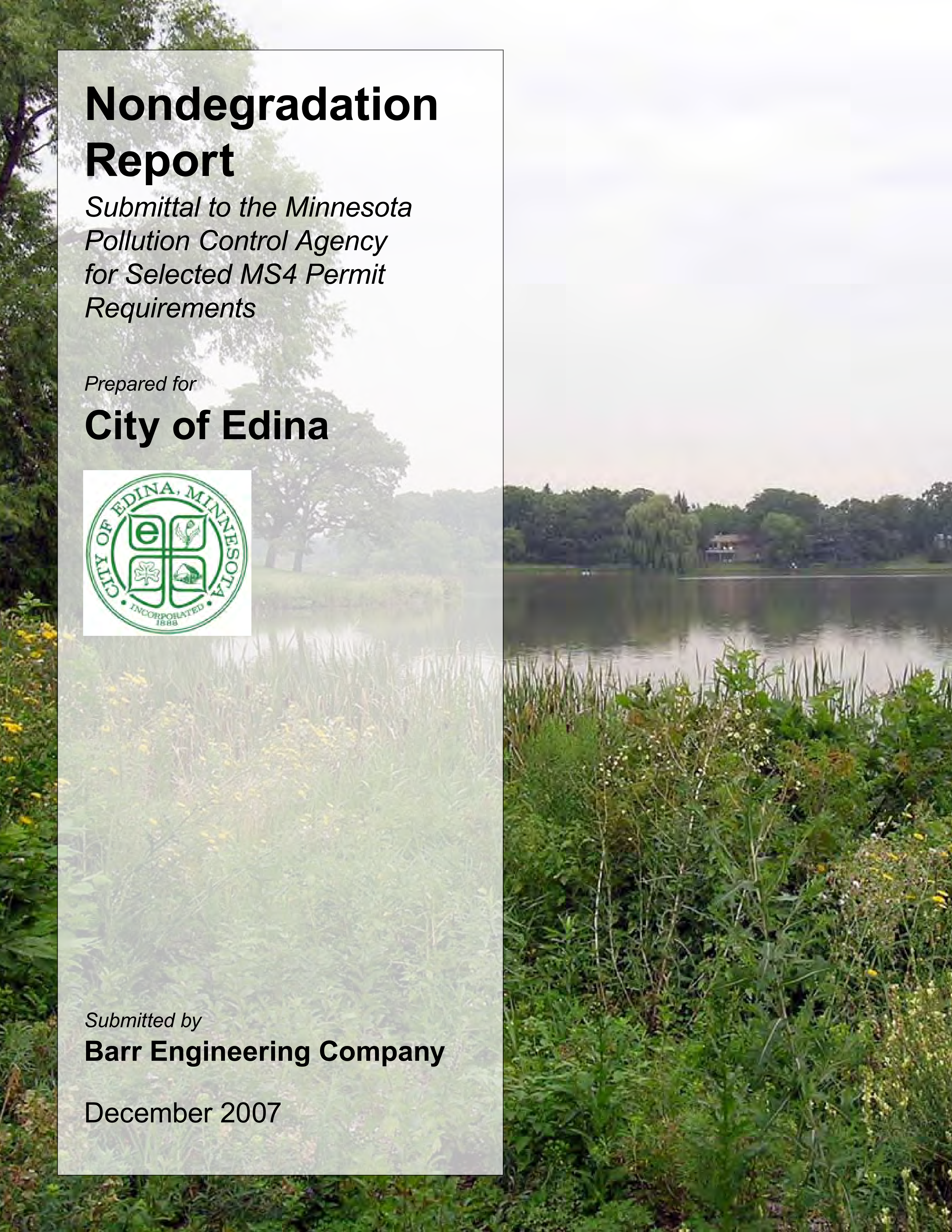

Nondegradation Report

Submittal to the Minnesota Pollution Control Agency for Selected MS4 Permit Requirements

Prepared for

City of Edina

Submitted by

Barr Engineering Company

December 2007

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Executive Summary

The Minnesota Pollution Control Agency (MPCA) revised the General National Pollutant Discharge Elimination System/State Disposal System (NPDES/SDS) Permit MNR040000 (Permit) for the City of Edina to Discharge Storm Water Associated with Municipal Separate Storm Sewer Systems (MS4), effective June 1, 2006. Edina had previously completed a Storm Water Pollution Prevention Program (SWPPP) to address the six minimum control measures required by the previous permit. This report has been developed to address modifications to the SWPPP for measures that may be necessary to meet the new, applicable requirements of Appendices C and D in the re-issued MS4 permit. Appendix C covers discharges to wetlands that are applicable to the City of Edina. Appendix D covers the nondegradation requirements for Selected MS4s (30 permittees including the City of Edina), including the development of a loading assessment and nondegradation report.

For the loading assessment, the Simple Method was used to determine the pollutant loadings and runoff volumes from each of the land uses within each watershed and the P8 Model was used to account for the effects of Best Management Practice (BMP) implementation for the time periods of interest in the Permit conditions. The loading assessment modeling results were summarized for the city's two major watershed districts, Minnehaha Creek Watershed District (MCWD) and Nine Mile Creek Watershed District (NMCWD), to show the Simple Method loading and volume estimates for each time period, as well as the loading and volume estimates after applying the P8 model design criteria for BMP implementation, based on the ordinances and design standards that were in place when the various developments occurred.

The results show that the total average annual flow volume from the city has increased by approximately 4.1 percent since 1988 and would continue toward a 4.5 percent increase by 2020, without implementation of volume reduction BMPs such as infiltration. Following implementation of runoff retention design standards for development and redevelopment, the overall average annual flow volume from the city in 2020 is expected to decrease to levels that are approximately 2 percent less than 1988 conditions. The loading assessment indicates that implementation of watershed BMPs, in the past and planned for the future, will ensure that the total phosphorus (TP) and total suspended solids (TSS) loads from the city will not increase between 1988 and 2020.

The loading assessment and nondegradation report were completed assuming that future BMP implementation throughout the city would follow the draft NMCWD runoff retention design standards, which require the onsite retention (through infiltration or other runoff retention practices) of one inch of runoff volume over all new impervious surfaces of the contributory drainage area of the parcel. At the time of this study, both of the watershed districts within the city are in the process of revising their stormwater management rules and drafting new stormwater quality treatment standards. Since most the of development and redevelopment anticipated between 2006 and 2020 is within the Nine Mile Creek portion of the city and since NMCWD has already developed their draft water quality treatment rules and standards (the MCWD is currently in the preliminary stages of their rule revision process), it was assumed for purposes of this analysis that the City will plan to adopt treatment requirements that follow the NMCWD draft stormwater management rules. Upon development and approval of the revised watershed district design standards, the city will update its development review policies, standards and procedures, as cited in the SWPPP. This approach will ensure the following:

- Receiving water quality should be improved for lakes, wetlands and streams in Edina as a result of future development and redevelopment
- Channel erosion and stream morphology changes will be minimized as a result of future development and redevelopment
- Further protection will be provided for the physical and biological integrity of the stream and wetland corridors
- Controlled bounce and duration of inundation in the city's wetlands and preservation of the functions and values for each type of wetland classification

City of Edina Nondegradation Report Submittal to the Minnesota Pollution Control Agency for Selected MS4 Permit Requirements

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1.0 Introduction

1.1 MS4 Permit Requirements

The Minnesota Pollution Control Agency (MPCA) revised the General NPDES/SDS Permit MNR040000 (Permit) for the City of Edina to Discharge Storm Water Associated with Municipal Separate Storm Sewer Systems (MS4), effective June 1, 2006. Edina had previously completed a Storm Water Pollution Prevention Program (SWPPP) to address the six minimum control measures required by the previous permit. This report has been developed to address modifications to the SWPPP for measures that may be necessary to meet the new, applicable requirements of Appendices C and D in the re-issued MS4 permit. Appendix C of the MS4 permit covers discharges to wetlands that are applicable to the City of Edina. Appendix D of the MS4 permit covers the nondegradation requirements for Selected MS4s (30 permittees including the City of Edina), including the development of a loading assessment and nondegradation report. The following sections describe the sections of the permit that are now relevant for the City of Edina.

1.1.1 Loading Assessment

Each Selected MS4 must assess the change in stormwater discharge loading for its permitted area using a pollutant loading water quality model that, at minimum, addresses changes in average annual flow volume, total suspended solids (TSS), and total phosphorus (TP). This modeling should be based on two time periods: from 1988 to the present, and from the present to 2020. The Selected MS4s must use a simple model, or another more complex model that they find to be more appropriate, that addresses the parameters of concern. This may include a model that the Selected MS4 has already used. Other assessment methods may be used if they can be shown to be as effective at quantifying the increase in loading as the modeling methods. The models and/or other methods will be used as part of the assessment to develop the Nondegradation Report, to help in selecting appropriate best management practices (BMPs) that address nondegradation, to determine whether additional control measures can reasonably be taken to reduce pollutant loading.

1.1.2 Nondegradation Report

Selected MS4s that have significant new or expanded discharges are required to complete a Nondegradation Report and, upon approval, to incorporate its findings on BMPs that address nondegradation into their SWPPP. The BMPs should address changes in pollutant loadings as far as is reasonable and practical through future development. Additionally, the BMPs shall address, as far as is reasonable and practical, the negative impacts of increased stormwater discharge volumes that cause increased depth and duration of inundation of wetlands having the potential for a significant adverse impact to a designated use of the wetland, or changes in stream morphology that have the potential for a significant adverse impact to a designated use of the streams.

The Nondegradation Report must include consideration of the Loading Assessment, which must include analysis of runoff volume and may include removal of pollutants by BMPs already initiated. For purposes of the permit, 1988 levels consistently attained means runoff that would have been produced under approximately average conditions of rainfall. Local stormwater management plans and other pertinent factors may also be considered. BMPs implemented by other parties may be considered when those BMPs affect the stormwater from the area of the Selected MS4. If the pollutant loadings cannot be reduced to levels consistently attained in 1988, the Nondegradation Report must describe reasonable and practical BMPs that the Selected MS4 plans to incorporate into a modified SWPPP. The Selected MS4 must consider alternatives, explain which alternatives have been studied but rejected and why, and propose alternatives that are reasonable and practical. The Nondegradation Report must give high priority to BMPs that address impacts of future growth, such as ordinances for new development. Where increases in pollutant loading have already occurred due to past development, the Nondegradation Report must consider retrofit and mitigation options (BMPs) that the Selected MS4 determines to be reasonable, practical, and appropriate for the community. The Selected MS4 is responsible for developing any site specific cost/benefit, social, and environmental information that the Selected MS4 wishes to bring to the Agency's attention. The Selected MS4 must incorporate the BMPs into a modified SWPPP and include an implementation schedule that addresses new development and retrofit BMPs it proposes to implement.

1.1.3 Proposed SWPPP Modifications and Submittals to MPCA

Prior to submittal to the MPCA, the proposed SWPPP modifications to address nondegradation will be public noticed at the local level. Each Selected MS4 shall also submit its SWPPP modifications to address nondegradation to the appropriate local water authority (e.g. watershed organizations or county water planning authority) in time to allow for their review and comment. The Nondegradation Report explaining the proposed BMPs and the entire SWPPP must be made available to the public and local water authority upon request.

Selected MS4s must submit their proposed changes to the SWPPP, reports addressing nondegradation for all waters, together with other supporting documents, to the MPCA in accordance with the schedule in Appendix E of the permit. This submittal must include:

1. The Loading Assessment.
2. The Nondegradation Report.
3. The proposed SWPPP modifications to address nondegradation.
4. The public and local water authority comments on the proposed SWPPP modifications to address nondegradation, with a Record of Decision on the comments.
5. An application to modify the permit.

1.1.4 Discharges to Wetlands

The permit does not authorize physical alterations to wetlands, or other discharge adversely affecting wetlands, if the alteration will have a significant adverse impact to the designated uses of a wetland. Any physical alterations to wetlands that will cause a potential for a significant adverse impact to a designated use must be implemented in accordance with the avoidance, minimization and mitigation requirements of Minn. R. 7050.0186 and other applicable rules.

1.1.5 Discharges Affecting Source Water Protection Areas

Minnesota Department of Health (MDH) regulates wellhead protection planning activities carried out by public water suppliers in the state. BMPs shall be incorporated into the SWPPP to protect any of the following drinking water sources that the MS4 discharge may affect, and a map of these sources shall be included with the SWPPP, if they have been mapped:

1. Wells and source waters for drinking water supply management areas identified as vulnerable under Minn. R. 4720.5205, 4720.5210, and 4720.5330, and
2. Source water protection areas for surface intakes identified in the source water assessments conducted by or for the MDH under the federal Safe Drinking Water Act.

MDH's Evaluating Proposed Storm Water Infiltration Projects in Vulnerable Wellhead Protection Areas (July, 2006 Draft) should be used to evaluate projects that use infiltration to manage stormwater.

1.2 Discussion of MPCA Guidance

1.2.1 Responses to Comments

Following the close of the comment period on the draft permit, the MPCA issued responses to comments received through April 15, 2005 on the Permit. To provide further guidance on compliance with the Permit requirements, this section describes responses to comments that pertain to the following subjects:

- Loading Assessment modeling approach and complexity
- Addressing volume as a parameter of concern for the Loading Assessment and Nondegradation Report
- Nondegradation requirements for Wetlands

1.2.1.1 Modeling Approach and Complexity

In response to several comments regarding the modeling approach and complexity required for the Loading Assessment described in the Permit, the MPCA stated that the Loading Assessment should include changes to pollutant loadings associated with changes due to past land use changes and changes due to anticipated land use changes. The Loading Assessment is intended to be used as a planning tool to compare 1988 levels to present and 2020 levels of discharge. It is to be presented as comparative results (increase), not absolute (accurate) flow, total suspended solids (TSS), and phosphorus discharge levels from the MS4. It is acceptable for MS4s to do more extensive modeling for design of BMPs, but it should be explained.

The Permit does not, however, specifically require that BMPs be factored into the Loading Assessment, but the MPCA clearly states that BMP analysis could be provided if any Selected MS4 so desires. The assessment can include changes due to BMPs that have already been implemented, if increase in the loading since 1988 is explicitly stated, as well as changes due to BMPs that are planned to be implemented and written into the MS4's ordinances or other regulatory mechanisms.

MPCA further states that the Loading Assessment was developed after considerable discussion, including discussion with consultants, cities, and the League of Minnesota Cities. It was determined that to limit costs the nature of the assessment must be limited. The MPCA chose not to include treatment options in this requirement since the level of modeling must be significantly increased to model treatment. Many communities will not be conducting other modeling, therefore this requirement will be a cost that needs careful distinction between what is desirable and what is required. The MPCA chose a level that will prevent undue burden while still developing useful information.

The Loading Assessment is comparable to an influent analysis, while the Nondegradation Report addresses the actual discharges of stormwater to receiving water. The permittees are allowed to show reduction in discharge or to make other arguments they believe are appropriate in the development of the Nondegradation Report. A detailed Loading Assessment can support the Nondegradation Report.

Under the provisions of Minn. R. 7050.0185, subp. 4, the MPCA must "determine whether additional control measures beyond those required by subpart 3 can reasonably be taken to minimize the impact of the discharge on the receiving water." The MPCA does not have absolute numeric or other criteria that it will use in making this determination for each of the Selected MS4s. The criterion of "reasonableness" requires flexibility and site specific determinations. Reasonableness determinations will therefore be made on a case-by-case basis. Site specific variations in situation, funding, population, and receiving water will be as critical to the determination of reasonableness as a specific increase in loading. Additionally, the MPCA must note that the required analysis and documentation for the Nondegradation Plans are relative, not absolute, in nature. For example, the Loading Assessments required by the permit are net changes; we do not calculate the actual pollutant loading, just estimates of the relative quantity of the change.

1.2.1.2 Average Annual Flow Volume

In response to several comments regarding the requirement for addressing volume as a parameter of concern for the Loading Assessment and Nondegradation Report described in the Permit, the MPCA stated that permit and guidance were revised to include more specifics on how flow volume will be addressed in BMPs and the Nondegradation Report. The responses were qualified by first stating that when an MS4 develops a Nondegradation Report, site specific objections, costs and other considerations can be raised, which the MPCA must consider in its determinations. Reasonable measures, not any and all measures, must be installed. For this permit, the reasonableness of volume control policy is not general and applicable for all MS4s, but is determined on an individual, site specific basis. In some situations the problems created by increased flow volume can be reduced and minimized by effective implementation of appropriate BMPs based on site specific conditions.

The MPCA asserts that based on the following statutory definition (**Minn. Stat. § 115.01 Definitions** *Subd. 13.* ***Pollution of water, water pollution, pollute the water.***) and actual environmental impacts, volume may qualify as water pollution under many specific conditions:

> *"Pollution of water," "water pollution," or "pollute the water" means: (a) the discharge of any pollutant into any waters of the state or the contamination of any waters of the state so as to create a nuisance or render such waters unclean, or noxious, or impure so as to be actually or potentially harmful or detrimental or injurious to public health, safety or welfare, to domestic, agricultural, commercial, industrial, recreational or other legitimate uses, or to livestock, animals, birds, fish or other aquatic life; or (b) the alteration made or induced by human activity of the chemical, physical, biological, or radiological integrity of waters of the state.*

MPCA staff looked at the rules that are applicable to nondegradation (Minn. R. 7050.0185) and studied the concept of increased loading of one or more pollutants as used in the rule. They determined that the rule directs the MPCA to consider the adverse effects of increased flow volume, and where effects are adverse, to consider flow volume as a pollutant. It is not volume per se that was asked to be addressed but the change in volume related to MS4 development. Additionally, it is well known that increases in flow can have a variety of negative environmental impacts. A discussion of the reasoning for the inclusion of volume of stormwater as a pollutant was provided in excerpts from Chapter 11 of the Minnesota 2001-2005 Nonpoint Source Management Program Plan. These excerpts are summarized below:

- Hydromodification, which involves changes in flow patterns in natural waterways such as rivers or streams and wetlands, is the second leading cause of impairment of fresh waters. Removal of perennial vegetation led to a decrease in infiltration and an increase in the volume of runoff. Exposing soils to wind and water increased sediment loads carried by runoff. Impervious surfaces and artificial drainage systems increased the volume of runoff and accelerated the rate at which water was removed from the landscape. Impervious surfaces in urban areas also transported runoff more rapidly and in greater volumes than before development.
- Minn. Stat. § 155.01, subd. 13 (b) defines pollution of waters as "the alteration made or induced by human activity of the chemical, physical, biological, or radiological integrity of waters of the state". The basis for this statute is that human activity, such as hydromodification, affects these waters in many adverse ways. Under natural conditions and at bank-full capacity, studies have shown that streams can handle a flow approximately equal to the 1.5- to 2-year frequency peak discharge within their banks (Rosgen, 1994; Leopold *et al.,* 1964). After urbanization, increased runoff can cause bank-full flow to be exceeded several times each year. In addition to increased flooding, this condition causes previously

stable channels to erode and widen. Much of the eroded material becomes bed load and can smother bottom-dwelling organisms.

