City of Willmar
Watershed Management Plan

August 2012

Prepared for the City of Willmar
by Barr Engineering Company

Watershed Management Plan

Prepared for the
City of Willmar

Adopted by
City of Willmar City Council
July 2, 2012

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.

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Reg. No 19252 Date August 10, 2012

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City of Willmar

Watershed Management Plan

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1.0 Executive Summary

1.1 Purpose and Scope

The *City of Willmar Watershed Management Plan* (Plan) is intended to guide the use, development, maintenance, and restoration of surface water resources within the City of Willmar and the surrounding watersheds. Prior to the development of this Plan, several planning documents have guided the city's water resource management needs, including the following:

- *City of Willmar Watershed Management Plan, Draft (1998)*
- *City of Willmar Stormwater Management Ordinance (Ordinance No. 1227) (1999, revised 2005)*
- *City of Willmar Comprehensive Plan (2009)*

This Plan replaces the Draft 1998 Plan. This Plan sets the course for the city's management of the water resources in the city and is intended to provide a comprehensive tool that the city may use to meet the following needs:

- Analyze and improve the current stormwater management system
- Meet current and future water quality requirements
- Plan for growth, including development and redevelopment
- Incorporate the city's NPDES Phase II MS4 Permit and SWPPP

The Plan sets goals and policies for the city and its resources, provides data and other background information, assesses city-wide and specific issues, and lists implementation tasks to achieve the goals. The Plan also provides information regarding the funding of the implementation program.

1.2 Regulatory Background and History

This Plan outlines water resource regulations and management strategy within the City of Willmar. To that end, this Plan complies with existing city ordinances, codes, and standards. This Plan also reflects the local, state, and federal regulations and programs to which the City of Willmar must adhere. State and federal laws have changed over the years, as has the role of the city in water resource management. A history of applicable state and federal mandates related to stormwater management is presented in **Appendix A**. A history of relevant city regulations is presented as a timeline shown in **Figure 1-1**.

1.3 Plan Content and Organization

The Plan sets the course for the city's management of the water resources and stormwater within the city. The Plan sets goals and policies for the city and its resources, provides

data and other background information, outlines the applicable regulations, assesses city-wide and specific issues, and lists implementation tasks to achieve goals. The Plan also provides information regarding the funding of the implementation program.

The text of the Plan is organized into eight major sections and two appendices, summarized as follows:

Section 1	**Executive Summary**
Section 2	**Goals and Policies**
Section 3	**Physical Environment Inventory**
Section 4	**Stormwater System Analysis**
Section 5	**Programs and Regulations**
Section 6	**Assessment of Issues and Opportunities**
Section 7	**Implementation Program**
Section 8	**References**
Appendix A	**Background Information**
Appendix B	**Additional Issues and Opportunities**

The Plan includes additional appendices containing reference material. These appendices are included after Appendix B.

1.3.1 Section 1 - Executive Summary

The Executive Summary provides information regarding the purpose and intent of the Plan and local regulatory history, and summarizes the highlights of the Plan, including the Plan purpose and scope, goals, policies, and implementation tasks.

1.3.2 Section 2 – Goals and Policies

This section presents the city's water resource vision in the form of its goals and policies. Goals and policies are included for the following subject areas:

- Water Quality
- Water Quantity and Flooding
- Wetlands
- Groundwater
- Erosion and Sedimentation
- Recreation, Habitat and Shoreland Management

- Land Use Management
- Education and Public Involvement
- Financing

1.3.3 Section 3 – Physical Environment

The Willmar Physical Environment section provides technical information describing the surface and subsurface conditions of the city. Most of this section presents an inventory, including land use, climate and precipitation, topography, soils, geology, groundwater, Minnesota Department of Natural Resources (MDNR) public waters, wetlands, water quality information, and major basins and overall drainage patterns. Additional physical environment information is included in **Appendix A, Background Information**, including water quality data, recreational areas, and habitat resources. This inventory includes the areas within Willmar's municipal boundary as well as the four watersheds that include the City of Willmar. This section also includes a number of maps, such as maps of land use, MDNR public waters, wetlands, and drainage basins, and maps showing the drainage patterns for each major drainage basin.

1.3.4 Section 4 – Stormwater System Analysis

This section presents recent hydrologic/hydraulic modeling and water quality (P8) modeling performed within the city and surrounding watersheds. This section describes the modeling process and presents results in tables included at the end of the section. Hydrologic/hydraulic modeling results include high-water elevations and peak runoff rates for subwatersheds within and around the city. Inundation areas identified in the modeling are shown on figures included in **Section 3**. Specific flooding issues identified by modeling are discussed in **Section 6**, Assessment of Issues and Opportunities. Water quality modeling results include phosphorus loadings from subwatersheds and percent phosphorus removal in stormwater detention ponds; these results are included in tables at the end of **Section 4**.

1.3.5 Section 5 – Programs and Regulations

The existing city programs and regulations which govern the management of water resources within the city are described in this section. This section also describes those local and state programs in which the city must participate. Summary and discussion of the following regulatory topics include:

- City of Willmar Regulatory Controls
    - Stormwater Management Ordinance

- Erosion and Sediment Control
- Wetland Management
- Floodplain Management
- Shoreland Management

- Regulatory Programs Affecting the City
  - Water Quality/NPDES Phase II MS4 Permit
  - Storm Water Pollution Prevention Program (SWPPP)
  - Total Maximum Daily Load (TMDL) Allocations
- Other Agency Responsibilities

This section summarizes the requirements and approval process for new development and redevelopment within the city. This section also identifies other local, state, and federal standards applicable to projects within the city and surrounding watersheds.

1.3.6 Section 6 – Assessment of Issues and Opportunities

This section presents a summary of the general and specific water resource-related issues, problems, and challenges facing the City of Willmar. These issues are summarized in **Table 1-1** and include water quality, stormwater runoff rate and volume, and erosion and sedimentation issues. **Section 6** also summarizes opportunities available to the city to address these issues. This section discusses the adequacy of the city's ordinances and official controls, education and public involvement program, and stormwater system maintenance program to address these issues. Additional information regarding issues and opportunities is provided in **Appendix B**.

1.3.7 Section 7 – Implementation Program

This section of the Plan describes the significant components of the city's implementation program, including its NPDES Phase II MS4 permit, operation and maintenance of its stormwater system, education and public involvement, funding, ordinance implementation and official controls, implementation priorities, studies, and construction projects. Implementation tables are included at the end of the section, providing planning level cost estimates, funding sources, and proposed years for task implementation.

1.3.8 Section 8 – References

Section 8 lists the documents and other references used in the preparation of the Plan.

1.3.9 Appendix A – Background Information

This section describes location and history of Willmar and a brief history of stormwater regulation in Minnesota. This section also includes additional, detailed information regarding several of the topics included in **Section 3** (Physical Environment), including a list of major stormwater ponding areas located in each of the city's four watersheds. This section also includes a technical discussion of the hydrologic/hydraulic modeling presented in **Section 4** (Stormwater System Analysis).

1.3.10 Appendix B – Additional Issues and Opportunities

This section provides greater detail regarding the regulatory and environmental issues facing the City of Willmar. This section includes discussion of water quality issues such as impaired waters downstream of Willmar and the surrounding watersheds and groundwater protection. This section also discusses the roles and responsibilities of other local, state, and federal agencies. A list of additional funding sources available to the city is also presented.

Table 1-1 Summary of Stormwater Issues Applicable to the City of Willmar

Category	Issue
NPDES Stormwater Pollution Prevention Program (SWPPP)	• Public education & outreach
	• Public participation
	• Illicit discharge detection and elimination
	• Construction site runoff control
	• Post construction stormwater management
	• Pollution prevention/housekeeping
	• Determination of adequacy of the city's SWPPP to meet requirements of US EPA TMDL implementation plans
	• Evaluation of infiltration within wellhead protection areas
Impaired Waters	• Eagle Lake (mercury TMDL approved in 2008)
	• Hawk Creek
	• Lake Wakanda
	• Kasota Lake
	• Little Kandiyohi Lake
	• South Fork of the Crow River
	• Minnesota River, Mississippi River, and other downstream water bodies
	• TMDL development and implementation

Category	Issue
General Stormwater Management	• Reduce stormwater volume
	• Increase stormwater quality
	• Maximize infiltration
	• Wetland management
	• Erosion and sedimentation
	• Groundwater protection
Kandiyohi County Issues	• Phosphorus loading to lakes and streams
	• Pollution hazards from failing SSTS
	• Invasive aquatic species
	• Public education
City Issues	• Public awareness about water resources in the city and appropriate stewardship is limited
	• Updated floodplain mapping and floodplain regulation
	• Shoreland management
	• Stormwater management in developing areas
	• Groundwater infiltration and wellhead protection
	• Specific erosion and sedimentation control issues
	• Preservation of natural areas
	• Evaluate current stormwater system and address localized areas of inadequate storm sewer capacity
	• Implementation of future TMDL requirements
	• Local flooding issues
	• Stormwater system maintenance

Section 2: Goals and Policies

City of Willmar Watershed Management Plan

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2.0 Goals and Policies

2.1 Introduction

This section outlines the goals that form the basis for stormwater management within the City of Willmar and those regional watersheds which encompass the city. These watersheds include two drainage basins: the Hawk Creek basin and the Southeast Willmar basin (see **Section 3.5**). The Hawk Creek drainage basin is further subdivided into the Hawk Creek watershed and the Foot Lake watershed (see **Figure 3-6**). The Southeast Willmar basin is divided into the Southeast Willmar watershed and the Lake Wakanda watershed (see **Figure 3-6**). Goals are defined for surface water quality, surface water quantity, groundwater, wetlands and habitat, floodplains, open space and recreational areas, land use management, education, and funding. The policies intended to accomplish these goals are presented in the following section.

The City of Willmar's primary reasons for developing this Plan were to:

- Provide a comprehensive guidance document for the management of water resources within the city and adjacent watersheds
- Identify and address drainage issues within the city
- Analyze the current stormwater system to identify areas in need of upgrading (e.g. updated hydrologic/hydraulic modeling)
- Incorporate current water quality needs or requirements
- Update the previous draft watershed management plan to incorporate the City's NPDES Phase II MS4 Permit and SWPPP
- Reflect changes in land use and plan for additional growth and the potential for redevelopment

The goals and policies contained in this plan address the problems and issues presented in **Section 6**. The goals and policies presented here that may be applicable to areas outside the city's municipal boundary are intended to be consistent with the goals presented in the Kandiyohi County Comprehensive Local Water Plan. The Kandiyohi County Comprehensive Local Water Plan seeks to provide for future development and redevelopment, while minimizing negative impacts to surface water and enhancing the environment.

This Plan identifies several specific goals upon which the city bases its water resources planning and management functions. Each goal has several corresponding policies that provide the means for achieving the established goal.

2.2 Water Quality

2.2.1 Goal

Maintain or improve the water quality of lakes, wetlands, watercourses, and the quality of water leaving detention basins within the City of Willmar and adjacent watersheds necessary to support designated beneficial uses, and improve the quality of surface water discharged to water bodies downstream of the City of Willmar (per Lower Minnesota River Dissolved Oxygen TMDL and future TMDL requirements).

2.2.2 Policies

1. The city may modify its review, permitting, and enforcement processes for construction activities within its jurisdiction as necessary to ensure that water quality requirements are met.

2. The city will continue to implement all aspects of its NPDES Phase II MS4 permit Stormwater Pollution Prevention Program (SWPPP).

3. The city will require development and redevelopment to comply with the conditions and policies presented in the city's SWPPP and Stormwater Management Ordinance.

4. The city will promote water management policies and programs to preserve the quality and maintain the beneficial uses of all lakes, ponds, streams, and other water resources in the community and surrounding environment.

5. The city will preserve and increase, where feasible, the ability of the city's stormwater system to provide water quality treatment.

6. The city will cooperate with the counties, townships, and adjacent landowners outside the city's jurisdiction to encourage pollutant reduction.

7. The city will resolve water quality issues through cooperation and collaboration with the adjoining township and other appropriate public entities.

8. The city will assist the efforts of Kandiyohi County, the MPCA, or other entities in their performance of water quality monitoring in the city.

9. The city will continue to use water quality modeling results to identify areas that require monitoring or additional treatment.

10. The city will participate in the TMDL study process; the city will determine if any changes to the city's stormwater system or best management practices (BMPs) are needed to minimize impacts to impaired waters and will comply with permit requirements resulting from approved TMDLs (e.g. Lower Minnesota River Dissolved Oxygen TMDL and future TMDLs).

11. The city will provide or require an appropriate level of stormwater treatment upstream of wetlands and meet the requirements of the Wetland Conservation Act.

12. The city will use or require the use of appropriate best management practices (BMPs) to improve water quality by removing sediment and nutrients from runoff.

13. The city will promote groundwater infiltration practices where soil conditions allow and infiltration is not detrimental to the quality of groundwater resources, especially within its wellhead protection area.

14. The city will consider innovative methods for water quality treatment.

15. The city will require that the design, testing, installation, and maintenance of erosion and sediment control operations and facilities meet the standards and specifications given in the Minnesota Pollution Control Agency's *Protecting Water Quality in Urban Areas*, as amended.

16. The city will promote water quality improvement through the public education elements of the city's SWPPP, which addresses water quality topics such as groundwater protection, illicit discharge, lawn fertilizer and household hazardous waste.

17. The city will consider requiring that all development or redevelopment plans that incorporate water quality elements include a detailed city-approved maintenance plan which conforms to city, county, and state standards and criteria.

18. The city will design stormwater facility inlets to minimize debris from entering the conveyance system and impeding the flow path; the city will reduce disposal of debris and other detrimental materials into the stormwater system through public education.

19. The city will design outlet control structures, wherever practical, to restrict both high and low flows, to maximize sedimentation and nutrient removal.

2.3 Water Quantity and Flooding

2.3.1 Goal

Preserve, maintain, and improve the city's stormwater storage and detention systems to control excessive volumes and rates of runoff, control flooding, protect public health and safety, and prevent the inundation of occupied structures.

2.3.2 Policies

1. The city will preserve and increase, where feasible, the storage capacity of the existing stormwater system.

2. The city will seek opportunities to incorporate runoff control, infiltration, and other best management practices into infrastructure and redevelopment projects as a means to improve stormwater management in developed areas.

3. The city will continue to require projects falling under its jurisdiction to comply with the city's Stormwater Management Ordinance.

4. The city will require the following stormwater runoff management practices on development and redevelopment sites: infiltration or filtration, flow attenuation using vegetated swales and natural depressions, stormwater retention facilities, and stormwater extended detention facilities.

5. The city may use on-site or regional stormwater detention to reduce flooding, control discharge rates, and provide necessary storage volumes.

6. The city will promote stormwater infiltration to reduce runoff volumes in areas where soil conditions allow and it is not detrimental to groundwater resources. In areas where infiltration is not feasible, the city will promote filtration.

7. The city will promote increased greenspace, native vegetation, and other infiltration measures wherever practical and appropriate to allow for the infiltration of stormwater runoff.

8. The city will require emergency overflow structures of waterbodies (i.e. swales, spillways, or other secondary outlets) to be constructed to safely convey the 100-year peak discharge downstream and away from buildings in the event of a plugged outlet or events larger than the 100-year critical storm event.

9. The city will develop and implement a pond maintenance plan that incorporates procedures for monitoring water and sediment depth, outlet and inlet conditions, criteria for maintenance, and funding needed to maintain and restore the ponds to their original condition (following MPCA guidelines, e.g. sediment disposal, pond inventory, etc.).

10. The city will continue to require that post-development or redevelopment peak discharge rates achieve the criteria established in the city's Stormwater Management Ordinance.

11. The city will continue to require developers' hydrologic studies to use hydrograph methodology and be based on existing (pre-project) and proposed development conditions.

12. The city will encourage the reduction of peak discharge rates below existing conditions for redevelopment projects.

13. The city will require storm sewer systems (including catch basin grates, trash racks, pipes, and all city roadway curb and gutter facilities) to be designed to provide discharge capacity for the 10-year storm event (level of service). The level of service is the portion of the storm sewer system's total capacity needed to convey runoff without unusual hardship or significant interference with public activities.

14. The city will seek opportunities to upgrade the existing storm sewer system to provide discharge capacity for an appropriate level of services (currently the 10-year storm event based on 1961 TP-40 rainfall data) as part of redevelopment and/or road reconstruction. The city may reassess its level of service design storm criteria following publication of the 2012 TP-40 update.

15. The city will allow water depths of up to three and one half inches in roadway curbs during storm events up to the 10-year event, or a depth of water which covers no more than one half a driving lane. These criteria allow safe vehicle passage and allow the crown of the road to remain visible.

16. In low-lying or flood-prone areas, the city may require additional storm sewer capacity above the 10-year level of service in order to provide a sufficient level of protection in those areas and/or upstream of those areas.

17. The city will require a level of protection along all trunk conveyors, streams, and open channels and around all ponds, wetlands, detention basins, and lakes based on the 100-year critical storm event. The level of protection refers to the entire stormwater system's (e.g. pipes, ponds, swales) capacity to convey or store runoff without significant damage to structures or risk to public health and safety.

    The city will require all roadways adjacent to ponding basins or that cross flows from drainage waterways, creeks, or other major flow conveyors to be constructed or protected to prevent overtopping in the 100-year critical storm event.

18. The city will require minimum building elevations as specified in the city's Stormwater Management Ordinance.

19. The city will discourage development in floodplain areas.

20. The city will maintain and require no net loss of floodplain storage and will manage floodplains to maintain critical 100-year flood storage volumes.

21. The city will continue to identify, assess, and address drainage problems within the city. The city will seek to resolve existing flood problems or flood problems that arise in the future within available funding constraints.

22. The city will maintain its stormwater system in accordance with the city's SWPPP and maintenance plan (see Section 7.3).

23. The city will require owners of private stormwater systems (e.g. pipes, ponds, or drainageways) to maintain, clean, and replace systems as needed to preserve design capacity and will obtain agreements with such owners in that regard.

24. The city will manage ditches and open channels as potential natural resource areas as well as stormwater conveyors.

2.4 Wetlands

2.4.1 Goal

Achieve no net loss of wetlands, including acreage, functions, and values. Where practicable, improve the functions, values, biodiversity, and acreage of wetlands.

2.4.2 Policies

1. The city will continue to defer local government unit (LGU) authority for administration of the Wetland Conservation Act (WCA) to Kandiyohi County.

2. The city will cooperate with the Kandiyohi County SWCD in their administration of the WCA.

3. The city will continue to require an appropriate level of pretreatment of stormwater runoff prior to discharge to wetlands.

4. The city will continue to require a buffer of natural vegetation around wetlands and detention basins as specified in the city's Stormwater Management Ordinance. In specific cases, the city may allow flexibility in its requirements if the goals of the ordinance are met.

5. The city seeks to achieve no net loss of wetland quantity, quality, and biological diversity. Unavoidable wetland alterations must be mitigated in conformance with WCA requirements.

6. The city will work to protect wetlands from chemical, physical, biological, or hydrologic changes so as to prevent significant adverse impacts to the following designated wetland functions: maintaining biological diversity, preserving wildlife habitat, providing recreational opportunities, erosion control, groundwater recharge, low flow augmentation, stormwater retention, creek sedimentation, and aesthetic enjoyment, as specified in Minnesota Rules 7050.

7. The city will seek to enhance existing wetlands as funding and opportunities allow.

8. The city will attempt to limit water level fluctuations (bounce) in wetlands or detention basins to prevent adverse habitat changes, where feasible.

2.5 Groundwater

2.5.1 Goal

Protect the quality and quantity of groundwater resources to preserve it for sustainable and beneficial purposes.

2.5.2 Policies

1. The city will continue to defer the maintenance of municipal wells and the implementation of the Wellhead Protection Plan (WHPP) to Willmar Municipal Utilities.

2. The city will promote infiltration of stormwater and resulting groundwater recharge where it is feasible and does not pose a threat to groundwater quality; infiltration projects will be implemented using guidance from the Minnesota Department of Health's *Evaluating Proposed Storm Water Infiltration Projects in Vulnerable Wellhead Protection Areas* (*2007*), and the MPCA's *Minnesota Stormwater Manual* (*2005, as updated*).

3. The city will continue to prohibit the installation of new subsurface sewage treatment systems (SSTS) within the city and require connection to the city's sanitary sewer system.

4. The city will continue to prohibit installation of new, privately-owned water supply systems, and the repair or extension of such existing systems, when connection can be made to the city's water system.

5. The city will continue to require sealing of all abandoned wells in accordance with the practices approved by Kandiyohi County and the Minnesota Department of Health (MDH).

6. The city will promote awareness of groundwater resource issues through public education and information programs.

2.6 Erosion and Sedimentation

2.6.1 Goal

Protect the capacity of the stormwater system, prevent flooding, and maintain or improve water quality by preventing erosion and unplanned sedimentation from occurring, and correct existing erosion and sedimentation problems.

2.6.2 Policies

1. The city will continue to enforce its grading, erosion and sedimentation control requirements through the city's Stormwater Management Ordinance.

2. The city will encourage the use of non-surface inflow inlets to tile systems and buffer strips in agricultural areas of the city.

3. The city will seek to preserve and enhance natural vegetation to the greatest practical extent as funding and opportunities allow.

4. The city will continue to require erosion and sediment control design criteria specified in the MPCA's *Protecting Water Quality in Urban Areas*.

2.7 Recreation, Habitat and Shoreland Management

2.7.1 Goal

Protect and enhance fish and wildlife habitat and recreation opportunities in Willmar and the surrounding watersheds; manage watershed projects and programs to achieve healthy ecosystems.

2.7.2 Policies

1. The city will cooperate with Kandiyohi County SWCD in local projects and programs that seek to provide quality habitats for fish and wildlife (e.g. Re-invest in Minnesota Reserve Program).

2. The city will seek to protect wildlife habitat in future development areas as opportunities allow.

3. The city will enforce buffer zones of native vegetation around ponds and wetlands to provide habitat, in accordance with the city's standards. Land use and ownership may limit the ability to provide or require buffer zones.

4. The city will encourage alternative landscape designs that increase beneficial habitat, wildlife, and recreational uses (e.g. infiltration).

2.8 Land Use Management

2.8.1 Goal

Protect and conserve water resources by promoting sustainable growth, integrated land use and land use planning, and water resource management.

2.8.2 Policies

1. The city will implement land use management policies and programs that will protect the natural resources of the city and surrounding area. The city will analyze (through hydrologic/hydraulic modeling and/or water quality modeling)

and determine the impacts of proposed land use changes or increased impervious areas and determine measures to prevent negative impacts.

2. The city will use natural resource information (e.g. the presence of environmentally sensitive areas) to help guide the direction of future expansion of the city and for public open space acquisition programs.

3. The city will encourage the owners of large tracts of undeveloped land to implement soil erosion control measures.

4. The city will preserve prime agricultural land from non-agricultural development to the greatest extent possible.

5. The city will support brownfield redevelopment projects as opportunities and funding allow.

6. The city will identify and preserve areas best suited for future parks, open spaces, and trails, as opportunities allow.

2.9 Education and Public Involvement

2.9.1 Goal

Increase public awareness and understanding of water and natural resource management issues; increase public interaction with water resources and healthy ecosystems; involve citizens, agencies, and organizations in the city's water resources management decisions.

2.9.2 Policies

1. The city will continue to implement its public education program, including the public education elements of its SWPPP. The SWPPP includes the development and distribution of educational materials to the general public and targeted groups regarding the following topics:

    - city ordinances, policies and programs pertaining to water resources,
    - groundwater,
    - wetlands,
    - native vegetation and buffers,
    - fish and wildlife protection,
    - alternative landscaping methods,
    - public area maintenance,
    - illicit discharge
    - litter control, pet wastes, recycling, trash disposal,

- grass clippings, lawn chemicals, and leaf collection, and
- hazardous materials.

2. The city will distribute information via the city's online newsletter, local newspapers, cable television, the city's website, and other appropriate media.

3. The city will seek broad citizen participation in stormwater management issues attained through the continued involvement of citizen groups and residents.

4. The city will continue to implement the public participation and involvement elements of its SWPPP, including an annual meeting to solicit public input on the SWPPP.The city will continue to support water monitoring efforts and collaborate with the MPCA, MDNR, Kandiyohi County SWCD, and other agencies to share available data.

5. The city may participate in the revision and update of the Kandiyohi County Comprehensive Local Water Plan. The city will consider opportunities to partner with Kandiyohi County and its Soil and Water Conservation District (SWCD) as local governmental units (LGUs) obtain grant funding from the Board of Water and Soil Resources' (BWSR) or other agencies.

2.10 Financing

2.10.1 Goal

Minimize and fairly distribute public expenditures for plan implementation, with emphasis on using the city's stormwater utility to finance projects and collaborating/partnering with other entities.

2.10.2 Policies

1. The city will use its stormwater utility to pay for as many stormwater management projects as possible.

2. The city will explore grants, loans, and cost-share opportunities whenever possible and practical to reduce the project costs borne by the stormwater utility and the general fund.

Section 3.0 Physical Environment Inventory

City of Willmar Watershed Management Plan

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3.0 Willmar Physical Environment

3.1 Introduction

This section gives an overview of the physical environment of the City of Willmar. It includes information about the city's land use, climate, topography, soils, geology, and groundwater resources. It also discusses surface water resources and drainage patterns. Additional detail regarding these and other topics can be found in Appendix A of this Plan.

Figures referenced in this section are located after the Figures tab.

3.2 Land Use

The *City of Willmar Comprehensive Plan* (comprehensive plan) (City of Willmar, 2009) provides detailed information about the historical, existing, and projected land uses in the city. The city adopted their most recent Zoning Ordinance in 1994. The city also adopted a geographic information system (GIS) Zoning Map in 2004 and updated it in 2008. A map of existing land use developed for hydrologic/hydraulic modeling is presented in **Figures 3-1** and **3-2** and varies slightly from the land use map presented in the city's Comprehensive Plan. The current land use presented in **Figures 3-1** and **3-2** was developed using the city's current zoning map, land cover data from the National Land Cover Dataset (NLCD), and aerial photography. Land use distributions presented in the following paragraphs refer to the land use mapping developed for the hydrologic/hydraulic modeling.

Most of the City of Willmar is developed. Much of the undeveloped area within the city boundary is zoned as agricultural. Residential land use comprises 29% of the city's area (including surface water) and represents the largest percentage of developed land within the city. Of this, about 6% is classified as high density residential (occupied by multiple family units or high density single family units). Multi-family residential areas occur throughout the city, but are concentrated in a few areas. In these areas, apartments serve as buffers between single family residential areas and commercial areas. Mobile homes also occupy a small percentage of residential land use. The City of Willmar presently has two mobile home parks, which include 186 mobile homes and 231 total lots.

Commercial development occupies 9% of the city's total land area. Commercial uses are concentrated along major highways and collector roads. Industrial and office land use is concentrated around the former airport and along US Highway 12, and occupies 8% of the city. Parks and open space (including wetlands and open water) occupy 24% of the city's total land area and institutional uses occupy another 5% of the city's land area. Approximately 16% of the city is currently being used for agricultural purposes.

Areas of undeveloped land are scattered throughout the developed portions of the city as well as in fringe areas. Undeveloped areas are zoned for agricultural, industrial, commercial, residential, or open space uses.

The city's comprehensive plan projects a population increase from approximately four to twenty-four percent by the year 2025. Changes in the demographics of the city will influence land development and land use. Additional residential land use areas may be necessary to accommodate the higher estimates of population growth.

Several areas within the city are poised for future development. Future land uses are shown in the city's Comprehensive Plan, which identifies and describes eleven specific Urban Growth Areas (labeled A-K). Future land use projections may be used to identify areas where water resource enhancements or stormwater improvements can be implemented in conjunction with development or redevelopment. Future land use is presented in this plan as **Figure 3-3**.

Land use data is an important factor for estimating surface water runoff. The hard or impervious surface areas associated with each land use greatly affect the amount of runoff generated from an area. Significant changes in land use can increase runoff due to added impervious surfaces, removal of vegetation, soil compaction and changes to drainage patterns. Since Willmar is expecting changes in land use within the city, stormwater management will be an important consideration in developing areas and in any potential redevelopment areas.

3.3 Climate and Precipitation

The amount, rate, and type of precipitation are important factors in determining flood levels and stormwater runoff rates and volumes, 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).

Willmar Climate & Precipitation Facts	
Mean July temperature	72° F
Mean January temperature	10° F
Average annual precipitation	28.2 inches
Average annual snowfall	48 inches
Annual lake evaporation	31 inches

Source: NOAA online weather data and Hydrology Guide for Minnesota

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. Extreme storm events utilized for evaluating the City of Willmar's stormwater system are presented in **Section 4**. Recent extreme storm events in the City of Willmar include 3.45 inches of rainfall within a one-hour period on August 21, 2007, 3.15 inches of rainfall in a four-hour period on August 26, 2006, and 3.00 inches of rainfall on August 16, 2009 (precipitation totals are from the National Weather Service).

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. Analysis of rainfall data (1971-2000) from the Minneapolis-St. Paul International Airport (MSP) station found that 90 percent of the storms produced 1.05 inches or less of rainfall (MPCA, 2005b). **Table 3-1** lists the precipitation and runoff events that are used for design purposes in the City of Willmar (including the hydrologic modeling described in **Section 4**). **Appendix A** describes the various sources of precipitation-frequency data. The US Environmental Protection Agency's (EPA) National Urban Runoff Program (NURP) also provides estimates of the average duration between storm events for various locations (US EPA, 1986).

Table 3-1 Selected Precipitation and Runoff Events

Type and Frequency	Duration	Amount (Inches)
Rainfall		
1-year	24 hour	2.4
2-year		2.7
5-year		3.4
10-year		4.0
50-year		5.2
100-year		5.8
Runoff (snowmelt)		
10-year	10 day	4.6
25-year		5.6
50-year		6.3
100-year		7.0

Source: *Minnesota Hydrology Guide* (USDA Soil Conservation Service, 1975)

Because of its location near the center of the North American continent, Willmar (and Minnesota) has a continental climate, meaning it experiences a wide variation in climate conditions (e.g., droughts and floods, heat and cold). Additional sources of climatic data are presented in **Appendix A**.

3.4 Topography

The topography of Willmar is gently rolling till plain. Elevation changes are modest throughout the city, ranging from approximately 1,100 feet to 1,210 feet above sea level. The elevation at Willmar Municipal Airport is approximately 1,126 feet above sea level. Slopes are mild within the city. The steepest slopes occur on the north side of Foot Lake and around Willmar Lake, but are still generally less than 10 percent. Slopes throughout the majority of the city are less than 2 percent.

Elevation contours with 2-foot intervals are available for the entire City of Willmar (NAVD88 vertical datum). The topographic data for the study area is presented in **Figure 3-4** in NGVD29 vertical datum, and for the city in **Figure 3-5**. All elevation data presented in this Plan are NGVD29 vertical datum unless otherwise specified. Outside of the city's municipal boundary, USGS quadrangle maps provide topographic data for the surrounding watersheds; these maps were used to delineate subwatersheds beyond the city's municipal boundary. The following USGS 10-foot contour interval topographic maps cover the city and surrounding watersheds:

- Willmar, Minnesota (Map 3518)
- Solomon Lake, Minnesota (Map 3418)

3.5 Watersheds and Drainage Patterns

The topography of the area divides the city into two major drainage basins, which are further subdivided into four watersheds. The Hawk Creek drainage basin, which drains to the Minnesota River, includes the Foot Lake watershed and the Hawk Creek watershed. The Southeast Willmar drainage basin, which is ultimately tributary to the Mississippi River, includes the Southeast Willmar watershed and the Lake Wakanda watershed. These watersheds are shown in **Figure 3-6** and are described in greater detail in **Section 4**. Individual maps of these watersheds are located in the section marked by the Figures tab at the end of this WMP. **Table 3-2** presents the total area of each watershed as well as the watershed area located within the City of Willmar's municipal boundary.

Table 3-2 Approximate Drainage Basin and Watershed Areas

Drainage Basin	Watershed	Total Watershed Area		Watershed Area within the city	
		Acres	Sq. miles	Acres	Sq. miles
Hawk Creek Drainage Basin	Hawk Creek	17,110	26.7	3,070	4.8
	Foot Lake	20,750	32.4	3,720	5.8
Southeast Willmar Drainage Basin	Southeast Willmar	3,130	4.9	2,590	4.0
	Lake Wakanda	41,890	65.5	160	0.2

* These areas are based on the most recent topographic data available during Plan development

3.5.1 Foot Lake Watershed

The northeast portion of the City of Willmar lies within the Foot Lake watershed. This watershed includes a chain of lakes (Eagle Lake, Skataas Lake, Swan Lake, and Willmar Lake), which drain to Foot Lake before discharging to the Hawk Creek watershed via a drainage ditch. Swan Lake, Willmar Lake, and Foot Lake are located within the city, while Eagle Lake and Skataas Lake are upstream of the city. The Foot Lake watershed also receives drainage from a large area located northeast of Willmar, outside the city's municipal boundary. The total Foot Lake watershed is approximately 20,750 acres (32.4 square miles), of which 3,720 acres (5.8 square miles) are located within the city. The Foot Lake watershed is further broken down into 34 subwatersheds. **Figure 3-7** presents the 34 subwatersheds and drainage patterns for the Foot Lake watershed, and **Figures 3-8** and **3-9** present the subwatersheds within the developed portions of the Foot Lake Watershed. The city maintains a book detailing the ponds within the city. Several ponds and lakes located in the Foot Lake watershed are described in **Appendix A**.

3.5.2 Hawk Creek Watershed

The Hawk Creek watershed receives runoff from the western portion of the City of Willmar, as well as from other areas outside the city's municipal boundary. This watershed also receives outflow from Foot Lake. This watershed ultimately drains to the Minnesota River. In total, the Hawk Creek watershed is approximately 17,110 acres (26.7 square miles), and areas of the Hawk Creek watershed are further broken down into 84 subwatersheds. Approximately 3,070 acres (4.8 square miles) of the Hawk Creek watershed are located within the city. **Figures 3-10** and **3-11** present the subwatersheds and drainage patterns for the Hawk Creek watershed. These figures are located in the section marked by the Figures tab. The city maintains a book detailing the ponds within the city. Several ponds and lakes located in the Hawk Creek watershed are described in **Appendix A**.

3.5.3 Southeast Willmar Watershed

The Southeast Willmar watershed is surrounded by the Hawk Creek watershed, the Foot Lake watershed, and the Lake Wakanda watershed. The Southeast Willmar watershed includes most of the developed area of the City of Willmar, and is almost entirely contained within the city. The Southeast Willmar watershed drains to the southeast and is ultimately tributary to Lake Wakanda. However, during high flow events, overflows from the Southeast Willmar watershed will also drain to the Foot Lake and Hawk Creek watersheds. The Southeast Willmar watershed is approximately 3,130 acres (4.9 square miles), of which 2,590 acres (4.0 square miles) are located within the city's municipal boundary; the Southeast Willmar watershed is further broken down into 228 subwatersheds. **Figure 3-12** shows watershed and drainage information within the Southeast Willmar watershed. This

figure can be found in the section marked by the Figures tab. The city maintains a book detailing the ponds within the city. Several ponds and lakes located in the Southeast Willmar watershed are described in **Appendix A**.

3.5.4 Lake Wakanda Watershed

A small portion (about 160 acres) of the Lake Wakanda watershed is located within the city's municipal boundary. The total watershed area is 41,890 acres (65.5 square miles). As the majority of the Lake Wakanda watershed lies outside of the city, limited detailed information is available regarding the watershed. The watershed drains to the south and is tributary to the South Fork of the Crow River. **Figure 3-13** shows all of the subwatersheds in the Lake Wakanda watershed. This figure can be found in the section marked by the Figures tab. The city maintains a book detailing the ponds within the city. Several ponds and lakes located in the Lake Wakanda watershed are described in **Appendix A**.

3.6 Soils

Most soils within the City of Willmar fall under the urban lands-udorthents complex classification. These landscapes have been significantly altered to a degree that classification of the original soils is not practical. Udorthents are areas that have been leveled for development, often using cut and fill from nearby rises. Glacial till accounts for much of the fill, which can also consist of broken concrete, asphalt, or refuse materials. 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.

The infiltration capacities of soils affect the amount of direct runoff resulting from rainfall. Higher infiltration rates for a given soil indicate lower runoff potential. Conversely, soils with low infiltration rates produce high runoff volumes and high peak discharge rates. 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. Most udorthents are classified as poorly drained or very poorly drained.

According to the Kandiyohi County soil survey, most of the underlying soils in the watersheds surrounding the City of Willmar are classified as hydrologic soil group B, with moderate infiltration rates. Some soils are classified as group C, with low infiltration rates. Much of the area within the city's municipal boundary is unclassified with respect to hydrologic soil group, owing to its level of disturbance during development. The hydrologic soil groups in and around Willmar are presented in **Figures 3-14** and **3-15**.

Additional information on soil types in undeveloped areas of the city and the surrounding watersheds is included in **Appendix A**.

3.7 Geology and Groundwater Resources

The City of Willmar relies on groundwater for its municipal water supply. Municipal supply wells are operated and maintained by Willmar Municipal Utilities. Sixteen municipal wells are located in Willmar (ten in the Southwest Well Field, six in the Northeast Well Field); all but one of these are located in buried-drift aquifers. One municipal well is located in a Cretaceous bedrock aquifer of Hinckley Sandstone.

The majority of non-municipal wells in and around Willmar are located in outwash (i.e. quaternary or unconsolidated) aquifers. Outwash aquifers may be classified as surficial-drift aquifers or buried-drift aquifers. Surficial-drift aquifers are typically located near ground level and are unconfined. These wells may have depths ranging from 30-240 feet deep and yields ranging from 25-500 gallons per minute. Buried-drift aquifers are often located within thick drift and are usually confined. Well depths in buried-drift aquifers are typically 80-380 feet deep, with yields of approximately 25-500 gallons per minute.

The City of Willmar does not currently have a wellhead protection plan (WHPP). The city is currently on a list for phasing public water supplies into the state's wellhead protection program, but is positioned low on that list (number 263) due to the low probability of groundwater contamination. The risk of groundwater contamination is low because of a thick layer of clayey till between the surface and the buried-drift aquifer used by the city.

Additional information regarding the bedrock geology underlying the City of Willmar and adjacent watersheds is included in **Appendix A**.

3.8 MDNR Public Waters

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" (see box at left).

The MDNR uses county-scale maps to show the general location of the public waters and public waters wetlands 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 from the MDNR's website (http://www.dnr.state.mn.us/waters/watermgmt_section/pwi/maps.html).

Public waters
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 lakes are designated with a "p" in the identification number.
Public waters wetlands
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). Public waters wetlands are designated with a "w" in the identification number.

There are thirty-two uniquely identified public waters lakes partially or completely within the City of Willmar and surrounding watersheds. Public waters lakes are listed in **Table 3-3** and include 15 unnamed water bodies as well as several larger water bodies, including: Eagle Lake (#34-0171), Minnetaga Lake (#34-0076), Little Kandiyohi Lake (#34-0096), Skataas Lake (#34-0196), Swan Lake (#34-0106), Willmar Lake (#34-0180), Foot Lake (#34-0181), Lake Wakanda (#34-0169), and others. Additionally, there are twenty-two uniquely identified public waters wetlands (designed with a "w" in the identification number) within the City of Willmar and surrounding watersheds. These include 21 unnamed public waters wetlands and Ramblewood Marsh (#34-0448).

Public waters watercourses (perennial streams, intermittent streams, and drainage ditches) within the City of Willmar and surrounding watersheds include 4.9 miles of Hawk Creek, approximately 4.5 miles of intermittent streams and drainage ditches upstream of Minnetaga Lake, and 1.3 miles of perennial streams connecting Eagle Lake, Swan Lake, and Willmar Lake. **Figures 3-16** and **3-17** show the public waters in the City of Willmar and surrounding watersheds.

Table 3-3 Public Waters Lakes Within and Around Willmar

Public Waters ID	Name	Acres	Watershed
Public Waters Lakes within or adjacent to the city			
34-0171	Eagle Lake	842.8	Foot Lake
34-0196	Skataas Lake	204.0	Foot Lake
34-0186	Swan Lake	241.7	Foot Lake
34-0180	Willmar Lake	642.0	Foot Lake

Table 3-3 Public Waters Lakes Within and Around Willmar

Public Waters ID	Name	Acres	Watershed
Public Waters Lakes within or adjacent to the city			
34-0181	Foot Lake	585.1	Foot Lake
34-0446	Ramblewood Slough	19.0	Foot Lake
34-0370	Unnamed	38.1	Foot Lake
Public Waters Lakes in the watersheds surrounding the city			
34-0139	Burr Oak Lake	44.9	Foot Lake
34-0195	King Lake	151.8	Foot Lake
34-0193	Point Lake	176.6	Foot Lake
34-0140	Unnamed	69.1	Foot Lake
34-0370	Unnamed	38.1	Foot Lake
34-0131	Unnamed	28.3	Foot Lake
34-0545	Unnamed	27.9	Foot Lake
34-0136	Unnamed	27.6	Foot Lake
34-0517	Unnamed	21.7	Foot Lake
34-0530	Unnamed	17.7	Foot Lake
34-0130	Unnamed	17.3	Foot Lake
34-0546	Unnamed	14.9	Foot Lake
34-0169	Wakanda, Lake	1864.2	Lake Wakanda
34-0073	Cherry Lake	71.0	Lake Wakanda
34-0097	Eleanor Lake	265.5	Lake Wakanda
34-0105	Kasota Lake	442.5	Lake Wakanda
34-0096	Little Kandiyohi Lake	975.4	Lake Wakanda
34-0076	Minnetaga Lake	820.3	Lake Wakanda
34-0027	Summit Lake	137.7	Lake Wakanda
34-0106	Swan Lake	351.1	Lake Wakanda
34-0447	Unnamed	62.2	Lake Wakanda
34-0529	Unnamed	8.1	Lake Wakanda
34-0452	Unnamed	36.4	Hawk Creek
34-0453	Unnamed	31.0	Hawk Creek
34-0451	Unnamed	30.5	Hawk Creek
34-0454	Unnamed	23.3	Hawk Creek

3.9 Wetlands

Wetland identification within the city and surrounding watersheds is currently limited to the U.S. Fish and Wildlife Service's National Wetland Inventory (NWI) Mapping, which

Kandiyohi County uses as the basis for its wetland inventory. The U.S. Fish and Wildlife Service established the National Wetland Inventory (NWI) to document the characteristics, extent and status of the United States' wetlands. Wetlands identified by the NWI mapping are presented in **Figures 3-18** and **3-19**. More information about NWI wetlands can be found on the NWI website: http://www.fws.gov/nwi/index.html

Most of the wetlands within the city are located near Foot Lake. There are a few wetlands located in the southwest part of the city including Ramblewood Marsh, and southeast of the municipal boundary including the area of the proposed Grass Lake project. There may be additional wetlands located in the city that are not shown on the map.

The city requires wetland delineation by a certified wetland delineator for all stormwater management plan submittals, ensuring identification of wetlands prior to site development that may not be included in the NWI. Kandiyohi County presently serves as the local governmental unit (LGU) responsible for administering the Wetland Conservation Act (WCA) within the city and surrounding watersheds.

3.10 Surface Water System

Storm sewers, ditches, streams, curbs, and gutters provide drainage for the city. **Figures 3-7** through **3-13** show the city's storm sewer system (as available in electronic data). The stormwater drainage system will be extended or reconstructed as part of development, redevelopment and future street maintenance projects.

3.10.1 Lakes

There are five major lakes within or adjacent to the City of Willmar: Foot Lake, Willmar Lake, and Swan Lake (which are located within the city), and Eagle Lake and Skataas Lake (which are located just outside the city upstream of Foot Lake). Eagle Lake covers 843 acres and is the most upstream of the aforementioned lakes. Eagle Lake outlets to Skataas Lake, which is 204 acres in size. Downstream of Skataas Lake, Foot Lake is approximately 585 acres in size and located in the north-central portion of the city directly north of downtown and east of Willmar Lake. Willmar Lake is located in the northeast portion of Willmar and is approximately 642 acres. Swan Lake is also located in the northeast portion of Willmar, west of State Highway 294.

3.10.2 Streams and Ditches

The City of Willmar contains over 10.5 miles of streams and ditches, as delineated by the MDNR, 1.9 miles of which are considered public watercourses. Minnesota Statutes, Section 103G.005 Subd. 15a9 defines public waters watercourses as natural and altered watercourses with a total drainage area greater than two square miles. Hawk Creek (County Ditch 10) flows for 1.9 miles in the northwest corner of the City of Willmar immediately downstream from Foot Lake; this reach is the only public watercourse within the city's municipal boundary. Other major watercourses include approximately 1.4 miles of the County Ditch 23A, flowing

through the center of Willmar, and approximately 1.8 miles of Branch 3 of County Ditch 23A, flowing along the eastern edge of the City of Willmar. Both of these ditches discharge downstream of US Highway 71. The remaining MNDR-delineated streams within the city's municipal boundary are not designated as public watercourses and include unnamed tributaries to Hawk Creek, County Ditch 23A, Branch 3 of County Ditch 23A, or the various lakes located in the northern part of the city.

Another approximately 10.1 miles of public watercourses are present in the watersheds surrounding the city. Outside the city's municipal boundary, public watercourses include 4.3 miles of Hawk Creek downstream of the city, 4.5 miles of intermittent ditch upstream of Lake Minnetaga, and about 1.2 miles of perennial streams connecting Eagle Lake, Swan Lake, and Willmar Lake. None of the rivers or streams within the city municipal boundary or surrounding watersheds are designated trout streams.

Ditches identified as public waters may be part of private drainage systems or public drainage systems (also known as judicial or county ditches). A public drainage system is one administered under Chapter 103E of Minnesota Statutes and is under the jurisdiction of a drainage authority (e.g. county, watershed district). County Ditch 10 (Hawk Creek), County Ditch 23A, Branch 3 of County Ditch 23A, and unnamed tributaries fall under the jurisdiction of the county ditch authority (Kandiyohi County). Additional requirements for public drainage systems are included in Minnesota Statutes 103E.015, 103E.215, 103E.215, 103E.411, and 103E.701 Subdivision 6.

3.10.3 Stormwater Ponds

The City of Willmar uses stormwater ponds to treat stormwater runoff and reduce stormwater flows. The stormwater ponds fall into three classifications: detention ponds, extended detention ponds, and wet ponds. Detention basins restrict stormwater flow for a short period of time. Between rain events, detention basins usually drain completely and are typically dry. Extended detention ponds restrict flow for a longer period of time, but will eventually drain completely if there is a longer amount of time between storm events. Wet ponds have a permanent pool of water. There are many stormwater ponds throughout the city. The city maintains a book with stormwater pond information. Detailed information on several of the ponds can be found in **Appendix A.**

3.11 Water Quality

This section contains a summary of the recent water quality modeling performed for the City of Willmar and information for waterbodies listed as impaired by the MPCA. Additional description of the water quality modeling is included in **Appendix A**. Existing water quality data and sampling programs are also described

in **Appendix A**. Locations with existing water quality data are shown in **Figures 3-20** and **3-21**.

3.11.1 Water Quality Modeling Summary

For the 1998 draft Plan, the city performed water quality modeling (using a P8 computer model) of stormwater ponds within the city and included in the hydrologic model of the city storm sewer system (see **Section 4.4**). For this Plan, the city updated the model to incorporate stormwater ponds constructed since the earlier modeling effort. **Section 4.4** presents the results of the water quality modeling. Appendix A includes more detailed descriptions of the P8 modeling process. **Figure 3-22** shows the location of each stormwater pond included in the City of Willmar P8 model.

3.11.2 Impaired Waters

The Minnesota Pollution Control Agency (MPCA) maintains a list of impaired waters as per the requirements of the federal Clean Water Act (CWA). This list is sometimes referred to as the 303(d) list; the 303(d) list, however, is only a subset of the impaired waters list and includes only those impaired waters for which a TMDL has not been completed and approved. Water bodies on the impaired waters list have exceeded the water quality criteria established by the MPCA for one or more parameters. Water bodies on the impaired waters list are required to undergo an assessment that addressees the cause and sources of the impairment. This process is known as a total maximum daily load (TMDL) analysis.

Impaired waters basins and streams located within the watersheds surrounding Willmar or closely downstream of Willmar are listed in **Table 3-4** along with impairment and status of any TMDLs, and are shown in **Figure 3-23**.

Table 3-4 Impaired Waters Within or Immediately Downstream of Willmar and the Surrounding Watersheds

Public Waters Name	Reach Name	Public Waters ID	Impaired Use	Pollutant/ Stressor	First Listed	TMDL Start Date	TMDL Completion Date
Waterbodies and/or reaches located within the City of Willmar							
Eagle Lake	--	34-0171	Aquatic Consumption	Mercury in Fish Tissue	1998	TMDL Approved (2008)	
Hawk Creek	Headwaters (Foot Lake) to T119 R35W S18 (south line)	0702-0004-627	Aquatic Consumption	Mercury in Fish Tissue	2006	TMDL Approved (2008)	
Waterbodies and/or reaches located within the watersheds adjacent to the city							
Lake Wakanda	--	34-0169	Aquatic Recreation	Nutrient, Eutrophication, Biological Indicators	2008	2010	2013
Kasota Lake	--	34-0105	Aquatic	Nutrient, Eutrophication,	2010	2010	2016

Table 3-4 Impaired Waters Within or Immediately Downstream of Willmar and the Surrounding Watersheds

Public Waters Name	Reach Name	Public Waters ID	Impaired Use	Pollutant/ Stressor	First Listed	TMDL Start Date	TMDL Completion Date
			Recreation	Biological Indicators			
Little Kandiyohi Lake	--	34-0096	Aquatic Recreation	Nutrient, Eutrophication, Biological Indicators	2010	2010	2016
Waterbodies and/or reaches located downstream of the city and adjacent watersheds							
South Fork, Crow River	Headwaters to Hutchinson Dam	0701-0205-540	Aquatic Life	Aquatic Macroinvertebrate Bioassessments	2006	2010	2016
South Fork, Crow River	Headwaters to Hutchinson Dam	0701-0205-540	Aquatic Life	Fish Bioassessments	2002	2010	2016
South Fork, Crow River	Headwaters to Hutchinson Dam	0701-0205-540	Aquatic Life	Turbidity	2006	2010	2016
South Fork, Crow River	Headwaters to Hutchinson Dam	0701-0205-540	Aquatic Consumption	Mercury in Fish Tissue	1998	TMDL Approved	
Hawk Creek	T119 R35W S18 (north line) to T118 R37W S31 (south line)	0702-0004-508	Aquatic Recreation	Mercury in Fish Tissue	2006	TMDL Approved (2008)	
Hawk Creek	T117 R37W S6 (to Chetomba Ck)	0702-0004-510	Aquatic Recreation	Mercury in Fish Tissue	2006	TMDL Approved (2008)	

Information in table based on MPCA draft 2012 impaired waters list. Note that all impaired waters listed in table are also listed in the MPCA 2010 impaired waters list.

Eagle Lake and three reaches of Hawk Creek downstream of Foot Lake are listed as impaired for mercury but are not included in the draft 2012 303(d) list, as a mercury TMDL has been approved for those water bodies. In addition to impaired waters located within or immediately downstream of the watersheds surrounding Willmar, there are several impaired waters located downstream of Willmar, including:

- Hawk Creek (unnamed reaches approximately 30 miles downstream of Willmar)
- South Fork of the Crow River (below Hutchinson Dam)
- Otter Lake (Hutchinson, MN)
- Minnesota River
- Mississippi River
- Lake Pepin

The criteria used to determine if a lake is impaired vary, according to the lake's ecoregion. Two ecoregions cover Willmar and the surrounding watersheds, the North Central Hardwood Forest ecoregion (NCHF or CHF) in the northeast and the Western Corn Belt Plains ecoregion (WCBP) in the southwest.

