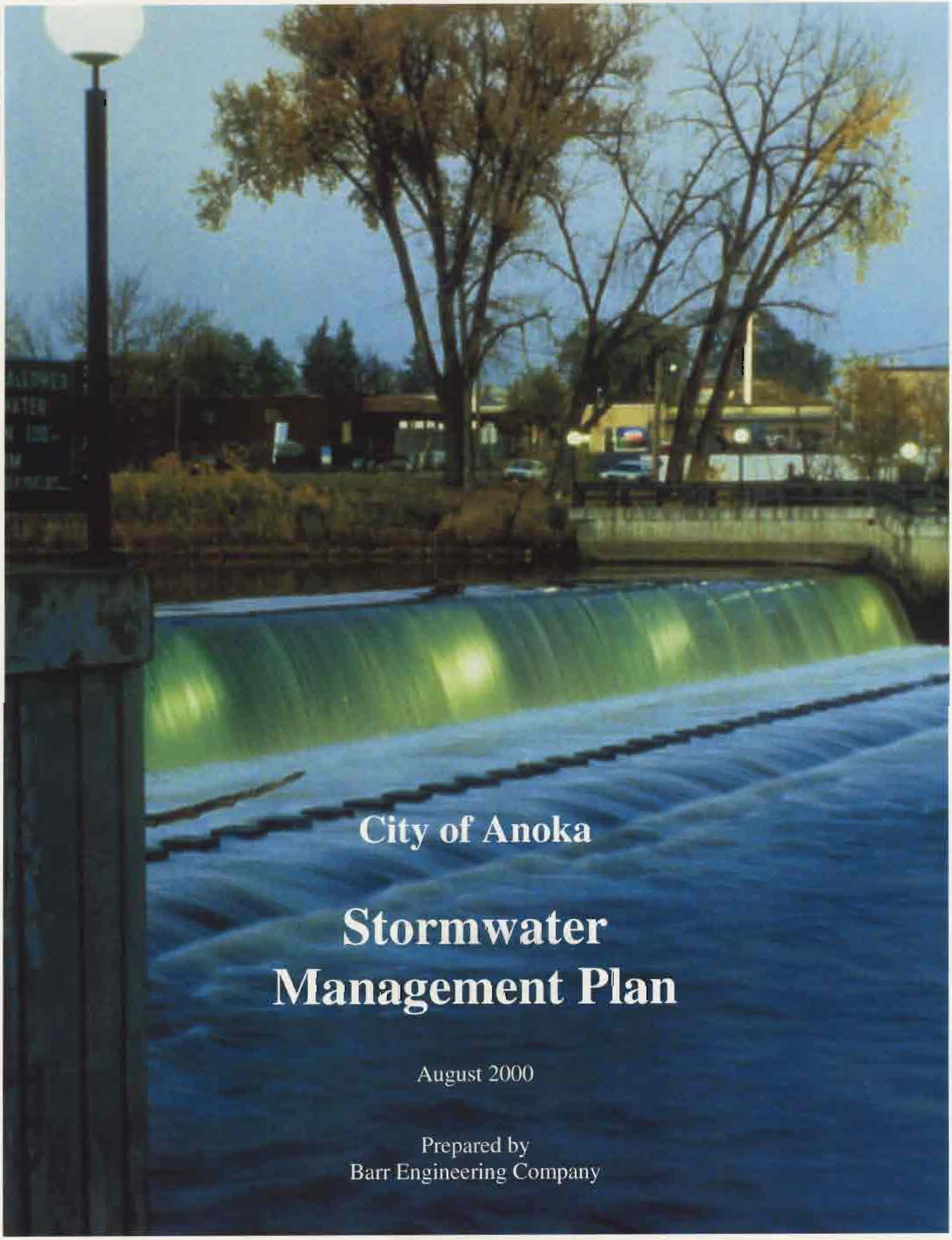

City of Anoka

Stormwater Management Plan

August 2000

Prepared by
Barr Engineering Company

City of Anoka

Stormwater Management Plan

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1.0 Executive Summary

The *City of Anoka Stormwater Management Plan* is divided into the Executive Summary and fourteen additional sections, which are described as follows:

Section 2: Introduction—presents background information regarding the city, general watershed information, and plan purposes.

Section 3: Policies for Stormwater Planning—presents background information, goals, policies and design standards covering runoff management and flood control and water quality management, National Pollutant Discharge Elimination System (NPDES) considerations, funding mechanisms, and the city's proposed education program. Section 3.1.1 summarizes the stormwater management policies.

Sections 4 through 12 (Watershed Descriptions and Recommendations)—describes the general watershed area, drainage patterns, flood protection concerns, stormwater system analysis and results, and implementation recommendations for each of the following major watersheds in the city: Mississippi River East, Mississippi River West, Anoka Enterprise, Rum River Northeast, Rum River Northwest, Rum River Southeast , Rum River Southwest, U.S. Highway 169 and 10, and Coon Rapids Tributary. Section 1.1.2 provides a summary of the highlights for each watershed.

Section 13: Technical Methods and Assumptions—describes the data, methods and assumptions used for the stormwater analyses.

Section 14: System Maintenance—discusses the city's responsibilities with respect to maintenance of stormwater facilities and presents a stormwater system maintenance guide.

Section 15: Implementation Program—presents proposed projects, programs and initiatives which address issues identified in the other sections of the plan, in accordance with goals and policies stated in Section 3. This section also presents financial considerations and the procedure for revisions and amendments to the stormwater management plan. Section 1.1.3 provides a summary of the implementation program.

Section 16: Wetlands—Discusses the city's responsibilities with respect to wetland protection.

1.1 City of Anoka Goals, Problems, and Potential Solutions

1.1.1 Goals

Runoff Management and Flood Control (Section 3.1)

- No flow rate increases in already-overtaxed stormwater systems.
- Adopt and implement a stormwater management ordinance.
- Place high priority on providing 100-year level of protection for the city's stormwater system.
- Require 10-year level of service for new stormwater systems and for existing systems as opportunities arise.
- Manage waterways as potential natural resource areas.

This section also presents policies and design standards for minimum building elevations and stormwater management facilities, and policies for working with other units of government.

Water Quality Management (Section 3.2)

- Modify city review, permitting and enforcement processes for construction activities to ensure water quality goals are met.
- Heighten community awareness through education and training.
- Manage city water resources so that the beneficial uses of streams, wetlands, ponds, and lakes remain available to the community.
- Work with the counties, townships, and upstream landowners (outside the city's jurisdiction) to encourage upstream pollutant reduction in areas closer to the source of such pollutants.
- Use regional detention areas, where practical and physically possible, as opposed to individual on-site detention to reduce flooding, control discharge rates, and provide necessary storage volume.
- Implement a runoff water quality monitoring program, if required to do so (i.e. NPDES requirements).
- Promote stormwater retention through infiltration practices and demonstration projects, where soil conditions allow and where not detrimental to groundwater supplies.

- Erosion and sediment control operations and facilities must meet the standards and specifications given in the Minnesota Pollution Control Agency's handbook of Best Management Practices entitled *Protecting Water Quality in Urban Areas.*

- Extended detention basins will be constructed to provide water quality treatment just prior to discharge to the rivers.

This section also describes water quality management standards, as taken from the proposed stormwater management ordinance, stormwater management plan review and permitting standards, stormwater management plan approval standards and a checklist of best management practices (BMPs).

Funding Mechanisms (Section 3.4)

- The city will investigate whether to adopt and implement a stormwater utility, in addition to the current funding methods (ad valorem taxes and special assessments), to fund the implementation program.

1.1.2 Problems, Issues and Potential Solutions

This section summarizes the problems, issues and potential solutions identified in Sections 4 through 12 of the plan.

Mississippi River East Watershed (Section 4)

The plan recommends upgrading of storm sewer systems on 9th Avenue, Kings Lane, Fifth Avenue, Oakwood Drive, and Oakwood Lane, and the construction of one new stormwater detention basin.

To protect the water quality of the Mississippi River, the plan recommends the construction of three water quantity/quality detention basins at various locations in the watershed and/or the addition of appurtenances to the storm sewer where the construction of a basin is not practical or feasible.

Mississippi River West Watershed (Section 5)

The plan recommends the upgrading of storm sewer systems along Ferry Street, Franklin Lane, Levee Avenue, West Lane, Porter Avenue, and construction of a stormwater detention area within Sorensen Park.

To protect the water quality of the Mississippi River, the plan recommends the construction of four water quantity/quality detention basins at various locations in the watershed and/or the addition of appurtenances to the storm sewer where the construction of a basin is not practical or feasible.

Anoka Enterprise Watershed (Section 6)

No existing or future capacity problems were identified in this watershed. It is recommended that the city carefully review proposed storm sewer systems accompanying development plans to ensure no future capacity problems occur. A detailed survey of the existing storm water detention basins is necessary to determine if the existing basins need to be modified to provide the necessary storage.

To protect the water quality of the Mississippi River, the plan recommends the construction of an appurtenance to the storm sewer where the sewer system outlets to the river.

Rum River Northeast Watershed (Section 7)

The plan recommends the upgrading of storm sewer systems at Bryant Circle, Grant Circle, 9th Lane, Grant Street, Garfield Street, 7th Avenue, and 41st Street. A detailed survey of the four existing basins and storm water detention basins is necessary to determine if the existing basins need to be modified to provide the necessary storage.

To protect the water quality of the Rum River, the plan recommends the construction of one water quantity/quality detention basin off of Grant Street and/or the addition of appurtenances to the storm sewer where the construction of a basin is not practical or feasible.

Rum River Northwest Watershed (Section 8)

No existing or future capacity problems were identified in this watershed. It is recommended that the city carefully review proposed storm sewer systems accompanying development plans to ensure no future problems occur. A detailed survey of the two existing basins is necessary to determine if the existing basins need to be modified to provide the necessary storage.

To protect the water quality of the Rum River, the plan recommends the construction of appurtenances within the storm sewer where there is direct discharge into the river.

Rum River Southeast Watershed (Section 9)

The plan recommends the upgrading of storm sewer systems along Jefferson Street, Washington Street, 5th Avenue, Brisbin Street, 7th Avenue, 10th Avenue, Adams Street, Harrison Street, Taylor Street, and Polk Street. A detailed survey of the three existing storm water detention basins is necessary to determine if the existing basins need to be modified to provide the necessary storage.

To protect the water quality of the Rum River, the plan recommends the construction of five water quantity/quality detention basins at various locations in the watershed and/or the addition of appurtenances to the storm sewer where the construction of a basin is not practical or feasible.

Rum River Southwest Watershed (Section 10)

The plan recommends the upgrading of storm sewer systems along Benton Street and Webster Street.

To protect the water quality of Rum River, the plan recommends the construction of appurtenances to the storm sewer at the outlets to the river.

U.S. Highway 169 and 10 Watershed (Section 11)

The plan recommends the upgrading of storm sewer systems along Euclid Avenue, Fairoak Avenue, Western Street, State Avenue, Branch Avenue, and 8th Avenue. John Ward Park serves as a detention basin; however, construction of an outlet is required to connect the park with the highway system at West Main Street. A detailed survey of the four existing basins is required to determine if sufficient storage is provided.

To protect the water quality of Rum River, the plan recommends the construction of five water quantity/quality basins at various locations in the watershed and/or the addition of appurtenances within the storm sewer where construction of a basin is not practical or feasible.

Coon Rapids Tributary Watershed (Section 12)

No existing or future capacity problems were identified in this watershed. It is recommended that the city carefully review proposed storm sewer systems accompanying development plans to ensure no future problems occur.

The plan assumes that the water quality treatment is the responsibility of the city of Coon Rapids as the points of discharge into major water bodies is not within the Anoka city limits.

1.1.3 Implementation Program

Section 15 of the plan presents the city's implementation program, which can be divided into projects, programs, and special studies. In order of priority, corrective, preventive, and investigative work needs to be completed to implement this plan.

Table 15-1 includes programmatic activities, such as adoption and implementation of a stormwater management ordinance, implementation of a stormwater system maintenance program, and establishment and implementation of a stormwater utility.

2.0 Introduction

2.1 Study Area General Description and Watershed Nomenclature

The city of Anoka is bisected by the Rum River, and its southern limits are situated along the Mississippi River. Early-development occurred along the southern portion of the Rum River. The city has since expanded northward to the most recent development in the northwest corner.

The city's land use plan is shown on Figure 2-1. The majority of the city is developed except for the portion located north of Bunker Lake Road.

All of the land in the city of Anoka eventually drains to the Mississippi River. The northwest corner and southernmost regions of the city are directly tributary to the Mississippi, which flows southeasterly. The downtown and remaining portions of the city are directly tributary to the Rum River, which joins the Mississippi at the southern edge of the city.

This plan covers the following nine major watersheds in the city of Anoka:

1. Mississippi River East
2. Mississippi River West
3. Anoka Enterprise
4. Rum River Northeast
5. Rum River Northwest
6. Rum River Southeast
7. Rum River Southwest
8. U.S. Highway 169 and 10
9. Coon Rapids Tributary

These nine watersheds are shown on Figure 2-2. Sections 4 through 12 describe the stormwater management requirements and recommended system improvements for each of these watersheds. The nine major watersheds were subdivided into minor watersheds and subwatersheds. Watershed divides were determined using USGS quadrangle maps (10-foot contour interval) and field verified.

Minor watersheds in each of the major watersheds were designated according to the street or other location where the watershed outlets. For example, the Jefferson Street subwatersheds are labeled JF-1,2,3,...etc., the Porter Avenue watersheds are labeled PTR-1,2,3,... etc., and the Moore Middle School watersheds are labeled MMS-1,2,3,... etc.

2.2 Plan Purposes

This plan provides the city of Anoka with an overall comprehensive stormwater management plan. This plan was developed to address current and future stormwater issues, especially those related to future development and redevelopment. In particular, this plan responds to the following issues:

- The city needs to establish a stormwater utility to raise the funds needed to construct new storm sewer systems, retrofit old systems, establish water quality treatment facilities, and maintain the stormwater management system.
- The city needs overall stormwater management planning that recognizes the potential for the city to annex additional lands.
- The future MPCA requirements of the city of Anoka to obtain an NPDES permit as part of Phase II of the NPDES Stormwater Regulations.

Surface water management technology has changed significantly since the city first developed. Water quality and wetland preservation issues are now major concerns and land use assumptions have changed.

The first goal of this Stormwater Management Plan is to provide for flood control and natural resource management. In addition, the city realizes it could be affected by the provisions of several new legislative mandates, including:

1. Assisting property owners, developers, and contractors in complying with the requirements of the construction permitting portion of the National Pollutant Discharge Elimination System (NPDES) permit program under the Federal Clean Water Act (MPCA's NPDES construction stormwater permit).
2. Identifying all wetlands, floodplains, and floodway areas to assist the city in complying with the Minnesota Wetland Conservation Act of 1991 and the wetland permitting requirements of the Corps of Engineers under Section 404 of the Clean Water Act.
3. Municipalities with populations under 100,000 will likely be required to obtain a NPDES stormwater discharge permit as part of the reauthorization of the Clean Water Act. The cities

will need to address water quality management as part of the NPDES stormwater permit; this plan will provide the framework for the city to meet at least some of the likely permit requirements.

This plan will assist the city of Anoka in defining and implementing a comprehensive and environmentally sound system of surface water management. It is intended to be used as a tool to:

1. Plan for projects and other water management activities so as to correct existing problems and prevent foreseeable future problems from occurring.

2. Assist the city in considering water resource impacts resulting from variances to the city's long-range land use plan.

3. Enable the city to grow/redevelop in a systematic and orderly manner while protecting its vital water resources.

In order to accomplish these objectives, the plan considers a specific array of land uses within the city's legal boundary. If and when land uses change, this plan provides the means to (1) address the proposed changes; (2) determine the impact of the changes on the city's infrastructure, flooding, and natural resources; and (3) determine the actions needed within the proposed areas of land use change to prevent undesirable impacts.

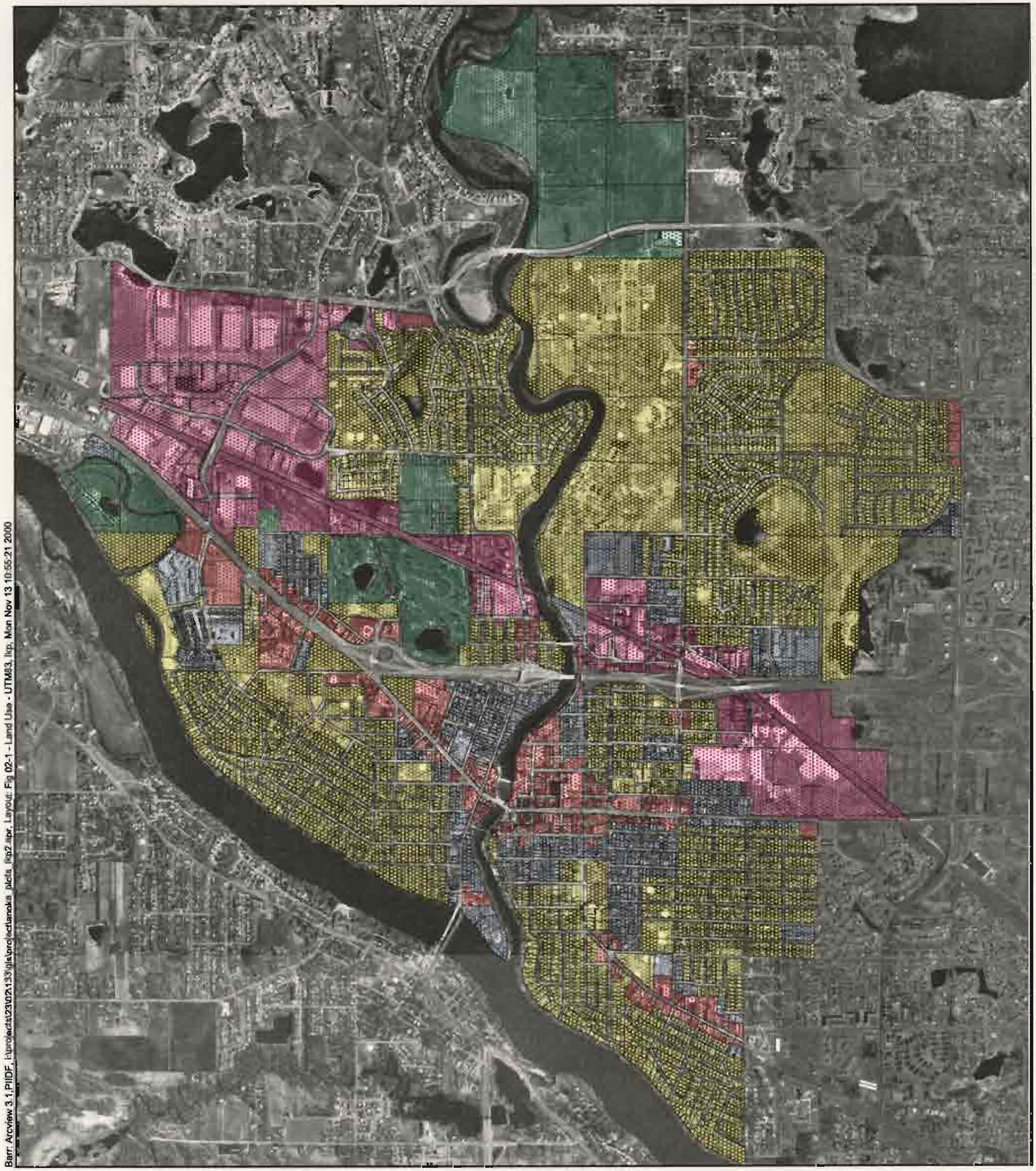

Figure 2-1

LAND USE
City of Anoka
Anoka, Minnesota

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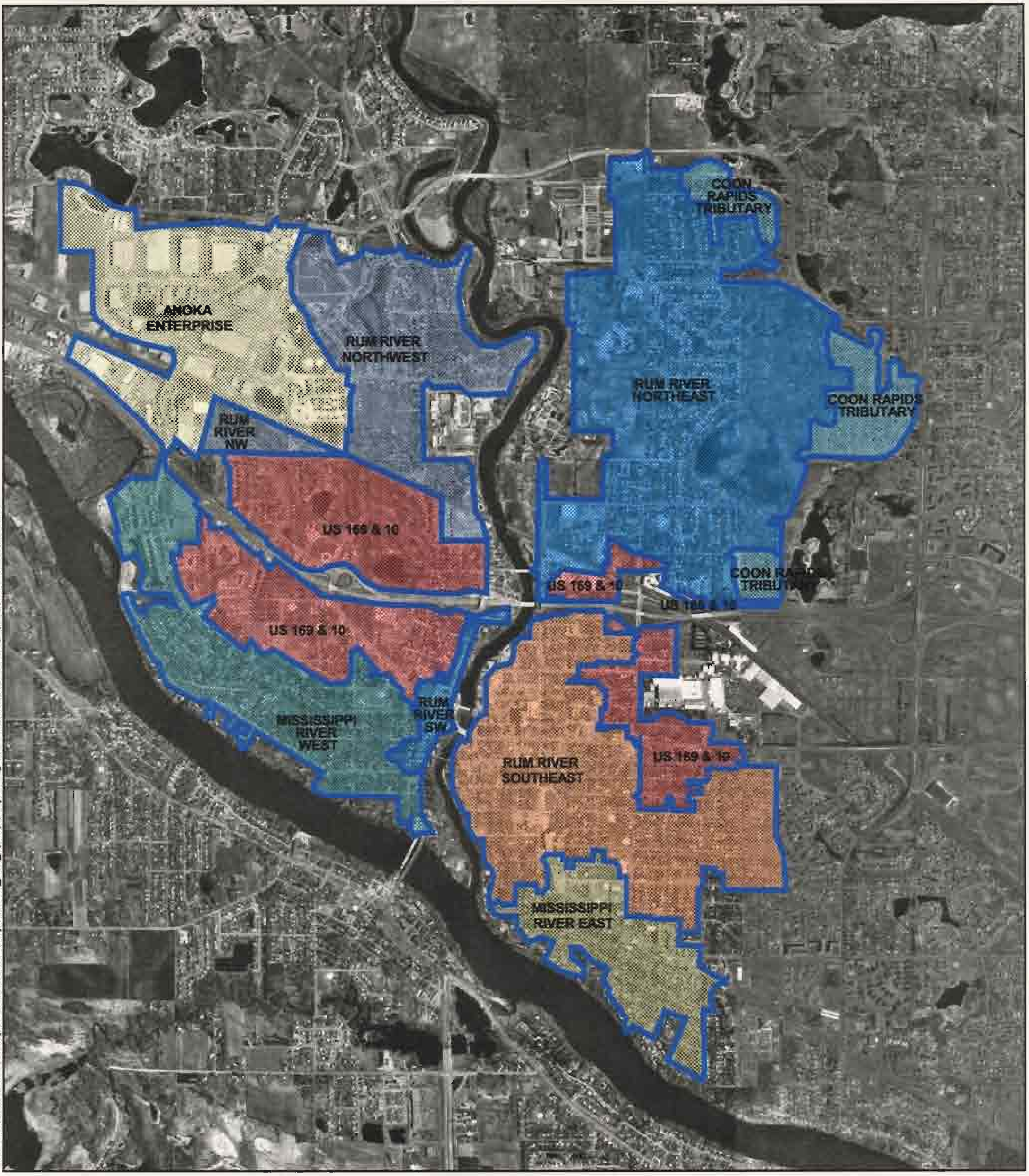

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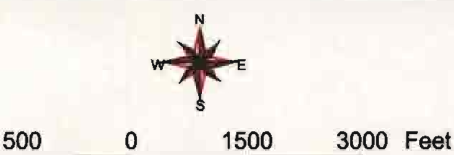


Figure 2-2

MAJOR WATERSHEDS
City of Anoka
Anoka, Minnesota

3.0 Policies for Stormwater Planning

This section presents background information, policies and design standards covering runoff management and flood control, water quality management, wetland management, National Pollution Discharge Elimination System (NPDES) considerations, funding mechanisms, and the city's proposed education program.

3.1 Runoff Management and Flood Control

The city of Anoka's stormwater drainage system extends throughout the developed areas of the city. The drainage system includes a combination of storm sewers, culverts, roadway curb and gutter, flumes, spillways, overflow swales and ditches that discharge to the rivers, detention ponding basins, wetlands and lakes throughout the city. Storm sewers are typically designed to handle the flows from a 10-year frequency storm event, a storm that has a 10 percent chance of occurring in any given year. The other surface components are designed to manage flows the storm sewers cannot handle for events up to the 100-year frequency storm event, a storm that has a 1 percent chance of occurring in any given year. For most of the city's drainage systems, there is no additional capacity for added stormwater runoff from new developments and redevelopments. It is important that there be no flow rate increases in those systems that are already over capacity. As areas develop or redevelop, the effect of the proposed projects on the system will need to be determined.

It is important to understand the difference between **level of service** and **level of protection** when designing and analyzing stormwater systems.

- **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 street flooding.
- **Level of protection** is defined as the total system capacity required to avoid flooding of structures and to provide for public safety. Typically, the level of protection is the level at which street flooding, overflow swales, piping systems and basins work as a total system to prevent flooding of homes/businesses and to prevent dangerous flooding of streets.

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 water not 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 overland 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 where an outlet is only provided by the storm sewer, the surface 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 general practice, the design event used for level of service (storm sewer design event) corresponds to a return period of 10 years or less, while the design event used for level of protection (total system design event) corresponds to a return frequency of 100 years.

The 100-year and 10-year storms are defined as the critical 100-year or 10-year duration events that result in the greatest flood (water surface) elevations and peak discharges for any area to be protected (the level of protection). There are many 100-year storm and runoff events of varying duration that could be analyzed. Depending on the watershed characteristics, one of these events will present flow and flood conditions worse than the others. For this plan, the 10-year critical and the 100-year, 1-hour events were used for analysis. The 100-year, 1-hour storm was used to design and analyze ponding areas. The 10-year critical event, either ½-hour or 1 hour, was used to design and analyze storm sewer pipes.

Table 15-1 presents the design criteria for the proposed ponding basins within each major watershed throughout the city. Presently, there are many options for basin development. The information presented represents one possibility. It is the intent of the city and this plan to be flexible and allow for other designs proposed by developers or owners, as long as the design conforms to the overall intent of this plan. The most important basin design parameters to be met are the 100-year and 10-year peak discharges listed in each section, which should not be exceeded unless a reanalysis is completed. The basin design parameters are conceptual only and are subject to change. For example, watershed boundaries may change as a result of new topographic mapping and/or development, which would alter ponding requirements. Since the ponding recommendations are conceptual, final design of the basins must be undertaken prior to basin construction.

3.1.1 Runoff Management and Flood Control Policies

The following sections present the city of Anoka's policies and design standards that address runoff management and flood control, which are incorporated into the stormwater management regulations.

