Stormwater Management Plan

Prepared for the:

Village of Twin Lakes, Wisconsin

Prepared by:

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NOTE TO THE READER: This document (finalized in January 2004) is the completion of a study originally conducted between 1995 and 1997 for the Village of Twin Lakes. The Village of Twin Lakes contracted with Earth Tech, Inc. (Rust Environment and Infrastructure at the time) to conduct a stormwater management study in 1995. The study was partially funded through a grant from the Wisconsin Department of Natural Resources. A draft version of the document was submitted to the Village in June of 1997 for final review. For various reasons, the review was not completed. In order to fulfill grant requirements, the WDNR requested the Village complete the plan. To meet this request, the Village met with the WDNR and Earth Tech in July of 2003 to review and discuss updates to the draft plan (1997) plan. The Village then contracted with Earth Tech to finalize the document with the agreed upon updates.

The updates incorporated into this document are limited to:

1. *Review of the 1997 document and incorporate minor edits;*
2. *Add water quality information for Lakes Mary and Elizabeth with updated information;*
3. *Update the estimated costs for the recommended structural best management practices;*
4. *Update the discussion on the local ordinances related to stormwater management and construction erosion control and the Village's state stormwater permit status;*
5. *Add a section to the document explaining the background on the original plan development.*

It is important to note this updated document does not contain updates on several items that may affect some of the conclusions and/or recommendations. Of particular importance are the following items:

1. *Land use: Changes in land use since 1997 have not been updated in this report. These changes may impact the pollution loading analysis and the hydrologic/hydraulic analysis (Chapters 4 and 5).*
2. *Drainage area boundaries: Available digital mapping and topographic information have undergone significant improvements since 1997. Also, new land development may cause change in drainage patterns. Changes to the drainage boundaries from these factors have not been incorporated into this document. These changes may impact the pollution loading analysis and the hydrologic/hydraulic analysis (Chapters 4 and 5).*
3. *Best management practices: Since the original development of this plan in 1997, many innovative structural Best Management Practices (BMPs) have been developed, and become more commonly used in urban settings for the control of stormwater pollution. Examples of these newer BMPs include: rain gardens, bio-swales; bio-retention areas; proprietary BMPs (usually underground in-line systems, or catch basin inserts); and conservation development principals. These practices were not discussed, or considered for applicability to the stormwater management needs of Twin Lakes during the 1997study.*

1.0 INTRODUCTION

1.1 Project Background

The Village of Twin Lakes (Village) is located in southwest Kenosha County, Wisconsin. In 1990, the Village population was 3,989; the Village has continued to experience steady growth over the past thirteen years. The 2000 census estimated that the Village population has grown to 5,124 residents. The Village formed a lake district during 1974, and later received partial funding for the preparation of a stormwater management plan from the Wisconsin Department of Natural Resources (WDNR). The grant is funded through the Wisconsin Lake Management Planning Project Grant Program, which provides funds for lake restoration projects to lake districts and incorporated lake associations.

This document serves as the stormwater management plan for the Lake Mary and Lake Elizabeth drainage area, and includes the following information: natural resources and infrastructure, hydrologic and hydraulic modeling, nonpoint source pollutant loadings, water quality analysis, stormwater management alternatives, recommendations for implementation, and cost estimates. It is important to note that this document does not include updates regarding the land use, nonpoint pollutant loadings, or hydrologic/hydraulic analyses conducted for the original study. This document does include updates relative to the lake's water quality conditions, local ordinances, and relevant state programs.

The focal points of the stormwater management plan are Lake Mary and Lake Elizabeth. Most of the Village lies within the watersheds to these lakes. The study area is defined as the watersheds of both lakes within the Wisconsin border, within the Kenosha County border, which includes about 2,600 acres of developed and rural (agricultural) lands (Figure 1-1). The entire watershed area for the two lakes is 5,931 acres when the portion extending past the Wisconsin-Illinois border and into Walworth County is included. Lake Mary is the "upper" lake and has a surface area of 297 acres. At its deepest point, Mary is 33 feet deep, and has a mean depth of 9 feet. At 638 acres, Elizabeth is the larger of the two lakes. Elizabeth has a maximum depth of 32 feet and a mean depth of 11 feet. The southern end of Lake Elizabeth and a portion of its watershed extend south of the state line into McHenry County, Illinois. This portion of the watershed was not included as part of the study. Both lakes are used extensively for boating, fishing, skiing, and swimming. There is a competitive ski team that uses Lake Mary for its summer shows. There is a link between a decline in recreational and aesthetics uses, and poor water quality. The completion of this stormwater management plan is one step in the process of preserving and improving water quality for future beneficial uses.

1.2 Purpose and Objectives

The stormwater management plan addresses remediation of existing water quality and quantity problems, such as nonpoint source pollution, flooding, and prevention of future problems as a result of existing and future urbanization in the study area.

Early in the planning program, specific objectives were created during discussions with the Village, the Lake District and the WDNR. The issues considered when developing the factors were:

- Village and District's objectives for the project
- Special concerns regarding the project
- Project schedule and milestones
- Lines of communications
- Deliverables

1.3 Scope of Services

The processes used to prepare the Stormwater Management Plan review of background information, field reconnaissance and data collection, hydrologic and hydraulic analysis, water quality analysis, and development and evaluation of alternatives, preparation and presentation of this report. More specifically, the scope of services for this planning project included the following:

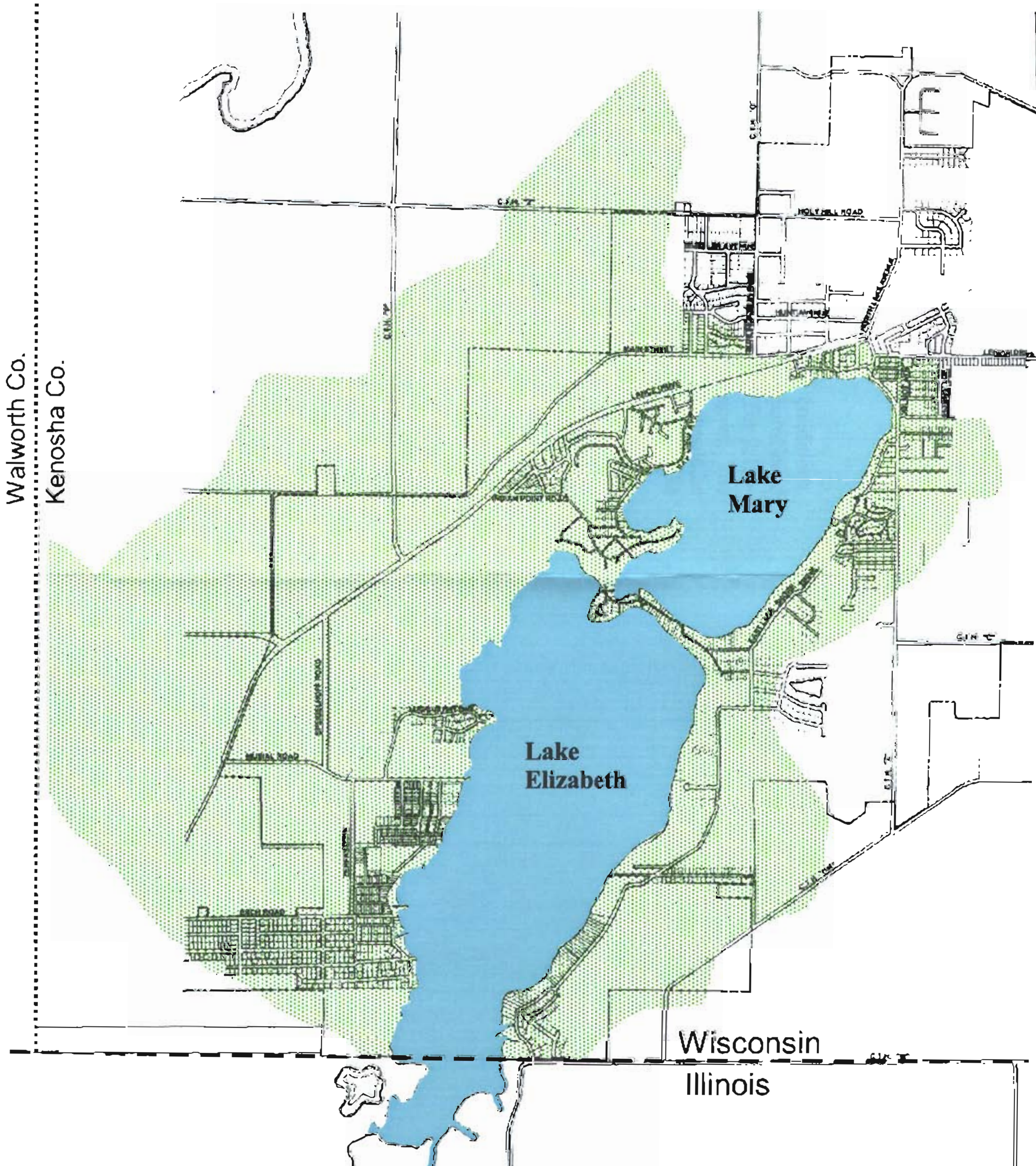
1. Define Project Setting - Collect data, inventory system, delineate drainage patterns, create data base system, inventory soils, delineate current and future land uses, and assess operations/maintenance.

2. Perform Analyses - Calculate stormwater flows and volumes, evaluate hydraulic capacity of the key stormwater conveyance structures, estimate existing/future urban and rural nonpoint source pollutant loads, assess the lake water quality, and assign a trophic state index (T.S.I.) to each lake.

3. Develop Recommendations - Address existing flooding problems, prevent future flood problems, analyze and select Best Management Practices (BMPs) to control pollutants, determine appropriate BMP locations, and suggest operation/maintenance improvements.

4. Develop Final Plan Document - Prepare a comprehensive Stormwater Management Plan that summarizes the results of the analyses and documents the planning and evaluation processes. The purpose of the plan is to guide the Lake District and the Village when implementing the recommendations. The plan also addresses priorities, schedule, responsible agencies and entities, regulatory rules, and a means of financing the recommendations.

It is important to note that this is a planning investigation, and not an engineering design analysis. The plan is intended to define systems and problems, explore a range of alternative solutions, and recommend the course of action. Implementation of structural BMPs recommended in this report will require additional fieldwork, the preparation of detailed design and construction documents, and may include obtaining State and/or Federal permits, where applicable.


Walworth Co.
Kenosha Co.
Lake Mary
Lake Elizabeth
Wisconsin
Illinois

2.0 PHYSICAL FEATURES AND REGULATORY FRAMEWORK

The geographic extent of the study area is 2,600 acres in the Wisconsin portion of the Lake Mary and Lake Elizabeth watersheds. Of the 2,600 acres, about 70 percent is within the Village limits. This chapter discusses selected natural resources and infrastructure features of the project area pertinent to the study. Topics presented include: sub-basins comprising the watershed, conveyance and storage facilities, soils, existing and future land uses, precipitation, and stormwater regulatory framework.

2.1 Drainage Basins

A basin is a unit of area that divides the watershed into smaller tracts of similar physical and hydrologic conditions. Basins are the basic building blocks of the hydrologic analysis. The 581-acre Lake Mary Watershed was partitioned into 21 basins, which ranged in size from 1.7 to 428 acres. The average size of the basins was 56.7 acres. The 2,135-acre Lake Elizabeth Watershed was partitioned into 31 basins, which ranged in size from 5.4 acres to 445 acres. The average size of the basins was 83 acres. Basin boundaries for both watersheds are shown in Figure 2-1. It should be noted that only the drainage areas within Wisconsin were delineated for this analysis. The drainage basin for Lake Elizabeth includes an area to the south in Illinois.

Elevations within the project area range from about 950 feet above mean sea level in the southern portions to approximately 793 feet above mean sea level along Lake Elizabeth for a total relief of 157 feet. Basins were delineated using the best available mapping, which was updated in 1990, and other data supplemented with field reconnaissance.

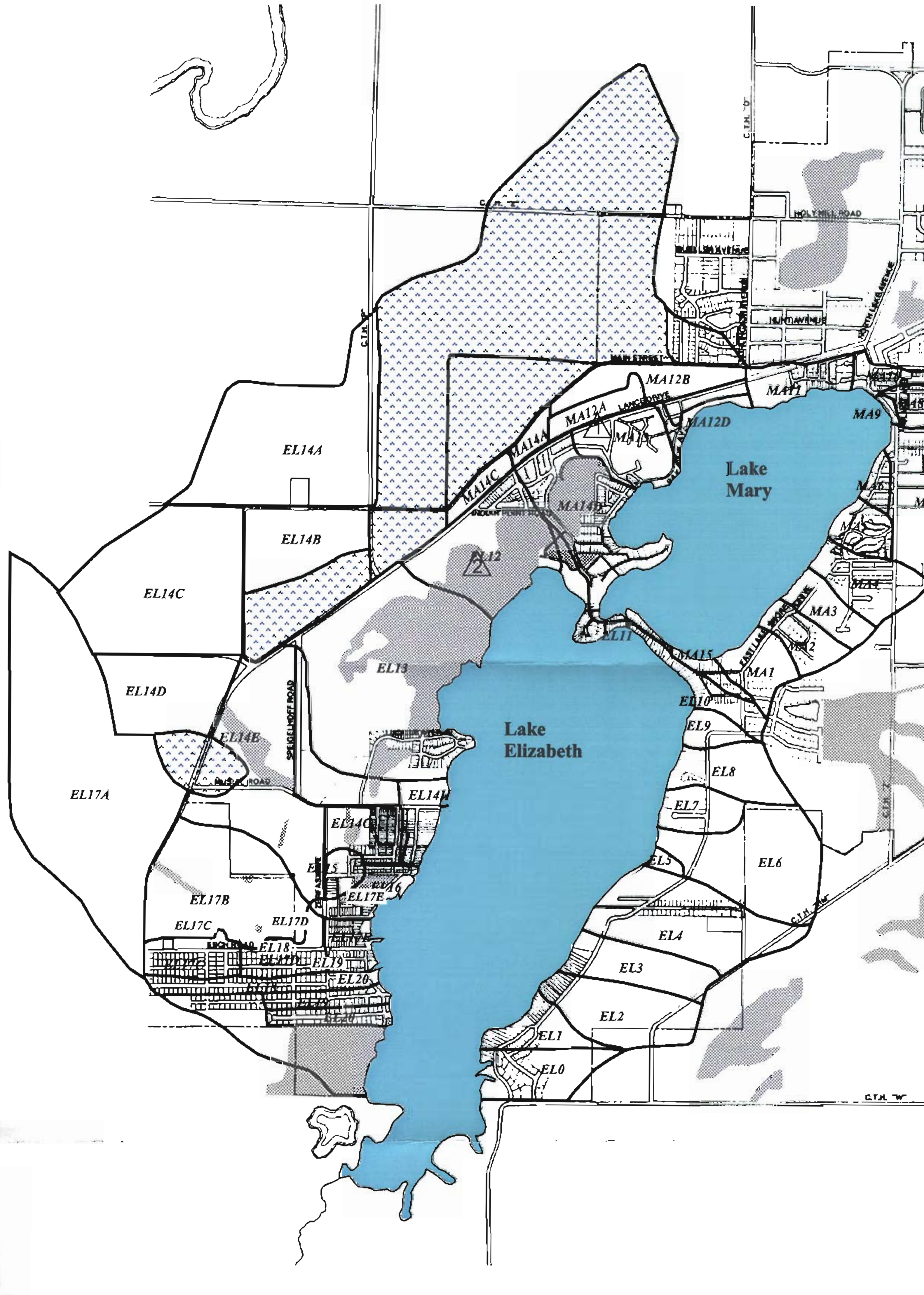
2.2 Conveyance and Storage Facilities

Knowledge of existing and proposed conveyance and storage facilities is essential to watershed planning efforts. These facilities determine the route that stormwater and pollutants move from the land surface, through the watershed, and ultimately to Lake Mary and Lake Elizabeth. Conveyance facilities typically consist of swales, roadside ditches, storm sewers, culverts, and natural and constructed channels. Storage facilities within the study area consist of natural wetlands and constructed stormwater detention facilities.

Most of the project area is drained through a system of constructed or natural channels. The channels flow under roads through bridges or culverts. Based on the USGS "quad" maps (1987) there are no mapped channels to Mary Lake and 2 mapped channels conveying surface water to Lake Elizabeth: 1) an unnamed tributary entering the lake on the southeast shore, (just north of the state line) and 2) an unnamed intermittent tributary entering the lake on the western shore through a residential area and dredged harbor area. The northwest portion of the project area contains large areas that are internally drained (depressional areas that capture surface runoff but have no outlet; see Figure 2-2). Stormwater entering these areas either infiltrates to the ground or evaporates. Because of infiltration or evaporation, lands draining to these depressions do not contribute flow or nonpoint source pollution to the lakes.

