Bassett Creek Watershed Management Commission Street Sweeping Prioritization Study

Prepared for
Bassett Creek Watershed Management Commission

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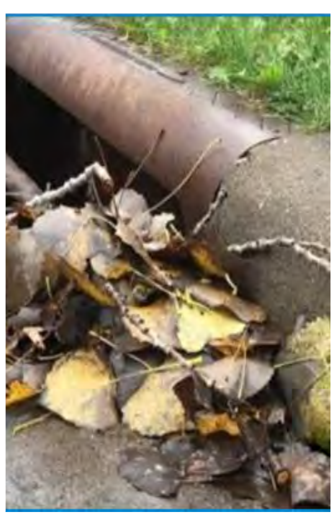

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September 2025

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Executive Summary

At their meeting in October 2024, the Commission approved a scope of work and directed the Commission Engineer to perform a street sweeping prioritization study to guide the most effective use of enhanced street sweeping to improve water quality in the watershed. The project began by collecting information on current sweeping operations in each city and Hennepin County (Table 2-3). Sweeping by cities varies widely across the watershed, ranging from only one sweep per year in Minnetonka to seven sweeps per year in Robbinsdale. Data gathering and modeling also included mapping tree canopy cover and use of the Commission's water quality model (P8) to understand where stormwater treatment is already in place.

The study evaluated the relative effectiveness of different street sweeping scenarios in terms of:

- Recovery: stormwater pollutants recovered/collected by sweepers.
- Reduction: pollution reduction to downstream waterbodies when existing best management practices (BMPs) are taken into account.
- Cost-benefit: calculated on a seasonal basis.

A Baseline Sweeping Scenario of one spring, one summer, and two fall sweeps was agreed upon by the Commission's Technical Advisory Committee (TAC) for the purposes of this project and used as a comparison to actual sweeping operations.

Results from this analysis indicate that if the Baseline Scenario was used across the whole watershed, an estimated additional 114 pounds of total phosphorus (TP) and 4,528 pounds of total suspended solids (TSS) would be prevented from reaching priority waterbodies each year (Table 3.2).

Results included in Table 3-3 and Table 3-4 present the estimated increase in pollutant removal benefits of moving to the Baseline Scenario by major subwatershed and by city. The Plymouth Creek East subwatershed receives the highest rank in terms of expected benefits in pollutant reduction to a receiving priority waterbody by subwatershed, while the City of Plymouth receives the highest rank in terms of pollutant reduction by city. Another way to analyze the data is to normalize it by curb mile (which removes the factor of subwatershed/city size and street area). Results normalized by curb mile, presented in Appendix C, indicate that the Lost Lake subwatershed ranks highest for pollutant reduction by subwatershed and the City of Medicine Lake ranks highest for pollutant reduction by city.

Cost-benefit analysis in this study supports the conclusion that street sweeping is a highly cost-effective BMP for phosphorus reduction (Hobbie et al, 2020; EOR, 2022), especially in highly developed watersheds with limited opportunities for structural BMP implementation. Conclusions include:

- Cost effectiveness of fall sweeping: The first sweep within a season results in the highest recovery value (per Kalinosky et al., 2015), and recovery decreases with each subsequent sweeping each season. Table 3-5 shows that the first fall sweeping has the most favorable cost-benefit and that even though the 2nd fall sweeping has a less favorable cost-benefit than the first fall sweeping, it is still similar to the first sweeping of the spring season. These results highlight the degree to which fall sweeping is more cost-effective than sweeping in the spring or summer.

- Cost efficiency: Table 3-5 shows a cost-benefit range of $170 to $830 per pound of TP recovery per year, generally increasing (i.e., becoming less efficient) as more seasonal sweeping is being conducted.

In addition to evaluating the water quality benefits of street sweeping toward reducing TSS and TP, the Commission also wanted to understand the potential for street sweeping to reduce chloride loading to downstream waterbodies. A literature review of current research on the subject, a survey of current de-icing practices in the watershed, and relevant TMDL findings were used to evaluate chloride reduction through sweeping. Based on the available data the study concludes that while street sweeping can be an important component of a city's larger effort for addressing chlorides and collecting excess salt before it's transported downstream to receiving waters, it is not an effective overall strategy for managing chloride loading. Under current practices, it's estimated that less than 0.01% of the chloride applied annually is removed through current sweeping practices in the BCWMC area. Further, while increasing winter sweeping could increase chloride reduction, there are challenges associated with this activity including difficulties sweeping during icy conditions, ineffectiveness of filters during wet conditions, and concerns about equipment corrosion.

Recommendations resulting from this study were developed based on coordination and review of key project results (e.g., cost-benefit analysis, prioritization results, etc.), discussion with BCWMC and member city staff, and from research and outreach activities conducted to develop the tools utilized in this and other similar studies.

- Mapping of prioritized street sweeping areas (Figure 3-1 and Figure 3-2) and tabular summaries comparing and ranking the relative effectiveness of evaluated sweeping scenarios (Table 3-3 and Table 3-4) could be used to develop enhanced street sweeping programs and policies in the BCWMC. Goals outlined in the BCWMC's draft 2026-2035 Watershed Management Plan should also be reviewed and considered when prioritizing enhanced sweeping efforts.

- BCWMC may consider review of their Capital Equipment Cost Share Policy to incorporate findings from this study. For example, to ensure that Commission funds are being allocated toward activities and priority areas that are anticipated to be most beneficial toward improving water quality within their priority waterbodies (Section 3.2, Table 3-4).

- Individual cities may use the study results to improve their own street sweeping efforts. For example, cities may review the relative ranking by city (Section 3.2, Table 3-3) to determine the value in increasing the number of seasonal street sweeping operations performed. They may also consider sharing cost-benefit information (Section 3.3) to internal stakeholders to demonstrate the value of enhanced street sweeping as a BMP for water quality improvement and/or achieving progress towards waste load allocation goals established by regional TMDLs.

1 Introduction and Project Background

Street sweeping is a critical non-structural best management practice (BMP) employed by cities throughout Minnesota for the purposes of maintaining road surfaces, improving public safety through clearing of walking lanes and trash removal, and improving water quality through the removal of accumulated sediment, bacteria, excess chlorides, and vegetation detritus (e.g., grass clippings and leaf litter). The water quality impact of street sweeping is a topic of emerging research in Minnesota; recent studies promote the practice as a highly cost-effective BMP for phosphorus reduction to downstream waterbodies (Hobbie et al, 2020; EOR, 2022). Many cities and other transportation authorities are considering ways to enhance their existing street sweeping efforts to improve water quality benefits.

The Bassett Creek Watershed Management Commission's (BCWMC) draft 2026-2035 Watershed Management Plan (BCWMC, 2025) identifies several goals related to reducing pollution from stormwater including achieving nutrient standards in Medicine Lake, significantly improving water quality in Lost and Northwood Lakes, and maintaining or improving water quality in all other priority lakes and streams.

In consideration of recent research and alignment with the goals outlined in their draft Watershed Management Plan, the BCWMC conducted a study to evaluate the potential benefits of implementing enhanced street sweeping within the Bassett Creek Watershed. The study included conducting a survey to better understand existing street sweeping programs throughout the BCWMC, developing a methodology to rank and prioritize areas for enhanced sweeping, and estimating the benefits of additional sweeping within the watershed. Specific objectives of this street sweeping study are outlined below:

- Evaluate pollutant recovery and reduction accomplished by existing street sweeping programs throughout the BCWMC (Section 2)
- Evaluate potential pollutant reduction through new street sweeping scenarios identified by the Commission (Section 3)
- Evaluate the cost-benefit of seasonal street sweeping operations (Section 3.3)
- Evaluate the effectiveness of street sweeping as a chloride reduction practice (Section 4)
- Provide a summary of general guidance and recommendations for enhanced street sweeping within the watershed (Section 5)

The following technical report summarizes the methodology used to evaluate and prioritize street sweeping efforts, evaluate the effectiveness and cost-benefit of various street sweeping scenarios for total phosphorus (TP), total suspended sediment (TSS), and chloride management, and outlines general recommendations regarding street sweeping implementation and best practices.

2 Watershed-Wide Evaluation of Street Sweeping: Existing Conditions

Before evaluating opportunities and estimating the pollutant removal benefits of enhanced street sweeping, which includes prioritizing street sweeping areas, it was critical to first develop a methodology to evaluate the effectiveness of existing street sweeping operations within the BCWMC. The following subsections outline the methodology used to evaluate (a) pollutant loading from stormwater runoff within the Bassett Creek Watershed, (b) street sweeping pollutant recovery based on existing sweeping operations, and (c) street sweeping pollutant reduction to receiving waterbodies. A high-level overview of the models and calculations used to evaluate existing street sweeping performance is included below:

1) Barr Engineering Company's (Barr) GIS-based water quality model (GIS WQM) was used to evaluate (a) pollutant loading from stormwater runoff throughout the BCWMC and (b) street sweeping recovery based on existing street sweeping operations (Section 2.3).

2) The BCWMC's existing P8 water quality models were used to estimate the cumulative pollutant load reduction from existing water quality BMPs in all modeled subwatersheds included within this study (Section 2.4).

3) Results from the GIS WQM and P8 models were combined to estimate the pollutant load recovery and pollutant load reduction throughout the BCWMC (Section 2.5).

