preservation of an easement corridor for a future outlet, depending on the relationship between the 100-year flood elevation and the natural overflow. These situations are illustrated in **Figures 3-1** and **3-2**.

4. The City will, where feasible, provide outlets from landlocked basins to keep outflow rates low enough to allow for as much infiltration as possible. Drawdown time to within one foot of the normal water level should not exceed 48 hours to reduce damage to upland vegetation.

5. The City will establish high water elevations and determine whether outlets are needed for landlocked basins that, where practicable, account for long duration events, such as multiple-year wet cycles and high runoff volume events.

6. In the event that water levels on landlocked basins threaten to flood structures, the City intends to provide emergency pumping as necessary to protect the structures.

7. The City will seek to remove the structures in the floodplain in the Old Village/Concord Boulevard neighborhoods to provide 100-year level of protection, recognizing that the marinas will remain in place.

8. The City will consider recruiting volunteers to participate in the MDNR's lake level monitoring program for MDNR public waters. The MDNR sets and maintains the lake level indicator (staff gage) and resets the staff gage each spring after ice-out. The volunteers would read and record the water levels.

3.2.4 Erosion and Sediment Control

Goal 1:
Prevent erosion and sedimentation to the greatest extent possible.

Goal 2:
Regulate land-disturbing activities to protect against erosion and sedimentation.

Goal 3:
Implement soil protection and sedimentation controls to maintain health, safety, and welfare.

Goal 4:
Enforce erosion and sediment controls consistent with ordinances, SWPPP, and MS4 Program.

Policies

1. The City will update its Erosion Control Ordinances as described in the SWPPP Application for Reauthorization.

2. The City will, where feasible, consider during the design of stream bank stabilization and streambed control the presence of unique or special site conditions, energy dissipation potential, adverse effects, preservation of natural processes and habitat, as well as aesthetics in addition to standard engineering and economic criteria.

3. The City requires the preparation and submittal of erosion control plans for land development and other construction work that disturbs one or more acres of land. Erosion control plans must be prepared by a qualified individual, conform to the MPCA's NPDES General Permit to Discharge Stormwater from Construction Sites, and incorporate the appropriate BMPs described in *Protecting Water Quality in Urban Areas* (MPCA, 2000). Erosion control plans shall also conform to all future NPDES Phase II stormwater regulations that apply to erosion control. The NPDES General Permit requirements cover both temporary and permanent erosion controls.

   The erosion control plan must contain sufficient detail to show erosion control methods on individual building sites, such as silt fence and gravel driveway entrances. Waterborne sediment must be prevented from leaving the site during and after construction to prevent sedimentation of downstream water bodies.

4. Through the City's review of new building construction plans, the City requires erosion controls on individual building sites.

5. The City requires implementation of site restoration and erosion control measures for excavation or fill activities under the City's excavation and fill ordinance.

6. The City will inspect City-permitted/approved projects to monitor compliance with and enforce City requirements and permit/approval conditions. The frequency of inspection will depend upon the project size, the risk of failure, and the level of activity. City enforcement includes promptly notifying permittees of any erosion and sedimentation problems found on the site and requiring permittees to correct the problems.

7. The City will discourage the alteration of the natural course and meandering of streams or ditches, except when foreseeable erosion threatens to damage structures, utilities or natural amenities, or impair the drainage system.

8. The City will collect a cash surety charge or another type of fee to ensure that City-permitted/approved projects are completed in accordance with City regulations and permit/approval conditions. If a permittee does not correct an identified problem within a reasonable amount of time, the City will use the cash surety (or other collected fee) to pay for correcting the problem. The City will use other enforcement measures as necessary and as allowed by Minnesota law. *(The City's revised stormwater management ordinance, currently in draft form, includes these provisions.)*

9. The City will provide/require effective energy dissipation devices that reduce outlet velocities to four (4) feet per second or less at all conveyance system discharges to prevent bank, channel or shoreline erosion.

3.2.5 Wetland Management

Goal 1:
Preserve wetlands for water retention, recharge, soil conservation, wildlife habitat, aesthetics, and natural enhancement of water quality.

Goal 2:
Achieve no net loss of wetlands, in conformance with the Minnesota Wetland Conservation Act (WCA) and associated rules (Minnesota Rules 8420).

Policies:

1. The City is the local governmental unit (LGU) responsible for administering the Wetland Conservation Act and rules.

2. The City will complete an inventory and assessment of the City's wetlands over the next ten years. The City will classify and determine the functions and values of wetlands as part of its phased inventory and assessment process. In areas where a wetland inventory and assessment has not been completed, the City will require individual wetland assessments on an as-needed basis (e.g. when a development is proposed that would possibly impact a wetland).

3. All water bodies in the City that are not City-designated lakes will be classified according to the City's wetland classification system developed for the Northwest Area (see **Section 2.0.9.2** of this plan). The City's wetland management classification system takes into account the susceptibility of the wetlands to degradation by stormwater inputs and ranks the wetlands accordingly.

4. In the Northwest Area, the City will implement the recommended wetland management standards shown in **Table 2–7**. These wetland management standards are based on the wetland rank (classification) and desired level of protection (e.g., highest to lowest protection). The wetland management standards include buffer strip width, structural setback distance from buffer strip, amount of pretreatment required for phosphorus removal, and storm bounce restrictions.

5. In the other areas of the City, the City will consider implementing the recommended wetland management standards shown in **Table 2–7**.

6. The City will develop, adopt, and implement a new wetland ordinance.

7. The City will submit its wetland management plan to each WMO for review and approval.

8. The City will continue to seek grants and other funding opportunities (e.g., Metropolitan Council grants and BWSR local water planning challenge grants) to offset the costs of its wetland inventory and assessment process.

9. The City will protect wetlands from impacts (e.g., filling or draining) in the following order: avoid, minimize, mitigate. Mitigation of unavoidable wetland impacts must be accomplished through restoration (first priority), enhancement (second priority), or wetland creation (third priority).

3.2.6 Recreation, Habitat and Shoreland Management

Goal:
Protect and enhance fish and wildlife habitat and recreation opportunities, and maintain shoreland integrity.

Policies

1. The City will continue to enforce its shoreland ordinance.

2. The City will continue to implement its Mississippi River Critical Area Plan, which is consistent with Critical Area/Mississippi National River Recreation Area (MNRRA) Tier 1 policies.

3. In the Northwest Area, the City will implement the recommended natural resource management standards shown in **Table 2–12**. These natural resource management standards are based on the management classification and desired level of protection (e.g., highest to lowest protection).

4. In the other areas of the City, the City will consider implementing the recommended natural resource management standards shown in **Table 2–12.**

5. The City will maintain existing public access to the City-designated lakes (see **Table 2.8**); for those City-designated lakes where there currently is no public access, the City may seek to obtain easements for passive access during development or redevelopment.

6. The City will consider performing natural resource inventories outside of the Northwest Area, including identification and mapping of existing and future greenway areas.

7. The City will encourage public and private landowners to maintain wetlands and open space areas for the benefit of wildlife.

8. The City will promote and encourage protection of non-disturbed shoreland areas and restoration of disturbed shorelines to their natural state as much as possible.

9. The City requires the preservation of shoreline vegetation during and after construction projects.

10. The City will adopt a City-wide wetland ordinance (similar to Northwest Area Wetland Management Standards) outlining wetland buffer and bounce requirements. This ordinance will require an average buffer width of 20 feet (and a minimum of 15 feet) around lakes, streams and wetlands when new or redevelopment projects exceed one acre.

11. Where feasible, the City will prioritize shoreland areas for restoration.

12. The City will seek opportunities to maintain, enhance, or provide new habitat as part of wetland modification, stormwater facility construction, or other appropriate projects.

13. The City will seek to incorporate into proposed projects alternative landscape designs that a) increase beneficial habitat, wildlife and recreational uses; promote infiltration and vegetative water use; and b) decrease detrimental wildlife uses (such as beaver dams, goose

overabundance) that damage water control facilities, shoreline vegetation, water quality or recreational facilities.

3.2.7 Education and Public Involvement

Goal 1:
Increase public support of the City's stormwater and water resource related efforts.

Goal 2:
Inform the public about the City's water resources and stormwater system, including their use, protection, and management.

Goal 3:
Raise public awareness regarding the steps they can take to reduce pollutants in stormwater runoff.

Goal 4:
Involve the public in stormwater management programs and decision-making.

Goal 5:
Perform public education and outreach, and invite public participation and involvement consistent with the City's NPDES Phase II MS4 Permit.

Policies

1. The City will implement the public education, outreach, participation, and involvement BMPs identified in the City's SWPPP for its NPDES Phase II MS4 Permit. This outreach may include providing materials to the Rotary Club, Lions Club, Chamber of Commerce, or other civic organizations.

2. The City will consider recruiting and training volunteers to conduct monitoring and participate in shore clean-up activities.

3. The City will consider implementing a recognition program for volunteers.

4. The City will explore joint education efforts with the WMOs, adjacent cities, Dakota County, and other stakeholders.

5. The City will incorporate public involvement and education efforts into the City's significant proposed projects.

6. The City will form citizen committees on an as-needed basis.

7. The City encourages its City Engineer and Public Works Director to attend WMO Board Meetings to provide technical advice and information to the Board.

3.2.8 Groundwater

Goal 1:
Protect the quality and quantity of the City's groundwater resources.

Goal 2:
The City will continue to participate in the Southeast Metro Groundwater Group.

Policies

1. The City will prepare, enact, and enforce a wellhead protection plan for its public water supply wells, when required to do so.

2. The City will encourage groundwater recharge and protect recharge areas from potential sources of contamination. The City will promote groundwater recharge through infiltration of stormwater runoff. The City will use available information and guidance (e.g., Minnesota Department of Health and Metropolitan Council guidance) to evaluate the potential impacts of stormwater infiltration BMPs on groundwater.

3. The City will continue to enforce its impervious surface ordinance which limits the impervious coverage based on lot size.

4. The City is committed to the proper design, location, installation, and maintenance of Subsurface Sewage Treatment Systems (SSTS). The City will continue to implement and enforce its SSTS Ordinance. The ordinance includes the following requirements:

   - All systems must be designed and constructed in accordance with Minnesota Rules Chapter 7080, 7081, 7082, and 7083.
   - Site review, percolation tests, and system design must be submitted in conjunction with building plans before permits for construction are issued.
   - All ISTS installations require a permit. Permits for SSTS installation or repair are issued only to State-licensed contractors.
   - Inspections during construction are completed by Minnesota Pollution Control Agency certified City inspectors.
   - Location and installation specifics are recorded on a Dakota County report form by the installer and reviewed by a City inspector. Record forms become part of the City permit property file for that address.
   - Soil boring and analysis reports, prepared by a licensed designer or professional engineer trained in SSTS systems, must be submitted for each new proposed lot to assure the existence of at least two potential SSTS locations. Licensed City staff review and approve these potential locations prior to final plat approval.
   - SSTS tanks must be pumped once every three years or an inspection performed by a licensed contractor to assure that sludge and scum layers do not exceed levels required by Minnesota Pollution Control Agency Rule Chapter 7080.
   - Commercial and industrial properties serviced by an SSTS must be annually inspected by licensed City inspectors to verify water use and suitable effluent quality for onsite treatment.
   - Animal waste, commercial wastewater, and industrial wastewater must not be discharged unless a State disposal system permit is obtained from the Minnesota Pollution Control Agency.
   - Nonconforming systems must be upgraded to bring them into compliance at such time that building permits are issued for additional bedrooms or bathrooms or at such time a building permit is issued for any structure in the Shoreland area.
   - SSTS systems with a service to their property are required to hook up by December 31st of the year following construction.

In addition to the above requirements, the City's SSTS Program includes:

- Information dissemination to property owners to heighten awareness and encourage proper use of SSTS.
- Coordination of City and County regulations to assure effective and efficient programs and enforcement.

5. The City will cooperate with Dakota County in its efforts to promote awareness of groundwater resource issues through public education and information programs.

6. The City supports the policies in the Dakota County groundwater plan.

3.2.9 Funding

Goal 1:
Achieve fair/equitable funding of the costs of the City's stormwater system

Goal 2:
Pursue grant funding to assist in funding stormwater improvement projects. This may include working with Dakota County Soil and Water Conservation District as well as other programs.

Policies

1. Funds generated by the stormwater utility will be used to cover the following costs:

    a. Preparing, updating, and meeting the requirements of the City's NPDES Phase II MS4 Permit
    b. Operation, maintenance, and repair of the City's stormwater system (including pipes, ponds, outfalls and control structures)
    c. Reconstruction of stormwater system infrastructure
    d. Studies to analyze future/current drainage, flooding, and/or water quality issues
    e. Implementing retrofit flood control projects
    f. Implementing retrofit water quality projects

2. The City will periodically update the stormwater utility rate structure to ensure the utility generates sufficient funds to cover the costs of the City's stormwater system.

3. The City will continue to use the Storm Water Special Tax District levy to fund capital projects until a stormwater utility is implemented; after implementation of a stormwater utility, the City may choose to use the Storm Water Special Tax District levy for certain projects.

4. The City may request and receive cost sharing from the LMRWMO (in accordance with the joint powers agreement) for the costs of water quality monitoring, studies, projects, etc. that are undertaken for intercommunity water resources at the direction of the LMRWMO.

5. The City will seek LMRWMO assistance in determining the cost allocation for intercommunity flooding and erosion control studies and construction projects, understanding that these cost allocations will be based on LMRWMO's "allowable flow" concepts.

3.3 Regulatory Framework/Agency Responsibilities

The following paragraphs summarize the water-related responsibilities of the Minnesota Department of Natural Resources, Minnesota Board of Water and Soil Resources, Minnesota Pollution Control Agency, Minnesota Department of Health, Minnesota Environmental Quality Board, Metropolitan Council, Dakota County, U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, and Lower Mississippi River WMO. See **Section 4.3.1** for information regarding the City's existing ordinances and official controls and **Section 5.5** (**Table 5-2** in particular) for a summary of the City's current stormwater-related design standards.

3.3.1 Minnesota Department of Natural Resources

The Minnesota Department of Natural Resources (MDNR) Division of Waters (Waters) manages water resources through a variety of programs in its Water Management Section, Surface Water and Hydrographics Section, and Ground Water and Climatology Section. MDNR Waters administers the public waters work permit program, the water appropriation permit program, and the dam safety permit program. MDNR Fisheries also administers the aquatic plant management control permit program and other fishery related permits.

In addition to permit programs, the MDNR oversees the floodplain management program, the public waters inventory program, the shoreland management program, the flood damage reduction grant program, the wild and scenic rivers program, various surface and groundwater monitoring programs, and the climatology program. The MDNR is involved in enforcement of the Wetland Conservation Act (WCA) and is responsible for identifying, protecting, and managing calcareous fens.

The MDNR's public waters work permit program (Minnesota Statutes 103G) requires a MDNR public waters permit for work below the Ordinary High Water level (OHWL) that will alter or diminish the course, current, or cross-section of any public waters or public waters wetlands, including lakes, wetlands and streams. For lakes and wetlands, the MDNR's jurisdiction extends to designated U.S. Fish and Wildlife Service Circular #39 Types 3, 4, and 5 wetlands which are 10 acres or more in size in unincorporated areas, or 2.5 acres or more in size in incorporated areas. The program prohibits most filling of public waters and public waters wetlands for the purpose of creating upland areas. The public waters work permit program was amended in 2000 to reclassify public waters and to make the administrative program more consistent with the WCA administrative program. Under certain conditions, work can be performed below the OHWL without a public waters work permit. Examples include docks, watercraft lifts, beach sand blankets, ice ridge removal/grading, riprap, and shoreline restoration.

3.3.2 Minnesota Board of Water and Soil Resources

The Minnesota Board of Water and Soil Resources (BWSR) oversees the state's watershed management organizations (joint powers, county and watershed district organizations), oversees the state's Soil and Water Conservation Districts, and administers the rules for the WCA and metropolitan area watershed management.

3.3.3 Minnesota Pollution Control Agency

The Minnesota Pollution Control Agency (MPCA) administers the State Discharge System/National Pollutant Discharge Elimination System (NPDES) Permit program (point source discharges of wastewater), the NPDES General Construction Stormwater Permit program, the NPDES General

Industrial Stormwater Permit program, the NPDES Phase I and Phase II Storm Water Permit program, and the subsurface sewage treatment system regulations (7080 Rules). The MPCA also reports the state's "impaired waters" to the U.S. Environmental Protection Agency. Spills should be reported directly to the MPCA.

The MPCA no longer administers Section 401 of the Clean Water Act Water Quality Certification program, which means the MPCA no longer evaluates 401 applications for conformance with water-quality standards, and the MPCA has waived its 401 authority in most cases. However, formal applications for 401 certification must still be sent to the MPCA.

3.3.4 Minnesota Department of Health

The Minnesota Department of Health (MDH) administers the Well Management Program, the Wellhead Protection Program, and the Safe Drinking Water Act rules. The MDH also issues fish consumption advisories. See the Minnesota Department of Health website (http://www.health.state.mn.us/divs/eh/water/index.html) for more information about these programs.

3.3.5 Minnesota Environmental Quality Board

The Minnesota Environmental Quality Board (EQB) administers the state's environmental review program, including Environmental Assessment Worksheets (EAW) and Environmental Impact Statements (EIS).

3.3.6 Metropolitan Council

The Metropolitan Council provides regional planning and wastewater services (collection and treatment) for the seven county metropolitan area. The Metropolitan Council provides review and comment on watershed management plans, local water management plans, and local comprehensive (land use) plans; conducts lake monitoring (including the Citizen Assisted Monitoring Program); and conducts river and stream monitoring.

3.3.7 Dakota County

Counties (including Dakota County) have a wide variety of duties, including property assessment, record-keeping, road maintenance (including street sweeping, and snow/ice control), administration of election and judicial functions, social services, corrections, child protection, library services, hospitals and rest homes, public health services, planning and zoning, economic development, parks and recreation, water quality, and solid waste management and recycling (including yard waste and compost sites).

The counties' responsibilities directly related to the City include:

- Levying taxes for the City.
- Construction and maintenance of county highways/roads.
- Groundwater management, including preparing and adopting groundwater plans (see Dakota County *Groundwater Protection Plan*, 2000).
- Adopting and implementing the county's MS4 SWPPP.

3.3.8 U.S. Army Corps of Engineers

The U.S. Army Corps of Engineers (COE) administers the Section 10 of the Rivers and Harbors Act permit program, and the Section 404 permit program.

3.3.9 U.S. Environmental Protection Agency

The U.S. Environmental Protection Agency (EPA) develops and enforces regulations, offers financial assistance, performs environmental research, sponsors voluntary partnerships and programs, furthers environmental education, and publishes information. Of particular relevance to the management of the City's water resources, the EPA administers the federal Clean Water Act. The EPA has delegated many of its Clean Water Act responsibilities to the MPCA, including the NPDES Permit programs (point and nonpoint source programs). The EPA prepares the list of the nation's impaired waters (made up of each state's list of impaired waters) and mandates the preparation of total maximum daily load studies (TMDLs) for the "listed" waters.

3.3.10 Lower Mississippi River WMO and Eagan-Inver Grove Heights WMO

The Lower Mississippi River WMO (LMRWMO) and Eagan-Inver Grove Heights WMO are joint powers watershed management organizations, formed in response to the requirements of the Metropolitan Surface Water Management Act (now Minnesota Statutes 103B). The authority of the LMRWMO and the Eagan-Inver Grove Heights WMO is set by law and by their respective joint powers agreements.

The LMRWMO joint powers agreement includes the member cities of:

Dakota County:		Ramsey County:
Inver Grove Heights	South St. Paul	St. Paul
Lilydale	Sunfish Lake	
Mendota Heights	West St. Paul	

The Eagan-Inver Grove Heights joint powers agreement includes the member cities of Eagan and Inver Grove Heights which are both located in Dakota County.

The LMRWMO limits its role to addressing intercommunity water resource management issues. The LMRWMO's general goals (quoted from the LMRWMO plan) are to:

- Keep regulation at the local level – the LMRWMO will not administer a permit program.
- Manage and assist member communities with *intercommunity* runoff and water management issues. The member communities are responsible for primary management of stormwater runoff and water management issues.
- Classify and monitor intercommunity water resources. Assist communities in monitoring or management plans/studies so communities can manage intercommunity water resources to meet their intended use. Intercommunity water resources are water bodies that have intercommunity tributary watersheds.
- Monitor and evaluate stormwater runoff quality.
- Coordinate intercommunity management planning for stormwater runoff, flooding and other water quantity issues.
- Develop policies to be implemented by the cities to protect the LMRWMO's water resources.

- Assess performance of the LMRWMO and the member cities toward achieving the goals stated in this plan.
- Provide member cities with useful information about the LMRWMO, its activities, and water resource management.
- Responsible for reviewing member cities annual progress reports. This will likely consist of an implementation plan progress update.
- Responsible for reviewing, commenting and approving local water management plans (i.e., this WRMP) prepared by their member cities.
- The Eagan-Inver Grove Heights WMO was forming during the preparation of this plan update. The Eagan Inver Grove Heights WMO role and its goals and policies are yet to be determined. The City will adhere to those goals and rules once established.

4.0 Assessment of Problems and Issues

This section presents and discusses the status of problems and issues in the City, in the following topic areas: water quality, stormwater runoff rates and volumes, erosion and sediment control, and adequacy of existing programs. Within each topic area (except adequacy of existing programs), general issues are discussed first, followed by more specific issues. The unresolved or ongoing location-specific issues discussed in this section are shown on **Figure 4-1**.

4.0 Water Quality Problems and Issues

4.0.1 Stormwater Runoff Quality Issues

Pollutants are discharged to surface waters as either point sources or nonpoint sources. Point source pollutants discharge to receiving surface waters at a specific point from a specific identifiable source. Discharges of treated sewage from a wastewater treatment plant or from an industry are examples of point sources. Unlike point sources, nonpoint source pollution cannot be traced to a single source or pipe. Instead, pollutants are carried from land to water in stormwater or snowmelt runoff, in seepage through the soil, and in atmospheric transport. All these forms of pollutant movement from land to water make up nonpoint source pollution.

For lakes, ponds, and wetlands, phosphorous is typically the pollutant of major concern. Point sources of phosphorus typically come from municipal and industrial discharges to surface waters, whereas nonpoint sources of phosphorus come from urban runoff, construction sites, subsurface sewage treatment systems (SSTS), and, in agricultural areas, from fields and feedlots. Point sources frequently discharge continuously throughout the year, while nonpoint sources (with the exception of SSTS) discharge in response to precipitation or snowmelt events.

For most water bodies, nonpoint source runoff, especially stormwater runoff, is a major contributor of phosphorus. As urbanization increases and other land use changes occur in the City, nutrient and sediment inputs (i.e., loadings) from stormwater runoff can far exceed the natural inputs to the City's water bodies. Stormwater runoff can carry significant amounts of phosphorus from the watershed into a water body. In addition to phosphorus, stormwater runoff may contain pollutants such as oil, grease, chemicals, nutrients, metals, litter, and pathogens, which can severely reduce water quality. Land use changes resulting in increased imperviousness (e.g., urbanization) or land disturbance (e.g., urbanization, construction or agricultural practices) also result in increased amounts of phosphorus carried in stormwater runoff. In addition to watershed (stormwater runoff) sources, other possibly significant sources of phosphorus include atmospheric deposition, internal loading (e.g., release from anoxic sediments, algae die-off, aquatic plant die-back, and fish-disturbed sediment), and failing SSTS. A significant number of properties in the City are served by SSTS. Should any of these systems fail, they have the potential to add nutrients, bacteria, and other pollutants to City water bodies.

As phosphorus loadings increase, it is likely that water quality degradation will accelerate, resulting in unpleasant consequences, such as profuse algae growth (algal blooms) and/or the proliferation of rooted aquatic plants. Algal blooms, overabundant aquatic plants, and the presence of nuisance/exotic species, such as Eurasian watermilfoil, purple loosestrife, and curlyleaf pondweed, interfere with recreational and aesthetic uses of water bodies. Phosphorus loadings must be reduced to control or reverse water quality degradation.

The Lower Mississippi River WMO (LMRWMO) completed a water quality modeling study (*Water Quality Modeling Study, Ivy Falls Creek, Interstate Valley Creek, and Highway 13 Watersheds*, Barr Engineering, 2003) and a subsequent feasibility study (*Water Quality Feasibility Study, Ivy Falls Creek, Interstate Valley Creek, and Highway 13 Watersheds*, Barr Engineering, 2004) as part of the LMRWMO's overall initiative to improve the quality of stormwater runoff reaching the Mississippi River. The Sunfish Lake drainage basin is a small part of the Interstate Valley Creek watershed, so these studies included a portion of the City of Inver Grove Heights. The studies investigate one water quality improvement best management practice (BMP) in the City—the deepening of an existing pond located southwest of Hornbean Lake, adjacent to Interstate 494. The feasibility study concluded that this BMP was feasible, although it would require the involvement/approval of MnDOT because MnDOT constructed the pond. Before moving forward with implementation of the BMP, the LMRWMO feasibility study noted that a final design would need to be prepared, and the cost allocation would need to be developed.

The Minnesota Pollution Control Agency's (MPCA) Stormwater Program is designed to reduce the pollution and damage caused by stormwater runoff. Mandated by Congress under the federal Clean Water Act, the National Pollutant Discharge Elimination System (NPDES) Stormwater Program is a national program for addressing polluted stormwater runoff. Minnesota regulates the disposal of stormwater through State Disposal System (SDS) permits. The MPCA issues combined NPDES/SDS permits for construction sites, industrial facilities and municipal separate storm sewer systems (MS4s). Through the MPCA's MS4 program, the City of Inver Grove Heights is required to obtain a NPDES Phase II (MS4) Storm Water permit.

Current City standards require implementation of water quality treatment best management practices for development projects (typically ponds), but the City may need to achieve higher levels of water quality treatment than is currently required.

4.0.2 Impaired Waters and TMDL Issues

The federal Clean Water Act (CWA) requires states to adopt water quality standards to protect the nation's waters. Water quality standards designate beneficial uses for each waterbody and establish criteria that must be met within the waterbody to maintain the water quality necessary to support its designated use(s). Section 303(d) of the CWA requires each state to identify and establish priority rankings for waters that do not meet the water quality standards. The list of impaired waters, or sometimes called the 303(d) list, is updated by the state every two years.

For impaired waterbodies, the CWA requires the development of a total maximum daily load (TMDL). A TMDL is a threshold calculation of the amount of a pollutant that a waterbody can receive and still meet water quality standards. A TMDL establishes the pollutant loading capacity within a waterbody and develops an allocation scheme amongst the various contributors, which include point sources, nonpoint sources and natural background, as well as a margin of safety. As a part of the allocation scheme, a waste load allocation (WLA) is developed to determine allowable pollutant loadings from individual point sources (including loads from storm sewer networks in MS4 communities), and a load allocation (LA) establishes allowable pollutant loadings from nonpoint sources and natural background levels in a waterbody. TMDL reports/studies must be approved by the United States Environmental Protection Agency (EPA).

Other than reaches of the Mississippi River, no water bodies in the City of Inver Grove Heights are on the MPCA's 2014 List of Impaired Waters. The following table lists the impaired reaches of the Mississippi River within the City, the affected MPCA designated use, the pollutant or stressor that is not meeting the MPCA water quality criteria, and the MPCA target for starting and completing the TMDL process.

Table 4-1 Summary of the Mississippi River Reaches on the MPCA 2008 Impaired Waters List

Mississippi River Reach	Pollutant or Stressor	Affected MPCA Beneficial Use	MPCA Listing Date/Target TMDL start/completion
Metro WWTP to Rock Island RR Bridge (RM 835 to 830)	PFOS in Fish	Aquatic Consumption	2008/2008/2022
	PCB in Fish Tissue	Aquatic Consumption	1998/1998/2011
	Turbidity	Aquatic Life	1998/2008/2011
Rock Island RR Bridge to Lock & Dam #2 (RM 830 to 815.2)	PFOS in Fish	Aquatic Consumption	2008/2008/2022
	PCB in Fish Tissue	Aquatic Consumption	1998/1998/2011
	Turbidity	Aquatic Life	1998/2008/2011
	PFOs in water column	Aquatic Consumption	2014/2014/2027

The two reaches listed in **Table 4-1** included past impaired waters listings for mercury water column and mercury in fish tissue. The mercury in Minnesota fish comes almost entirely from atmospheric deposition, with approximately 90 percent originating outside of Minnesota (MPCA, 2004). Because the main source of mercury comes from outside the state and the atmospheric deposition of mercury is relatively uniform across the state, the MPCA developed a statewide TMDL report to address the problem. The EPA approved the MPCA's mercury TMDL report. As a result, the two reaches of the Mississippi River in the City that were listed for mercury impairments were removed from the impaired waters list.

Although no lakes in the City are currently listed as impaired, lakes could be listed in the future. For the MPCA to list a water body (besides a river or stream) on the impaired waters list, it must meet the MPCA's definition of a "lake" (see **Section 2.0.11**), and there must be sufficient data to determine if the lake is impaired (see current MPCA guidance manual).