Storm water in most of the Village is conveyed via roadside ditches. There are limited storm pipes in the commercial areas, and along the eastern shores of Lake Mary. Information such as velocities and discharges on conveyance systems (particularly storm sewers and culverts) helps to determine the cause of local flooding problems.

and Town of Randall: 1990, SEWRPC



0 1/2 1 Mile

(Scale is approximate)

The information contained on this figure i:
available at the time of it's development (
Updates and changes in the information s
are not incorporated.

There are two major wetlands within the study area (Figure 2-1). One wetland is located near the southwest shore of Lake Mary, and the second wetland is located along the northwest shore of Lake Elizabeth. These wetlands currently act as detention facilities to temporarily store stormwater runoff from nearby agricultural and urban areas.

2.3 Soils

The nature of soils comprising the top layer of unconsolidated material is important because soil properties are a primary factor in determining the volume of runoff associated with a given rainfall. The U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS, formerly known as the Soil Conservation Service, SCS) classifies soils using different methods. Methods of classifying soils are often based on the erosion factors, drainage, and soil groups of common soil units.

The USDA Soil Survey was used for this planning level study to define the soil groups in the study area. Caution should be used when characterizing the soils of urbanized areas from the USDA Soil Survey. The high degree of land disturbing activities can change a soil's physical properties. The soil survey is the only source of information regarding infiltration rates without conducting soil infiltration tests in the field. For implementation of site specific recommendations from this report, field measurements are necessary to properly construct the best management practices.

2.3.1 Soil Groups

The NRCS classifies soils hydrologically as Group A, B, C, or D. The hydrologic group is used to estimate runoff from precipitation. Group A has the least runoff potential and Group D has the greatest. A general description of these groups is given below.

- <u>Group A</u>: Soils have low runoff potential and high infiltration rates even when thoroughly wetted. These soils consist of deep, well drained sands or gravels.
- <u>Group B</u>: Soils have moderate infiltration rates and potential for runoff. Group B soils consist of moderately deep, to deep, and moderate to well drained soils. These are the most common hydrologic soil group found in the western project area.
- <u>Group C</u>: Soils have low infiltration rates and generally impede the downward movement of water. These soils have more moderately fine to fine textures and provide greater runoff volumes when thoroughly wetted.
- <u>Group D</u>: Soils have very low infiltration rates and very high runoff potential. These soils are usually clays with high swelling potential and/or soils with a permanently high water table.

2.3.2 Soil Types

The study area consists of four main soil types, all of which are Group A, B, or A/B soils. The soil types include the following:

- <u>Fox - Casco association</u>: Well drained soils that have a clay loam and silty clay loam subsoil (Group B).
- <u>Miami association</u>: Well drained soils that have a silty clay loam and clay loam subsoil (Group B).
- <u>Casco - Rodman association</u>: Well drained and excessively drained soils that have a clay loam or gravel loam subsoil (Group A/B).

- Warsaw - Plano association: Well drained soils that have a loam to silty clay loam subsoil (Group B).

2.4 Land Use

Type and distribution of land use (existing and future) are important components of a water quality and flood control investigation. The conversion from a rural to an urban land use can markedly alter the nonpoint source pollution loadings, and the volume and timing of runoff within a watershed. Adverse impacts usually occur when land use is converted from rural to urban because the results are usually a large increase in impervious surfaces and runoff volumes and a decrease in runoff time. The net effect can be very large increases in peak flow, flood stages, areas of inundation, and nonpoint source pollutant generation and transport.

2.4.1 Existing Land Use

Existing land use was obtained from Official (1990) Zoning District Maps provided by the Village. In addition, 1995 aerial photographs were reviewed and verified in the field.

2.4.2 Future Land Use

The Village's future land use plan is based on a planning effort currently underway. The projected land use was applied only to those lands that were undeveloped at the time of this study (1997). It was also assumed that none of the existing delineated wetlands will be developed in the future. Future land use is considered the "full build-out" condition, and assumes that zoned land is fully developed.

2.4.3 Comparison of Existing and Future Conditions

Table 2-1 and Figure 2-2 compare the existing (1995) with the predicted future land use conditions for the Lake Mary Watershed. Table 2-2 and Figure 2-3 compare the existing (1995) with the predicted future land use conditions for the Lake Elizabeth Watershed. Significant increases in residential land use, coupled with small commercial land use increases, are predicted over the next 10 to 20 years. This is important because the decrease in vegetated (pervious) areas and the increase in the residential and commercial land uses will result in significant increases in the volume of stormwater runoff and the nonpoint source pollutants unless management measures are implemented.

TABLE 2-1
LAKE MARY WATERSHED LAND USE COMPARISON

Land Use	1995 Conditions		Future Conditions	
	acres	% of total	acres	% of total
Agricultural	82	14%	0	0 %
Office / Institutional	9	2%	9	2%
Residential (low / medium density)	168	29%	204	35%
Residential (high density)	142	24%	159	27%
Open Space	42	7%	38	7%
Commercial / Business	44	8%	75	13%
Wetland	17	3%	17	3%
Total Draining to Lake Mary	503	87%	503	87%
Internally Drained Area	78	13%	78	13%

TABLE 2-2
LAKE ELIZABETH WATERSHED LAND USE COMPARISON

Land Use	1995 Conditions		Future Conditions	
	acres	% of total	acres	% of total
Agricultural	1,402	65.7%	883	41.3%
Residential (low density)	8	0.4%	317	14.9%
Residential (medium density)	370	17.3%	512	24.0%
Residential (high density)	89	4.2%	99	4.7%
Open Space	107	5.0%	107	5.0%
Commercial / Business	3	0.1%	60	2.8%
Wetland	156	7.3%	156	7.3%
Totals	2,135	100%	2,135	100%

Figure 2-2: Comparison of Current & Future Land Use Acres
Lake Mary Watershed

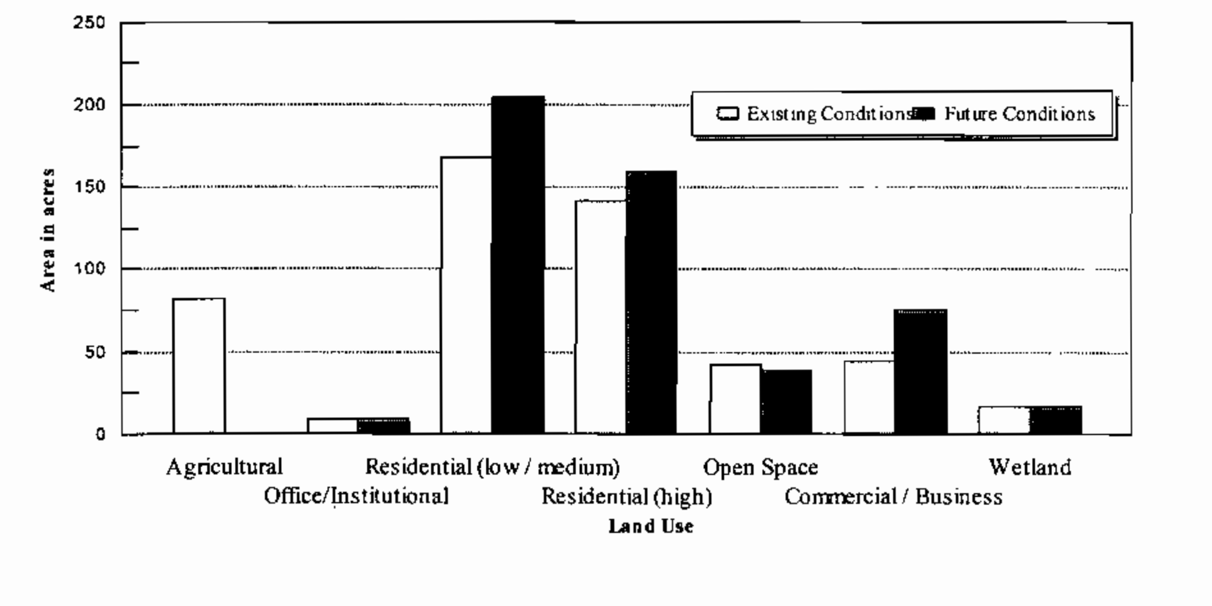
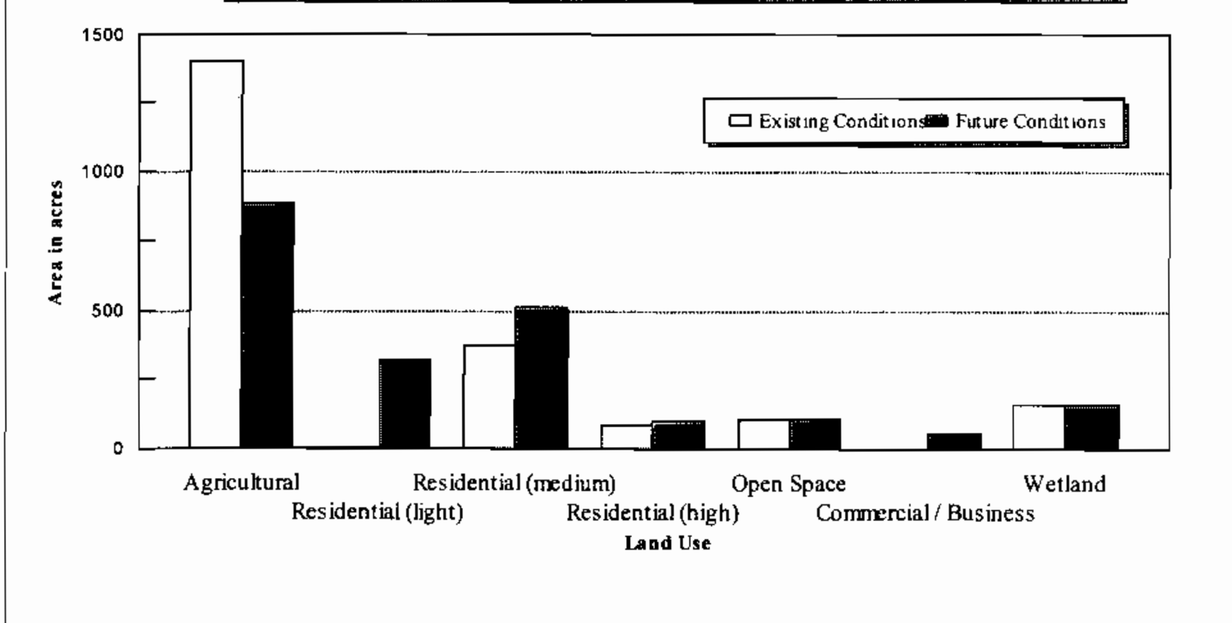


Figure 2-3: Comparison of Current & Future Land Use Acres
Lake Elizabeth Watershed



2.5 Precipitation

The watershed has a climate characterized by markedly different seasons with corresponding large variations in temperature and precipitation type, amount, and intensity. The primary source used to predict total rainfall amounts for this project was the U.S. Department of Commerce, Weather Bureau Technical Paper No. 40: "The Rainfall Frequency Atlas of the United States." The regional rainfall intensity-duration-frequency data, documented in the Southeastern Wisconsin Regional Planning Commission (SEWRPC) Community Assistance Planning Report No. 152, "A Stormwater Drainage and Flood Control system Plan for the Milwaukee Metropolitan Sewerage District," was also consulted.

Storms were analyzed to determine which intensities and durations resulted in the most critical peak flows during flooding conditions. Table 2-3 summarizes the storm events and precipitation amounts screened for this project.

TABLE 2-3
INTENSITY-DURATION-DEPTH RAINFALL DATA (INCHES)

Duration	Recurrence Interval			
	2-Year	10-Year	25-year	100-year
2-Hour	1.65	2.33	X	X
24-Hour	X	X	4.53	5.60

NOTE: These rainfall depths based on U.S. Department of Commerce Technical Paper No. 40 differ slightly from those obtained using SEWRPC regional equations.

The rainfall data for pollutant loading analysis came from rainfall records for the year 1981 in Milwaukee, Wisconsin. This is defined by the WDNR to be a "typical" year of rainfall and is assumed to best predict the potential average runoff and pollutant loadings. The Source Load and Management Model (SLAMM), introduced in Chapter 3, uses the 1981 rainfall year to generate the pollutant loadings for the various land use and other conditions.

2.6 Stormwater Management Regulatory Framework

Over the past few years, changes in stormwater management have occurred at the federal, state, and local government levels, with respect to stormwater quality and quantity. Below is a summary of the major programs at each government level that govern stormwater regulations and management.

2.6.1 State Government

The WDNR is the agency responsible for the permitting and regulatory framework in Wisconsin, with respect to water resources. Permits governing stormwater management, erosion control, water quality certification, and wetland water quality certification are addressed in this section, as well as performance standards.

2.6.1.1 Municipal Stormwater Discharge Permit (Chapter NR 216, Subchapter I)

The Village meets the designation of a Phase II municipality, as determined by the U.S. Environmental Protection Agency (USEPA), which governs the national pollutant discharge elimination system (NPDES) program. The

WDNR has authority to implement the regulations under the Wisconsin Discharge Elimination System (WPDES) program. Nearly two-thirds of the Village is designated as an urbanized area, based on 2000 U.S. Census data, under the Round Lake Beach – McHenry – Grayslake, Illinois –Wisconsin area map (USEPA web page: http://www.epa.gov/npdes/pubs/wisconsin.pdf).

The Village shall provide the following detailed information to the WDNR, in conjunction with its NR 216 application, to receive coverage under the program:

- Adequate legal authority;
- Storm sewer map;
- Existing management programs;
- Industrial source identification;
- Discharge characterization;
- Pollutant loadings;
- Proposed monitoring program;
- Proposed management program; and
- Fiscal analysis

The proposed monitoring program shall be consistent with the performance standards set forth in NR 151. This regulation is also discussed below. The municipal permit is typically valid for a period of five years, and must be reissued at the end of term. The WDNR requires the submittal of an annual report by March 31 of each year. The current schedule calls for the WDNR's NR 216 re-draft to be adopted in 2004. The Village will likely be issued a permit after this time.

2.6.1.2 Construction Site Stormwater Discharge Permit (Chapter NR 216, Subchapter III)

A landowner who creates a point source stormwater discharge to a water of the state, associated with a construction site activity, is required to submit an NOI to the WDNR. If a landowner is proposing one acre or greater of site disturbance then the NOI requirement is in effect. Requirements of the NOI application include the following:

- Notice of Intent application;
- Application fee ($200);
- Erosion control plan, consistent with the "Wisconsin Construction Site Best Management Practice Handbook" (WDNR Pub. WR-222 November 1993 Revision);
- Groundwater limitations;
- Site map;
- Control measures;
- Prohibited discharges; and

- Stormwater Management Plan (required for post-development activities that alter runoff volumes or quality from existing conditions

The landowner is also required to perform inspections and maintenance associated with the erosion control and stormwater management plans. In addition, the plans must be in conformance with other local ordinances (discussed below).

2.6.1.3 Runoff Management (Chapter NR 151)

The purpose of the NR 151 regulations is to establish runoff pollution performance standards for agriculture, non-agriculture, and transportation facility activities. Chapter NR 151 Subchapter II establishes performance standards and prohibitions for agricultural practices, facilities, and operations. The following activities are addressed in Subchapter II:

- Sheet, rill and wind erosion;
- Manure storage facilities;
- Clean water diversions;
- Nutrient management;
- Cropland; and
- Livestock

Chapter NR 151 Subchapter III establishes non-agricultural performance standards that must be met, both during and after construction. The purpose of the subchapter is to limit nonpoint runoff pollution in order to achieve water quality standards. During construction, the landowner shall met an 80 percent reduction in the sediment load carried in runoff and provide for sediment control on all sites that disturb one acre or more. Post-construction standards are required in a stormwater management plan for new and re-development (under specific site conditions) and shall address the following:

- Total suspended solids;
- Peak discharge;
- Infiltration;
- Protective areas;
- Fueling and vehicle maintenance; and
- Location and timing of BMP installation

Chapter NR 151 Subchapter III also establishes the performance standards for the Municipal Stormwater Discharge Permit previously discussed under Chapter NR 216 regulations. The permitted municipality must adopt and implement a stormwater management program that contains the following components:

- Public information and education program;

- Municipal program for the collection and management of leaf and grass clippings; create a public education program on the topic;
- Nutrient management program on municipal properties with over five acres of pervious area;
- Detection and elimination of illicit discharges to storm sewers;
- By March 10, 2008, accomplish a 20 percent reduction in total suspended solids in runoff; and
- By March 10, 2013, accomplish a 40 percent reduction in total suspended solids in runoff

2.6.1.4 Water Quality Standards for Wetlands (Chapter NR 103)

In 1991, the State of Wisconsin promulgated an administrative rule (NR 103), which sets forth the review process used by the WDNR for projects affecting jurisdictional wetlands. The impacts may be direct (for example, filling or excavating within a jurisdictional wetland) or indirect (such as changes in the hydrology of a nearby wetland). The review criteria used by the WDNR include: (1) is the project wetland dependent? (2) are there practicable alternatives? (3) what are the impacts on wetland functional values, such as water quality? (4) what are the cumulative impacts? and (5) what are potential secondary impacts? Projects that are not wetland dependent and have practical alternatives will be denied a permit. Applications for this permit are handled jointly through the District Office of the WDNR (Bureau of Water Regulation) and the U.S. Army Corps of Engineers (USACE), which also has jurisdiction over non-isolated wetlands.