Impaired waters located within or downstream of Willmar and the associated TMDL issues are discussed in greater detail in **Appendix B**.

3.12 Water Quantity/Flooding

3.12.1 Stormwater Management Network

The City of Willmar manages stormwater runoff through a comprehensive network of storm sewers, ditches, streams, curbs and gutters conveying water to ponds, wetlands, and lakes. The system includes over 3,400 structures and over 56 miles of pipe (as of 2004). **Figures 3-7** through **3-13** show the city's storm sewer system (as available as electronic data).

The city has identified several existing flooding issues; these locations are presented in **Figure 3-24**. Suggested or recommended improvements to the stormwater system intended to resolve local flooding issues have been identified using hydrologic/hydraulic modeling of the Willmar stormwater system (see **Section 4**). Those potential improvements are presented in **Figure 3-25**.

The City of Willmar continues to maintain, expand, or reconstruct elements of its stormwater management system as part of development, redevelopment and future street maintenance projects. The city has developed, and continues to update, a complete storm sewer system map.

3.12.2 Water Quantity Modeling

The City of Willmar maintains a city-wide hydrologic and hydraulic model used to design and evaluate performance of the city's stormwater management system (see **Section 4** of this Plan for more details). The city has updated this model on an on-going basis since its original creation for the 1998 draft Plan to reflect new development, redevelopment and storm sewer system improvements. The model will continue to be updated as conditions dictate.

3.12.3 Flood Insurance Studies

A Flood Insurance Study (FIS) contains information regarding flooding in a community, including flood history of the community and information on engineering methods used to develop Flood Insurance Rate Maps (FIRM) for a community. The July 1977 City of Willmar Flood Insurance Study contains the most current flood information and maps available for the City of Willmar. The FIS and flood maps for Kandiyohi County are currently being updated and, once published, will replace the July 1977 City of Willmar Flood Insurance Study.

The City of Willmar does not have a floodplain ordinance and does not participate in the federal government's flood insurance program . Kandiyohi County has a floodplain ordinance which applies to unincorporated areas of the county.

3.13 Habitat and Recreational Areas

The City of Willmar and surrounding watersheds contain an abundance of recreational areas, wildlife habitat, ecological features, and scenic areas. These resources are discussed in **Appendix A**. **Figure 3-26** presents native vegetation and areas of significant biodiversity in the City of Willmar and surrounding watersheds. The communities shown in **Figure 3-26** are further described in **Appendix A**.

3.14 Pollutant Sources

In addition to nonpoint sources of runoff, such as surface water runoff in the city, there are multiple sites with industrial or construction stormwater permits within the City of Willmar and surrounding watersheds. National Pollutant Discharge Elimination System (NPDES) permitted point source discharges located within the City of Willmar and the watersheds surrounding the city include:

- Willmar Regional Treatment Center Water Treatment Plant, Station ID: MN0062332-SD-1
- Green Lake Sanitary Sewer and Water District Wastewater Treatment Plant – Treatment Facility Bypass, Station ID: MN0023841-SD-1 (formerly known as Kandiyohi Wastewater Treatment Plant)
- Green Lake Sanitary Sewer and Water District Wastewater Treatment Plant – Main Facility Discharge, Station ID: MN0023841-SD-2 (formerly known as Kandiyohi Wastewater Treatment Plant)
- Willmar Wastewater Treatment Plant – Unnamed Discharge, Station ID: MN0025259-SD-6 (new discharge permitted in 2010, replacing locations SD-1 and SD-2)
- Willmar Wastewater Treatment Plant – Upgraded Facility Discharge, Station ID: MN0025259-SD-5 (new discharge in 2010, replacing locations SD-1 and SD-2)
- Willmar Wastewater Treatment Plant – County Ditch 23A Bypass, Station ID: MN0025259-SD-1 (discontinued in 2010; discharge relocated to locations SD-5 and SD-6)
- Willmar Wastewater Treatment Plant – Main Facility Discharge – County Ditch 46, Station ID: MN0025259-SD-2 (discontinued in 2010; discharge relocated to locations SD-5 and SD-6)
- Willmar Wastewater Treatment Plant – Draintile Discharge, Station ID: MN0025259-SD-4

The locations listed above are shown on **Figures 3-20** and **3-21**. In 2010, two of the Willmar Wastewater Treatment Plant discharges listed above (SD-1 and SD-2) were discontinued. New permitted outfalls (SD-5 and SD-6, listed above) were issued for the

new discharge locations. For more information on these sources, as well as monitoring data, see the MPCA website (http://www.pca.state.mn.us/data/edaWater/index.cfm).

Additional point sources of pollution may include leaking underground storage tanks (LUST), feedlots, and subsurface sewage treatment systems (SSTS). Information regarding these sources in the City of Willmar and surrounding watersheds is included in **Appendix A** and available from the MPCA's "What's in my Neighborhood?" website (http://cf.pca.state.mn.us/wimn/).

Figures

City of Willmar Watershed Management Plan

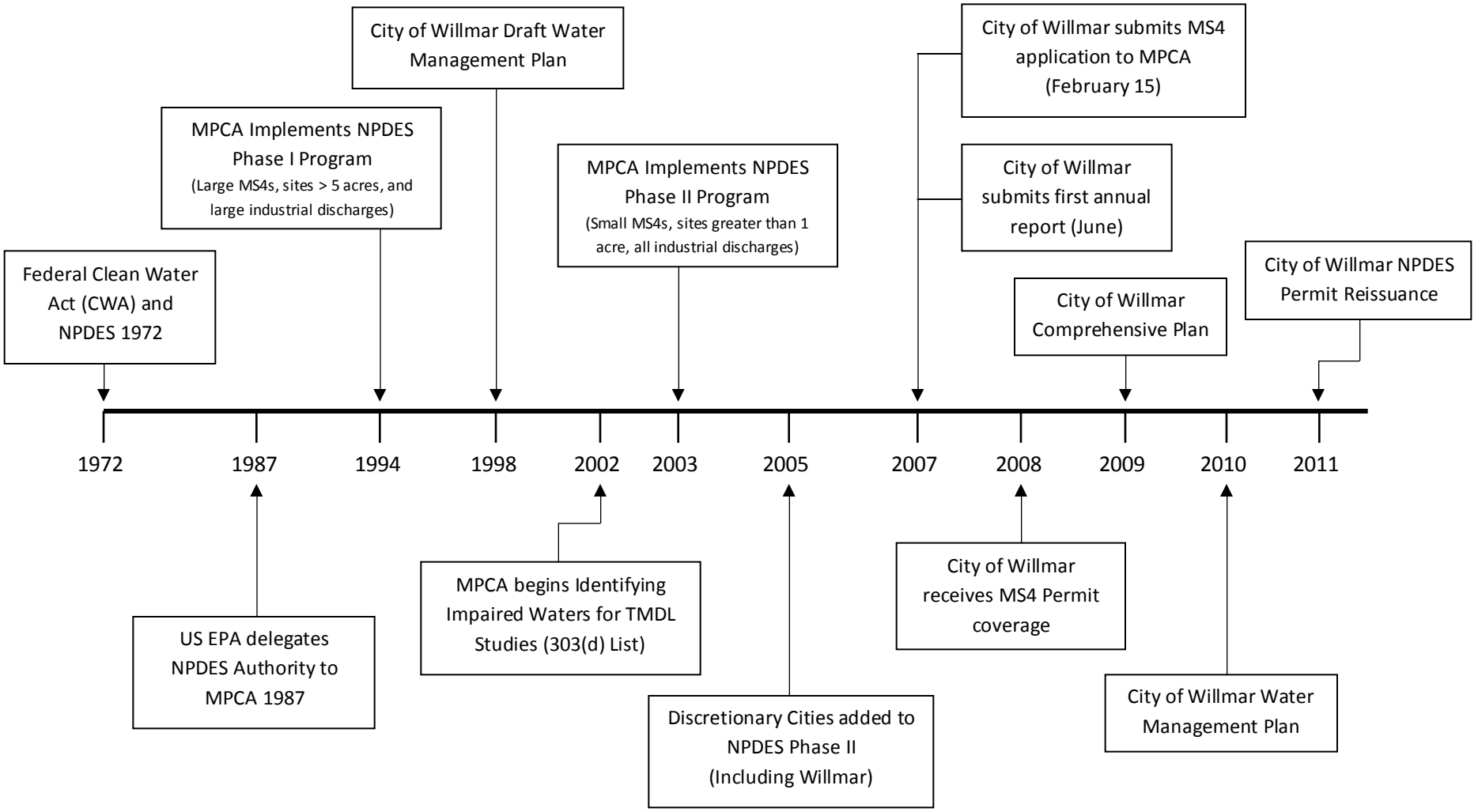
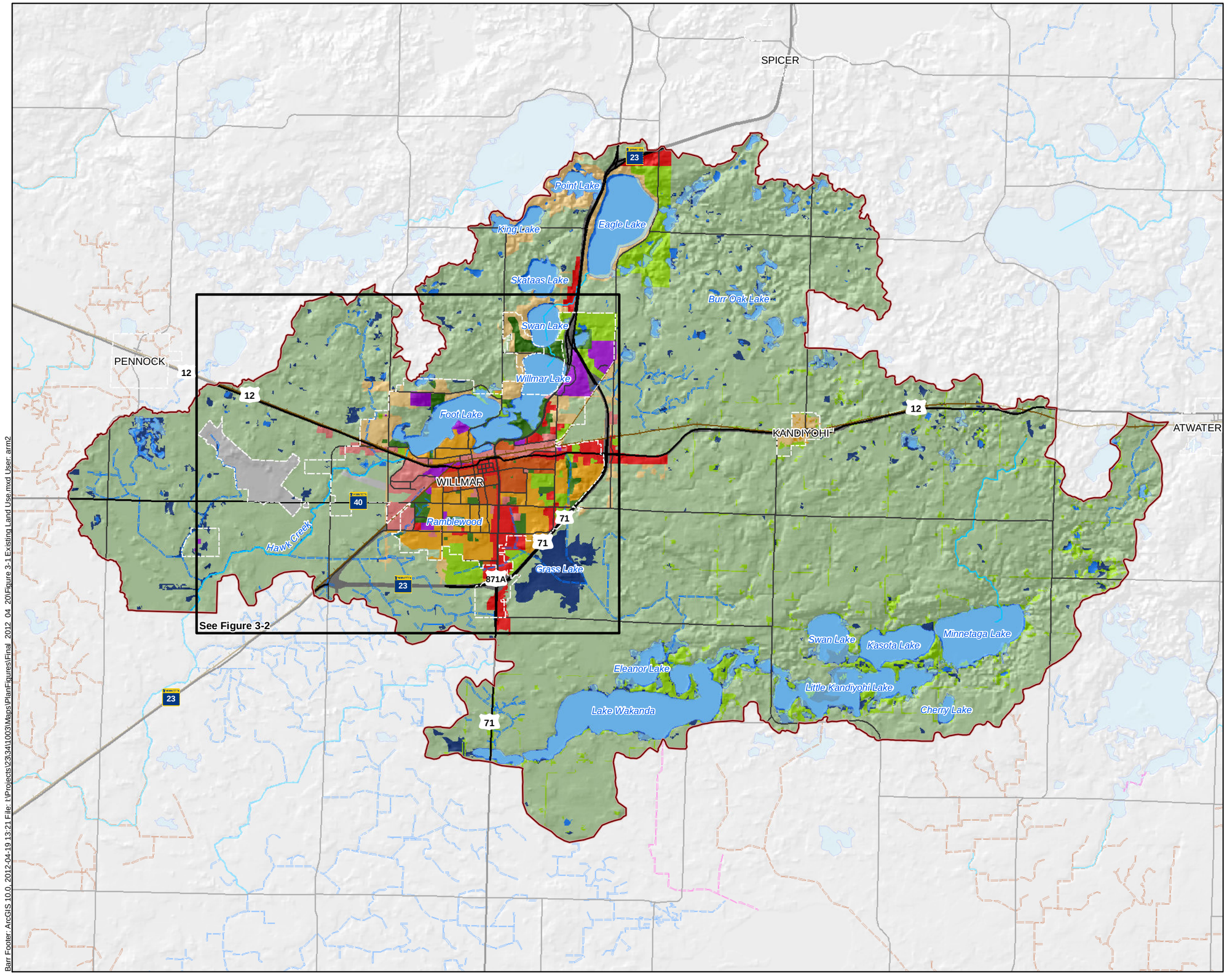


Figure 1-1

STORMWATER TIMELINE

City of Willmar - Watershed Management Plan Update

Kandiyohi County, MN



StudyArea
Municipalities
Rivers and Streams
County Ditch
Judicial Ditch
State Ditch
Lakes

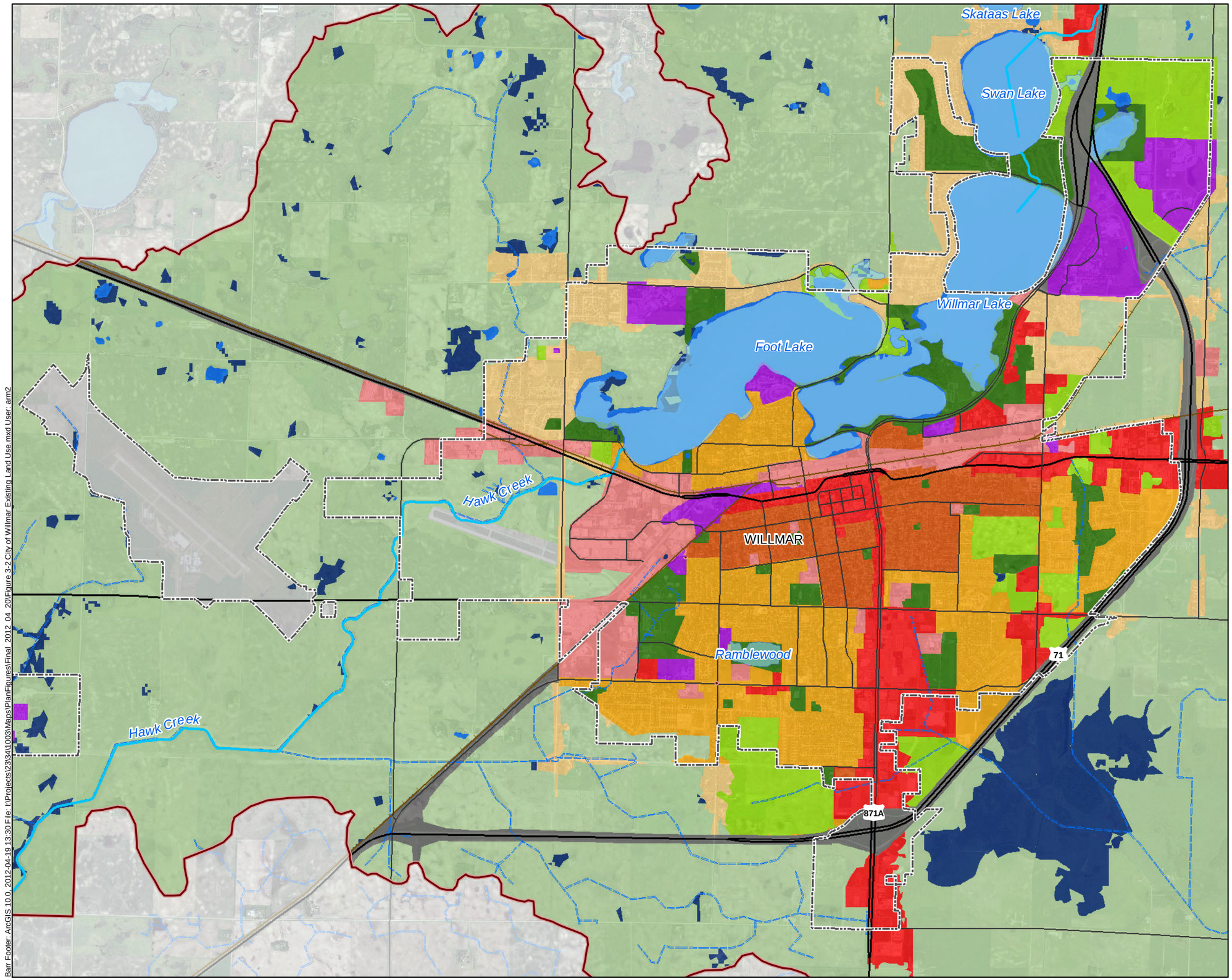
Existing Impervious Land Cover Classification	Zoning District*
Agricultural	A
Airport	G
Natural	--
Developed Park	P
Commercial	GB, CBD, SC
Institutional	G, T
Industrial/Office	I-1, I-2
Highway	--
High Density Residential	R-5
Medium Density Residential	R-4
Low Density Residential	R-1, R-2, R-3
Water	--
Wetland	--

*City zoning district that generally corresponds to impervious land cover classifications developed for hydrologic modeling.

0 1 2
Miles

Figure 3-1
EXISTING LAND USE
City of Willmar
Watershed Management Plan Update
Kandiyohi County, Minnesota

Barr Footer: ArcGIS 10.0, 2012-04-19 13:21 File: I:\Projects\2334\11003\Maps\PlanFigures\Final_2012_04_20\Figure 3-1 Existing Land Use.mxd User: arm2



StudyArea
Municipalities
County Ditch
Judicial Ditch
State Ditch
Rivers and Streams
Lakes

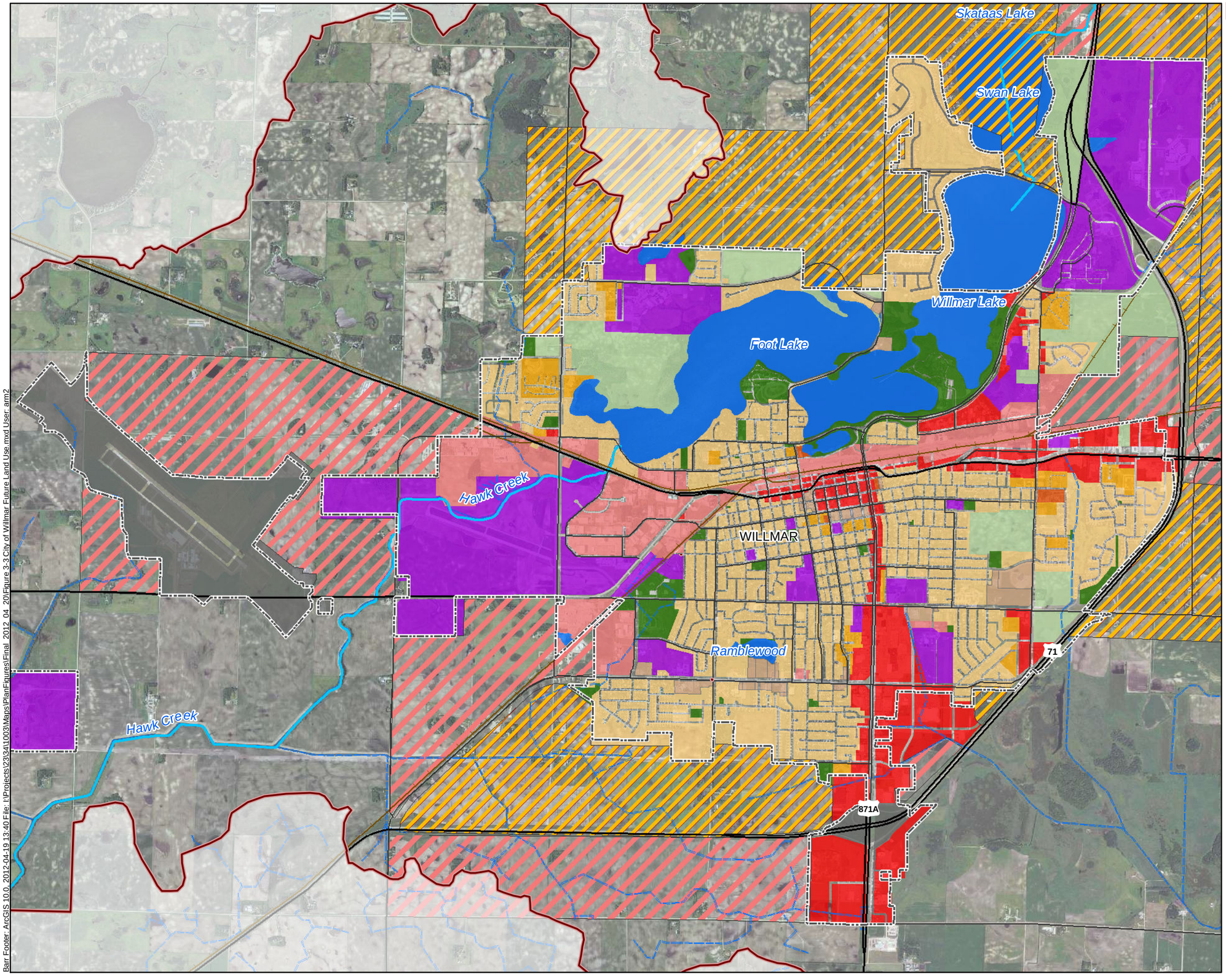
Existing Impervious Land Cover Classification	Zoning District*
Agricultural	A
Airport	G
Natural	--
Developed Park	P
Commercial	GB, CBD, SC
Institutional	G, T
Industrial/Office	I-1, I-2
Highway	--
High Density Residential	R-5
Medium Density Residential	R-4
Low Density Residential	R-1, R-2, R-3
Water	--
Wetland	--

*City zoning district that generally corresponds to impervious land cover classifications developed for hydrologic modeling.

3,100 1,550 0 3,100
Feet

Figure 3-2
CITY OF WILLMAR EXISTING LAND USE
City of Willmar
Watershed Management Plan Update
Kandiyohi County, Minnesota

Barr Footer: ArcGIS 10.0, 2012-04-19 13:30 File: I:\Projects\23\41003\Maps\PlanFigures\Final_2012_04_20\Figure 3-2 City of Willmar Existing Land Use.mxd User: arm2



StudyArea
Municipalities
County Ditch
Judicial Ditch
State Ditch
Rivers and Streams
Lakes

Future Land Use
General Business
Residential

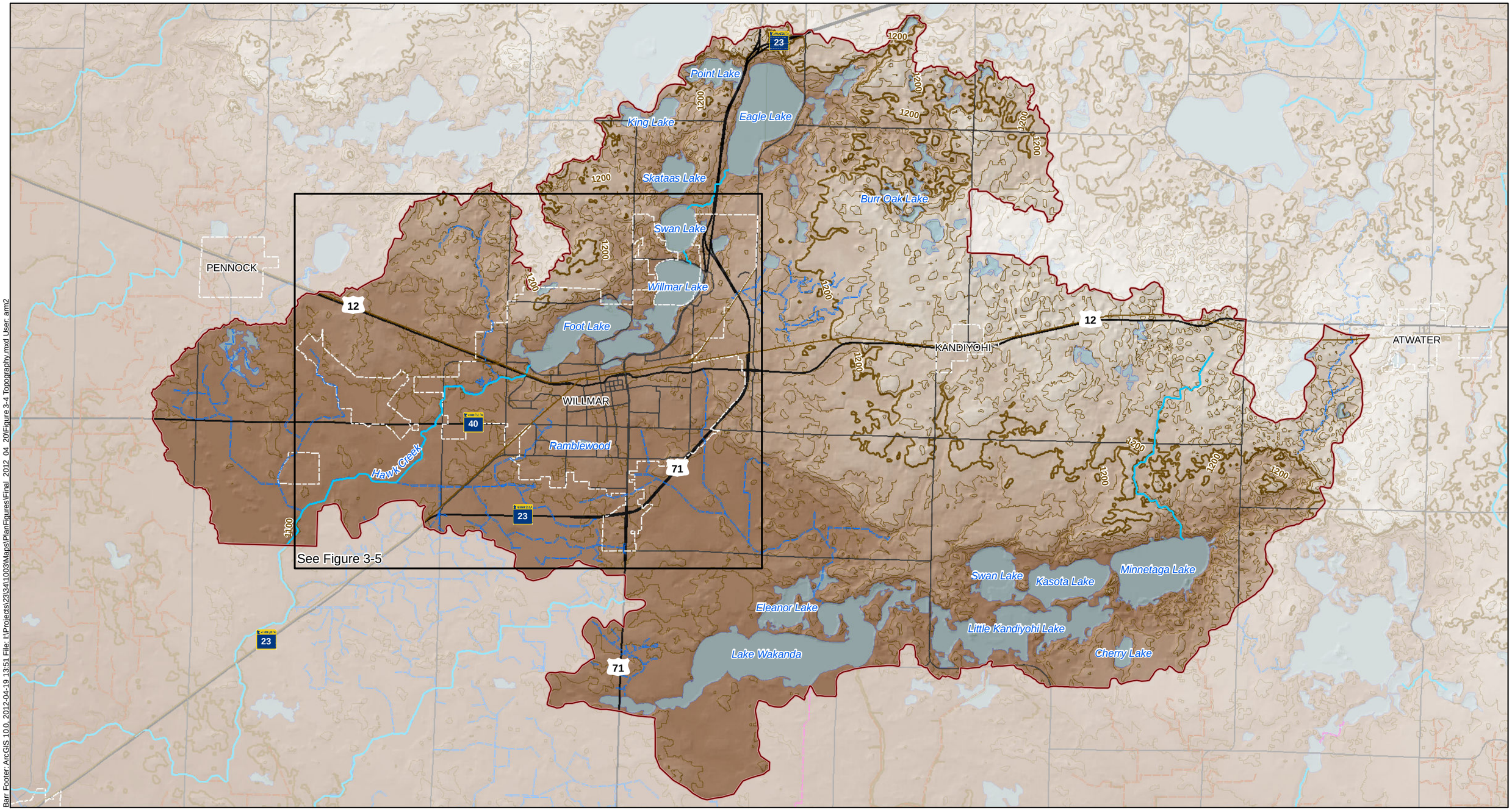
Existing Impervious Land Cover Classification	Zoning District*
Agricultural	A
Airport	G
Natural	--
Developed Park	P
Commercial	GB, CBD, SC
Institutional	G, T
Industrial/Office	I-1, I-2
Highway	--
High Density Residential	R-5
Medium Density Residential	R-4
Low Density Residential	R-1, R-2, R-3
Water	--
Wetland	--

*City zoning district that generally corresponds to impervious land cover classifications developed for hydrologic modeling.

3,100 1,550 0 3,100
Feet

Figure 3-3
CITY OF WILLMAR FUTURE LAND USE
City of Willmar
Watershed Management Plan Update
Kandiyohi County, Minnesota

Barr Footer: ArcGIS 10.0, 2012-04-19 13:40 File: I:\Projects\23\41\003\Maps\PlanFigures\Final_2012_04_20\Figure 3-3 City of Willmar Future Land Use.mxd User: arm2



Barr Footer: ArcGIS 10.0, 2012-04-19 13:51 File: I:\Projects\23\34\11003\Maps\PlanFigures\Final_2012_04_20\Figure 3-4 Topography.mxd User: arm2

BARR

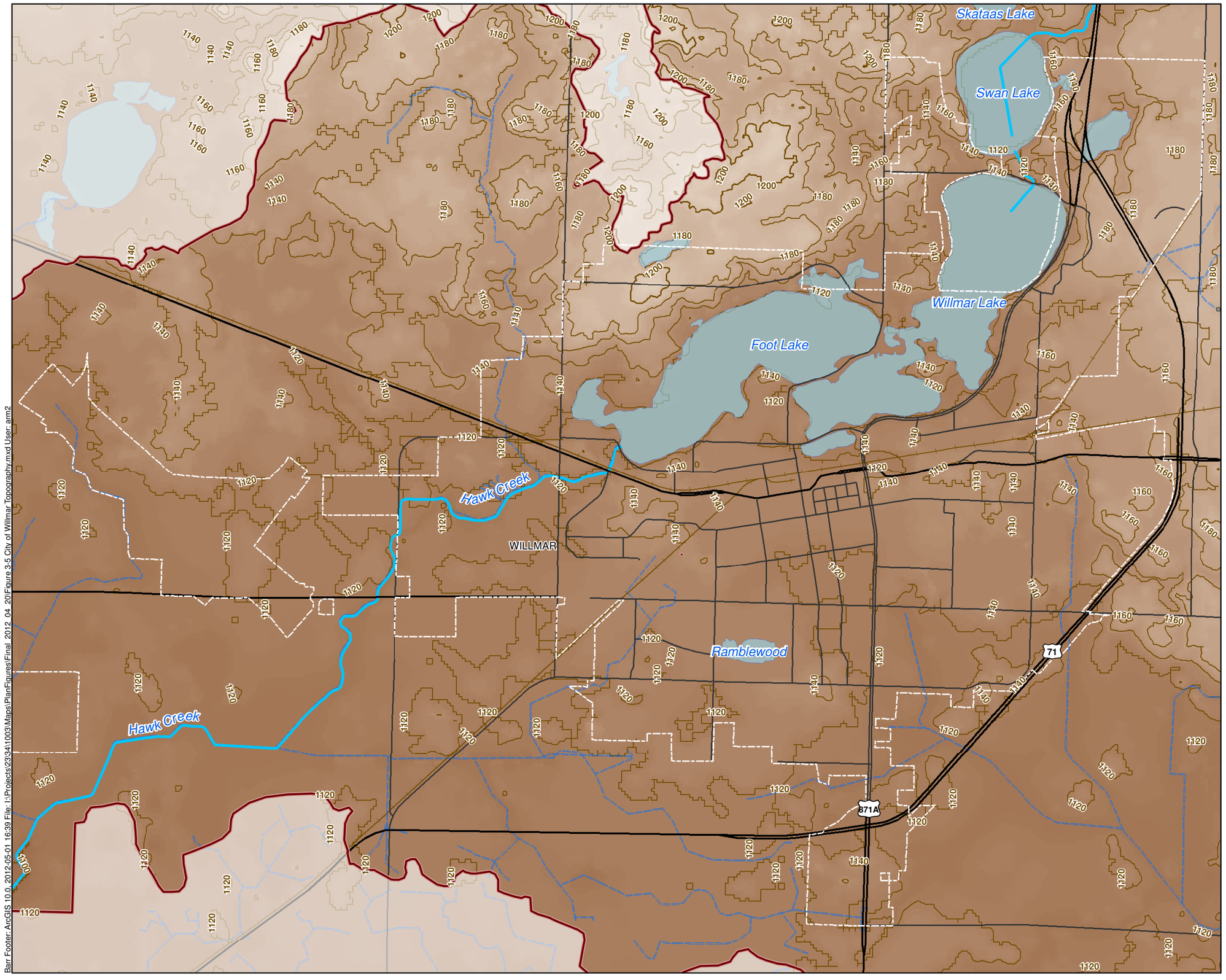
0 1 2
Miles

StudyArea
Municipalities
County Ditch
Judicial Ditch
State Ditch
Streams and Rivers
Lakes

Surface Contours (NAVD88)
100 Foot
20 Foot

Surface Elevation (NAVD88)
High : 1296
Low : 1065

Figure 3-4
TOPOGRAPHY
City of Willmar
Watershed Management Plan Update
Kandiyohi County, Minnesota



StudyArea
Municipalities
County Ditch
Judicial Ditch
State Ditch
Rivers and Streams
Lakes

Surface Contours (NAVD88)

50 Foot
10 Foot

Surface Elevation (NAVD88)

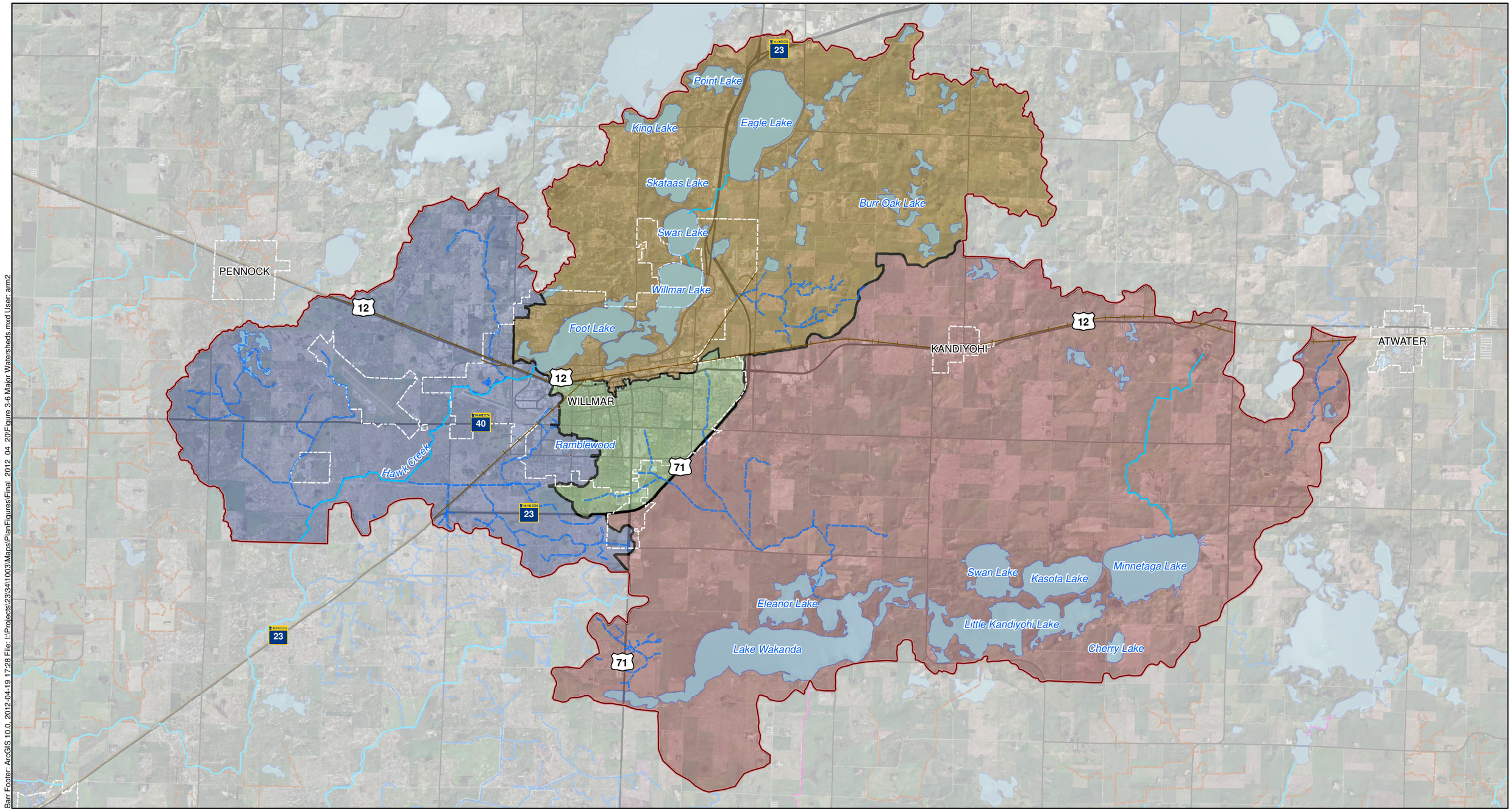
High : 1296
Low : 1065

3,100 1,550 0 3,100
Feet

N

Barr Footer: ArcGIS 10.0, 2012-05-01 16:39 File: I:\Projects\23\34\11003\Maps\PlanFigures\Final 2012_04_20\Figure 3-5 City of Willmar Topography.mxd User: arm2

Figure 3-5
CITY OF WILLMAR TOPOGRAPHY
City of Willmar
Watershed Management Plan Update
Kandiyohi County, Minnesota



Barr Footer: ArcGIS 10.0, 2012-04-19 17:28 File: I:\Projects\23\34\11003\Maps\PlanFigures\Final_2012_04_20\Figure 3-6 Major Watersheds.mxd User: arm2

BARR

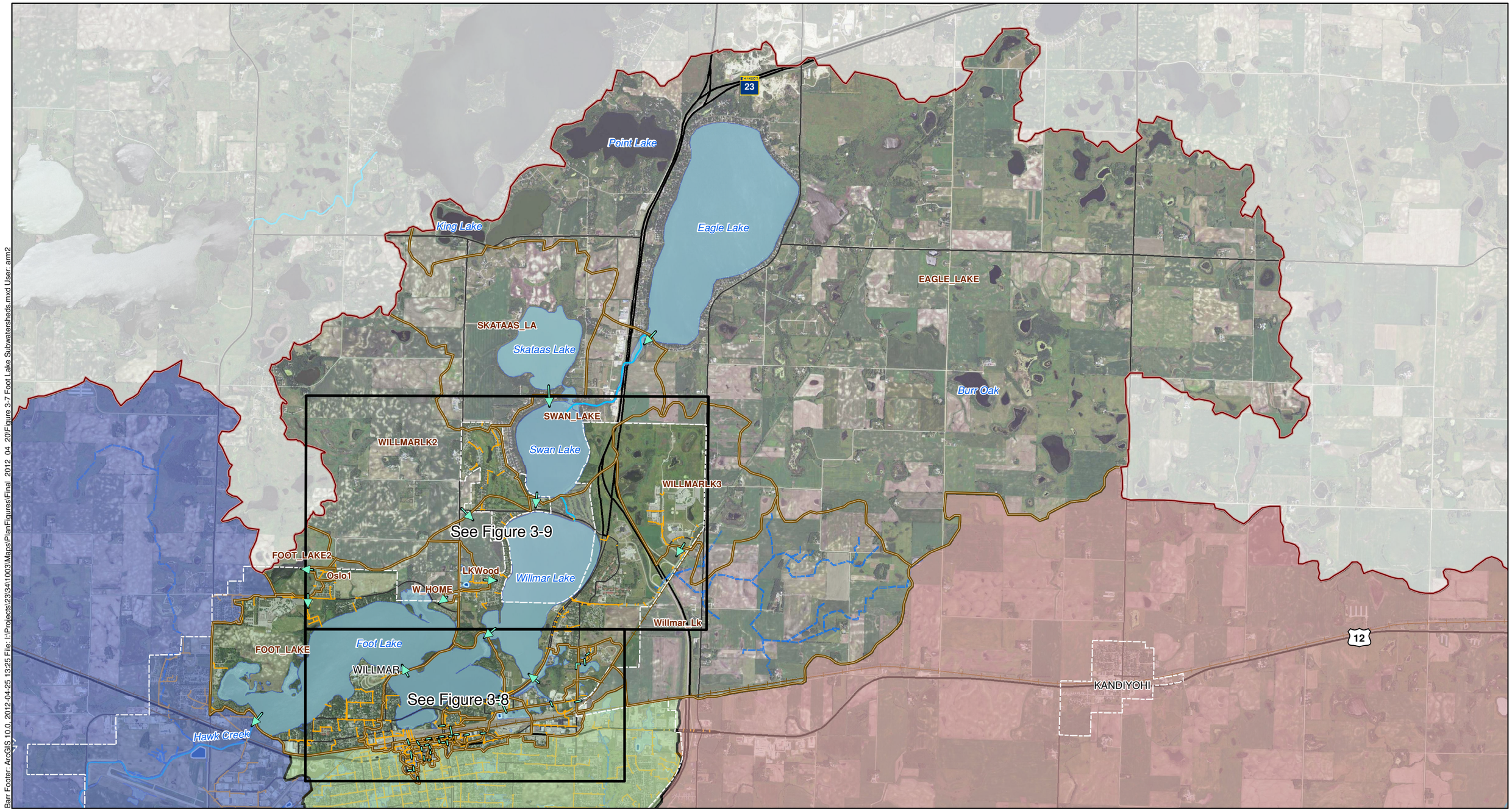
0 1 2
Miles
N

StudyArea
County Ditch
Judicial Ditch
State Ditch
Streams and Rivers
Lakes

Municipalities

Major Watersheds
Southeast Willmar
Foot Lake
Hawk Creek
Lake Wakanda

Figure 3-6
MAJOR WATERSHEDS
City of Willmar
Watershed Management Plan Update
Kandiyohi County, Minnesota



Barr Footer: ArcGIS 10.0, 2012-04-25 13:25 File: I:\Projects\23\3411003\Maps\PlanFigures\Final_2012_04_20\Figure 3-7 Foot Lake Subwatersheds.mxd User: arm2

BARR

0 2,000 4,000

Feet

N

- StudyArea
- Oslo1 Subwatersheds
- Municipalities
- Approximate 100-year HWL*
- Flow Arrow
- Public Storm Sewer
- County Ditch
- Judicial Ditch
- State Ditch
- Streams and Rivers
- Stormwater Ponds

* 100-year HWL mapped using NGVD29

Figure 3-7
FOOT LAKE SUBWATERSHEDS
City of Willmar
Watershed Management Plan Update
Kandiyohi County, Minnesota

Barr Footer: ArcGIS 10.0, 2012-04-25 13:46 File: I:\Projects\23\3411003\Maps\PlanFigures\Final_2012_04_20\Figure 3-8 South Foot Lake Subwatersheds.mxd User: arm2

BARR

0 500 1,000

Feet

N

- StudyArea
- Subwatersheds (G-m5)
- Approximate 100-year HWL*
- Municipalities
- Flow Arrow
- Public Storm Sewer
- County Ditch
- Judicial Ditch
- State Ditch
- Rivers and Streams
- Stormwater Ponds

* 100-year HWL mapped using NGVD29

Figure 3-8
SOUTH FOOT LAKE SUBWATERSHEDS
City of Willmar
Watershed Management Plan Update
Kandiyohi County, Minnesota

Barr Footer: ArcGIS 10.0, 2012-04-25 14:04 File: I:\Projects\23134\1003\Maps\PlanFigures\Final_2012_04_20\Figure 3-9 Central Foot Lake Subwatersheds.mxd User: arm2

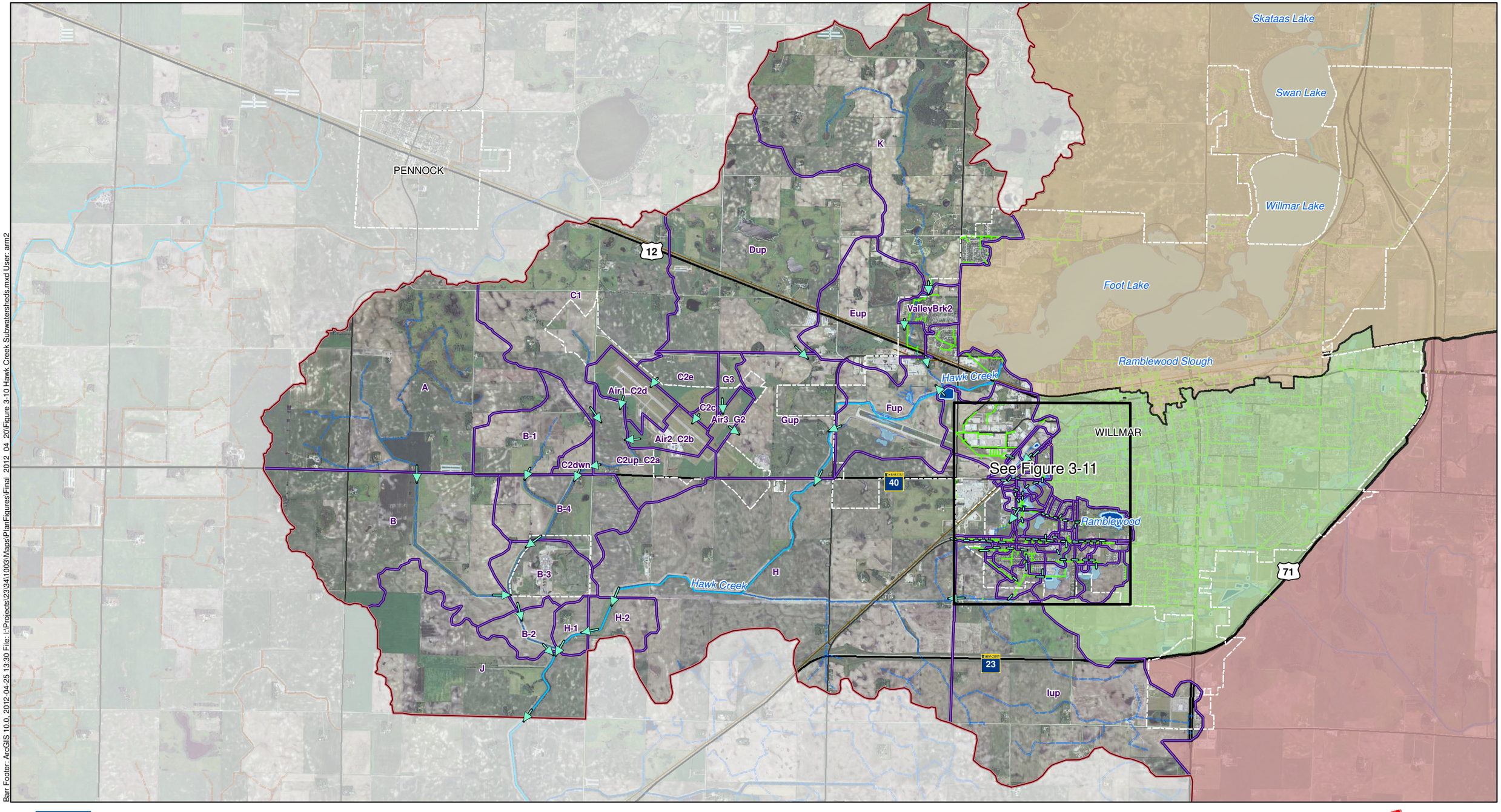
BARR

0 600 1,200
Feet
N

- StudyArea
- Subwatersheds (G-m5)
- Approximate 100-year HWL*
- Municipalities
- Flow Arrow
- Public Storm Sewer
- County Ditch
- Judicial Ditch
- State Ditch
- Rivers and Streams
- Stormwater Ponds

* 100-year HWL mapped using NGVD29

Figure 3-9
CENTRAL FOOT LAKE SUBWATERSHEDS
City of Willmar
Watershed Management Plan Update
Kandiyohi County, Minnesota



BARR

0 2,000 4,000
Feet
N

- StudyArea
- Subwatersheds (Gup)
- Approximate 100-year HWL*
- Municipalities
- Flow Arrow
- Public Storm Sewer
- County Ditch
- Judicial Ditch
- State Ditch
- Rivers and Streams
- Stormwater Ponds

* 100-year HWL mapped using NGVD29

Figure 3-10
HAWK CREEK SUBWATERSHEDS
City of Willmar
Watershed Management Plan Update
Kandiyohi County, Minnesota

Hawk Creek
Fup
Hwy5_POND
SSF-12
SSF-8
SSF-9
SSF-7
SSF-11
SSF-10
40
WILLMAR
SSF-5
SSF-6
SSF-14B
SSF-1C
SSF-1D
SSF-4
SSF-1B
SSF-14C
SSF-1
SSF-14A
E-m2
E-m1
E-m6
SSF-3
E-m7
Ramblewood
E-m5a
SSF-2
FIELD1E
SSF-13
E-m27
E-m18
E-m19
E-m24
E-m25
E-m26
E-m30
E-m5b
E-m35
E-m34
E-m15
E-m16
E-m20
E-m21
E-m23
E-m28
E-m33
E-m36
FamEYE
E-m11
E-m8
E-m13
E-m37
WW2
E-m39
E-m12
23rd-5
E-m38
23rd-4
E-m41
23rd-2
23rd-3
WW3

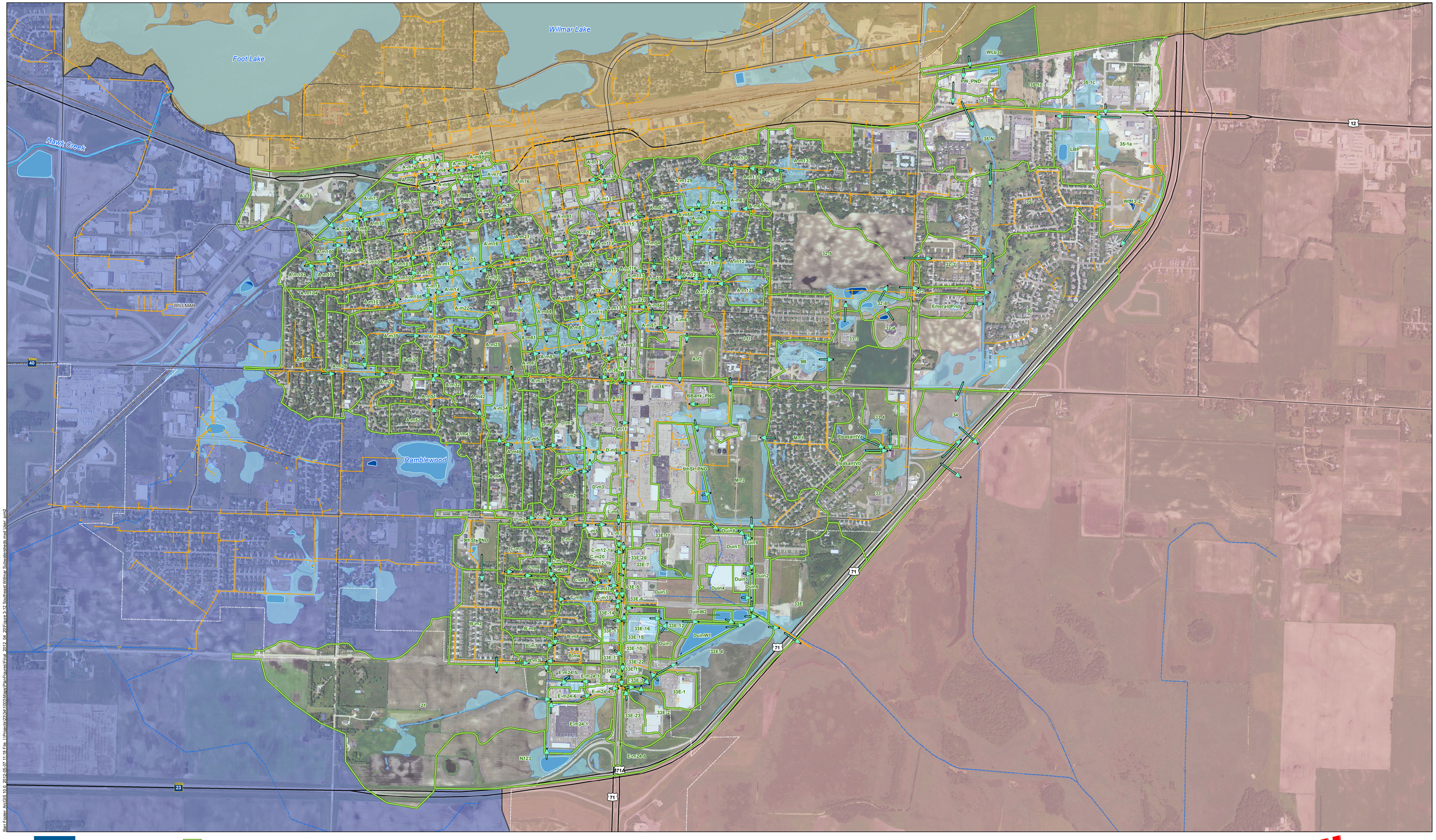
BARR

0 500 1,000
Feet
N

- StudyArea
- WW3 Subwatersheds
- Approximate 100-year HWL*
- Municipalities
- Flow Arrow
- Public Storm Sewer
- County Ditch
- Judicial Ditch
- State Ditch
- Rivers and Streams
- Stormwater Ponds