The city adopts the following general runoff management and flood control policies (Sections 3.1.1.1 and 3.1.1.2 provide specific policies and standards):

1. The city of Anoka will place a high priority on providing 100-year level of protection for the city's stormwater system. The city will require new stormwater systems to provide 100-year level of protection. Existing systems that currently do not provide 100-year level of protection will be modified to provide 100-year level of protection. Proposed additions and modifications to the stormwater system are shown in Table 15-1.

2. The city will require new stormwater systems to provide 10-year level of service. Existing systems that currently do not provide 10-year level of service will be modified, as opportunities arise and as needed, to provide 10-year level of service.

3. The city will manage ravines, ditches, creeks and other waterways as potential natural resource areas to protect their natural characteristics as well as their stormwater conveyance capabilities. This will require the construction of basins. As development/redevelopment occurs, ponding basins must be constructed to detain stormwater runoff prior to its discharge into a ravine, ditch, stream, or other waterway.

3.1.1.1 Minimum Building Elevations

To prevent flooding of buildings, it is recommended that the city adopt the following policies/design standards:

1. All lowest floor elevations and other permanent fixtures including heating and air conditioning ventilation systems should meet the following:

    - Be a minimum of 2 feet above the 100-year flood elevation for basins with pipe outlets or waterways.

    - For landlocked basins, no piped outlet, the minimum building elevation should be the greater of either 2 feet above the level resulting from two concurrent 100-year, single event rainfall events or 2 feet above the 100-year 10-day snowmelt. In either case, the starting elevation of the basin/waterbody prior to the runoff event should be established by one of the following:

        (a) Existing Ordinary High Water level established by the Minnesota Department of Natural Resources;

        (b) Annual water balance calculation approved by the city of Anoka;

        (c) Local observation well records, as approved by the city of Anoka; or

(d) Mottled soil.

Note: The 100-year landlocked basin flood elevation may be lowered by excavating an overflow swale or constructing an outlet pipe at an overflow point.

2. The lowest entry elevations (i.e., windows, window wells, walkout elevations) for buildings adjacent to overflow swales and/or conveyance channels should be at least 2 feet above the 100-year flow elevation of the swale or channel at the point where the swale or channel is closest to the building.

3.1.1.2 Stormwater Management Facilities Design Standards

The city adopts the following policies/design standards for all new stormwater management facilities (i.e. basins, storm sewers, etc.):

1. All ponding basins and basin outlet pipes should be designed to collectively detain and convey the flows from the 100-year frequency storm (100-year level of protection). Detention basins should be designed to contain the flows from the 100-year frequency storm without overtopping.

2. All lateral storm sewer systems, including catch basin grates, and all city roadway curb and gutter facilities should be designed to convey flows from the 10-year frequency storm (10-year level of service).

3. All roadways adjacent to ponding basins or through which flows from drainage waterways, creeks, or other major flow conveyors are conveyed should be constructed or protected such that they are not overtopped by runoff from the 100-year frequency storm event (100-year level of protection).

4. Where practical and physically possible, regional detention areas, as opposed to individual on-site detention, should be used to reduce flooding, to control discharge rates, and to provide necessary storage volumes whenever possible. Where regional detention areas are not in place or existing systems are already over capacity, the city will require individual on-site detention at new developments to ensure the new developments do not worsen conditions for the existing systems under present watershed development conditions.

5. Promote stormwater retention through infiltration practices and demonstration projects, where soil conditions allow and where not detrimental to groundwater supplies.

6. All constructed slopes within the 100-year storage volume of a ponding basin should be 4 feet horizontal to 1 foot vertical (4H:1V) where possible, and in no case should they be steeper than 3H:1V.

7. All ponding basins should be provided with a protected emergency overflow structure to prevent undesired flooding resulting from extreme storms or plugged outlet conditions. The emergency overflow path should be protected with permanent, nondegrading erosion control materials (i.e. riprap or geosynthetics).

8. Each ponding basin should be provided with an all-weather access road for maintenance purposes.

3.2 Water Quality Management

This section of the city's plan sets forth background water quality information, the city's water quality management policies, and the city's design standards. This section also describes the city's review process and its specific requirements for construction activities within the city.

3.2.1 Background Water Quality Information

The rivers, streams, ponds, lakes, and wetlands in the city of Anoka are an important community asset. These resources supply aesthetic and recreational benefits, in addition to providing wildlife habitat and refuge. The city recognizes the need to assure adequate water quality in the water bodies within the city and will take steps to protect these resources. The city of Anoka will manage the city's water resources so that the beneficial uses of rivers, lakes, streams, ponds and wetlands remain available to the community. Such beneficial uses may include aesthetic appreciation, wildlife habitat protection, nature observation, and recreational activities.

When natural areas become urbanized, stormwater runoff from impervious areas such as new roads, highways, industries, commercial areas, and residential areas collects and conveys pollutants at above natural rates to adjacent water bodies. In addition to flooding concerns, numerous studies have documented the adverse or accelerated water quality impacts associated with converting land from its native, undisturbed state to urban and even agricultural land uses. Outflow from urbanized areas, especially, significantly accelerates the natural degradation of our lakes, streams and rivers.

As land urbanizes, the amount of impervious cover of the watershed increases. The results in higher phosphorus loads delivered from the watershed to the receiving water body. Consequently, the city considers areas that will be undergoing significant future development to be "hot spots" in terms of phosphorus loading.

At the same time, an increase in population density generally results in an increased appreciation for the many benefits of urban rivers, streams, ponds, lakes, and wetlands. This results in strong public pressure to mitigate the impacts of urbanization, to reduce the effects of past water quality degradation, and to prevent the potential effects of future development.

Phosphorus and suspended sediments are recognized as being particularly detrimental to the health of lakes and streams. As a result, the city is promoting measures to reduce the influx of these pollutants to its water bodies. Many other pollutants are transported by the same processes that convey phosphorus. Therefore, phosphorus reduction measures for stormwater runoff may also reduce the flow of other pollutants to area resources.

The city's watershed management and land development policies are directed mainly at controlling the amount of phosphorus and sediment that is carried by runoff from the watershed. High phosphorus levels in streams and lakes lead to algal proliferation. Abundant algae reduces water clarity, may impair fish habitat, can cause scum and odor problems, and is generally considered unsightly. Water quality monitoring shows that controlling phosphorus levels is the key to controlling algal growth in most Minnesota water bodies.

Closely related to reducing phosphorus loads to water bodies is controlling suspended sediment inflows. Suspended sediment carried by stormwater runoff typically consists of fine particles of soil, dust, dirt, organic material, and undissolved fertilizer. Suspended sediment loads can also carry heavy metals, oils, and other pollutants. High volumes of suspended sediment can be the result of:

- Erosion from agricultural land.
- Runoff from city streets, buildings, parking lots, and other impervious areas, which washes accumulated sediment from those areas.
- Runoff from urban areas with higher flows and higher velocities, which in turn causes channel and swale erosion.
- Runoff from construction sites with poor erosion and sediment control or with poorly maintained sediment control facilities.

Sediment clouds streams and lakes, thereby disturbing or destroying aquatic life, other wildlife, and their habitats. Sediment is also a major source of phosphorus because dissolved phosphorus frequently attaches to small sediment particles. As a result, many of the city's standards are aimed at preventing or slowing the transport of fine soil, dust, and dirt particles into streams, waterways, and lakes.

The city intends to use regional water quality treatment facilities as its prime method to attain the city's water quality goals. However, in addition to regional facilities, implementation of best management practices will be necessary for specific areas and for construction sites throughout the city and its tributary watersheds. Table 3-1 presents an example BMP checklist and Table 3-2 provides a listing of BMPs. Such practices are particularly important in areas where regional facilities do not exist or are not feasible. Sections 3.2.3, 3.2.4, and 3.2.5 present the city's water quality-related design standards.

3.2.2 Water Quality Management Policies

The city adopts the following water quality policies:

1. The city of Anoka will include in its review permitting and enforcement processes for construction activity provisions to ensure that water quality goals are met.

2. The city will work to heighten community awareness of water quality management through education and training.

3. The city will manage its water resources so that the beneficial uses of streams, wetlands, ponds, and lakes remain available to the community.

4. The city of Anoka will work with the adjacent municipalities to encourage upstream pollutant reduction in areas closer to the source of such pollutants.

5. The city will use regional detention areas, where practical and physically possible, as opposed to individual on-site detention to reduce flooding, control discharge rates, and provide for water quality management.

6. The city will promote stormwater retention through infiltration practices and demonstration projects in locations where soil conditions permit and where groundwater supplies will not be impacted.

7. The design, testing, installation, and maintenance of erosion and sediment control operations and facilities must meet the standards and specifications given in the Minnesota Pollution Control Agency's handbook of best management practices entitled *Protecting Water Quality in Urban Areas*, as amended; and the requirements of the Lower Rum River Water Management Organization.

3.2.3 Water Quality Management Standards

One purpose of the city of Anoka's stormwater management regulations is to control or eliminate soil erosion and sedimentation within the city. The regulations establish standards and specifications to minimize soil erosion and sedimentation resulting from land alterations or development activity. The stormwater management regulations establish procedures for issuance, approval, administration, and enforcement of a permit regulating land alteration. The regulations require the submission of stormwater management plans that will provide the following information for areas altered of 1 acre or greater in size.

- **Existing site map.** A map of existing site conditions showing the site and areas immediately adjacent to the site.
- **Drainage computations.** For each subwatershed, computations must be provided showing the peak discharge rate and runoff volume for the 100-year rainfall storm event for existing and proposed site conditions and the 10-year post-development peak discharge rate. The drainage computations for the site must meet either the discharge requirements set by the city's stormwater management plan.
- **Site construction plan.** A map showing site conditions during construction, including an erosion control plan.
- **Plan of final site conditions.** A plan of final site conditions showing the site changes.

3.2.4 Stormwater Management Plan Review/Permitting Procedure

Permit applicants must submit stormwater management plans to the city of Anoka for review in accordance with the stormwater management regulations.

3.2.5 Stormwater Management Plan Approval Standards

The standards in this section apply to stormwater management plan approval by the city.

3.2.5.1 Site Dewatering

The regulations require that water pumped from a construction site must be treated through appropriate controls and that water may not be discharged in a manner that causes erosion or flooding of the site, off-site property, receiving channels or a wetland.

3.2.5.2 Sediment Tracking

The regulations require each construction site to have graveled roads, rocked access drives and parking areas of sufficient size to prevent tracking of sediment onto public or private roadways. Contractors must remove any sediment reaching a public or private road by street cleaning (not flushing) before the end of each workday.

3.2.5.3 Drain Inlet Protection

The regulations require protection of all storm drain inlets during construction until control measures are in place with a silt fence, straw bale, or equivalent barrier meeting accepted design criteria, standards and specifications contained in the most current version of the MPCA publication *Protecting Water Quality in Urban Areas.*

3.2.5.4 Site Erosion Control

The stormwater regulations require the following applicable criteria be met for construction activities that result in runoff leaving the site:

- All site activities must be conducted in a logical sequence to minimize the amount of bare soil exposed at any one time. If possible, grading operations that disturb existing vegetation or ground cover must be undertaken to minimize the area of bare soil exposed at any one time.

- Runoff from the entire disturbed area on the site must be controlled by meeting the conditions of either 1 and 2 or 1 and 3, described below.

    1. All disturbed ground left inactive for thirty (30) or more days must be stabilized by seeding and mulching or sodding. After September 15, the site must be stabilized by providing temporary cover (such as mulch) or other equivalent control measures until final vegetation can be established in the spring.

    2. For sites with more than 5 acres disturbed at one time the contractor must construct one or more temporary or permanent sedimentation basins. Each sedimentation basin must have: (1) a surface area of at least 1 percent of the area draining to the basin, and (2) at least 3 feet of depth (dead-storage), and (3) constructed in accordance with accepted design specifications. The contractor must regularly maintain the sedimentation basins and periodically remove sediment to maintain a depth of 3 feet. The basin discharge rate must also be sufficiently low to prevent erosion along the discharge channel or the receiving water.

3. For sites with less than 5 acres disturbed at one time, the city encourages, but does not require, construction of sedimentation basins. At a minimum, silt fences, straw bales, or equivalent control measures must be placed along all sideslope and downslope sides of the site. Silt fences placed in concentrated flow channels perpendicular to the flow direction must be reinforced by snow fence and support posts. The use of silt fences, straw bales, or equivalent control measures must include a maintenance and inspection schedule.

3.2.5.5 Stormwater Management Criteria for Permanent Facilities

- **General Requirements**

1. The stormwater management regulations require applicants to provide permanent stormwater detention facilities if regional facilities have not been constructed within the watershed of the proposed project. When required to provide such facilities, all necessary stormwater management facilities must be provided to store increased runoff from the 100-year storm peak discharge to a predevelopment rate. Upon construction of a regional stormwater detention facility in the watershed, the city may allow (but is not obligated to allow) some or all of these stormwater management facilities to be removed.

2. Applicants must give consideration to reducing the need for stormwater management facilities by incorporating the use of natural topography and land cover such as wetlands, ponds, natural swales and depressions as they exist before development to the degree that they can accommodate the additional flow of water without compromising the integrity or quality of the wetland or pond.

3. The following stormwater management practices must be investigated during development of the stormwater management plan, in the following descending order of preference:

    a. Natural infiltration of precipitation and runoff on-site.

    b. Flow attenuation by use of open vegetated swales, and natural depressions.

    c. Stormwater retention facilities.

    d. Stormwater detention facilities.

4. A combination of successive practices may be used to achieve the applicable minimum runoff rate control requirements specified in above. The applicant must provide justification for the method selected.

- **Design standards** (taken from the stormwater management regulations). Stormwater detention facilities required by the city of Anoka to incorporate water quality treatment features, must be designed according to the most current technology as reflected in the MPCA publication *Protecting Water Quality in Urban Areas* and Lower Rum River Water Management Organization criteria and must contain, at a minimum, the following design factors:

  1. A permanent pond surface area for wet detention basins, or wetted area for the extended detention in modified dry basins, equal to two percent of the impervious area draining to the pond or one percent of the entire area draining to the pond, whichever amount is greater.

  2. An average permanent pool depth of 4 to 10 feet for wet detention basins.

  3. Wet storage volume for wet basins, or the extended detention volume for modified dry basins, equal to or greater than the runoff from a 2-inch rainstorm event from the entire drainage area tributary to the basin and sediment storage adequate to hold at least 25 years of sediment accumulation.

  4. A permanent pool length-to-width ratio of 3:1 or greater.

  5. A minimum protective shelf extending ten feet into the permanent pool with a slope of 10H:1V, beyond which slopes should not exceed 4H:1V (5H:1V or flatter is preferred).

  6. A protective buffer strip of vegetation surrounding the permanent pool at a minimum width of 25 feet.

  7. All stormwater detention facilities must have a device ("skimmer") to prevent oil, grease, and other floatable materials from moving downstream as a result of normal operations.

  8. Stormwater detention facilities for new development must be sufficient to limit peak flows in each subwatershed to those that existed before the development for the 100-year storm event. All calculations and hydrologic models/information used in determining peak flows must be submitted to the city along with the stormwater management plan.

  9. All stormwater detention facilities must have a forebay to remove coarse-grained particles prior to discharge into a watercourse or storage basin.

  10. All overflow swales designed to pass runoff flows from part or all of the 100-year event that have a channel slope of 2 percent or steeper, or other 100-year discharge velocities that will exceed 4 feet per second must be armored with permanent, non-photo-degrading erosion control materials.

Although not required by the city's stormwater management regulations, the city suggests that the following design standards also be applied:

1. The distance between the major inlets and normal outlet should be maximized to provide the greatest flow distance for flow through the basin.
2. The design should include effective energy dissipation devices that reduce outlet velocities to 4 fps or less. These outlets should consist of stilling basins or other such devices that prevent erosion at all stormwater outfalls into the detention basin, and at the basin outlet.
3. Trash and floatable debris skimming devices should be placed at the outlet of all on-site detention basins to provide treatment up to the critical duration 5-year storm event.

3.2.5.6 Wetlands

- Runoff must not be discharged directly into wetlands without treatment of the runoff.
- A 25-foot wide protective buffer strip of natural vegetation surrounding all wetlands is recommended.
- Wetlands must not be drained or filled, wholly or partially, unless replaced by restoring or creating wetland areas of at least equal public value in accordance with the rules adopted by the Minnesota Board of Water and Soil Resources. Replacement must be guided by the following principles in descending order of priority:
    1. Avoiding the direct or indirect impact of the activity that may destroy or diminish the wetland;
    2. Minimizing the impact by limiting the degree or magnitude of the wetland activity and its implementation;
    3. Rectifying the impact by repairing, rehabilitating, or restoring the affected wetland environment;
    4. Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the activity; and
    5. Compensating for the impact by replacing or providing substitute wetland resources or environments.

3.2.5.7 Manholes

All newly installed and rehabilitated manholes located immediately upstream of the discharge point to a waterbody must have a sump provided for the collection of coarse-grained material. Such basins should be cleaned when the sump areas are half filled with material.

3.2.5.8 Inspection and Maintenance

All stormwater management facilities must be designed to minimize maintenance needs and to provide maintenance access. The Anoka city engineer, or designated representative, will inspect all stormwater management facilities during construction, during the first year of operation, and at least once every 5 years thereafter. The inspection records will be kept on file in the engineering department. It is the applicant's responsibility to obtain any necessary easements or other property interests to allow access to the stormwater management facilities for inspection and maintenance purposes.

3.2.5.9 Models/Methodologies/Computations

Hydrologic models and design methodologies used for the determination of runoff and analysis of stormwater management structures must be approved by the city of Anoka. Plans, specification and computations for stormwater management facilities submitted for review must be signed by a registered professional engineer. All computations must be submitted with the proposed plans for review, unless otherwise approved by the Anoka city engineer.

3.3 NPDES Considerations

Under the federal 1987 Clean Water Act revision, discharges of pollutants into waters of the United States are prohibited without a permit under the National Pollutant Discharge Elimination System (NPDES) program. The purpose of the NPDES stormwater regulation is to reduce the water quality impact of stormwater drainage systems on receiving water bodies. Traditionally, this program concentrated on discharges from industries and publicly owned treatment plants. Under the current NPDES program rules, discharges associated with industrial activities, construction projects, and certain municipalities must be covered by an NPDES stormwater permit.

Currently, the city of Anoka is not required to be covered under a NPDES discharge permit for stormwater. Municipalities with populations under 100,000 were not included in the first round of municipal permitting by the United States Environmental Protection Agency (U.S. EPA). However, municipalities with smaller populations (>10,000) are likely to be addressed in the reauthorization of the Clean Water Act. Final regulations for the reauthorization (Phase II regulations) are expected in the near future. Although the final Phase II regulations are not ready, it is likely the regulations will require the city to develop, implement and enforce a stormwater management program designed to reduce pollutants from the city's storm sewer system. The city's stormwater management program would be required to include the following strategies:

1. Public education and outreach on stormwater impacts.
2. Public involvement and public participation.
3. Elicit discharge detection and elimination.
4. Construction site stormwater runoff control.
5. Post-construction stormwater management in new development and redevelopment.
6. Pollution prevention and good housekeeping methods for municipal operations (i.e. public works garages).

Once the Phase II regulations are finalized, the Minnesota Pollution Control Agency (MPCA) will have three years to develop a procedure for complying/implementing with the regulations. The MPCA is considering a watershed-based strategy, not individual NPDES permits. The MPCA will likely issue a general NPDES permit to the city, based on the city's water quality goals, for its water bodies. The MPCA would then monitor the city's progress towards meeting its water quality goals. The city of Anoka may wish to wait to implement a comprehensive water quality management program until notified by the EPA or the MPCA about the permit requirements. However, there are several tasks that the city may undertake at this time which would assist the city in completing the permit application and complying with the future permit requirements. These tasks include:

1. Source Identification
2. Identification and Implementation of Best Management Practices
3. Simplified Water Quality Monitoring
4. Education Program (see Section 3.5)

3.3.1 Pollutant Source Identification

Identification of stormwater pollutant sources includes identification of illicit pollutant discharges and nonpoint sources throughout the city. An illicit pollutant discharge is defined as a nonpermitted point source of pollutants that discharges to the storm sewer system at a specific location.

Illicit discharges are often identified by observing the existing storm sewer systems during dry weather conditions. This work would include the review of storm sewer plans, field investigation of the major outfalls in the city and of the major creeks and waterways, and random sampling of manholes throughout the city. The guidance manual for Part 1 of the NPDES municipal permit application provides a detailed methodology for dry weather sampling of storm sewer systems. The city of Anoka could proceed with the identification of illicit discharges based on this methodology. This work would involve five tasks, including:

- Identification of dry weather sampling network and sampling protocol.
- Identification of methods for estimating discharges from illicit discharges.
- Identification of methods for locating illicit discharges.
- Implementation of dry weather sampling and illicit discharge source identification.
- Remedial action to correct any found illicit discharges.

The purpose of the this work is to determine: (1) if illicit discharges exist, (2) where these discharges originate, and (3) the water quality of the discharges. Ultimately, any illicit discharge identified would be removed from the system.

Nonpoint pollutant sources include concentrated areas of material storage, high impact land use activity, and areas of erosion and site specific problem areas throughout the city and in outlying watersheds that drain into the city. Traditionally, nonpoint source pollution is associated with land use activities such as agricultural, commercial, industrial, and construction activities. Identification of problem areas will provide the city with potential management alternatives required in Part 2 of the NPDES permit. Also, any construction project that is 5 acres or more requires an NPDES Construction Permit to be issued for the work, as well as strict compliance with the permit provisions.

3.3.2 Identification of Best Management Practices

The city of Anoka stormwater management policies and standards identify BMPs for construction site stormwater runoff control, and post-construction stormwater management in new and redeveloped areas.

Problem areas identified as a part of the source identification process may need to be retrofitted with stormwater BMPs before or as part of a future NPDES municipal permit process. The entire watershed contributing to storm sewers in the city should be considered for water quality management. Activities upstream of the city of Anoka may have a greater impact on the discharges to environmentally sensitive areas than stormwater runoff from the storm sewer system within the city. This determination may require coordination, negotiation, and participation with other city, county and state offices.

In preparation for future NPDES activities, the city can identify and develop management alternatives for site specific conditions and for general application throughout the city of Anoka. Based on the source identification portion of the proposed NPDES work, the city may prepare an implementation plan that includes:

Urban BMPs

Detention Basins
Constructed Water Quality Wetlands
Grassed Swales
Filter Strips
Oil & Grit Separators
Floatable Skimmers

Agricultural BMPs

Nutrient and Pesticide Management
Vegetative and Tillage Practices
Structural Practices
Animal Wastes Systems
Livestock Control
Stormwater Management Control
Septic Systems

Construction BMPs

Section 3.2.5.4 describes the criteria for erosion control associated with construction activities.

Housekeeping BMPs

Fertilizer/Chemical Management
Litter Control
Street Sweeping
Illegal dumping

Several BMP manuals are available to help identify the most appropriate application for each site. In addition to site specific details, the pollutant removal efficiency of the different options needs to be considered in the implementation of BMPs. These details will need to be addressed in the BMP identification process.

3.3.3 Implementation of Best Management Practices

BMPs identified for the city of Anoka may be implemented by incorporation with other ongoing programs or by special projects. Four possible methods of BMP implementation include:

Surface Water Management Plan

The city of Anoka's stormwater management plan requires implementation of water quality BMPs as part of future development in the city. Additional structural water quality BMPs are presented in Section 4 through Section 12 of this plan.

Industrial NPDES

All industries within the city of Anoka should be operating under a NPDES Industrial Stormwater Permit and should have prepared a Stormwater Pollution Prevention Plan (SWPPP). The city should contact each industry about reviewing their SWPPP. The purpose of reviewing these plans is to determine the adequacy of each plan and to determine if BMPs could be added to each site as a part of the existing permit requirements.

City Ordinances

Certain BMPs, especially housekeeping BMPs, may be implemented through city ordinances. However, the inclusion of areas outside the city of Anoka in the NPDES activities may be accomplished by working with Anoka County, adjoining townships, the Lower Rum River Water Management Organization and/or the State of Minnesota to create ordinances or other approaches for areas outside the city limits.

Special Projects

If implementation of identified BMPs cannot be facilitated by the means above, special projects may be necessary to address specific areas. These projects will be similar in nature to other municipal development and maintenance projects.

3.3.4 Simplified Water Quality Monitoring

The most uncertain portion of future NPDES municipal permits is whether the city will be required to monitor stormwater runoff. If it becomes apparent that stormwater runoff monitoring will be required, the city of Anoka should begin a simplified water quality monitoring program. The purpose of the monitoring would be to characterize the condition of water quality in stormwater runoff from the city and determine the impact of the city's stormwater runoff on downstream water resources.

This work would include periodic collection of samples from the major outfalls and directly from selected water resources. A per storm event "grab sample" program is recommended for these major outfalls. The city may be able to coordinate a volunteer sampling program with other units of government or other groups to minimize the costs associated with such a program.

Each sampling site would be monitored for discharge and for a select list of water quality parameters. Generally, the parameter list would include total suspended solids, nutrients (nitrogen and phosphorus), biochemical oxygen demand, bacteria, oil and grease, and possibly certain metals. The purpose of the inflow monitoring is to determine the pollutant loading from the area tributary to the river. The purpose for monitoring the selected water resources is to determine the pollutant load from upstream of the city and to determine the impact of the city and the watersheds that drain through the city on downstream water quality.

3.4 Funding Mechanisms

Minnesota Statutes (M.S.) 429, 444, 462 and 473 are some of the statutes governing the methods municipalities can use to raise funds to finance various surface water management efforts. The following paragraphs describe many of the funding methods available by statute to cities.

3.4.1 Ad Valorem Taxes

The most common revenue source used to finance municipal services, including minor maintenance for drainage and water quality facilities is general taxation. Using property taxes has the effect of spreading the cost over the entire tax base of the community.

The State legislature has made this avenue very difficult with the levy limit requirements for municipalities. As a result, funding projects that exceed general tax limits requires a bond referendum to be passed. This process can be very time-consuming and expensive.

3.4.2 Special Assessment (M.S. 429)

Special assessments are used to finance special services in municipalities ranging from water quality treatment pond maintenance to construction of capital improvements. The assessments are levied against properties benefiting from the special services. The philosophy of this method is that the specially benefited properties pay in relation to special benefits received. In this case, the benefit is the increase in the market value of the properties.

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 city has used special assessments to pay for past projects. The disadvantages of using this method include the difficulty in determining and proving benefit; inability to assess runoff contributions; the rigid procedural requirements; and the hardship experienced by residents and other landowners to pay large special assessments. The city would prefer to use other methods to pay for projects, but may use special assessments in conjunction with the stormwater utility for some projects.