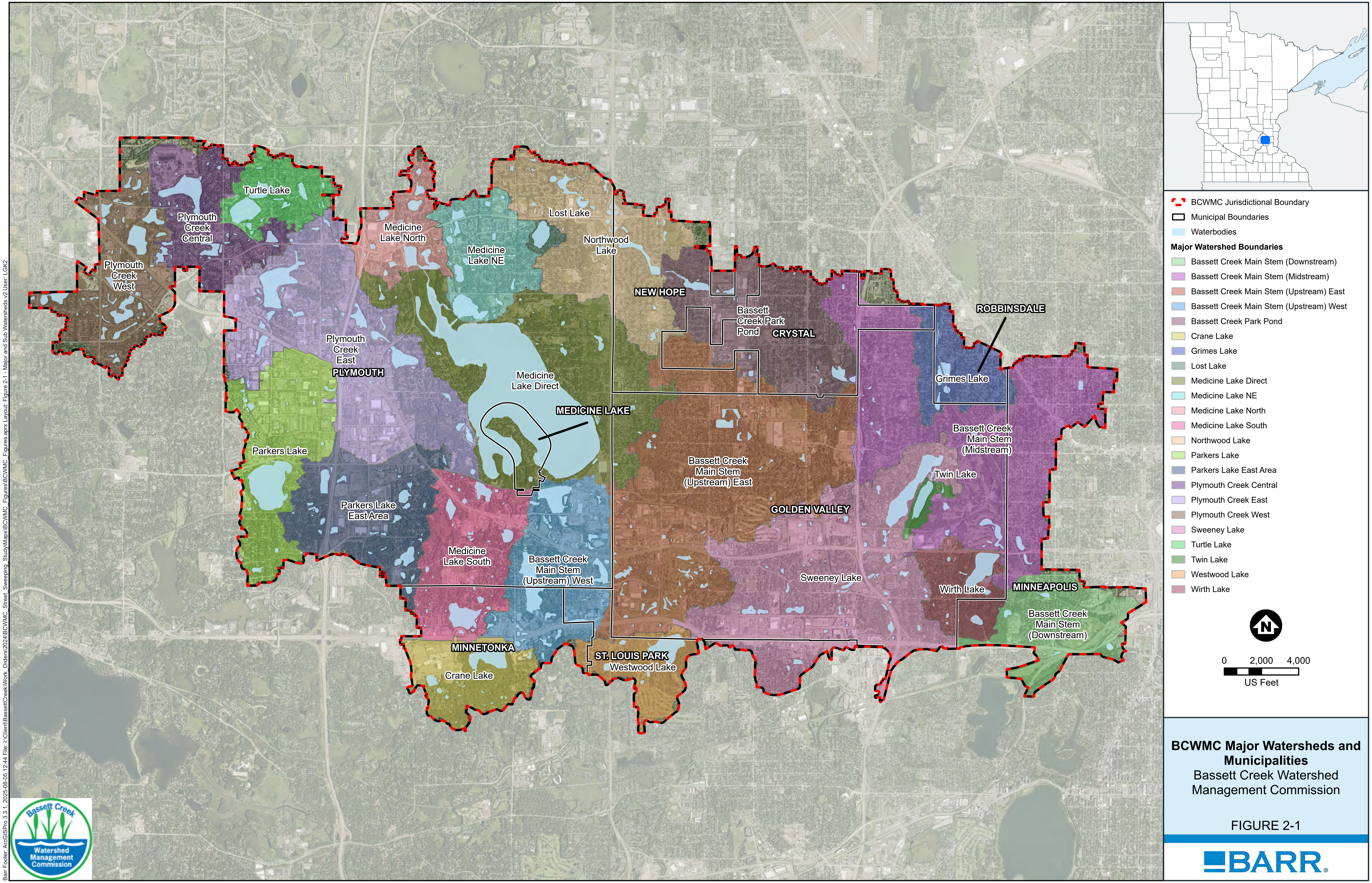
Information in the following subsections describes model development and methodology used to evaluate the effectiveness of street sweeping operations. Throughout this report, results are summarized watershed-wide, but also by municipality and by major subwatershed. This is done to allow for comparison of existing street sweeping operations within each city, comparison of street sweeping effectiveness within major subwatersheds, and estimation of street sweeping recovery and reduction to receiving waterbodies. Table 2-1, Table 2-2, and Figure 2-1 provide a summary of the municipal and major subwatershed area boundaries utilized in this study. As shown in Table 2-1, "Curb Length" equates to the length of street curb miles (accounting separately for each side of the street) within each of the member cities, within the boundaries of the BCWMC. "Road Area" is the proportion of each municipality that is covered in roadway, and "Average Canopy Cover over Roads" is the average amount of the roadway area within each of the municipalities that is covered by overhanging tree canopy. Similarly, within Table 2-2, these factors are summarized by major subwatershed.

Table 2-1 Municipal Area Summary

Municipality	Area Summary within BCWMC Hydrologic Boundary				
	Area (acres)	Area (% of study area)	Curb Length (miles)	Road Area (%)	Avg. Canopy Cover over Roads (%)
Plymouth	11,625	46%	398	8%	5%
Golden Valley	6,664	26%	295	10%	5%
Minneapolis	1,838	7%	105	12%	15%
Crystal	1,272	5%	68	11%	4%
New Hope	1,233	5%	59	9%	2%
Minnetonka	1,217	5%	48	10%	13%
St. Louis Park	791	3%	36	11%	6%
Robbinsdale	348	1%	23	13%	12%
Medicine Lake	237	1%	3	2%	23%

Table 2-2 Major SubWatershed Area Summary

Major SubWatershed	Area (acres)	Curb Length (miles)	Road Area (%)	Avg. Canopy Cover over Roads (%)
Bassett Creek Main Stem (Downstream)	794	36	11.4%	7.9%
Bassett Creek Main Stem (Midstream)	2416	134	11.6%	11.9%
Bassett Creek Main Stem (Upstream) East	2852	123	9.9%	3.3%
Bassett Creek Main Stem (Upstream) West	1064	39	9.9%	5.5%
Bassett Creek Park Pond	1254	59	9.8%	4.5%
Crane Lake	566	20	7.9%	22.0%
Grimes Lake	499	30	11.7%	11.9%
Lost Lake	55	2	5.8%	19.3%
Medicine Lake Direct	2506	71	6.3%	7.1%
Medicine Lake NE	665	26	7.6%	4.8%
Medicine Lake North	490	19	9.5%	2.0%
Medicine Lake South	934	31	8.4%	9.8%
Northwood Lake	1324	62	10.2%	2.8%
Parkers Lake	1065	32	6.5%	5.6%
Parkers Lake East Area	1059	39	8.8%	8.3%
Plymouth Creek Central	801	33	8.6%	2.2%
Plymouth Creek East	2045	69	8.8%	3.9%
Plymouth Creek West	1059	40	8.7%	1.6%
Sweeney Lake	2400	125	13.1%	4.6%
Turtle Lake	416	17	8.1%	2.9%
Twin Lake	77	2	3.7%	16.5%
Westwood Lake	449	11	5.2%	10.9%
Wirth Lake	434	16	8.7%	17.7%



BCWMC Major Watersheds and Municipalities
Bassett Creek Watershed Management Commission

FIGURE 2-1

2.1 Summary of existing street sweeping operations

As a first step, it was critical to understand existing street sweeping operations throughout the BCWMC. The BCWMC contains roadways that are owned and maintained by its member cities as well as other transportation authorities - Hennepin County and the State of Minnesota (through the MN Department of Transportation). In the winter of 2024, Barr and Commission staff developed a draft list of survey questions to obtain more information on existing street sweeping operations within the BCWMC. The draft survey was reviewed and updated based on comments from a technical advisory group consisting of staff from the City of Plymouth and City of Golden Valley. The final survey was distributed to member cities, Hennepin County, and MnDOT in January 2025. Ten of the eleven organizations that were requested to complete the BCWMC street sweeping survey provided information. The MnDOT did not complete the survey. A complete record of all survey responses is included in **Appendix A**. Key questions from the survey and a summary of general responses to each are provided in Table 2-3:

Table 2-3 Municipal Street Sweeping Survey Response Summary

Organization	Question: How many routine street sweeping events are conducted per year and when does sweeping usually occur?	Question: What type and how many sweepers are used?	Question: Are certain areas swept more frequently than others?	Sweepings per season assumptions for modeling (#/season)			Question: What are your biggest barriers to street sweeping?
				Spring	Summer	Fall	
Minneapolis	Two comprehensive sweeps in the spring and fall, entertainment and event areas 7-day cycles, chain of lakes, parkways on a 15-day cycle through the summer. Commercial node and AD50 area 30-day cycle, and residential neighborhoods 3-5 times a summer.	Eleven mechanical, 5 regenerative and two small vacuum sweepers for bike lanes.	Yes, due to location to water bodies, economic, commercial activity, and the number of people using the area.	1	4	1	On-street parking and sweep transfer points for handling materials
St Louis Park	Typically early spring, late spring, summer, and fall.	We have two mechanical sweepers. We also hire additional sweepers in the spring to sweep the entire city within a few days.	We have priority areas that are swept first and they are determined by traffic volumes, street slopes, and proximity to water bodies.	2	1	1	Typically seasonal conditions in the fall and spring; can't sweep the ice.
Minnetonka	One citywide sweep in the spring, and one specialized sweeping area in a subwatershed in the fall in the Nine Mile Creek Watershed.	Three Elgin Pelican mechanical sweepers are used.	One subwatershed area is swept in the fall as part of a water quality improvement project (Nine Mile Creek Watershed).	1	0	0	No significant barriers during sweeping operations. The frequency of sweeping is limited by available staff.
Golden Valley	Three full sweeping events: spring, summer, and fall.	Mechanical Sweepers, Toolcats, loaders, trackless, dump trucks, a total of 12 pieces of equipment are used	No. We do start in priority areas that drain directly to the creek.	1	1	1	Weather, staff time, and budget
Hennepin County	We do a complete sweeping every spring and fall, with spot sweeping done throughout the year as needed.	Mechanical	--	1	0	1	On-street parking
Plymouth[1]	Sweep at least 3 times a year (spring, early summer and late summer/early fall) and try to get a 4th if possible. Sweep main roads that don't have residential properties off of them to collect leaves/debris. We do not sweep roads in residential areas in the fall for leaves, due to storage limitations of that debris. Also do special event/main roads, etc. but we didn't account for that.	2 mechanical pelicans, 1 regenerative Tymco	Yes, we typically sweep some trouble spots after heavier rain events. Most are around Medicine Lake.	1	2	1	Garbage cans placed in the streets. We try to schedule not to sweep in garbage zones for that day.
New Hope[2]	The city completes one city-wide sweeping in the spring, and one city-wide sweeping in the fall. We sweep both the Meadow Lake and Northwood Lake areas at least once per month. If we have a big storm event that drops leaves/debris, we will sweep these areas again, so that would be the "or more" situation.	The city owns one dustless vacuum sweeper that is used by city staff throughout the year. Multiple mechanical sweepers are used during the two contracted city-wide sweepings in the spring and fall.	Aside from these city-wide contracted sweepings, the city operates one sweeper that sweeps Meadow Lake and Northwood Lake subwatersheds on a routine basis (monthly or more).	1	0	1	Staff availability and budget
Robbinsdale	Streets – These are swept 2 times in the spring, then approx. once each month after that until freeze. Usually twice in the fall. So, depending on spring melt, April-November, 7 to 9 times annually.	One mechanical sweeper.	Yes, heavy traffic areas, mostly State Aid roads and streets near the lakes.	2	3	2	Staffing (it is hard to dedicate one person to this all the time as we have other work demands), on-street parking is also a challenge for us. Screening and disposal is time consuming and expensive. (We just ordered a screener so this might get better?)
Crystal	We typically sweep once in the spring and summer and two to three times in the fall, weather permitting.	One mechanical and one regenerative air.	We have an area by the lake that has become a priority area	1	1	2	Time and budget
Medicine Lake[3]	1 time in the spring; 1 time in the fall	--	--	1	0	1	--
MnDOT[4]	*No response provided to street sweeping survey*	*No response provided to street sweeping survey*	*No response provided to street sweeping survey*	0	0	0	*No response provided to street sweeping survey*

[1] Number of sweeps per season pertains to non-residential roads in the City of Plymouth. Residential roads are not swept in the fall.
[2] Areas around Northwood and Meadow Lake were given a sweeping frequency of 4-4-4.
[3] Responses for Medicine Lake were provided by the City of Plymouth who is responsible for Medicine Lake's street sweeping.
[4] For the baseline sweeping analysis, it was assumed that MnDOT does not routinely sweep state-owned highways and interstates within the BCWMC. This assumption was made to be most conservative for the baseline scenario and given no response was provided by MnDOT on the sweeping survey.

2.2 Street sweeping: Pollutant recovery vs reduction

Recent street sweeping studies have made a distinction between pollutant "recovery" versus pollutant "reduction" (EOR, 2022). Within this study, the terms are defined as follows:

- **Pollutant recovery**: the mass of pollutants collected from the swept surface during street sweeping operations.

- **Pollutant reduction**: the mass of pollutants prevented from reaching downstream waterbodies.

Results from research conducted on this topic have been utilized to develop street sweeping recovery "calculators" to estimate pollutant load recovery associated with street sweeping operations (Kalinosky et al., 2015; Hobbie et al, 2020), including the recently published MPCA Street Sweeping Calculator. While the estimation of pollutant mass recovery is critical to evaluating the performance of street sweeping operations, it is important to acknowledge that not every pound of pollutant "recovered" via street sweeping equates to a pound of pollutant "reduced" to downstream receiving waterbodies. Examples of processes impacting the relationship between recovery and reduction include:

- **Downstream water quality treatment**: If there are BMPs downstream of street sweeping operations, material removed via street sweeping may have instead been removed by the downstream BMP, such as a stormwater pond, in the absence of sweeping.

- **Bioavailability**: Total phosphorus held in leaf litter and other sources may not decompose and become biologically available in receiving waterbodies.

- **Pollutant delivery**: Some fraction of the pollutants residing on a street may not have been conveyed to downstream waterbodies in the absence of street sweeping. E.g., wind action may move leaf material from the street into a park where it degrades over the winter and following spring, never reaching a downstream waterbody.

The purpose of this section and definitions is to highlight that (a) a majority of modern studies have focused on estimating pollutant recovery from street sweeping and that (b) pollutant reduction is equal to or less than pollutant recovery. While this study attempts to account for the impact of downstream water quality treatment (BMPs) within the Bassett Creek watershed, it does not account for processes related to bioavailability or pollutant delivery, which have not been well studied and are outside of the focus of this study. For this reason, pollutant reduction cited in the study should only be used for relative comparison and prioritization of street sweeping efforts within the Bassett Creek watershed. Calculation of street sweeping recovery is discussed further in Section 2.3, and calculation of street sweeping reduction to priority waterbodies is discussed in Section 2.5.

2.3 GIS WQM: Pollutant loading and street sweeping recovery

Barr's GIS WQM is a GIS-based water quality model used to estimate pollutant loading and BMP performance. For this study, only the pollutant loading and street sweeping modules within the GIS WQM were utilized. A complete description of methodology used in the GIS WQM can be found in the City of Richfield Street Sweeping Prioritization Study technical memorandum (Barr, 2021).

To analyze pollutant loading and street sweeping recovery using the GIS WQM, the following datasets were used:

- **Watershed imperviousness**: Directly connected imperviousness was estimated using land use-based assumptions and impervious surface data from a combination of 2024 NearMap aerial imagery, Microsoft Building Footprints, and 2022 MnDOT data.

- **Canopy cover**: Barr developed tree canopy cover estimates using GIS processing techniques referencing 2024 NearMap.

- **Road surfaces**: Barr developed road surface polylines (GIS delineations that identify the locations of road surfaces) and delineated road surface area using MnDOT 2022 data. Road surfaces were then checked for accuracy with 2024 aerial imagery.

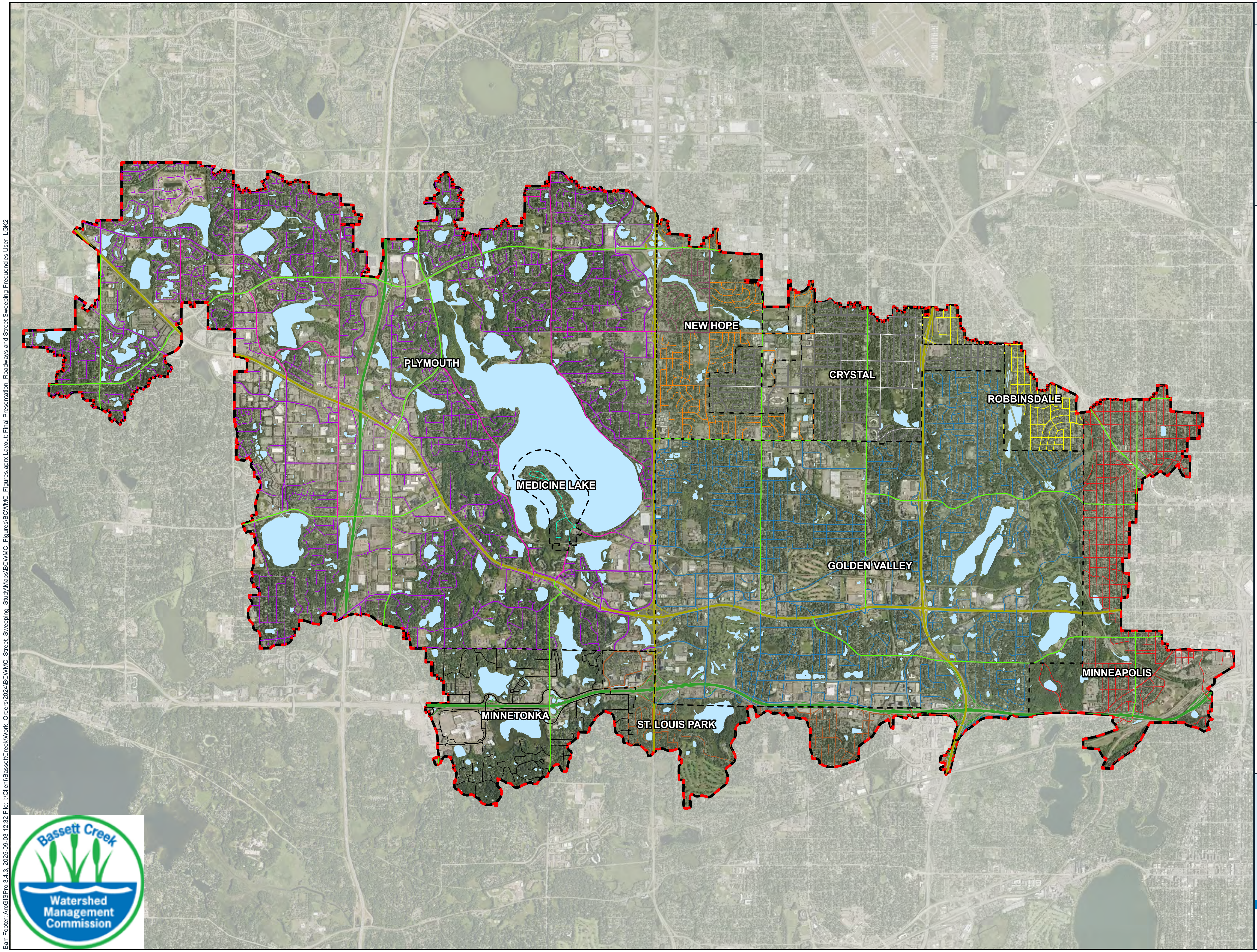
- **Street sweeping frequency**: The seasonal street sweeping frequency assumed for operations within the BCWMC (by member cities, Hennepin County, and MnDOT) was developed using survey responses and assumptions outlined in Table 2-3.