* 100-year HWL mapped using NGVD29

Figure 3-11
EAST HAWK CREEK SUBWATERSHEDS
City of Willmar
Watershed Management Plan Update
Kandiyohi County, Minnesota



BARR

0 400 800 1,600

Feet

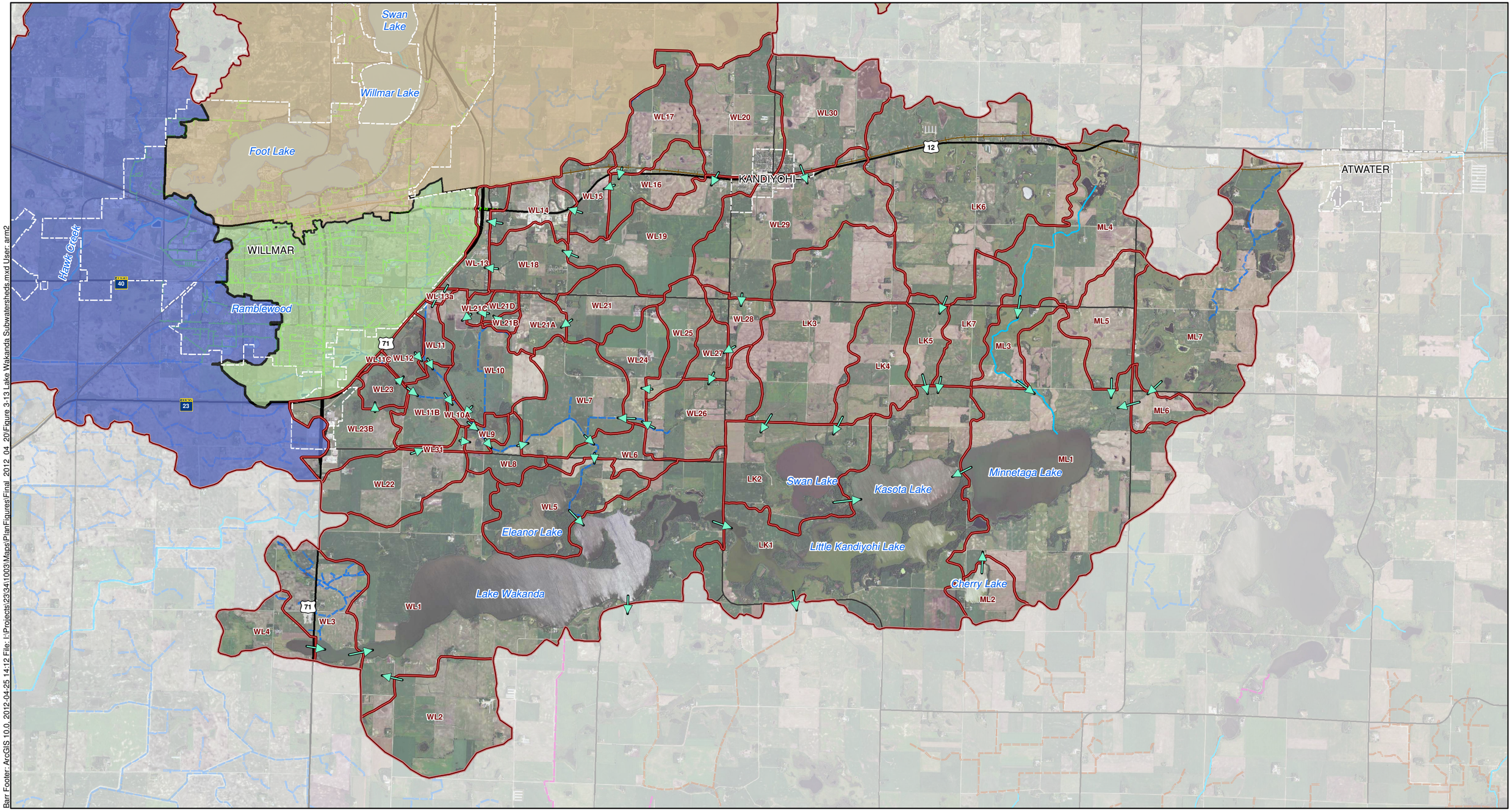
N

- M-f2 Subwatersheds
- Municipalities
- Approximate 100-year HWL*
- Flow Arrow
- Public Storm Sewer
- Rivers and Streams
- Stormwater Ponds
- County Ditch
- Judicial Ditch
- State Ditch

* 100-year HWL mapped using NGVD29

Figure 3-12
SOUTHEAST WILLMAR SUBWATERSHEDS
City of Willmar
Watershed Management Plan Update
Kandiyohi County, Minnesota

Barr Footer: ArcGIS 10.0, 2012-06-07 11:18 File: L:\Projects\23\3411\003\Maps\Plan\Figures\Final_2012_04_20\Figure 3-12 Southeast Willmar Subwatersheds.mxd User: emr2



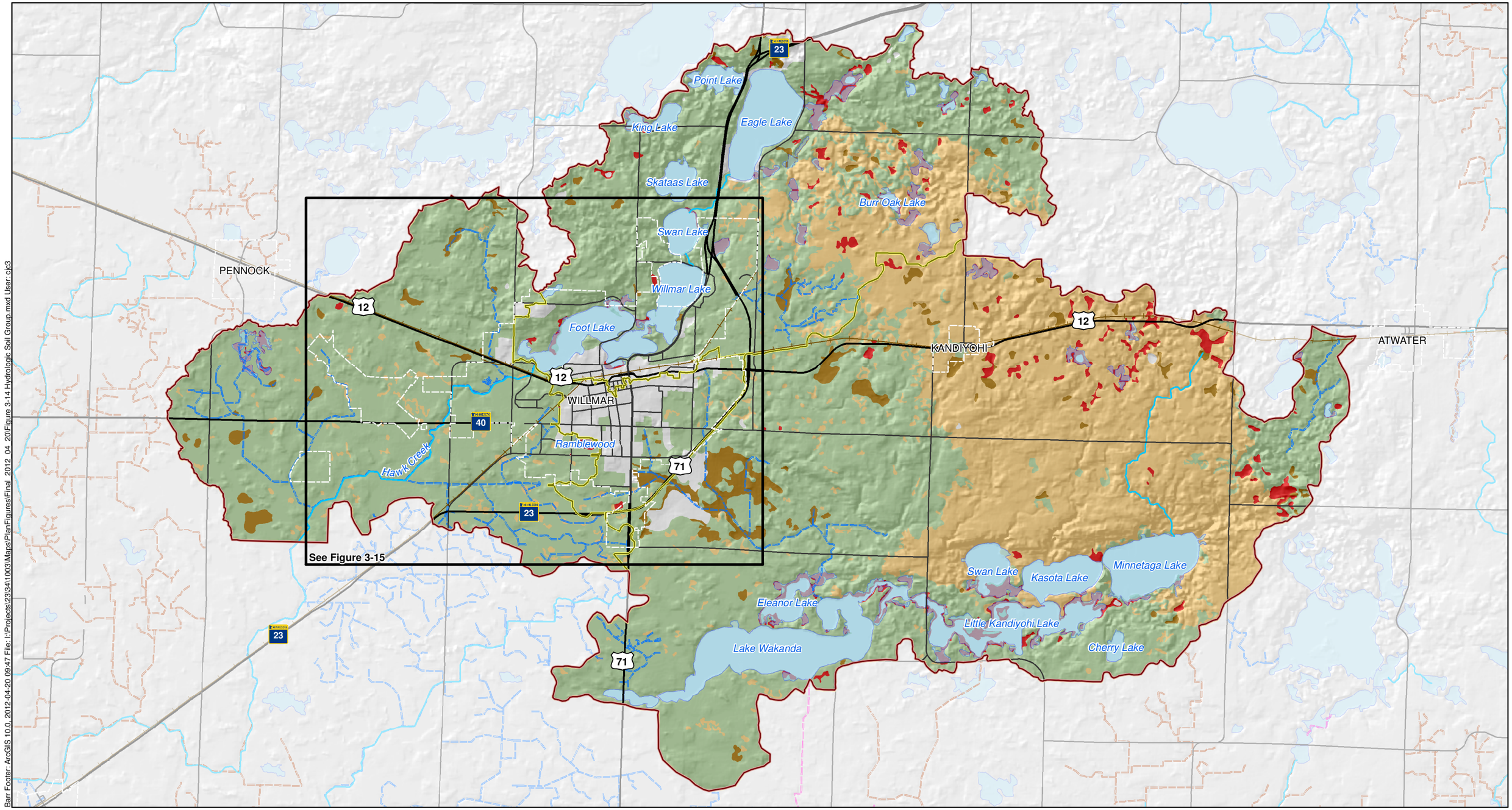
BARR

0 3,000 6,000
Feet
N

- StudyArea
- WL1 Subwatersheds
- Municipalities
- Approximate 100-year HWL*
- Flow Arrow
- Public Storm Sewer
- County Ditch
- Judicial Ditch
- State Ditch
- Rivers and Streams
- Stormwater Ponds

* 100-year HWL mapped using NGVD29

Figure 3-13
LAKE WAKANDA SUBWATERSHEDS
City of Willmar
Watershed Management Plan Update
Kandiyohi County, Minnesota



Barr Footer: ArcGIS 10.0, 2012-04-20 09:47 File: I:\Projects\23\3411003\Maps\PlanFigures\Final_2012_04_20\Figure 3-14 Hydrologic Soil Group.mxd User: cjc3

BARR

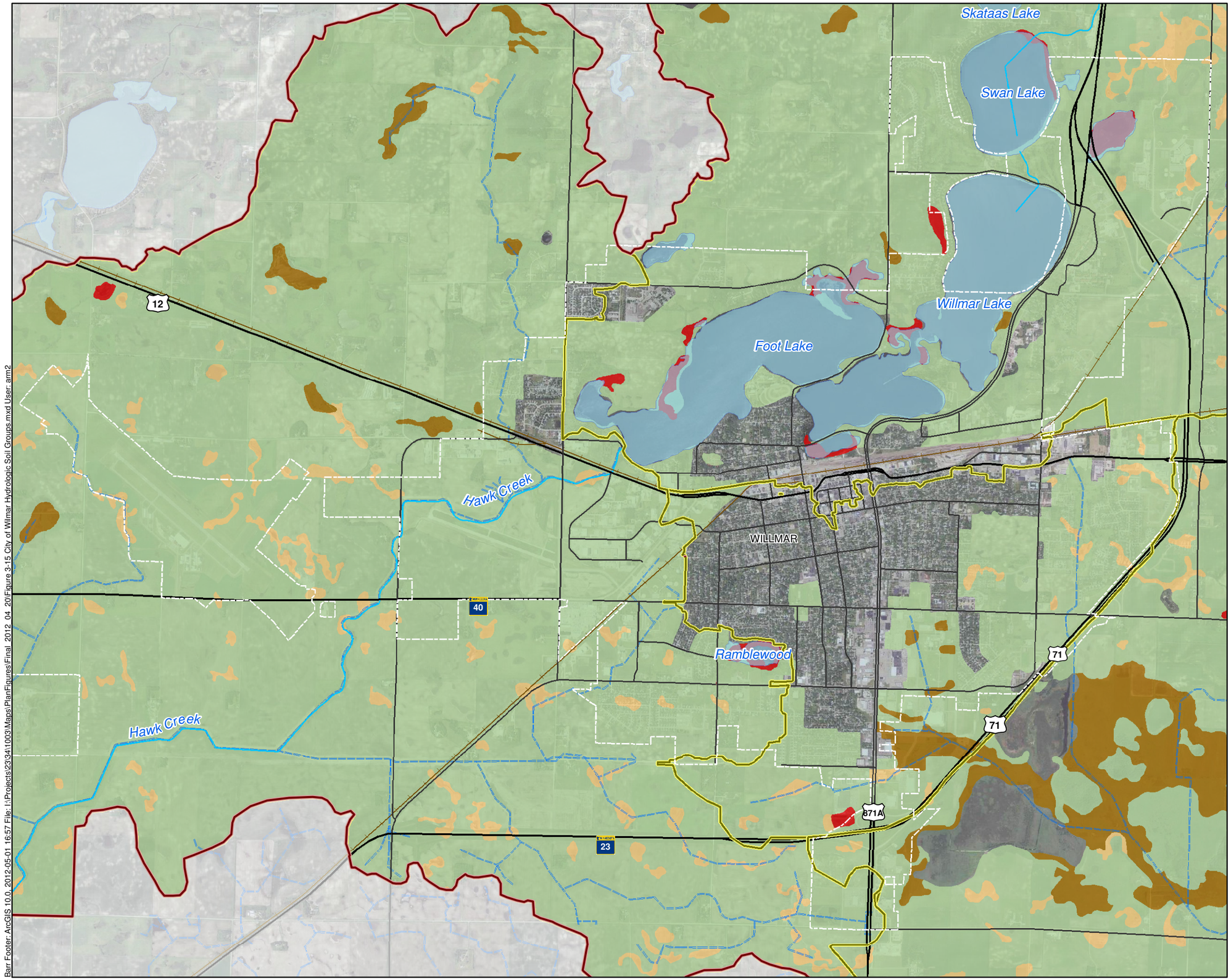
0 1 2
Miles

N

Major Watersheds
Municipalities
Rivers and Streams
County Ditch
Judicial Ditch
State Ditch

Hydrologic Soils Group
A
B
C
D
Unclassified

Figure 3-14
HYDROLOGIC SOIL GROUPS
City of Willmar
Watershed Management Plan Update
Kandiyohi County, Minnesota



StudyArea
Major Watersheds
Municipalities
County Ditch
Judicial Ditch
State Ditch
Rivers and Streams
Lakes

Hydrologic Soils Group

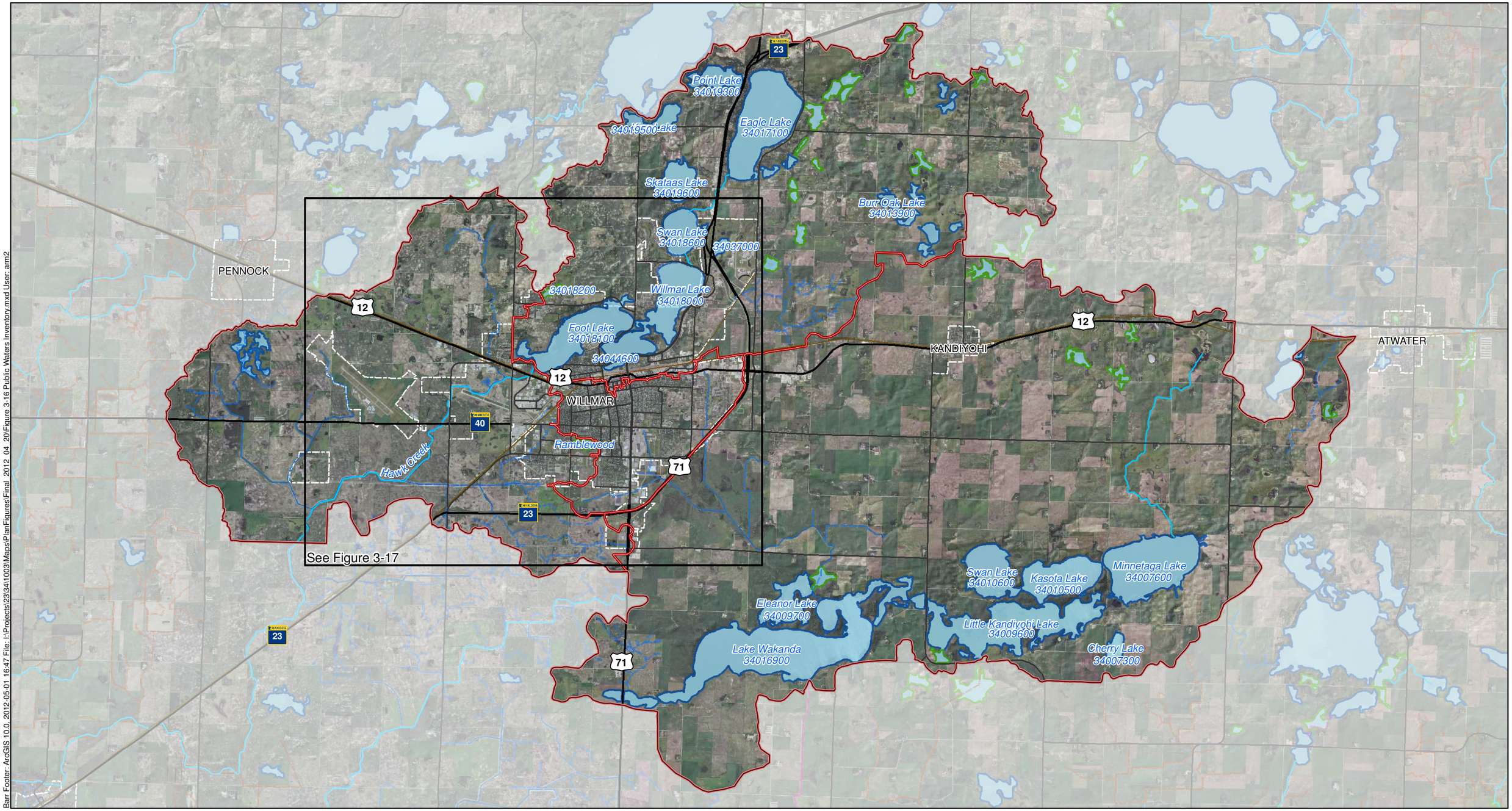
A
B
C
D
Unclassified

3,100 1,550 0 3,100

Feet

N

Figure 3-15
CITY OF WILLMAR
HYDROLOGIC SOIL GROUPS
City of Willmar
Watershed Management Plan Update
Kandiyohi County, Minnesota



Barr Footer: ArcGIS 10.0, 2012-05-01 16:47 File: I:\Projects\23\3411003\Maps\PlanFigures\Final_2012_04_20\Figure 3-16 Public Waters Inventory.mxd User: arm2

BARR

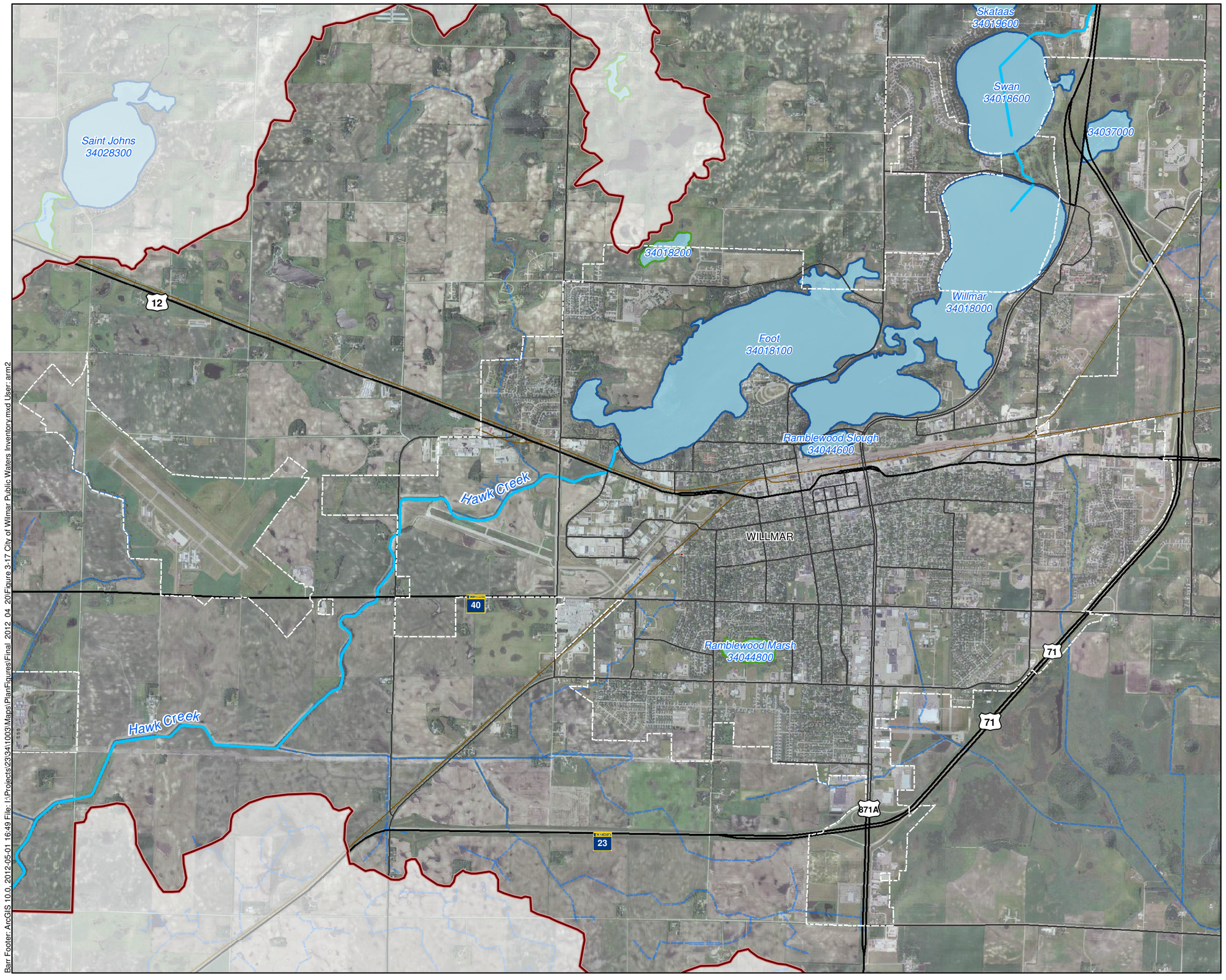
0 1 2
Miles

N

- StudyArea
- Major Watersheds
- Municipalities
- County Ditch
- Judicial Ditch
- State Ditch
- Public Waters Inventory Rivers and Streams
- Public Waters
- Public Waters Wetlands

Note: Public Waters are labeled with the DNR Division of Waters Lake Identification Number.

Figure 3-16
PUBLIC WATERS INVENTORY
City of Willmar
Watershed Management Plan Update
Kandiyohi County, Minnesota



StudyArea
Municipalities
County Ditch
Judicial Ditch
State Ditch
Public Waters Inventory Rivers and Streams
Public Waters
Public Waters Wetlands

Note: Public Waters are labeled with the DNR Division of Waters Lake Identification Number.

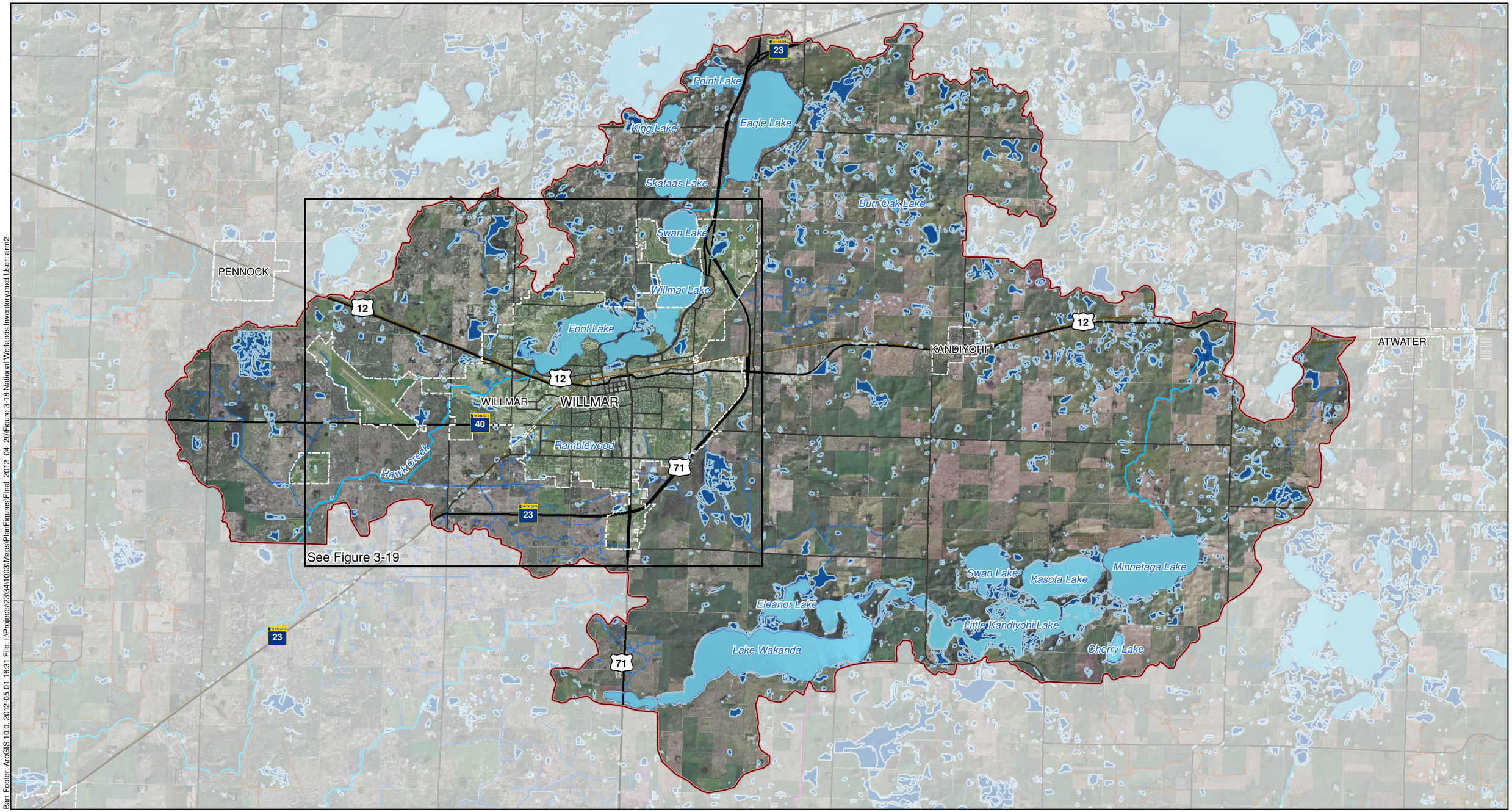
3,100 1,550 0 3,100
Feet

N

BARR

Figure 3-17
CITY OF WILLMAR
PUBLIC WATERS INVENTORY
City of Willmar
Watershed Management Plan Update
Kandiyohi County, Minnesota

Barr Footer: ArcGIS 10.0, 2012-05-01 16:49 File: I:\Projects\23\41\003\Maps\PlanFigures\Final 2012_04_20\Figure 3-17 City of Wilmar Public Waters Inventory.mxd User: arm2



Barr Footer: ArcGIS 10.0, 2012-05-01 16:31 File: I:\Projects\23\3411003\Maps\PlanFigures\Final_2012_04_20\Figure 3-18 National Wetlands Inventory.mxd User: arm2

BARR

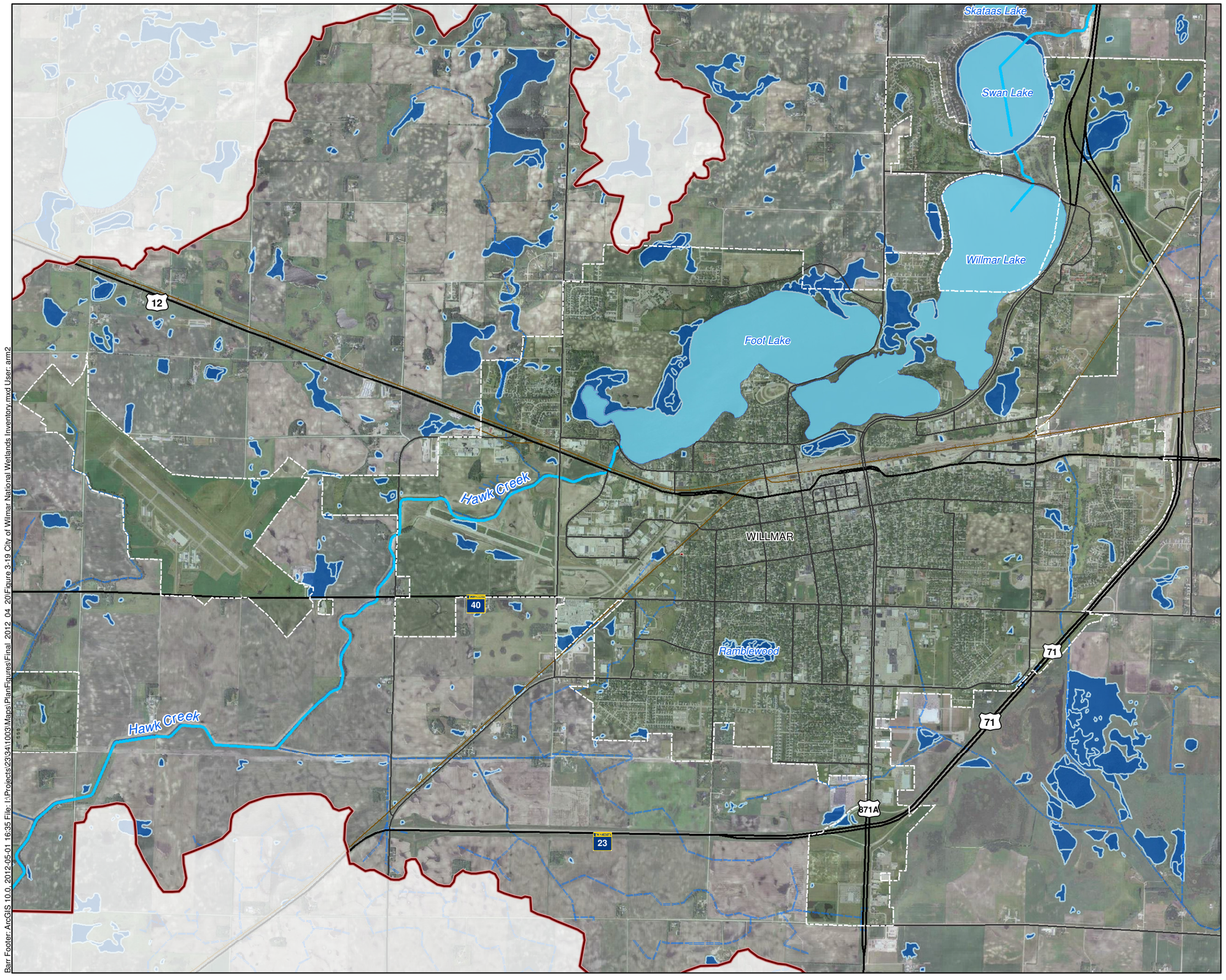
0 1 2
Miles

N

StudyArea
Municipalities
County Ditch
Judicial Ditch
State Ditch
Rivers and Streams

National Wetland Inventory (NWI)
Wetlands
Riverine, Lake

Figure 3-18
NATIONAL WETLAND INVENTORY
City of Willmar
Watershed Management Plan Update
Kandiyohi County, Minnesota



StudyArea
Municipalities
County Ditch
Judicial Ditch
State Ditch
Rivers and Streams

National Wetland Inventory (NWI)

Wetlands
Riverine, Lake

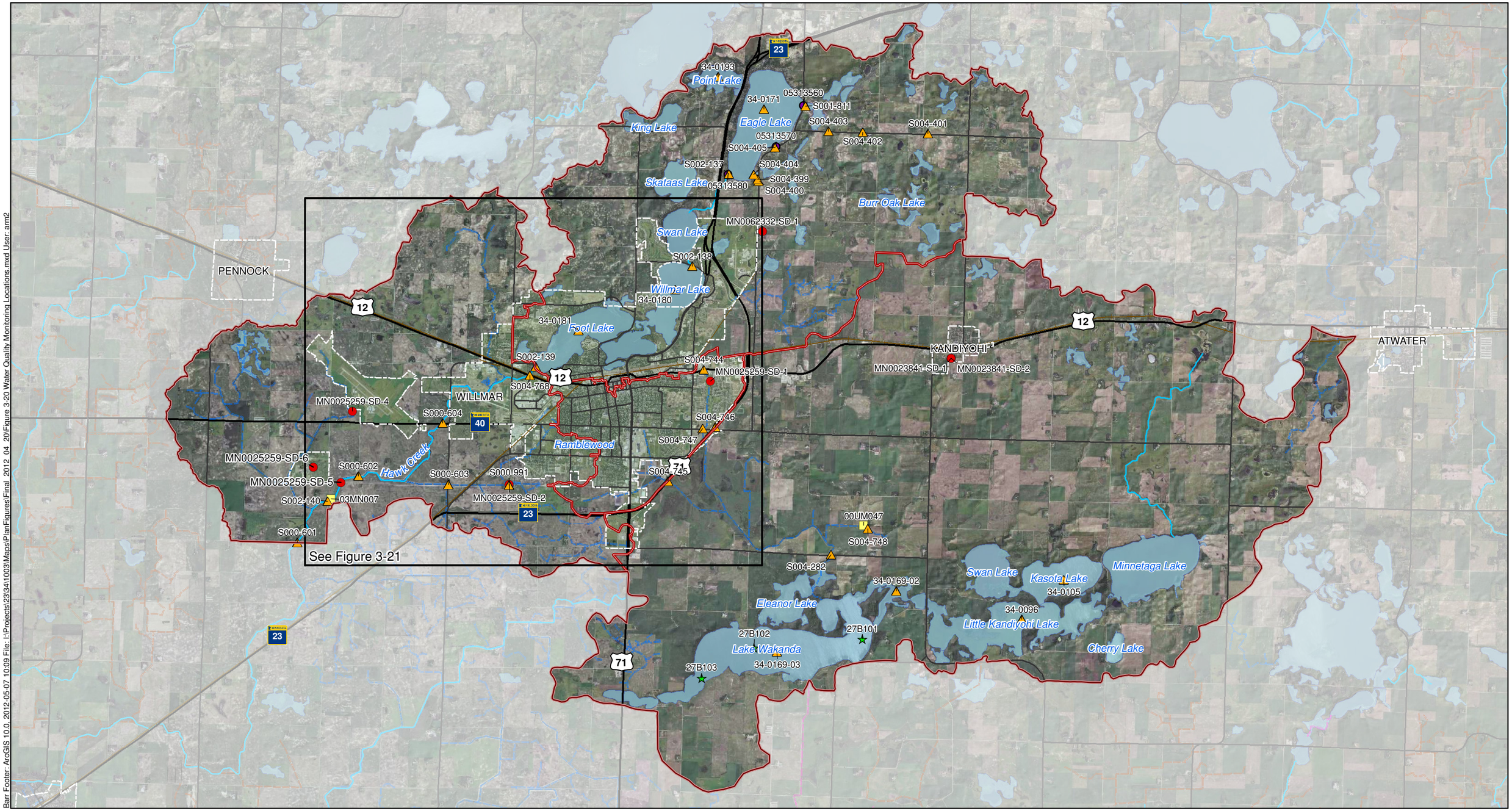
3,100 1,550 0 3,100
Feet

N

BARR

Figure 3-19
CITY OF WILLMAR
NATIONAL WETLANDS INVENTORY
City of Willmar
Watershed Management Plan Update
Kandiyohi County, Minnesota

Barr Footer: ArcGIS 10.0, 2012-05-01 16:35 File: I:\Projects\23\34\1003\Maps\PlanFigures\Final_2012_04_20\Figure 3-19 City of Wilmar National Wetlands Inventory.mxd User: arm2



BARR

0 1 2
Miles

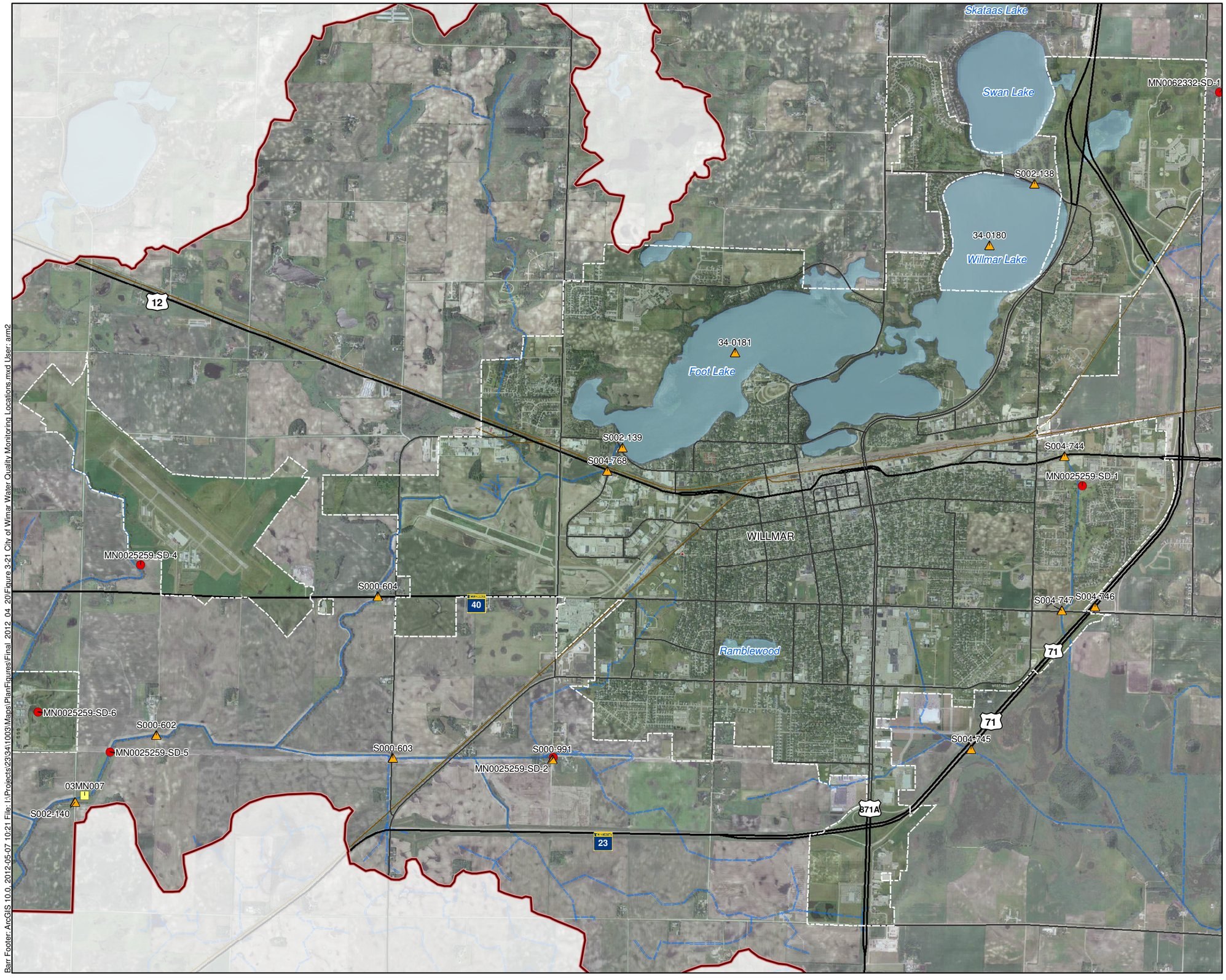
N

- StudyArea
- Major Watersheds
- Municipalities
- County Ditch
- Judicial Ditch
- State Ditch
- Rivers and Streams
- Lakes

Water Quality Locations

- EPA Monitoring
- MPCA Environmental Data Access Surface WQ
- Biological Monitoring
- USGS Monitoring
- NPDES Discharge

Figure 3-20
WATER QUALITY MONITORING LOCATIONS
City of Willmar
Watershed Management Plan Update
Kandiyohi County, Minnesota



Water Quality Locations

- MPCA Environmental Data Access Surface WQ
- Biological Monitoring
- NPDES Discharge
- StudyArea
- Municipalities
- County Ditch
- Judicial Ditch
- State Ditch
- Rivers and Streams
- Lakes

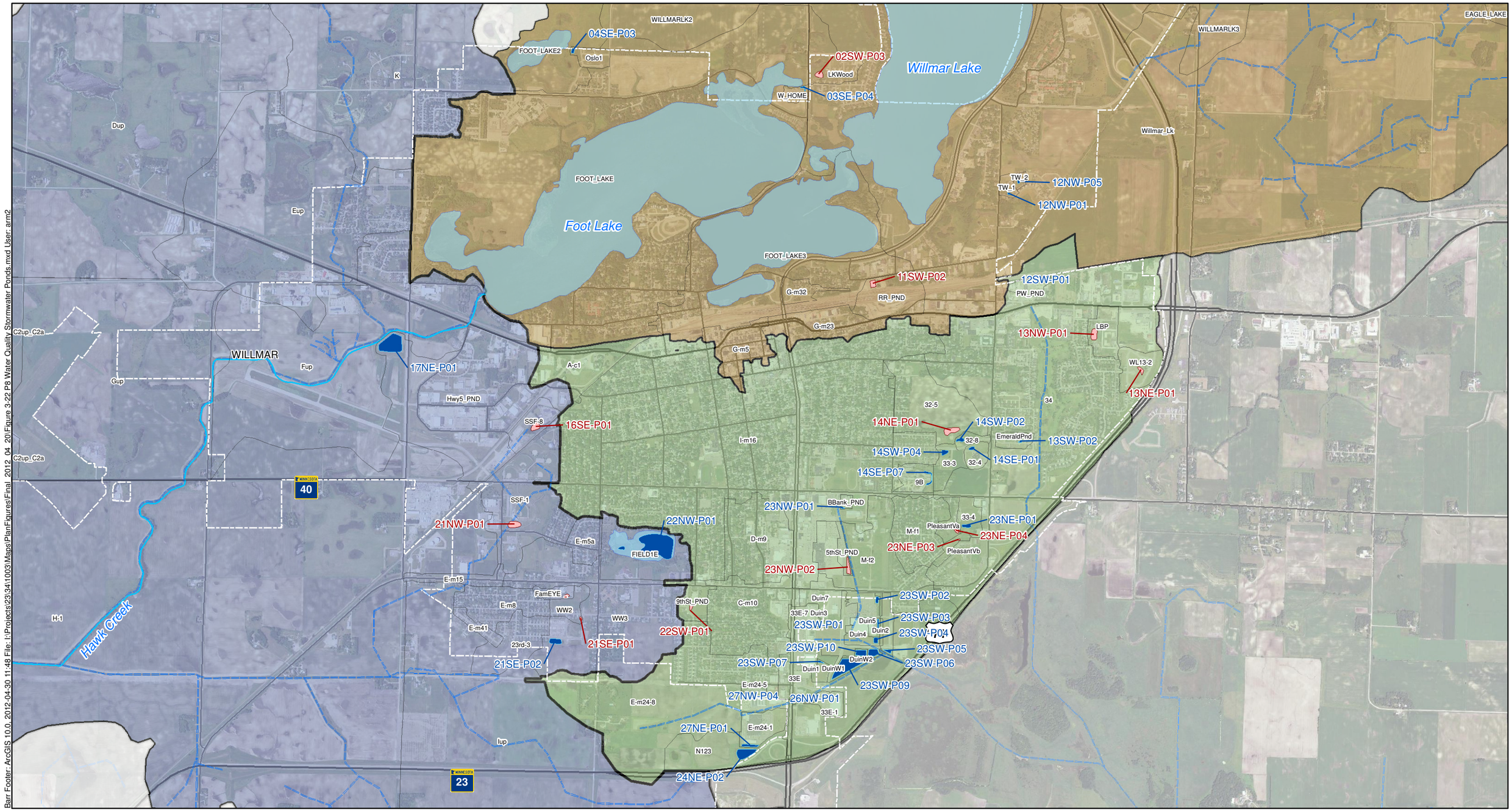
3,100 1,550 0 3,100

Feet

N

Figure 3-21
CITY OF WILLMAR WATER QUALITY MONITORING LOCATIONS
City of Willmar
Watershed Management Plan Update
Kandiyohi County, Minnesota

Barr Footer: ArcGIS 10.0, 2012-05-07 10:21 File: I:\Projects\23\41\003\Maps\PlanFigures\Final 2012_04_20\Figure 3-21 City of Wimar Water Quality Monitoring Locations.mxd User: arm2



Barr Footer: ArcGIS 10.0, 2012-04-30 11:48 File: I:\Projects\23\341\003\Maps\PlanFigures\Final_2012_04_20\Figure 3-22 P8 Water Quality Stormwater Ponds.mxd User: arm2

BARR

0 1,250 2,500

Feet

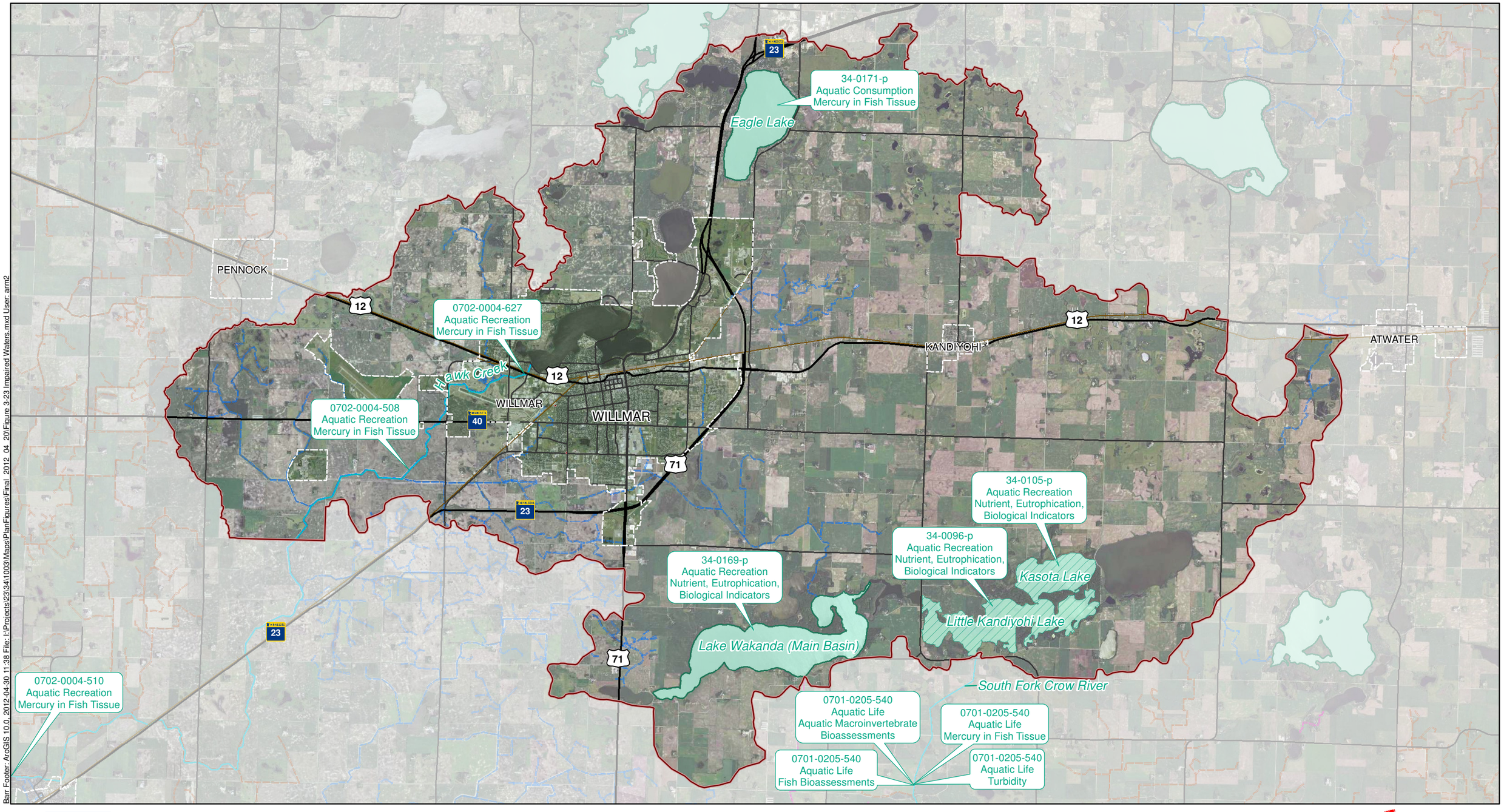
N

- Streams and Rivers
- Public Waters Inventory Basins
- Stormwater Pond
- Dry Stormwater Pond
- Municipalities

Major Watersheds

- SE Willmar
- Foot Lake
- Hawk Creek

Figure 3-22
P8 WATER QUALITY STORMWATER PONDS
City of Willmar
Watershed Management Plan Update
Kandiyohi County, Minnesota



Barr Footer: ArcGIS 10.0, 2012-04-30 11:38 File: I:\Projects\23\3411003\Maps\PlanFigures\Final_2012_04_20\Figure 3-23 Impaired Waters.mxd User: arm2

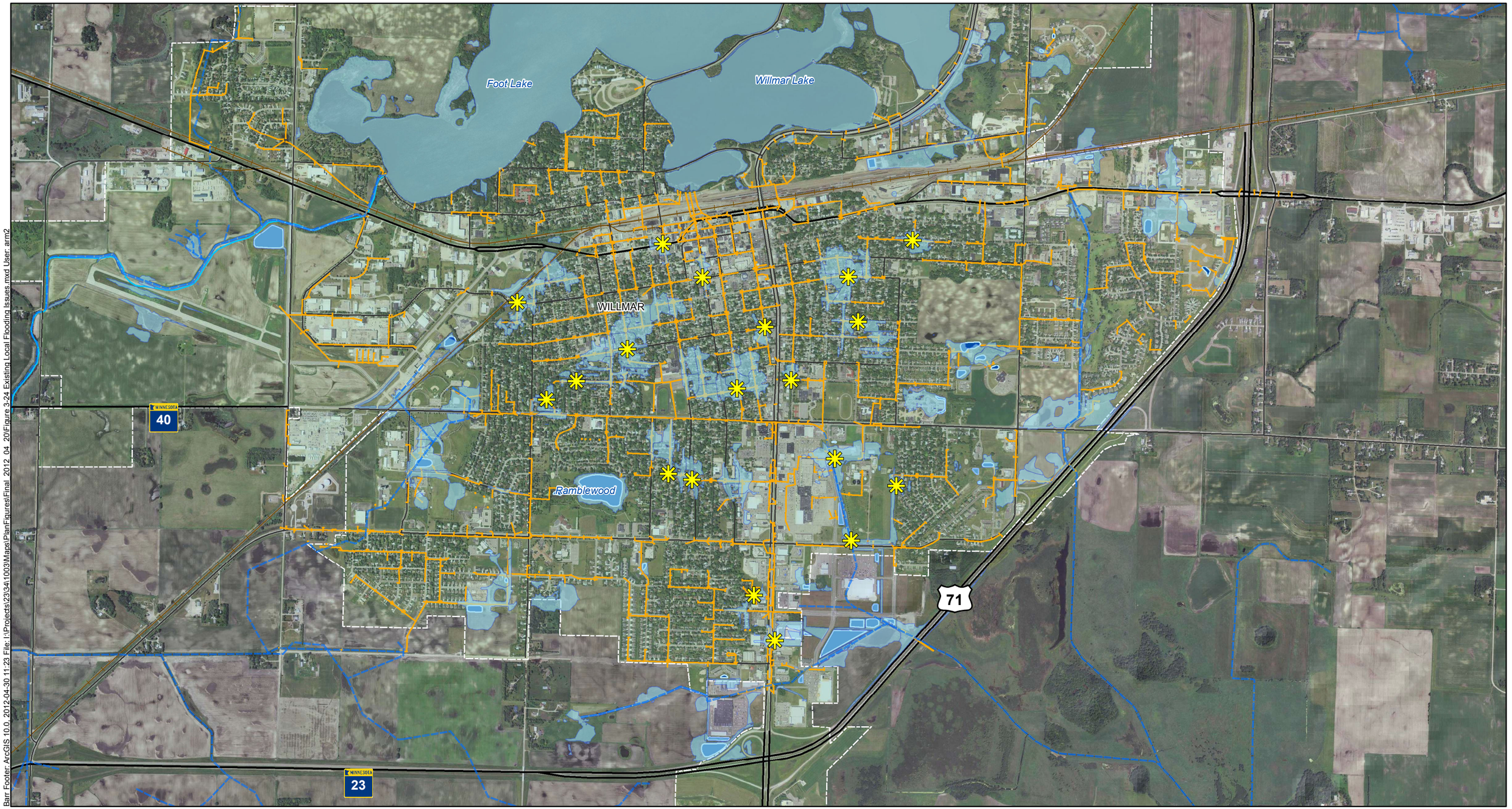
BARR

0 1 2
Miles
N

- StudyArea
- Municipalities
- County Ditch
- Judicial Ditch
- State Ditch
- Impaired Stream (2008)
- Impaired Lake (2008)
- Impaired Lake (Draft 2010 List)