3.4.3 Building Permits, Land Development Fees, Land Exaction Fees, and Connection Charges (M.S. 462.358)

As land is developed or built upon, stormwater runoff and pollution loading increase. Administrative and capital costs can be recovered at the time the building permit is issued or when land development is approved. A city can charge a system connection fee, a land development fee and/or require dedication of land for ponding or drainage purposes. Where land is dedicated, the land must be part of the parcel being developed.

These fees usually address problems in new developments and not in existing developments, so they will not be effective in the already-developed portions of the city.

3.4.4 Stormwater Utility (M.S. 444.075)

A stormwater utility is set up in a similar manner to that used for sanitary sewer and water utilities. Under a utility system, a stormwater utility fee (typically billed quarterly) is charged against all parcels within the city. The fees are usually proportionate to the amount of runoff each parcel of land contributes to a drainage system. The fees can be used to finance drainage system projects, surface water quality improvements, infrastructure replacement, studies, operations and maintenance. The fees can be accumulated to pay for such activities, or can be established as the revenue stream to pay for bonds sold to initially pay for such activities. The utility system is sometimes argued as being "just another tax". Regardless, it allows municipalities a way to finance surface water management at far less cost than many of the other possible methods available to cities, and it is typically far easier for residents and businesses to pay small monthly fees than large special assessments. Many cities currently use this funding mechanism.

3.4.5 State Funding Sources

Other than stormwater utility fees, taxes and assessments, the city of Anoka could receive funding from various state sources, such as grant and loan programs. The city could use loans for projects instead of county-issued bonds. The following paragraphs list various state-funded sources, grouped according to the state agency that administers the various funding programs.

The Minnesota Board of Water and Soil Resources (BWSR) administers several grant programs, some of which could be applied to cities. Applicable BWSR grant programs include challenge grants (M.S. 103B.3369), cost-share grants, special projects "turn-back" monies, and the Reinvest in Minnesota (RIM) Reserve Program. With the exception of challenge grants, BWSR funding is offered to the public through the local SWCD.

The Minnesota Pollution Control Agency (MPCA) administers the Clean Water Partnership (CWP) grant and loan 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 (DNR) administers many grant programs which could be applicable to the city of Anoka, including the Flood Hazard Mitigation Grant Assistance program, local grants program, trail grants program, cooperative water recreation program, and dam safety program. Funding for many of these programs changes after each legislative session. The DNR prepares individual fact sheets for each of the grant programs.

Other state funding programs include the Legislative Commission on Minnesota Resources (LCMR) 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 Agriculture's Agriculture Best Management Practices (Ag BMP) Loan Program, Mn/DOT State Aid Funds, and ISTEA funds.

3.4.6 Federal Funding Sources

The city of Anoka 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 CWP program. The EPA also administers the 604b Grant Program, targeting water quality improvements in urban areas; the 319 Grant Program, for implementing non-point source pollution projects; and the Environmental Education Grant, for financing 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 Fund, 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.

3.4.7 Private Funding Sources

The McKnight Foundation administers their Mississippi River Program, an environmental initiative for the 10-state Mississippi River watershed. The foundation's priorities are phosphorus reduction, nitrogen management, and river corridor protection. Most of the funding goes to nonprofit groups.

The Minnesota Environmental Initiative administers the Contaminant Cleanup Development Grant Program which was created by the state legislature to provide financial incentives. Ducks Unlimited and Pheasants Forever funds are available for projects which 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 Elks), youth groups (i.e., Boy/Girl Scouts), Adopt-a-Highway/River cleanup groups, and sportsman clubs.

3.4.8 Current and Proposed City Funding Mechanisms

The city of Anoka currently uses ad valorem (general) taxes and special assessments to finance its surface water management efforts, along with land dedication and easement acquisition during the platting process. In addition to the current funding methods, the city will consider adopting a stormwater utility to fund the implementation program listed in this plan. See Section 15.3 for more information regarding financial considerations.

3.5 Education Program

The city of Anoka believes public education will be an important and effective method to control non-point source pollution since it emanates from broad reaches of the landscape. A public education program will raise citizen awareness regarding pollutant sources in everyday life from all types of property. The city will educate its residents, businesses, industries and staff concerning pollutant reduction, best management practices, the link between daily housekeeping activities and the condition of the city of Anoka's water resources, and awareness of natural resources in general.

The city will also seek to inform its residents, businesses, industries and staff of initiatives, projects, etc. completed by the community that address the city's education goals. The city held public meetings with developers and builders to discuss the draft watershed management plan and its implications.

Education and housekeeping practices are especially important within the city limits since there is limited land available to provide water quality treatment facilities. The city of Anoka will develop and distribute educational materials to the general public and targeted groups regarding:

- Natural resources within and adjacent to the city
- Importance of pollutant reduction in stormwater runoff
- City ordinances, policies and programs pertaining to water resources
- Reducing fertilizer/herbicide use
- Lawn care practices that prevent organic debris from reaching storm sewer systems
- Household and automobile hazardous waste disposal
- Problems with pet waste and proper disposal
- Litter control
- Recycling and trash disposal
- Composting, leaf collection, and grass clippings
- Residential stormwater drainage
- Native vegetation
- Public area maintenance
- Alternative landscaping methods
- Plantings in buffer zones along wetlands, lakes, rivers and streams
- Car washing

Information will be distributed via the city's newsletter, local newspapers, cable television and any other appropriate media.

Table 3-1 Example Checklist of Common Best Management Practices (BMPs) for Development or Redevelopment

Description Of BMP	Was BMP Used in Project?	Location Used or Basis for Nonusage:
1. Reduce area of impervious surface (pavement, roofs, etc.)		
2. French drains and other subsurface drains		
3. Infiltration trench and dry well		
4. Parking lot/rooftop runoff storage with outlet protection		
5. Detention basin with outlet protection		
6. Wetland treatment area		
7. Retention (infiltration) basin		
8. Parking lot oil/grease separators		
9. Storm drain inlet protection		
10. Riprap or other storm drain outlet protection		
11. Slope stabilization and erosion control measures		
12. Grit chambers/manholes		
13. Extended detention basin		
14. Other (describe):		

* Further descriptions of these and other BMPs can be found in "Protecting Water Quality in Urban Areas" (MPCA, 1989).

Table 3-2 Best Management Practices

Institutional Source Controls

- No Littering Ordinance
- Pet Waste Pet Litter "Pooper Scooper" Ordinance
- Chemical Use/Storage Ordinance
- Recycling Programs
- Public Education Programs
- Vacant Lot Cleanup Ordinance
- Spill Prevention Ordinance

Nonstructural Source Controls

- Program to Prevent Illicit Discharges
- Street Sweeping

Cleaning of Storm Drains

Minor Structural Source Controls

- Diversion Channels
- Grass Swales
- Natural Channels to Reduce Erosion
- Vegetative Controls on Exposed Soils

Minor Structural Discharge Elimination Methods

- Development and Maintenance of Recharge Areas
- Development and Maintenance of Porous Pavement

Moderate Structural Controls for Floatables/oils Removal

- Development and Maintenance of Parking Lot Oil/Grease Separators
- Development and Maintenance of Parking Lot and Rooftop Runoff Storage with Outlet Protection

Major Structural Controls for Floatables/oils Removal

- Detention Basin with Outlet Protection
- Wetlands Treatment Area

4.0 Mississippi River East Watershed

4.1 General Watershed Description

The Mississippi River East Watershed and the subwatersheds that comprise it are shown in detail in Figure 4-1. This watershed consists of the land in the city of Anoka that drains directly to the Mississippi River on the east side of the Rum River.

The Mississippi River East Watershed includes the southernmost portion of the city. The area of this watershed is approximately 445 acres. The watershed is mostly developed, with land use consisting of single family residential, multiple family residential, and a small section of commercial land use.

4.1.1 Drainage Patterns

This watershed drains south via storm sewers to the Mississippi River. There are eight stormwater outfalls that discharge directly to the Mississippi River, east of Rum River. From east to west, the five storm sewer network minor watersheds modeled for this project are:

9th Avenue (9TH)

Kings Lane (KGS)

Oakwood Drive (OWD)

5th Avenue (5TH)

Oakwood Lane (OWL)

Each storm sewer system is named for the location of the minor watershed outlet. Subwatersheds within these minor watersheds were delineated, named and numbered according to the minor watershed. For example, the system draining to 5th Avenue is so named because the outlet for the stormwater system is on 5th Avenue. The nine subwatersheds are numbered consecutively from the outlet.

There are no existing stormwater detention basins within this subwatershed.

4.1.2 Flood Protection Concerns

Where the storm sewer system capacity is not sufficient, surface overflow will occur via the streets to the lowest point within the watershed. For the Mississippi River East Watershed, overflow occurs toward the river. If sufficient capacity for the critical 10-year storm at these outlet points is not maintained, it is possible ponding will occur in the street and yards at this storm frequency until surface overflow occurs. It appears that flooding of homes or businesses will not occur since the surface overflow is at an elevation below the lowest structure.

4.2 Stormwater System Analysis and Results

The 10-year and 100-year event flood analyses were performed for the Mississippi River East Watershed. Table 4-1 presents watershed information and the results of the 10-year and 100-year critical storm events.

4.3 Implementation Considerations

As a part of the surface water management planning process, the problem areas were investigated to determine possible mitigation alternatives. To solve the Mississippi River East Watershed's existing and future drainage problems while providing 10-year level of service and 100-year level of protection, an increase in storm sewer carrying capacity and provision of stormwater detention is required. Also, water quality management of surface runoff from the drainage basins prior to discharging to the Mississippi River is required. These issues are discussed in the following paragraphs.

4.3.1 Increased Storm Sewer Capacity Projects

An increase in pipe capacity for parts of this watershed is necessary to provide a 10-year level of service. Figure A (in Appendix B) summarizes the proposed and existing systems. Pipes shown in orange are existing pipes which provide the required level of service. The blue lines indicate existing pipes which do not meet the design criteria based on information available. Yellow lines indicate proposed locations of future systems. The preliminary pipe sizes required for the blue and yellow lines are shown in red. Peak runoff discharges along the conveyance system for the 10-year and 100-year frequency storm events are identified by the green and red circles, respectively. The 9th Avenue, Kings Lane, Oakwood Drive, 5th Avenue, and Oakwood Lane storm sewer upgrade projects listed in Table 15-1 are all within the Mississippi River East Watershed.

4.3.2 Construction of Additional Stormwater Basins

The construction of a stormwater basin located in subwatershed 9th_5 would allow for smaller pipe sizes to be used while also providing treatment to the runoff before it discharges into the river. Table 4-2 lists the necessary live storage for the basin.

4.3.3 Construction of Water Quality Basins

Figure B (in Appendix B) shows the locations where water quality basins would greatly reduce the amount of suspended solids and phosphorus load to the Mississippi River. Table 4-2 lists the necessary "dead storage" required to remove 90 percent of the suspended solids and 60 percent of the total phosphorus load. Where land is not available for basin construction, appurtenances within the storm sewer system, e.g. grit chambers, water quality treatment manholes, may be added to reduce the load. These appurtenances will not be as effective as a treatment basin and the removal efficiency will decrease. The basins proposed are preliminary design with more study needed to finalize the basin design. Table 15-1 includes the basin construction projects as implementation tasks.

4.3.4 Acceptance of Lower Level of Service

From the hydraulic model results, many of the city's storm sewer pipes cannot handle the runoff from a 10-year event. This may not be a serious problem, but more of an inconvenience because of inundation since this area of the city is fortunate enough to be sloped towards the river. In the areas of steep slopes, much of the excess stormwater runoff that cannot be managed in the existing pipes can flow downstream in the system of roads, curbs and gutters, and overflow swales. The areas where the overflow system may create problems are: (1) where the natural terrain is too flat, (2) where low areas exist and unwanted ponding occurs (i.e. at intersections and in developed parts of the city), and (3) when roads carrying the excess runoff make sharp turns.

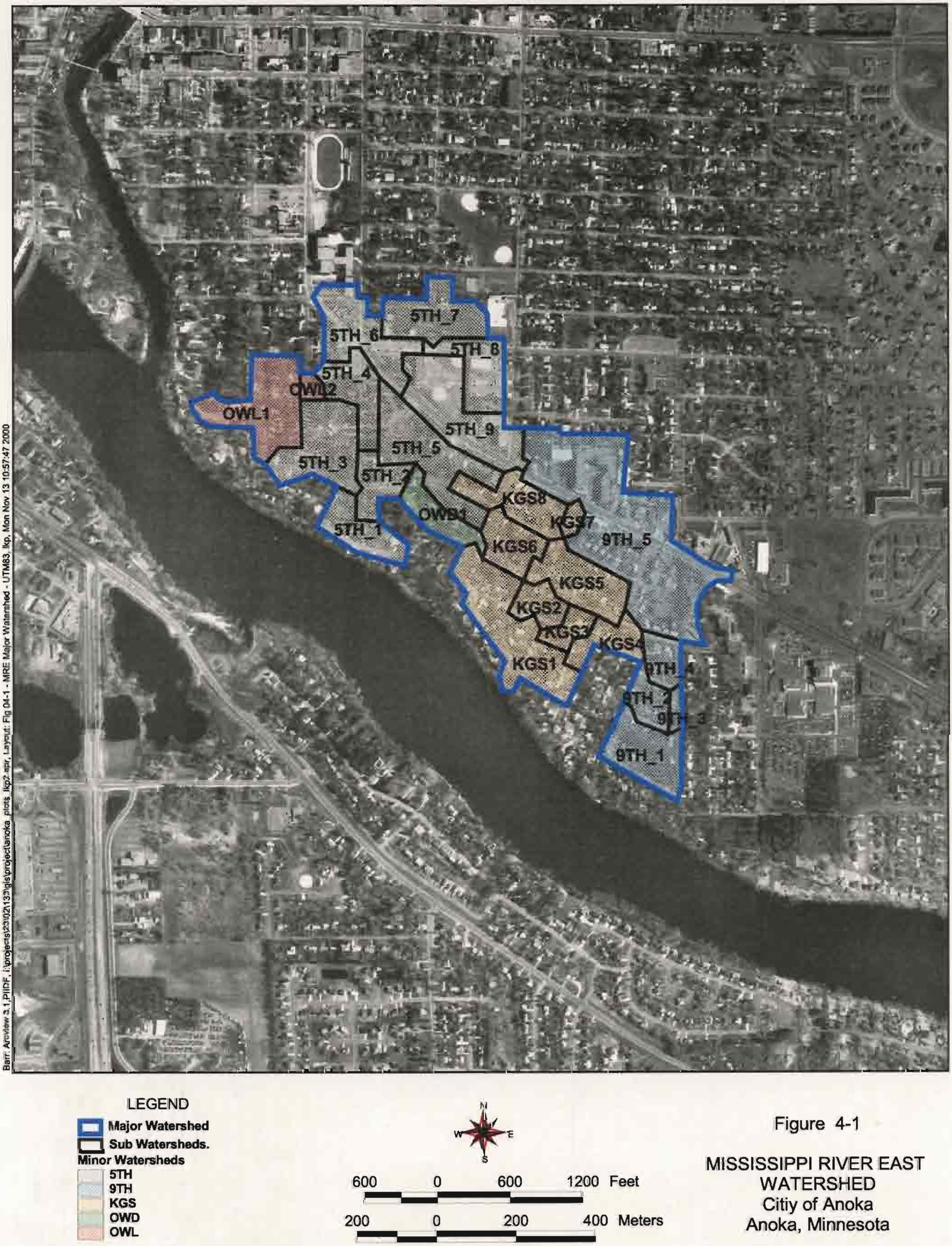


Figure 4-1

MISSISSIPPI RIVER EAST WATERSHED
Citiy of Anoka
Anoka, Minnesota

Barr: Arcview 3.1,PIIDF, I:\projects\23\02\133\gis\project\anoka_plots_lkp2.apr, Layout: Fig 04-1 - MRE Major Watershed - UTM83_lkp, Mon Nov 13 10:57:47 2000

Table 4-1: Results of the Mississippi River East Watershed
10 year and 100 year Critical Storm Events

Minor Watershed	Subwatershed	Drainage Area (acres)	Impervious Percentage	Peak Runoff Rate (cfs) 10-yr storm	Peak Runoff Rate (cfs) 100-yr storm
5TH	1	5.3	20	9	19
5TH	2	4.3	20	9	17
5TH	3	8.6	20	13	27
5TH	4	5.9	30	11	21
5TH	5	10.9	40	26	45
5TH	6	9.0	44	18	32
5TH	7	7.2	34	17	32
5TH	8	6.0	38	11	19
5TH	9	11.8	42	23	41
9TH	1	7.3	20	11	23
9TH	2	3.2	20	7	14
9TH	3	1.2	20	3	6
9TH	4	2.0	20	4	8
9TH	5	30.8	46	35	63
KGS	1	12.4	20	15	31
KGS	2	3.0	20	8	15
KGS	3	2.2	20	5	11
KGS	4	4.3	20	6	12
KGS	5	7.3	20	11	21
KGS	6	4.3	20	8	16
KGS	7	1.0	45	3	6
KGS	8	6.3	33	13	24
OWL	1	10.1	20	13	26
OWL	2	0.9	20	2	5
OWD	1	5.0	20	9	18

Table 4-2: Results of 100 year Storm Event Basin Requirements for Mississippi River East Watershed

Subwatershed	Drainage Area acres	Dead Storage acre-ft	Live Storage acre-ft	Total Storage acre-ft	100yr Discharge cfs	Oultet Size
Proposed Ponds						
9TH_5	30.8	2.0	4.8	6.8	3	12"
KGS1	40.8	1.6	0*	1.6		
5TH_1	57.4	2.6	0*	2.6		

* Note: These basins have been sized only for water quality purposes.
If constructed, live storage must be determined.

5.0 Mississippi River West Watershed

5.1 General Watershed Description

The Mississippi River West Watershed includes the southern portion of the city west of the Rum River, which drains directly into the Mississippi River. This watershed is approximately 287 acres. It is made up of mostly single-family residential with small sections of multiple-family residential and commercial land use. Figure 5-1 shows the watershed and subwatershed boundaries.

5.1.1 Drainage Patterns

Portions of the Mississippi River West Watershed are serviced by storm sewers. Subwatersheds within this watershed were delineated and named according to the location of the minor watershed outlet. For example, the Levee Avenue subwatershed is so named because the outlet for the stormwater system is on Levee Avenue. All of the subwatersheds ultimately discharge to the Mississippi River. This watershed has two existing stormwater basins in the private town home development.

There are eight stormwater outfalls that discharge directly to the Mississippi River, west of Rum River. From east to west, the storm sewer network minor watersheds modeled for this project are:

Mississippi West (MW)

Levee Avenue (LEV)

Shaw Avenue (SHAW)

West Lane (WEST)

Porter Avenue (PTR)

Benton Street (BEN)

Private Town Home Development (PV)

5.1.2 Flood Protection Concerns

Where the storm sewer system capacity is not sufficient, surface overflow will occur via the streets to the lowest point within the watershed. For the Mississippi River West Watershed, the water reaching the low points is conveyed via pipe to the Mississippi River. If sufficient capacity for the critical

10-year storm at these outlet points is not maintained, it is possible that ponding will occur in the streets and yards at this storm frequency until the surface overflow occurs. However, as with the Mississippi River East watershed, it appears that flooding of homes is not likely to occur as the land is sloped towards the Mississippi River and the surface overflow is at an elevation below the lowest structure.

5.2 Stormwater System Analysis and Results

The 10-year and 100-year event analyses were performed for the Mississippi River West Watershed. Table 5-1 presents watershed information and the results of the 10-year and 100-year flood analyses for each of the subwatersheds shown on Figure 5-1.

5.3 Implementation Considerations

To solve the Mississippi River West Watershed's existing and future drainage problems while providing 10-year level of service and 100-year level of protection, a combination of increased storm sewer capacity and stormwater detention is required. These are discussed in the following paragraphs.

5.3.1 Increased Storm Sewer Capacity Projects

An increase in pipe capacity is necessary in regions of this watershed to provide a 10-year level of service for its storm sewer system. Figure A summarizes the proposed and existing systems. Pipes shown in orange are existing pipes which provide the required level of service. The blue lines indicate existing pipes which do not meet the design criteria based on information available. Yellow lines indicate proposed locations of future systems. The preliminary pipe sizes required for the blue and yellow lines are shown in red. Peak runoff discharges along the conveyance system for the 10-year and 100-year frequency storm events are identified by the green and red circles, respectively. The new pipes shown are recommended to decrease the overland distance to the storm sewer inlets, minimize localized ponding, and provide capacity to meet the design criteria. The Ferry Street, Franklin Lane, Levee Avenue, West Lane and Porter Avenue storm sewer upgrade projects listed in Table 15-1 are all within the Mississippi River West Watershed.

5.3.2 Construction of Additional Stormwater Basins

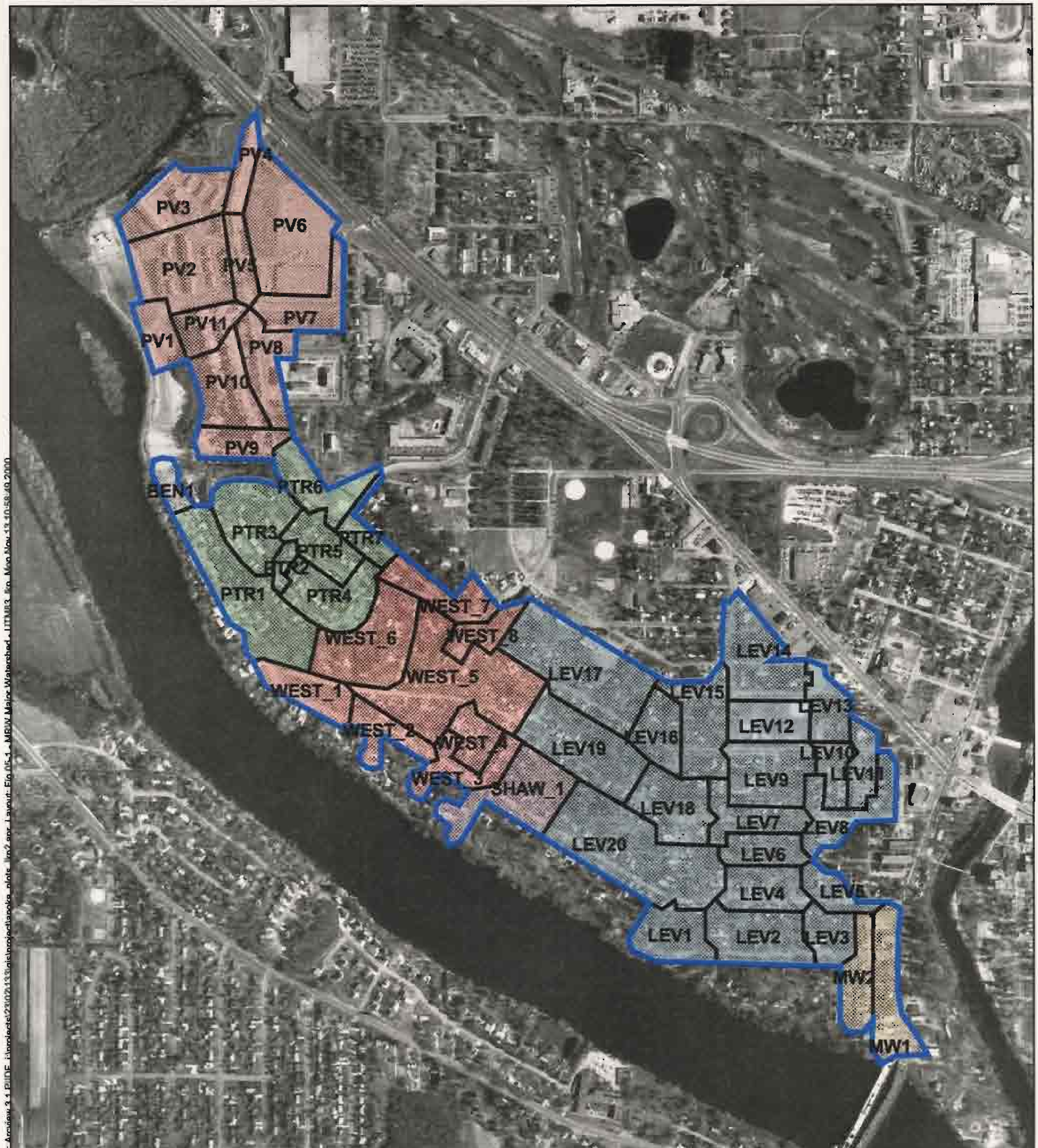
Currently, Sorensen Park is sufficient for stormwater storage for the 100-year event if the recommended piped outlet is provided. Table 5-2 lists the necessary live storage for the 100-year event. Construction of a basin at this location may reduce the recommended pipe upgrade sizes downstream while also providing water quality treatment.

5.3.3 Construction of Water Quality Basins

Figure B shows the locations where water quality basins would greatly reduce the amount of suspended solids and phosphorus load to the Mississippi River. Table 5-2 lists the necessary "dead storage" volume required to remove 90 percent of the suspended solids and 60 percent of the total phosphorus load. Where land is not available for basin construction, appurtenances within the storm sewer system, e.g. grit chambers, water quality treatment manholes, may be added to reduce the load. These appurtenances will not be as effective as a treatment basin and the removal efficiency will decrease. The basins proposed are preliminary with more study needed to finalize the basin design. Table 15-1 includes the basin construction projects as implementation tasks.

5.3.4 Acceptance of Lower Level of Service

From the hydraulic model results, many of the city's storm sewer pipes cannot handle the runoff from a 10-year event. This may not be a serious problem, but more of an inconvenience since this area of the city is fortunate enough to be sloped towards the river. In the areas of steep slopes, much of the excess stormwater runoff that cannot be managed in the existing pipes, can flow downstream in the system of roads, curbs and gutters, and overflow swales. The areas where the overflow system may create problems are: (1) where the natural terrain is too flat, (2) where low areas exist and unwanted ponding occurs (i.e. at intersections and in developed parts of the city), and (3) when roads carrying the excess runoff make sharp turns.



