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

Prepared for

City of Lakeville

Submitted by

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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 Lakeville to Discharge Storm Water Associated with Municipal Separate Storm Sewer Systems (MS4), effective June 1, 2006. Lakeville 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 permit. Appendix C covers discharges to trout waters and wetlands that are applicable to the city of Lakeville. Appendix D covers the nondegradation requirements for Selected MS4s (30 permittees including the city of Lakeville), 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 each of the city's six 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 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, without BMPs, the total average annual flow volume from the city has increased significantly since 1988 and would continue to increase substantially by 2020, without implementation of infiltration practices. Following implementation of BMPs the overall average annual flow volume from the city in 2020 is 40 percent higher than the flow volume estimate from 1988 but continued implementation of infiltration practices will offset the increases in flow volume between 2006 and 2020 and result in an overall flow volume reduction of more than 7 percent, compared to the volume estimate for 2006. Approximately 56% of the overall average annual flow volume increase between 1988 and 2020 can be attributed to development within the lake watersheds of the city between 1988 and 2006. Implementation of infiltration practices should maintain the average annual flow volume increases in the creek watersheds of the city to 26% of the 1988 combined volume for the same watersheds. 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 loading assessment and nondegradation report were completed assuming that future BMP implementation would follow the Vermillion River Watershed Joint Powers Organization (VRWJPO) Standards (VRWJPO, 2007) for most of the city, with the exception of the South Creek watershed, which would continue to follow the more stringent volume control requirements established in the South Creek Management Plan. As a result, 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 Lakeville
- Channel erosion and stream morphology changes will be controlled
- Further protection will be provided for the physical and biological integrity of the stream and wetland corridors
- Temperature changes for trout streams and their tributaries will be mitigated and changes in flow will be controlled
- Controlled bounce and duration of inundation in the city's wetlands and preservation of the functions and values for each type of wetland classification
- Wherever possible, the rules will be applied to redevelopment projects to mitigate past increases in storm water runoff volume and further improve receiving water quality and habitat

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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 Lakeville to Discharge Storm Water Associated with Municipal Separate Storm Sewer Systems (MS4), effective June 1, 2006. Lakeville 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 permit. Appendix C covers discharges to trout waters and wetlands that are applicable to the city of Lakeville. Appendix D covers the nondegradation requirements for Selected MS4s (30 permittees including the city of Lakeville), 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 Lakeville.

1.1.1 Loading Assessment

Each Selected MS4 must assess the change in storm water 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 storm water 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 flow 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 storm water management plans and other pertinent factors may also be considered. BMPs implemented by other parties may be considered when those BMPs affect the storm water 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; and

5. An application to modify the permit.

1.1.4 Discharges Adversely Impacting Trout Waters

The following requirements apply to Trout Waters:

1. Does not authorize new or expanded discharges adversely impacting Trout Waters unless, at minimum, administrative procedures or other measures are established to assure that you make the following determinations and document the basis for your decision:

    a. That there is no feasible and prudent alternative to the proposed discharge; and

    b. All prudent and feasible measures needed to avoid or reduce impacts to Trout Waters, and to preserve the existing high quality of the water will be implemented (see Part 2 below).

2. If the discharge cannot be avoided, then consider measures to protect water quality and prevent temperature increases. Acceptable measures include reducing the impervious surfaces, diversion away from the stream and use of filter strips, infiltration, biofiltration, or enhanced grass swales to treat runoff before discharge to the Trout Water. Innovative alternatives to ponds are specifically encouraged for Trout Water discharges if they provide equivalent treatment.

1.1.5 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.

1.1.6 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 storm water.

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

- Nondegradation requirements for Special Waters

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 storm water 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 storm water 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 bottomdwelling 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% of the precipitation events are less than 1.0 inch. These rainfall events also account for approximately 65% 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 your 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, you may wish to demonstrate that your flow increase 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. To address flow volume some of the options 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 24 hour storm on an average annual basis, and that this represents 67% of the cumulative volume of precipitation. This means that runoff reduction often can be related to BMPs that reduce flow 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, evapo-transpiration, disconnection of impervious surfaces, reduced imperviousness, filterstrips, 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 storm water 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).

1.2.1.4 Special Waters Considerations

The evaluation for special waters is contained in Appendix C and the evaluation of other waters is contained in Appendix D**.** The test for Outstanding Resource Value Waters (ORVWs) is that feasible and prudent alternatives must be used. The test for other waters is reasonable and practical BMPs to be implemented. These analyses have a different criteria and standard of judgment with a long history of precedent that must be considered. The exact format of the evaluation is not described, but this distinction should be kept in mind as evaluations are planned; the MPCA will also address this in guidance.

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 your 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 storm water 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 storm water 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 option have been rejected and the basis for such rejection.

1.3 Lakeville Storm Water Management Planning and Water Quality Improvement Projects

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

- Surface Water Management Plan (1994)—Established water quality goals and BMP implementation requirements for all new development within the city.

- Lake Marion Diagnostic-Feasibility Study: Water Quality Issues and Potential Restorative Measures (1997)—Lake Marion is a high quality lake in the Vermillion River watershed.

- Orchard Lake Diagnostic-Feasibility Study: Water Quality Issues and Potential Restorative Measures (1999)—Orchard Lake is a high quality lake in the Credit River watershed.

- South Creek Management Plan (2000)—South Creek is a trout stream that is tributary to the Vermillion River.

- City of Lakeville Wetland Management Plan (2003)—The Wetland Management Plan (WMP) was developed in conformance with Minnesota Rules 8420.0650 and meets the requirements of the Wetland Conservation Act. The WMP provides a comprehensive approach for the protection and management of wetlands within the City, identifies regional wetland mitigation sites, and provides management strategies for different types of wetlands.

- The City has continued work on the following ongoing water quality monitoring and improvement programs and projects:

    - Lake Marion Aquatic Plant Surveys and Eurasian Watermilfoil Treatment/Curlyleaf Pondweed Control

    - Orchard Lake Aquatic Plant Surveys and Curlyleaf Pondweed Harvesting

    - Valley Lake Barley Straw and Shoreline Restoration

    - Lee Lake Barely Straw and Fisheries Survey

    - Iron Treatment Study on Lee and Orchard Lakes

    - Adopt-A-Pond and Eagle Scout Project

    - Citizen Assisted Monitoring Program (CAMP)

    - Wetland Health Evaluation Project (WHEP)

    - Vermillion River Watch

    - Piezometers, Rain and Temperature Gauges, Dissolved Oxygen Measurements

- Development Reviews
- Storm water education presentations, outreach, meetings and training
- Wellhead Protection Program

2.0 Loading Assessment

2.1 Land Use/Land Cover Compilation

An important parameter for estimating historical TP and TSS loading and stormwater runoff volumes is an accurate determination of land use and land cover (LULC) for the city of Lakeville for the years of interest. These LULC data are available in Geographic Information System (GIS) data format for various years in the Twin City Metropolitan area, but due to rapid growth in Lakeville, the LULC data available does not reflect the development status of the City during the years specifically analyzed for this study.

To meet the Permit requirements, it will be necessary to estimate average annual runoff volumes, TP and TSS loadings for 1988 (the base year), 2006, and 2020. To get a consistent comparison of LULC for all three years using the data that were available, a generalized LULC classification system was developed. The LULC classes used are shown in Table 2-1.

Table 2-1 Land Use and Land Cover (LULC) Classes

Class Name	Description
Agriculture (Cultivated)	Row Crops, Small Grains, Hay Pasture
Airport	Airlake Airport
Commercial	Commercial areas and corporate campuses
Forest	Forested areas within parks or undeveloped areas
Grassland	Non forested open space including most developed parks
Highway	Interstate 35
Industrial	Manufacturing, utilities, etc
Institutional	Schools, churches, City buildings
Rural Residential	Large lot housing, mostly outside of the MUSA boundary
Single Family Residential	Single family homes with lots size typically less than an acre
Multi-Family Residential	Duplexes, townhouses, apartments, condomiums, etc
Water	Wetlands, Lakes, Detentions Ponds

LULC for the city of Lakeville for the 1988, 2006 and 2020 are summarized in Table 2-2. Table 2-2 shows that agriculture and some forest and grassland has been or will be replaced by residential, commercial, industrial and some institutional land uses during the two time periods.

Sources used to derive the data for 1988 and 2006 include the 1984 and 2005 Metropolitan Council Landuse GIS data, USGS National Land Cover Database (NLCD, 1992), Dakota County Parcel Data, 1991 and 2006 aerial photography. The City Wetland Inventory and

parcel-based development information was obtained from City of Lakeville Engineering and Planning staff. The data used to estimate the 2020 LULC included the City's 2020 Comprehensive Plan, 2006 LULC data and information from the City of Lakeville Engineering and Planning staff.

Table 2-2 Lakeville Land Use and Land Cover (LULC) Areas (in acres)

Landuse/Landcover	1988	2006	2020
Agriculture	10,799	6,213	1,413
Airport	15	44	48
Commercial/Corporate Campus	190	727	1,572
Forest	3,221	2,448	1,444
Grassland	3,215	1,495	1,534
Highway	252	328	327
Industrial	300	833	1,119
Institutional	209	905	967
Multi-Family Residential	94	809	2,508
Rural Residential	529	487	1,481
Single Family Residential	3,117	7,624	9,491
Water	2,224	2,254	2,260
CITY TOTAL**	24,164	24,165	24,164

**Totals aren't the same for all years due to rounding errors

Figures 2-1, 2-2 and 2-3 show the LULC developed for 1988, 2006 and 2020, respectively. Most of the non-urban land cover was estimated using the 1992 USGS NLCD land cover data.

2.2 Watershed Imperviousness Determination

Another parameter that is required to develop estimates of average annual runoff volume, TP and TSS loadings is imperviousness. Imperviousness was estimated 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. Since imperviousness data was not specifically available for 1988 or 2006 additional data development and calculations were necessary for the city of Lakeville.