Public Waters ID → 34-0169-p
Impaired Use → Aquatic Recreation
Pollutant/Stressor → Nutrient, Eutrophication, Biological Indicators

Figure 3-23
IMPAIRED WATERS
City of Willmar
Watershed Management Plan Update
Kandiyohi County, Minnesota



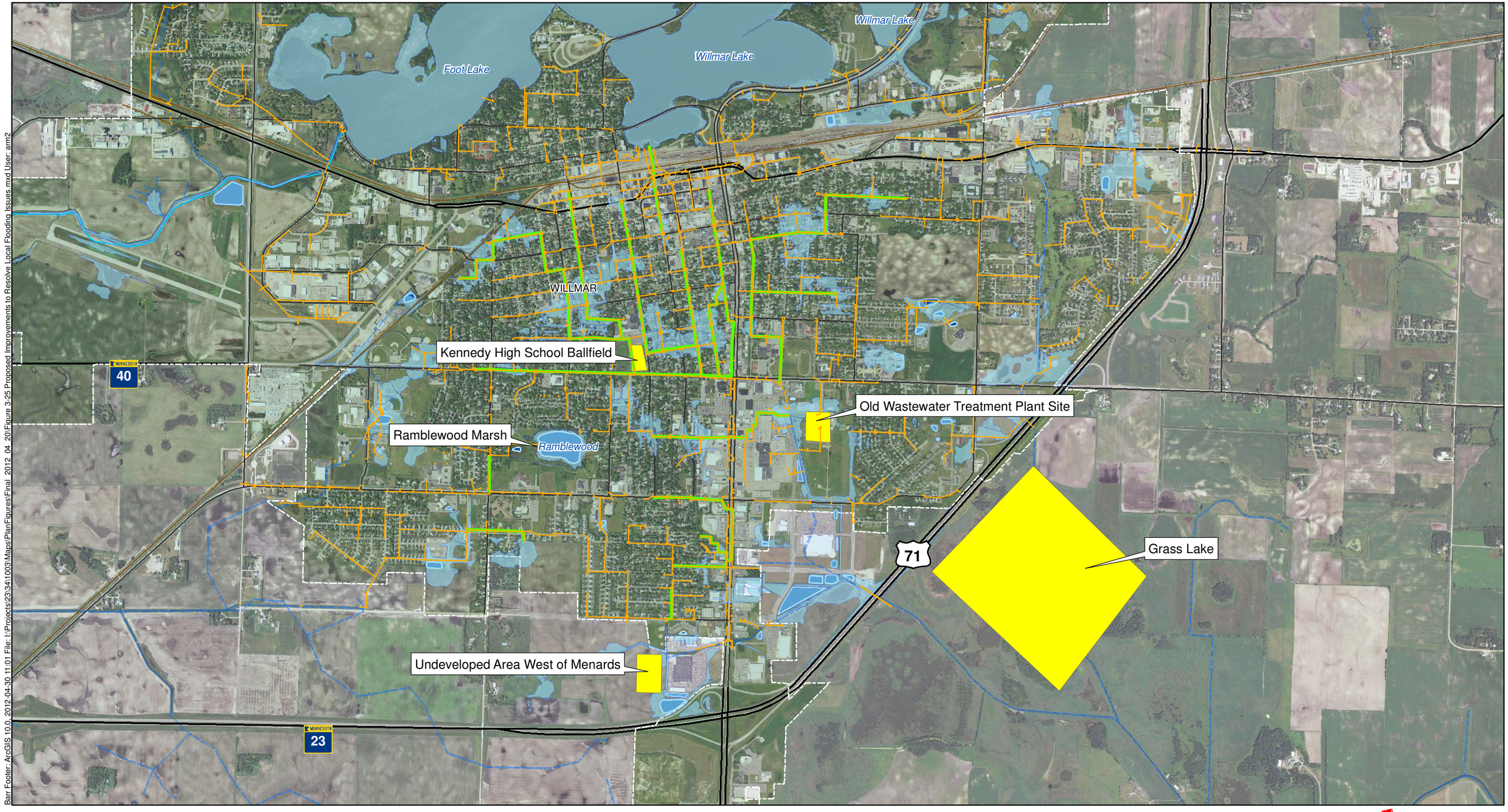
Areas of Known Flooding
Public Storm Sewer
Streams and Rivers
Approximate 100-year HWL*
Stormwater Ponds
County Ditch
Judicial Ditch
State Ditch
Municipalities

* 100-year HWL mapped using NGVD29

BARR

0 1,000 2,000
Feet
N

Figure 3-24
EXISTING LOCAL FLOODING ISSUES
City of Willmar
Watershed Management Plan Update
Kandiyohi County, Minnesota



Barr Footer: ArcGIS 10.0, 2012-04-30 11:01 File: I:\Projects\23\3411003\Maps\PlanFigures\Final_2012_04_20\Figure 3-25 Proposed Improvements to Resolve Local Flooding Issues.mxd User: arm2

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0 1,000 2,000

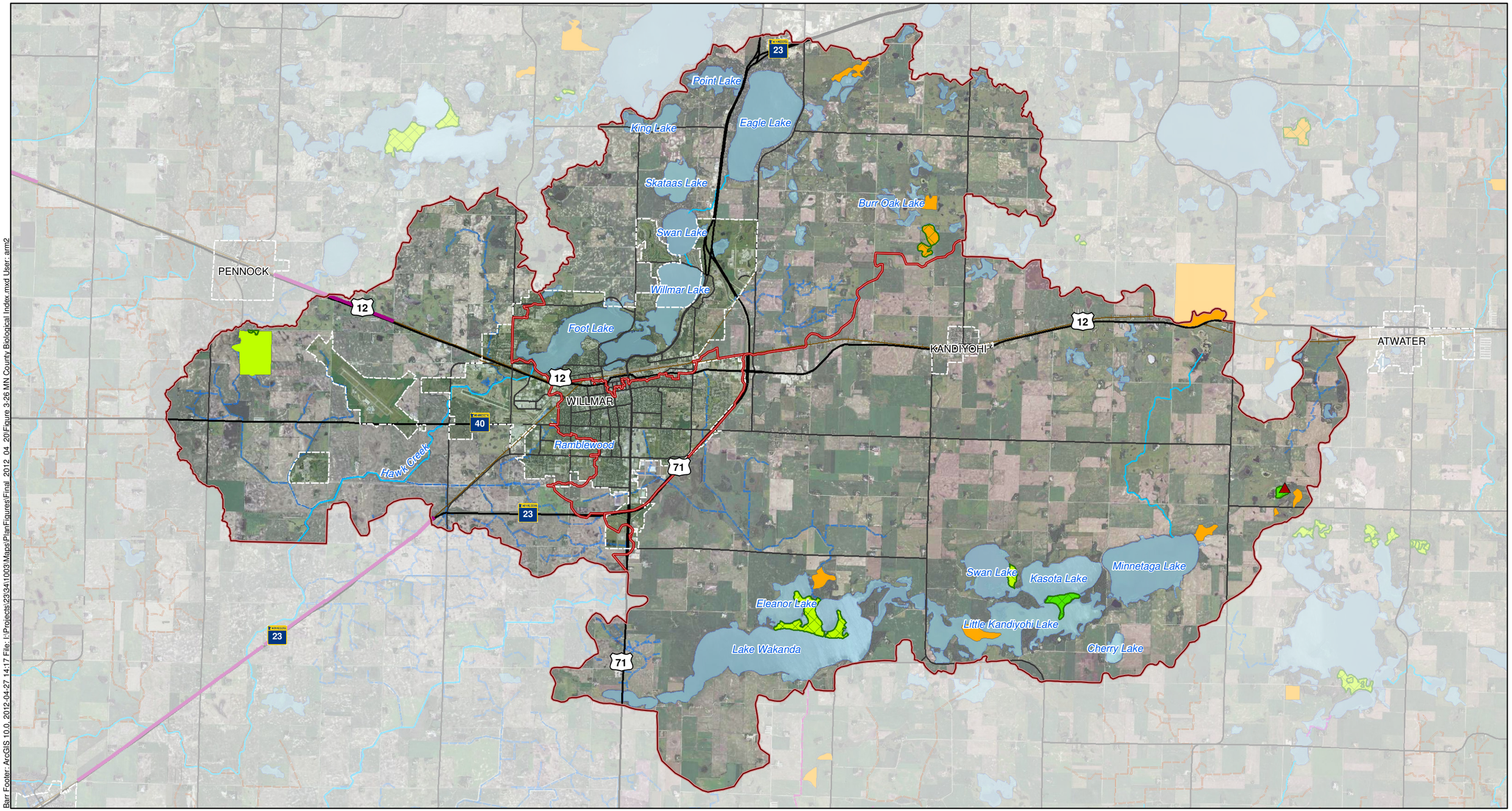
Feet

N

- Public Storm Sewer
- Increased Pipe Capacity
- Streams and Rivers
- County Ditch
- Judicial Ditch
- State Ditch
- Stormwater Ponds
- Approximate 100-year HWL*
- Potential Ponding Areas Identified by the City for Further Analysis
- Municipalities

* 100-year HWL mapped using NGVD29

Figure 3-25
PROPOSED IMPROVEMENTS TO RESOLVE LOCAL FLOODING ISSUES
City of Willmar
Watershed Management Plan Update
Kandiyohi County, Minnesota



Barr Footer: ArcGIS 10.0, 2012-04-27 14:17 File: I:\Projects\23\34\1003\Maps\PlanFigures\Final_2012_04_20\Figure 3-26 MN County Biological Index.mxd User: arm2

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0 1 2
Miles
N

- Calcareous Fens
- Railroad Right-of-Way Prairie
- Native Plant Communities

Biodiversity Significance
- High
- Moderate
- Below Threshold

- County Ditch
- Judicial Ditch
- State Ditch
- Rivers and Streams
- Lakes
- StudyArea
- Major Watersheds

Figure 3-26
MINNESOTA COUNTY BIOLOGICAL INDEX
City of Willmar
Watershed Management Plan Update
Kandiyohi County, Minnesota

LEVEL OF SERVICE

10 YEAR STORM - FOR URBAN AREAS

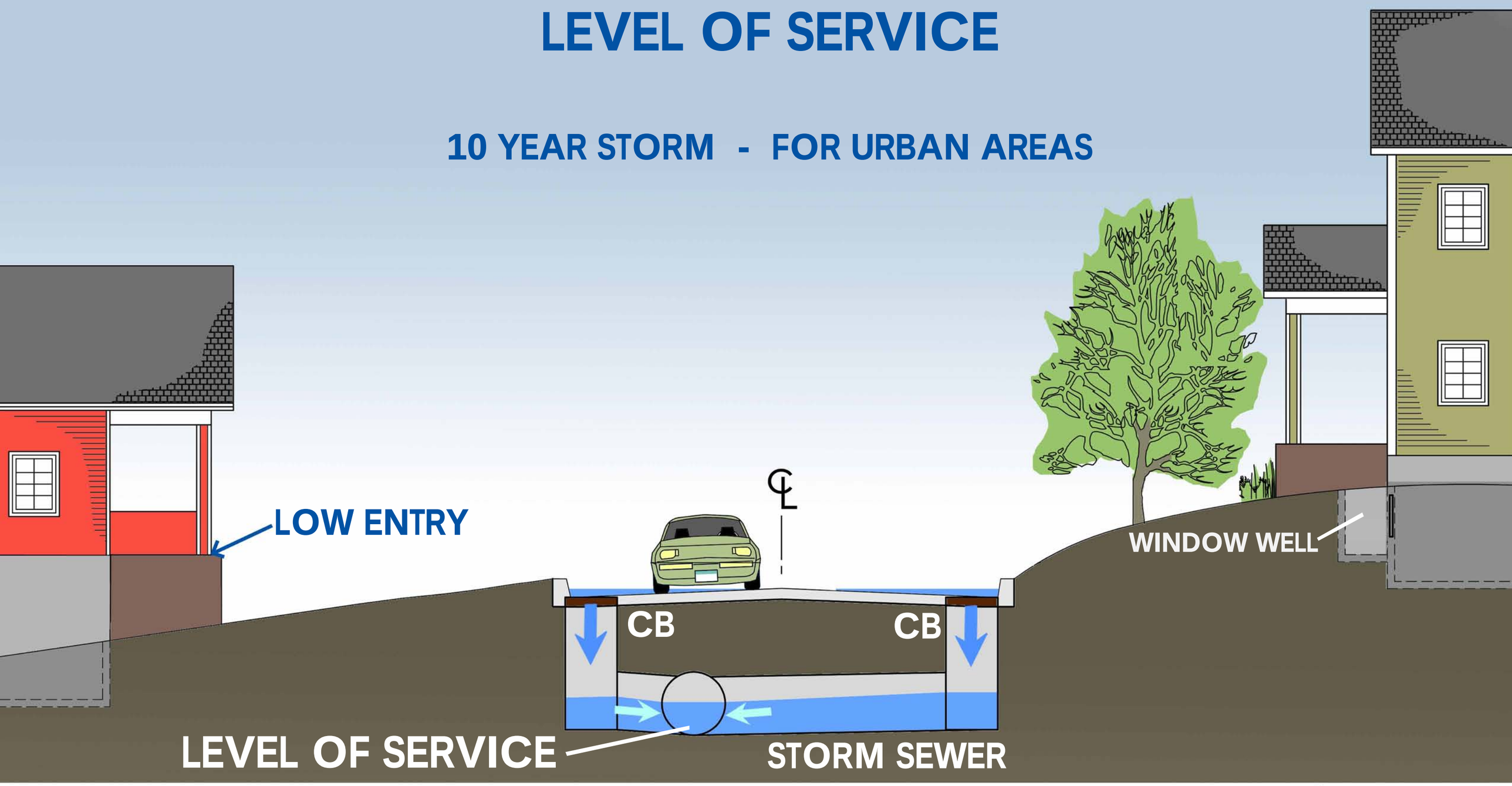

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Figure 6-1
LEVEL OF SERVICE SCHEMATIC
City of Willmar
Watershed Management Plan Update
Kandiyohi County, MN

LEVEL OF PROTECTION

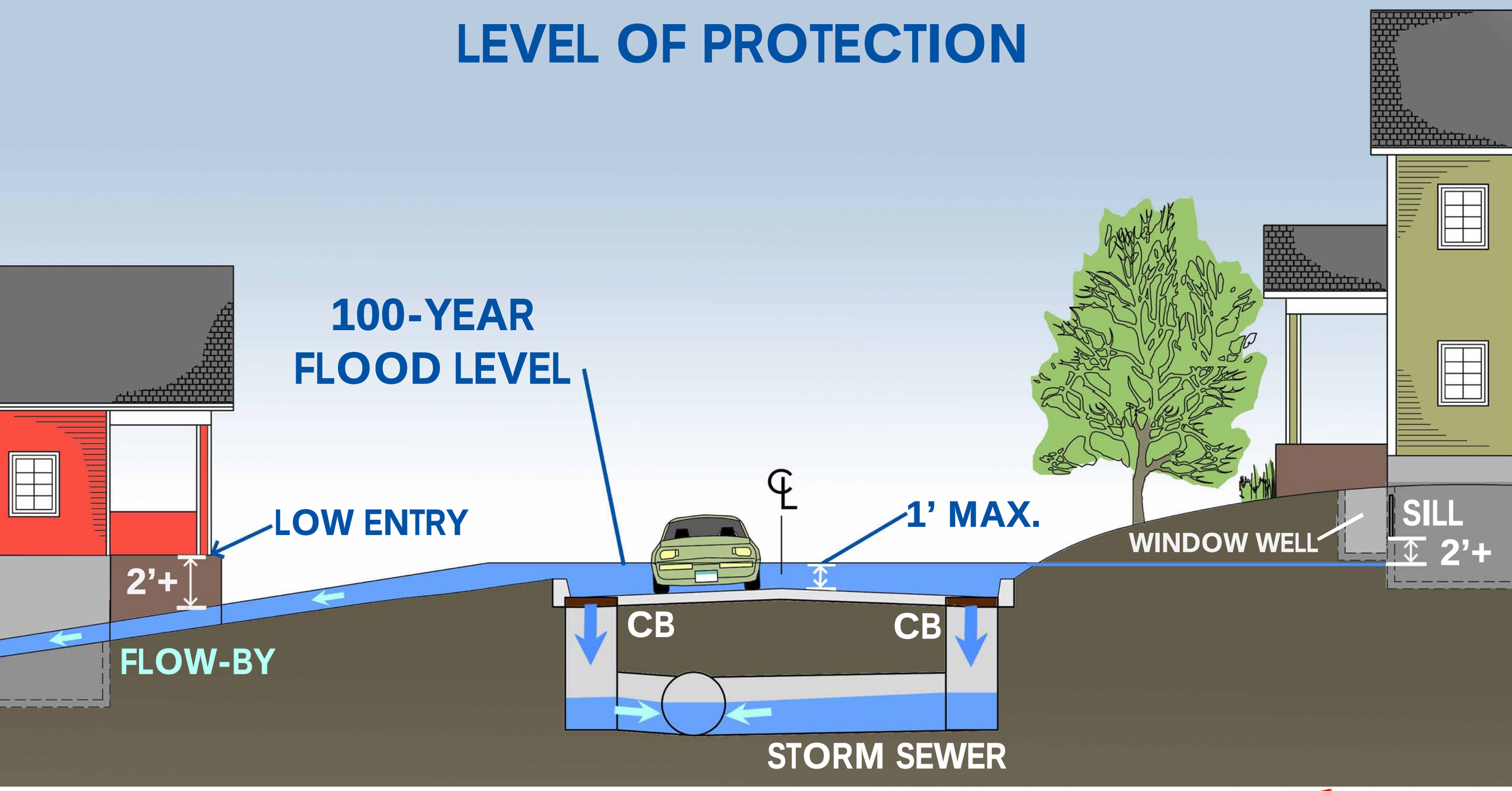

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Figure 6-2
LEVEL OF PROTECTION SCHEMATIC
City of Willmar
Watershed Management Plan Update
Kandiyohi County, MN

Section 4: Stormwater System Analysis

City of Willmar Watershed Management Plan

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List of Tables

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4.0 Stormwater System Analysis

4.1 Introduction

This section gives an overview of the hydrologic, hydraulic, and water quality modeling completed for the City of Willmar and surrounding watersheds for this Plan. The modeling results are provided in tables at the end of this section and figures at the end of Section 3.

Figures referenced in this section are located after the Figures tab.

4.2 Mapping and Data

The city used geographic information system (GIS) software ArcView (version 9.3) to organize, store, and present much of the information in this plan. Applications included organizing much of the modeling data and storing maps (aerial photos and topographic maps) used in figures. Aerial photos used in the maps represent 2009 land use conditions. ArcView was also used to incorporate the city's and the Minnesota Department of Transportation's (MnDOT) road network, utilities, wetlands and streams.

The trunk storm sewer network used in the hydraulic model was digitized using the city's existing electronic storm sewer data as a base, including manholes, catch basins, and pipes. The purpose of the digitizing effort was to simplify the city's storm sewer network so it could be used in the hydraulic model. Recent development and modifications to the city's existing storm sewer system, as well as its stormwater detention ponds, were also incorporated into the hydraulic model based on information from as-built drawings or project-record drawings. Additional details were also obtained from as-built drawings or project-record drawings regarding: invert and ground elevations of manholes and catch basins; pipe size, type, length, and invert elevations; outlet types; and stormwater pond data.

4.3 Hydrologic Watershed Modeling

Many different hydrologic/hydraulic models have been completed for the City of Willmar. As part of the *Draft 1998 Watershed Management Plan* (City of Willmar, 1998), the city completed extensive modeling of its trunk storm sewer system. The city updated the modeling that was completed for the *Draft 1998 Watershed Management Plan* as changes were made to the storm sewer network. In 2008, Kandiyohi County completed additional hydrologic/hydraulic modeling for the *Grass Lake Restoration Study* in August 2008 (Kandiyohi County, 2009). During the creation of the *City of Willmar Watershed Management Plan*, the city made additional changes to the city-wide model. These changes included:

- The hydrologic/hydraulic models of the north and south portions of the city were combined to form a single hydrologic/hydraulic model.

- The land use and percentage of impervious area data in the city-wide hydrologic/hydraulic model was updated to reflect existing (2009) conditions, based on 2009 aerial photographs and city records of developments since 1998.
- Watershed areas in the model were updated based on revised watershed divides.
- Storage elevations in the model were adjusted in portions of the model to convert the entire model to NGVD29 datum.
- Storm sewer, grading, and land use information from over 100 developments was incorporated into the model.

In the future, as changes are made to the storm sewer network, the city plans to update the XP-SWMM model so it will reflect current conditions within the City of Willmar. In addition to the city-wide XP-SWMM model, the Federal Emergency Management Agency (FEMA) is in the process of updating the Kandiyohi County Flood Insurance Study (FIS) (see **Section 3.12.3**).

4.3.1 Hydrologic Model

The city used the U.S. EPA's Storm Water Management Model (SWMM), with a graphical interface provided by XP Software (XP-SWMM32 and XP-SWMM 2009), as the hydrologic/hydraulic computer-modeling package for the modeling completed in 1998 and then updated for the 2010 Plan, respectively. XP-SWMM 2009 uses design storms and local rainfall data, coupled with watershed characteristics, to generate local runoff (overland, channel, stream, etc.); the model then routes local runoff downstream into storm sewer pipes or through open ditch networks to a final receiving water body, such as a large stormwater detention pond (e.g. Ramblewood Marsh), or lake (e.g. Lake Wakanda). XP-SWMM 2009 accounts for storage in ponding areas or ditches, backflow in pipes or ditches, surface flooding, and tailwater conditions that may exist and affect upstream discharges or pipe flows.

4.3.2 Hydrologic Model Results

The city's XP-SWMM modeling effort covered all watersheds and ponds in the city. The model is separated into four watersheds, including the Hawk Creek and Foot Lake watersheds (located in the Hawk Creek drainage basin), and the Southeast Willmar and Lake Wakanda watersheds (located in the Southeast Willmar drainage basin). These watersheds are described in **Section 3.5**. The model was developed with a moderate level of detail in the developed portions of the city, especially locations of known flooding as reported by city staff. Remaining contributing areas in the city (i.e. less populated areas and areas not identified by city staff to exhibit frequent flooding problems) were included in the model, but with less detail. In these areas, larger subwatersheds were delineated to locations of major flow restrictions such as culverts or road crossings. These areas were included in the XP-SWMM model to account for all flows in the city and assess downstream boundary

conditions. In these larger subwatersheds, the peak flood elevation and peak flowrate information represents conditions at the outlet of the subwatershed, not throughout the entire subwatershed area.

4.3.2.1 Southeast Willmar Watershed

Table 4-1 presents watershed inputs and modeling results for each modeled minor watershed included in the 2010 XP-SWMM model within the Southeast Willmar watershed, as well as the 100- and 10-year high water elevations. Areas where model results indicate flooding of street intersections and depressions with at least 0.5 acre-feet of water during or following the 100-year critical storm event are shown on **Figure 3-12**). **Table 4-5** summarizes the modeling results for every stormwater pond included in the 2010 XP-SWMM model. All of the data in the tables is grouped according to subwatershed.

4.3.2.2 Foot Lake Watershed

Table 4-2 presents watershed inputs and modeling results for each modeled minor watershed included in the 2010 XP-SWMM model within the Foot Lake watershed, as well as the 100- and 10-year high water elevations. Areas where model results indicate flooding of street intersections and depressions with at least 0.5 acre-feet of water during or following the 100-year critical storm event are shown on **Figures 3-7** through **3-9**. **Table 4-5** summarizes the modeling results for every stormwater pond included in the 2010 XP-SWMM model. All of the data in the tables is grouped according to subwatershed.

4.3.2.3 Hawk Creek Watershed

Table 4-3 presents watershed inputs and modeling results for each modeled minor watershed included in the 2010 XP-SWMM model within the Hawk Creek watershed, as well as the 100- and 10-year high water elevations. Areas where model results indicate flooding of street intersections and depressions with at least 0.5 acre-feet of water during or following the 100-year critical storm event are shown on **Figures 3-10** and **3-11**. **Table 4-5** summarizes the modeling results for every stormwater pond included in the 2010 XP-SWMM model. All of the data in the tables is grouped according to subwatershed.

4.3.2.4 Lake Wakanda Watershed

Table 4-4 presents watershed inputs and modeling results for each modeled minor watershed included in the 2010 XP-SWMM model within the Lake Wakanda watershed, as well as the 100- and 10-year high water elevations. The 100-year inundation area was not mapped for the Lake Wakanda watershed due the limited extent of the city's detailed topographic information, which does not extent into the watershed. The entire Lake Wakanda Watershed is located outside the city municipal

boundary and does not contain stormwater ponds constructed as part of development.

4.3.3 Hydrologic Modeling Technical Background

The amount of runoff generated from a watershed depends on numerous factors, including the total watershed area, the soil types present in the watershed, the percent impervious area in the watershed, the runoff path through the watershed, and the slope of the land within the watershed. This section summarizes the original watershed runoff characteristics used in the XP-SWMM models developed for the 1998 draft *Watershed Management Plan*. Any changes that were made as part of the updated XP-SWMM modeling for this Plan are also included.

Watershed Total Area: The initial watershed delineation was performed using the city's electronic coverage in ArcView of two-foot contour-interval topography. For areas outside the two-foot contour data, initial watershed delineations were performed using USGS quadrangle maps (7.5 minute series). In addition, watersheds were field-delineated as part of the 1998 modeling effort.

For the 2010 modeling effort, the watersheds from the 1998 modeling, coupled with more recent two-foot topography, were used to verify watershed divides for the older portions of downtown Willmar. In newly developed areas of the city, the two-foot topography, in conjunction with as-built drawings and project record drawings, was used to delineate watershed divides.

A total of 404 separate watersheds were delineated and modeled for the 2010 model. Similar to watersheds in downtown Willmar, watersheds in the newly developed areas were delineated to stormwater detention ponds and inlets to the trunk storm sewer system. Each stormwater detention pond was assigned its own watershed and the outlet structure from each pond was modeled as the watershed outlet. As a result, watersheds delineated in developed areas are smaller, which allowed for a more detailed evaluation of existing and potential flooding problems.

For the *Grass Lake Restoration Study* (Kandiyohi County, 2009), Kandiyohi County updated the watersheds from the 1998 draft Plan to include additional divides along the fringe of the Lake Wakanda watershed. As part to the *Grass Lake Restoration Study,* the model was also calibrated to a large rainfall event that occurred on August 26, 2005. The total precipitation for this event was 3.15 inches which lasted less than four hours (near a 50-year event, other recent extreme precipitation events are listed in **Section 3.3**). The model predicted peak flood elevations for this calibration event that closely matched the estimated flood elevations based on aerial photographs taken after that storm event and anecdotal information provided by the City. The city verified the revised watershed divides and used the calibrated model parameters in the 2010 XP-SWMM model.

The city will continue to update the model in the future as the storm sewer system within the city changes. This will allow the city to continue to administer its current floodplain management efforts and monitor the impact development has on the storm sewer system.

Depression Storage: Without accurate field measurements, the amount of depression storage is difficult to determine and varies from impervious to pervious surfaces. Published information on depression storage based on the watershed characteristics, as well as depression storage values compiled from past models of municipal watersheds, was used to select depression storage values for this study. For the 2010 XP-SWMM model updates, depression storage values of 0.06 inches and 0.17 inches were used in all watersheds for impervious and pervious areas, respectively.

Infiltration: When the city updated the subwatersheds for the 2010 modeling effort, the individual soil type for each subwatershed was accounted for. An area-weighted initial and final rate of infiltration (F_o and F_c in inches/hour) was calculated for each subwatershed. The following table summarizes the infiltration rate for each soil type that was used in the 2010 modeling. For future design or development, if any additional information becomes available about the soil type (e.g. soil borings or field classifications), the city should use the updated information to determine infiltration rates at that location.

Table 4-6 Initial and Final Infiltration Rates

Hydrologic Soil Group	F_o (in/hr)	F_c (in/hr)
A	5	0.38
B	3	0.23
C	2	0.1
D	1	0.03

Watershed Impervious Percentage: The 100-year and 10-year hydrologic/hydraulic analyses assumed existing (2009) development conditions in the watershed to identify current concerns with the city storm sewer system. Thirteen land use types were identified for the 2010 modeling analyses: (1) agricultural, (2) airport, (3) commercial, (4) developed park, (5) highway, (6) industrial/office, (7) institutional, (8) natural, (9) high density residential, (10) medium density residential, (11) light density residential, (12) wetland, and (13) water. Land uses were translated into percent impervious areas according to the values in the following table.

Table 4-7 Percent Impervious by Current (2009) Land Use

Land Use	Total Impervious Percent %	Directly Connected Impervious Percent %
Agricultural	5	0
Airport	5	0
Commercial	85	80
Developed Park	10	0
Highway	60	40
Industrial/Office	50	45
Institutional	70	65
Natural	5	0
High Density Residential	58	52
Medium Density Residential	44	35
Light Density Residential	35	20
Wetland	50	50
Water	100	100

The impervious area used in the XP-SWMM computer model to generate runoff is, by definition, hydraulically (or directly) connected to the drainage system being analyzed. This means that runoff from this portion of impervious area will not flow over a pervious area such as lawns or ball fields before reaching the storm sewer system (e.g. catch basins). This directly connected impervious percentage includes driveways, rooftops, and parking areas that are directly connected to the storm sewer system. Runoff from the portion of a rooftop draining onto adjacent pervious areas would not be considered directly connected impervious areas; for modeling purposes, these are not considered impervious areas.

Drainage Network: The drainage network is made of existing infrastructure within the city including storm sewer pipe, detention ponds, and open ditches used to convey stormwater downstream to a final receiving water body (e.g. a lake). The drainage network information necessary for the detailed modeling was acquired from as-built drawings, project record drawings, and available information in the city's electronic database of the storm sewer system.

Rainfall Information: The city evaluated two storm events as a part of the 2010 XP-SWMM modeling: the 10-year and 100-year 24-hour storm events. Rainfall values (referred to as volumes) were taken from the National Weather Service *Technical Paper 40* (TP 40) and are as follows: the 10-year 24-hour rainfall volume is 4.1 inches; the 100-year 24-hour rainfall volume is 5.8 inches. The hyetograph used in the 2010 model for both storm events was the Soil Conservation Service (SCS –

currently known as the Natural Resource Conservation Service, or NRCS) Type II event.

Snowmelt Information: The city evaluated the 100-year 10-day snowmelt event as part of the 2010 XP-SWMM modeling analysis. The total runoff value (referred to as volume) of 7.0-inches was taken from the Natural Resources Conservation Service (NRCS – formerly SCS) *Technical Release 60* (TR 60).

4.4 Water Quality Watershed Modeling

The city used the P8 (Program for Predicting Polluting Particle Passage through Pits, Puddles and ponds, IEP, Inc. 1990) Urban Catchment (computer) model to perform water quality modeling for its *Draft 1998 Watershed Management Plan*. For the 2010 Plan, the city updated the earlier modeling to reflect stormwater ponds that were constructed and that were incorporated into the City's hydrologic model of the storm sewer network. A more detailed description of the P8 water quality model is presented in **Appendix A**.

The P8 model was run for two separate scenarios, a low and high pollutant removal efficiency, in order to encompass the range of expected removal efficiencies for dry detention ponds. See **Appendix A** for further discussion of the two scenarios. **Table 4-8** shows the P8 water quality modeling results for the Willmar stormwater ponds included in the updated P8 model. The actual long-term treatment efficiency of dry detention ponds is likely somewhere between the low and high range removal estimates. **Figure 3-22** shows the location of each stormwater pond included in the City of Willmar P8 model.

Table 4-8 Modeled Stormwater Pond Pollutant Removal Efficiencies

Subwatershed	Name	City ID	Low Range TSS Removal (%)	High Range TSS Removal (%)	Low Range TP Removal (%)	High Range TP Removal (%)
Hawk Creek						
Hwy5_PND	Highway 5 Pond	17NE-P01	90	89	59	57
FamEYE	Family Eye & ENT Development Pond	-	0	83	0	50
WW2	West Winds 2nd Addition Development Pond	21SE-P01	0	59	0	25
WW3	West Winds 3rd Addition Development Pond	21SE-P02	63	62	28	26
SSF-1	Swansson Field Basin	21NW-P01	0	86	0	53
SSF-8	Industrial Ponding Basin	16SE-P01	0	93	0	63
FIELD1E	Ramblewood Marsh	22NW-P01-03	92	92	70	70
Foot Lake						
TW-2	Trentwood Estates Phase I Development Pond	12NW-P05	93	93	62	62
TW-1	Trentwood Estates Phase I Development Pond	12NW-P01	87	87	49	49
W_Home	Copperleaf Development Pond	03SE-P04	94	94	64	64
LKWood	Lake wood Additions Ponding Basin	02SW-P03	0	99	0	66
Oslo1	Oslo Meadows Development Pond	04SE-P03	93	93	61	61
RR_PND	Burlington Northern & Santa Fe Railway Pond	11SW-P02	0	75	0	41
SE Willmar						
32-4	YMCA Development Pond	14SE-P01	87	87	56	56

Table 4-8 Modeled Stormwater Pond Pollutant Removal Efficiencies

Subwatershed	Name	City ID	Low Range TSS Removal (%)	High Range TSS Removal (%)	Low Range TP Removal (%)	High Range TP Removal (%)
32-8	Olena Ave SE Basin	14SW-P02-3	84	84	32	32
33-4	Pleasantview Drive Pond	23NE-P01	85	85	54	54
33E-1	Home Depot Development Pond	26NW-P01	84	84	53	53
33E-7		23SW-P01	77	77	44	44
5thSt_P	5th Street Pond	23NW-P02	0	85	0	54
9B		14SE-P07	72	72	39	39
33-3	Olena Ave SE Basin	14SW-P04	58	58	26	26
32-5		14NE-P01	0	45	0	12
9thSt_P	9th Street Pond	22SW-P01	0	80	0	47
BBank_P	Bremer Bank Pond	23NW-P01	78	78	46	46
Duin1	Waterview Business Park Ponding Area	23SW-P07	87	87	56	56
Duin2	Waterview Business Park Ponding Area	23SW-P05	93	93	62	62
Duin3	Waterview Business Park Ponding Area	23SW-P06	92	92	61	61
Duin4	Waterview Business Park Ponding Area	23SW-P04	92	92	62	62
Duin5	Waterview Business Park Ponding Area	23SW-P03	94	94	64	64
Duin7	Waterview Business Park Ponding Area	23SW-P02	77	77	44	44
E-m24-5	Sterling Apartments	27NW-P04	80	80	48	48
Emerald	Emerald Pond	13SW-P02	82	82	50	50
LBP	Landmark Business Park Pond	13NW-P01	0	86	0	54
N123		24NE-P02 & 03	99	99	96	96
E-m24-1	Menards Pond	27NE-P01	78	78	46	46
PleasanA	Pleasantview Drive Pond	23NE-P04	0	78	0	45
PleasanB	Pleasantview Drive Pond	23NE-P03	0	70	0	36
PW_PND	Kandiyohi County Public Works Building Pond	12SW-P01	82	82	51	51
DuinW1	Waterview Business Park Ponding Area	23SW-P09	100	100	96	96
DuinW2	Waterview Business Park Ponding Area	23SW-P10	100	100	93	93
WL13-2		13NE-P01	0	63	0	29

Table 4-1
Hydrologic & Hydraulic Modeling Results
City of Willmar Subwatershed

			10-Year 24-Hour SCS Type II Design Event			100-Year 24-Hour SCS Type II Design Event			100-Year 10-Day Snow Melt Event			Critical 100-Year Event
Subwatershed	Area (acres)	Directly Connected Percent Impervious (%)	Total Runoff Depth (in)	Peak Runoff Rate (cfs)	Flood Elevation	Total Runoff Depth (in)	Peak Runoff Rate (cfs)	Flood Elevation	Total Runoff Depth (in)	Peak Runoff Rate (cfs)	Flood Elevation	
21	217.2	7	1.23	140	1111.9	2.34	261	1113.2	7.00	40	1111.2	24-Hour
30	167.2	25	1.82	205	1118.3	3.05	338	1119.7	7.00	31	1113.2	24-Hour
33	98.3	44	2.33	167	1114.9	3.67	261	1115.8	7.00	18	1112.5	24-Hour
34	32.0	20	1.75	43	1115.0	2.95	74	1115.8	7.00	6	1112.3	24-Hour
35	77.7	23	1.90	122	1118.5	3.12	206	1119.9	7.00	14	1115.1	24-Hour
32-1	95.0	41	2.46	236	1126.3	3.79	366	1126.7	7.00	18	1124.7	24-Hour
32-2	10.2	33	2.33	30	1118.3	3.59	44	1119.7	7.00	2	1113.7	24-Hour
32-3	23.7	34	2.32	61	1124.8	3.60	94	1125.0	7.00	4	1124.2	24-Hour
32-4	9.6	80	3.44	30	1119.9	5.00	42	1120.6	7.00	2	1119.6	24-Hour
32-5	87.4	12	1.58	114	1119.9	2.73	205	1120.6	7.00	16	1119.6	24-Hour
32-8	6.3	10	1.68	13	1119.9	2.80	22	1120.6	7.00	1	1119.1	24-Hour
33-3	16.4	17	1.80	26	1119.8	2.99	45	1120.6	7.00	3	1117.6	24-Hour
33-4	13.5	76	3.34	41	1115.1	4.88	59	1116.2	7.00	3	1112.5	24-Hour
33E	86.9	33	2.10	143	1111.4	3.37	232	1112.2	7.00	16	1111.1	24-Hour
33E-1	10.7	80	3.44	33	1111.6	5.00	47	1112.6	7.00	2	1111.1	24-Hour
33E-10	0.5	34	2.37	2	1111.7	3.64	2	1112.6	7.00	0	1111.1	24-Hour
33E-11	23.5	0	1.37	40	1110.1	2.43	71	1112.5	7.00	4	1114.2	10-Day Snow Melt
33E-12	4.8	31	1.99	13	1111.5	3.21	20	1112.3	7.00	1	1111.1	24-Hour
33E-13	3.7	80	3.45	11	1114.6	5.02	16	1115.4	7.00	1	1111.1	24-Hour
33E-14	0.5	80	3.46	1	1113.6	5.03	2	1115.0	7.00	0	1111.1	24-Hour
33E-15	1.0	80	3.46	3	1114.2	5.03	4	1115.2	7.00	0	1111.1	24-Hour
33E-16	7.4	80	3.42	23	1115.1	4.98	32	1115.2	7.00	1	1114.7	24-Hour
33E-17	3.1	80	3.45	10	1111.7	5.01	14	1113.0	7.00	1	1111.1	24-Hour
33E-18	3.1	80	3.48	9	1113.4	5.06	13	1114.5	7.00	1	1111.1	24-Hour
33E-19	0.4	80	3.56	1	1111.7	5.19	2	1112.6	7.00	0	1111.1	24-Hour
33E-2	11.4	80	3.44	35	1113.9	5.00	50	1114.6	7.00	2	1111.6	24-Hour
33E-20	0.7	80	3.46	2	1115.4	5.02	3	1115.8	7.00	0	1111.1	24-Hour
33E-22	9.5	80	3.48	29	1111.6	5.06	42	1112.6	7.00	2	1111.1	24-Hour
33E-23	9.9	69	3.19	30	1114.5	4.68	43	1114.6	7.00	2	1111.3	24-Hour
33E-3	1.1	80	3.57	3	1111.6	5.19	5	1112.6	7.00	0	1111.1	24-Hour
33E-4	34.5	5	1.23	46	1111.5	2.29	87	1112.3	7.00	6	1111.1	24-Hour
33E-5	1.1	80	3.46	3	1114.1	5.02	5	1114.9	7.00	0	1111.1	24-Hour
33E-6	1.3	80	3.45	4	1113.3	5.02	6	1114.9	7.00	0	1111.1	24-Hour
33E-7	10.5	80	3.42	32	1114.2	4.98	46	1114.8	7.00	2	1111.1	24-Hour
35-1	10.6	71	3.24	32	1135.0	4.75	46	1135.9	7.00	2	1132.2	24-Hour
35-1a	29.2	57	2.88	78	1146.1	4.31	118	1146.4	7.00	5	1145.5	24-Hour
35-N	63.3	44	2.44	130	1125.4	3.79	205	1126.5	7.00	12	1121.8	24-Hour
5thSt_PND	7.3	80	3.41	22	1111.5	4.97	32	1112.7	7.00	1	1111.2	24-Hour
9B	16.2	35	2.29	36	1119.8	3.58	58	1120.6	7.00	3	1117.7	24-Hour
9thSt_PND	20.6	21	1.89	38	1129.2	3.09	64	1129.4	7.00	4	1128.4	24-Hour

Table 4-1
Hydrologic & Hydraulic Modeling Results
City of Willmar Subwatershed

			10-Year 24-Hour SCS Type II Design Event			100-Year 24-Hour SCS Type II Design Event			100-Year 10-Day Snow Melt Event			Critical 100-Year Event
Subwatershed	Area (acres)	Directly Connected Percent Impervious (%)	Total Runoff Depth (in)	Peak Runoff Rate (cfs)	Flood Elevation	Total Runoff Depth (in)	Peak Runoff Rate (cfs)	Flood Elevation	Total Runoff Depth (in)	Peak Runoff Rate (cfs)	Flood Elevation	
A-c1	57.5	62	2.97	160	1125.4	4.42	238	1125.9	7.00	11	1123.0	24-Hour
A-f1	3.7	80	3.45	12	1115.6	5.02	16	1118.6	7.00	1	1111.6	24-Hour
A-f2	13.9	5	1.57	29	1114.6	2.66	49	1115.7	7.00	3	1111.5	24-Hour
A-m1	1.9	65	3.10	6	1126.7	4.57	8	1127.0	7.00	0	1120.0	24-Hour
A-m10	5.6	61	2.98	17	1124.3	4.42	24	1124.7	7.00	1	1115.4	24-Hour
A-m100	4.9	28	2.18	13	1126.1	3.41	20	1126.5	7.00	1	1125.6	24-Hour
A-m101	6.4	52	2.76	19	1126.1	4.15	28	1126.5	7.00	1	1125.7	24-Hour
A-m102	6.5	49	2.70	19	1128.8	4.07	28	1129.0	7.00	1	1126.5	24-Hour
A-m103	3.1	52	2.78	9	1122.3	4.16	13	1122.5	7.00	1	1116.2	24-Hour
A-m104	13.7	41	2.52	41	1127.3	3.84	59	1127.4	7.00	3	1116.6	24-Hour
A-m105	2.0	51	2.76	6	1122.4	4.14	9	1122.4	7.00	0	1115.7	24-Hour
A-m106	2.9	52	2.77	9	1119.9	4.16	13	1120.5	7.00	1	1115.4	24-Hour
A-m107	10.3	46	2.62	31	1121.4	3.97	44	1121.5	7.00	2	1115.7	24-Hour
A-m108	6.9	36	2.37	19	1119.9	3.66	28	1120.4	7.00	1	1115.4	24-Hour
A-m109	12.8	52	2.77	38	1127.5	4.15	55	1127.6	7.00	2	1120.8	24-Hour
A-m11	3.2	52	2.77	10	1121.4	4.16	14	1123.3	7.00	1	1114.0	24-Hour
A-m110	4.2	52	2.77	12	1117.2	4.15	18	1118.3	7.00	1	1112.8	24-Hour
A-m111	4.6	43	2.55	13	1117.7	3.88	19	1118.3	7.00	1	1114.0	24-Hour
A-m114	5.0	55	2.85	15	1122.5	4.25	22	1122.7	7.00	1	1116.4	24-Hour
A-m115	7.8	72	3.25	24	1126.4	4.77	34	1126.5	7.00	1	1117.4	24-Hour
A-m116	1.6	80	3.46	5	1122.5	5.03	7	1122.9	7.00	0	1116.1	24-Hour
A-m117	7.1	71	3.22	21	1123.0	4.73	31	1123.6	7.00	1	1116.4	24-Hour
A-m119	6.9	47	2.66	20	1119.1	4.01	29	1119.4	7.00	1	1118.7	24-Hour
A-m12	0.8	52	2.78	2	1120.0	4.17	4	1120.6	7.00	0	1113.6	24-Hour
A-m120	3.2	52	2.77	10	1119.8	4.16	14	1120.6	7.00	1	1118.7	24-Hour
A-m121	8.1	60	2.98	24	1121.8	4.42	35	1121.9	7.00	2	1119.6	24-Hour
A-m122	9.7	52	2.77	29	1129.2	4.16	42	1129.2	7.00	2	1120.7	24-Hour
A-m123	2.7	52	2.78	8	1131.5	4.16	11	1132.2	7.00	0	1122.3	24-Hour
A-m124	3.0	52	2.79	9	1132.7	4.17	13	1132.8	7.00	1	1124.7	24-Hour
A-m125	9.1	52	2.76	26	1130.8	4.15	39	1131.1	7.00	2	1125.5	24-Hour
A-m126	6.8	52	2.77	20	1132.6	4.16	29	1132.7	7.00	1	1127.5	24-Hour
A-m127	10.5	52	2.76	31	1131.3	4.15	45	1131.5	7.00	2	1128.5	24-Hour
A-m128	2.0	80	3.46	6	1121.5	5.03	9	1121.9	7.00	0	1113.5	24-Hour
A-m129	21.6	52	2.75	61	1132.3	4.14	90	1132.6	7.00	4	1126.2	24-Hour
A-m13	4.1	52	2.77	12	1119.4	4.16	18	1120.3	7.00	1	1113.1	24-Hour
A-m130	10.1	49	2.69	29	1135.9	4.06	43	1136.1	7.00	2	1128.0	24-Hour
A-m131	1.5	52	2.79	4	1136.4	4.17	6	1136.6	7.00	0	1128.9	24-Hour
A-m132	4.0	52	2.77	12	1136.5	4.16	17	1136.6	7.00	1	1129.7	24-Hour
A-m133	23.1	53	2.77	66	1136.8	4.17	97	1137.1	7.00	4	1130.9	24-Hour
A-m135	3.7	80	3.45	11	1136.9	5.02	16	1136.9	7.00	1	1132.1	24-Hour

Table 4-1
Hydrologic & Hydraulic Modeling Results
City of Willmar Subwatershed

			10-Year 24-Hour SCS Type II Design Event			100-Year 24-Hour SCS Type II Design Event			100-Year 10-Day Snow Melt Event			Critical 100-Year Event
Subwatershed	Area (acres)	Directly Connected Percent Impervious (%)	Total Runoff Depth (in)	Peak Runoff Rate (cfs)	Flood Elevation	Total Runoff Depth (in)	Peak Runoff Rate (cfs)	Flood Elevation	Total Runoff Depth (in)	Peak Runoff Rate (cfs)	Flood Elevation	
A-m136	2.1	80	3.45	7	1132.2	5.02	9	1133.5	7.00	0	1128.9	24-Hour
A-m137	11.9	80	3.44	37	1131.0	5.01	52	1131.1	7.00	2	1126.4	24-Hour
A-m138	2.8	63	3.04	9	1117.8	4.50	12	1119.2	7.00	1	1116.0	24-Hour
A-m14	6.4	46	2.61	18	1119.3	3.96	27	1120.3	7.00	1	1112.9	24-Hour
A-m15	14.1	45	2.59	40	1119.4	3.93	59	1120.3	7.00	3	1113.7	24-Hour
A-m16	7.2	44	2.50	17	1119.5	3.85	26	1120.3	7.00	1	1114.1	24-Hour
A-m17	6.1	52	2.77	18	1120.5	4.16	26	1120.7	7.00	1	1115.7	24-Hour
A-m18	1.7	44	2.60	5	1119.9	3.94	7	1120.4	7.00	0	1115.1	24-Hour
A-m19	5.3	51	2.75	16	1121.5	4.13	23	1121.7	7.00	1	1115.1	24-Hour
A-m20	1.4	52	2.79	4	1119.5	4.17	6	1120.3	7.00	0	1114.3	24-Hour
A-m21	12.1	52	2.77	36	1119.5	4.16	52	1120.3	7.00	2	1114.6	24-Hour
A-m22	8.6	35	2.36	25	1119.3	3.63	36	1120.2	7.00	2	1112.8	24-Hour
A-m23	2.1	39	2.47	6	1118.5	3.76	9	1119.3	7.00	0	1112.5	24-Hour
A-m25	27.3	16	1.83	62	1117.5	2.99	100	1118.5	7.00	5	1112.0	24-Hour
A-m26	22.1	35	2.36	63	1126.9	3.63	93	1127.1	7.00	4	1121.7	24-Hour
A-m29	18.5	35	2.35	52	1125.2	3.63	77	1125.3	7.00	3	1119.1	24-Hour
A-m3	2.7	65	3.09	8	1126.5	4.56	12	1127.0	7.00	1	1118.9	24-Hour
A-m30	5.0	35	2.34	14	1124.9	3.62	21	1125.2	7.00	1	1118.4	24-Hour
A-m32	3.2	35	2.36	9	1122.7	3.64	13	1124.9	7.00	1	1116.0	24-Hour
A-m34	11.4	35	2.37	33	1118.8	3.64	48	1120.0	7.00	2	1113.1	24-Hour
A-m35	18.6	45	2.60	54	1116.3	3.94	79	1118.8	7.00	3	1111.7	24-Hour
A-m36	2.2	61	2.99	7	1116.0	4.43	10	1118.7	7.00	0	1111.6	24-Hour
A-m38	19.8	32	2.26	51	1119.9	3.52	79	1120.4	7.00	4	1113.9	24-Hour
A-m39	19.4	35	2.32	50	1119.9	3.60	77	1120.4	7.00	4	1116.2	24-Hour
A-m4	2.9	75	3.33	9	1126.3	4.86	13	1126.6	7.00	1	1116.9	24-Hour
A-m41	5.5	35	2.37	16	1125.5	3.64	24	1125.7	7.00	1	1121.5	24-Hour
A-m42	8.4	35	2.35	24	1119.9	3.63	36	1120.6	7.00	2	1115.2	24-Hour
A-m43	21.9	35	2.33	59	1120.7	3.61	89	1120.8	7.00	4	1116.9	24-Hour
A-m45	9.9	35	2.36	29	1120.3	3.64	42	1120.5	7.00	2	1115.9	24-Hour
A-m46	15.4	35	2.37	45	1118.9	3.64	66	1119.2	7.00	3	1116.6	24-Hour
A-m48	6.4	55	2.84	19	1125.4	4.25	28	1125.8	7.00	1	1121.9	24-Hour
A-m50	40.0	35	2.25	83	1129.3	3.54	134	1129.5	7.00	7	1122.8	24-Hour
A-m51	9.9	35	2.33	26	1125.8	3.61	39	1126.1	7.00	2	1118.3	24-Hour
A-m52	10.8	35	2.35	30	1125.8	3.62	45	1126.0	7.00	2	1119.9	24-Hour
A-m53	17.4	54	2.82	52	1128.3	4.21	75	1128.6	7.00	3	1120.4	24-Hour
A-m54	6.7	52	2.77	20	1126.7	4.16	29	1127.2	7.00	1	1119.5	24-Hour
A-m55	4.7	52	2.78	14	1125.0	4.16	20	1125.4	7.00	1	1117.2	24-Hour
A-m56	2.4	51	2.75	7	1121.8	4.13	10	1122.1	7.00	0	1115.7	24-Hour
A-m57	6.1	39	2.45	18	1121.6	3.75	26	1122.2	7.00	1	1114.7	24-Hour
A-m58	2.5	52	2.78	8	1132.1	4.17	11	1132.4	7.00	0	1123.9	24-Hour