The criteria used to determine if a lake is impaired vary, according to the lake's ecoregion. Two ecoregions cover Inver Grove Heights—the North Central Hardwood Forest (NCHF or CHF) and the Western Corn Belt Plains (WCBP) ecoregions. **Figure 4-2** shows the location of these ecoregions in the City. The criteria for WCBP lakes are less stringent than for NCHF lakes and are listed below (MPCA guidance manual, 2005). The MPCA is proposing less stringent criteria for shallow lakes, as described in the document *Minnesota Lake Water Quality Assessment Report: Developing Nutrient Criteria* (MPCA, 2005). The MPCA defines shallow lakes as lakes with a) a maximum depth of 15 feet or less; or b) 80% or more of the lake is littoral (the percent of the lake that is 15 feet deep or less). These "shallow lakes" criteria are also included in the table below:

Table 4-2. MPCA Impaired Waters Listing Criteria/Proposed Listing Criteria

Ecoregion/ Lake Type	Water Quality Constituent		
	Total Phosphorus ug/L (ppb)	Chlorophyll-a ug/L (ppb)	Secchi Disc meters
North Central Hardwood Forest			
Deep Lakes[1]	<40	<14	≥1.4
Shallow Lakes[1]	<60	<20	≥1.0
Western Corn Belt Plains			
Deep Lakes[1]	<65	<22	≥0.9
Shallow Lakes[1]	<90	<30	≥0.7

[1]Current listing criteria, taken from *Minnesota Rules 7050.0222.*

Lake Pepin is on the impaired waters list for excess nutrients. Once the Lake Pepin TMDL is completed (2015), it could impact the City of Inver Grove Heights, since the area tributary to Lake Pepin is the entire Mississippi River (and Minnesota River) basin upstream of the lake. Load reductions could be assigned to the City, based on the TMDL results. This Water Resources Management Plan would likely need to be amended to incorporate the TMDL requirements. Also, the TMDL requirements could be incorporated into the City's NPDES Phase II MS4 permit.

4.0.3 Specific Water Quality Issues

The City contains a large number of lakes, ponds, and wetlands, but only a few of these are large enough to develop for more than neighborhood recreational use. An issue for the City is that the lakes with the highest water quality, such as parts of the Marcott chain of lakes, are not accessible to the public—there are no adjoining park lands or public access points. Other lakes and ponds in the City that are accessible to the public are of lesser water quality (e.g. Simley Lake and Seidls Lake). Most of the water bodies within the City are more valuable for aesthetic enjoyment and wildlife habitat than for recreational uses.

Little water quality data has been collected on most of the City's lakes and ponds, reflecting the lack of recreational opportunities provided by most water bodies in the watershed. More water quality data is beginning to be collected, but additional water quality data is needed. As more water quality is collected and analyzed, it is likely that a number of the City-designated lakes will not meet MPCA criteria and be added to the MPCA's impaired waters list.

All of these issues make it difficult for the City to determine their role in addressing water quality issues, such as citizen complaints or preparation/implementation of future TMDL studies for impaired waters.

Future lake water quality issues that involve LMRWMO "intercommunity" water bodies may require the involvement of the LMRWMO.

The following paragraphs present the water quality issues for the following significant water bodies in the City: Hornbean Lake, Seidls Lake, Dickman Lake, Golf Course Pond, Simley Lake, Marcott/Rosenberger Lake, Marcott/Ohmans Lake, Marcott Lake (DNR #19-263W), and Schmitt Lake.

Simley Lake

Simley Lake is an 11-acre lake located in Inver Grove Heights. There is a small city park, comprised of the island in the middle of the lake. Access to the park is limited to a pedestrian trail to the island. There is no public access on the lake. Land use in the watershed includes a high school, as well as commercial, and residential land uses. Most of the watershed is developed. Based on available water quality data from the Metropolitan Council's Citizen Assisted Monitoring Program (CAMP) for 1995-2002 the long-term average conditions for total phosphorus and chlorophyll show the lake would fall into the City's NCHF Shallow classification. The LMRWMO monitored Simley Lake in 2012 and 2013. More water quality monitoring data should be collected to better classify the lake and determine if the lake water quality is degrading. The City of Inver Grove Heights installed stormwater quality treatment structures to improve the water quality of Simley Lake.

In 2009 and 2010 the City conducted a shoreline restoration project for Simley Lake. Additionally, in 2013 carp were removed from the lake and removal efforts will continue through 2014.

Marcott Lakes

There are no public access points or adjoining park land on any of the Marcott chain of lakes in Inver Grove Heights. Land use in the watershed is currently a mixture of low density residential, highway, and undeveloped land. The undeveloped land is proposed to be low density or rural density residential in the future. Water quality data are available from the Metropolitan Council's Citizen Assisted Monitoring Program (CAMP) for Marcott (Rosenberger) Lake (DNR #19-041), a 22-acre lake at the north end of the chain. Based on both the average of the 1993 – 1999 data and the 1999 data alone, the lake water quality is very good, falling well within the City's WCBP Deep classification. Highway runoff and slope failures have threatened the water quality of Rosenberger Lake in the past. Secchi disc transparency data for 27-acre Marcott Lake II (Ohman's Lake, DNR #19-0042) for 1988 and 1989 and water quality data from 1997 indicate the water quality is good. The LMRWMO also monitored the Marcott lakes in 2012 and 2013.

Dickman Lake

Dickman Lake is a 20-acre lake located in northwestern Inver Grove Heights. The lake's tributary area includes a small portion of the City of Sunfish Lake, between I-494 and Robert Trail. There is no outlet from Dickman Lake/Loch Gregor. Existing land use in the watershed includes low density residential, park land, and undeveloped land. Future land use in the watershed will convert the undeveloped land to low density residential land use. There are no parks or public access on the lake. There is a limited amount of water quality data available for this lake from 1997. There are currently no concerns regarding the water quality of the lake, but more monitoring data should be collected to better classify the lake.

Dickman Lake is an LMRWMO "intercommunity" water body, so resolving any future lake water quality issues may require the involvement of the LMRWMO. The LMRWMO monitored the lake in both 2010 and 2011; however, they have no plans for continuing that monitoring.

Hornbean Lake (DNR #19-47P)

The City of Sunfish Lake has expressed concern in the past that development in Inver Grove Heights will have a negative impact on the water quality of Hornbean Lake. The LMRWMO Plan noted that it is important for the City of Inver Grove Heights to implement water quality best management practices to reduce the impact of development on the water quality of Hornbean Lake. As more water quality data is collected and analyzed, it will be possible to track changes to the lake's water quality. Hornbean Lake is an LMRWMO "intercommunity" water body, so resolving any future lake water quality issues may require the involvement of the LMRWMO. The LMRWMO indicated in their Watershed Management Plan that BMP construction aimed to reduce negative impacts to Hornbean Lake would be completed with development.

Golf Course Pond
This 14-acre pond is located in Inver Grove Heights. Southview Country Club is adjacent to the pond. Other land uses in the watershed include mostly low density residential, with a small amount of medium density residential. There is no public access on the pond. The only water quality data available are Secchi disc transparencies for 1988, which show the pond to be hypereutrophic and placing it into the range of the City's NCHF Shallow classification. There are currently no concerns regarding the water quality of the pond.

Golf Course Pond is an LMRWMO "intercommunity" water body, so resolving any future lake water quality issues may require the involvement of the LMRWMO.

Seidls Lake
Residents in the Seidls Lake area have expressed concern about the water quality of Seidls Lake. As noted in **Section 2.0.10**, the lake's water quality appears to be degrading, although trends have not been calculated. Although the water body is small (4 acres), it is surrounded by parkland in South St. Paul and Inver Grove Heights, which makes it a popular destination for local residents. Seidls Lake is an LMRWMO "intercommunity" water body, so resolving any future lake water quality issues may require the involvement of the LMRWMO.

Prior to the Centex development on the south side of Seidls Lake, the area was an unregulated dump site (e.g., clean fill and construction debris), and a couple of major eroded gullies discharged to Seidls Lake. As a result of the development, the gully erosion problems were addressed and two-cell water quality treatment basins were installed.

4.1 Stormwater Runoff Rates and Volumes Problems and Issues

The following paragraphs discuss stormwater runoff rates and volumes issues (including water level issues), first presenting the general issues, and then providing information about specific rate and volume issues in the City.

4.1.1 General Issues

In a natural, undeveloped setting, the ground is often pervious, which means that water (including stormwater runoff) can infiltrate into the soil. Land development dramatically changes how stormwater runoff moves in the local watershed. The changes begin during construction, when clearing and grading of the site results in less infiltration, higher rates and volumes of stormwater runoff, and increased erosion. As construction continues, ground surfaces become covered with impervious materials (e.g., asphalt and concrete) that prevent infiltration of water into the soil. As a result, the rate and volume of stormwater runoff from the site further increases, which can create significant problems for downstream water resources. If the land drains to a landlocked basin, the additional volume of runoff can increase the water level and flood level of the basin. If the land drains to a stream, the additional runoff volume can cause the stream to flow full for longer durations, which increases the erosion potential. The increase in runoff rates from sites can also increase flooding risks and erosion. In addition, the reduced amount of infiltration means less water is being recharged into the groundwater system, which can result in decreased base flows in creeks and streams and, potentially, a loss to the long-term sustainability of groundwater drinking supplies.

Although both high water levels (flooding) and low water levels are of concern to City residents and City staff, more concern and attention is usually paid to flooding because it is a greater threat to public health and safety, and can result in significant economic losses. Of special concern is flooding on landlocked water bodies, which prolongs the damages/impacts. There are numerous landlocked basins (basins that have no surface water outlet) in the City of Inver Grove Heights, especially in the western and southern parts of the City. Landlocked basins are often located in kettle basins, which formed in glacial till and ice contact stratified drift (glacial moraine topography). As glaciers retreated, large blocks of ice were left behind, which were then buried beneath glacial deposits. When the ice melted, depressions (kettle basins) were left behind, which typically have no natural outlet stream. These types of glacial deposits are characterized by rugged or “hummocky” relief.

Since there is no surface outlet, runoff which collects in these “landlocked” depressions is removed only by seepage and evaporation. As a result, landlocked basins are subject to wide variations in water levels and their 100-year floodplains typically cover large areas. In addition, evaporation is likely to be low during periods of above-average precipitation, since cooler air temperatures and cloudy days result in less evaporation. As water tables rise during periods of above-average precipitation, seepage out of landlocked basins can also decrease.

The seepage from landlocked basins provides important groundwater recharge benefits. Also, landlocked basins do not discharge surface waters to downstream basins, which could otherwise be negatively impacted by the additional stormwater volume.

The City may be requested to provide outlets from landlocked basins to prevent damages that occur during periods of sustained high water levels, but it is not always feasible or reasonable for the City to do so. For example, it may not be feasible to provide outlets because of the long distances to the nearest outlet, the depth of the pipe, and the capacity of the nearest outlet. It may not be reasonable to provide outlets because of the downstream impacts on flood levels and/or water quality. It can also be difficult for the City to provide even temporary relief during flooding situations for the same reasons that it is difficult to provide permanent outlets.

Damages caused by flooding include:

- Damage to homes, businesses and other buildings
- Damage to infrastructure (e.g., roads, bridges)
- Flooding of individual septic systems, rendering them unusable
- Damage or destruction of recreational trails and bridges

Flooding may cause other damages that are harder to quantify, including the following:

- Flooding of roads so they are impassable to emergency vehicles, residents, and school buses
- Shoreline erosion
- Destruction of vegetation, such as grass, shrubs, trees, etc.
- Unavailability of recreational facilities for use by the public (e.g., inundation of shoreline) and/or restricted recreational use of water bodies
- More strain on budgets and personnel for repairing flood-damaged facilities and controlling public use of facilities during flooding events
- Alterations to mix and diversity of wildlife species as a result of inundation of upland habitats

Floodplain management is the management of development and other activities in or near the floodplain to prevent flood damages. The MDNR defines floodplain management as “the full range of public policy and action for ensuring wise use of the floodplains. It includes everything from collection and dissemination of flood control information to actual acquisition of floodplain lands, construction of flood control measures, and enactment and administration of codes, ordinances, and statutes regarding floodplain land use."

Minnesota law defines the floodplain as the land adjoining lakes, water basins, rivers, and watercourses that has been or may be covered by the "100-year" or "regional" flood. Floodplains of larger basins and streams are mapped by the FEMA on Flood Insurance Rate Maps, which are included in community Flood Insurance Studies. The City manages activities in the FEMA-designated floodplain areas through the City's floodplain ordinance.

The City has determined 100-year flood levels for many water bodies that have not been mapped on FEMA Flood Insurance Rate Maps. The City manages activities within the floodplains of these water bodies through its permit/approval processes. An important requirement in the City's floodplain ordinance and City policies is the setting of the lowest floor elevation (see **Section 3.2.3** for these requirements). The City's establishment of flood levels and lowest floor elevation requirements has been very effective at preventing the construction of homes, businesses and other structures within the floodplain.

In the past and as part of this WRMP, the City determined 100-year flood levels for a number of the City's water bodies, including landlocked drainage basins (see **Section 2.1**). However, the City has not yet determined the 100-year flood levels for a large number of landlocked ponds/depressions in the City. The past 100-year flood levels have been based on TP-40 and TP-49 precipitation data. Future analyses will be completed using Atlas 14, as this is now the most recently published precipitation data.

Although less likely to result in significant economic losses, the City recognizes low water levels can also have negative impacts. Possible negative impacts include interference with or diminished recreational use of the water resources, through reduced or lost access to the water resource by the public and shoreline residents, reduced aesthetic enjoyment of the water resources (e.g., from mud flats, smells), loss of wildlife habitat, and winterkill of fish. The City cannot control drought, which is the main cause of deleterious low water levels.

Refer to the most recent Northwest Area Regional Basin Map at the City Engineering division for the overflow information and management classification for the regional basins located in the Northwest Area.

4.1.2 Specific Issues

Specific water quantity issues include intercommunity issues and issues wholly contained within the City.

Intercommunity Issues

Schmitt Lake
Schmitt Lake is located in the far northern part of the City, in the Highway 110-494 Drainage Basin. The Schmitt Lake outlet (a rectangular orifice) plugs frequently. The frequency of maintenance has been increased to address the plugging issues.

Seidls Lake
Seidls Lake is a landlocked water body in Inver Grove Heights and South St. Paul that experiences extended periods of high water levels. These high water levels have interfered with citizen use of the adjoining park land. The Lower Mississippi River WMO (LMRWMO) completed a feasibility study

for providing an outlet from the lake. The study recommended a lift station and storm sewer to carry water from the lake into South St. Paul's storm sewer system. The City is currently pursuing funding for design and construction of the outlet, and costs will be shared between Inver Grove Heights, South St. Paul, and West St. Paul. (See **Section 2.1.8** for more information.)

Dawn Way and 59th Street

There is a storm sewer capacity problem in the area of Dawn Way and 59th Street East, located in the Old Village Drainage Basin. This area also receives drainage from Fleming Field Airport/South St. Paul. A recent expansion of the airport's storm sewer system has worsened the capacity problem in the area. The cost for this work will be shared between Inver Grove Heights and South St. Paul. An allowable flow memorandum was completed by the LMRWMO in 2008.

Trailer Court Pond

This pond receives drainage from a large intercommunity watershed that includes Inver Grove Heights, West St. Paul, and Sunfish Lake. MNDOT has expressed concerns with the existing EOF. The City will coordinate with MNDOT to determine if future action is needed. An allowable flow study for Trailer Court Pond was completed by the LMRWMO in 2013.

Argenta Trail/Eagan Drainage Basins

The Eagan *Stormwater Management Plan* (draft, 2006) shows a proposed four-inch diameter orifice outlet from watershed/pond F-022 (designated FP-13 in the Eagan plan) to watershed/pond F-018 (designated FP-9 in the Eagan plan). In subsequent discussions, City of Inver Grove Heights and City of Eagan staff agreed that flows from F-022 (in the Argenta Trail Drainage Basin) will drain to F-025 (in the Eagan Drainage Basin).

Eagan Drainage Basin

The Eagan *Stormwater Management Plan* (draft, 2006) shows a proposed 12-inch diameter outlet from watershed F-018 (designated FP-9 in Eagan plan) discharging to watershed F-025 (designated FP-8 in Eagan plan). The City of Inver Grove Heights and City of Eagan staff agrees on this drainage pattern. However, the flood elevations for watershed F-025 reported in **Table 2-19A** in this plan may need to be revisited, as they do not include the impact of flows from watershed F-018.

For watershed W-002, the Eagan *Stormwater Management Plan* (draft, 2006) shows a lower 100-year flood elevation than reported in **Table 2-19A**. However, the City of Eagan's model does not reflect more recent information regarding additional watersheds that are tributary to W-002. Watershed W-002 is designated GP-8 in the Eagan plan.

The flood levels shown in **Table 2-19B** may need to be revised. The results shown are from a HydroCAD modeling effort performed for the Southern Lakes development, and only the 24-hour rainfall event was modeled. Also, the HydroCAD model assumed a four-inch diameter orifice at Elevation 908.3 for watershed EAG-640. Subsequent City of Eagan as-builts show a 12-inch diameter outlet at Elevation 909.3 (EAG-640 is designated LP-30 in the Eagan *Stormwater Management Plan* (draft, 2006). Outflows from the Southern Lakes development drain into the City of Eagan. The Eagan plan shows higher flood levels (based on the 100-year 10-day snowmelt event) for two of the ponds in Inver Grove Heights, but the City of Eagan's hydrologic model was based on larger, less detailed watersheds than the Southern Lakes development model.

Local City Issues

78th Street and Concord Boulevard
The City is planning to construct a stormwater basin near the intersection of 78th Street and Concord Boulevard. The City owns land at this location. This basin will improve stormwater management prior to discharging stormwater from the South Grove Area directly to the Mississippi River.

64th Street and Doffing Avenue
The City has televised the large diameter storm sewer from Doffing Avenue to the Mississippi River. This outfall is anticipated to be replaced in the coming years. In several locations the storm sewer is eroding and needs relining or replacement. This storm sewer is also part of the City emergency levee that protects the area from Mississippi River flood and a better method of closing the outfall should be considered. The City is interested in pursuing grants to fund these improvements.

Concord Boulevard/77th Street/Dickman Trail
The City has televised the large diameter trunk storm sewer and in many locations the invert is eroded. The City needs to repair the storm sewer from the outfall near River Road and 77th Street to 77th Street and Dickman Trail to the cattle pass under Concord Boulevard. It is anticipated that a relining/replacement project will be completed. The City will pursue grants to help fund this project.

Dixie Avenue and Dickman Trail
Redevelopment in this area is anticipated in the near future and the City has identified the need for a stormwater basin just east of Dixie Avenue and Dickman Trail. In addition, upstream erosion has led to significant sedimentation to this storm sewer system. It is likely these improvements will be constructed in conjunction with development/redevelopment.

Mississippi River Floodplain
Several properties in the Old Village/Concord Boulevard neighborhoods are within the FEMA-designated 100-year floodplain of the Mississippi River. To date, the City has acquired 16 of these properties from willing sellers.

Babcock Trail, Valley Park, and South Grove Drainage Basins
A number of landlocked basins are located in the Babcock Trail and Valley Park drainage basins. The drainage system improvements constructed as part of the 70th Street reconstruction project (between Cahill Avenue and Concord Boulevard) included provisions to allow for future discharge from these landlocked basins into the 70th Street system. The project included installation of a short piece of storm sewer pipe at the intersection of Cahill Avenue and 70th Street that will accommodate 23 cfs of future proposed pumping from the Babcock Trail and Valley Park drainage basins. The proposed outflow rate of 23 cfs is based on:

- 4.5 cfs from the basin in watershed CP 10;
- 14.4 cfs from the basin in watershed BP 17; and
- 4.1 cfs to serve local flows to the basins in watersheds CP 6 and CP 5.

The basins in watersheds CP 6 and CP 5 straddle 70th Street and are connected by a culvert under the roadway. The outlet to the 70th Street system would be from these basins. The 23 cfs flow rate will not occur at the same time as summer rainstorms, and the 70th Street system has adequate capacity for this flow.

Marcott Lakes/Ohmans Lake (MDNR #19-42P)
In 2003, a City resident contacted the MDNR and City staff regarding increased water levels on Ohmans Lake, the downstream lake in the Marcott chain of lakes. MDNR staff visited the site, but no further actions were taken. City and MDNR staff identified the need for water level monitoring on this and other water bodies in the City, through the MDNR's lake level monitoring program. In the future, the City may need to perform a study of water levels on Ohmans Lake, depending on the results of lake level observations.

Local/Miscellaneous Drainage Improvements
Refer to the City's engineering division for the current list/map of local drainage improvements that staff is aware of. This list/map is constantly being updated to reflect changes.

Citizen Survey Results
Through a previously completed online survey, citizens identified a number of drainage-related issues. These issues typically fall into one of the following groups, each with a distinct City response:

1. The drainage issue is limited to the resident's lot—in this case, it is the responsibility of the property owner to resolve the drainage problem, but City staff will provide recommendations to the property owner.

2. The drainage issue is the result of a larger scale problem that is not covered by the City's Code, Ordinances, or Policies—in this case is the responsibility of the involved property owners to resolve the drainage problem.

3. The drainage issue is the result of a larger scale problem that is covered by the City's Code, Ordinances, or Policies —in this case, there are two levels of City involvement:

    a. Relatively minor issues that can be resolved/addressed quickly by City maintenance staff
    b. Larger issues that can be resolved only through a public improvement project, which requires a longer process to implement

4.2 Erosion and Sediment Control

Sediment is as a major contributor to water pollution. Stormwater runoff from streets, parking lots, and other impervious surfaces carries suspended sediment—fine particles of soil, dust and dirt carried in moving water. Abundant amounts of suspended sediment are carried by stormwater runoff when erosion occurs.

Although erosion and sedimentation are natural processes, they are often accelerated by human activities, especially construction. Prior to construction, the existing vegetation on the site intercepts rainfall and slows down stormwater runoff rates, which allows more time for runoff to infiltrate into the soil. When a construction site is cleared and graded, the vegetation (and its beneficial effects) is removed. Also, natural depressions that provided temporary storage of rainfall are filled and graded, and soils are exposed and compacted, resulting in increased erosion, sedimentation and decreased infiltration. As a result, the rate and volume of stormwater runoff from the site increases (*Minnesota Urban Small Sites BMP Manual*, 2001). The increased stormwater runoff rates and volumes cause increased soil erosion, which releases significant amounts of sediment that may enter the City's water resources. Sanding and salting of roadways can also lead to the release of significant amounts of sediment to the City's water resources.

Regardless of its source, sediment deposition decreases water depth, degrades water quality, smothers fish and wildlife habitat, and degrades aesthetics. Sediment deposition can also wholly or partially block culverts, manholes, storm sewers, etc., causing flooding. Sediment deposition in detention ponds and wetlands also reduces the storage volume capacity, resulting in higher flood levels and/or reducing the amount of water quality treatment provided. Suspended sediment, carried in water, clouds lakes and streams and disturbs aquatic habitats. Sediment also reduces the oxygen content of water and is a major source of phosphorus, which is frequently bound to the fine particles. Erosion also results in channelization of stormwater flow, increasing the rate of stormwater runoff, and further accelerating erosion.

As erosion and sedimentation increase, the City's stormwater management systems (e.g., ponds, pipes) require more frequent maintenance, repair, and/or modification to ensure they will function as designed.

The City is aware of existing erosion and sedimentation problems at various stormwater ponds and pond inlets. Specific examples include:

- Golf Course Pond has experienced severe erosion around its entire shore, but the erosion may be the result of a high water table, and not the result of wave action or runoff. The City had a preliminary analysis done, but this is not a high priority issue to address because of the low risk to residents.
- Erosion and sedimentation occurs frequently at Seidls Lake. There is no outlet so significant water level fluctuations result in sparse vegetation and erosion susceptible soils.

Monitoring the stormwater system, including inspection of sediment build-up in stormwater ponds, will be an increasingly important task for the City.

Continued urbanization in the City will result in increased erosion and sedimentation, unless effective erosion prevention and sediment control measures are implemented before, during, and after construction.

In recognition of these issues, the City's ordinances and approval processes address erosion and sediment control at construction sites. The current ordinance requires implementation of temporary and permanent erosion and sediment control measures for developments and other projects. Although the City conducts inspections of City-permitted/approved projects, the City may not be aware of problems at these sites until some time has passed. In addition, the City may not be aware of erosion and sedimentation problems at locations where a City permit/approval is not required. In both situations, it would be helpful if City residents notified City staff of such problems.

In addition to meeting City requirements, owners and operators of construction sites disturbing one or more acres of land must obtain a National Pollutant Discharge Elimination System (NPDES) Construction Storm-water Permit from the Minnesota Pollution Control Agency (MPCA). Owners/operators of sites smaller than one acre that are a part of a larger common plan of development or sale that is one acre or more must also obtain permit coverage. The MPCA developed the NPDES General Storm-water Permit for Construction Activity (NPDES construction permit), which went into effect on August 1, 2003. A key permit requirement is the development and implementation of a Storm-water Pollution Prevention Plan (SWPPP) with appropriate best management practices (BMPs). The SWPPP must be a combination of narrative and plan sheets that address foreseeable conditions, include a description of the construction activity, and address the potential for discharge of sediment and/or other potential pollutants from the site.

The project's plans and specifications must incorporate the SWPPP before applying for NPDES permit coverage. The permittee must also ensure final stabilization of the site, which includes final stabilization of individual building lots.

4.3 Adequacy of Existing Programs

4.3.1 City Ordinances and Official Controls

The City has the following water resource/stormwater-related ordinances currently in place:

- Stormwater management ordinance (Title 9, Chapter 5), which includes provisions for erosion and sediment control, and wetland protection. Excavation and fill ordinance (Title 9, Chapter 4), which also includes limited provisions for erosion control, and stormwater drainage.
- Floodplain management ordinance (Title 10, Chapter 13, Article D)
- Shoreland management ordinance (Title 10, Chapter 13, Article B)
- Subdivision ordinance (Title 11)
- Zoning ordinance (Title 10), including Subd. 39—Northwest Area Planned Unit Development Overlay District
- Illicit Discharge Detection and Elimination Ordinance (Title 9, Chapter 5) which regulates non stormwater discharges to the storm drainage system.
- Impervious Surface Ordinance (Title 10) which outlines the amount of impervious coverage is allowed based on lot size.

The City developed a stormwater guidance document for the Northwest Area—*Inver Grove Heights Stormwater Manual Northwest Area (December 2006).* The City developed the stormwater manual to facilitate compliance with the standards set forth in the Planned Unit Development for the Northwest Area. The City's stormwater manual includes the best management practices (BMP) design guidance, CADD drawings, construction and maintenance checklists and costing information provided in the Minnesota Stormwater Manual (released on December 2, 2005), plus additional information addressing typical constraints in the Northwest Area, guidance on the application of better site design (BSD) techniques, and a detailed example of the application of pretreatment and volume control standards to a typical development in the Northwest Area. The stormwater manual contains nine chapters and seven appendices; the chapters are:

Chapter 1: Purpose and Use of the Manual

Chapter 2: Unique Features of the Northwest Area— The information presented in this chapter orients the Manual user to the general setting and key features of the Northwest Area, including its varied physical topography, areas of extensive tree cover, and numerous landlocked basins, some of which are wetlands.

Chapter 3: Integrating Stormwater Management Into Site Design—This chapter begins with a general discussion of the stormwater impacts associated with urbanization. It then introduces the Manual user to integrated stormwater management, a comprehensive approach to stormwater management. Integrated stormwater management is a proactive method that can be used to evaluate the factors that affect precipitation as it moves through the hydrologic cycle, while at the same time accommodating the land development activities that come with population growth. The process begins with reducing the initial generation of excess runoff and then focuses on ways to control runoff rates and volumes, preserve water quality and promote ground water recharge in a logical way using the simplest techniques possible to achieve the desired management outcome. The process of applying an integrated stormwater management approach to development includes: (1) Designing the site keeping the overall watershed patterns in mind; (2) Use and restoration of natural resources; (3) Water quantity and water quality issues; (4) Rate and volume control techniques and (5) pollution prevention.

Chapter 4: Better Site Design Techniques—This chapter introduces the Manual user to the principles of better site design (BSD) and discusses how to plan and apply BSD techniques to development projects. Better site design includes a series of techniques that reduce impervious cover, conserve natural areas, use pervious areas to more effectively treat stormwater runoff, and promote the treatment train approach to runoff management. The goal of better site design is to reduce runoff volume and mitigate site impacts when decisions are being made about the proposed layout of a development site. These techniques are known by many different names, such as low impact development, design with nature, sustainable development and conservation design.

Chapter 5: Best Management Practices—Chapter 5 provides the designer with an introduction to the recommended BMPs for the Northwest Area. The first section of the chapter identifies the BMPs and the second section introduces the designer to the main factors that should be evaluated in selecting a BMP or group of BMPs to meet the City's stormwater management requirements.

The BMPs presented in this chapter are arranged in three categories: non-structural or planning level BMPs; structural BMPs; and supplemental pre- and post-treatment BMPs.

Chapter 6: Additional Design Considerations—The objective of this chapter is to raise the design engineer's awareness about certain factors that could affect the performance of BMPs. These factors include cold weather design considerations, potential stormwater hotspots, and mosquito control. Discussion of each of these factors includes an introduction to the issue, key points to consider in designing BMPs and suggestions for addressing these points.

Chapter 7: Stormwater Sizing Criteria—This chapter outlines an approach for consistent sizing of stormwater management practices. It describes the City's various stormwater management requirements/standards and discusses in general terms how an applicant can develop a stormwater management plan to address these standards. The following standards are reviewed in this chapter: volume control (recharge and infiltration), peak discharge (rate control), water quality/pretreatment, wetland bounce, and stormwater sizing for redevelopment projects.

Chapter 8: Details of Stormwater Best Management Practices (BMPs)—This chapter provides information on the design, expected performance, and maintenance requirements of BMPs. This chapter follows up on the introductory information provided in Chapter 5, with detailed guidance on how a particular BMP, once selected, is designed, constructed and maintained.