2.6.1.4 Navigable Waters, Harbors and Navigation (Chapter 30)

The WDNR has the authority to regulate activities that affect navigable waterways. This includes lakes, streams, and rivers within Wisconsin. Almost all waterways with a defined channel and bank are considered "navigable" if the channel can float a craft, even if it carries water for only a portion of the year. Any project that places fill in or removes material from a waterway, disturbs streambanks, or in any way impacts navigation, requires a Chapter 30 permit. Projects such as stream bank stabilization, dredging, or "improvements" to a navigable stream channel will likely require this review and approval.

The permit application process is jointly coordinated with the USACE, as well as the local government agency that administers zoning and/or shoreland requirements. Applications for this permit are handled through the District Office of the WDNR, Bureau of Water Regulation.

2.6.2 Local Government

The Village is responsible for administering local regulations and permitting, with respect to erosion control and grading, filling and stormwater control. Other zoning and/or shoreland ordinances may apply, in addition to those listed below. The text of the ordinances summarized below are provided in Appendix D.

2.6.2.1 Erosion Control Ordinance (Chapter 14.21)

The Village has an erosion control ordinance to reduce the amount of sediment and other pollutants leaving sites during construction. The ordinance applies to all land disturbing activities that are related to any of the following: 1) subdivisions; 2) certified survey approvals; 3) land disturbance affecting an area of four thousand square feet or more; 4) activities involving excavation or filling of four hundred cubic yards of material; 5) street, highway, road, or bridge construction; 6) underground utilities of three hundred linear feet or more; or 7) land disturbance on slopes of

12 percent or more. Provisions of the ordinance for construction sites require the contractor, landowner, or land user to be in compliance with the following:

- Submittal of a permit application and an erosion control plan from the contractor, landowner, or land user for land disturbance greater than one acre or on multiple lots.
- Submittal of a permit application and an erosion control plan statement from the contractor, landowner, or land user for land disturbance less than one acre or on a single lot.
- Approval of the plan and issuance of a permit with conditions from the building inspector.
- Inspection of the construction site to check for compliance with the erosion control plan.
- Ability of the Village to take enforcement action if the activity occurs without a valid permit, if the plan is not implemented properly, or if the conditions of the permit are not met.

2.6.2.2 Grading, Filling and Stormwater Control (Chapter 14.22)

The Village has implemented a grading, filling and stormwater control ordinance to protect developed and undeveloped properties from increased runoff that results from land disturbing activities. This section of the ordinance applies to all land disturbing activities that are related to any of the following: 1) land disturbance affecting an area of one thousand square feet or more; 2) activities involving excavation or filling of forty cubic yards of material certified survey approvals; 3) street, highway, road, or bridge construction; 4) underground utilities of three hundred linear feet or more; or 5) land disturbance on slopes of twelve percent or greater. Provisions of the ordinance include:

- Submittal of a permit application and a runoff control plan to the building inspector from the contractor, landowner, or land user for land disturbance greater than one acre.
- Submittal of a permit application and a runoff control plan statement to the building inspector from the contractor, landowner, or land user for land disturbance less than one acre.
- Approval of the plan and issuance of a permit with conditions from the building inspector.
- Inspection of the construction site to check for compliance with the erosion control plan.
- Ability of the Village to take enforcement action if the activity occurs without a valid permit, if the plan is not implemented properly, or if the conditions of the permit are not met.

2.6.2.3 Lawn Fertilizer Application Control (Chapter 8.60)

In 2002 the Village adopted an ordinance to reduce phosphorus runoff from the application of lawn fertilizers. The Village recognizes that phosphorus is one of the significant factors in nuisance algae and macrophyte growth in the lakes. The ordinance prohibits applying fertilizer containing phosphorus to lawn areas with the Village unless soil testing confirms that the soil is below "established phosphorous levels for typical area soils." Fertilizer application is also prohibited from impervious surfaces, drainage ways, and buffer zones (areas near the lakes or wetlands).

3.0 LAKE WATER QUALITY ASSESSMENT

The primary purpose of this study is to provide recommendations for the protection of Mary and Elizabeth Lakes from nonpoint source pollution. Both lakes are highly valued resources and receive a great deal of year-round, recreational use. The primary recreational uses on the lakes are skiing, fishing, boating, and swimming, which can be adversely affected by degraded water quality.

3.1 Water Quality Measurements

To assess the water quality of Wisconsin Lakes, three parameters are often used. A black and white disk referred to as a "Secchi disk" is one common way to measure water clarity. Chlorophyll a, a measurement of the amount of algae in the lake, is a second method used to assess water quality. The third method is a measurement of the nutrient phosphorus, and is used to determine the likelihood of an algae bloom occurring in the lake. Both Chlorophyll a and phosphorus concentrations are determined using laboratory analyses. Table 3-1 provides a guide for determining the qualitative results of the water quality indices that were monitored in Elizabeth and Mary Lakes.

TABLE 3-1

WATER QUALITY INDICES BASED ON SECCHI DISK DEPTH, TOTAL CHLOROPHYLL A, AND TOTAL PHOSPHORUS.

Description	Secchi Depth (feet)	Total Chlorophyll a (µg/L)	Total Phosphorus* (µg/L)
Excellent	>20	<1	< 1
Very Good	10 –20	1.0 – 4.9	1 – 9
Good	6.5 – 10	5.0 – 9.9	10 – 29
Fair	5.0 – 6.5	10.0 – 14.9	30 – 49
Poor	3.25 – 5.0	15 – 29.9	50 – 149
Very Poor	< 3.25	> 30.0	> 150

Source: http://www.dnr.state.wi.us/org/water/fhp/lakes/selfhelp/01summary/01Sumseast4.htm

*Please note that 4 µg/L is the lowest concentration that the laboratory generally measures; therefore the highest rating that a lake can obtain is "very good." It is possible that a lake obtained results of "Below Level of Detection," or less than 4 µg/L, meaning that the actual concentration may have been better than "very good."

3.2 Trophic State Index (T.S.I.)

Another way to determine the health of a lake system is to compute the Trophic State Index (T.S.I.), which is based on Secchi depth, total Chlorophyll a, total phosphorus, or all three parameters. The T.S.I., or trophic status, is the level of nutrient enrichment in the lake. Lakes can be divided into three main levels of nutrient enrichment categories: oligotrophic, mesotrophic, and eutrophic. A lake's trophic status is determined using a mathematical formula, which is unique to Wisconsin. The trophic state is a continuum scale of 0 to 100, with zero corresponding to the clearest (and usually most nutrient poor) lake possible, and 100 corresponding to the least clear (and presumably, most nutrient rich) lake. The preferred method of calculating the overall T.S.I. is based on the Chlorophyll a data, provided that the data is available. Because the T.S.I. is used to predict biomass, Chlorophyll a is the best indicator. If this chemistry data is not available, as was the case for Mary Lake, the Secchi T.S.I. is used. The T.S.I. for a lake can be calculated using the following equations (Lillie and others, 1993):

- T.S.I.Secchi = 60.0 –33.2 * (log10Secchi depth)
- T.S.I.Chlorophyll a = 34.82 + (17.41 * (log10Chlorophyll a concentration))
- T.S.I.total phosphorus = 28.24 + (17.81 * (log10total phosphorus concentration * 1,000))

3.2.1 Oligotrophic

Lakes are categorized as oligotrophic if they register a T.S.I. between 0 and 40. These lakes are considered nutrient poor and are characterized by very high Secchi depths. The lakes are very clear, contain plenty of oxygen even in deep water, and may have cold-water fish species living in them.

3.2.2 Mesotrophic

Lakes that fall in the middle of the continuum are classified as mesotrophic. These lakes have a T.S.I. between 40 and 50, and may have low oxygen concentrations, particularly in the deeper portions of the lake. The water clarity is moderately clear.

3.2.3 Eutrophic

Lakes that contain high concentrations of nutrients and register a T.S.I. that is greater than 50 are categorized as eutrophic. These lakes have low Secchi disk readings and are typically depleted of oxygen in deep waters during the summer. The lakes may experience blue-green algae blooms and support warm water fish species. A lake with a T.S.I. above 70 is referred to as hypereutrophic.

3.3 Aquatic Plants

If a lake has many rooted aquatic plant and generally clear water, the Trophic State Index could be a mischaracterization of the true nutrient status of the lake. Lakes dominated by aquatic plants may have high amounts of phosphorus in the bottom sediments and relatively low phosphorus in the water column. Because algae cannot utilize phosphorus from bottom sediments, lakes that produce algae are indicative of high phosphorus concentrations in the water column. Most lakes have a fairly stable ratio of aquatic plants to algae. Trophic Status Index only indicates the portion of nutrients that are found in the water column, as evidenced by the amount of algae. If most of the nutrients are held in the sediments and the lake is loaded with aquatic plants, then the true, total nutrient status cannot be accurately measured using the Trophic Status Index.

3.4 Water Quality Results

The water quality analysis includes Secchi disk depth, total phosphorus concentration, and total Chlorophyll a concentration for Lake Elizabeth. The only data available for Lake Mary pertains to Secchi disk depth. The T.S.I. is included for both lakes, based on Secchi, phosphorus, and chlorophyll a, and Secchi only, for Elizabeth and Mary Lakes, respectively. All of the analyses in this section are based on the information available through the WDNRs

Self-Help Citizen Monitoring program. The raw data for Elizabeth and Mary Lakes are contained in Appendix A, Tables A-3 and A-4.

3.4.1 Secchi Disk

Figure 3-1 presents a comparison between the overall average Secchi disk depths for Elizabeth, Mary, and Paddock Lakes. Figure 3-1 reveals that Paddock Lake contains, on average, better water clarity than Elizabeth and Mary. The water clarity of Lake Mary is generally better than that of Lake Elizabeth, by nearly one foot of Secchi disk depth over the period monitored. Comparing the data for the three lakes with the values in Table 3-1, all three meet the "good" description when the data is averaged over the years, which corresponds to a Secchi depth range of 6.5 to 10 feet. Figure 3-2 indicates that Mary Lake received a "fair" condition, on average, during the summer 2000. Elizabeth Lake received a "fair" description during two years (1991 and 1993), and a "poor" description in 1994. Mary actually received an "excellent" description during the same time period (1994).

When interpreting the percent distribution column in Table 3-2, 10 percent of the lakes in southeastern Wisconsin have greater water clarity, as determined by Secchi depth. Conversely, 64 percent of the lakes in southeastern Wisconsin experience worse water clarity conditions. In summary, Mary and Elizabeth Lakes share roughly the same water clarity condition as 26 percent of the lakes in Southeastern Wisconsin. Other lakes in the area (Paddock, Powers, and Silver Lakes) are included on Table 3-2 for reference purposes.

TABLE 3-2

LAKE CONDITION BASED ON SECCHI DEPTH (FEET)

	Secchi depth (feet)	Condition	Percent of distribution of lakes in SE Wisconsin
	> 19.7	Best Condition	1
Powers (13.15)	9.8 – 19.7		9
Paddock (9.72) Mary (7.94) Elizabeth (6.96)	→ 6.6 – 9.8		26
Silver (6.07)	3.3 – 6.6		31
	< 3.3	Worst Condition	33

Figure 3-1

Overall Average Summer Secchi Depth (feet) for Elizabeth, Mary and Paddock Lakes

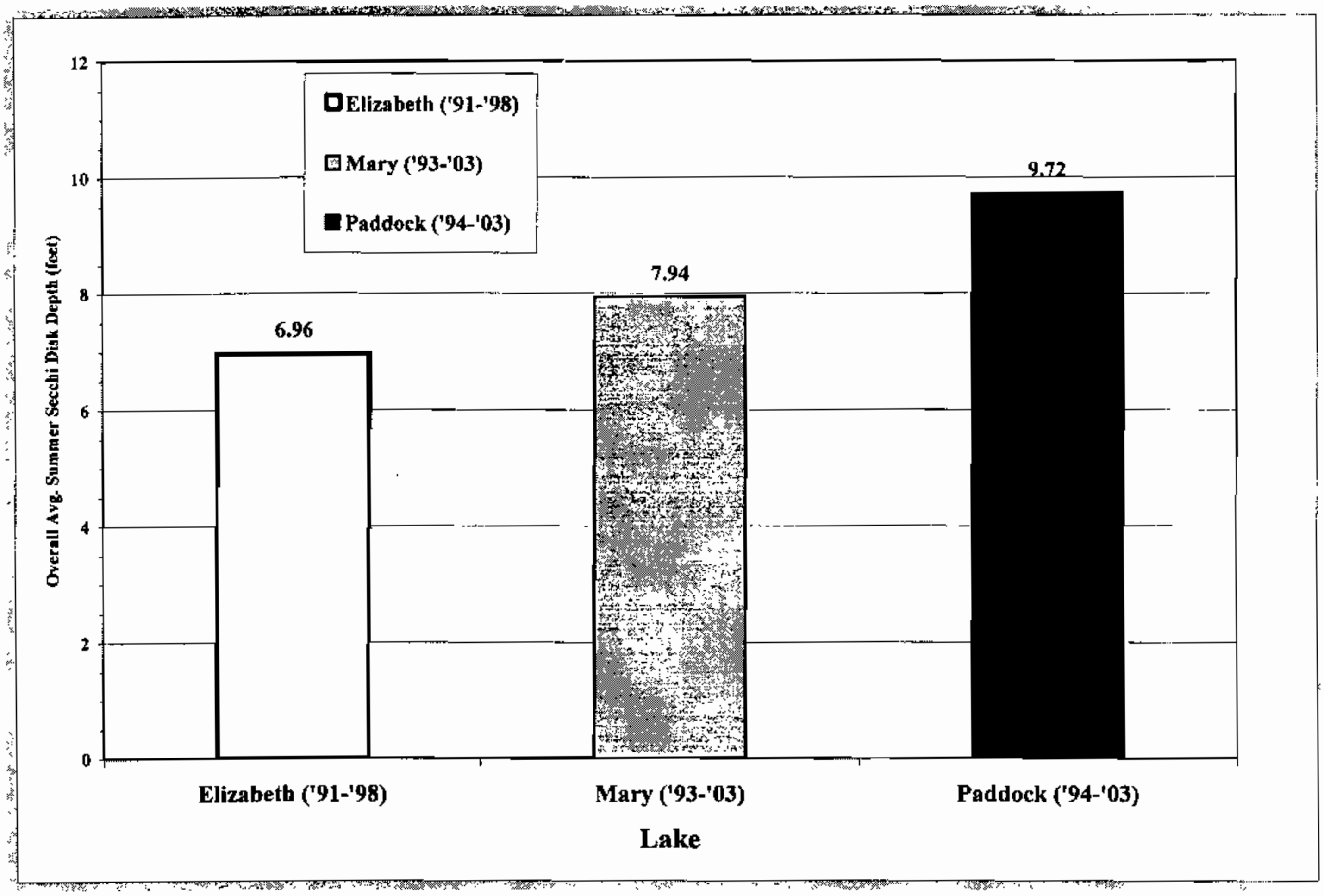
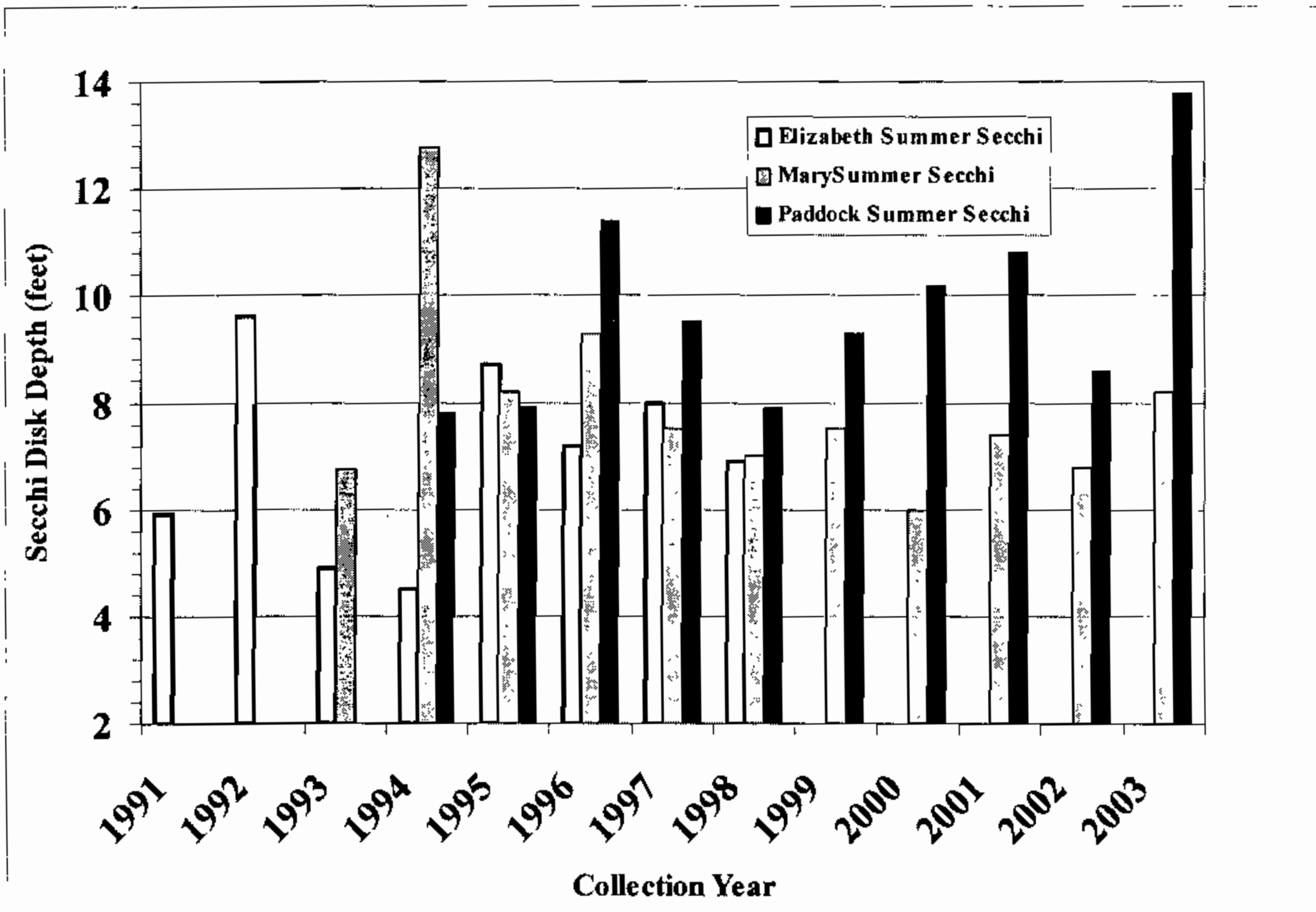