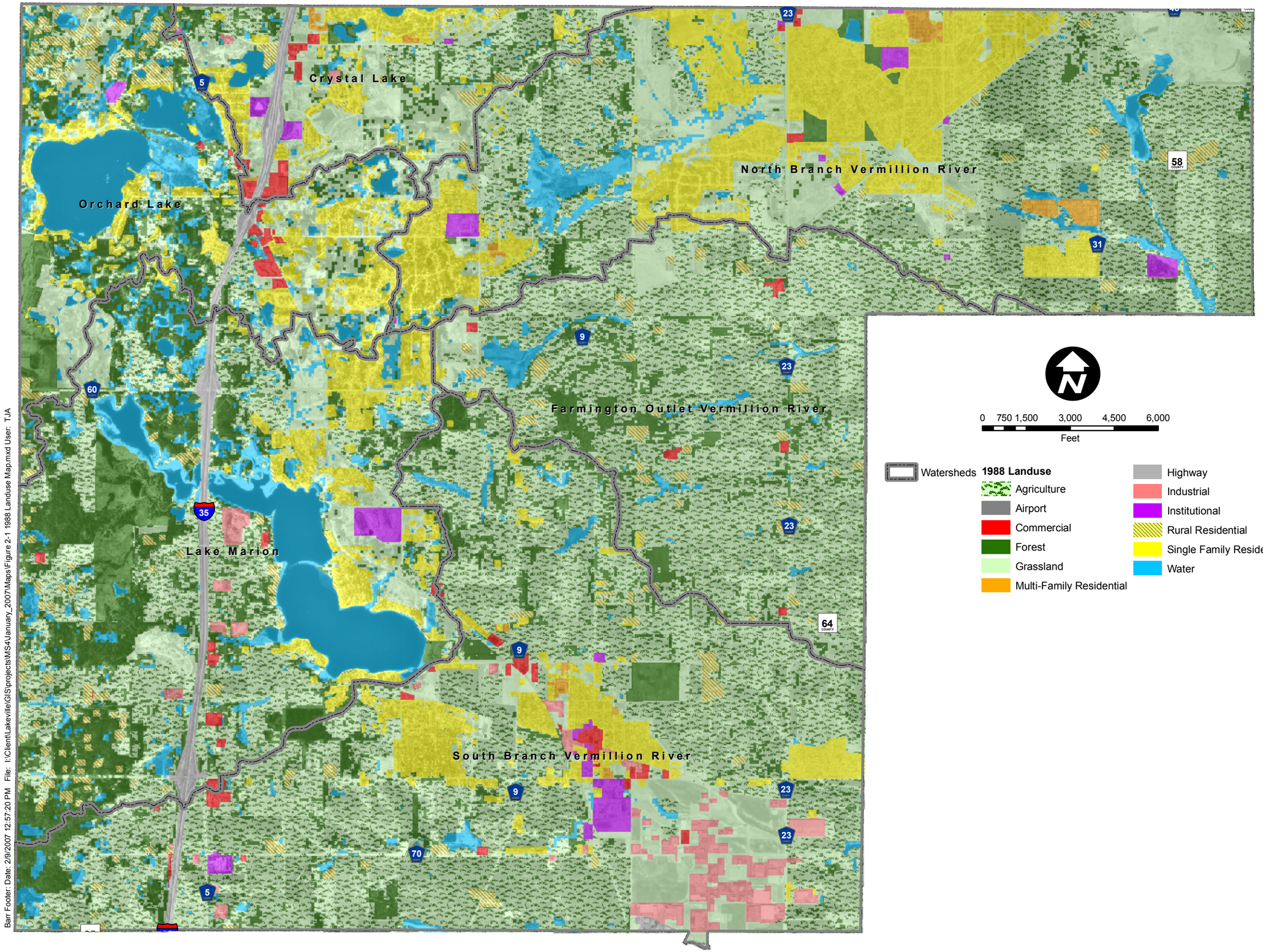
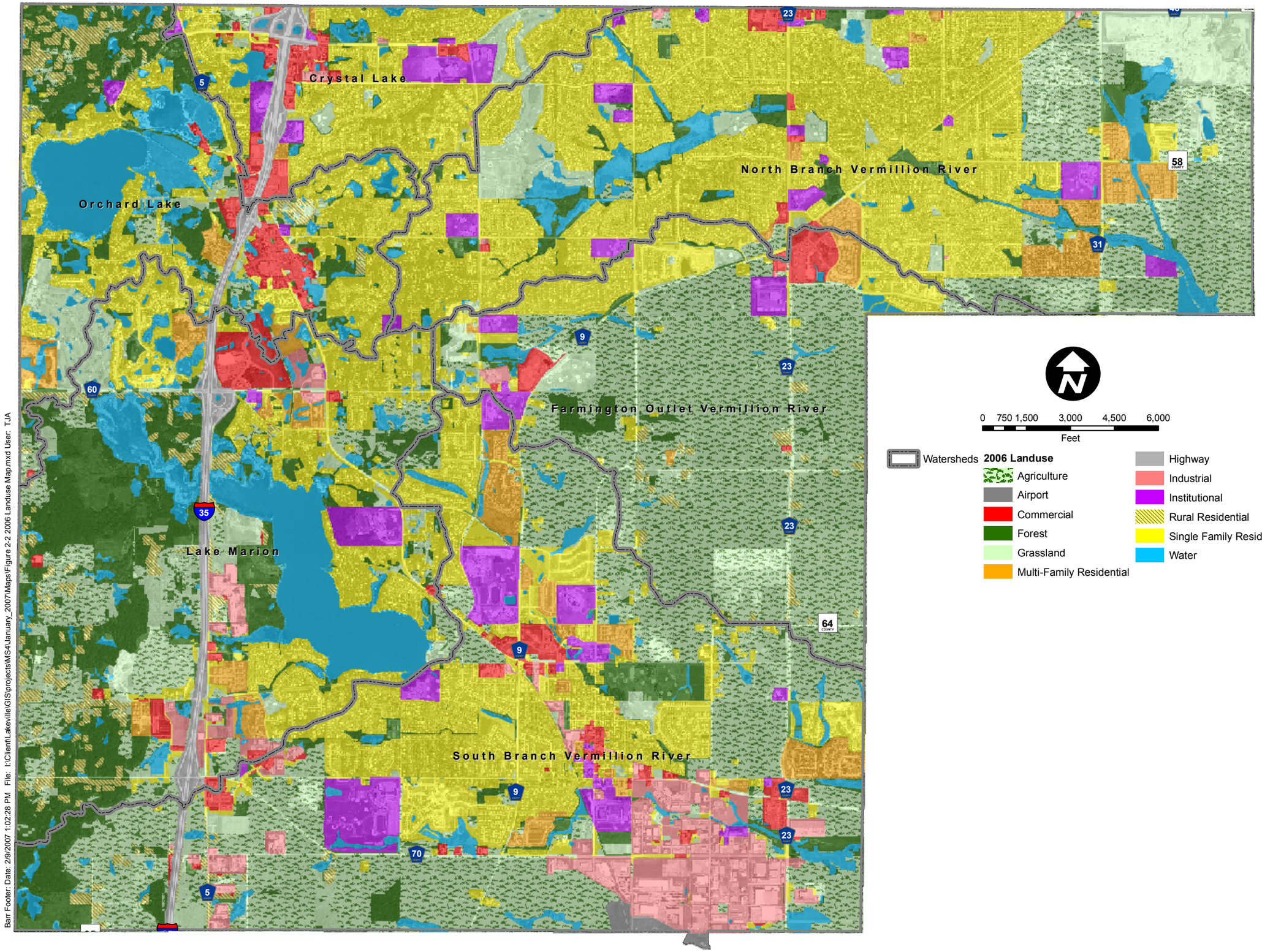


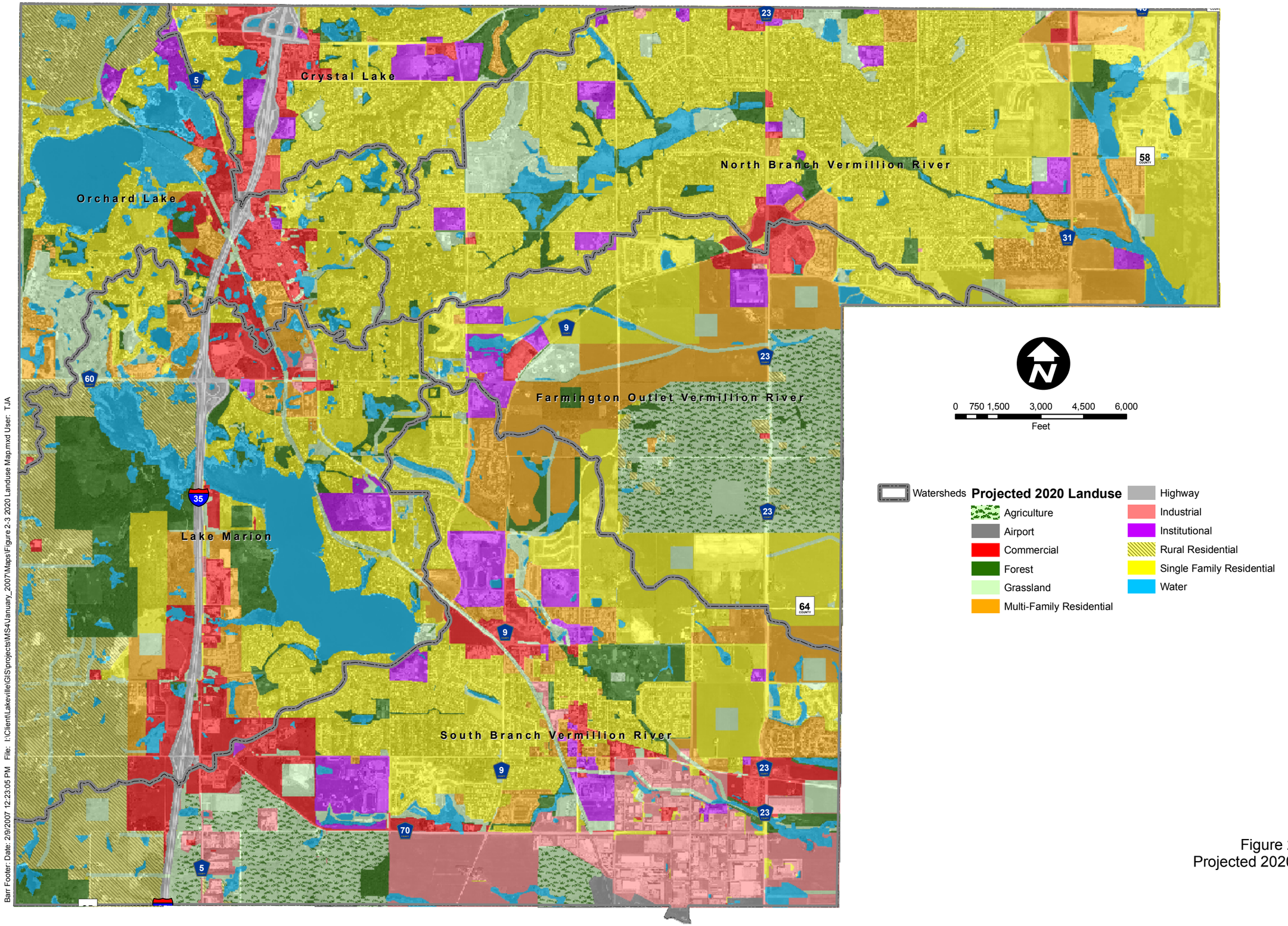
Figure 2-1
1988 Landuse

Barr Footer: Date: 2/9/2007 12:57:20 PM File: I:\Client\Lakeville\GIS\projects\MS4\January_2007\Maps\Figure 2-1 1988 Landuse Map.mxd User: TJA



Barr Footer: Date: 2/9/2007 1:02:28 PM File: I:\Client\Lakeville\GIS\projects\MS4\January_2007\Maps\Figure 2-2 2006 Landuse Map.mxd User: TJA

Figure 2-2
2006 Landuse



Barr Footer: Date: 2/9/2007 12:23:05 PM File: I:\Client\Lakeville\GIS\projects\MS4\January_2007\Maps\Figure 2-3 2020 Landuse Map.mxd User: TJA

Figure 2-3
Projected 2020 Landuse

2.2.1 1988 Imperviousness Determinations

The estimate of the amount of imperviousness in 1988 in Lakeville required that the developed area of the City be identified. Developed areas were identified using the Metropolitan Council 1984 land use, county parcel data providing year built dates, and aerial photography. Once these areas were identified, imperviousness was determined by overlaying the developed area of Lakeville in 1988 with the 1991 LandSat-derived estimates of imperviousness.