Table 4-1
Hydrologic & Hydraulic Modeling Results
City of Willmar Subwatershed

			10-Year 24-Hour SCS Type II Design Event			100-Year 24-Hour SCS Type II Design Event			100-Year 10-Day Snow Melt Event			Critical 100-Year Event
Subwatershed	Area (acres)	Directly Connected Percent Impervious (%)	Total Runoff Depth (in)	Peak Runoff Rate (cfs)	Flood Elevation	Total Runoff Depth (in)	Peak Runoff Rate (cfs)	Flood Elevation	Total Runoff Depth (in)	Peak Runoff Rate (cfs)	Flood Elevation	
A-m59	4.1	42	2.54	12	1132.2	3.86	18	1132.5	7.00	1	1125.2	24-Hour
A-m6	4.6	79	3.43	14	1126.6	4.99	20	1126.7	7.00	1	1119.3	24-Hour
A-m60	12.0	51	2.75	36	1132.2	4.13	52	1132.5	7.00	2	1126.6	24-Hour
A-m61	1.8	52	2.77	5	1132.2	4.16	8	1132.6	7.00	0	1124.4	24-Hour
A-m62	3.9	52	2.77	12	1132.2	4.15	17	1132.6	7.00	1	1124.9	24-Hour
A-m63	19.1	41	2.50	53	1121.1	3.81	79	1122.0	7.00	4	1112.7	24-Hour
A-m67	13.2	52	2.77	39	1132.2	4.16	57	1132.6	7.00	2	1126.2	24-Hour
A-m68	2.9	50	2.73	9	1133.0	4.10	13	1133.6	7.00	1	1132.0	24-Hour
A-m69	1.3	52	2.79	4	1125.3	4.17	6	1125.6	7.00	0	1120.8	24-Hour
A-m7	1.8	75	3.33	6	1126.5	4.87	8	1126.6	7.00	0	1120.0	24-Hour
A-m70	7.2	57	2.89	22	1123.4	4.31	31	1124.9	7.00	1	1119.5	24-Hour
A-m71	4.6	68	3.16	14	1123.5	4.65	20	1123.7	7.00	1	1118.7	24-Hour
A-m72	8.8	52	2.77	26	1123.1	4.16	38	1123.3	7.00	2	1117.6	24-Hour
A-m73	6.9	75	3.35	21	1123.4	4.88	30	1124.9	7.00	1	1121.2	24-Hour
A-m74	4.5	52	2.77	13	1126.1	4.16	20	1126.7	7.00	1	1122.0	24-Hour
A-m75	3.9	80	3.45	12	1129.7	5.02	17	1129.7	7.00	1	1124.0	24-Hour
A-m76	1.5	58	2.92	4	1128.0	4.35	6	1128.0	7.00	0	1122.9	24-Hour
A-m77	3.7	52	2.78	11	1122.5	4.16	16	1124.1	7.00	1	1114.9	24-Hour
A-m78	4.0	52	2.79	12	1119.1	4.17	17	1119.9	7.00	1	1114.2	24-Hour
A-m79	11.3	50	2.73	33	1118.5	4.11	48	1118.6	7.00	2	1114.0	24-Hour
A-m8	1.7	77	3.38	5	1126.9	4.93	8	1127.0	7.00	0	1121.5	24-Hour
A-m80	7.9	48	2.65	22	1117.2	4.01	33	1118.1	7.00	1	1113.6	24-Hour
A-m81	3.7	46	2.62	11	1117.2	3.97	16	1118.1	7.00	1	1113.1	24-Hour
A-m82	2.4	43	2.55	7	1117.1	3.87	10	1118.0	7.00	0	1112.9	24-Hour
A-m83	7.3	52	2.77	22	1117.1	4.15	31	1118.0	7.00	1	1112.8	24-Hour
A-m84	8.1	52	2.77	24	1117.1	4.15	35	1118.1	7.00	2	1112.8	24-Hour
A-m85	7.6	52	2.76	22	1117.1	4.15	32	1118.0	7.00	1	1112.4	24-Hour
A-m86	7.2	56	2.87	22	1117.2	4.28	31	1118.1	7.00	1	1112.1	24-Hour
A-m87	5.4	52	2.76	15	1117.1	4.15	23	1118.0	7.00	1	1112.6	24-Hour
A-m88	8.2	52	2.75	23	1117.1	4.14	34	1118.0	7.00	2	1113.0	24-Hour
A-m89	4.4	52	2.78	13	1118.5	4.17	19	1118.6	7.00	1	1115.2	24-Hour
A-m9	3.6	80	3.40	10	1125.9	4.96	15	1126.4	7.00	1	1116.3	24-Hour
A-m90	5.4	60	2.97	16	1121.1	4.41	23	1121.2	7.00	1	1117.8	24-Hour
A-m91	10.9	77	3.39	34	1122.9	4.93	48	1123.0	7.00	2	1120.2	24-Hour
A-m92	1.2	80	3.46	4	1118.0	5.03	5	1119.2	7.00	0	1111.9	24-Hour
A-m93	9.2	72	3.27	28	1120.1	4.79	40	1120.3	7.00	2	1112.2	24-Hour
A-m95	3.2	52	2.77	10	1122.2	4.16	14	1122.4	7.00	1	1115.1	24-Hour
A-m96	1.1	80	3.46	3	1124.1	5.02	5	1124.2	7.00	0	1120.1	24-Hour
A-m97	4.6	64	3.06	14	1123.9	4.53	20	1123.9	7.00	1	1119.9	24-Hour
A-m98	0.6	80	3.46	2	1126.2	5.02	2	1127.3	7.00	0	1119.4	24-Hour

Table 4-1
Hydrologic & Hydraulic Modeling Results
City of Willmar Subwatershed

			10-Year 24-Hour SCS Type II Design Event			100-Year 24-Hour SCS Type II Design Event			100-Year 10-Day Snow Melt Event			Critical 100-Year Event
Subwatershed	Area (acres)	Directly Connected Percent Impervious (%)	Total Runoff Depth (in)	Peak Runoff Rate (cfs)	Flood Elevation	Total Runoff Depth (in)	Peak Runoff Rate (cfs)	Flood Elevation	Total Runoff Depth (in)	Peak Runoff Rate (cfs)	Flood Elevation	
A-m99	3.0	66	3.11	9	1126.0	4.58	13	1126.0	7.00	1	1119.3	24-Hour
BBank_PND	2.8	80	3.46	9	1115.2	5.03	12	1115.4	7.00	1	1114.3	24-Hour
B-m2	38.3	33	2.20	76	1114.4	3.47	124	1117.0	7.00	7	1111.3	24-Hour
B-m3	2.6	26	2.14	8	1114.0	3.35	11	1115.5	7.00	0	1111.3	24-Hour
B-m4	8.4	46	2.61	24	1114.6	3.96	36	1116.3	7.00	2	1111.3	24-Hour
B-m7	5.1	35	2.36	15	1117.5	3.64	22	1118.1	7.00	1	1111.5	24-Hour
B-m8	6.3	36	2.38	18	1117.7	3.66	27	1117.8	7.00	1	1111.7	24-Hour
B-m9	11.9	35	2.37	35	1117.5	3.64	51	1117.6	7.00	2	1111.7	24-Hour
C-m1	12.1	30	2.22	33	1130.3	3.46	50	1130.6	7.00	2	1125.0	24-Hour
C-m10	6.0	68	3.16	18	1113.6	4.65	26	1115.0	7.00	1	1111.1	24-Hour
C-m11	0.5	80	3.46	2	1114.1	5.03	2	1115.1	7.00	0	1111.1	24-Hour
C-m12-1a	0.7	80	3.46	2	1115.4	5.02	3	1115.8	7.00	0	1111.1	24-Hour
C-m12-1b	0.7	80	3.46	2	1115.1	5.03	3	1115.4	7.00	0	1111.1	24-Hour
C-m13	2.2	75	3.33	7	1113.8	4.87	10	1114.7	7.00	0	1111.1	24-Hour
C-m16	5.1	35	2.37	15	1115.1	3.64	22	1115.3	7.00	1	1111.1	24-Hour
C-m2	0.9	35	2.38	3	1121.9	3.66	4	1124.5	7.00	0	1120.1	24-Hour
C-m20	10.6	71	3.22	32	1114.5	4.73	46	1114.6	7.00	2	1111.7	24-Hour
C-m3	1.6	35	2.38	5	1124.2	3.65	7	1124.3	7.00	0	1120.7	24-Hour
C-m4	4.1	35	2.36	12	1134.8	3.63	17	1134.8	7.00	1	1129.2	24-Hour
C-m5	0.7	35	2.38	2	1132.1	3.66	3	1132.1	7.00	0	1125.8	24-Hour
C-m6	4.7	34	2.33	14	1125.2	3.59	20	1127.7	7.00	1	1121.0	24-Hour
C-m8	18.3	35	2.34	50	1116.7	3.62	76	1116.9	7.00	3	1111.4	24-Hour
C-m9	6.6	35	2.33	17	1114.8	3.61	26	1115.3	7.00	1	1111.1	24-Hour
D-m1	1.4	35	2.38	4	1117.2	3.65	6	1117.8	7.00	0	1114.6	24-Hour
D-m11	1.5	80	3.46	5	1115.1	5.03	7	1116.0	7.00	0	1111.5	24-Hour
D-m2	13.5	35	2.35	38	1117.2	3.62	56	1117.8	7.00	3	1114.6	24-Hour
D-m3	11.0	76	3.35	34	1117.2	4.89	48	1117.8	7.00	2	1114.0	24-Hour
D-m4	13.3	50	2.73	39	1117.2	4.10	57	1117.8	7.00	3	1113.2	24-Hour
D-m5	16.8	35	2.37	49	1118.9	3.64	72	1119.2	7.00	3	1116.7	24-Hour
D-m6	11.3	35	2.37	33	1118.9	3.64	48	1119.2	7.00	2	1114.7	24-Hour
D-m7	13.2	35	2.36	38	1117.2	3.63	56	1117.8	7.00	2	1113.8	24-Hour
D-m9	7.7	80	3.45	24	1116.3	5.02	34	1117.2	7.00	1	1111.7	24-Hour
Duin1	5.4	68	3.05	16	1111.5	4.52	23	1112.5	7.00	1	1111.1	24-Hour
Duin2	10.4	64	3.01	29	1111.5	4.46	44	1112.3	7.00	2	1111.1	24-Hour
Duin3	31.9	61	2.89	92	1111.5	4.32	136	1112.3	7.00	6	1111.1	24-Hour
Duin4	11.7	80	3.42	36	1112.1	4.98	51	1112.9	7.00	2	1111.3	24-Hour
Duin5	3.7	80	3.45	11	1111.5	5.02	16	1112.3	7.00	1	1111.1	24-Hour
Duin6	1.4	80	3.45	4	1111.5	5.02	6	1112.3	7.00	0	1111.1	24-Hour
Duin7	10.4	80	3.43	32	1111.9	4.99	45	1112.8	7.00	2	1111.5	24-Hour
Duin8	1.0	80	3.37	3	1110.0	4.92	4	1112.5	7.00	0	1114.1	10-Day Snow Melt

Table 4-1
Hydrologic & Hydraulic Modeling Results
City of Willmar Subwatershed

			10-Year 24-Hour SCS Type II Design Event			100-Year 24-Hour SCS Type II Design Event			100-Year 10-Day Snow Melt Event			Critical 100-Year Event
Subwatershed	Area (acres)	Directly Connected Percent Impervious (%)	Total Runoff Depth (in)	Peak Runoff Rate (cfs)	Flood Elevation	Total Runoff Depth (in)	Peak Runoff Rate (cfs)	Flood Elevation	Total Runoff Depth (in)	Peak Runoff Rate (cfs)	Flood Elevation	
Duin9	1.3	80	3.46	4	1111.6	5.03	6	1112.4	7.00	0	1111.1	24-Hour
DuinW1	7.9	0	0.64	4	1111.5	1.60	10	1112.3	7.00	1	1111.1	24-Hour
DuinW2	1.7	0	0.76	1	1111.5	1.75	3	1112.3	7.00	0	1111.1	24-Hour
E-m24-1	22.7	79	3.45	70	1113.1	5.01	100	1113.6	7.00	4	1113.9	10-Day Snow Melt
E-m24-10	2.9	80	3.44	9	1112.0	5.01	13	1113.1	7.00	1	1111.2	24-Hour
E-m24-4	2.9	80	3.46	9	1111.7	5.04	13	1112.8	7.00	1	1111.1	24-Hour
E-m24-5	4.1	53	2.78	12	1112.1	4.17	18	1113.2	7.00	1	1111.2	24-Hour
E-m24-6	4.3	80	3.45	13	1111.8	5.02	19	1113.0	7.00	1	1111.1	24-Hour
E-m24-8	5.2	65	3.11	16	1116.4	4.58	23	1116.4	7.00	1	1111.5	24-Hour
EmeraldPnd	9.3	32	2.25	23	1130.6	3.51	36	1130.8	7.00	2	1128.1	24-Hour
I-f1	68.8	37	2.37	166	1112.9	3.68	260	1113.8	7.00	13	1111.2	24-Hour
I-m16	71.0	74	3.17	161	1112.9	4.69	247	1113.8	7.00	13	1111.2	24-Hour
LBP	22.6	69	3.17	63	1144.9	4.68	94	1145.8	7.00	4	1142.2	24-Hour
L-m1	3.9	35	2.34	11	1138.2	3.62	16	1138.3	7.00	1	1133.3	24-Hour
L-m2	3.2	35	2.36	9	1132.1	3.64	14	1133.9	7.00	1	1128.6	24-Hour
L-m3	1.2	35	2.38	4	1127.1	3.65	5	1127.1	7.00	0	1122.3	24-Hour
L-m4	9.8	35	2.37	29	1122.0	3.65	42	1122.1	7.00	2	1116.0	24-Hour
L-m5	3.3	77	3.38	10	1119.3	4.93	15	1119.7	7.00	1	1113.9	24-Hour
L-m6	2.5	80	3.45	8	1118.1	5.02	11	1118.5	7.00	0	1113.2	24-Hour
L-m7	5.4	80	3.45	17	1117.3	5.01	24	1117.5	7.00	1	1111.1	24-Hour
M-f1	56.8	35	2.20	104	1112.9	3.49	168	1113.8	7.00	11	1111.2	24-Hour
M-f2	113.7	36	1.98	152	1112.9	3.23	238	1113.8	7.00	21	1111.2	24-Hour
N123	64.4	16	1.66	70	1112.4	2.86	122	1113.6	7.00	12	1113.9	10-Day Snow Melt
PleasantVa	10.7	45	2.57	29	1115.4	3.92	44	1116.8	7.00	2	1112.5	24-Hour
PleasantVb	6.5	35	2.32	17	1115.6	3.60	26	1117.2	7.00	1	1112.5	24-Hour
PW_PND	9.6	71	3.20	27	1139.0	4.71	40	1141.2	7.00	2	1135.6	24-Hour
WL13-2	25.4	35	2.29	57	1146.9	3.58	91	1147.7	7.00	5	1146.1	24-Hour
WLL3a	24.2	4	1.48	42	1141.3	2.58	74	1141.9	7.00	4	1140.8	24-Hour
35-1b	28.6	45	2.53	68	1141.0	3.87	106	1141.8	7.00	5	1135.8	24-Hour
35-1c	50.0	80	3.40	144	1147.1	4.97	211	1147.4	7.00	9	1146.1	24-Hour

Table 4-2
Hydrologic & Hydraulic Modeling Results
Foot Lake Subwatershed

			10-Year 24-Hour SCS Type II Design Event			100-Year 24-Hour SCS Type II Design Event			100-Year 10-Day Snow Melt Event			Critical 100-Year Event
Subwatershed	Area (acres)	Directly Connected Percent Impervious (%)	Total Runoff Depth (in)	Peak Runoff Rate (cfs)	Flood Elevation	Total Runoff Depth (in)	Peak Runoff Rate (cfs)	Flood Elevation	Total Runoff Depth (in)	Peak Runoff Rate (cfs)	Flood Elevation	
EAGLE_LAKE	11076.4	18	1.21	6419	1127.2	2.24	10060	1128.2	7.00	2046	1130.5	10-Day Snow Melt
FOOT_LAKE	1436.2	50	2.27	1654	1118.0	3.57	2632	1118.5	7.00	265	1120.1	10-Day Snow Melt
FOOT_LAKE2	122.9	19	1.78	177	1179.5	2.98	304	1179.9	7.00	23	1180.0	10-Day Snow Melt
FOOT_LAKE3	416.2	68	3.14	1085	1118.5	4.64	1628	1119.3	7.00	77	1121.5	10-Day Snow Melt
G-m10	0.6	80	3.45	2	1129.6	5.02	2	1131.8	7.00	0	1126.0	24-Hour
G-m11	1.0	80	3.45	3	1130.4	5.02	4	1132.4	7.00	0	1127.2	24-Hour
G-m12	4.1	80	3.45	13	1132.2	5.01	18	1133.7	7.00	1	1128.8	24-Hour
G-m14	0.7	66	3.11	2	1126.6	4.58	3	1126.8	7.00	0	1122.7	24-Hour
G-m15	3.6	74	3.24	10	1127.8	4.76	14	1128.2	7.00	1	1122.4	24-Hour
G-m16	7.7	79	3.37	21	1128.6	4.93	32	1129.2	7.00	1	1121.6	24-Hour
G-m18	2.3	71	3.17	6	1125.5	4.68	9	1125.5	7.00	0	1123.2	24-Hour
G-m19	6.2	80	3.44	19	1129.8	5.00	27	1131.3	7.00	1	1121.6	24-Hour
G-m20	1.4	80	3.44	4	1129.8	5.00	6	1129.9	7.00	0	1126.6	24-Hour
G-m21	1.8	60	2.97	5	1131.0	4.41	8	1132.4	7.00	0	1127.0	24-Hour
G-m22	2.8	63	3.05	9	1129.2	4.51	12	1129.4	7.00	1	1123.2	24-Hour
G-m23	2.8	63	3.05	9	1127.7	4.51	12	1128.4	7.00	1	1122.3	24-Hour
G-m26	3.9	50	2.72	11	1127.7	4.09	17	1128.1	7.00	1	1121.7	24-Hour
G-m27	12.9	49	2.71	38	1128.0	4.08	55	1128.1	7.00	2	1122.0	24-Hour
G-m31	17.5	49	2.66	47	1134.5	4.03	72	1136.5	7.00	3	1127.2	24-Hour
G-m32	14.5	49	2.69	41	1125.2	4.06	61	1127.1	7.00	3	1121.5	24-Hour
G-m33	3.4	80	3.45	10	1132.1	5.02	15	1134.7	7.00	1	1128.0	24-Hour
G-m34	4.2	77	3.37	13	1129.6	4.91	18	1129.7	7.00	1	1126.4	24-Hour
G-m5	12.1	72	3.26	37	1125.4	4.77	53	1127.8	7.00	2	1121.6	24-Hour
G-m8	1.5	63	3.03	5	1127.0	4.48	7	1131.2	7.00	0	1124.8	24-Hour
G-m9	3.1	80	3.45	10	1127.8	5.02	14	1129.9	7.00	1	1121.7	24-Hour
LKWood	39.6	13	1.55	50	1124.8	2.68	90	1125.2	7.00	7	1126.6	10-Day Snow Melt
Oslo1	11.4	20	1.95	28	1181.3	3.13	44	1181.5	7.00	2	1180.7	24-Hour
RR_PND	44.2	49	2.58	96	1132.3	3.96	149	1132.5	7.00	8	1132.1	24-Hour
SKATAAS_LA	1226.4	21	1.57	1156	1130.6	2.73	1877	1131.0	7.00	227	1130.8	24-Hour
SWAN_LAKE	668.6	50	2.62	1434	1122.1	4.01	2232	1122.6	7.00	124	1123.5	10-Day Snow Melt
TW_1	5.7	20	1.95	14	1136.7	3.14	22	1138.1	7.00	1	1134.0	24-Hour
TW_2	3.1	20	1.98	8	1139.4	3.16	13	1140.2	7.00	1	1138.2	24-Hour
W_HOME	4.9	29	2.02	8	1127.2	3.28	13	1127.4	7.00	1	1127.0	24-Hour
Willmar_Lk	2859.9	25	1.39	2213	1118.5	2.45	3465	1119.3	7.00	528	1121.6	10-Day Snow Melt
WILLMARLK2	1628.0	4	1.18	1063	1182.0	2.26	2058	1183.2	7.00	301	1181.7	24-Hour
WILLMARLK3	819.6	18	1.69	840	1141.6	2.90	1422	1142.4	7.00	151	1141.3	24-Hour
WLL1	100.7	38	2.24	178	1123.7	3.55	285	1124.9	7.00	19	1122.3	24-Hour
WLL2	89.1	58	2.82	211	1125.1	4.26	322	1125.3	7.00	16	1123.5	24-Hour
WLL3	47.6	6	1.51	77	1133.4	2.62	137	1133.8	7.00	9	1133.0	24-Hour
WLL4	45.8	26	2.06	96	1133.5	3.29	156	1134.3	7.00	9	1133.5	24-Hour

Table 4-3
Hydrologic & Hydraulic Modeling Results
Hawk Creek Subwatershed

			10-Year 24-Hour SCS Type II Design Event			100-Year 24-Hour SCS Type II Design Event			100-Year 10-Day Snow Melt Event			Critical 100-Year Event
Subwatershed	Area (acres)	Directly Connected Percent Impervious (%)	Total Runoff Depth (in)	Peak Runoff Rate (cfs)	Flood Elevation	Total Runoff Depth (in)	Peak Runoff Rate (cfs)	Flood Elevation	Total Runoff Depth (in)	Peak Runoff Rate (cfs)	Flood Elevation	
23rd-2	67.5	8	1.33	55	1122.1	2.44	102	1123.3	7.00	12	1123.2	24-Hour
23rd-3	38.2	11	1.25	26	1114.1	2.35	44	1115.9	7.00	7	1112.2	24-Hour
23rd-4	7.7	36	2.29	17	1120.9	3.59	27	1121.0	7.00	1	1114.5	24-Hour
23rd-5	1.9	35	2.32	5	1122.7	3.60	7	1122.8	7.00	0	1122.0	24-Hour
A	1589.2	9	0.90	636	1103.1	1.86	1053	1105.2	7.00	294	1105.9	10-Day Snow Melt
Air1_C2d	158.3	0	1.16	110	1112.4	2.24	224	1114.1	7.00	29	1111.8	24-Hour
Air2_C2b	109.8	0	1.08	59	1112.5	2.14	121	1113.3	7.00	20	1111.8	24-Hour
Air3_G2	52.8	0	1.26	49	1116.6	2.35	97	1117.2	7.00	10	1115.7	24-Hour
B	1129.2	2	0.73	274	1103.8	1.66	545	1106.1	7.00	209	1105.7	24-Hour
B-1	317.2	2	0.86	106	1107.3	1.84	212	1108.3	7.00	59	1107.7	24-Hour
B-2	119.5	1	1.13	73	1103.3	2.20	148	1105.7	7.00	22	1105.3	24-Hour
B-3	239.3	5	0.98	100	1103.8	2.00	187	1106.1	7.00	44	1105.7	24-Hour
B-4	390.7	4	0.90	137	1105.9	1.89	255	1107.2	7.00	72	1106.7	24-Hour
C1	1037.0	3	0.92	369	1111.6	1.94	719	1114.1	7.00	192	1110.7	24-Hour
C2c	26.1	0	1.36	27	1115.9	2.48	52	1116.3	7.00	5	1115.4	24-Hour
C2dwn	45.0	0	1.43	90	1109.1	2.49	154	1110.1	7.00	8	1109.1	24-Hour
C2e	142.6	0	1.03	67	1124.0	2.09	139	1124.5	7.00	26	1123.6	24-Hour
C2up_C2a	285.8	1	1.08	155	1110.1	2.15	318	1111.1	7.00	53	1109.8	24-Hour
Dup	1434.5	3	0.83	438	1118.3	1.80	852	1120.6	7.00	265	1120.2	24-Hour
E-m1	7.2	35	2.30	17	1125.1	3.59	27	1126.3	7.00	1	1122.9	24-Hour
E-m11	5.3	35	2.40	15	1122.7	3.70	22	1122.9	7.00	1	1119.6	24-Hour
E-m12	20.6	35	2.38	50	1123.2	3.69	78	1123.3	7.00	4	1121.2	24-Hour
E-m13	14.8	35	2.35	36	1123.2	3.66	56	1123.3	7.00	3	1121.8	24-Hour
E-m15	2.7	37	2.31	6	1114.3	3.62	9	1115.2	7.00	0	1112.1	24-Hour
E-m16	2.5	37	2.38	6	1114.9	3.67	10	1116.3	7.00	0	1112.5	24-Hour
E-m18	1.7	38	2.41	5	1116.0	3.70	7	1118.5	7.00	0	1112.8	24-Hour
E-m19	1.4	38	2.35	3	1117.7	3.66	5	1119.7	7.00	0	1113.5	24-Hour
E-m2	4.8	32	2.28	13	1124.5	3.54	20	1126.0	7.00	1	1122.9	24-Hour
E-m20	3.6	37	2.40	10	1118.9	3.69	15	1120.5	7.00	1	1114.9	24-Hour
E-m21	6.2	45	2.55	16	1122.7	3.90	25	1122.8	7.00	1	1118.1	24-Hour
E-m23	4.9	46	2.62	14	1126.1	3.97	21	1126.3	7.00	1	1122.3	24-Hour
E-m24	2.3	42	2.52	6	1125.3	3.84	9	1125.9	7.00	0	1120.9	24-Hour
E-m25	2.6	42	2.51	7	1123.8	3.83	10	1125.7	7.00	0	1119.7	24-Hour
E-m26	2.2	42	2.34	4	1122.7	3.67	6	1123.6	7.00	0	1118.6	24-Hour
E-m27	2.5	54	2.78	7	1121.8	4.18	10	1122.1	7.00	0	1116.9	24-Hour
E-m28	2.9	45	2.56	8	1121.1	3.91	12	1121.7	7.00	1	1115.9	24-Hour
E-m30	7.1	35	2.34	19	1121.9	3.62	29	1122.2	7.00	1	1115.3	24-Hour
E-m33	2.7	35	2.33	7	1123.6	3.61	11	1123.7	7.00	1	1117.9	24-Hour

Table 4-3
Hydrologic & Hydraulic Modeling Results
Hawk Creek Subwatershed

			10-Year 24-Hour SCS Type II Design Event			100-Year 24-Hour SCS Type II Design Event			100-Year 10-Day Snow Melt Event			Critical 100-Year Event
Subwatershed	Area (acres)	Directly Connected Percent Impervious (%)	Total Runoff Depth (in)	Peak Runoff Rate (cfs)	Flood Elevation	Total Runoff Depth (in)	Peak Runoff Rate (cfs)	Flood Elevation	Total Runoff Depth (in)	Peak Runoff Rate (cfs)	Flood Elevation	
E-m34	1.5	35	2.35	4	1126.7	3.63	6	1126.8	7.00	0	1121.3	24-Hour
E-m35	1.7	43	2.52	5	1131.2	3.85	7	1131.2	7.00	0	1125.9	24-Hour
E-m36	9.8	63	2.99	27	1133.0	4.45	41	1133.1	7.00	2	1127.8	24-Hour
E-m37	11.7	29	2.25	28	1119.8	3.52	45	1120.0	7.00	2	1114.7	24-Hour
E-m38	3.9	33	2.30	11	1121.2	3.57	16	1121.3	7.00	1	1115.6	24-Hour
E-m39	18.8	40	2.43	47	1123.7	3.75	72	1123.8	7.00	4	1116.3	24-Hour
E-m41	9.5	35	2.32	25	1112.9	3.60	38	1114.2	7.00	2	1112.0	24-Hour
E-m5a	8.2	37	2.32	18	1124.3	3.62	29	1124.7	7.00	2	1121.0	24-Hour
E-m5b	3.8	35	2.30	9	1122.2	3.59	14	1122.6	7.00	1	1115.6	24-Hour
E-m6	6.9	35	2.22	13	1124.6	3.51	21	1124.8	7.00	1	1121.5	24-Hour
E-m7	8.0	35	2.30	19	1124.3	3.58	30	1124.8	7.00	1	1121.4	24-Hour
E-m8	5.1	33	2.31	15	1119.7	3.58	21	1119.9	7.00	1	1118.0	24-Hour
Eup	476.7	13	1.32	356	1130.4	2.43	612	1130.7	7.00	88	1130.5	24-Hour
FamEYE	7.8	41	2.44	18	1118.5	3.76	28	1118.7	7.00	1	1115.9	24-Hour
FIELD1E	78.0	25	2.17	158	1119.4	3.46	258	1120.2	7.00	14	1120.8	10-Day Snow Melt
Fup	603.5	8	1.07	301	1110.7	2.11	535	1113.3	7.00	111	1112.3	24-Hour
G3	50.4	2	1.39	56	1121.0	2.50	106	1121.4	7.00	9	1120.4	24-Hour
Gup	561.0	2	0.92	181	1110.1	1.94	363	1112.7	7.00	104	1111.7	24-Hour
H	2995.8	5	0.76	847	1104.9	1.68	1508	1108.0	7.00	553	1107.2	24-Hour
H-1	74.7	7	1.17	44	1104.1	2.25	82	1106.9	7.00	14	1106.2	24-Hour
H-2	131.1	0	0.85	38	1104.1	1.86	78	1106.9	7.00	24	1106.2	24-Hour
Hwy5_PND	269.6	36	1.74	252	1112.7	2.88	399	1113.7	7.00	50	1112.5	24-Hour
Iup	1425.3	5	0.83	455	1110.9	1.79	809	1113.3	7.00	263	1111.5	24-Hour
J	852.6	2	0.45	126	1099.2	1.13	227	1101.6	7.00	157	1101.1	24-Hour
K	1845.6	4	1.01	851	1145.6	2.05	1650	1147.3	7.00	341	1147.2	24-Hour
SSF-1	12.5	5	1.47	19	1121.5	2.57	34	1122.6	7.00	2	1122.9	10-Day Snow Melt
SSF-10	27.0	14	1.69	41	1128.4	2.85	72	1128.7	7.00	5	1127.3	24-Hour
SSF-11	12.8	1	1.51	31	1128.1	2.56	50	1128.9	7.00	2	1128.0	24-Hour
SSF-12	3.6	44	2.59	11	1130.1	3.92	16	1130.1	7.00	1	1128.6	24-Hour
SSF-13	6.9	69	3.17	21	1124.6	4.66	30	1125.0	7.00	1	1123.6	24-Hour
SSF-14A	11.7	39	2.44	33	1122.9	3.74	49	1123.0	7.00	2	1122.9	24-Hour
SSF-14B	3.8	13	1.81	10	1123.3	2.94	15	1124.3	7.00	1	1122.9	24-Hour
SSF-14C	1.1	0	1.41	2	1122.1	2.47	4	1122.6	7.00	0	1122.9	10-Day Snow Melt
SSF-1B	1.3	0	1.48	3	1122.7	2.53	5	1123.1	7.00	0	1122.9	24-Hour
SSF-1C	7.8	0	1.32	10	1123.5	2.40	19	1123.8	7.00	1	1123.3	24-Hour
SSF-1D	7.9	0	1.38	13	1123.8	2.45	24	1124.1	7.00	1	1123.5	24-Hour
SSF-2	26.4	49	2.69	69	1122.1	4.07	105	1122.6	7.00	5	1120.9	24-Hour
SSF-3	10.0	0	1.46	22	1121.5	2.52	37	1122.6	7.00	2	1122.9	10-Day Snow Melt

Table 4-3
Hydrologic & Hydraulic Modeling Results
Hawk Creek Subwatershed

			10-Year 24-Hour SCS Type II Design Event			100-Year 24-Hour SCS Type II Design Event			100-Year 10-Day Snow Melt Event			Critical 100-Year Event
Subwatershed	Area (acres)	Directly Connected Percent Impervious (%)	Total Runoff Depth (in)	Peak Runoff Rate (cfs)	Flood Elevation	Total Runoff Depth (in)	Peak Runoff Rate (cfs)	Flood Elevation	Total Runoff Depth (in)	Peak Runoff Rate (cfs)	Flood Elevation	
SSF-4	11.2	11	1.60	16	1125.2	2.74	28	1125.3	7.00	2	1124.9	24-Hour
SSF-5	3.8	12	1.77	9	1128.7	2.90	15	1128.9	7.00	1	1128.3	24-Hour
SSF-6	2.0	45	2.62	6	1128.7	3.96	9	1129.0	7.00	0	1128.4	24-Hour
SSF-7	15.4	45	2.57	41	1128.7	3.91	62	1129.4	7.00	3	1128.6	24-Hour
SSF-8	22.7	45	2.57	60	1128.9	3.91	91	1129.9	7.00	4	1129.2	24-Hour
SSF-9	2.6	56	2.89	8	1131.0	4.30	11	1131.4	7.00	0	1132.4	10-Day Snow Melt
ValleyBrk2	87.9	19	1.64	97	1127.4	2.82	165	1127.7	7.00	16	1125.8	24-Hour
WW2	14.0	36	2.26	27	1118.3	3.56	44	1118.7	7.00	3	1115.9	24-Hour
WW3	66.8	18	1.62	71	1115.7	2.79	121	1116.6	7.00	12	1112.8	24-Hour

Table 4-4
Hydrologic & Hydraulic Modeling Results
Lake Wakanda Subwatershed

			10-Year 24-Hour SCS Type II Design Event			100-Year 24-Hour SCS Type II Design Event			100-Year 10-Day Snow Melt Event			Critical 100-Year Event
Subwatershed	Area (acres)	Directly Connected Percent Impervious (%)	Total Runoff Depth (in)	Peak Runoff Rate (cfs)	Flood Elevation	Total Runoff Depth (in)	Peak Runoff Rate (cfs)	Flood Elevation	Total Runoff Depth (in)	Peak Runoff Rate (cfs)	Flood Elevation	
LK1	3683	35	2.17	4754	1105.2	3.52	7429	1106.0	7.00	680	1107.6	10-Day Snow Melt
LK2	1210	25	2.23	1464	1106.8	3.65	2390	1107.7	7.00	223	1107.6	24-Hour
LK3	1820	0	1.62	806	1163.1	2.96	1602	1165.5	7.00	336	1160.5	24-Hour
LK4	655	0	1.76	550	1160.7	3.10	1067	1161.5	7.00	121	1158.7	24-Hour
LK5	293	0	1.85	264	1171.4	3.21	507	1173.7	7.00	54	1170.6	24-Hour
LK6	2787	4	1.60	1096	1201.6	2.91	2035	1202.7	7.00	515	1201.1	24-Hour
LK7	522	0	1.79	381	1179.1	3.16	746	1180.5	7.00	96	1177.8	24-Hour
ML1	3634	22	1.79	3073	1105.9	3.10	4862	1106.8	7.00	671	1109.2	10-Day Snow Melt
ML2	305	22	1.66	321	1132.6	2.85	525	1133.0	7.00	56	1133.1	10-Day Snow Melt
ML3	347	0	1.93	405	1165.5	3.30	748	1167.9	7.00	64	1164.7	24-Hour
ML4	1371	1	1.67	737	1198.0	3.01	1455	1199.5	7.00	253	1197.1	24-Hour
ML5	635	0	1.81	658	1142.9	3.15	1245	1144.4	7.00	117	1142.9	24-Hour
ML6	202	0	1.63	86	1123.1	2.98	168	1125.0	7.00	37	1124.0	24-Hour
ML7	2196	4	1.01	808	1129.9	2.08	1536	1134.3	7.00	406	1130.5	24-Hour
WL1	4778	36	2.02	6059	1106.0	3.29	9439	1106.7	7.00	882	1108.1	10-Day Snow Melt
WL10	739	3	0.83	318	1110.5	1.80	653	1111.3	7.00	136	1111.1	24-Hour
WL10A	39	1	1.10	44	1110.5	2.12	87	1111.3	7.00	7	1111.1	24-Hour
WL11	143	25	1.55	165	1110.6	2.70	277	1111.3	7.00	26	1111.1	24-Hour
WL11B	354	30	1.50	335	1110.5	2.57	524	1111.3	7.00	65	1111.1	24-Hour
WL11C	25	27	1.84	45	1110.9	3.03	76	1111.3	7.00	5	1111.1	24-Hour
WL12	189	45	2.11	276	1111.2	3.38	429	1111.3	7.00	35	1111.2	24-Hour
WL-13	278	19	1.83	443	1129.7	3.03	761	1132.1	7.00	51	1129.5	24-Hour
WL-13a	27	9	1.34	22	1117.1	2.45	40	1119.6	7.00	5	1116.9	24-Hour
WL14	339	26	1.89	465	1150.7	3.13	772	1152.5	7.00	63	1148.9	24-Hour
WL15	324	3	0.94	154	1173.8	1.95	309	1175.2	7.00	60	1175.1	24-Hour
WL16	414	4	1.38	329	1182.7	2.52	631	1183.5	7.00	77	1181.8	24-Hour
WL17	601	2	1.67	487	1195.6	2.96	942	1196.0	7.00	111	1195.1	24-Hour
WL18	507	2	1.10	268	1145.0	2.17	538	1147.2	7.00	94	1144.9	24-Hour
WL19	953	2	1.17	614	1178.2	2.25	1232	1181.2	7.00	176	1177.1	24-Hour
WL2	1136	1	0.81	302	1110.3	1.79	623	1111.1	7.00	210	1110.7	24-Hour
WL20	944	2	1.58	483	1217.7	2.90	953	1222.4	7.00	174	1213.1	24-Hour
WL21	466	0	0.91	155	1171.3	1.94	321	1171.6	7.00	86	1171.1	24-Hour
WL21A	235	0	1.08	138	1122.9	2.13	284	1124.0	7.00	43	1122.6	24-Hour
WL21B	46	0	1.16	34	1125.2	2.23	69	1125.4	7.00	8	1125.2	24-Hour
WL21C	54	0	0.94	22	1120.6	1.96	46	1121.0	7.00	10	1120.6	24-Hour
WL21D	76	0	0.65	15	1123.4	1.56	31	1123.7	7.00	14	1123.4	24-Hour
WL22	735	0	0.82	200	1111.9	1.81	411	1112.8	7.00	136	1112.3	24-Hour
WL23	157	39	1.91	213	1110.3	3.12	333	1111.3	7.00	29	1111.1	24-Hour
WL23B	531	22	1.61	539	1110.2	2.78	882	1111.3	7.00	98	1111.1	24-Hour
WL24	400	0	0.89	136	1116.5	1.91	283	1117.7	7.00	74	1117.1	24-Hour

Table 4-4
Hydrologic & Hydraulic Modeling Results
Lake Wakanda Subwatershed

			10-Year 24-Hour SCS Type II Design Event			100-Year 24-Hour SCS Type II Design Event			100-Year 10-Day Snow Melt Event			Critical 100-Year Event
Subwatershed	Area (acres)	Directly Connected Percent Impervious (%)	Total Runoff Depth (in)	Peak Runoff Rate (cfs)	Flood Elevation	Total Runoff Depth (in)	Peak Runoff Rate (cfs)	Flood Elevation	Total Runoff Depth (in)	Peak Runoff Rate (cfs)	Flood Elevation	
WL25	385	0	1.16	282	1171.9	2.24	569	1172.8	7.00	71	1171.6	24-Hour
WL26	748	0	0.98	253	1124.0	2.04	512	1125.7	7.00	138	1125.4	24-Hour
WL27	186	0	0.89	61	1172.6	1.91	126	1174.2	7.00	34	1174.5	10-Day Snow Melt
WL28	245	1	1.19	162	1189.7	2.28	328	1191.8	7.00	45	1189.8	24-Hour
WL29	1514	2	1.61	974	1193.0	2.91	1896	1195.5	7.00	280	1192.5	24-Hour
WL3	761	8	0.79	270	1106.0	1.66	442	1106.7	7.00	141	1108.1	10-Day Snow Melt
WL30	990	3	1.85	701	1219.2	3.24	1335	1220.2	7.00	183	1218.4	24-Hour
WL31	48	0	1.37	81	1110.9	2.43	145	1111.7	7.00	9	1111.4	24-Hour
WL4	401	16	1.57	418	1106.0	2.74	730	1106.7	7.00	74	1108.1	10-Day Snow Melt
WL5	909	26	1.72	890	1106.2	2.94	1398	1106.9	7.00	168	1108.2	10-Day Snow Melt
WL6	299	0	0.70	62	1107.8	1.63	131	1109.5	7.00	55	1108.8	24-Hour
WL7	913	0	0.89	314	1108.0	1.90	660	1109.6	7.00	169	1108.9	24-Hour
WL8	231	0	0.89	76	1109.7	1.90	158	1110.3	7.00	43	1110.2	24-Hour
WL9	116	0	0.72	37	1110.5	1.66	82	1111.3	7.00	21	1111.1	24-Hour

Table 4-5
100-Year Hydraulic Modeling Results for Storm Water Ponds

Pond Name	City ID	Subwatershed	Normal Water Level (ft)	Area at Normal Level (ac)	100-Year 24-Hour Flood Level (ft)	100-Year 24-Hour Flood Bounce (ft)	Surface Area at 100-Year 24-Hour Flood Level (ac)	100-Year 10-Day Snowmelt Flood Level (ft)	100-Year 10-Day Snowmelt Flood Bounce (ft)	Surface Area at 100-Year 10-Day Snowmelt Flood Level (ac)	Critical Event	Outlet Size
Southeast Willmar Watershed												
Waterview Business Park Ponding Area	23SW-P07	Duin1	1109	0.2	1112.5	3.5	0.4	1111.1	2.1	0.3	24-Hour	Special Pond Outlet Structure[1]
Waterview Business Park Ponding Area	23SW-P05	Duin2	1107.25	0.4	1112.3	5.0	0.7	1111.1	3.9	0.6	24-Hour	Special Pond Outlet Structure[1]
Waterview Business Park Ponding Area	23SW-P06	Duin3	1107.25	1.3	1112.3	5.0	1.6	1111.1	3.9	1.6	24-Hour	Special Pond Outlet Structure[1]
Waterview Business Park Ponding Area	23SW-P04	Duin4	1109	0.5	1112.9	3.9	0.7	1111.3	2.3	0.6	24-Hour	Special Pond Outlet Structure[1]
Waterview Business Park Ponding Area	23SW-P03	Duin5	1105	0.3	1112.3	7.3	0.5	1111.1	6.1	0.4	24-Hour	Special Pond Outlet Structure[1]
Waterview Business Park Ponding Area	23SW-P02	Duin7	1109	0.4	1112.8	3.8	0.6	1111.5	2.5	0.5	24-Hour	Special Pond Outlet Structure[1]
Waterview Business Park Ponding Area	23SW-P09	DuinW1	1108.5	7.0	1112.3	3.8	7.7	1111.1	2.6	7.3	24-Hour	Overland Swale
Waterview Business Park Ponding Area	23SW-P10	DuinW2	1108.5	1.6	1112.3	3.8	1.7	1111.1	2.6	1.6	24-Hour	Overland Swale
Emerald Pond	13SW-P02	EmeraldPnd	1127	0.1	1130.8	3.8	2.2	1128.1	1.1	0.2	24-Hour	8"
Pleasantview Drive Pond	23NE-P04	PleasantVa	1111.35	0.3	1116.8	5.5	0.5	1112.5	1.2	0.3	24-Hour	15"
Pleasantview Drive Pond	23NE-P03	PleasantVb	1111.45	0.1	1117.2	5.8	0.2	1112.5	1.0	0.1	24-Hour	18"
Pleasantview Drive Pond	23NE-P01	33-4	1111	0.5	1116.2	5.2	1.1	1112.5	1.5	0.6	24-Hour	Special Pond Outlet Structure[1]
Landmark Business Park Pond	13NW-P01	LBP	1139	0.7	1145.8	6.8	8.9	1142.2	3.2	0.9	24-Hour	Special Pond Outlet Structure[1]
5th Street Pond	23NW-P02	5thSt_PND	1107.9	0.0	1112.7	4.8	0.9	1111.2	3.3	0.7	24-Hour	2- 5" Drain Tile
9th Street Pond	22SW-P01	9thSt_PND	1126	0.2	1129.4	3.4	1.1	1128.4	2.4	0.6	24-Hour	8"
Bremer Bank Pond	23NW-P01	BBank_PND	1113	0.1	1115.4	2.4	0.1	1114.3	1.3	0.1	24-Hour	Special Pond Outlet Structure[1]
Kandiyohi County Public Works Building Pond	12SW-P01	PW_PND	1134.7	0.2	1141.2	6.5	2.0	1135.6	0.9	0.2	24-Hour	18"
Home Depot Development Pond	26NW-P01	33E-1	1109	0.3	1112.6	3.6	0.4	1111.1	2.1	0.4	24-Hour	36"
YMCA Development Pond	14SE-P01	32-4	1119	0.3	1120.6	1.6	0.3	1119.6	0.6	0.3	24-Hour	12"
Olena Ave SE Basin	14SW-P04	33-3	1116.5	0.0	1120.6	4.1	1.8	1117.6	1.1	0.0	24-Hour	27"
Olena Ave SE Basin	14SW-P02-3	32-8	1118	0.8	1120.6	2.6	3.5	1119.1	1.1	1.9	24-Hour	12"
Woodberry Development Pond	13NE-P01	WL13-2	1142	0.0	1147.7	5.7	1.1	1146.1	4.1	0.6	24-Hour	Special Pond Outlet Structure[1]
Menards Pond	27NE-P01	E-m24-1	1108.5	0.7	1113.6	5.1	1.2	1113.9	5.4	1.2	10-Day Snow Melt	15"
Sterling Apartments	27NW-P04	E-m24-5	1110.1	0.1	1113.2	3.1	0.2	1111.2	1.1	0.1	24-Hour	36"
	14NE-P01	32-5	1115.5	0.0	1120.6	5.1	5.3	1119.6	4.1	2.1	24-Hour	12"
	14SE-P07	9B	1116.8	0.1	1120.6	3.8	7.9	1117.7	0.9	0.9	24-Hour	48"
	23SW-P01	33E-7	1109	0.3	1114.8	5.8	2.2	1111.1	2.1	0.3	24-Hour	18"
Foot Lake	-	FOOT_LAKE	1117.3	565.0	1118.5	1.2	577.2	1120.1	2.8	617.5	10-Day Snow Melt	6x12' Box Culvert
Willmar Lake	-	Willmar_Lk	1117.3	460.4	1119.3	2.0	475.2	1121.6	4.3	521.1	10-Day Snow Melt	Stream
Swan Lake	-	SWAN_LAKE	1121.3	232.4	1122.6	1.3	236.1	1123.5	2.2	238.8	10-Day Snow Melt	Stream
Skataas Lake	-	SKATAAS_LA	1130	212.0	1131.0	1.0	212.3	1130.8	0.8	212.4	24-Hour	Stream
Eagle Lake	-	EAGLE_LAKE	1126	848.4	1128.2	2.2	951.7	1130.5	4.5	1035.4	10-Day Snow Melt	Stream
Foot Lake Watershed												
Oslo Meadows Development Pond	04SE-P03	Oslo1	1180	0.2	1181.5	1.5	0.3	1180.7	0.7	0.3	24-Hour	6"
Lake wood Additions Ponding Basin	02SW-P03	LKWood	1124	4.3	1125.2	1.2	7.6	1126.6	2.6	9.6	10-Day Snow Melt	12"
Welcome to Our Home Development Pond	03SE-P04	W_HOME	1126	0.2	1127.4	1.4	0.3	1127.0	1.0	0.2	24-Hour	Special Pond Outlet Structure[1]
Burlington Northern & Santa Fe Railway Pond	11SW-P02	RR_PND	1125	0.3	1132.5	7.5	6.7	1132.1	7.1	1.4	24-Hour	6"
Trentwood Estates Phase I Development Pond	12NW-P01	TW_1	1133	0.1	1138.1	5.1	0.2	1134.0	1.0	0.1	24-Hour	18"
Trentwood Estates Phase I Development Pond	12NW-P05	TW_2	1138	0.1	1140.2	2.2	0.1	1138.2	0.2	0.1	24-Hour	18"
Hawk Creek Watershed												
West Winds 2nd Addition Development Pond	21SE-P01	WW2	1112	0.0	1118.7	6.7	2.5	1115.9	3.9	0.1	24-Hour	6"
West Winds 3rd Addition Development Pond	21SE-P02	WW3	1108	0.4	1116.6	8.6	10.4	1112.8	4.8	1.4	24-Hour	36" & 24"
Family Eye & ENT Development Pond	-	FamEYE	1112.5	0.0	1118.7	6.2	0.5	1115.9	3.4	0.2	24-Hour	5" Drain Tile
Swanson Field Basin	21NW-P01	SSF-1	1115.5	0.2	1122.6	7.1	10.5	1122.9	7.4	12.6	10-Day Snow Melt	Special Pond Outlet Structure[1]
Industrial Ponding Basin	16SE-P01	SSF-8	1126.7	1.6	1129.9	3.2	2.3	1129.2	2.5	2.2	24-Hour	10" Drain Tile
Highway 5 Pond	17NE-P01	Hwy5_PND	1110	5.5	1113.7	3.7	7.7	1112.5	2.5	7.4	24-Hour	Special Pond Outlet Structure[1]
Ramblewood Marsh	22NW-P01-03	FIELD1E	1117.74	5.4	1120.2	2.4	13.7	1120.8	3.1	16.2	10-Day Snow Melt	Special Pond Outlet Structure[1]

[1] Special Pond Outlet Structure indicates that the outlet from the pond is complex consisting of a combonation of orifices, weirs, and pipes.

Section 5: Programs and Regulations

City of Willmar Watershed Management Plan

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5.0 Programs and Regulations

This section provides details of the City of Willmar's programs and regulations that affect water resources management within the city. It also provides a general overview of the programs and regulations of other government entities affecting Willmar and the watersheds surrounding the city.

