Lake Volney

Subwatershed Analysis

Le Sueur County, Minnesota

December 22nd, 2025

Project No. 24-32103

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CLEAN WATER LAND & LEGACY AMENDMENT

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EXECUTIVE SUMMARY

Lake Volney and its surrounding subwatersheds reside within Le Sueur County, Minnesota. The purpose of this study is to develop recommendations for enhancing water quality discharging from the surrounding rural and residential areas located within the Lake Volney subwatershed. This subwatershed analysis provides recommendations for cost-effectively treating and managing stormwater runoff originating from both rural agricultural and residential shoreline areas. This report provides technical details and recommendations to identify, evaluate, and prioritize potential stormwater best management practices (BMPs) within the Lake Volney watershed. Projects and practices referenced herein are proposed for both agricultural and residential shoreline areas and are ranked based on if the BMP is a priority BMP. In addition to the BMP priority rankings, this report includes preliminary BMP siting, cost estimation, and pollutant reduction estimations. Site specific planning, designs, and refined cost estimations should be completed following engagement of all stakeholders.

The approximate 269-acre Lake Volney is located at the intersection of Section 36 of Lexington Township, Section 31 of Montgomery Township, Section 1 of Cordova Township, and Section 6 of Kilkenny Township, within Le Sueur County, Minnesota. The approximate 2,019-acre watershed was delineated using minor subwatershed boundaries. Lake Volney's contributing drainage area extends across Sections 29 through 32 of Montgomery Township, Section 35 and 36 of Lexington Township, Section 1 of Cordova Township, and Sections 5 and 6 of Kilkenny Township within Le Sueur County. Lake Volney has been designated as impaired for aquatic recreation for excess nutrients causing eutrophication (i.e.. excess phosphorous). The majority of the lakeshore is developed residential land, but the larger watershed is a mixture of rural residential, agricultural, and open space.

This stormwater subwatershed analysis focuses on assigning a priority rank to sited BMPs. This process consists of adding practices to developed residential areas and/or land being used for agricultural production to treat stormwater runoff and reduce nutrient and sediment loading. The approach referenced throughout this report results in a cost per dollar of pollutant removed for a given BMP (cost-effectiveness). Within this subwatershed analysis, ISG estimated both total costs and pollutant reduction estimates to then determine priority rank and the cost-effectiveness of each potential BMP.

The approximate 2,019-acre watershed was delineated using minor subwatershed boundaries. Le Sueur County provided GIS data to ISG which included a county-wide digital elevation model (DEM), delineated "lake catchments," and flow paths. The provided 50 lake catchments were the starting point for evaluating and identifying areas that would benefit from BMP implementation at a subwatershed scale. Le Sueur County provided lake catchments including 50 catchments that were draining to Lake Volney. At the scale of each lake catchment, RUSLE2 stormwater modeling was completed using the "Chisago SWCD protocol (Rural Subwatershed Analysis Protocol Part 1 – Targeting)" methodology. Once priority lake catchments were established, BMPs could be implemented through desktop analysis, GIS tools, and aerial imagery. The Chisago SWCD "Rural Subwatershed Analysis Protocol Part 2 – Prioritizing" was referenced to assist BMP site selection and modeling.

BMPs sited throughout this process were then analyzed at a BMP catchment scale. BMP catchments draining from a single, or multiple, delineated lake catchments could be analyzed further to estimate Total Phosphorous (TP) and Total Suspended Solids (TSS) loading rates at a BMP catchment scale. The purpose of analyzing the subwatershed at the BMP catchment scale provide a local, much more zoomed in, load that captured site specific details corresponding to what each BMP is draining. Finally, cost estimates were developed for each BMP project. Cost estimates included factors such as approximate practice life span, operation and maintenance costs, and base implementation costs. Having both TP and TSS load reductions for each specific BMP, along with cost estimates, allowed ISG to calculate cost-effectiveness for both TP and TSS. Priority rankings were then applied to BMPs. The methodology described does not compare rural agricultural BMPs to residential shoreline BMPs as site conditions between both land uses are variable.

A variety of stormwater BMPs were identified for both rural agricultural lands (RA) and residential shorelines (RS). They included:

- Grassed Waterways (RA)
- Water and Sediment Control Basins (WASCOBs) or Control Structures (RA)
- Contour Buffer Strips (RA)
- Wetland Restorations (RA)
- Storage Pond (RA)
- Lakeshore Restorations (Soil Lifts, Toe Wood, Native Vegetation) (RS)

If stakeholder engagement is completed and a project is selected, site specific engineering design and engineered plan sets must be developed. This would follow an informative process to all partnerships, landowners involved, or external entities demonstrating interest. Maps of Lake Volney that are referenced herein are provided in Appendix A below.

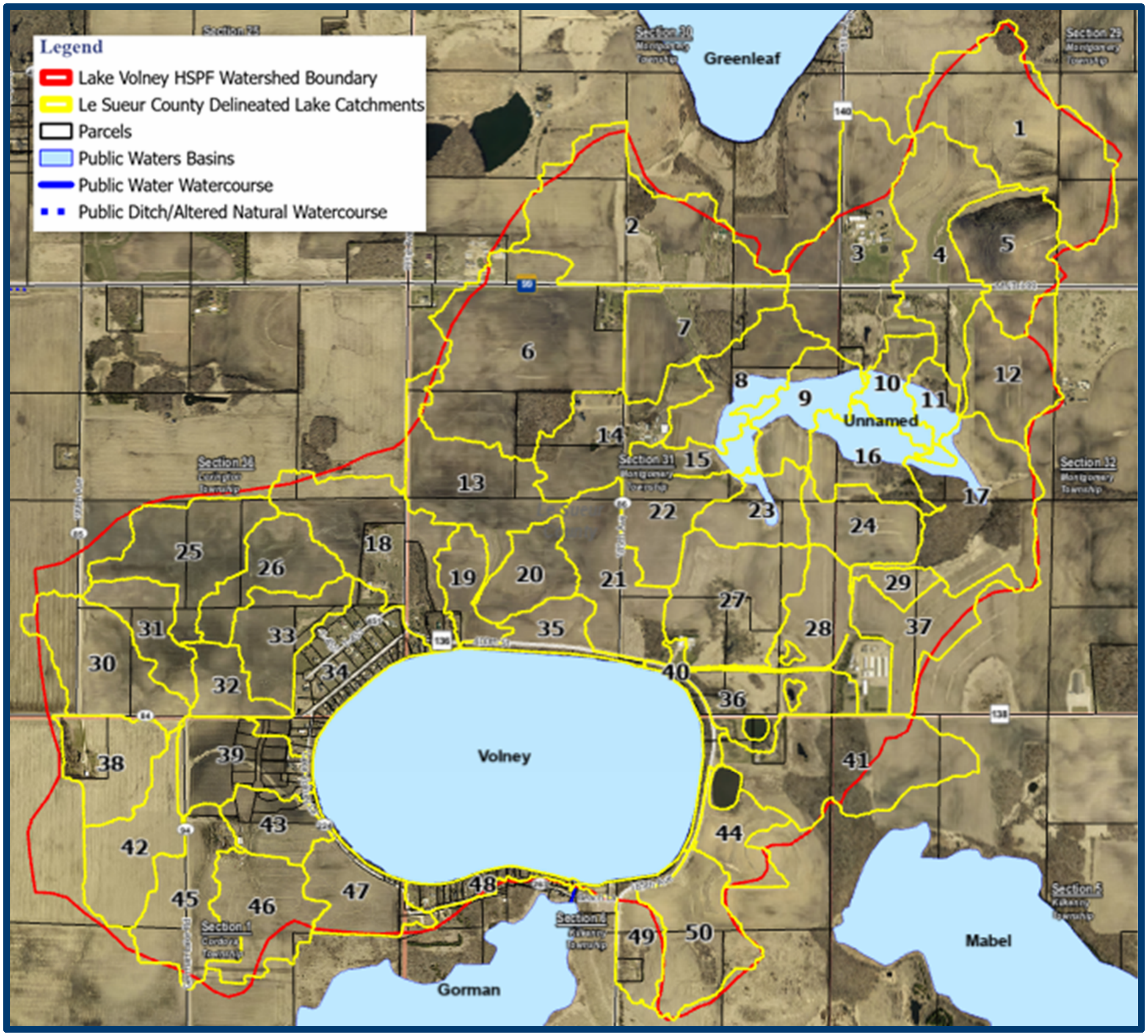

FIGURE 1 LAKE VOLNEY SUBWATERSHED OVERVIEW

Project Ranking

Appendix B contains tables that summarize potential BMPs that could be implemented throughout the Lake Volney subwatershed. BMPs depicted below highlight the top practices sited within the rural landscape and developed residential shoreline landscape. The tables rank BMPs by priority rank. Additional information includes the cost per pound of total phosphorous removed and cost per ton of total suspended solids removed, per BMP project lifespan.

Project installation is up to the discretion of all interested parties. Factors including project location, construction timing, total cost, and landowner willingness may impact project implementation. Rural BMPs were only ranked against other rural BMPs, and residential shoreline restoration projects were only ranked against other residential shoreline restoration projects.

ABOUT THIS DOCUMENT

The Lake Volney subwatershed analysis is a watershed management and planning tool which includes BMP reduction modeling and cost estimates. This tool helps to prioritize BMP and provide performance information such as cost-effectiveness to maximize pollutant reduction per dollar spent.

The analysis was broken down into residential shoreline catchments and rural catchments based on the topography of the Lake Volney subwatershed.

This document presents the findings of Lake Volney's subwatershed analysis.

Residential Shoreline Catchments

This report covers subwatersheds adjacent to or draining directly into Lake Volney that are developed residential shoreline areas. A desktop "Score Your Shore" shoreline assessment was completed by ISG and was used to identify priority areas to implement shoreline restoration project opportunities. Properties scoring "low" were prioritized for BMP siting, reduction calculations, and cost estimation.

Rural Catchments

This report covers the subwatersheds adjacent to or draining directly into Lake Volney. The Chisago SWCD protocol "Rural Subwatershed Analysis Protocol Part 1 – Targeting" methodology was utilized as guidance to help to visualize higher contributing TP and TSS areas to Lake Volney and to determine pollutant loading from each catchment, but all rural catchments were analyzed during this process. This process was completed by ISG.

DOCUMENT ORGANIZATION

This document is organized into two major sections plus references. Each section is briefly described below.

Methods

The methods section outlines the methodology used when analyzing the Lake Volney subwatershed. It provides an overview of the subwatershed loading determinations, BMP siting, pollutant reduction calculations, cost/treatment analysis, and BMP prioritization.

Project Ranking

The BMP rankings throughout the entire subwatershed are ranked and compiled in tables in Appendix B. The list is organized by BMP priority ranking and provides cost per pound of total phosphorous removed for each BMP. Additional information is included which is based on the cost per ton of total suspended solids removed by each BMP. The preliminary implementation costs, BMP life spans, and operation and maintenance costs are included in the cost-effectiveness calculations.

There are various potential ways to prioritize BMPs. The referenced tables in Appendix B are a starting point, but do not include external considerations. Other considerations for BMP prioritization could include:

- Landowner Willingness
- Non-Targeted Pollutant Reductions
- Project Construction Timeline
- Access to Funding
- Contingency Costs
- Changes within the Subwatershed Landscape

References

This section references resources utilized in conjunction with the methodology described throughout this analysis.

Appendices

This section provides supplemental information and the findings of the Lake Volney subwatershed assessment.

BACKGROUND

Project Background

The purpose of this study is to develop recommendations for implementing Best Management Practices (BMPs) that enhance water quality discharging from the surrounding rural and residential areas located within the Lake Volney subwatershed. Lake Volney has been designated as impaired for aquatic recreation for excess nutrients causing eutrophication (i.e. excess phosphorus). The Minnesota Pollution Control Agency (MPCA) has set eutrophication water quality standards for deep lakes in the Northern Central Hardwoods Ecoregion at ≤ 40 ug/L. Monitoring data collected from Lake Volney from 2022-2024 resulted in a growing season average of 69 ug/L. for lake surface samples which classified its impairment status. Lake Volney is approximately 269 acres, has a maximum depth of approximately 60 feet, and has 2.49 miles of shoreline. Furthermore, the study area encompasses 2,019 acres which includes 50 minor subwatershed boundaries that drain to Lake Volney.

Lake Volney has mixed land uses that mostly consist of residential and agriculture but also includes smaller tracts of forested and wetland areas. It is considered a popular recreational lake that has a public water access and County Park located on the south side of the lake. There is also an Aquatic Management Area (AMA) located on the west side of the lake. Furthermore, Lake Volney is connected to Lake Gorman through its outlet into a Wildlife Management Area (WMA) located south of Lake Volney. Lastly, Lake Volney has an active lake association that promotes lake stewardship through participation of volunteer lake monitoring, aquatic species management, and partnering with local and state agencies to implement BMPs.

A subwatershed assessment of Lake Volney was initiated by Le Sueur County in June of 2025 to identify, prioritize, and target watershed management solutions for the lake and its subwatershed that focus on improving water quality. There have been a number of studies, assessments, plans, clean water grants, and water quality monitoring efforts developed and completed for Lake Volney. This subwatershed assessment is building on existing conservation efforts and is the first major effort focused on targeting and prioritizing the highest pollutant loading subwatershed drainage areas to Lake Volney. The identified elements of the subwatershed assessment include:

- Identifying water quality data gaps and potential pollutant loading;
- Examining existing internal and external pollutant loading for each minor subwatershed utilizing relevant modeling and methodologies;
- Identifying BMPs to achieve recommended pollutant load and volume reductions to improve water quality;
- Evaluating feasibility, efficiency, approximate life span, implementation costs, operation and maintenance, and cost benefit of BMPs.

METHODS

Selection of Subwatershed

The Cannon River Comprehensive Watershed Management Plan was developed as part of the One Watershed, One Plan (1W1P) program. The goal of this plan is to support partnerships and local governments in an effort to implement plans to manage and improve water quality for priority watercourses. Within the Cannon River Comprehensive Watershed Management Plan, Lake Volney is located in a Tier 3 Surface Water Priority Area, a Tier 1 Wetland Restoration Priority Area, and a Tier 1 Groundwater Priority Area. Lake Volney is highlighted as a local priority resource for Le Sueur County and the Le Sueur County Soil and Water Conservation District (SWCD). Goals listed in this documentation are the implementation of BMPs on agricultural lands (e.g., wetland enhancements/restorations, and sediment control basins), in an effort to improve Lake Volney's water quality. Quantitative goals for Lake Volney include 62.3% or 1,063 lbs./year of TP reduction. The Plan supports partnerships and local governments to target, prioritize, and implement a plan to manage and improve water quality at a subwatershed scale. The focus of this subwatershed analysis is Lake Volney and contributing lands within the subwatershed. For this study, the Lake Volney subwatershed areas were broken up into two categories, residential (e.g. shoreline properties) and rural (e.g. agricultural lands).

Residential Catchment Selection

This assessment includes areas of land draining directly into Lake Volney. These areas are developed residential shoreline properties that were selected based on a "Score Your Shore" score. Properties receiving a "low" score were selected, because they likely will have the highest impact on water quality. These areas were analyzed due to their proximity to Lake Volney, which translates into direct water quality impacts. These residential shoreline areas contain the densest development in comparison to the rest of the subwatershed and likely have little to no existing stormwater treatment.

Rural Lake Catchment Selection

This assessment includes the entire Lake Volney subwatershed. Lake catchments draining directly to or draining to an adjacent lake catchment were chosen for study. Lake Volney is a major recreational lake that is impaired for aquatic recreation for excess nutrients causing eutrophication (i.e.. excess phosphorous). The lake's watershed is approximately 2,019-acres, which is characterized by mostly agricultural lands. Focus areas included draining agricultural lands because of the proximity to the lake which translates to direct water quality impacts.

Targeted pollutants for this analysis were total phosphorous (TP) and total suspended solids (TSS). Total phosphorous is a nutrient commonly associated with stormwater and agricultural runoff, which may cause excess algae production and in turn, low oxygen levels in waterbodies, which can be harmful to aquatic life. Total suspended solids were selected as an additional target pollutant due to its associated with stormwater runoff which causes turbidity in waterbodies. Total suspended solids are important as they carry other pollutants such as phosphorous and heavy metals, which attach to sediment particles.

Subwatershed Assessment Methods

The process used for this assessment is outlined below and was modified from the Rural Subwatershed Analysis Protocol developed by the Chisago Soil and Water Conservation District (Chisago SWCD). Part 1 “Targeting” and Part 2, “Prioritizing”.

Step 1 Subwatershed Assessment

The subwatershed assessment included determining the objectives or target locations for targeted pollutants within the Lake Volney subwatershed. This process involved meeting with local stakeholders such as Le Sueur County and Le Sueur County SWCD, to determine the priority issues within the Lake Volney subwatershed. This step was used to define preferred BMP treatment options and performance criteria. The scale of analysis was reduced throughout this process, meaning that TP and TSS loading rates were broken down at scale. The analysis began at Lake Volney at its subwatershed scale, before being broken down into 50 “lake catchments” within the Lake Volney subwatershed. Within these “lake catchments”, analysis was reduced to a scale of 143 BMP catchments, which drained from a singular or multiple “lake catchments”. This provided a local site-based approach that captured more detail relating to the conditions of the landscape when determining BMP loading.

Step 2 Desktop Analysis

A desktop analysis involved a GIS-based assessment of Lake Volney and it’s subwatershed to determine high priority or problematic areas. This step helped to identify areas of lower priority, meaning they are contributing lower amounts of TP and TSS. Accurate GIS data was imperative in conducting this analysis. GIS layers and other data were provided by Le Sueur County.

Le Sueur County provided ISG with a 1-foot by 1-foot digital elevation model (DEM), along with a hydro-conditioned 1-foot by 1-foot DEM. This hydro-conditioned DEM provided ISG with information relating to where stormwater conveyances exist and information relating to how water flows through the watershed. Because this was developed by Le Sueur County, flowlines and lake catchments were already delineated and were calibrated to provide consistency throughout the desktop analysis. In addition to the elevation data, Le Sueur County provided ISG with soil data, parcel data, and high-resolution imagery. Land cover data was made available from the State of Minnesota.

The Chisago Soil and Water Conservation Service Rural Targeting Protocol was utilized to determine high priority locations within the Lake Volney subwatershed (Chisago SWCD – Rural Subwatershed Analysis Protocol Part 1 – Targeting). This process illustrates the development of numerous factors required for the Revised Universal Soil Loss Equation (RUSLE2), which is used to determine which areas are more susceptible to soil loss. Potential soil loss could be calculated for each lake catchment within the Lake Volney subwatershed to assist in determining priority areas. The lake catchments utilized throughout this process were delineated by Le Sueur County and utilized throughout this entire analysis. Utilizing calibrated GIS data developed by ISG, statewide data, ESRI’s ArcGIS tool package, and the Targeting protocol as guidance, ISG developed Revised Universal Soil Loss Equation (RUSLE2) factors to utilize in calculations.