- In this process, stream habitat diversity is damaged or lost. Water that was once slowed by bends, pools, and woody debris in the water column moves faster and with greater volume cutting into the bed and eroding the banks. This faster flowing water carries with it an increased sediment load, some of which is deposited in the downstream reaches. Many fish and invertebrate species cannot use substrates that are laden with excessive silt for reproduction, feeding, or cover. Riffles and pools become scarce or absent as the stream is converted from riffle, run, pool sequences to long runs or pipes. Not only is habitat diversity affected but the stream hydrology becomes inherently less stable. As water leaves the system faster, the natural hydrologic timing is altered. The overall effect is an increase in the intensity of the high flows and decreased duration of low flow events. If the water is stored to prevent increased peak flows, then the flow duration is extended. Streams in which the surrounding vegetation has been removed or altered are usually compromised by an increase in the amount of silt-laden runoff. Also, water temperatures within the stream may rise as the overhead canopy is removed exposing the stream to full sunlight.
- Urbanization also changes the extent and duration of inundation in wetlands, which can modify the established wetland vegetation. Measures to control discharges to wetlands must control the peaks and volume of flow to wetlands, if they are to be protected. This also means that reduced surface and ground water flow caused by diversion to storm sewers is also an area of concern, especially for sensitive wetlands.
- Urbanizing areas increase runoff from small events in greater proportion than large events. This is important because, in Minnesota, more than 90 percent of the precipitation events are less than 1.0 inch. These rainfall events also account for approximately 65 percent of the cumulative runoff quantity in urban areas and proportionately large amounts of the pollutant loading associated with these rainfall events (Pitt, 1998). While the significance of large flood events should not be underestimated, the smaller flows with an approximately nine month to two-year return period frequency, are probably as important or more important to overall water quality. These flows can be very erosive and can be the major source of increased pollutant loading. Pollutant loading is more closely associated with total runoff volume than with peak runoff rates. Utilizing methods to maintain volumes and peaks closer to those that originally shaped the channel can reduce the channel reshaping process in a watershed. Examples of appropriate management techniques are the volume reduction that results from the use of swales instead of curb and gutter, reduced impervious surfaces or infiltration structures. Wetland and upland vegetation can affect or be significantly affected by hydrologic changes. For example, drainage can obviously change the vegetation at a site, but increased water that drains from a project area into an off-site drainage basin can impact trees and other vegetation, including wetland vegetation. In such cases, water itself is the damaging agent even if it is clean. The increase in water level, both surface and subsurface, can result in the death of roots. Roots require oxygen from the air, and saturated soils create an anaerobic condition that will eventually kill the roots. A case in point is a tamarack swamp

that receives water from several developments. As water levels increase through the swamp, the increased flow depth results in the death of many of the tamarack trees, even though they are tolerant of wet conditions. In Minnesota, we have several tree species that tolerate short periods of flooding, but we should be encouraging diversity and be mindful of sensitive areas downstream. Likewise vegetation in upland areas can change the infiltration capacity or evapotranspiration capacity of a watershed. By using native plantings that have denser canopies and/or deeper root networks the storage capacity of the upland areas are significantly increased reducing run-off volumes, especially in the smaller storms.

Addressing average annual flow volume in the nondegradation plan may show that the modeling effort indicates a significant increase in flow from 1988. This is an indication to the MPCA that the loading of one or more pollutants has increased, and the plan will need to address what is reasonable and practical to get the flow back to 1988 levels. Alternatively, a municipality may wish to demonstrate that an increase in flow has not resulted in water quality degradation and therefore does not need to be addressed. The MPCA has found flow volume to be related to significant degradation; therefore claims to the contrary will be carefully scrutinized. Some of the options to address flow volume include consideration of BMPs for flows existing before 1988, BMPs for flows developed since 1988, and limitations on future flows. The MPCA notes that the 1.0-inch event is about the 90th percentile event for a 24-hour storm on an average annual basis, and that this represents 67 percent of the cumulative volume of precipitation. This means that runoff reduction often can be related to BMPs that reduce runoff from events smaller than 1.0 inches in depth. If properly designed, the BMPs could also treat some percentage of flow related to larger events without loss of effectiveness for reasons such as re-suspension. Depending on development patterns, zoning, soils, water table, and other factors, many communities may be able to meet the non degradation goal of returning the flow to pre-1988 levels. Treatment BMPs that reduce flow include infiltration basins, trenches, bio-retention, enhanced swales, evapotranspiration, disconnection of impervious surfaces, reduced imperviousness, filter strips, and variations and combinations of these and other BMPs.

In some instances, a community may not be able to reduce the flows to 1988 levels. If so, the basis for this conclusion should be explained. For example the current problems may be related to past development patterns, past or present zoning, soils, water table, and other factors that may be pertinent. In establishing the case, any cost information that is available, especially site specific information, should be provided. The MPCA must consider the potential impact of the discharge on the receiving water and cumulative impacts of multiple discharges. While MS4s are not required to develop information on this aspect of the analysis, they may find it beneficial to supply information that supports their position.

1.2.1.3 Wetlands

In response to several comments and questions regarding the designated uses and nondegradation requirements for wetlands in the Permit, the MPCA clarified that the terms "designated uses" of the permit relate to MPCA rules and requirements and are set by MPCA through notice and comment rulemaking under state law and any changes to designated uses would have to be made through notice and comment rulemaking. The MPCA has included, in guidance, the pertinent parts of those rules to help describe the context of these terms. The permit and rules are under MPCA authority and the permit implements the rules.

Under this NPDES permit, the permittee is required to comply with conditions that are established to protect the water quality standards of wetlands as listed in Minn. R. 7050. One of the purposes of the NPDES permit is to establish requirements or conditions that the permittee must operate under in order to assure compliance with the water quality standards. While the Wetland Conservation Act (WCA) for Local Government Units (LGUs) does regulate the activities that cause draining, filling and some excavation to certain wetlands, the WCA does allow for ten categories of exemptions to these requirements, does not have jurisdiction over all wetlands that are considered waters of the state, and does allow the LGU to vary wetland sequencing requirements if a local wetland plan is developed. The permittee must recognize the nondegradation standards for wetlands and the required mitigation sequence of Minn. R. 7050.0186 to mitigate for degradation of wetlands, apply to all wetlands that are considered waters of the state. The MPCA water quality standards provide more comprehensive water quality protection for all wetlands in Minnesota than is required of the LGU to implement under WCA. Application of the WCA by the LGU will provide comparable wetland protection to wetland impacts in many to most cases and the WCA determination would also satisfy the Minn. R. 7050.0186 determination. However, in the few projects where the requirements of the WCA are not as comprehensive as MPCA water quality standards, then the requirements of the NPDES permit will require an LGU to make a determination that will also satisfy Minn. R. 7050.0186. Considering those exceptions, allowing the permittee to only reference the WCA requirements for wetland protection would not be adequate to assure compliance with the NPDES permit for all cases.

The MPCA does not anticipate that it will review and make a separate determination (a duplicate effort) regarding the evaluation of the sequence mitigation requirements when that determination has been conducted by the permittee. MPCA enforcement of the NPDES permit requirements of Minn. R. 7050.0186 regarding wetland impacts associated with a component of the stormwater system should only be necessary if the LGU does not apply the permit requirements to their determinations. A separate determination by the permittee under the NPDES requirements that a wetland alteration activity satisfy Minn. R. 7050.0186 sequencing is only initiated when the WCA requirements exempt or consider the wetland or the activity nonjurisdictional or if the local wetland plan designation of the wetland does not require full sequence evaluation for impacts of a wetland alteration. It should be noted the WCA also recognizes that there may be other agencies or programs that have regulatory jurisdiction regarding wetland impacting activities. The WCA rules contained in Minn. R. 8420.0105, item B state that WCA rule is in addition to other regulations including those of the United States Army Corps of Engineers, United States Department of Agriculture, Minnesota state agencies, watershed districts, and local governments. Also, specifically the WCA requires that the person conducting an activity in a wetland under an exemption ensure the activity is conducted in compliance with all other applicable federal, state, and local requirements (see Minn. R. 8420.0115).

1.2.2 Guidance Manual for MS4s

The purpose of this draft report (MPCA, 2006) is to provide guidance for MS4s to comply with the Permit requirements, including the nondegradation policy. Nondegradation is achieved if 1988 levels of flow and pollutants can be maintained. If it is not feasible for a Selected MS4 to demonstrate that it has achieved 1988 levels of flow and pollutants, the MPCA must find if additional measures (BMPs) are "reasonable and practical" (Minn. R. 7050.0185). These measures are in addition to the minimum measures of the permit. The MPCA will review required submittals such as the loading assessments, and other information such as water plans, population growth data and development plans to determine appropriate measures. During the review, the MPCA will consider what additional control measures would be reasonable to reduce the impact on the receiving water in light of the relative importance of the economic and social impacts. The objective is to allow the MPCA to make an informed, public decision that reasonably balances additional BMP costs against the adverse impact on the environment posed by the new or expanded discharge.

Under Minn. R. 7050.0185, the MPCA is free to consider whatever information is available while the MS4 has the opportunity, albeit the burden, to demonstrate to the MPCA why expanded discharges are necessary to accommodate important economic or social development and what treatment is reasonable and practical. This burden is appropriately placed upon the MS4 since the discharger is in the position to know the relative costs and benefits of the proposed actions. The MPCA must consider the economic and social development of the community; this means the houses, jobs, taxes, recreational opportunities, and other impacts on the public at large that will result from development. Therefore, the MS4 should point out to the MPCA how and why the public has benefited from the development that created the new or expanded significant discharge, and why the public costs associated with the proposed BMPs are reasonable.

1.2.2.1 Loading Assessment

Loading Assessment modeling must be conducted for the entire MS4, not for individual watersheds or areas unless the MS4 will model these for their own interests. Some communities may wish to use models that address peak flows, or site specific increased loading. While this makes some sense in terms of overall plan development, it is not required by the permit; it is an option that the MPCA encourages but does not require. Modeling examples of methods that may be acceptable include but are not limited to the following:

- The Simple Method
- PONDNET
- SLAMM
- P8 Urban Catchment Model
- XP-SWMM

Modeling or assessment methods will be used to estimate increases in loading based on two time periods, 1988 to current development and current to projected (2020 or ultimate, whichever is first) development. Modeling may also be used to help in the decision making process of determining appropriate BMPs to implement to bring those discharges back to 1988 levels, or maintaining those levels into the future if they are not already exceeded. Use of the models in this manner is not required but is encouraged.

The MPCA expects that the model will produce relative values. For this effort, the MPCA is more concerned with the average annual increases than about specific event increases. It is not as important for this particular requirement of the permit to get the actual loads correct as it is to model consistently, showing the relative change in loads rather than the actual loads. Also note, the permit does not require the development of annual rainfall tables or calculation of hydrographs and/or store and release calculation.

All models need to be adapted for use in the specific circumstances of each MS4. Gather available information on land use/imperviousness and other pertinent facts from conditions that existed or will exist from 1988 to 2020. Selection of the appropriate method is often dependant on the readily available or collectable data as well as on the outputs or results required. Since the MPCA’s goal is to show relative increases or decreases in loading, a simple method can be used rather than a more complex model. MS4s may still want to use models that are more complex for their own purposes. The permit requirement is to consistently model between time periods so that the result can be objectively compared. An MS4 may want to select a model that can model BMPs to show removal from various practices that you may have installed or that you may want to install. This is not necessary for compliance with the permit, but makes sense when it comes to justifying your nondegradation plan. The model does not need to calculate design features such as hydrographs, but can show removal rates based on design criteria which can be just as useful for planning purposes. Design calculations may need to be run before implementation but often these can be run on a much smaller scale. Runoff and loading factors should be developed based on available information. BMP modeling, while optional, can be used in plan development and could consider BMP measures taken since 1988 to present and proposed BMP measures for present to 2020 or ultimate development conditions. The MPCA has examples of how the “simple method” can be applied to every community in the metro area.

The modeler must provide an explanation of assumptions and calculation methods. The inputs will need to be listed and the values shown. All values will need to be explicitly stated. The modeler must also provide an explanation of assumptions and calculation used in the model, whether they are inherent to the model or assigned by the user. The exact algorithms must be shown. The results of the model must be examined to demonstrate reasonable results from the model runs. Outlier values that do not seem in line with reasonable results must be explained or discussed in enough detail to help the MPCA decide the significance of the results.

1.2.2.2 Nondegradation Report

Based on the modeling, local stormwater management plans, and other pertinent factors, permittees must develop a Nondegradation Report to get new or expanded discharges back to 1988 levels. Where increases in runoff or pollutant loading has occurred due to new or expanded discharges from stormwater runoff, the Nondegradation Report must include retrofit and mitigation options (BMPs) that the permittee has determined to be reasonable and practical to be included in the permittee’s SWPPP.

Each Selected MS4 will submit its SWPPP, including BMPs proposed to be included, to the appropriate water authority, watershed organizations or county water planning authority, for their review and comment. The Nondegradation Report, as the basis for the SWPPP, will also be available to the water authority. The intention is that these groups will work together to create a Nondegradation Report that is acceptable to the public and other affected parties. As required in the permit, the proposed SWPPP, as based on the Nondegradation Report, will be public noticed at the local level for public participation.

The Nondegradation Report explains the decisions made by the permittee regarding the incorporation of BMPs into their SWPPP to meet the nondegradation requirements. The purpose of the Nondegradation Report is “to allow the MPCA to make an informed, public decision that reasonably balances additional BMP costs against the adverse impact on the environment posed by the new or expanded discharge”

(Minn. R. 7050.0185). The report is an explanation of the nondegradation implementation plan proposed to be adopted by the MS4 community, explaining why some measures have been rejected and why the measures taken are reasonable and practicable given the circumstances for the community they serve.

To help the MPCA determine if discharge loads should be allowed to increase, Selected MS4s must submit pertinent information that demonstrates how potentially adverse water quality impacts from a new or expanded discharge have been addressed. The goal of the Nondegradation Report is to demonstrate what additional control measures would be reasonable to reduce the impact on the receiving water in light of the relative importance of the environmental, economic and social impacts. The Report should explain all aspects of the proposed Report that the permittee intends to implement. It is understood that the SWPPP itself may have already addressed some specific aspects of nondegradation, and it may be beneficial to note these in the Report. The Report should also address the alternatives that have been studied but rejected. It is not necessary to include all rejected alternatives, but it will be very important to establish the general thinking regarding why some options have been rejected and the basis for such rejection.

1.3 Edina Storm Water Management Planning and Water Quality Improvement Projects

In addition to its SWPPP (City of Edina, 2006), the City of Edina has completed and implemented several stormwater management planning and water quality improvement projects and programs since 1988. These projects and programs are summarized below:

- Wellhead Protection Program (January 2000)
- City of Edina Comprehensive Water Resource Management Plan (CWRMP) (2003)—Established water quality and wetland management policies and BMP implementation requirements for all new development and redevelopment within the city.
- Construction of Centennial Lakes Park— Includes construction of a 10-acre pond that provides water quality treatment to a drainage area of approximately 216 acres.
- Incorporation of water quality treatment BMPs into annual street and storm sewer repair projects
- Development reviews
- Stormwater education presentations, outreach, meetings and training

The City has worked with the two watershed districts within the city to develop and implement several additional stormwater management planning and water quality improvement projects and programs since 1988. These projects and programs are summarized below:

- Nine Mile Creek Watershed District (NMCWD) Water Management Plan (1996, 2007)
- Minnehaha Creek Watershed District (MCWD) Comprehensive Water Resources Management Plan (1997, 2007)
- MCWD Pamela Park Wetland Restoration and Water Quality Improvement Project (2000)
- Functional Assessment of Wetlands within the Minnehaha Creek Watershed District (2003)
- NMCWD Mirror Lake Use Attainability Analysis (Draft, 2004)
- NMCWD Nine Mile Creek Use Attainability Analysis (2004)
- NMCWD Arrowhead Lake Use Attainability Analysis (Draft, 2006)
- NMCWD Indianhead Lake Use Attainability Analysis (Draft, 2006)
- NMCWD Lake Cornelia Use Attainability Analysis (Draft, 2006)
- MCWD Minnehaha Creek Visioning Partnership

2.0 Loading Assessment

2.1 Land Use Compilation

To meet the Permit requirements, it was necessary to estimate average annual flow volumes, TP and TSS loadings for 1988 (the base year), 2006, and 2020. An important parameter for estimating historical TP and TSS loading and stormwater runoff volumes is an accurate determination of land use (LU) for the City of Edina for the years of interest.

To get a consistent comparison of land use for all 3 years using the data that were available, a generalized land use classification system was developed. The land use categories used are shown in Table 2-1. It is important to note that the land areas within the state- and county-owned right-of-ways were excluded from the City's loading assessment, since stormwater from these areas is not covered under the City's MS4 permit.

Table 2-1 Land Use Categories

Land Use Category Name	Description
Commercial	Commercial areas and corporate campuses
Developed Park	Parks with developed sports facilities
Golf Course	Fred Richards and Braemar Public Golf Courses & Interlachen and Edina Country Clubs
Gravel Mine	Former Hedberg & Sons Co. gravel pit
High-Density Residential	Apartments, condominiums, etc
Industrial/Office	Manufacturing, utilities, etc
Institutional	Schools, churches, city buildings
Low-Density Residential	Single family homes with up to 5 units per acre
Medium-Density Residential	Single family homes with between 5 and 10 units per acre, duplexes, townhouses
Natural/Park/Open	Forest, undeveloped areas, and/or open space within conservation or park areas
Railroad	Railroad tracks and surrounding land
Water	Wetlands, lakes, detentions ponds
State & County Right-of-Way	Right-of-Way for State- and County-owned roadways

The land use information developed for 1988 and 2006 are shown in Figures 2-1 and 2-2, respectively. The 2006 land use characterization was based on the City's 1999 existing land use information, with revisions made to reflect land use changes since that time. 2006 aerial photography and GIS parcel information from the City was used to identify the land use changes since 1999. The 1988 land use information was then derived by revising the existing conditions (2006) land use to reflect 1988 conditions. This was completed by identifying all areas that had changed land use through review of aerial photography from 1987 and 1991, city GIS parcel information (including year of construction information), and land development permit records for the period between 1988 and 2006.