Additional calculations were required for areas identified as rural residential, since the imperviousness derived from the LandSat data for this landuse class did not compare well with actual measures of imperviousness. To provide a better estimate of rural residential areas, impervious areas were digitized from aerial photography for areas shown as being rural residential west of I-35 in the 1984 Metropolitan Land Use data. This effort resulted in the following:

- Imperviousness for areas designated as rural residential outside of the MUSA line (note that these are rural residential "areas" identified by the Met council land use and only cover the "developed" portion of the parcels) is 21.5%

- Estimated imperviousness for entire rural residential parcels and adjacent Right-of-Way (ROW) is 7.0%

Therefore, rural residential areas in 1988 were assigned an imperviousness of 21.5 % in the 1988 analysis. All other developed land use areas were assigned imperviousness based on the 1991 LandSat-derived imperviousness.

2.2.2 2006 Imperviousness Determinations

LandSat-derived imperviousness data was not available for 2006. As a result, the areas that developed between 2002 (when the latest imperviousness data layer is available) and 2006 were identified and imperviousness calculated separately from the pre-2002 development shown on the 2002 LandSat-derived coverage. The Metropolitan Council land use data was used to determine areas of development that had occurred between 2002 and 2006, along with 2006 aerial photography and input from Lakeville city staff, to determine the 2006 land cover characteristics for these areas.

Areas developed before 2002 were flagged and imperviousness was calculated using the 2002 imperviousness data. Imperviousness in areas of Lakeville developed after 2002 was estimated using a relationship that was developed between land use and imperviousness. City-wide average imperviousness was developed for each of the specific land use types using the 2000 Metropolitan

Council Land Use coverage and the 2000 LandSat-derived imperviousness estimates. The average imperviousness values for each land use type are summarized in Table 2-3.

Table 2-3 Average Imperviousness by Land Use Type for Lakeville

Land Use Class	Percent Imperviousness
Estimated using 2000 Metropolitan Land Use Data and 2000 Imperviousness Data	
Airport	21.0%
Commercial	67.5%
Industrial	66.9%
Institutional	41.6%
Industrial	66.9%
Multi-Family Residential	43.3%
Highway	58.6%
Single-Family Residential	26.2%
Estimated using Aerial Photography, Parcel and Land Use Data	
Rural Residential (developed areas only)*	21.5%
Rural Residential (entire parcel)**	7.0%

*Used for 1988 and 2006 Analysis
**Used for 2020 Analysis

The total imperviousness is the sum of the impervious area for areas developed before 2002 and those developed after 2002.

2.2.3 2020 Imperviousness Determinations

The imperviousness of developed areas were estimated using the land use classes shown in Table 2-1 and the estimated imperviousness summarized in Table 2-3. It should be noted that for rural residential areas, an imperviousness of 7 percent was used to reflect the parcel-wide nature of land use shown in the 2020 City Comprehensive Plan.

2.2.4 Summary of Land Use/Land Cover by Watershed

ArcMap GIS was used to intersect the six major watershed divides with the LULC and imperviousness data for 1988, 2006, and 2020. The data were summarized by the following land use characteristics to develop inputs for estimating runoff volume, TP and TSS loading:

- Urban Area (includes Airport, Commercial/Corporate Campus, Highway, Industrial, Institutional, Multi-Family Residential, Single Family Residential, Rural Residential)

- Percent of Urban area that is impervious
- Grassland
- Forest
- Cultivated Agriculture
- Hay/Pasture Agriculture
- Water

The division of agriculture between cultivated and hay/pasture was estimated using agricultural land cover types in Lakeville from the 1991 USGS NLCD LULC data. In 1991, 61 percent of the agricultural area was cultivated and 39 percent was hay/pasture. These percentages for each land cover type were applied to agricultural areas within the city for 1988, 2006 and 2020. The land use/land cover characteristics are summarized by major watershed in Table 2-4.

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, our 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

Table 2-4 Lakeville Landuse/Landcover (LULC) by Watershed for 1988, 2006 and 2020

1988 LULC by Watershed

WATERSHED	Hay/Pasture	Cultivated	Forest	Grass	Water	Total Urban	Urban Impervious Area*	Urban Percent Impervious Percentage	Watershed Total
Cystal Lake	94	147	140	541	71	434	166	38.3%	1,428
Farmington Outlet Vermillion River	1,021	1,597	335	155	104	148	32	21.3%	3,361
Lake Marion	516	807	1,342	408	909	797	205	25.7%	4,780
North Branch Vermillion River	972	1,521	237	982	340	1,633	477	29.2%	5,685
South Branch Vermillion River	1,521	2,379	647	642	157	1,072	450	41.9%	6,419
Orchard Lake	87	135	520	486	641	621	172	27.7%	2,490
TOTAL	**4,212**	**6,587**	**3,221**	**3,215**	**2,224**	**4,706**	**1,501**	**31.9%**	**24,164**

2006 LULC by Watershed

WATERSHED	Hay/Pasture	Cultivated	Forest	Grass	Water	Total Urban	Urban Impervious Area*	Urban Percent Impervious Percentage	Watershed Total
Cystal Lake	4	7	38	94	67	1,218	483	39.7%	1,428
Farmington Outlet Vermillion River	911	1,426	106	113	65	740	236	31.9%	3,361
Lake Marion	218	342	1,114	374	861	1,871	619	33.1%	4,780
North Branch Vermillion River	413	647	269	543	368	3,445	1,129	32.8%	5,686
South Branch Vermillion River	842	1,317	485	192	283	3,300	1,385	42.0%	6,419
Orchard Lake	33	52	435	178	610	1,181	346	29.3%	2,490
TOTAL	**2,423**	**3,790**	**2,448**	**1,495**	**2,254**	**11,756**	**4,198**	**35.7%**	**24,165**

2020 LULC by Watershed

WATERSHED	Hay/Pasture	Cultivated	Forest	Grass	Water	Total Urban	Urban Impervious Area*	Urban Percent Impervious Percentage	Total
Cystal Lake	0	0	83	32	67	1,246	457	36.7%	1,428
Farmington Outlet Vermillion River	359	562	56	212	70	2,101	716	34.1%	3,361
Lake Marion	1	1	658	286	860	2,975	933	31.4%	4,780
North Branch Vermillion River	0	0	244	371	368	4,703	1,411	30.0%	5,686
South Branch Vermillion River	191	299	326	405	284	4,914	2,075	42.2%	6,418
Orchard Lake	0	0	77	229	610	1,574	497	31.6%	2,490
TOTAL	**551**	**862**	**1,444**	**1,534**	**2,260**	**17,513**	**6,304**	**36.0%**	**24,164**

*Portion of Total Urban

- 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. Our approach for model selection 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.

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)

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 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 2-1 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.

For this loading assessment, we have chosen to use the Simple Method to determine the pollutant loadings and runoff volumes from each of the land uses within each watershed and then use the P8 model 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 the City of Lakeville has conducted a significant amount of monitoring of stormwater runoff and receiving water quality/quantity, none of the studies included monitoring of runoff from individual land uses or specific land cover types. P8 Models have been developed, and calibrated with the available data, for portions of the city as part of diagnostic-feasibility studies. However, these studies were completed in the mid-1990s and the P8 Models are not representative of either 1988 or current (2006) land use conditions, they include natural wetlands in the modeling network, and do not include all of the individual BMPs for each developed site within the watershed (typically due to a lack of site-specific BMP information for each site and the size limitation of the model). 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, we will then assess the benefit that current BMP implementation has had on the flow, TP and TSS loadings within the city limits using the 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 management organizations, 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 storm water 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 of the six 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 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 agricultural and urban land 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 Lakeville 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 also used to calculate the TP and TSS loadings, for the various land uses present within Lakeville watersheds. In the urbanized portion of each watershed, average annual runoff volume was calculated using the following relationships (as described in Schueler, 1987):

Annual Runoff Coefficient [RC] = 0.05 + ((0.009) x (Impervious Fraction) x 100)

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

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. The annual runoff coefficients (percentage of rainfall resulting in runoff) were determined for each of the land uses based on a review of the available literature. Reckhow et al. (1980) summarized the TP and water yield monitoring results of several published monitoring studies throughout the country that were specific to individual land uses or land cover types. All of the available water runoff and rainfall volume data were taken from Reckhow et al. (1980) and used to determine the median runoff coefficients for the cultivated and hay/pasture land use categories. The median runoff coefficients for the cultivated and hay/pasture land use categories were 0.12 and 0.11, respectively. For the forested land use, curve number methodology, assuming good ground cover, was applied to the long-term Twin City rainfall

records to estimate that the relative event-based cumulative runoff coefficient was 0.03. It was assumed that grassland would exhibit the same runoff coefficient as forestland. Each of these runoff coefficients, for non-urban land uses, show good relative agreement with the urban pervious runoff coefficient of 0.05 shown above (taken from Schueler [1987]). For the non-urbanized portion of each watershed, average annual runoff volume was calculated for each land use category using the following relationship:

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

The agricultural areas of the city, specified by the Metropolitan Council land use coverage for 2020, did not divide out pasture/hay and cultivated. Therefore, the division of agricultural land between pasture/hay and cultivated (predominately row crops) was estimated using the breakdown from the USGS National Land Cover Inventory (1991). The break down was 39% for pasture/hay and 61% for cultivated land cover.

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. In the urbanized portion of each watershed the TP runoff concentrations were calculated using the following relationships, developed from several Minnesota urban runoff water quality monitoring studies, for the Detailed Assessment of Phosphorus Sources to Minnesota Watersheds (Barr Engineering Company, 2004), and peer-reviewed by MPCA staff:

TP Runoff Concentration (ug/L) = 1075 - 14.4 x Impervious (%) – 5.7 x Annual Rainfall (inches)

Phosphorus loading from urbanized portion of each watershed was then calculated according to the following equation (Barr Engineering Company, 2004):

Urban TP Load (lbs.) = Concentration (ug/L) x *Annual Runoff Volume (acre-feet)* x *0.00272*

The TP contributions from non-urban land uses 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 cultivated, hay/pasture and forested land use categories. The median TP export coefficients for the cultivated, hay/pasture and forested land use categories were 0.78, 0.54 and 0.09 lbs/ac/yr, respectively. The TP export coefficient for cultivated lands is a

conservatively low estimate for Lakeville, since MCES (2004) has observed annual TP yields in the range of 0.87 to 1.64 lbs/ac/yr at its Vermillion River watershed monitoring station in Hastings, which has predominantly been cultivated. It was assumed that grassland would exhibit the same TP export coefficient as forestland. The average annual phosphorus loading from each land use in each watershed was then calculated according to the following equation:

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

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. In the urbanized portion of each watershed the TSS average annual runoff concentration was assumed to be 100 mg/L, based on the median NURP studies TSS concentration cited by Athayede et al. (1983).