Revised Universal Soil Loss Equation (RUSLE2)

The Revised Universal Soil Loss Equation (RUSLE2) is an empirical model used to predict soil movement within a field and can be used to estimate erosion potential. RUSLE2 factors included a rainfall-runoff erosivity factor (R), soil erodibility factor (K), slope length and slope steepness factor (LS), cover management factor (C), and conservation practice factor (P). Each of these factors was developed using the previously discussed data, tools, and methodology or combination of and could be used in calculation to determine the average annual soil loss potential (tons/acre/year) for each catchment. Additional information regarding the development of each factor is described below.

- Rainfall-Runoff Erosivity Factor (R) – US EPA Pollutant Load Estimation Tool was utilized.
- Soil Erodibility Factor (K) – Le Sueur County provided information and ISG calibrated the data along side Web Soil Survey.
- Steepness Factor (LS) – Utilizing the provided DEMs from Le Sueur County, ISG could develop flow direction, flow accumulation, and slope raster’s to calculate this factor.
- Cover Management Factor (C) – ISG utilized NLCD Land Cover information and assigned values to each land cover type which was provided in the “Targeting” methodology.
- Conservation Practice Factor (P) – ISG assumed no conservation through this process.

Due to the relationship between TSS and TP loading, TP loading could be determined. The process determining final TP load is described in “Step 4. Treatment Analysis/Cost Estimates” below. This process utilized RUSLE2 TSS loading and calibrated HSPF loading.

Prioritization

After lake catchments containing the highest potential phosphorous loading and total suspended solids loading were identified, prioritization took place. Prioritization was completed on a smaller scale within the lake catchments. The goal of prioritization was to locate potential priority

or other resource concern areas at a field scale. Prioritization involved siting suggested BMPs that could be implemented. The Chisago Soil and Water Conservation Service Rural Targeting Protocol (Chisago SWCD – Rural Subwatershed Analysis Protocol Part 2 – Prioritization) was utilized to help determine BMP implementation locations. Additionally, the U.S. Department of Agriculture's Agriculture Conservation and Planning Framework (ACPF) toolbox and database was utilized for BMP siting. Following these processes, and in addition to high-resolution imagery-based siting, ISG was able to suggest options for BMP implementation that could improve water quality throughout the Lake Volney subwatershed. Cost-effectiveness calculations were performed, and a cost-effectiveness value was assigned to sited BMPs. Priority BMPs were then determined based on the methodology in the "Retrofit Ranking" section below.

Score Your Shore

Score Your Shore served as an assessment tool for evaluating habitat conditions on developed lakefront properties. The Score Your Shore protocol evaluated terrestrial and adjacent aquatic habitats within the upland zone, shoreland zone, and aquatic zones. The score focused greatly on vegetation quality and density as restorations or maintenance is dependent on the quality and structural diversity of natural shoreline vegetation.

The score your shore assessment was completed via desktop review utilizing high resolution aerial imagery. With the limitations of desktop review, scores for categories for aquatic submerged plant and aquatic openings in plant beds were not included in the analysis. This resulted in a maximum score of 60.

ISG categorized the shoreland properties based on the Score Your Shore Rankings. ISG categorized candidate lakeshore restoration sites as either "low priority", "medium priority", or "high priority." Medium priority candidates were sited that lacked a vegetated buffer at least 5-feet deep from the lakeshore and had active instability/erosion. High priority sites additionally had overland flow concentrations converging at the site and would be especially well suited to a vegetated buffer to filter that water. Low priority sites consisted of an existing buffer of non-native plants and potential for shoreline erosion based on surrounding landscape. Paths of concentrated flow were determined using ISG's Subcatchment Tools, with LiDAR data. Areas where shoreland improvements were recommended are included in a map in Appendix A.

Step 3 Retrofit Reconnaissance Field Investigation

Le Sueur SWCD and Le Sueur County have had previous working history with lakeshore owners and agricultural producers within the watershed to address a variety of resources concerns as well as implement conservation practices through various grant funding opportunities. As a result, local agency staff have extensive knowledge of existing property conditions and landowners' concerns within the watershed. The field investigation component for Lake Volney and its subwatershed was minimal for this subwatershed assessment as this step was already thoroughly completed through previous work by local agency staff and through identification of known water quality issues by landowners.

Existing conservation practices that have already been implemented and existing site conditions were taken into consideration to evaluate the feasibility of project installation options. Based off of these factors, retrofit options listed below in Table 1 were identified within the subwatershed.

TABLE 1. STORMWATER BMP TREATMENT OPTIONS

Best Management Practices	Definition
Contour Buffer Strip	A strip of perennial vegetation planted downslope of existing cropland. The width of the buffer strip must be equal to or greater in size than the adjoining crop strips. Reduces agricultural erosion and runoff, infiltrates pollutants, and improves water infiltration and saturation.
Grassed Waterway	A grass channel in an agricultural field, planted to reduce erosion where there is concentrated flow.
Water & Sediment Control Basin (WASCOB)	An earthen embankment that is constructed perpendicular to an area with concentrated flow. Water and sediment from agricultural runoff are trapped which reduces gully erosion by controlling flow within the drainage area. The basin releases water slowly, usually through infiltration or a pipe outlet and tile line.
Grade Stabilization	A structure used to control the grade in channels; both natural and constructed. Reduces gully erosion, stabilizes the channel, and prevents head cutting where there is concentrated flow.
Wetland Restoration	Restoring disturbed areas in which hydrological characteristics (soil, water, and vegetation) have been significantly altered and have lost its ecological function. Planting native wetland and upland species to provide wildlife habitat. Water is held within the wetland for a period of time to allow nutrients to settle and to reduce peak flows and volumes.
Storage Pond	A constructed pond designed to collect stormwater runoff and store water and pollutants. Water is held within the pond for a period of time to allow nutrients to settle and to reduce peak flows and volumes.
Native Vegetation (Critical Area Planting)	Planting native deep-rooted vegetation such as trees, shrubs, vines, grasses, or legumes on highly erodible or critically eroding areas. Protects soil from erosion and reduces runoff and creates habitat.
Soil Lifts	Made with soil layers wrapped in biodegradable fabric. The wrapping makes the layers stackable, so that soil sections may be placed on top of others and creates a shelf. Seeding and plantings of native vegetation are applied, and the lift is left to settle. Stabilizes and protects the shoreline from erosion and runoff.
Toe Wood	A bench along the shoreline is created and filled with wood debris and soil. The fill is covered with live cuttings that develop deep root systems. Stabilizes and protects the shoreline from erosion and runoff.

Step 4 Treatment Analysis/Cost Estimates

BMPs were preliminarily sited and presented for review to Le Sueur County. Following the siting revisions, BMPs most likely to address the pollutant reduction goals, that appear to have feasible design and desirable costs, were chosen for the cost-effectiveness analysis. Estimated costs included design, base implementation costs, and operation and maintenance costs, annualized across an estimated BMP lifespan (10-30 years). Estimated benefits included pounds of phosphorus and tons of total suspended solids removed. BMPs were then assigned a priority ranking. Additional information was provided such as cost-effectiveness described as cost per pound of total phosphorus removed annually and cost per ton of total suspended solids removed annually. This process was followed for both residential shoreline catchments and rural agricultural catchments.

Rural Catchments

This process used numerous factors included in the Revised Universal Soil Loss Equation (rainfall erosivity, soil types, land use, topography) to determine which areas are more susceptible to soil loss. Spatial information was examined through ESRI's ArcGIS package, using the Targeting protocol as guidance. The 50 lake catchments provided through this process were assigned a soil loss potential value based on the Revised Universal Soil Loss Equation calculations described above. Lake catchments with the highest soil loss potential became priority areas for siting best management practices.

Additional information such as average slopes and concentrated flow paths was determined through the GIS tools as well. The Chisago SWCD's Rural Priority Protocol (Part 2 – Prioritizing) was used as guidance to determine potential rural BMP project locations. These projects would be located within the 50 lake catchments determined through the Targeting exercise as these areas hold the greatest potential for soil and nutrient export. A desktop analysis was completed using a variety of tools including aerial photography, topography, soils, and the Agricultural Conservation and Planning Framework ArcGIS tools (ACPF), to determine potential BMP or management practice options within the priority zones. These potential BMPs were spatially located on maps and field verified where possible within the Lake Volney subwatershed. Maps of BMP siting are located within Appendix A.

Once BMPs were sited throughout the priority Lake Volney catchments, TP and TSS loading rates were determined. Using HSPF-SAM TP and TSS loading rates and RUSLE2 loading rates, ISG developed a final loading determination corresponding to each individual BMP. It is important to note that this process was followed as HSPF-SAM contains calibrated nutrient loading data for the Cannon River Watershed but is at a minor watershed scale. Additionally, RUSLE2 loading is heavily dependent on land use type which produces exceptionally large TSS loading values. ISG utilized both of these methods to create a "HSPF-RUSLE2 Local Cropland Weighted Load" for both TP and TSS. To do this, ISG utilized HSPF-SAM Basin Source Loads corresponding to each land use type and calculated a "HSPF Local Basin Load" for both TP and TSS. Next, a "HSPF Local Cropland Basin Load" was determined using HSPF-SAM Basin Source Loads for only cropland. Using both these HSPF loads, ISG calculated a "HSPF-RUSLE2 Local Cropland Weighted Load" by determining the fraction of the RUSLE2 TSS load in each of the 50 lake catchments and applying said fraction to the HSPF-SAM Basin Source Loads corresponding to cropland only. Once the "HSPF-RUSLE2 Local Cropland Weighted Load" was determined for both TP and TSS, the "HSPF-RUSLE2 Local Cropland Weighted Load Rate" could be determined for each of the 50 lake catchments within the Lake Volney subwatershed. This process provided ISG with individual loading rates for each lake catchment at a more detailed scale than a minor watershed level to allow for more detailed targeting.

The next part of this process was to utilize the "HSPF-RUSLE2 Local Cropland Weighted Load Rate," individualized for each lake catchment, and apply it to the BMP drainage area corresponding to where the BMP drainage area is spatially located within each lake catchment. It is important to note that some BMPs have drainage areas draining from multiple lake catchments. For example, a contour buffer strip or wetland could treat water draining from two or three different lake catchments. Because each lake catchment had different TP and TSS loading rates, ISG calculated a weighted average TP and TSS loading rate, corresponding to the portion each BMP catchment that resides in a portion of each lake catchment. This allowed for a more nuanced field scale loading determination, capturing the detail of the landscape draining to each individual BMP.

Lakeshore Erosion and Residential Runoff Pollutant Estimation

Based on the "Score Your Shore" analysis described above, properties receiving a "low" score were prioritized for shoreland restoration implementation. These properties were broken up into two separate treatment methods, overland flow treatment and shoreline restoration.

1. <u>Overland Flow – </u>For each priority property, TP and TSS loading estimates were calculated based upon an assumed average lakeshore parcel. This approach was used based upon a WinSLAMM analysis to evaluate the variability of TP and TSS loading from various lakeshore parcels. Results from this analysis showed minimal variability in loading due to the small footprint of each lakeshore parcel. Therefore, a standard TSS and TP load was assigned to each individual parcel. BMPs implemented for overland flow treatment included native vegetation. This practice provided an assumed 65% TP and TSS reduction.

2. <u>Eroding Lakeshore Face – </u>For each priority property, TP and TSS loading estimates were calculated using the NRCS Streambank Erosion Calculation Formula for the shoreline restoration portion of this analysis. This formula uses a variety of factors such as eroding bank length, eroding bank height, soil weight, and lateral recession rate, which is based on soil classification. After calculating TSS loading, a relationship of 1,481 pounds of TSS per 1 pound of TP was applied to determine TP loading. This provided ISG with a total TP and TSS load for each individual priority lake shore property. BMPs implemented for shoreline restoration included soil lifts. This practice provided an assumed 100% TP and TSS reduction. If soil lifts are deemed to be inadequate for shoreline restoration, toe wood could be an alternative practice at a higher expense.

It is worth noting that each practice was modeled individually, therefore the benefits of projects may not be additive when serving the same treatment area. Reported treatment levels are dependent upon optimal site selection, condition, and sizing.

Cost Estimates

Residential Catchments

The calculated cost estimates were determined for shoreline restoration and overland flow treatment for residential catchments. BMPs for shoreline restoration included native vegetation to treat overland flow and soil lifts for shoreline restoration. Unit costs for each were determined from previous ISG projects. The calculated cost estimates were determined based on design costs, implementation costs, operation and maintenance costs, and BMP life span. Total costs were determined on an annualized basis. The high-level costs referenced herein provide an estimate of BMP total costs, but unknown, site-specific parameters may change design aspects, which will impact costs and reduction levels. An alternative BMP could be included if soil lifts are deemed to be inadequate for shoreline restoration. Toe wood is the alternative practice but is expected to be approximately 430% more expensive per linear foot of shoreline than soil lifts. It is important to note that no site-specific construction investigation was included in this analysis, therefore cost-estimates only account for general site considerations. As previously noted, engineering design assistance, plan development, and site investigation, should be completed to account for existing stormwater systems or other stormwater treatment interactions to avoid upstream flooding implications.

Rural Catchments

The calculated cost estimates were determined for the rural landscape. BMPs for the rural landscape included grassed waterways, water and sediment control basins (WASCOBs) or other control structures, wetland restorations, and contour buffer strips. Unit costs for each were determined from previous ISG projects and/or the Chisago Soil and Water Conservation Service Rural Targeting Protocol (Chisago SWCD – Rural Subwatershed Analysis Protocol Part 2 – Prioritization). The protocol was utilized for determining project life span and operation and maintenance cost estimates. The calculated cost estimates were determined based on design costs, implementation costs, operation and maintenance costs, and BMP life span. Total costs were determined on an annualized basis. The high-level costs referenced herein provide an estimate of BMP total costs, but unknown site-specific parameters may change design aspects, which will impact costs and reduction levels. It is important to note that no site-specific construction investigation was included in this analysis, therefore cost-estimates only account for general site considerations. As previously noted, engineering design assistance, plan development, and site investigation, should be completed to account for existing stormwater systems or other stormwater treatment interactions to avoid upstream flooding implications.

RETROFIT RANKING

Rural BMP Ranking

A prioritization methodology was developed and applied to the full list of potential BMPs to identify the BMPs which implementation efforts should be focused on. Cost-effectiveness is a valuable metric to direct implementation funds towards projects that result in the greatest pollutant reduction per dollar spent, but it is not a comprehensive evaluation of key variables that influence effective implementation and measurable progress towards Lake Volney water quality goals. These variables are total TP load reduction, cost of BMP implementation, and number of BMPs implemented necessary to accomplish reduction goals. While cost-effectiveness is the relationship between the first two variables, it does not consider the cumulative TP load reduction necessary to accomplish Lake Volney water quality goals. Therefore, only focusing on cost-effectiveness can result in BMPs that provide significantly greater TP load reduction to not be considered. This can be an issue when there are significant TP load reduction targets, which is the case for Lake Volney. Therefore, if only cost-effectiveness is used to direct implementation efforts, it will result in more BMPs needing to be implemented to accomplish similar TP load reductions which can be less efficient and challenging when relying on voluntary adoption.

To evaluate this approach, scenarios comparing implementation approaches focused only on cost-effectiveness to a combination of cost-effectiveness and total TP load reduction was conducted. Results from this analysis showed that by selecting the top 25% of BMPs based on cost-effectiveness, and top 25% of BMPs based on TP load reductions, it would result in the most impactful implementation approach and represent priority BMPs. A brief summary comparing the outcomes of this analysis for a few scenarios follows.

Focusing only on cost-effectiveness ranking, implementation of the top 25% of BMPs based on cost-effectiveness would result in the implementation of 21 BMPs costing approximately $226,000 resulting in an estimated cumulative TP load reduction of 235 lbs./year. Compare this to the prioritization approach of combining cost-effectiveness with total TP load reductions to balance selecting the most cost-effective and impactful, in terms of TP load reduction, BMPs. Implementing BMPs that fall within the top 25% of cost-effectiveness and top 25% of TP load reduction would result in the implementation of 21 BMPs costing approximately $952,000 resulting in an estimated cumulative TP load reduction of 508 lbs./year. While this costs significantly more to implement, it also results in much greater TP reductions, making greater progress towards the desired outcomes for Lake Volney. To accomplish a TP load reduction of 500 lbs./year or greater based only on cost effectiveness, 35 BMPs would need to be implemented costing approximately $982,000 resulting in an estimate cumulative TP load reduction of 535 lbs./year. Table 2 and Figure 2 below depict the 21-priority ranked BMPs. A comprehensive table containing all sited and analyzed BMPs is compiled within Appendix B. Treatment levels depicted below are dependent on optimal siting and sizing, or any other site constraints. These rankings present BMPs individually and do not represent treatment train effects. In some instances, BMPs are sited in series, but reduction calculations and cost-effectiveness are not additive and do not represent achievable benefits.