Chapter 9: Modeling Methodology and Example Design Procedure—This chapter of the manual is intended to serve as a guide for satisfying the stormwater management requirements of the Northwest Area (NWA) of Inver Grove Heights. To accomplish this task, a hypothetical development site called Inver Grove Heights Meadows has been created to demonstrate the steps that will need to be taken to meet these stormwater requirements. Given that most of the standards require matching pre-development or existing conditions for a given rainfall event, the general order of these calculations are as follows: pre-development analysis, better site design analysis, post-development analysis. For each of these analyses, the steps required to perform the analysis will be presented first, followed by the application to Inver Grove Heights Meadows. Throughout the chapter, the design engineer will be notified of the City's submittal requirements.

The City requires different permits and/or approvals for land disturbing projects (including developments), depending on the type of project. The following is a listing of the water resource or stormwater-related City permits and/or approvals:

- Concept Plan Review
- Preliminary Plat Approval
- Administrative Subdivision
- Final Plat Approval
- Major Site Plan Approval
- Rezoning Approval
- Comprehensive Plan Amendment
- Planned Unit Development (PUD) Permit
- Conditional Use Permit
- Building Permit
- Land Alteration (Excavation and Fill) Permit
- Wetland Conservation Act Approval

Applications for preliminary plat approvals, major site plan approval, and planned unit development permits must include a grading and drainage plan, an erosion control plan, and a wetland plan. A land alteration permit is generally required if more than 500 cubic yards (CY) of material will be excavated or filled. For excavation/fill amounts between 500 CY and 10,000 CY, administrative approval is sufficient. For excavation/fill amounts exceeding 10,000 CY, the permit must first go to the Environmental Commission and then to the City Council for approval. The City Engineer has the final discretion regarding land alteration permit requirements. The City is currently in the process of updating its land alteration permit requirements.

Building permit, preliminary plat/PUD approval, and excavation permit applicants must meet the requirements of the City's Stormwater Management Ordinance.

4.3.2 LMRWMO Water Body (Lake and Pond) Classification System

The City developed its own classification system to reflect the City's location in two MPCA ecoregions and to align the classification system with the MPCA's listing criteria (see **Section 2.0.11**). These classifications are similar to the LMRWMO classification system.

4.3.3 Education and Public Involvement Program

Much of the City's water resource/stormwater related education and public involvement program is described in the City's NPDES Phase II MS4 permit (see **Section 2.0.8** and **Table 5.1** for more information). In general, the City's education and public involvement program includes:

- Production and distribution of literature (brochures, handouts, "Insights" newsletter)
- Posting of information on the City website and collecting of feedback from site visitors
- Recruitment of volunteers for monitoring efforts (e.g., Wetland Health Evaluation Program, Citizen Assisted Monitoring Program)

- Appointment of residents to advisory commissions (e.g., environmental commission, planning commission)
- Obtaining public input on proposed projects through neighborhood meetings, informational meetings, public hearings, etc.
- Obtaining public input on the City's NPDES Phase II MS4 permit SWPPP through the annual public meeting and website visits
- Sponsoring or holding educational workshops

The City does not anticipate needing any additional education and public involvement programs, but to meet the needs of this WRMP, the City will likely need to recruit more volunteers for additional water quality and lake level monitoring efforts.

4.3.4 Maintenance of Stormwater System

The City is responsible for maintaining its stormwater system—storm sewer pipes, ponds, pond inlets/outlets, and channels. As described in the City's NPDES Phase II MS4 permit SWPPP the City performs (or plans on performing) the following SWPPP activities outlined in **Table 5.1** or contained in the SWPPP Application for Reauthorization in **Appendix B**.

4.3.5 Groundwater Protection

The City protects its groundwater supply by following current standards for well construction. All of the City's groundwater wells meet current standards, which mean the wells do not present pathways for contamination to readily enter the groundwater supply. However, the City's aquifer has a high sensitivity to contamination because the local geological setting provides a lower level of protection. Also, the susceptibility of the City's source water is considered high because of the tritium content of the well water in bedrock. Source water susceptibility refers to the likelihood that a contaminant will reach the source of drinking water. It reflects the assessment results for well sensitivity, aquifer sensitivity, and water quality data (Minnesota Department of Health Source Water Assessment website).

Since the City's groundwater supply has a high sensitivity and a high susceptibility to contamination, it is important that recharge areas be protected from contamination.

4.3.6 Adequacy of Existing Capital Improvement and Implementation Programs to Correct Problems

This WRMP, along with its capital improvement and implementation programs, gives the City adequate tools to correct current and future problems.

5.0 Implementation Program

5.1 Implementation Program Components

Table 5.1 contains a comprehensive list of the MS4 activities and projects, programs, and studies that make up the City of Inver Grove Heights implementation program for the next 10 years (2014 through 2023). The City developed this program by evaluating the requirements in the MS4 permit (see MS4 SWPPP Application for Reauthorization in **Appendix B**), reviewing existing information (**Section 2**), identifying potential and existing problems (**Section 4**), developing goals and policies (**Section 3**), and then assessing the need for programs, studies or projects. The City estimated total costs, identified possible funding sources, and developed an approximate schedule to complete the implementation activities. It is anticipated these tables may be updated during the life of this Plan.

5.2 Implementation Priorities

The implementation components listed in **Table 5.1** were prioritized to make the best use of available local funding, meet MS4 Permit requirements, address existing water management problems, and prevent future water management problems from occurring. **Table 5.1** identifies which activities are MS4 Permit Requirements, MS4 Permit Requirements – within 12 months, Annual Requirements, or Capital Projects/Programs/Studies. The City's implementation plan reflects its responsibility to protect the public health, safety and general welfare of its citizens by addressing problems and issues that are specific to the City of Inver Grove Heights.

5.3 Financial Considerations

The City plans to use funds generated from its General Fund and Stormwater Utility as the primary funding mechanism for its implementation program including; maintenance, repairs, capital projects, studies, etc. If funds from the General Fund and Utility Fee do not cover necessary costs, the City will consider adjusting the Stormwater Utility Fee to cover the costs associated with the implementation program. The City will continue to review the stormwater utility fee annually and adjust based on the stormwater related needs of the City and other available funding mechanisms.

The City may also consider using plan implementation taxes (MN Statutes 103B.241) in the future if general funds or stormwater utility funds are not sufficient to fund the projects. The City will take advantage of grant or loan programs to offset project costs where appropriate and cost-effective. The City will require private landowners to install BMPs with new projects or redevelopment. Private improvements will be funded by the landowners.

5.4 Plan Revision and Amendments

The City may need to revise this Plan to keep it current. The City may amend this plan at any time in response to a petition by a resident or business. Written petitions for plan amendments must be submitted to the City Administrator. The petition must state the reason for the requested amendment, and provide supporting information for the City to consider the request. The City may reject the petition, delay action on the petition until the next full plan revision, or accept the petition as an urgent issue that requires immediate amendment of the plan. The City of Inver Grove Heights may also revise/amend the plan in response to City-identified needs. This Plan is intended to be in effect for 10 years. The Plan will be revised/updated at that time, to the extent necessary.

5.5 Design Standards

Table 5-2 summarizes the City's stormwater management-related design standards. In addition, the City refers Dakota County Soil and Water Conservation District Low Impact Development Standards for BMP design.

5.6 Ordinance Implementation and Official Controls

The City's current ordinances and official controls and future needs are described in **Section 4.3.1**. Some of the City's ordinances and official controls are tied with the City's implementation of its NPDES Phase II MS4 permit (shown in **Table 5.1** and **Appendix B**). To meet the future needs of the City and address changing regulation, the City will continue to update its ordinances as necessary.

TABLE 5.1

INVER GROVE HEIGHTS LOCAL WATER MANAGEMENT IMPLEMENTATION PLAN

No.	Project Description	MS4 Permit Requirement	Initial 12 Month Requirement	Annual Requirement	Projects, Programs, & Studies	10 Year Cost Estimate[1]	Possible Funding Sources[3]	Proposed Cost By Year[1,2]										Comments
								2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	
1	Systems Mapping - Update Stormwater Sewer System Map and basin inventory. The mapping and inventory will be completed within 12 months of the date permit coverage is extended. Once completed, the inventory will be submitted to the MPCA MS4 Permit Program.	✓	✓	✓		$40,000	General Fund/ Storm Water Utility	$4,000	$4,000	$4,000	$4,000	$4,000	$4,000	$4,000	$4,000	$4,000	$4,000	See SWPPP Application for Reauthorization (Appendix B)
2	Construction Site Stormwater Runoff Control - The City will update regulatory mechanisms to meet or exceed the requirements of MPCA permit to discharge stormwater associated with construction activity, as well as review ordinances to ensure they meet the new construction general permit requirements within 12 months of the date permit coverage is extended.	✓	✓			$3,500	General Fund/ Storm Water Utility	$3,500										See SWPPP Application for Reauthorization (Appendix B)
3	BMP Construction Guidance - Develop BMP construction guidance document for developers and contractors within 12 months of the date permit coverage is extended	✓	✓		✓	$4,500	General Fund/ Storm Water Utility	$4,500										See SWPPP Application for Reauthorization (Appendix B)
4	Post-construction Stormwater Management - The City will evlaute and update related ordinances and documentation methods to meet the requirements of the MS4 permit within 12 months of the date permit coverage is extended.	✓	✓			$10,000	General Fund/ Storm Water Utility	$5,000	$5,000									See SWPPP Application for Reauthorization (Appendix B)
5	Enforcement Response Procedures - Existing ERP's including NPDES Inspection Form, Erosion and Sediment Control Inspection Report, and a Notice of Erosion Control Requirement for Construction will be updated to meet the permit requirements within 12 months the date permit coverage is extended.	✓	✓			$4,000	General Fund/ Storm Water Utility	$4,000										See SWPPP Application for Reauthorization (Appendix B)
6	Public Education and Outreach - The City will complete the following public education and outreach activities to stay compliant with MS4 Permit requirements within 12 months the date permit coverage is extended: -NPDES/MS4/SWPPP related brochures at City Hall -Minimum of two NPDES/MS4/SWPPP public education related articles in the City's Insights newsletter. -Continue annual joint powers agreement with Dakota County Soil and Water Conservation District to educate the public through the DCSWCD Blue Thumb program -Continue annual joint powers agreement with Dakota COunty Soil and Water Conservation District to educate the public through the City's Raingarden Program in relation to appropriate public improvement projects. -The City will update the website to meet permit reuirements within 12 months the date permit coverage is extended -When possible, the City will make presentations to community groups and attend community group meetings. -Other	✓	✓	✓		$100,000	General Fund/ Storm Water Utility	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	See SWPPP Application for Reauthorization (Appendix B)

No.	Project Description	MS4 Permit Requirement	Initial 12 Month Requirement	Annual Requirement	Projects, Programs, & Studies	10 Year Cost Estimate[1]	Possible Funding Sources[3]	Proposed Cost By Year[1,2] 2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	Comments
7	Annual SWPPP Assessment & Annual Reporting 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 Water Resources webpage. City staff will submit the annual report to the MPCA prior to June 30th for the previous calendar year.	✓	✓	✓		$20,000	General Fund/ Storm Water Utility	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	See SWPPP Application for Reauthorization (Appendix B)
8	Annual Public Meeting/Event Provide public notice and present the draft MS4 annual report to one public event per year to solicit public input regarding the adequacy of the City's SWPPP. Public input received (oral and written) will be recorded in a record of decision and evaluated by the City's MS4 General Contact. City responses (if relevant) will be made in writing to each commenter. Hold one event per calendar year of the MS4 permit cycle. Maintain web-based online system allowing citizens and businesses to notify City of issues related to stormwater or illicit discharge.	✓		✓		$35,000	General Fund/ Storm Water Utility	$3,500	$3,500	$3,500	$3,500	$3,500	$3,500	$3,500	$3,500	$3,500	$3,500	See SWPPP Application for Reauthorization (Appendix B)
9	Online Availability of the Stormwater Pollution Prevent Plan (SWPPP) Program Document - The City will make the SWPPP and 2013 annual report available on the Water Resources webpage within 12 months from the date the MS4 permit coverage is extended to the City.	✓	✓	✓		$5,000	Storm Water Utility	$500	$500	$500	$500	$500	$500	$500	$500	$500	$500	See SWPPP Application for Reauthorization (Appendix B)
10	IDDE Program - The City will review and update the written procedures of the following within 12 months the date permit coverage is extended: - Identification of priority areas likely to have illicet discharges as descrbied in the permit - Timely response to known, suspected, and reported illicit discharges -Investigating, locating and eliminating the source of illicit discharges -ERPs for eliminating the illicit discharges and needed corrective actions -Record keeping as required by the MS4 permit	✓	✓	✓		$16,500	General Fund/ Storm Water Utility	$3,000	$1,500	$1,500	$1,500	$1,500	$1,500	$1,500	$1,500	$1,500	$1,500	See SWPPP Application for Reauthorization (Appendix B)
11	Construction Site Stormwater Runoff Control - The City will update regulatory mechanisms to meet or exceed the requirements of MPCA permit to discharge stormwater associated with construction activity, as well as review ordinances to ensure they meet the new construction general permit requirements within 12 months of the date permit coverage is extended.	✓	✓			$3,500	General Fund/ Storm Water Utility	$3,500										See SWPPP Application for Reauthorization (Appendix B)
12	IDDE Community Reporting - The City's IT department will update request system on City webpage to include a link to report illicit discharges. To be completed within 12 months from the date MS4 permit coverage is extended.	✓	✓			$1,000	General Fund/ Storm Water Utility	$1,000										See SWPPP Application for Reauthorization (Appendix B)

No.	Project Description	MS4 Permit Requirement	Initial 12 Month Requirement	Annual Requirement	Projects, Programs, & Studies	10 Year Cost Estimate[1]	Possible Funding Sources[3]	Proposed Cost By Year[1,2]										Comments
								2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	
13	Employee Training - 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.	✓	✓	✓		$10,000	General Fund/ Storm Water Utility	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	See SWPPP Application for Reauthorization (Appendix B)
14	Sanitary Sewer/Stormsewer Televise - The City will, as needed, hire a consultant to televise sections of the sewer system to find illicit connection in the system.				✓	$50,000	General Fund/ Storm Water Utility	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	See SWPPP Application for Reauthorization (Appendix B)
15	IDDE Priority Inspection Map - Develop map to identify high-priority outfalls and high-risk establishments. To be completed within 12 months from the date MS4 permit coverage is extended.	✓	✓			$3,000	General Fund/ Storm Water Utility	$3,000										See SWPPP Application for Reauthorization (Appendix B)
16	Pollution Prevention - The City will develop spill prevention and control plans for municipal facilities by the end of year 1 of the MS4 permit cycle. Educational materials will be distributed to each municipal facility by the end of year 2.	✓	✓			$2,500	General Fund/ Storm Water Utility	$2,500										See SWPPP Application for Reauthorization (Appendix B)
17	Pollution Prevention - The City will continue to develop facilities inventory to include potential pollutants and will create a map of all identified facilities within 12 months of the date permit coverage is extended.	✓	✓			$2,500	General Fund/ Storm Water Utility	$2,500										See SWPPP Application for Reauthorization (Appendix B)
18	Pollution Prevention - Increase inspection frequency of maintenance yard. Once weekly and after all rain events utillze a checklist for the inspection that documents findings and allows staff to compare to previous inspections. Inspection frequency to be evaluated after year 1.	✓	✓	✓		$25,000	General Fund/ Storm Water Utility	$2,500	$2,500	$2,500	$2,500	$2,500	$2,500	$2,500	$2,500	$2,500	$2,500	See SWPPP Application for Reauthorization (Appendix B)
19	Pollution Prevention - Annual staff training on fertilizer application, pesticide/herbicide application, and mowing discharge.	✓	✓	✓		$5,000	General Fund/ Storm Water Utility	$500	$500	$500	$500	$500	$500	$500	$500	$500	$500	See SWPPP Application for Reauthorization (Appendix B)
20	Pollution Prevention - Annual training focused on automotive maintenance program (automotive inspections and washing), spill cleanup training, hazardous materials training, building leak prevention and inspection training.	✓	✓	✓		$5,000	General Fund/ Storm Water Utility	$500	$500	$500	$500	$500	$500	$500	$500	$500	$500	See SWPPP Application for Reauthorization (Appendix B)
21	Pollution Prevention - Annual training on parking lot and street cleaning, storm drain systems cleaning, road salt materials management.	✓	✓	✓		$5,000	General Fund/ Storm Water Utility	$500	$500	$500	$500	$500	$500	$500	$500	$500	$500	See SWPPP Application for Reauthorization (Appendix B)
22	Pond Assessment Procedures & Schedule - City will develop procedures for determining TSS and TP treatment effectiveness of City owned ponds used for treatment of stormwater and develop a prioritized inspection and maintenance schedule.	✓	✓		✓	$52,000	General Fund/ Storm Water Utility	$10,000	$10,000	$4,000	$4,000	$4,000	$4,000	$4,000	$4,000	$4,000	$4,000	See SWPPP Application for Reauthorization (Appendix B)

No.	Project Description	MS4 Permit Requirement	Initial 12 Month Requirement	Annual Requirement	Projects, Programs, & Studies	10 Year Cost Estimate[1]	Possible Funding Sources[3]	Proposed Cost By Year[1,2] 2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	Comments
23	Wellhead Protection - The City is conducting a wellhead protection study and will address and MS4 permit issues related to wellhead protection within 12 months of the completion of the study.	✓			✓	$2,000	General Fund/ Storm Water Utility		$2,000									See SWPPP Application for Reauthorization (Appendix B)
24	Construction Site Stormwater Runoff Control - The City will develop or review the following within 12 months the date permit coverage is extended: - Develop written procedures for site plan reviews - Develop notification system for owners and operators proposing construction activity to apply for and obtain coverage under the MPCA's construction activity permit -Develop written procedures for receipt and consideration of reports of noncompliance or other stormwater related information -Develop written procedures for conducting site ESC inspections - Update the City's grading, land alteration, building, and ROW permits and construction site stormwater runoff ordinance to meet MPCA General Permit requirements - Develop written procedures to track and archive all plan review and inspection documents	✓	✓			$10,000	General Fund/ Storm Water Utility	$5,000	$5,000									See SWPPP Application for Reauthorization (Appendix B)
25	Construction Site Inspections - Ensure at least 10% of inspections conducted annually are performed at sites deemed as high priority inspection sites. Inspection procedures will be evaluated for the first year and changes implemented within 24 months of the date permit coverage is extended.	✓	✓	✓		$600,000	General Fund/ Storm Water Utility / Developers Agreement	$60,000	$60,000	$60,000	$60,000	$60,000	$60,000	$60,000	$60,000	$60,000	$60,000	See SWPPP Application for Reauthorization (Appendix B)
26	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, equipments, and disposal), stormwater quality priority areas, and routes annually through the end of the MS4 permit cycle.	✓		✓		$1,500,000	General Fund/ Storm Water Utility	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	See SWPPP Application for Reauthorization (Appendix B)
27	Structural Stormwater BMP, Outfall, and Pond Inspections - Continue inspection of structural pollution control devices on a regular basis and inspect all outfalls, sediement basins, and ponds every 5 years.	✓	✓	✓		$250,000	General Fund/ Storm Water Utility	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	$25,000	See SWPPP Application for Reauthorization (Appendix B)
28	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)	✓	✓	✓		$50,000	General Fund/ Storm Water Utility	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000	See SWPPP Application for Reauthorization (Appendix B)

No.	Project Description	MS4 Permit Requirement	Initial 12 Month Requirement	Annual Requirement	Projects, Programs, & Studies	10 Year Cost Estimate[1]	Possible Funding Sources[3]	Proposed Cost By Year[1,2] 2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	Comments
29	Storm Drain Cleaning - The City will continue to clean sump manholes and SPCDs annually. The City will document the number of structures cleaned each year.	✓		✓		$150,000	General Fund/ Storm Water Utility	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	See SWPPP Application for Reauthorization (Appendix B)
30	Employee 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.	✓	✓	✓		$10,000	General Fund/ Storm Water Utility	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	See SWPPP Application for Reauthorization (Appendix B)
31	Road Salt Application Review - The City will continue to evaluate current practices of road salt applications, alternative products, calibration of equipment, inspection of vehicles, staff training. This includes documenting salt applied each year. The City will continue to annually evaluate and implement this program throughout the MS4 permit cycle.	✓		✓		$20,000	General Fund/ Storm Water Utility	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	$2,000	See SWPPP Application for Reauthorization (Appendix B)
32	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 consists of documenting the date, pond ID, project limits/construction plans, volume of sediment removed, test results (if any), and disposal location. Begin report in 2015.	✓	✓			$4,000	General Fund/ Storm Water Utility	$4,000										See SWPPP Application for Reauthorization (Appendix B)
33	Stockpiles, Storage and Material Handling Area Inspections - Conduct quarterly written inspections of all stockpile, sotrage and material handling areas (per the 2014 facility inventory), through the end of the MS4 permit cycle.	✓	✓	✓		$25,000	General Fund/ Storm Water Utility	$2,500	$2,500	$2,500	$2,500	$2,500	$2,500	$2,500	$2,500	$2,500	$2,500	See SWPPP Application for Reauthorization (Appendix B)
34	Site Plan Review - Every applicant for a City permit to allow land-disturbing activities must submit a project specific stormwater management plan (if applicable) and/or erosion control plan to the City	✓				$500,000	General Fund/ Developer's Agreement	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	See SWPPP Application for Reauthorization (Appendix B)
35	Park and Open Space Training Program - City to develop and conduct training program	✓	✓	✓		$6,500	General Fund/ Storm Water Utility	$2,000	$500	$500	$500	$500	$500	$500	$500	$500	$500	See SWPPP Application for Reauthorization (Appendix B)
36	Fleet and Building Maintenance Training Program - City to develop and conduct training program	✓	✓	✓		$6,500	General Fund/ Storm Water Utility	$2,000	$500	$500	$500	$500	$500	$500	$500	$500	$500	See SWPPP Application for Reauthorization (Appendix B)
37	Develop Sprill Prevention and Control Plan - City will develop program for municipal facilities.	✓	✓			$3,000	General Fund/ Storm Water Utility	$3,000										See SWPPP Application for Reauthorization (Appendix B)
38	Annual Progress Report to WMO - The City will provide an update to the WMOs outlining implementation program progress and other important information.				✓	$2,500	General Fund/ Storm Water Utility	$250	$250	$250	$250	$250	$250	$250	$250	$250	$250	
39	BMP, Outfall, and Pond Maintenance - Based on inspection results, maintenance will be performed.				✓	$1,500,000	General Fund/ Storm Water Utility	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000	

No.	Project Description	MS4 Permit Requirement	Initial 12 Month Requirement	Annual Requirement	Projects, Programs, & Studies	10 Year Cost Estimate[1]	Possible Funding Sources[3]	Proposed Cost By Year[1,2]										Comments
								2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	
40	Northwest Area drainage improvements: ponding, storm sewer and rain gardens.				✓	$3,000,000	Northwest Area Fees / Developers Agreement	$300,000	$300,000	$300,000	$300,000	$300,000	$300,000	$300,000	$300,000	$300,000	$300,000	
41	Seidls Lake Outlet - Stormwater lift station and storm sewer to address water quality and erosion concerns..				✓	$250,000	Storm Water Utility/ Stormwater Special Tax			$250,000								
42	Valley Park Drainage Basin Outlet: stormwater lift station and storm sewer - connect to 70th Street system				✓	$500,000	Storm Water Utility/ Stormwater Special Tax										$500,000	
43	Atlas 14 Risk Assessment - Updated City wide modeling for Atlas 14				✓	$115,000	General Fund / Storm Water Utility/		$65,000	$25,000	$25,000							
44	Wetland inventory and assessment				✓	$100,000	General Fund/ Storm Water Utility	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	
45	Miscellaneous updates to existing hydrologic models				✓	$100,000	General Fund/ Storm Water Utility	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	
46	XP SWMM snowmelt modeling and report (including map and tables) - other unmodeled areas (e.g., Albavar Path, Rosemount, portions of Babcock Trail drainage basins)				✓	$56,000	General Fund/ Storm Water Utility					$56,000						
47	Revise Water Resources Management Plan				✓	$200,000	General Fund/ Storm Water Utility										$200,000	
48	Golf Course Pond—feasibility study to address shoreline erosion issues				✓	$10,000	General Fund/ Storm Water Utility					$10,000						
49	Water Quality Monitoring - Simley Lake, Dickman Lake, Ohmans Lake, and/or others as necessary.				✓	$30,000	General Fund/ Storm Water Utility						$10,000		$10,000		$10,000	
50	Dawn Way and 59th Street Capactiy Issues				✓	$359,000	General Fund/ Storm Water Utility						$359,000					
51	Develop Wetland Ordinance				✓	$30,000	General Fund/ Storm Water Utility		$30,000									
52	Dixie Avenue and Dickman Trail Stormwater Basin Construction and Storm Sewer Improvements				✓	$450,000	Developers Agreement/ Grants				$450,000							
53	78th and Concord Blvd Stormwater Management Basin Construction and Storm Sewer Improvements				✓	$400,000	General Fund/ Storm Water Utility/Grants			$400,000								
54	64th Street/Doffing Avenue Storm Sewer Improvements				✓	$600,000	Developers Agreement/ General Fund/ Storm Water Utility/Grants							$600,000				

No.	Project Description	MS4 Permit Requirement	Initial 12 Month Requirement	Annual Requirement	Projects, Programs, & Studies	10 Year Cost Estimate[1]	Possible Funding Sources[3]	Proposed Cost By Year[1,2]										Comments
								2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	
55	Concord Blvd/77th Street/Dickman Trail Storm Sewer Improvements				✓	$350,000	Developers Agreement/ General Fund/ Storm Water Utility/Grants			$350,000								
56	Local/Misc. Drainage Improvements				✓	$500,000	Developers Agreement/ General Fund/ Storm Water Utility/Grants	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	$50,000	
	TOTAL					$9,762,500		$919,250	$980,250	$1,892,250	$1,342,250	$933,250	$1,236,250	$1,467,250	$877,250	$867,250	$1,577,250	

[1] Cost estimates are preliminary and subject to review and revision as engineer's reports are completed and more information becomes available. Table reflects 2014 costs and do not account for inflation. Costs generally include labor, equipment, materials, and all other costs necessary to complete each activity. For City completed activities, staff time is included in the cost. Some of the costs outlined above may be included in other operational costs budgeted by the City.