Figure 3-2

Average Summer Secchi Disk Depth for the Lakes by Year



3.4.2 Total Phosphorus Concentration

The average total phosphorus concentration for Elizabeth Lake is 18.35 µg/L for the period between 1993 and 2002. According to Table 3-3, only 7 percent of the lakes in southeastern Wisconsin exhibit a better condition than Elizabeth Lake, with respect to phosphorus. The data reveals that the condition of Elizabeth Lake is similar to 21 percent of southeastern Wisconsin lakes; this translates to 72 percent of the lakes having a nutrient condition worse than Elizabeth Lake. Using Paddock Lake as a reference, both lakes exhibit comparable phosphorus concentrations, with Elizabeth Lake having a slightly lower concentration (18.35 versus 18.58). Data was not available for Mary Lake.

TABLE 3-3

LAKE CONDITION BASED ON TOTAL PHOSPHORUS CONCENTRATION

	Total Phosphorus (µg/L)	Condition	Percent of distribution of lakes in SE Wisconsin
	< 10	Best Condition	7
Silver (17.81) Elizabeth(18.35) Paddock (18.58)	→ 10 – 20	↓	21
	20 – 30	↓	15
	30 – 50	↓	21
	50 – 100	↓	21
	100 – 150		3
	> 150	Worst Condition	12

3.4.3 Total Chlorophyll *a* Concentration

The average total Chlorophyll *a* concentration for Elizabeth Lake is 6.5 µg/L between 1993 and 2002. According to Table 3-4, 22 percent of the lakes in southeastern Wisconsin experience a better condition than Elizabeth Lake. The data reveals that the condition of Elizabeth Lake is comparable to 31 percent of southeastern Wisconsin lakes; this translates to 48 percent of the lakes having higher (worse) Chlorophyll a concentrations than Elizabeth Lake. Data was not available for Mary Lake. When compared to a reference lakes (Paddock and Silver), Elizabeth has a higher concentration of Chlorophyll a (6.5 versus 4.3 and 5.52 respectively). Paddock Lake, therefore, ranks among the best condition of all southeastern Wisconsin lakes.

TABLE 3-4
LAKE CONDITION BASED ON TOTAL CHLOROPHYLL A CONCENTRATION.

	Chlorophyll a (µg/L)	Condition	Percent of distribution of lakes in SE Wisconsin
Paddock (4.3) →	0 – 5	Best Condition	22
		↓	
Silver (5.52) Elizabeth (6.5) →	5 – 10		31
	10 – 15		14
	15 – 30		12
	> 30	Worst Condition	22

3.4.4 Trophic State Indices and Summary of Data Analysis (Lake Elizabeth)

As previously discussed, the most reliable predictor of T.S.I. is based on the concentration of Chlorophyll *a*. Figure 3-3 indicates that the general trend for Elizabeth, using Chlorophyll a as the indicator, is mesotrophic. The data, overall, suggest that Elizabeth exhibits a trophic status of meso-to eutrophic. In general, the data support a description of "good" overall water quality within Lake Elizabeth.

3.4.5 Trophic State Index and Summary of Data Analysis (Lake Mary)

The T.S.I. for Lake Mary was calculated using the only data source available, which was Secchi disk depth. The data for Lake Mary suggest that overall, the lake is classified as mesotrophic. During late spring/early summer 1996, the data suggests that Lake Mary is oligotrophic. Based on the trend toward mesotrophic, this data is not likely indicative of the overall water quality in Lake Mary. In general, the data support a description of "good" overall water quality within Lake Mary. (see Figure 3-4)

Both lakes (Mary and Elizabeth) T.S.I.'s are compared to selected other lakes in the region in Figure 3-5.

Figure 3-3
Average Secchi, Phosphorus, and Chlorophyll a for Lake Elizabeth

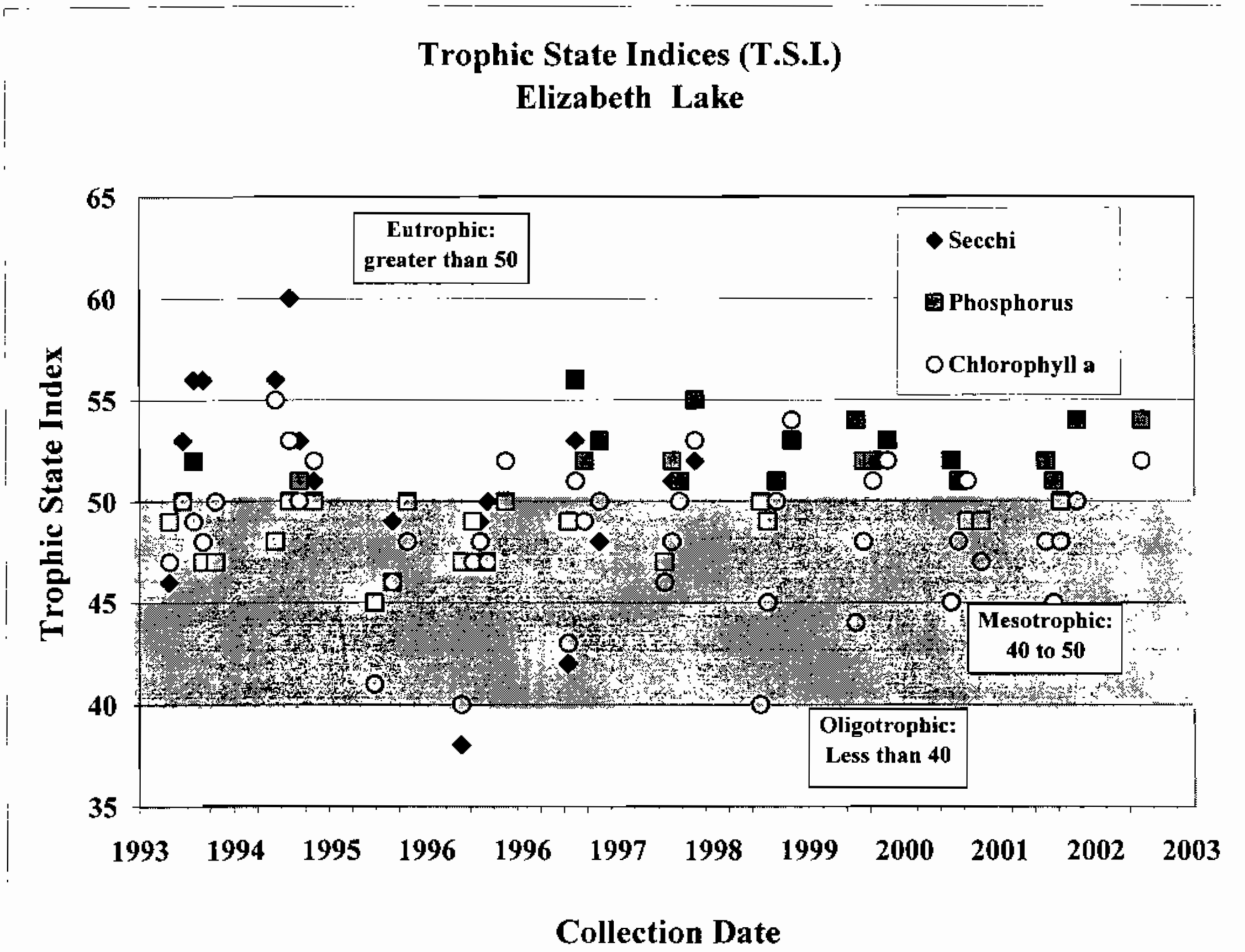


Figure 3-4
Average T.S.I. Based on Secchi for Lake Mary

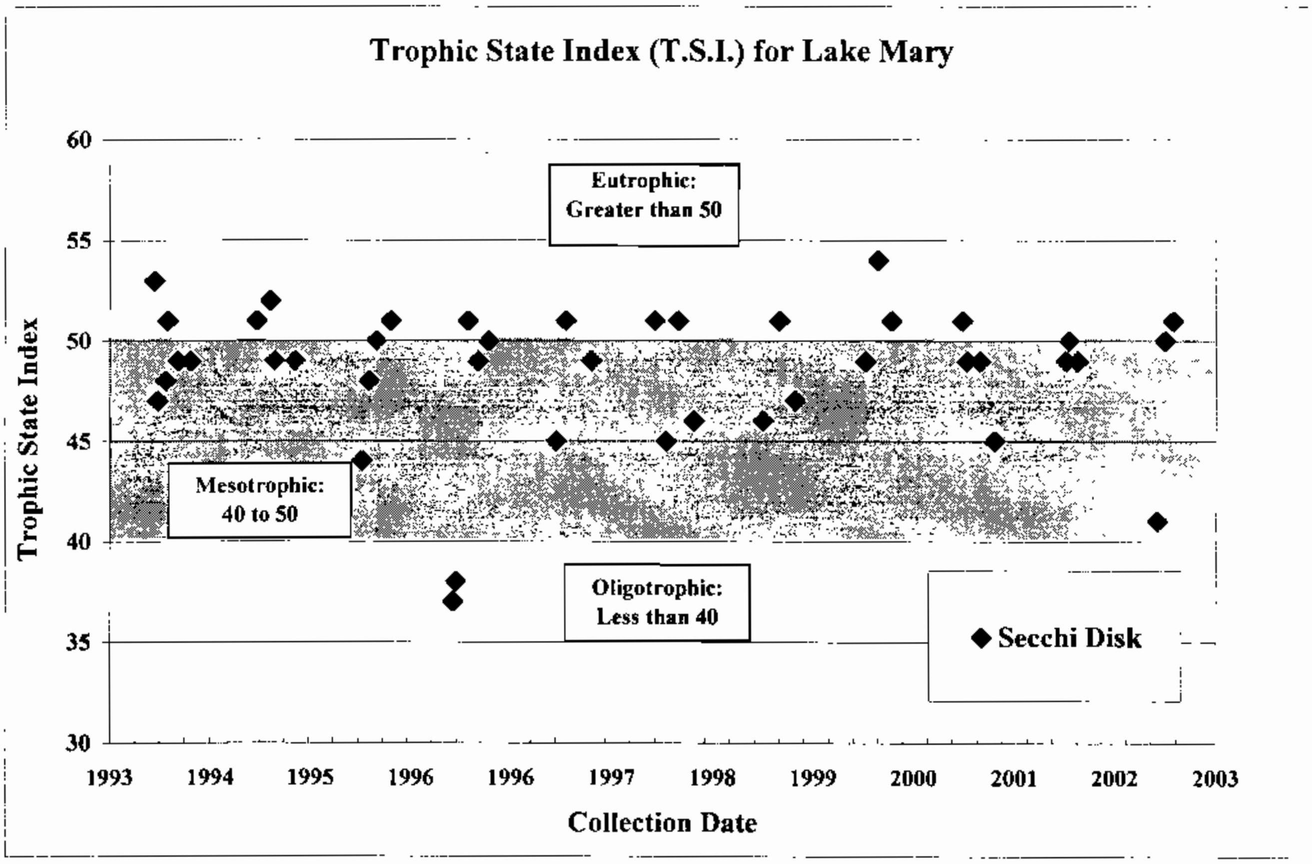
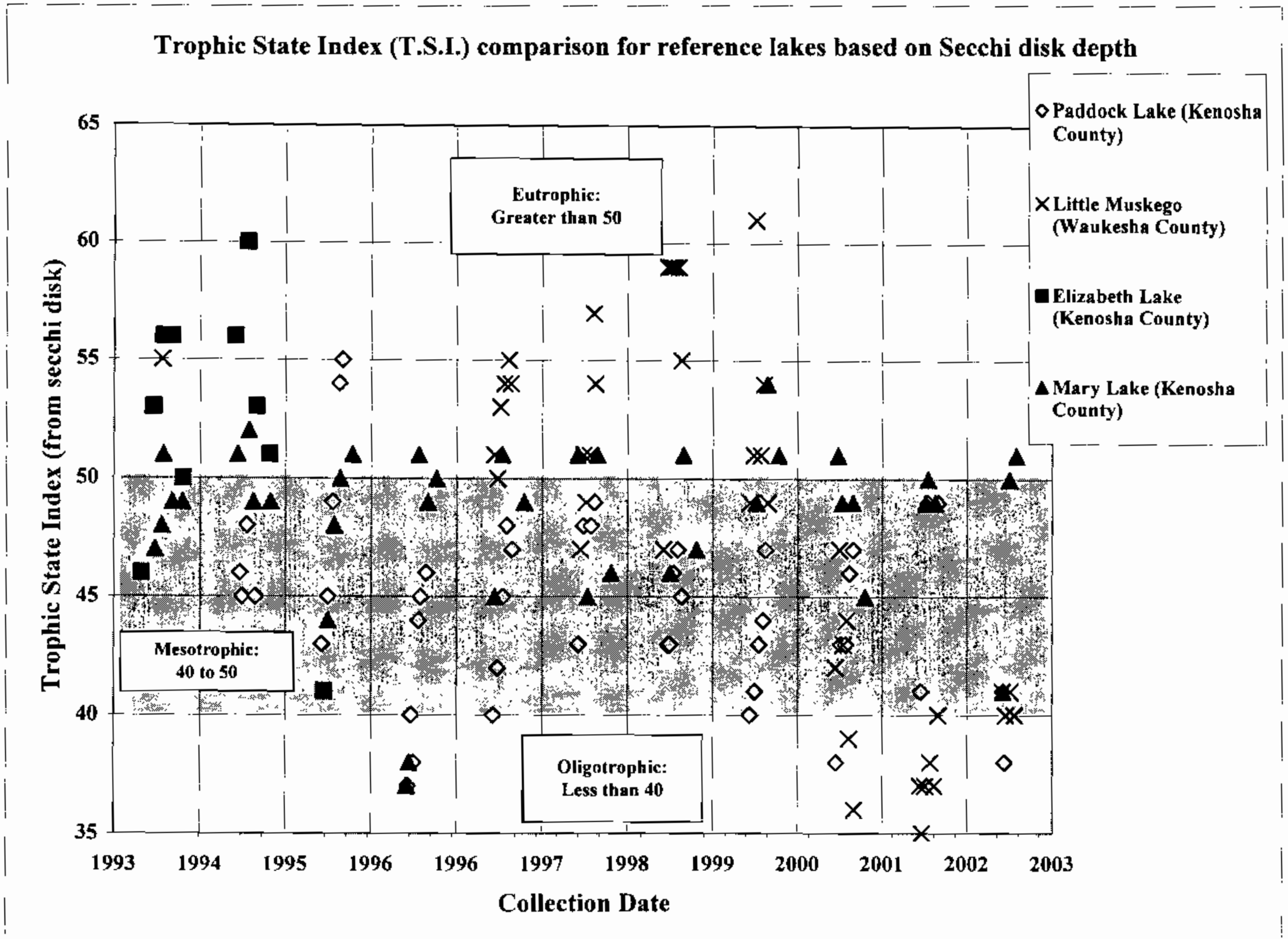


Figure 3-5 Comparison of Average Secchi T.S.I. for Study and Reference Lakes



4.0 HYDROLOGIC, HYDRAULIC AND NONPOINT SOURCE POLLUTANT METHODOLOGY

Achieving the established water quality and flood control objectives require an understanding of the hydrologic, hydraulic, and water quality characteristics of the Lake Mary and Lake Elizabeth Watersheds. The most important aspects of the watershed's hydrology are volume (acre-feet) and rate (cubic feet per second) of stormwater runoff at various locations, under existing and future conditions. Hydraulics differs from hydrology, and includes flow depths and flooded areas, as a result of the hydrologic responses within the watershed.