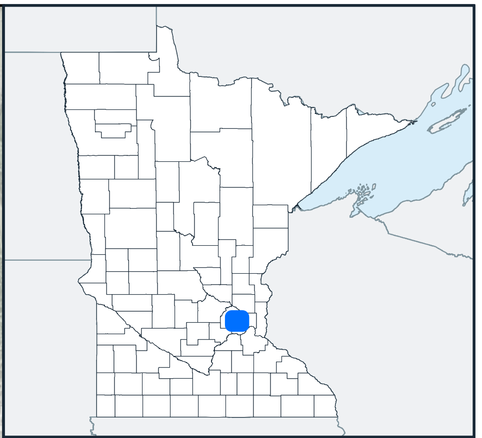
The following provides a high-level overview of processing used to develop pollutant loading values and estimates of street sweeping recovery:

- **Pollutant loading**: TP and TSS loadings were estimated within the GIS WQM based on directly connected imperviousness (Barr, 2020).

- **Street sweeping recovery**: Street sweeping pollutant recovery is estimated using empirical relationships for TSS and TP developed by Sutherland and Jelen, 1997 and Kalinosky et al., 2015. These empirical relationships are a function of canopy cover, average sweeping interval, and regression coefficients which vary by month to reflect seasonal phosphorus loading conditions.

Figure 2-2shows the road areas, maintenance authorities, and simulated baseline seasonal street sweeping frequency for roadways across the BCWMC. Finer resolution maps for these areas are included in **Appendix B**. Figure 2-3 through Figure 2-5 show the percent canopy cover, percent impervious cover, and estimated areal TP loading rate for all areas within the BCWMC legal boundary, respectively.





- BCWMC Jurisdictional Boundary
- Municipal Boundaries
- Waterbodies

Street Sweeping Frequencies *

- CRYSTAL - 1 Sp/1 Su/2 F
- GOLDEN VALLEY - 1 Sp/1 Su/1 F
- MEDICINE LAKE - 1 Sp/0 Su/1 F
- MINNEAPOLIS - 1 Sp/4 Su/1 F
- MINNETONKA - 1 Sp/0 Su/0 F
- NEW HOPE - 1 Sp/0 Su/1 F
- NEW HOPE/NORTHWOOD LAKE - 4 Sp/4 Su/4 F
- ROBBINSDALE - 2 Sp/3 Su/2 F
- PLYMOUTH RESIDENTIAL - 2 Sp/1 Su/0 F
- PLYMOUTH NONRESIDENTIAL - 2 Sp/1 Su/1 F
- ST. LOUIS PARK - 2 Sp/1 Su/1 F
- HENNEPIN COUNTY - 1 Sp/0 Su/1 F
- STATE HIGHWAY - 0 Sp/0 Su/0 F
- INTERSTATE - 0 Sp/0 Su/0 F

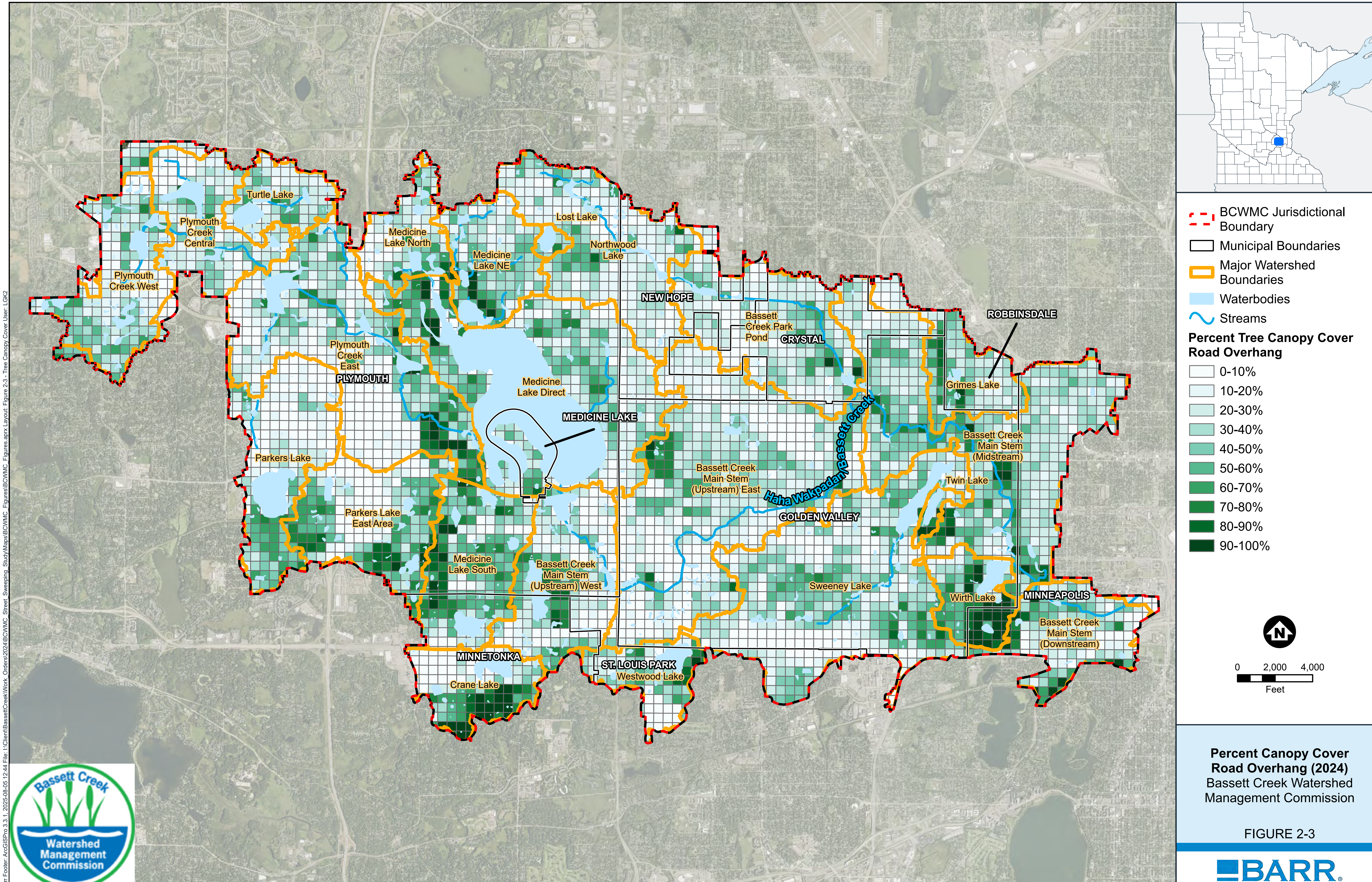
* Sp = spring
Su = summer
F = fall

0 2,500 5,000
Feet

Road Areas and Existing Street Sweeping Frequency
Bassett Creek Watershed Management Commission