TSS loading from urbanized portion of each watershed was then calculated according to the following equation:

Urban TSS Load (lbs.) = Concentration (mg/L) x *Annual Runoff Volume (acre-feet)* x *2.72*

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 coefficients for the hay/pasture and forested land use categories. The median TSS export coefficients for the hay/pasture and forested land use categories were 25 and 5 lbs/ac/yr, respectively. It was assumed that grassland would exhibit the same TSS export coefficient as forestland. MCES (2004) had monitored the Vermillion River watershed at Hastings and determined that the average annual TSS export was 63 lbs/ac/yr. Since, at that scale, the watershed area has predominantly been cultivated and the sediment delivery ratio would be estimated to be 0.2 (based on the watershed area and USDA [1972]), the long-term average TSS export coefficient for the cultivated land would be expected to be 315 lbs/ac/yr, as a conservatively low estimate. The average annual TSS loading from each land use in each watershed was then calculated according to the following equation:

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

2.3.4 BMP Implementation Modeling

As previously discussed, P8 water quality modeling was used to assess the benefit that current, and expected future, BMP implementation would have on the flow, TP and TSS loadings within the city limits for developments based on the ordinances and design standards that controlled the treatment efficiency of the BMPs when development occurred. Table 2-6 shows the BMP design requirements that controlled the treatment efficiency of the BMPs associated with each new development since 1988 and how the BMPs will likely be designed and implemented through 2020 for each watershed in the city. In a few cases, development plans were approved with a BMP design that did not fully meet the ordinances or design standards that were in place at the time that development occurred. Most of these cases involved developments that could not meet the VRWJPO draft infiltration requirement, but attained the NURP design requirement, or could not meet the South Creek infiltration requirement, but could attain the VRWJPO draft infiltration or NURP design requirements. As a result, the city developed a parcel-based GIS coverage that showed all of the developments in the city and the BMP design standard that was used at the time that development occurred. This coverage was intersected with the watershed boundaries to determine the total areas of development that complied with the various BMP design standards that controlled the treatment efficiency for the time periods that are of interest in the Permit conditions.

Table 2-6 Lakeville BMP Implementation Schedule Assumptions for Nondegradation Loading Assessment

WATERSHED	1988-1994	1994-2000	2000-2003	2003-Present	Present-2020
Cystal Lake	No Treatment	NURP Design			VRWJPO 0.5" Infiltration Requirement
Farmington Outlet Vermillion River	No Treatment	NURP Design		VRWJPO 0.5" Infiltration Requirement	VRWJPO 0.5" Infiltration Requirement
Lake Marion	No Treatment	NURP Design			VRWJPO 0.5" Infiltration Requirement
North Branch Vermillion River	No Treatment	NURP Design		VRWJPO 0.5" Infiltration Requirement	VRWJPO 0.5" Infiltration Requirement
South Branch Vermillion River	No Treatment	NURP Design	South Creek Management Plan 1.5" Infiltration Requirement		
Orchard Lake	No Treatment	NURP Design			VRWJPO 0.5" Infiltration Requirement

As a result of the BMP implementation schedule shown in Table 2-6 (and the discussion from above), there were three controlling P8 model design criteria scenarios, indicative of the ordinances and design standards that were in place when development occurred, that were completed to evaluate how the treatment efficiencies would reduce runoff volumes, TP and TSS loadings delivered to surface waters within each of the city's watershed areas. Each of the three design scenarios was run in P8 for a hypothetical low-density residential development with 25% imperviousness and a commercial development with 80% imperviousness to obtain a range of treatment efficiencies, as well as the average efficiency, that would be expected for the same design standard. Since the city has required pretreatment for all infiltration practices, the three infiltration requirement scenarios were run with pretreatment (wet detention) of the stormwater runoff before flowing to the infiltration practice. For the NURP design scenario, the P8 Model estimated average TP and TSS load reductions of 56% and 87%, respectively. It was assumed that no volume reduction would be realized from implementation of the NURP design requirements. P8 modeling of the VRWJPO 0.5" infiltration requirement predicted average annual flow volume, TP and TSS load reductions of 79%, 89%, and 95%, respectively. P8 modeling of the South Creek Management Plan 1.5" infiltration requirement predicted average annual flow volume, TP and TSS load reductions of 96%, 96%, and 97%, respectively.

2.4 Results and Discussion

Table 2-7 shows the results of the loading assessment modeling, which were summarized for each of the six 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 P8 model design criteria examples (with BMPs), based on the parcel-based GIS coverage that showed all of the developments in the city and the BMP design standard that was implemented for each development.

2.4.1 Average Annual Flow Volume

Table 2-7 and Figure 2-4 show that the total average annual flow volume from the city has increased significantly since 1988 and would continue to increase substantially by 2020, without implementation of the proposed BMPs. Table 2-7 shows that implementation of infiltration practices within the creek watersheds of the city offset some of the increased flow volume between 1988 and 2006. A review of the development data, from the parcel-based GIS coverage, revealed that between 40 and 51% of the area within the Lakeville portion of the Crystal Lake, Lake Marion and Orchard Lake watersheds had developed without implementation of any post-construction BMPs and very

little to no portion of the Crystal Lake and Orchard Lake watershed would have had infiltration practices by 2006. Whereas in Lakeville's creek watersheds, only 34%, 22%, and 17% of the respective North Creek, South Creek and Farmington Outlet watersheds had developed without implementation of any post-construction BMPs, primarily in the period between 1988 and 2005. Overall, in the creek watersheds, 26% of the watershed area developed without implementation of any BMPs, but by 2006, 32% of the total creek watershed area had developed with implementation of infiltration practices. As a result, Table 2-7 and Figure 2-5 show that approximately 45% of the overall average annual flow volume increase between 1988 and 2006 can be attributed to development within the lake watersheds of the city.

Table 2-7 and Figures 2-4 and 2-5 show that continued implementation of infiltration, as planned in the future, will continue to offset the increases in flow volume between 2006 and 2020 and will also result in an overall flow volume reduction of approximately 7 percent (from 11,168 to 10,419 acre-feet), compared to the volume estimate for 2006. Table 2-7 and Figure 2-5 show that continued implementation of infiltration practices in the future would reduce the average annual flow volumes in all of the watersheds in the city, compared to present conditions. However, the overall average annual flow volume from the city in 2020, with BMP implementation, is still 40 percent higher than the flow volume estimate from 1988. Approximately 56% of the overall average annual flow volume increase between 1988 and 2020 can be attributed to development within the lake watersheds of the city between 1988 and 2006. As a result, Table 2-7 and Figure 2-5 show that implementation of infiltration practices should maintain the average annual flow volume increases in the creek watersheds of the city to 26% of the 1988 combined volume for the same watersheds.

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 will be suitable for implementation of infiltration practices. A review of the Dakota County Soil Survey shows that between 13 and 25 percent of the land area with the Lakeville watersheds may not have suitable soils for infiltration practices. For this analysis, it was assumed that any reduction in the infiltration volume associated with unsuitable soils within individual developments would be offset by additional infiltration volume associated with future redevelopment projects that would be subject to the VRWJPO volume control rule. Neither type of infiltration volume is currently reflected in Table 2-7.

Table 2-7 Lakeville Nondegradation Loading Assessment Summary

Without BMPs	WATERSHED TOTAL RUNOFF (acre-feet)			WATERSHED TP YIELD (LBS)			WATERSHED TSS YIELD (LBS)		
WATERSHED	**1988**	**2006**	**2020**	**1988**	**2006**	**2020**	**1988**	**2006**	**2020**
Cystal Lake	539	1,227	1,169	633	1,130	1,207	166,388	333,103	316,326
Farmington Outlet	869	1,292	2,120	1,985	2,369	2,738	554,988	639,179	687,188
Lake Marion	1,054	1,864	2,492	1,869	2,387	3,089	425,281	554,294	663,752
North Creek	2,051	3,274	3,735	3,479	4,250	4,824	850,081	1,010,156	1,006,598
South Creek	2,328	4,123	5,372	3,721	4,394	4,617	1,099,428	1,380,090	1,511,060
Orchard Lake	592	978	1,312	873	1,313	1,615	173,617	267,318	352,276
TOTAL	7,434	12,758	16,200	12,559	15,844	18,090	3,269,784	4,184,140	4,537,200
With BMPs									
WATERSHED									
Cystal Lake	539	1,227	1,169	633	893	894	166,388	219,823	203,046
Farmington Outlet	869	1,107	966	1,985	2,003	1,189	554,988	531,412	262,041
Lake Marion	1,054	1,645	1,620	1,869	1,948	1,646	425,281	404,071	299,477
North Creek	2,051	3,208	3,056	3,479	3,562	2,968	850,081	749,445	544,815
South Creek	2,328	3,003	2,598	3,721	3,172	2,093	1,099,428	915,842	593,744
Orchard Lake	592	978	1,011	873	1,151	1,109	173,617	214,543	200,877
TOTAL	7,434	11,168	10,419	12,559	12,729	9,899	3,269,784	3,035,134	2,104,000

Figure 2-4 Lakeville Loading Assessment—City-Wide Average Annual Flow Volume

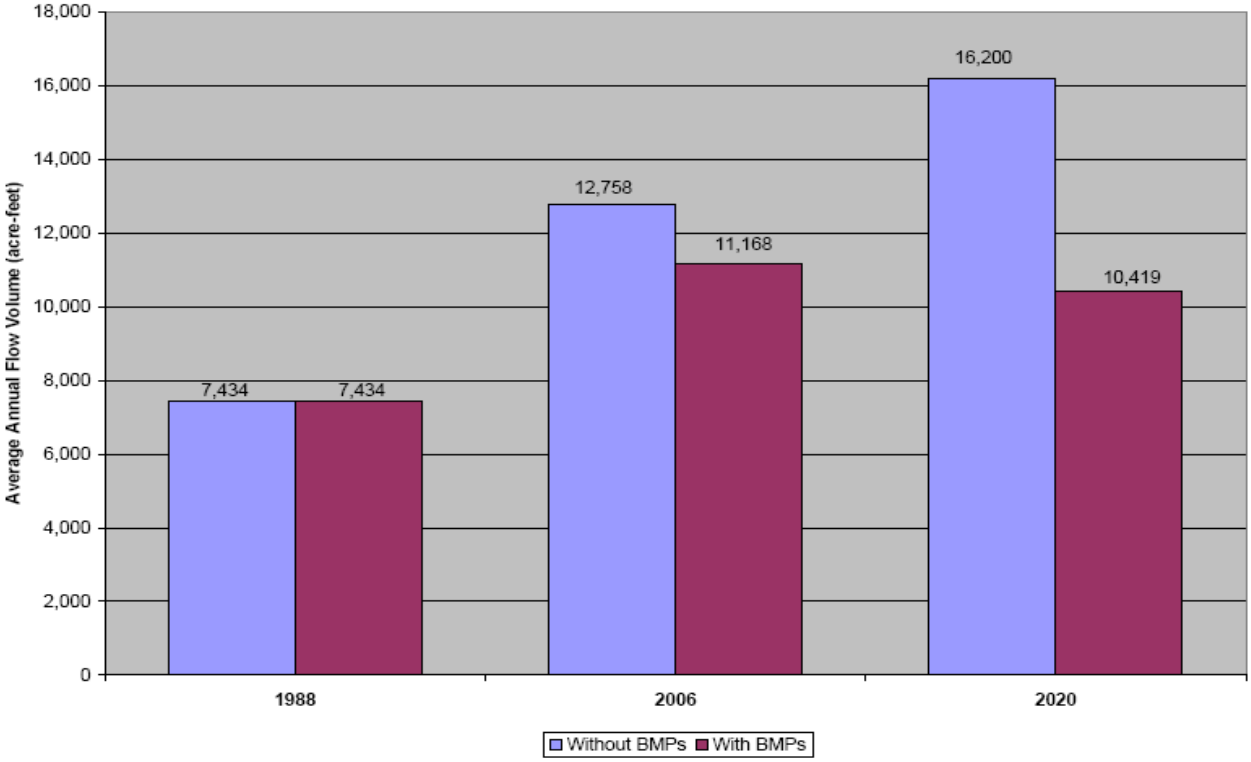


Figure 2-5 Lakeville Loading Assessment—Average Annual Flow Volume by Watershed w/ BMP Implementation