4.1 Nonpoint Source Pollutants

Water quality characteristics include the physical, chemical, and biological attributes of stormwater runoff under existing and future conditions. As rain falls on rooftops, lawns, parking lots, streets, highways, and agricultural land, the stormwater runoff picks up pollutants such as sediment, nutrients, pesticides, road salt, oil, heavy metals, and bacteria. These pollutants have adverse effects on lake water quality.

Three pollutants of concern in Lake Elizabeth and Lake Mary are sediment, phosphorus and heavy metals. Sediment is a water quality concern because suspended sediments cause turbid waters, impede boat navigation (where sediment is deposited), and destroy fish spawning habitat. Sediments often carry several other pollutants that are attached to fine particles, such as metals and nutrients.

Phosphorus is a major source of nutrients for supporting the growth of phytoplankton (single-celled algae), free-floating macrophytes (aquatic weeds), and rooted macrophytes (cattails). When these aquatic plants die, they decompose on the lake bottom and may cause low dissolved oxygen concentrations in the lake. Low dissolved oxygen concentrations often result in the generation of unpleasant odors and the exclusion of cold-water fish populations.

Heavy metals are a major pollutant associated with runoff from industrial, commercial and heavy traffic areas. Some heavy metals can enter the food chain and impair fish survival, or cause fish to become unsafe for human consumption.

4.2 Relationship between Water Quantity and Quality

As suggested by the preceding definitions, the hydrologic, hydraulic, and water quality characteristics of Lake Mary and Lake Elizabeth Watersheds are interrelated. For example, the rate of stormwater runoff in the watershed, which is influenced by the extent of urbanization, affects hydraulic characteristics such as depth and flow velocity in storm sewers and channels. Similarly, the pollutant concentrations present in stormwater runoff that are flushed into the lakes are determined largely by land use, hydrologic, and hydraulic characteristics within the watershed.

A shopping center has a larger percentage of impervious surfaces (parking lots, rooftops, etc.) than a low density, single-family residential development. Therefore, the same rainfall event creates a greater volume and runoff rate from a shopping center than a low-density residential development of the same area. Previous studies also indicate that the shopping center contributes more nonpoint source pollution per acre of area than a low-density residential development.

4.3 Hydrologic and Hydraulic Model Selection (HYDRA)

The selection of a hydrologic/hydraulic model began with a review of various models. The Village and Earth Tech reviewed the pros and cons of several models and agreed on a model that best fit the project's needs for the hydrologic/hydraulic analysis.

The computer model HYDRA, developed and supported by Pizer, Inc., was selected for hydrologic/hydraulic simulation. This model features user-friendly screens for input, analysis, and output functions. The model is also compatible with GIS applications. The model simulates both open channel and pipe flow.

4.4 HYDRA Methodology

Sources of information used to prepare input to HYDRA included:

- Storm sewer maps of the Village.
- 1"=600'; 2-foot contour mapping.
- Field reconnaissance and survey information.
- Design storm precipitation as previously shown in Table 2-3 in Chapter 2.
- Land use data obtained from aerial photographs and field checks.

4.5 HYDRA Simulation

A rainfall hyetograph (a pattern of rainfall intensity over time) is applied to each basin in the watershed and the corresponding basin hydrograph (a pattern of stormwater flow versus time) is generated for each basin. For any given hyetograph, each basin has a unique hydrograph based on basin characteristics such as area, slope, soil type, and land use. The resulting basin hydrographs are routed through the watershed conveyance system (channels, storm sewers, and culverts) and storage network (dry and wet ponds, wetlands) properly accounting for increases in volume and peak flow due to inputs from basins along the stream system and decreases in peak flow caused by storage attenuation effects. Hydrographs are added at junctions and the cumulative process continues on downstream ending at the outlets of both lakes.

A sensitivity analysis of rainfall distributions, recurrence intervals, and durations was conducted. Rainfall hyetographs based on the Huff First Quartile, 2-hour distribution (Huff, 1967) were selected as the most appropriate for the analysis of smaller conveyance structures such as culverts and storm sewers. All structures were also analyzed using the 25- and 100-year design storms with a 24-hour duration, under both existing and future land use conditions.

Existing hydraulic conditions of the conveyance system were modeled to identify undersized elements of the stormwater system. In other words, channels, sewers, culverts, and storage facilities with inadequate capacities to carry stormwater runoff were identified. Identification and prioritization of the most critical deficiencies accomplished the flood control objective and lead to recommendations for remedial actions.

A second reason for simulating existing conditions was to provide a benchmark against which the hydrologic/hydraulic effects of urbanization can be measured. Because of the flood control objective, portions of the watershed most likely to be adversely affected by increased runoff volumes and discharges could be identified and prioritized for recommended control measures.

4.6 Water Quality Model Selection (SLAMM)

For water quality simulation, the "Source Loading and Management Model" (SLAMM), developed by the WDNR for use in the State's Nonpoint Source Pollution Abatement Program, was selected. The model was selected for the following reasons:

- The model was calibrated with extensive data from water quality monitoring conducted in southeastern Wisconsin. Thus, the model has been shown to accurately predict nonpoint source pollutant loads from urban areas in Wisconsin and from the geographic region this study represents.
- The model is used extensively in nonpoint source pollution and stormwater management studies in Wisconsin; thus, the analysis is consistent with other studies.

4.7 The SLAMM Methodology

Information used as input to the SLAMM included:

- Land use
- Hydrologic soil grouping
- Drainage system
- Existing stormwater control practices
- Annual rainfall
- Street conditions

Using this data, the SLAMM estimates for each basin the annual contribution (in pounds or tons per year) of three selected pollutants to the lakes. The three pollutants analyzed are sediments, phosphorous, and lead. The potential water quality impacts from these pollutants are discussed previously in this chapter.

The SLAMM basin-by-basin estimates of annual nonpoint source pollutant loadings help identify the most critical pollutant-generating areas. This targeting process helps select the most cost-effective Best Management Practices (BMPs) that will achieve the pollutant reduction goals set forth in the objectives.

4.8 Steps for Applying the SLAMM

Pollutant loading estimation by the SLAMM relies on two informational processes. The first process uses characteristics such as existing and future land uses and soil hydrologic grouping to create a data table for each basin. The second process is to create a set of the SLAMM data files tailored to the source area characteristics of each land use in the watershed.

Each of the SLAMM data files rely on a number of sub-files to compute pollutant loadings. Original files for land use, rainfall, runoff, and pollutant data were obtained from the WDNR. These same files are used in the loading analysis for the Priority Watershed studies. These files were modified as needed to best represent site conditions and were used to predict annual pollutant loading rates.

Each land use file was broken down by contributing source area, such as streets, parking lots, rooftops, and landscaped areas. The source areas were refined to reflect the percent of directly connected impervious areas (DCIA). The DCIA are source areas that drain directly to the stormwater conveyance system, with little or no infiltration to the groundwater. All other source areas are considered to be non-DCIA and typically drain to vegetated areas. Street parking density, roadway drainage type (swales, curbs, etc.), and street sweeping practices were also incorporated.

Rainfall data for the year 1981 was used in the SLAMM model because it represents a typical year of rainfall. All of the data files were run using the SLAMM Version 6.1 to analyze suspended solids, phosphorous, and total lead loadings. The model reports the results in pounds (or tons) per year. As was the case with HYDRA, the SLAMM, was applied to the Lake Elizabeth and Lake Mary Watersheds for existing and future land use conditions. The existing condition simulation helps to quantify and explain the sources of current nonpoint pollution problems. This is the basis for remedial actions. Results of the existing condition simulation also provide a benchmark against which the water quality effects of future urban development can be measured. This in turn leads to identification of preventive BMPs.

4.9 Estimating Other Pollution Sources

Additional urban contributions of nonpoint source pollutants include stream bank erosion and construction site erosion. A field inspection of the study area indicated little stream bank stability problems. Sediment from stream bank erosion was considered negligible for purposes of this study.

Construction site erosion can be a major contributor of sediment to surface water systems. According to the Land Use Plan recently developed by the Village, 681 acres of agricultural land and open space will be developed in the next 20 years within the project area. This translates to an annual development rate of about 34 acres per year. The erosion rate applied to the development rate results in a predicted sediment loading rate of 680 tons per year. The erosion rate can be reduced by as much as 70 percent with aggressive construction site erosion control measures and enforcement of the Village ordinances.

5.0 THE SLAMM AND HYDRA MODELING RESULTS

5.1 HYDRA Results of Stormwater Conveyance System Capacity

The hydrologic behavior of the Twin Lake Watershed was simulated with the HYDRA model under existing and future land use conditions. These simulations show inadequacies of some existing conveyance systems, especially under future land use conditions. The future land use conditions reflect the changes in current land use due to planned or projected development. The Village provided the development plans that were used to model the hydrologic behavior under future conditions. The model also provides peak flows and volumes required for the sizing of facilities to prevent future flooding.

5.1.1 Identification of Stormwater Conveyance System Capacity

Several storm events were simulated to analyze the existing conveyance structures in fifteen basins. Of the conveyance systems analyzed, nine discharge into Lake Mary and six outlet into Lake Elizabeth (see Figure 5-1). The 2-, 10-, 25-, and 100-year recurrence interval storm events were simulated for both existing and future land use conditions. Table 5-1 shows peak flow values for various duration storms and recurrence intervals under existing and predicted future land use conditions. The recurrence interval is a way of assigning a probability to a certain storm event. For example, the 25-year, 24-hour rainfall event has a four percent probability of occurring or being exceeded in any one year, over a 24-hour period. For the Village area, this rainfall event is predicted to be 4.53 inches over a 24-hour period.

5.1.2 Inadequate Conveyance Structures

At the original time of drafting this document, the village had not identified significant flooding problems within the project area. Subsequent to that time, the village (in February of 2001 and revised in December 2003) listed 16 public or semi-public areas within the village with identified local flooding concerns. These areas are described below.

- Area around Shady Lane and Willow Road-localized flooding
- Esch Road Corridor-large water volume in the ditch line and flooding at the Zerfas intersection
- Zerfas Road-street flooding
- Second Street-street flooding during Major storm events
- Drainage ditch north of Musial Road-large water volume and flooding at intersection with Lucille Avenue
- Lucille Avenue-sheet draining across street
- Willow Street-street flooding west of Rosebud Avenue
- Lance Drive at Bay View Avenue-street flooding in major events-high level of animal waste in water flow (12/03)
- North Lake Avenue-street flooding in area of Holy Hill Road
- Gateway Drive-localized sheet draining over street
- Wilmot Road-near Barry Road
- Chapel Avenue-flooding of water off of hill on east side near Barry Road
- Maple Street-east end of road, minor flooding of road
- East Lake Shore Drive-at outfall of detention basin for Whispering Trails Subdivision-flooding of downstream parcels in major storm events
- Schoors Lane-at East Lake Shore Drive, interruption of flow in ELSD ditch line
- Sunnyside Street-at intersection with State Line Road, street flooding

The hydrologic modeling indicates one area of concern and several areas of future concern with respect to adequate storm sewer capacity. There is one area with inadequate capacity under both existing and future land use conditions. The pipe that runs from the corner of Lance Drive and Bay View Avenue (past the motel) to a manhole junction at the park on Bay View Avenue is heavily silted (Figure 5-1). In addition, the 36-inch pipe that discharges into Lake Mary and is connected to the above pipe is predicted to be a minor flooding concern. If the Village considers a project in the future to adequately size the storm sewer pipes in basin MA-12, it is recommended that the 36-inch pipe should also be resized to reduce flooding concerns.

Lake Mary has one other location of hydrologic concern under future conditions in basin MA-14 (Figure 2-1). The culvert that runs under Lance Drive (above the Bonnie Brae easement) discharges into two 18-inch storm sewer pipes. These pipes under future development conditions will not be adequate to handle low flows. The culverts that channel water under the roads and connect the swales to the wetland north of Bonnie Brae should also be investigated for adequate capacity under future land use conditions.

Lake Elizabeth has one storm sewer system of hydrologic concern. The system runs from the corner of Esch Road and Park Street east down an easement to an outlet into the lake. The slope of this pipe is relatively flat and therefore, the capacity of the current 30-inch pipe is restricted.