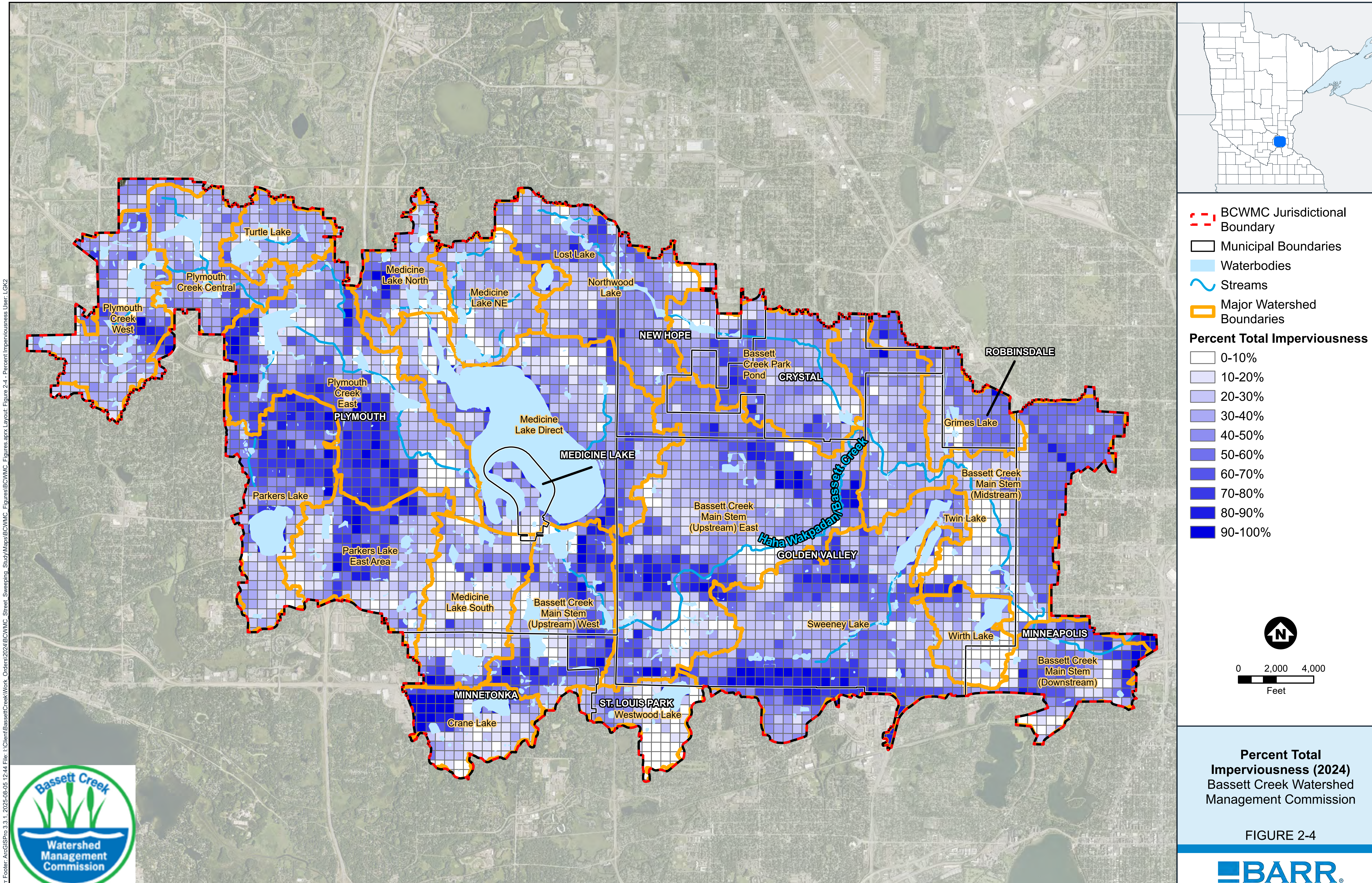
FIGURE 2-2

BARR



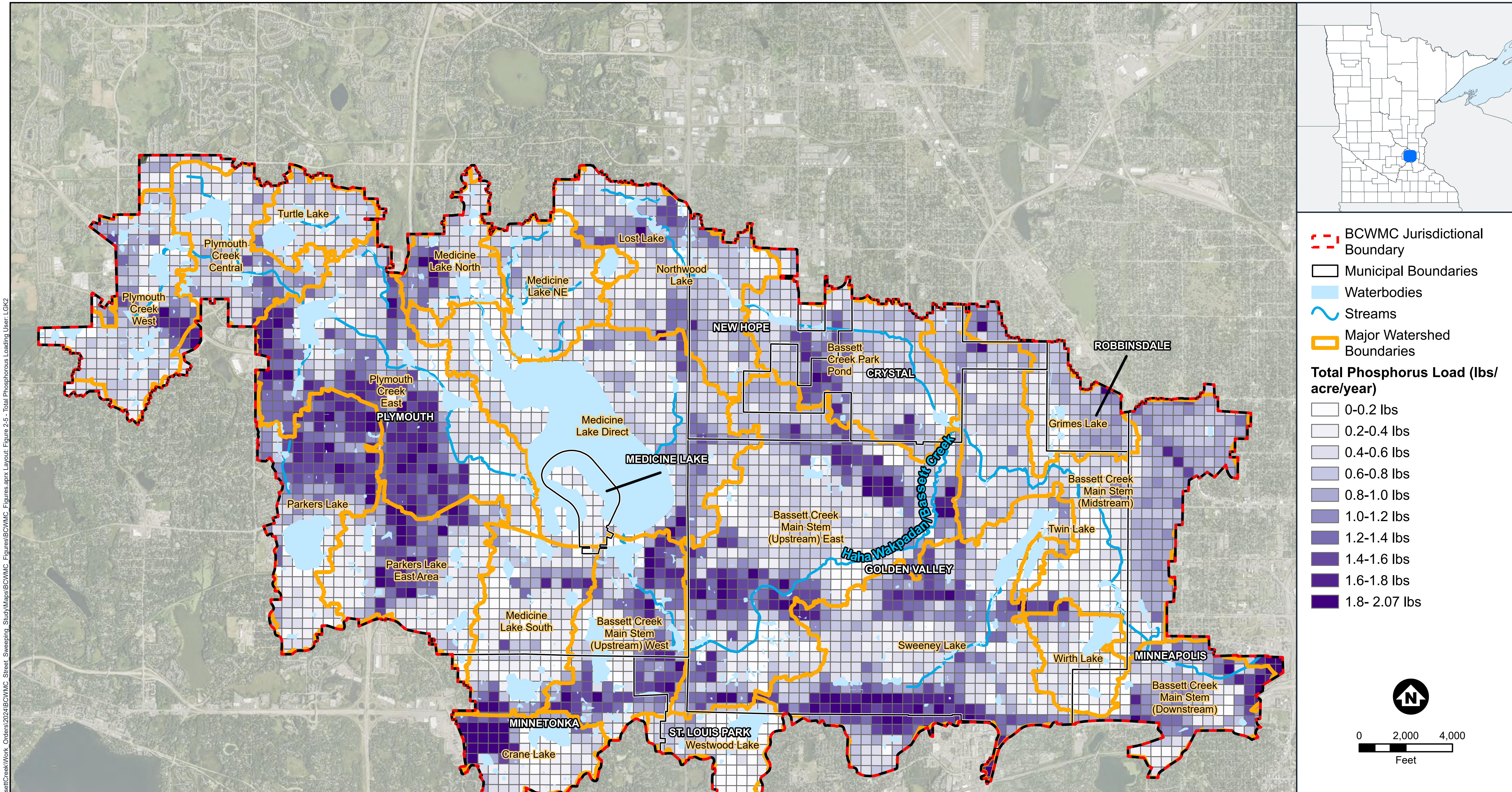
Percent Canopy Cover Road Overhang (2024)
Bassett Creek Watershed Management Commission

FIGURE 2-3



Percent Total Imperviousness (2024)
Bassett Creek Watershed Management Commission

FIGURE 2-4



Estimated Areal Total Phosphorus Loading
Bassett Creek Watershed Management Commission

FIGURE 2-5

2.4 P8: Downstream treatment from existing BMPs

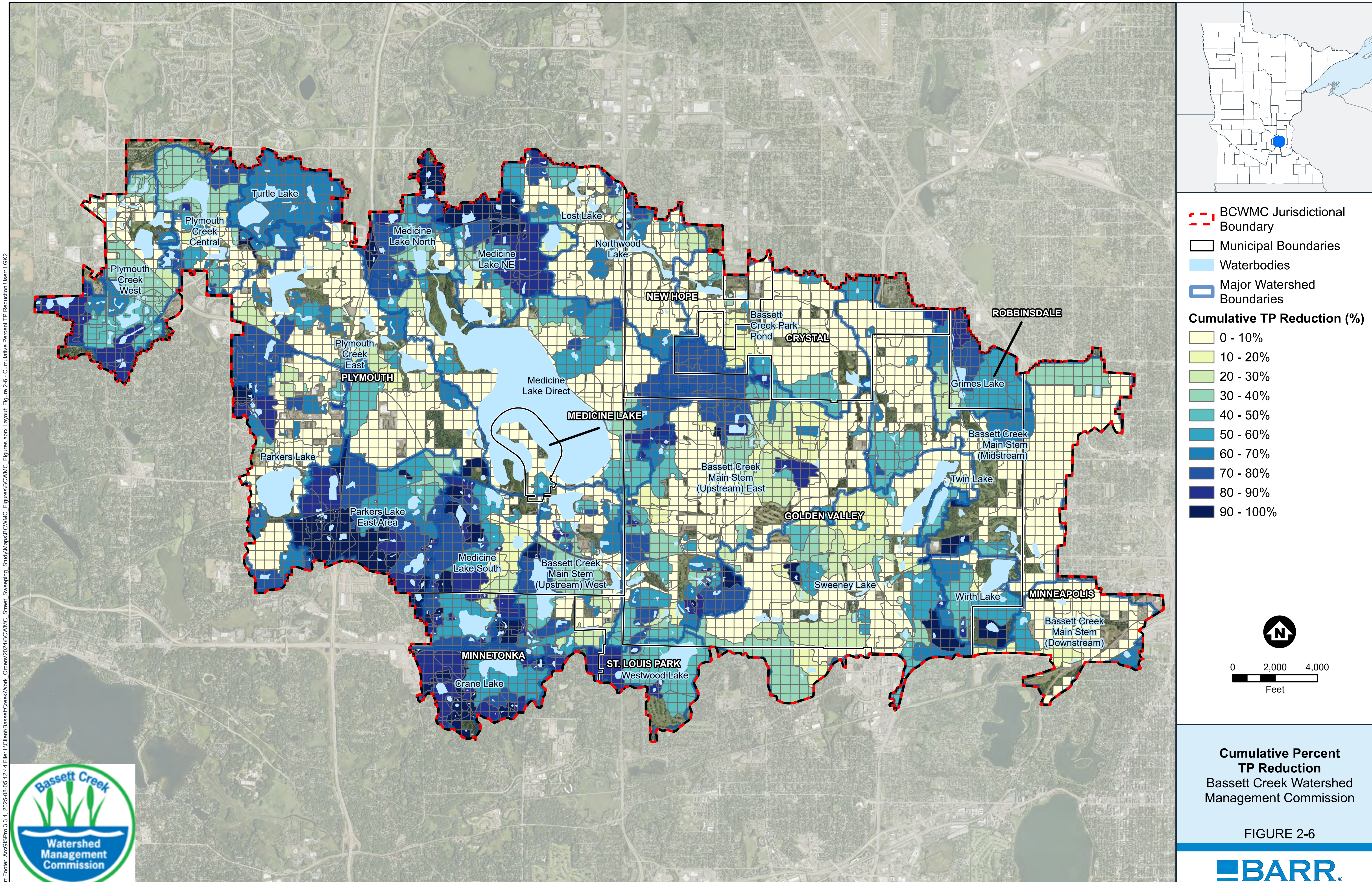
The BCWMC's P8 models were used to evaluate the amount of pollution reduction being achieved by existing water quality BMPs within the watershed. Results from the P8 models were used to estimate the percent (%) of cumulative pollutant load reduction occurring downstream from all modeled P8 catchments (i.e., downstream water quality treatment, as described in Section 2.2). This information was then used to calculate street sweeping pollutant reduction to downstream waterbodies as shown below in Equation 1:

[1]

$$Street\ Sweeping\ Pollutant\ Reduction\ to\ Waterbody\ \left(\frac{lbs}{yr}\right) = Street\ Sweeping\ Pollutant\ Recovery\ \left(\frac{lbs}{yr}\right) \times (1 - Existing\ Cumulative\ Downstream\ Pollutant\ Reduction\ (\%))$$

Calculation of pollutant reduction is a useful metric for evaluating street sweeping prioritization efforts, as this value more closely approximates the amount of pollutant reduction that could be anticipated to the BCWMC's (receiving) priority waterbodies.