LEGEND

- Major Watershed
- Sub Watersheds

Minor Watersheds

- BEN
- LEV
- MW
- PTR
- PV
- SHAW
- WEST

N / W / E / S

600 0 600 1200 Feet

200 0 200 400 Meters

Figure 5-1

MISSISSIPPI RIVER WEST WATERSHED
City of Anoka
Anoka, Minnesota

Table 5-1: Results of the Mississippi River West Watershed					
10 year and 100 year Critical Storm Events					
Minor Watershed	Subwatershed	Drainage Area (acres)	Impervious Percentage	Peak Runoff Rate (cfs) 10-yr storm	Peak Runoff Rate (cfs) 100-yr storm
LEV	1	5.3	20	8	16
LEV	2	6.5	20	10	20
LEV	3	3.6	20	7	13
LEV	4	4.5	20	7	14
LEV	5	3.2	24	7	14
LEV	6	3.9	20	6	62
LEV	7	4.9	20	8	16
LEV	8	5.6	33	9	16
LEV	9	7.1	22	13	25
LEV	10	3.3	23	6	11
LEV	11	3.0	44	8	15
LEV	12	4.5	5	13	33
LEV	13	3.3	75	12	21
LEV	14	8.2	50	15	27
LEV	15	7.0	20	8	16
LEV	16	3.8	20	8	17
LEV	17	13.2	20	16	33
LEV	18	6.5	20	13	25
LEV	19	8.9	20	11	23
LEV	20	16.4	20	18	37
BEN	1	1.1	20	2	5
MW	1	6.6	52	12	22
MW	2	4.9	31	8	15
PTR	1	12.6	20	16	33
PTR	2	1.2	20	3	6
PTR	3	7.7	20	10	20
PTR	4	6.3	20	13	25
PTR	5	4.6	20	9	18
PTR	6	4.1	20	13	26
PTR	7	3.3	22	6	11
PV	1	3.6	25	12	23
PV	2	7.8	45	29	53
PV	3	7.8	43	30	54
PV	4	3.1	71	11	17
PV	5	3.1	58	7	13
PV	6	12.8	90	65	100
PV	7	5.3	45	10	17
PV	8	5.9	45	18	31

Table 5-1: Results of the Mississippi River West Watershed 10 year and 100 year Critical Storm Events					
Minor Watershed	Subwatershed	Drainage Area (acres)	Impervious Percentage	Peak Runoff Rate (cfs) 10-yr storm	Peak Runoff Rate (cfs) 100-yr storm
PV	9	2.6	45	7	12
PV	10	6.5	45	19	33
PV	11	4.4	45	13	24
SHAW	1	7.3	20	9	19
WEST	1	4.3	20	7	13
WEST	2	3.5	20	7	13
WEST	3	4.0	20	6	13
WEST	4	3.3	20	6	13
WEST	5	15.1	20	20	40
WEST	6	10.0	20	15	29
WEST	7	7.2	15	8	16
WEST	8	2.8	20	6	11

Table 5-2: Results of 100 year Storm Event Basin Requirements for Mississippi River West Watershed

Subwatershed	Drainage Area acres	Dead Storage acre-ft	Live Storage acre-ft	Total Storage acre-ft	100yr Discharge cfs	Oultet Size
Existing Basins with Improvements						
PV3	18.7	1.6	0.8	2.4	20	
PV11	35.0	2.4	6.2	8.6	65	36"
Proposed Ponds						
LEV1	123.7	5.0	0*	5.0		
LEV12	37.5	1.0	15.4	16.4	5	
WEST1	48.3	2.0	0*	2.0		
PTR1	40.1	1.5	0*	1.5		

* Note: These basins have been sized only for water quality purposes.
If constructed, live storage must be determined.

6.0 Anoka Enterprise Watershed

6.1 General Watershed Description

Figure 6-1 shows the Anoka Enterprise Watershed and its subwatersheds. This region is located in the northwest corner of the city. It is routed to the Mississippi River through a significant storm sewer network.

This watershed includes the industrial park of the city and the Anoka-Hennepin Technical College. The 362-acre watershed includes a small area of single family residential with the remainder classified as industrial land use.

6.1.1 Drainage Patterns

The Anoka Enterprise watershed is served by the city's stormwater system. The stormwater system is comprised of storm sewers, ditches, and basins. Anoka Enterprise watershed is made up of one minor watershed that discharges to the Mississippi River near King's Island. The minor watershed is:

Anoka Enterprise (AEP)

There are four existing basins in this watershed which can be used for stormwater detention.

6.1.2 Flood Protection Concerns

Where the storm sewer system capacity is not sufficient, surface overflow will occur via the streets to the lowest point within the subwatershed. Unlike the other Mississippi River watersheds, the Anoka Enterprise Watershed will not overflow to the river, but rather to the existing basins. If the storage and outflow capacities of the basins in this watershed are not sufficient, the basins will overflow, which could impact existing structures adjacent to these ponding basins. Detailed survey information is required to determine the capacity of the existing basins.

6.2 Stormwater System Analysis and Results

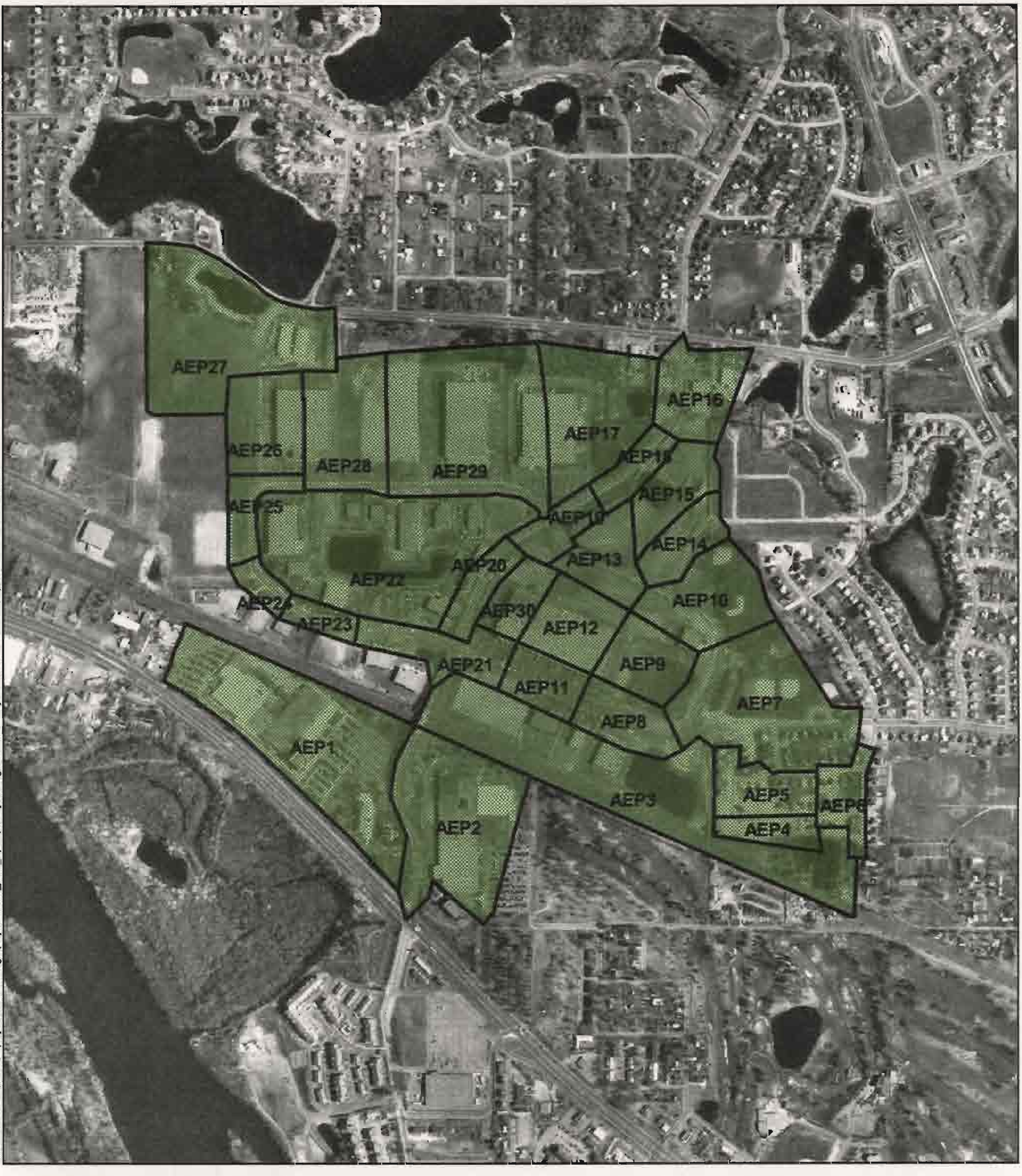
The 10-year and 100-year flood events were analyzed for the Anoka Enterprise Watershed. Table 6-1 presents watershed information and the results of the 10-year and 100-year analyses for each of the subwatersheds shown on Figure 6-1.

6.3 Implementation Considerations

This region of the city provides sufficient storm sewer capacity to meet the 10-year level of service and 100-year level of protection downstream of the basins. Topography of only the basin located in AEP22 was available. Both the basin storage capacity and outlet sizes are adequate. The other basins will be sufficient with the existing outlet if the necessary storage in Table 6-2 is provided.

6.3.1 Construction of Water Quality Basins

The existing basins will provide sufficient water quality treatment if the necessary "dead storage" volume as stated in Table 6-2 is provided. No new basins are required although the outlet to the Mississippi River should have an added appurtenance to reduce the sediment flow into the river from those watersheds downstream of the water quality basins. Table 6-2 lists the necessary "dead storage" required to remove 90 percent of the suspended solids and 60 percent of the total phosphorus load.



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LEGEND

Sub Watersheds
Minor Watersheds
AEP2

N
W E
S

600 0 600 1200 Feet

200 0 200 400 Meters

Figure 6-1

ANOKA ENTERPRISE WATERSHED
City of Anoka
Anoka, Minnesota

Table 6-1: Results of the Anoka Enterprise Watershed
10 year and 100 year Critical Storm Events

Minor Watershed	Subwatershed	Drainage Area (acres)	Impervious Percentage	Peak Runoff Rate (cfs) 10-yr storm	Peak Runoff Rate (cfs) 100-yr storm
AEP	1	2.5	90	5	8
AEP	2	23.8	65	70	115
AEP	3	27.1	48	44	75
AEP	4	3.0	20	5	9
AEP	5	6.3	20	8	17
AEP	6	5.7	20	10	20
AEP	7	25.5	16	25	53
AEP	8	6.5	65	26	29
AEP	9	6.5	65	17	28
AEP	10	11.4	35	24	39
AEP	11	6.7	65	23	18
AEP	12	8.4	65	33	312
AEP	13	7.2	65	25	56
AEP	14	5.1	65	13	22
AEP	15	6.8	65	18	29
AEP	16	6.2	63	15	24
AEP	17	23.3	62	57	94
AEP	18	6.5	65	24	53
AEP	19	4.7	65	17	16
AEP	20	4.0	65	13	21
AEP	21	7.6	65	20	35
AEP	22	28.7	65	79	341
AEP	23	2.8	65	13	21
AEP	24	2.4	65	11	17
AEP	25	5.5	65	16	26
AEP	26	13.6	65	39	64
AEP	27	31.0	57	77	129
AEP	28	15.8	65	63	104
AEP	29	22.9	65	54	89
AEP	30	3.9	65	16	27

Table 6-2: Results of 100 year Storm Event Basin Requirements for Anoka Enterprise Watershed

Subwatershed	Drainage Area acres	Dead Storage acre-ft	Live Storage acre-ft	Total Storage acre-ft	100yr Discharge cfs	Oultet Size
Existing Basins with Improvements						
AEP22	100.2	6.5	17.0	23.5	24	30"&24"
AEP17	23.3	3.0	3.1	6.1	12	
AEP27	31.0	2.4	5.2	7.6	6	24"
AEP3	131.9	7.0	18.2	25.2	32	36"

7.0 Rum River Northeast Watershed

7.1 General Watershed Description

Figure 7-1 shows the Rum River Northeast minor watersheds and subwatersheds. The region is located north of U.S. Highway 169 and 10 and east of the Rum River.

The Rum River Northeast Watershed is the largest with an area of 670 acres, approximately 1 square mile. The general land uses of this watershed include single family residential and multiple family residential. This drainage basin includes the new high school and library facilities.

7.1.1 Drainage Patterns

This entire watershed is serviced by the city's storm sewer. There are a series of basins which provide both quantity and quality control. Ultimately, surface water is conveyed via storm sewer west to the Rum River.

There are two stormwater outlets that discharge directly to the Rum River; however the watershed was divided into five minor watershed because of the complexity and large area of the systems. From north to south, the storm sewer minor watersheds modeled for this project are:

38th Lane (38TH)
Bryant Avenue (BRY)
Sunny Acres Pond (SA)
Grant Street (GRT)
4th Avenue (4AV)

Table 7-1 summarizes these results.

This watershed has four existing basins, two of which were designed as stormwater detention basins.

The Anoka High School and Anoka Metro Regional Treatment Center located immediately east of the Rum River were not analyzed. Both of these facilities drain directly to the Rum River. The high school storm sewer information was not provided, so its adequacy was not determined. However, the outlet to the Rum River will require an added appurtenance for water quality purposes. Because surface overflow of these areas will drain to the river, flooding of the structures is not a concern. If future improvements are made to the existing system at these facilities, water quality treatment must be provided.

7.1.2 Flood Protection Concerns

Excess water that the existing storm sewer system cannot handle flows toward the basins within this watershed. If the storage and outflow capacities of the basins in this watershed are not sufficient, the basins will overflow, which could impact existing structures adjacent to these ponding basins. Detailed survey information is required to determine the capacity of the existing basins.

7.2 Stormwater System Analysis and Results

The 10-year and 100-year events were analyzed for the Rum River Northeast Watershed. Table 7-1 summarizes the results of the 10-year and 100-year analyses for each of the subwatersheds shown on Figure 7-1.

7.3 Implementation Considerations

Existing and future drainage problems within the watershed can be resolved with a combination of increased storm sewer capacity and storage volume within the existing basins. These are discussed in the following paragraphs.

7.3.1 Increased Storm Sewer Capacity Projects

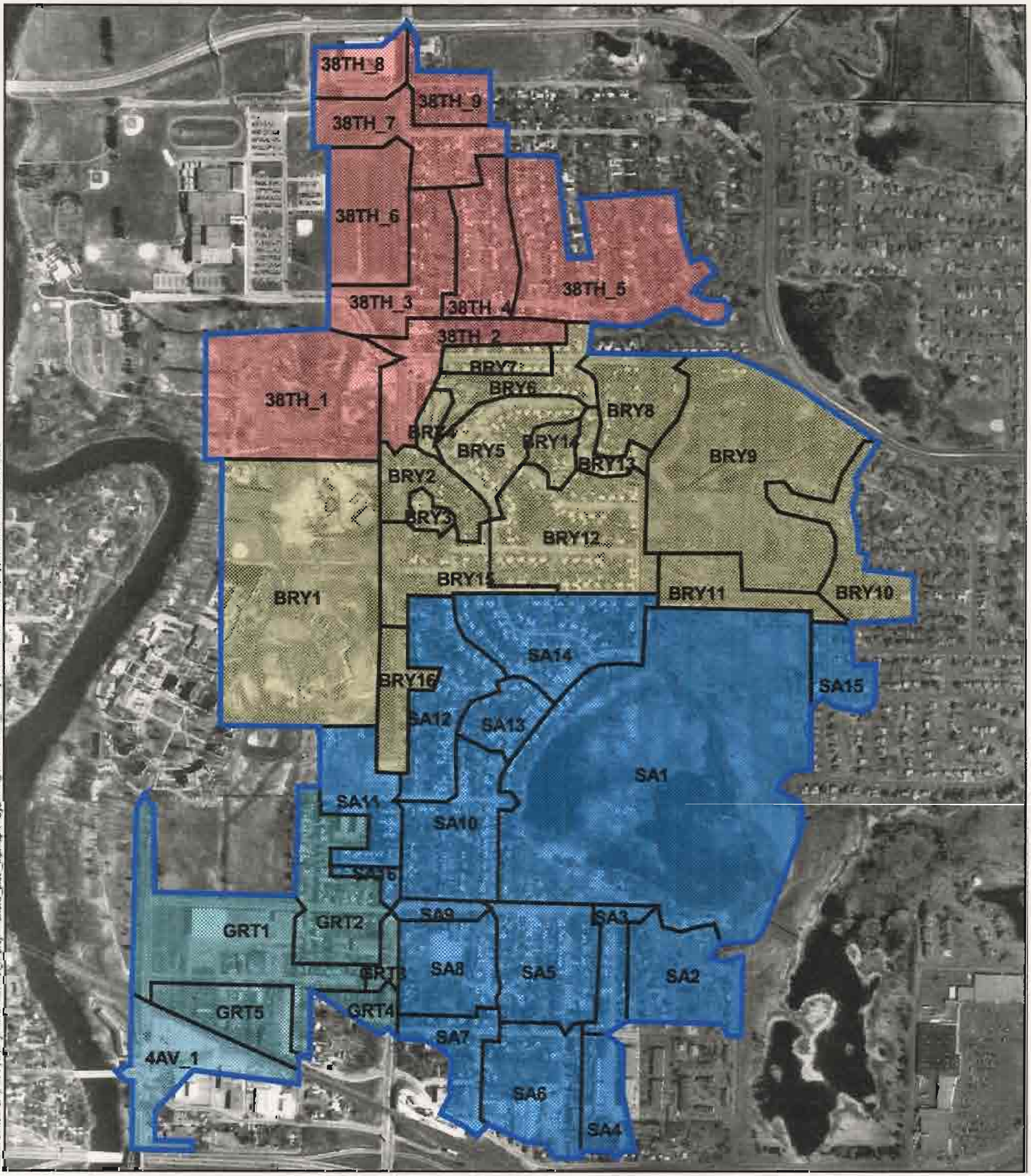
The city needs to increase pipe sizes in parts of this watershed to provide 10-year level of service. Figure A summarizes the proposed and existing systems. Pipes shown in orange are existing pipes which provide the required level of service. The blue lines indicate existing pipes which do not meet the design criteria based on information available. Yellow lines indicate proposed locations of future systems. The preliminary pipe sizes required for the blue and yellow lines are shown in red. Peak runoff discharges along the conveyance system for the 10-year and 100-year frequency storm events are identified by the green and red circles, respectively. Storm sewer upgrade projects for the Rum River Northeast Watershed are listed in Table 15-1.

7.3.2 Construction of Additional Stormwater Basins

New stormwater detention basins are not necessary if the existing basins provide the required amounts of storage. Table 7-2 lists the stormwater storage volumes necessary for 100-year storage.

7.3.3 Construction of Water Quality Basins

Figure B shows one new location where a water quality basin would greatly reduce the amount of suspended solids and phosphorus load to the Rum River. The existing basins will also provide treatment to runoff if the required volume of dead storage is provided. Table 7-2 lists the necessary "dead storage" to remove 90 percent of the suspended solids and 60 percent of the total phosphorus load. Where land is not available for basin construction, appurtenances within the storm sewer system, e.g. grit chambers, water quality treatment manholes, may be added to reduce the load. These appurtenances will not be as effective as a treatment basin and the removal efficiency will decrease.



LEGEND
- Major Watershed
- Sub Watersheds

Minor Watersheds
- 38TH
- 4AV
- BRY
- GRT
- SA

N W E S

600 0 600 1200 Feet

200 0 200 400 Meters

Figure 7-1

RUM RIVER NORTHEAST WATERSHED
City of Anoka
Anoka, Minnesota

Table 7-1: Results of the Rum River Northeast Watershed

10 year and 100 year Critical Storm Events

Minor Watershed	Subwatershed	Drainage Area (acres)	Impervious Percentage	Peak Runoff Rate (cfs) 10-yr storm	Peak Runoff Rate (cfs) 100-yr storm
4AV	1	15.1	61	34	56
38TH	1	27.3	12	52	97
38TH	2	13.2	34	28	49
38TH	3	13.6	21	16	32
38TH	4	10.9	20	14	28
38TH	5	29.6	20	27	56
38TH	6	13.8	20	20	39
38TH	7	13.1	14	13	26
38TH	8	5.5	5	6	14
38TH	9	6.3	20	9	18
BRY	1	50.8	18	58	113
BRY	2	7.8	20	12	23
BRY	3	1.3	20	3	51
BRY	4	1.8	25	4	9
BRY	5	10.8	20	15	31
BRY	6	7.9	20	14	25
BRY	7	3.7	21	7	13
BRY	8	10.4	20	29	50
BRY	9	46.4	14	106	198
BRY	10	9.9	20	12	24
BRY	11	8.1	20	10	20
BRY	12	23.1	20	27	54
BRY	13	3.7	20	6	11
BRY	14	3.5	20	7	13
BRY	15	12.4	20	13	28
BRY	16	5.7	20	14	26
GRT	1	27.5	54	29	53
GRT	2	15.4	35	25	47
GRT	3	3.1	32	7	13
GRT	4	3.3	41	15	24
GRT	5	9.0	63	17	28
SA	1	97.7	11	225	401
SA	2	48.6	20	55	112
SA	3	5.5	20	7	14
SA	4	7.3	45	13	23
SA	5	39.7	20	50	101
SA	6	17.8	37	24	46
SA	7	7.5	36	14	26

Table 7-1: Results of the Rum River Northeast Watershed

10 year and 100 year Critical Storm Events

Minor Watershed	Subwatershed	Drainage Area (acres)	Impervious Percentage	Peak Runoff Rate (cfs) 10-yr storm	Peak Runoff Rate (cfs) 100-yr storm
SA	8	11.3	20	20	40
SA	9	3.1	20	5	11
SA	10	15.0	20	16	32
SA	11	9.2	15	13	27
SA	12	15.6	20	21	42
SA	13	5.3	20	9	18
SA	14	20.2	20	22	46
SA	15	5.2	20	6	12
SA	16	2.0	21	3	7

Table 7-2: Results of 100 year Storm Event Basin Requirements for Rum River Northeast Watershed

Subwatershed	Drainage Area acres	Dead Storage acre-ft	Live Storage acre-ft	Total Storage acre-ft	100yr Discharge cfs	Oultet Size
Existing Basins with Improvements						
SA1	290.1	12.0	43.9	55.9	6	24"
38TH_1	133.2	4.8	33.0	37.8	3	
BRY9	86.3	3.0	23.8	26.8	5	
BRY1	50.8	1.8	31.7	33.5	3	
Proposed Ponds						
GRT1	60.4	4.0	0*	4.0		

* Note: Proposed basins have been sized only for water quality purposes.
If constructed, live storage must be determined.

8.0 Rum River Northwest Watershed

8.1 General Watershed Description

The Rum River Northwest Watershed is 276 acres. Figure 8-1 shows the Rum River Northwest minor watersheds modeled for this plan. The general land uses in this watershed include single family residential, industrial, and open/agricultural.

8.1.1 Drainage Patterns

From the industrial park limits, the runoff from the watershed flows east to the Rum River, which then flows south to the Mississippi River. The majority of the Rum River Northwest Watershed drains through storm sewer systems.

One extensive storm sewer network exists in this watershed, while the remainder is serviced by outlets which flow directly to the Rum River. Modeling was performed for these two minor watersheds:

McKinley Street (MK)
Rum Northwest (RNW)

The McKinley Street network includes two basins within its system.

8.1.2 Flood Protection Concerns

There are no known existing problems in this watershed. The subwatersheds that directly outfall into the river will not have any flooding problems as it appears the overflow will drain to the river. For the remaining watersheds, any excess water that the existing storm sewer system cannot handle flows toward the basins within this watershed. If the storage and outflow capacities are not sufficient, the basins will overflow, which could result in impacts to the existing structures. Detailed survey information is required to determine the capacity of the existing basins.

8.2 Stormwater System Analysis and Results

The 10-year and 100-year events were analyzed for the portions of the Rum River Northwest Watershed that are served by the city's storm sewer system. Table 8-1 summarizes the results of the 10-year and 100-year analyses for each of the subwatersheds shown on Figure 8-1.

8.3 Implementation Considerations

The city's existing storm sewer systems are adequate for this watershed. The necessary storage and outlet sizes were determined to provide adequate detention for the storm sewer network to function and are given in Table 8-2.

8.3.1 Construction of Water Quality Basins

Figure B shows the locations where appurtenances in the storm sewer or water quality basins would reduce the amount of suspended solids and phosphorus load to the Mississippi River. Appurtenances will not be as effective as a treatment basin and the removal efficiency will decrease. Table 8-2 lists the necessary "dead storage" needed to remove 90 percent of the total suspended solids and 60 percent of the total phosphorus load.