TABLE 2. PRIORITY RURAL BMP RAKINGS TABLE

BMP Number	BMP Type	Main Lake Catchment ID	Total BMP Drainage Area (ac)	HSPF/TSA Weighted Local BMP TSS Load (t/yr)	HSPF/TSA Weighted Local BMP TP Load (lb/yr)	TSS Reduced (t/yr)	TP Reduced (lb/yr)	Total Project Cost ($)	Annual Total Project Cost ($/Year)	TSS Cost Effectiveness ($/Ton Reduced/Year)	TP Cost Effectiveness ($/lb. Reduced/Year)	Rank TSS Cost Effectiveness	Rank TP Cost Effectiveness	Priority BMP (Yes/No)
2	Grassed Waterway	1	38.01	4.33	20.07	2.69	9.03	$ 1,203	$ 120	$ 45	$ 13	1	1	Yes
142	Wetland Restoration	30	117.29	9.50	44.02	7.13	18.93	$ 6,928	$ 462	$ 65	$ 24	2	2	Yes
18	Grassed Waterway	13	43.38	2.47	11.44	1.53	5.15	$ 1,567	$ 157	$ 102	$ 30	3	3	Yes
26	Grassed Waterway	45	31.45	2.86	13.26	1.77	5.97	$ 2,266	$ 227	$ 128	$ 38	4	4	Yes
24	Grassed Waterway	30	23.80	2.15	9.97	1.33	4.49	$ 2,399	$ 240	$ 180	$ 53	7	6	Yes
141	Wetland Restoration	30	109.76	8.91	41.28	6.68	17.75	$ 15,688	$ 1,046	$ 157	$ 59	6	9	Yes
75	WASCOB	50	38.33	7.42	34.35	6.67	29.20	$ 18,823	$ 1,882	$ 282	$ 64	13	11	Yes
36	Grassed Waterway	41	15.01	2.68	12.40	1.66	5.58	$ 3,841	$ 384	$ 231	$ 69	11	12	Yes
67	WASCOB	30	72.75	6.34	29.37	5.71	24.96	$ 18,823	$ 1,882	$ 330	$ 75	15	13	Yes
53	Grassed Waterway	44	7.38	2.16	10.01	1.34	4.50	$ 3,490	$ 349	$ 260	$ 77	12	14	Yes
66	WASCOB	13	81.53	5.86	27.16	5.28	23.08	$ 18,823	$ 1,882	$ 357	$ 82	18	15	Yes
9	Grassed Waterway	21	19.84	2.08	9.66	1.29	4.35	$ 3,667	$ 367	$ 284	$ 84	14	16	Yes
74	WASCOB	21	40.37	4.24	19.65	3.82	16.70	$ 18,823	$ 1,882	$ 493	$ 113	22	17	Yes
140	Wetland Enhancement	3	64.40	5.91	27.38	4.43	11.78	$ 22,670	$ 1,511	$ 341	$ 128	16	19	Yes
137	Wetland Enhancement	41	90.26	18.31	84.82	13.73	36.47	$ 73,217	$ 4,881	$ 355	$ 134	17	21	Yes
68	WASCOB	50	17.98	3.48	16.11	3.13	13.70	$ 18,823	$ 1,882	$ 601	$ 137	32	22	Yes
78	WASCOB	18	56.14	3.47	16.08	3.12	13.67	$ 18,823	$ 1,882	$ 602	$ 138	33	23	Yes
135	Wetland Enhancement	6	372.54	38.57	178.67	28.93	76.83	$ 172,945	$ 11,530	$ 399	$ 150	19	24	Yes
70	WASCOB	45	29.81	2.71	12.57	2.44	10.68	$ 18,823	$ 1,882	$ 771	$ 176	40	31	Yes
61	WASCOB	46	33.54	2.46	11.40	2.21	9.69	$ 18,823	$ 1,882	$ 850	$ 194	42	34	Yes
134	Wetland Enhancement	6	743.19	83.07	384.83	62.30	165.48	$ 491,968	$ 32,798	$ 526	$ 198	26	35	Yes

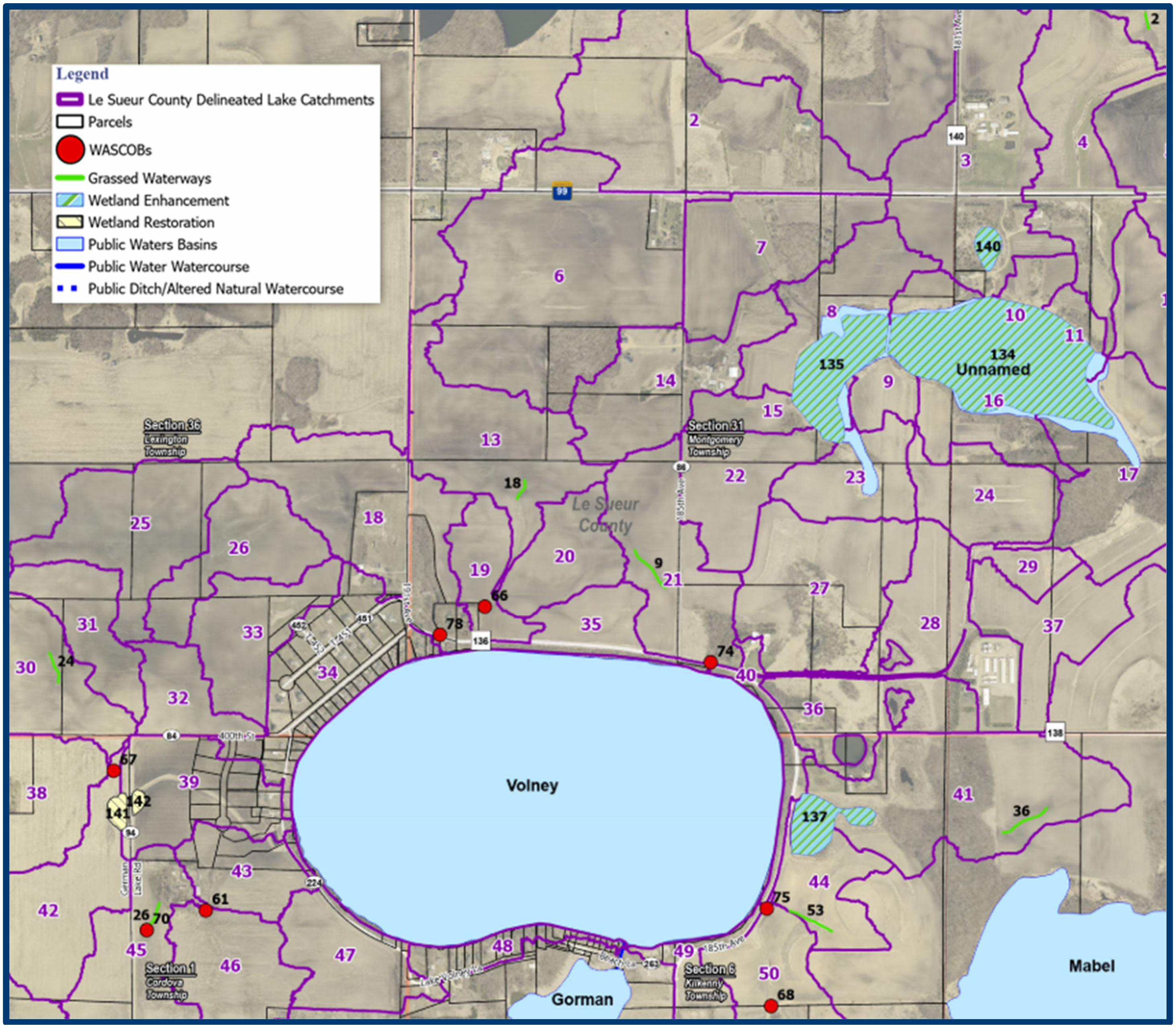

FIGURE 2. PRIORITY RURAL BMP RAKINGS MAP

Residential BMP Ranking

BMPs sited and ranked for rural areas were presented separately from residential shoreline areas. Potential shoreline BMPs are organized by priority and cost-effectiveness based on cost per pound of total phosphorous removed per year. Lakeshore restorations and overland flow treatment were ranked on a property-by-property scale. For shoreline BMPs, the selection of parcels that scored poorly on the Score Your Shore analysis was used to prioritize efforts. As a result, all identified shoreline BMPs are considered priorities to implement. Table 3, along with the tables in Appendix B, depict the BMP prioritization of residential shoreline areas. Total cost per ton of total suspended solids removed per year is also included within this table. Benefits relating to nutrient reductions were determined by ISG through numerical analysis. Additional BMPs not included in numerical analysis, but provide indirect benefit and value, are listed below.

TABLE 3. PRIORITY RESIDENTIAL BMP RAKINGS TABLE

BMP Number	BMP	PIN	Owner	Score Your Shore Score (%)	Shoreline Length (ft)	Total Shoreline TSS Loss (ton/yr)	Total Shoreline TP Loss (lb/yr)	TSS Shoreline Reduction (ton/yr)	TP Shoreline Reduction (lb/yr)	Overland TSS Load (ton/yr)	Overland TP Load (lb/yr)	TSS Overland Reduction (ton/yr)	TP Overland Reduction (lb/yr)	Implementation Cost ($)	Total Annual Cost ($/yr)	TSS Cost Effectiveness ($/ton reduced/yr)	TP Cost Effectiveness ($/ton reduced/yr)	TSS Rank	TP Rank
18	Soil Lift	06.450.0070	SETH T STIER &	19.31%	121	0.60	0.81	0.60	0.81					$ 42,219	$ 4,222	$ 7,000	$ 5,184	1	1
7	Soil Lift	08.450.0080	ROBYN J MONROE	6.21%	90	0.45	0.61	0.45	0.61					$ 31,487	$ 3,149	$ 7,000	$ 5,184	4	2
8	Soil Lift	06.450.0080	KEVIN D & ELIZABETH A SKELLY	13.10%	64	0.32	0.43	0.32	0.43					$ 22,443	$ 2,244	$ 7,000	$ 5,184	5	3
5	Soil Lift	08.450.0050	PAUL & MARY JOHNSON	6.21%	91	0.45	0.61	0.45	0.61					$ 31,743	$ 3,174	$ 7,000	$ 5,184	8	4
17	Soil Lift	08.450.0140	TIMOTHY G & RENAE J SUNDBERG	16.55%	120	0.60	0.81	0.60	0.81					$ 41,983	$ 4,198	$ 7,000	$ 5,184	12	5
2	Soil Lift	08.450.0030	DALE M & JAYNE M HIRDLER	0.00%	23	0.11	0.15	0.11	0.15					$ 7,889	$ 789	$ 7,000	$ 5,184	2	6
4	Soil Lift	09.750.0030	BERNARD T & SANDRA L WEBER	3.45%	87	0.43	0.58	0.43	0.58					$ 30,318	$ 3,032	$ 7,000	$ 5,184	3	7
9	Soil Lift	08.450.0160	KIMBERLY REAK &	13.10%	45	0.23	0.31	0.23	0.31					$ 15,870	$ 1,587	$ 7,000	$ 5,184	6	8
20	Soil Lift	08.450.0010	KENNETH J & DOLORES A KALINA	19.31%	9	0.04	0.06	0.04	0.06					$ 3,135	$ 314	$ 7,000	$ 5,184	7	9
10	Soil Lift	02.570.0140	DOUGLAS R PINT	14.48%	164	0.82	1.11	0.82	1.11					$ 57,519	$ 5,752	$ 7,000	$ 5,184	9	10
16	Soil Lift	02.570.0150	ALENA M OTTERDAHL	16.55%	184	0.92	1.24	0.92	1.24					$ 64,313	$ 6,431	$ 7,000	$ 5,184	11	11
19	Soil Lift	08.036.5100	KENNETH J & DOLORES A KALINA	19.31%	83	0.42	0.56	0.42	0.56					$ 29,123	$ 2,912	$ 7,000	$ 5,184	13	12
1	Soil Lift	02.450.0060	DALE M & JAYNE M HIRDLER	0.00%	34	0.17	0.23	0.17	0.23					$ 11,872	$ 1,187	$ 7,000	$ 5,184	14	13
6	Soil Lift	08.450.0070	TIMOTHY L & SUSAN J HANSON	6.21%	90	0.45	0.61	0.45	0.61					$ 31,672	$ 3,167	$ 7,000	$ 5,184	16	14
14	Soil Lift	06.450.0010	MICHAEL R BENZICK &	15.86%	80	0.40	0.54	0.40	0.54					$ 28,155	$ 2,815	$ 7,000	$ 5,184	18	15
12	Soil Lift	02.001.2900	THOMAS M & SUSANN K MILLER	15.86%	147	0.74	1.00	0.74	1.00					$ 51,579	$ 5,158	$ 7,000	$ 5,184	10	16
3	Soil Lift	08.450.0040	DAVID A & CONNIE SIMONSON	0.00%	62	0.31	0.42	0.31	0.42					$ 21,547	$ 2,155	$ 7,000	$ 5,184	15	17
13	Soil Lift	02.001.3000	KENT & SUSAN RICHARDSON	15.86%	107	0.54	0.73	0.54	0.73					$ 37,589	$ 3,759	$ 7,000	$ 5,184	17	18
40	Native Vegetation Strip	08.450.0010	KENNETH J & DOLORES A KALINA	19.31%	9					0.0007	0.01	0.0004	0.007	$ 5,358	$ 611	$ 1,445,632	$ 93,966	19	19
22	Native Vegetation Strip	08.450.0030	DALE M & JAYNE M HIRDLER	0.00%	23					0.0007	0.01	0.0004	0.007	$ 8,448	$ 920	$ 2,177,006	$ 141,505	20	20
21	Native Vegetation Strip	02.450.0060	DALE M & JAYNE M HIRDLER	0.00%	34					0.0007	0.01	0.0004	0.007	$ 11,037	$ 1,179	$ 2,789,825	$ 181,339	21	21
29	Native Vegetation Strip	08.450.0160	KIMBERLY REAK &	13.10%	45					0.0007	0.01	0.0004	0.007	$ 13,636	$ 1,439	$ 3,404,881	$ 221,317	22	22
23	Native Vegetation Strip	08.450.0040	DAVID A & CONNIE SIMONSON	0.00%	62					0.0007	0.01	0.0004	0.007	$ 17,326	$ 1,808	$ 4,278,232	$ 278,085	23	23
28	Native Vegetation Strip	06.450.0080	KEVIN D & ELIZABETH A SKELLY	13.10%	64					0.0007	0.01	0.0004	0.007	$ 17,908	$ 1,866	$ 4,416,067	$ 287,044	24	24
34	Native Vegetation Strip	06.450.0010	MICHAEL R BENZICK &	15.86%	80					0.0007	0.01	0.0004	0.007	$ 21,621	$ 2,237	$ 5,294,821	$ 344,163	25	25
39	Native Vegetation Strip	08.036.5100	KENNETH J & DOLORES A KALINA	19.31%	83					0.0007	0.01	0.0004	0.007	$ 22,250	$ 2,300	$ 5,443,811	$ 353,848	26	26
24	Native Vegetation Strip	09.750.0030	BERNARD T & SANDRA L WEBER	3.45%	87					0.0007	0.01	0.0004	0.007	$ 23,027	$ 2,378	$ 5,627,685	$ 365,800	27	27
27	Native Vegetation Strip	08.450.0080	ROBYN J MONROE	6.21%	90					0.0007	0.01	0.0004	0.007	$ 23,787	$ 2,454	$ 5,807,476	$ 377,486	28	28
26	Native Vegetation Strip	08.450.0070	TIMOTHY L & SUSAN J HANSON	6.21%	90					0.0007	0.01	0.0004	0.007	$ 23,907	$ 2,466	$ 5,835,998	$ 379,340	29	29
25	Native Vegetation Strip	08.450.0050	PAUL & MARY JOHNSON	6.21%	91					0.0007	0.01	0.0004	0.007	$ 23,953	$ 2,470	$ 5,846,866	$ 380,046	30	30
33	Native Vegetation Strip	02.001.3000	KENT & SUSAN RICHARDSON	15.86%	107					0.0007	0.01	0.0004	0.007	$ 27,753	$ 2,850	$ 6,746,291	$ 438,509	31	31
31	Native Vegetation Strip	02.001.2600	PAUL J & JAYNE A SKLUZACEK	15.86%	117					0.0007	0.01	0.0004	0.007	$ 29,975	$ 3,072	$ 7,272,127	$ 472,688	32	32
37	Native Vegetation Strip	08.450.0140	TIMOTHY G & RENAE J SUNDBERG	16.55%	120					0.0007	0.01	0.0004	0.007	$ 30,609	$ 3,136	$ 7,422,201	$ 482,443	33	33
35	Native Vegetation Strip	08.450.0120	HAPPY HOUR ANYTIME LLC	15.86%	120					0.0007	0.01	0.0004	0.007	$ 30,609	$ 3,136	$ 7,422,201	$ 482,443	34	34
38	Native Vegetation Strip	06.450.0070	SETH T STIER &	19.31%	121					0.0007	0.01	0.0004	0.007	$ 30,762	$ 3,151	$ 7,458,515	$ 484,803	35	35
32	Native Vegetation Strip	02.001.2900	THOMAS M & SUSANN K MILLER	15.86%	147					0.0007	0.01	0.0004	0.007	$ 36,846	$ 3,760	$ 8,898,484	$ 578,401	36	36
30	Native Vegetation Strip	02.570.0140	DOUGLAS R PINT	14.48%	164					0.0007	0.01	0.0004	0.007	$ 40,707	$ 4,146	$ 9,812,331	$ 637,801	37	37
36	Native Vegetation Strip	02.570.0150	ALENA M OTTERDAHL	16.55%	184					0.0007	0.01	0.0004	0.007	$ 45,124	$ 4,587	$ 10,857,692	$ 705,750	38	38

In addition to the shoreline restoration and overland flow treatment BMPs listed within this analysis, other practices may benefit Lake Volney from a water quality standpoint or ecological standpoint. Examples that may be applicable to Lake Volney include:

1) **Yard Care Practices:** Limited fertilizer use, appropriate yard waste disposal, and native vegetation establishment

2) **Invasive Species Treatment:** Treatment of invasive species preventing spread and promoting native species

BATHTUB

To assess Lake Volney's water quality response to the proposed reductions, the calibrated Bathtub model from the 2014 Total Maximum Daily Load (TMDL) was used. To validate the use of this model, a review of water quality data was conducted to determine if water quality conditions have changed since the development of the TMDL. Monitoring years 2009-2010 were used to develop the 2014 TMDL, resulting in a Bathtub model calibrated to represent a growing season average TP of 63 ug/L for the lake surface. Monitoring data collected from Lake Volney from 2022-2024 resulted in a growing season average TP of 69 ug/L for lake surface samples. Given year to year variability in climate, this difference is negligible and the use of the 2014 TMDL model is still relevant.

TP load reductions achieved from the BMPs summarized in the Retrofit Analysis section were simulated in the calibrated Bathtub model to estimate the lake benefits of these implementation efforts. The calibrated current conditions model estimates of total TP load to Lake Volney of 1,780 lbs./year resulting in the growing season average of 63 ug/L. The TMDL study identified a reduction of 1,065 lbs./year is necessary to achieve water quality standards plus the Margin of Safety (MOS) which is incorporated in TMDLs to account for modeling and assumptions error. The estimated lake response based on the Bathtub model using the TP load reductions of 508 lbs./year, accomplished after implementation of all selected BMPs in the Retrofit Analysis, would result in a growing season mean TP of 51 ug/L in Lake Volney. This progress accomplishes approximately 48% of the total load reduction identified in the TMDL to meet water quality standards.

SUMMARY + CONCLUSION

The Lake Volney subwatershed analysis provides a comprehensive assessment and prioritization of potential best management practices (BMPs) to improve water quality in Lake Volney in Le Sueur County, Minnesota. This analysis focused on siting and prioritizing BMPs to reduce total phosphorous (TP) and total suspended solids (TSS) loads from both residential shoreline and rural agricultural areas throughout the Lake Volney subwatershed.