[2] 10 Year cost projections are based upon 2 MS4 Permit Cycles with year 1 program updates occurring again in 2019

[3] 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

Table 5-2. City of Inver Grove Heights Standards

Topic Area	Standard
Stormwater Runoff Quality	Building permit, preliminary plat/PUD approval, custom graded lots, conditional use permit, and excavation permit applicants must meet the requirements of the City's Stormwater Management Ordinance
	Applications for preliminary plat approvals, major site plan approval, conditional use permit, planned unit development permits, and custom grading agreements must include a grading and drainage plan, an erosion control plan, and a wetland plan
	Storm water management plans must be submitted for land alteration and development activities that fall under the jurisdiction of the City's Stormwater Management Ordinance. Any lot of record without an approved grading plan is required to enter into a custom grading agreement by City code. The current ordinance includes the following stormwater quality treatment pond requirements: • Permanent pond surface area equal to two percent of the impervious area draining to the pond or one percent of the entire area draining to the pond, whichever amount is greater • Average permanent pool depth of four to ten feet • Permanent pool length-to-width ratio of 3:1 or greater • Minimum protective shelf extending ten feet into the permanent pool with a slope of 10:1 beyond which slopes should not exceed 3:1 • Protective buffer strip of vegetation surrounding the permanent pool at a minimum width of 10 feet • Skimming device to keep oil, grease, and other floatable material from moving downstream • Provide maintenance access *(The City's Stormwater Management Ordinance is currently under revision; the revised ordinance will include updated water quality treatment requirements. Depending on project location –within or outside Northwest Area, these requirements may vary.)*
	New outfalls: pretreatment of stormwater required before discharge to water resources and/or infiltration practices
	BMPs required that reduce TSS by 85% and TP by 55% for development and redevelopment projects
	LID design concepts must be considered for development projects[1]
	Project proposers must consider methods for reducing the amount of impervious surface on their sites
Stormwater Runoff Rates & Volumes	Building permit, preliminary plat/PUD approval, custom graded lots, conditional use permit, and excavation permit applicants must meet the requirements of the City's Stormwater Management Ordinance
	Applications for preliminary plat approvals, major site plan approval, conditional use permit, planned unit development permits, and custom grading agreements must include a grading and drainage plan, an erosion control plan, and a wetland plan

Table 5-2. City of Inver Grove Heights Standards

<table>
<tr><th>Topic Area</th><th>Standard</th></tr>
<tr><td>Stormwater Runoff Rates & Volumes (Cont’d)</td><td>Storm water management plans must be submitted for land alteration and development activities that fall under the jurisdiction of the City’s Stormwater Management Ordinance. The current ordinance includes the following stormwater runoff rate and volume requirements:
• Stormwater must be managed so that the two-year, ten-year, and hundred-year storm peak discharge rates existing before the proposed land alteration shall not be increased and accelerated.
• The following stormwater management practices shall be investigated in developing a storm water management plan, in the following descending order of preference:
o Infiltration of runoff on-site, if suitable soil conditions are available for use
o Flow attenuation by use of open vegetated swales and natural depressions
o Storm water retention facilities; and
o Storm water detention facilities
• Stormwater retention facilities for new development must be sufficient to limit peak flows in each subwatershed to those that existed before the development for the 2-, 10, and 100-year storm event.
• Stormwater volume control of 1-inch from new impervious surfaces must be provided. If infiltration is unachievable (refer to NPDES standards for acceptable limitations) filtration of this volume will be required.
• Redevelopment of impervious surfaces (exceeding 5,000 square feet) will trigger stormwater management requirements. Linear projects are expected to meet this requirement where feasible. Discretion is up to the City Engineer.
(The City’s Stormwater Management Ordinance is currently under revision; the revised ordinance will include updated stormwater runoff rate and volume requirements.)</td></tr>
</table>

Table 5-2. City of Inver Grove Heights Standards

Topic Area	Standard
Stormwater Runoff Rates & Volumes (Cont'd)	Low Impact Development (LID) design concepts must be incorporated into development projects located In the Northwest Area (in addition to other City Design Standards). Specific LID-related requirements and considerations per Subd. 39 of the City's Subdivision Ordinance include: • Post development runoff volume must match predevelopment runoff volume for the 5-year 24-hour event. • Proposed developments must use infiltration rainwater gardens, vegetated swales, parking lot bioretention, infiltration basins/trenches, disconnection of impervious surfaces, green roofs, and other LID techniques. • Mass grading should be avoided to reduce compaction of natural/open space areas. • Joint parking and shared driveway arrangements are encouraged. • Pervious materials may be used for parking lot surfaces and are encouraged for single-family residential driveways. • Parking lot curbing generally must be flat or have breaks at regular intervals to convey runoff into the stormwater system. • Residential downspouts and sump pumps must discharge to cisterns and/or permeable surfaces, while non-residential downspouts and sump pumps must meet this requirement if reasonably possible. • Narrower street widths are allowed, with restrictions. • Wetland bounce is regulated dependent on wetland type.
	Storm sewer systems must be designed to provide 10-year level of service, based on the critical-duration event. Storm sewer shall be designed consistent with current 10-State Standards (GLURMB). Proposed open channels shall be design to provide a minimum of 10-year erosion and scour protection.
Stormwater Runoff Rates & Volumes (Cont'd)	The portions of the stormwater system that convey outflows from ponding areas must be sized to convey the critical 10-year storm flow or the required 100-year outflow from upstream ponding areas, whichever is greater
	100-year level of protection must be provided along all trunk conveyors, streams, and open channels, and around all wetlands, ponds, detention basins, lakes, and emergency overflow routes based on the critical duration event (precipitation or snowmelt)
	Pond outlet structure designs must incorporate emergency overflow structures (where feasible) to prevent undesired flooding resulting from storms larger than the 100-year event or plugged outlet conditions
	Multi-stage pond outlets should be used to control flows from smaller, less frequent storms
	Only the existing tributary area may discharge to a landlocked basin, unless provision has been made for an outlet from the basin
	Project proposers must consider methods for reducing the amount of impervious surface on their sites
Floodplain Management	Lowest floor elevation[2] requirements: • For lots adjacent to an inundation area with an outlet—2 feet above the critical 100-year flood level • For lots adjacent to an open channel—2 feet above the critical 100-year flood level • For lots adjacent to landlocked basins—lowest floor elevation established according to relationship between the 100-year flood elevation and the basin's natural overflow (see **Figures 3-1** and **3-2** for the requirements)

Table 5-2. City of Inver Grove Heights Standards

Topic Area	Standard
	For landlocked basins, existing natural overflow paths must be preserved, emergency overflow routes must be created, or easement corridors for future outlets must be preserved, depending on the relationship between the 100-year flood elevation and the basin's natural overflow (see **Figures 3-1** and **3-2** for the requirements) • Contingency plans for emergency overflows are required For new development within the floodplain, flood proofing to FEMA standard and other agreements with the City may be necessary.
Erosion and Sediment Control	Erosion and sediment control plans must be submitted for land development and other construction work. Erosion and sediment control plans must: • Be prepared by a qualified individual • Conform to the MPCA's NPDES General Permit to Discharge Stormwater from Construction Sites, including temporary and permanent erosion controls • Incorporate appropriate BMPs from *Protecting Water Quality in Urban Areas* (MPCA, 2000) • Show erosion control methods on individual building sites • Include two levels of sediment protection upstream of water bodies
	Building permit, preliminary plat/PUD approval, custom graded lots, conditional use permit, and excavation permit applicants must meet the requirements of the City's Stormwater Management Ordinance
	Applications for preliminary plat approvals, major site plan approval, conditional use permit, custom grading agreements, and planned unit development permits must include a grading and drainage plan, an erosion control plan, and a wetland plan
Erosion and Sediment Control (Cont'd)	Storm water management plans must be submitted for land alteration and development activities that fall under the jurisdiction of the City's Stormwater Management Ordinance. The current ordinance includes the following erosion control requirements: • Channel erosion shall not occur as a result of the proposed land disturbing or development activity. • Channelized runoff from adjacent areas passing through the site shall be diverted around disturbed areas, if practical. Otherwise, the channel shall be protected as described below. • All activities on the site shall be conducted in a logical sequence to minimize the area of bare soil exposed at any one time.
Erosion and Sediment Control (Cont'd)	Effective energy dissipation devices that reduce outlet velocities to four (4) feet per second or less must be provided at all conveyance system discharges to prevent bank, channel or shoreline erosion. In addition, the invert of outlets/outfalls to water bodies shall be 0.5 feet below the normal water level.

Table 5-2. City of Inver Grove Heights Standards

Topic Area	**Standard**
Erosion and Sediment Control (Cont'd)	• Runoff from the entire disturbed area on the site shall be controlled by meeting either 1) and 2), or 1) and 3) below: 1. All disturbed ground left inactive for 14 or more days shall be stabilized by seeding or sodding (only available prior to September 15) or by mulching or covering or other equivalent control measure. 2. For sites with more than 1 acres disturbed at one time, or if a channel originates in the disturbed area, one or more temporary or permanent sedimentation basins shall be constructed. Each sedimentation basin shall have a surface area of at least one percent of the area draining to the basin and at least three feet of depth and constructed in accordance with accepted design specifications. Sediment shall be removed to maintain a depth of three feet. The basin discharge rate shall also be sufficiently low as to not cause erosion along the discharge channel or the receiving water. 3. For sites with less than 1 acres disturbed at one time, silt fences, straw bales, or equivalent control measures shall be placed along all side slope and downslope side of the site. If a channel or area of concentrated runoff passes through the site, silt fences shall be placed along the channel edges to reduce sediment reaching the channel. The use of silt fences, straw bales, or equivalent control measure must include a maintenance and inspection schedule. • Any soil or dirt storage piles containing more than 10 cubic yards of material should not be located with a downslope drainage length of less than 25 feet from the toe of the pile to a roadway or drainage channel. If remaining for more than seven days, they shall be stabilized by mulching, vegetative cover, tarps or other means. Erosion from piles which will be in existence for less than seven days shall be controlled by placing straw bales or silt fence barriers around the pile. In-street utility repair or construction soil or dirt storage piles located closer than 25 feet of a roadway or drainage channel must be covered with tarps or suitable alternative control, if exposed for more than seven days, and the storm drain inlets must be protected with straw, bale or other appropriate filtering barriers. *(The City's Stormwater Management Ordinance is currently under revision; the revised ordinance will include updated erosion and sediment control requirements. Regardless, permit applicants must conform to the MPCA's NPDES General Permit to Discharge Stormwater from Construction Sites)*
Erosion and Sediment Control (Cont'd)	Site restoration and erosion control measures are required for excavation or fill activities falling under the City's excavation and fill ordinance
	Effective energy dissipation devices are required at all conveyance system discharges to prevent bank, channel or shoreline erosion
	The invert of outfalls into ponding areas must be placed 0.5 feet below the normal water level or as directed by the City
Recreation, Habitat and Shoreland Management	Shoreline vegetation must be preserved during and after construction projects

Table 5-2. City of Inver Grove Heights Standards

Topic Area	Standard
Groundwater	Subsurface sewage treatment systems (SSTS) must meet the following requirements: • All systems must be designed and constructed in accordance with Minnesota Rules Chapter 7080. • Site review, percolation tests, and system design must be submitted in conjunction with building plans before permits for construction are issued. • All SSTS installations require a permit. Permits for SSTS installation or repair are issued only to State-licensed contractors. • Soil boring and analysis reports, prepared by a licensed designer or professional engineer trained in SSTS systems, must be submitted for each new proposed lot to assure the existence of at least two potential SSTS locations. • Animal waste, commercial wastewater, and industrial wastewater must not be discharged unless a State disposal system permit is obtained from the Minnesota Pollution Control Agency. • Nonconforming systems must be upgraded to bring them into compliance at such time that building permits are issued for additional bedrooms or bathrooms or at such time a building permit is issued for any structure in the Shoreland area.
Groundwater (Cont'd)	All stormwater shall be directed to a pretreatment BMP prior to discharge to an infiltration/filtration facility.

[1]Subd. 39 of the City's Subdivision Ordinance requires incorporation of LID design concepts into development projects located in the Northwest Area.

[2]The lowest floor elevation is the elevation of the lowest floor of a building on a lot adjacent to an inundation area (wetland, lake, pond, stream, or open channel)

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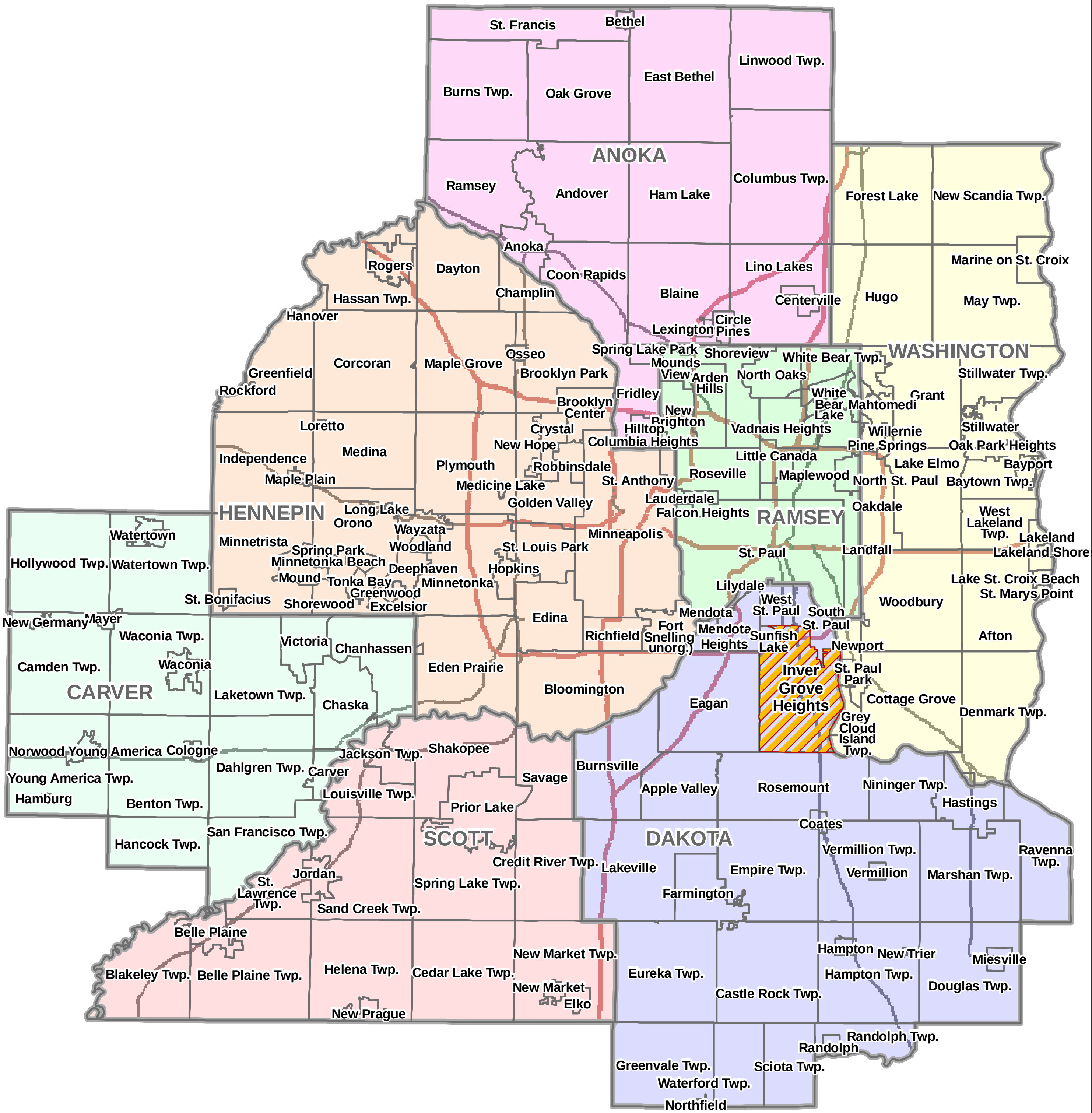
APPENDIX A

Figures

Barr Footer: Date: 11/15/2008 10:36:28 AM File: I:\Client\Inver_Grove_Heights\gis\NewPlan\CityWide\Geodatabases\Maps\Figure 01-1 City of Inver Grove Heights Location Map.mxd User: TJA



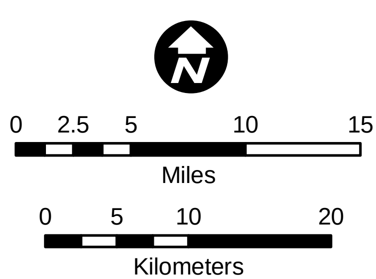
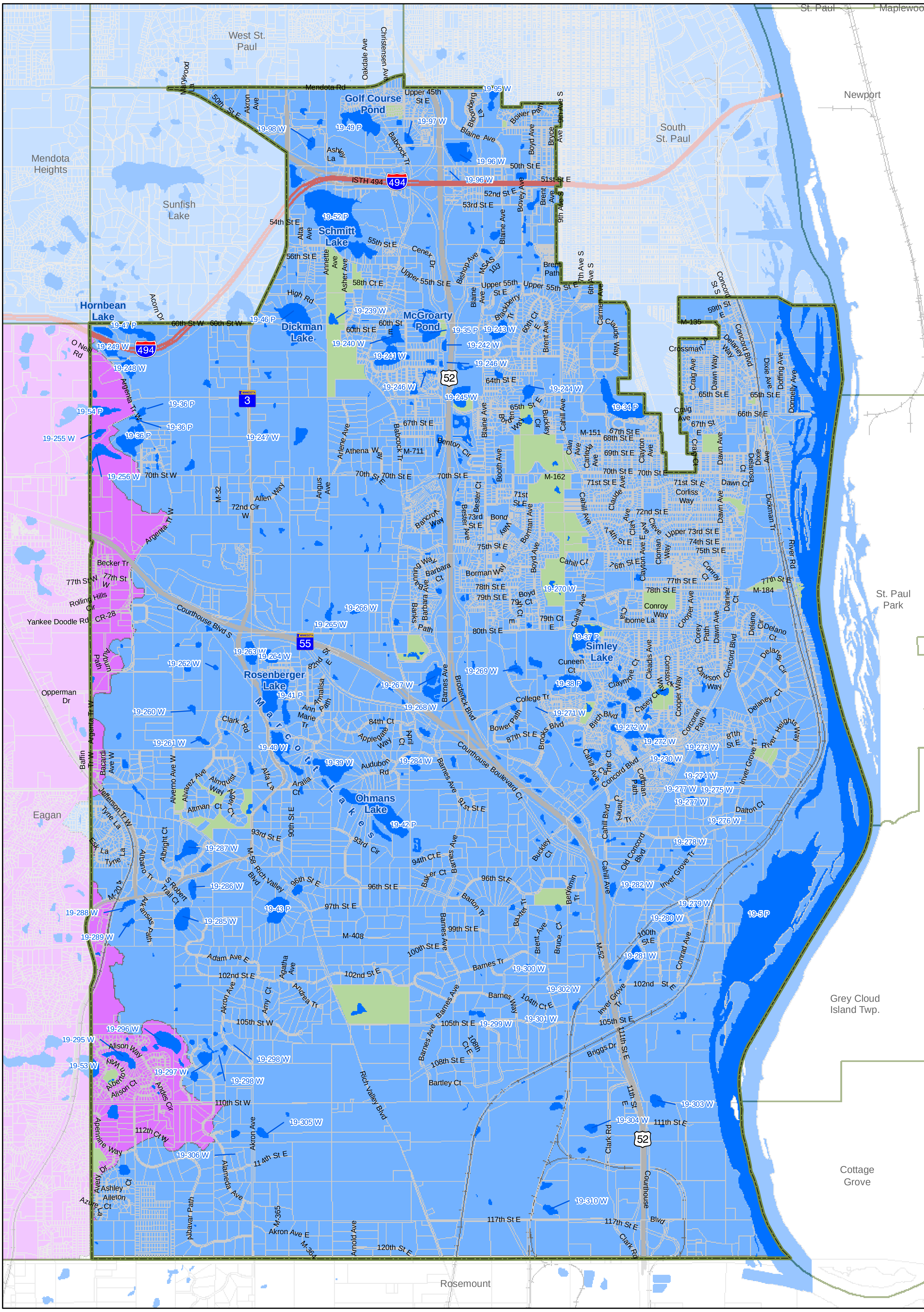


Figure 1-1
CITY OF INVER GROVE HEIGHTS
LOCATION MAP
Inver Grove Heights
Water Resources Management Plan



![Inver Grove Heights logo]

- City of Inver Grove Heights
- Lower Mississippi River WMO
- Eagan-Inver Grove Heights WMO
- City Parks

0 1,500 3,000 6,000
Feet

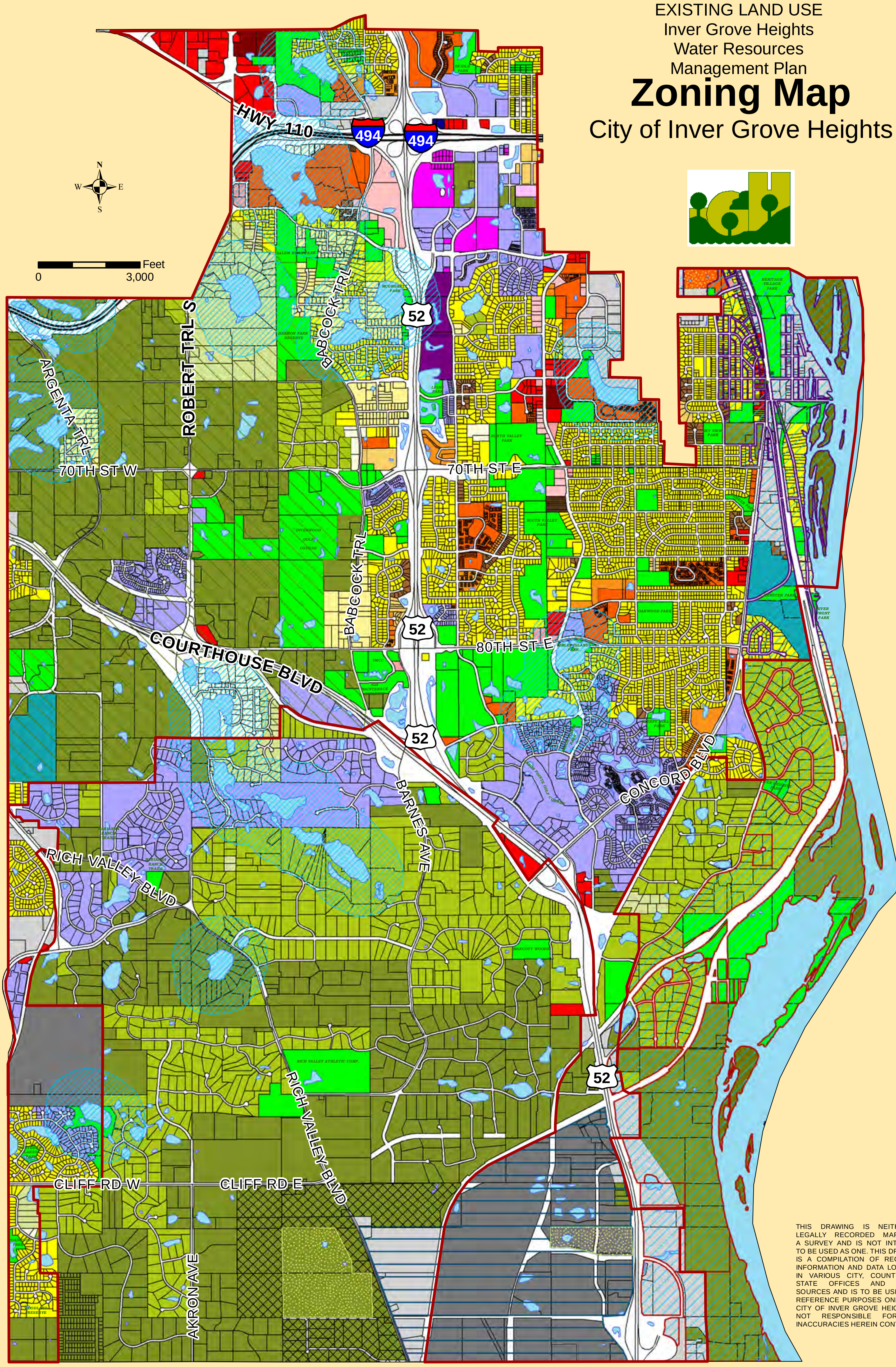
0 500 1,000 2,000
Meters

Figure 1-2
WATERSHED MANAGEMENT ORGANIZATIONS (WMO)
Inver Grove Heights
Water Resources Management Plan

Figure 2-1
EXISTING LAND USE
Inver Grove Heights
Water Resources
Management Plan

Zoning Map

City of Inver Grove Heights



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Updated: January 2014

- MUSAbndy
- Shoreland District: Urban River Zone; Critical 4
- Shoreland District: Transitional River Zone
- IRM Overlay District
- Industrial Overlay
- North West Area Overlay District
- Sand and Gravel Overlay District
- Shoreland & Critical Overlay Districts
- A, Agricultural
- E-1, Estate (2.5 ac.)
- E-2, Estate (1.75 ac.)
- R-1A, Single Family (1.0 ac.)
- R-1B, Single Family (0.5 ac.)
- R-1C, Single Family (0.25 ac.)
- R-2, Two-Family
- R-3A, 3-4 Family
- R-3B, up to 7 Family
- R-3C, > 7 Family
- R-4, Mobile Home Park
- B-1, Limited Business
- B-2, Neighborhood Business
- B-3, General Business
- B-4, Shopping Center
- OP, Office Park
- PUD, Planned Unit Development
- Office PUD
- Comm PUD, Commercial PUD
- MF PUD, Multiple-Family PUD
- I-1, Limited Industrial
- I-2, General Industrial
- P, Public/Institutional
- Surface Water
- ROW

Map produced by the City of Inver Grove Heights

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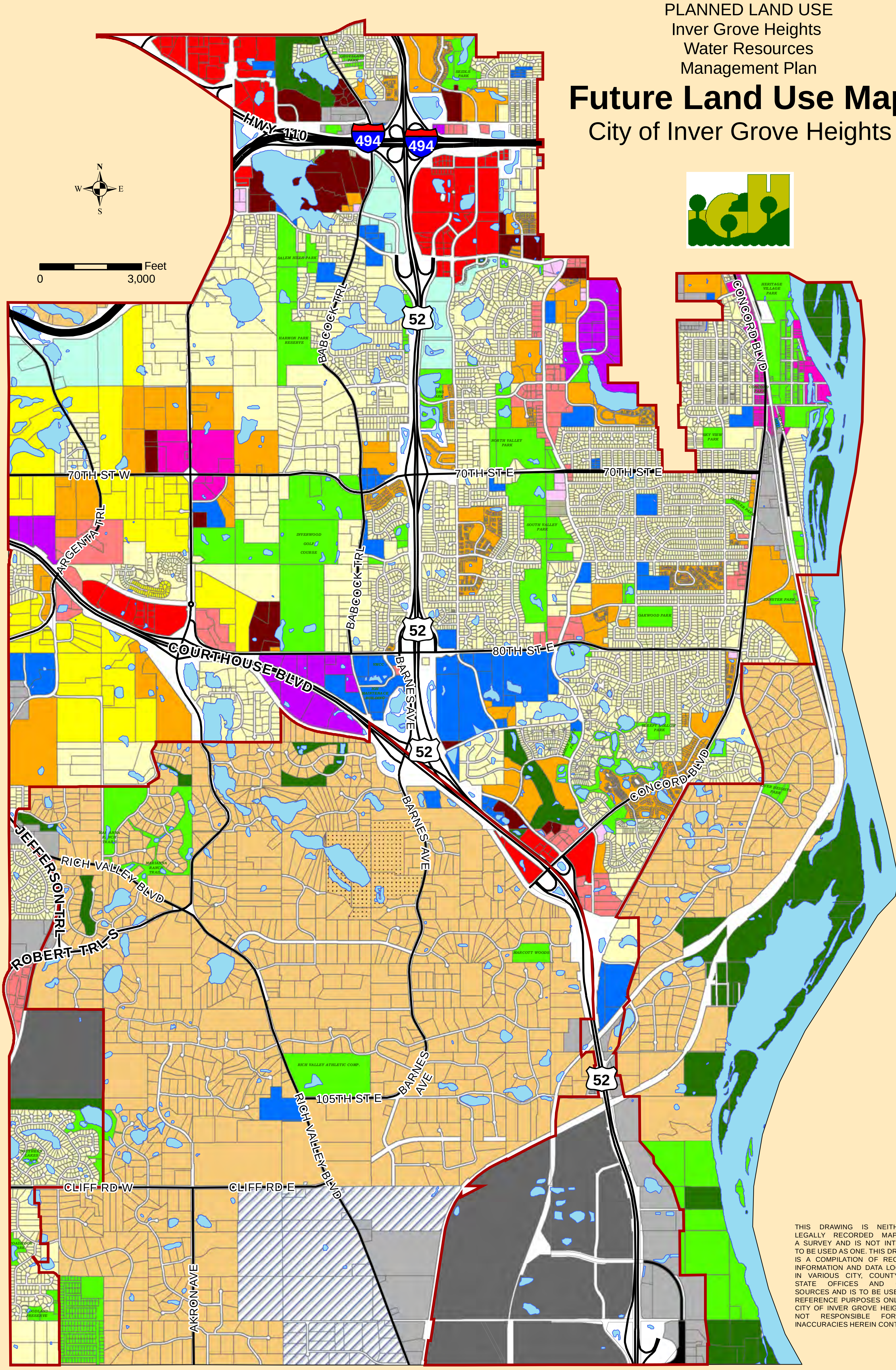
Figure 2-2
PLANNED LAND USE
Inver Grove Heights
Water Resources
Management Plan

Future Land Use Map

City of Inver Grove Heights



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Updated: January 2014

- MUSA Limits
- Rural Density Residential / Private Recreation Open Space
- Rural Density Residential
- Low Density Residential
- Low-Medium Density Residential
- Medium Density Residential
- High Density Residential
- Neighborhood Commercial
- Community Commercial
- Regional Commercial
- Mixed Use
- Office
- Industrial Office Park
- Light Industrial
- General Industrial
- Public / Institutional
- Public Open Space
- Private Open Space
- Rail Road
- Industrial Open Space
- Open Water / Wetlands

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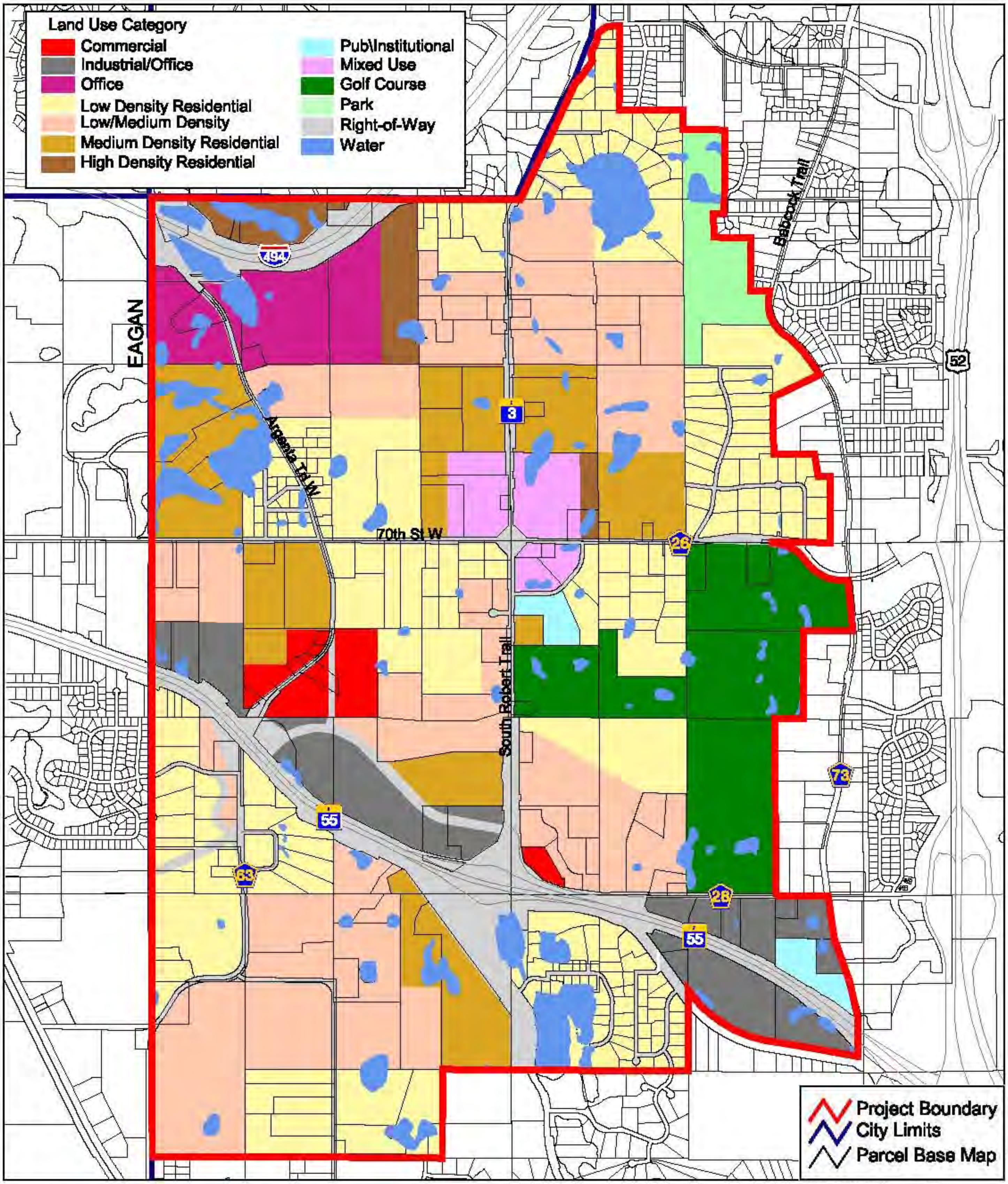