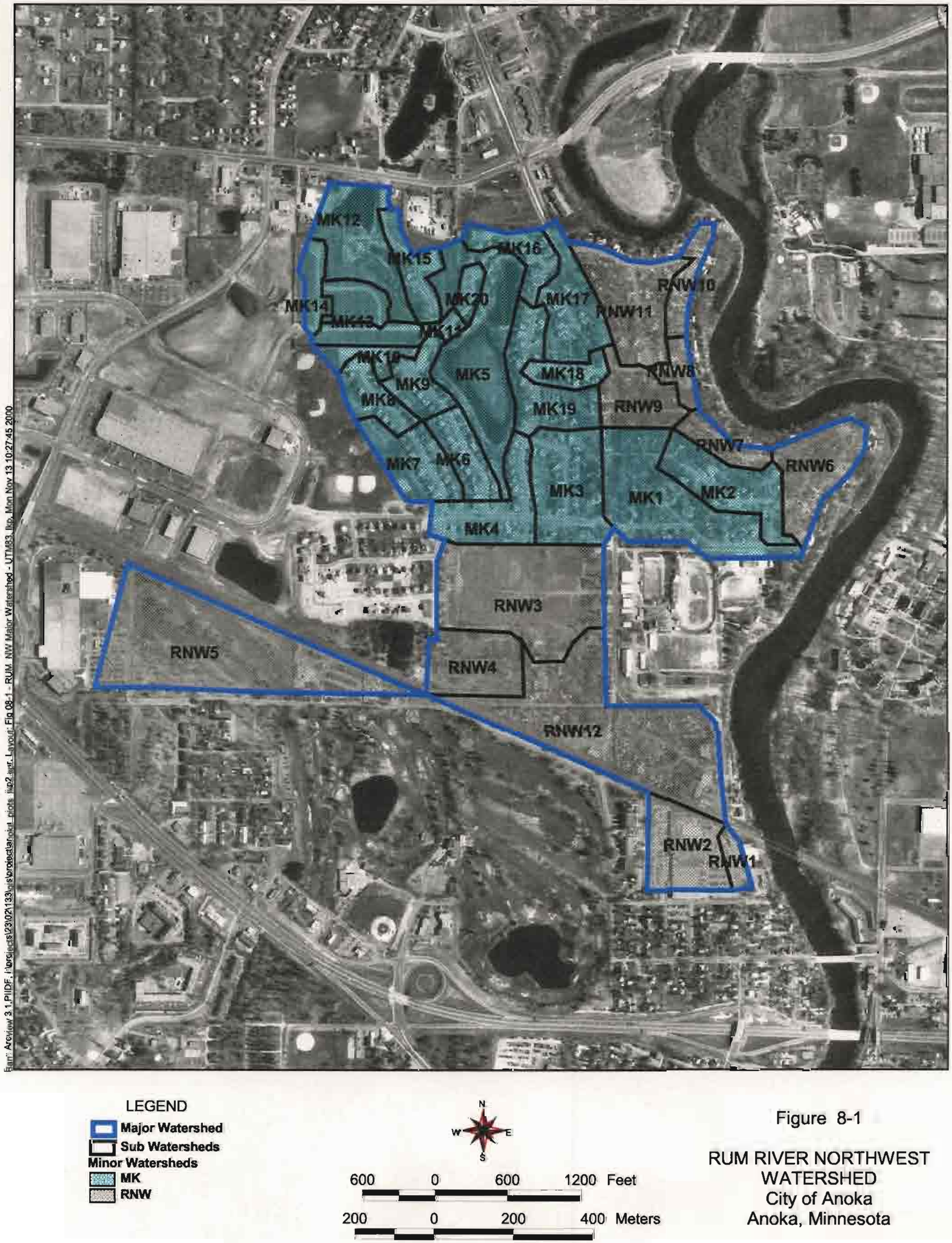


Figure 8-1

RUM RIVER NORTHWEST WATERSHED
City of Anoka
Anoka, Minnesota

Table 8-1: Results of the Rum River Northwest Watershed
10 year and 100 year Critical Storm Events

Minor Watershed	Subwatershed	Drainage Area (acres)	Impervious Percentage	Peak Runoff Rate (cfs) 10-yr storm	Peak Runoff Rate (cfs) 100-yr storm
MK	1	18.2	20	19	39
MK	2	9.9	20	11	22
MK	3	11.1	20	14	28
MK	4	7.4	17	10	20
MK	5	23.5	13	62	112
MK	6	4.9	20	10	20
MK	7	6.9	15	10	21
MK	8	5.3	20	11	21
MK	9	4.5	20	8	15
MK	10	2.7	20	8	17
MK	11	4.2	20	6	11
MK	12	17.4	21	66	114
MK	13	2.6	20	6	11
MK	14	3.8	20	9	17
MK	15	4.5	29	7	14
MK	16	5.6	22	8	16
MK	17	9.9	20	16	31
MK	18	3.6	20	7	14
MK	19	10.3	20	13	27
MK	20	1.8	45	6	11
RNW	1	2.2	65	9	15
RNW	2	9.3	65	23	38
RNW	3	28.2	8	86	209
RNW	4	10.0	52	28	48
RNW	5	33.0	5	37	83
RNW	6	9.7	20	13	26
RNW	7	3.6	20	6	12.5
RNW	8	3.0	20	6	11
RNW	9	7.7	20	14	27
RNW	10	4.5	20	6	13
RNW	11	11.7	20	17	34
RNW	12	34.0	51	70	120

Table 8-2: Results of 100 year Storm Event Basin Requirements for Rum River Northwest Watershed

Subwatershed	Drainage Area acres	Dead Storage acre-ft	Live Storage acre-ft	Total Storage acre-ft	100yr Discharge cfs	Oultet Size
Existing Basins with Improvements						
MK5	88.5	3.0	14.0	17.0	5	30"
MK12	22.7	1.0	3.3	4.3	5	

9.0 Rum River Southeast Watershed

9.1 General Watershed Description

Figure 9-1 shows the Rum River Southeast minor watershed and its subwatersheds. This region is located south of U.S. Highway 169 and 10 and east of the Rum River and it is the oldest part of the city.

This watershed includes Moore Middle School, Washington Elementary School, the city of Anoka offices, and the downtown area. General land uses in this watershed vary from single-family residential to multiple-family residential and commercial.

9.1.1 Drainage Patterns

The Rum River Southeast watershed is served by the city's storm sewer system. The stormwater system is complex because there are two trunk systems that carry the majority of the runoff. Rum River Southeast watershed is made up of 12 minor watersheds. From north to south the subwatersheds are:

Polk Street (POLK)
Tyler Street (TY)
Harrison Street (HAR)
Main Street (MAIN)
Monroe Street (MON)
Jefferson Street (JF)
Moore Middle School (MMS)
Adams Street (ADAMS)
Washington Street (WASH)
6th Avenue (6TH)
10th Avenue (10TH)
Brisbin Street (BRIS)

These are shown in Figure 9-1.

9.1.2 Flood Protection Concerns

Where the storm sewer system capacity is not sufficient, surface overflow will occur via the streets to the lowest point within the subwatershed. The Rum River Southeast Watershed has some areas which will not overflow to the river. The proposed and existing storage and outflow capacities are necessary to prevent basin overflow and the flooding of existing structures. Detailed survey information is required to determine the capacity of the existing basins.

9.2 Stormwater System Analysis and Results

The 10-year and 100-year events were analyzed for the Rum River Southeast Watershed. Table 9-1 presents watershed information and the results of the 10-year and 100-year analyses for each of the subwatersheds shown on Figure 9-1.

9.3 Implementation Considerations

As a part of the surface water management planning process, the problem areas were investigated to determine possible mitigation alternatives. To solve the Rum River Southeast Watershed's existing and future drainage problems while providing 10-year level of service and 100-year level of protection, will require a combination of increased storm sewer capacity and provision of stormwater detention. These are discussed in the following paragraphs.

9.3.1 Increased Storm Sewer Capacity Projects

Pipe carrying capacity needs to be increased in parts of this watershed to provide 10-year level of service for the city's storm sewer system. Figure A summarizes the proposed and existing systems. Pipes shown in orange are existing pipes which provide the required level of service. The blue lines indicate existing pipes which do not meet the design criteria based on information available. Yellow lines indicate proposed locations of future systems. The preliminary pipe sizes required for the blue and yellow lines are shown in red. Peak runoff discharges along the conveyance system for the 10-year and 100-year frequency storm events are identified by the green and red circles, respectively. Modifications are necessary because the all of the watershed does not naturally flow to the Rum River. The limited capacity could result in flooding of homes and businesses. All of the minor watersheds require upgrades, which are listed in Table 15-1.

9.3.2 Construction of Additional Stormwater Basins

The city proposes to provide the necessary storage required for each of the existing basins as listed in Table 9-2 and as shown in Figure B. These basins will reduce the amount of increased storm sewer capacity required and prevent flooding from the 100-year storm.

9.3.3 Construction of Water Quality Basins

Figure B shows the new locations where water quality basins would greatly reduce the amount of suspended solids and phosphorus load to the Rum River. The existing basins will also provide treatment to runoff if the required volume of "dead storage" is provided. Table 9-2 lists the necessary "dead storage" to remove 90 percent of the suspended solids and 60 percent of the total phosphorus load. If land is not available for new basin construction, appurtenances within the storm sewer system, e.g. grit chambers, water quality treatment manholes, may be added to reduce the load. These appurtenances will not be as effective as a treatment basin and the removal efficiency will decrease.

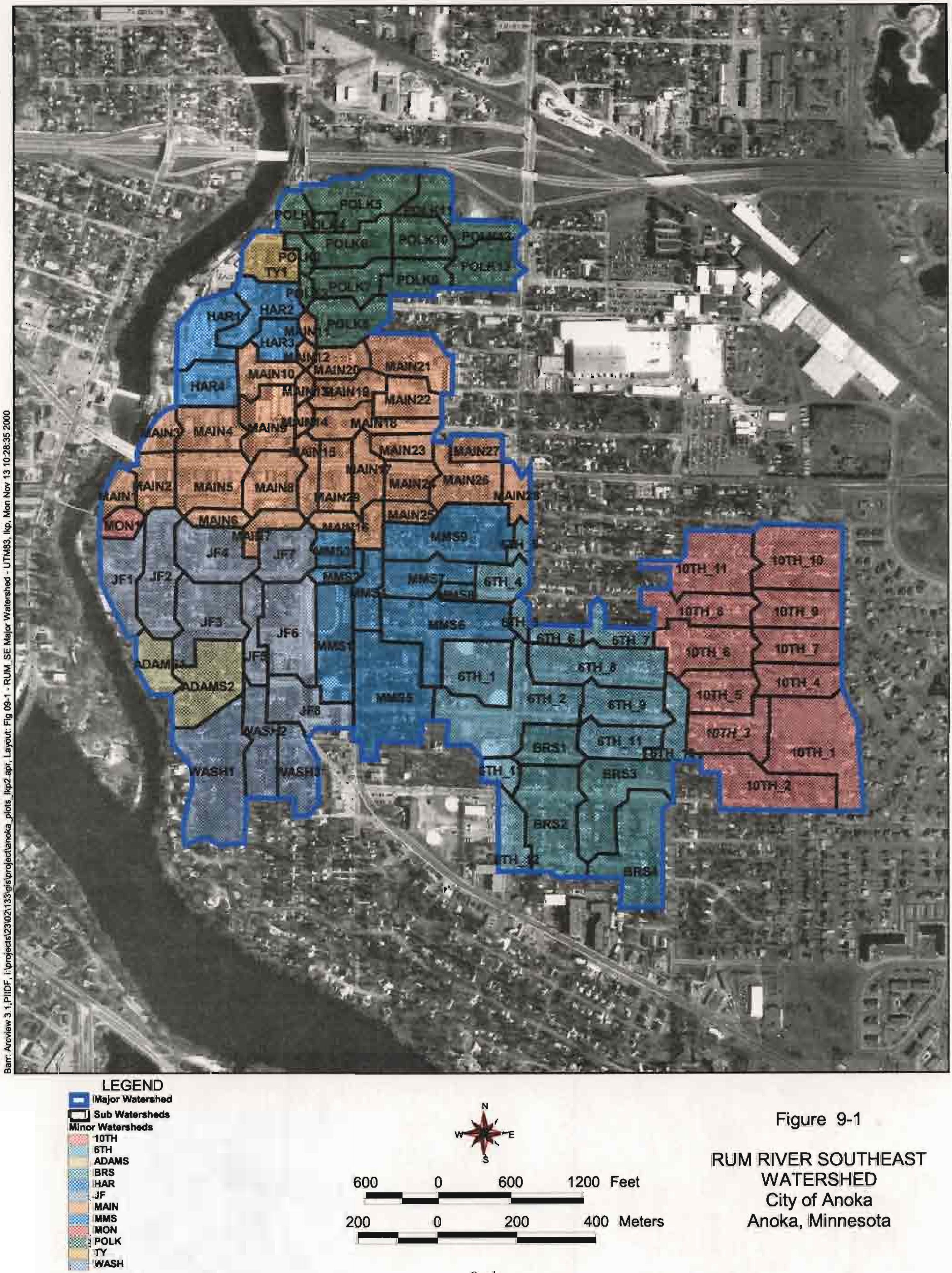


Figure 9-1

RUM RIVER SOUTHEAST WATERSHED
City of Anoka
Anoka, Minnesota

Table 9-1: Results of the Rum River Southeast Watershed 10 year and 100 year Critical Storm Events					
Minor Watershed	Subwatershed	Drainage Area (acres)	Impervious Percentage	Peak Runoff Rate (cfs) 10-yr storm	Peak Runoff Rate (cfs) 100-yr storm
10TH	1	11.6	51	21	45
10TH	2	12.75	20	17	34
10TH	3	4.94	20	8	16
10TH	4	3.51	20	5	10
10TH	5	2.97	20	5	11
10TH	6	6.86	20	8	17
10TH	7	4.78	20	7	14
10TH	8	9.88	20	12	24
10TH	9	5.10	20	8	15
10TH	10	9.57	20	13	26
10TH	11	7.17	20	9	17
ADAMS	1	3.2	20	5	11
ADAMS	2	7.6	20	12	24
6TH	1	6.5	5	8	47
6TH	2	11.5	20	18	35
6TH	3	1.2	25	3	6
6TH	4	3.6	40	9	16
6TH	5	1.7	31	5	9
6TH	6	1.7	20	4	9
6TH	7	2.8	20	6	11
6TH	8	8.4	20	12	35
6TH	9	5.1	20	9	21
6TH	10	4.0	20	8	16
6TH	11	4.3	20	6	13
6TH	12	2.9	48	7	11
6TH	13	1.6	20	4	8
BRS	1	4.0	20	7	15
BRS	2	9.6	24	17	32
BRS	3	7.1	20	13	25
BRS	4	9.6	21	12	24
HAR	1	5.7	90	18	28
HAR	2	5.0	57	15	26
HAR	3	2.2	67	11	17
HAR	4	4.7	90	15	23
JF	1	5.1	39	9	9
JF	2	7.6	54	13	23
JF	3	6.4	37	13	24
JF	4	6.5	46	16	28

Table 9-1: Results of the Rum River Southeast Watershed

10 year and 100 year Critical Storm Events

Minor Watershed	Subwatershed	Drainage Area (acres)	Impervious Percentage	Peak Runoff Rate (cfs) 10-yr storm	Peak Runoff Rate (cfs) 100-yr storm
JF	5	3.6	26	8	15
JF	6	7.7	20	14	27
JF	7	4.5	44	11	20
JF	8	5.9	20	10	21
MAIN	1	1.5	90	8	12
MAIN	2	3.5	90	14	21
MAIN	3	1.8	90	8	12
MAIN	4	4.3	90	16	25
MAIN	5	6.6	90	21	32
MAIN	6	2.1	68	7	11
MAIN	7	3.0	58	9	16
MAIN	8	5.4	90	19	30
MAIN	9	2.9	90	16	25
MAIN	10	4.3	90	18	27
MAIN	11	0.9	30	3	5
MAIN	12	0.9	47	3	6
MAIN	13	1.0	90	6	9
MAIN	14	0.9	90	5	8
MAIN	15	3.4	90	13	20
MAIN	16	3.7	59	13	22
MAIN	17	6.6	87	22	35
MAIN	18	4.7	71	15	24
MAIN	19	3.1	40	8	15
MAIN	20	2.9	22	6	12
MAIN	21	5.0	20	9	18
MAIN	22	4.1	20	9	18
MAIN	23	2.0	90	17	26
MAIN	24	2.7	82	12	19
MAIN	25	1.6	45	6	11
MAIN	26	5.7	76	18	28
MAIN	27	1.6	85	8	13
MAIN	28	2.5	67	10	17
MAIN	29	3.7	90	21	33
MMS	1	6.7	20	19	40
MMS	2	2.0	34	5	10
MMS	3	1.8	55	7	13
MMS	4	3.3	39	8	15
MMS	5	12.2	42	23	41

Table 9-1: Results of the Rum River Southeast Watershed 10 year and 100 year Critical Storm Events for the City of Anoka					
Minor Watershed	Subwatershed	Drainage Area (acres)	Impervious Percentage	Peak Runoff Rate (cfs) 10-yr storm	Peak Runoff Rate (cfs) 100-yr storm
MMS	6	9.6	35	19	36
MMS	7	4.0	45	9	16
MMS	8	1.2	45	4	8
MMS	9	9.5	45	21	37
MON	1	1.8	68	8	13
POLK	1	2.3	46	12	22
POLK	2	1.5	38	5	8
POLK	3	1.0	31	3	6
POLK	4	1.0	20	3	6
POLK	5	7.3	23	15	29
POLK	6	4.4	20	8	15
POLK	7	4.0	20	9	18
POLK	8	4.9	20	8	16
POLK	9	4.0	20	7	14
POLK	10	3.8	20	7	14
POLK	11	4.3	20	8	15
POLK	12	2.7	24	7	14
POLK	13	4.5	25	11	23
TY	1	3.6	47	8	14
WASH	1	11.5	20	14	29
WASH	2	6.3	20	12	23
WASH	3	4.8	20	8	16

Table 9-2: Results of 100 year Storm Event Basin Requirements for Rum River Southeast Watershed

Subwatershed	Drainage Area acres	Dead Storage acre-ft	Live Storage acre-ft	Total Storage acre-ft	100yr Discharge cfs	Oultet Size
Existing Basins with Improvements						
6TH_1	73.7	2.0	8.4	10.4	30	36"
BRS2	33.0	1.2	4.0	5.2	3	15"
10TH_1	141.4	4.0	10.5	14.5	5	42"
Proposed Ponds						
HAR1	17.4	2.0	0*	2.0		
POLK1	45.8	1.8	0*	1.8		
MAIN1	86.9	8.3	0*	8.3		
JF1 (small)	5.1	0.3	0*	0.3		
JF1 (big)	101.1	4.88	0*	4.88		
TY1	3.5	0.22	0*	0.22		

* Note: Proposed basins have been sized only for water quality purposes.
If constructed, live storage must be determined.

10.0 Rum River Southwest Watershed

10.1 General Watershed Description

Figure 10-1 shows the Rum River Southwest Watershed and its subwatersheds. This region is located south of U.S. Highway 169 and 10 and west of the Rum River.

This watershed includes only a very small area and consists of single-family residential land use.

10.1.1 Drainage Patterns

The Rum River Southwest Watershed flows east directly into the Rum River either via storm sewer or overland flow.

10.1.2 Flood Protection Concerns

The low point on Franklin Avenue where it intersects with the alley does not have any means of discharge according to the information provided. This could be an area of flooding and a pipe is necessary to direct flows away from the homes surrounding the low point. This is discussed in the following sections. The remainder of the watershed overflows to the river.

10.2 Stormwater System Analysis and Results

The 10-year and 100-year storm events were analyzed for the portions of the Rum River Southwest Watershed that are served by the city's storm sewer system. Table 10-1 presents watershed information and the results of the 10-year and 100-year analyses for each of the subwatersheds shown on Figure 10-1. There are no existing basins in this watershed.

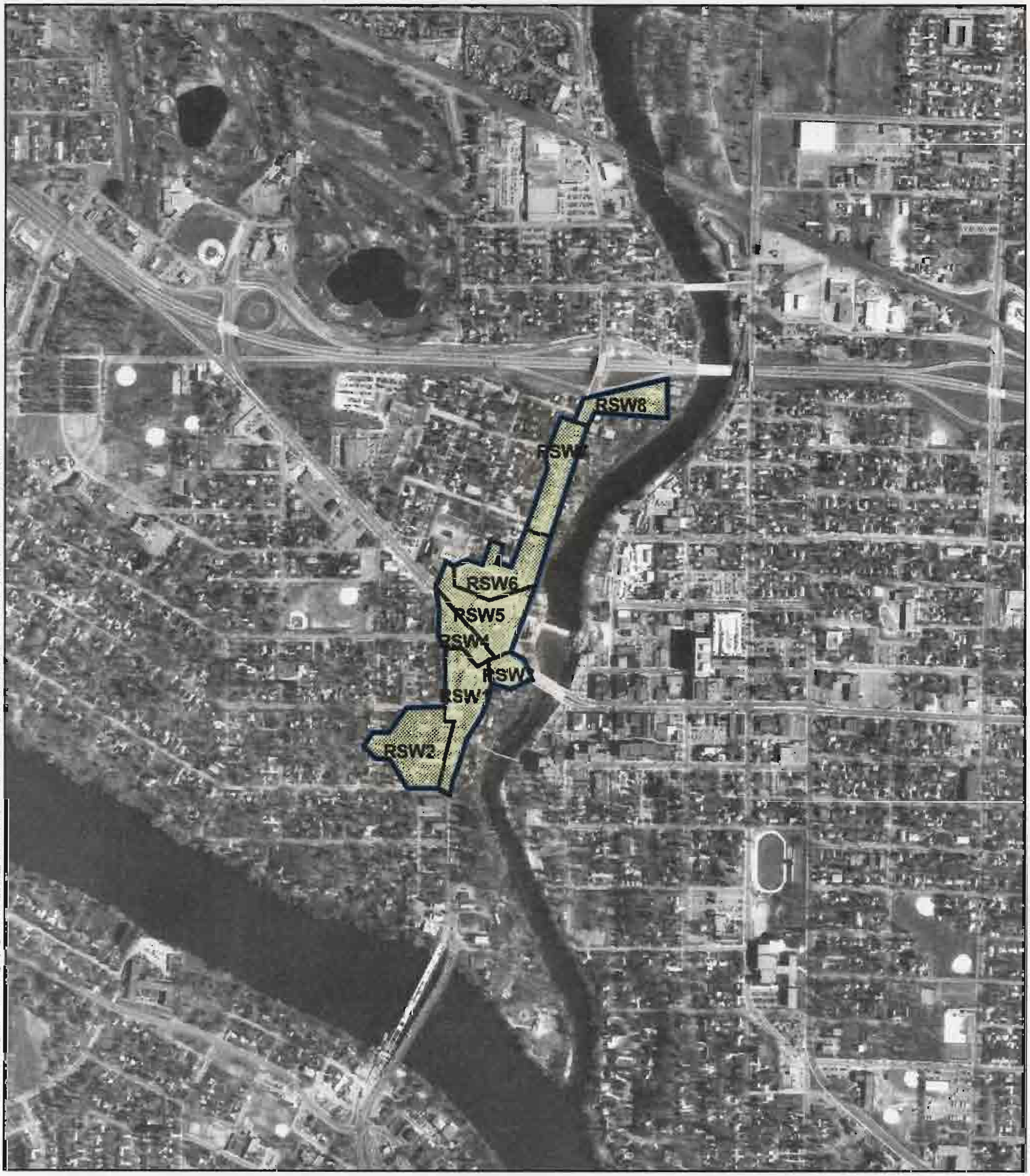
10.3 Implementation Considerations

10.3.1 Increased Storm Sewer Capacity Projects

The carrying capacity of the existing storm sewer system needs to be increased in parts of this watershed to provide 10-year level of service for the city's storm sewer system. Figure A summarizes the proposed and existing systems. Pipes shown in orange are existing pipes which provide the required level of service. The blue lines indicate existing pipes which do not meet the design criteria based on information available. Yellow lines indicate proposed locations of future systems. The preliminary pipe sizes required for the blue and yellow lines are shown in red. Peak runoff discharges along the conveyance system for the 10-year and 100-year frequency storm events are identified by the green and red circles, respectively. The aforementioned intersection on Franklin Avenue requires a capacity for the 100-year flow rather than the 10-year, to protect the existing structure in the area. The Benton Street and Webster Street storm sewer upgrade projects listed in Table 15-1 are located within the Rum River Southwest Watershed.

10.3.2 Construction of Water Quality Basins

Figure B shows the locations where appurtenances within the storm sewer, e.g. grit chambers, water quality treatment manholes, would reduce the amount of suspended solids and phosphorus load to the Mississippi River. These appurtenances will not be as effective as a treatment basin and the removal efficiency will decrease; however, the runoff volumes in this watershed are small, and land is not available for basin construction.



Barr: Arcview 3.1,PIIDF, I:\projects\23\02\133\gis\project\anoka_plots_lkp2.apr, Layout: Fig 10-1 - RUM_SW Major Watershed - UTM83, lkp, Mon Nov 13 10:29:44 2000

LEGEND

Sub Watersheds
Major Watershed
Minor Watersheds
RSW

N W E S

600 0 600 1200 Feet

200 0 200 400 Meters

Figure 10-1

RUM RIVER SOUTHWEST WATERSHED
City of Anoka
Anoka, Minnesota

Table 10-1: Results of the Rum River Southwest Watershed
10 year and 100 year Critical Storm Events

Minor Watershed	Subwatershed	Drainage Area (acres)	Impervious Percentage	Peak Runoff Rate (cfs) 10-yr storm	Peak Runoff Rate (cfs) 100-yr storm
RSW	1	5.4	57	10	17
RSW	2	5.8	36	14	25
RSW	3	1.2	65	6	11
RSW	4	1.0	20	2	4
RSW	5	5.2	90	14	22
RSW	6	3.7	55	11	20
RSW	7	3.4	45	9	15
RSW	8	3.0	45	7	13

11.0 U.S. Highway 169 and 10 Watershed

11.1 General Watershed Description

Figure 11-1 shows the U.S. Highway 169 and 10 minor watersheds and its subwatersheds. This region includes the areas tributary to the storm sewer network maintained by the state for Highway 169 and 10 which extends through the entire city from east to west.

This watershed includes the golf course and cemeteries. General land uses in this watershed are varied, with a combination of commercial, open/agricultural, single family residential, and multiple family residential.

11.1.1 Drainage Patterns

The U.S. Highway 169 and 10 watershed was analyzed only for the portions of storm sewer maintained by the city of Anoka. The state's system for the highway was not evaluated and assumed adequate. Flows at the discharge locations into the highway system are given, and the networks upstream of the discharge points were analyzed. U.S. Highway 169 and 10 watershed is made up of nine minor watersheds that are serviced by city storm sewer systems that discharge into the highway system. From east to west the minor watersheds are:

Fairoak Avenue, south of Hwy 169 (FOS)
Fairoak Avenue, north of Hwy 169 (FON)
Church Street (CH)
Golf Course (GC)
State Avenue (STA)
Branch Avenue (BRC)
Highway 169 (US169)
7th Avenue (7TH)
8th Avenue (8TH)

11.1.2 Flood Protection Concerns

This watershed also has low points that may lead to flooding during the 100-year storm event. The subwatersheds where this is a concern are FON3 (intersection of Verndale and Jerome Street) and STA7 (alley section south of Clay and east of Branch Avenue). These areas do not have an overland flow route for runoff exceeding the 10-year storm event. Pipes with 100-year capacity are necessary to direct flows away from the homes surrounding the low points. This is discussed in the following sections.

11.2 Stormwater System Analysis and Results

The 10-year and 100-year storm events were analyzed for the portions of the U.S. Highway 169 and 10 Watershed that are served by the city's storm sewer system. Table 11-1 presents watershed information and the results of the 10-year and 100-year flood analyses for each of the subwatersheds shown on Figure 11-1.

11.3 Implementation Considerations

This region of the city requires several upgrades to the existing system.

11.3.1 Increased Storm Sewer Capacity Projects

Pipe capacity needs to be increased in parts of this watershed to provide 10-year level of service for the city's storm sewer system. Figure A summarizes the proposed and existing systems. Pipes shown in orange are existing pipes which provide the required level of service. The blue lines indicate existing pipes which do not meet the design criteria based on information available. Yellow lines indicate proposed locations of future systems. The preliminary pipe sizes required for the blue and yellow lines are shown in red. Peak runoff discharges along the conveyance system for the 10-year and 100-year frequency storm events are identified by the green and red circles, respectively. The low points require pipes able to carry the 100-year flow rather than the 10-year, as there is no other relief for this area. The Fairoak Avenue, Church Street, Branch Avenue, and State Avenue storm sewer upgrade projects listed in Table 15-1 are all located within the U.S. Highway 169 and 10 Watershed.

11.3.2 Construction of Additional Stormwater Basins

The existing basins in this watershed will be sufficient if the necessary storage and outlet sizes are provided as given in Table 11-2. Further investigation of these basins is necessary to determine their actual storage capacity.

11.3.3 Construction of Water Quality Basins

The existing basins will provide treatment to runoff if the required volume of dead storage is provided. Table 11-2 lists the necessary "dead storage" needed to remove 90 percent of the suspended solids and 60 percent of the total phosphorus load before entering the highway storm sewer network. New basin locations are shown on Figure B where the runoff receives no treatment prior to entering the highway system. If land is not available for basin construction, appurtenances within the storm sewer system, e.g. grit chambers, water quality treatment manholes, may be added to reduce the load; however, the appurtenances provide a lower removal efficiency.