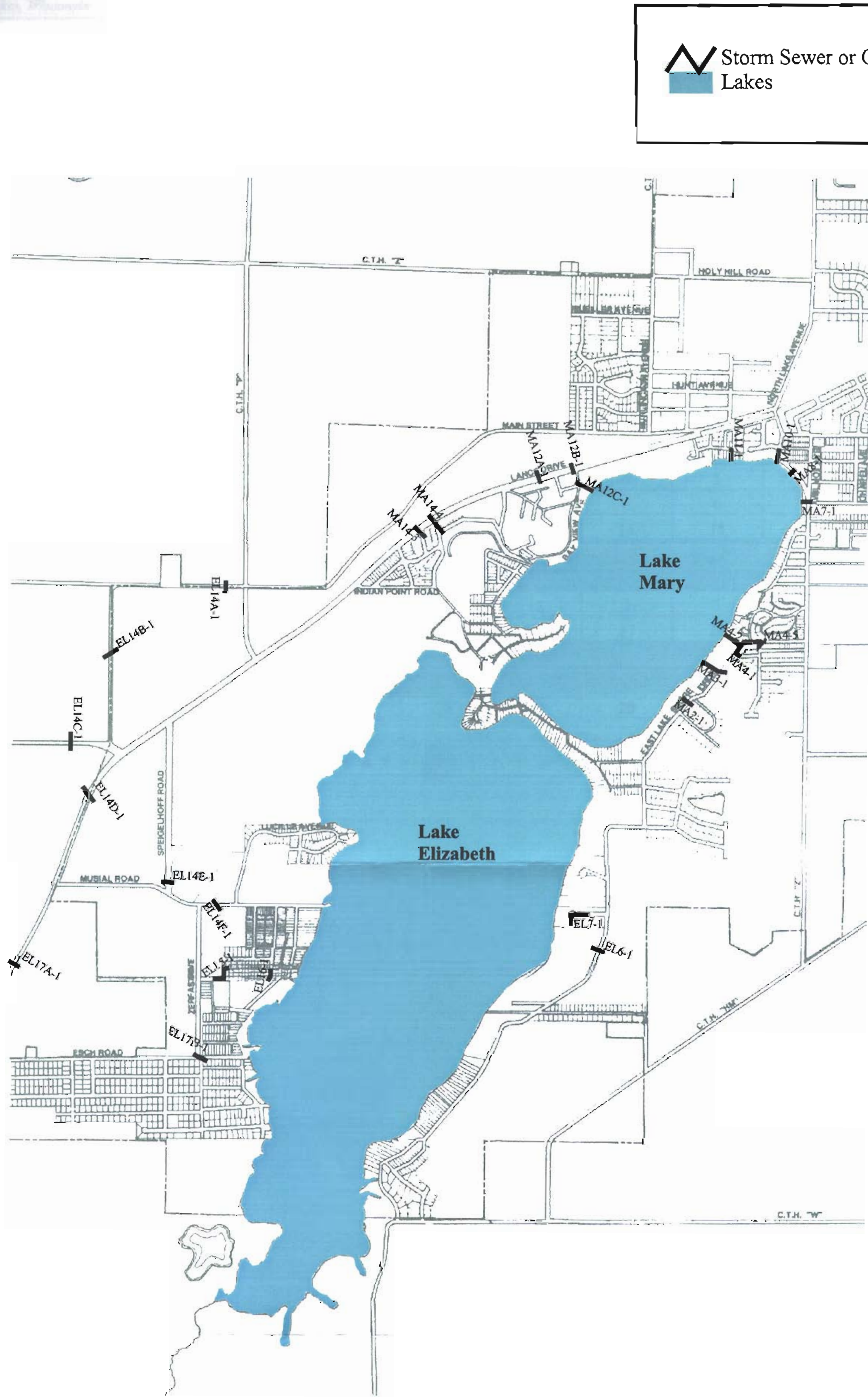

Storm Sewer or C
Lakes
Lake Mary
Lake Elizabeth
C.T.H. "Z"
HOLY HILL ROAD
C.T.H. "P"
MAIN STREET
LANCE DRIVE
INDIAN POINT ROAD
BAY VIEW AVE
EAST LAKE SHORE DRIVE
SPIEGELHOFF ROAD
MUSIAL ROAD
ESCH ROAD
C.T.H. "KW"
C.T.H. "W"
MA12A-1
MA12B-1
MA12C-1
MA14A-1
MA14B-1
MA7-1
MA4-5
MA4-1
MA2-1
EL14A-1
EL14B-1
EL14C-1
EL14D-1
EL14E-1
EL14F-1
EL17A-1
EL7-1
EL6-1

TABLE 5-1

CALCULATED FLOWS WITHIN THE TWIN LAKES WATERSHED

Basin	Pipe Diameter (inches)	Pipe Capacity (cfs)	2 Year, 2 hour storm		10 Year, 2 hour storm		25 Year, 24 hour storm		100 Year, 24 hour storm	
			Existing flow, cfs	Future flow, cfs	Existing flow, cfs	Future flow, cfs	Existing flow, cfs	Future flow, cfs	Existing flow, cfs	Future flow, cfs
MA2-1	24	21	10	10	15	15	6	6	8	8
MA3-1	30	48	9	9	14	14	6	6	8	8
MA4-1	18	11	5	5	7	7	3	3	4	4
MA4-2	15	13	6	6	10	10	4	4	5	5
MA4-3	48	194	18	18	27	27	10	10	13	13
MA4-4	18	20	18	18	27	27	10	10	13	13
MA4-5	18	7	18	18	27	27	10	10	13	13
MA7-1	30	34	36	36	54	54	27	27	34	34
MA8-1	30	160	13	13	19	19	6	6	7	7
MA10-1	24	17	9	9	13	13	5	5	6	6
MA11-1	18	4	15	15	23	23	6	6	8	8
MA12A-1	36	55	22	39	33	57	14	18	19	24
MA12B-1	24	15	71	71	106	106	39	39	50	50
MA12C-1	36	50	93	110	139	163	53	57	69	73
MA14-1	36	87	1	8	2	12	2	3	3	4
MA14-2	36	43	9	40	15	59	17	26	24	34
MA14-3	18	37	76	115	123	174	111	121	156	168
MA14-4	18	20	76	114	123	173	111	121	156	168
EL6-1	36	50	18	18	28	28	20	20	29	29

TABLE 5-1

CALCULATED FLOWS WITHIN THE TWIN LAKES WATERSHED

Basin	Pipe Diameter (inches)	Pipe Capacity (cfs)	2 Year, 2 hour storm		10 Year, 2 hour storm		25 Year, 24 hour storm		100 Year, 24 hour storm	
			Existing flow, cfs	Future flow, cfs	Existing flow, cfs	Future flow, cfs	Existing flow, cfs	Future flow, cfs	Existing flow, cfs	Future flow, cfs
EL7-1	36	56	4	4	6	6	3	3	4	4
EL16-1	16	3	7	7	11	11	6	6	9	9
EL15-1	24	13	6	6	10	10	3	3	4	4
EL17A-1	103	2,453	21	21	40	40	53	53	78	78
EL17B-1	30	23	95	112	160	183	152	156	218	224
EL14A-1	24	21	19	19	34	34	41	41	59	59
EL14B-1	36	61	24	55	42	84	51	60	75	85
EL14C-1	36	61	36	70	69	115	85	94	125	136
EL14D-1	36	61	42	76	83	129	102	111	150	161
EL14E-1	48	132	49	95	100	165	123	140	185	202
EL14F-1	36	61	52	103	107	178	130	148	195	214

Note: Lightly shaded flows indicates structures with minor hydraulic concern

Note: Dark shaded flows indicates structures with potential significant hydraulic concern

Note: The values presented in this table are for planning level analyses only. They are not suitable for design level purposes.

"cfs" = cubic feet per second

Under current land use conditions, this area is flagged as a minor concern (Table 5-1); however, basin EL-17 is slated for significant development north of Esch Road. This will increase runoff volumes and peak flows through this area and the model predicts that this system will be a significant concern in the future.

5.2 Identification of Critical Nonpoint Pollutant Sources and Loadings

Nonpoint source pollutant loadings for lead, sediment, and phosphorous were calculated for each land use and basin. The basins and land uses were compared to determine areas of critical pollutant loadings. Tables 5-2 and 5-3 report the pollutant loadings by existing and future land uses, respectively, for Lake Mary; Tables 5-4 and 5-5 report the same information for Lake Elizabeth.

The distribution of land use within each basin clearly affects the pollutant loadings of the basin. Tables 5-2 to 5-5 show that agricultural lands are the largest contributors of phosphorus and sediment loads. This occurs because of the large areas these lands cover and the relatively high unit area loadings the land use produces. The pollutant loads for each basin are shown in Appendix A.

5.3 Identification of Critical Basins

Critical basins were identified and analyzed for sediment, phosphorus and lead. These pollutants represent the types of nonpoint source pollutants found within the watershed. Using the SLAMM results for future land use conditions, basins were ranked in descending order by their annual sediment loads. Sediment was chosen as an "indicator" pollutant. Generally, the significance of the other pollutants (phosphorous and lead) is proportional to the sediment load. Those basins that cumulatively contribute 50 percent of the watershed's pollutant load (under future land use conditions) were identified as "critical" sources (see Figure 5-2).

TABLE 5-2

LAKE MARY ANNUAL POLLUTANT LOADS BY CURRENT LAND USE CONDITIONS

Land Use	Acres		Phosphorus		Sediment		Lead	
	(acres)	(%)	(lbs/yr)	(%)	(tns/yr)	(%)	(lbs/yr)	(%)
Agricultural	160	28%	138	41%	68.9	63%	0	0%
Office/Institutional	9	2%	12	4%	1.4	1%	3	1%
Residential (med. density)	168	29%	20	6%	3.5	3%	15	6%
Residential (high)	141	24%	68	20%	5.6	5%	29	12%
Open Space	42	7%	5	1%	1.2	1%	4	2%
Commercial/ Business	44	8%	97	29%	29.3	27%	187	79%
Wetland	17	3%	0	0%	0.0	0%	0	0%
Total	581	100%	340	100%	109.8	100%	237	100%

TABLE 5-3

LAKE MARY POLLUTANT LOADS BY FUTURE LAND USE CONDITIONS

Future Land Use	Acres		Phosphorus		Sediment		Lead	
	(acres)	(%)	(lbs/yr)	(%)	(tns/yr)	(%)	(lbs/yr)	(%)
Office/Institutional	9	1%	12	4%	1.4	3%	3	1%
Residential (low density)	26	4%	1	0%	0.2	0%	1	0%
Residential (med. density)	257	44%	20	8%	2.8	5%	12	4%
Residential (high)	159	27%	78	30%	6.7	12%	34	10%
Open Space	38	7%	4	2%	1.2	2%	4	1%
Commercial	75	13%	143	55%	42.4	78%	275	84%
Wetland	17	3%	0	0%	0.0	0%	0	0%
Total	581	100%	258	100%	54.5	100%	328	100%

TABLE 5-4

LAKE ELIZABETH POLLUTANT LOADS BY CURRENT LAND USE CONDITIONS

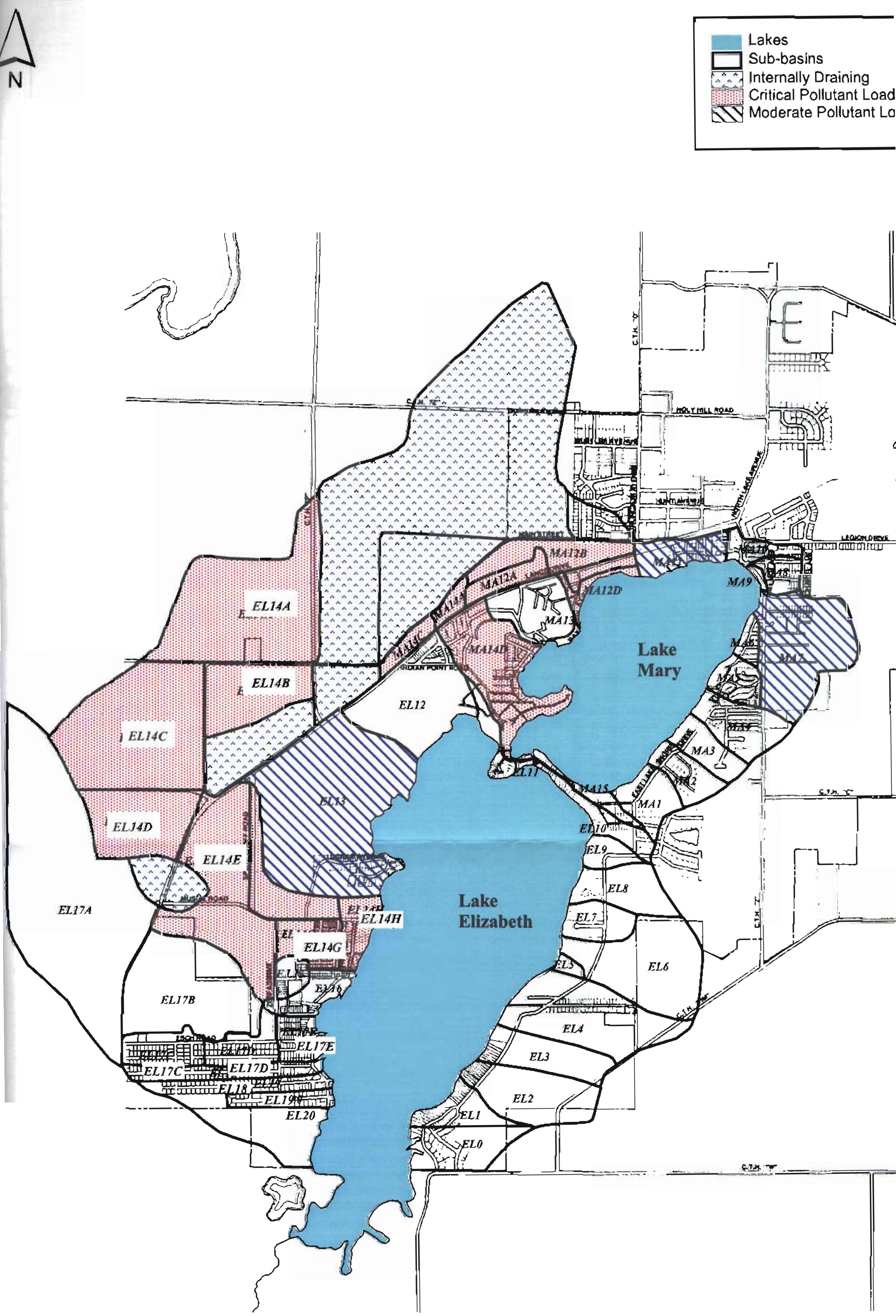
Land Use	Acres		Phosphorus		Sediment		Lead	
	(acres)	(%)	(lbs/yr)	(%)	(tns/yr)	(%)	(lbs/yr)	(%)
Agricultural	1,402	66%	1,206	95%	603.0	98%	0	0%
Residential (low density)	8	0%	0	0%	0.0	0%	0	0%
Residential (med. density)	370	17%	24	2%	3.4	1%	14	35%
Residential (high)	89	4%	36	3%	3.2	1%	18	45%
Open Space	107	5%	3	0%	3.2	1%	2	5%
Commercial	3	0%	3	0%	0.9	0%	6	15%
Wetland	156	7%	0	0%	0.0	0%	0	0%
Total	2,135	100%	1,273	100%	613.7	100%	40	100%

Table 5-5 Lake Elizabeth Pollutant Loads by Future Land Use Conditions

Future Land Use	Acres		Phosphorus		Sediment		Lead	
	(acres)	(%)	(lbs/yr)	(%)	(tns/yr)	(%)	(lbs/yr)	(%)
Agricultural Lands	883	41%	759	76%	446.6	89%	0	0%
Residential (low density)	317	15%	13	1%	1.8	0%	6	2%
Residential (med. density)	512	24%	38	4%	5.3	1%	22	7%
Residential (high)	99	5%	41	4%	3.6	1%	19	6%
Open Space	107	5%	3	0%	3.2	1%	2	1%
Commercial	60	3%	139	14%	42.4	8%	269	85%
Wetlands	156	7%	0	0%	0.0	0%	0	0%
Total	2,135	100%	994	100%	502.9	100%	318	100%

5.4 The SLAMM Nonpoint Source Pollutant Loading Results

The results of the SLAMM analysis are consistent with other urban land use watersheds: land uses with the greatest amount of impervious areas produce the highest pollutant loads per unit area. Commercial areas and high-density residential developments are the most significant sources of nonpoint source pollution, with the exception of construction sites and agricultural land, which dominate sediment loading. Future pollutant loadings show a decline in sediment and phosphorus loads, but a substantial increase in lead loads for both lakes. The decrease in sediment and phosphorus loads is because the agriculture lands currently deliver equal or more amounts of sediment and phosphorus than the predicted future land uses. The converted land uses (primarily commercial and residential) are expected to generate more heavy metal loads (lead) than the agricultural lands they are replacing.


N
Lakes
Sub-basins
Internally Draining
Critical Pollutant Load
Moderate Pollutant Lo
Lake Mary
Lake Elizabeth
HOLY HILL ROAD
MAIN STREET
LEGION DRIVE
C.T.H.
EL14A
EL14B
EL14C
EL14D
EL14E
EL14G
EL14H
EL12
EL13
EL11
EL10
EL9
EL8
EL7
EL6
EL5
EL4
EL3
EL2
EL1
EL0
EL16
EL17A
EL17B
EL17C
EL17D
EL17E
EL18
EL20
MA12B
MA12A
MA12D
MA13
MA14B
MA15
MA9
MA7
MA3
MA2
MA1

6.0 DEVELOPMENT AND EVALUATION OF ALTERNATIVES

The next step in the analysis was to propose structural and nonstructural stormwater management alternatives to remedy the nonpoint source pollution and flooding problems within the watershed. These alternatives helped develop a plan to address the water quality and flooding objectives of the plan.

6.1 Analysis of Control Methods

Analyzing ways to meet pollutant reduction goals within the watershed was the first step in the analysis. Low cost nonpoint source pollution control methods were assessed first. These include nonstructural practices such as street sweeping, catch basin cleaning, and roof and parking lot disconnection. Modifications to the SLAMM were made to model the impact these changes would have on the pollutant loadings. Each change was modeled as an independent management practice, and then the practices were applied and modeled cumulatively. In the final SLAMM analysis, structural best management practices (wet and dry detention basins) were incorporated.

6.1.1 Street Sweeping

The Village currently conducts street sweeping in the spring and fall of each year. Increasing the street sweeping to twice a month results in an annual pollutant load reduction of approximately 22 percent and 28 percent for Lakes Mary and Elizabeth, respectively (Tables 6-1 and 6-2). These results are based on the SLAMM analysis conducted for the project. Generally, higher intensity land uses, such as commercial and industrial, showed a greater percent increase in pollutant reduction with more frequent street sweeping.