The approximate 269-acre Lake Volney is impaired for aquatic recreation due to excess nutrients. Using the Chisago Soil and Water Conservation District's Rural Subwatershed Analysis Protocols and GIS-based analysis, ISG identified and evaluated 50 rural lake catchments and sited 143 BMPs throughout the approximate 2,019-acre watershed. This process involved utilizing the Revised Universal Soil Loss Equation (RUSLE2) and HSPF-SAM modeling data. Using this information, a weighted local loading rate for TP and TSS was determined and could be applied to each BMP drainage area at a BMP drainage area scale. Following the calculation of TP and TSS loading to each sited BMP, cost-effectiveness could be determined. The rural agriculture practices included grassed waterways, water and sediment control basins (WASCOBs) or other control structures, wetland restorations, contour buffer strips, and storage ponds.

Residential shoreline areas followed a similar process. Shoreline properties receiving a "low" score through the "Score Your Shore" analysis were chosen as priority areas for BMP implementation. Shoreline loading rates for TSS were calculated using the NRCS Streambank Erosion Calculator. Additionally, a ratio of pound of TP per pound of TSS could be applied to the TSS load to determine a TP load. Shoreline restoration and overland flow treatment practices were soil lifts and native vegetation establishments, respectively. Toe wood was analyzed as an alternative if soil lifts were deemed inadequate but is not presented within this report as it is significantly more expensive than soil lifts.

Each BMP was analyzed based on reduction efficiency, approximate life span, implementation costs, and operation and maintenance costs. BMPs were assigned a priority rank based upon the relationship between total TP reduction and TP cost-effectiveness. Scenarios comparing implementation approaches focused only on cost-effectiveness compared to a combination of cost-effectiveness and total TP load reduction were evaluated. Results from this analysis showed that by selecting the top 25% of BMPs based on cost-effectiveness, and top 25% of BMPs based on TP load reductions, it would result in the most impactful implementation approach and represent priority BMPs. Additional information relating to cost per pound of TP removed per year and cost per ton of TSS removed per year was provided. Separate rankings were developed for rural agricultural and residential shoreline areas as the purpose of each BMP is to treat varying land conditions and pollutant sources. The ranking provided stakeholders with the ability to prioritize BMP siting based on its greatest water quality benefit and present findings to landowners or external entities.

This analysis provided a technical planning tool to support stakeholders in improving the water quality of Lake Volney. This report aligns with the goals within the framework of the Cannon River Comprehensive Watershed Management Plan and the One Watershed, One Plan (1W1P) initiative. This planning effort can be utilized to improve the long-term ecological and recreational health of Lake Volney and its subwatershed.

By siting high-impact, cost-effective BMP opportunities, Le Sueur County and the Le Sueur County Soil and Water Conservation District can work with landowners and any other external entities to develop a foundational plan for improving Lake Volney's water quality. Next steps include stakeholder and landowner engagement, selection of desired BMPs for implementation, and site-specific investigation and planning. Once BMP selection has occurred, engineering design and plan development will need to be completed before BMP implementation.

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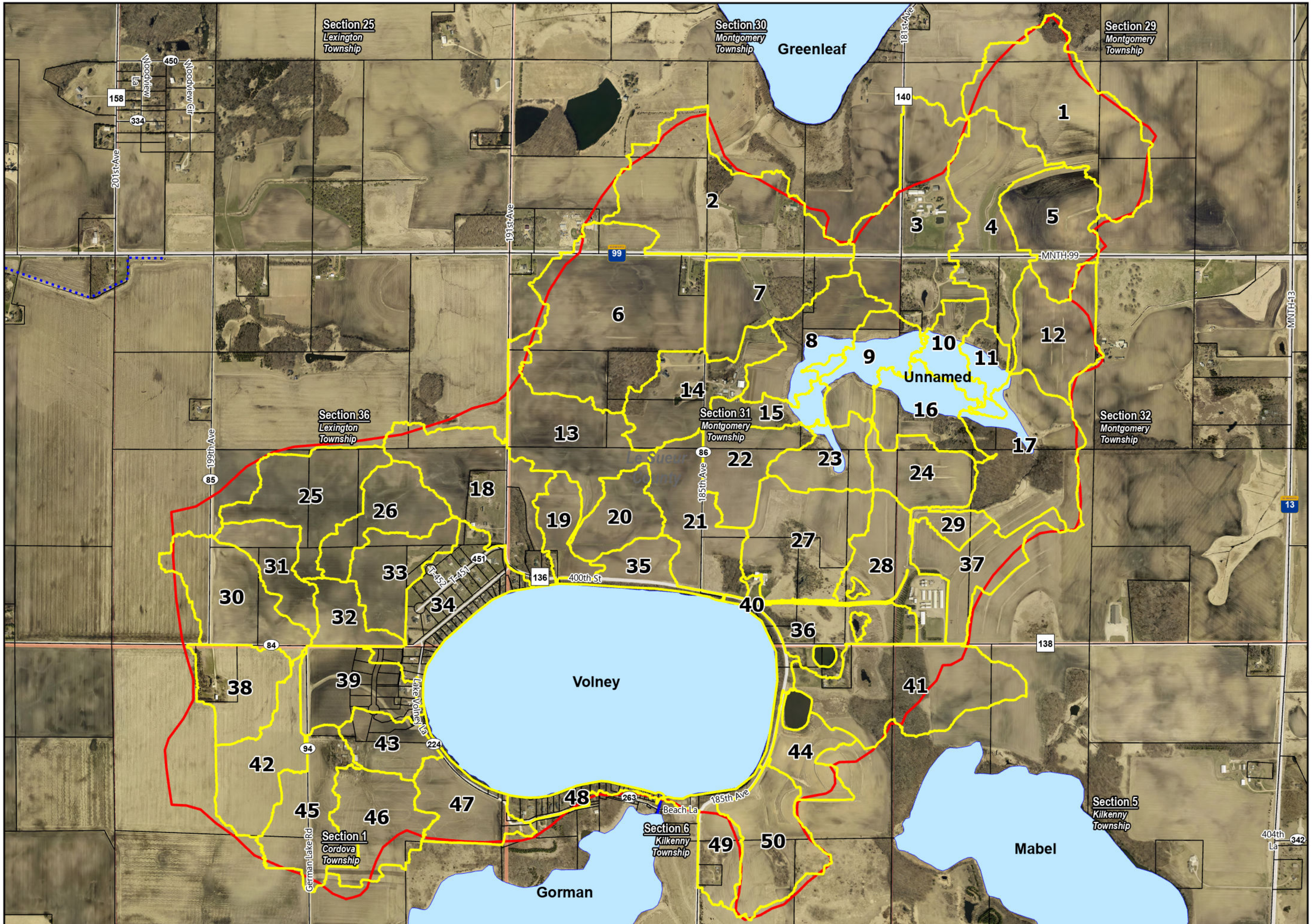
APPENDIX A: LAKE VOLNEY MAPS

Existing Map

Lake Volney

Le Sueur County, Minnesota

Thursday, November 6, 2025



Legend

- Lake Volney HSPF Watershed Boundary
- Le Sueur County Delineated Lake Catchments
- Parcels
- Public Waters Basins
- Public Water Watercourse
- Public Ditch/Altered Natural Watercourse

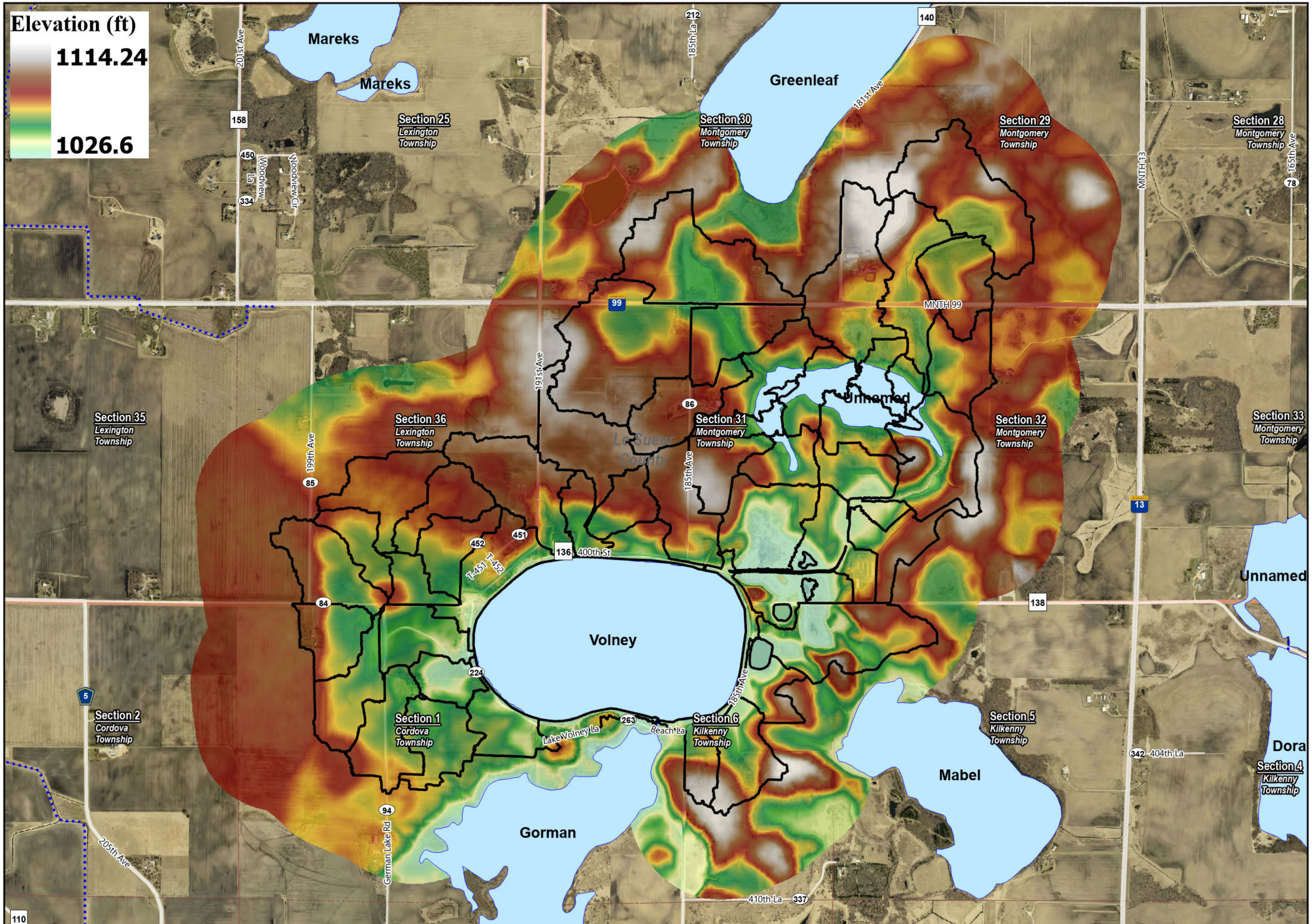
PN: 24-32103

Source:

Orthophotograph (MnGeo WMS, 2015)
Tile/Ditch (Le Sueur County, 12/16/2016)
Parcels (Le Sueur County, 12/16/2016)
Lakes (MN DNR, July, 2008)
Major Stream (MN DNR, July 2008)
Counties (MN DNR, July 2013)
PLSS (MnGeo/USGS)

N

0 300 600 1,200 Feet



Elevation Map

Lake Volney

Le Sueur County, Minnesota

Thursday, November 6, 2025

Legend

- Le Sueur County Delineated Lake Catchments
- Public Waters Basins
- Public Water Watercourse
- Public Ditch/Altered Natural Watercourse

PN: 24-32103

Source:

Orthophotograph (MnGeo WMS, 2015)

Tile/Ditch (Le Sueur County, 12/16/2016)

Parcels (Le Sueur County, 12/16/2016)

Lakes (MN DNR, July, 2008)

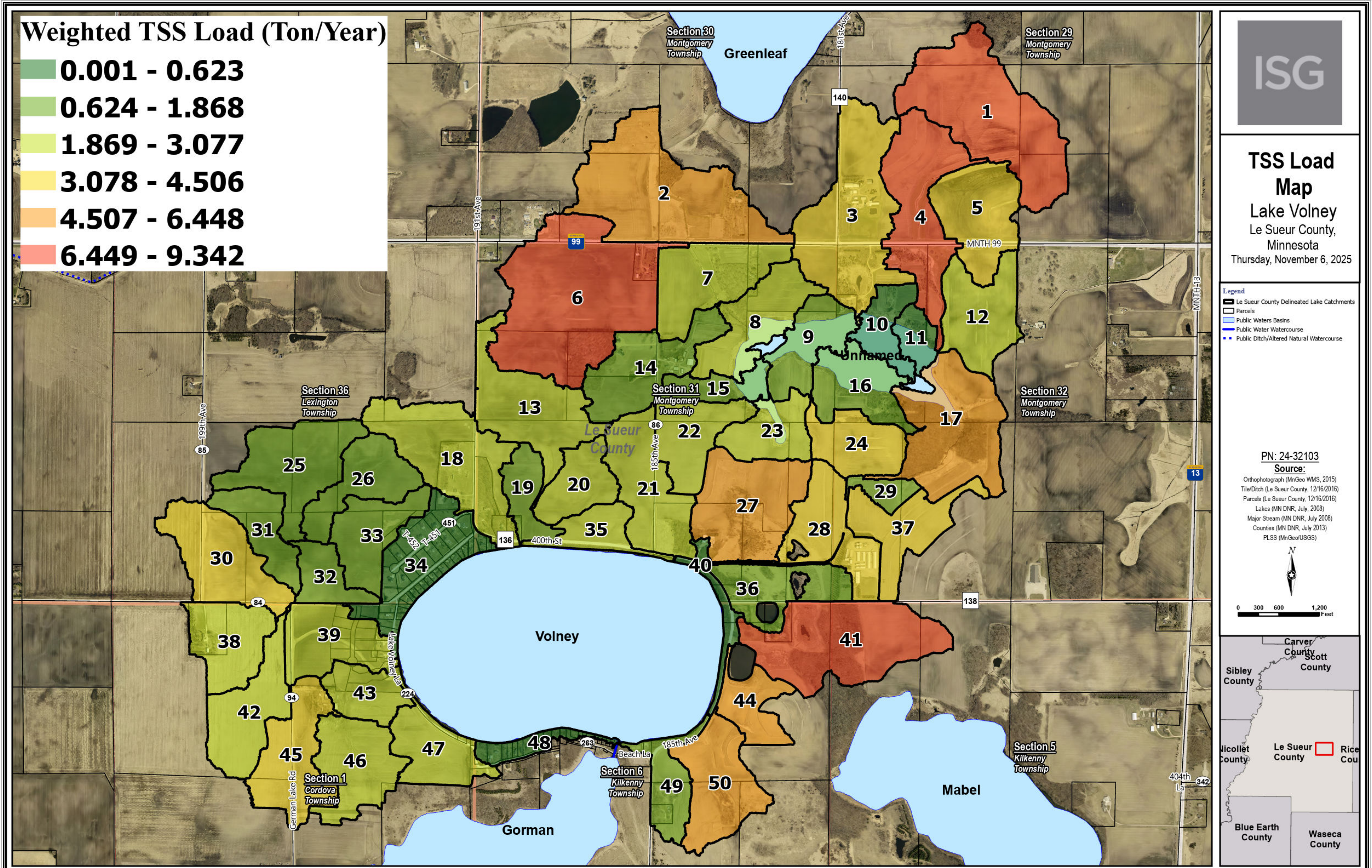
Major Stream (MN DNR, July 2008)

Counties (MN DNR, July 2013)

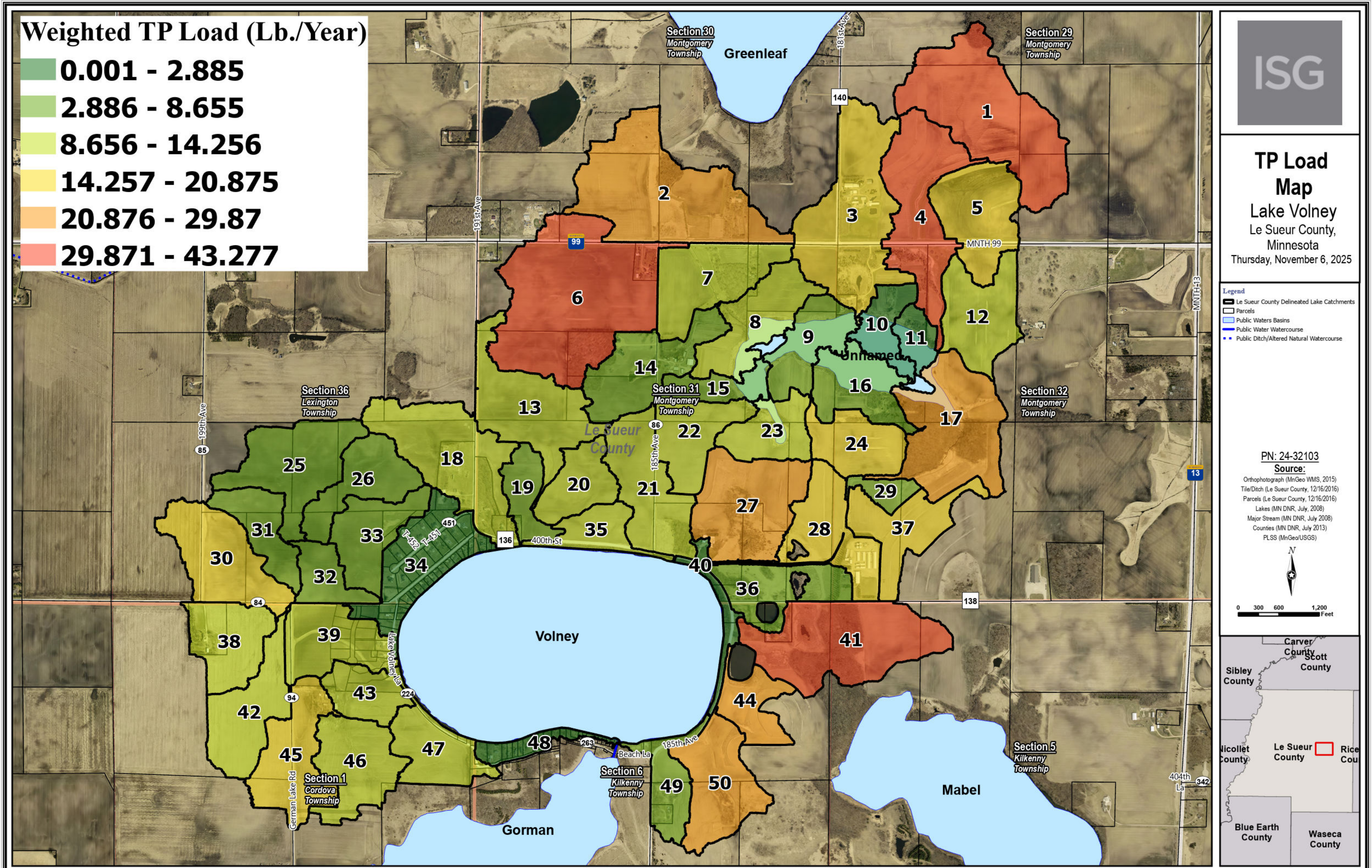
PLSS (MnGeo/USGS)