P:\23\19\851\Proposed Land Use NW Expansion Area.CDR RLG 09-13-06

Source: Bonestroo Rosene Anderlik & Associates, Figure 5-5 Proposed Land Use, Northwest Expansion Area AUAR, 2005

0 1000 2000
Feet

Figure 2-3
PROPOSED LAND USE
NORTHWEST AREA
Inver Grove Heights
Water Resources Management Plan

SYSTEM	GEOLOGIC UNIT	THICKNESS (Feet)	LITHOLOGY	
Quaternary	Alluvium	0-150		
	Glacial Drift	0-400		
Ordovician	Decorah Shale	0-95		Decorah-Platteville Aquifer
	Platteville Limestone	30-50		
	St. Peter Sandstone	140-160		St. Peter Aquifer
	Shakopee Dolomite	35-60		Prairie Du Chien-Jordan Aquifer
	New Richmond Sandstone	0-10		
	Oneota Dolomite	70-90		
Cambrian	Jordan Sandstone	80-105		
	St. Lawrence Formation	35-70		
	Franconia Sandstone	100-200		Franconia-Galesville Aquifer
	Ironton - Galesville Sandstones	250-400		
	Eau Claire Formation			
	Mount Simon Sandstone			Mount Simon-Hinckley Aquifer
Precambrian	Hinckley Sandstone	75-175		

SOURCE: United States Geological Survey

Figure 2-4
GEOLOGIC COLUMN
Inver Grove Heights
Water Resources Management Plan

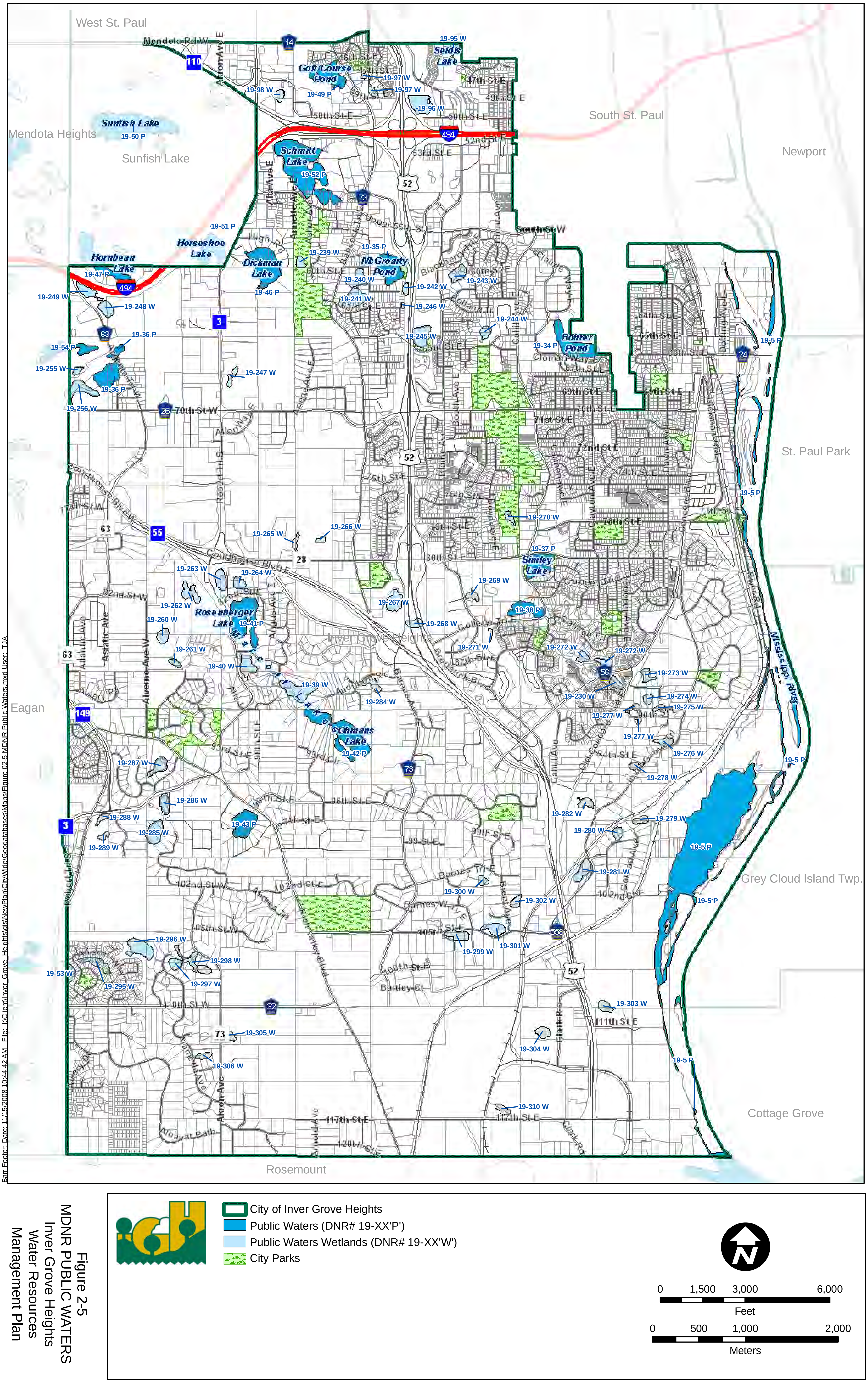
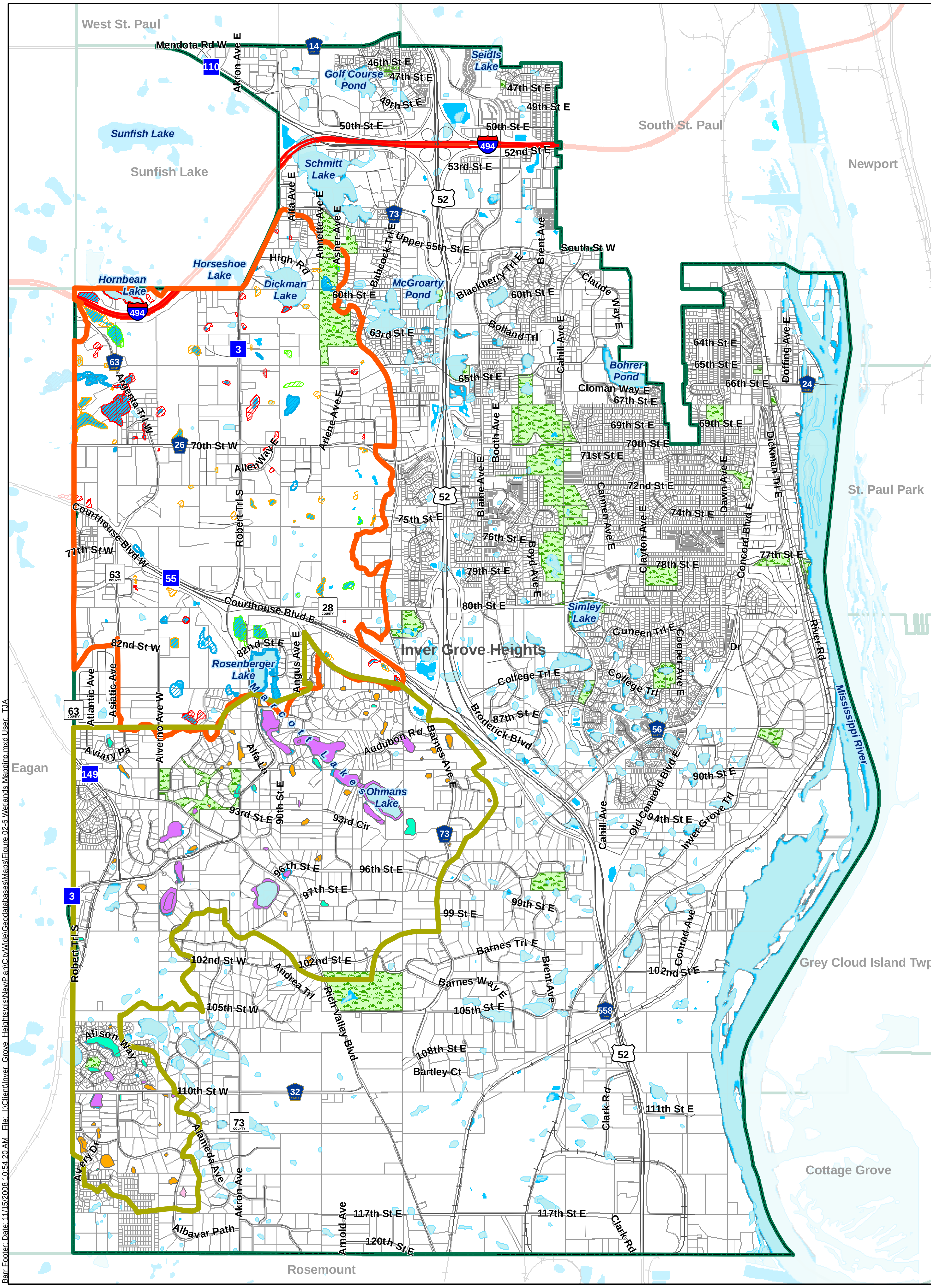


Figure 2-5
MDNR PUBLIC WATERS
Inver Grove Heights
Water Resources
Management Plan



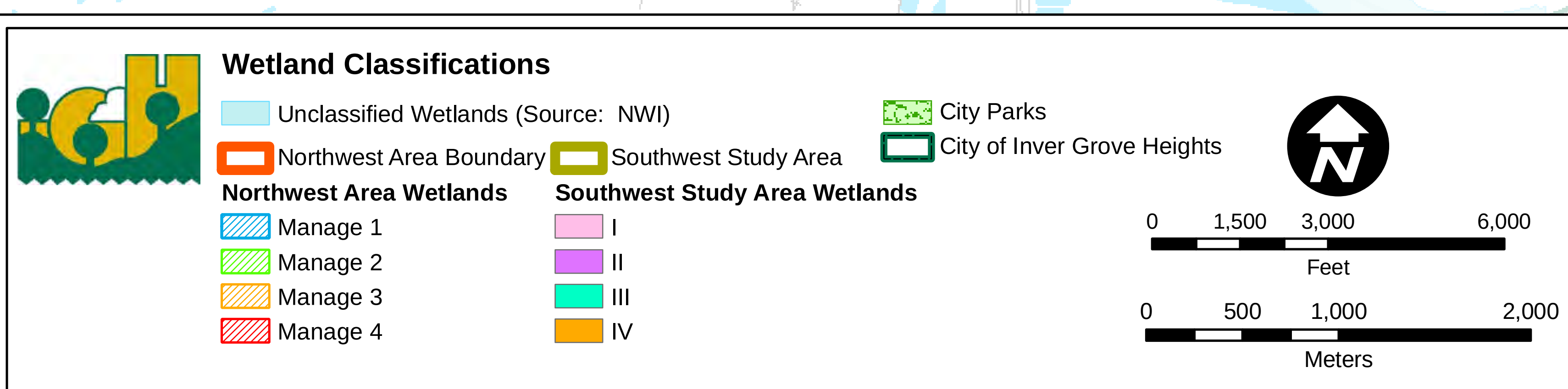


Figure 2-6
WETLANDS MAPPING
Inver Grove Heights
Water Resources
Management Plan

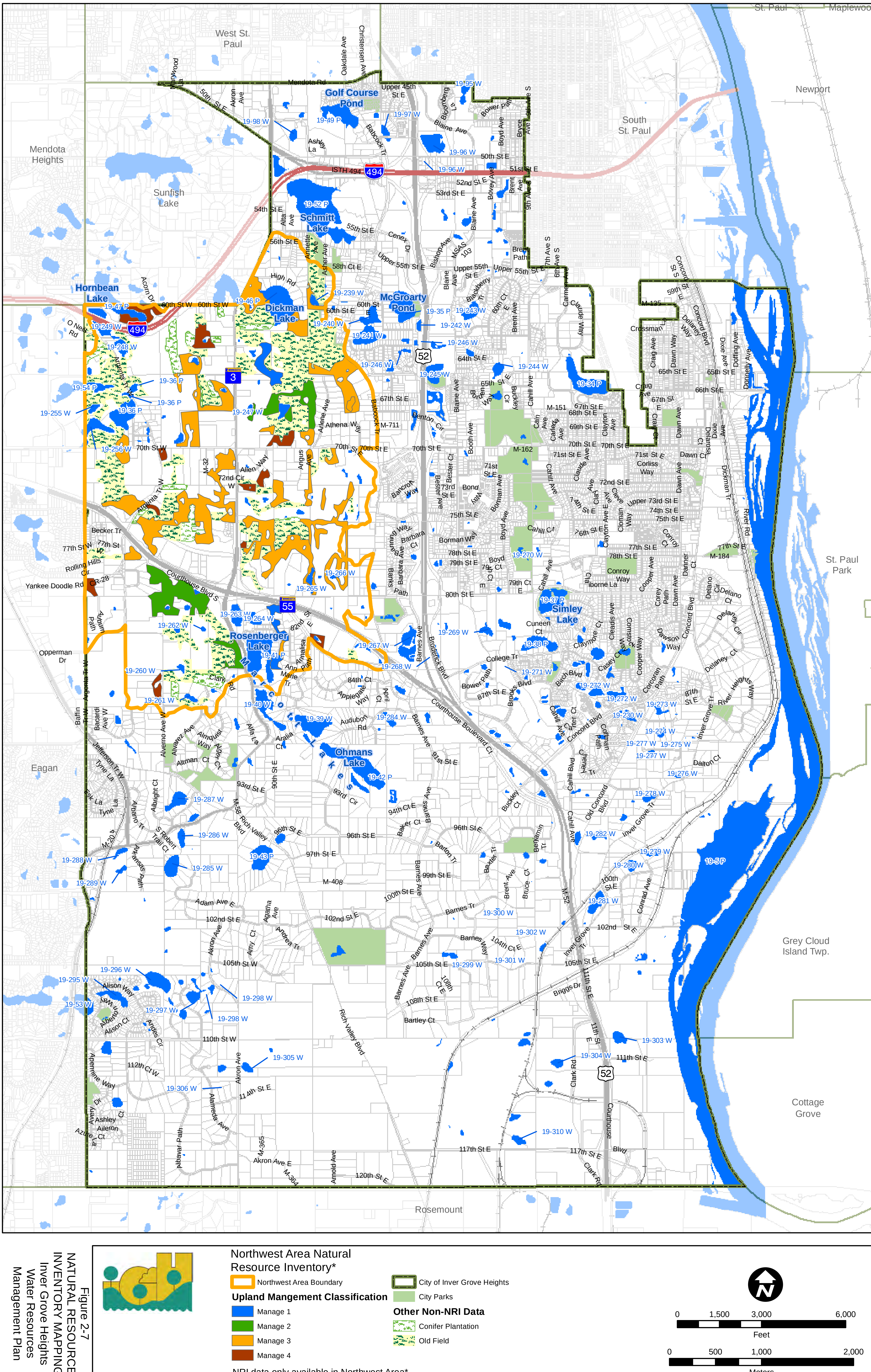


Figure 2-7
NATURAL RESOURCE INVENTORY MAPPING
Inver Grove Heights
Water Resources Management Plan

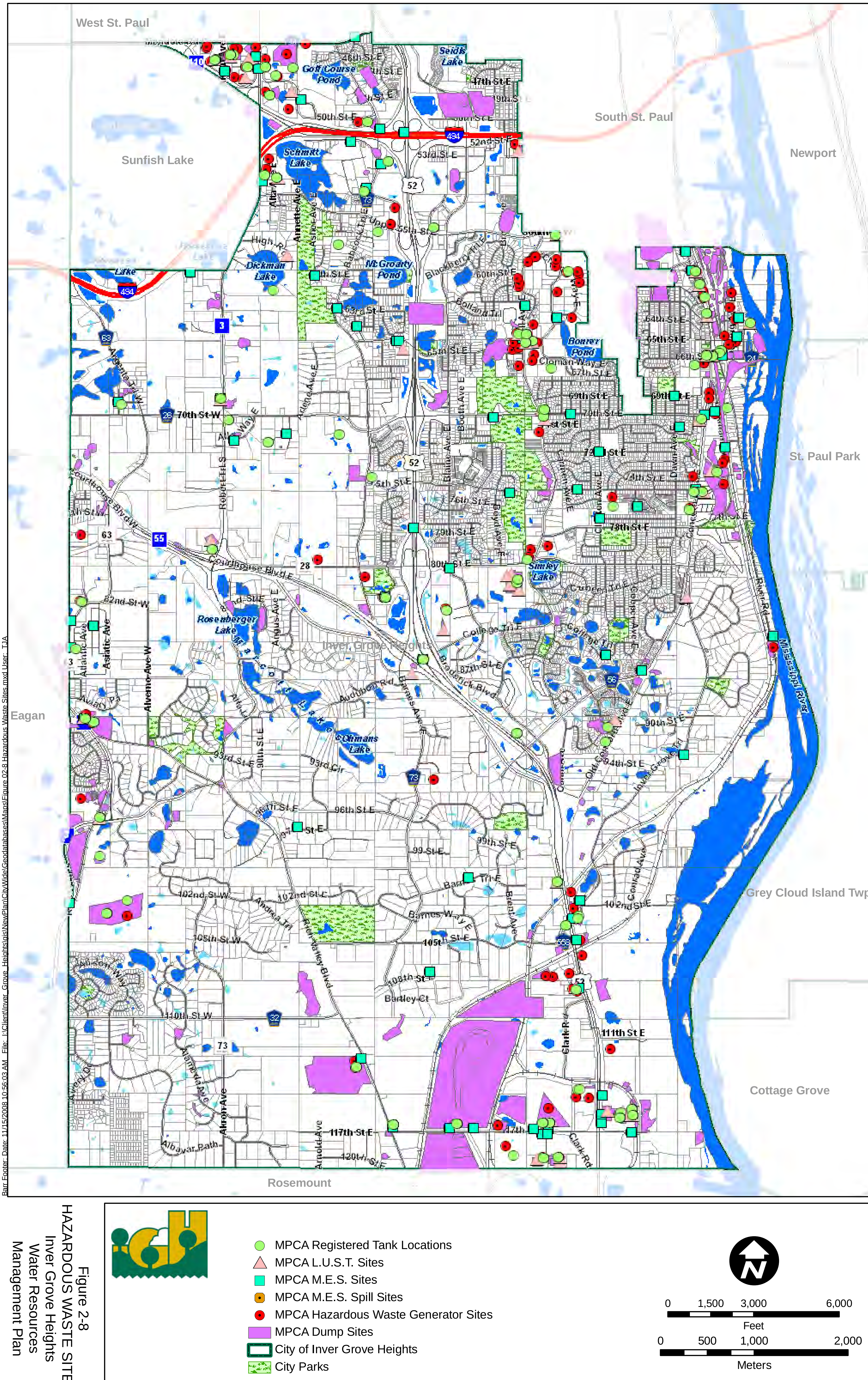
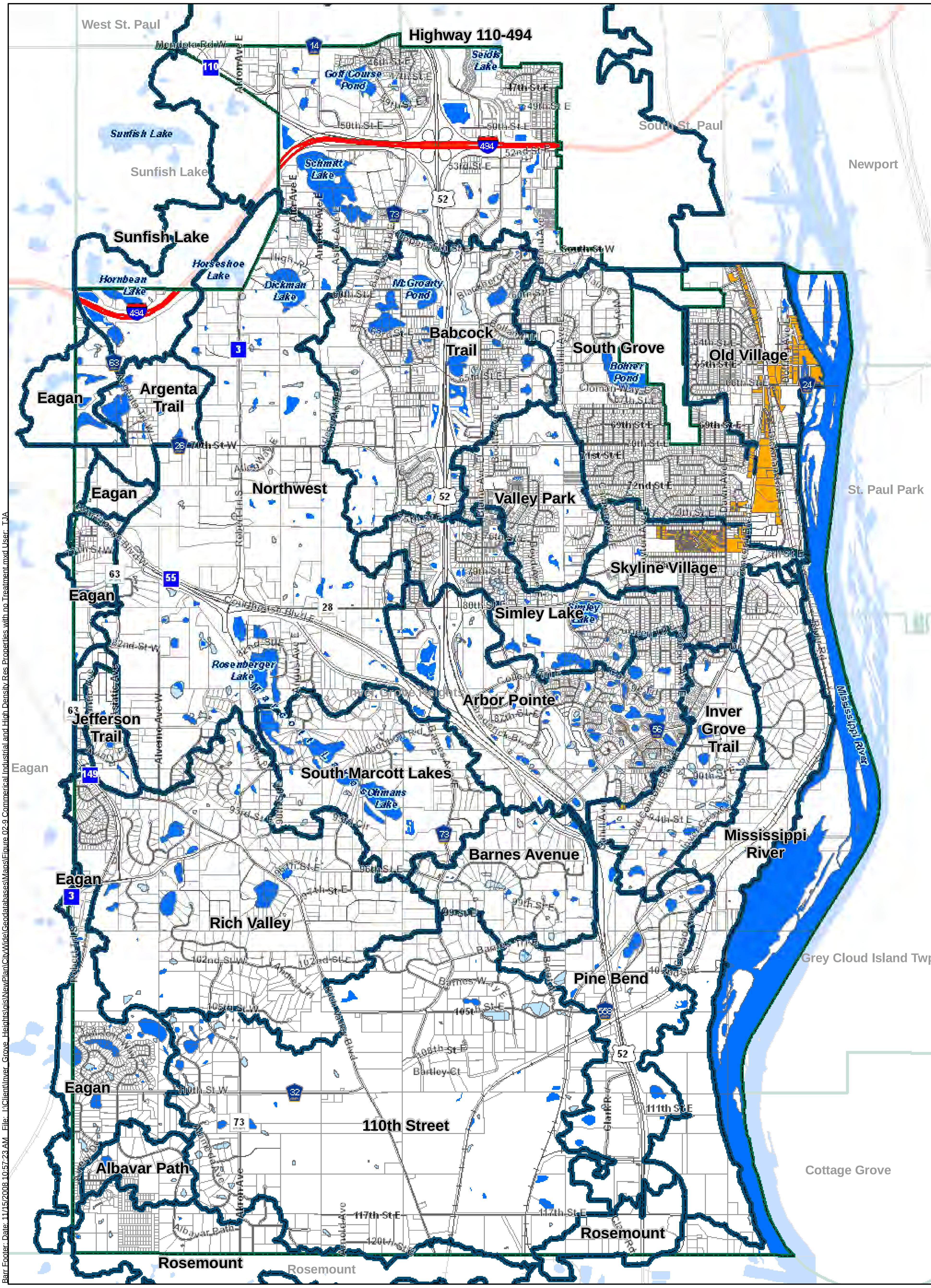


Figure 2-8
HAZARDOUS WASTE SITES
Inver Grove Heights
Water Resources
Management Plan



Properties
Drainage Basins
City of Inver Grove Heights

0 1,500 3,000 6,000
Feet
0 500 1,000 2,000
Meters

Figure 2-9
COMMERCIAL, INDUSTRIAL AND HIGH DENSITY RESIDENTIAL PROPERTIES WITH NO TREATMENT
Inver Grove Heights Water Resources Management Plan

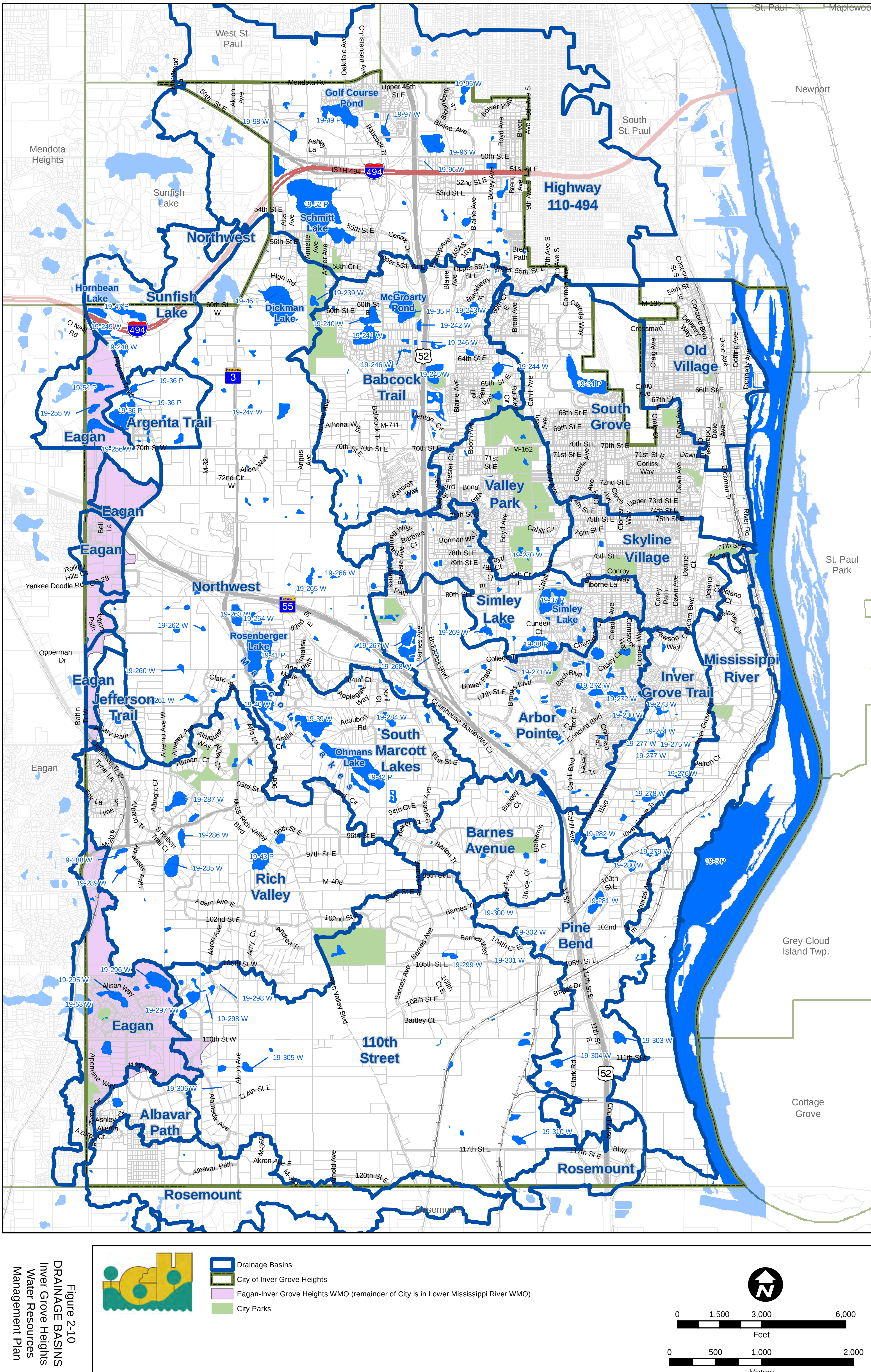
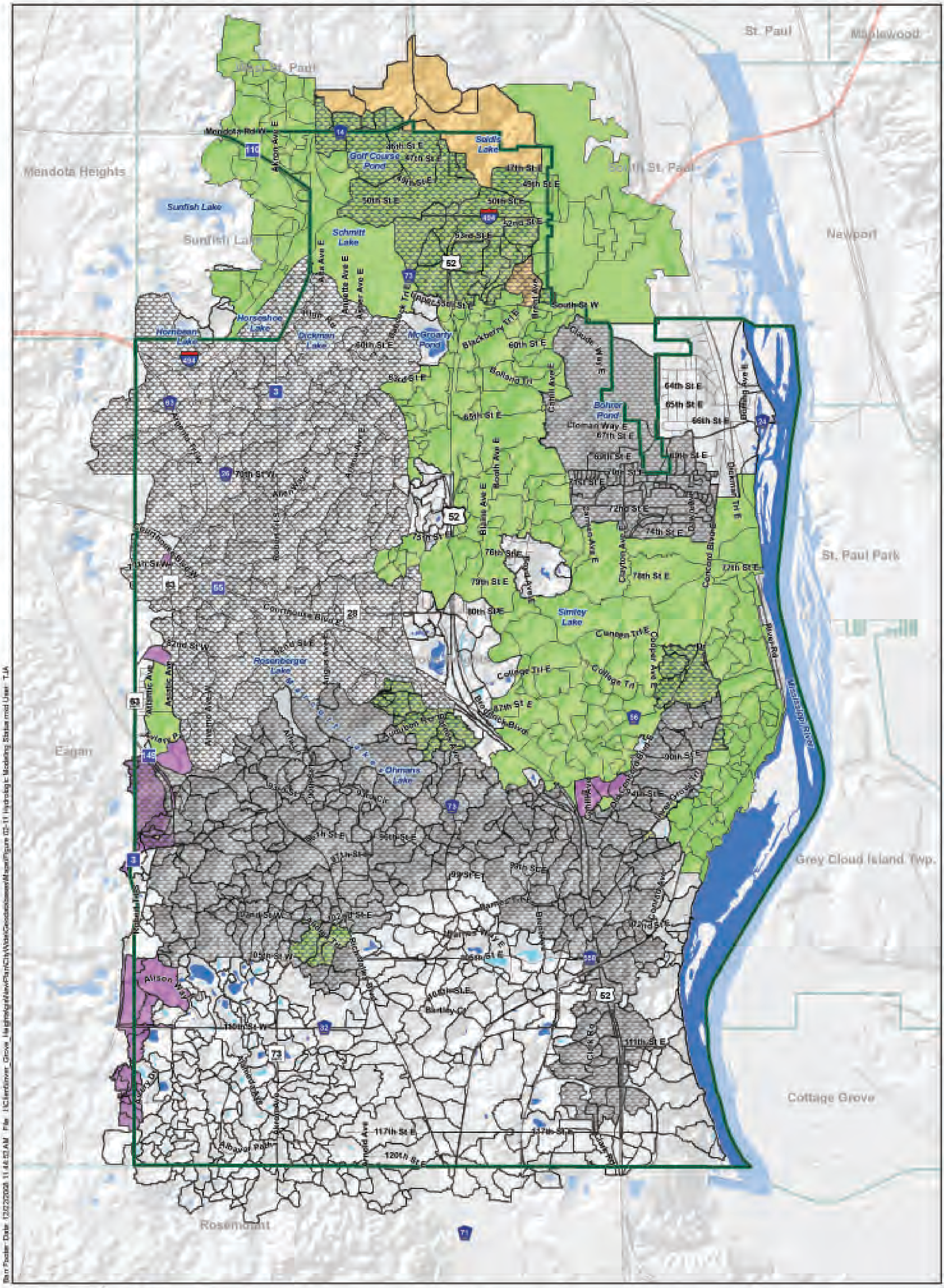


Figure 2-10
DRAINAGE BASINS
Inver Grove Heights
Water Resources
Management Plan



City of Inver Grove Heights
EOR Modeling Status (XPSWMM)

Modeling Status

- No Hydrologic Modeling
- XP-SWMM
- XP-SWMM, Barr Watershed Model
- XP-SWMM, HydroCAD
- XP-SWMM, Meyer Model
- XP-SWMM, Barr Watershed Model, Meyer Model
- Barr Watershed Model
- Barr Watershed Model, Meyer Model
- HydroCAD
- HydroCAD, Barr Watershed Model, Meyer Model
- HydroCAD,Barr Watershed Model

0 1,500 3,000 6,000
Feet

0 500 1,000 2,000
Meters

Figure 2-11
HYDROLOGIC
MODELING STATUS
Inver Grove Heights Surface
Water Management Plan

Not Landlocked:
1. Outflows (piped or overland) occur in the 100-Year 10 day snowmelt event
2. Flood storage between normal and primary overflow elevations is less than the runoff volume from the 1-year 24 hour storm for the directly tributary watershed (not including runoff from tributary watersheds)

Semi-Landlocked:
1. Outflows (piped or overland) occur in the 100-Year 10 day snowmelt event
2. Flood storage between normal and primary overflow elevations is greater than the runoff volume from the 1-year 24 hour storm for the directly tributary watershed (not including runoff from tributary watersheds) (i.e. outflows occur only occasionally)

Landlocked:
1. No outflows occur in the 100-Year 10 day snowmelt event
2. Terminal Watershed: typically the watershed containing the lowest basin in a subbasin; determined using engineering judgment.