TABLE 6-1

COMPARISON OF INCREASED STREET SWEEPING ON FUTURE ANNUAL POLLUTANT LOADS FOR LAKE MARY

Street Sweeping Frequency	Sediment	
	(Tons/Yr)	% Reduction
Existing (2x/yr)	53.22	-
2x/month (Apr-Oct)	41.29	22%

TABLE 6-2

COMPARISON OF INCREASED STREET SWEEPING ON FUTURE ANNUAL POLLUTANT LOADS FOR LAKE ELIZABETH

Street Sweeping Frequency	Sediment	
	(Tons/Yr)	% Reduction
Existing (2x/yr)	55.92	-
2x/month (Apr-Oct)	40.29	28%

6.1.2 Directing Runoff From Roofs and Parking Lots to Vegetated Areas

This practice refers to the redirection of runoff from roofs and parking lots to vegetated areas, rather than direct to the storm sewer system. For purposes of this analysis, this practice was "applied" only to predicted new commercial development within the project area. This practice results in three benefits: (1) reduce the volume and peak flow of runoff from a site; (2) reduces the velocity of the runoff; and (3) decreases the amount of pollutants in the runoff. Incorporating this requirement during the site development phase of new construction is a low (or no) cost approach to achieving nonpoint source pollution control. By disconnecting all roofs and parking lots from future developments directly from the storm sewer system, the annual pollutant load to each lake was reduced by about two percent.

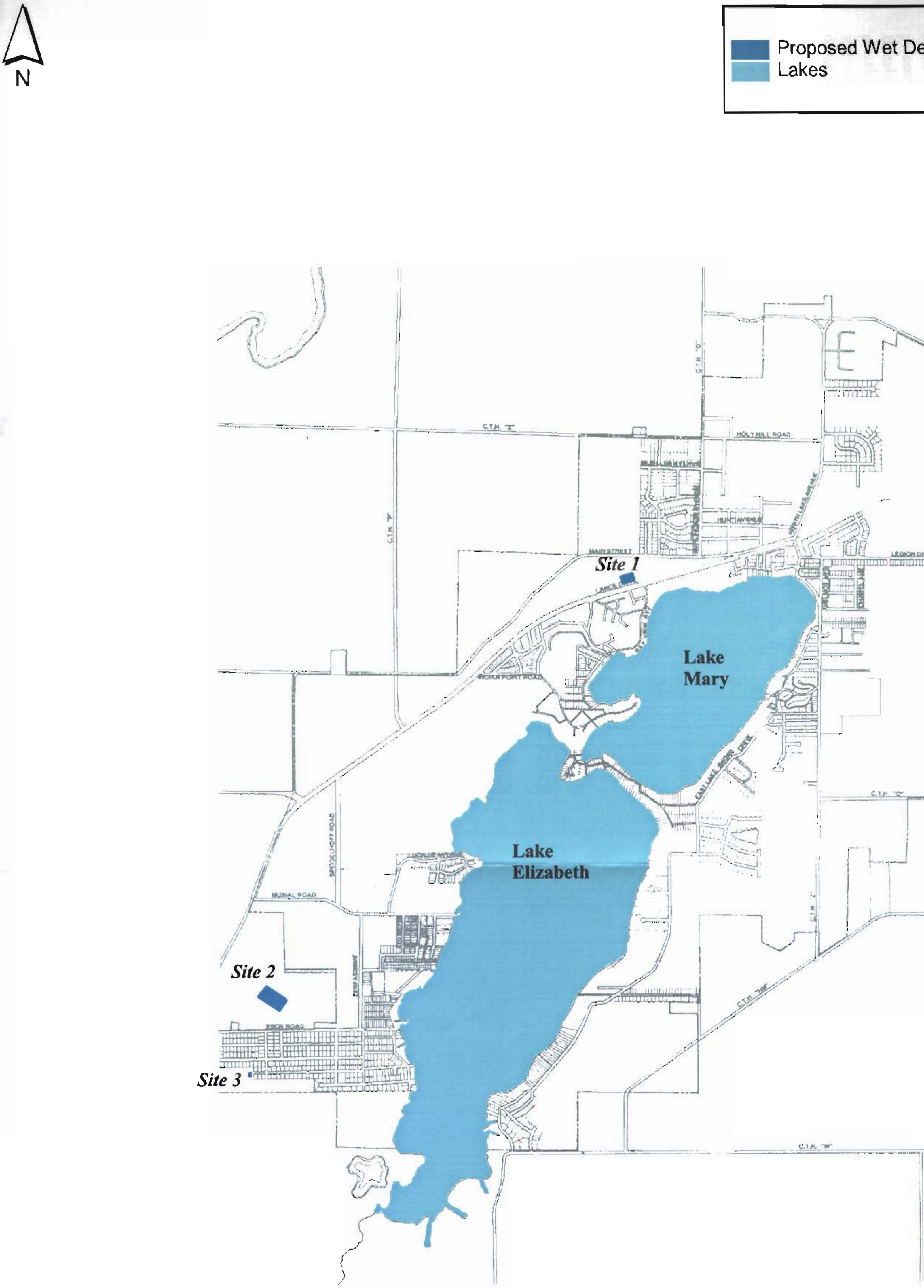
6.1.3 Wet Detention Basins

Detention basins are constructed depressions into which stormwater is directed. These basins detain the stormwater and release the runoff at a slower rate. The detention basins can be designed to have a permanent pool of water (wet detention basin) or no permanent pool of water (dry detention basin). The wet basins are more effective at reducing pollutants. Both types of basin can reduce the rate of stormwater runoff, and prevent or reduce flooding. Sites within the project area were investigated for suitable detention basin locations. Three sites were determined to have the best potential for success (Figure 6-1).

Site 1: Wet detention north of the intersection of Lance Road and Bayview Avenue. Contributing drainage areas are basins MA12A and MA12B.

Site 2: Wet Detention on intermittent storm channel north of Esch Road. Contributing drainage areas are basins EL17A and EL17B.

Site 3: Existing Dry Detention converted to a wet pond near Sunset Drive and Hickory Lane. Contributing drainage area is approximately 11 acres. [*NOTE: Since this original recommendations was made (in 1997); new development has occurred in the area of this site. The dry detention basin no longer exists at this location. Recommendations regarding stormwater quality control measures in this area will need to be re-evaluated by the Village to determine feasible structural practices to reduce stormwater pollution to Lake Elizabeth.*]


N
Proposed Wet De
Lakes
Site 1
Site 2
Site 3
Lake Mary
Lake Elizabeth

6.2 Summary of Management Practices

Constructing and maintaining the wet detention facility at Site 1 would result in an overall annual sediment reduction to Mary Lake of about 31 percent. Site 2 would contribute to an overall sediment reduction of 12 to 27 percent to Lake Elizabeth, depending on the size of the detention basin. The overall reduction of pollution to Lake Elizabeth by converting Site 3 to a wet basin is small; however, the cost of converting this site to a water quality practice is relatively low (*NOTE feasibility issue previously discussed*]. Table 6-3 provides conceptual design information for the proposed detention facilities. Figure 6-2 shows a schematic drawing of a typical wet detention design.

The results below reflect future land use conditions and are the cumulative effect of all recommended nonstructural practices, plus the three detention facilities. The following are the predicted results from the nonpoint source pollutant analysis (SLAMM modeling):

- 53 percent reduction in the future sediment load to Lake Mary;
- 22 percent reduction in phosphorus loading to Lake Mary;
- 55 percent reduction in the sediment load to Lake Elizabeth; and
- 28 percent reduction in phosphorus loading to Lake Elizabeth.

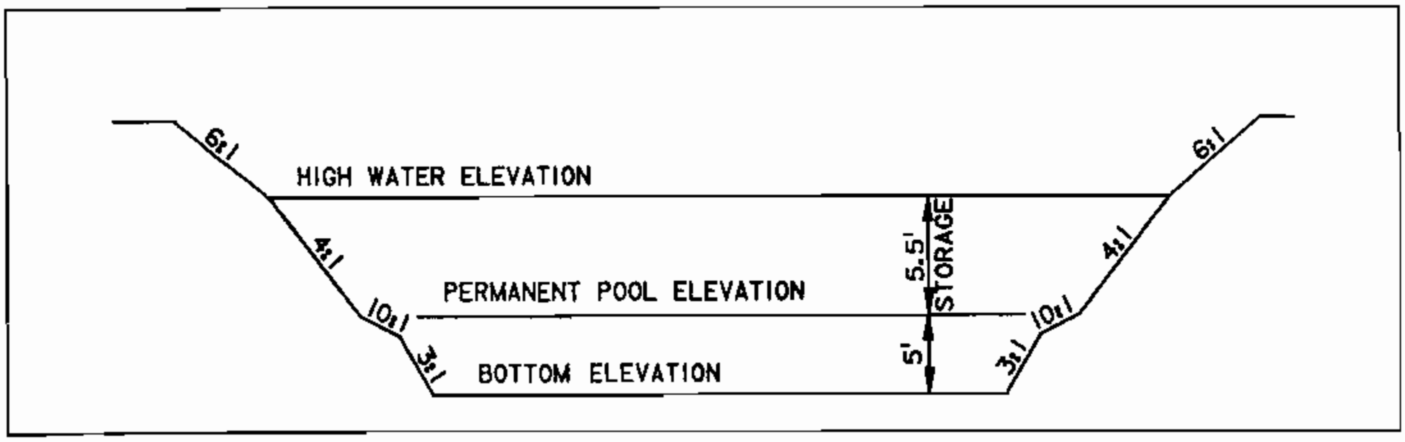
TABLE 6-3
PERFORMANCE CHARACTERISTICS OF PROPOSED WET DETENTION FACILITIES

Performance Characteristic	1-Acre Wet Detention Site 1	3-Acre Wet Detention Site 2	6.5-Acre Wet Detention Site 2	Converted Wet Detention Site 3*
Design Inflow (25-yr - cfs)	115	290	290	16
Design Outflow (25-yr - cfs)	47	145	59	6
Normal Pool Elevation (feet above basin bottom)	5.0	5.0	5.0	3.0
Maximum Elevation (feet above basin bottom, 25-yr)	9.8	10.3	9.6	6.4
Maximum Storage (25-yr, ac-ft)	5.9	18	32	0.61
Sediment Reduction (%, based on total load to lake)	31%	12%	27%	<1%

Note that there are two basin sizes reported at site 2. The 6.5-acre basin is the size required to meet the WDNR 1001 design standard of reducing solids by 90%. A smaller, less costly 3-acre basin was analyzed to determine its effectiveness on water quality and local flooding conditions. All values reported in the above table are for planning purposes only. The values are not suitable for a design level analysis.

* Site 3 feasibility needs to be re-evaluated because of changes in land use since the original recommendations were developed.

Figure 6-2: Schematic of Proposed Wet Detention Facility



7.0 RECOMMENDATIONS, AND IMPLEMENTATION

Throughout this document, management practices have been analyzed for reducing runoff-related flooding and water quality impacts. This chapter lays out a specific set of recommendations to achieve those objectives. As noted earlier, structural and nonstructural methods are available to help meet these objectives.

Nonstructural management measures recommended for the Lake Mary and Lake Elizabeth watersheds are presented first in this chapter. The chapter concludes with a discussion of the recommended structural management measures. A cost table for both the nonstructural and structural recommendations is provided at the end of this chapter.

All analyses are based on planning level study. A more detailed, site-specific analysis must be performed before any design work is done.

NOTE: Since the original development of this plan in 1997, many innovative structural Best Management Practices (BMPs) have been developed, and become more commonly used in urban settings for the control of stormwater pollution. Examples of these newer BMPs include: rain gardens, bio-swales; bio-retention areas; proprietary BMPs (usually underground in-line systems, or catch basin inserts); and conservation development principals. These practices were not discussed, or considered for applicability to the stormwater management needs of Twin Lakes during the 1997 study. The Village may wish to evaluate these options for stormwater management in the future.

7.1 Recommended Nonstructural Measures

The following is a list of recommended measures that do not require physical construction to aid in the accomplishment of meeting the Village's stormwater management, erosion control, and water goal objectives. Many of the recommendations pertain to the creation of new policies and plans, or the enforcement of existing policies and plans.

7.1.1 Enforcement of Existing Ordinances

It is recommended that the Village vigorously enforce the current Erosion Control (Chapter 14.21), Grading, Filling and Stormwater Control (Chapter 14.22), and Fertilizer Management (Chapter 8.60) ordinances. Although sediment from construction sites was not specifically analyzed for this project, construction sites have been shown to be a major source of sediment in developing urban areas. Plat reviews for developments outside of the Village (where erosion may impact stormwater conveyance systems or water resources within the Village), but within the extraterritorial limits, should have an erosion control plan as a plat review requirement. If additional staffs are needed to enforce and administer the ordinance, a permit fee system could be developed to cover additional costs.

7.1.2 Street Sweeping

Frequent sweeping on streets with curb and gutter drainage can greatly reduce the delivery of pollutants to receiving waters. The Village has increased street sweeping to twice per month, and it is recommended that they maintain that current level. The SLAMM analysis indicates that increased street sweeping will have a significant affect on annual pollutant loading.

7.1.3 Stormwater Management Guide

It is recommended that the Village develop a Stormwater Management Guide for residential and commercial developers. The Village currently has guidelines for development with respect to stormwater quantity and peak flow, but no quality guidelines. A formal Stormwater Management Guide would help standardize the current guidelines and cover other beneficial aspects of stormwater management. The guide could be used by Village staff when reviewing new development proposals and would establish specific criteria and requirements for developers to meet. This document should include the following major topics:

- Stormwater management policy: to manage the quantity and quality of stormwater under future land use conditions.
- Design criteria: for swales, storm sewers, channels, conveyance systems, sedimentation basins, wet and dry ponds, and other storage facilities. A specific recommendation is that new industrial and commercial developments must direct runoff from rooftops and parking lots to vegetated areas (not directly to the storm sewer system), and treat the runoff to reduce the annual sediment load by at least 80 percent.

7.1.4 Review Village Procedures

Another suggestion to improve water quality is that the Village review its procedures and activities related to stormwater quality and modify them where appropriate. The Village should evaluate:

- Storage and handling of hazardous materials by the Village departments (pesticides, paints, solvents, petroleum, lubricants, etc.).
- Village vehicle and equipment maintenance procedures (runoff from washing, waste oil, antifreeze, hydraulic fluid disposal, etc.).
- Schedule and policies on leaf pickup, winter road sanding/salting, and other street department responsibilities.
- Village staff training on handling hazardous materials, response to spills, and pollution prevention techniques.

7.1.5 Public Education and Information Program

The Village should develop a public education and information program. Residents and visitors should be made aware of the current water quality condition of the lakes and their impacts on water quality. We recommend that the Village focus its educational efforts on the following topics:

- Inform citizens about the destination of stormwater entering grates, inlets, and swales. Stenciling on sidewalks is an effective method of communicating this information.
- Inform homeowners on yard and house practices they could use to minimize nonpoint source pollution runoff and reduce contact between runoff and pollutants.
- Gear the information/education messages to health-related issues or beneficial impact to future users of the water resources.

7.1.6 Hazardous Materials Recycling Program

Another recommendation is the development of a routine clean sweep recycling program for hazardous materials that will encourage citizens to participate. The goal is to eliminate the dumping of oil, anti-freeze, paints, solvents, and other pollutants into the sewer/swale system of the Village that directly flow into the lakes. There may be opportunities to team with other local communities or the county in this effort.

7.1.7 Interagency Coordination and Stakeholder Involvement

The Village should coordinate with County and State agencies to work with local agricultural landowners to adopt conservation practices that will reduce the sediment and phosphorus loads generated from the agricultural lands. From the nonpoint source pollution analysis conducted it is clear that large quantities of sediment and phosphorus loads are coming from rural/agricultural lands. Any effort the Village can extend to help and encourage landowners to adopt practices that minimize sediment delivery to receiving waters will help preserve the water quality of Lake Mary and Elizabeth.

7.2 Recommended Structural Measures

The following list contains recommended structural measures related to the implementation of this stormwater plan. The recommended structural measures include physical construction, such as resizing existing culverts and storm sewer pipes, and installing wet or dry detention ponds.

7.2.1 Upgrade of Undersized Pipe (Lance Drive and Bay View Avenue)

The sewer system at Lance Drive and Bay View Avenue was revealed to have an undersized sewer pipe. To accommodate future development in the area between Lance Drive and Main Street, a combination of stormwater detention north of Lance Drive and replacement of the existing sewer pipe with a larger one is recommended. Stormwater detention, coupled with proper planning, may minimize the impacts from increased runoff. The larger sewer would eliminate standing water that occurs in the motel parking lot and will aid with the increased flow volume after development occurs.