The plans, ordinances, and programs referenced in this section are intended as a resource for staff, residents, and people doing business in Willmar. They also serve as a guide to the City of Willmar's water resources program for proposers of projects, project reviewers, and others.

The details presented here represent the programs as they exist at the date of this Plan. Some of the programs will certainly change. Users of this section should check the city's web site at http://www.ci.willmar.mn.us to locate any revisions to the following programs that may have occurred since publication of this Plan. When discrepancies arise between this Plan and city codes or ordinances, information presented in the city codes or ordinances should be considered the most accurate.

5.1 City of Willmar Water Management Regulatory Framework

The City of Willmar manages stormwater to protect life, property, water bodies within the city, and receiving waters outside the city. The City of Willmar created regulatory programs that accomplish these aims. The city intends to continue its implementation of the regulations and programs contained in this section.

City regulations and land use controls include the following water resource-related plans, ordinances, standards, and guidelines:

- Willmar NPDES Phase II MS4 Stormwater Pollution Prevention Program (2007)—(see **Section 5.2.1** & **Appendix C**)
- Stormwater Management Ordinance (City Ordinance Number 1227)—(see **Appendix D**), this ordinance addresses:
    - Stormwater management (including quantity and quality)
    - Grading, erosion, and sediment control
    - Wetland management
    - Minimum building elevations
- Sanitary Sewer Regulations (Municipal Code, Chapter 16)
- Building Code (Municipal Code, Chapter 4.5)
- Zoning Ordinance (City Ordinance Number 849)
- Subdivision Ordinance (City Ordinance Number 2.023)

The city requires permits and/or approvals for land disturbing activities (including developments), depending on the type of activity. The following is a general list of city permits and/or approvals:

- Building Permit
- Excavation Permit
- Grading Plan Review
- Conditional Use Permit
- Minnesota Pollution Control Agency (MPCA) NPDES Construction Stormwater Permit
- Stormwater Management Plan Approval, including:
    - Stormwater Management
    - Erosion and Sediment Control
    - Grading/Site Plan

Applications for building permits for one and two family dwellings, multi-family residential units, commercial, industrial, institutional, and office space, as well as any other land disturbance activity, must include a stormwater management plan, as specified in the city's Stormwater Management Ordinance. The stormwater management plan may also need to include an erosion and sediment control plan and grading plan, depending upon which criteria of the ordinance are triggered.

The City of Willmar defers the administration of the Wetland Conservation Act (WCA) to Kandiyohi County. This authority includes requiring and verifying that all projects impacting wetlands meet the requirements of the WCA. Additional regulations applicable to wetland areas are described in **Section 5.1.5**.

The City of Willmar is required to meet the conditions of its NPDES Phase II MS4 permit and to implement the Willmar Storm Water Pollution Prevention Program (SWPPP). The city continues to actively engage the MPCA and others to keep its permit and implementation up to date with regard to technology and regulations. The Minnesota Pollution Control Agency (MPCA) is in the process of revising and reissuing the Phase II NPDES MS4 Permit (see **Section 5.2.1**).

To meet the MS4 permit requirements, conform to federal, state, and local standards, and improve the city's surface water management effectiveness, the city will review and update its existing plans and ordinances to bring them in conformance with the policies and goals of this Plan and the NPDES MS4 Permit requirements.

5.1.1 Stormwater Management Ordinance

Ordinance 1227 is the City of Willmar's Stormwater Management Ordinance. This is a comprehensive ordinance that addresses storm sewer design, stormwater drainage, water quality treatment design standards for stormwater detention facilities, temporary and permanent erosion and sediment control, and wetland

considerations. This ordinance was recently revised and should take precedence over the requirements and procedures described in this Plan, if discrepancies arise. This ordinance may be revised in the future to conform with the reissued Phase II NPDES MS4 Permit (see **Section 5.2.1**).

The ordinance requires applicants for land disturbing activities (excluding specific exemptions included in the ordinance) to submit a stormwater management plan via a building permit, site plan approval, or preliminary plat approval. The stormwater management plan is evaluated against all or some of the general standards included in the ordinance, depending upon the size of the land disturbance activity and impervious area.

All stormwater management plans must include erosion and sediment controls, regardless of the size of the land disturbance activity. In addition, land disturbance activities meeting a minimum area threshold are subject to a grading review. Stormwater rate control and water quality control are also required if certain minimum impervious area thresholds are exceeded. Refer to **Appendix D** for specific ordinance requirements. The ordinance describes the application and review process, required plan elements, and plan approval standards.

The full text of this ordinance is included in this plan in **Appendix D**.

5.1.1.1 Stormwater Management Plan Review and Permitting Process

The plan review process and permitting procedures for stormwater management plans are detailed in the Stormwater Management Ordinance (see **Appendix D**). A stormwater management plan may be approved subject to compliance with conditions to ensure that the requirements of the stormwater management ordinance are met. Conditions may include limiting the size or type of development, requiring construction of structures, drainage facilities, storage basins and other facilities, requiring replacement of vegetation, establishment of required monitoring procedures, staging the work over time, or requiring alteration of the site design to ensure buffering.

The City of Willmar may require payment of a processing and approval fee for stormwater management plan approval if outside consultant review is required. The city may also require payment of other fees for letters of credit, escrow payments, and signing of development agreements.

5.1.1.2 Stormwater Management Plan Approval Standards

The city has established relevant standards applicable to development and redevelopment. The standards included in the Stormwater Management Ordinance (see **Appendix D**) are applicable to stormwater management plan approval and address the following issues:

- Site dewatering
- Waste and material disposal
- Sediment tracking
- Drain inlet protection
- Site erosion control
- Stormwater management criteria for permanent facilities
- Wetlands
- Steep slopes
- Catch basins
- Drain leaders
- Inspection and maintenance
- Models/methodologies/computations
- Compliance with local and county water management plans
- Easements

5.1.2 Erosion and Sediment Control

The City of Willmar's Stormwater Management Ordinance (see **Appendix D** of this Plan) requires stormwater management plans to address temporary construction site erosion and permanent erosion and sediment control. The ordinance requires construction of temporary or permanent sedimentation basins and/or requires the placement of control measures along all sideslope and downslope sides of the site depending upon the size of the disturbed areas. For all sites, the ordinance requires stabilization (e.g. seeding and mulching, sodding) of all disturbed ground left inactive for 14 or more days. The ordinance also requires erosion control measures for soil and dirt stockpiles.

The stormwater management ordinance also requires the following regarding permanent erosion and sediment control practices:

- Applicants must show that accelerated channel erosion will not occur as a result of the proposed activity.
- Permanent stormwater detention facilities must provide storage for both runoff and sediment, and be maintained regularly to remove accumulated sediment.

In addition to the city's ordinances and requirements, proposers of projects disturbing one or more acres of land are required to obtain from the MPCA a NPDES General Stormwater Permit for Construction Activity. The NPDES Construction Permit covers both temporary and permanent erosion and sediment controls. Similar to the city's stormwater management ordinance, the NPDES permit requires provision of temporary sedimentation basins for sites that will disturb five or more acres of land.

For sites that are five or more acres, the city requires submittal of a formal erosion control plan. For sites less than five acres, the city requires a site plan and any erosion and sediment controls required by the Stormwater Management Ordinance, NPDES Permit Application, and City Standard Specification for Construction.

Standards for grading and erosion control in the City of Willmar are included in the Stormwater Management Ordinance.

5.1.3 Floodplain Management

The City of Willmar does not have a floodplain management ordinance. New structures are protected from flooding by adhering to minimum building elevation requirements specified in the city's Stormwater Management Ordinance (see **Appendix D**). Minimum building elevations are defined relative to the 100-year regional flood elevation, and are applicable to Federal Emergency Management Agency (FEMA) floodplains as well as floodplain areas defined by the city. The July 1977 City of Willmar Flood Insurance Study (FIS) contains the most current flood information and maps available for the City of Willmar. The FIS and flood maps for Kandiyohi County are currently being updated and, once published, will replace the July 1977 City of Willmar Flood Insurance Study. Kandiyohi County has a floodplain ordinance that applies to unincorporated areas of the county.

5.1.4 Shoreland Management

The City of Willmar has a zoning ordinance (City Ordinance 849) that defines shoreland districts within the city. The city's zoning ordinance regulates the use of any shoreland of public waters, and regulates lot size and density within shoreland districts. Kandiyohi County has a MDNR-approved shoreland ordinance that applies only to lakes located in unincorporated areas. City staff consults with county staff regarding shoreland issues on projects located in shoreland areas within the city. The city may be required by the MDNR to adopt a shoreland management ordinance in the future.

5.1.5 Wetland Management

The City of Willmar manages wetlands in accordance with the requirements of WCA and the standards outlined in the city's Stormwater Management Ordinance (see **Appendix D)**. Kandiyohi County presently serves as the local governmental unit (LGU) responsible for administering the WCA within the city and surrounding

watersheds. Wetland mapping within the city and surrounding watersheds is based on the U.S. Fish and Wildlife Service's National Wetland Inventory (NWI) (see **Section 3.9**). In addition to the NWI, wetland identification is performed during the development and re-development permitting process.

In addition to the city and county requirements, wetland management within the City of Willmar is also governed by the following federal, state, regional and local regulations. Those regulatory programs are listed below and described in greater detail in **Appendix B**.

- Section 10 of the Rivers and Harbors Act
- Section 404 of the Clean Water Act
- Section 401 of the Clean Water Act
- Food Security Act of 1985, "Swampbuster"
- MDNR Public Waters program
- Wetland Conservation Act of 1991 (WCA)
- State Water Quality Standards, Minnesota Rules 7050

5.2 Regulatory Programs Affecting the City

There are several programs at the state and federal level which require the City of Willmar to implement controls to manage stormwater and/or protect water resources. Key programs affecting the city are described in this section of the Plan.

5.2.1 National Pollution Discharge Elimination System (NPDES) Program

The City of Willmar is included in a group of communities with populations greater than 10,000 that are federally required to obtain a Municipal Separate Storm Sewer System (MS4) permit for managing non-point source stormwater. The Phase II National Pollution Discharge Elimination System (NPDES) permit program requires cities such as Willmar to file a Phase II NPDES MS4 permit with the Minnesota Pollution Control Agency (MPCA), which addresses how the city will regulate and improve storm water discharges. The permit must include a Stormwater Pollution Prevention Program (SWPPP) addressing all of the requirements of the permit. Willmar submitted its most recent permit application in 2007. The city's SWPPP is described in **Section 5.2.2**.

In Minnesota, the NPDES Program is administered by the MPCA (see **Appendix B**). The NPDES program also includes the NPDES General Stormwater Permit for Construction Activity, the NPDES General Industrial Stormwater Permit program, and the subsurface sewage treatment system (SSTS) regulations (7080 Rules).

The MPCA is in the process of reissuing the Phase II NPDES MS4 Permit. The current revisions will shift from permit program development to an emphasis on measuring progress and implementation. The draft MS4 General Permit was placed on public notice for comment in Summer 2011. The revised draft permit will be placed on public notice in Spring 2012, and is anticipated to become effective later in 2012.

The main issues addressed in the reissued MS4 General Permit may include:

- Impaired waters and total maximum daily loads (TMDLs)
- Construction stormwater erosion and sediment control
- Post-construction BMP operations and maintenance
- Mapping of the stormwater system
- SWPPPs and coordination with local water plans
- Non-degradation/anti-degradation
- Minimum control measures for education

Anticipated changes to the MS4 General Permit include revisions to the above topics. These revisions are described in the *Overview of Revisions to the General Permit for Small Municipal Separate Storm Sewer Systems* (MPCA, 2011). That document, and more information on the permit reissuance and schedule, can be found at the MPCA's website:

http://www.pca.state.mn.us/index.php/water/water-types-and-programs/stormwater/municipal-stormwater/municipal-separate-storm-sewer-systems-ms4.html

5.2.2 City of Willmar Stormwater Pollution Prevention Program (SWPPP)

The current Phase II NPDES MS4 permit must include a SWPPP addressing all of the requirements of the permit. Willmar's NPDES Phase II MS4 SWPPP addresses six minimum control measures (MCMs) outlined in the permit requirements. The City of Willmar has already developed and put in place many of the best management practices (BMPs) required in the NPDES permit. The MCMs required by the permit are:

1. Public Outreach and Education
2. Public Participation/Involvement
3. Illicit Discharge Detection and Elimination
4. Construction Site Runoff Control
5. Post Construction Runoff Control

6. Pollution Prevention/Good Housekeeping

The SWPPP identifies issues related to the above minimum measures and more. For example, the city has added several BMPs to the SWPPP to address total maximum daily load (TMDL) reports and implementation plans (see **Section 5.2.3**), including the Lower Minnesota River Dissolved Oxygen TMDL.

The SWPPP is designed to address these issues, thereby minimizing the discharge of pollutants into the city's stormwater system, protecting and enhancing water quality, and satisfying the appropriate requirements of the Clean Water Act of 1984 (as amended). The complete SWPPP is presented in **Appendix C** of this plan.

5.2.3 Total Maximum Daily Load (TMDL) Allocations

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 water body and establish water quality criteria that must be met within the water body to maintain 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 is updated by the state every two years. The impaired waters list is sometimes referred to as the 303(d) list; the 303(d) list includes only the subset of impaired waters for which a TMDL has not yet been approved.

For impaired water bodies, the CWA requires the development of a total maximum daily load (TMDL) study. A TMDL is a threshold calculation of the amount of a pollutant that a water body can receive and still meet water quality standards. A TMDL establishes the pollutant loading capacity within a water body and develops an allocation scheme amongst the various contributors, which include point sources, non-point 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), and a load allocation (LA) is developed that establishes allowable pollutant loadings from non-point sources and natural background levels in a water body.

The City of Willmar's SWPPP requires the city to review the impaired waters list to identify any TMDLs that may affect the city's MS4 permit. The city must identify the location(s) of discharge(s) from the city's system to the impaired waters. The city's SWPPP requires the development of a contributing factors list and, if possible, a map of the contributing factors. The greater the detail that can be achieved in mapping contributing factors, the greater the flexibility will be in implementing BMPs to meet load reduction requirements. The city's SWPPP must incorporate information about all of the BMPs implemented to address the identified TMDL issues. The pending Phase II NPDES MS4 Permit reissuance is

expected to include changes for MS4 permit holders regarding the reporting of BMP implementation related to TMDLs.

Impaired waters within or immediately downstream from the City of Willmar and surrounding watersheds include Eagle Lake, Lake Wakanda, Kasota Lake, Little Kandiyohi Lake, the South Fork of the Crow River, and Hawk Creek. These waters are presented in Table 3-3.

5.2.4 Wellhead Protection and Groundwater Management

In 1998, the Minnesota Department of Health (MDH) enacted Rule 4720, which requires all public water suppliers that obtain their water from wells to prepare, enact, and enforce wellhead protection plans. A Wellhead protection plan (WHPP) is intended to protect drinking water from being polluted by managing potential sources of contamination. The City of Willmar does not currently have a wellhead protection plan (WHPP); the City of Willmar is currently on the list for phasing public water supplies into the wellhead protection program and will be notified by the MDH when it must begin preparing a WHPP.

The City of Willmar relies on groundwater for its municipal water supply; its municipal well field consists of sixteen active wells. The City of Willmar's municipal water supply system is maintained and operated by Willmar Municipal Utilities. Willmar Municipal Utilities will work with the MDH to develop a WHPP. The WHPP may include recommendations and/or regulations for protection of source water within the City of Willmar.

While the MDH is the official state agency responsible for addressing environmental health matters related to groundwater, various other agencies have groundwater management and protection roles. The MDNR regulates groundwater usage rate and volume as part of its charge to conserve and use the waters of the state. The MPCA administers and enforces laws relating to pollution of the state's waters, including groundwater. The Minnesota Geological Survey provides a complete account of the state's groundwater resources.

5.3 Other Agency Roles and Responsibilities

Along with the City of Willmar, various units of government are involved in regulating water resource related activities. The regulatory roles and responsibilities of the following entities as they pertain to water resources are described in **Appendix B**.

- Kandiyohi County
- Minnesota Department of Natural Resources (MDNR)
- Minnesota Board of Water and Soil Resources (BWSR)
- Minnesota Pollution Control Agency (MPCA)
- Minnesota Department of Health (MDH)

- Minnesota Environmental Quality Board (EQB)
- Minnesota Department of Transportation (MnDOT)
- Army Corps of Engineers (USACE)

Section 6: Assessment of Issues and Opportunities

City of Willmar Watershed Management Plan

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6.0 Assessment of Issues and Opportunities

This section discusses general and specific issues facing the City of Willmar regarding water resources management. This section examines water quality, stormwater runoff rates and volumes (water quantity), erosion and sediment control, and wetlands, as well as the adequacy of existing city programs. These issues are summarized in **Table 6-1**.

6.1 Water Quality Issues

6.1.1 Stormwater Runoff Quality Issues

Pollutants are discharged to surface waters as either point sources or non-point sources. Point source pollutants discharge to receiving surface waters at a specific point from a specific identifiable source. Examples of point sources include discharges of treated sewage from a wastewater treatment plant or from an industry. Non-point source pollution cannot be traced to a single source or pipe as with a point source. 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 non-point source pollution.

For lakes, phosphorous is the pollutant of major concern. Point sources of phosphorus typically come from municipal and industrial discharges to surface waters, whereas non-point 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 non-point sources (with the exception of SSTS) discharge as a result of precipitation that triggers surface runoff. As a result, non-point source pollution loading tends to dominate during normal or high flows, while point source loads dominate during low flows.

For most water bodies, non-point source 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. In addition to phosphorus, stormwater runoff may contain pollutants such as oil, grease, chemicals, other nutrients, metals, litter, and pathogens. All of these pollutants 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 sources, other possibly significant sources of phosphorus include atmospheric deposition, internal loading within lakes and ponds (e.g. release from

anoxic sediments, algae decomposition, aquatic plant die-back, and fish-disturbed sediment), and failing SSTS.

SSTS can be pollutant sources (see **Appendix A**). Sanitary sewer and water service is provided through most of the area within the city's municipal boundary. There are only a few remaining SSTS within the city.

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 (CWA), 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 Willmar is required to obtain a NPDES Phase II (MS4) Storm Water permit (see **Section 5.2.1**) and maintain a Storm Water Pollution Prevention Program, or SWPPP (see **Section 5.2.2**). The city's current SWPPP includes various best management practices aimed at protecting surface water quality. In the future, the city may need to refine these BMPs or add additional BMPs to comply with Total Maximum Daily Load (TMDL) requirements (see **Section 5.2.3** and **Section 6.1.2**).

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

Typically, ponds are constructed to treat non-point source runoff, removing phosphorus and sediment from the stormwater. Non-point source runoff affects not only the water resources located within Willmar and the surrounding watersheds, but also the South Fork Crow River, Minnesota River, and (ultimately) the Mississippi River.

Current city standards require the implementation of various best management practices for development projects in the interest of protecting surface water quality.

6.1.2 Impaired Waters and TMDL Issues

Section 303(d) of the Federal Clean Water Act requires each state to identify and establish priority rankings for waters that do not meet the water quality standards. 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 (see **Section 5.2.3**).

Table 3-3 lists the impaired waters located within the watersheds that include the City of Willmar or immediately downstream of those watersheds. **Table 3-3** lists 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 (or whether the TMDL has been approved).

For the MPCA to list a waterbody (besides a river or stream) on the impaired waters list, it must meet the MPCA's definition of a "lake" and there must be sufficient data to determine if the lake is impaired (MPCA, 2007a). The criteria for determining the impairment of lakes due to eutrophication, nutrients, or biological indicators are described in **Appendix B**.

6.1.2.1 Waters Impaired due to Mercury

Eagle Lake, Hawk Creek within and downstream of Willmar, as well as reaches of the South Fork Crow River downstream of Lake Wakanda are impaired for mercury in fish tissue. The MPCA has developed a statewide TMDL for mercury. Mercury in Minnesota fish comes almost entirely from atmospheric deposition (99.5%), with approximately 90 percent originating outside of Minnesota. Because the main source of mercury comes from outside the state and the atmospheric deposition of mercury is relatively uniform across the state, the TMDL for mercury includes an air emission target of 789 pounds/year and a water discharge limit of 24 pounds/year for Minnesota sources (MPCA, 2007b).

6.1.2.2 Impaired Waters within Willmar and the Surrounding Watersheds

Lake Wakanda, Little Kandiyohi Lake, and Kasota Lake (all located within the Lake Wakanda watershed) are impaired for aquatic recreation due to nutrients, eutrophication, and biological indicators. According to the (draft) 2010 impaired waters list, TMDLs for these water bodies are scheduled to begin between 2012 and 2017 and be completed by 2018 (2020 for Lake Wakanda). Following TMDL study completion, load reductions may be assigned to the city for Lake Wakanda, which is located downstream of the city's storm sewer network. The TMDL requirements will then be incorporated into the city's NPDES Phase II MS4 permit (see **Section 5.2.3**). This Plan would likely need to be amended to incorporate those TMDL requirements.

6.1.2.3 Impaired Waters Further Downstream of Willmar and the Surrounding Watersheds

There are several impaired waterbodies located downstream of Willmar and the surrounding watersheds, including:

- South Fork Crow River above Hutchinson Dam
- South Fork Crow River below Hutchinson Dam
- Lower Minnesota River
- Mississippi River
- Lake Pepin

These impairments are presented in **Table 3-3** and described in greater detail in **Appendix B**. TMDLs are schedule for these waterbodies over the next several years. Although Willmar is one of many MS4s located upstream of these impaired waterbodies, it is possible that waste load allocations could be applied to the city (see **Section 5.2.3**).

6.1.2.4 Lower Minnesota River Dissolved Oxygen TMDL

A TMDL for dissolved oxygen in the Lower Minnesota River was approved in 2004. The Lower Minnesota River dissolved oxygen TMDL implementation plan requires upstream MS4 communities (including Willmar) to reduce phosphorus loading from stormwater runoff by 30 percent. The percent reduction is corrected for growth and based on 2000 land use, assuming no BMPs in place at that time. The City of Willmar added several BMPs to the city's SWPPP to address the requirements of this TMDL and TMDLs in general. Specific BMPs implemented to address the dissolved oxygen TMDL include developing a phosphorus-contributing factors list, mapping existing BMPs, and tracking phosphorus reductions as new development occurs.

6.1.3 Specific Water Quality Issues

Those water bodies within and downstream of Willmar listed on the impaired waters list are summarized in **Section 3.11.4**, **Section 6.1.2.2**, and **Appendix B**.

6.1.3.1 City Water Quality Goals

For those lakes that are included on the impaired waters list due to nutrients, eutrophication, and biological indicators, water quality goals are defined by the MPCA ecoregion in which the lake is located (see **Appendix B**).

The city's water quality goals include the preservation of the beneficial uses of all lakes, streams, and waterbodies in the city and surrounding environment. The city has not defined quantitative water quality goals (e.g. total phosphorus concentrations, Secchi transparency) for specific water bodies within the city aside from those defined by the MPCA for impaired waters. The city may choose to establish water quality goals for specific water bodies in the future.

6.2 Stormwater Runoff Rates and Volumes Issues

6.2.1 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 compacted and 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. Further, 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.

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.

Although both high water levels (flooding) and low water levels are of concern to the city and its residents, more concern and attention is usually paid to flooding because it presents a greater threat to public health and safety, and can result in significant economic losses.

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

Landlocked basins have the potential for flooding. The only landlocked basin included in the hydrologic/hydraulic modeling of the city is Ramblewood Marsh, which is landlocked for events less than the 100-year event. If flooding issues were to develop in landlocked areas, the city may be requested to provide outlets from landlocked basins to prevent damages that occur during periods of sustained high water levels. It is possible that future expansion of the city may result in the development of areas surrounding landlocked basins not currently located within the city. In those situations, special consideration must be given to establishing the 100-year flood elevation and corresponding minimum building elevations. Minimum building elevations around landlocked basins are governed by the city's Stormwater Management Ordinance.

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.

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. The city's municipal code, however, does allow the city to limit the times and hours when city water may be used for non-essential activities.

6.2.1.1 Level of Service/Level of Protection

It is important to define the difference between level of service and level of protection when designing and analyzing stormwater systems. The level of service is defined as the system's capacity to convey runoff without unusual hardship or significant interference with routine public activities. Typically, this means flows remain in the storm sewer system and there is no significant street flooding. **Figure 6-1** shows a schematic of an urban stormwater conveyance system providing the level of service.

The City of Willmar accepts that there may be flooding of roadways up to a depth of 3.5 inches during the 10-year event in some locations. At this level of flooding, water is below the curb height, roadway crowns are generally visible, and roads are passable by motor vehicles. This level of flooding is typically very localized (e.g. specific intersections).

The level of protection is defined as the total system capacity required to avoid flooding of structures and provide for public safety. Typically, the level of protection is the level at which street flooding, overflow swales, piping systems and ponds work as a total system to prevent flooding of homes/businesses and to prevent dangerous flooding of streets. **Figure 6-2** shows a schematic of a stormwater conveyance system providing the level of protection.

A system's level of protection is determined by combining the capacity of the storm sewer and ponding system with the overland flow channels that carry the water that cannot be carried by the storm sewer system. For example, if a storm larger than the storm sewer's design event occurs, some of the runoff will not be captured by the storm sewer, and will instead flow in gutters or natural swales. In higher areas or in areas with well-defined overland flow patterns, this surface flow may not cause flooding. However, in low areas drained only by the storm sewer, the water may collect and flood adjacent property. In the first case, the overall drainage system provides a level of protection greater than the level of service provided by the storm sewer. In the latter case, the level of protection is essentially the same as the level of service.

In the City of Willimar, the design event used for level of service (storm sewer design event) currently corresponds to a return period of 10 years or less as defined by 1961 TP-40 values (*National Weather Bureau, 1961*). The design event used for level of protection (total system design event) corresponds to a return frequency of 100 years based on the 1961 TP-40 values. The TP-40 will be updated in 2012 with the likely outcome being increased design event rainfall depths. After publication of the 2012 TP-40 values, the city will assess its level of service and level of protection design event criteria and determine whether those rainfall depths should be updated.

6.2.2 Specific Water Quantity Issues

6.2.2.1 Impacts of Future Development on System Capacity

The developed parts of the city have complete stormwater drainage systems in place. Much of the existing drainage system has little or no additional capacity for added stormwater runoff from new developments and redevelopments. Some areas of the city are currently over capacity,

resulting in local flooding issues during larger events. As areas within the city develop or redevelop, the effect of the proposed projects on the stormwater system will need to be determined using an accurate hydrologic/hydraulic model which considers limitations of the system downstream of the development. The city's Stormwater Management Ordinance and other design standards will be applied to ensure sufficient design capacity for new and redeveloped stormwater system components. The city may revise the Stormwater Management Ordinance to more actively address existing flooding issues, especially those in the Southeast Willmar watershed (see **Section 6.2.3.3**).

6.2.2.2 Development of Floodplain Regulation

Kandiyohi County adopted a floodplain ordinance in 1990 in accordance with Minnesota Statutes 103F, which requires the development of a local floodplain ordinance to maintain eligibility and participation in the National Flood Insurance Program. This ordinance is applicable to the watersheds surrounding Willmar that are outside of Willmar's municipal boundary. The city's Stormwater Management Ordinance specifies minimum building elevations based on 100-year flood elevations for FEMA and city-defined floodplains, but does not include floodplain regulations (see **Section 5.1.3**). Permitted floodplain uses are not discussed in the city's zoning ordinance, although the city discourages development in the floodplain and maintains a "no net loss" policy regarding floodplain storage (see **Section 2.3.2**). Any floodplain ordinance developed by the city must be consistent with the MDNR's statewide criteria for floodplain management outlined in Minnesota Rules 6120.50 through 6120.62.

Floodplain mapping for Kandiyohi County was recently updated and will be published in the near future (see **Section 3.12.3**).

6.2.3 Local Flooding Issues

There are several existing flooding/drainage issues in the city. In addition to observed issues, hydrologic/hydraulic model results (see **Section 4**) indicate the potential for flooding issues in other areas of the city and surrounding watersheds. Flooding issues identified in the following sections are classified into two categories:

- **Observed Flooding Issues** - These are locations where city staff identified historical flooding problems. These areas are shown as stars in **Figure 3-24**. Model results also predicted flooding in these areas.

- **Modeled Flooding Issues** – These are areas where model results indicate flooding of street intersections and depressions with at least 0.5 acre-feet of water during or following the 100-year critical storm event, although in some locations, flooding issues have not been identified by the city.

The storm sewer network in the developed part of the city is complex and highly interconnected. The complexity of the system makes it is difficult to determine how best to address each area of local flooding. This section presents potential actions to address local flooding issues by upgrading sections of the storm sewer system or adding additional planned flood storage (e.g. increasing the capacity of existing stormwater ponds or constructing new ponds). The locations of all recommended improvements to the stormwater system are shown on **Figure 3-25**. The city will seek to address these flooding issues as funding allows. Prior to selecting methods to address specific local flooding issues, however, the city will conduct a complete detailed analysis of each area to determine the impact of these changes on the entire stormwater system.

6.2.3.1 Foot Lake Watershed

There is one known flooding issue in the Foot Lake watershed, near the intersection of 5th Street and Trott Avenue. Modeling results indicate the potential for additional flooding issues in other areas of the watershed due to limited pipe capacity and/or lack of available storage volume.

Observed Flooding Issues – The developed portions of the Foot Lake watershed surrounding the chain of lakes include many small, separate storm sewers that drain to the lakes. Otherwise, the watershed is primarily drained via overland flow (i.e. most water does not enter a storm sewer). There has been one reported flood problem in the Foot Lake watershed at the intersection of 5th Street and Trott Avenue. During the 10-year event, the existing trunk storm sewer system does not have the necessary capacity to handle the incoming flow. The city will consider increasing the capacity of the system when 5th Street SW is reconstructed. The location of this flooding issue is shown on **Figure 3-24**.

Modeled Flooding Issues – Model results indicate that some of the storm sewers in the northern part of the city do not have sufficient capacity to handle the peak runoff during the 10-year storm event. In addition, there are also locations where the existing storm sewer system does not provide a sufficient level of protection during a 100-year event.

- ***High Avenue NE*** – The culverts below High Avenue NE are currently undersized. During the 10-year event, significant ponding occurs between High Avenue NE and the railroad. This is a developed area; additional culvert capacity may be added below High Avenue NE in conjunction with street improvements or redevelopment.

- ***Ella Avenue NE*** – Model results indicate that the existing storm sewer in this location is currently undersized. Increasing the pipe capacity south of Ella Avenue NE to the east of 1st Street may reduce the

localized flooding in the residential development east of 1st Street between High Avenue NE and Ella Avenue NE. Such improvements could be implemented as part of street reconstruction.

6.2.3.2 Hawk Creek Watershed

There is one known flooding issue in the Hawk Creek watershed near the Swanson Ball Field. Modeling results indicate the potential for additional flooding issues in other areas of the watershed due to limited pipe capacity and/or lack of available storage volume.

Observed Flooding Issues – The majority of the Hawk Creek watershed is undeveloped and located outside the Willmar municipal boundary. There has been one reported flooding problem in the Hawk Creek watershed at the intersection of 15th Avenue and 22nd Street near the Swanson Ball Field. In response, the city constructed a stormwater ponding basin to mitigate local flooding. There have been no other reported flooding problems in this watershed. The locations of known flooding issues are shown on **Figure 3-24**.

Modeled Flooding Issues – Model results indicate that there is potential for flooding in the developed western portions of the city that drain to Hawk Creek. Model results indicate that some of the storm sewers in this area do not have sufficient capacity to handle the peak runoff during the 10-year storm. In addition, there are also locations where the existing storm sewer system does not provide a sufficient level of protection during a 100-year event. Increasing pipe sizes in this area, however, may not necessarily eliminate these flooding problems because the tailwater impacts of County Ditch 46 will continue to restrict flow.

- ***Swannson Ball Fields*** – In 2004 the city constructed a stormwater pond at the northeast corner of the intersection of 15th Avenue and 22nd Street (SSF-1). The stormwater pond was constructed to mitigate the flooding of Swannson Ball Field. Model results, however, indicate that during the 10-year event the field will be partially flooded, and during the 100-year event more than half of the field will be inundated. Increasing the volume of the existing stormwater pond may keep the Swanson Ball Field from flooding. Additionally, the ball fields north of Willmar Avenue (SSF-10) are also inundated during the 10-year event. A stormwater pond constructed southwest of the intersection of 18th Street and Willmar Avenue may alleviate this flooding.

- ***23rd Avenue SW*** – Increasing the pipe capacity south of 21st Street SW along 23rd Avenue SW to the Westwinds development pond may reduce the localized flooding along 23rd Avenue SW. Model results

indicate that the existing 54-inch trunk storm sewer in this location is currently undersized. As development continues in this area, the city is constructing a parallel system of 30-inch pipe to provide additional capacity. That system is not yet completed.

- ***20th Avenue SW*** – The existing pipe along 20th Avenue, west of 21st Street is undersized for the 10-year storm event and does not provide sufficient capacity to handle stormwater runoff. Increasing the size of this pipe may alleviate flooding. In addition, model results indicate that the pond west of subwatershed E-m8 will overtop during the 10-year storm event. Increasing the detention volume of this pond may prevent overtopping and improve drainage from upstream areas (due to reduced tailwater effect).

- ***19th Avenue SW*** – The existing pipe along 19th Avenue, west of 15st Street is undersized and does not provide sufficient capacity to handle stormwater runoff from the 10-year event. Increasing the pipe size may reduce localized flooding. The city may also choose to redirect this storm sewer system to the east and discharge into Ramblewood Marsh. Redirecting the storm sewer system will utilize available storage in Ramblewood Marsh that is currently not being used during the 10- or 100-year events.

- ***Richland Avenue*** – The existing pipes along Richland Avenue east of 16th Street SW do not provide sufficient capacity to handle runoff for the 10-year event. Increasing the size of these pipes will reduce the flooding along Richland Avenue and south of Richland Drive.

6.2.3.3 Southeast Willmar Watershed

There are several known flooding issues in the Southeast Willmar watershed, and modeling results indicate the potential for additional flooding issues in other areas of the watershed. The storm sewer network in the main part of the city is complex and highly interconnected. Therefore, it is difficult to know how best to address each area of local flooding without replacing large sections of the storm sewer system or completing a detailed analysis for each area. Flooding issues in the Southeast Willmar watershed are due to limited pipe capacity and/or lack of available storage volume.

Observed Flooding Issues – The locations of known flooding issues are shown on **Figure 3-24.** The majority of the Southeast Willmar watershed is developed and located within the Willmar municipal boundary. There have been several reported flooding problems within this watershed. In response, the city has actively worked to reduce the potential for flooding through ongoing storm sewer improvements and maintenance,

constructing stormwater ponds, and when necessary, purchasing flood prone lands.

Increasing pipe capacity within this watershed may be necessary to address flooding problems. **Figure 3-25** shows the locations of the trunk sewer along Willmar Avenue SW, as well as its major arteries, and four of the smaller, disconnected networks that drain to County Ditch 23. The city may seek to add additional capacity in several of these areas. In addition to the pipes shown in **Figure 3-25**, the city may seek to increase the size of lateral storm sewers and catch basin leads. The city will conduct a complete analysis of any proposed flood mitigation option to assess the impacts on the remainder of the storm sewer system.

In addition to increasing the capacity of the trunk storm sewer system, the construction of ponding areas will also be necessary to resolve the flooding issues in the Southeast Willmar watershed. Adding storage capacity will be more difficult in the upstream portions of this watershed, which is largely developed. **Figure 3-25** identifies possible future ponding locations including the old wastewater treatment plant site, south of the Landmark Development Park, near the Kennedy High School ball field area, and Ramblewoood Marsh.

Modeled Flooding Issues –Model results indicate that many of the storm sewers within the Southeast Willmar watershed do not have sufficient capacity to handle the peak runoff during the 10-year storm. In addition, there are also locations where the existing storm sewer system does not provide sufficient protection during a 100-year event. The general locations of suggested improvements to the storm sewer system described below are shown on **Figure 3-25**.

- ***Old Wastewater Treatment Facility*** – The city recently constructed a new wastewater treatment facility. Model results indicate that the location of the old wastewater treatment facility southeast of the intersection of Willmar Ave and 4th Street SE is prone to flooding during the 10-year event. The city is evaluating the feasibility of constructing a stormwater ponding area at this site to reduce local flooding.

- ***Kennedy High School Ballfield Area*** – Model results indicate that the existing storm sewer system east of Kennedy High School is currently undersized; the existing pipe does not provide sufficient capacity to handle stormwater runoff from the 10-year event. The city may consider increasing the pipe size to reduce flooding. In addition, there is potential to construct a stormwater detention basin near the Kennedy High School Ballfield. A detention pond at this location may

decrease the tailwater effect on the existing system and improve drainage in areas east of the ballfield.

- ***10th Street & Kandiyohi Avenue Intersection*** – Model results indicate that a combination of pipe capacity and the lack of off-street flood detention result in local flooding near the intersection of 10th Street and Kandiyohi Avenue during the 10-year event. The city may seek to increase the capacity of the trunk storm sewer system to reduce flooding near the intersection. The addition of flood detention near the Kennedy Ballfield may reduce the extent to which the trunk sewer capacity must be increased.

- ***24th Street & Oxford Drive*** – The existing pipe south of US Highway 12 to 24th Street (east of Branch 3 to County Ditch 23A) is undersized with respect to the 10-year event. The city may seek to increase the capacity of this pipe to reduce local flooding.

- ***Becker Avenue SE*** – The existing pipe along Becker Avenue between Charlotte Street and 12th Street is undersized. During the 10-year event, the existing pipe does not provide sufficient capacity to handle stormwater runoff. The city may seek to increase the capacity of this pipe to reduce local flooding. The city may also evaluate the potential to redirect this system to the large undeveloped area located south of Trott Avenue and east of 9th Street.

- ***Minnesota Avenue SE*** – Model results indicate that the existing pipe along Minnesota Avenue between 4th Street and Charlotte Street does not provide sufficient capacity to handle stormwater runoff in the 10-year event. The city may seek to increase the size of this pipe or redirect the storm sewer to the large undeveloped area to the south, located south of Trott Avenue and east of 9th Street.

- ***5th Street & Augusta Avenue*** – The existing pipe near this intersection is undersized. During the 10-year event the existing pipe does not provide sufficient capacity to handle stormwater runoff. The city may seek to increase the size of this pipe or redirect the storm sewer to the large undeveloped area to the south, located south of Trott Avenue and east of 9th Street.

- ***Undeveloped Area West of Menards*** - Model results indicate that the existing storm sewer system in the vicinity of the 28th Avenue and 1st Street intersection is currently undersized for the 10-year event. The city may seek to increase the size of this pipe. In addition, the city may evaluate the feasibility of constructing a detention pond in the undeveloped area west of Menards. A detention pond in this location

may decrease the tailwater effect on the existing system and improve drainage in areas east of Menards.

Phase III Modeling: Flood Mitigation Analysis (2011) – In 2011, the city evaluated evaluated options for minimizing or correcting the flooding issues identified in the southeast quadrant of the city using its existing XP-SWMM hydrologic/hydraulic model (see Section 4). The *City of Willmar – Phase III Modeling: Flood Mitigation Analysis* memo (City of Willmar, 2011) describes this analysis in detail (see **Appendix E)**. The study included analysis of five flood mitigation alternatives including combinations of increased pipe capacity and/or additional storage at sites including:

- Kennedy High School ballfield area
- Undeveloped area west of Menards
- Ramblewood Slough
- Grass Lake
- Former wastewater treatment plant (WWTP) site

The interconnected nature of the Southeast Willmar storm sewer network results in interactions between existing flood-prone areas (i.e., the water present at separate problem areas is essentially a single body of water). This prevents an accurate analysis of particular trouble spots and/or potential mitigation options in isolation. The study therefore included all of the Southeast Willmar watershed and stormwater system, while targeting four specific flooding areas Preliminary planning level cost estimates of flood reduction alternatives range from approximately $30 to $80 million.

The flood mitigation analysis provides several recommended actions to address flooding in the Southeast Willmar watershed, including:

1. Develop extended flood detention and water quality treatment at the former WWTP site
2. Complete a Flood Risk Assessment Feasibility Study, evaluating flood proofing and buyout options
3. Prepare and update an Emergency Flood Response Plan
4. Review and revise the city's Stormwater Management Ordinance
5. Continue to upgrade the city's existing stormwater system to provide 10-year level of service (see **Section 6.2.1.1**)

6. Perform regular updates to the city hydrologic/hydraulic modeling

7. Consider enrolling the city in the National Flood Insurance Program

These recommendations are described in greater detail in the *City of Willmar – Phase III Modeling: Flood Mitigation Areas* memo (City of Willmar, 2011). Several implementation items related to these recommended actions are included in **Section 7** and **Table 7-1** through **Table 7-4**. Based on the high estimated costs of alternatives described in the memo, an additional flood risk assessment feasibility study is recommended to evaluate solutions beyond pipes and ponds, such as flood proofing in targeted areas, or buyout and removal of structures.

6.2.3.4 Lake Wakanda Watershed

The Southeast Willmar watershed drains into the Lake Wakanda watershed. Flows in the Lake Wakanda watershed restrict flows leaving the Southeast Willmar watershed via tailwater impacts. This restriction of flows results in significant flooding in areas adjacent to the Waterview Business Park Development and projected annexation areas. The City of Willmar will evaluate stormwater improvements that reduce flooding west of the Highway 71/23 bypass. Reduction of flooding in this area may be achieved through the construction of the Grass Lake project, increased culvert capacity at the Highway 71/23 bypass, or additional ponding basins north of the Highway 71/23 bypass.

The proposed Grass Lake Restoration project (which is currently being evaluated) would greatly improve the downstream drainage conditions in the watershed, as well as in the Southeast Willmar watershed. The Grass Lake project, if implemented, will significantly reduce the tailwater impacts on flows leaving the Southeast Willmar watershed. Under the proposed project,the City of Willmar's drainage will be pumped into Grass Lake at a rate that prevents significant flooding of County Ditch 23.

If Grass Lake is not restored, the city may consider adding additional culvert capacity downstream of the Highway 71/23 bypass. The impacts of this improvement, however, may be limited due to the continued tailwater impacts that restrict the flow leaving the Southeast Willmar watershed. The city may also consider providing a large ponding area just upstream of the Highway 71/23 bypass. However, this would restrict development in the area.

6.3 Erosion and Sediment Control Issues

Sediment is a major contributor to water pollution. Stormwater runoff from streets, parking lots, and other impervious surfaces carries suspended sediment consisting of fine particles of soil, dust and dirt carried in moving water. Abundant amounts of suspended

sediment are carried by stormwater runoff when erosion occurs. Erosion also impacts stormwater rates and volumes. Vegetation slows down stormwater runoff rates, allowing it more time to infiltrate into the soil. As soil erodes, vegetation is removed from the ground surface, which results in increased rates of stormwater runoff. Erosion also results in channelization of stormwater flow, increasing the rate of stormwater runoff.

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 (Metropolitan Council, 2001), increasing soil erosion and the amount of sediment that may enter 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, open channels) require more frequent maintenance, repair, and/or modification to ensure they will function as designed. 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 of Willmar Stormwater Management Ordinance requires the submittal of erosion control plans (see **Section 5.1.2**). The city is currently revising its Stormwater Management Ordinance. The Stormwater Management Ordinance will detail the required elements of the erosion control plan and describe the permitting and inspection process.

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 Construction Storm-water Permit (NPDES construction 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 NPDES construction permit went into effect on August 1, 2003 and was revised in August, 2008. 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 SWPPP must include the following elements:

- Temporary erosion prevention and sediment control BMPs
- Permanent erosion prevention and sediment control BMPs
- Permanent stormwater management system
- Pollution prevention management measures

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.

6.3.1 Specific Sediment and Erosion Control Issues

There are few existing and potential future erosion problems in and near the City of Willmar.

There is the potential for tracking of sediment off the site of the dirt race track, which is located close to Foot Lake and Willmar Lake. In addition, unpaved streets north of the track may result in increased sediment runoff to Foot Lake. These areas are scheduled to be investigated in 2010.

6.4 Wetland Issues

Preservation of wetland areas is beneficial due to the many functions wetlands serve. Wetland functions may include nutrient uptake, stormwater storage, erosion control, low flow augmentation, wildlife habitat, and ground water recharge. Within the City of Willmar and the surrounding watersheds, Kandiyohi County acts as the Local Governmental Unit (LGU) responsible for implementation of the Wetland Conservation Act (WCA). Kandiyohi County manages wetlands within the county in accordance with the WCA, DNR Public Waters, U.S. Army Corps of Engineers regulations and Swampbuster provisions of the USDA Farm Program (Kandiyohi County, 2003).

6.5 Kandiyohi County Issues

In 2003, Kandiyohi County developed the Kandiyohi County Comprehensive Local Water Plan (Kandiyohi County, 2003). The plan is applicable to those areas under the jurisdiction of the county, which include the unincorporated areas within the watersheds surrounding the City of Willmar. In addition to providing an extensive inventory of water resources

within the county, the plan identified key issues that the county will address in the coming years. Those issues facing the county are listed in **Appendix B**.

6.6 Adequacy of Existing Programs

6.6.1 City Ordinances and Official Controls

The City of Willmar manages stormwater to protect life, property, water bodies within the city, and receiving waters outside the city. The City of Willmar creates and implements regulatory programs to accomplish these aims (see **Section 5**). The city intends to continue implementing the following regulations and programs.

City regulations and land use controls include the following water resource-related plans and ordinances:

- The City of Willmar Stormwater Pollution Prevention Program (2007)
- Stormwater Management Ordinance(City Ordinance No. 1227)
- The City of Willmar Comprehensive Plan (2008)
- Sanitary Sewer Regulations (Municipal Code, Chapter 16)
- Building Code (Municipal Code, Chapter 4.5)
- Zoning Ordinance (City Ordinance No. 1060)
- Subdivision Ordinance (Municipal Code, Chapter 14)

The City of Willmar defers LGU authority for the Wetland Conservation Act (WCA) to Kandiyohi County. This includes requiring and verifying that all projects impacting wetlands meet the requirements of the Minnesota WCA. Within the city, all projects impacting wetlands are subject to the city's Stormwater Management Ordinance, which includes wetland-specific policies.

The City of Willmar is required to meet the conditions of its NPDES Phase II MS4 permit and to implement the Willmar Storm Water Pollution Prevention Program (SWPPP). The city continues to actively engage the MPCA and others to keep its permit and implementation up to date with regard to technology and regulations.

The city also actively works with adjacent cities, townships, and the county to accomplish common goals.

6.6.2 Public Education and Public Involvement Program

The City of Willmar recognizes the need for public education and involvement programs to increase public awareness of water resource management and improve the quality of stormwater runoff. The city therefore develops and distributes

articles and information regarding water resource management and the city's SWPPP, including information on:

- stormwater issues
- non-point source pollution
- NPDES regulation and guidance
- annual public meetings
- illicit discharges
- erosion control
- shoreline management
- local agency contacts
- stormwater website links
- composting and pollution prevention

This information is distributed through city mailings, newspaper articles, brochures, presentations, website postings, notices on the local cable television station, and articles in the city newsletter.

The city is committed to active participation in collaborative water resource management opportunities. This includes participation as a member of the Lower Minnesota River Dissolved Oxygen TMDL, the Lower Minnesota River Turbidity TMDL, the Minnesota Cities Stormwater Coalition, the Minnesota Environmental Science and Economic Review Board (MESERB), and the Foot Lake Association.

The city's website provides pages and links devoted to water resource related issues including the city's NPDES MS4 Permit and SWPPP information, Willmar's Stormwater Management Ordinance, and other agency and organization websites. The city's website also provides links to brochures and posters addressing topics like rainwater gardens, fertilizer use, pet waste, and other stormwater-related issues. The city's website is located at http://www.ci.willmar.mn.us/.

The city annually presents an overview of its MS4 program and SWPPP at a city council meeting and holds a public hearing to receive oral and written comments regarding the city's stormwater management activities.

The city will continue to increase the public's awareness of the potential sources and negative effects of illicit non-stormwater discharges into the stormwater system, as well as alternative uses for unwanted materials by providing information on recycling options, services, and programs within the city, such as drop-off sites for household hazardous waste. The city will also educate and train its staff to identify, prevent and correct illicit discharges from public works activities and

other general city operations. These activities may include, but are not limited to, educational brochures, newsletters, and workshops.

The city will periodically review its educational and public involvement programs to keep them up to date and useful.

6.6.3 Maintenance of Stormwater System

The City of Willmar is responsible for maintenance of its stormwater system, which includes pipes, constructed ponds, lakes, wetlands, ditches, swales, and other drainageways. Other units of government are responsible for maintaining the stormwater systems under their control.

Owners of private stormwater facilities are responsible for maintaining their facilities in proper condition, consistent with the original performance design standards. Responsibilities include removal and proper disposal of all settled materials from ponds, sumps, grit chambers, and other devices, including settled solids. The city will inspect private stormwater facilities in response to complaints or obvious problems and notify the owners of needed cleaning and repairs.

Stormwater ponds that are classified as jurisdictional wetlands fall under the requirements of the WCA. Thus, the maintenance of these wetlands is more regulated and must follow the guidelines for maintenance outlined by the WCA. For example, sediment cannot be removed from these stormwater ponds below the original pond bottom. Ponds that are included in the National Wetland Inventory (NWI) will be evaluated to determine if they must be regulated by the WCA.

City crews sweep the city streets multiple times per year, including once in early spring (April) and then in the autumn, after leaf fall. From March to November, the city performs continuous sweeping of all streets. The city periodically uses vacuum equipment for street cleaning. The city (or its contractor) also cleans out accumulated sediment from storm sewers.

In addition to more typical maintenance measures, maintenance of the city's stormwater system may also mean maintaining or restoring the ecological characteristics of the natural portions of the stormwater system. The city of Willmar recognizes that maintenance of all of the city's stormwater facilities is an important part of stormwater management. Proper maintenance will ensure that the stormwater system provides the necessary flood control and water quality treatment.

For safety reasons and to prevent pipe plugging, trashracks are typically installed on storm sewer and culvert inlets. These trash racks prevent people from entering the pipes and keep large debris from becoming lodged in the pipes. If not inspected and maintained, the trash racks will become plugged with debris, such as branches, leaves, corn stalks, and other materials carried by storm flows. Even if

only partially plugged, additional flooding can occur. The city recognizes the importance of periodic removal of collected debris from its trash racks and inlets.

Stormwater ponding and water quality treatment facilities perform a desirable function by settling sediment out of the stormwater. However, if accumulated sediments are not periodically removed, such basins can experience a significant loss in necessary stormwater detention capacity and sediment storage volume. Therefore, the City of Willmar will periodically inspect stormwater storage basins and water quality treatment facilities to look for excessive sediment build-up and collected debris. If problems are noted, maintenance is then warranted. For sedimentation basins, if 10 percent of the storage capacity is filled with sediment or the water quality treatment zone is reduced by 25 percent, the basin will be dredged to provide its originally designed sediment storage volume. The MPCA provides guidance for the disposal of material removed from stormwater ponds (see **Appendix B**). For planning purposes, it is often assumed that such dredging may occur every ten years. However, basins that treat runoff from agricultural or developing watersheds may need to be cleaned more frequently due to the increased quantity of sediment loads. The MPCA has also recently implemented additional requirements for that require cities to develop and maintain stormwater pond inventories.

In general, vegetation in existing ponding facilities should be allowed to grow naturally on the side slopes of the basins and should not be mowed. This practice will allow ponding facilities to act like natural wetland areas by providing nearby upland wildlife habitat.