Figure 2-6 shows the cumulative TP reduction calculated across the Bassett Creek Watershed using the BCWMC's P8 models. As described above, the cumulative reduction figure highlights TP reduction achieved by existing water quality BMPs within the watershed. A value of 0% cumulative reduction indicates that there are no intermediate water quality BMPs between that point and the receiving priority waterbody. In these areas, raw street sweeping pollutant "recovery" is equivalent to street sweeping pollutant "reduction" to the priority waterbody (see discussion in Section 2.2). In other areas (i.e., areas tributary to intermediate water quality BMPs), pollutant reduction associated with street sweeping to the priority waterbody is estimated using Equation 1.



Cumulative Percent TP Reduction
Bassett Creek Watershed Management Commission

FIGURE 2-6

2.5 Watershed-wide street sweeping summary: Existing conditions

Using the methodology described in Sections 2.3 and Section 2.4, street sweeping pollutant recovery and reduction were evaluated for all areas within the BCWMC. Table 2-4 and Table 2-5 provide a summary of estimated street sweeping TSS and TP recovery and reduction, respectively, based on the reported existing street sweeping routines. As outlined in Section 2.4, pollutant reduction more-closely approximates the pollutant load kept out of downstream waterbodies by street sweeping operations. Table 2-4 shows that existing street sweeping operations are estimated to recover 2.3% of the estimated annual TSS loading from the watershed and 3.5% of the annual total phosphorus loading within the BCWMC. Table 2-5 shows this is expected to equate to about 1.3% of annual TSS and 2.6% of annual TP load reduction prior to discharge to BCWMC's priority water bodies.

Table 2-4 BCWMC Existing Street Sweeping Performance: Pollutant Recovery (collected by sweepers)

Pollutant	Estimated Current Total Loading (lb/yr)	Estimated Street Sweeping Recovery (lb/yr)	Estimated Street Sweeping Recovery (%)
TP	17,447	617	3.5%
TSS	5,270,976	121,667	2.3%

Table 2-5 BCWMC Existing Street Sweeping Performance: Pollutant Reduction (prevented from entering downstream waterbodies)

Pollutant	Estimated Current Total Loading (lb/yr)	Estimated Street Sweeping Reduction (lb/yr)	Estimated Street Sweeping Reduction (%)
TP	17,447	455	2.6%
TSS	5,270,976	67,684	1.3%

Using subwatersheds delineated within the GIS WQM model, results shown in Table 2-4 and Table 2-5 can be easily recalculated at a variety of scales. Table 2-6 shows TP recovery and reduction calculations for each major subwatershed within the Commission. **Appendix C** presents TSS and TP recovery and reduction results by municipality and by major subwatershed.

Table 2-6 BCWMC Existing Street Sweeping Performance: TP Recovery and Reduction by Major Subwatershed

Major Subwatershed	Area (acres)	Estimated Current TP Loading (lbs/yr)	Estimated Removals			
			Street Sweeping: Recovery		Street Sweeping: Reduction	
			Recovery (lbs/yr)	Recovery (%)	Reduction (lbs/yr)	Reduction (%)
Bassett Creek Main Stem (Downstream)	794	650	36	5.5%	34	5.2%
Bassett Creek Main Stem (Midstream)	2416	1,537	149	9.7%	135	9.2%
Bassett Creek Main Stem (Upstream) East	2852	2,218	62	2.8%	44	2.0%
Bassett Creek Main Stem (Upstream) West	1064	959	13	1.3%	9	0.9%
Bassett Creek Park Pond	1254	919	38	4.2%	36	3.9%
Crane Lake	566	397	5	1.4%	1	0.3%
Grimes Lake	499	323	36	11.1%	14	4.3%
Lost Lake	55	15	1	7.2%	1	6.2%
Medicine Lake Direct	2506	986	37	3.7%	27	2.7%
Medicine Lake NE	665	313	10	3.3%	4	1.1%
Medicine Lake North	490	327	6	1.8%	2	0.7%
Medicine Lake South	934	479	12	2.6%	6	1.3%
Northwood Lake	1324	915	34	3.7%	30	3.3%
Parkers Lake	1065	1,001	14	1.4%	11	1.1%
Parkers Lake East Area	1059	828	16	1.9%	3	0.4%
Plymouth Creek Central	801	475	12	2.6%	7	1.6%
Plymouth Creek East	2045	1,884	26	1.4%	21	1.1%
Plymouth Creek West	1059	637	13	2.0%	6	1.0%
Sweeney Lake	2400	2,053	64	3.1%	50	2.5%
Turtle Lake	416	203	6	3.1%	2	1.2%
Twin Lake	77	24	1	5.3%	1	2.4%
Westwood Lake	449	136	9	6.3%	3	2.7%
Wirth Lake	434	167	16	9.7%	7	4.7%
TOTAL	**25,226**	**17,447**	**617**	**3.5%**	**455**	**2.6%**

3 Street Sweeping Scenario Evaluation and Prioritization Mapping

In addition to modeling and evaluating the pollutant recovery efficiency of existing street sweeping operations, the developed GIS WQM model is capable of rapid evaluation of alternative street sweeping routines. For the purposes of this study, we evaluated an additional (watershed-wide) street sweeping scenario to assess impact and consider prioritization, using the following modeling analysis.

- **Scenario Analysis**: Evaluate alternative street sweeping scenario (Section 3.1).
- **Prioritization**: Utilize the results from the modeling scenario to develop street sweeping prioritization mapping (Section 3.2).
- **Cost-benefit**: Estimate the cost associated with completing seasonal street sweeping and calculate the cost-benefit based on both pollutant recovery and pollutant reduction to priority waterbodies (Section 3.3).

The following subsections outline scenario modeling and results, prioritization methodology, and mapping for evaluated street sweeping scenarios.

3.1 Street sweeping baseline scenario

To better understand the potential impact of changes to municipal street sweeping operations, BCWMC requested that Barr evaluate a uniform watershed-wide sweeping approach. This “Baseline Scenario” evaluates the impact of one watershed-wide street sweeping approach applied across the entire Bassett Creek Watershed: one spring sweeping, one summer sweeping, and two fall sweepings. (Section 3.2). The Baseline Scenario was selected at the BCWMC’s June 4, 2025 technical advisory committee (TAC) meeting and was selected to (1) establish a “baseline” seasonal street sweeping frequency for consideration by member cities and (2) develop a watershed-wide street sweeping approach to facilitate uniform prioritization (i.e., model and evaluate a consistent street sweeping modeling scenario across the study area to allow for equivalent comparison of relative street sweeping priority throughout the Bassett Creek Watershed).

Analyzing this scenario also allows for comparison of the estimated pollutant removal benefits achieved from the Baseline Scenario to results from existing street sweeping operations. This analysis provides an unbiased comparison of which areas throughout the Commission could benefit most from increasing existing seasonal street sweeping operations up to the Baseline Scenario (see Section 3.2).

Street sweeping pollutant recovery and reduction results for existing conditions and the Baseline Scenario are compared in Table 3-1 and Table 3-2. As can be seen, the Baseline Scenario resulted in higher recovery and reduction values than existing street sweeping operations. **Appendix C** presents TSS and TP recovery and reduction results by municipality and major subwatershed for existing conditions vs the Baseline Scenario, which can be used to evaluate the relative impact of each street sweeping scenario within specific cities and major subwatersheds.