Overflow Type:

Primary Overflow (Pipe)	Watershed has a pipe outlet as the primary overflow and there is flow in the pipe in the 100 year event
Primary Overflow (Overland)	Watershed has no pipe outlet, but there is an overland surface outlet in the 100 year event
Secondary Overflow (Overland)	The next-lowest overflow elevation, above the primary overflow; likely to flow to a different watershed than the primary overflow

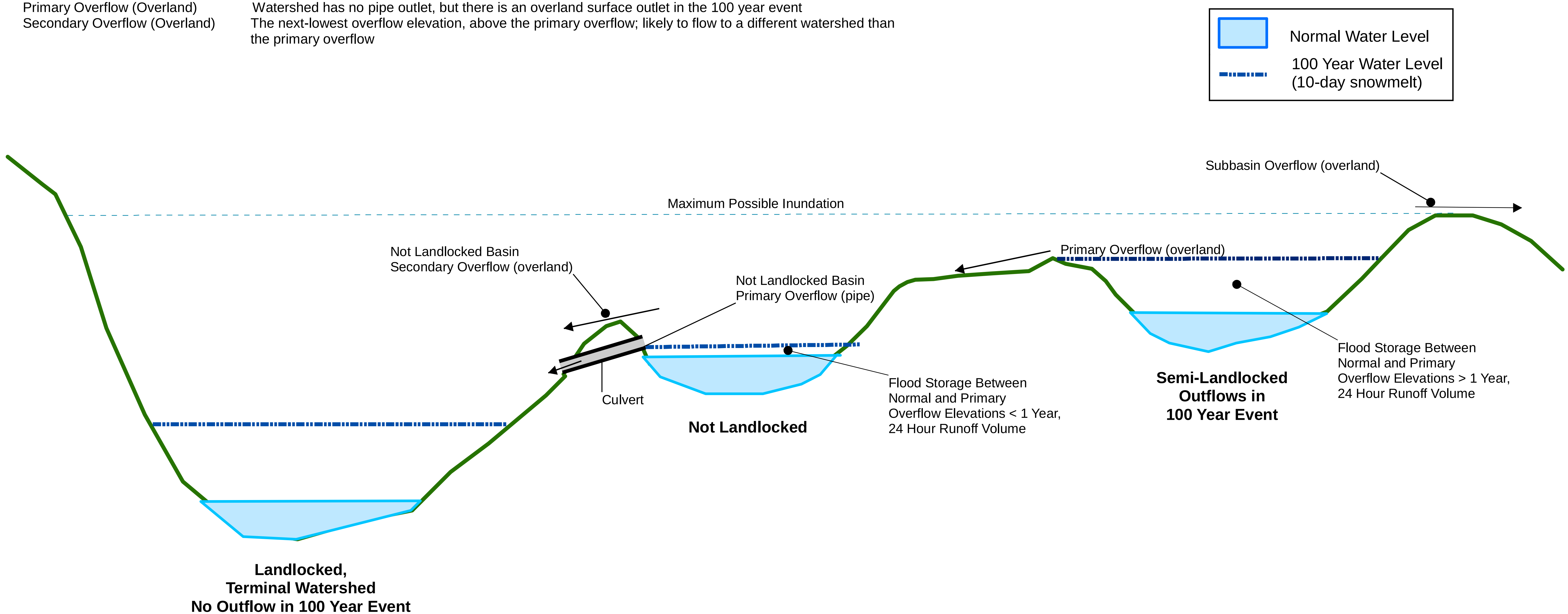
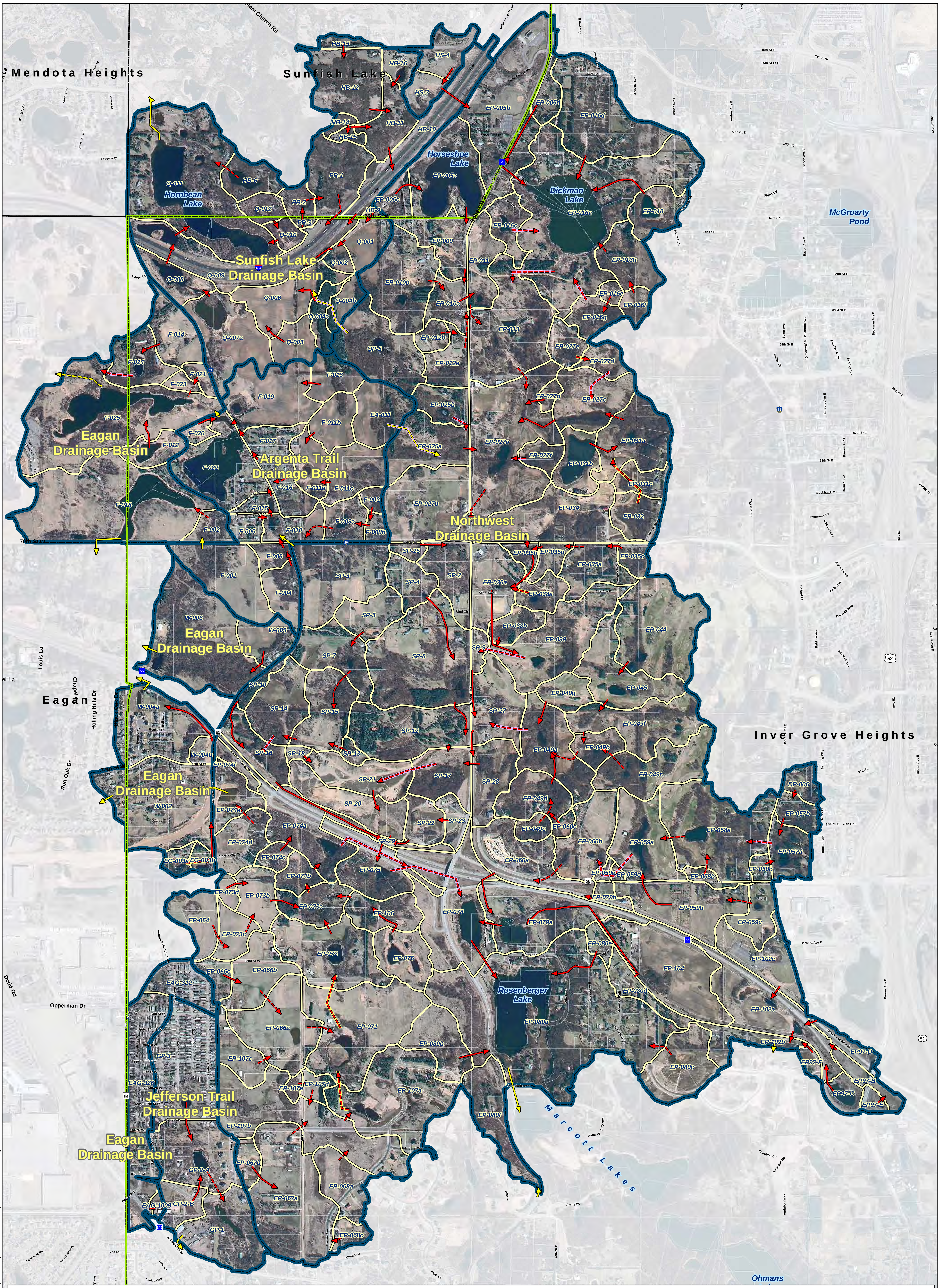


Figure 2-12
HYDROLOGY TERMINOLOGY - LANDLOCKED BASINS
Barnes Avenue, Inver Grove Trail, Pine Bend, Rich Valley, and South Marcott Lakes Drainage Basins
Inver Grove Heights
Water Resources Management Plan


Inter-Basin Flows (Where Available)
Flow Direction Arrows (Where Available)
City of Inver Grove Heights
Municipal Boundaries
Drainage Basins
Watersheds
0 350 700 1,400 2,100
Feet
0 100 200 400 600
Meters
Figure 2-13
110TH STREET, EAGAN (South)
ROSEMOUNT AND ALBAVAR
PATH DRAINAGE BASINS
Drainage Pattern Map
Inver Grove Heights Surface
Water Management Plan
Eagan Drainage Basin
Eagan
Eagan Drainage Basin
Albavar Path Drainage Basin
110th Street Drainage Basin
Rosemount Drainage Basin
Rosemount Drainage Basin
Rosemount
Gun Club Rd

Figure 2-14
SIMLEY LAKE AND ARBOR POINTE DRAINAGE BASINS
Drainage Pattern Map
Inver Grove Heights Surface Water Management Plan



Drainage Basins

Watersheds

Inter-Basin Flow Direction Arrows

- Not Landlocked
- Landlocked
- Currently Landlocked, pump planned
- Currently Landlocked, culvert planned

Flow Direction Arrows

- Not Landlocked
- Landlocked
- Currently Landlocked, pump planned
- Currently Landlocked, culvert planned
- City of Inver Grove Heights
- Municipal Boundaries

0 350 700 1,400 2,100
Feet

0 100 200 400 600
Meters

Figure 2-15
NORTHWEST, EAGAN (North), JEFFERSON TRAIL, SUNFISH LAKE AND ARGENTA TRAIL DRAINAGE BASINS
Drainage Pattern Map
Inver Grove Heights Surface Water Management Plan

Source of data for Argenta Trail, Northwest, and portions of Eagan Drainage Basin: Emmons & Olivier Resources, Inc.

Figure 2-16
BABCOCK TRAIL,VALLEY PARK, SOUTH GROVE, OLD VILLAGE AND SKYLINE VILLAGE DRAINAGE BASINS
Drainage Pattern Map
Inver Grove Heights Surface Water Management Plan

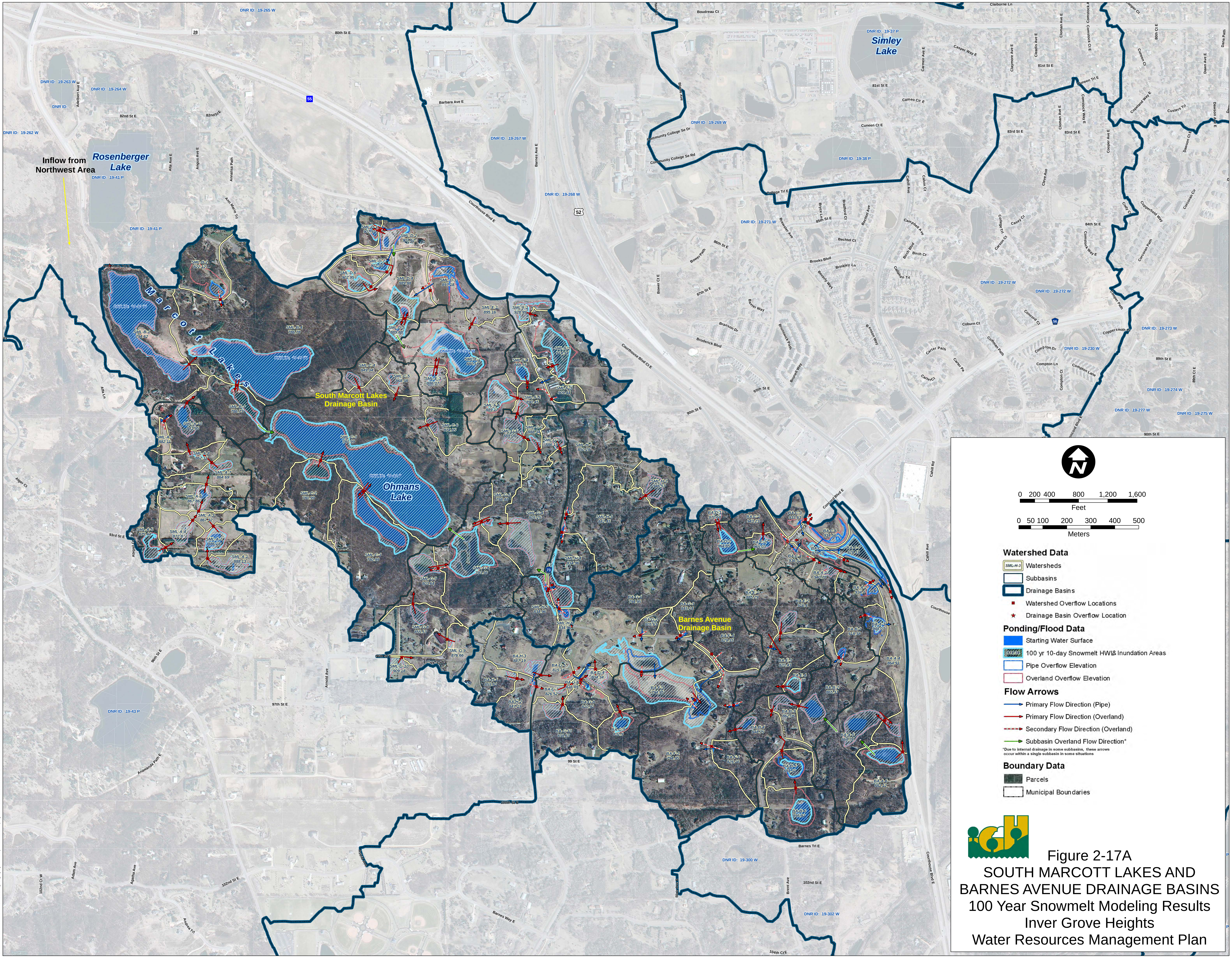


Figure 2-17A
SOUTH MARCOTT LAKES AND BARNES AVENUE DRAINAGE BASINS
100 Year Snowmelt Modeling Results
Inver Grove Heights
Water Resources Management Plan

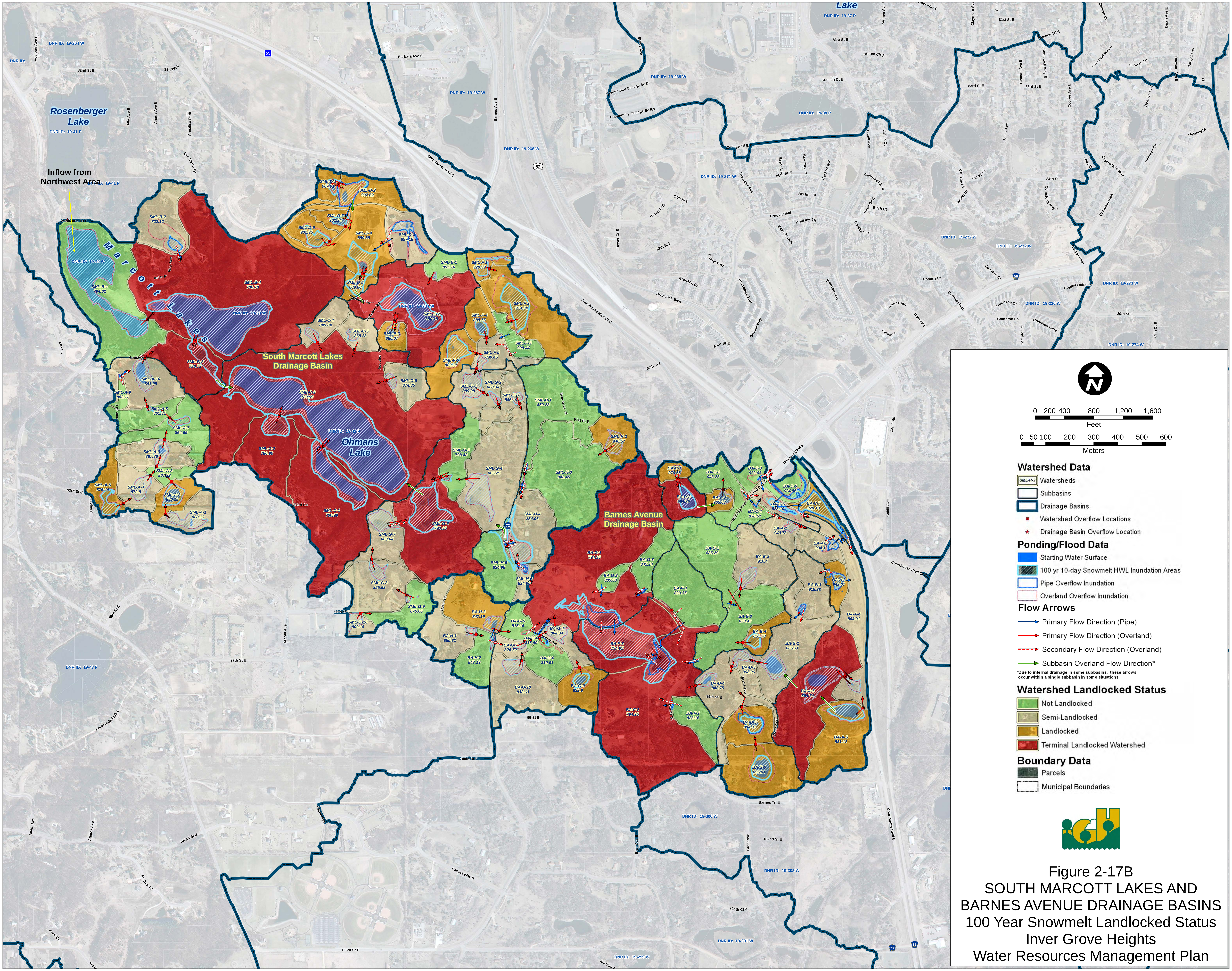
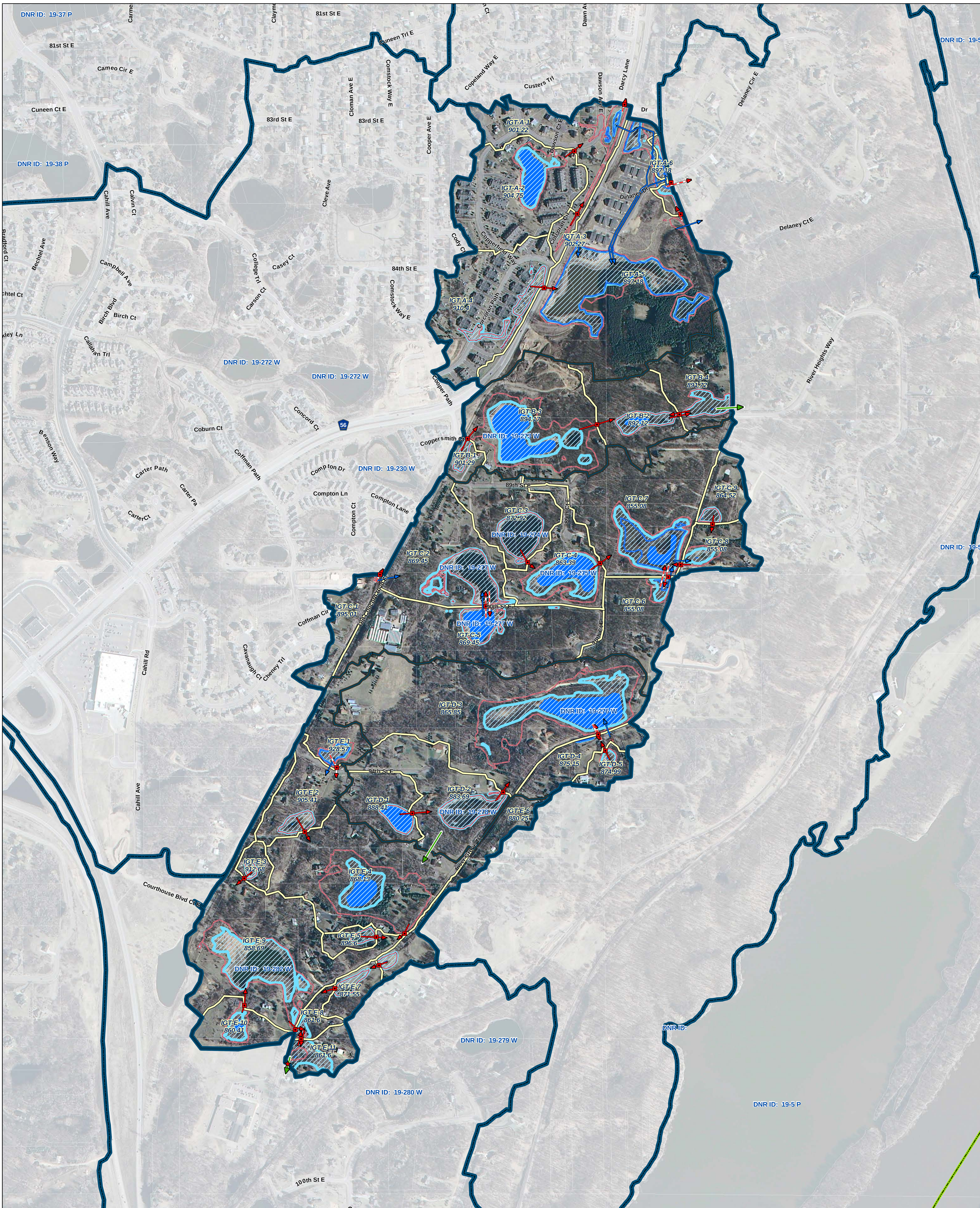


Figure 2-17B
SOUTH MARCOTT LAKES AND BARNES AVENUE DRAINAGE BASINS
100 Year Snowmelt Landlocked Status
Inver Grove Heights
Water Resources Management Plan


Figure 2-18
HIGHWAY 110-494 DRAINAGE BASIN
Drainage Pattern Map
Inver Grove Heights Surface
Water Management Plan
0 350 700 1,400
Feet
0 100 200 400 600
Meters
Inter-Basin Flow Direction Arrows
Flow Direction Arrows
Drainage Basins
Watersheds
Municipal Boundaries
City of Inver Grove Heights
West St. Paul
South St. Paul
Newport
Sunfish Lake
Inver Grove Heights
Sunfish Lake
Horseshoe Lake
Dickman Lake
McGroarty Pond
Schmitt Lake
Golf Course Pond
Seidls Lake



Watershed Data

- Watersheds
- Subbasins
- Drainage Basins
- Watershed Overflow Locations
- Drainage Basin Overflow Location

Ponding/Flood Data

- Starting Water Surface
- 100 yr 10-day Snowmelt HWL& Inundation Areas
- Pipe Overflow Elevation
- Overland Overflow Elevation

Flow Arrows

- Primary Flow Direction (Pipe)
- Primary Flow Direction (Overland)
- Secondary Flow Direction (Overland)
- Subbasin Overland Flow Direction*

*Due to internal drainage in some subbasins, these arrows occur within a single subbasin in some situations

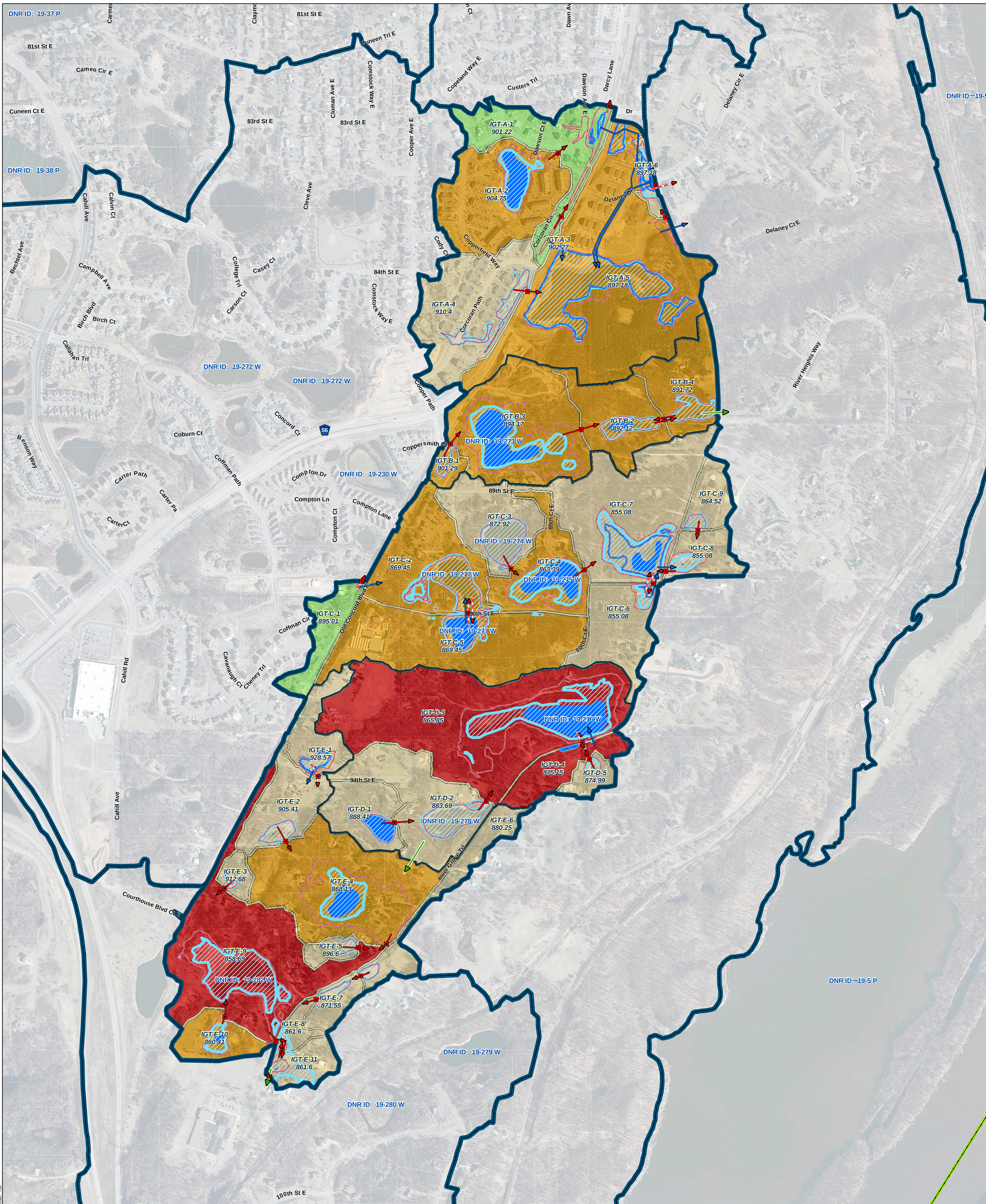
Boundary Data

- Parcels
- Municipal Boundaries

0 200 400 800
Feet

0 50 100 200 300
Meters

Figure 2-19A
INVER GROVE TRAIL
DRAINAGE BASIN
100 Year Snowmelt Modeling Results
Inver Grove Heights
Water Resources Management Plan



Watershed Data

- Watersheds
- Subbasins
- Drainage Basins
- Watershed Overflow Locations
- Drainage Basin Overflow Location