N

0 390 780 1,560 Feet



Weighted TSS Load (Ton/Year)
0.001 - 0.623
0.624 - 1.868
1.869 - 3.077
3.078 - 4.506
4.507 - 6.448
6.449 - 9.342
ISG
TSS Load Map
Lake Volney
Le Sueur County, Minnesota
Thursday, November 6, 2025
Legend
Le Sueur County Delineated Lake Catchments
Parcels
Public Waters Basins
Public Water Watercourse
Public Ditch/Altered Natural Watercourse
PN: 24-32103
Source:
Orthophotograph (MnGeo WMS, 2015)
Tile/Ditch (Le Sueur County, 12/16/2016)
Parcels (Le Sueur County, 12/16/2016)
Lakes (MN DNR, July, 2008)
Major Stream (MN DNR, July 2008)
Counties (MN DNR, July 2013)
PLSS (MnGeo/USGS)
N
0 300 600 1,200 Feet
Carver County
Scott County
Sibley County
Nicollet County
Le Sueur County
Blue Earth County
Waseca County
Greenleaf
Volney
Mabel
Gorman
Unnamed
Le Sueur County
Section 30 Montgomery Township
Section 29 Montgomery Township
Section 36 Lexington Township
Section 31 Montgomery Township
Section 32 Montgomery Township
Section 1 Cordova Township
Section 6 Kilkenny Township
Section 5 Kilkenny Township
MNTH 99
MNTH-13
191st Ave
199th Ave
185th Ave
181st Ave
400th St
Lake Volney La
German Lake Rd
Beach La
404th La
T-451
T-452
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50



Weighted TP Load (Lb./Year)
0.001 - 2.885
2.886 - 8.655
8.656 - 14.256
14.257 - 20.875
20.876 - 29.87
29.871 - 43.277
Section 30
Montgomery Township
Greenleaf
Section 29
Montgomery Township
Section 36
Lexington Township
Section 31
Montgomery Township
Section 32
Montgomery Township
Le Sueur County
Unnamed
Volney
Gorman
Mabel
Section 1
Cordova Township
Section 6
Kilkenny Township
Section 5
Kilkenny Township
MNTH 99
MNTH-13
191st Ave
199th Ave
185th Ave
181st Ave
400th St
Lake Volney La
Beach La
German Lake Rd
404th La
1
2
3
4
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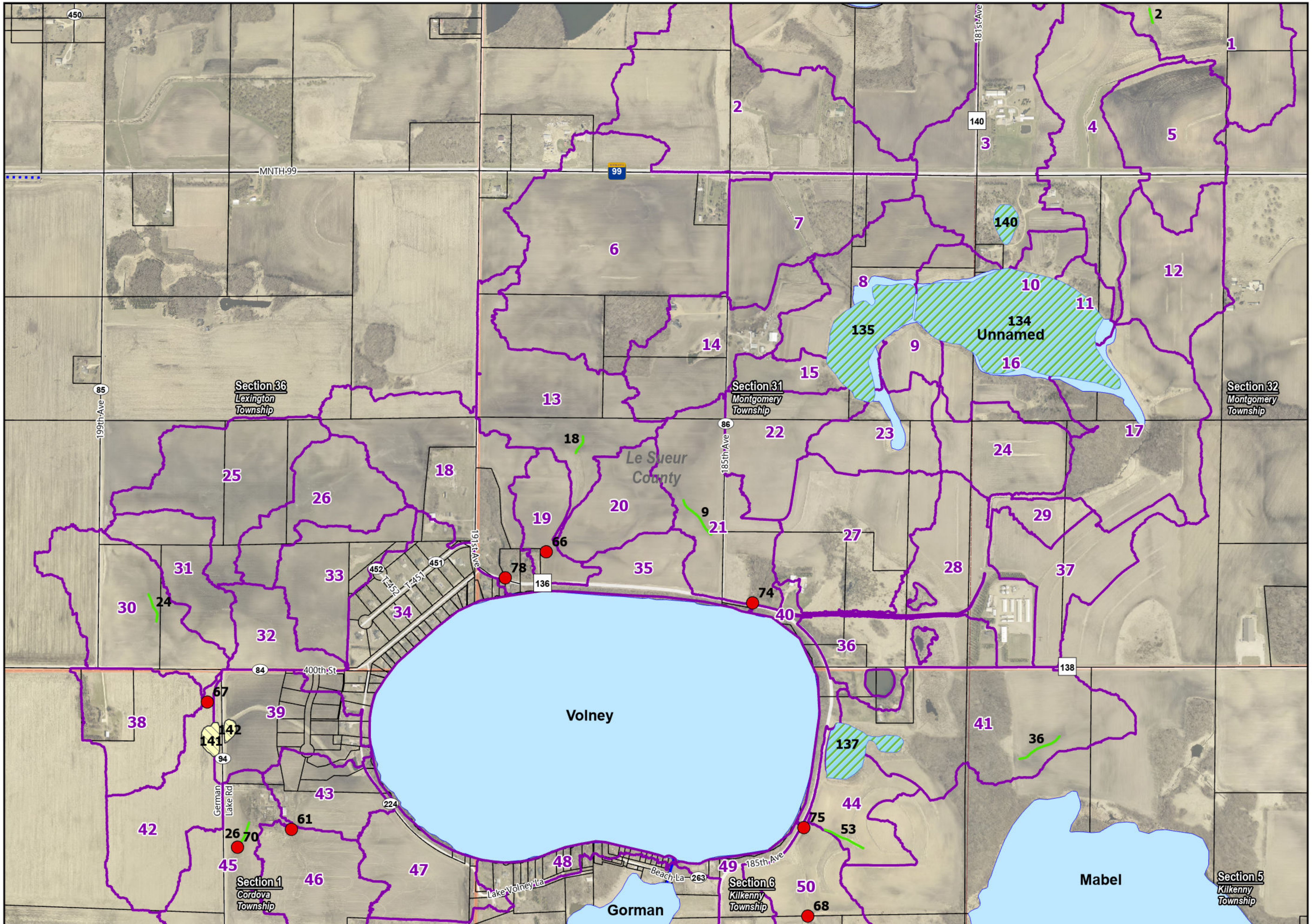
ISG
TP Load Map
Lake Volney
Le Sueur County, Minnesota
Thursday, November 6, 2025
Legend
Le Sueur County Delineated Lake Catchments
Parcels
Public Waters Basins
Public Water Watercourse
Public Ditch/Altered Natural Watercourse
PN: 24-32103
Source:
Orthophotograph (MnGeo WMS, 2015)
Tile/Ditch (Le Sueur County, 12/16/2016)
Parcels (Le Sueur County, 12/16/2016)
Lakes (MN DNR, July, 2008)
Major Stream (MN DNR, July 2008)
Counties (MN DNR, July 2013)
PLSS (MnGeo/USGS)
N
0 300 600 1,200 Feet
Carver County
Scott County
Sibley County
Le Sueur County
Blue Earth County
Waseca County

Priority BMP Map

Lake Volney

Le Sueur County, Minnesota

Wednesday, November 12, 2025



Legend

- Le Sueur County Delineated Lake Catchments
- Parcels
- WASCOBs
- Grassed Waterways
- Wetland Enhancement
- Wetland Restoration
- Public Waters Basins
- Public Water Watercourse
- Public Ditch/Altered Natural Watercourse

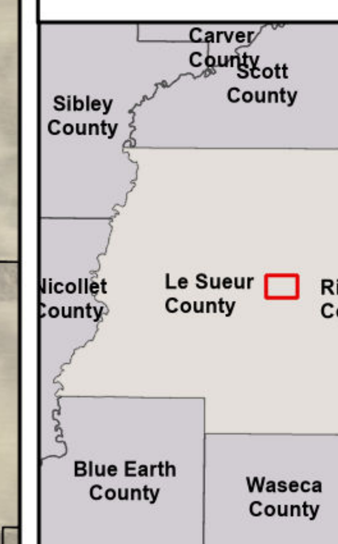
PN: 24-32103

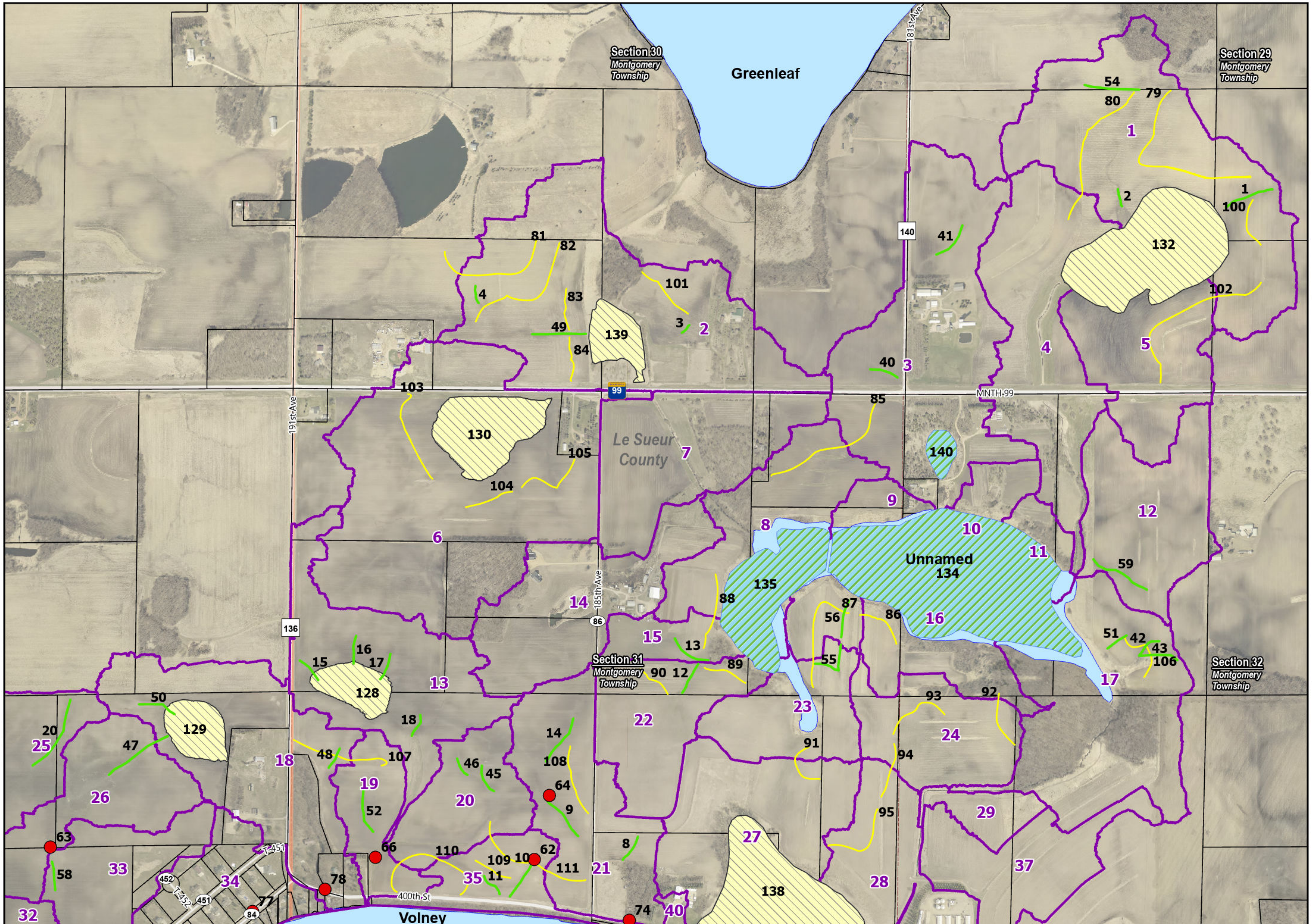
Source:

Orthophotograph (MnGeo WMS, 2015)
Tile/Ditch (Le Sueur County, 12/16/2016)
Parcels (Le Sueur County, 12/16/2016)
Lakes (MN DNR, July, 2008)
Major Stream (MN DNR, July 2008)
Counties (MN DNR, July 2013)
PLSS (MnGeo/USGS)

N

0 235 470 940 Feet





All Sited BMPs Map (North)

Lake Volney

Le Sueur County, Minnesota

Wednesday, November 12, 2025

Legend

- Le Sueur County Delineated Lake Catchments
- Parcels
- WASCOBs
- Grassed Waterway
- Contour Buffer Strips
- Wetland Enhancement
- Wetland Restoration
- Storage Pond
- Public Waters Basins
- Public Water Watercourse
- Public Ditch/Altered Natural Watercourse

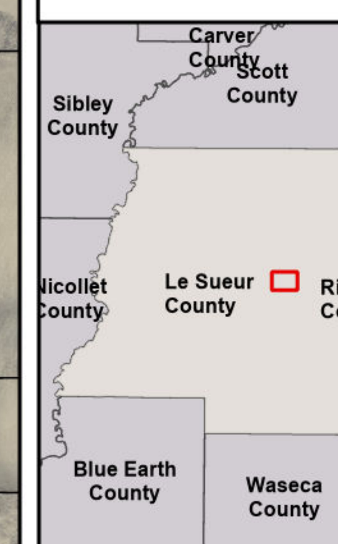
PN: 24-32103

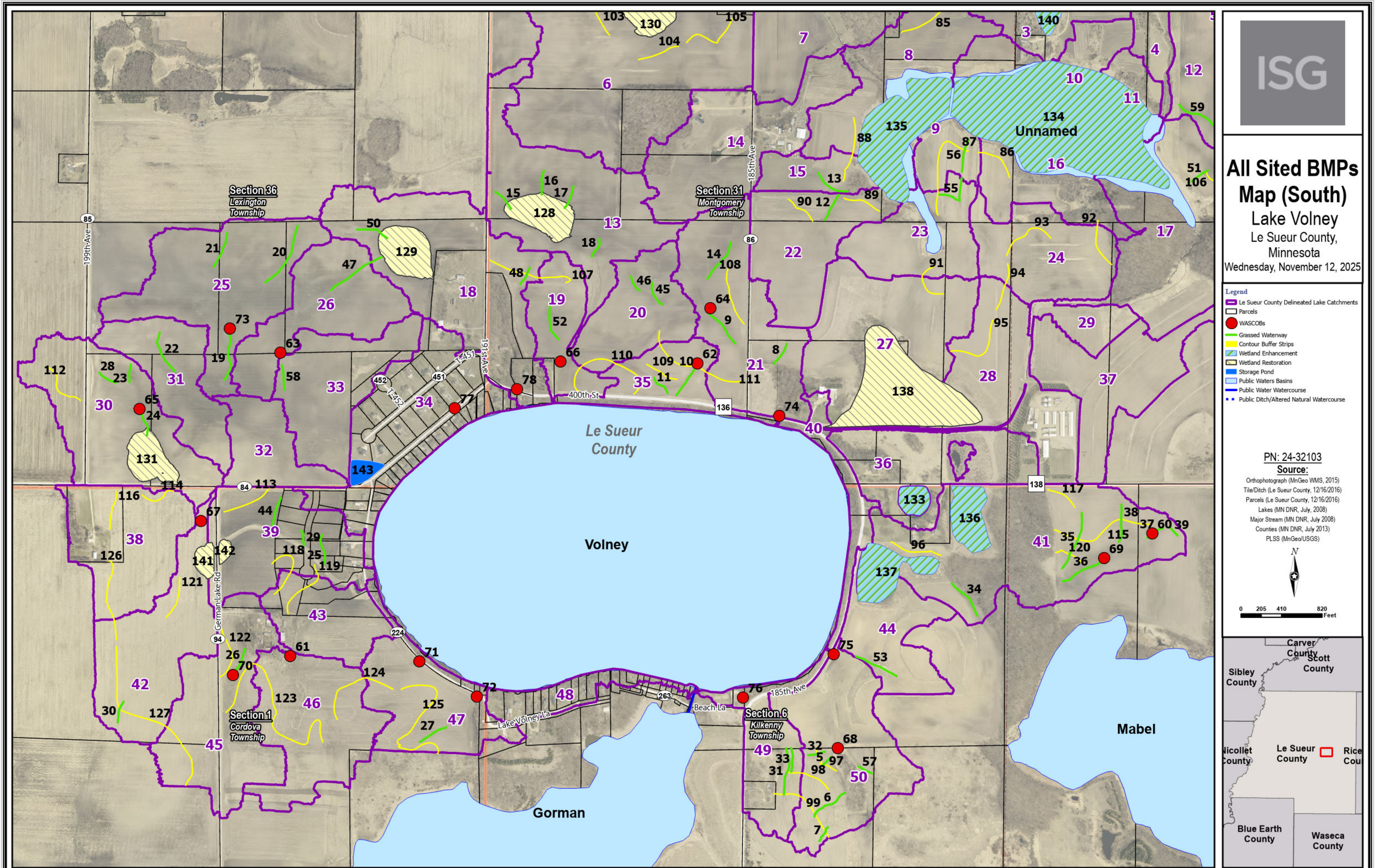
Source:

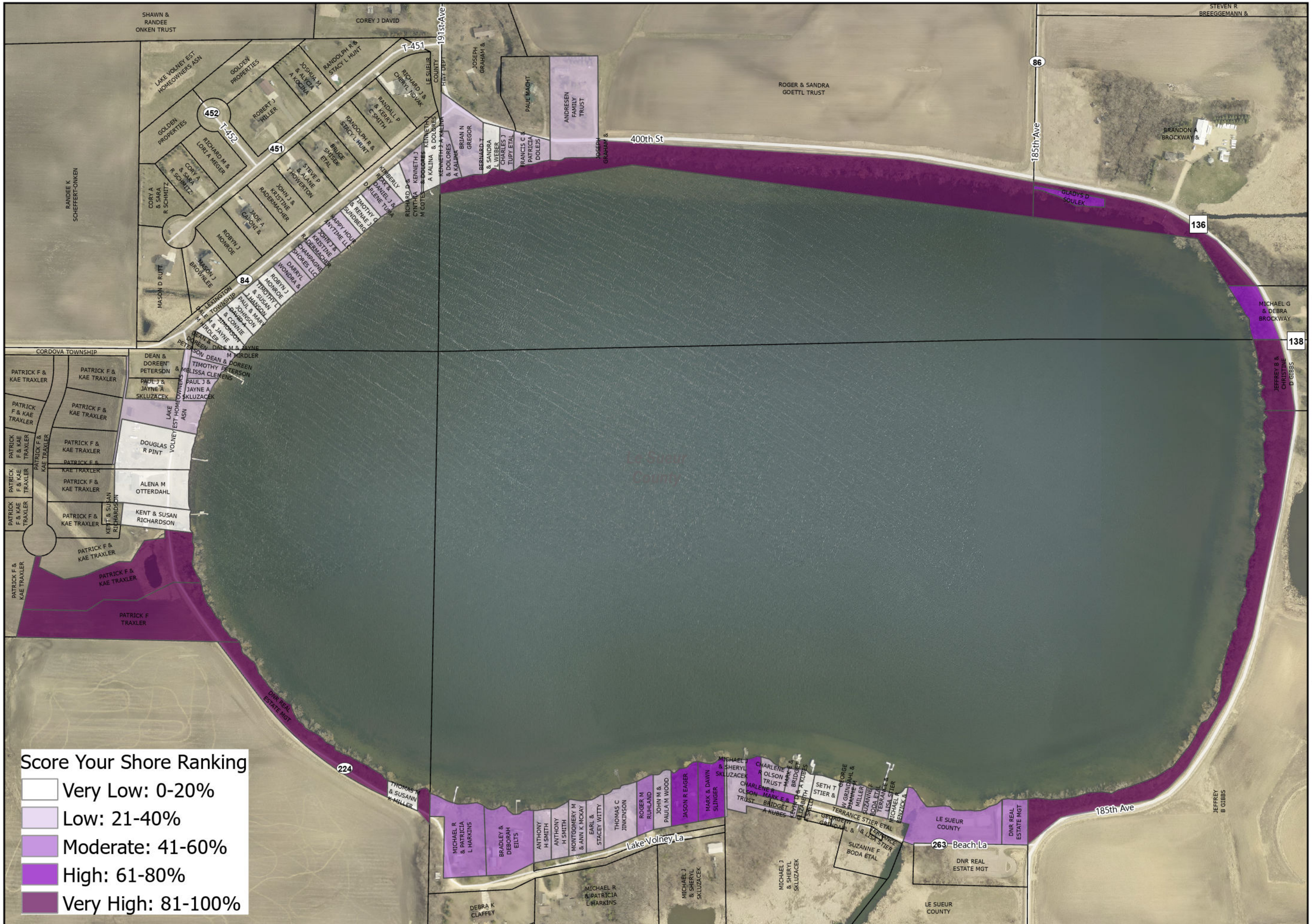
Orthophotograph (MnGeo WMS, 2015)
Tile/Ditch (Le Sueur County, 12/16/2016)
Parcels (Le Sueur County, 12/16/2016)
Lakes (MN DNR, July, 2008)
Major Stream (MN DNR, July 2008)
Counties (MN DNR, July 2013)
PLSS (MnGeo/USGS)

N

0 190 380 760 Feet




ISG
All Sited BMPs Map (South)
Lake Volney
Le Sueur County, Minnesota
Wednesday, November 12, 2025
Legend
Le Sueur County Delineated Lake Catchments
Parcels
WASCOBs
Grassed Waterway
Contour Buffer Strips
Wetland Enhancement
Wetland Restoration
Storage Pond
Public Waters Basins
Public Water Watercourse
Public Ditch/Altered Natural Watercourse
PN: 24-32103
Source:
Orthophotograph (MnGeo WMS, 2015)
Tile/Ditch (Le Sueur County, 12/16/2016)
Parcels (Le Sueur County, 12/16/2016)
Lakes (MN DNR, July, 2008)
Major Stream (MN DNR, July 2008)
Counties (MN DNR, July 2013)
PLSS (MnGeo/USGS)
N
0 205 410 820 Feet
Carver County
Scott County
Sibley County
Nicollet County
Le Sueur County
Rice County
Blue Earth County
Waseca County
Volney
Le Sueur County
Gorman
Mabel
134 Unnamed
Section 36 Lexington Township
Section 31 Montgomery Township
Section 1 Cordova Township
Section 6 Kilkenny Township
400th St
185th Ave
191st Ave
199th Ave
German Lake Rd
Lake Volney La
Beach La
T-451
T-452



Score Your Shore Prioritization Map

Lake Volney

Le Sueur County, Minnesota

Monday, December 22, 2025

Legend

Parcels

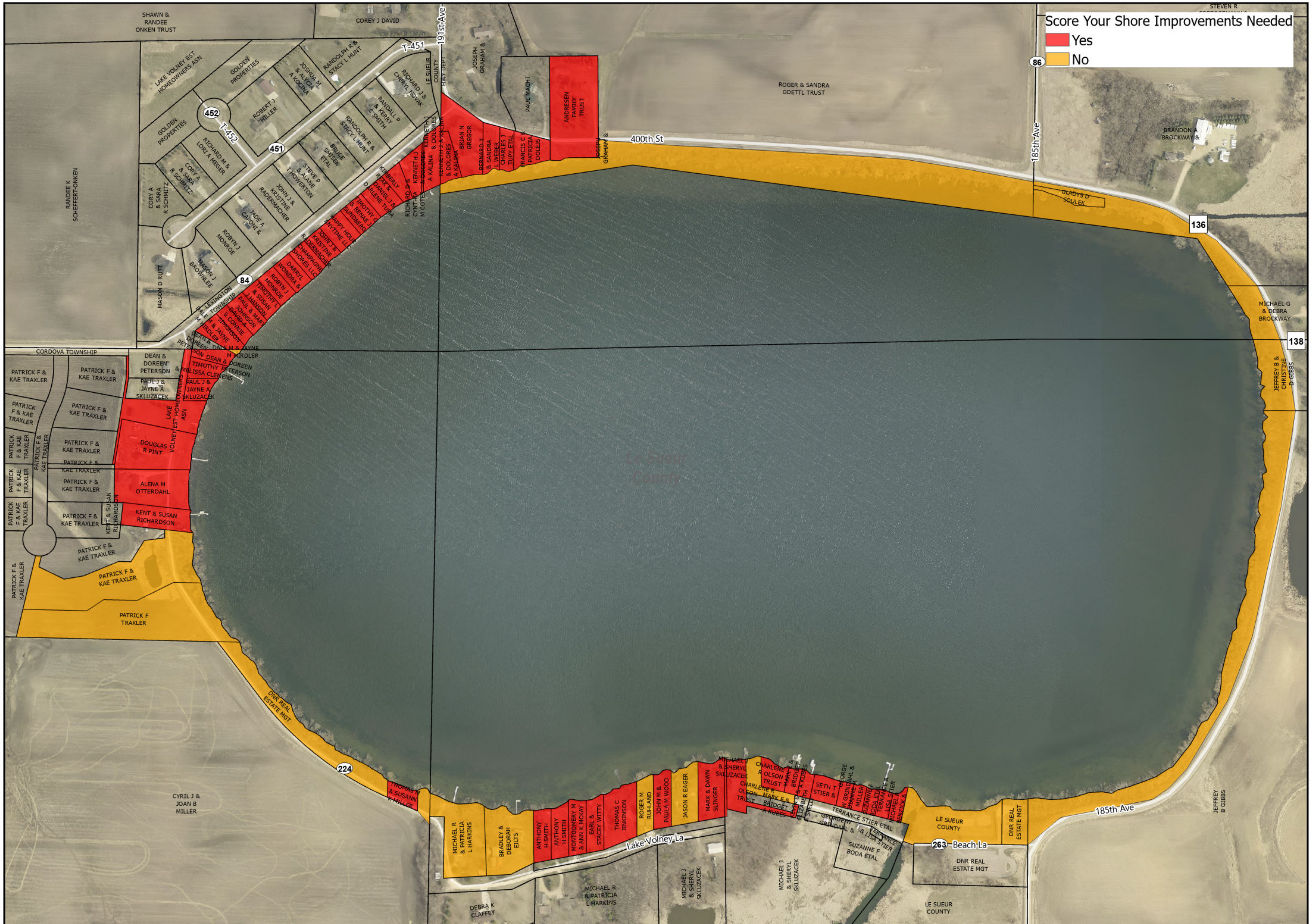
PN: 24-32103

Source:

Orthophotograph (MnGeo WMS, 2015)
Tile/Ditch (Le Sueur County, 12/16/2016)
Parcels (Le Sueur County, 12/16/2016)
Lakes (MN DNR, July, 2008)
Major Stream (MN DNR, July 2008)
Counties (MN DNR, July 2013)
PLSS (MnGeo/USGS)

N

0 95 190 380 Feet



Score Your Shore Improvements Map

Lake Volney

Le Sueur County, Minnesota

Thursday, November 6, 2025

Legend

Parcels

PN: 24-32103

Source:

Orthophotograph (MnGeo WMS, 2015)
Tile/Ditch (Le Sueur County, 12/16/2016)
Parcels (Le Sueur County, 12/16/2016)
Lakes (MN DNR, July, 2008)
Major Stream (MN DNR, July 2008)
Counties (MN DNR, July 2013)
PLSS (MnGeo/USGS)

N

0 95 190 380 Feet

APPENDIX B: LAKE VOLNEY COST-EFFECTIVENESS TABLES

LE SUEUR COUNTY
LAKE VOLNEY SUBWATERSHED ANALYSIS
11/12/2025

Rank of Potential Rural Best Management Practices Based on TP Cost Effectiveness

BMP Number	BMP Type	BMP Type Label	Main Lake Catchment ID	Total BMP Drainage Area (ac)	HSPF/TSA Weighted Local BMP TSS Load (t/yr)	HSPF/TSA Weighted Local BMP TP Load (lb/yr)	TSS Reduction Efficiency (%)	TP Reduction Efficiency (%)	TSS Reduced (t/yr)	TP Reduced (lb/yr)	TSS Remaining (t/yr)	TP Remaining (lb/yr)	Base Implementation Cost ($)	O & M Factor (%)	Life Span (Years)	Total Project Cost ($)	Annual Total Project Cost ($/Year)	TSS Cost Effectiveness ($/Ton Reduced/Year)	TP Cost Effectiveness ($/lb. Reduced/Year)	Rank TSS Cost Effectiveness	Rank TP Cost Effectiveness	Priority BMP (Yes/No)
2	Grassed Waterway	2	1	38.01	4.33	20.07	62%	45%	2.69	9.03	1.65	11.04	$ 1,003	2%	10	$ 1,203	$ 120	$ 45	$ 13	1	1	Yes
142	Wetland Restoration	15	30	117.29	9.50	44.02	75%	43%	7.13	18.93	2.38	25.09	$ 6,025	1%	15	$ 6,928	$ 462	$ 65	$ 24	2	2	Yes
18	Grassed Waterway	18	13	43.38	2.47	11.44	62%	45%	1.53	5.15	0.94	6.29	$ 1,305	2%	10	$ 1,567	$ 157	$ 102	$ 30	3	3	Yes
26	Grassed Waterway	26	45	31.45	2.86	13.26	62%	45%	1.77	5.97	1.09	7.29	$ 1,889	2%	10	$ 2,266	$ 227	$ 128	$ 38	4	4	Yes
24	Grassed Waterway	24	30	23.80	2.15	9.97	62%	45%	1.33	4.49	0.82	5.49	$ 1,999	2%	10	$ 2,399	$ 240	$ 180	$ 53	7	6	Yes
141	Wetland Restoration	14	30	109.76	8.91	41.28	75%	43%	6.68	17.75	2.23	23.53	$ 13,642	1%	15	$ 15,688	$ 1,046	$ 157	$ 59	6	9	Yes
75	WASCOB	16	50	38.33	7.42	34.35	90%	85%	6.67	29.20	0.74	5.15	$ 14,479	3%	10	$ 18,823	$ 1,882	$ 282	$ 64	13	11	Yes
36	Grassed Waterway	36	41	15.01	2.68	12.40	62%	45%	1.66	5.58	1.02	6.82	$ 3,201	2%	10	$ 3,841	$ 384	$ 231	$ 69	11	12	Yes
67	WASCOB	8	30	72.75	6.34	29.37	90%	85%	5.71	24.96	0.63	4.41	$ 14,479	3%	10	$ 18,823	$ 1,882	$ 330	$ 75	15	13	Yes
53	Grassed Waterway	53	44	7.38	2.16	10.01	62%	45%	1.34	4.50	0.82	5.51	$ 2,908	2%	10	$ 3,490	$ 349	$ 260	$ 77	12	14	Yes
66	WASCOB	7	13	81.53	5.86	27.16	90%	85%	5.28	23.08	0.59	4.07	$ 14,479	3%	10	$ 18,823	$ 1,882	$ 357	$ 82	18	15	Yes
9	Grassed Waterway	9	21	19.84	2.08	9.66	62%	45%	1.29	4.35	0.79	5.31	$ 3,056	2%	10	$ 3,667	$ 367	$ 284	$ 84	14	16	Yes
74	WASCOB	15	21	40.37	4.24	19.65	90%	85%	3.82	16.70	0.42	2.95	$ 14,479	3%	10	$ 18,823	$ 1,882	$ 493	$ 113	22	17	Yes
140	Wetland Enhancement	13	3	64.40	5.91	27.38	75%	43%	4.43	11.78	1.48	15.61	$ 19,713	1%	15	$ 22,670	$ 1,511	$ 341	$ 128	16	19	Yes
137	Wetland Enhancement	10	41	90.26	18.31	84.82	75%	43%	13.73	36.47	4.58	48.34	$ 63,667	1%	15	$ 73,217	$ 4,881	$ 355	$ 134	17	21	Yes
68	WASCOB	9	50	17.98	3.48	16.11	90%	85%	3.13	13.70	0.35	2.42	$ 14,479	3%	10	$ 18,823	$ 1,882	$ 601	$ 137	32	22	Yes
78	WASCOB	19	18	56.14	3.47	16.08	90%	85%	3.12	13.67	0.35	2.41	$ 14,479	3%	10	$ 18,823	$ 1,882	$ 602	$ 138	33	23	Yes
135	Wetland Enhancement	8	6	372.54	38.57	178.67	75%	43%	28.93	76.83	9.64	101.84	$ 150,387	1%	15	$ 172,945	$ 11,530	$ 399	$ 150	19	24	Yes
70	WASCOB	11	45	29.81	2.71	12.57	90%	85%	2.44	10.68	0.27	1.89	$ 14,479	3%	10	$ 18,823	$ 1,882	$ 771	$ 176	40	31	Yes
61	WASCOB	2	46	33.54	2.46	11.40	90%	85%	2.21	9.69	0.25	1.71	$ 14,479	3%	10	$ 18,823	$ 1,882	$ 850	$ 194	42	34	Yes
134	Wetland Enhancement	7	6	743.19	83.07	384.83	75%	43%	62.30	165.48	20.77	219.35	$ 427,799	1%	15	$ 491,968	$ 32,798	$ 526	$ 198	26	35	Yes
11	Grassed Waterway	11	35	9.48	1.79	8.27	62%	45%	1.11	3.72	0.68	4.55	$ 1,409	2%	10	$ 1,690	$ 169	$ 153	$ 45	5	5	No
28	Grassed Waterway	28	30	13.58	1.23	5.69	62%	45%	0.76	2.56	0.47	3.13	$ 1,252	2%	10	$ 1,503	$ 150	$ 197	$ 59	8	7	No
12	Grassed Waterway	12	22	16.01	1.80	8.34	62%	45%	1.12	3.75	0.68	4.58	$ 1,834	2%	10	$ 2,201	$ 220	$ 197	$ 59	9	8	No
3	Grassed Waterway	3	2	4.75	0.54	2.50	62%	45%	0.33	1.13	0.21	1.38	$ 600	2%	10	$ 720	$ 72	$ 215	$ 64	10	10	No
49	Grassed Waterway	49	2	11.71	1.33	6.17	62%	45%	0.83	2.78	0.51	3.39	$ 2,959	2%	10	$ 3,551	$ 355	$ 430	$ 128	20	18	No
19	Grassed Waterway	19	25	41.26	1.54	7.12	62%	45%	0.95	3.20	0.58	3.91	$ 3,460	2%	10	$ 4,152	$ 415	$ 436	$ 130	21	20	No
5	Grassed Waterway	5	50	1.48	0.29	1.33	62%	45%	0.18	0.60	0.11	0.73	$ 749	2%	10	$ 899	$ 90	$ 506	$ 151	23	25	No
42	Grassed Waterway	42	17	2.93	0.57	2.66	62%	45%	0.36	1.20	0.22	1.46	$ 1,502	2%	10	$ 1,803	$ 180	$ 507	$ 151	24	26	No
57	Grassed Waterway	57	50	1.86	0.36	1.67	62%	45%	0.22	0.75	0.14	0.92	$ 975	2%	10	$ 1,170	$ 117	$ 524	$ 156	25	27	No
37	Grassed Waterway	37	41	2.34	0.42	1.93	62%	45%	0.26	0.87	0.16	1.06	$ 1,197	2%	10	$ 1,437	$ 144	$ 555	$ 165	27	28	No
15	Grassed Waterway	15	13	8.80	0.50	2.32	62%	45%	0.31	1.04	0.19	1.28	$ 1,501	2%	10	$ 1,801	$ 180	$ 580	$ 172	30	29	No
45	Grassed Waterway	45	20	6.44	0.56	2.57	62%	45%	0.34	1.16	0.21	1.42	$ 1,669	2%	10	$ 2,003	$ 200	$ 582	$ 173	31	30	No
54	Grassed Waterway	54	1	8.48	0.97	4.48	62%	45%	0.60	2.01	0.37	2.46	$ 3,039	2%	10	$ 3,647	$ 365	$ 609	$ 181	34	32	No
14	Grassed Waterway	14	21	8.63	0.91	4.20	62%	45%	0.56	1.89	0.34	2.31	$ 2,878	2%	10	$ 3,453	$ 345	$ 614	$ 183	35	33	No
52	Grassed Waterway	52	19	6.94	0.72	3.35	62%	45%	0.45	1.51	0.27	1.84	$ 2,546	2%	10	$ 3,056	$ 306	$ 682	$ 203	36	36	No
76	WASCOB	17	49	16.01	2.25	10.43	90%	85%	2.03	8.87	0.23	1.56	$ 14,479	3%	10	$ 18,823	$ 1,882	$ 929	$ 212	43	37	No
136	Wetland Enhancement	9	41	51.17	9.13	42.29	75%	43%	6.85	18.18	2.28	24.10	$ 50,562	1%	15	$ 58,147	$ 3,876	$ 566	$ 213	28	38	No
69	WASCOB	10	41	12.40	2.21	10.25	90%	85%	1.99	8.71	0.22	1.54	$ 14,479	3%	10	$ 18,823	$ 1,882	$ 945	$ 216	44	39	No
139	Wetland Restoration	12	2	81.42	9.26	42.90	75%	43%	6.95	18.45	2.32	24.45	$ 52,183	1%	15	$ 60,010	$ 4,001	$ 576	$ 217	29	40	No
10	Grassed Waterway	10	35	3.16	0.60	2.76	62%	45%	0.37	1.24	0.23	1.52	$ 2,325	2%	10	$ 2,790	$ 279	$ 756	$ 225	38	41	No
8	Grassed Waterway	8	21	3.75	0.39	1.83	62%	45%	0.24	0.82	0.15	1.00	$ 1,557	2%	10	$ 1,868	$ 187	$ 765	$ 227	39	42	No
34	Grassed Waterway	34	41	3.77	0.67	3.12	62%	45%	0.42	1.40	0.26	1.71	$ 2,705	2%	10	$ 3,246	$ 325	$ 779	$ 232	41	43	No
65	WASCOB	6	30	21.42	1.94	8.98	90%	85%	1.74	7.63	0.19	1.35	$ 14,479	3%	10	$ 18,823	$ 1,882	$ 1,079	$ 247	51	44	No
40	Grassed Waterway	40	3	3.59	0.33	1.53	62%	45%	0.20	0.69	0.13	0.84	$ 1,612	2%	10	$ 1,935	$ 193	$ 947	$ 282	45	45	No
38	Grassed Waterway	38	41	2.79	0.50	2.31	62%	45%	0.31	1.04	0.19	1.27	$ 2,441	2%	10	$ 2,929	$ 293	$ 949	$ 282	46	46	No
64	WASCOB	5	21	15.83	1.66	7.71	90%	85%	1.50	6.55	0.17	1.16	$ 14,479	3%	10	$ 18,823	$ 1,882	$ 1,257	$ 287	57	47	No
1	Grassed Waterway	1	1	4.91	0.56	2.59	62%	45%	0.35	1.17	0.21	1.43	$ 2,809	2%	10	$ 3,371	$ 337	$ 972	$ 289	47	48	No