Riprap areas along banks, in overflow swales, or around storm sewer or culvert outlets frequently need maintenance due to poor riprap design, vandalism, natural degradation, or a combination thereof. Riprap is placed in those locations to prevent damage that would result from highly erosive flow velocities. If not periodically maintained, significant erosion will occur resulting in pipe damage, downstream sediment problems, and potential safety issues. The city will inspect riprap areas as part of its regular outfall inspections (as governed by the MS4 permit) and perform the necessary maintenance.

The city will maintain its information about stormwater facilities within the City of Willmar to assist in determining maintenance requirements. The city will notify owners of public and private stormwater facilities of the need to conduct periodic maintenance.

The city's stormwater-related maintenance program is shown in **Table 7-5**.

6.6.4 Adequacy of Existing Capital Improvement Program to Correct Problems

This Plan, its capital improvement and implementation programs, combined with the existing and possible future funding mechanisms, provide the city with adequate tools to correct current and future stormwater management issues. These stormwater projects and tasks will be incorporated into the city's annual street and utility improvement program. The city's annual improvement program should be sufficient to address stormwater issues in the City of Willmar.

6.6.4.1 Stormwater Utility

The stormwater utility is the city's primary means of paying for stormwater-related expenses. Minnesota Statute 444.075 allows cities to establish and implement stormwater utilities. The City of Willmar established and implemented its stormwater utility in 2008. Through the stormwater utility, the city collects approximately $100,000 per year. The fees are used to perform routine maintenance and repairs to the stormwater system, implement MS4 SWPPP best management practices, pay for projects, undertake studies, and review or revise ordinances. This is currently the city's only source of funding for stormwater management projects. Larger projects are paid for through bonds, which are paid back through the stormwater utility.

6.6.4.2 Additional Funding Mechanisms

The city has considered using other methods to pay for stormwater projects, including tax levies or special assessments. The city may consider additional funding methods in the future. Other funding mechanisms are listed below and described in **Appendix B**.

- Local Funding Sources:
    - Special Assessments
    - Impact Fees/Development Costs
    - Tax Increment Financing
- State Funding Sources
    - Minnesota Board of Soil and Water Resources
    - Minnesota Pollution Control Agency
    - Minnesota Department of Natural Resources
- Federal Funding Sources
    - US Environmental Protection Agency

- US Army Corps of Engineers
- U.S. Fish and Wildlife Service
- Natural Resource Conservation Service
- Federal Emergency Management Agency

- Private Funding Sources

6.7 Opportunities

The City of Willmar has several distinct opportunities which might assist in implementing this plan. The city will actively pursue these opportunities.

Partnerships

The MDNR, Kandiyohi County, the Kandiyohi County SWCD, and other agencies may provide technical support and funding toward solving various water resource problems and completing water resource projects. These organizations have a long record of working successfully with individual cities toward meeting shared goals. Additionally, regional lake associations (i.e. the Foot Lake Association) provide support and funding for addressing various issues concerning water quality of specific lakes. The city will continue to collaborate, coordinate, and cooperate with these organizations.

Grant Applications

The city will continue its efforts to actively seek grant opportunities and apply for grants and other funding as it becomes available. These funds can provide an important resource for funding water resource projects.

Development and Annexation

The City of Willmar continues to grow. As growth continues, additional development will occur, along with the possible annexation of new areas into the city. New development provides an opportunity to implement appropriate stormwater management BMPs, address existing problems, preserve natural resources, and add recreational areas. The city will continue to be proactive in using the controls at its disposal to use the opportunities presented by development to accomplish the goals presented in this Plan.

Agricultural Land Conversion

Urban development of agricultural land typically results in reduced loading of sediment to receiving waters. While the City of Willmar seeks to protect prime farmlands, the conversion of some farmland to urban uses may occur as the city develops. Along with the opportunity to apply stormwater BMPs as part of development, these projects will reduce the amount of agricultural land acting as a source of sediment in stormwater runoff.

Redevelopment

In developed areas of the city, redevelopment will provide the primary opportunity for the city to upgrade its stormwater management system, restore and improve natural resources, and add or expand recreational opportunities. The city will use redevelopment opportunities, when presented, to accomplish the goals of this Plan.

Table 6-1 Summary of Stormwater Issues for the City of Willmar

Category	Issue
NPDES Stormwater Pollution Prevention Program (SWPPP)	• Public education & outreach
	• Public participation
	• Illicit discharge detection and elimination
	• Construction site runoff control
	• Post construction stormwater management
	• Pollution prevention/housekeeping
	• Determination of no prudent/feasible alternatives to discharge to impaired waters
	• Evaluation of infiltration within wellhead protection areas
Impaired Waters	• Hawk Creek
	• Lake Wakanda
	• Kasota Lake
	• Little Kandiyohi Lake
	• South Fork of the Crow River
	• Downstream water bodies (e.g. Minnesota River, Mississippi River)
	• TMDL development and implementation
General Stormwater Management	• Reduce stormwater volume
	• Increase stormwater quality
	• Maximize infiltration
	• Wetland management
	• Erosion and sedimentation
	• Groundwater protection
Kandiyohi County Issues	• Phosphorus loading to lakes and streams
	• Pollution hazards from failing SSTS
	• Invasive aquatic species
	• Public education
City Issues	• Public awareness about water resources in the city and appropriate stewardship is limited
	• Updated floodplain mapping and floodplain regulation
	• Shoreland management
	• Stormwater management in developing areas

Table 6-1 Summary of Stormwater Issues for the City of Willmar

Category	Issue
City Issues (cont.)	• Groundwater infiltration and wellhead protection
	• Specific erosion and sedimentation control issues
	• Preservation of natural areas and pristine farmland
	• Repair/address localized areas of inadequate storm sewer capacity
	• Implementation of future TMDL requirements
	• Local flooding issues
	• Stormwater system maintenance

Section 7: Implementation

City of Willmar Watershed Management Plan

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7.0 Implementation

This section describes the city's implementation program to address the issues identified in the Plan. The issues addressed in the implementation plan include operation and maintenance of the stormwater system, education and public involvement, funding of the program, design standards, ordinance implementation and official controls, and projects. Implementation items from the city's NPDES Phase II MS4 permit and Storm Water Pollution Prevention Program (SWPPP) are incorporated into this section.

The City of Willmar is responsible for overall management of stormwater and water resources within the city's boundaries. The city's location at the upstream end of watersheds that extend far beyond the city's boundaries (and control) means the city will need to cooperate with downstream communities and Kandiyohi County to manage the effects of development and drainage improvements. The city will continue to work with Kandiyohi County, which currently serves as the local governmental unit (LGU) responsible for administering the Wetland Conservation Act (WCA) within the city boundaries, and continue to implement and enforce its ordinances related to water resource management.

7.1 NPDES Phase II MS4 Permit

The City of Willmar is required to maintain a NPDES Phase II MS4 permit under the Clean Water Act (see **Section 5.2.1** and **6.1.1**). 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 Willmar to control or reduce the pollutants in stormwater runoff to the maximum extent practicable. These BMPs are a combination of education, maintenance, control techniques, system design and engineering methods, and other such provisions that are appropriate to meet the requirements of the NPDES MS4 permit.

BMPs have been planned and implemented by the city to address six minimum control measures (MCMs) as outlined in the rules (see **Section 5.2.1**) For each of these minimum control measures, the city identified appropriate BMPs, along with measurable goals, an implementation schedule, and the persons responsible to complete each measure. The city has also added several BMPs to its SWPPP to address total maximum daily load (TMDL) reports and implementation plans, including the Lower Minnesota River Dissolved Oxygen TMDL (see **Section 6.1.2.4**). The SWPPP BMP implementation program is incorporated into the city's overall stormwater implementation program presented in **Tables 7-1**, **7-2**, **7-3**, and **7-4**. A complete copy of the city's SWPPP is included in this Plan as **Appendix C**.

Prior to June 30 of each year of the five-year permit cycle, the city must hold an annual public meeting. The city will publish a notice in the local newspaper (and possibly the city's website) at least 30 days prior to the scheduled 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**. Although not currently applicable, 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 MPCA is in the process of reissuing the Phase II NPDES MS4 Permit (see **Section 5.2.1**). The revised draft permit is anticipated to become effective later in 2012. Revisions to the MS4 permit may require changes to the city's implementation program as new and/or revised elements of the MS4 permit are incorporated into the city's SWPPP.

7.2 Operation and Maintenance of Stormwater System

The City of Willmar is responsible for construction, maintenance, and other projects in or along the city's stormwater management system (i.e. ponds, pipes, ditches, channels). Other units of government and private parties are responsible for maintaining their stormwater systems (see **Section 6.6.3**). The city will continue and expand upon its operation and maintenance activities as needed to ensure that the city's stormwater system functions as designed. The city's operation and maintenance program is closely tied with the city's implementation of its NPDES Phase II MS4 permit. The city's operation and maintenance program is included as **Table 7-4**.

7.2.1 Adequacy of Maintenance Program

The city's current maintenance program, which is based on its SWPPP, is designed to meet the conditions of the city's NPDES Phase II MS4 Permit and to maintain an effective stormwater management system. The city currently performs a variety of maintenance activities. These practices include regularly scheduled activities (e.g. continuous street sweeping, storm sewer discharge point inspections, etc.) as well as those performed on an as-needed basis (e.g. stormwater pond sediment removal, catch basin cleaning, etc.). These programs are detailed in **Table 7-5**. The city will revise its maintenance program as necessary to meet any changed or additional requirements resulting from the pending MS4 permit revision (see **Section 5.2.1**).

7.2.2 Need for Other Maintenance Programs

The City of Willmar will continue to develop and redevelop, resulting in changes in land use, zoning, and drainage patterns. This activity may require the revision of current maintenance programs or the development of new maintenance practices in the future. The City of Willmar's stormwater maintenance strategy will continue to be assessed and revised to remain in alignment with the goals and standards of Kandiyohi County and all regulatory agencies.

7.3 Education and Public Involvement Program

The City of Willmar implements various education and communication programs aimed at water resource issues. The city develops and distributes information regarding the city's water resources. The city also works collaboratively with Kandiyohi County, the Kandiyohi County SWCD, Hawk Creek Watershed, and area schools in distributing educational materials and promoting/supporting outreach programs (see **Section 6.6.2**).

The city presents an overview of its MS4 program and SWPPP at a city council meeting annually. The city will continue to promote public awareness of the potential sources and negative effects of illicit non-stormwater discharges. The city relies on county programs for recycling and household hazardous waste disposal. Locations facilitating these programs are located within the city and are used heavily by city residents. The city will also review the current educational activities undertaken by its staff to identify, prevent and correct illicit discharges from daily public works activities and other general city operations. Educational activities may include, but are not limited to, educational brochures, newsletters, web-postings, and workshops.

The city also seeks to encourage public participation in stormwater-related issues. The city annually holds a public hearing to receive oral and written comments regarding the city's stormwater management activities. The city also hopes to broaden public participation in the future.

In the future, the city will periodically review its education and public involvement programs to keep them up to date and useful.

7.4 Funding of Implementation Program

The stormwater utility is the city's primary means of paying for stormwater-related capital projects and studies. The City of Willmar established and implemented its stormwater utility in 2008. Through the stormwater utility, the city collects approximately $100,000 per year. Funding for other expenses, including maintenance, repairs, and ordinance development and review comes from the city's annual tax levy and is part of the regular city budget.

The city also charges impact fees for those areas discharging to regional ponding basins. In addition, the City of Willmar requires developers to construct the ponding, storm sewers, etc. that the city requires, thus reducing the capital cost borne by the city.

In addition to impact fees and stormwater utility funds, the city will also take advantage of grant and loan programs to offset project costs where appropriate and cost-effective. Other available funding sources are listed in summarized in **Section 6.6.4.2** of this Plan in summarized in **Appendix B**.

7.5 Design Standards

Stormwater management design standards are included in the City of Willmar's Stormwater Management Ordinance summarized in **Section 5.1.1** and included in **Appendix D** of this Plan. The Willmar Municipal Code also adopts several design standards by reference (e.g. CEAM Sanitary Sewer System Design Standards for pipe specifications). The city's municipal code may be found at the city's website at: www.ci.willmar.mn.us

7.6 Ordinance Implementation and Official Controls

The city's current ordinances and official controls are described in **Section 5**, and needs and issues related to the city's ordinances are addressed in **Section 6**.

Periodically, the city may revise its ordinances, procedures, and policies to be consistent with the City of Willmar MS4 Permit SWPPP, incorporate new or revised requirements, and to meet the standards of other regulatory agencies. While this Plan is intended to summarize the important elements of the city's ordinances and official controls, the city's SWPPP and ordinances should be considered accurate when inconsistencies arise between those documents and this Plan.

The City of Willmar defers authority for implementing the Wetland Conservation Act (WCA) to Kandiyohi County, which acts as the Local Governmental Unit (LGU) responsible for implementing the WCA in Willmar and the surrounding watersheds. The city plans to continue this relationship in the future.

If required in the future, the city will revise its SWPPP and city ordinances to incorporate pollutant load reductions resulting from pending or future total maximum daily load (TMDL) studies (see **Section 6.1.2**). Pollutant load reductions stemming from total maximum daily load (TMDL) studies for impaired reaches of Hawk Creek and/or the South Fork of the Crow River are likely to be finalized in the coming years. Load reductions may be assigned to the City of Willmar, which may require the implementation of additional BMPs by the city.

7.7 Implementation Program

Tables 7-1, **7-2**, **7-3,** and **7-4** provide a comprehensive list of the water management projects, studies, programs, and official controls that comprise the City of Willmar implementation program. The city defined the conceptual scope of work for each implementation item, evaluated the total costs and funding sources, and proposed schedule for each program element. **Tables 7-1**, **7-2**, **7-3,** and **7-4** show planning-level cost estimates, proposed year of implementation, and proposed financing source for each element of the implementation program. These tables will require revision as new issues

or needs arise. The activities listed in **Table 7-3** and **Table 7-4** will be incorporated into the city's existing Capital Improvement Program, where appropriate.

The current implementation plan is designed to make the best use of available funding, address existing stormwater management issues, and plan for the future to prevent future stormwater management problems. The city prioritizes implementation items with consideration of many factors. Those factors may include the city's responsibility to protect the public health, safety, and general welfare of its citizens, available funding sources, project costs, cooperative opportunities, and others.

Table 7-1 Official Controls and Regulations Implementation Program

Project Name/Description (MS4 BMP, if applicable)	Location	Cost Estimate[1]	Performed By	Proposed Year	Financing	Comments
Implement city SWPPP, including maintenance program for stormwater system (see Table 7-5)	City-wide	$100,000/yr[3]	City Staff	Ongoing	General Fund, Stormwater Utility, Impact Fees	See Table 7-4 and city SWPPP for individual items. Revised MS4 permit (anticipated Fall 2012) may prompt revisions to city's SWPPP.
Implement NPDES Construction Stormwater General Permit	City-wide	$0 [2]	City Staff	Ongoing	General Fund	
Implement TMDL requirements into SWPPP and perform BMPs related to TMDL implementation	City-wide	Varies	City Staff	Ongoing	General Fund, Stormwater Utility	Pending requirements of approved TMDLs
Cooperate with Kandiyohi County to implement the Wetland Conservation Act	City-wide	$0 [2]	City Staff	Ongoing	General Fund	Kandiyohi County acts as LGU
Administer city's stormwater management ordinance, including erosion control regulations and enforcement	City-wide	$0 [2]	City Staff, Consultant	Ongoing	Stormwater Utility, Permit Fees	City Stormwater Management Ordinance 1227
Review and revise city's stormwater management ordinance to minimize or mitigate existing/future flooding issues and incorporate additional water quality regulations	City-wide	$10,000 [3]	City Staff, Consultant	2013	General Fund	Recommended in the *City of Willmar – Phase III Modeling: Flood Mitigation Analysis* (see Appendix E)
Administer city shoreland management ordinance	City-wide	$0 [2]	City Staff, Consultant	When required	General Fund	
Develop city floodplain management ordinance or incorporate floodplain requirements into existing ordinances and enroll in the National Flood Insurance Program	City-wide	$10,000 [3]	City Staff, Consultant	When required	General Fund	Recommended in the *City of Willmar – Phase III Modeling: Flood Mitigation Analysis* (see Appendix E)
Develop and update an emergency flood response plan	City-wide	$5,000 [3]	City Staff, Consultant	2013	General Fund	Recommended in the *City of Willmar – Phase III Modeling: Flood Mitigation Analysis* (see Appendix E)

Table 7-1 Official Controls and Regulations Implementation Program

Project Name/Description (MS4 BMP, if applicable)	Location	Cost Estimate[1]	Performed By	Proposed Year	Financing	Comments
Encourage reduction of impervious areas at development sites and redevelopment sites and promote infiltration practices in accordance with SWPPP and stormwater management ordinance	Developing areas of the city	$0 [2]	City Staff	Ongoing	General Fund	To be undertaken and funded by developers prior to development.
Meet at least annually with county highway staff, county planning staff and township officials to learn about upcoming development and road work that could affect the city's stormwater management system and seek opportunities to partner on projects	Hawk Creek, Foot Lake, and Lake Wakanda watersheds	$0 [2]	City Staff	Ongoing	General Fund	
Maintain an updated record of all known SSTS in the city.	City-wide	$0 [2]	City Staff	Ongoing	Stormwater Utility	

[1] Cost estimates are based on 2010 dollars, do not account for inflation, reflect costs in addition to work performed by City staff, and are for planning purposes only.

[2] No additional cost aside from City staff time.

[3] Dollar expenses reflect work to be performed by consultant.

Table 7-2 Public Education, Involvement, and Outreach Implementation Program

Project Name/Description	Location	Cost Estimate[1]	Performed By	Proposed Year	Financing	Applicable SWPPP MS4 BMP
Distribute educational materials (via website, presentations, mailings, etc.)	City-wide	$0 [2]	City Staff	Ongoing	General Fund	1a-1
Implement an education program	City-wide	$0 [2]	City Staff	Ongoing	General Fund	1b-1
Develop website information, pamphlets, and presentations	City-wide	$0 [2]	City Staff	Ongoing	General Fund	1c-1
Encourage public participation by engaging specific groups and planning outreach activities	City-wide	$0 [2]	City Staff	Ongoing	General Fund	1c-2
Illicit discharge education for residents and staff	City-wide	$0 [2]	City Staff	2010	General Fund	1c-3, 3d-1
Construction site runoff education for staff, developers, builders, and property owners	City-wide	$0 [2]	City Staff	2010	General Fund	1c-4
Post-construction stormwater publications and presentations	City-wide	$0 [2]	City Staff	2010 and Ongoing	General Fund	1c-5
Pollution prevention and good housekeeping for municipal operations	City-wide	$0 [2]	City Staff	2010 and Ongoing	General Fund	1c-6
Coordination and/or support of educational program with other organizations	City-wide	$0 [2]	City Staff	2010	General Fund	1d-1
Develop a TMDL public communication plan	City-wide	$0 [2]	City Staff	2010	General Fund	TMDL general 1
Comply with public notice requirements, conduct annual public meeting, and solicit, consider, and record public input on SWPPP	City-wide	$0 [2]	City Staff	Ongoing	General Fund	1e-1, 2a-1, 2b-1, 2c-1

[1] Cost estimates are based on 2010 dollars, do not account for inflation, reflect costs in addition to work performed by City staff, and are for planning purposes only.

[2] No additional cost aside from City staff time.

Table 7-3 Studies and Physical Improvements Implementation Program

Number	Project Name	Location	Cost Estimate[1]	Performed By	Proposed Year	Financing	Comments
#1a	Conduct a Flood Risk Assessment Feasibility Study to evaluate mitigation options (including flood proofing and buyouts) for observed and modeled flooding/drainage issues within the city (see Table 7-4)	See Table 7-4	$100,000 [4]	City Staff, Consultant	2013	Stormwater Utility, General Fund	Recommended in the *City of Willmar - Phase III Modeling: Flood Mitigation Analysis* (see Appendix E)
#1b	Correct, mitigate, or minimize flooding/drainage issues within the city (see Table 7-4)	See Table 7-4	See Table 7-4	City Staff, Consultant, Contractor	See Table 7-4	See Table 7-4	Varies by location, see Table 7-4.
#2	Implement SWPPP tasks to address Lower Minnesota River Dissolved Oxygen TDML requirements and associated best management practices (see SWPPP item TMDL#1)	City-wide	Varies by Task	City Staff, Consultant	2010 and Ongoing	Stormwater Utility, Available Grants	
#3	Encourage, require, or provide water quality treatment at redevelopment sites, to the extent practical	Redevelopment sites	$10,000-$100,000 per site [4]	City Staff, Contractor, Consultant	Ongoing	Possible Grants, Developer Funds, and Construction Bonds	To be provided during redevelopment
#4	Identify and install new stormwater treatment facilities that can be placed in streets as part of road reconstruction (i.e. Stormceptors or other prefabricated devices)	Older, highly developed parts of the city	$50,000-$200,000 [4]	City Staff, Contractor, Consultant	As part of planned road reconstruction	Stormwater Utility, Construction Bonds, Impact Fees	
#5	Use water quality modeling to identify stormwater detention ponds requiring additional water quality treatment	TBD	$10,000-$20,000 [4]	City Staff, Consultant	2010-2011	Stormwater Utility	

Table 7-3 Studies and Physical Improvements Implementation Program

Number	Project Name	Location	Cost Estimate[1]	Performed By	Proposed Year	Financing	Comments
#6	Modify stormwater detention ponds to provide additional water quality treatment.	TBD	$20,000-$100,000 [4]	City Staff, Contractor, Consultant	2010-2019	Stormwater Utility	Modifications could include deepening ponds and/or changing outlet structures.
#7	Secure easements over floodplains, detention areas, wetlands, ditches, and all other parts of the stormwater system	Developing and redeveloping areas	$0 [2]	City Staff	Ongoing	N/A	Require developers to provide at time of development/re-development
#8	Seek opportunities to restore and enhance wetlands	City-wide	NA [3]	Consultant, Contractor	Ongoing	Grants	
#9	Stabilize and restore eroded drainageways	TBD	Cost Varies	City Staff, Consultant, Contractor	2010	Construction Bonds and Cost Share (Kandiyohi County, SWCD, MDNR, and the Foot Lake Association)	Stabilization and restoration may include installation of permanent geotextile erosion control material or riprap.
#10	Develop a program for maintaining unpaved roadways within the city to minimize the amount of offsite sediment transport and erosion	KRA Speedway, Kandiyohi County Fairgrounds, other unpaved roadways	$0 [2]	City Staff, Consultant	2010	General Fund, Stormwater Utility	
#11	Amend or revise watershed management plan as needed	City-wide	$100,000 [4]	City Staff, Consultant	Ongoing, (2019-2020)	Stormwater Utility	
#12	Update city hydrologic / hydraulic modeling as needed	City-wide	$5,000 [4]	City Staff, Consultant	Ongoing	Stormwater Utility	Recommended in the *City of Willmar - Phase III Modeling: Flood Mitigation Analysis* (see Appendix E)

[1] Cost estimates are based on 2010 dollars, do not account for inflation, reflect costs in addition to work performed by City staff, and are for planning purposes only.

Table 7-3 Studies and Physical Improvements Implementation Program

[2] No additional cost aside from City staff time.

[3] Work performed only if funded through grants.

[4] Dollar expenses reflect work to be performed by consultant and or contractor.

Table 7-4 Studies and Physical Improvements Implementation Program – Flood Mitigation and Drainage Issues

Number	Project Name[1]	Location	Cost Estimate[2]	Performed By	Proposed Year	Financing	Comments
#1	Phase II – Former Waste Water Treatment Plant site feasibility study (for stormwater treatment and extended flood detention) and construction (Phase I completed)	Southeast of intersection of Willmar Avenue and 4th Street	>$1,000,000	City Staff, Consultant, Contractor	2013	MPCA Grants	Potential location for additional planned flood storage and water quality treatment. May also provide flood mitigation to locations to the south and east along 19th Avenue SW and 9th Street SE. See *City of Willmar - Phase III Modeling: Flood Mitigation Analysis* (see Appendix E)
#2	Western interceptor storm sewer upgrade	19th Avenue SW between 15th Street SW and 30th Street SW	$250,000 - $1,000,000	City Staff, Consultant, Contractor	2012-2013	General Fund, Stormwater Utility	Performed in conjunction with sanitary sewer upgrade
#3	Storm sewer reconstruction and "quiet zone" at Trott Avenue	Area near the intersection of Trott Avenue and 16th Street	$250,000- $1,000,000	City Staff, Consultant, Contractor	2013	Stormwater Utility or Grants	Potential pipe capacity or flood storage issue. Storm sewer reconstruction coordinated with road reconstruction
#4	Kennedy High School ball field feasibility study and construction	Northwest of intersection of Willmar Avenue and 7th Street	>$1,000,000	City Staff, Consultant, Contractor	As Funding Allows	Stormwater Utility or Grants	Potential location for additional planned flood storage and water quality treatment. See *City of Willmar - Phase III Modeling: Flood Mitigation Analysis* (see Appendix E)
#5	Undeveloped area west of Menards feasibility study and construction	North of State Hwy 23	>$1,000,000	City Staff, Consultant, Contractor	As Funding Allows	Stormwater Utility or Grants	Potential location for additional planned flood storage and water quality treatment. See *City of Willmar - Phase III Modeling: Flood Mitigation Analysis* (see Appendix E)

Table 7-4 Studies and Physical Improvements Implementation Program – Flood Mitigation and Drainage Issues

Number	Project Name[1]	Location	Cost Estimate[2]	Performed By	Proposed Year	Financing	Comments
#6	Ramblewood Marsh feasibility study and construction	Northeast of intersection of 19th Avenue and 15th Street	>$1,000,000	City Staff, Consultant, Contractor	As Funding Allows	Stormwater Utility or Grants	Potential location for additional planned flood storage and water quality treatment. May provide flood mitigation along 15th Avenue SW. See *City of Willmar – Phase III Modeling: Flood Mitigation Analysis* (see Appendix E)
#7	5th Street and Trott Avenue Intersection feasibility study and construction	Intersection of 5th Street and Trott Avenue	<$250,000	City Staff, Consultant, Contractor	Coordinated with routine road maintenance	Stormwater Utility or Grants	Potential pipe capacity issue. Completion of a feasibility study is required to identify the specific cause.
#8	High Avenue feasibility study and construction	South of High Avenue NE east of Porto Rico Street NE	<$250,000	City Staff, Consultant, Contractor	Coordinated with routine road maintenance	Stormwater Utility or Grants	Potential pipe capacity issue. Completion of a feasibility study is required to identify the specific cause.
#9	Ella Avenue feasibility study and construction	Along Ella Avenue east of 1st Street NE	<$250,000	City Staff, Consultant, Contractor	Coordinated with Routine Road Maintenance	Stormwater Utility or Grants	Potential pipe capacity issue. Completion of a feasibility study is required to identify the specific cause.
#10	Swannson Ball Field feasibility study and construction	Northwest of the intersection of 18th Street and Willmar Avenue	$250,000-$1,000,000	City Staff, Consultant, Contractor	As Funding Allows	Stormwater Utility or Grants	Potential planned flood storage issue. Completion of a feasibility study is required to identify the specific cause. Some adjustments made to existing pond as part of 2011 street reconstruction
#11	23rd Avenue SW feasibility study and construction	Along 23rd Avenue south of 21st Street to the Westwinds Development pond.	$250,000-$1,000,000	City Staff, Consultant, Contractor	Coordinated with Routine Road Maintenance	Stormwater Utility or Grants	Potential pipe capacity issue. Completion of a feasibility study is required to identify the specific cause.
#12	19th Avenue SW feasibility study and construction	Along 19th Avenue west of 15th Street	$250,000-$1,000,000	City Staff, Consultant, Contractor	Coordinated with Routine Road Maintenance	Stormwater Utility or Grants	Potential pipe capacity issue. Completion of a feasibility study is required to identify the specific cause.

Table 7-4 Studies and Physical Improvements Implementation Program – Flood Mitigation and Drainage Issues

Number	Project Name[1]	Location	Cost Estimate[2]	Performed By	Proposed Year	Financing	Comments
#13	Richland Avenue feasibility study and construction	Along Richland Avenue east of 16th Street SW	$250,000-$1,000,000	City Staff, Consultant, Contractor	Coordinated with Routine Road Maintenance	Stormwater Utility or Grants	Potential pipe capacity issue. Completion of a feasibility study is required to identify the specific cause.
#14	Terrace Drive SW feasibility study and construction	Along Terrace Drive SW west of 1st Street	$250,000-$1,000,000	City Staff, Consultant, Contractor	Coordinated with Routine Road Maintenance	Stormwater Utility or Grants	Potential pipe capacity issue. Completion of a feasibility study is required to identify the specific cause.
#15	1st Street feasibility study and construction	Along 1st Street south of intersection with 24th Avenue SW	$250,000-$1,000,000	City Staff, Consultant, Contractor	Coordinated with Routine Road Maintenance	Stormwater Utility or Grants	Potential pipe capacity issue. Completion of a feasibility study is required to identify the specific cause.
#16	Intersection of 10th Street and Kandiyohi Avenue feasibility study and construction	Area near the intersection of 10th Street and Kandiyohi Avenue	>1,000,000	City Staff, Consultant, Contractor	As Funding Allows	Stormwater Utility or Grants	Potential pipe capacity and flood storage issue. Completion of a feasibility study is required to identify the specific cause.
#17	Intersection of 2nd Street SW and Kandiyohi Avenue feasibility study and construction	Area near the intersection of 2nd Street and Kandiyohi Avenue	$250,000-$1,000,000	City Staff, Consultant, Contractor	Coordinated with Routine Road Maintenance	Stormwater Utility or Grants	Potential pipe capacity or flood storage issue. Completion of a feasibility study is required to identify the specific cause.
#18	Intersection of 24th Street and Oxford Drive feasibility study and construction	South of US Highway 12 between County Ditch 23A to 24th Street	$250,000-$1,000,000	City Staff, Consultant, Contractor	Coordinated with Routine Road Maintenance	Stormwater Utility or Grants	Potential pipe capacity issue. Completion of a feasibility study is required to identify the specific cause.
#19	Intersection of 2nd Street SE and 11th Avenue SE feasibility study and construction	Area near the intersection of 2nd Street and 11th Avenue	$250,000-$1,000,000	City Staff, Consultant, Contractor	Coordinated with Routine Road Maintenance	Stormwater Utility or Grants	Potential pipe capacity or flood storage issue. Completion of a feasibility study is required to identify the specific cause.

Table 7-4 Studies and Physical Improvements Implementation Program – Flood Mitigation and Drainage Issues

Number	Project Name[1]	Location	Cost Estimate[2]	Performed By	Proposed Year	Financing	Comments
#20	Intersection of Litchfield Avenue and 7th Street SW feasibility study and construction	Area near the intersection of Litchfield Avenue and 7th Street	$250,000-$1,000,000	City Staff, Consultant, Contractor	Coordinated with Routine Road Maintenance	Stormwater Utility or Grants	Potential pipe capacity or flood storage issue. Completion of a feasibility study is required to identify the specific cause.
#21	Minnesota Avenue SE feasibility study and construction	Along Minnesota Avenue between 4th Street and Charlotte Street	$250,000-$1,000,000	City Staff, Consultant, Contractor	Coordinated with Routine Road Maintenance	Stormwater Utility or Grants	Potential pipe capacity issue. Completion of a feasibility study is required to identify the specific cause.
#22	Intersection of 5th Street and Augusta Avenue feasibility study and construction	Area near the intersection of 5th Street and Augusta Avenue	$250,000-$1,000,000	City Staff, Consultant, Contractor	Coordinated with Routine Road Maintenance	Stormwater Utility or Grants	Potential pipe capacity issue. Completion of a feasibility study is required to identify the specific cause.
#23	Grace Avenue feasibility study and construction	Along Grace Avenue SW west of 13th Street SW	$250,000-$1,000,000	City Staff, Consultant, Contractor	Coordinated with Routine Road Maintenance	Stormwater Utility or Grants	Potential pipe capacity issue. Completion of a feasibility study is required to identify the specific cause.
#24	Grass Lake feasibility study and construction	Southeast of US Hwy 71	>$1,000,000	City Staff, Consultant, Contractor	As Funding Allows	Stormwater Utility or Grants	Potential location for additional planned flood storage and water quality treatment. See *City of Willmar – Phase III Modeling: Flood Mitigation Analysis* (see Appendix E)

[1] List of potential projects. The City may find that implementing one project may provide mitigation in another part of the city.

[2] The cost estimates shown may change depending on results of the feasibility study. Dollar expenses reflect non-city staff costs and may include capital costs, contractor/consultant costs, and other expenses.

Table 7-5 Stormwater System Maintenance Guide

Practice	Frequency	Cost Estimate[1]	Performed By	Funding	MS4 BMP	Comments
Wetland and stormwater pond inspections	After heavy rainstorms	$0 [2]	City Staff	NA	NA	Brief site inspection to record sediment buildup, skimmer and inlet/outlet structure conditions, erosion at inlet, outlet, and on slopes, debris, vegetation and visual water quality.
Maintain storm sewer system map	As needed	$0 [2]	City Staff	NA	3a-1	Maintain an update comprehensive map of the city's stormwater system components
Documentation of operation and maintenance of BMPs	Ongoing	$2,000/yr	City Staff, Consultant	Stormwater Utility	5c-1	Review and document those best management practices relevant to the operation and maintenance of the city's stormwater system
Ditch and drainageway inspections	After heavy rainstorms (same time as wetland and pond inspections)	$0 [2]	City Staff	NA	NA	Brief site inspection to record sediment buildup, channel and sideslope erosion, debris, and vegetation.
Street sweeping	Continuously between March and November	$0 [2]	City Staff	NA	6a-2	Sweep streets from March to November. Most streets are swept multiple times. The city rents vacuum equipment periodically for material collection.
Catch basin inspection, cleaning and repair	Inspect after heavy rainstorms, clean/repair as needed	$2,000/yr	City Staff, Contractor	Stormwater Utility	NA	Clean catch basins after heavy rainstorms, especially those in depression areas, to prevent encroachment of sediment and debris above flow line of pipe; repair deteriorated catch basins.
Storm sewer discharge point inspections	Twice a year, and following storm events	$0 [2]	City Staff	NA	NA	Inspect direct discharge points into stormwater ponds and wetlands to determine if discharge point is free of sediment and to observe the condition of any upstream treatment facility (if applicable).
MS4 outfall inspection	At least 20% of outfalls annually	$0 [2]	City Staff	NA	6b-3	Inspect a minimum of 20% of all MS4 outfalls, sediment basins, and ponds within the city each year on a rotating basis, and document inspection results.

Table 7-5 Stormwater System Maintenance Guide

Practice	Frequency	Cost Estimate[1]	Performed By	Funding	MS4 BMP	Comments
Pollution control devices inspection	Annually	$0 [2]	City Staff	NA	6b-2	All structural pollution control devices are required to be inspected annually
Sediment removal from stormwater system elements (e.g ponds, ditches)	As needed	Varies	Contractor	Stormwater Utility	NA	Based on results of pond, wetland and ditch inspections, remove accumulated sediment where it impedes stormwater flow, from areas not designated for sediment removal, and where storage capacity is decreased 10 percent by sediment and/or the water quality treatment zone is decreased 25 percent.
Inspection of city stockpile, storage and material handling areas	Annually	$0 [2]	City Staff	NA	6b-4	City staff will inspect all exposed stockpiles and storage/material handling areas located on City-owned property
Inspection follow-up	Ongoing	$0 [2]	City Staff	NA	6b-5	Determination of repair, replacement, or maintenance measures as directed by the Director of Public Works shall be documented and recorded in the City's SWPPP.
Reporting/retention of inspection records and response	Ongoing	$2,000/yr	City Staff, Consultant	Stormwater Utility	6b-6	Inspection records shall be maintained and the results of all inspections summarized in an annual report.
Evaluation of inspection frequency	Annually	$0 [2]	City Staff	NA	6b-7	The City will retain the records of inspection results and any maintenance performed/recommended. If patterns arise after a 2-yr period, inspection frequency may be adjusted.
Outlet structure and skimmer maintenance	As needed	$1,000/yr	City Staff, Contractor	Stormwater Utility	NA	Determine maintenance needs based on results of stormwater pond, wetland and ditch inspections.
Debris and litter control	Variable	$0 [2]	City Staff, Volunteers	NA	NA	Collect debris and litter as part of regular inspection program; control litter through public education efforts.
Herbicide use in waters and along roadsides	Ongoing	$0 [2]	City Staff	NA	NA	The City will discourage the application of herbicide in waters and along roadsides, and will use only if absolutely necessary.

Table 7-5 Stormwater System Maintenance Guide

Practice	Frequency	Cost Estimate[1]	Performed By	Funding	MS4 BMP	Comments
Alternative road deicing chemicals	Ongoing	$0 [2]	City Staff	NA	NA	Encourage use of alternative and experimental deicing chemicals that have less impact on water quality.
Televising, jetting, and repair of storm sewers and culverts	As needed	Varies	City Staff	NA	NA	Televising, jetting, and repair of storm sewers and culverts performed based on results of annual inspections of pipes with a known history of sedimentation problems.

[1] Cost estimates are based on 2010 dollars, do not account for inflation, reflect costs in addition to work performed by City staff, and are for planning purposes only.

[2] No additional cost aside from City staff time.

Section 8: References

City of Willmar Watershed Management Plan

8.0 References

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Appendix A: Background Information

City of Willmar Watershed Management Plan

Table of Contents

1.0 Background Information

1.1 Introduction

The City of Willmar Watershed Management Plan is intended to be a useful management tool for the city, its residents, and those doing business in Willmar. To this end, the Plan contains key information regarding the city's policies (Section 2), a physical inventory of the city's environmental (Section 3), stormwater system (Section 4), programs and regulations (Section 5), water resources issues (Section 6) and implementation of this Plan (Section 7).

Many topics within the Plan have been abbreviated in the interest of clarity and maintaining the usefulness of the document. This appendix includes additional information regarding the City of Willmar, and its surrounding environmental resources.

1.2 Location and History

The City of Willmar (estimated population 19,040 in 2007) is located approximately 90 miles west of the seven county Twin Cities metropolitan area in central Kandiyohi County. The area within the city's municipal boundary covers 9,563 acres (14.9 square miles). By 2025, the population of Willmar is forecast to increase to somewhere between 19,800 and 23,800 (estimates vary by source) and may incorporate additional land within the urban growth boundary (see Map 2C of the City of Willmar Comprehensive Plan).

The City of Willmar is bordered on the north by Dover Township, on the east by Kandiyohi Township, on the south by Willmar Township, and on the west by St. Johns Township. The majority of the City of Willmar is bordered by Willmar Township. A small portion of the city (approximately 190 acres) is entirely surrounded by St. Johns Township to the west of Willmar Township. Similarly, Willmar Municipal Airport extends into St. Johns Township, and is not physically connected to the remainder of the City of Willmar (although it is bordered on the east by Willmar Township). Major highways run through the city, including Trunk Highway (TH) 23, TH 40, TH 294, U.S. Highway 12, and U.S. Highway 71. Important water resources in the city include:

- Willmar Lake
- Eagle Lake
- Skataas Lake
- Foot Lake
- Swan Lake
- Lake Wakanda

The City of Willmar lies within four subwatersheds that are tributary to two major watersheds. The Foot Lake and Hawk Creek subwatersheds cover the north and west part of Willmar and drain to the Minnesota River. The Lake Wakanda and Southeast Willmar

subwatersheds cover much of the city and area to the southeast of Willmar and drain to the South Fork Crow River.

The City of Willmar was originally platted in 1869 by surveyors for the St. Paul and Pacific Railroad. By 1871, more than 20 businesses had established themselves in Willmar, which became the County Seat of Kandiyohi County. In 1901, Willmar was incorporated from a village into a city. The city continues to develop and several Urban Growth Areas are identified in the city's Comprehensive Plan. Currently, there is a large area of rural/rural residential land on the south side of the city; higher density development is not expected in this area in the foreseeable future. Section 3.2 of the Plan discusses land use in Willmar.

1.3 Regulatory Background and History

This Plan reflects numerous other water resource-related state and federal mandates that the city must meet. As state and federal laws have changed over the years, the role of the city in water resource management has also changed. The following paragraphs provide the background and history of some of these mandates (references: "Minnesota Environment," Minnesota Pollution Control Agency (MPCA), Volume 7, Number 1—Summer 2007, the MPCA's website www.pca.state.mn.us, and the City of Plymouth's July/August 2007 edition of "Environmental Extra").

In 1945, the Minnesota State Legislature authorized a new state Water Pollution Control Commission because too many communities were dumping raw sewage into lakes and rivers. One of the Commission's jobs was to encourage communities to build wastewater treatment plants to stop the flow of raw sewage into rivers and lakes. Three years later, in 1948, the United States (U.S.) Congress enacted the Federal Water Pollution Control Act (FWPCA) in response to the threat that polluted water posed to the public health and welfare.

In 1967, the Minnesota Legislature created the Minnesota Pollution Control Agency in response to oil spills and other major environmental incidents. Its mission was to protect the air, land, and waters of the state.

Five years later, in 1972, the U.S. Congress enacted amendments to the FWPCA to address the growing public awareness and concern for controlling water pollution. This act became known as the Clean Water Act (CWA). Amendments to the CWA in 1977 addressed "point source" facilities, such as municipal sewage plants and industrial facilities. The National Pollutant Discharge Elimination System (NPDES) became the program for regulation of point source pollution. As a "delegated permitting authority," the MPCA issues combined State Disposal System (SDS) and NPDES stormwater permits.

In 1987, the Minnesota Legislature enacted laws to control polluted runoff, broadening attention from "point" source to "nonpoint" source pollution, which is the movement of pollutants from land to water, typically in stormwater or snowmelt runoff from streets, lawns, construction sites, farms, etc. Also in 1987, state regulatory authority for this

program was delegated from the U.S. Environmental Protection Agency (EPA) to the MPCA. In 1987, an amendment to the federal Clean Water Act required implementation of a two-phase comprehensive national program to address stormwater runoff.

In 1990, the EPA promulgated regulations establishing the Phase I Stormwater Program. The Phase I federal regulations required two general categories of stormwater discharges to be covered under a NPDES stormwater permit: (1) regulated categories of industrial activity including construction activity that disturbs 5 or more acres of land, and (2) municipal separate storm sewer systems (MS4s) serving populations of 100,000 or more (including Minneapolis and St. Paul).

In 1994 and 1995, the MPCA promulgated rules to establish the Phase I Stormwater Program at the state level. Under Phase I, Minneapolis and St. Paul obtained individual permits and designed and implemented stormwater programs. By 1999,the Phase II federal regulations were promulgated, which expanded the scope of the NPDES Stormwater Program to include smaller MS4s in urbanized areas, construction activities that disturb between 1 and 5 acres of land, and smaller municipally owned industrial activities. The MPCA then promulgated rules related to the Phase II federal regulations to fulfill federal NPDES delegation responsibilities. The rules establish the NPDES stormwater permit requirements for regulated MS4s, construction, and industrial activities.

In 2002, the MPCA began identifying surface water resources that are impaired for their identified uses such as swimming and aquatic habitat. As required by the Clean Water Act, if a water body is included on the impaired waters list, it triggers an analysis called a total maximum daily load (TMDL) study. The TMDL analysis determines the impaired water body's capacity to assimilate specific pollutants and still meet water quality standards. A TMDL also develops an allocation scheme among the various contributors—point sources, nonpoint sources and natural background—as well as a margin of safety. 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, sometimes called the 303(d) list, is updated by the states every 2 years.

Then in 2003, Phase II of the NPDES program began. Phase II is a broader program that includes smaller construction sites, municipally owned or operated industrial activity, and many more municipalities (MS4s). Regulated parties under the Phase II program must develop stormwater pollution prevention plans to address their stormwater discharges, and determine the appropriate pollution prevention practices or "best management practices" to minimize pollution for their specific site. Each of the three permit types—construction, industrial, MS4—has distinct requirements and some regulated parties may require more than one permit. In the same year, the MPCA issued a General Permit for municipalities with populations over 10,000 (MS4 permit), including Willmar. The permit requires cities to comply with six "minimum control measures," which include public education, public outreach, illicit discharge detection and elimination, construction site stormwater runoff control, post-construction stormwater management, and pollution prevention/good housekeeping measures. Approximately 200 MS4s in Minnesota were mandated by the

Phase II federal regulations as requiring NPDES permit coverage; these include municipalities located within the boundaries of an urbanized area.

1.4 Climate and Precipitation Frequency

The amount, rate, and type of precipitation are important in determining flood levels and stormwater runoff rates and volumes, all of which impact water resources. Section 3.3 of the Plan details how short and long duration precipitation events affect stormwater system sizing in the City of Willmar. Short duration, high intensity events used to design or evaluate a city's stormwater system are often referred to as "design storms." Consideration must be given the choice of design storms, which may draw from several data sources.

The major sources of information regarding rainfall in the region are publications TP-40 and TP-49 issued by the National Weather Bureau (now the National Weather Service) in 1961 and 1964, respectively. These data are generally consistent with the specific analysis of Minneapolis-St. Paul intensity-frequency data compiled by Yarnell (USDA, 1944). The sources give information on storm durations of up to 10 days. Runoff from spring snowmelt is also important in this region. The Soil Conservation Service's *National Engineering Handbook*, Hydrology, Section 4 (USDA SCS, 1993) presents maps of regional runoff volume. The information from all of these sources (except for the Yarnell analysis) is summarized in the *Minnesota Hydrology Guide*, published by the USDA's Soil Conservation Service (USDA SCS, 1975). **Table 3-1** in the Plan lists the precipitation and runoff events that are used for design purposes in the City of Willmar (including the hydrologic modeling described in **Section 4**). Those numbers are consistent with the current numbers in the TP-40 and TP-49 publications. The TP-40 is currently being revised and a new version is expected in 2012. When those results are available, the city will assess the adequacy of its existing design storm criteria and may update its hyrologic/hydraulic models.

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

- For climate information about Central and Southern Minnesota, including Willmar: http://www.weather.gov/climate/xmacis.php?wfo=mpx
- 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

1.5 Watershed Ponds and Lakes

Section 3.5 of the Plan summarizes the watersheds that include the City of Willmar: the Foot Lake watershed, the Hawk Creek watershed, the Southeast Willmar watershed, and the Lake Wakanda watershed. These watersheds are shown in **Figure 3-6**. This section lists the significant ponds and lakes located in each watershed.

1.5.1 Foot Lake Watershed

The following ponds and ponding areas are located in the Foot Lake watershed, with the subwatershed names noted:

- **Foot Lake (FOOT_LAKE) -** Foot Lake is a Minnesota Department of Natural Resources (MDNR) public water (#34-0181-p). The outlet from Foot Lake is at the southwest corner of the lake, which discharges to Hawk Creek.
- **Eagle Lake (EAGLE_LAKE)** – Eagle Lake is an MDNR public water (#34-0171-p) and is located at the upstream end of the Willmar chain of lakes, and northeast of the Willmar municipal boundary. The outlet from Eagle Lake is at the southwest corner of the lake; a channel carries outflows to Swan Lake. The Eagle Lake subwatershed also contains MDNR public waters King Lake (#34-0195-p), Point Lake (#34-0193-p), and Burr Oak Lake (#34-0139-p).
- **Skataas Lake (SKATAAS_LA**) – Skataas Lake is an MDNR public water (#34-0196-p) and is located at the upstream end of the Willmar Chain of Lakes, and north of the Willmar municipal boundary. The outlet from Skataas Lake is located in the south portion of the lake, where a natural channel conveys lake outflows to Swan Lake.
- **Swan Lake (SWAN_LA**) – Swan Lake is an MDNR public water (#34-0186-p) and is located in the Willmar Chain of Lakes west of Highway 294 and south of 40th Avenue NW, and immediately north of the Willmar municipal boundary. This lake discharges via an open channel located on the south side of the lake to the north end of Willmar Lake.
- **Willmar Lake (Willmar_Lk)** – Willmar Lake is an MDNR public water (#34-0180-p) and is located in the Willmar Chain of Lakes south of County Highway 41 and west of Memorial Parkway. The majority of Willmar Lake is located within the municipal boundary. This lake discharges to Foot Lake via an open channel located in the south west corner of the lake below County Highway 41.
- **Oslo Meadows Pond (Oslo1)** – This sedimentation pond treats the stormwater collected in the Oslo Meadows development and discharges west to an unnamed MDNR public water (#34-18200[FOOT_LAKE2]) before ultimately reaching Foot Lake.
- **Lakewood Additions Ponding Basin (LKWood**) – This ponding area collects local stormwater runoff from the Lakewood Addition development. The basin outlets south via a storm sewer culvert crossing 16th Avenue NE and then follows an existing ditch to Willmar Lake.
- **Copper Leaf Development Pond (W_HOME)** – This pond collects local stormwater runoff from the Welcome to Our Home development and discharges southwest into an existing ditch that eventually outlets to Foot Lake.

- **Burlington Northern and Santa Fe Railway Pond (RR_PND)** – This pond collects stormwater runoff from the rail yard located south of High Avenue NE and east of Porto Rico Street NE. The outflows from this pond are conveyed through storm sewer discharges north into Foot Lake.

1.5.2 Hawk Creek Watershed

The following ponds and ponding areas are located in the Hawk Creek watershed, with the subwatershed names noted. All of the following stormwater ponds are located within the Willmar municipal boundary:

- **West Winds Second Addition Pond (WW2)** – This pond collects stormwater runoff from the West Winds Second Addition and discharges east into the trunk storm sewer system located parallel to 16th Street SW.
- **West Winds Third Addition Pond (WW3)** – This is a regional stormwater pond that collects local stormwater runoff from the West Winds Third Addition. In addition, the trunk storm sewer along 23rd Avenue SW discharges to this ponding area. The pond outlet is located in the northwest corner and is connected to the trunk storm sewer that continues west along 23rd Avenue SW.
- **Family Eye & ENT Development Pond (FamEYE)** – the outlet from the Family Eye & ENT development pond is located on the east side of the pond. Outflows are carried east in storm sewers to the trunk storm sewer located parallel to 16th Street SW.
- **Swanson Field Basin (SSF-1)** – This ponding area was constructed to detain stormwater runoff from Swanson Field and surrounding areas. Outflows are carried southeast through the storm sewer system to County Ditch 46.
- **Industrial Ponding Basin (SSF-8**) – This ponding area collects stormwater runoff from the surrounding industrial area. The basin drains through drain tile that connects to the storm sewer system and eventually outlets to the Swanson Field Basin.
- **Highway 5 Pond (Hwy5_PND)** – The Highway 5 pond is a regional stormwater pond that currently collects stormwater runoff from the undeveloped area to the southeast and the existing industrial/office area north of Highway 40 and south of U.S. Highway 12. In the future, the pond will also collect stormwater runoff from the Willmar Industrial Park when it is constructed in the currently undeveloped area. The pond outlet is located in the northwest corner of the pond. Outflows discharge directly into Hawk Creek through the pond outlet structure and constructed emergency overflow.