7.2.2 Upgrade of Undersized Culvert (West of Lance Drive)

The culvert system that channels water down to the street elevation from west of Lance Drive to Bonnie Brae Avenue is currently undersized. Under future development conditions, this area may experience more frequent flooding. To prevent the problem from becoming worse, proper management of additional runoff north and west of Lance Drive is recommended. Excavation and enlargement of the conveyance system may relieve the current flooding, but would significantly disrupt the landowners in the area. Therefore, carefully management of future development may be sufficient for the time being.

7.2.3 Upgrade Undersized Pipe and Construct Detention Basin (Esch Road)

The sewer pipe that runs under the easement in continuation of Esch Road to Elizabeth Lake is undersized for existing conditions, and the problem will be exacerbated under future development conditions. Construction of a detention pond in the open area between Lance Drive and the corner of Esch Road and Park Avenue is recommended. In addition to the detention pond, replacement of the existing sewer pipe with a larger one is recommended. This will help attenuate the peak flow rates entering the sewer system east of Park Avenue. At a minimum, the existing undersized pipe should be replaced with a larger pipe.

7.3 Recommended Locations for Detention Basins

It is recommended that the Village construct detention facilities at the following locations:

7.3.1 Basin 1

Location:	North of Lance Road and Bayview Avenue
Approximate Pond Size:	1.0 acres (permanent pool area)
Basins treated:	MA12A and MA12B
Property Ownership:	Private

7.3.2 Basin 2

Location:	North of Esch Road
Approximate Pond Size:	3.0 acres (permanent pool area)
Basins treated:	EL17A and EL17B
Property Ownership:	Private

7.3.3 Basin 3

Location:	Existing Dry Basin near Sunset Drive & Hickory Lane
Approximate Pond Size:	0.13 acres (permanent pool area)
Basins treated:	1/4 EL18
Property Ownership:	Unknown

NOTE: This site will require re-evaluation. The existing dry detention basin that existed at the time of the study (1997) no longer exists because of new land development activities.

The conceptual design criteria given above and in Table 6-3 must be confirmed with specific design analysis. The criteria provided assumes that the facilities are built in sequence: Basin 1, Basin 2, and Basin 3. In terms of priority, Basins 1 and 2 are the most significant for flood control and nonpoint source pollution control purposes. Basin 3 is the least significant; however, it is also the least expensive alternative.

7.4 Cost Estimates

Tables 7-1, 7-2, and 7-3 summarize cost estimates for the increased street sweeping and the detention basins. The sources of the cost estimates are specified. Actual costs for construction of the detention basins would likely be determined through a contractor bidding process.

TABLE 7-1

BASIN 1 ESTIMATED COSTS
(NORTH OF LANCE ROAD AND BAYVIEW AVENUE)

Item	Description	Quantity	Unit	$/Unit	Total $
	Mobilization/Demobilization				
1	Mobilization/Demobilization	1	project	$1,000	$1,000
	Subtotal				$1,000
	Basin Construction				
2	Clearing and Grubbing	1.48	ac	$8,275	$12,268
3	Strip and Stockpile Topsoil	598	cy	$1.52	$909
4	General Excavation	17,345	cy	$3.00	$52,035
5	Place and Compact Spoil	4,336	cy	$1.10	$4,770
6	Haul and Dispose Spoil	13,009	cy	$7.00	$91,061
7	Respread Topsoil	598	cy	$1.61	$963
8	Hydroseed	3,588	sy	$0.35	$1,256
9	Riprap	287	cy.	$28.50	$8,180
10	Basin Inlet	1	ea	$5,000	$5,000
11	Basin Outlet	1	ea	$20,000	$20,000
	Subtotal				$196,442
	Construction Subtotal				$197,442
12	Project Contingencies (1)	1	project	20%	$39,488
	Construction Total				$236,930
13	Engineering Fees (10% of Construction Total) (2)	1	project	10%	$23,693
	Project Total				**$260,623**

(1) Land purchase costs not included

(2) Engineering estimate assumes federal/state/local government permits are not required for project

TABLE 7-2

BASIN 2 ESTIMATED COSTS
(NORTH OF ESCH ROAD)

Item	Description	Quantity	Unit	$/Unit	Total $
	Mobilization/Demobilization				
1	Mobilization/Demobilization	1	project	$1,000	$1,000
	Subtotal				$1,000
	Basin Construction				
2	Clearing and Grubbing	3.86	ac	$8,275	$31,915
3	Strip and Stockpile Topsoil	1,556	cy	$1.52	$2,364
4	General Excavation	51,111	cy	$3.00	$153,333
5	Place and Compact Spoil	12,778	cy	$1.10	$14,056
6	Haul and Dispose Spoil	38,333	cy	$7.00	$268,333
7	Respread Topsoil	1,556	cy	$1.61	$2,504
8	Hydroseed	9,333	sy	$0.35	$3,267
9	Riprap	747	cy.	$28.50	$21,280
10	Basin Inlet	1	ea	$5,000	$5,000
11	Basin Outlet	1	ea	$20,000	$20,000
	Subtotal				$522,051
	Construction Subtotal				$523,051
12	Project Contingencies (1)	1	project	20%	$104,610
	Construction Total				$627,661
13	Engineering Fees (10% of Construction Total) (2)	1	project	10%	$62,766
	Project Total				**$690,427**

(1) Land purchase costs not included

(2) Engineering estimate assumes federal/state/local government permits are not required for project

TABLE 7-3

BASIN 3 ESTIMATED COSTS
(EXISTING DRY BASIN NEAR SUNSET DRIVE & HICKORY LANE)

Item	Description	Quantity	Unit	$/Unit	Total $
	Mobilization/Demobilization				
1	Mobilization/Demobilization	1	project	$1,000	$1,000
	Subtotal				$1,000
	Basin Construction				
2	Clearing and Grubbing	0.00	ac	$8,275	$0
3	Strip and Stockpile Topsoil	0	cy	$1.52	$0
4	General Excavation	0	cy	$3.00	$0
5	Place and Compact Spoil	0	cy	$1.10	$0
6	Haul and Dispose Spoil	0	cy	$7.00	$0
7	Respread Topsoil	0	cy	$1.61	$0
8	Hydroseed	0	sy	$0.35	$0
9	Riprap	0	cy.	$28.50	$0
10	**Basin Inlet**	1	ea	$5,000	$5,000
11	Basin Outlet	1	ea	$20,000	$20,000
	Subtotal				$25,000
	Construction Subtotal				$26,000
12	Project Contingencies (1)	1	project	20%	$5,200
	Construction Total				$31,200
13	Engineering Fees (10% of Construction Total) (2)	1	project	10%	$3,120
	Project Total				$34,320

(1) Land purchase costs not included
(2) Engineering estimate assumes federal/state/local government permits are not required for project

TABLE 7-4

SUMMARY OF ESTIMATED RECOMMENDED PRACTICE COSTS

Recommended BMP	Estimated Capitol Costs	Estimated Annual Costs +
Basin 1	$260,600	$3,700
Basin 2	$690,400	$8,400
Basin 3	$34,300	$1,600
Street Sweeping *	$0	$26,600
Totals:	$985,300	$40,300

+ SEWRPC Tech. Rpt. 31, 1991; Updated to 2003 at 3% annual inflation rate
* Recommended schedule - twice per month

7.5 Potential Funding Alternatives

There are a number of funding mechanisms that can be used to finance the Village's stormwater management needs. Table 7-5 contains a list of these funding options and a summary of the activities that each funding source can be used for. These mechanisms can be used individually or in combination. Descriptions of funding sources used to finance stormwater management programs are discussed below. Advantages and disadvantages associated with each alternative are also discussed, as well as an indication of the activity (e.g., administration services, operation/maintenance, renewal/replacement, capital improvements, and water quality monitoring) for which the funding source is best suited.

7.5.1 General Fund

In most communities, funds for stormwater management are provided from the General Fund. This source can be best considered a "bank" into which revenues are placed and from which most programs are funded. The major income source for the General Fund is ad valorem (property) taxes. This income is based primarily upon the assessed valuation of property within the Village. This revenue source can be used for funding administration, renewal/replacement, construction, maintenance, and water quality monitoring costs.

7.5.2 Special Taxing/Assessment Districts

Income from a special taxing district or special assessment district is generally dedicated to that district. That is, the area that is designated as "special," for whatever reason, would pay an additional tax or have an increased assessment. The funds from the additional tax or assessment are returned to that area. For example, if stormwater management facilities are constructed to benefit a particular drainage basin within the Village then that area could be designated a special taxing district and an additional tax levy could be assigned to the property within the area.

7.5.3 Gas Tax

State gas tax revenues are currently being used for drainage needs in conjunction with improvements to the transportation system, such as the construction of a detention pond in Sheboygan, Wisconsin. Special legislation would be required to increase or set aside a portion of the state gas tax for use on projects that are primarily stormwater management in scope.

7.5.4 Local Option Sales Tax

The County could impose a local option sales tax if approved by the voting public. The revenue would be distributed to each of the local governments and could be used for infrastructure capital improvements.

Clearly, stormwater management Capital Improvement Projects (CIP) can be funded using this source. However, by law, the funds can only be used for capital improvements--the funds cannot be used for management services and operation and maintenance (O&M) activities. In addition, sales tax revenues can be unreliable, since they vary from year-to-year depending on the vitality of the economy. Therefore, it is not sufficient to form the foundation of the financial plan for the stormwater management program.

7.5.5 Homeowners Association

The homeowners association concept is similar to the special assessment district in that a relatively small area would receive an additional levy. This method is generally available only for residential parcels. In the case where no special district could be established, or where a private entity is responsible for the maintenance of a stormwater facility, a homeowners association fee may be a reasonable approach. Assessments are specific depending on the needs and desires of each association. Capital improvements, operation and maintenance, and water quality monitoring for the residential development can be funded by this method.

7.5.6 Fees/Licenses/Permits

Funding from this source is generally limited to the cost of permit review and the inspection of construction. Other revenue sources must be utilized to finance other aspects of the stormwater management program such as administration, operation and maintenance, and capital improvements.

7.5.7 Penalties and Fines

Similar to permit fees, penalties, and fines are limited in scope. Such income can be placed in the General Fund; however, it may be more reasonable to use the fines to correct the violation or any subsequent ones. This type of income could be used to subsidize a comprehensive stormwater management program and would not support the entire program.

7.5.8 Bonds

General obligation, revenue, or special assessment bonds are normally used by governments to pay for large capital improvement programs. Repayment of a bond is normally through the General Fund (i.e., ad valorem tax income); however, special assessment district income, as well as utility revenues, can be used to pay the debt service. Bonds would allow large-scale capital improvement programs to be initiated when the facilities are needed rather than waiting until the funds are accumulated.

7.5.9 Pay-As-You-Go Sinking Fund

As an adjunct to revenue bond financing, this type of stormwater funding is most common. Essentially, a separate account is formed to receive revenues from numerous sources such as ad valorem taxes or stormwater utility income. The fund accumulates revenues until sufficient money is available for an identified project. Then the total project amount is removed from the fund and the fund "sinks" in size and the growth stage starts over. This method is generally associated with capital improvement programs where it is not advantageous to incur long-term debt.

7.5.10 Subdivision Exactions

As a condition of approval for development, the Village can require the developer of a subdivision or large parcel to construct stormwater management facilities and dedicate them to the Village upon completion. In addition, developers could be required to donate drainage easements or other types of partial rights to the Village for stormwater management purposes. Thus, the developer would be responsible for funding the capital program while the Village would be responsible for funding the operation and maintenance. It is possible, however, to find that stormwater facilities designed, constructed, and transferred to the Village may not have been properly designed or that its discharge may aggravate downstream flooding problems.

7.5.11 Developer Incentives

Incentives could be offered to induce developers to use proper stormwater management planning techniques. Such incentives, for example, could include waiving maximum allowable residential densities if land is dedicated to the Village for stormwater management purposes. This method would still require the construction of the stormwater facility by the Village; however, the land costs for the stormwater management facility would be reduced. The two significant concerns regarding the implementation of this method are: (1) to review the compatibility of developers' plans with respect to the goals and objectives of the land use element of the village's land use plan; and (2) to assess the magnitude of nonpoint source pollution problems due to higher intensity level of development.

7.5.12 Betterment Charges

When a stormwater management facility is constructed to deal with a problem near a community, the property within the community will tend to increase in value. For example, if a drainage system is installed along a street where no stormwater management system had previously existed, then the control of flooding increases the value of property next to the road. The capital cost for such improvements could therefore be apportioned to the property owner(s). This apportionment of charges provides that the benefactors of the stormwater management system improvements would fund the program. The increase in property values resulting from such improvements is hard to estimate and this value may be less than the construction cost, thus limiting recovery.

7.5.13 Fee-In-Lieu-Of

An alternative to requiring developers to construct stormwater management facilities is to require them to pay an initial front-end charge for the capital improvements needed to service their development. The charge would be representative of the development's contribution to the regional facility in the watershed. A fee-in-lieu-of is a technique to generate the funding needed for capital improvements in a watershed. The term is derived from the case in which a developer is required to construct infrastructure, including stormwater systems. Since construction of small-scale systems is not always advisable, particularly because of the problems associated with the acceptance of the operation and maintenance costs, the better choice is a fee paid to the Village to construct a larger system. The fee is the developer's share of the regional facility.

There are two general areas where a fee-in-lieu-of is appropriate. First, a fee-in-lieu-of is appropriate where there is a large marginal cost of constructing additional facilities. A developer may pay for a portion of the construction of a large regional detention facility in-lieu-of the construction of a detention facility for an individual development.

The second area where a fee-in-lieu-of is appropriate is where the introduction of a sizable development causes the need for a new type of stormwater management system. For example, the stormwater problem may be adequately controlled within a watershed with the use of drainage ditches and swales. However, with the introduction of a new development, a detention/retention facility may be required. In this case, the developer could elect to pay a fee-in-lieu-of for the construction of the facility.

The collection of fee-in-lieu-of monies promotes the implementation of regional systems rather than the small-scale individual systems. The larger stormwater facilities are easier to maintain and can handle large-scale problems. Developers may be required to wait until sufficient funding is available for the regional system and until the facility can be constructed, unless they commit to building an interim system that can be removed or incorporated into the regional system. In developed portions of the Village that may have significant existing needs, there would be fewer new developments to contribute to the construction of larger regional facilities. Nevertheless, the fee-in-lieu-of process can reasonably be associated with a stormwater utility in newer portions of communities.

7.5.14 Stormwater Utility

Using revenues from a user charge system to fund stormwater management programs is relatively new in Wisconsin. To date, many Wisconsin communities have or are in the process of evaluating user fees as an alternative for financing stormwater management. In February 1994, the Village of Lake Delton became the first Wisconsin community to pass an ordinance establishing a stormwater utility.

The concept of the stormwater utility was developed in the western U.S. in the mid-70s. Since this time, several other municipal governments (Bellevue, Washington; Miami, Florida, Sarasota, Florida; Louisville, Kentucky; Denver, Colorado; New Orleans, Louisiana; Sacramento, California; Tulsa, Oklahoma; and Austin, Texas, are just a few examples) have adopted ordinances to initiate a stormwater utility.

The fee payer is assigned an equitable share of the cost of the stormwater management program, based on the relative contribution to the stormwater problem. This share is determined by the amount of runoff attributed to the property; the greater the runoff, the greater the contribution to the problem. The relative amount of runoff is estimated by the actual amount of impervious area on the parcel. This allows the utility to be equitable, and fairly distributes the stormwater management program costs.

The establishment of a stormwater utility to generate revenue provides funding for the five significant aspects of a comprehensive stormwater management program (administration, operation and maintenance, renewal/replacement, capital improvements, and monitoring). The income can also be used to pay the debt service for a stormwater capital improvement program, thereby leveraging the utility's annual revenue into a major program.

TABLE 7-5

ALTERNATIVE FUNDING METHODS
STORMWATER MANAGEMENT ACTIVITIES

Funding Alternative	Functional Program Elements			
	Stormwater Management Administration and Design	Capital Improvement Program	Operation and Maintenance	Water Quality Monitoring
Stormwater Utility	☆	☆	☆	☆
General Fund	☆	☆	☆	☆
Special Taxing District	☆	☆	☆	
Homeowners Association		☆	☆	☆
Gas Tax	☆	☆	☆	
Local Option Sales Tax		☆		
Bonds		☆		
Pay-as-you-go Sinking Fund		☆		☆
Subdivision Exactions		☆		
Fee-in-lieu-of		☆		
Developer Incentives		☆		
Betterment Charge		☆		
Penalties/Fines	☆	☆		☆
Fees/Permits	☆			