The amount of water area was assumed to be consistent throughout the years of interest except for the addition of approximately 10 acres of open water in the Centennial Lakes development. The water area for the portion of the city within the Minnehaha Creek Watershed District was determined based on the wetland inventory developed for the *Functional Assessment of Wetlands within the Minnehaha Creek Watershed District* (Hennepin Conservation District, 2003). The water area for the remaining portion of the city was based on the City's wetland inventory developed as part of the City's 2003 CWRMP.

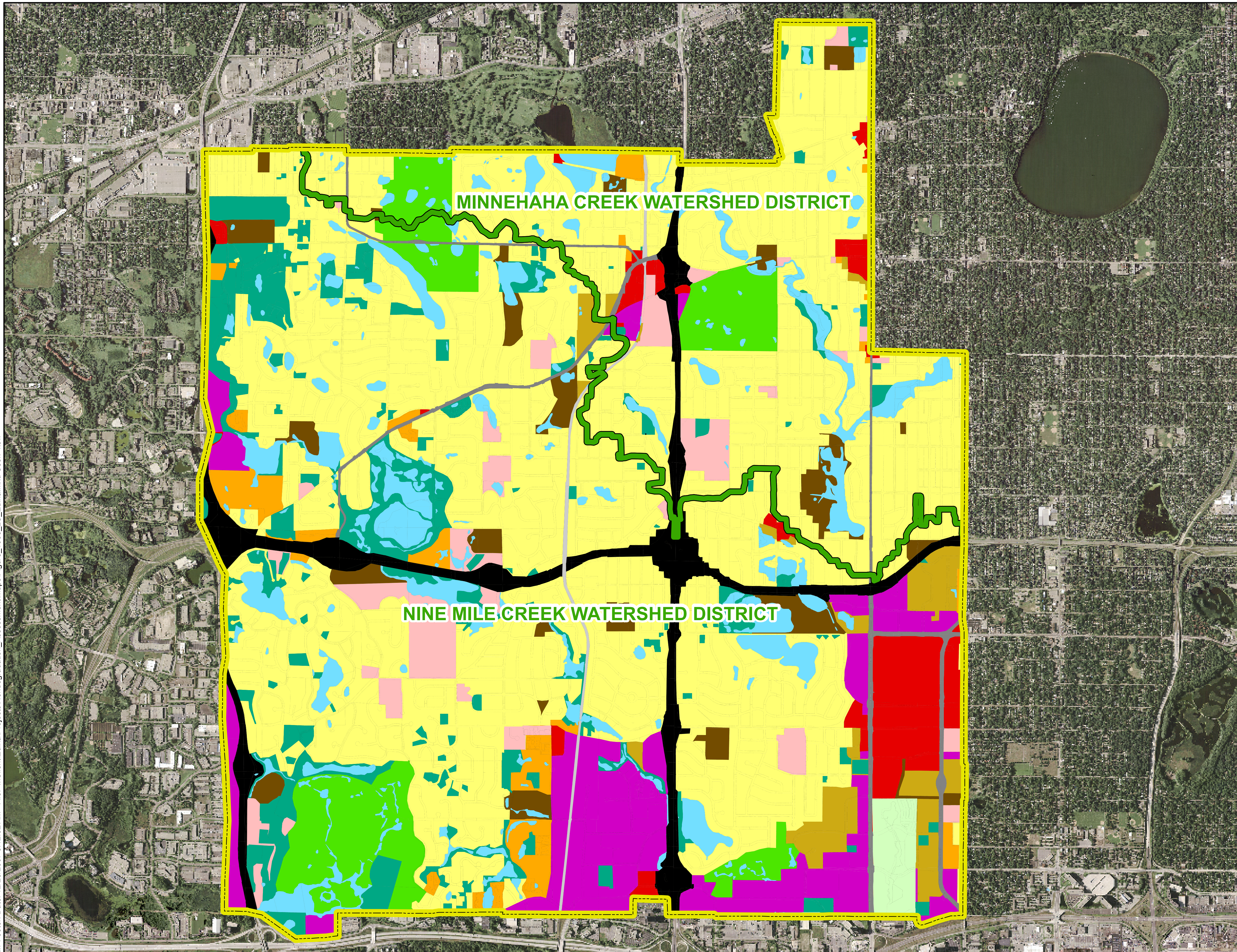
The land use information developed for 2020 is shown in Figure 2-3. The 2020 land use information was derived by revising the existing conditions (2006) land use to reflect anticipated changes in land use by the year 2020, based on input from city planning and engineering staff. Since the City of Edina is primarily fully developed, the anticipated amount of development between now and 2020 is minimal. However, considerable redevelopment is expected, specifically in the commercial and industrial areas of the city. The City's future land use information developed for planning purposes identifies the areas slated for redevelopment as 'mixed use' land use. To be consistent with the land use categories developed for this analysis, it was necessary to convert the areas identified as 'mixed use' to the land use categories described in Table 2-1.

City planning and engineering staff expect future redevelopment to occur within the existing commercial and industrial areas of the city. The areas identified as likely to redevelop have been categorized into three groups for purposes of this analysis: the Gateway area, the Greater Southdale area, and the Industrial Park area (Figure 2-4). The future land use assumptions used for the Gateway area were based on the land use scenario from the draft *Gateway Study Area Final Alternative Urban Areawide Review* (2007) that represented the densest and most impervious land use for the area (Scenario 1). This scenario assumed the following breakdown of land use, based on the LU categories listed in Table 2-1: Two (2) percent high density residential, 97 percent industrial/office, 1 percent natural/open/park. The future land use for the Greater Southdale and the Industrial Park areas was assumed to be consistent with existing (2006) land use. Although redevelopment is expected throughout these areas, the land use is generally expected to stay the same. The exception is a 5.5-acre parcel in the Industrial Park area where development is expected to result in a change from natural/park/open LU to industrial/office LU.

A summary of the land use for the City of Edina for the years 1988, 2006 and 2020 is provided in Table 2-2. The largest decrease in land use since 1988 has been in the natural/park/open LU category, which has been or will be replaced by residential, commercial, industrial, institutional, and golf course land uses during the two time periods. High density residential land use shows the greatest increase in the past and upcoming years. This increase generally represents the City of Edina's efforts to provide available housing for its aging population.

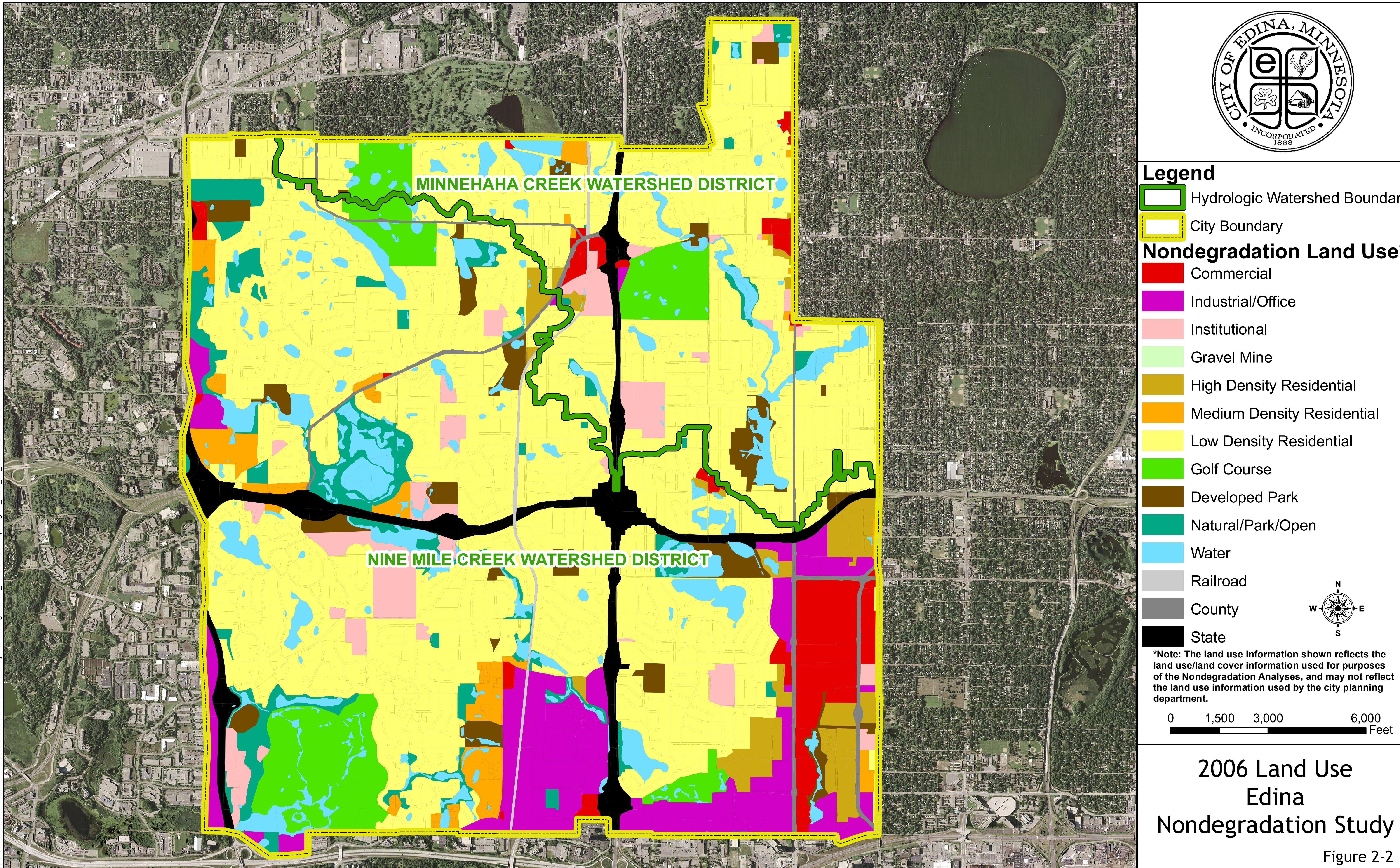
Table 2-2 Edina Land Use Areas (in acres)

Land Use	1988	2006	2020
Commercial	305	345	349
Developed Park	283	295	295
Golf Course	573	594	594
Gravel Mine	90	0	0
High Density Residential	231	267	269
Industrial/Office	702	725	728
Institutional	354	374	374
Low Density Residential	5,352	5,533	5,557
Medium Density Residential	222	250	250
Natural/Park/Open	718	437	404
Railroad	38	38	38
Water	779	789	789
State- & County-Owned Right-of-Way	558	558	558
TOTAL	**10,205**	**10,205**	**10,205**

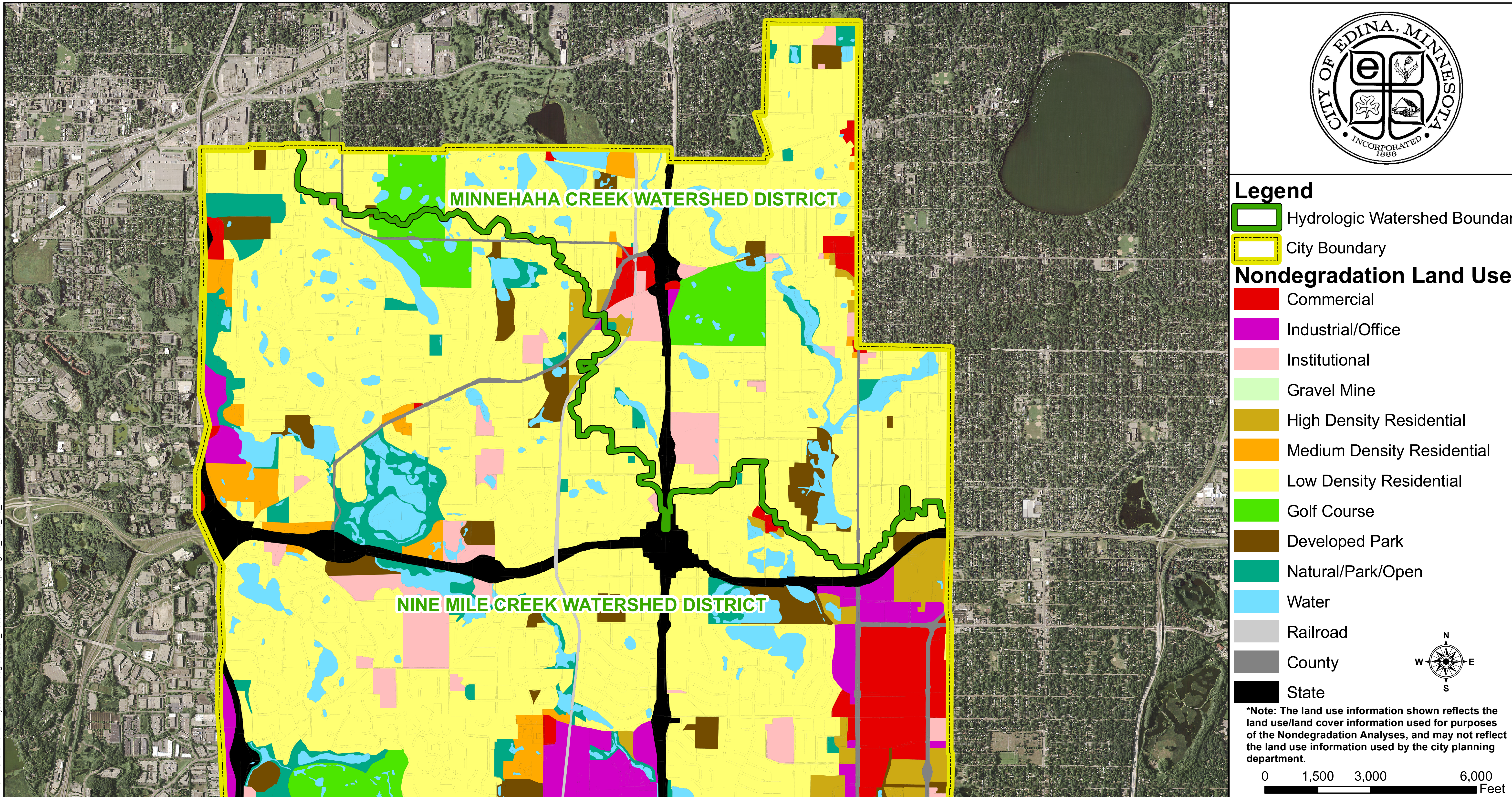


1988 Land Use
Edina
Nondegradation Study

Figure 2-1



Barr Footer: Date: 12/28/2007 8:14:14 AM File: I:\Client\Edina\Projects\Nondegradation_Assessment\Maps\Figure_2006_LU_Edina.mxd User: kow



2020 Land Use
Edina
Nondegradation Study

Figure 2-3

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CITY OF EDINA, MINNESOTA
INCORPORATED 1888

Legend

Generalized Future Redevelopment Area*

*Note: These areas represent the general areas of anticipated redevelopment. Not all parcels in the identified generalized areas will be redeveloped.

N W E S

0 500 1,000 2,000 Feet

Areas of Future Redevelopment

Edina Nondegradation Study

Figure 2-4

2.2 Watershed Imperviousness Determination

Another parameter that is required to develop estimates of average annual flow volume, TP and TSS loadings is imperviousness. Imperviousness was estimated for each land use category using satellite-derived (LandSat) data developed by the University of Minnesota for the MPCA. These data are available for the entire Twin Cities Metropolitan areas for the years 1986, 1991, 1998, 2000 and 2002.

The type and density of land use is different between the portions of the city within the Minnehaha Creek and Nine Mile Creek watersheds. In general, the portion of the city within the Minnehaha Creek Watershed District was mostly developed prior to the 1960's and is predominantly residential land use. Most of Edina's commercial, industrial/office, and recently developed residential areas lie within the Nine Mile Creek Watershed District. Due to these differences, imperviousness was calculated separately for portions of the city within each watershed district. Imperviousness for 1988 conditions was determined by overlaying the 1988 LU on the 1991 LandSat-derived estimates of imperviousness and calculating an average imperviousness for each land use within each watershed district. Imperviousness for 2006 was determined by overlaying the 2006 LU with the 2002 LandSat-derived estimates of imperviousness (the most current LandSat data available), and calculating an average imperviousness for each land use within each watershed district. Since the City of Edina was primarily developed by 1988, it was assumed that the average percent impervious by land use for 1988 and 2006 would be the most representative for the load calculations for all years of analysis. For 2020, it was assumed that in general the imperviousness would stay the same as the values calculated, except where additional information was available. For future (2020) conditions, all parcels slated for redevelopment in the Gateway redevelopment area were assumed to be 75 percent impervious, based on the most conservative future land use assumption from the Gateway Study Area Final Alternative Urban Areawide Review (2007).

The imperviousness assumptions for several categories (natural/ park/ open, water, gravel mine) were determined based on review of aerial imagery and literature values, due to accuracy limitations of the LandSat data for these land use categories and the years of the land use and imperviousness data not matching. The calculated imperviousness values for each land use type for areas of the city within the MCWD and NMCWD are summarized in Table 2-3.

In the 1988 land use, approximately 90 acres were identified as gravel mine land use (Table 2-2). In the early 1990's, this area was redeveloped into the Centennial Lakes Park area, which included construction of a pond, park, and mixed-use area consisting of commercial, residential, and office land use. For purposes of the loading assessment, the gravel mine site was assumed to be ten percent impervious based on review of historic aerial photos.

2.2.1 Summary of Land Use and Imperviousness by Watershed

ArcMap GIS was used to intersect the hydrologic boundary of the two major watersheds within the city with the LU data for 1988, 2006, and 2020. The resulting acreage for each land use category within the Minnehaha Creek and Nine Mile Creek watersheds was then multiplied by the calculated impervious fractions (Table 2-3) to determine the amount of impervious area. The land use areas and estimated impervious areas are summarized by major watershed in Table 2-4.