1.5.3 Southeast Willmar Watershed

The following ponds and ponding areas are located in the Southeast Willmar watershed, with the subwatershed names noted:

- **Waterview Business Park Ponds (Duin1, Duin2, Duin3, Duin4, Duin5, & Duin7) —** These ponds are part of the Waterview Business Park. Each pond outlets directly to the adjacent County Ditch 23A, which conveys flows southeast through a culvert crossing US Hwy 71.
- **Emerald Pond (EmeraldPnd) —** This pond was constructed as part of the Emerald Pond Development. The outlet from this pond is on the southeast side; outflows are carried in a storm sewer to Branch 3 of County Ditch 23A, located east of 19th Street SE.
- **Pleasantview Drive Ponds (PleasantVa, PleasantVb & 33-4)** – These ponds collect stormwater runoff from the residential developments along Pleasantview Drive SE between 12th Street SE and 15th Street SE. The outlets from these ponds connect to the storm sewer system which discharges to Branch 3 of County Ditch 23A.
- **Landmark Business Park Pond (LBP)** – This pond discharges to the north into the storm sewer system which outlets to Branch 3 of County Ditch 23A east of 23rd Street SE and south of US Highway 12.
- **5th Street Pond (5thSt_PND)** – This pond discharges to the east into the adjacent County Ditch 23A.
- **9th Street Pond (9thSt_PND)** – The outlet for this stormwater pond is located on the south side of the pond, where it connects to the adjacent storm sewer system along 9th Street SW.
- **Bremer Bank Pond (BBank_PND)** – This pond was constructed as part of the Bremer Bank development and collects local stormwater runoff within the Bremer Bank development area. The outlet from this pond is located on the west side where it connects to the storm sewer system along 4th Street SE.
- **Kandiyohi County Public Works Building Pond (PW_PND) —** This pond was constructed as part of the Kandiyohi County Public Works Building development. The pond collects stormwater runoff from the Public Works Building and surrounding area. The outlet from the pond is located on the west end and discharges to the storm sewer system that connects to Branch 3 of County Ditch 23A south of US Highway 12.
- **Home Depot Development Pond (33E-1) —** This pond was constructed as part of the Home Depot development. The outlet from this pond is on the northwest side, which connects directly to the adjacent County Ditch 23A system.
- **YMCA Development Pond (32-4)** – This pond was constructed as part of the YMCA development. The outlet from this pond is on the northwest side, which connects directly to the adjacent storm sewer below Olena Avenue SE.
- **Ramblewood Marsh (FIELD1E)** – Ramblewood Marsh is a MDNR public water wetland (#34-0448-w) located northeast of the 19th Avenue SW and 15th Street

SW intersection. The outlet is located on the east side of the ponding area and connects to the adjacent storm sewer system. However, even during large events (i.e. the 100-year event) the area is primarily landlocked and very little flow is released from the storage area due to a restrictive outlet structure.

- **Olena Avenue SE Basins (33-3 & 32-8)** – These ponding areas are located east of 12th Street SE north and south of Olena Avenue SE. The outlets from the ponding areas are connected to the storm sewer system, which outlets to Branch 3 of County Ditch23A, located east of 19th Street SE.
- **Woodberry Development Pond (WL13-2)** – This pond was constructed as part of the Woodberry development. The outlet from this pond is on the south side, which connects to the ditch along the US Highway 71 right-of-way.
- **Menards Development Pond (E-m24-1)** – This pond was constructed as part of the Menards development. The outlet from this pond connects directly to the city storm sewer system.
- **Sterling Apartments Development Pond (E-m24-5)** – This pond was constructed as part of the Sterling Apartments development. The outlet from this pond is on the south side which connects to the adjacent County Ditch 23A system.

1.5.4 Lake Wakanda Watershed

The following ponds and ponding areas are located in the Lake Wakanda watershed, with the subwatershed names noted:

- **Grass Lake Ponding Area (WL11, WL12, WL11B, WL23)** – This ponding area is located southeast of US Highway 71. The ponding area outlets through a natural drainage channel located in the southeast portion of the Grass Lake Ponding area.
- **Lake Wakanda (WL1)** –Lake Wakanda is an MDNR public water (#34-0169-p). The outlet structure from Lake Wakanda is located on the south side of the lake which ultimately connects to the South Fork of the Crow River.
- **Eleanor Lake (WL5)** – Eleanor Lake is an MDNR public water (#34-0097-p). The outlet from Eleanor Lake is located on the south side of the lake, which connects to Lake Wakanda via a natural channel.
- **Little Kandiyohi Lake and Kasota Lake (LK1)** –Little Kandiyohi Lake and Kasota Lake are MDNR waters (#34-0096-p and #34-0105-p, respectively). Kasota Lake is connected to Little Kandiyohi Lake via a natural channel located on the south side of the lake. Little Kandiyohi Lake outlets via a natural channel located on the south side of the lake, which ultimately connects to the South Fork of the Crow River.

- **Swan Lake (LK2)** – Swan Lake is an MDNR public water (#34-0106-p). The outlet from Swan Lake is located on the south side of the lake, which connects to Kasota Lake via a natural channel.

- **Minnetaga Lake (ML1)** – Minnetaga Lake is an MDNR public water (#34-0076-p). The outlet from Minnetaga Lake is located on the west side of the lake, which connects to Kasota Lake.

- **Cherry Lake (ML2)** – Cherry Lake is an MDNR public water (#34-0073-p). The outlet from Cherry Lake is located on the north side of the lake, which connects to Minnetaga Lake.

1.6 Soils

Section 3.6 of the Plan describes the hydrologic soil types in the City of Willmar and adjacent watersheds. Although the majority of the city is developed, there are small areas of undisturbed land within the city. Soils in the undisturbed areas are Estherville and Ves soils (well drained), Fieldon and Webster soils (poorly drained), and Glencoe soils (very poorly drained). Estherville soils are generally located in flat areas or rises. Glencoe soils often occur in depressions and may be subject to ponding.

The predominant soil types within the watersheds surrounding the City of Willmar are Canisteo-Harps loams and Ves-Swanlake loams of 2 to 6 percent slope. The Ves-Swanlake loams are undulating, well-drained soils. Areas occupied by this soil type are irregular in shape and typically cover between 3 and 20 acres. The Swanlake soil occurs on sloping ridges and knolls, while Ves soils are more common on less steep slopes and lower rises. The split between the two soil types is approximately 60 to 80 percent Ves loams and 20 to 40 percent Swanlake loams; the two types are so well mixed that separate classification of the two types is not practical. Permeability is moderate in these soils and the available water capacity is high. Many of these areas are cropped. These areas are also well-suited for development and septic tank absorption fields (USDA and SCS, 1987).

Canisteo-Harps loams are nearly level, poorly drained soils. Canisteo soils typically occur in plane and concave areas at the base of steeper slopes. Harps soils occur at the rims of depressions. The permeability of these soils is moderate and the available water capacity is high. Surface runoff is slow from these soils. The seasonal high water table is approximately 1 to 3 feet below the surface. Most of these areas are cropped. These soils are not well suited for development due to wetness and the high water table (US Department of Agriculture and Soil Conservation Service, 1987).

1.7 Geology and Groundwater Resources

The bedrock underlying the City of Willmar and surrounding watersheds includes cretaceous rock from 65 to 225 million years ago (e.g. sandstone) as well as Middle Archean rock from between 3 and 3.6 billion years ago (Minnesota Geological Society, 1996). The depth to bedrock identified in the Kandiyohi County Well Index (CWI) ranges from 250 feet to over 500 feet. The quaternary geology (unconsolidated material above

the bedrock) is divided between Wadena Lobe – Alexandria Moraine, which covers most of the Foot Lake watershed and the eastern half of the Lake Wakanda watershed, and Des Moines Lobe – Altamont Moraine (MGS GIS data).

Bedrock and outwash aquifers are present in Kandiyohi County, with outwash (i.e. quaternary or unconsolidated) aquifers more common in the northern part of the county. Despite the predominance of bedrock aquifers around Willmar, the majority of wells in and around Willmar are located in outwash aquifers. Outwash aquifers typically have yields of approximately 25-500 gallons per minute.

According to the Minnesota Geological Survey's (MGS) well records for Kandiyohi County, Cretaceous bedrock aquifers typically have yields ranging from 10 to 250 gallons per minute (Kandiyohi County Local Water Management Plan, 2003).

1.8 Water Quality

This section contains a summary of existing water quality data and water quality sampling programs. This section also includes a detailed description of the P8 water quality modeling performed for the City of Willmar as part of this Plan. **Figure 3-22** shows the location of each stormwater pond included in the City of Willmar P8 model.

1.8.1 Water Quality Sampling Programs

The following programs are current or past water quality monitoring efforts that have been or are being done within the City of Willmar.

1.8.1.1 Surface Water Assessment Grant (SWAG) Monitoring

The MPCA's Surface Water Assessment Grant (SWAG) is designated to provide local organizations and citizen volunteers with funding to complete surface water monitoring necessary to meet assessment requirements and identify if designated uses are being met. The program began in 2006. Several lakes within the Hawk Creek watershed were monitored in 2008 and 2009 through a SWAG. Lakes monitored using this grant include Foot Lake, Point Lake, Skataas Lake, Swan Lake, and Willmar Lake. More information on the SWAG program can be found on the Minnesota Pollution Control Agency's website (http://www.pca.state.mn.us/water/swagrant.html).

1.8.1.2 Citizen Lake Monitoring Program (CLMP)

The MPCA's Citizen Lake Monitoring Program (CLMP) uses volunteers to take weekly transparency measurements on lakes during the summer. These transparency measurements are available for several lakes in and around Willmar, including Eagle Lake, Foot Lake, Point Lake, Skataas Lake, Swan Lake, Lake Wakanda, and Willmar Lake. More information on the CLMP can be found on the MPCA website (http://proteus.pca.state.mn.us/water/clmp.html).

1.8.2 Water Quality Data Summary

The programs listed above provide water quality data that is available for lakes within the City of Willmar and surrounding watersheds. These locations are presented in **Figures 3-20** and **3-21**. Data is available for the following lakes (and years):

- Eagle Lake (1954, 1970, 1973-1974, 1978, 1980, 1992-1994, 1998-2008)
- Foot Lake (1975, 2005-2009)
- Kasota Lake (2005-2008)
- Little Kandiyohi Lake (2005-2008)
- Minnetaga Lake (2007-2008)
- Point Lake (1978, 2008-2009)
- Skataas Lake (2008-2009)
- Swan Lake (2008-2009)
- Lake Wakanda (1976-1978, 2001-2008)
- Willmar Lake (2006-2009)

Data collected from the lakes listed above typically include Secchi disc transparency, dissolved oxygen (DO), temperature, and pH collected throughout the summer. Concentrations of total phosphorus (TP), total Kjeldahl nitrogen (TKN), and turbidity measured three to four times per summer are also available for many of the lakes listed above. The data may be accessed from the MPCA's Environmental Data Access (MPCA EDA) website (http://proteus.pca.state.mn.us/data/eda/search.cfm).

The MPCA's EDA website also contains data collected from streams and drainage ditches around the city (see **Figures 3-20** and **3-21**). Several monitoring locations are located along Hawk Creek and its upstream tributary sites. Some monitoring locations include only stream transparency data, while other sites also include eutrophication parameters (e.g. total phosphorus, chlorophyll a, etc.). Biological monitoring of a site located on an unnamed drainage ditch in the Lake Wakanda watershed in 2000 included fish counts and determined a fish index of biological integrity (IBI) of 14, which classified the site as very poor.

1.8.3 Water Quality Modeling Technical Background

For the 1998 draft plan, the city performed water quality modeling (using the P8 computer model) of stormwater ponds within the city and that were included in the hydrologic model of the city storm sewer system (see **Section 4.3**). The P8 modeling included in the 1998 draft plan utilized hourly precipitation data and daily temperature data from the Minneapolis-St. Paul International Airport for the

1994-1995 water year. The model calculated average phosphorus loading from subwatersheds and phosphorus and total suspended solids removal efficiencies from stormwater ponds. For this plan, the city updated the earlier modeling to reflect stormwater ponds that were constructed and were incorporated into the City's hydrologic model of the storm sewer network.

P8 is a useful diagnostic tool for evaluating and designing watershed improvements and best management practices (BMPs). P8 uses long-term climatic data so that watersheds and BMPs can be evaluated for varying hydrologic conditions. When evaluating the results of the modeling, it is important to consider that the results provided are more accurate in terms of relative differences than in absolute results. The model predicts the percent difference in phosphorus reduction between various BMP options in the watershed fairly accurately. It also provides a realistic estimate of the relative differences in phosphorus and water loadings from the various subwatersheds and major inflow points to a lake or other receiving water for an average climatic year. However, since runoff quality is highly variable with time and location, the actual values of phosphorus loadings from a watershed will fluctuate. Various site-specific factors, such as lawn care practices, illicit point discharges and construction-related erosion are not accounted for in the model. The model provides values that are considered to be typical for the region and the watershed's respective land uses.

The P8 model created for this plan was run using hourly precipitation data provided for the 1995 water year (October 1, 1994 – September 30, 1995) from the Minneapolis/St. Paul (MSP) airport. A precipitation adjustment factor was applied to the data to represent a year with near normal annual precipitation for the Willmar area. The total adjusted precipitation used in the P8 model was 28.11 inches, which includes 3.04 inches of snowmelt runoff volume from the watershed.

The EPA Nationwide Urban Runoff Program (NURP) 50th percentile particle file was used in the P8 model to estimate solids and total phosphorus loadings from the watershed area because it represents typical particle buildup and washoff for urban-type developments. A pervious curve number was selected for each P8 drainage basin based upon soil type, land use and hydrologic conditions. An overall composite pervious curve number was determined by weighting the areas for the given soil groups within each drainage basin. The impervious subwatershed areas were divided into directly-connected and unconnected fractions that vary by land use type. The directly-connected impervious fraction for each land use type was used to determine the overall subwatershed impervious fraction for the P8 model. Using an SCS curve number of 98, the unconnected impervious area was weighted with the pervious area to determine the overall subwatershed pervious curve number. The overall and directly-connected impervious percentages that were assumed for each of the land uses used in the P8 model were the same as those used in the XP-SWMM modeling (see **Table 4-7**).

The P8 model was run for two separate scenarios, a low and high pollutant removal efficiency, in order to encompass the range of expected removal efficiencies for dry detention ponds. The low and high ranges of pollutant removal efficiencies are based on applying the P8 model particle removal scale factors of zero and one, respectively, to the dry detention ponds in the watershed. A particle removal scale factor of zero will result in none of the particles being removed by the treatment device in the model. A particle removal scale factor of one allows P8 to model the removal of particles based on their settling (velocity) characteristics. The actual long-term treatment efficiency of dry detention ponds is likely somewhere between the low and high range removal estimates, since the P8 model cannot simulate scour and particle re-suspension. Therefore, if a particle settles out in a dry detention pond during a small runoff event, the model considers it to be gone from the system, even though a larger runoff event capable of re-suspending the particle may follow it in the simulation. The particle removal scale factor was not changed (from one) for wet detention ponds. As a result, the tabulated pollutant removal efficiencies may be more optimistic for wet detention ponds that possess smaller average depths, since the potential for bottom scour from high flows, and for wind mixing, increases as the average depth decreases.

1.9 Habitat and Recreational Areas

1.9.1 Parks and Recreational Areas

The City of Willmar contains 37 parks and recreational areas covering approximately 280 acres. Willmar parks offer baseball and soccer fields; softball diamonds; basketball and tennis courts; outdoor skating rinks; playground equipment; sand volleyball courts; horseshoe and bocce courts, and picnic shelters. There are several biking and hiking trails within and around the City of Willmar, including the Glacial Lakes State Trail, which follows a former Burlington Northern Railroad grade for 22 paved miles between Willmar and the Kandiyohi/Stearns County line.

Robbins Island is a large regional park located between Foot Lake and Willmar Lake in northeast Willmar. This park includes 55 acres of wooded hills. Recreational facilities at this location include a public swimming beach, fishing, hiking and nature trails, picnic shelters, and several sports fields.

A detailed list and map of recreational areas located within and around Willmar is included in the City of Willmar Comprehensive Plan.

1.9.2 Fish and Wildlife Habitat

Many of the lakes located in Willmar and the surrounding watersheds support varied fish species. The MDNR conducted fish surveys on six lakes in and around Willmar between 2004 and 2007: Eagle Lake, Foot Lake, Minnetaga Lake, Point Lake, Lake Wakanda, and Willmar Lake. Skataas Lake was surveyed by the MDNR in 1992. The

fish surveys identified between eight and eighteen species of fish in each lake. Eagle Lake, with a maximum depth of over 60 feet and high water clarity, supports the most diverse fish population including: bigmouth buffalo, black bullhead, black crappie, bluegill, common carp, freshwater drum, green sunfish, hybrid sunfish, largemouth bass, northern pike, orangespotted sunfish, pumpkinseed sunfish, smallmouth bass, walleye, white sucker, yellow bullhead, and yellow perch.

The MDNR has stocked walleye adults, fingerlings, and/or fry in the following lakes at least every two years dating back to 2000: Eagle Lake, Foot Lake, Point Lake, Lake Wakanda, and Willmar Lake. Lake Minnetaga was stocked with walleye in 2008

There are two State Wildlife Management Areas located in Willmar: the Willmar Wildlife Management Area located across US Highway 71 from Swan Lake, and the Eagle Lake Wildlife Management Area on County Road 9 southeast of Eagle Lake. Wildlife management areas (WMAs) are established to protect lands and waters that have a high potential for wildlife production, public hunting, trapping, fishing, and other compatible recreational uses. The MDNR manages these areas to protect wildlife habitat for future generations, providing opportunities for hunting, fishing and wildlife watching, and promoting important wildlife-based tourism. More information regarding WMAs can be obtained from the MDNR's website (http://www.dnr.state.mn.us/wmas/index.html).

1.9.3 Unique Features and Scenic Areas

The MDNR produces the Minnesota County Biological Survey that identifies natural communities and areas of biodiversity significance; the Kandiyohi County survey was completed in 2002. The survey shows that the original (pre-development) vegetation of Willmar was predominantly prairie, with smaller areas of wet prairie and big hardwoods (oak, maple, basswood, and hickory); hardwood areas were concentrated around Little Kandiyohi Lake and Lake Wakanda.

The Minnesota County Biological Survey also identifies native plant communities. Native plant communities are groups of native plants that interact with the environment in ways not significantly affected by modern human activity or by non-native plant or animal species. These groups of native species form recognizable units, such as an oak forest, a prairie, or a marsh. These areas are identified in **Figure 3-26**. The Kandiyohi County Biological Survey identified 350 acres of native plant communities. The majority of this area is located near Little Kandiyohi Lake and Lake Wakanda and is occupied by elm, basswood, and black ash forests. Areas of calcareous fen and seepage meadow also occur in the Lake Wakanda watershed. Native plant communities of cattail marsh were identified in the Foot Lake watershed, and mesic prairie was identified in the Hawk Creek watershed.

Sites of biological significance are also identified in the County Biological Survey. These sites demonstrate low, moderate, or high biodiversity. Within the

watersheds surrounding Willmar, 940 acres are identified by the County Biological Survey as having low biodiversity significance (these areas are classified as having biodiversity below the minimum threshold on **Figure 3-26**). Moderate biodiversity significance is assigned to 466 acres, and 75 acres are classified as having a high level of biodiversity significance. These areas are identified in **Figure 3-26**.

In addition to the Minnesota County Biological Survey, the National Heritage Information System (NHIS) contains information on rare plants, animals, and natural communities. The NHIS data shows the Northern Grasshopper Mouse and Short-eared Owl present within the watersheds surrounding the City of Willmar. The data also identifies Bald Eagle populations at two locations within the watersheds surrounding Willmar.

Several unique plant species are present around Little Kandiyohi Lake and Lake Wakanda. Additional rare plant species are identified within the Foot Lake watershed and Hawk Creek watershed. The MDNR's NHIS maintains the data regarding specific rare plants/animals species and locations.

1.10 Additional Pollutant Sources

Section 3.14 of the Plan lists permitted NPDES discharges in the City of Willmar and surrounding watersheds. Additional point sources of pollution may include leaking underground storage tanks (LUST), feedlots, and subsurface sewage treatment systems (SSTS). Information regarding these sources in the City of Willmar and surrounding watersheds is included in this section. Additional information regarding pollutant sources is available from the MPCA's "What's in my Neighborhood?" website (http://cf.pca.state.mn.us/wimn/).

1.10.1 Leaking Underground Storage Tanks (LUST)

There are approximately 120 sites listed in the MPCA's Leaking Underground Storage Tank (LUST) database located within the watersheds surrounding Willmar, including some within the city's municipal boundary. This database includes sites where remediation actions are completed and ongoing. Remediation for all but four sites listed in the database is complete. More information regarding LUST sites and cleanup activity is available from the MPCA's website (http://www.pca.state.mn.us/programs/lust_pSearch.cfm).

1.10.2 Feedlots

The county feedlot program is an arrangement between the MPCA and county governments where the county is responsible for the implementation of feedlot rules and regulations such as registration, permitting, inspections, education and assistance and complaint follow-up. Kandiyohi County has developed databases of the feedlots in their jurisdiction. The MPCA provides program oversight, and policy, technical and enforcement support. Minnesota Rules chapter 7020 requires owners of an animal feedlot or manure storage area with 50 or more animal units,

or 10 or more animal units if in a shoreland area (less than 300 feet from a stream or river, less than 1,000 from a lake) to register every four years. Large feedlots meeting certain animal number thresholds are required to have an NPDES permits; no feedlots in Willmar have applied for NPDES permits. Typically, feedlots that confine livestock under a roof with a pit for liquid manure tend to produce less feedlot runoff than open facilities. In addition, land application of manure can be a major source of non-point pollution runoff. There is one feedlot currently located within the city.

1.10.3 Subsurface Sewage Treatment Systems (SSTS)

Septic systems are called subsurface treatment systems (SSTS) by the MPCA and are also known as individual sewage treatment systems (ISTS). Households and communities with nonconforming septic systems can be a pollution source (mainly fecal coliform and nitrogen), especially during periods of low flows in the streams. These nonconforming SSTS may provide partial settling and treatment, but on the whole do not fully treat the wastewater, whether due to inadequate soils, undersizing of the system, or improper maintenance.

The MPCA adopted new SSTS Rules in February 2008 requiring counties to verify the subsurface soil conditions prior to issuing a "notice of compliance" for each new and repaired SSTS. Kandiyohi County has an SSTS ordinance (County Ordinance 27) which regulates SSTS for all areas in the county which do not have an SSTS ordinance. The Kandiyohi County ordinance requires an SSTS compliance inspection prior to home sales, when certain land use permits are requested, or if a complaint has been filed.

Appendix B: Additional Issues and Opportunities

City of Willmar Watershed Management Plan

Table of Contents

List of Tables

1.0 Additional Issues and Opportunities

1.1 Introduction

This Plan is intended to be a useful management tool for the city, its residents, and those doing business in Willmar. To this end, the Plan contains key information regarding the city's policies (**Section 2**), a physical inventory of the city's environmental (**Section 3**), stormwater system (**Section 4**), programs and regulations (**Section 5**), water resources issues (**Section 6**) and implementation of this Plan (**Section 7**).

Many topics within the Plan have been abbreviated in the interest of clarity and maintaining the usefulness of the document. This appendix includes additional information regarding the water resource issues facing the City of Willmar and its surrounding watersheds.

1.2 Impaired Waters and TMDL Issues

Section 303(d) of the Clean Water Act requires each state to identify and establish priority rankings for waters that do not meet the water quality standards. **Section 6.1.2** of the Plan discusses impaired waters and total maximum daily load (TMDL) issues within the City of Willmar and surrounding watersheds. This section goes into greater detail regarding the criteria for listing some waters as impaired and discusses impaired waters downstream of Willmar and the surrounding watersheds.

1.2.1 Impaired Waters Listing Criteria – Eutrophication, Nutrients, and Biological Indicators

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" and there must be sufficient data to determine if the lake is impaired (MPCA, 2007a). Specific criteria for acceptable levels of nutrients have been developed by the MPCA depending upon a lake's "eco-region" and the depth of the lake. Two ecoregions encompass the watersheds surrounding Willmar, the North Central Hardwood Forest ecoregion (NCHF or CHF) in the eastern half of the Foot Lake and Lake Wakanda watersheds, and the Western Corn Belt Plains ecoregion (WCBP) in the remaining portion, including the City of Willmar.

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). The MPCA has less stringent criteria for shallow lakes (see **Table B-1**). **Table B-1** presents the MPCA's water quality criteria for impaired waters within the North Central Hardwood Forest (NCHF) and Western Corn Belt Plains (WCBP) ecoregions (MPCA, 2005a). The criteria for WCBP lakes are less stringent than for NCHF lakes.

Table B-1 MPCA Impaired Waters 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			
Trout lakes	<20	<6	<2.5
Deep Lakes	<40	<14	>1.4
Shallow Lakes	<60	<20	>1.0
Western Corn Belt Plains			
Deep Lakes	<65	<22	>0.9
Shallow Lakes	<90	<30	>0.7

**Minnesota Rules Chapter 7050 (approved by US EPA, June 2008).*

1.2.2 Impaired Waters Downstream of Willmar and the Surrounding Watersheds

Stormwater runoff from Willmar is ultimately tributary to the South Fork Crow River and the Minnesota River. Downstream of Willmar, there are additional impairments to the South Fork Crow River above and below Hutchinson Dam, the Minnesota River downstream of Hawk Creek, and the Mississippi River downstream of the Crow River and Minnesota River.

Downstream of Lake Wakanda, the South Fork Crow River upstream of Hutchinson Dam is impaired for aquatic life based on aquatic macroinvertibrate bioassessments, fish bioassessments, and turbidity. TMDLs for these impairments are scheduled to begin in 2010 and be completed in 2016. Stormwater from the city is ultimately tributary to this reach via Lake Wakanda. It is possible that TMDL load reduction requirements could be assigned to the city based on these TMDLs.

Otter Lake in Hutchinson is listed on the 2010 list and draft 2012 list as impaired for aquatic recreation due to nutrients, eutrophication, and biological indicators. The TMDL is scheduled to begin in 2010 and be completed in 2016. In several reaches downstream of Hutchinson Dam, the South Fork of the Crow River is impaired for aquatic life, aquatic recreation, and aquatic consumption due to various stressors, including mercury in fish tissue, fish bioassessments, aquatic macroinvertibrate bioassessments, turbidity, chloride, and fecal coliform. The mercury TMDL for aquatic consumption was approved in 2008. Other TMDLs are scheduled for completion between 2010 and 2016, and may result in waste load allocations to upstream dischargers, including the City of Willmar.

Several reaches of the Minnesota River downstream of the confluence with Hawk Creek are impaired for aquatic consumption, aquatic recreation, and aquatic life resulting from mercury in fish tissue, mercury in the water column, PCBs in fish tissue, PCBs in the water column, turbidity, dissolved oxygen, and fecal coliform.

The mercury TMDL for aquatic consumption was approved in 2008. TMDLs for turbidity and PCBs in fish tissue and the water column are currently underway for several reaches of the Minnesota River.

A TMDL for dissolved oxygen in the Lower Minnesota River was approved in 2004. The Lower Minnesota River dissolved oxygen TMDL implementation plan requires upstream MS4 communities (including Willmar) to reduce phosphorus loading from stormwater runoff by 30 percent. The percent reduction is corrected for growth and based on 2000 land use assuming no BMPs in place at that time. The City of Willmar added several BMPs to the city's SWPPP to address the requirements of this TMDL and TMDLs in general. Specific BMPs implemented to address the dissolved oxygen TMDL include developing a phosphorus-contributing factors list, mapping existing BMPs, and tracking phosphorus reductions as new development occurs.

Downstream of the Minnesota River, the Mississippi River is impaired for aquatic life, aquatic recreation, and aquatic consumption due to stressors including mercury, PCBs, perfluorooctane sulfonate (PFOS), turbidity, and fecal coliform. Lake Pepin, on the Mississippi River, is on the impaired waters list for excess nutrients. Any implementation requirements stemming from these TMDLs applicable to the city will then be incorporated into the city's NPDES Phase II MS4 permit. This Plan may need to be updated to incorporate those TMDL requirements.

1.3 Wetland Management and Regulatory Issues

In addition to the city and county requirements, wetland management within the City of Willmar is also governed by the following federal, state, regional and local regulations. Those regulatory programs are described in this section.

Federal regulatory programs include the following:

Section 10 of the Rivers and Harbors Act—The Corps of Engineers (COE) is the responsible agency for this program, which regulates the placement of structures and/or work in, or affecting, navigable waters of the United States.

Section 404 of the Clean Water Act—The COE has primary responsibility for administering the program but the Environmental Protection Agency (EPA) can appeal to a higher COE authority or veto a COE decision. This program regulates excavation of wetlands and the discharge of dredged or fill material into waters of the United States, which includes wetlands. There are basically two types of Section 404 permits: (1) regional and nationwide general permits, and (2) individual permits.

Section 401 of the Clean Water Act—The Environmental Protection Agency delegated responsibility for this program to the MPCA. Activities which require a Section 10, Section 404, or Federal Energy Regulatory Commission permit must first obtain Section 401

water quality certification from the MPCA stating that the activity conforms to state water quality standards.

Food Security Act of 1985, "Swampbuster"—The U.S. Department of Agriculture, through the Farm Service Agency and the Natural Resources Conservation Service, handles administrative and technical requirements. The program regulates the alteration of wetlands for agricultural use and prohibits farmers who receive federal subsidies from draining wetlands. Alteration of a wetland results in ineligibility for all government price and income support programs.

State regulatory programs include the following:

MDNR Public Waters program, Minnesota Statutes 103G (see **Section 3.8** of this plan)—The MDNR is the responsible agency for administering this program.

Wetland Conservation Act of 1991 (WCA)—Local government units (LGUs) are responsible for administering the rules. The intent of the WCA is to promote no net loss of wetlands. The WCA rules regulate draining and filling activities in all wetlands, except MDNR public waters and public waters wetlands. The WCA rules (Minnesota Rules 8420) require that drained and filled wetlands be replaced at a minimum replacement ratio of 2:1 in non-agricultural areas. Local units of government may have stricter wetland regulations. Amendments to the WCA in 1994 allow for the preparation of wetland management plans by local units of government that may give them more flexibility through a more regional wetland analysis. The MDNR is involved in enforcement of the WCA and is responsible for identification, protection and management of calcareous fens. The Minnesota Legislature significantly amended the WCA three times, mostly to accommodate the varying needs of the different geographic areas of the state.

Other state rules include:

State Water Quality Standards, Minnesota Rules 7050—The MPCA is the responsible agency. The rules include water use classifications and water quality standards for wetlands that are narrative rather than numerical. The rules include a mitigative process to protect wetlands from significant adverse impacts and to maintain nondegradation of designated wetland uses. Although not prohibited, the MPCA discourages the use of wetlands for stormwater treatment. In the few projects where the requirements of the WCA are not as comprehensive as MPCA water quality standards, the Phase II NPDES MS4Permit requires the LGU to make a determination that will also satisfy Minn. R. 7050.0186.

As part of administering the WCA rules, the designated LGUs are responsible for requiring the delineation of wetlands and the determination of wetland functions and values. Kandiyohi County Soil and Water Conservation District (SWCD) is the LGU responsible for administering the WCA within the city limits and in unincorporated areas of the county adjoining the city. **Figures 3-18** and **3-19** show the wetlands in the city, as identified by the U.S. Fish and Wildlife Service's National Wetland Inventory (NWI).

1.4 Groundwater Protection Issues

The City of Willmar relies on groundwater for its municipal water supply; its municipal well field consists of sixteen active wells. **Section 5.2.4** of the Plan describes regulatory programs governing groundwater protection. The City of Willmar's municipal water supply system is maintained and operated by Willmar Municipal Utilities, which is responsible for compliance with regulatory programs, including the Minnesota Department of Health's (MDH) Wellhead Protection Program. This section discusses groundwater quality and groundwater protection issues.

1.4.1 Infiltration and Groundwater Vulnerability Issues

Infiltration is promoted by the MPCA, Kandiyohi County, and the city as a means of reducing stormwater runoff rates and volumes (see **Sections 2.3** and **2.5**). The City of Willmar relies on groundwater for its municipal water supply. The city is ranked low on the MDH's list of municipalities requiring Wellhead Protection Plans (WHPPs), due to the low probability of contamination in the city's aquifers (see **Section 3.7**). Thus, a WHPP has not yet been developed for the City of Willmar. Regardless, it is important that groundwater recharge areas be protected from contamination.

One way the city protects its groundwater supply is by following applicable state standards for well construction (see **Section 5.2.4** of this plan). In an effort to reduce the potential adverse affects of pollutants from surface infiltration, the City of Willmar will consider the Minnesota Department of Health's *Evaluating Proposed Stormwater Infiltration Projects in Vulnerable Wellhead Protection Areas* (MDH, 2007) as guidance in evaluating all proposed infiltration projects. The city will also utilize additional pertinent information (when available) in determining the potential adverse effects of stormwater infiltration on the aquifer.

The city will continue to evaluate and allow infiltration practices only in those areas where such practices are deemed acceptable. If the proposed infiltration or discharge is determined by the city to potentially cause adverse effects to the local drinking water supply, the city will prohibit the construction of the infiltration area or incorporate the necessary BMPs to reduce the identified pollutant(s) prior to infiltrating.

1.5 Kandiyohi County Issues

Kandiyohi County has jurisdiction in the unincorporated areas of the watersheds surrounding the City of Willmar. The county has identified several key issues facing the county in its Comprehensive Local Water Plan (Kandiyohi County, 2003). In addition to the items highlighted in this Plan, the county is responsible for floodplain and wetland management within the county. These issues are discussed in this section.

1.5.1 Comprehensive Local Water Plan Issues

In 2003, Kandiyohi County developed the *Kandiyohi County Local Water Plan*. The plan is applicable to those areas under the jurisdiction of the county. In addition to providing an extensive inventory of water resources within the county, the plan identified key issues that the county will address in the coming years. The plan classified issues in decreasing level of importance as "Urgent", "Important", or "Noteworthy". Urgent issues are those those that must be addressed immediately and pose serious threats to public health or sensitive resources.

Urgent issues include the following:

- Phosphorus loading to county lakes
- Groundwater and surface water pollution hazards from failing SSTS
- Continued coordination and communication between local and state agencies for BMP funding and other environmental related projects
- Control of Eurasian watermilfoil and other invasive species
- Protecting existing pristine farmland from development
- Educating the public on water resource management issues

Issues classified as "Important" are those that the county will address as funds and personnel are available. Some of the important issues highlighted in the plan include:

- Promotion of shoreland management
- Management of stormwater
- Promotion of alternative tile intake systems and buffer strips
- Maintenance of the county's drainage system
- Restoration of drained wetlands and lakebeds
- Need to conduct an inventory of available GIS data

Issues classified as "Noteworthy" are those that are not critical to human health or resource protection. Some of the noteworthy issues highlighted in the plan include:

- Explore conducting a voluntary inventory of failing ISTSs
- Documentation of wastewater discharges

- Need to list and promote watershed management-like organizations in the Water Plan
- Control of cormorants, geese and pelicans
- Utilization of restored gravel pits as wildlife habitat
- Implementation of no wake zone on lakes where motorized watercraft are damaging shoreline
- Limiting the horsepower of watercraft engines on shallow lakes
- Support of the Grass Lake restoration project
- Proper prescription of aeration systems

1.5.2 County Wetland Management

Within the City of Willmar and the surrounding watersheds, Kandiyohi County acts as the Local Governmental Unit (LGU) responsible for implementation of the Wetland Conservation Act (WCA). The Kandiyohi County SWCD manages wetlands within the county in accordance with the WCA, DNR Public Waters program, U.S. Army Corps of Engineers regulations and Swampbuster provisions of the USDA Farm Program (Kandiyohi County, 2003).

1.5.3 Floodplain Management

Kandiyohi County administers a floodplain ordinance in unincorporated areas of the county, which includes large areas of the watersheds surrounding the City of Willmar. The floodplain ordinance utilizes the July 1977 City of Willmar Flood Insurance Study (FIS). The FIS and flood maps for Kandiyohi County are currently being updated and, once published, will replace the July 1977 City of Willmar Flood Insurance Study.

A Flood Insurance Study (FIS) contains information regarding flooding in a community, including flood history of the community and information on engineering methods used to develop Flood Insurance Rate Maps (FIRMs) for a community. The FIS, together with a county's floodplain ordinance, allows Kandiyohi County to participate the National Flood Insurance Program (NFIP).

Homeowners within Federal Emergency Management Agency (FEMA) designated floodplains are required to purchase flood insurance if their community participates in the NFIP. 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).

1.6 Other Agency Roles and Responsibilities

Along with the City of Willmar, various units of government are involved in regulating water resource related activities, including Kandiyohi County, 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, Minnesota Department of Transportation, and Army Corps of Engineers.

The regulatory roles and responsibilities of these entities as they pertain to water resources are described in this section.

Kandiyohi County

Counties (including Kandiyohi County) have a wide variety of duties. The county's 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 the Kandiyohi County *Comprehensive Local Water Plan*, 2003).
- Implementation of WCA

More information is available at the Kandiyohi County website: http://www.co.kandiyohi.mn.us/

Minnesota Department of Natural Resources (MDNR)

The 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 administers the aquatic plant management control permit program and other fishery related permits.

Public Waters

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. The City of Willmar cooperates with this program by referring project proposers to the MDNR. The MDNR public waters in the city of Willmar are listed in **Section 3.8** and shown in **Figures 3-16** and **3-17** of this plan.

The MDNR classified Foot Lake as a "general development" lake and Skataas Lake as a "recreational development" lake. Recreational development lakes have stricter requirements than general development lakes. For example, lots on recreational environment lakes must be larger and wider, and structures and sewage treatment systems must be set back further from the water than on general development lakes.

Groundwater

The MDNR regulates groundwater usage rate and volume as part of its charge to conserve and use the waters of the state. For example, suppliers of domestic water to more than 25 people or applicants proposing a use that exceeds 10,000 gallons per day or 1,000,000 gallons per year must obtain a water appropriation permit from the MDNR. Appropriation permits from the MDNR are not required for domestic uses serving less than 25 persons for general residential purposes. The MDNR is also responsible for mapping sensitive groundwater areas, conducting groundwater investigations, addressing well interference problems, and maintaining the observation well network.

Dam Safety

The MDNR administers the state's dam safety program (MN Rules 6115.0300 – 6115.0520), which applies to all impoundments that pose a potential threat to public safety or property. Dams six feet or lower in height and dams that impound 15 acre-feet or less of water are exempt from the rules. Dams less than 25 feet high that impound less than 50 acre-feet of water are also exempt, unless there is a potential for loss of life. The dam safety rules require that the downstream impacts of a dam failure be analyzed under high-flow conditions (i.e. greater than a 100-year flood).

Proposed stormwater ponding areas discussed in other sections of this plan could potentially come under the jurisdiction of the dam safety rules. If so, it is likely that the City would encourage modified pond designs or multiple ponds so that the ponding project would not come under the jurisdiction of the dam safety rules.

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.

More information is available at the MDNR website: www.dnr.state.mn.us

Minnesota Board of Water and Soil Resources (BWSR)

BWSR oversees the state's watershed management organizations (joint powers, county and watershed district organizations, county water managers), oversees the state's Soil and Water Conservation Districts, and administers the Wetland Conservation Act.

More information is available at the BWSR website: www.bwsr.state.mn.us

Minnesota Pollution Control Agency (MPCA)

The MPCA administers the State Discharge System/National Pollutant Discharge Elimination System (NPDES) Permit program (point source discharges of wastewater), the NPDES General Stormwater Permit for Construction Activity, the NPDES General Industrial Stormwater Permit program, the NPDES Phase I and Phase II Storm Water Permit program, and the subsurface sewage treatment system (SSTS) 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 Minnesota Pollution Control Agency (MPCA) administers and enforces laws relating to pollution of the state's waters, including groundwater. The MPCA monitors ambient groundwater quality, and administers SSTS design and maintenance standards. The Tanks and Spills Section of the MPCA regulates the use, registration and site cleanup of underground and above ground storage tanks. The MPCA is responsible for administering the programs regulating construction and reconstruction of subsurface sewage treatment systems (SSTS). The MPCA requires an inspection program for SSTS that meets MPCA standards. Minnesota Rules 7080 govern administration and enforcement of new and existing SSTS.

The MPCA resumed selective administration of the Section 401 of the Clean Waters Act – Water Quality Certification Program in 2007. The program is primarily administered by the U.S. Army Corps of Engineers (COE). Section 401 certification is required to obtain a federal permit for any activity that will result in a discharge to navigable waters of the U.S. Formal applications for 401 certification must be sent to the MPCA.

Guidance for Dredged Materials (Stormwater Pond Maintenance)

The MPCA considers material excavated below the ordinary high water level (OHWL) of waterbasins, watercourses, public waters, or public waters wetlands (as defined by Minnesota Statutes 103G.005) to be dredged material. Because dredged material is defined as a waste and is regulated by the MPCA, a guidance document developed for managing dredged material available from the MPCA website: http://www.pca.state.mn.us/water/dredgedmaterials.html.

The MPCA's guidance document provides assistance in determining what type(s) of regulatory oversight and/or permit is required at projects and sites involving the

removal and management (storage, treatment, disposal and/or reuse) of dredged materials, once excavated, as well as what is required for discharges from the project site and/or management control site(s), including stormwater.

Because the MPCA's guidance is not mandatory, it does not establish or affect legal rights or obligations. However, should a permit be needed for managing the dredged material, such as in the event of short term or long term storage of dredged material on site, any generation of runoff from the stored materials (including stormwater runoff), dewatering runoff, etc., then following the guidance will help ensure a project is in compliance.

Some types of dredging projects do not require a permit from the MPCA for the management of dredged material; examples include the following:

- Projects involving the removal of less than or equal to 3,000 cubic yards of material with no surface water discharge (i.e., the material is immediately hauled away or any dewatering water infiltrates and does not runoff), and where the material is either:
    - more than 93% sand, as determined by the grain size analysis;
    - characterized as having contaminant values less than the relevant soil reference values (SRV) for the proposed disposal option; or,
    - disposed at a site or landfill that already has an MPCA permit to manage dredged material (industrial waste management plan).
- Projects involving the removal of more than 3,000 cubic yards with no surface water discharge that is disposed at a site or landfill that already has an MPCA permit to manage dredged material (industrial waste management plan).

If not disposed of in a landfill, the dredged material needs to be characterized according to the relevant soil reference values (SRV). A Level 1 SRV is required for the material to be re-used on residential/recreational lands, whereas a Level 2 SRV means the material must be re-used on industrial sites. The guidance document specifies the number, location, and depth of sediment cores that are to be collected.

For projects not requiring a permit, information pertaining to the project must be submitted to the MPCA for review prior to initiation of dredge activities. A Notification to Manage Dredged Materials without a Permit (notification) is used for this purpose. The MPCA will review the notification within 30 days, and if there's no response otherwise from the MPCA, no permit is required and the project can proceed. Even if no permit is required, sediment cores must be collected and analyzed. If a permit is required, it needs to be submitted at least 180 days before the anticipated date of dredging.

More information is available at the MPCA website: www.pca.state.mn.us

Minnesota Department of Health (MDH)

The MDH is the official state agency responsible for addressing all environmental health matters, including groundwater protection. The MDH administers the Well Management Program, the Wellhead Protection Program, and the Safe Drinking Water Act rules. The MDH also issues fish consumption advisories. The MDH is responsible for preventing pollution of water supplies to ensure safe drinking water sources and limit public exposure to contaminants. Through implementation of the federal Safe Drinking Water Act, the MDH conducts the Public Water Supply Program, which allows the MDH to monitor groundwater quality and train water supply system operators. The 1996 amendments to the federal Safe Drinking Water Act require the MDH to prepare source water assessments for all of Minnesota's public water systems and to make these assessments available to the public.

Through its Well Management Program, the MDH administers and enforces the Minnesota Water Well Code, which regulates activities such as well abandonment and installation of new wells. The MDH also administers the Wellhead Protection Program, which is aimed at preventing contaminants from entering the recharge zones of public water supply wells.

In 1997, the Wellhead Protection Program rules (Minnesota Rules 4720.5100 to 4720.5590) went into effect. These rules require all public water suppliers that obtain their water from wells to prepare, enact, and enforce wellhead protection plans (see **Section 5.2.4**). The MDH prepared a prioritized ranking of all such suppliers in Minnesota. Regardless of the ranking, Rules 4720 require all public water suppliers to have initiated wellhead protection measures for the inner wellhead management zone prior to June 1, 2003. If a city drills a new well and connects it to the distribution system, the city must begin development of a wellhead protection plan. Wellhead protection plans include: delineation of groundwater "capture" areas (wellhead protection areas), delineation of drinking water supply management areas (DWSMA), assessment of the water supply's susceptibility to contamination from activities on the land surface, and management programs, such as identification and sealing of abandoned wells, and education/public awareness programs. As part of its role in wellhead protection, the MDH developed the guidance document "Evaluating Proposed Stormwater Infiltration Projects in Vulnerable Wellhead Protection Areas" (MDH, 2007).

See the Minnesota Department of Health website (http://www.health.state.mn.us/divs/eh/water/index.html) for more information about these programs.

Minnesota Environmental Quality Board (EQB)

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

More information is available at the EQB website: www.eqb.state.mn.us

Minnesota Department of Transportation (MnDOT)

The MnDOT is responsible for major maintenance and reconstruction of storm sewer infrastructure associated with state highways. In the City of Willmar, these locations include Highway 23 (US Highway 71), Highway 12, Highway 40, and Highway 294.

More information is available at the MnDOT website: www.dot.state.mn.us

U.S. Army Corps of Engineers (COE)

The COE administers the Section 10 of the Rivers and Harbors Act permit program, and the Section 404 permit program.

> **Section 404 - Authorizations.** The Federal Clean Water Act requires that anyone who wants to discharge dredged or fill material into U.S. waters including wetlands must first obtain a Section 404 permit from the U.S. Army Corps of Engineers. Examples of activities that require a Section 404 permit include: construction of boat ramps, placement of riprap for erosion protection, placing fill in a wetland, building a wetland, construction of dams or dikes, stream channelization, and stream diversion.
>
> When Section 404 permit applications are submitted to the Corps of Engineers, the applications are typically posted for the U.S. Fish and Wildlife Service, the U.S. Forest Service, the U.S. EPA, and other federal agencies to review and provide comments on the application. The Corps of Engineers evaluates permit requests for the potential impact to various functions and values of the wetland.
>
> **Section 401 - Water Quality Certifications.** Section 401 certification is required to obtain a federal permit for any activity that will result in a discharge to navigable waters of the U.S. The program is primarily administered by the U.S. Army Corps of Engineers (COE) along with the MPCA. A Section 401 water quality certification may be granted if the applicant demonstrates that the proposed activity "will not violate Minnesota's water quality standards or result in adverse long-term or short-term impacts on water quality." Greater protection is given to a category of waters designated as Outstanding Resource Value Waters. The waters in this category have received this designation because of their exceptional value. These waters include such groups as scientific and natural areas, wild, scenic and recreational river segments and calcareous fens.

More information is available at the COE website: www.usace.army.mil

1.7 Other Funding Mechanisms

Section 6.6.4 of the Plan presents the primary methods used by the City of Willmar to fund its stormwater management implementation program (see Section 7). In addition to the city's general tax levy and stormwater utility, there are other local, state, and federal funding options available to the city. Several of those options are described in this section.

1.7.1 Funding Mechanisms within the City

In addition to the stormwater utility and general funds from the city's tax levy, the following local options are available to the city:

Special Assessments

Special assessments are used to finance special services ranging from maintenance to construction of improvement projects and are levied against properties benefiting from the special services. The philosophy of this method is that the benefited properties pay in relation to the benefits received. The disadvantages of using special assessments include the difficulty in determining and proving benefits, inability to assess runoff contributions, and the rigid procedural requirements.

Impact Fees/Development Costs

Many cities impose impact fees such as connection charges, building permit fees, etc. to pay for the costs of providing stormwater management services to newly developing areas. The City of Willmar charges impact fees for those areas discharging to regional ponding basins. In addition, the City of Willmar requires developers to construct the ponding, storm sewers, etc. that the city requires, thus reducing the capital cost borne by the city.

1.7.2 State Funding Sources

In addition to stormwater utility fees, taxes, assessments, and the other funding sources discussed above, the City of Willmar could obtain funding from various state sources, such as grant and loan programs. The city could use loans for projects instead of city-issued bonds. The following paragraphs list various state-funded sources, grouped according to the state agency that administers the various funding programs.

The **Board of Water and Soil Resources** (BWSR) administers several grant programs, some of which could be applied to cities. Applicable BWSR grant programs include Clean Water Legacy funding and local water management challenge grants (Minnesota Statues 103B.3369). Other possible applicable programs include cost-share grants and special projects of "turn-back" monies, but BWSR funding is available only through the local SWCD.

The **Minnesota Pollution Control Agency** administers the Clean Water Legacy (CWL) fund program, Watershed Resource Restoration grants (EPA-funded Section 319 program), and the Minnesota Water Pollution Control Revolving Loan Fund.

The **Minnesota Department of Natural Resources** (MDNR) administers many grant programs that could be appropriate for the City of St. Louis Park, including the Flood Hazard Mitigation Grant Assistance program, local grants program, trail grants program, cooperative water recreation program, and dam safety program.

However, funding for many of these programs change after each legislative session. The MDNR prepares individual fact sheets for each of the grant programs.

Other state funding programs include the **Legislative-Citizen Commission on Minnesota Resources** (LCCMR) funds for non-urgent demonstration and research projects, the **Minnesota Department of Trade and Economic Development's** Contaminant Cleanup Development Grant Program, the **Minnesota Department of Transportation** State Aid Funds, and Federal transportation funds.

1.7.3 Federal Funding Sources

The City of Willmar could also receive funding from various federal sources, a few of which are discussed in the following paragraphs.

The **U.S. Environmental Protection Agency** (EPA) has discretionary funds available through each division and program area of the EPA and administers the Clean Lakes Program (CLP) established by Section 314 of the Clean Water Act; the CLP is similar to the MPCA's CWL program. The EPA also administers the 604b Grant Program that targets water quality improvements in urban areas, and the Environmental Education Grant that finances local environmental education initiatives.

The **U.S. Army Corps of Engineers** administers the Planning Assistance to States (Section 22) program, the Project Cooperation Agreement (PCA) program, also known as the LCA (Local Cooperation Agreement) program for construction of flood control projects, the Section 14 bank protection program, the Flood Plain Management Services Program, the Aquatic Plant Control Program, and provides many GIS products through its GIS Center.

The **U.S. Fish and Wildlife Service** administers the North American Wetlands Conservation Grants Program, as part of the North American Wetlands Conservation Act (NAWCA).

The **Natural Resource Conservation Service** (NRCS) has funds available for technical assistance on various surface water projects, operations and maintenance, inspections and repairs. The NRCS also administers the Environmental Quality Incentives Program (EQIP), which was established through the 1996 Farm Bill Program.

The **Federal Emergency Management Agency** (FEMA) has funds available to restore areas (including water resources) damaged or destroyed by a disaster.

1.7.4 Private Funding Sources

In addition to state and federal funding sources, some private funding sources may be available.

Ducks Unlimited and **Pheasants Forever** funds are available for projects that enhance, create, or protect waterfowl or pheasant habitat.

Individual entities needing to provide wetland mitigation in compliance with the Wetland Conservation Act (WCA) may have funds and/or technical resources available to restore or create wetland function and values lost or intended to be destroyed as part of a project.

Other private funding sources include service organizations (i.e., Lions Club and Rotary), youth groups (i.e., Boy/Girl Scouts), Adopt-a-Highway/River cleanup groups, and sportsman clubs.