2.4.2 Total Phosphorus

Table 2-7 and Figure 2-6 show that the average annual total phosphorus loading from the city has increased since 1988 and would continue to increase by 2020, without implementation of the proposed BMPs. Table 2-7 shows that implementation of the wet detention pond and infiltration practices within the creek watersheds of the city offset most of the increased phosphorus load between 1988 and 2006. As previously discussed, a large portion of the Crystal Lake, Lake Marion and Orchard Lake watersheds had developed without implementation of any post-construction BMPs and very little to no portion of the Crystal Lake and Orchard Lake watershed would have had infiltration practices by 2006. Lakeville's creek watersheds, however, only had a small portion develop without implementation of any post-construction BMPs, primarily in the period between 1988 and 2005. By 2006, 32% of the total creek watershed area had developed with implementation of infiltration practices. The city has also required pretreatment for infiltration practices that will protect the system from clogging with sediment and protect groundwater quality.

Table 2-7 and Figure 2-6 show that continued implementation of infiltration, 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 TP load reduction of more than 22 percent (from 12,729 to 9,899 lbs.), compared to the total load estimate for 2006. Table 2-7 shows that continued implementation of infiltration practices in the future will reduce the TP loading in all of the watersheds in the city, compared to present conditions. Also, the overall average annual TP load from the city in 2020, with BMP implementation, is 21 percent lower than the TP load estimate from 1988.

2.4.3 Total Suspended Solids

Table 2-7 and Figure 2-7 show that the average annual TSS loading from the city has increased since 1988 and would continue to increase by 2020, without implementation of the proposed BMPs. Table 2-7 shows that implementation of the wet detention pond and infiltration practices within the creek watersheds of the city offset the increased TSS load between 1988 and 2006. As previously discussed, a large portion of the Crystal Lake and Orchard Lake watersheds had developed without implementation of any post-construction BMPs and very little to no portion of the Crystal Lake and Orchard Lake watershed would have had infiltration practices by 2006. Lakeville's creek watersheds, however, only had a small portion develop without implementation of any post-construction BMPs, primarily in the period between 1988 and 2005. By 2006, 32% of the total creek watershed area had developed with implementation of infiltration practices.

Figure 2-6 Lakeville Loading Assessment—City-Wide Total Phosphorus Loading

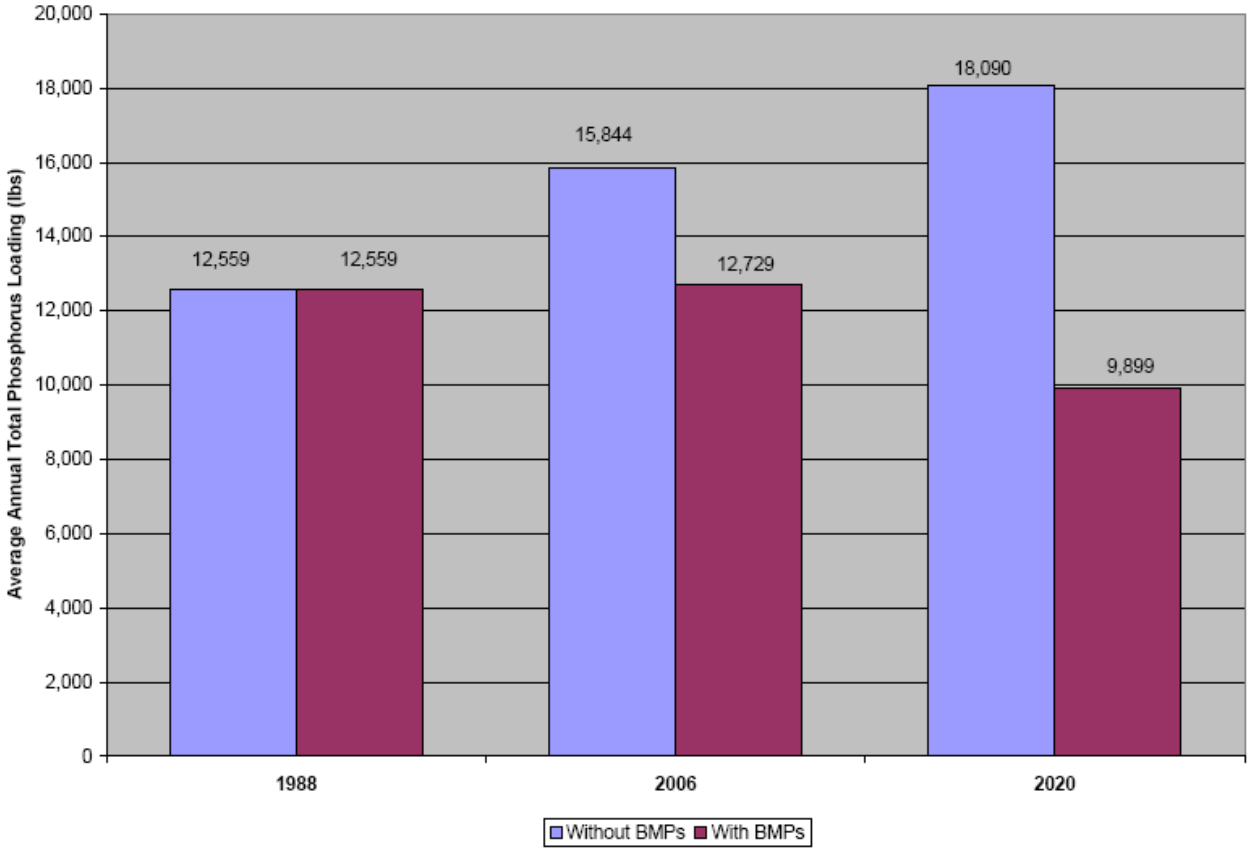
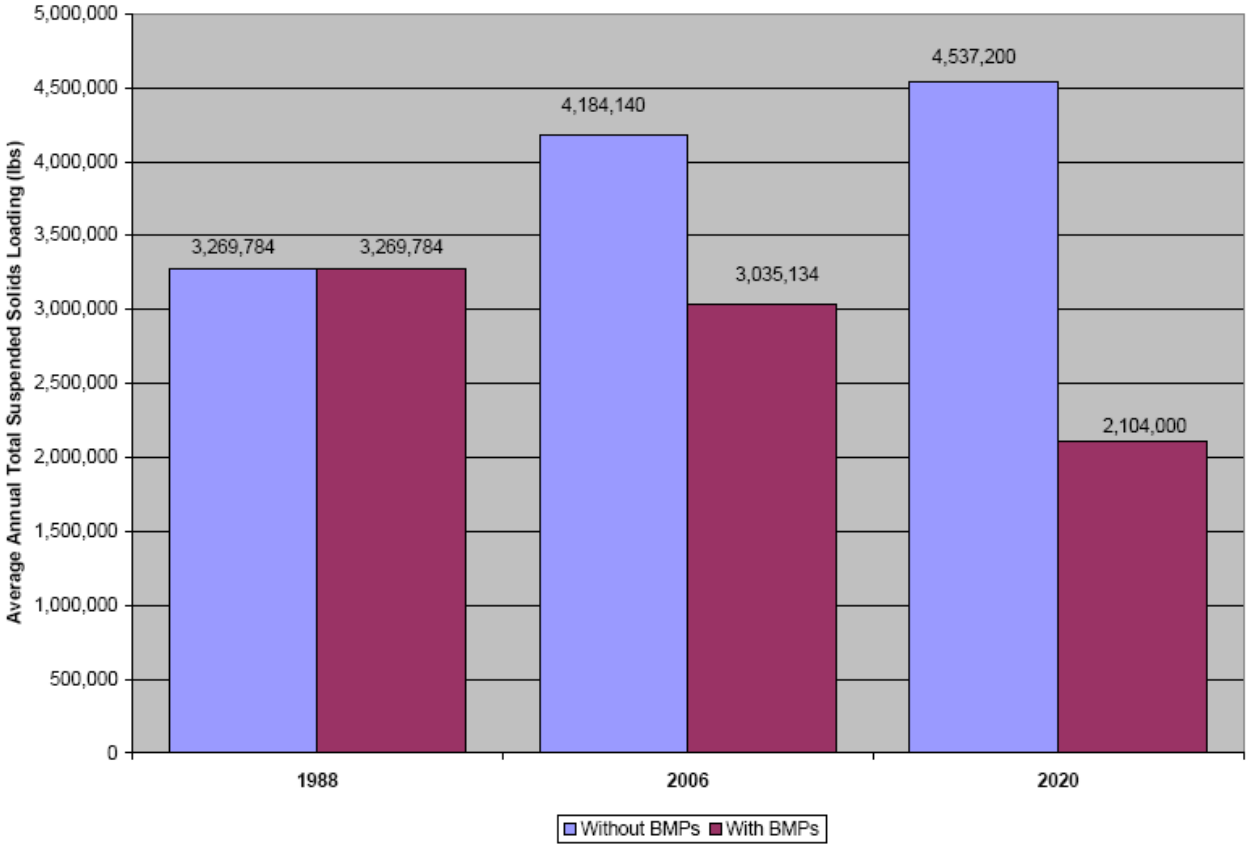


Table 2-7 and Figure 2-7 show that continued implementation of infiltration, as planned in the future, will continue to offset and significantly decrease the overall TSS loading between 2006 and 2020 by more than 31 percent (from 3,035,207 to 2,104,000 lbs.), compared to the total load estimate for 2006. Table 2-7 shows that continued implementation of infiltration practices in the future will reduce the TSS loading in all of the watersheds in the city, compared to present conditions. Also, the overall average annual TSS load from the city in 2020, with BMP implementation, is 36 percent lower than the TSS load estimate from 1988. With the exception of the Crystal Lake and Orchard Lake watersheds, all of the remaining watersheds are projected to have lower TSS load estimates in 2020, compared to 1988.