Table 2-3 Imperviousness by Land Use Type for Edina

Land Use Class	Minnehaha Creek Watershed Percent Imperviousness	Nine Mile Creek Watershed Percent Imperviousness
Commercial	79.8	83.9
Developed Park	22.4	23.2
Golf Course	7.6	3.9
Gravel Mine	N/A	10.0
High Density Residential	59.9	58.1
Industrial/Office	65.1	73.4
Institutional	51.2	39.9
Low Density Residential	26.5	25.4
Medium Density Residential	40.2	43.5
Natural/Park/Open	0.0	0.0
Railroad	37.5	27.8
Water	100.0	100.0

Table 2-4 Edina Land Use (LU) Areas and Imperviousness by Watershed for 1988, 2006 and 2020 (in acres)

Watershed	Land Use	Area (acres)		
		1988	2006	2020
Minnehaha Creek	Commercial	54	53	53
	Developed Park	66	66	66
	Golf Course	194	194	194
	Gravel Mine	0	0	0
	High Density Residential	10	18	18
	Industrial/Office	15	3	3
	Institutional	98	112	112
	Low Density Residential	1,820	1,822	1,822
	Medium Density Residential	21	21	21
	Natural/Park/Open	47	35	35
	Railroad	10	10	10
	Water	215	215	215
	TOTAL	2,549	2,549	2,549
	Area Impervious[1]	632	636	636
	Percent Impervious[2]	27%	27%	27%
Nine Mile Creek	Commercial	250	292	295
	Developed Park	217	230	230
	Golf Course	379	400	400
	Gravel Mine	90	0	0
	High Density Residential	221	249	251
	Industrial/Office	687	722	725
	Institutional	256	262	262
	Low Density Residential	3,533	3,711	3,735
	Medium Density Residential	201	229	229
	Natural/Park/Open	672	401	369
	Railroad	28	28	28
	Water	564	574	574
	TOTAL	7,098	7,098	7,098
	Area Impervious[1]	2,011	2,142	2,154
	Percent Impervious[2]	31%	33%	33%

2.3 Modeling Approach and Methodology for Loading Estimates

Complex models used to answer simple questions are not advantageous and simple models that do not model important or required physical processes are not useful. In keeping with the Permit conditions and guidance discussed in Section 1.2, the modeling approach was developed based on the following requirements:

- The loading assessment should include changes to pollutant loadings associated with changes due to past land use changes and changes due to anticipated land use changes
- The modeling will produce relative values, as the MPCA is more concerned with the average annual increases than about specific event increases. It is not as important to get the actual loads correct as it is to model consistently, showing the relative change in loads rather than the actual loads
- The assessment can include changes due to BMPs that have already been implemented, if increase in the loading since 1988 is explicitly stated, as well as changes due to BMPs that are planned to be implemented and written into the MS4's ordinances or other regulatory mechanisms
- The model does not need to calculate design features such as hydrographs, but can show removal rates based on design criteria, which can be just as useful for planning purposes. Design calculations may need to be run before implementation but often these can be run on a much smaller scale.

Currently, there are several water quality models available for simulating urban runoff and the treatment effectiveness of BMPs. Table 2-5 presents a qualitative comparison of several of the important attributes associated with some of the more common runoff water quality model capabilities based on the various selection criteria. The compiled model attributes and capabilities come primarily from peer-reviewed manuals (U.S. EPA, 1997; Burton and Pitt, 2001), with additional updated information based on our own experience and professional judgment. The water quality models included in the table are generally listed in increasing order of complexity (from left to right). For each attribute or selection criteria the models are categorized by possessing low, medium (intermediate) or high capabilities. Those capabilities that are not incorporated into a particular model, or were not applicable, were also indicated. The model selection approach for this assessment involved comparison of the advantages and limitations of the various models as they pertain to the Permit requirements, available data, and objectives of the city.

The Simple Method is an empirical approach developed for estimating pollutant export from various land uses. It is used at the site-planning level to predict pollutant loadings under a variety of development scenarios. The Pondnet model is an empirical model developed to evaluate water quality treatment performance, flow and phosphorus routing in pond networks with the following input parameters defined by the user: watershed area, runoff coefficient, pond surface area, pond mean depth, period length, period precipitation and phosphorous runoff concentrations. The spreadsheet is designed so that the phosphorous removal of multiple ponds in series can be evaluated. The SLAMM model can identify pollutant sources and evaluate the effects of a number of different stormwater control practices on runoff. The model performs continuous mass balances for particulate and dissolved practices on runoff. The P8 model was developed to continuously simulate the generation and transport of stormwater runoff pollutants in small urban catchments and to assess impacts of development on water quality, with minimum site-specific data.

P8 includes several routines for evaluating the expected removal efficiency for particular site plans, selecting or siting BMPs necessary to achieve a specified level of pollutant removal, and comparing the relative changes in pollutant loads as a watershed develops. The Generalized Watershed Loading Functions (GWLF) model was developed to assess point and nonpoint loadings of nutrients from urban and agricultural watersheds and to evaluate the effectiveness of certain land use management practices. The model includes rainfall/runoff and erosion and sediment generation components, as well as total and dissolved nutrient loadings. The XP-SWMM model is a watershed-scale model originally developed by the EPA to address urban stormwater and assist in storm-event analysis and derivation of design criteria for structural control of stormwater pollution. XP-SWMM is data intensive, but allows for continuous or storm event simulations and application to complex watersheds and land uses.

Table 2-5 shows that the only limitation with the P8 model, as it relates to the modeling requirements for the loading assessment, is that it is not intended to be used to determine pollutant loadings from non-urban land uses. However, the Simple Method, PONDNET and GWLF can be used to determine pollutant loadings from both urban and non-urban land uses. Both the Simple Method and PONDNET are typically used on an annual time scale. Table 2-5 also shows that the Simple Method, PONDNET and GWLF lack the ability to model the BMPs that would typically be considered for implementation by the City (such as vegetated drainage ways, extended detention, infiltration/filtration practices and street sweeping). SLAMM lacks a snowmelt runoff routine, does not have any capabilities for including baseflow in BMP analysis, and does not have the model output features contained in the P8 model. XP-SWMM is more complex, but is not in the public domain, is significantly more expensive, and BMP modeling is more cumbersome, less accurate and less intuitive than the P8 model.

Table 2-5 Comparison of Modeling Attributes/Capabilities by Selection Criteria

Criteria/Attributes		Simple Method	PONDNET	SLAMM	P8	GWLF	XP-SWMM
Time Scale	Annual	H	H	--	--	--	--
	Single Event	H	--	--	H	--	H
	Continuous	--	--	H	H	H	H
Hydrology	Runoff	L	L	H	H	H	H
	Baseflow	--	--	--	L	H	H
	Snowmelt	--	--	--	H	--	H
Pollutant Loading (Constituents)	Sediment (TSS)	H	--	H	H	H	H
	Nutrients	H	H	H	H	H	H
Pollutant Loading (Land Uses)	Urban	H	H	H	H	H	H
	Agricultural	H	H	--	--	H	--
Pollutant Routing	Transport	--	--	L	L	L	H
	Erosion	--	--	--	--	H	H
	Transformation	--	--	--	--	--	L
Hydraulic Flow Routing/Diversions		--	--	--	L	L	H
Model Output	Statistics	L	L	L	H	L	H
	Graphics	--	--	L	H	M	H
	Hydro/Pollutographs	--	--	--	H	--	H
	Format Options	L	L	H	H	H	H
	Sensitivity Analysis	--	--	--	H	--	--
Input Data	Requirements	L	L	M	M	M	H
	Calibration	L	L	L	M	L	H
	Default Data	L	H	H	H	H	M
	User Interface	L	L	H	H	H	H
GIS Compatibility		L	L	--	M	L	M
BMPs-General	Evaluation	--	H	M	H	L	H
	Design Criteria	--	H	L	H	--	H
Specific BMPs	Ponds/Wetlands	--	H	H	H	--	H
	Extended Detention	--	--	M	H	--	H
	Infiltration/Filtration	--	--	H	H	--	M
	Street Sweeping	--	--	H	H	--	M
	Others	--	--	H	H	--	L
Documentation	Peer Acceptance	H	H	H	H	H	H
	Technical Support	L	L	M	H	L	H
Cost	Software	L	L	M	L	L	H
	Use	L	L	M	M	M	H

H – High M – Medium (Intermediate) L – Low -- Not Incorporated (Not Applicable)

For this loading assessment, the Simple Method was chosen to determine the pollutant loadings and runoff volumes from each of the land uses within each watershed. The P8 model was selected to account for the effects of BMP implementation for the time periods of interest in the Permit conditions. In addition to the discussion associated with Table 2-5, the following information provides further justification for choosing the Simple Method/P8 model combination for the loading assessment modeling, in comparison to SLAMM, PONDNET, XP-SWMM, or some combination thereof:

- The Simple Method inputs can be directly derived within GIS
- PONDNET does not model TSS loadings and is only intended for modeling TP within wet detention ponds
- SLAMM is more detailed than P8 with respect to distinguishing source loading areas (such as driveways, parking lots, lawns, etc.), but P8 exceeds the capabilities of SLAMM when it comes to networking of watersheds/BMPs and many of the graphics and advanced output features
- P8 provides routines for performing sensitivity analyses and can also be run in design mode to determine required sizes of BMP(s) to meet treatment criteria
- P8 has the highest peer acceptance in Minnesota for urban runoff and BMP water quality modeling and enhancements have been supported by the MPCA
- P8 is free, user-friendly and easy to learn with its menu driven system
- P8 allows for some GIS compatibility via ASCII text file import of watershed data and export of results
- P8 models actual hourly precipitation and climatic data as it occurs, with its associated antecedent moisture conditions, while SLAMM only reads in the total precipitation and duration of each rainfall event and does not model actual runoff events in real-time with their associated antecedent moisture conditions
- Unlike SLAMM, P8 allows for hydrologic calibration within the program and can be calibrated/validated to time series runoff events continuously simulated from climatic data

While some monitoring data of stormwater runoff and receiving water quality/quantity has been collected by the watershed districts, none of the studies included monitoring of runoff from individual land uses or specific land cover types. P8 models have been developed as part of the city's CWRMP (2003), and calibrated with the available data for portions of the city as part of Use Attainability Analyses performed by the NMCWD. However, the P8 Models are representative of only 2002-2006 land use conditions (depending on the receiving waterbody) and they include natural wetlands in the modeling network. Since the presence of natural wetlands in the modeled drainage systems would affect the downstream water and pollutant loadings, it would not accurately distinguish between the expected treatment levels or provide a truly relative comparison between the predicted loadings, with and without the presence of the watershed BMPs.

Following the initial assessment of TSS, TP and volume contributions with the Simple Method, the benefits that current BMP implementation has had on the flow volume, TP and TSS loadings within the city limits were assessed using P8 water quality modeling for developments based on P8 model design criteria examples that are indicative of the ordinances and design standards that were in place by the City, the watershed districts, the Wetland Conservation Act and the MPCA when development occurred. Based on the available data, combining the Simple Method and P8 Model for the loading assessment ensures full compliance with the Permit requirements, for the following reasons:

- The Simple Method ensures that a consistent method for calculating average annual volumes and loadings will be applied to all land uses to produce relative values across the two times periods of interest, as discussed in the Permit and Guidance Manual (see Sections 1.1.1 and 1.2.2.1 of this report)
- The P8 Model simulations of volume and pollutant loading reductions associated with BMP implementation, according to the various ordinances and design standards that were in place when development occurred, is consistent with the Permit conditions and Guidance Manual and provides a consistent method for calculating relative removal rates as suggested in Section 1.2.2.1 (which includes the following excerpts from the Guidance Manual, "The model…can show removal rates based on design criteria… Design calculations may need to be run before implementation but often these can be run on a much smaller scale.)
- Excludes the effects that natural wetlands would have on improving the stormwater quality within each watershed, which ensures that the loading assessment estimates that include BMPs (discussed in Section 2.4) do not take credit for treatment by natural wetlands
- The City will not have to revise and update existing P8 models to exclude the effects of natural wetlands or collect significantly more data on every BMP to develop new P8 models for the rest of the city, which would represent significantly more cost for a product that would not provide a "distinction between what is desirable and what is required. The MPCA chose a level [in its loading assessment requirements] that will prevent undue burden while still developing useful information." (MPCA Guidance Manual, 2006)

The loading assessment modeling results were summarized for each land use within the city within the two major watersheds to show the Simple Method loading and volume estimates for each time period, as well as the loading and volume estimates after applying the predicted removal efficiencies from the P8 model design criteria examples, based on the ordinances and design standards that were in place when the various developments occurred.

2.3.1 Average Annual Flow Volume

The conversion of land areas to alternate uses leads to changes in watershed hydrology and pollutant load rates. The areal increase in impervious surfaces in urban areas over undeveloped rural and natural land uses leads to greater surface water runoff volumes. The increased runoff coupled with human activities increases the types of pollutants and delivery rate of these pollutants to surface waters. Impermeable surfaces shed water as surface runoff, as do agricultural practices that convert natural land cover, which reduces the infiltration and evapotranspiration components of the hydrologic cycle. Surface runoff in urbanized areas is generally directed to storm sewers and other conveyance systems to rapidly move the large volumes to receiving waters and prevent flooding. This section provides a general discussion about the methodology used to quantify the amount of runoff from the various land uses in the Edina watersheds during the two time periods of interest for the Permit conditions.

As previously discussed, the Simple Method was used to estimate the average annual runoff volumes, which in turn, are used to calculate the TP and TSS loadings for the various land uses present within the Edina watersheds. The average annual runoff volume was calculated for each land use class using the following relationships (as described in Schueler, 1987):

Annual Runoff Coefficient [RC] = 0.05 + (0.009 x LU Percent Imperviousness)

Annual Runoff Volume (acre-feet) = RC x Annual Rainfall (inches) x LU Area (acres) / 12

The calculated LU percent imperviousness for each land use class can be found in Table 2-3. The average annual rainfall was assumed to be 29.4 inches, based on the 1971- 2000 average annual precipitation from the Minneapolis International Airport precipitation gauge (MSP).

There is no monitoring data available for runoff volumes or quality from individual land uses or specific land cover types within the city. The annual runoff coefficients (percentage of rainfall resulting in runoff) were determined based on review of available literature. The annual runoff coefficients for most of the land use categories were calculated using the equation described above, with the exception of the natural/park/open and gravel mine land uses. For the natural/park/open land use, curve number methodology, assuming good ground cover, was applied to the long-term Twin City continuous rainfall records to estimate that the relative event-based cumulative runoff coefficient (RC) was 0.03. This runoff coefficient for natural areas shows good relative agreement with the urban pervious runoff coefficient of 0.05 (taken from Schueler [1987]). The annual runoff coefficient for the gravel mine land use category was assumed to be the same as that of natural/park/open land use (0.03) due to the low runoff potential from the gravel mine site. The calculated average annual flow volume for each land use class within each major watershed are summarized in Table 2-6.

Table 2-6 Edina City-Wide Average Annual Flow Volume by Watershed for 1988, 2006 and 2020 (Without BMPs – Land Use Only)

	Land Use	1988 Average Annual Flow Volume (acre-feet)	2006 Average Annual Flow Volume (acre-feet)	2020 Average Annual Flow Volume (acre-feet)
Minnehaha Creek	Commercial	102	100	100
	Developed Park	41	41	41
	Golf Course	56	56	56
	Gravel Mine	0	0	0
	High Density Residential	15	25	25
	Industrial/Office	24	5	5
	Institutional	123	141	141
	Low Density Residential	1,285	1,287	1,287
	Medium Density Residential	21	21	21
	Natural/Park/Open	3	3	3
	Railroad	9	9	9
	Water	501	501	501
	TOTAL	2,180	2,189	2,189
Nine Mile Creek	Commercial	494	577	583
	Developed Park	138	146	146
	Golf Course	79	83	83
	Gravel Mine	7	0	0
	High Density Residential	310	349	353
	Industrial/Office	1,196	1,257	1,266
	Institutional	257	263	263
	Low Density Residential	2,410	2,531	2,547
	Medium Density Residential	217	248	248
	Natural/Park/Open	49	30	27
	Railroad	21	21	21
	Water	1,313	1,337	1,337
	TOTAL	6,491	6,842	6,874
City Wide	**TOTAL**	8,671	9,030	9,063

2.3.2 Total Phosphorus

As previously discussed, there is no monitoring data available for runoff volumes or quality from individual land uses or specific land cover types within the city. Therefore, the expected TP concentrations for each urban land use type were estimated using the concentrations listed in the *2005 MPCA Minnesota Storm Water Manual*. The land use specific TP concentrations used for Edina's loading assessment are summarized in Table 2-7.

Phosphorus loadings from urbanized portions of the city were calculated according to the following equation:

$$\text{TP Load (lbs.)} = \text{Land Use Runoff TP Conc. (mg/L)} \times \text{Annual Runoff Volume (acre-feet)} \times 2.72$$

The TP contributions from non-urban land uses (natural/open/park) were based on Reckhow et al. (1980), which summarized the TP export coefficients produced from several published monitoring studies throughout the country that were specific to individual land uses or land cover types. All of the available TP export coefficient data were taken from Reckhow et al. (1980) and used to determine the median export coefficients for the non-urban land use categories. The median TP export coefficient for the natural/open/park land use categories was 0.09 lbs/ac/yr. It was assumed that runoff from the gravel mine land use would exhibit the same TP export coefficient as natural/open/ park.

The average annual phosphorus loading from non-urban land uses (natural/open space and gravel mine) was calculated according to the following equation:

$$\text{TP Load (lbs)} = \text{Land Use Area (acres)} \times \text{TP Export Coefficient (lbs/ac/yr)}$$

The TP concentrations and TP export coefficients assumed for each land use category are listed in Table 2-7. It was assumed that there would be no TP contribution from the water areas. The calculated TP loading for each land use class within each major watershed are summarized in Table 2-8.