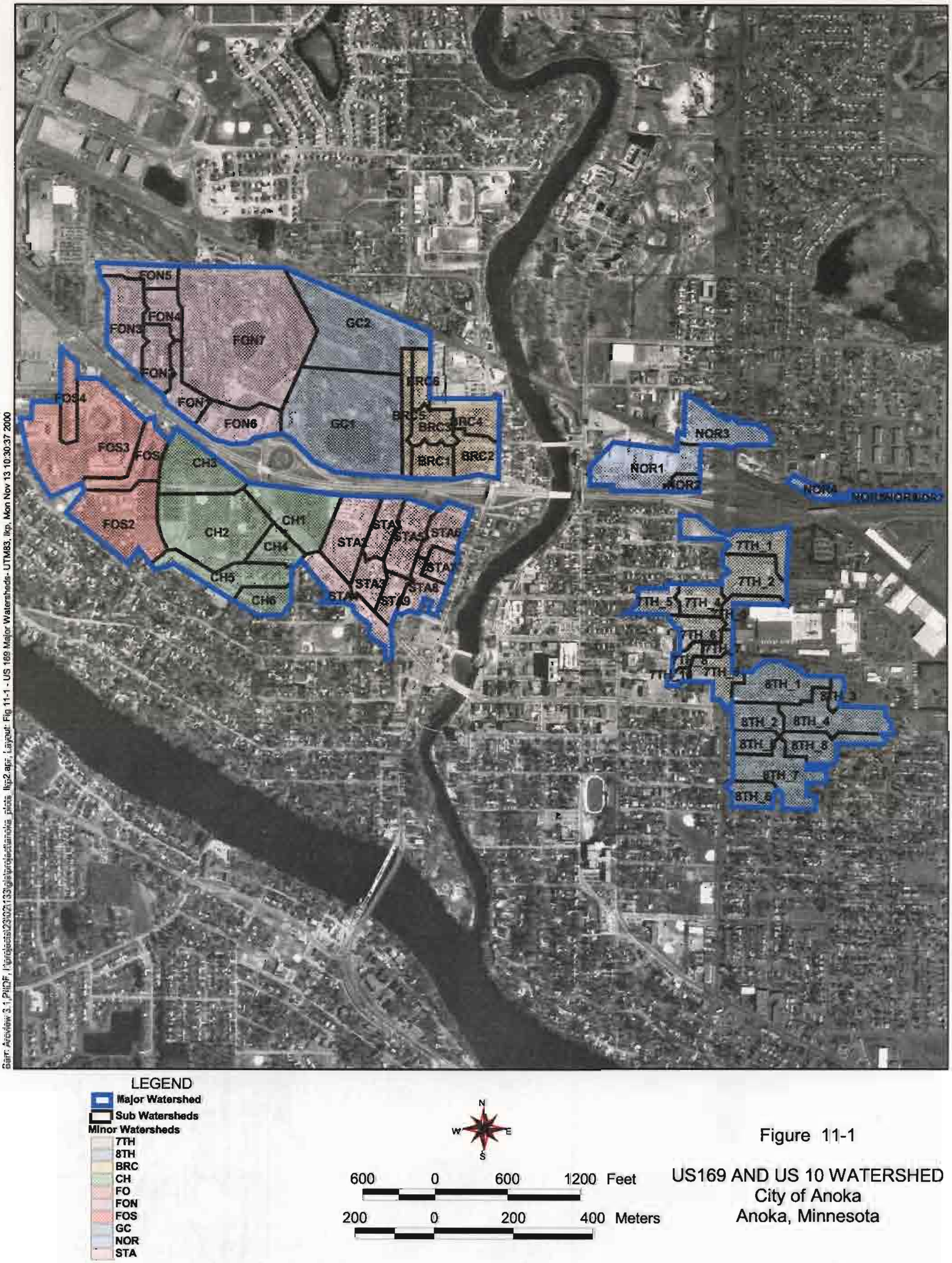


Figure 11-1

US169 AND US 10 WATERSHED
City of Anoka
Anoka, Minnesota

Table 11-1: Results of the U.S. Highway 169 and 10 Watershed

10 year and 100 year Critical Storm Events

Minor Watershed	Subwatershed	Drainage Area (acres)	Impervious Percentage	Peak Runoff Rate (cfs) 10-yr storm	Peak Runoff Rate (cfs) 100-yr storm
7TH	1	8.6	34	12	23
7TH	2	8.2	32	15	27
7TH	3	3.3	34	8	16
7TH	4	5.3	45	18	28
7TH	5	4.1	24	8	16
7TH	6	4.6	27	10	19
7TH	7	2.0	20	5	11
7TH	8	2.0	20	5	10
7TH	9	6.3	52	17	29
7TH	10	1.0	61	5	8
8TH	1	9.8	34	15	29
8TH	2	4.8	40	10	18
8TH	3	1.5	57	5	9
8TH	4	12.2	41	18	34
8TH	5	3.2	20	6	11
8TH	6	4.5	20	9	17
8TH	7	9.3	20	14	27
8TH	8	2.0	20	4	9
BRC	1	4.3	20	5	85
BRC	2	6.8	41	17	30
BRC	3	5.1	20	9	42
BRC	4	6.9	65	26	43
BRC	5	5.2	18	5	11
BRC	6	4.2	45	9	16
CH	1	19.8	75	45	73
CH	2	19.4	7	24	53
CH	3	12.1	5	13	30
CH	4	5.9	61	14	24
CH	5	10.4	21	11	23
CH	6	4.5	20	8	16
FON	1	5.9	50	15	26
FON	2	6.6	51	14	24
FON	3	10.5	45	24	42
FON	4	5.5	23	9	18
FON	5	5.9	18	9	20
FON	6	10.8	33	40	79
FON	7	59.5	5	88	185

Table 11-1: Results of the U.S. Highway 169 and 10 Watershed

10 year and 100 year Critical Storm Events

Minor Watershed	Subwatershed	Drainage Area (acres)	Impervious Percentage	Peak Runoff Rate (cfs) 10-yr storm	Peak Runoff Rate (cfs) 100-yr storm
FOS	1	4.7	39	11	20
FOS	2	16.4	13	24	51
FOS	3	27.9	53	56	95
FOS	4	3.5	20	5	9
GC	1	36.7	4	60	121
GC	2	25.7	5	76	188
STA	1	4.9	45	15	26
STA	2	10.3	86	30	47
STA	3	5.0	52	12	20
STA	4	9.2	75	22	35
STA	5	5.6	45	12	20
STA	6	6.1	45	13	23
STA	7	3.0	45	11	19
STA	8	5.1	45	15	25
STA	9	5.6	45	13	23
NOR	1	13.8	61	28	47
NOR	2	2.0	45	6	11
NOR	3	8.3	58	20	33
NOR	4	2.5	65	6	10
NOR	5	1.4	45	5	8
NOR	6	0.8	45	3	5
NOR	7	1.2	45	4	7

Table 11-2: Results of 100 year Storm Event Basin Requirements for U.S. Highway 169 and 10 Watershed

Subwatershed	Drainage Area acres	Dead Storage acre-ft	Live Storage acre-ft	Total Storage acre-ft	100yr Discharge cfs	Oultet Size
Existing Basins with Improvements						
GC1	148.7	6.0	24.0	30.0	20	44"
FOS3	30.1	3.1	4.4	7.5	14	30"
FON7	92.5	1.6	6.3	7.9	5	
Proposed Ponds						
7TH_1	99.7	4.6	0*	4.6		
8TH_1	54.2	1.2	8.0	9.2	5	
STA2	54.7	4.0	0*	4.0		
BRC1	34.9	2.0	0*	2.0		
CH2	46.5	0.6	5.4	6.0	3	

* Note: These basins have been sized only for water quality purposes.
If constructed, live storage must be determined.

12.0 Coon Rapids Tributary Watershed

12.1 General Watershed Description

Figure 12-1 shows the Coon Rapids Tributary minor watersheds and subwatersheds. This watershed is comprised of the sections of Anoka which drain into the storm sewer network of the city of Coon Rapids.

General land use in this watershed is single-family residential.

12.1.1 Drainage Patterns

There are portions of Anoka which ultimately flow into Coon Rapids, but have storm sewer in the city of Anoka extending to the city border. These regions continue into the neighboring city and enter its network. These regions were evaluated only for the sections within Anoka city limits. Downstream of the city limits, the adequacy of the system is unknown. From north to south the subwatersheds are:

41st Street (41ST)
Bunker Lake Road (BL)
Coon Rapids (CR)

12.1.2 Flood Protection Concerns

This watershed consists of areas that either flow into a bordering basin or into the Coon Rapids storm sewer system. Capacity of the basin located within Coon Rapids must be evaluated for adequacy to determine if flooding is a valid concern for the structures within the area.

12.2 Stormwater System Analysis and Results

The 10-year and 100-year flood events were analyzed for the portions of the Coon Rapids Tributary Watershed that are served by the city's storm sewer system. Table 12-1 presents watershed information and the results of the 10-year and 100-year flood analyses for each of the subwatersheds shown on Figure 12-1.

12.3 Implementation Considerations

This region of the city provides sufficient storm sewer capacity to meet the 10-year level of service upstream of the Coon Rapids system.

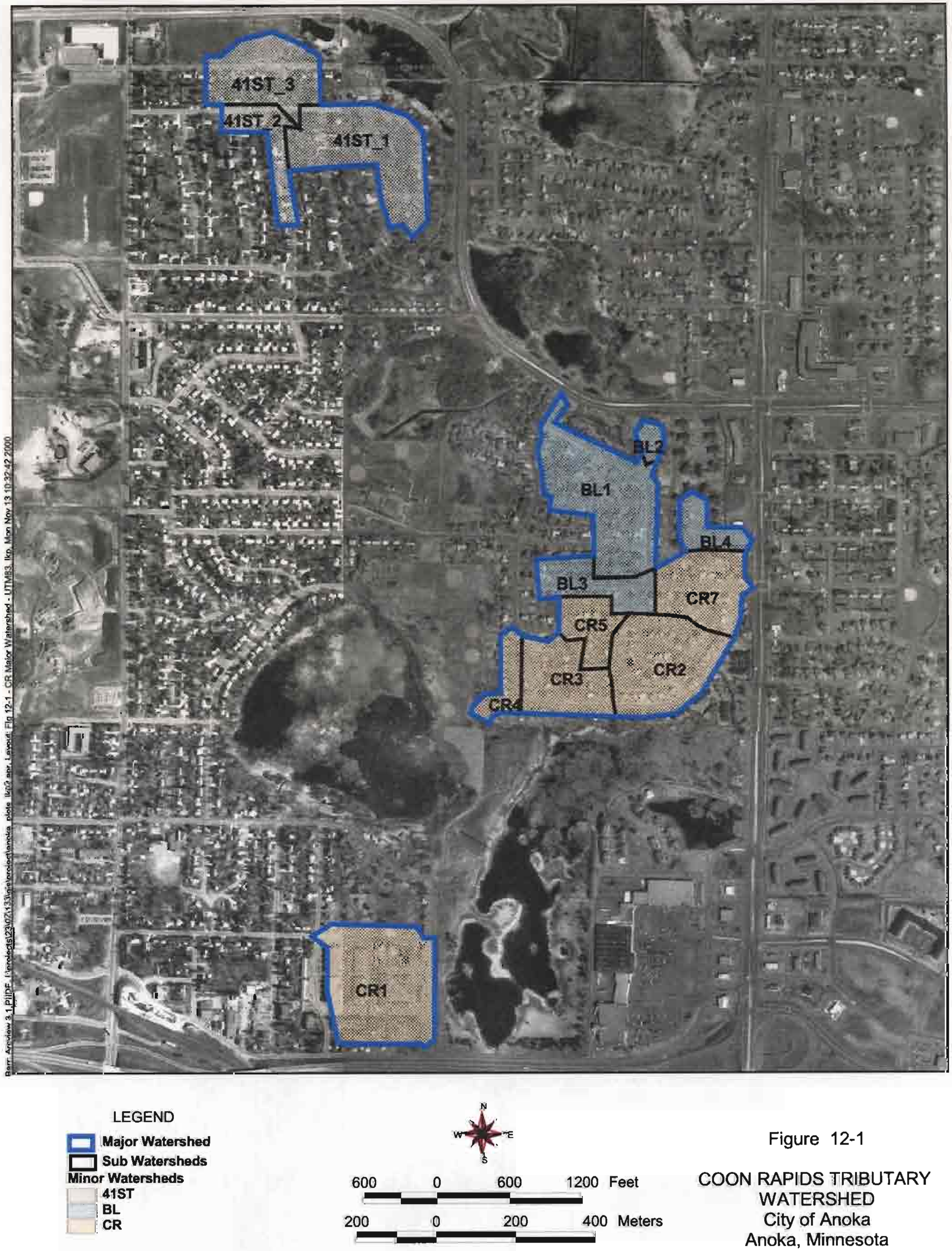


Figure 12-1

COON RAPIDS TRIBUTARY WATERSHED
City of Anoka
Anoka, Minnesota

Table 12-1: Results of the Coon Rapids Tributary Watershed
10 year and 100 year Critical Storm Events

Minor Watershed	Subwatershed	Drainage Area (acres)	Impervious Percentage	Peak Runoff Rate (cfs) 10-yr storm	Peak Runoff Rate (cfs) 100-yr storm
BL	1	18.6	20	22	45
BL	2	1.2	20	3	7
BL	3	7.1	20	9	18
BL	4	3.6	37	11	21
CR	1	20.4	40	25	46
CR	2	14.8	24	21	41
CR	3	9.7	20	19	38
CR	4	5.2	20	11	23
CR	5	5.9	20	12	25
CR	6	9.6	25	18	34
41ST	1	18.2	20	18	37
41ST	2	6.6	20	9	18
41ST	3	18.0	20	25	51

13.0 Technical Methods and Assumptions

13.1 Mapping and Data

The geographic information system (GIS) software ArcView (version 3.1) was used to organize, store and present information. Applications included organizing the modeling data and storing maps (aerial photos) used in figures. Metropolitan Council aerial photographs reflect the area's conditions in 1997. The city provided the land use, road, wetland, and storm sewer data.

13.2 Watershed Modeling

13.2.1 Hydrologic Modeling

13.2.1.1 Hydrologic Model

The Barr Watershed Model was chosen as the hydrologic computer model for this study. This model is a practical urban runoff model, and it is based on methods used for the Barr Hydrograph Method developed in the late-1950s. The model works with each part of the rainfall-runoff process to estimate stormwater discharges and volumes. It requires the input of rainfall and watershed information.

13.2.1.2 Rainfall Information

Both the 10-year and 100-year frequency storms were evaluated for ten different durations to determine the critical storm event for each frequency. For both frequencies, the 1-hour and 1/2-hour storms were the most critical. The following data used for the study area were taken from NOAA Technical Memorandum NWS Hydro-35, and National Weather Service Technical Paper 40 (TP 40).

Storm Frequency	1/2-Hour Duration	1-Hour Duration
10-year Rainfall	1.65"	2.1"
100-year Rainfall	2.4"	3.1"

The hyetographs for short duration storms were developed from data in a paper entitled, "Relation of Hourly Mean Rainfall to Actual Intensities", published in Civil Engineering in May, 1940. The hyetograph is shaped similar to the storm pattern shown by C.J. Keifer and H.H. Chu in a paper entitled, "Synthetic Storm Pattern for Drainage Design", published in the Proceedings of the American Society of Civil Engineers, August, 1957. The hyetograph is also very similar to the second quartel hyetograph discussed in a paper by F.A. Huff entitled, "Time Distribution of Rainfall in Heavy Storms", published in Water Resources Research, Fourth Quarter, 1967.

13.2.1.3 Watershed Runoff Characteristics

The amount of runoff from a watershed depends on numerous factors, including the total watershed area, pervious and impervious area in the watershed, the flow length through the watershed, the average velocity of flow, the slope of the land within the watershed, and losses through depression storage, infiltration, and interception. These parameters are described below.

Watershed Total Area: Barr performed the initial watershed delineation using USGS quadrangle topographic maps (7.5-minute series). After this initial delineation, divides were field verified and modified as needed to accurately model the watersheds. A total of 306 separate watersheds were delineated and modeled for the study. The watersheds in the downtown and developed areas are smaller to allow for more detailed evaluation.

Pervious and Impervious Areas: The 100-year and 10-year hydrologic/hydraulic analyses assumed ultimate development conditions in the watershed to better estimate long-term post-development drainage system needs. Projected future land use was estimated from the city of Anoka's land use maps. Five land use types were identified for the analyses: (1) agricultural/open space, (2) single-family residential, (3) multiple-family residential, (4) commercial, and (5) industrial. Land uses were translated into percent impervious areas according to the values in Table 13-1.

Flow Length: This parameter represents the longest path rainfall must follow before reaching the collection point of each subwatershed.

Average Flow Velocity: This is the rate at which rainfall passes through the subwatershed. For overland flow this was taken to be 0.9 feet/second.

Terrain Slope: The general slope of the land in the city of Anoka was modeled as a rolling terrain for pervious areas, which uses a slope-length factor of 0.003.

Depression Storage: The amount of depression storage represents the rainfall that never reaches a primary stormwater collection system, but gets intercepted by depressions along the way. Without accurate field measurements, the amount of depression storage is difficult to determine. For the purposes of this modeling effort, 0.10 inch was used for impervious surfaces, and 0.2 inch for pervious surfaces.

Infiltration: Vegetative cover in urbanizing areas generally includes grassy open areas, residential lots, commercial-industrial areas, and wooded areas. As the land becomes urbanized, wooded areas tend to decrease and the largest soil cover becomes grassed areas with trees. The predominant soil type for the watersheds in this study, according to Anoka County Soils Survey, were Type B. Consequently, the initial and final rates of infiltration used in the model were 2.5 in/hr and 1.0 in/hr, respectively.

Interception: This is defined as the amount of rainfall captured by leaves, blades of grass, and other objects and returned to the atmosphere by evaporation. It is dependent on the type of vegetative cover; however, the significance of interception is generally considered to be minimal in urban storm drainage design. The values used for impervious and pervious interception are 0.05 and 0.15 inches, respectively.

Table 13-1 Percent Impervious Areas for Land Uses in the Study Area

Type of Land Use	Assumed Percent Impervious Area
Agricultural/ Open Space	5
Single Family	20
Multiple Family	45
Commercial	75-90
Industrial	65

13.3.1 Water Quality Modeling

13.3.1.1 Water Quality Model

The computer model P8 (Program for Predicting Polluting Particle Passage through Pits, Puddles and Ponds, IEP, Inc., 1990) was used to estimate both the water, suspended solids, and phosphorus loads introduced from the tributary area of each basin or outlet into the rivers. P8 is a useful diagnostic tool for evaluating and designing watershed improvements and best management practices (BMPs).

13.3.1.2 Rainfall and Temperature Information

The model requires hourly precipitation and temperature data; long-term data can be used so that watersheds and BMPs can be evaluated for varying hydrologic conditions. Hourly precipitation data was obtained from the Minneapolis-St. Paul International Airport for October 1994 through September 1995 (1995 water year, which represents average yearly precipitation). Average daily temperature data was obtained from the NWS site at the Minneapolis-St. Paul International Airport.

13.3.1.3 Basin Information

Stage-Area-Discharge information is required for each basin in the model. The city was only able to provide information on one of the basins so assumptions were made for the other existing basins. The surface area of each basin was determined from the aerial photo, and four feet of dead storage was assumed. Live storage was taken as recommended from the hydraulic analysis of the storm sewer system capacity. All the basins were modeled with the recommended outlet sizes from the hydraulic analysis.

13.3.1.4 Watershed Parameters

Several factors, including the total watershed area, the pervious Curve Number, land use, and direct and indirect impervious fractions are needed for each watershed. This data is used to determine two important numbers used in the model: direct impervious fraction, and the weighted Curve Number. The amount of runoff generated from a watershed is determined in the model using all of these parameters. A description of each follows.

Tributary Watershed Data: The area of the watershed tributary to each basin determined by the addition of all the subwatersheds draining to the specified basin or outlet to the river.

Pervious Curve Number: The Anoka County Soils Survey was consulted to determine the soil types within each tributary watershed and a pervious curve number was selected for each watershed. The majority of Anoka has soil Type B, so a Curve Number for the pervious section of 61 was used.

Land use: This data is the same as that used for the hydrologic modeling, and was provided by the city of Anoka.

Direct and Indirect Impervious Percentages: The direct or connected impervious percentage includes driveways and parking areas that are directly connected to the storm sewer system. The indirect impervious percentage is that area which is not directly connected to any storm sewer system and must first travel over a pervious surface. Table 13-2 shows the Barr standard numbers used for these values.

Overall Watershed Direct Impervious Fraction: This value represents the total fraction of impervious area that is directly connected to the storm sewer system for the entire watershed.

Weighted Pervious Curve Number: This weighted SCS Curve Number is based on the pervious and impervious areas and curve numbers.

Table 13-2 Direct, Indirect and Total Impervious Fractions Based on Land Use

Type of Land Use	Direct Impervious	Indirect Impervious	Total Impervious
Agricultural/ Open Space	3%	2%	5%
Single-Family	15%	5%	20%
Multiple-Family	35%	10%	45%
Commercial	80%	5%	85%
Industrial	60%	5%	65%

Recommended storm sewer improvements are shown on Figure A.

14.0 System Maintenance

14.1 Maintenance of Stormwater Facilities

The city of Anoka stormwater system includes not only pipes and constructed basins, but also lakes, wetlands, ditches, swales, and other drainageways. In addition to more typical maintenance measures, maintenance of the stormwater system may also mean maintaining or restoring the ecological characteristics of the natural portions of the stormwater system. The city of Anoka recognizes that maintenance of the 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.

14.1.1 Private Stormwater Facilities

Owners of private storm water facilities are responsible for maintaining the facilities in proper condition, consistent with the original performance design standards. Responsibilities include removal and proper disposal of all settled materials from basins, sumps, grit chambers, and other devices, including settled solids at a maximum of every 5 years. One (1)- to 5-year waivers from this requirement may be granted by the city engineer when the owner presents evidence that the facility has additional capacity to remove settled solids in accordance with the original design capacity. Owners of private stormwater facilities must provide the city with a maintenance plan that defines who will conduct the maintenance, the type of maintenance and the maintenance intervals.

14.1.2 Publicly Owned Stormwater Facilities

The city of Anoka is responsible for performing the maintenance of the stormwater facilities under city ownership. The Minnesota Department of Transportation is responsible for maintaining road ditches and culverts along U.S. Highway 169/10. Anoka County is responsible for maintaining road ditches and culverts along C.S.A.H. 1, C.S.A.H. 18, C.S.A.H. 21, C.R. 45, C.R. 46, C.R. 53, and C.S.A.H. 66. The city will also notify the owners of other publicly owned stormwater facilities if scheduled maintenance is needed according to periodic site inspections or maintenance plans on file.

The city will develop an inventory and maintain a database for all private and public storm water facilities within the city of Anoka to assist in determining maintenance requirements. The city is responsible for notifying owners of public and private stormwater facilities of the need to conduct maintenance at least every five years.

In addition to constructing the drainage and water quality improvements called for in this Plan, the city will regularly inspect and maintain key components of the system. Key components include storm sewer and culvert inlets, overflow drainage swales, stormwater ponding and water quality treatment basins, and riprap-protected banks, storm sewer and culvert outlets.

14.1.3 Maintenance of Storm Sewer and Culvert Inlets

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

14.1.4 Maintenance of Ponding Facilities

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. Also, if left unattended, these facilities can become overgrown with unwanted vegetation that could reduce their effectiveness and hinder access for periodic maintenance. Therefore, the city of Anoka will periodically inspect stormwater storage basins and water quality treatment facilities to look for excessive sediment build-up, collected debris and unwanted vegetation. If problems are noted, maintenance is then warranted. For sedimentation basins, it is estimated that approximately every 25 years the basins will need to be dredged to provide the originally-designed sediment storage volume. For planning purposes, it is often assumed that an inspection of the basin capacities should occur every 5 years.

Overflow swales can turn into steep eroding channels if an ongoing erosion problem is not stabilized and the area restored. Typical stabilization materials could include permanent (nonphoto-degrading) geotextile erosion control material or riprap accompanied by a properly designed filter material.

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

This plan identifies sites for future ponding facilities that may be existing wetland areas. Alteration of these areas by grading or filling operations will most likely require involvement of Anoka SWCD, the agency responsible (local government unit, or LGU) for administering the 1991 Wetland Conservation Act (WCA) in the city of Anoka and surrounding areas. In some cases, upland areas surrounding existing wetlands can be excavated to provide additional habitat, flood storage, water quality treatment, and more wetland areas if desired. However, if a wetland alteration falls under the jurisdiction of the WCA and the Army Corps of Engineers, alteration of wetland types (for example, from vegetated to open water) may require creating additional wetland area with the same wetland types to compensate for the wetland types lost during the alteration. Therefore, sediment collection areas in constructed basins should be excavated regularly, so that wetland vegetation does not grow in those areas and become considered a wetland type that would need to be replaced elsewhere. If possible, the LGU and Army Corps of Engineers (COE) should sign off on constructed basins, indicating that even if wetland vegetation and other wetland characteristics become dominant, the constructed basin does not fall within the jurisdiction of the LGU or COE.

14.1.5 Riprap Recommendations

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 annually inspect riprap areas and perform the necessary maintenance.

14.1.6 Street Sweeping

The maintenance guide (Table 14-1) calls for the city to sweep streets and parking lots twice a year—once after snowmelt and again after leaf fall. The city will place a higher priority on sweeping streets directly tributary to sensitive resources.

Table 14-1 Maintenance Guide—City of Anoka

Practice	Frequency	Comments
Wetland and Stormwater Basin Inspections	Once every 5 years	Brief, on-site inspection and survey to record sediment buildup, skimmer and inlet/outlet structure conditions, erosion at inlet, outlet, and on slopes, debris, vegetation and visual water quality.
Ditch Inspections	As needed	Brief, on-site inspection to record sediment buildup, channel and sideslope erosion, debris, and vegetation.
Street and Parking Lot Sweeping	Twice a year (Downtown weekly)	Sweep streets once following snowmelt and again after leaf fall. Sweep areas directly tributary to sensitive water resources first. Sweep more frequently if need arises.
Storm Sewer Inlet/Catch Basin Repair and Cleaning	As needed, following major storm events	Repair deteriorated catch basins; clean storm sewer inlets and catch basins to prevent encroachment of sediment and debris above flow line of pipe.
Storm Sewer Discharge Point Inspections	Once a year, and following major storm events	Inspect direct discharge points into stormwater basins and wetlands to determine if discharge point is free of sediment and to observe the condition of any upstream treatment facility (if applicable).
Sediment Removal	As needed	Based on results of stormwater basin, wetland and ditch inspections/surveys, remove sediment from areas where it impedes stormwater flow, and from areas not designated for sediment removal
Outlet Structure and Skimmer Maintenance	As needed	Determine maintenance needs based on results of stormwater basin, wetland and ditch inspections.
Debris and Litter Control	Variable	Collect debris and litter as part of regular inspection program; control litter through public education efforts.
Alternative Road Deicing Chemicals	Encourage their use	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	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.