Ponding/Flood Data

- Starting Water Surface
- 100 yr 10-day Snowmelt HWL Inundation Areas
- Pipe Overflow Inundation
- Overland Overflow Inundation

Flow Arrows

- Primary Flow Direction (Pipe)
- Primary Flow Direction (Overland)
- Secondary Flow Direction (Overland)
- Subbasin Overland Flow Direction*

*Due to internal drainage in some subbasins, these arrows occur within a single subbasin in some situations

Watershed Landlocked Status

- Not Landlocked
- Semi-Landlocked
- Landlocked
- Terminal Landlocked Watershed

Boundary Data

- Parcels
- Municipal Boundaries

0 200 400 800
Feet

0 50 100 200 300
Meters

Figure 2-19B
INVER GROVE TRAIL
DRAINAGE BASIN
100 Year Snowmelt Landlocked Status
Inver Grove Heights
Water Resources Management Plan

Figure 2-20
MISSISSIPPI RIVER DRAINAGE BASIN
Drainage Pattern Map
Inver Grove Heights Surface
Water Management Plan

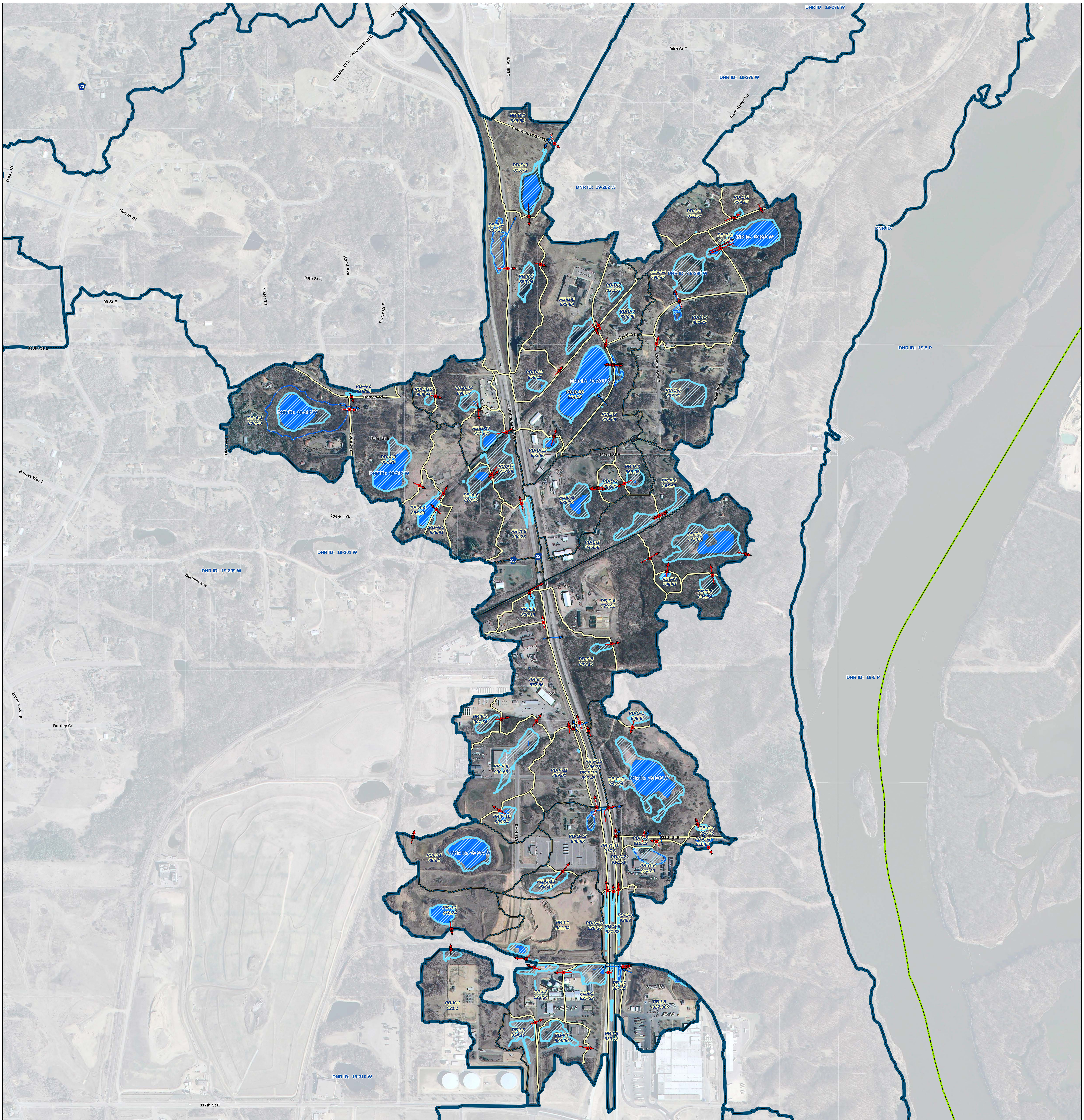


Figure 2-21A
PINE BEND DRAINAGE BASIN
100 Year Snowmelt
Modeling Results
Inver Grove Heights Water
Resources Management Plan

Watershed Data

- Watersheds
- Subbasins
- Drainage Basins
- Watershed Overflow Locations
- Drainage Basin Overflow Location

Ponding/Flood Data

- Starting Water Surface
- 100 yr 10-day Snowmelt HWL& Inundation Areas
- Pipe Overflow Elevation
- Overland Overflow Elevation

Flow Arrows

- Primary Flow Direction (Pipe)
- Primary Flow Direction (Overland)
- Secondary Flow Direction (Overland)
- Subbasin Overland Flow Direction*

*Due to internal drainage in some subbasins, these arrows occur within a single subbasin in some situations

Boundary Data

- Parcels
- Municipal Boundaries

0 200 400 800 1,200 1,600
Feet

0 50 100 200 300 400 500 600
Meters

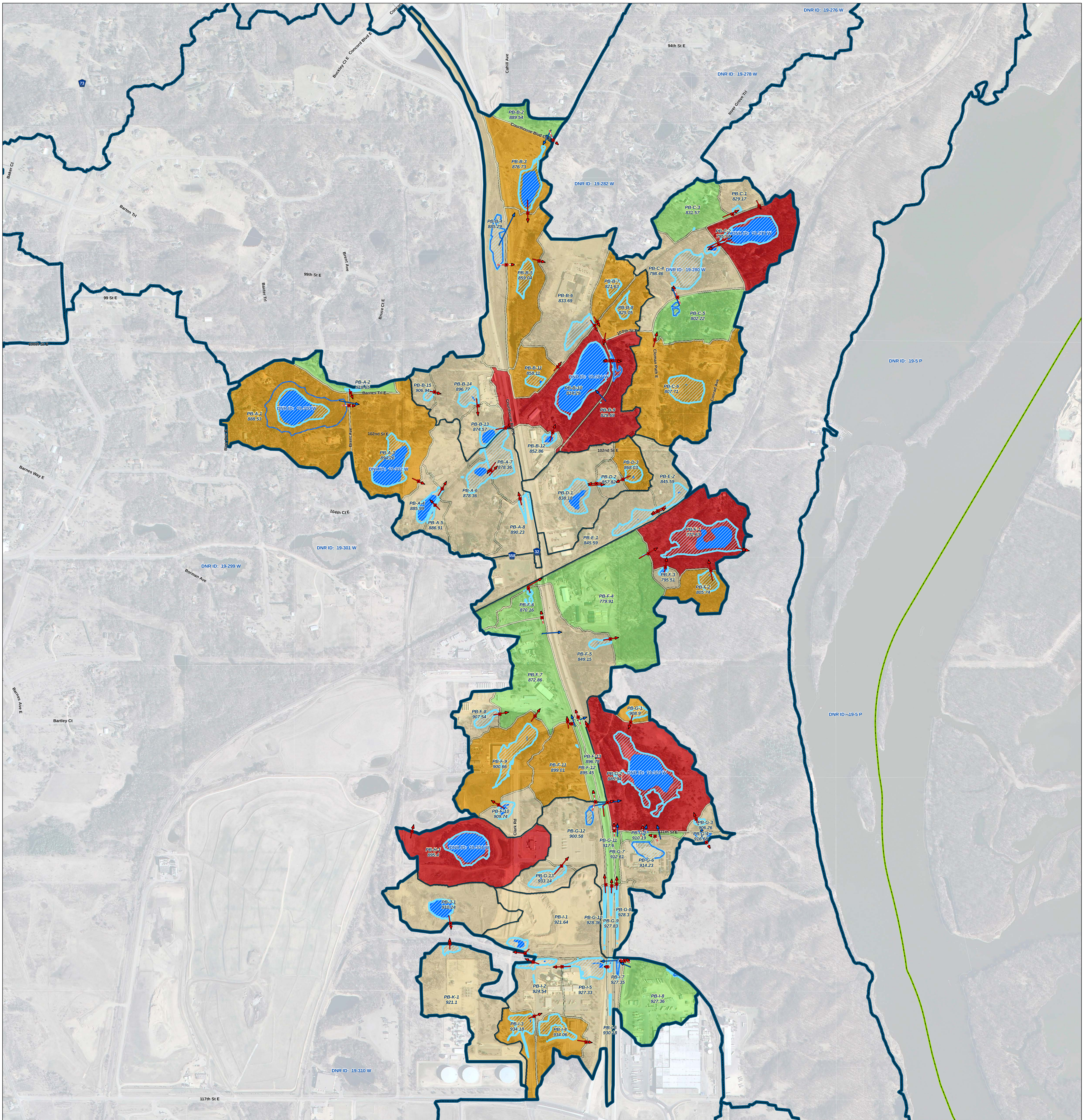


Figure 2-21B
PINE BEND DRAINAGE BASIN
100 Year Snowmelt
Landlocked Status
Inver Grove Heights Water Resources Management Plan

Watershed Data
- Watersheds
- Subbasins
- Drainage Basins
- Watershed Overflow Locations
- Drainage Basin Overflow Location

Ponding/Flood Data
- Starting Water Surface
- 100 yr 10-day Snowmelt HWL Inundation Areas
- Pipe Overflow Inundation
- Overland Overflow Inundation

Flow Arrows
- Primary Flow Direction (Pipe)
- Primary Flow Direction (Overland)
- Secondary Flow Direction (Overland)
- Subbasin Overland Flow Direction*

*Due to internal drainage in some subbasins, these arrows occur within a single subbasin in some situations

Watershed Landlocked Status
- Not Landlocked
- Semi-Landlocked
- Landlocked
- Terminal Landlocked Watershed

Boundary Data
- Parcels
- Municipal Boundaries

0 200 400 800 1,200 1,600 2,000
Feet

0 50 100 200 300 400 500 600
Meters

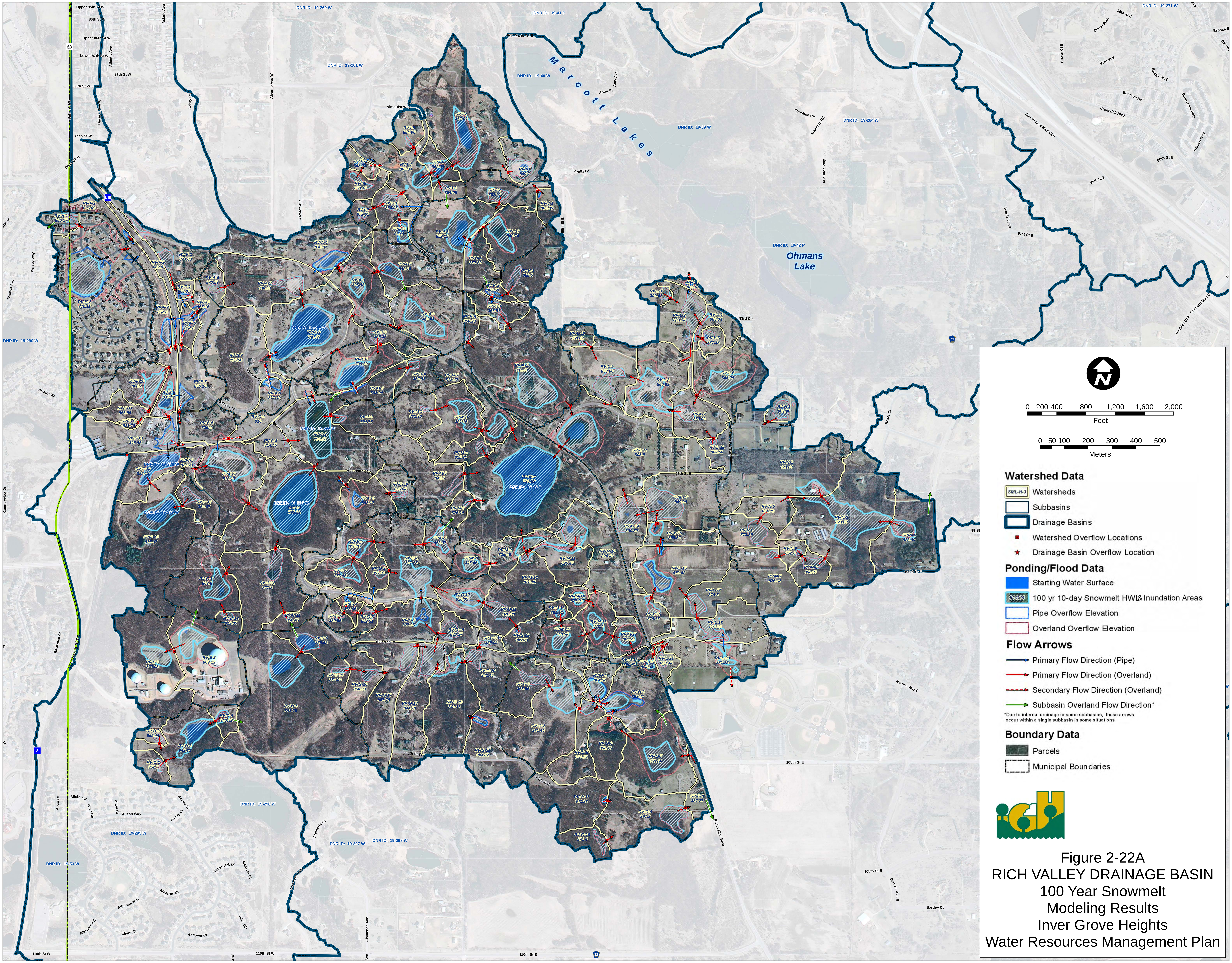


Figure 2-22A
RICH VALLEY DRAINAGE BASIN
100 Year Snowmelt
Modeling Results
Inver Grove Heights
Water Resources Management Plan

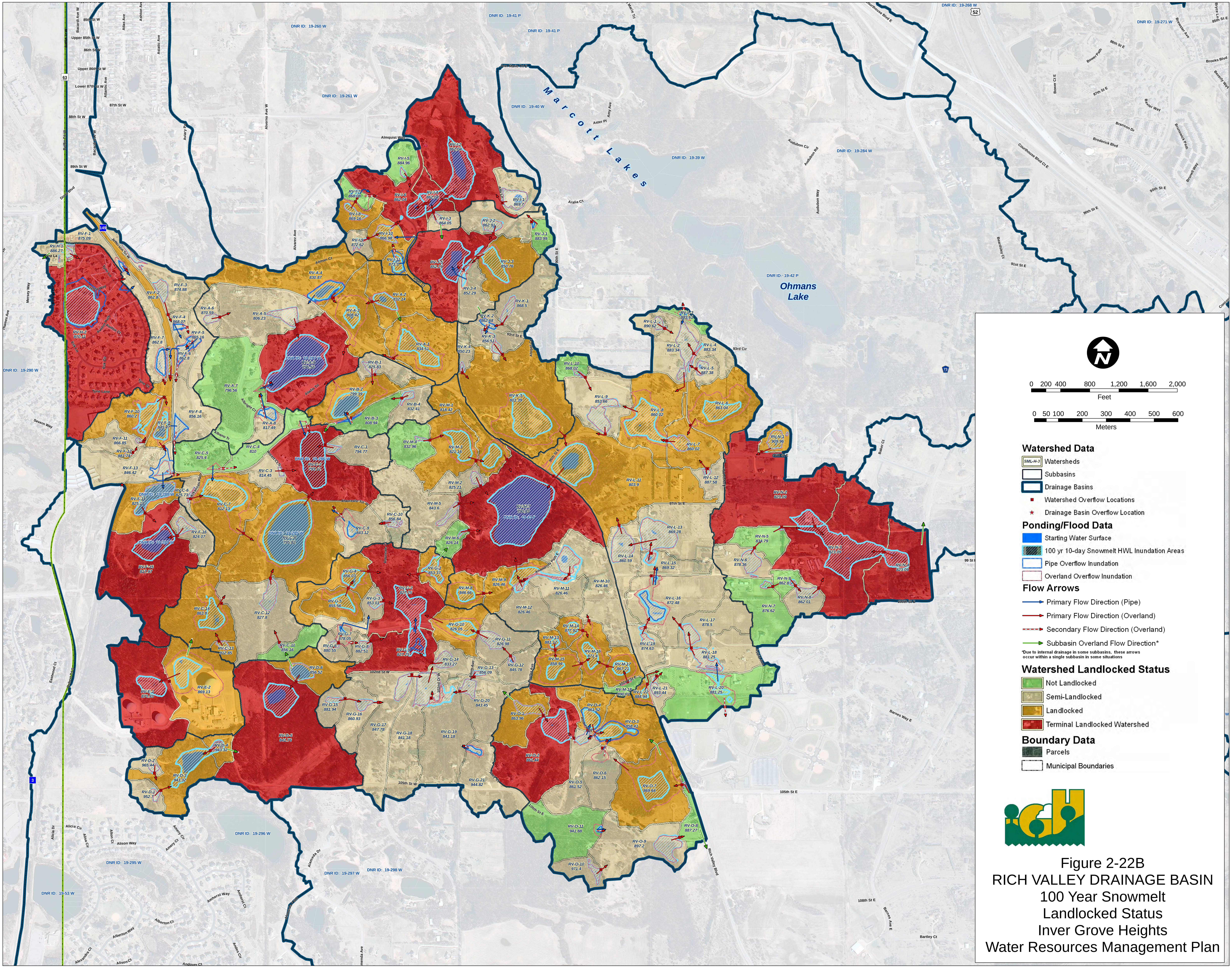


Figure 2-22B
RICH VALLEY DRAINAGE BASIN
100 Year Snowmelt
Landlocked Status
Inver Grove Heights
Water Resources Management Plan

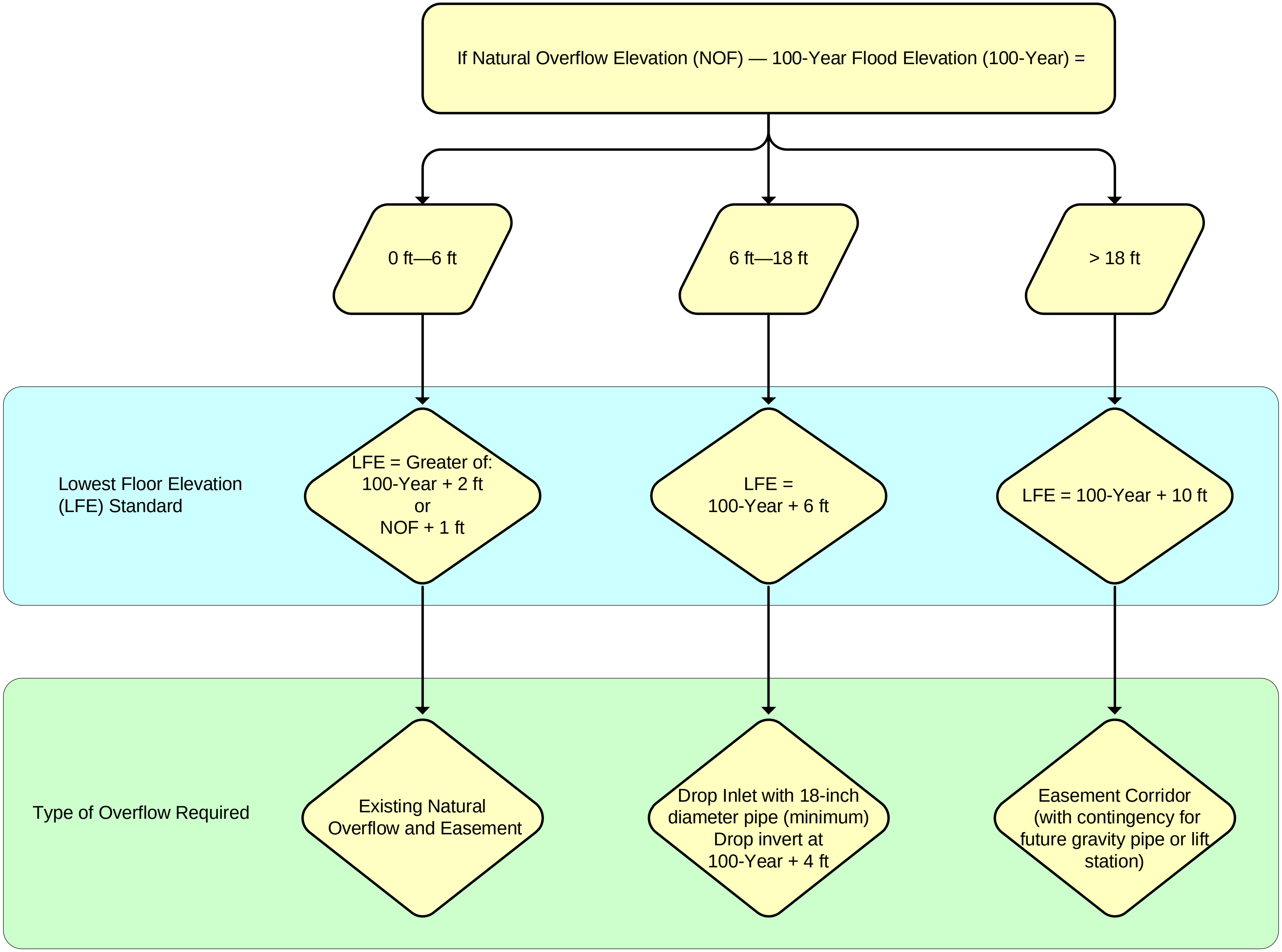


Figure 3-1
LOWEST FLOOR ELEVATION STANDARDS AND TYPE OF OVERFLOW–LANDLOCKED BASINS
Inver Grove Heights
Water Resources Management Plan

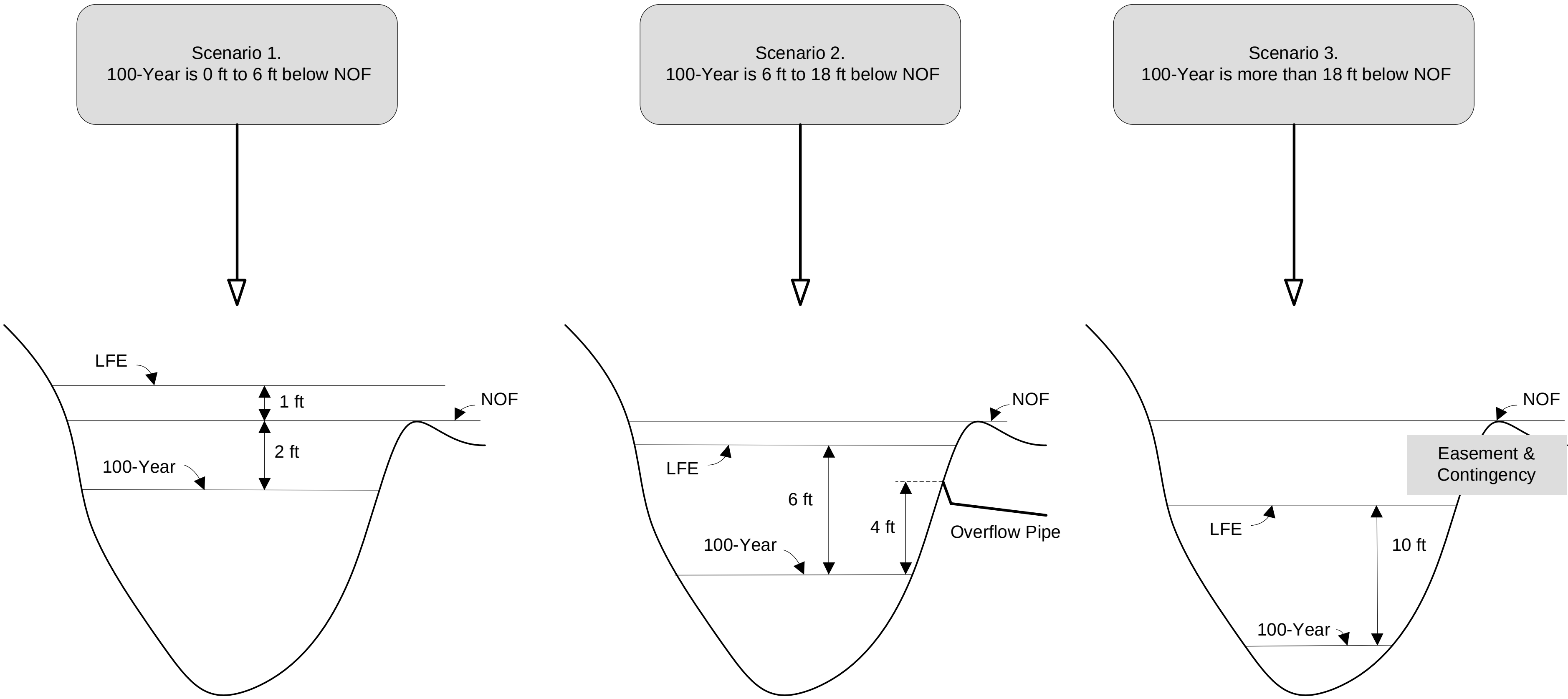


Figure 3-2
LOWEST FLOOR ELEVATION STANDARDS AND
TYPE OF OVERFLOW SCENARIOS–LANDLOCKED BASINS
Inver Grove Heights
Water Resources Management Plan

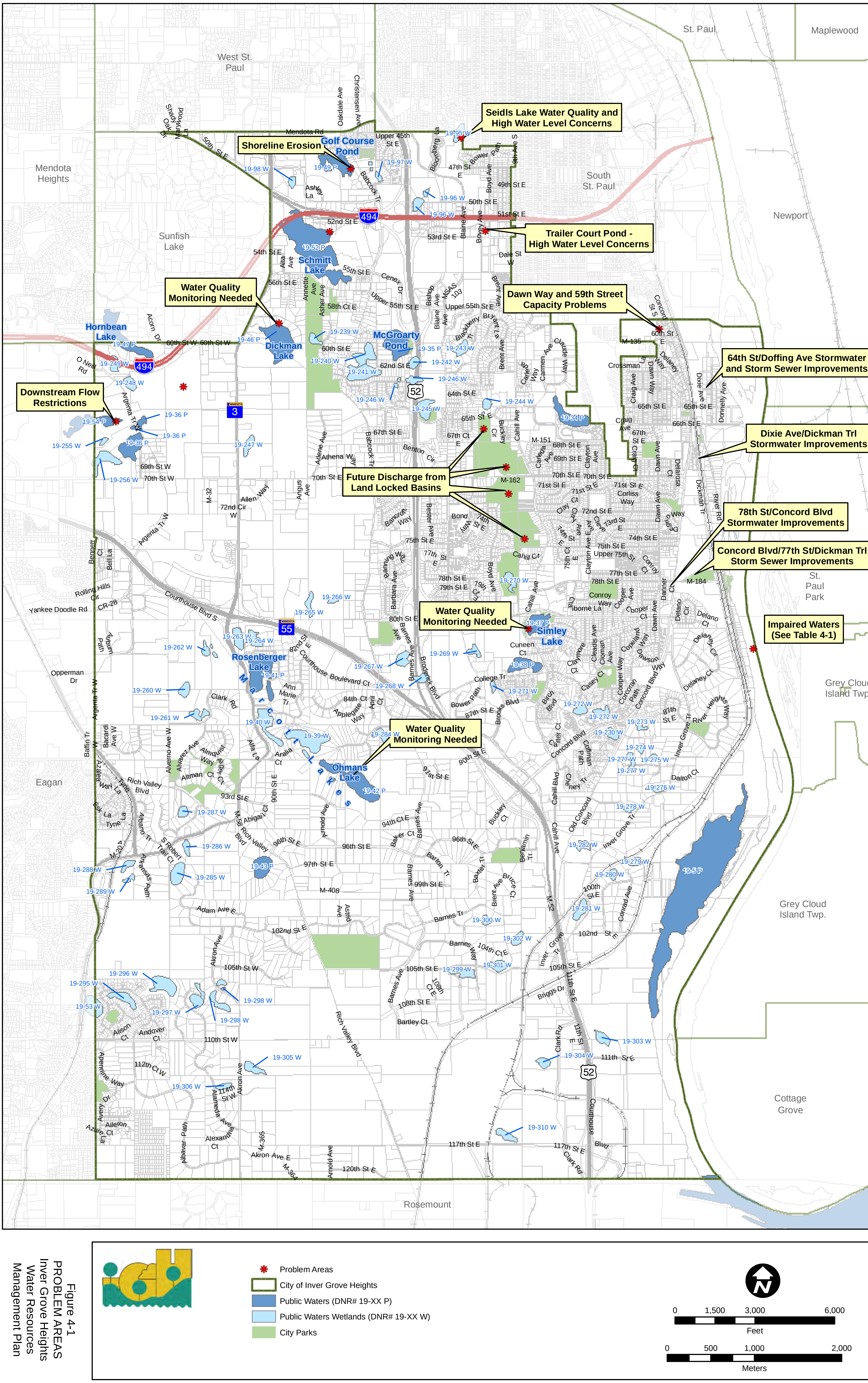
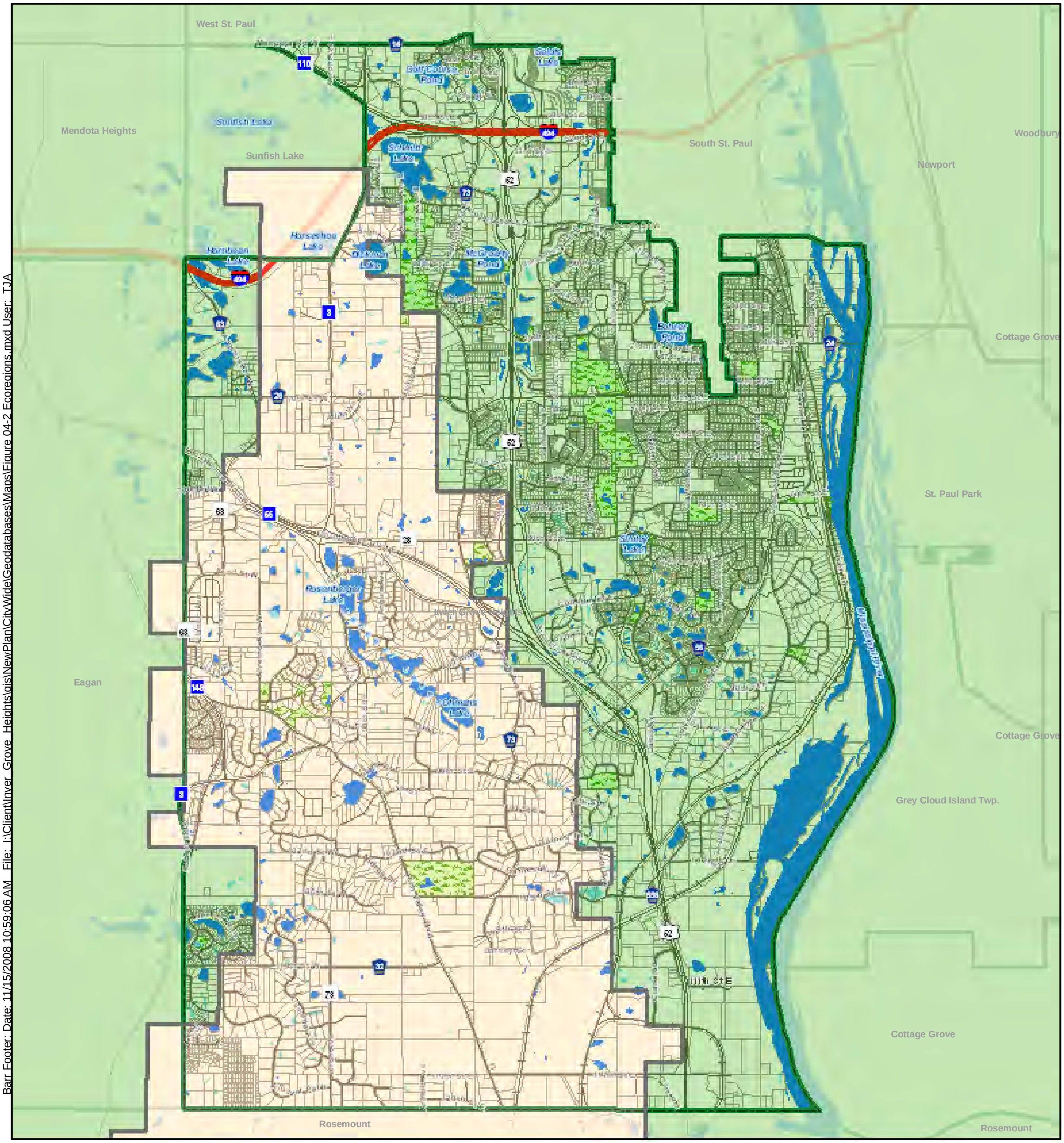