Table 2-7 TSS and TP concentrations and Export Coefficients for each LU Category

Land Use	TP Concentration[1] (mg/L)	TP Export Coefficient[2] (lbs/acre/yr)	TSS Concentration[3,4] (mg/L)		TSS Export Coefficient[5] (lbs/acre/yr)
Commercial	0.22		43-54	48.5	
Developed Park	0.31		51-78	64.5	
Golf Course	0.31		51-78	64.5	
Gravel Mine		0.09			5
High Density Residential	0.3		68	68	
Industrial/Office	0.26		77-82	79.5	
Institutional	0.18		17	17	
Low Density Residential	0.3		48	48	
Medium Density Residential	0.3		48-68	58	
Natural/Park/Open		0.09			5
Railroad	0.25		81-99	90	
Water					

1 - Minnesota Stormwater Manual, Table 8.7
2 - Reckhow *et al.*, 1980
3 – Table 9, Summary of Available Stormwater Data Included in NSQD, version 1.0 (From "The Design, Use, and Evaluation of Wet Detention Ponds for Stormwater Quality Management Using WinDETPOND," Pitt, 2003)
4 - For TSS loading calculations, the average of the range was used
5 – A median coefficient based on MCES, 2004; DeByle and Packer, 1972; Harms *et al.*, 1974; Webber and Elrick, 1967; Sonzogni *et al.*, 1980

Table 2-8 Edina City-Wide Total Phosphorus (TP) by Watershed for 1988, 2006 and 2020 (Without BMPs – Land Use Only)

	Land Use	1988 Total Phosphorus (lbs)	2006 Total Phosphorus (lbs)	2020 Total Phosphorus (lbs)
Minnehaha Creek	Commercial	61	60	60
	Developed Park	34	34	34
	Golf Course	47	47	47
	Gravel Mine	0	0	0
	High Density Residential	12	21	21
	Industrial/Office	17	4	4
	Institutional	60	69	69
	Low Density Residential	1,049	1,050	1,050
	Medium Density Residential	17	17	17
	Natural/Park/Open	4	3	3
	Railroad	6	6	6
	Water	0	0	0
	TOTAL	1,307	1,311	1,311
Nine Mile Creek	Commercial	295	345	349
	Developed Park	116	123	123
	Golf Course	67	70	70
	Gravel Mine	8	0	0
	High Density Residential	253	285	288
	Industrial/Office	846	889	895
	Institutional	126	129	129
	Low Density Residential	1,966	2,065	2,078
	Medium Density Residential	177	202	202
	Natural/Park/Open	61	36	33
	Railroad	14	14	14
	Water	0	0	0
	TOTAL	3,929	4,158	4,181
City Wide	**TOTAL**	5,236	5,469	5,492

2.3.3 Total Suspended Solids

As previously discussed, there is no monitoring data available for runoff volumes or quality from individual land uses or specific land cover types within the city. For all land use categories except natural/open/park area and gravel mine, the TSS runoff concentrations were taken from Pitt (2003). TSS loadings from all land use classes except natural/open/park area and gravel mine were then calculated according to the following equation:

TSS Load (lbs.) = Land Use Runoff TSS Conc. (mg/L) x *Annual Runoff Volume (acre-feet)* x *2.72 (conversion factor)*

The TSS contributions from non-urban land uses were based on several literature sources (MCES, 2004; DeByle and Packer, 1972; Harms et al., 1974; Webber and Elrick, 1967; Sonzogni et al., 1980), which summarized the TSS export coefficients produced from several published monitoring studies throughout the country that were specific to individual land uses or land cover types. All of the available TSS export coefficient data were taken from the literature sources and used to determine the median export coefficient for the natural/open/park land use categories. The median TSS export coefficient for natural/open/park land use was 5 lbs/ac/yr. It was assumed that runoff from gravel mine sites would exhibit similar TSS export coefficients as those of natural/open/park land. The average annual TSS loadings from the natural/open/park and gravel mine areas in each watershed were then calculated according to the following equation:

TSS Load (lbs.) = Land Use Area (acres) x TSS Export Coefficient (lbs/ac/yr)

The TSS concentration and TSS export coefficient for each land use category is listed in Table 2-7. It was assumed that there would be no TSS contribution from the water areas. The calculated TSS loading for each land use class within each major watershed are summarized in Table 2-9.

Table 2-9 Edina City-Wide Total Suspended Solids (TSS) by Watershed for 1988, 2006 and 2020 (Without BMPs – Land Use Only)

	Land Use	1988 Total Suspended Solids (lbs)	2006 Total Suspended Solids (lbs)	2020 Total Suspended Solids (lbs)
Minnehaha Creek	Commercial	13,446	13,208	13,208
	Developed Park	7,108	7,108	7,108
	Golf Course	9,861	9,861	9,861
	Gravel Mine	0	0	0
	High Density Residential	2,667	4,733	4,733
	Industrial/Office	5,169	1,097	1,097
	Institutional	5,680	6,504	6,504
	Low Density Residential	167,778	167,994	167,994
	Medium Density Residential	3,310	3,310	3,310
	Natural/Park/Open	233	176	176
	Railroad	2,244	2,244	2,244
	Water	0	0	0
	TOTAL	217,496	216,235	216,235
Nine Mile Creek	Commercial	65,106	76,043	76,852
	Developed Park	24,181	25,570	25,570
	Golf Course	13,883	14,634	14,634
	Gravel Mine	452	0	0
	High Density Residential	57,364	64,615	65,284
	Industrial/Office	258,662	271,781	273,686
	Institutional	11,882	12,163	12,163
	Low Density Residential	314,517	330,373	332,490
	Medium Density Residential	34,228	39,042	39,042
	Natural/Park/Open	3,357	2,007	1,845
	Railroad	5,136	5,136	5,136
	Water	0	0	0
	TOTAL	788,768	841,364	846,702
City Wide	**TOTAL**	1,006,264	1,057,599	1,062,937

2.3.4 BMP Implementation Modeling

As previously discussed, P8 water quality modeling was used to assess the benefit that past, current, and expected future BMP implementation would have on the flow volume, TP and TSS loadings within the city. P8 water quality modeling was conducted to determine the appropriate treatment removal efficiencies for each of the BMP implementation categories. The methodology for calculating the treatment removals and resulting loading reductions for each of these categories is discussed in further detail below.

Past BMP Implementation

Land Development/Redevelopment BMPs

Historically, the water quality treatment BMP requirements for land development and redevelopment activities within the City of Edina have varied based on both the watershed that the development area was located in and the year of development. The City and watershed districts have implemented conventional stormwater quality treatment requirements since the late-1980s, typically in the form of stormwater detention ponds which are effective for removal of sediment and phosphorus from the stormwater runoff. A timeline of the water quality treatment design standards required by each of the watershed districts throughout the past two decades is provided in Table 2-10.

P8 modeling was used to estimate the pollutant removal efficiencies achieved by implementation of the various design standards for runoff volume, TP, and TSS. Each of the design standard scenarios listed in Table 2-10 were simulated in P8 for a hypothetical low-density residential development with 25 percent impervious and a commercial development with 80 percent impervious to obtain a range of treatment efficiencies, as well as the average efficiency, that would be expected upon implementation of the design standard. The predicted removal efficiencies for each design standard and associated time period are summarized in Table 2-11. It was assumed that no volume reduction would be realized from implementation of the historic water quality treatment design standards, which focused on construction of sedimentation ponds.

Table 2-10 Edina BMP Implementation Schedule Assumptions and Timeline of Water Quality Treatment Requirements for Nondegradation Loading Assessment

ORGANIZATION	1988-1989	1990-1992	1993-1995	1996-1998	1999-2004	2005-Present
Minnehaha Creek Watershed District	Remove sediment > 0.1 mm with 90% trap efficiency for a 1-year storm			NURP Design Standards[1]		Remove 50% of TP load
Nine Mile Creek Watershed District	Remove sediment > 0.1 mm for a 10-year (1.7”), 30-minute storm		NURP Design Standards[1]			

[1] MPCA, 1989

Table 2-11 Predicted Pollutant Removal Efficiencies for BMP Implementation as a Result of Water Quality Treatment Standards for Land Development Activities

Watershed	Year Built	BMP Type	Runoff Reduction (%)	TP Removal (%)	TSS Removal (%)
Past BMP Implementation					
Minnehaha Creek[1]	1988-1995	Pond	0	18	47
Minnehaha Creek[1]	1996-2004	Pond	0	56	87
Minnehaha Creek[1]	2005-2006	Pond	0	50	82
Nine Mile Creek[1]	1988-1992	Pond	0	30	61
Nine Mile Creek[1]	1993-2006	Pond	0	56	87
Future BMP Implementation					
Entire City[1]	2006-2020	Infiltration	85	86	93

[1] Removal efficiencies are based on the results from P8 modeling

To compute the reduction in pollutant loading from implementation of past development BMPs, it was necessary to identify the development areas that were subject to BMP requirements. Since some residential areas throughout the city developed on a lot-by-lot basis since 1988, not all parcels were required to implement BMPs. To quantify the areas of development requiring BMP implementation, a parcel-based GIS coverage was developed that identified all of the developments and redevelopments in the city that were required to implement stormwater BMPs between 1988 and 2006 and identified the year of development. This coverage was intersected with the watershed boundaries to determine the total areas of development that were subject to the various BMP design standards for the time periods of interest. The loading reductions were then calculated by computing the predicted loading from the identified development areas based on land use and applying the estimated treatment removal efficiencies to quantify the reduction. The calculated loading reductions for each design standard and associated time period are summarized in Table 2-12.

Due to the developed nature of the city, regional detention ponds have generally been supported by the City for development or redevelopment locations where on-site stormwater treatment is not practical or feasible.

City- and Watershed District- Sponsored BMP Implementation

Construction of Centennial Lakes Park, a 24-acre park and pond, is a city-sponsored project completed since 1988 that has resulted in significant reductions in stormwater pollutant loading. The park and 10-acre pond was designed to offer recreational amenities, but also provides stormwater rate control and water quality treatment. The pond receives stormwater runoff from a tributary area of approximately 216 acres. Based on P8 modeling completed as part of the City's 2003 CWRMP, the pond removes approximately 59 percent of the TP loading and 91 percent of the TSS loading on an average annual basis. Based on the calculated loading for the Centennial Lakes drainage area and the predicted removal efficiencies, the estimated annual TP and TSS load reductions are 133 lbs and 48,337 lbs, respectively.

The City of Edina values the many water resources within the city, and is continually seeking opportunities to partner with the local watershed districts to protect and/or improve water quality. Beginning in 2000, the City partnered with the Minnehaha Creek Watershed District to implement the Pamela Park Wetland Restoration and Water Quality Improvement Project. The project involved two phases of water quality improvements. The first phase was construction of a series of three stormwater ponds to provide water quality treatment to approximately 297 acres of previously untreated residential property prior to discharge in an existing wetland and Minnehaha Creek. The second phase of the project involved removing accumulated sediment from open water areas of Lake Pamela and constructing ponds within existing wetland areas located at the two major storm sewer outfalls to the lake, to provide water quality treatment for approximately 129 acres of residential area. Water quality modeling calculations completed as part of the project indicated that the improvements would result in a total phosphorus load reduction to Minnehaha Creek of approximately 133 lbs per year (MCWD, 2000). This predicted annual TP removal translates into an annual TSS load reduction of 48,337 lbs, based on the modeling results from Centennial Lakes.

In addition to these city- and watershed district-sponsored water quality improvement projects, the City of Edina seeks opportunities to improve the quality of stormwater runoff as part of its street repair and maintenance program. Throughout the last several years, the City has installed seven stormwater treatment devices as a part of its roadway improvement projects. The City has installed these underground treatment systems, typically V2B1 structures by Environment21, in areas where implementation of conventional stormwater BMPs was not feasible, or where the receiving water bodies were targeted for water quality improvements, such as Lake Cornelia and Minnehaha Creek.

To quantify the loading reductions from the stormwater treatment devices, the tributary areas to the BMPs were identified based on the subwatershed delineation completed as part of the City's 2003 CWRMP (Barr, 2003). Pollutant removal efficiency assumptions were then applied to the calculated loadings from these land areas to compute the loading reduction. The sediment and phosphorus removal efficiencies of the water quality treatment devices are dependent upon many factors, including the magnitude of stormwater flows, the size of the treatment device, and the particle distribution of the suspended sediment in the stormwater. For purposes of this analysis, the stormwater treatment systems were assumed in general to have a runoff reduction of 0 percent, TP reduction of 5 percent, TSS reduction of 40 percent based on the Bowling Green, Kentucky Stormwater BMP Manual (2006). The predicted loading reductions from the City-installed stormwater treatment devices are summarized in Table 2-12. In addition to installation of the underground stormwater treatment devices, the City has installed over 70 sump manholes since 1988 as a part of the City's annual street and storm sewer repair and improvement projects. The sump manholes, designed to provide removal of sediment and other pollutants from stormwater inflows, are cleaned out on an annual basis as part of the City's BMP maintenance program.

Future Development and Redevelopment

To estimate the City's annual runoff volume, TP, and TSS pollutant loading for the year 2020, it was necessary to quantify the loading reductions from BMP implementation as a result of future land development and redevelopment. At the time of this study, both of the watershed districts within the city, the Nine Mile Creek Watershed District (NMCWD) and the Minnehaha Creek Watershed District (MCWD), are in the process of revising their stormwater management rules and drafting new stormwater quality treatment standards. Upon development of the new standards by the watershed districts, it is the City's intention to adopt the revised standards. Since most the of development and redevelopment anticipated between 2006 and 2020 is within the Nine Mile Creek portion of the city and since NMCWD has already developed their draft water quality treatment rules and standards (the MCWD is currently in the preliminary stages of their rule revision process), it will be assumed for purposes of this analysis that the City will plan to adopt treatment requirements that mimic the NMCWD draft water quality treatment standards.

Table 2-12 Predicted Average Annual Pollutant Loading Reductions from Past BMP Implementation

Watershed	Project/BMP Type	Runoff Reduction (ac-ft)	TP Reduction (lbs)	TSS Reduction (lbs)
Past BMP Implementation- Land Development/Redevelopment BMPs				
Minnehaha Creek: 1988-1995	WQ Ponds	0	0	0
Minnehaha Creek: 1996-2004	WQ Ponds	0	6	1,646
Minnehaha Creek: 2005-2006	WQ Ponds	0	1	438
Nine Mile Creek: 1988-1992	WQ Ponds	0	9	3,357
Nine Mile Creek: 1993-1995	WQ Ponds	0	12	3,144
Nine Mile Creek: 1996-2006	WQ Ponds	0	35	12,402
City- and Watershed District- Sponsored BMP Implementation				
Minnehaha Creek	City of Edina/ MCWD Pamela Park Wetland Restoration and WQ Improvement Project	0	133[1]	48,337
Nine Mile Creek	City of Edina Centennial Lakes	0	133	48,337
Minnehaha Creek	Underground Stormwater Treatment Devices	0	3	3,647
Nine Mile Creek	Underground Stormwater Treatment Devices	0	<1	264
	Totals	**0**	**332**	**121,572**

[1] MCWD, 2000

The NMCWD's draft treatment standards (August, 2007) are focused on stormwater volume reduction, as well as TP and TSS removal. The draft rules require onsite retention of one inch of runoff volume over all new impervious surfaces of the contributory drainage area of the parcel. P8 modeling was used to estimate the runoff volume, TP and TSS pollutant removal efficiencies achieved by implementation of the draft NMCWD design standard, assuming implementation of infiltration BMPs to meet the runoff retention requirement. The infiltration design standard scenario was simulated in P8 for a hypothetical low-density residential development with 25 percent impervious and a commercial development with 80 percent impervious to obtain a range of treatment efficiencies, as well as the average efficiency, that would be expected upon implementation of infiltration basins to meet the runoff retention design standard. The predicted average annual removal efficiencies for stormwater runoff volume, TP and TSS are 85 percent, 86 percent and 93 percent, respectively.

To calculate the anticipated loading reduction from implementation of the proposed design standards, it was necessary to predict the amount of area that is expected to change between the years 2006 and 2020 due to development and redevelopment. This was estimated by identifying and quantifying the areas where land use is predicted to change based on comparison of 2006 and 2020 land use, as well as quantifying anticipated areas of redevelopment, as identified by city staff. Due to the developed nature of the city, anticipated land use changes as a result of development are minimal and are primarily limited to the remaining development of the Parkwood Knolls residential area in the northwest corner of the city.

Although minimal additional development is expected to occur in the time period between 2006 and 2020, considerable redevelopment is anticipated, specifically in the commercial and industrial areas of the city. The areas identified as likely to redevelop have been categorized into three groups for purposes of this analysis: the Gateway area, the Greater Southdale area, and the Industrial Park area (Figure 2-4). For the Gateway area, the areas of anticipated redevelopment (and required BMP implementation) were identified based on the draft Gateway Study Area Final Alternative Urban Areawide Review (2007) and discussions with city staff. For purposes of this analysis, it was assumed that 61 percent of the Gateway land area shown in Figure 2-4 would be redeveloping prior to 2020. For the Greater Southdale area and the Industrial Park area, the areas of anticipated redevelopment (and required BMP implementation) were identified based on discussions with city staff. For purposes of this analysis, it was estimated that redevelopment would occur throughout approximately 25 percent of the Greater Southdale area and 28 percent of the Industrial Park area.

Once the areas of anticipated development and redevelopment were identified, the loading reductions were determined by calculating the anticipated loading from these areas using the methodology described in Section 2.3.1 through Section 2.3.3, and then calculating the loading reduction based on the predicted average annual removal efficiencies for runoff volume, TP, and TSS determined from the P8 modeling. The predicted loading reductions from implementation of the proposed NMCWD runoff retention standards are summarized in Table 2-13 for each watershed area within the city.

Table 2-13 Predicted Average Annual Pollutant Loading Reductions from Implementation of Future Runoff Retention BMP Design Standards (assuming 2020 LU conditions)

Watershed	Runoff Reduction (ac-ft)	TP Reduction (lbs)	TSS Reduction (lbs)
Minnehaha Creek[1]	0	0	0
Nine Mile Creek	538	371	110,292
Totals	**538**	**371**	**110,292**

[1] No loading reductions are predicted for the portions of the city within the MCWD as a result of the proposed runoff retention standards because no significant development or redevelopment was expected in this area by 2020.

2.4 Results and Discussion

Table 2-14 shows the results of the loading assessment modeling, which were summarized for each of the two major watersheds to show the Simple Method loading and volume estimates for each time period (without BMPs), as well as the loading and volume estimates after applying the predicted reductions from BMP implementation (Tables 2-12 and 2-13).

Evaluation of impacts of BMPs on runoff volume, TP, and TSS loads was limited to structural practices such as ponds designed to watershed design standards, infiltration practices, and storm treatment structures. There are a number of non-structural practices that the City of Edina has also implemented to address surface water quality runoff. The City implements a street sweeping program, with thorough biannual (spring and fall) street sweeping throughout the entire city, as well as intermittent sweeping focused on commuter routes and areas of high sediment accumulation. Street sweeping can reduce both TP and TSS loads and studies of high-efficiency street sweeping practices indicated that TSS reductions can range from 25 to 40 percent (Pitt, Bannerman, and Sutherland, 2004). The City has also sought opportunities to reduce impervious surface by decreasing street widths as a part of the City's street repair and improvement projects. Decreased street widths reduce the volume of stormwater runoff, in addition to reducing maintenance costs and slowing traffic speeds. The City of Edina has also complied with the statewide phosphorus lawn fertilizer ban in place since 2004. Studies evaluating the impact of a phosphorus fertilizer ban suggest that phosphorus loads from pervious areas that would typically be fertilized would result in a 17 percent TP load reduction (Barten and Jahnke, 1997). The impacts of these practices on TP and TSS loads have not been factored into the City of Edina loading assessment and as a result, the estimates of TP and TSS loads for 2006 and 2020 in this report can be considered conservative.