Recommended basin water quantity and quality are shown on Figure B.

15.0 Implementation Program

15.1 Implementation Program Components

Table 15-1 is a comprehensive list of the projects and programs that comprise the city of Anoka's implementation program. This plan identified existing and potential problems (Section 4 through Section 12), developing goals and policies (Section 3), and assessing the need for projects. Table 15-1 summarizes the implementation program and projects presented for each study area within the city. The city will incorporate these program elements into its existing/proposed Capital Improvements Program (CIP).

15.2 Financial Considerations

The city of Anoka intends to fully evaluate the feasibility of financing its implementation program by developing and implementing a Stormwater Utility. Such a utility would fund maintenance, repairs, capital projects, studies, etc. pertaining to the city's stormwater system. Examples include storm sewer installation for new developments, storm sewer upgrades, construction of regional ponding basins, and basin retrofit projects. The city may also develop and implement a storm sewer connection charge for new developments; the monies collected would be deposited into the stormwater utility fund. One of the uses of the stormwater utility would be to fund necessary trunk system improvements to accommodate development. The connection charges could then be used to refund the stormwater utility.

If implemented, the proposed city stormwater utility rates would vary according to land use (i.e. single-family residential, multiple-family residential, commercial, industrial, and open/agricultural). Higher rates would be applied to land uses with higher amounts of impervious surface. The city would review the stormwater utility rates annually and adjust rates as needed.

The city may also use general taxes in conjunction with, or in place of, stormwater utility funds for the public education and information programs and other administrative programs. The city will explore all available, appropriate and cost-effective funding options to finance plan implementation. Examples include grant and loan programs, such as Minnesota Board of Water and Soil Resources Challenge Grants, Minnesota Department of Natural Resources grants, North American Wetlands Conservation Act grants, and McKnight Foundation grants.

15.3 Plan Revisions/Amendments

The Anoka city council adopted this plan in October of 2000. The Anoka Watershed Management Plan is based on information that was current at the time of plan preparation and is therefore subject to change. Changes in land use, zoning, watersheds, and drainage patterns, and revisions to governmental regulations/rules could affect all or part of this plan. As a result, the city may need to revise the plan to keep it current. The city expects that most revisions to the plan will be minor (i.e. changes to the implementation program), and not require a major revision to the plan. The city of Anoka may revise the plan at any time in response to city-identified needs.

Table 15-1. Proposed Implementation Program—City of Anoka

ID #	Planned Activity	Location	Comments
1	Adopt, implement and enforce stormwater management regulations as provision of zoning ordinance	City-wide	
2	Implement stormwater system maintenance program	City-wide	See Table 14-1. Includes all maintenance tasks except sediment removal.
3	Establish and implement stormwater utility	City-wide	
4	Develop and implement education and information program for general public and targeted groups	City-wide	See Section 3.5 for more information.
	Mississippi River East Watershed		
5	Improvements to existing basin as necessary.	9TH-5 Mississippi River East Watershed	Need 2.0 acre-feet dead storage, 4.8 acre-feet live storage
6	Construct 1.6 acre-foot extended detention basin	KGS-1 Mississippi River East Watershed	
7	Construct 2.60 acre-foot extended detention basin	5TH-1 Mississippi River East Watershed	
8	Storm sewer upgrade	Ninth Avenue Mississippi River East Watershed	Projects to be completed, in whole or in part, as opportunities arise, in conjunction with other infrastructure projects.
9	Storm sewer upgrade	King's Lane Mississippi River East Watershed	Projects to be completed, in whole or in part, as opportunities arise, in conjunction with other infrastructure projects.
10	Storm sewer upgrade	Oakwood Drive Mississippi River East Watershed	Projects to be completed, in whole or in part, as opportunities arise, in conjunction with other infrastructure projects.
11	Storm sewer upgrade	Fifth Avenue Mississippi River East Watershed	Projects to be completed, in whole or in part, as opportunities arise, in conjunction with other infrastructure projects.
12	Storm sewer upgrade	Oakwood Lane Mississippi River East Watershed	Projects to be completed, in whole or in part, as opportunities arise, in conjunction with other infrastructure projects.
13	Add appurtenances to river outlet pipes where necessary.		Projects to be completed, in whole or in part, as opportunities arise, in conjunction with other infrastructure projects.

Table 15-1 Proposed Implementation Program—City of Anoka Continued

ID #	Planned Activity	Location	Comments
	Mississippi River West Watershed		
14	Improvements to existing basin as necessary.	LEV-9 Mississippi River West Watershed	Need 1.0 acre-feet dead storage, 15.4 acre-feet live storage
15	Construct 5.0 acre-foot extended detention basin	LEV-1 Mississippi River West Watershed	
16	Construct 2.0 acre-foot extended detention basin	WEST-1 Mississippi River West Watershed	
17	Construct 1.5 acre-foot extended detention basin	PTR-1 Mississippi River West Watershed	
18	Storm sewer upgrade	Ferry Street Mississippi River West Watershed	Projects to be completed, in whole or in part, as opportunities arise, in conjunction with other infrastructure projects.
19	Storm sewer upgrade	Franklin Lane Mississippi River West Watershed	Projects to be completed, in whole or in part, as opportunities arise, in conjunction with other infrastructure projects.
20	Storm sewer upgrade	Levee Avenue Mississippi River West Watershed	Projects to be completed, in whole or in part, as opportunities arise, in conjunction with other infrastructure projects.
21	Storm sewer upgrade	West Lane Mississippi River West Watershed	Projects to be completed, in whole or in part, as opportunities arise, in conjunction with other infrastructure projects.
22	Storm sewer upgrade	Porter Avenue Mississippi River West Watershed	Projects to be completed, in whole or in part, as opportunities arise, in conjunction with other infrastructure projects.
23	Add appurtenances to river outlet pipes where necessary.		Projects to be completed, in whole or in part, as opportunities arise, in conjunction with other infrastructure projects.

Table 15-1 Proposed Implementation Program—City of Anoka Continued

ID #	Planned Activity	Location	Comments
	Anoka Enterprise Watershed		
24	Improvements to existing basin as necessary.	AEP-3 Anoka Enterprise Watershed	Need 7.0 acre-feet dead storage, 18.2 acre-feet live storage
25	Improvements to existing basin as necessary.	AEP-17 Anoka Enterprise Watershed	Need 3.0 acre-feet dead storage, 3.1 acre-feet live storage
26	Improvements to existing basin as necessary.	AEP-22 Anoka Enterprise Watershed	Need 6.5 acre-feet dead storage, 17.0 acre-feet live storage
27	Improvements to existing basin as necessary.	AEP-27 Anoka Enterprise Watershed	Need 2.4 acre-feet dead storage, 5.2 acre-feet live storage
28	Add appurtenances to river outlet pipes where necessary.		Projects to be completed, in whole or in part, as opportunities arise, in conjunction with other infrastructure projects.
	Rum River Northeast Watershed		
29	Improvements to existing basin as necessary.	SA-1 Rum River Northeast Watershed	Need 12.0 acre-feet dead storage, 43.9 acre-feet live storage
30	Improvements to existing basin as necessary.	38TH_1 Rum River Northeast Watershed	Need 4.8 acre-feet dead storage, 33.0 acre-feet live storage
31	Improvements to existing basin as necessary.	BRY-9 Rum River Northeast Watershed	Need 3.0 acre-feet dead storage, 23.8 acre-feet live storage
32	Improvements to existing basin as necessary.	BRY-1 Rum River Northeast Watershed	Need 1.8 acre-feet dead storage, 31.7 acre-feet live storage
33	Construct 4.0 acre-foot extended detention basin	GRT-1 Rum River Northeast Watershed	
34	Storm sewer upgrade	Bryant Circle Rum River Northeast Watershed	Projects to be completed, in whole or in part, as opportunities arise, in conjunction with other infrastructure projects.
35	Storm sewer upgrade	Grant Circle Rum River Northeast Watershed	Projects to be completed, in whole or in part, as opportunities arise, in conjunction with other infrastructure projects.
36	Storm sewer upgrade	Ninth Lane Rum River Northeast Watershed	Projects to be completed, in whole or in part, as opportunities arise, in conjunction with other infrastructure projects.

Table 15-1 Proposed Implementation Program—City of Anoka Continued

ID #	Planned Activity	Location	Comments
37	Storm sewer upgrade	Grant Street Rum River Northeast Watershed	Projects to be completed, in whole or in part, as opportunities arise, in conjunction with other infrastructure projects.
38	Storm sewer upgrade	Garfield Street Rum River Northeast Watershed	Projects to be completed, in whole or in part, as opportunities arise, in conjunction with other infrastructure projects.
39	Storm sewer upgrade	Seventh Avenue Rum River Northeast Watershed	Projects to be completed, in whole or in part, as opportunities arise, in conjunction with other infrastructure projects.
40	Storm sewer upgrade	41st Avenue Rum River Northeast Watershed	Projects to be completed, in whole or in part, as opportunities arise, in conjunction with other infrastructure projects.
41	Add appurtenances to river outlet pipes where necessary.		Projects to be completed, in whole or in part, as opportunities arise, in conjunction with other infrastructure projects.
	Rum River Northwest Watershed		
42	Improvements to existing basin as necessary.	MK-5 Rum River Northwest Watershed	Need 3.0 acre-feet dead storage, 14.0 acre-feet live storage
43	Improvements to existing basin as necessary.	MK-12 Rum River Northwest Watershed	Need 1.0 acre-feet dead storage, 3.0 acre-feet live storage
44	Storm sewer upgrade	St. Frances Bl. Rum River Northwest Watershed	Projects to be completed, in whole or in part, as opportunities arise, in conjunction with other infrastructure projects.
45	Add appurtenances to river outlet pipes where necessary.		Projects to be completed, in whole or in part, as opportunities arise, in conjunction with other infrastructure projects.
	Rum River Southeast Watershed		
46	Improvements to existing basin as necessary.	6TH_1 Rum River Southeast Watershed	Need 2.0 acre-feet dead storage, 8.4 acre-feet live storage
47	Improvements to existing basin as necessary.	BRS-2 Rum River Southeast Watershed	Need 1.2 acre-feet dead storage, 4.0 acre-feet live storage
48	Improvements to existing basin as necessary.	10TH_1 Rum River Southeast Watershed	Need 4.0 acre-feet dead storage, 10.5 acre-feet live storage

Table 15-1 Proposed Implementation Program—City of Anoka Continued

ID #	Planned Activity	Location	Comments
49	Construct 8.3 acre-foot extended detention basin	MAIN-1 Rum River Southeast Watershed	
50	Construct 4.9 acre-foot extended detention basin	JF-1 Rum River Southeast Watershed	
51	Construct 2.0 acre-foot extended detention basin	HAR-1 Rum River Southeast Watershed	
52	Construct 0.25 acre-foot extended detention basin	TY-1 Rum River Southeast Watershed	
53	Construct 1.8 acre-foot extended detention basin	POLK-1 Rum River Southeast Watershed	
54	Storm sewer upgrade	Tenth Avenue Rum River Southeast Watershed	Projects to be completed, in whole or in part, as opportunities arise, in conjunction with other infrastructure projects.
55	Storm sewer upgrade	Brisbin Street Rum River Southeast Watershed	Projects to be completed, in whole or in part, as opportunities arise, in conjunction with other infrastructure projects.
56	Storm sewer upgrade	Seventh Avenue Rum River Southeast Watershed	Projects to be completed, in whole or in part, as opportunities arise, in conjunction with other infrastructure projects.
57	Storm sewer upgrade	Jefferson Avenue Rum River Southeast Watershed	Projects to be completed, in whole or in part, as opportunities arise, in conjunction with other infrastructure projects.
58	Storm sewer upgrade	Fifth Avenue Rum River Southeast Watershed	Projects to be completed, in whole or in part, as opportunities arise, in conjunction with other infrastructure projects.
59	Storm sewer upgrade	Washington Street Rum River Southeast Watershed	Projects to be completed, in whole or in part, as opportunities arise, in conjunction with other infrastructure projects.
60	Storm sewer upgrade	Adams Street Rum River Southeast Watershed	Projects to be completed, in whole or in part, as opportunities arise, in conjunction with other infrastructure projects.
61	Storm sewer upgrade	Harrison Street Rum River Southeast Watershed	Projects to be completed, in whole or in part, as opportunities arise, in conjunction with other infrastructure projects.

Table 15-1 Proposed Implementation Program—City of Anoka Continued

ID #	Planned Activity	Location	Comments
62	Storm sewer upgrade	Taylor Street Rum River Southeast Watershed	Projects to be completed, in whole or in part, as opportunities arise, in conjunction with other infrastructure projects.
63	Storm sewer upgrade	Polk Street Rum River Southeast Watershed	Projects to be completed, in whole or in part, as opportunities arise, in conjunction with other infrastructure projects.
64	Storm sewer upgrade	5^{th} Avenue Rum River Southeast Watershed	Projects to be completed, in whole or in part, as opportunities arise, in conjunction with other infrastructure projects.
65	Add appurtenances to river outlet pipes where necessary.		Projects to be completed, in whole or in part, as opportunities arise, in conjunction with other infrastructure projects.
	Rum River Southwest Watershed		
66	Storm sewer upgrade	Benton Street Rum River Southwest Watershed	Projects to be completed, in whole or in part, as opportunities arise, in conjunction with other infrastructure projects.
67	Storm sewer upgrade	Webster Street Rum River Southwest Watershed	Projects to be completed, in whole or in part, as opportunities arise, in conjunction with other infrastructure projects.
68	Add appurtenances to river outlet pipes where necessary.		Projects to be completed, in whole or in part, as opportunities arise, in conjunction with other infrastructure projects.
	US 169 & 10 Watershed		
69	Improvements to existing basin as necessary.	GC-1 US 169 & 10 Watershed	Need 6.0 acre-feet dead storage, 24.0 acre-feet live storage
70	Improvements to existing basin as necessary.	CH-2 US 169 & 10 Watershed	Need 0.6 acre-feet dead storage, 5.4 acre-feet live storage
71	Improvements to existing basin as necessary.	FOS-3 US 169 & 10 Watershed	Need 3.1 acre-feet dead storage, 4.4 acre-feet live storage
72	Improvements to existing basin as necessary.	FON-7 US 169 & 10 Watershed	Need 1.6 acre-feet dead storage, 6.3 acre-feet live storage
73	Construct stormwater basin with 1.2 acre-feet of dead storage and 8.0 acre-feet live storage.	8TH_1 US 169 & 10 Watershed	

Table 15-1 Proposed Implementation Program—City of Anoka Continued

ID #	Planned Activity	Location	Comments
74	Construct 4.0 acre-foot extended detention basin	STA-2 US 169 & 10 Watershed	
75	Construct 2.0 acre-foot extended detention basin	BRC-1 US 169 & 10 Watershed	
76	Construct 9.2 acre-foot stormwater and extended detention basin	8TH-1 US 169 & 10 Watershed	
77	Construct 4.6 acre-foot extended detention basin	7TH-1 US 169 & 10 Watershed	
78	Storm sewer upgrade	Euclid Avenue US 169 & 10 Watershed	Projects to be completed, in whole or in part, as opportunities arise, in conjunction with other infrastructure projects.
79	Storm sewer upgrade	Fairoak Avenue US 169 & 10 Watershed	Projects to be completed, in whole or in part, as opportunities arise, in conjunction with other infrastructure projects.
80	Storm sewer upgrade	Western Street US 169 & 10 Watershed	Projects to be completed, in whole or in part, as opportunities arise, in conjunction with other infrastructure projects.
81	Storm sewer upgrade	State Avenue US 169 & 10 Watershed	Projects to be completed, in whole or in part, as opportunities arise, in conjunction with other infrastructure projects.
82	Storm sewer upgrade	Branch Avenue US 169 & 10 Watershed	Projects to be completed, in whole or in part, as opportunities arise, in conjunction with other infrastructure projects.
83	Storm sewer upgrade	Eighth Avenue US 169 & 10 Watershed	Projects to be completed, in whole or in part, as opportunities arise, in conjunction with other infrastructure projects.
84	Add appurtenances to river outlet pipes where necessary.		Projects to be completed, in whole or in part, as opportunities arise, in conjunction with other infrastructure projects.

Table 15-1 Proposed Implementation Program—City of Anoka Continued

ID #	Planned Activity	Location	Comments
	City-wide		
85	Basin maintenance— sediment removal	City-wide	Accumulated sediment will need to be dredged from basins approx. every 5 years. Assuming about 30 basins, this means 6 basins/year will require dredging.
86	Purchase street sweeper/vacuum	City-wide	Coordinate with city's Capital Equipment Program (CEP)
87	Partner with county, adjacent townships and upstream landowners outside city's jurisdiction to reduce pollutant /sediment loadings.	City-wide	This task includes projects, meetings, and/or agreements.
88	Develop and implement runoff water quality monitoring program.	City-wide, at targeted locations	Implement only if required to do so by NPDES or other regulations.
89	Promote stormwater retention through infiltration practices and demonstration projects	City-wide	Promotion of stormwater retention could be achieved by providing incentives to developers.

16.0 Wetlands

16.1 Regulatory Controls

The protection and preservation of wetland is an integral part of stormwater management. There are federal, state, regional, and local regulations pertaining to wetland management. 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:

- **Protected Waters and Wetlands program, Minnesota Statutes 103G**—The DNR 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 DNR-protected waters and wetlands. The WCA rules (Minnesota Rules 8420) require that drained and filled wetlands be replaced at a minimum replacement ratio of 2:1 in nonagricultural areas. Local units of government may have stricter wetland regulations. Amendments to 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 DNR 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 wetland designated uses.

As part of administering the WCA rules, the designated LGUs are responsible for delineating wetlands and determining wetland functions and values. The Lower Rum River Water Management Organization (LRRWMO) is the LGU responsible for administering the WCA in the city of Anoka. Since the city anticipates little development and it does not have the staff capabilities to address wetland impacts, the city of Anoka believes the water management organization best handles the wetland issues.

Although not prohibited, the MPCA discourages the use of wetlands for stormwater treatment. LRRWMO encourages presettlement of stormwater runoff prior to discharge to wetlands, to help prevent sedimentation of wetlands.

Figure 16-1 show the wetlands located within the city of Anoka (more information on the wetland inventory is presented at the end of this section). There may be additional wetlands smaller than 0.1 acre in the city that are not shown on the map.

In general, the Metropolitan Council encourages cities to determine wetland functions and values, and include criteria for wetland buffer strips in their local water management plans. Specific to city of Anoka, the Metropolitan Council encourages the city of focus on redevelopment issues and public education regarding wetland protection and the importance of vegetative buffers.

The LRRWMO requires a Wetland Alteration Permit for any activity that may affect the size, shape or character of a wetland. Proposals for wetland alterations must include:

- Narrative describing purpose of project and efforts taken to avoid or minimize wetland impacts.

- Grading and sediment-erosion control plan showing existing and proposed elevations for wetland and spoil disposal areas.

- Wetland delineation and support documentation in accordance with WCA rules.

- Wetland Replacement Plan application for projects involving fill or drainage.

16.2 Public Waters

The DNR's Protected Waters and Wetlands Permit Program (Minnesota Statutes 103G) requires a DNR-protected waters permit for any work below the Ordinary High Water elevation (OHW) or any work that will alter or diminish the course, current, or cross-section of any protected water, including lakes, wetlands, and streams. For lakes and wetlands, the DNR'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 the filling of protected waters and wetlands for the purpose of creating upland areas.

16.3 Management Objectives

16.3.1 Goal

The goal of the City is to achieve no net loss of wetlands, including acreage, functions, and values. Where practicable, improve the functions, values, biological diversity, and acreage of existing wetlands will be improved.

16.3.2. Policies

1. Wetland alteration is discouraged. Use the city's wetland inventory to identify where proposed projects may impact wetlands. Unavoidable wetland alterations must be mitigated in conformance with the Wetland Conservation Act (WCA) requirements. In addition, wetland alterations need to comply with other LRRWMO constraints.

2. Cooperate with LRRWMO's administration of their wetland alteration rules.

3. Determine wetland functions and values on an individual basis, as needed, using either the wetland type index system or the Minnesota Routine Assessment Method (MnRAM).

4. Seek to restore previously existing wetlands and enhance existing wetlands.

5. Involve the appropriate regulatory agencies (LRRWMO, U.S. Army Corps of Engineers, and the DNR) in the planning of any proposed water quality or flood control facilities identified in this plan that may be located within a wetland.

6. Where feasible, provide buffer zones of native vegetation around basins and wetlands to provide habitat. Educate the public regarding wetland protection and the importance of creating and maintaining vegetative buffers. Land use and property ownership may limit the ability to provide buffer zones.

7. Where feasible, minimize water level fluctuations (bounce) in wetlands or detention basins to prevent adverse habitat changes.

The Modified Routine Assessment Method for Evaluating Wetland Functions and Values as summarized in Appendix A was used to identify the functional value of wetlands within the city of Anoka. This is a simplified version of the Minnesota Routine Assessment Method for Evaluating Wetland Functions (MnRAM). This modified version has been reviewed and accepted byt the Minnesota Board of Water and Soil Resources. This is consistent with the requirements of the LRRWMO. The assessment of each wetland is listed on Table 16-1 and Table 16-1A.

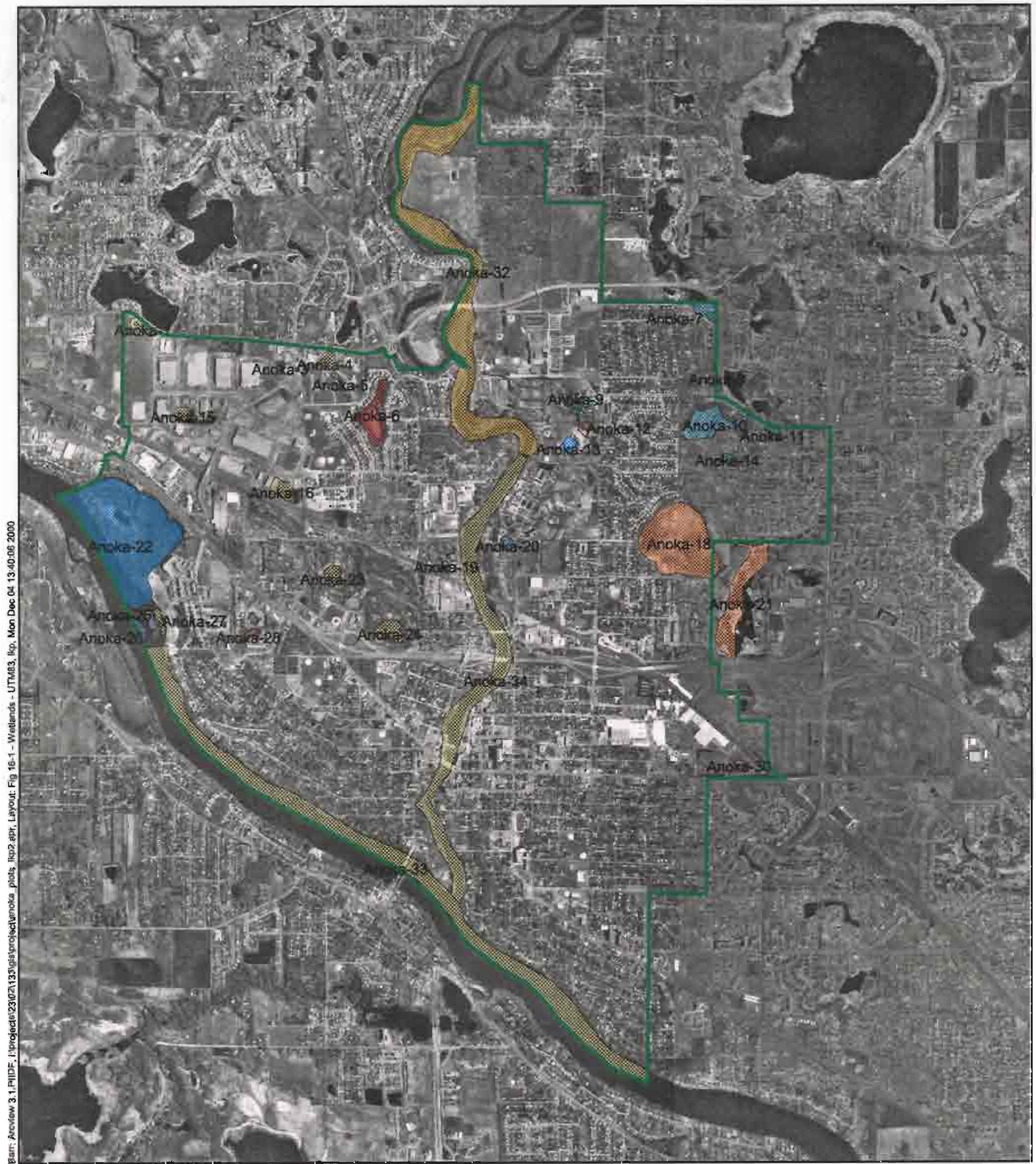


Figure 16-1

WETLANDS
City of Anoka
Anoka, Minnesota

Table 16-1 City of Anoka Wetland Classifications

ID Number	Circular 39	National Wetlands Inventory Code (NWI)	DNR #	Modified Routine Assessment									Sensitivity*
				Date	Hydrology	Vegetation	Wildlife	Fisheries	Attenuation	Quality	Shore Protection	Aesthetics	
Anoka-1	Type 5	PEMC & PUBG	N/A	10/9/98	2	2	2	2	3	3	0	2	Moderate
Anoka-3	Type 5	PUBF	N/A	10/9/98	1	1	1	0	3	3	0	1	Least
Anoka-4	Type 5	PEMF, PUBF, & PEMC	N/A	10/9/98	2	3	2	0	2	3	0	3	Moderate
Anoka-5	Type 3	PEMC & PSS1C	N/A	10/9/98	1	3	2	0	2	4	0	2	Moderate
Anoka-6	Types 3 & 5	PEMF & PUBF	119W	10/9/98	1	3	3	0	2	4	0	3	Moderate
Anoka-7	Type 3	PSS6Cd & PEMCd	610W	10/22/98	1	1	1	0	4	4	0	2	Least
Anoka-8	Types 3 & 6	No information available	N/A	10/22/98	1	1	1	0	2	4	0	2	Least
Anoka-9	Types 3 & 6	PEMCd	N/A	10/22/98	1	1	1	0	2	1	1	2	Least
Anoka-10	Type 3	PEMC, PFO1C, PEMF, PUBFx, & PEMCd	N/A	10/22/98	1	2	2	0	2	4	0	3	Moderate
Anoka-11	Types 3 & 6	PEMC	N/A	10/22/98	1	1	2	0	3	3	0	3	Least
Anoka-12	Type 2	PEMCd	N/A	10/22/98	1	1	2	0	2	3	0	2	Least
Anoka-13	Types 2 & 3	PEMCd	N/A	10/22/98	1	1	1	0	3	3	0	2	Least
Anoka-14	Types 1 & 2	PEMU	N/A	10/22/98	1	1	2	0	3	3	0	2	Least
Anoka-15	Type 5	No information available	N/A	10/9/98	1	1	1	0	3	2	0	2	Least
Anoka-16	Type 5	No information available	N/A	10/9/98	1	2	2	0	4	2	0	2	Moderate
Anoka-18	Types 2, 3 & 6	PEMC, PFO1B, PEMF, & PUBF	630W	10/22/98	2	2	3	0	3	4	3	3	Moderate
Anoka-19	Type 5	PEMC	N/A	10/20/98	1	1	1	0	2	1	0	1	Least
Anoka-20	Types 1 & 2	PSS1B	N/A	10/20/98	2	1	1	0	2	3	0	3	Least
Anoka-21	Types 2, 3 & 6	PSS6C, PEMC, PEMF, PFO6C & PSS1C	711W	10/22/98	1	1	1	0	2	3	0	2	Least
Anoka-22	Types 2, 5& 6	PFO1Ch, PSS1C, PUBFh, PUBF, & L1UBHh	N/A	10/15/98	1	3	3	2	4	3	3	3	Moderate
Anoka-23	Type 5	PUBG	107W	10/9/98	1	1	1	0	3	2	2	2	Least
Anoka-24	Type 5	PUBG	108W	10/9/98	1	1	1	0	3	2	2	2	Least
Anoka-25	Types 2 & 7	PFO1C	N/A	10/20/98	1	1	2	1	2	3	0	2	Least
Anoka-26	Types 6 & 7	PFO1C	N/A	10/15/98	3	2	2	4	1	1	3	3	Moderate
Anoka-27	Type 5	PSS1C	N/A	10/20/98	1	2	2	0	2	3	0	2	Moderate
Anoka-28	Types 3 & 5	PSS1C	N/A	10/20/98	1	1	2	0	3	3	0	2	Least
Anoka-30	Type 2	PEMC	N/A	10/20/98	2	1	2	0	2	3	0	2	Moderate
Anoka-32	Types 3, 5& 6	No information available	N/A	10/15/98	2	3	3	3	1	3	2	3	Moderate
Anoka-33	Type 5	No information available	N/A	10/15/98	1	1	2	2	1	2	2	2	Least
Anoka-34	Type 5	No information available	N/A	10/15/98	1	1	2	2	1	1	2	1	Least