LE SUEUR COUNTY
LAKE VOLNEY SUBWATERSHED ANALYSIS
11/12/2025

Rank of Potential Rural Best Management Practices Based on TP Cost Effectiveness

BMP Number	BMP Type	BMP Type Label	Main Lake Catchment ID	Total BMP Drainage Area (ac)	HSPF/TSA Weighted Local BMP TSS Load (t/yr)	HSPF/TSA Weighted Local BMP TP Load (lb/yr)	TSS Reduction Efficiency (%)	TP Reduction Efficiency (%)	TSS Reduced (t/yr)	TP Reduced (lb/yr)	TSS Remaining (t/yr)	TP Remaining (lb/yr)	Base Implementation Cost ($)	O & M Factor (%)	Life Span (Years)	Total Project Cost ($)	Annual Total Project Cost ($/Year)	TSS Cost Effectiveness ($/Ton Reduced/Year)	TP Cost Effectiveness ($/lb. Reduced/Year)	Rank TSS Cost Effectiveness	Rank TP Cost Effectiveness	Priority BMP (Yes/No)
22	Grassed Waterway	22	31	9.89	0.56	2.57	62%	45%	0.34	1.16	0.21	1.42	$ 2,880	2%	10	$ 3,456	$ 346	$ 1,003	$ 298	48	49	No
72	WASCOB	13	47	15.14	1.58	7.32	90%	85%	1.42	6.22	0.16	1.10	$ 14,479	3%	10	$ 18,823	$ 1,882	$ 1,323	$ 302	63	50	No
44	Grassed Waterway	44	39	4.91	0.39	1.79	62%	45%	0.24	0.81	0.15	0.99	$ 2,068	2%	10	$ 2,481	$ 248	$ 1,035	$ 308	49	51	No
143	Storage Pond	1	25	158.83	8.76	40.58	76%	36%	6.66	14.61	2.10	25.97	$ 59,538	1%	15	$ 68,469	$ 4,565	$ 686	$ 312	37	52	No
32	Grassed Waterway	32	50	1.03	0.20	0.92	62%	45%	0.12	0.42	0.08	0.51	$ 1,101	2%	10	$ 1,321	$ 132	$ 1,069	$ 318	50	53	No
120	Contour Buffer Strip	42	41	4.09	0.73	3.38	75%	62%	0.55	2.10	0.18	1.28	$ 5,735	2%	10	$ 6,882	$ 688	$ 1,258	$ 328	58	54	No
73	WASCOB	14	25	38.17	1.42	6.58	90%	85%	1.28	5.60	0.14	0.99	$ 14,479	3%	10	$ 18,823	$ 1,882	$ 1,472	$ 336	70	55	No
6	Grassed Waterway	6	50	2.28	0.44	2.04	62%	45%	0.27	0.92	0.17	1.12	$ 2,611	2%	10	$ 3,133	$ 313	$ 1,146	$ 341	52	56	No
17	Grassed Waterway	17	13	4.33	0.25	1.14	62%	45%	0.15	0.51	0.09	0.63	$ 1,531	2%	10	$ 1,837	$ 184	$ 1,202	$ 357	53	57	No
50	Grassed Waterway	50	18	5.49	0.34	1.57	62%	45%	0.21	0.71	0.13	0.87	$ 2,158	2%	10	$ 2,590	$ 259	$ 1,230	$ 366	54	58	No
27	Grassed Waterway	27	47	2.94	0.31	1.42	62%	45%	0.19	0.64	0.12	0.78	$ 1,964	2%	10	$ 2,357	$ 236	$ 1,238	$ 368	55	59	No
106	Contour Buffer Strip	28	17	5.04	0.99	4.57	75%	62%	0.74	2.84	0.25	1.74	$ 8,879	2%	10	$ 10,654	$ 1,065	$ 1,439	$ 376	64	60	No
97	Contour Buffer Strip	19	50	3.39	0.66	3.04	75%	62%	0.49	1.88	0.16	1.15	$ 5,908	2%	10	$ 7,089	$ 709	$ 1,441	$ 376	65	61	No
39	Grassed Waterway	39	41	0.65	0.12	0.54	62%	45%	0.07	0.24	0.04	0.30	$ 763	2%	10	$ 916	$ 92	$ 1,274	$ 379	59	62	No
51	Grassed Waterway	51	17	0.99	0.19	0.90	62%	45%	0.12	0.40	0.07	0.49	$ 1,280	2%	10	$ 1,535	$ 154	$ 1,277	$ 380	60	63	No
41	Grassed Waterway	41	3	3.71	0.34	1.58	62%	45%	0.21	0.71	0.13	0.87	$ 2,285	2%	10	$ 2,742	$ 274	$ 1,299	$ 386	62	64	No
63	WASCOB	4	26	23.32	1.15	5.31	90%	85%	1.03	4.52	0.11	0.80	$ 14,479	3%	10	$ 18,823	$ 1,882	$ 1,823	$ 417	79	65	No
13	Grassed Waterway	13	15	4.06	0.31	1.46	62%	45%	0.19	0.65	0.12	0.80	$ 2,367	2%	10	$ 2,840	$ 284	$ 1,458	$ 434	67	66	No
16	Grassed Waterway	16	13	3.60	0.20	0.95	62%	45%	0.13	0.43	0.08	0.52	$ 1,554	2%	10	$ 1,865	$ 186	$ 1,468	$ 437	69	67	No
46	Grassed Waterway	46	20	1.63	0.14	0.65	62%	45%	0.09	0.29	0.05	0.36	$ 1,109	2%	10	$ 1,331	$ 133	$ 1,526	$ 454	72	68	No
71	WASCOB	12	47	9.95	1.04	4.81	90%	85%	0.93	4.09	0.10	0.72	$ 14,479	3%	10	$ 18,823	$ 1,882	$ 2,013	$ 460	82	69	No
25	Grassed Waterway	25	39	3.35	0.26	1.22	62%	45%	0.16	0.55	0.10	0.67	$ 2,145	2%	10	$ 2,574	$ 257	$ 1,573	$ 468	73	70	No
130	Wetland Restoration	3	6	89.01	10.00	46.33	75%	43%	7.50	19.92	2.50	26.41	$ 121,825	1%	15	$ 140,099	$ 9,340	$ 1,245	$ 469	56	71	No
59	Grassed Waterway	59	12	5.47	0.43	1.99	62%	45%	0.27	0.90	0.16	1.09	$ 3,527	2%	10	$ 4,233	$ 423	$ 1,590	$ 473	74	72	No
23	Grassed Waterway	23	30	1.56	0.14	0.65	62%	45%	0.09	0.29	0.05	0.36	$ 1,163	2%	10	$ 1,396	$ 140	$ 1,595	$ 474	75	73	No
131	Wetland Restoration	4	30	40.42	3.66	16.94	75%	43%	2.74	7.28	0.91	9.66	$ 45,690	1%	15	$ 52,544	$ 3,503	$ 1,277	$ 481	61	74	No
98	Contour Buffer Strip	20	49	4.15	0.67	3.10	75%	62%	0.50	1.92	0.17	1.18	$ 7,938	2%	10	$ 9,526	$ 953	$ 1,901	$ 496	80	75	No
4	Grassed Waterway	4	2	1.01	0.11	0.53	62%	45%	0.07	0.24	0.04	0.29	$ 992	2%	10	$ 1,191	$ 119	$ 1,672	$ 497	76	76	No
7	Grassed Waterway	7	50	0.63	0.12	0.56	62%	45%	0.08	0.25	0.05	0.31	$ 1,090	2%	10	$ 1,309	$ 131	$ 1,732	$ 515	77	77	No
43	Grassed Waterway	43	17	1.20	0.24	1.09	62%	45%	0.15	0.49	0.09	0.60	$ 2,120	2%	10	$ 2,543	$ 254	$ 1,745	$ 519	78	78	No
103	Contour Buffer Strip	25	6	9.77	1.10	5.09	75%	62%	0.82	3.15	0.27	1.93	$ 13,762	2%	10	$ 16,514	$ 1,651	$ 2,006	$ 524	81	79	No
99	Contour Buffer Strip	21	50	5.86	0.99	4.56	75%	62%	0.74	2.83	0.25	1.73	$ 12,491	2%	10	$ 14,989	$ 1,499	$ 2,028	$ 530	83	80	No
132	Wetland Restoration	5	1	135.83	16.77	77.67	75%	43%	12.57	33.40	4.19	44.27	$ 237,519	1%	15	$ 273,147	$ 18,210	$ 1,448	$ 545	66	81	No
138	Wetland Restoration	11	27	65.94	13.29	61.58	75%	43%	9.97	26.48	3.32	35.10	$ 190,851	1%	15	$ 219,479	$ 14,632	$ 1,468	$ 553	68	82	No
133	Wetland Enhancement	6	36	6.34	1.31	6.07	75%	43%	0.98	2.61	0.33	3.46	$ 18,881	1%	15	$ 21,713	$ 1,448	$ 1,473	$ 554	71	83	No
55	Grassed Waterway	55	23	1.97	0.27	1.23	62%	45%	0.17	0.56	0.10	0.68	$ 2,853	2%	10	$ 3,424	$ 342	$ 2,074	$ 617	84	84	No
48	Grassed Waterway	48	18	1.80	0.11	0.52	62%	45%	0.07	0.23	0.04	0.28	$ 1,244	2%	10	$ 1,493	$ 149	$ 2,163	$ 643	85	85	No
115	Contour Buffer Strip	37	41	6.15	1.10	5.08	75%	62%	0.82	3.15	0.27	1.93	$ 17,121	2%	10	$ 20,545	$ 2,054	$ 2,497	$ 652	87	86	No
83	Contour Buffer Strip	5	2	3.21	0.37	1.69	75%	62%	0.27	1.05	0.09	0.64	$ 6,080	2%	10	$ 7,296	$ 730	$ 2,665	$ 696	89	87	No
96	Contour Buffer Strip	18	41	2.92	0.52	2.41	75%	62%	0.39	1.50	0.13	0.92	$ 8,702	2%	10	$ 10,442	$ 1,044	$ 2,673	$ 698	90	88	No
35	Grassed Waterway	35	41	1.78	0.32	1.47	62%	45%	0.20	0.66	0.12	0.81	$ 3,866	2%	10	$ 4,639	$ 464	$ 2,356	$ 701	86	89	No
82	Contour Buffer Strip	4	2	9.57	1.09	5.04	75%	62%	0.82	3.13	0.27	1.92	$ 18,524	2%	10	$ 22,229	$ 2,223	$ 2,723	$ 711	92	90	No
31	Grassed Waterway	31	49	1.66	0.23	1.08	62%	45%	0.14	0.49	0.09	0.59	$ 3,040	2%	10	$ 3,649	$ 365	$ 2,520	$ 750	88	91	No
93	Contour Buffer Strip	15	24	4.11	0.55	2.54	75%	62%	0.41	1.57	0.14	0.96	$ 10,004	2%	10	$ 12,005	$ 1,200	$ 2,924	$ 764	94	92	No
58	Grassed Waterway	58	33	2.13	0.11	0.53	62%	45%	0.07	0.24	0.04	0.29	$ 1,590	2%	10	$ 1,908	$ 191	$ 2,690	$ 800	91	93	No
102	Contour Buffer Strip	24	5	11.13	1.23	5.68	75%	62%	0.92	3.52	0.31	2.16	$ 24,573	2%	10	$ 29,487	$ 2,949	$ 3,205	$ 837	96	94	No
109	Contour Buffer Strip	31	35	1.50	0.28	1.31	75%	62%	0.21	0.81	0.07	0.50	$ 5,709	2%	10	$ 6,851	$ 685	$ 3,234	$ 844	97	95	No
80	Contour Buffer Strip	2	1	8.46	1.05	4.85	75%	62%	0.79	3.01	0.26	1.84	$ 21,396	2%	10	$ 25,675	$ 2,567	$ 3,269	$ 854	98	96	No