2.4.1 Average Annual Flow Volume

Table 2-14 and Figure 2-5 show that the total average annual flow volume from the city has increased since 1988 and would continue to increase by 2020, without implementation of the proposed future runoff retention design standards. This analysis assumes that the current design standards (water quality ponds) have no required impact on volume reduction. Estimated annual runoff volumes increased by approximately 4.1 percent from 1988 to 2006 and are expected to increase up to 4.5 percent by 2020, assuming the implementation of existing design standards, only. Figure 2-5 shows the predicted runoff volume contributions within the city for the years 1988, 2006, and 2020, with a total increase of about 359 acre-feet between 1988 and 2006.

The Nine Mile Creek Watershed District is currently amending their stormwater rules to require onsite retention of the first inch of runoff from the new impervious surfaces of the contributory drainage area of new development and redevelopment sites. The scenario evaluating volume reduction from onsite runoff retention (modeled as infiltration) for development and redevelopment sites from 2006 to 2020 (see Table 2-13 and Figure 2-5) indicates that city-wide implementation of the draft runoff retention standards can reduce the expected 2020 city-wide annual runoff volumes by roughly 6 percent when compared to 2006 (from 9,030 acre-feet to 8,525 acre-feet). Under this BMP implementation scenario, the average annual runoff volume from the city in 2020 is lower than baseline conditions of 1988 by about 2 percent. Figure 2-6 shows the estimated average annual flow volume from each watershed for each year of interest, assuming implementation of past and future BMP implementation. Since no future development or redevelopment was identified in the portion of the city that drains to Minnehaha Creek, no volume reduction was predicted for this part of the city in the future.

FIGURE 2-5
Edina Loading Assessment
City-Wide Average Annual Flow Volume

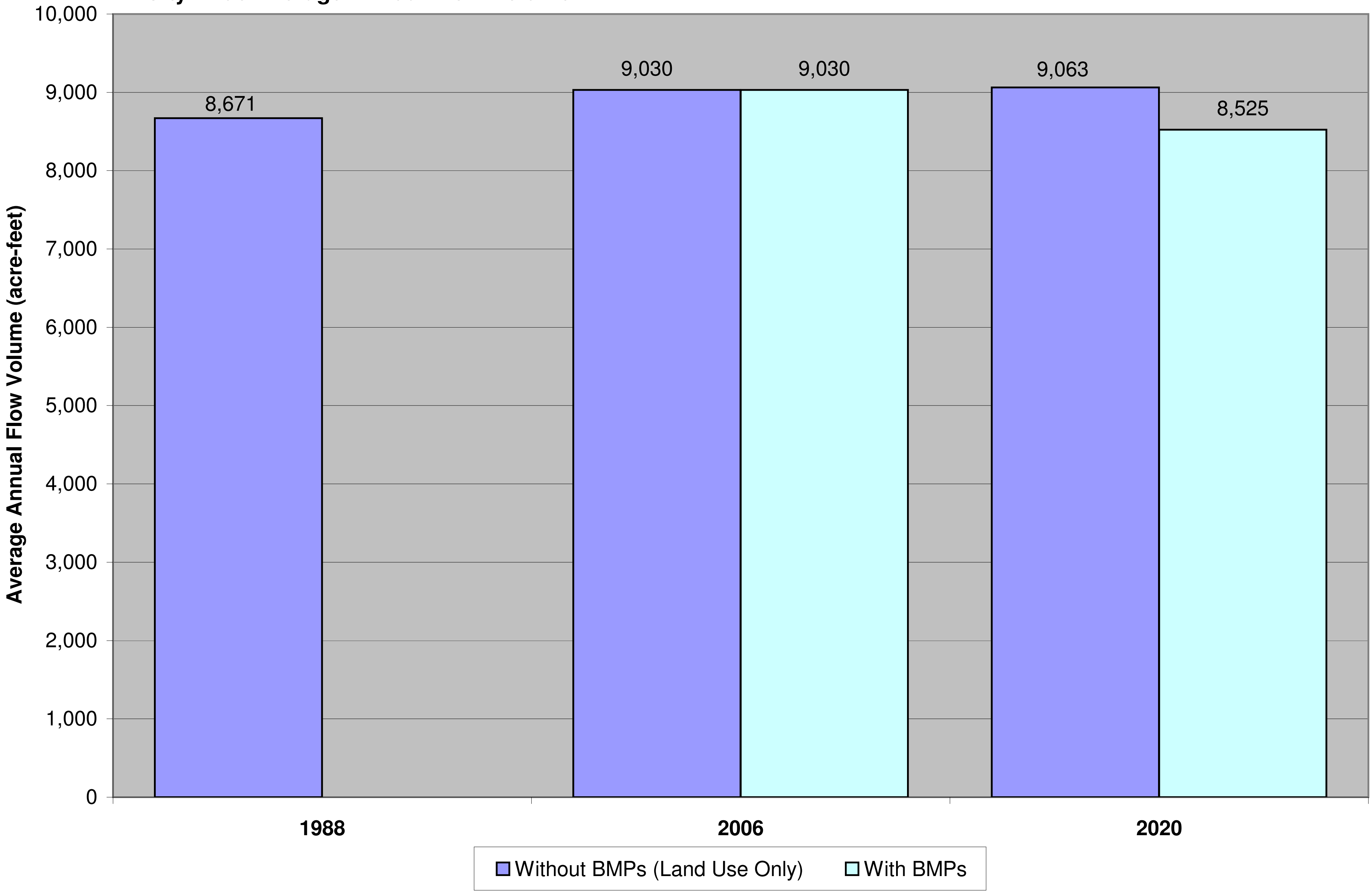

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FIGURE 2-6
Edina Loading Assessment -- Average Annual Flow Volume by Watershed with BMP Implementation

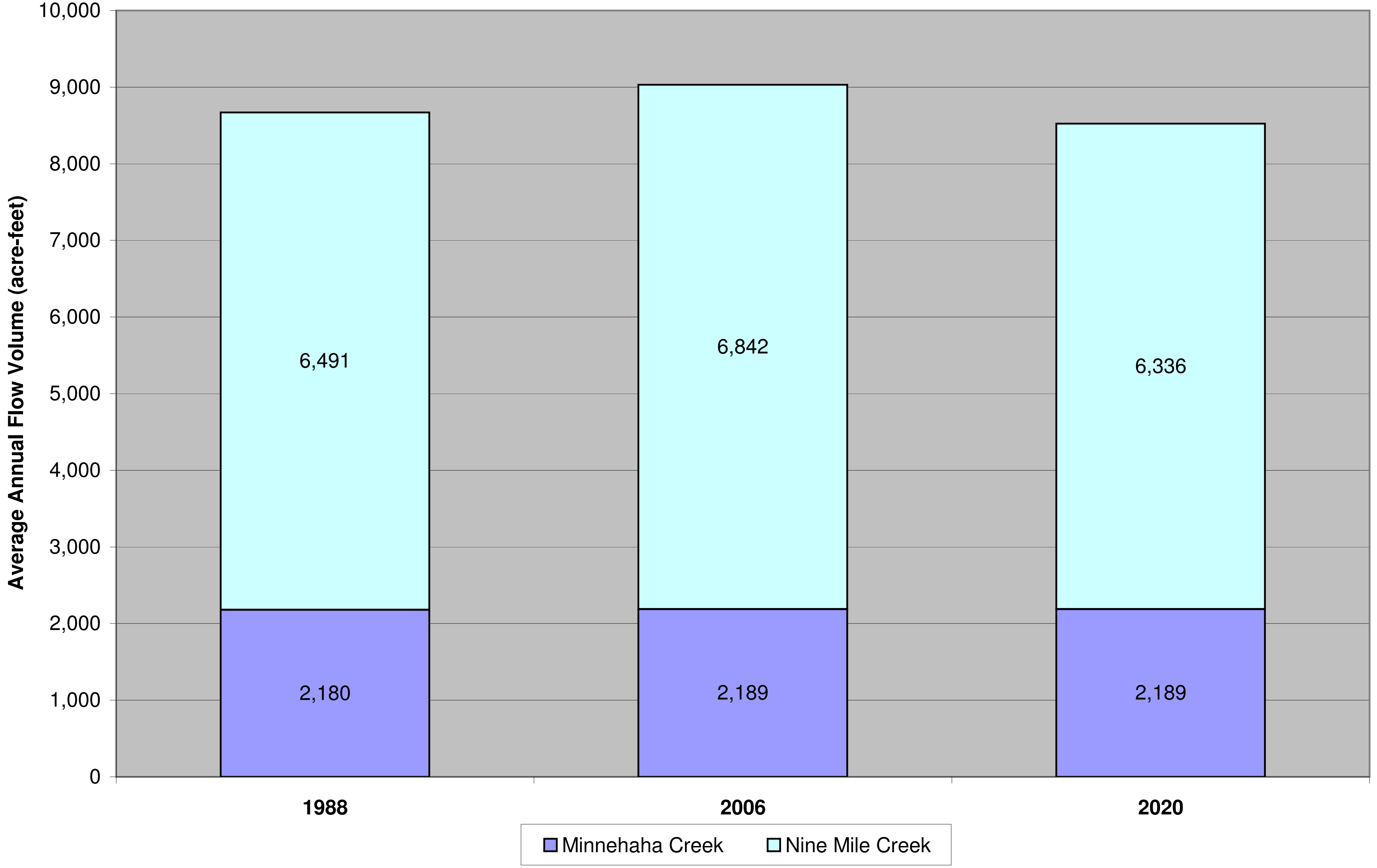

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Table 2-14 Edina Nondegradation Loading Assessment Summary

Without BMPs (Land Use Only)

	WATERSHED TOTAL RUNOFF (acre-feet)			WATERSHED TP YIELD (LBS)			WATERSHED TSS YIELD (LBS)		
WATERSHED	**1988**	**2006**	**2020**	**1988**	**2006**	**2020**	**1988**	**2006**	**2020**
Minnehaha Creek	2,180	2,189	2,189	1,308	1,311	1,311	217,495	216,235	216,235
Nine Mile Creek	6,491	6,842	6,874	3,929	4,158	4,181	788,768	841,364	846,702
TOTAL	**8,671**	**9,030**	**9,063**	**5,236**	**5,469**	**5,492**	**1,006,264**	**1,057,599**	**1,062,937**

With BMPs

	WATERSHED TOTAL RUNOFF (acre-feet)			WATERSHED TP YIELD (LBS)			WATERSHED TSS YIELD (LBS)		
WATERSHED	**1988**	**2006**	**2020**	**1988**	**2006**	**2020**	**1988**	**2006**	**2020**
Minnehaha Creek	2,180	2,189	2,189	1,308	1,168	1,168	217,495	162,167	162,167
Nine Mile Creek	6,491	6,842	6,336	3,929	3,969	3,621	788,768	773,860	668,905
TOTAL	**8,671**	**9,030**	**8,525**	**5,236**	**5,137**	**4,789**	**1,006,264**	**936,027**	**831,072**

2.4.2 Total Phosphorus

Table 2-14 and Figure 2-7 show that the average annual total phosphorus loading from the city has increased since 1988 and would continue to increase by 2020, without the implementation of BMPs. Table 2-14 shows that implementation of the water quality ponds and other BMPs throughout each of the city's watersheds has offset the increased phosphorus load between 1988 and 2006.

Table 2-14 and Figure 2-7 show that implementation of runoff retention standards for land development and redevelopment, as planned in the future, will continue to offset the increases in total phosphorus loading between 2006 and 2020 and will also result in an overall annual TP load reduction of approximately 7 percent (from 5,137 lbs to 4,789 lbs), as compared to the total load estimate for 2006. It is expected that the implementation of runoff retention practices will also help keep the total phosphorus loads in the future below baseline conditions, with 2020 TP loads expected to be about 9 percent lower than the estimated 1988 loads.

2.4.3 Total Suspended Solids

Table 2-14 and Figure 2-8 show that the average annual TSS loading from the city has increased since 1988 and would continue to increase by 2020, without the implementation of BMPs.
Table 2-14 shows that implementation of water quality ponds and other BMPs throughout the city has offset the increased TSS load between 1988 and 2006.

Table 2-14 and Figure 2-8 show that implementation of runoff retention standards for land development and redevelopment, as planned in the future, will continue to offset the increases in total suspended solids loading between 2006 and 2020 and will also result in an overall TSS load reduction of approximately 11 percent (from 936,027 lbs to 831,072 lbs.), as compared to the total load estimate for 2006. It is expected that the implementation of runoff retention practices will also help keep the total suspended solid loads in the future below baseline conditions, with 2020 TSS loads expected to be about 17 percent lower than the estimated 1988 loads.

FIGURE 2-7
Edina Loading Assessment
City-Wide Total Phosphorus Loading

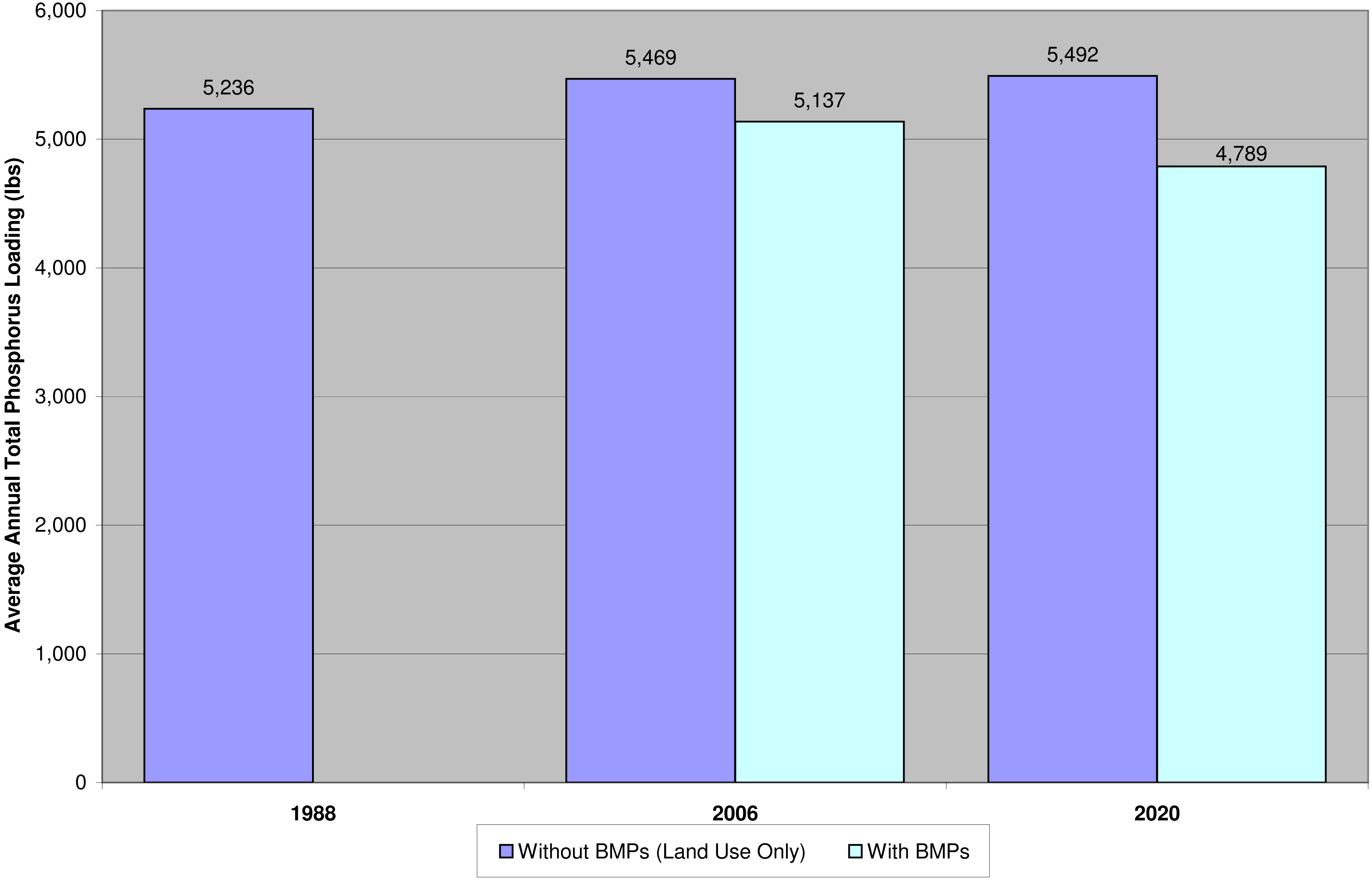

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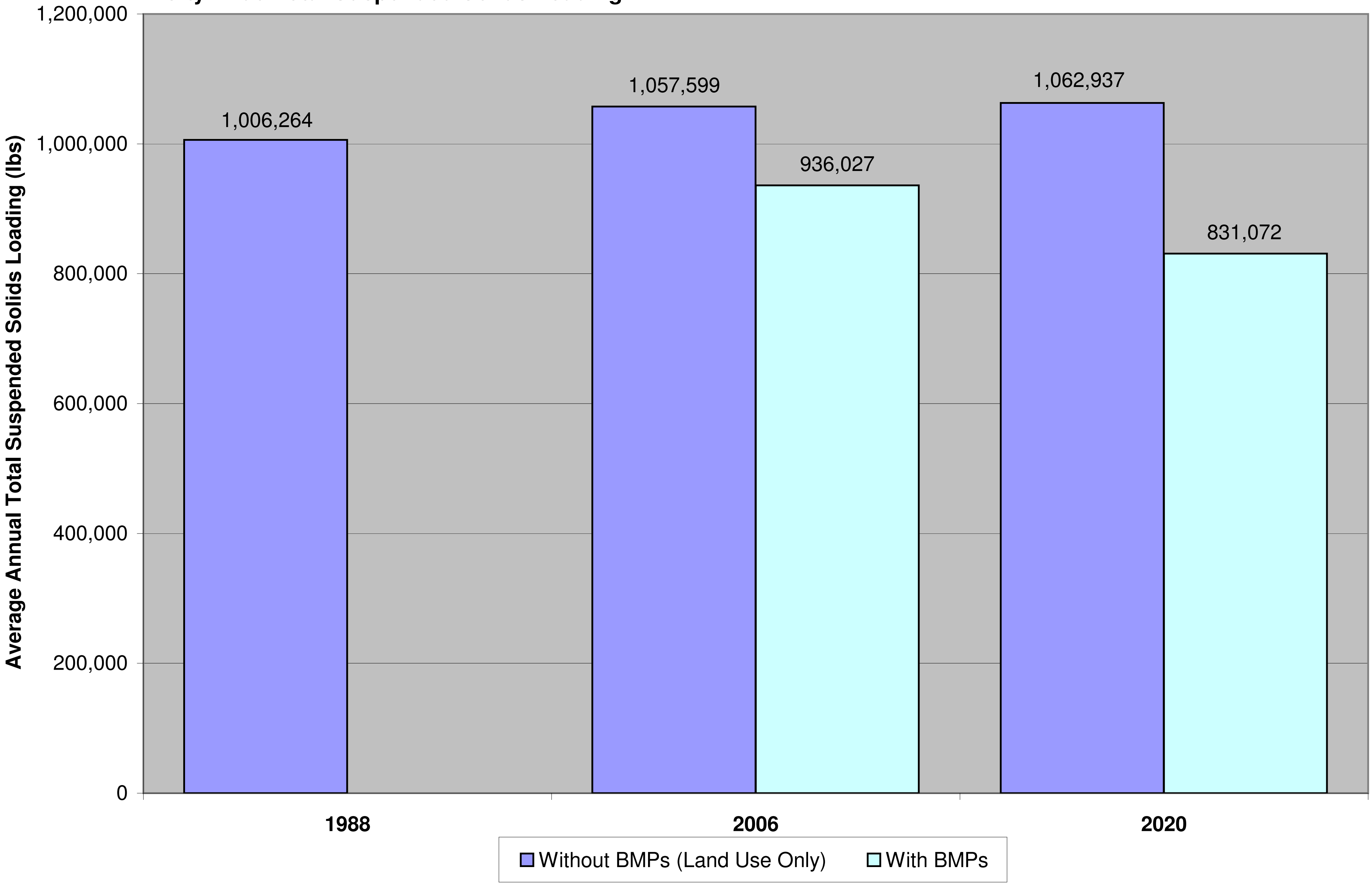
FIGURE 2-8
Edina Loading Assessment
City-Wide Total Suspended Solids Loading



P:\Mpls\23 MN\27\2327H05 Edina Nondegradation Assessment\WorkFiles\Pollutant_Loading_Model\Nondeg_Load_Assess_Edina.xls: TSSChart

3.0 Nondegradation Report

3.1 Future Conditions Loading Assessment

Table 2-14 and Figure 2-5 show that the predicted total average annual flow volume from the city has increased by approximately 4.1 percent since 1988 and would continue toward a 4.5 percent increase by 2020, without implementation of runoff retention practices. If the NMCWD draft runoff retention design standards are applied for future development and redevelopment, the overall average annual flow volume from the city in 2020 is expected to decrease to levels that are approximately 2 percent lower than 1988 (baseline) conditions. As discussed in Section 2.4, the loading assessment indicates that implementation of watershed BMPs, in the past and planned for the future, will ensure that the TP and TSS loads from the city will not increase between 1988 and 2020.