Figure 4-1
PROBLEM AREAS
Inver Grove Heights
Water Resources
Management Plan

Barr Footer: Date: 11/15/2008 10:59:06 AM File: I:\Client\Inver_Grove_Heights\gis\NewPlan\CityWide\Geodatabases\Maps\Figure 04-2 Ecoregions.mxd User: TJA



Ecoregions*

- North Central Hardwood Forest
- Western Corn Belt Plains
- City of Inver Grove Heights
- City Parks

*Source: Minnesota Pollution Control Agency

0 2,500 5,000 10,000
Feet

0 1,000 2,000
Meters

Figure 4-2
ECOREGIONS
Inver Grove Heights
Water Resources Management Plan

APPENDIX B

SWPPP Application for Reauthorization and MS4 General Permit

Minnesota Pollution Control Agency
520 Lafayette Road North | St. Paul, Minnesota 55155-4194 | 651-296-6300
800-657-3864 | 651-282-5332 TTY | www.pca.state.mn.us | Equal Opportunity Employer

March 17, 2014

Tom Kaldunski
City of Inver Grove Heights
8150 Barbara Ave
Inver Grove Heights, MN 55077

RE: Issuance of Coverage under the National Pollutant Discharge Elimination System/State Disposal System (NPDES/SDS) General Permit MNR040000 for Municipal Separate Storm Sewer Systems for City of Inver Grove Heights MS4

Dear Mr. Kaldunski:

In accordance with Minn. R. 7001.0140, the Commissioner of the Minnesota Pollution Control Agency (MPCA) has made a final determination to issue coverage under the National Pollutant Discharge Elimination System/State Disposal System (NPDES/SDS) General Permit MNR040000 for Municipal Separate Storm Sewer Systems (MS4 General Permit) to the City of Inver Grove Heights, effective March 17, 2014. Please find enclosed a copy of the above referenced MS4 General Permit.

The MPCA's final decision to issue permit coverage is based on the following:

- MPCA staff has reviewed your MS4 General Permit application and Stormwater Pollution Prevention Program (SWPPP) Document.
- Public notice and opportunity for comment on your MS4 General Permit application and SWPPP Document has been provided, and no comments were received.

As you know, it is the responsibility of the MS4 owner and/or operator to comply with the requirements of the MS4 General Permit and your SWPPP Document. This issuance of coverage does not preclude the MPCA from following up with an inspection or audit to verify compliance with the MS4 General Permit and SWPPP Document. Also, be aware that as a condition of recordkeeping, Part IV.C.3. of the MS4 General Permit requires that the permittee retain their SWPPP Document and all records pertinent to it for at least three (3) years beyond the term of the MS4 General Permit.

In addition, for an MS4 that was covered under the previous MS4 General Permit (issuance date June 1, 2006), coverage under that permit is terminated on the coverage date as specified above. An MS4 covered under the new MS4 General Permit is required to report on activities that were required or committed to under the previous permit.

Finally, the MPCA thanks you for your cooperation in the permitting process. Please retain this letter as documentation of your MS4 General Permit coverage under the NPDES/SDS Permit MNR040000.

Please contact MS4 team member Claudia Hochstein at 651-757-2881 with any questions.

Sincerely,

Duane Duncanson

This document has been electronically signed.

Duane Duncanson
Supervisor, Municipal Compliance Unit I
St. Paul Office
Municipal Division

cc: City of Inver Grove Heights MS4 File

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 Inver Grove Heights *County: Dakota
(city, county, municipality, government agency or other entity)

*Mailing address: 8150 Barbara Avenue

*City: Inver Grove Heights *State: MN *Zip code: 55077

*Phone (including area code): (651) 450-2500 *E-mail: tkaldunski@invergroveheights.org

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

*Last name: Kaldunski *First name: Thomas
(department head, MS4 coordinator, consultant, etc.)

*Title: City Engineer

*Mailing address: 8150 Barbara Avenue

*City: Inver Grove Heights *State: MN *Zip code: 55077

*Phone (including area code): (651) 450-2572 *E-mail: tkaldunski@invergroveheights.org

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

Last name: Kaldunski First name: Thomas
(department head, MS4 coordinator, consultant, etc.)

Title: City Engineer

Mailing address: 8150 Barbara Avenue

City: Inver Grove Heights State: MN Zip code: 55077

Phone (including area code): (651) 450-2572 E-mail: tkaldunski@invergroveheights.org

Verification

1. 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
2. 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: Thomas J. Kaldunski
(This document has been electronically signed)

Title: City Engineer Date (mm/dd/yyyy): 12/20/2013

Mailing address: 8150 Barbara Avenue

City: Inver Grove Heights State: MN Zip code: 55077

Phone (including area code): (651) 450-2572 E-mail: tkaldunski@invergroveheights.org

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.*

Inver Grove Heights has partnerships with non-regulated organizations to help develop some of our educational materials and provide training for our MS4 program.

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: Illicit Discharge Form (attached)

   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:

   Title 9, Chapter 5, Section 13: Illicit Connections and Discharges to the MS4

   Title 9, Chapter 4: Excavations and Fills

   Direct link:

   http://www.sterlingcodifiers.com/codebook/index.php?book_id=542

   ☐ 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: Checklist, Standard Plates, Inspections, Agreements with escrows and sureties

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:

Title 8, Water & Sewer Public Services:

Chapter 5: Subsurface Sewage Treatment Systems

Ttile 9, Building & Development:

Chapter 5: Stormwater Management, Section 1-12

Chapter 4: Excavations and Fills

Title 10, Zoning Regulations:

Chapters 3: Administration & Enforcement

Chapter 13: Special Use Districts

Chapter 15: Performance Standards

Direct link:

http://www.sterlingcodifiers.com/codebook/index.php?book_id=542

☐ 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:

The City will update regulatory mechanisms to meet or exceed the requirements of MPCA permit to Discharge Stormwater Associated with Construction Activity within 12 months of the date permit coverage is extended.

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. ☒ Yes ☐ No
2. BMPs to minimize the discharge of sediment and other pollutants. ☒ Yes ☐ No
3. BMPs for dewatering activities. ☐ Yes ☒ No
4. Site inspections and records of rainfall events ☒ Yes ☐ No
5. BMP maintenance ☒ Yes ☐ No
6. Management of solid and hazardous wastes on each project site. ☐ Yes ☒ 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. ☒ Yes ☐ No
8. Criteria for the use of temporary sediment basins. ☐ 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 will review ordinances to ensure they meet the new construction general permit requirements within 12 months of the date permit coverage is extended .

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: 2008 Northwest Area Stormwater Manual, 2006 2nd Generation Water Resources Management Plan, 2011 LMRWMO Watershed Management Plan, 2007 GCLWMO Watershed Management Plan, Storm Water Facilities Maintenance Agreements requesting private facilities annual reporting on storm water facilities

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:

Ttile 9, Chapter 5 Stormwater Management, Section 1-12

Title 9, Chapter 4: Excavations and Fills

Direct link:

http://www.sterlingcodifiers.com/codebook/index.php?book_id=542

☐ 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, sufficient to provide a functioning treatment system and prevent adverse impacts to groundwater, when the infiltration device will be constructed in areas: ☐ Yes ☒ No

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:

Related ordinances will be evaluated and updated to meet the requirements within 12 months of date permit coverage is extended.

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:

   ERPs will be established or updated to meet the Permit requirements within 12 months the date permit coverage is extended.

B. Describe your ERPs:

The City has an NPDES Inspection Form, Erosion and Sediment Control Inspection Report, and a Notice of Erosion Control Requirement for Construction that staff uses to enforce the NPDES and MS4 program

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

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

The Engineering Staff inspects an average of 20% of the storm system annualy with handheld GPS unit, Engineering Staff asbuilt new storm systems, Engineering Staff send storm system updates to IT Division for mapping, IT Division annually maps storm system in GIS with asbuilt attachements

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:

The City has a partial inventory on the existing basins in the community. The inventory will be updated to meet new *perimit requirements within 12 months of the date permit coverage is extended.*

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**:

   Our community is a mix of residential, commercial, and industrial properties. Our primary focus in the past has been on residential issues, though we do not have specific high-priority topics. We partner with Dakota County Soil and Water Conservation District and the Lower Mississippi River Watershed to provide education to our residents. They provide us with information on topics that we mail out to all households twice a year. These topics remind home owners of proper practices for such activities as raking grass clippings, cleaning up pet waste, and home car washing. We also remind residents and businesses periodically of the importance of the illicit discharge program, protection of drainage ponds, the NPDES system, Coal Tar restrictions per ordinance, and the City's SWPPP. Updates on our website are used to communicate stormwater-related messages.

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/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
Brochures	Update NPDES/MS4/SWPPP related brochures available for public handout within 12 months the date permit coverage is extended.
Newsletter Articles	Place a minimum of two NPDES/MS4/SWPPP public education related articles in the City's Insights newsletter.
Public Outreach	Continue annual joint powers agreement with Dakota County Soil and Water Conservation District to educate the public with through the DCSWCD Blue Thumb Program
Public Outreach	Continue annual joint powers agreement with Dakota County Soil and Water Conservation District to educate the public through the City's Raingarden Program in relation to appropriate public improvement projects

BMP categories to be implemented	Measurable goals and timeframes
Website	The City will update the website to meet permit requirements within 12 months the date permit coverage is extended

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

   City Engineer or Consultant

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:

   Annually we notice, present and hear comments on our annual SWPPP update at a stand alone meeting held at City Hall. This typically occurs around May/June.

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**
Annual Meeting	Annually hold a meeting for soliciting public comment to the Cities SWPPP.
Public Notice	Publish the notice of Annual Meeting soliciting public comment in the City's newsletter, local paper, and City website.
Website Complaint System	Maintain a web-based online system allowing citizens and businesses to notify City of issues related to storm water or illicit discharge. The City's goal is to respond to the inquiry within 48-hours.

BMP categories to be implemented	**Measurable goals and timeframes**
SWPPP Document kept on Website	Provide an updated copy of the City's SWPPP online within 12 months the date permit coverage is extended.

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:

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

   City Engineer and Administration

C. MCM 3: Illicit discharge detection and elimination

1. 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 has an ordinance that prohibits illicit discharges and connections. City Staff and public works employees are trained to look for any signs of illicit discharge while on the job. The City has unwritten procedures to review the IDDE *complaint, a Form document the IDDE activity, conduct Inspections , follow-up and enforce the IDDE code.*

2. 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:

Related ordinances and procedures (ERPs and SOPs) will be evaluated and updated to meet the requirements within 12 months the date permit coverage is extended

C.2.d The City will review and update written procedures for identification of priority areas likely to have illicit discharges as described in the permit (Part III.D.3.f). Procedures will be in place within 12 months following the date permit coverage is extended.

C.2.e The City will review and update written procedures for timely response to known, suspected, and reported illicit discharges as described in the permit (Part III.D.3.g). Procedures will be in place within 12 months following the date permit coverage is extended.

C.2.f The City will review and update written procedures for investigating, locating and eliminating the source of illicit discharges as described in the permit (Part III.D.3.f). Procedures will be in place within 12 months following the date permit coverage is extended.

C.2.h The City will review and update procedures for using ERPs for eliminating the illicit discharges and needed corrective actions as described in the permit (Part III.D.3.g). Procedures will be in place within 12 months following the date permit coverage is extended.

3. 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
Ordinance	Review Ordinance yearly to ensure that it continues to meet the needs of the City and legal requirements
Training	Annually conduct an educational seminar to educate the Public

	and City Employees about the hazards associated with illicit discharges. Invite one member of the City Council, or other regulatory agency to attend.

BMP categories to be implemented	**Measurable goals and timeframes**
Illicit Discharge Detection and Elimination (IDDE) Program	Review annually the illicit discharge written procedures for detection, response and reporting. Utilize the IDDE program as described in the Permit (Part III.3.h) to make adjustments to written procedures as necessary.
Inspections	Annually inspect locations identified as high-priority outfalls and around high-risk establishments (fast food restaurants, dumpster, car washes, mechanics, oil changes)
Illicit Discharge Investigation	As needed hire a consultant to televise a section of our sewer system, collect grab samples or perform other effective testing procedures to find illicit connection in the system.
Community Reporting Options and Documentation Procedures	IT department will update request system on City webpage to include a link to report Illicit Discharges. This will allow the City to receive, documents, and respond to citizen reports of illicit discharges. Within 12 months.

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:

   Related ordinances and procedures (ERPs and SOPs) will be evaluated and updated to meet the requirements within 12 months of 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:

   City Engineer

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 review of construction site erosion and sediment control(ESC) plans before projects begin, and work with contractors to ensure appropriate and correct use of erosion and sediment control BMPs on sites. The Engineering Division primarily checks for compliance with construction site ESC plans. Other departments assist in reporting IDDE, erosion and sediment control infractions. The City has unwritten policies to review erosion and sediment control plans, provide SWPPPs for projects disturbing over 1-acre, a City Engineer approved plan is necessary prior to issuance of building permit, a preconstruction meeting must be held prior to site disturbance,

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 ☐ Yes ☒ No

conducting construction site inspections?

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.

D.2.a The City uses a City checklist for site plan reviews but does not have any established written procedures. The City will develop written procedures for site plan reviews as described in the Permit (Part III.D.4.b). Procedures will be in places within 12 months of the date permit coverage is extended.

D.2.b The City will include a notification to owners and operators proposing construction activity to apply for and obtain coverage under the MPCA's construction activity permit into the written procedures for (D.2.a) as described in the Permit (Part III.D.4.b). Notification will be included in the procedures within 12 months of the date permit coverage is extended.

D.2.c The City will develop written procedures for receipt and consideration of reports of noncompliance or other stormwater related information on construction activity submitted by the public as describedin the permit (Part III.D.4.b). Notification will be included in the procedures within 12 months of the date permit coverage is extended.

D.2.d The City currently documents ESC inspections and notices of violations utilizing City forms. The City will develop written procedures for conducting site ESC inspections as describedin the permit (Part III.D.4.b). Forms will be updated and written procedures will be in place within 12 months following the date permit coverage is extended.

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
Site Plan Review	City Engineering Staff utilizes a checklist for review of NPDES Erosion Control Permits submitted to the department for review. On going.
Erosion Protection Maintenance Memo to Builders	An erosion control handout, which explains how to properly install erosion control BMPs, is provided with the issuance of a building permit. On going.

BMP categories to be implemented	Measurable goals and timeframes
Permit Update	Update the City's grading, land alteration, building, and ROW permits and construction site stormwater runoff ordinance to meet MPCA General Permit to discharge stormwater associated with construction activity within 12 months of the date permit coverage is extended.
Checklist for site plan review	Update procedures for site plan review annually and incorporate changes into the review process within 12 months of the date permit coverage is extended
Prioritize Inspections	Ensure at least 10% of inspections conducted annually are performed at sites deemed as high priority inspection sites (e.g. near sensitive receiving waters, projects larger than 5 acres). Inspection procedures will be evaluated for the first year of the permit cycle and changes will be implemented within 24 months of the date permit coverage is extended.

Permit Application System	Develop written procedures to track and archive all plan review and inspection documents within 12 months of the date permit coverage is extended.

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

   City Engineer and Engineering Staff

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:

   The City has post-constuction stormwater management ordinance to encourage the utilization of BMPs for stormwater runoff from new and redevelopment projects, as well as to ensure the maintenance and operation of the stormwater BMPs. The City has unwritten policies to review plans for meeting permanent turf establishement requirements, post stormwater ordinance, and comprehensive plans. A set of City Engineer approved plans meeting post storm water requirements with a executed stormwater agreement is required prior to issuance of building permit. An operation and maintenance plan and annual recording requirement is included in all stormwater agreements to ensure proper operation and maintenance of post stormwater facilities.

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.2 The City uses a checklist for site plan reviews but does not have any established written procedures. The City will develop written procedures for site plan reviews as described in the Permit (Part III.D.5.b). Procedures will be in places within 12 months of the date permit coverage is extended.

   E.3 The City will review or create written procedures for documentation of post-construction stormwater management as described in the Permit (Part III.D.5.c). Procedures will be in places within 12 months of 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
Site Plan Review	Completed plan review process and documentation procedures for sites qualifying as a land disturbance in accordance with the City Ordinance. Annually.
Encourage the use of structural and non-structural BMPs during review of new and redevelopment projects	Implement Stormwater retention/detention ponds as a BMP immediately in areas where it is appropriate. Developers encouraged to install stormwater facilities meeting the infiltration requirements. Incorporate implementing sand and organic filters into plan

	review process. Annually per development review.
Stormwater retention/detention	Implement stormwater retention/detention ponds as a BMP immediately in areas where it is appropriate. Annually per development review.
Stabilization Seeding	Document violations of seeding provisions and types of enforcement actions. Per incident.
Outlet Structure stabilization	Document number of structures stabilized. Annually.
Land Development Ordinance	Complete ordinance including illicit discharges, erosion and sediment control at construction sites, and post construction runoff from new development and redevelopment. To be updated within 12 months of the date permit coverage is extended.
Inspections to verify proper maintenance of stormwater BMPs	On average complete around 20% of inspections for City maintained BMPs. Annually, 100% within the 5-year permit cycle.

BMP categories to be implemented	**Measurable goals and timeframes**
Update ordinance to meet new permit requirements	Within 12 months of the date permit coverage is extended, revise ordinance to meet permit requirements
Develop written procedures for site plan review	Within 12 months of the date permit coverage is extended, develop site plan review procedures that must be completed prior to the start of construction activity
Document Pertinent Project Information	Maintain all related documents pertaining to each new or redeployment project in more user-friendly filing system for better records management. Implement *within 12 months of the date permit coverage is extended.*
BMP Construction Guidance	Develop BMP construction guidance document for developers and contractors within 12 months of the date permit coverage is extended
Storm Water Pollution Prevention Plan	Complete review and updates to SWPPP for IGH within 12 months of 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:

   Director of Public Works, City Engineer or Engineering Staff

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 currently inspects its structural pollution control devices on a regular basis and inspects all of its outfalls, sediment basins, and ponds every 5 years. The City inspects stockpiles, storage, and material handling areas at the maintenance yard for potential discharges and maintenance BMPs. The city is evaluating the use of road salt for winter road maintenance activities to reduce chlorides entering our water resources. The City sweeps streets once in the fall after leaf drop and once in the spring. Maintenance staff is trained annually on various topics related to pollution prevention during maintenance activities..

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:

   Facilities inventory will be created in the next 12 months and added as an appendix to the City's SWPPP document.

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**
Park and Open Space Training Program	Training focused on fertilizer application, pesticide/herbicide application, and mowing discharge. Annually.
Fleet and Building Maintenance Training Program	Training focused on automotive maintenance program (automotive inspections and washing), spill cleanup training, hazardous materials training, building leak prevention and inspection training. Annually.
Stormwater Systems Maintenance Training Program	Training focused on parking lot and street cleaning, storm drain systems cleaning, road salt materials management. Annually.
Parking Lots & Street Cleaning	Train Employees and document number of times each street is swept annually. Goal is sweep 2 times per year. Training to occur Annually.
Storm Drain Cleaning System	Document Number of Sumps cleaned per year.
Road Salt Materials Management Program	Document amount of salt applied each year and train employees in road salt management and application methods. Goal is 3 empoyees trained annually.
Storm Sewer Inspection Program	Average Annual inspection of 20% of completed City-Owned BMPs Annual inspection of 100% of pollution control devices.
Evaluate Inspection Frequency	Evaluate inspection records and determine if inspection frequency needs to increase or decrease.

BMP categories to be implemented	**Measurable goals and timeframes**
Develop Spill Prevention & Control Plans for Municipal Facilities	Develop plans describing spill prevention and control procedures by the end of the Year 1. Conduct annual spill prevention and response training sessions to all municipal employees. Distribute education materials, i.e. posters and pamphlets to each municipal facility by the end of year 2.
Increase Inspection Frequency of Maintenance Yard	Once weekly and after all rain events utilizing a checklist for the inspection that documents findings and allows staff to compare to previous inspections. Frequenscy of inspection will be evaluated after year 1.
Facility Inventory	Continue lot develop facilities inventory to include potential pollutants. Create a map of all indentified facilities Within 12 months of the date permit coverage is extended
Pond Assessment Procedures & Schedule	In year 1, develop procedures for determining TSS and TP treatment effectiveness of City owned ponds used for treatment of stormwater. Implement schedule in year 2-5.

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:

F.6. The City will evaluate and develop a precedure for assesseing ponds to determine TSS and TP effectiveness as described in the Permit (Part III.D.6.d) This study will develop procedures for determining TSS and tP treatment effectiveness of City-owned ponds used for treatment of stormwater. A schedule will be implemented in years 2 through 5.

F.7. The City will evaluate and develop written procedures for inspection of structural stormwater BMP's, ponds, outfalls, stockpiles, and storage & material handling areas as described in the Permit (Part III.D.6.f). Procedures will be in places within 12 months of the date permit coverage is extended.

F.8. The City will evaluate, develop and implement a stormwater management training program commensurate with each employee's job duties as described in the Permit (Part III.D.6.g). Procedures will be in places within 12 months of the date permit coverage is extended.

F.9. The City will evaluate and develop written procedures to document inspections, maintenance, and training as described in the Permit (Part III.D.6.h). Procedures will be in places within 12 months of the date permit coverage is extended.

F.10 The City is conducting a wellhead protection study. The City will address any MS4 permit issues related to wellhead protection areas within 12 months of the completion of the study.

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

City Engineer

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

Attached is draft BMP Table for the City of IGH. The City will update the BMP table of storm water facilities within 12 months of the date permit coverage is extended.

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.

*Attach this completed form with your SWPPP Document at the time of submittal. At a **minimum,** provide all of the information "*" items (TMDL Project Name, Type of WLA, Numeric WLA, Unit, Flow Condition, and Pollutant of Concern).*

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
Inver Grove Heights City	MS400096	Fish Lake Nutrient TMDL	19-0057-00	Individual	0.003	lbs/day		N/A	Fish Lake	Phosphorus	9/9/2010
Inver Grove Heights City	MS400096	Lower Mississippi River Basin Fecal Coliform Bacteria TMDL	07040001-507	Categorical	5.99	10^12 organisms/month		High	Vermillion River; Below trout stream portion to South Br. Vermillion River	Fecal Coliform	4/5/2006
Inver Grove Heights City	MS400096	Lower Mississippi River Basin Fecal Coliform Bacteria TMDL	07040001-507	Categorical	1.57	10^12 organisms/month		Moist	Vermillion River; Below trout stream portion to South Br. Vermillion River	Fecal Coliform	4/5/2006
Inver Grove Heights City	MS400096	Lower Mississippi River Basin Fecal Coliform Bacteria TMDL	07040001-507	Categorical	0.36	10^12 organisms/month		Mid-Range	Vermillion River; Below trout stream portion to South Br. Vermillion River	Fecal Coliform	4/5/2006
Inver Grove Heights City	MS400096	Lower Mississippi River Basin Fecal Coliform Bacteria TMDL	07040001-507	Categorical	**	10^12 organisms/month		Dry	Vermillion River; Below trout stream portion to South Br. Vermillion River	Fecal Coliform	4/5/2006
Inver Grove Heights City	MS400096	Lower Mississippi River Basin Fecal Coliform Bacteria TMDL	07040001-507	Categorical	**	10^12 organisms/month		Low	Vermillion River; Below trout stream portion to South Br. Vermillion River	Fecal Coliform	4/5/2006
Inver Grove Heights City	MS400096	Lower Mississippi River Basin Fecal Coliform Bacteria TMDL	07040001-506	Categorical	8.62	10^12 organisms/month		High	Vermillion River; South Br. Vermillion River to the Hastings Dam	Fecal Coliform	4/5/2006
Inver Grove Heights City	MS400096	Lower Mississippi River Basin Fecal Coliform Bacteria TMDL	07040001-506	Categorical	3.09	10^12 organisms/month		Moist	Vermillion River; South Br. Vermillion River to the Hastings Dam	Fecal Coliform	4/5/2006
Inver Grove Heights City	MS400096	Lower Mississippi River Basin Fecal Coliform Bacteria TMDL	07040001-506	Categorical	1.57	10^12 organisms/month		Mid-Range	Vermillion River; South Br. Vermillion River to the Hastings Dam	Fecal Coliform	4/5/2006
Inver Grove Heights City	MS400096	Lower Mississippi River Basin Fecal Coliform Bacteria TMDL	07040001-506	Categorical	0.30	10^12 organisms/month		Dry	Vermillion River; South Br. Vermillion River to the Hastings Dam	Fecal Coliform	4/5/2006
Inver Grove Heights City	MS400096	Lower Mississippi River Basin Fecal Coliform Bacteria TMDL	07040001-506	Categorical	**	10^12 organisms/month		Low	Vermillion River; South Br. Vermillion River to the Hastings Dam	Fecal Coliform	4/5/2006

Compliance Schedule PART II.D.6.f.-g.

Is your MS4 currently meeting its WLA for any approved TMDLs?

- ☐ **NO** (Complete Table 1, Strategies for continued BMP implementation beyond the term of this permit, and Table 2 below)
- ☑ **YES** (Provide the following information below)

Go to: Table 1 **Go to:** Strategies… **Go to:** Table 2

If YES, indicate the WLAs (may be grouped by TMDL Project) you believe are reasonably being met. For each WLA, list the implemented BMPs and provide a narrative strategy for the long-term continuation of meeting each WLA. PART II.D.6.g.(1)-(2)

Fish Lake Nutrient TMDL:

The City of IGH is meeting the wasteload allocation. The City of IGH, MS400096, is not contributing to the impairment of Fish Lake due to our land locked basins and restricted flow of 1 cfs to the Fish Lake drainage basin.

Lower Mississippi River Basin Fecal Coliform Bacteria TMDL:

The City of IGH is meeting the wasteload allocation. The City of IGH, MS400096, is not contributing to the impairment of the Lower Mississippi River Basin Fecal Coliform Bacteria TMDL related to the Vermillion River drainage basin due to IGH's land locked basins and restricted flows to Rosemount that do not reach the Vermillion River several miles south of IGH.