Table 3-1 BCWMC Street Sweeping Recovery Results for Existing Conditions vs. Baseline Scenario

Pollutant	Estimated Current Total Loading (lbs/yr)	Estimated Street Sweeping Recovery by Scenario			
		Existing Conditions		Baseline Scenario (1-1-2)	
		Recovery (lbs/yr)	Recovery (%)	Recovery (lbs/yr)	Recovery (%)
TP	17,447	617	3.5%	820	4.7%
TSS	5,270,976	121,667	2.3%	136,223	2.6%

Table 3-2 BCWMC Street Sweeping Reduction Results for Existing Conditions vs. Baseline Scenario

Pollutant	Estimated Current Total Loading (lbs/yr)	Estimated Street Sweeping Reduction by Scenario			
		Existing Conditions		Baseline Scenario (1-1-2)	
		Reduction (lbs/yr)	Reduction (%)	Reduction (lbs/yr)	Reduction (%)
TP	17,447	455	2.6%	569	3.3%
TSS	5,270,976	67,684	1.3%	72,212	1.4%

3.2 Watershed-wide street sweeping prioritization

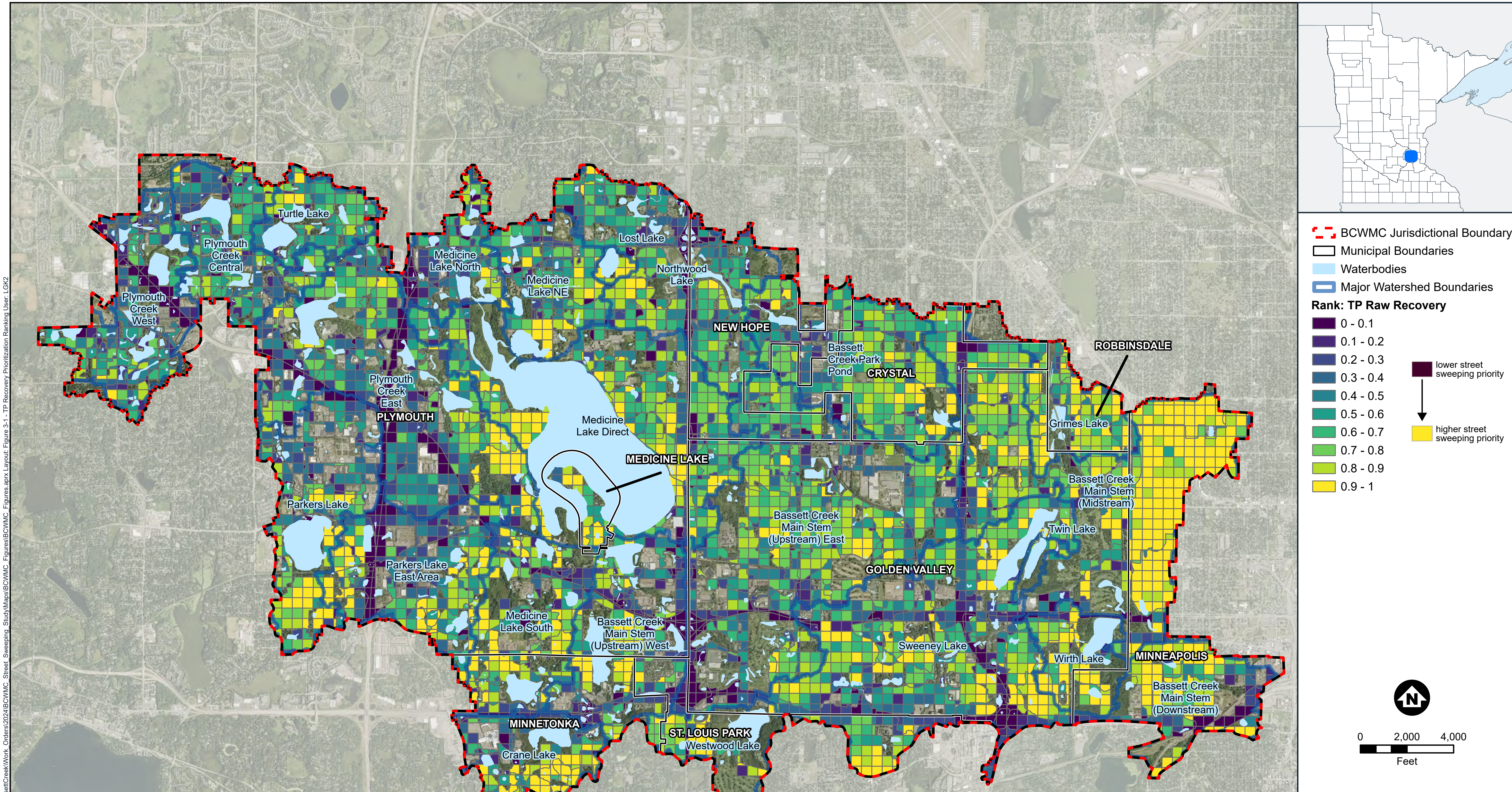
Utilizing results from the GIS WQM model, the relative effectiveness of street sweeping can be evaluated by subwatershed. Specifically, the value of pollutant load reduction per curb-mile can be evaluated and compared to determine where street sweeping is most and least effective across the Commission. Street sweeping prioritization can be evaluated utilizing recovery or reduction results. The summary below compares the pros and cons of these strategies:

- **Recovery prioritization**: Prioritizes street sweeping by evaluating total TSS and TP pollutant recovery across the Commission.
    - **Pros**: Priority areas can be identified consistently, watershed-wide (not reliant on P8 results).
    - **Cons**: Does not account for BMP treatment opportunities downstream of street sweeping areas (i.e., does not prioritize based on pollutant reduction to downstream, receiving waterbodies).
- **Reduction prioritization**: Prioritizes street sweeping by evaluating total TSS and TP pollutant reduction to receiving waterbodies.
    - **Pros**: Accounts for downstream treatment/attempts to more closely approximate the pollutant load reduction to receiving waterbodies.
    - **Cons**: Reduction priority can only be evaluated in areas where water quality modeling has been performed.

Using GIS WQM and P8 cumulative pollutant reduction results (Figure 2-6), total recovery and reduction values were calculated at a smaller scale (average size: 2.3 acres) utilizing results from the watershed-wide Baseline Scenario (see Section 3.1). Specifically, recovery and reduction values per curb-mile were calculated, normalized, and ranked for all modeled GIS WQM subwatershed-grid areas to produce a final ranking value (1 = highest-ranked priority area, 0 = lowest-ranked priority area).

Figure 3-1 and Figure 3-2 display prioritization rankings at the subwatershed scale for both TP recovery and reduction, respectively. Prioritization ranking for pollutant recovery is primarily a function of tree canopy density over street areas, while prioritization ranking for total reduction is additionally a function of cumulative pollutant reduction achieved by structural BMPs downstream of the street sweeping area (see Figure 2-6).

While review of Figure 3-1 and Figure 3-2 can be used to identify areas of higher and lower prioritization throughout the watershed, results at this scale may be difficult to incorporate directly into an enhanced street sweeping strategy, as municipalities are likely unable to vary street sweeping operations street-by-street or block-by-block.

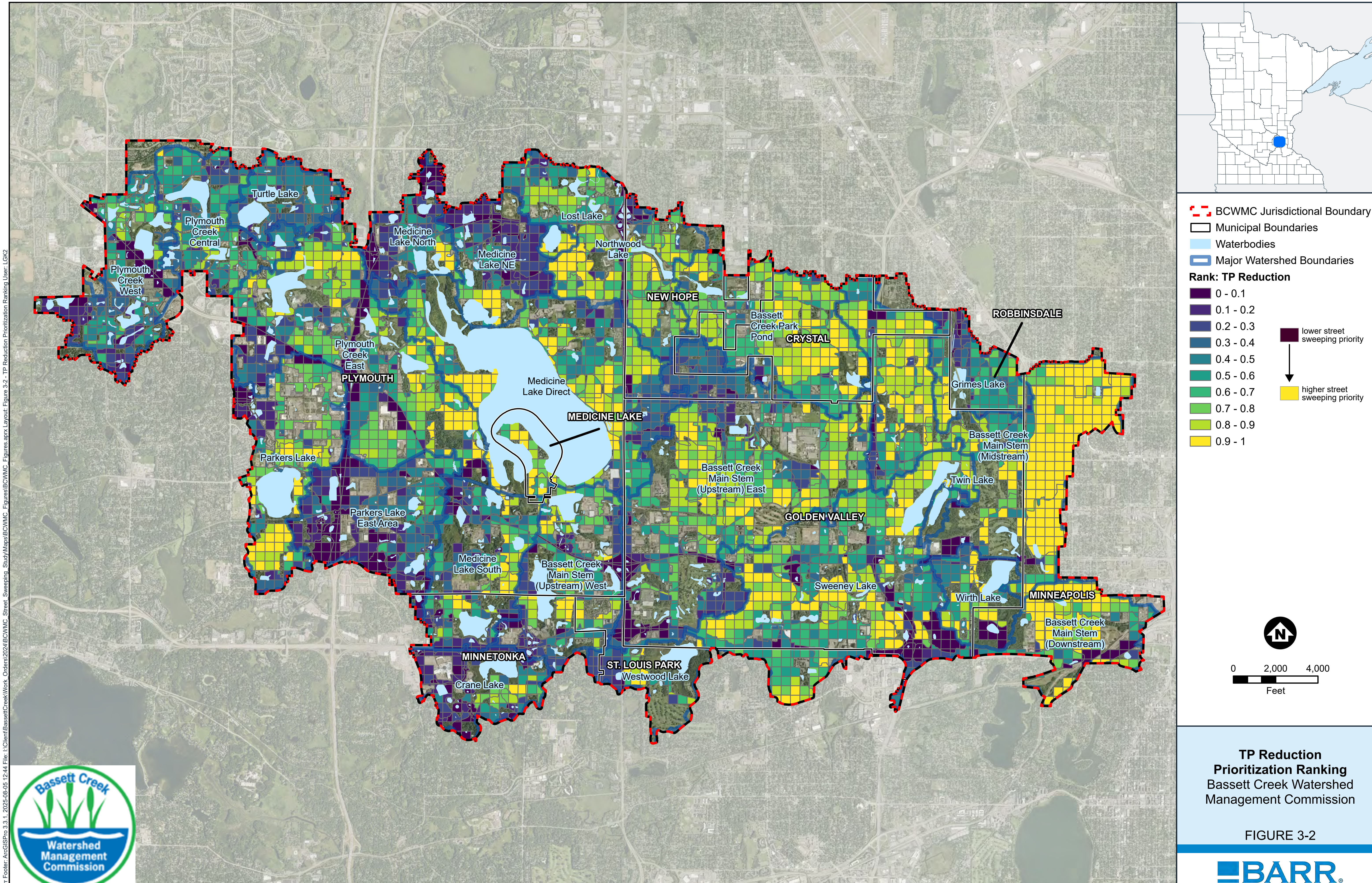


TP Recovery Prioritization Ranking
Bassett Creek Watershed Management Commission

FIGURE 3-1

BARR

Barr Footer: ArcGISPro 3.3.1, 2025-08-05 12:44 File: I:\Client\BassettCreek\Work Orders\2024\BCWMC Street Sweeping Study\Maps\BCWMC_Figures\BCWMC_Figures.aprx Layout: Figure 3-1 - TP Recovery Prioritization Ranking User: LGK2