The NMCWD's draft treatment standards (December, 2007) require onsite retention of one inch of runoff volume over all new impervious surfaces of the contributory drainage area of the developing/redeveloping parcel. There are many opportunities at a variety of scales to achieve onsite retention (abstraction) of runoff, with the primary method being infiltration of runoff in rainwater gardens or infiltration basins. Other runoff retention practices include evapotranspiration and storage and reuse of stormwater. Use of native vegetation in landscapes, which typically has more developed root systems than turf grass, can promote the infiltration of runoff into the ground and uptake by plants can increase evapotranspiration. Roof downspouts can be directed into stormwater planters that provide storage of stormwater, promote evapotranspiration through the planted vegetation, and provide treatment of water infiltrating through the soils while also providing an opportunity to improve aesthetics. Similarly, rain barrels and cisterns can allow for the collection of runoff from small areas, such as residential roofs, for reuse, such as irrigation, or for improved infiltration into the soil with the slow release of the stored water. There is also the opportunity for the collection and storage of runoff at the development site scale in large underground storage tanks that can also be reused for irrigation or other uses.

It should be noted that the results projected for the 2020 land use conditions assume that all of the soils in the undeveloped portions of each watershed and areas of redevelopment will be suitable for implementation of infiltration practices. A review of the Hennepin County Soil Survey shows that portions of the land area within the City of Edina may not have suitable soils for infiltration practices. Figure 3-1 depicts the infiltration capacity based on hydrologic soil group classification for the underlying soils within the city. To address concerns regarding the feasibility of implementing on-site infiltration, the Nine Mile Creek Watershed District has introduced the concept of volume banking. The NMCWD, in conjunction with participating municipalities, would provide a framework for those developments going above and beyond the NMCWD retention requirements to obtain volume credits. These credits could then be sold to other permit applicants unable to achieve the runoff retention requirements due to site constraints. The City of Edina could actively participate in this volume banking program and develop a process for developers to obtain volume credits when site conditions are not suitable for infiltration or other runoff retention practices. However, even if the volume banking is used by developers, a minimum of ½-inch of rainfall abstraction, through some method, must be provided onsite. Another option to address unsuitable onsite infiltration conditions would be to allow developers to contribute to implementation of regional volume reduction BMPs instead of meeting onsite runoff retention requirements.

In addition to the reduction in annual runoff volume from implementation of runoff retention design standards, the City will seek opportunities to implement volume reduction BMPs as part of city projects. Specifically, the City will strive to meet the required phosphorus load reductions identified by the Minnehaha Creek Watershed District as part of the MCWD 2006 Comprehensive Water Resources Management Plan using runoff volume reduction techniques, where feasible.

The loading assessment indicates that implementation of watershed BMPs, in the past and planned for the future, will ensure that the runoff volume, TP and TSS loads from the city will not increase between 1988 and 2020. As a result, the following sections of the Nondegradation Report discuss how BMPs, incorporated into a modified SWPPP, will address the nondegradation goal of maintaining baseline conditions or decreasing average annual flow volume, TP and TSS loads as far as is reasonable and practical.

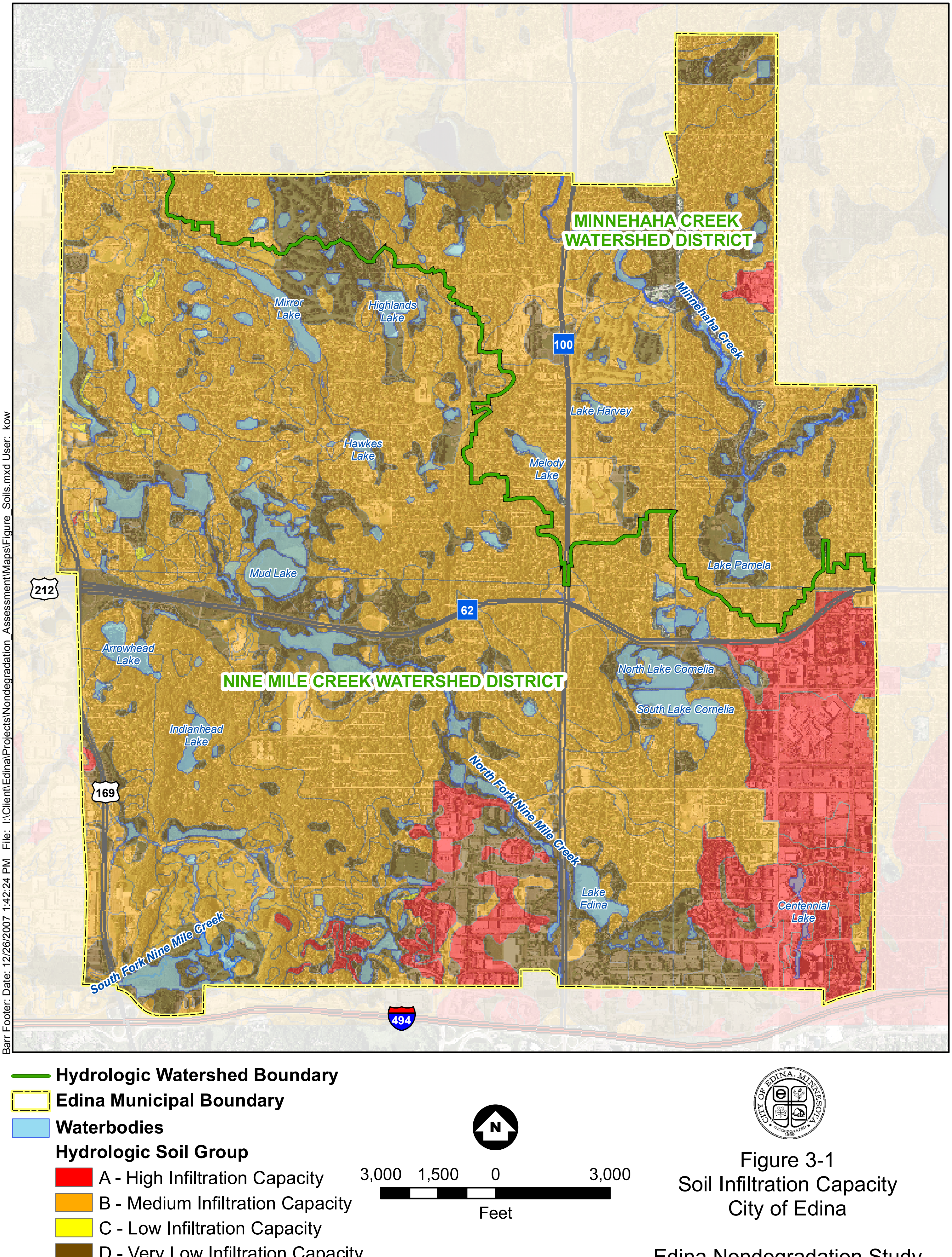


Figure 3-1
Soil Infiltration Capacity
City of Edina

Edina Nondegradation Study

Barr Footer: Date: 12/26/2007 1:42:24 PM File: I:\Client\Edina\Projects\Nondegradation Assessment\Maps\Figure Soils.mxd User: kow

3.1.1 Implications of Impaired Waters for Addressing Expanded Discharges in Nondegradation Report

Table 3-1 lists the receiving waters within the City of Edina that the MPCA has included in its draft 2008 impaired waters listings because previous data indicate the water quality does not meet the MPCA's water quality standards. The U.S. Environmental Protection Agency (EPA) requires that the MPCA develop and submit Total Maximum Daily Load (TMDL) studies for each water body that they have on the impaired waters list. TMDL studies are used to determine what the maximum allowable pollutant loadings are for each water body without exceeding the water quality standards. The allowable pollutant loading is then allocated to each of the NPDES-permitted (including MS4s) and non-regulated sources of pollutants in the watershed.

Several of the impairments listed in Table 3-1 may be related to excess nutrient loading and/or runoff volume. Lake Cornelia (North) and Lake Edina, both listed for total phosphorus impairment, have been newly added to the draft list of Impaired Waters for 2008. Table 3-1 indicates that Nine Mile Creek is on the impaired waters list for chloride, turbidity, and biotic integrity (fish). The listing for Nine Mile Creek for turbidity may be the result of excess nutrient inputs. However, recent turbidity and fish biota data may lead to the Creek being delisted for the turbidity impairment. Nine Mile Creek Watershed District is currently working with the MPCA to address this issue. Additionally, it is important to note that the estimated current and future TP and TSS loads and future stormwater volume from the City of Edina are lower than the estimated loads from the city in 1988.

It is conceivable that the pollutant load allocations developed as part of future TMDL studies will dictate that the City will need to provide further loading reductions, beyond those currently projected in the nondegradation load assessment. As a result, the City is aware of the potential implications of future TMDL allocations associated with the impaired waters that are receiving stormwater discharge.

Specifically, the City will strive to meet the required phosphorus load reductions identified by the Minnehaha Creek Watershed District as part of the MCWD Draft TMDL for Lake Hiawatha. Although Lake Hiawatha is not located within the City of Edina, the lake receives flow (and associated pollutants) from Minnehaha Creek. Specific phosphorus load reductions for each contributing city were identified in the MCWD Draft TMDL for Lake Hiawatha, and were incorporated into the MCWD Comprehensive Water Resources Management Plan (Wenck, 2007). Because the portion of the city that drains to Minnehaha Creek is fully-developed and significant redevelopment is not expected, the opportunities to achieve loading reductions from implementation of development and redevelopment design standards are minimal. The City will work with the MCWD to develop a strategy to achieve the identified loading reductions.

Table 3-1 City of Edina Waters on MPCA's Draft 2008 Impaired Waters List

Reach	Description	Affected use	Pollutant or stressor
Minnehaha Creek	Lake Minnetonka to Mississippi River	Aquatic life	Fish bioassessments
Minnehaha Creek	Lake Minnetonka to Mississippi River	Aquatic Recreation	Fecal Coliform
Minnehaha Creek	Lake Minnetonka to Mississippi River	Aquatic Life	Chloride
Nine Mile Creek	Headwaters to Minnesota River	Aquatic life	Chloride
Nine Mile Creek	Headwaters to Minnesota River	Aquatic life	Fish bioassessments
Nine Mile Creek	Headwaters to Minnesota River	Aquatic life	Turbidity
Lake Cornelia (North)		Aquatic Recreation	Total Phosphorus
Lake Edina		Aquatic Recreation	Total Phosphorus

3.2 BMP Selection Considerations

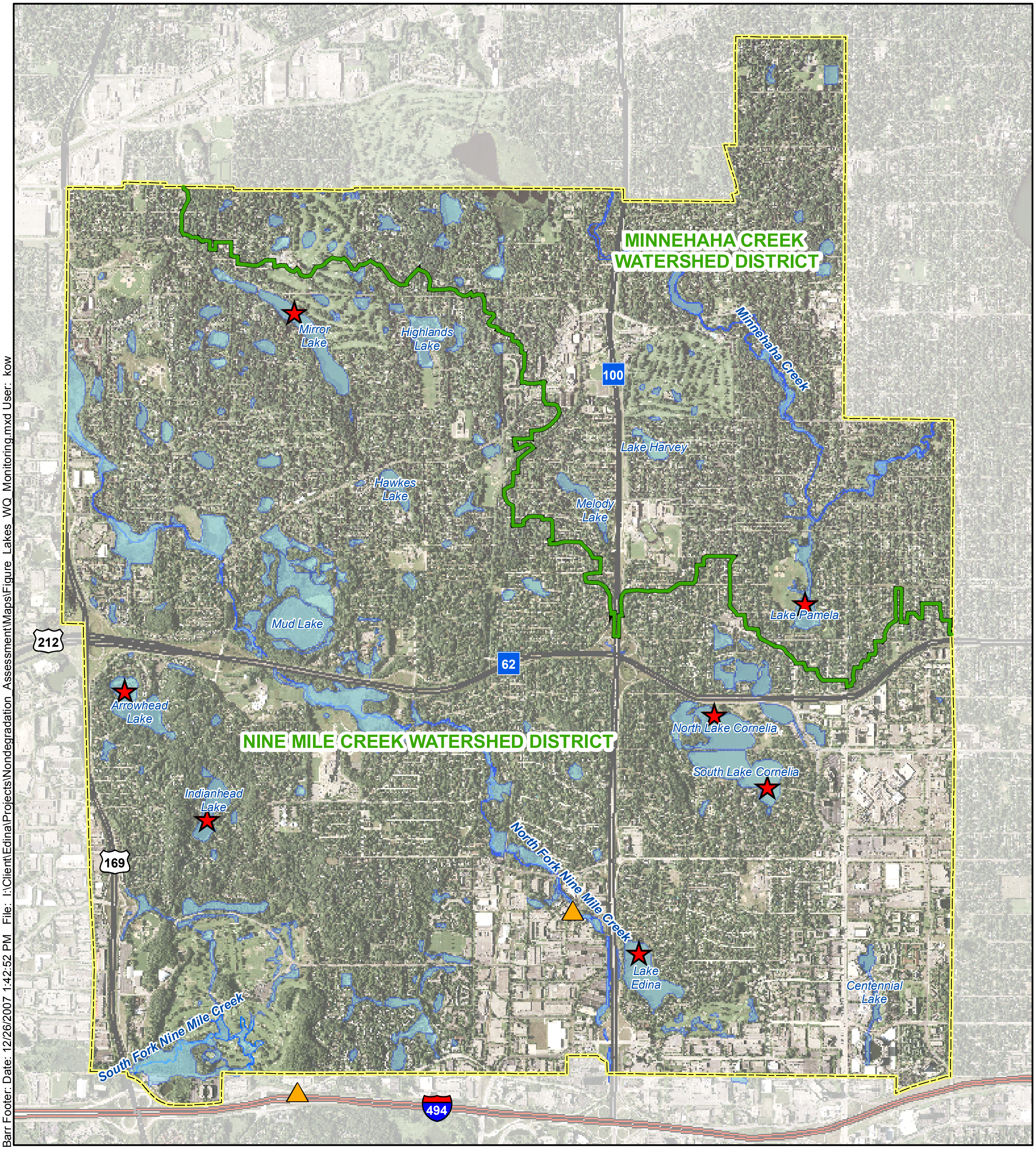
3.2.1 Receiving Water Quality

As discussed in Section 2.4, the loading assessment indicates that past implementation of BMPs has reduced TP and TSS loads from the city between 1988 and 2006. The loading assessment also indicates that implementation of the BMPs planned for the future will ensure that the overall average annual runoff volume, TP and TSS loads from the city will not increase between 1988 and 2020.

Limited water quality data has been collected for the lakes within the City of Edina. In 1972, 1990, 2001, and 2004, the Nine Mile Creek Watershed District collected in-lake water quality data for Mirror Lake, which was used in support of the NMCWD Mirror Lake Use Attainability Analysis (Draft) (Barr, 2004). In 2004, the NMCWD also collected in-lake water quality data for Lake Cornelia (North and South), Arrowhead Lake and Indianhead Lake, for development of the Lake Cornelia Use Attainability Analysis (Draft) (Barr, 2006) and Arrowhead and Indianhead Lakes Use Attainability Analysis (Draft) (Barr, 2006). In addition to the lake monitoring data collected by the NMCWD, water quality data has also been collected for several lakes by citizen monitoring volunteers and published annually by the Metropolitan Council. The locations of the lakes in Edina that have been a part of the Metropolitan Council Citizen-Assisted Monitoring Program (CAMP) in the past are shown in Figure 3-2.

A summary of the historic summer average total phosphorus concentrations for the monitored lakes in Edina is provided in Table 3-2. The summary reflects the data collected by both the NMCWD and the Metropolitan Council CAMP. As can be seen in the table, the available data is limited for most of the Edina lakes. It should be noted that lakes and ponds are dynamic, so that relatively infrequent sampling cannot provide a complete picture of the status of the water body in question. The situation is further complicated by the impossibility of inferring statistically significant trends from relatively few water quality sampling results. A minimum of about ten (summer average) data points is thought to be required to reliably identify a water quality trend.

The NMCWD also has two continuous flow monitoring stations within or near Edina; one along the North Fork of Nine Mile Creek at the Metro Boulevard crossing, and another along the South Fork of Nine Mile Creek at the 78th Street crossing, just south of the city boundary with Bloomington (Figure 3-2). The monitoring stations collect data on stream flow and several water quality parameters, including turbidity. The water quality monitoring data is available from the Nine Mile Creek Watershed District upon request.