*See Table 16-1A

Key:
0 = N/A
1 = Low
2 = Medium
3 = High
4 = Exceptional

Table 16-1A: City of Anoka Wetland Classifications: Sensitivity Evaluation

High	Moderate	Least
Special consideration must be given to avoid altering these wetland types. Inundation must be avoided. Water chemistry due to alteration by stormwater impacts can also cause adverse impacts.	These wetlands can tolerate only moderate alterations in hydrology. They have very good wildlife habitat value and a relatively diverse plant community. They will tolerate an additional 6 inches of inundation, but will be adversely impacted by sediment and/or nutrient loading and prolonged high water levels.	These wetlands are usually so degraded that input of urban stormwater may not have adverse impacts.
Maintain the existing **Storm Water Bounce** or degree of water level fluctuation.	Maintain the existing **Storm Water Bounce** or degree of water level fluctuation. Limit the maximum addition of water to 6 inches.	No limit for **Storm Water Bounce** or degree of water level fluctuation.
Maintain the existing **Discharge Rate.**	Maintain the existing **Discharge Rate.**	Maintain or decrease the existing **Discharge Rate**.
For 1 & 2 year storm events, maintain existing **Inundation periods**.	For 1 & 2 year storm events maintain existing **Inundation periods**. Limit maximum innundation to one additional day.	For 1 & 2 year storm events, maintain existing **Inundation periods**. Limit maximum innundation to an additional 7 days.
For 10 year storm events and greater, maintain existing **Inundation periods**.	For 10 year storm events and greater maintain existing **Inundation periods**. Limit maximum inundation to an additional 7 days.	For 10 year storm events and greater, maintain existing **Inundation periods**. Limit maximum innundation to an additional 21 days.
Do not change the **outlet control elevation**.	Do not change the **outlet control elevation**.	May raise **outlet control elevation** up to 4 feet above existing outlet elevation.
For landlocked wetlands, keep the **Run-out** control elevations above the delineated wetland edge.	For landlocked wetlands, keep the **Run-out** control elevations above the delineated wetland edge.	For landlocked wetlands, keep the **Run-out** control elevations above the delineated wetland edge.
<u>Recommendation</u>: If not already implemented, a preservation program should be initiated. Active protection from invasive plant species should begin. Purple Loosestrife, reed canary grass, and hybrid cattail should be eradicated from these wetlands.	<u>Recommendation:</u> These wetlands have good potential to restore native plant communities. It is well worth the effort to control invasive species (especially purple loosestrife) in these wetlands.	<u>Recommendation</u>: These wetlands could be altered to improve stormwater storage and to improve water quality and not severely impact the wetland quality.
Sedge Meadows, Open Bogs, Coniferous Bogs, Calcareous Fens, Low Praries, Coniferous Swamps, Lowland Hardwood Swamps, Seasonally Flooded Basins	Shrub-carrs, Alder Thickets, Fresh (Wet) Meadows, Shallow Marshes, Deep Marshes	Gravel Pits, Cultivated Hydric Soils, Dredged Material/Fill Material Disposal Sites

<u>Note:</u>

These management levels are based on the criteria set forth inthe "Storm-water and Wetlands: Planning and Evaluation Guidelines for Addressing Potential Impacts of Urban Storm-Water and Snow-melt Runoff on Wetlands" prepared by the State of Minnesota Storm-Water Advisory Group, published June 1997.

Appendix A

MINNESOTA ROUTINE ASSESSMENT METHOD (MnRAM) FOR EVALUATING WETLAND FUNCTIONS - Version 2.0

USER ADVISORIES:

Prerequisites

This primary purpose of this qualitative method is to provide an organized and consistent procedure to document observations and conclusions about wetland processes. It may be modified to fit special circumstances provided justification for the modifications is developed as part of the evaluation. This method requires training and experience in wetland science before it can be accurately applied. Professional judgement incorporated into the evaluation is intended to affect the outcome.

This method is intended for routine applications; for very complex or controversial sites a more elaborate method may be required. When possible (and especially for difficult or controversial sites) it is recommended that a diverse team of trained and experienced wetland professionals conduct the evaluation together. As with any method relying on professional judgement, the results will improve with training, practice and experience.

Several of the assessment items will be easier to complete with less field time if a preliminary office review of references such as the USGS topographic maps, stormwater management maps and plans, the county soil survey, NWI maps, aerial photography, and other off-site resources are checked to establish the history and setting of the wetland under evaluation. An evaluation for a small wetland (<10 acres) with normal circumstances in an area familiar to the evaluator(s) can be usually be completed in about 2 to 3 hours.

Size and Scale

If all other factors are the same, a wetland's total functional capacity is proportional to its size -- thus, size must be a consideration in the evaluation and any subsequent comparisons. Evaluations based on a unit size (e.g., per acre) may allow for a more direct comparison of wetlands of different sizes. However, there is importance in dispersion of wetlands as a wetland can only perform a function where it is located. Cumulatively then, smaller wetlands may provide functional benefits on a broader basis than larger wetlands. Thus, it is important to complete the evaluation with both landscape scale and site specific perspectives in mind.

Reference Standard Wetlands

A REFERENCE STANDARD WETLAND is a wetland judged to have the highest level of overall sustainable functional capacity for its type -- based on a classification system such as Circular 39, the Cowardin/National Wetland Inventory system or the Hydrogeomorphic system (HGM) -- within the Wetland Comparison Domain (see page 4 for definition). Reference Standard Wetlands will be the least disturbed/altered wetlands within the Wetland Comparison Domain. NOTE: In rare circumstances where the Wetland Comparison Domain is too small to include a high quality wetland, Reference Standard Wetlands may be identified in similar areas adjacent to the Wetland Comparison Domain. Functional evaluation of wetlands requires that Reference Standard Wetlands be designated prior to the evaluation to establish a common base of comparison. Ideally, Reference Standard Wetlands of each wetland type should be established in each Wetland Comparison Domain. However, for purposes of expediency, evaluations without Reference Standard Wetland sites may be conducted if the characteristics of Reference Standard Wetlands can be established and agreed to based on previous experience and familiarity with the wetlands in a particular Wetland Comparison Domain.

Functions vs. Values

A wetland function is a physical, chemical, or biological process or attribute of a wetland -- simply something a wetland does. For example, the process of retaining surface water is a commonly cited wetland function. A wetland value is the extent to which a wetland function is perceived as beneficial to an individual or society. Reduced flood damages to downstream properties is a value generally associated with the function of surface water retention.

While it's important to understand the distinction between functions and values, land use decisions involving wetlands typically involve consideration of both. Therefore, in the interest of practicality and to provide more useful information for making decisions about wetlands, this assessment method addresses a variety of wetland functions along with some of the related values. An attempt was made to separate the evaluations of functions and values, to provide the user a more clear understanding of how a proposed activity may affect a wetland's ability to perform a particular function, as compared to the function's relative importance (or value) resulting from its location on the landscape or socio-economic influences. This was not always possible, however. Some of the assessment parameters are difficult to assign as functions or values, and are thus combined in the same section. For instance, the assessment of water quality protection includes some purely functional aspects (geomorphological features of the wetland) and some value-related aspects (presence/absence of recreational waterbodies downstream). Other points to remember in conducting and applying the results of this assessment are:

- Wetland functions are closely linked to the long-term sustainability of the assessment wetland as a viable ecosystem.

- Generally, wetland functions can be measured more objectively than values, which are culturally derived. The wetland values included in this wetland assessment method are those that are more easily evaluated and generally thought to be positive.

- There are values associated with all of the assessed functions; some of them are just not explicitly evaluated by this method. In applying the results of this method, decision-makers must consider the relative value of each of the functions and the potential trade-offs involved. The results of this method are intended to provide objective information to aid the decision making process.

Wetland Ranking

A commonly asked question is: "If MnRAM does not use a numerical rank or rating system, who will decide which combination of functions is/are the most important? How can you compare wetlands?" The answer to the first question is the same as always -- people will decide. Functional assessment methods cannot make such decisions. By treating the various functions separately, MnRAM gives decision makers a more complete understanding of the tradeoffs associated with their land use decisions involving wetlands. The results are that MnRAM provides people with much better information for comparing wetlands than methods that somehow integrate all wetland functions into a single number. Such methods obfuscate, rather than illuminate the role that wetlands play in the landscape.

While a need for wetland functional analysis exists, it can lead to the perception of a wetland as a bundle of functions that can be teased apart and scattered around, rather than an integrated ecological system. There is also the risk that, having performed a functional assessment, we think we know all there is to know about a particular wetland, when in fact our understanding may be limited.

Value judgements about which wetland functions are to be given the greatest emphasis are left to the entity conducting or sponsoring the assessment and are best applied in the context of a comprehensive wetland protection and management plan so that decisions about wetlands are made on a landscape, watershed or community basis before an action or proposal necessitates a judgement about use priorities on a case-by-case basis. *Rankings or ratings cannot be used to compare wetlands in different Wetland Comparison Domains.* Before assigning numerical rankings or qualitative ratings, it is necessary to establish Reference Standard Wetland sites for each wetland type in the Wetland Comparison Domain.

Definitions

Major watershed = 81 major watershed units as defined by the U.S. Geological Survey and listed in MN Rule Chapter 8420.0110.

Local watershed = subwatershed area within major watershed.

Immediate Watershed = direct surface drainage area into the wetland.

References

"Wisconsin Department of Natural Resources Rapid Assessment Methodology for Evaluating Functional Values" (David R. Seibert, November 1992).

"A Hydrogeomorphic Classification for Wetlands" (US Army Corps of Engineers, Report WRP-DE-4, Mark Brinson, August 1993).

"A Conceptual Framework for Assessing the Functions of Wetlands" (US Army Corps of Engineers, Report WRP-DE-3, Daniel Smith, August 1993).

"Wetland Plants and Plant Communities of MN and WI", 2nd Ed.; (USACOE - St. Paul District; Eggers & Reed).

"City of Plymouth Wetland Inventory and Ordinance Project"; developed by Peterson Environmental Consulting, Inc.

"City of Bloomington Wetland Inventory Project" as developed by Shelly Peterson and Scott Thureen, City of Bloomington, MN.

"Hydrology of Wisconsin Wetlands. Information Circular 40, U.S. Geological Survey"; Novitski, R.P., 1982.

Developed by Minnesota Interagency Wetlands Group

Board of Water & Soil Resources: John Jaschke, Barbara Ohman, Eric Mohring, Dan Eklund
Department of Natural Resources: Erv Berglund, Bruce Gerbig, Doug Norris, Bill Penning
Department of Transportation: Sarma Straumanis, Nick Tiedeken, Brad Kovach
Pollution Control Agency: Mark Gernes, Judy Helgen, Larry Zdon
U.S. Army Corps of Engineers: Steve Eggers, Tim Fell, Paul Richert
USDA-Natural Resources Conservation Service: Mark Oja, Sid Cornelius
U.S. Fish and Wildlife Service: Nick Rowse, Loyd Mitchell, Jack Arnold
St. Louis County Highway Department: Tom Tri

For more information or to receive a copy contact John Jaschke at the Minnesota Board of Water and Soil Resources at (651)296-3767.
M:\MNRAM\MNRAM2.JJ September 11, 1998

Modified Routine Assessment Methodology for Evaluating Wetland Functions and Values

Wetland Number: ________________ Name of Wetland: ______________________________

Location: ____

Watershed: ______________________ Ownership: ___________________________________

Date: _______ Evaluator(s): ____

Cowardin Classification: ____

Circular 39 Classification: ____________

Is field inspection significantly different to aerial photo? **Y or N**

Estimated Size in acres: ______

Connected waters and wetlands:

Summary of Function and Value Assessment:

Function	Value	Reason
Hydrology		
Vegetation Diversity		
Wildlife Habitat		
Fishery Habitat		
Flood/Stormwater Attenuation		
Water Quality Protection		
Shoreline Protection		
Aesthetics/Recreation/Education		

Hydrology	Vegetation Diversity	Wildlife Habitat	Fishery Habitat	Flood/Stormwater Attenuation	Water Quality Protection	Shoreline Protection	Aesthetics/Recreation/Education

Key:
0 = N/A
1 = Low
2 = Medium
3 = High
4 = Exceptional

Function/Value Classification Code: ______________________________

Hydrology and Surrounding Land Use

1. Hydrogeomorphology: (riverine, lacustrine, palustrine, floodplain, constructed)
2. Hydrology source: (groundwater, storm sewer, flow through wetland, unknown)
3. Has hydrology been substantially altered: **Y or N** If yes please explain:

4. Does wetland have discernable inlets and outlets? **Y or N** If yes please describe:

5. Standing water: **Y or N** If yes, maximum depth: ______
6. Percent inundated: _____%
7. Wetland's watershed in acres: ________ Describe the surrounding land uses:

Vegetation

1. Record the percent of the site occupied by vegetation communities for each stratum and record the dominant species present.

	% open water
	% floating leafed community dominated by:
	% emergent community dominated by:
	% herbaceous community dominated by:
	% shrub community dominated by:
	% tree community dominated by:

2. Invasive and Exotic species:

	percent of area
	percent of area
	percent of area

3. Plant community types and quality:

Plant community #1:	Quality level:
Plant community #2:	Quality level:
Plant community #3:	Quality level:

4. Is the wetland plant community scarce or rare within the local matrix? **Y or N**

Wildlife Habitat

1.

Y	**N**	Is the wetland used by locally rare species or listed species of U.S. or Minnesota?
Y	**N**	Is the area surrounding the wetland undeveloped and uncultivated?
Y	**N**	Does wildlife have uninhibited access to the wetland?
Y	**N**	Is wetland part of a corridor or corridor system?
Y	**N**	Compared to the matrix, is this wetland type rare or declining significantly?
Y	**N**	Is the wetland a provider for seasonal or intermittent habitat?

2. Observed wildlife at visit:

Fish Habitat

1. **Y or N** Is the wetland contiguous with a permanent waterbody or watercourse such that it provides spawning/nursery habitat for gamefish?

Flood and Stormwater Storage/Attenuation

1. **H M L** Functional level of the outlet in providing flood and stormwater storage/attenuation. (H – No outlet. M – Constricted or managed outlet. L – Excavated or enlarged outlet.)
2. **H M L** Functional level of retarding rate of flow through the wetland. (H – No channels present. M – Channels present, but not connected. L – Channels connecting inlet to outlet.)
3. **H M L** What is the flood/stormwater management level of the wetland. (H – Receives directed stormwater and water level managed to maximize flood/stormwater retention. M – Receives directed stormwater and water level unmanaged for flood/stormwater retention. L – Receives no directed stormwater and water level unmanaged for flood/stormwater retention.)
4. Describe the location of the wetland within the watershed. Upper Mid Lower

Water Quality Protection

1.

Y	**N**	Does the wetland receive direct discharge of managed water?
Y	**N**	Does the surrounding area potentially deliver significant nutrient and/or sediment loads to the wetland?
Y	**N**	Does the wetland configuration allow adequate residence time so that sediments are able to settle?
Y	**N**	**N/A** For non-isolated wetlands, does the wetland have significant vegetative density to decrease water energy and allow settling of suspended material?
Y	**N**	Does the wetland have significant vegetative material to potentially increase uptake of dissolved nutrients?
Y	**N**	Are there signs of excess nutrient loading to the wetland? Algae bloom, reed canary grass, hybrid cattails

2. **Y or N** Does the wetland have a upland vegetative buffer area on upland adjacent to its boundary which slows and filters overland flow? If yes, note buffer characteristics within 100 ft. of wetlands edge.

3. Note average percent slope within 200 ft. of wetlands edge:_______________
4. **Y or N** Are there problems with eroding shorelines, or at structures within wetland? If yes, please explain:

Shoreline Protection

Y	**N**	Is the wetland a fringe area of a lake or watercourse? If no, skip to next section.
Y	**N**	If yes, is the shoreline exposed to frequent wave action?
Y	**N**	Is the shoreline wetland vegetated with submerged of emergent vegetation or perennial wetland species in the wash zone?
Y	**N**	Is the stream/lake bank prone to erosion?

Aesthetics/Recreation/Education and Science

1. Note recreational, educational, and aesthetic values at this wetland and note possibilities:

Appendix B

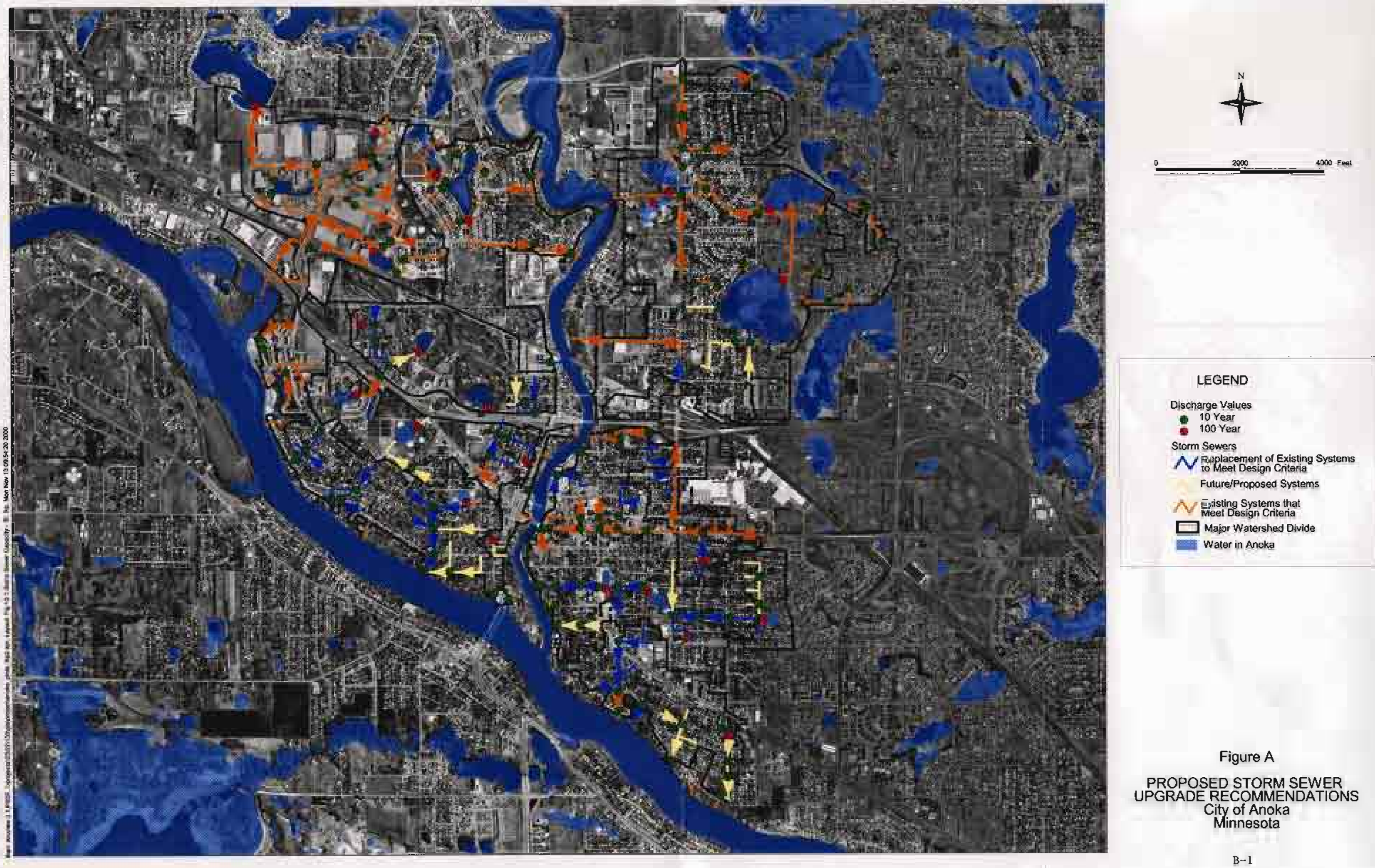
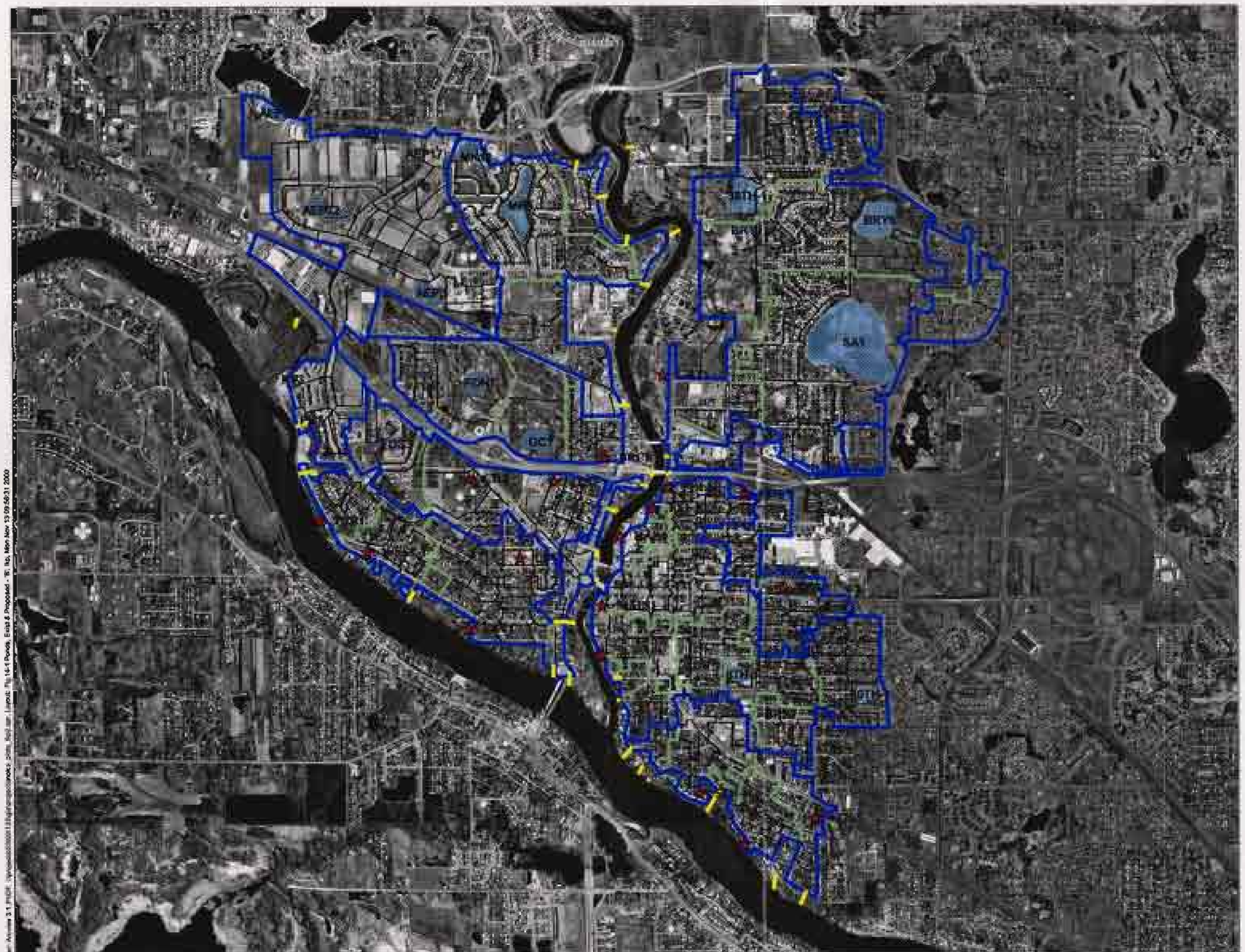


Figure A

PROPOSED STORM SEWER UPGRADE RECOMMENDATIONS
City of Anoka
Minnesota



N

0 2000 4000 Feet

LEGEND

- Proposed Basins
- Appurtenances
- Major Watersheds
- Minor Watersheds
- Subwatersheds
- Existing and Improved Basins

Figure B

WATER QUANTITY AND QUALITY
BASIN RECOMMENDATIONS
City of Anoka
Minnesota