Figure 2-7 Lakeville Loading Assessment—City-Wide Total Suspended Solids Loading



3.0 Nondegradation Report

3.1 Future Conditions Loading Assessment

Table 2-7 and Figure 2-4 show that the total average annual flow volume from the city has increased significantly since 1988 and would continue to increase substantially by 2020, without implementation of the proposed BMPs. As discussed in Section 2.4, the results of the loading assessment, following implementation of BMPs, indicates that the overall average annual flow volume from the city in 2020 is 41 percent higher than the flow volume estimate from 1988 but continued implementation of infiltration practices will offset the increases in flow volume between 2006 and 2020 and result in an overall flow volume reduction of more than 7 percent, compared to the volume estimate for 2006.

It should be noted that the results projected for the 2020 land use conditions assume that enough of the soils in the undeveloped portions of each watershed will be suitable for implementation of infiltration practices within each new development. A review of the Dakota County Soil Survey shows that between 13 and 25 percent of the land area with the Lakeville watersheds may not have suitable soils for infiltration practices. For the loading assessment analysis, it was assumed that any reduction in the infiltration volume associated with unsuitable soils within individual developments would be more than offset by additional infiltration volumes associated with future redevelopment projects that would be subject to the South Creek Management Plan and VRWJPO volume control rules. As a result, neither of these potential changes to the infiltration, and associated changes to runoff volumes, in each watershed is currently reflected in the loading assessment estimates, shown in Table 2-7.

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. As a result, the following sections of the Nondegradation Report discuss how BMPs, incorporated into a modified SWPPP, will address and mitigate the projected increases in average annual flow volume, as far as is reasonable and practical.

The following sections also include discussion about the BMP selection considerations, the alternatives that were evaluated, and the basis for the selected BMP approach for both new development and retrofits of existing development. The BMP selection considerations primarily

consist of receiving water quality, stream morphology/channel erosion, trout streams, wetlands and source water protection.

As discussed in Section 2.3.4, the loading assessment was completed assuming that future BMP implementation would follow the VRWJPO draft rules and standards (VRWJPO, 2006) for most of the city, with the exception of the South Creek watershed, which would continue to follow the more stringent volume control requirements established in the South Creek Management Plan. For the loading assessment it was assumed that the VRWJPO draft volume control rule would control the treatment efficiency for future (between 2007 and 2020) BMP implementation within all of the remaining watersheds in the city (see Table 2-6). The following sections will provide the rationale for choosing to implement the South Creek Management Plan volume control requirements within the South Creek watershed, and then requiring the VRWJPO draft rules and standards for the future design and implementation of the remaining BMPs in the city.

3.2 BMP Selection Considerations for New Development

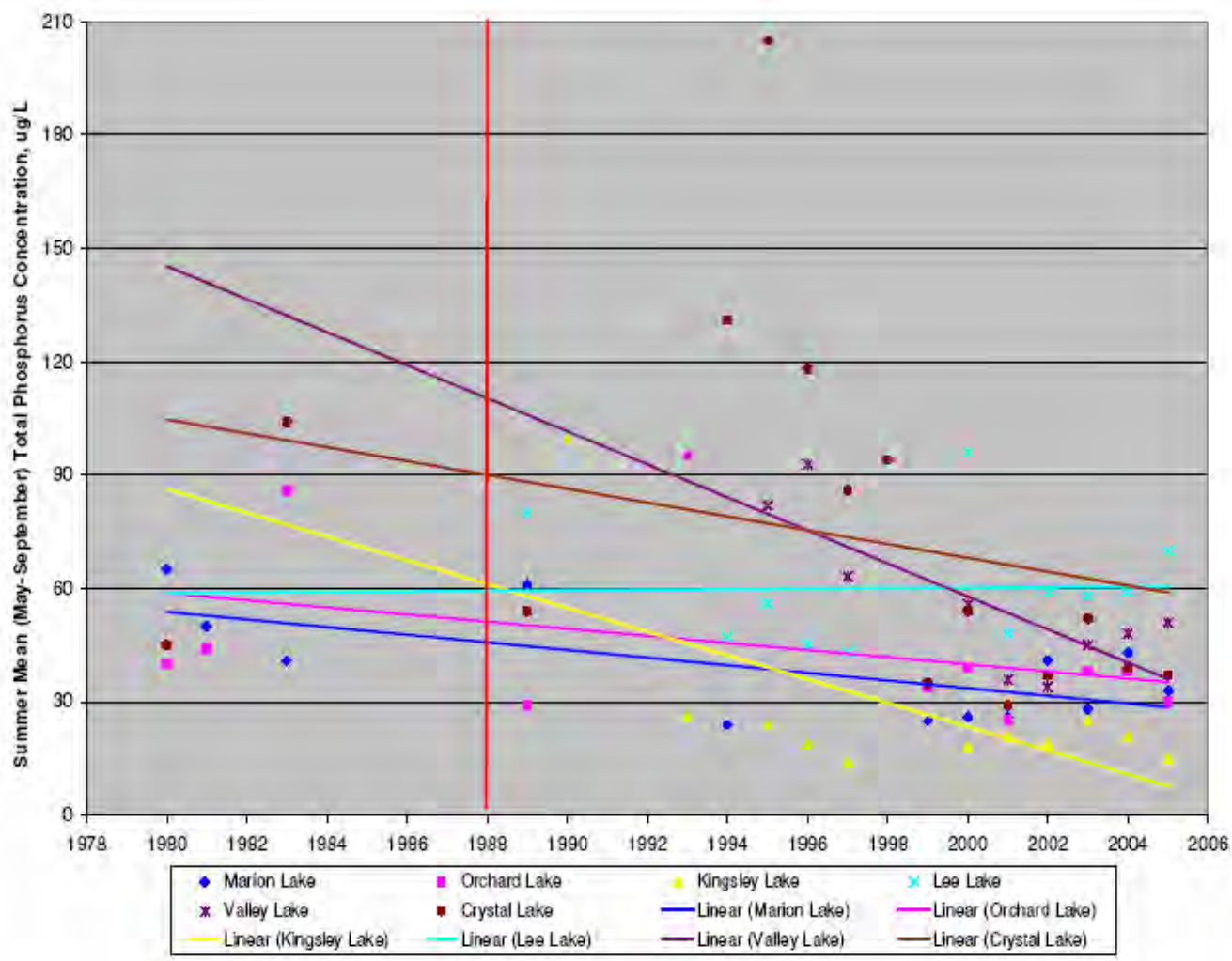
3.2.1 Receiving Water Quality

As discussed in Sections 2.4.2 and 2.4.3, the loading assessment indicates that past implementation of BMPs had limited increases in the overall TP load and reduced the TSS loads from the city watersheds between 1988 and 2006. The loading assessment also indicates that implementation of the BMPs planned for the future, will ensure that the overall TP and TSS loads from the city will not increase between 1988 and 2020, while the overall average annual flow volume will increase. For both time periods, BMP implementation will ensure that the flow volume will increase at a higher rate than the TP and TSS loads in every watershed. As a result, the runoff and receiving water quality will be improved for TP and TSS, even for watersheds (such as Crystal and Orchard Lakes) that will have increasing TP and TSS loads between 1988 and 2020.

Figure 3-1 indicates that past implementation of BMPs has ensured that there has not been deteriorating water quality conditions in the lake watersheds within the city of Lakeville. With the exception of Lee Lake, which does not exhibit a trend in summer-mean TP concentration, all of the remaining lakes have had improving trends in in-lake TP concentrations since 1988. The MINLEAP lake water quality model was used in conjunction with the loading assessment TP loadings from the Lake Marion watershed to verify the observed effect. MINLEAP predicts a 10 ug/L improvement in the TP concentration between 1988 and current conditions because of the improved watershed runoff water quality and increased flushing rate in the lake system. As a result, a comparison of the loading

assessment estimates for storm water runoff volume and TP/TSS loadings indicates that receiving water quality should be improved between 1988 and 2020 for lakes, wetlands and streams within the city of Lakeville.

Figure 3-1 Lakeville Lake Water Quality Trends—Total Phosphorus



3.2.2 Stream Morphology/Channel Erosion

As discussed in Section 2.4.1, between 40 and 51% of the area within the Lakeville portion of the Crystal Lake, Lake Marion and Orchard Lake watersheds had developed without implementation of any post-construction BMPs and very little to no portion of the Crystal Lake and Orchard Lake watershed would have had infiltration practices by 2006. Most of the storm water runoff generated

in these watersheds is conveyed to the lakes via storm sewer, so there are a limited number of open channels within these watersheds that could be subject to channel erosion due to increased flow volumes.

The Lake Marion watershed has a few open channels, but there are culvert crossings along these channels that have controlled the peak flows since the policy in the Lakeville Surface Water Management Plan would not have allowed increases in culvert flow capacity due to new development. As a result, the city has not observed any channel erosion in either the lake or creek watersheds in the past. One instance of erosion formed downstream of an outfall from a new development due to poor energy dissipation on a steep slope, but this condition is being corrected and is not attributable to increases in flow volume.

Approximately 56% of the overall estimated average annual flow volume increase between 1988 and 2020 would be attributed to development within the lake watersheds of the city between 1988 and 2006. In contrast to the lake watersheds, Lakeville's creek watersheds had developed only 34%, 22%, and 17% of the respective North Creek, South Creek and Farmington Outlet watershed areas without implementation of any post-construction BMPs, in the period between 1988 and 2003 or prior to 2000 in the South Creek watershed. Overall, 26% of the creek watershed areas developed without implementation of any post-construction BMPs, but by 2006, 32% of the total creek watershed area had developed with implementation of infiltration practices. Based on future implementation of infiltration practices (according to the VRWJPO Standards), Table 2-7 and Figure 2-5 show that the average annual flow volume in the creek watersheds by 2020 will be reduced by 10%, compared to the 2006 estimates, and the overall increase should be maintained at 26% of the 1988 combined volume for the same watersheds. Both the VRWJPO Standards and the South Creek Management Plan require the establishment of buffers along stream corridors, which will provide further protection for the physical and biological integrity within each watershed. In addition, Lakeville will continue to educate landowners and residents of existing developments about the importance of maintaining existing stream buffers.

As discussed in Section 2.3.4, the VRWJPO volume control Standard equates to 0.5-inch of infiltration storage volume over the surface of all newly created impervious areas. The P8 modeling results for developments subject to the draft volume control rule estimates a volume reduction of 79% for the site drainage. The P8 modeling results for developments subject to the South Creek Management Plan requirements estimates a volume reduction of 96% for the site drainage. This indicates that additional volume reductions start to diminish as the infiltration storage volumes start

to exceed 0.5-inch. As a result, future implementation of the VRWJPO Standards in all of the watersheds, combined with the South Creek Management Plan volume control requirements in the South Creek watershed, represents the BMP alternative that is the most reasonable and practical, in light of the increased costs and loss of useable space associated with the larger infiltration storage volumes.