NMCWD Stream Monitoring Stations

Lake Water Quality Sampling Locations

Hydrologic Watershed Boundary

Edina Municipal Boundary

Waterbodies

3,000 1,500 0 3,000

Feet

Figure 3-2
Water Quality Sampling
Locations in the City of Edina

Edina Nondegradation Study

Table 3-2 Historic Summer-Average Total Phosphorus Concentrations for Edina Lakes

Lake	Year	NMCWD Summer Average TP Concentration (May - September) (µg/L)	Metropolitan Council Summer Average TP Concentration (May - September) (µg/L)
North Lake Cornelia	2003	N / A	224 [5]
	2004	164 [1]	N / A
	2005	N / A	156 [7]
	2006	N / A	154 [8]
South Lake Cornelia	2004	190 [1]	N / A
Mirror	1972	133 [2]	N / A
	1990	99 [3]	N / A
	2001	73 [3]	N / A
	2004	119 [3]	N / A
Arrowhead Lake	2004	72 [4]	N / A
Indianhead Lake	2004	46 [4]	N / A
Pamela Lake	2005	N / A	81 [7]
Lake Edina	2004	N / A	106 [6]
	2005	N / A	128 [7]

1 - Barr Engineering. 2006. Lake Cornelia Use Attainability Analysis (Draft).

2 - Barr Engineering. 2004. Mirror Lake Use Attainability Analysis (Draft). * Average based on one sampling event from August, 1972

3 - Barr Engineering. 2004. Mirror Lake Use Attainability Analysis (Draft).

4 - Barr Engineering. 2006. Arrowhead and Indianhead Lakes Use Attainability Analysis (Draft).

5 - Metropolitan Council. 2004. Regional Report: A 2003 Study of the Water Quality of 140 Metropolitan Area Lakes

6 - Metropolitan Council. 2005. Regional Report: A 2004 Study of the Water Quality of 145 Metropolitan Area Lakes

7 - Metropolitan Council. 2006. Regional Report: A 2005 Study of the Water Quality of 172 Metropolitan Area Lakes

8 - Metropolitan Council. 2007. Regional Report: A 2006 Study of the Water Quality of 186 Metropolitan Area Lakes

3.2.2 Stream Morphology/Channel Erosion

The results of the loading assessment indicate that the total average annual flow volume from the city has increased by approximately 4.1 percent since 1988 and would continue to increase up to 4.5 percent by 2020, without implementation of the proposed future runoff retention practices. As discussed in Section 2.4, following the implementation of BMP design standards that focus on reducing runoff volume, the overall average annual flow volume from the city in 2020 is expected to decrease below 1988 baseline conditions.

The City recognizes that increases in stormwater runoff volume can result in increased channel erosion and detrimental effects on stream morphology. Beyond the future implementation of runoff retention design standards, the City will continue to seek opportunities to implement volume reduction BMPs to reduce the stormwater volume and pollutant loading, with prioritization given to areas that discharge directly to the creek systems and lakes within the city.

3.2.3 Wetlands

This section addresses, as far as is reasonable and practical, the potential negative impacts of increased stormwater discharge volumes that have caused increased depth and duration of inundation of wetlands having the potential for a significant adverse impact to a designated use of the wetland.

The Permit uses terms such as “designated uses” and/or “functions and values” which come from MPCA rules. The term “significant adverse impact” in the Permit is based on the existing water quality standards and applicable rules. The term implies “significant adverse impact to a designated use” of the water, as defined in water quality standards. The following rules apply to wetland mitigation. Wetland mitigation maintains nondegradation of wetland designated uses. The wetland mitigative sequence incorporates the following principles in descending order of priority:

1. Avoid the impact altogether by not taking a certain action or parts of an action;
2. Minimize the impact by limiting the degree or magnitude of the action and its implementation, and by taking affirmative actions to rectify the impact and reduce or eliminate the impact over time; and
3. Mitigate the unavoidable impact to the designated uses of a wetland by compensation. Compensatory mitigation shall be accomplished in the following descending order of priority of replacement:
    a. Restoration of a previously diminished wetland; and
    b. Creation of a wetland.

If compensatory mitigation is accomplished by restoration or creation, the replacement wetland shall be of the same type and in the same watershed as the impacted wetland, to the extent prudent and feasible. Compensatory mitigation shall be completed before or concurrent with the actual physical alteration of the wetland affected by the proposed project to the extent prudent and feasible.

The wetlands in the City of Edina are an important community asset. These resources supply aesthetic and recreational benefits, in addition to providing wildlife habitat and refuge. To protect the wetlands in the City of Edina, a goal of no net loss of wetland functions and values was adopted as part of the city's CWRMP (2003). To provide a basis for wetland protection efforts, an inventory and field assessment of all the wetlands within the city was completed. The wetland inventory identified wetland location, approximate size, type, wetland classification, dominant wetland vegetation, function, and value. As part of the inventory, the susceptibility of each wetland to degradation by stormwater input was assessed and categorized as high, moderate, or least susceptible. Management recommendations were developed for each sensitivity classification. For the highly susceptible wetland types, the management recommendations include giving special consideration to these wetland systems to avoid alteration, avoiding inundation, and preventing increases in storm water bounce or degree of water level fluctuation. The results of the loading assessment, with future implementation of BMPs, show that the runoff retention requirements will reduce average annual flow volume based on existing conditions and baseline (1988) conditions, and in turn, should reduce the bounce and duration of inundation in the some of the city's wetlands.

The NMCWD and MCWD are the Local Government Units (LGUs) for administration of the WCA in the City of Edina. The City continues to work in conjunction with the watershed districts on issues pertaining to wetland alterations within the city boundary. The City encourages the use of buffer zones to protect wetlands, and provides buffer zones of native vegetation around ponds and wetlands, where feasible. The MCWD currently has wetland buffer requirements and the Nine Mile Creek Watershed District is considering development of buffer requirements as part of their rule revision process that is underway.

As discussed in Section 1.2.1.3, the WCA does allow for ten categories of exemptions to the requirements and does not have jurisdiction over all wetlands that are considered waters of the state. In the few projects where the requirements of the WCA are not as comprehensive as MPCA water quality standards, then the requirements of the NPDES permit will require an LGU to make a determination that will also satisfy Minn. R. 7050.0186. As a result, Edina will reference both the WCA and Minn. R. 7050.0186 requirements for wetland protection in their CWRMP and SWPPP.

Implementing the future runoff retention requirements discussed in the loading assessment , as well as following the wetland management recommendations in the City's CWRMP and complying with the future wetland buffer requirements of the watershed districts represents the most reasonable and practical means of preventing significant adverse impacts to the designated use of wetlands in the City of Edina.

3.2.3 Source Water Protection Areas

While the nondegradation report, in consideration of the loading assessment, has emphasized the implementation of infiltration and other runoff retention BMPs, both in the past and proposed for the future, Edina's SWPPP will account for source water protection areas as part of BMP planning and implementation. The SWPPP will show where the vulnerable wellhead protection areas are within the city and define the measures that will reduce the threat to drinking water to the maximum extent practicable. These measures will be developed in accordance with the Minnesota Department of Health's, Evaluating Proposed Stormwater Infiltration Projects in Vulnerable Wellhead Protection Areas, and the MPCA's, Minnesota Storm Water Manual guidance for potential stormwater hotspots. Infiltration practices will not be allowed within the 1-year time-of-travel (emergency response zone) Drinking Water Supply Management Area (DWSMA).

3.3 Retrofit and Mitigation BMP Options

As redevelopment occurs throughout the city in the future, the proposed NMCWD runoff retention design standards will be applicable to redevelopment sites. As indicated in the loading assessment, this will result in reductions of runoff volume, TP, and TSS loadings to city waterbodies.

As they have done in the past, the City will seek opportunities to implement water quality treatment BMPs as part of their annual street improvement and repair work. The City will also continue to decrease stormwater volume by reducing the width of roadways, where feasible.

The City may also improve the condition of parks, wetlands, and watersheds when the opportunity arises. Wetland restorations, native plantings, bank stabilization, infiltration practices, and other BMP construction projects will be considered during planning to improve water quality throughout the City of Edina property.

3.4 Cost/Benefit, Social and Environmental Considerations

Since 1988, the primary method of stormwater treatment in the City of Edina has been construction of water quality ponds. Kuo et al. (1988) determined that extended wet detention ponds (water quality ponds) provided the most cost-effective performance, compared to infiltration trenches and porous pavements, to control storm water quantity and quality. Weiss et al. (2007) determined that constructed wetlands provide the most cost-effective treatment for TSS and TP, compared to wet basins, sand filters, bioretention filters and infiltration trenches, if land acquisition costs are ignored.

If land acquisition costs are factored into the analysis, wet basins would typically become more cost-effective in comparison to constructed wetland and bioretention systems. Ignoring land acquisition costs, Wossink and Hunt (2003) determined that the following BMPs would be expected to have decreasing levels of cost-effectiveness for treatment of TP loadings: bioretention in sandy soils, stormwater wetlands or wet ponds, bioretention in clay soils, and sand filters.

Although generally a cost effective method of stormwater treatment for removal of TP and TSS, water quality ponds do not provide significant stormwater volume reduction benefits. To address stormwater volume reduction in the future, the City of Edina intends to implement design standards that require infiltration or other retention practices for development and redevelopment areas. A review of the Hennepin County Soil Survey shows that portions of the land area within the City of Edina may not have suitable soils for infiltration practices. In addition, infiltration practices may be further restricted by proximity to drinking water wells, the seasonal high groundwater level and runoff from storm water hotspots, such as loading docks, fueling and vehicle maintenance areas. As a result, future implementation of runoff retention design standards will need to include flexibility for developments and redevelopments that have site constraints that significantly impact the BMP feasibility or cost-effectiveness and/or where excessive amounts of useable space are required to meet the runoff retention storage volume requirements.

3.5 Other BMPs and Considerations Not Included in the Loading Assessment

The results of the Loading Assessment with BMP implementation present the estimated volumes and pollutant loading estimates associated with structural BMP implementation and requirements. There are several nonstructural BMPs that have been, or will continue to be, implemented in the city that, collectively, would also be expected to make significant reductions in volume and pollutant loadings beyond those indicated in Table 2-14. These BMPs include the following:

- The lawn fertilizer phosphorus ban
- Street sweeping
- Impervious surface reduction
- Public education/participation/outreach
- Illicit discharge detection and elimination
- Pollution prevention/good housekeeping measures for municipal operations
- Litter and pet waste control ordinance (300.17 Subdivision 5)

In addition, there are other assumptions that were made about BMP implementation considered in the Loading Assessment that were especially conservative, which meant that the 2006 and 2020 loadings shown in Table 2-14, with BMP implementation, are generally conservative for the following reasons:

- There is evaporation and seepage to groundwater from sedimentation (water quality) ponds
- Disconnection of impervious surfaces from drainageways (i.e., surface runoff from impervious surface that flows to pervious areas)

4.0 Proposed SWPPP Modifications

This section describes the modifications that are proposed for the City of Edina SWPPP, based on the results of the loading assessment and discussion in the nondegradation report.

The loading assessment and nondegradation report were completed assuming that future BMP implementation throughout the city would follow the draft NMCWD runoff retention design standards, which require onsite retention (through infiltration or other runoff retention practices) of one inch of runoff volume over all new impervious surfaces of the contributory drainage area. At the time of this study, both of the watershed districts within the city are in the process of revising their stormwater management rules and drafting new stormwater quality treatment standards. Since most the of development and redevelopment anticipated between 2006 and 2020 is within the Nine Mile Creek portion of the city and since NMCWD has already developed their draft water quality treatment rules and standards (the MCWD is currently in the preliminary stages of their rule revision process), it was assumed for purposes of this analysis that the City will plan to adopt treatment requirements that follow the NMCWD draft runoff retention standards. Upon development and approval of the new watershed district standards, the City will update its development review policies, standards and procedures, as cited in the SWPPP. This approach will ensure the following:

- Receiving water quality should be improved for lakes, wetlands and streams in Edina as a result of future development and redevelopment
- Channel erosion and stream morphology changes will be minimized as a result of future development and redevelopment
- Further protection will be provided for the physical and biological integrity of the stream and wetland corridors
- Controlled bounce and duration of inundation in the city's wetlands and preservation of the functions and values for each type of wetland classification

In the few projects where the requirements of the WCA are not as comprehensive as MPCA water quality standards, then the requirements of the NPDES permit will require an LGU to make a determination that will also satisfy Minn. R. 7050.0186. As a result, Edina will reference both the WCA and Minn. R. 7050.0186 requirements for wetland protection in the Wetland Management Plan and the SWPPP.

The SWPPP will show where the vulnerable wellhead protection areas are within the city and define the measures that will reduce the threat to drinking water to the maximum extent practicable. These measures will be developed in accordance with the Minnesota Department of Health's, Evaluating Proposed Storm Water Infiltration Projects in Vulnerable Wellhead Protection Areas, and the MPCA's, Minnesota Stormwater Manual guidance for potential stormwater hotspots.

5.0 Comments on Proposed SWPPP Modifications

5.1 Public and Local Water Authority Comments on Proposed SWPPP Modifications

Prior to submittal to the MPCA, the Nondegradation Report and proposed SWPPP modifications to address nondegradation were public noticed at the local level as required in the Permit. The Nondegradation Report explaining the proposed BMPs and the entire SWPPP was made available to the public via the city's website and at the Edina City Hall. The City of Edina also submitted its Nondegradation Report and proposed SWPPP modifications to address nondegradation to the appropriate local water authorities (Minnehaha Creek Watershed District and Nine Mile Creek Watershed District) and the Metropolitan Council in time to allow for their review and comment. The following sections summarize the comments received from the public and the local water authorities on the proposed SWPPP modifications and the Nondegradation Report.

5.1.1 Public Comments on Nondegradation Report and Proposed SWPPP Modifications

There were no public comments on the Nondegradation Report and proposed SWPPP modifications.

5.1.2 Local Water Authority Comments on Nondegradation Report and Proposed SWPPP Modifications

5.1.2.1 Minnehaha Creek Watershed District (MCWD)

There were no formal comments received from the MCWD on the Nondegradation Report and proposed SWPPP modifications.

5.1.2.2 Nine Mile Creek Watershed District (NMCWD)

A December 19, 2007 letter was received from the NMCWD with comments regarding the Nondegradation Report and proposed SWPPP modifications. Overall, the NMCWD indicated that the report is very thorough and results in the city meeting the MS4 permit nondegradation requirements. The NMCWD commended the city for incorporating the most stringent watershed district rules city-wide, and offered the following comments:

1. Throughout the (draft) report, the NMCWD stormwater rule was stated as requiring onsite infiltration of runoff volume equal to one inch of rainfall over the impervious area of the onsite contributing drainage area. The rule is not limited to infiltration. The rule is for onsite runoff retention or abstraction, which includes infiltration as a management practice.

2. The stormwater rule has been revised to read: Provide for the onsite retention of 1 inch runoff volume over all impervious surfaces on the contributory drainage area of the parcel. This language change makes the rule easier to understand and results in a simpler calculation of the 1 inch retention requirement. The Nondegradation Report should reflect this revised language to be accurate.

3. The Report states that with the implementation of runoff reducing BMPs, the annual runoff volume will be 2% less than 1988 conditions. The BMPs analyzed in the report are based on infiltration and not retention or abstraction where other methods could result in greater volume reductions. Will further volume reductions be achieved if the modeling reflected runoff retention, not just infiltration?

4. To achieve further volume reduction, the NMCWD encourages the City of Edina to seek opportunities to retrofit existing stormwater treatment systems to incorporate retention or abstraction BMPs.

5.1.3 Metropolitan Council Comments on Nondegradation Report and Proposed SWPPP Modifications

In a December 21, 2007 letter discussing the Metropolitan Council review of the Nondegradation Report and proposed SWPPP modifications, the Metropolitan Council stated that the plan was found to be consistent with the Council's *Water Resources Management Policy Plan*, and offered the following comments:

1. The Metropolitan Council noted that the nondegradation plan requirement provides an opportunity to collect data over time on the assumptions used in the modeling to show that the best management practices used in the modeling exercise truly reduce TP and TSS loads to the degrees predicted.

2. The Metropolitan Council stressed that continued maintenance of the city's BMPs is necessary for these facilities to function at their design level throughout their expected life.

5.2 Record of Decision on the Comments

In response to the first NMCWD comment, the language in the report related to the draft NMCWD stormwater rules has been revised to reflect the most recent rule language, which refers to onsite runoff retention requirements instead of infiltration requirements. Although infiltration is an effective means to achieve runoff retention, the NMCWD draft language allows for additional flexibility in stormwater management practices.

In response to the second NMCWD comment, the language in the report related to the draft NMCWD stormwater rules has been revised to reflect the most recent rule language, which refers to onsite runoff retention of “one inch of runoff volume” instead of “the runoff volume equal to one inch of rainfall”.

In response to the third NMCWD comment, the volume reduction achieved over time from runoff retention management practices will be dependent on many factors, the most significant being the storage volume, the rate at which water is lost (via infiltration, evapotranspiration, evaporation, pumping for irrigation, etc), and precipitation patterns (e.g., the intensity, duration, and frequency of events). For runoff management practices that are designed to retain one-inch of runoff volume from the impervious surfaces, the removal efficiency during a one-inch event should be consistent. However, the **annual** volume reduction expected from implementing the runoff retention BMPs will vary based on the design specifics, such as storage volume and rate of water loss.

For purposes of the loading assessment, the runoff volume, TP, and TSS pollutant removals resulting from the draft NMCWD runoff retention requirements were estimated using P8, assuming that runoff retention would occur via infiltration basins sized to hold (retain) the volume from one inch of runoff from the impervious surfaces of the hypothetical residential and commercial sites. This approach assumed all of the runoff from the impervious surfaces for a one-inch event would be stored in the basins and eventually lost through infiltration, using a moderate infiltration rate (0.5 in/hr). The estimated long-term pollutant removal efficiency would vary (increase or decrease) if design factors such as the infiltration rate or storage volume were altered or if the precipitation patterns were varied.

In response to the fourth NMCWD comment, the City of Edina will continue to seek opportunities to incorporate volume reduction BMPs into their street improvement and repair work and other capital improvement projects.

In response to the Metropolitan Council’s first comment, the City will work with the local water management organizations to explore the opportunities for implementing monitoring program(s) to determine BMP effectiveness.

In response to the Metropolitan Council’s second comment regarding the importance of continued BMP maintenance, the City will continue to address long-term operation and maintenance of BMPs in conformance with their SWPPP and the City of Edina Comprehensive Water Resources Management Plan (Barr, 2003).

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