LE SUEUR COUNTY
LAKE VOLNEY SUBWATERSHED ANALYSIS
11/12/2025

Rank of Potential Rural Best Management Practices Based on TP Cost Effectiveness

BMP Number	BMP Type	BMP Type Label	Main Lake Catchment ID	Total BMP Drainage Area (ac)	HSPF/TSA Weighted Local BMP TSS Load (t/yr)	HSPF/TSA Weighted Local BMP TP Load (lb/yr)	TSS Reduction Efficiency (%)	TP Reduction Efficiency (%)	TSS Reduced (t/yr)	TP Reduced (lb/yr)	TSS Remaining (t/yr)	TP Remaining (lb/yr)	Base Implementation Cost ($)	O & M Factor (%)	Life Span (Years)	Total Project Cost ($)	Annual Total Project Cost ($/Year)	TSS Cost Effectiveness ($/Ton Reduced/Year)	TP Cost Effectiveness ($/lb. Reduced/Year)	Rank TSS Cost Effectiveness	Rank TP Cost Effectiveness	Priority BMP (Yes/No)
95	Contour Buffer Strip	17	28	2.91	0.55	2.57	75%	62%	0.42	1.59	0.14	0.97	$ 11,381	2%	10	$ 13,657	$ 1,366	$ 3,288	$ 859	99	97	No
33	Grassed Waterway	33	49	0.71	0.10	0.46	62%	45%	0.06	0.21	0.04	0.25	$ 1,558	2%	10	$ 1,870	$ 187	$ 3,020	$ 898	95	98	No
77	WASCOB	18	34	6.19	0.52	2.40	90%	85%	0.47	2.04	0.05	0.36	$ 14,479	3%	10	$ 18,823	$ 1,882	$ 4,035	$ 922	105	99	No
84	Contour Buffer Strip	6	2	2.57	0.29	1.35	75%	62%	0.22	0.84	0.07	0.51	$ 6,535	2%	10	$ 7,842	$ 784	$ 3,577	$ 934	102	100	No
29	Grassed Waterway	29	39	0.72	0.06	0.26	62%	45%	0.04	0.12	0.02	0.14	$ 985	2%	10	$ 1,183	$ 118	$ 3,363	$ 1,000	100	101	No
111	Contour Buffer Strip	33	35	4.77	0.72	3.32	75%	62%	0.54	2.06	0.18	1.26	$ 17,371	2%	10	$ 20,845	$ 2,084	$ 3,876	$ 1,012	103	102	No
87	Contour Buffer Strip	9	23	4.77	0.65	2.99	75%	62%	0.48	1.86	0.16	1.14	$ 16,219	2%	10	$ 19,463	$ 1,946	$ 4,017	$ 1,049	104	103	No
128	Wetland Restoration	1	13	34.60	1.97	9.12	75%	43%	1.48	3.92	0.49	5.20	$ 53,906	1%	15	$ 61,992	$ 4,133	$ 2,798	$ 1,053	93	104	No
119	Contour Buffer Strip	41	43	3.60	0.42	1.94	75%	62%	0.31	1.20	0.10	0.74	$ 10,553	2%	10	$ 12,664	$ 1,266	$ 4,038	$ 1,054	106	105	No
79	Contour Buffer Strip	1	1	9.13	1.04	4.82	75%	62%	0.78	2.99	0.26	1.83	$ 26,661	2%	10	$ 31,993	$ 3,199	$ 4,100	$ 1,070	107	106	No
89	Contour Buffer Strip	11	22	2.11	0.24	1.10	75%	62%	0.18	0.68	0.06	0.42	$ 6,476	2%	10	$ 7,771	$ 777	$ 4,370	$ 1,141	109	107	No
100	Contour Buffer Strip	22	1	2.29	0.26	1.21	75%	62%	0.20	0.75	0.07	0.46	$ 7,367	2%	10	$ 8,840	$ 884	$ 4,516	$ 1,179	111	108	No
60	WASCOB	1	41	2.10	0.37	1.74	90%	85%	0.34	1.48	0.04	0.26	$ 14,479	3%	10	$ 18,823	$ 1,882	$ 5,583	$ 1,276	116	109	No
30	Grassed Waterway	30	42	0.92	0.06	0.29	62%	45%	0.04	0.13	0.02	0.16	$ 1,425	2%	10	$ 1,710	$ 171	$ 4,354	$ 1,295	108	110	No
129	Wetland Restoration	2	18	26.85	1.66	7.69	75%	43%	1.25	3.31	0.42	4.38	$ 55,920	1%	15	$ 64,308	$ 4,287	$ 3,443	$ 1,296	101	111	No
21	Grassed Waterway	21	25	2.80	0.10	0.48	62%	45%	0.06	0.22	0.04	0.27	$ 2,372	2%	10	$ 2,846	$ 285	$ 4,404	$ 1,310	110	112	No
20	Grassed Waterway	20	25	4.91	0.18	0.85	62%	45%	0.11	0.38	0.07	0.47	$ 4,365	2%	10	$ 5,238	$ 524	$ 4,621	$ 1,374	112	113	No
90	Contour Buffer Strip	12	22	1.52	0.17	0.79	75%	62%	0.13	0.49	0.04	0.30	$ 5,642	2%	10	$ 6,771	$ 677	$ 5,285	$ 1,380	113	114	No
86	Contour Buffer Strip	8	16	1.77	0.22	1.02	75%	62%	0.17	0.63	0.06	0.39	$ 7,395	2%	10	$ 8,874	$ 887	$ 5,355	$ 1,398	114	115	No
107	Contour Buffer Strip	29	18	5.49	0.43	1.97	75%	62%	0.32	1.22	0.11	0.75	$ 14,563	2%	10	$ 17,475	$ 1,748	$ 5,482	$ 1,432	115	116	No
81	Contour Buffer Strip	3	2	4.40	0.50	2.32	75%	62%	0.38	1.44	0.13	0.88	$ 17,811	2%	10	$ 21,374	$ 2,137	$ 5,695	$ 1,487	117	117	No
85	Contour Buffer Strip	7	8	5.43	0.54	2.49	75%	62%	0.40	1.54	0.13	0.94	$ 19,510	2%	10	$ 23,412	$ 2,341	$ 5,818	$ 1,519	118	118	No
62	WASCOB	3	35	1.61	0.30	1.40	90%	85%	0.27	1.19	0.03	0.21	$ 14,479	3%	10	$ 18,823	$ 1,882	$ 6,898	$ 1,577	125	119	No
91	Contour Buffer Strip	13	27	1.13	0.21	0.96	75%	62%	0.15	0.59	0.05	0.36	$ 7,893	2%	10	$ 9,472	$ 947	$ 6,123	$ 1,599	119	120	No
92	Contour Buffer Strip	14	24	1.53	0.20	0.93	75%	62%	0.15	0.58	0.05	0.35	$ 8,180	2%	10	$ 9,816	$ 982	$ 6,520	$ 1,703	120	121	No
101	Contour Buffer Strip	23	2	1.88	0.21	0.99	75%	62%	0.16	0.61	0.05	0.38	$ 8,961	2%	10	$ 10,753	$ 1,075	$ 6,705	$ 1,751	122	122	No
108	Contour Buffer Strip	30	21	2.26	0.24	1.10	75%	62%	0.18	0.68	0.06	0.42	$ 10,151	2%	10	$ 12,182	$ 1,218	$ 6,840	$ 1,786	123	123	No
110	Contour Buffer Strip	32	35	3.05	0.42	1.94	75%	62%	0.31	1.20	0.10	0.74	$ 17,888	2%	10	$ 21,465	$ 2,147	$ 6,844	$ 1,787	124	124	No
104	Contour Buffer Strip	26	6	1.43	0.16	0.74	75%	62%	0.12	0.46	0.04	0.28	$ 7,072	2%	10	$ 8,486	$ 849	$ 7,043	$ 1,839	126	125	No
117	Contour Buffer Strip	39	41	0.70	0.12	0.58	75%	62%	0.09	0.36	0.03	0.22	$ 5,630	2%	10	$ 6,756	$ 676	$ 7,214	$ 1,884	127	126	No
116	Contour Buffer Strip	38	38	1.71	0.14	0.66	75%	62%	0.11	0.41	0.04	0.25	$ 6,425	2%	10	$ 7,709	$ 771	$ 7,257	$ 1,895	128	127	No
126	Contour Buffer Strip	48	38	3.67	0.29	1.36	75%	62%	0.22	0.84	0.07	0.52	$ 13,422	2%	10	$ 16,106	$ 1,611	$ 7,309	$ 1,909	129	128	No
88	Contour Buffer Strip	10	8	2.57	0.23	1.08	75%	62%	0.17	0.67	0.06	0.41	$ 10,729	2%	10	$ 12,875	$ 1,287	$ 7,383	$ 1,928	130	129	No
56	Grassed Waterway	56	9	0.45	0.06	0.28	62%	45%	0.04	0.13	0.02	0.16	$ 2,075	2%	10	$ 2,490	$ 249	$ 6,574	$ 1,955	121	130	No
112	Contour Buffer Strip	34	30	1.94	0.18	0.81	75%	62%	0.13	0.50	0.04	0.31	$ 8,522	2%	10	$ 10,226	$ 1,023	$ 7,769	$ 2,029	131	131	No
105	Contour Buffer Strip	27	6	1.89	0.21	0.98	75%	62%	0.16	0.61	0.05	0.37	$ 10,459	2%	10	$ 12,550	$ 1,255	$ 7,881	$ 2,058	132	132	No
127	Contour Buffer Strip	49	45	6.75	0.55	2.53	75%	62%	0.41	1.57	0.14	0.96	$ 28,944	2%	10	$ 34,733	$ 3,473	$ 8,466	$ 2,211	133	133	No
94	Contour Buffer Strip	16	24	0.83	0.13	0.61	75%	62%	0.10	0.38	0.03	0.23	$ 7,926	2%	10	$ 9,511	$ 951	$ 9,589	$ 2,504	134	134	No
113	Contour Buffer Strip	35	39	1.73	0.14	0.63	75%	62%	0.10	0.39	0.03	0.24	$ 8,261	2%	10	$ 9,913	$ 991	$ 9,699	$ 2,532	135	135	No
125	Contour Buffer Strip	47	47	3.86	0.40	1.87	75%	62%	0.30	1.16	0.10	0.71	$ 25,743	2%	10	$ 30,892	$ 3,089	$ 10,221	$ 2,669	136	136	No
123	Contour Buffer Strip	45	46	6.39	0.51	2.36	75%	62%	0.38	1.46	0.13	0.90	$ 35,094	2%	10	$ 42,112	$ 4,211	$ 11,035	$ 2,881	137	137	No
124	Contour Buffer Strip	46	46	2.26	0.18	0.83	75%	62%	0.13	0.52	0.04	0.32	$ 14,622	2%	10	$ 17,546	$ 1,755	$ 13,037	$ 3,404	138	138	No
121	Contour Buffer Strip	43	42	1.19	0.08	0.38	75%	62%	0.06	0.24	0.02	0.14	$ 7,163	2%	10	$ 8,596	$ 860	$ 13,986	$ 3,652	139	139	No
122	Contour Buffer Strip	44	45	1.08	0.10	0.46	75%	62%	0.07	0.28	0.02	0.17	$ 9,909	2%	10	$ 11,891	$ 1,189	$ 16,129	$ 4,211	140	140	No
118	Contour Buffer Strip	40	39	0.86	0.09	0.39	75%	62%	0.06	0.24	0.02	0.15	$ 10,850	2%	10	$ 13,020	$ 1,302	$ 20,363	$ 5,317	141	141	No
47	Grassed Waterway	47	26	0.58	0.03	0.13	62%	45%	0.02	0.06	0.01	0.07	$ 3,923	2%	10	$ 4,707	$ 471	$ 26,613	$ 7,915	142	142	No
114	Contour Buffer Strip	36	38	0.31	0.03	0.12	75%	62%	0.02	0.07	0.01	0.05	$ 6,342	2%	10	$ 7,611	$ 761	$ 39,518	$ 10,319	143	143	No

LE SUEUR COUNTY
LAKE VOLNEY SUBWATERSHED ANALYSIS
12/22/2025

Rank of Potential Shoreline/Residential Best Management Practices Based on TP Cost Effectiveness

BMP Number	BMP	PIN	Owner	Score Your Shore Score (%)	Shoreline Length (ft)	Total Shoreline TSS Loss (ton/yr)	Total Shoreline TP Loss (lb/yr)	Shoreline BMP TSS Efficiency (%)	Shoreline BMP TP Efficiency (%)	TSS Shoreline Reduction (ton/yr)	TP Shoreline Reduction (lb/yr)	Overland TSS Load (ton/yr)	Overland TP Load (lb/yr)	Overland BMP TSS Efficiency (%)	Overland BMP TP Efficiency (%)	TSS Overland Reduction (ton/yr)	TP Overland Reduction (lb/yr)	Implementation Cost ($)	Maintenance Cost ($/yr)	Total Annual Cost ($/yr)	TSS Cost Effectiveness ($/ton reduced/yr)	TP Cost Effectiveness ($/ton reduced/yr)	TSS Rank	TP Rank
18	Soil Lift	06.450.0070	SETH T STIER &	19.31%	121	0.60	0.81	100%	100%	0.60	0.81							$ 42,219	$ -	$ 4,222	$ 7,000	$ 5,184	1	1
7	Soil Lift	08.450.0080	ROBYN J MONROE	6.21%	90	0.45	0.61	100%	100%	0.45	0.61							$ 31,487	$ -	$ 3,149	$ 7,000	$ 5,184	4	2
8	Soil Lift	06.450.0080	KEVIN D & ELIZABETH A SKELLY	13.10%	64	0.32	0.43	100%	100%	0.32	0.43							$ 22,443	$ -	$ 2,244	$ 7,000	$ 5,184	5	3
5	Soil Lift	08.450.0050	PAUL & MARY JOHNSON	6.21%	91	0.45	0.61	100%	100%	0.45	0.61							$ 31,743	$ -	$ 3,174	$ 7,000	$ 5,184	8	4
17	Soil Lift	08.450.0140	TIMOTHY G & RENAE J SUNDBERG	16.55%	120	0.60	0.81	100%	100%	0.60	0.81							$ 41,983	$ -	$ 4,198	$ 7,000	$ 5,184	12	5
2	Soil Lift	08.450.0030	DALE M & JAYNE M HIRDLER	0.00%	23	0.11	0.15	100%	100%	0.11	0.15							$ 7,889	$ -	$ 789	$ 7,000	$ 5,184	2	6
4	Soil Lift	09.750.0030	BERNARD T & SANDRA L WEBER	3.45%	87	0.43	0.58	100%	100%	0.43	0.58							$ 30,318	$ -	$ 3,032	$ 7,000	$ 5,184	3	7
9	Soil Lift	08.450.0160	KIMBERLY REAK &	13.10%	45	0.23	0.31	100%	100%	0.23	0.31							$ 15,870	$ -	$ 1,587	$ 7,000	$ 5,184	6	8
20	Soil Lift	08.450.0010	KENNETH J & DOLORES A KALINA	19.31%	9	0.04	0.06	100%	100%	0.04	0.06							$ 3,135	$ -	$ 314	$ 7,000	$ 5,184	7	9
10	Soil Lift	02.570.0140	DOUGLAS R PINT	14.48%	164	0.82	1.11	100%	100%	0.82	1.11							$ 57,519	$ -	$ 5,752	$ 7,000	$ 5,184	9	10
16	Soil Lift	02.570.0150	ALENA M OTTERDAHL	16.55%	184	0.92	1.24	100%	100%	0.92	1.24							$ 64,313	$ -	$ 6,431	$ 7,000	$ 5,184	11	11
19	Soil Lift	08.036.5100	KENNETH J & DOLORES A KALINA	19.31%	83	0.42	0.56	100%	100%	0.42	0.56							$ 29,123	$ -	$ 2,912	$ 7,000	$ 5,184	13	12
1	Soil Lift	02.450.0060	DALE M & JAYNE M HIRDLER	0.00%	34	0.17	0.23	100%	100%	0.17	0.23							$ 11,872	$ -	$ 1,187	$ 7,000	$ 5,184	14	13
6	Soil Lift	08.450.0070	TIMOTHY L & SUSAN J HANSON	6.21%	90	0.45	0.61	100%	100%	0.45	0.61							$ 31,672	$ -	$ 3,167	$ 7,000	$ 5,184	16	14
14	Soil Lift	06.450.0010	MICHAEL R BENZICK &	15.86%	80	0.40	0.54	100%	100%	0.40	0.54							$ 28,155	$ -	$ 2,815	$ 7,000	$ 5,184	18	15
12	Soil Lift	02.001.2900	THOMAS M & SUSANN K MILLER	15.86%	147	0.74	1.00	100%	100%	0.74	1.00							$ 51,579	$ -	$ 5,158	$ 7,000	$ 5,184	10	16
3	Soil Lift	08.450.0040	DAVID A & CONNIE SIMONSON	0.00%	62	0.31	0.42	100%	100%	0.31	0.42							$ 21,547	$ -	$ 2,155	$ 7,000	$ 5,184	15	17
13	Soil Lift	02.001.3000	KENT & SUSAN RICHARDSON	15.86%	107	0.54	0.73	100%	100%	0.54	0.73							$ 37,589	$ -	$ 3,759	$ 7,000	$ 5,184	17	18
40	Native Vegetation Strip	08.450.0010	KENNETH J & DOLORES A KALINA	19.31%	9							0.0007	0.01	65%	65%	0.0004	0.007	$ 5,358	$ 75	$ 611	$ 1,445,632	$ 93,966	19	19
22	Native Vegetation Strip	08.450.0030	DALE M & JAYNE M HIRDLER	0.00%	23							0.0007	0.01	65%	65%	0.0004	0.007	$ 8,448	$ 75	$ 920	$ 2,177,006	$ 141,505	20	20
21	Native Vegetation Strip	02.450.0060	DALE M & JAYNE M HIRDLER	0.00%	34							0.0007	0.01	65%	65%	0.0004	0.007	$ 11,037	$ 75	$ 1,179	$ 2,789,825	$ 181,339	21	21
29	Native Vegetation Strip	08.450.0160	KIMBERLY REAK &	13.10%	45							0.0007	0.01	65%	65%	0.0004	0.007	$ 13,636	$ 75	$ 1,439	$ 3,404,881	$ 221,317	22	22
23	Native Vegetation Strip	08.450.0040	DAVID A & CONNIE SIMONSON	0.00%	62							0.0007	0.01	65%	65%	0.0004	0.007	$ 17,326	$ 75	$ 1,808	$ 4,278,232	$ 278,085	23	23
28	Native Vegetation Strip	06.450.0080	KEVIN D & ELIZABETH A SKELLY	13.10%	64							0.0007	0.01	65%	65%	0.0004	0.007	$ 17,908	$ 75	$ 1,866	$ 4,416,067	$ 287,044	24	24
34	Native Vegetation Strip	06.450.0010	MICHAEL R BENZICK &	15.86%	80							0.0007	0.01	65%	65%	0.0004	0.007	$ 21,621	$ 75	$ 2,237	$ 5,294,821	$ 344,163	25	25
39	Native Vegetation Strip	08.036.5100	KENNETH J & DOLORES A KALINA	19.31%	83							0.0007	0.01	65%	65%	0.0004	0.007	$ 22,250	$ 75	$ 2,300	$ 5,443,811	$ 353,848	26	26
24	Native Vegetation Strip	09.750.0030	BERNARD T & SANDRA L WEBER	3.45%	87							0.0007	0.01	65%	65%	0.0004	0.007	$ 23,027	$ 75	$ 2,378	$ 5,627,685	$ 365,800	27	27
27	Native Vegetation Strip	08.450.0080	ROBYN J MONROE	6.21%	90							0.0007	0.01	65%	65%	0.0004	0.007	$ 23,787	$ 75	$ 2,454	$ 5,807,476	$ 377,486	28	28
26	Native Vegetation Strip	08.450.0070	TIMOTHY L & SUSAN J HANSON	6.21%	90							0.0007	0.01	65%	65%	0.0004	0.007	$ 23,907	$ 75	$ 2,466	$ 5,835,998	$ 379,340	29	29
25	Native Vegetation Strip	08.450.0050	PAUL & MARY JOHNSON	6.21%	91							0.0007	0.01	65%	65%	0.0004	0.007	$ 23,953	$ 75	$ 2,470	$ 5,846,866	$ 380,046	30	30
33	Native Vegetation Strip	02.001.3000	KENT & SUSAN RICHARDSON	15.86%	107							0.0007	0.01	65%	65%	0.0004	0.007	$ 27,753	$ 75	$ 2,850	$ 6,746,291	$ 438,509	31	31
31	Native Vegetation Strip	02.001.2600	PAUL J & JAYNE A SKLUZACEK	15.86%	117							0.0007	0.01	65%	65%	0.0004	0.007	$ 29,975	$ 75	$ 3,072	$ 7,272,127	$ 472,688	32	32
37	Native Vegetation Strip	08.450.0140	TIMOTHY G & RENAE J SUNDBERG	16.55%	120							0.0007	0.01	65%	65%	0.0004	0.007	$ 30,609	$ 75	$ 3,136	$ 7,422,201	$ 482,443	33	33
35	Native Vegetation Strip	08.450.0120	HAPPY HOUR ANYTIME LLC	15.86%	120							0.0007	0.01	65%	65%	0.0004	0.007	$ 30,609	$ 75	$ 3,136	$ 7,422,201	$ 482,443	34	34
38	Native Vegetation Strip	06.450.0070	SETH T STIER &	19.31%	121							0.0007	0.01	65%	65%	0.0004	0.007	$ 30,762	$ 75	$ 3,151	$ 7,458,515	$ 484,803	35	35
32	Native Vegetation Strip	02.001.2900	THOMAS M & SUSANN K MILLER	15.86%	147							0.0007	0.01	65%	65%	0.0004	0.007	$ 36,846	$ 75	$ 3,760	$ 8,898,484	$ 578,401	36	36
30	Native Vegetation Strip	02.570.0140	DOUGLAS R PINT	14.48%	164							0.0007	0.01	65%	65%	0.0004	0.007	$ 40,707	$ 75	$ 4,146	$ 9,812,331	$ 637,801	37	37
36	Native Vegetation Strip	02.570.0150	ALENA M OTTERDAHL	16.55%	184							0.0007	0.01	65%	65%	0.0004	0.007	$ 45,124	$ 75	$ 4,587	$ 10,857,692	$ 705,750	38	38

Note: If soil lifts are deemed inadequate for shoreline restorations, toe wood could be an alternative practice. Toe wood would be expected to be approximately 430% more expensive per linear foot of shoreline than soil lifts