3.2.3 Trout Streams

As discussed in Section 2.3.4, the city began development of the South Creek Management Plan in 1999 to evaluate alternative practices to wet detention ponds that would not exacerbate thermal loadings to the DNR-protected trout stream reaches in the South Creek watershed. The South Creek Management Plan (2000) provided requirements for establishing spill prevention and response procedures, buffers along the stream alignment, and implementing infiltration practices with storage volumes that were equivalent to 1.5 inches of rainfall over the impervious surface areas within each development. In addition to the South Creek watershed, the North Creek, Farmington Outlet and Lake Marion watersheds are also tributary to DNR-protected trout stream reaches in the Vermillion River watershed, although the Lake Marion outlet has rarely contributed flow to the South Creek watershed.

Since 2005 the city has required infiltration practices in the Farmington Outlet and North Creek watershed, based on the draft requirements proposed by the VRWJPO at that time (see Section 2.3.4). For the loading assessment it was assumed that the VRWJPO volume control Standard would be implemented within all of the watersheds in the city, with the exception of South Creek, which would continue to be subject to the South Creek Management Plan 1.5-inch infiltration requirement for future development. The VRWJPO Standards also contain runoff temperature control criteria and meet the minimum requirements of the MPCA's NPDES General Construction Permit for Special Waters. These infiltration requirements, combined with the peak flow restrictions, will control the bankfull flow conditions, relative to present conditions, and in the process, mitigate thermal impacts in the trout stream and tributary reaches of the Vermillion River watershed. The results of the loading assessment with implementation of BMPs (Table 2-7) shows that, relative to present conditions, there will not be new or expanded discharges impacting the trout waters. Table 2-7 indicates that there will be an average annual flow volume reduction of 8% in the Vermillion River watershed between 2006 and 2020.

In summary, the city has implemented and will continue to implement all reasonable and practical infiltration measures to mitigate temperature changes for trout streams and their tributaries, while

controlling flow changes (further discussed in Section 3.2.2) that affect turbidity, suspended solids, phosphorus and many chemical pollutant loadings. In addition, the city will provide further protection for the physical and biological integrity within the trout stream watersheds by implementing the following prudent and feasible measures:

- Establishment of buffers along stream corridors, based on the most restrictive requirements for each type of corridor in the South Creek Management Plan and the VRWJPO Standards
- Continued education of landowners and residents of existing developments about the importance of maintaining existing stream buffers and eliminating illicit discharges
- Establishing spill prevention and response procedures for industrial and municipal operations within the watersheds
- Regular inspections of outfalls for illicit discharges and of infiltration and other structural BMPs for proper functionality

As a result, the city of Lakeville has considered all feasible and prudent alternatives to discharges that would affect trout waters.

3.2.4 Wetlands

This section addresses, as far as is reasonable and practical, the potential negative impacts of increased storm water 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 City of Lakeville Wetland Management Plan (WMP, 2003) has been developed in conformance with Minnesota Rules 8420.0650 and meets the requirements of the Wetland Conservation Act (WCA). The WMP includes a discussion about the regulatory framework for wetlands in the city, including the role of the city as the Local Government Unit (LGU) for the WCA and an overview of other agency jurisdiction over wetlands. The WMP also discusses the methods and results of the functions and values assessment, management strategies and implementation program for the wetlands within the city. The WMP requires full sequence evaluation for impacts of a wetland alteration and provides wetland mitigation and replacement requirements.

The management strategies in the WMP that preserve the functions and values of wetlands in the city include wetland buffer requirements for each classification and storm water management requirements intended to maintain or minimize changes to bounce for a 2-year storm event, according to the requirements of each wetland classification. The results of the loading assessment, with future implementation of BMPs, shows that the infiltration requirements will reduce average annual flow volume, and in turn, reduce the bounce and duration of inundation in the city's wetlands.

The VRWJPO Standards (2007) provide specific criteria for wetland buffers, based on the functional wetlands assessment. Based on the wetland management classifications in the buffer rule, the city of Lakeville will incorporate more restrictive requirements into the WMP, where necessary, and apply the requirements to future development.

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, Lakeville will reference both the WCA and Minn. R. 7050.0186 requirements for wetland protection in the WMP and SWPPP.

Combining the infiltration requirements included in the loading assessment with the updated WMP requirements for buffers and storm water management represents the most reasonable and practical means of preventing significant adverse impacts to the designated use of wetlands in the city of Lakeville.

3.2.5 Source Water Protection Areas

While the nondegradation report, in consideration of the loading assessment, has emphasized the implementation of infiltration BMPs, both in the past and proposed for the future, Lakeville'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 Storm Water Infiltration Projects in Vulnerable Wellhead Protection Areas, and the MPCA's, Minnesota Stormwater 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

The city may 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 Lakeville property.

Section 3.1 notes that the loading assessment analysis assumed that any reduction in the infiltration volume associated with unsuitable soils within individual developments would be more than offset by additional infiltration volumes associated with future redevelopment projects that would be subject to the South Creek Management Plan and VRWJPO volume control standard. As a result, it is reasonable and practical to apply the South Creek Management Plan and VRWJPO Standards to redevelopment projects, wherever possible, to mitigate past increases in storm water runoff volume and further improve receiving water quality and habitat. Variances to some of the rules may

occasionally be granted in the case of hardships or when site conditions do not allow for proper BMP implementation.

3.4 Cost/Benefit, Social and Environmental Considerations

As discussed in Section 2.3.4, the VRWJPO volume control Standard equates to 0.5-inch of infiltration storage volume over the surface of all newly created impervious areas. The P8 modeling results for developments subject to the draft volume control rule estimates a volume reduction of 79% for the site drainage. The P8 modeling results for developments subject to the South Creek Management Plan requirements estimates a volume reduction of 96% for the site drainage. This indicates that additional volume reductions start to diminish as infiltration storage volumes exceed 0.5-inch. As a result, future implementation of the VRWJPO Standards in all of the watersheds, combined with the South Creek Management Plan volume control requirements in the South Creek watershed, represents the BMP alternative that provides the most cost-effective results, in light of the increased costs and loss of useable space associated with the larger infiltration storage volumes.

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 requirements for new developments. 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 2-7. These BMPs include the following:

- The lawn fertilizer phosphorus ban
- Street sweeping
- Public education/participation/outreach
- Illicit discharge detection and elimination
- Pollution prevention/good housekeeping measures for municipal operations

- Litter and pet waste control ordinances
- Buffer ordinance for surface waters

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, with BMP implementation, shown in Table 2-7 were higher for the following reasons:

- There is increased seepage to groundwater from storm water pretreatment measures and wet detention ponds
- Disconnection of impervious surfaces from drainageways
- Additional treatment associated with future redevelopment projects was not considered in the analysis

4.0 Proposed SWPPP Modifications

This section describes the modifications that are proposed for City of Lakeville 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 would follow the VRWJPO Standards (VRWJPO, 2007) for most of the city, with the exception of the South Creek watershed, which would continue to follow the more stringent volume control requirements established in the South Creek Management Plan. As a result, 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 Lakeville
- Channel erosion and stream morphology changes will be controlled
- Further protection will be provided for the physical and biological integrity of the stream and wetland corridors
- Temperature changes for trout streams and their tributaries will be mitigated and changes in flow will be controlled
- Controlled bounce and duration of inundation in the city's wetlands and preservation of the functions and values for each type of wetland classification
- Wherever possible, the rules will be applied to redevelopment projects to mitigate past increases in storm water runoff volume and further improve receiving water quality and habitat

In addition, the SWPPP will be modified to discuss further protection for the physical and biological integrity within the trout stream watersheds by implementing the following measures:

- Establishment of buffers along stream corridors, based on the most restrictive requirements for each type of corridor in the South Creek Management Plan and the VRWJPO Standards
- Continued education of landowners and residents of existing developments about the importance of maintaining existing stream buffers and eliminating illicit discharges

- Establishing spill prevention and response procedures for industrial and municipal operations within the watersheds

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, Lakeville should 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 proposed SWPPP modifications to address nondegradation were public noticed at the local level as required in the Permit. The City of Lakeville also submitted its SWPPP modifications to address nondegradation to the appropriate local water authorities (the Vermillion River Watershed Joint Powers Organization and the Black Dog Water Management Organization) in time to allow for their review and comment. The Nondegradation Report explaining the proposed BMPs and the entire SWPPP was made available to the public and local water authority upon request. The following sections summarize the comments received from the public and the local water authorities on the proposed SWPPP modifications and the Nondegradation Report. Copies of comment letters are included as attachments to this report.

5.1.1 Public Comments on Proposed SWPPP Modifications

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

5.1.2 Local Water Authority Comments on Proposed SWPPP Modifications

5.1.2.1 Vermillion River Watershed Joint Powers Organization (VRWJPO)

A letter discussing the VRWJPO review of the Nondegradation Report and SWPPP is included as an attachment to this submittal document. In the attached letter, the VRWJPO stated that the proposed BMPs implemented by the city meets or exceeds their Stormwater Management Standards. The VRWJPO also agrees that implementation of the proposed BMPs is reasonable and practical and will minimize water quality degradation as development occurs in the future. The review letter also provides the following comments:

- The city's official controls and Comprehensive Stormwater Management Plan must be revised as proposed in the Nondegradation Report as a part of the City's SWPPP modifications and the City must adopt the local watershed plan by November 3, 2007 with the BMPs addressed in the Report.

- References to the VRWJPO draft rules should be replaced by VRWJPO Standards

5.1.2.2 Black Dog Watershed Management Organization (BDWMO)

A letter discussing the BDWMO review of the Nondegradation Report and SWPPP is included as an attachment to this submittal document. In the attached letter, the BDWMO stated that the nondegradation plan is very thorough and conforms with the BDWMO Watershed Management Plan (BDWMO Plan). The review letter requests a clarification about the water quality treatment standards that the city will apply to future redevelopment projects in the BDWMO watershed and encourages the application of stormwater treatment BMPs (infiltration and wet detention ponds) to redevelopment projects, where feasible, in keeping with Policy 3, Section 5.3 of the BDWMO Plan.

5.2 Record of Decision on the Comments

In response to the comments in the VRWJPO review letter, the city of Lakeville is currently working on the next generation of the Surface Water Management Plan that will incorporate the BMPs addressed in the Nondegradation Report and SWPPP modifications. This report submittal has been revised to reflect the appropriate references to the VRWJPO Standards.

In response to the comment in the BDWMO review letter, the city of Lakeville fully intends to follow Policy 3, Section 5.3 of the BDWMO Plan for future redevelopment projects. The city is currently working on the next generation of the Surface Water Management Plan that will specifically describe the policy and BMPs requirements for redevelopment projects. Lakeville expects to implement infiltration and/or wet detention ponds as part of future redevelopment projects, wherever feasible and practicable. BDWMO is encouraged to provide input on the proposed policy and requirements contained in the updated SWMP.

References

Athayede, D.N., R.P. Healy and R. Field. 1983. Results of the Nationwide Urban Runoff Program, Volume I – Final Report. U.S. EPA, Water Planning Division. NTIS PB84-185552.

Barr Engineering Company. 1994. City of Lakeville Surface Water Management Plan. Prepared for the City of Lakeville.

Barr Engineering Company. 2004. Detailed Assessment of Phosphorus Sources to Minnesota Watersheds. Prepared for the Minnesota Pollution Control Agency.

Burton, Jr., G.A. and R.E. Pitt. 2001. Stormwater Effects Handbook: A Toolbox for Watershed Managers, Scientists, and Engineers. ISBN 0873719247. Lewis Publishers. CRC Press, LLC.

City of Lakeville. 2000. South Creek Management Plan. The Joint Environmental Affairs Committee/Economic Development Commission South Creek Subcommittee.

City of Lakeville. 2003. Wetland Management Plan.

Metropolitan Council Environmental Services (MCES). 2004. Vermillion River Monitoring Station Information.

Minnesota Pollution Control Agency (MPCA). 1989. Protecting Water Quality in Urban Areas. Best Management Practices for Minnesota.

Minnesota Pollution Control Agency (MPCA). 2006. Draft Guidance Manual for Small Municipal Separate Storm Sewer Systems (MS4s). For General Permit Number MNR040000.

Reckhow, K.H., M.N. Beaulac, and J.T. Simpson. 1980. Modeling Phosphorus Loading and Lake Response Under Uncertainty: A Manual and Compilation of Export Coefficients. EPA 440/5-80-011.

Schueler, T.R. 1987. Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban BMPs. Metropolitan Washington Council of Governments.

USDA, 1972. Sediment sources, yields, and delivery ratios. National Engineering Handbook, Section 3 Sedimentation.

U.S. Environmental Protection Agency (EPA). 1997. Compendium of Tools for Watershed Assessment and TMDL Development. EPA841-B-97-006.

Vermillion River Watershed Joint Powers Organization (VRWJPO). 2007. Vermillion River Watershed Joint Powers Organization Rules and Standards.

Walker, W.W., Jr. 1987. Design Calculations for Wet Detention Ponds. Prepared for St. Paul Water Utility. St. Paul, MN.

Attachments

Vermillion River Watershed Joint Powers Organization
14955 Galaxie Avenue ~ Apple Valley, MN 55124
952.891.7142 ~ Fax 952.891.7031

August 17, 2007

Mr. Keith H. Nelson, P.E.
City Engineer
20195 Holyoke Avenue
Lakeville, MN 55044

RE: Review of City of Lakeville Draft Nondegradation Report and Storm Water Pollution Prevention Program

Pursuant to the Minnesota Pollution Control Agency Stormwater General Permit No. MNR040000 for discharge of stormwater associated with municipal separate storm sewer systems (MS4), Vermillion River Watershed Joint Powers Organization (VRWJPO) staff is pleased to review the City of Lakeville draft Nondegradation Report (Report) and Storm Water Pollution Prevention Program (SWPPP) submitted on July 12, 2007.

The City's Report excellently summarizes the City's past growth in land use, planning, design standards and projects for stormwater management, and presents the modeling approach and methodology for loading assessment as well as the model results of nondegradation by implementing the Best Management Practices (BMPs) of infiltration for new development and redevelopment. The City asked VRWJPO two questions:

- **Do the BMPs that are being implemented by the City meet the requirements of the WMO's?**

  Answer: Yes. As shown in Table 2-6 of the Report, the City began to implement 1.5 inch of infiltration in the South Branch Vermillion River watershed (this should be South Creek watershed, because South Branch Vermillion River refers to the stream that flows through the Castle Rock and Vermillion townships to the Vermillion River east of the city) in 2000 and 0.5 inch of infiltration in the Farmington Outlet Vermillion River and North Branch Vermillion River watersheds in 2003. The loading assessment was done under an assumption that the City will implement 0.5 inch of infiltration within all of the watersheds in the city boundary with the exception of the South Creek watershed, which would continue to implement more stringent 1.5 inch of infiltration for new development and redevelopment.

  VRWJPO Stormwater Management Standards state:

  Post construction Water Quality Criteria

  1. *Post construction stormwater runoff quality measures shall meet the standard for the General Permit Authorization to Discharge Storm Water Associated With Construction Activity Under the National Pollutant Discharge Elimination System/State Disposal System Permit Program Permit MN R100001 (NPDES General Construction Permit) issued by the Minnesota Pollution Control Agency,*

August 1, 2003, as amended; except where more specific requirements are provided in paragraphs 2, 3, 4, and 5 below.

2. *Infiltration/filtration options, and Credits described under Runoff Volume Control Criteria 2, are the preferred approach to satisfying the water quality treatment requirements of the NPDES General Construction Permit in areas that drain to the trout stream portions of the Vermillion River and its tributaries where such areas do not first drain to a waterbody with 10 or more acres of open water.*

Runoff Volume Control Criteria

3. *The water quality control volumes necessary to meet the NPDES General Construction Permit that are satisfied using infiltration or filtration technologies (filtration only on Type C and D soils) can count toward the Volume Control requirements of these Standards.*

The stormwater in the city boundary, except in the Orchard Lake watershed, drains to the trout stream portions of the Vermillion River and its tributaries. According to the requirements of the VRWJPO Standards quoted above, 0.5 inch of water quality volume specified in the NPDES General Construction Permit issued by MPCA is preferred to be treated by infiltration/filtration. The City's current policy of implementing 0.5 inch of infiltration within all of the watersheds in the City other than the South Creek watershed where 1.5 inch of infiltration is being implemented thus meets or exceeds the requirements of the VRWJPO Standards.

- **Will the implementation of the BMPs minimize water quality degradation as development occurs in the future?**

Answer: Yes. The model results shown in Table 2-7 of the Report with implementation of the afore-mentioned infiltration practices indicate that total loading of phosphorus (TP) and total suspended solids (TSS) in 2020 will reduce by 21% and 36% of that in 1988, respectively, even though the total runoff volume will increase by 41% during the period. This affirms the effectiveness of the infiltration BMPs as reasonable and practical measures. The Report points out the limited data of runoff volumes or quality from individual land uses or specified land cover types. The Simple Method utilized runoff coefficients, pollutant concentrations, and export coefficients best available in literatures. The model also assumed that any reduction in the infiltration volume associated with unsuitable soils within individual developments would be offset by additional infiltration volume associated with future redevelopment projects that would be subject to the proposed infiltration BMPs. With these limitations, the Report proposes additional BMPs of buffer along the major waterways and streams and runoff temperature control measures in accordance with the VRWJPO Standards that were not included in the loading assessment. Other BMPs that are being implemented like the lawn fertilizer phosphorus ban and street sweeping were also not included in the loading assessment. Considering all these, VRWJPO staff believes that the implementation of the BMPs addressed in the Report will ensure nondegradation requirements of the City's MS4 General Permit.

In addition to the answers to the City's questions, the following comments are made:

1. The Report (in Chapter 4.0) addresses updating the City's development review policies, standards and procedures in accordance with the VRWJPO Stormwater Management Standards as applied in the loading assessment. It also addresses establishment of buffers along stream corridors in accordance with the VRWJPO Buffer Standards. The City's SWPPP refers to the City ordinances and Comprehensive Stormwater Management Plan (CSMP) in its BMPs and goals (MCM 3, 4, and 5). The City's official controls and CSMP must be revised as proposed in the Report as a part of the City's SWPPP modifications. Pursuant to the Minnesota Statutes 103B.235, the City must adopt local watershed plan by November 3, 2007 in compliance with the VRWJPO Watershed Plan and Standards. The City's watershed plan must include the BMPs addressed in the Report.

2. The Report refers to the VRWJPO draft rules and standards in its executive summary and Chapters 4 and 5. The VRWJPO Standards and Rules were adopted on October 26, 2006 and March 9, 2007, respectively, as a minor plan amendment. Even through they are subject to change, they are no longer draft documents. In pages 45 through 50 of the Report, "VRWJPO draft rules" should be replaced by "VRWJPO Standards."

VRWJPO believes the City's policies expressed in the Report provide an excellent framework for managing stormwater to achieve nondegradation of the water resources in the City. Please contact me at 952-891-7140 if you have any questions.

Sincerely,

Tae I. Kim

Tae I. Kim, P.E.
Senior Water Resources Engineer, Dakota County

c: Len Kremer, Barr Engineering Company
Paul Nelson, Scott County/VRWJPO Co-Administrator
Michelle Beeman, Dakota County Environmental & Natural Resources Director
Tom Berry, Dakota County Water Resources Department
Laura Jester, Dakota County SWCD, VRWJPO Administration

BLACK DOG WATERSHED MANAGEMENT ORGANIZATION

August 28, 2007

Mr. Keith H. Nelson
City Engineer
City of Lakeville
20195 Holyoke Avenue
Lakeville, MN 55044

Re: City of Lakeville Draft Nondegradation Plan and Stormwater Pollution Prevention Plan

Dear Mr. Nelson:

Thank you for submitting the City of Lakeville's Draft Nondegradation Plan and Stormwater Pollution Prevention Plan (SWPPP) to the Black Dog Watershed Management Organization (BDWMO) for review and comment prior to submitting the plans to the Minnesota Pollution Control Agency. The BDWMO also appreciates your attendance at the August 15, 2007 BDWMO Commission meeting to present the City's nondegradation plan; the Commission found the presentation very informative.

Overall, the City's nondegradation plan is very thorough and conforms with the BDWMO Watershed Management Plan (Plan). The BDWMO commends the City for developing an informative document that effectively summarizes land use changes, stormwater treatment requirements, and stormwater runoff loadings between 1988 and the present, and from the present to 2020. The BDWMO is pleased to see the measures the City of Lakeville will be taking to minimize future water quality degradation. In particular, the BDWMO commends the City for implementing a 0.5-inch infiltration requirement that will include the BDWMO portions of the City. This requirement goes beyond what the BDWMO Plan requires for new development.

The BDWMO has one question regarding the water quality treatment standards the City will apply to redevelopment. Of special concern to the Commission is the Crystal Lake watershed, large portions of which developed without implementation of any post-construction BMPs. Because it is fully developed, the City's infiltration requirements (or any other water quality treatment requirements) would not apply. As noted in the BDWMO Plan, "when areas redevelop, the BDWMO encourages the member cities to take full advantage of the opportunity to improve stormwater runoff management and water quality" (policy 3, Section 5.3).

With little or no new development to occur in the watershed, it is through redevelopment and other opportunities that additional stormwater treatment can be implemented. In Section 3.3 of the draft nondegradation plan, the City discusses possible retrofit and mitigation BMP opportunities. However, it is unclear whether the City will require implementation of BMPs during redevelopment. Therefore, the BDWMO encourages the City to require the application of stormwater treatment BMPs (infiltration and wet detention ponds) to redevelopment projects, where feasible.

Thank you for providing the BDWMO with the opportunity to review and comment on the City's nondegradation plan. We look forward to continuing our cooperative/collaborative relationship with the City.

Please feel free to contact me at 952-895-4505 or terry.schultz@ci.burnsville.mn.us if you have any questions.

Sincerely,
Black Dog Watershed Management Organization

Terry Schultz,
Administrator

c: BDWMO Commissioners
Karen Chandler – Barr Engineering
Len Kremer – Barr Engineering