TP Reduction Prioritization Ranking
Bassett Creek Watershed Management Commission

FIGURE 3-2

Barr Footer: ArcGISPro 3.3.1, 2025-08-05 12:44 File: I:\Client\BassettCreek\Work_Orders\2024\BCWMC_Street_Sweeping_Study\Maps\BCWMC_Figures\BCWMC_Figures.aprx Layout: Figure 3-2 - TP Reduction Prioritization Ranking User: LGK2

Table 3-3 and Table 3-4, below, are included to assist the BCWMC and their member cities with prioritization of enhanced street sweeping strategies at the scale of (a) municipal boundaries and (b) priority watershed boundaries. Table 3-3 and Table 3-4 compare the effectiveness of existing street sweeping operations to the Baseline Scenario, based on both pollutant recovery and pollutant reduction. Values are compared and ranked by city and by priority watershed to allow the BCWMC and their member cities to evaluate which areas would benefit most by increasing street sweeping operations up to the Baseline Scenario.

Results included in Table 3-3 and Table 3-4 summarize the estimated increase in pollutant removal benefits of moving to the Baseline Scenario by municipality and major subwatershed. Table C11 and Table C12 in Appendix C show the estimated benefits within each of these areas, normalized by curb mile. Using these two different approaches to develop a priority ranking provides a different lens and results when considering which areas across the watershed may be higher vs. lower in terms of pursuing increased sweeping. Presenting the results using both approaches allows the BCWMC and their member cities to consider results through multiple lenses. For example, when considering the additional benefit by subwatershed, the Medicine Lake Direct subwatershed receives the highest ranking in terms of the expected benefits of increased sweeping to raw pollutant recovery, and the Plymouth Creek East subwatershed receives the highest rank in terms of expected benefits in pollutant reduction to a receiving priority waterbody. When considering these additional benefits per curb mile being swept, the Crane Lake and Lost Lake subwatersheds become highest priority.

Further discussion on results and interpretation of these rankings is included in Section 5. **Appendix C** includes tables showing TSS recovery and reduction rankings by municipality and major subwatershed. Table 3-3 and Table 3-4 also highlight areas which are already swept more than the Baseline Scenario recommendation (i.e., one spring sweeping, one summer sweeping, and two fall sweepings). For example, Table 3-3 shows a decrease in street sweeping recovery and reduction for Minneapolis and Robbinsdale, which currently perform more seasonal sweeping than the Baseline Scenario (see Table 2-3).

Table 3-3 Street Sweeping TP Recovery and Reduction Ranking by Municipality

Municipality	Existing Conditions: TP Recovery (lbs/year)	Baseline Scenario (1-1-2)			Existing Conditions: TP Reduction (lbs/year)	Baseline Scenario (1-1-2)		
		Recovery (lbs/year)	Increase (lbs/year)	Recovery Increase Ranking (#)*		Reduction (lbs/year)	Increase (lbs/year)	Reduction Increase Ranking (#)*
Plymouth	158	295	138	1	98	181	83	1
Golden Valley	164	216	52	2	124	163	39	2
Minneapolis	148	125	-23	--	135	113	-22	--
Crystal	48	49	1	7	39	40	1	6
New Hope	35	39	3	4	30	31	1	7
Minnetonka	11	46	35	3	4	15	11	3
St. Louis Park	22	25	3	5	13	15	2	4
Robbinsdale	29	21	-8	--	10	8	-2	--
Medicine Lake	2	4	2	6	2	3	1	5
Total	**617**	**820**	**203**	**N/A**	**455**	**569**	**114**	**N/A**

* 1 = highest priority; 7 = lowest priority; -- = already sweeping more than baseline scenario

Table 3-4 Street Sweeping TP Recovery and Reduction Ranking by Major Subwatershed

Major Subwatershed	Existing Conditions: TP Recovery (lbs/year)	Baseline Scenario (1-1-2)			Existing Conditions: TP Reduction (lbs/year)	Baseline Scenario (1-1-2)		
		Recovery (lbs/year)	Increase (lbs/year)	Recovery Increase Ranking (#)*		Reduction (lbs/year)	Increase (lbs/year)	Reduction Increase Ranking (#)*
Bassett Creek Main Stem (Downstream)	36	30	-6	--	34	28	-6	--
Bassett Creek Main Stem (Midstream)	149	142	-7	--	135	127	-8	--
Bassett Creek Main Stem (Upstream) East	62	81	19	3	44	58	14	4
Bassett Creek Main Stem (Upstream) West	13	28	16	8	9	18	9	6
Bassett Creek Park Pond	38	43	5	16	36	40	4	11
Crane Lake	5	23	18	5	1	5	4	12
Grimes Lake	36	30	-6	--	14	12	-2	--
Lost Lake	1	2	1	19	1	2	1	18
Medicine Lake Direct	37	59	22	1	27	43	16	2
Medicine Lake NE	10	20	9	12	4	7	3	13
Medicine Lake North	6	12	6	15	2	5	3	16
Medicine Lake South	12	29	17	6	6	14	8	7
Northwood Lake	34	41	7	13	30	35	5	10
Parkers Lake	14	27	13	9	11	21	10	5
Parkers Lake East Area	16	32	16	7	3	7	4	14
Plymouth Creek Central	12	22	10	11	7	13	6	9
Plymouth Creek East	26	48	22	2	21	39	18	1
Plymouth Creek West	13	25	12	10	6	12	6	8
Sweeney Lake	64	83	18	4	50	64	14	3

Major Subwatershed	Existing Conditions: TP Recovery (lbs/year)	Baseline Scenario (1-1-2)			Existing Conditions: TP Reduction (lbs/year)	Baseline Scenario (1-1-2)		
		Recovery (lbs/year)	Increase (lbs/year)	Recovery Increase Ranking (#)*		Reduction (lbs/year)	Increase (lbs/year)	Reduction Increase Ranking (#)*
Turtle Lake	6	12	6	14	2	5	3	15
Twin Lake	1	2	0	20	1	1	0	20
Westwood Lake	9	11	2	18	4	4	0	19
Wirth Lake	16	19	3	17	7	9	2	17
Total	**617**	**820**	**203**	**N/A**	**455**	**569**	**114**	**N/A**

* 1 = highest priority; 20 = lowest priority; -- = area being swept more than baseline scenario

3.3 Cost-benefit analysis

To evaluate and compare the relative cost-benefit of street sweeping scenarios evaluated in this study, Barr developed high-level estimates of cost per sweeping operations. A detailed, municipality-specific cost evaluation of street sweeping operations was outside the scope of this analysis. Cost-efficiency information from the recently completed *City of Woodbury: Enhanced Street Sweeping Plan* (EOR, 2022) was used to estimate the cumulative cost of successive sweepings per season per lane-mile swept. Note: cost estimation information from the EOR study is highly specific to the City of Woodbury and should not be used to estimate actual cost per sweeping for other municipalities. However, because the goal of this analysis is to have an equivalent basis of comparison of cost across all swept road areas, this methodology was deemed sufficient for development of the cost-benefit analysis presented in this section. The cost associated with each successive sweeping was evaluated in two ways: (1) assuming street sweeping is conducted by municipal staff using municipal-owned street sweeping equipment; and (2) assuming that street sweeping is contracted out.

Development of cost for each strategy is described below:

- **Conducted by Municipality**: A regression equation developed from information with the Woodbury study (EOR, 2022) was utilized to calculate the cost-efficiency ($/lane-mile) for the total number of street sweepings performed annually.
- **Contracted**: A constant value of $102/lane-mile was used (EOR, 2022). Note that this value is within the range of contracted sweeping costs observed for street sweeping efforts conducted in Ramsey Washington Metro Watershed District in 2023 (Barr, 2024).

Utilizing the strategies above, cost was calculated for the watershed-wide enhanced street sweeping scenario (one spring, one summer, and two fall sweepings). Table 3-5 shows how the cost-benefit ranges for TP recovery and reduction by number of street sweeping operations conducted per season. From the review of the information provided, the following conclusions can be drawn:

- **Conducted by Municipality vs. Contracted**: Based on the methodology utilized (EOR, 2022), sweeping operations conducted by the municipality are more cost-efficient than contracted street sweeping.
- **Cost effectiveness of fall sweeping**: The first sweep within a season results in the highest recovery value (per Kalinosky et al., 2015), and recovery decreases with each subsequent sweeping each season). Table 3-5 shows that the first fall sweeping has the most favorable cost-benefit of all the baseline sweeping events. Additionally, Table 3-5 highlights that, even though the 2nd fall sweeping has a less favorable cost-benefit than the first fall sweeping, it is still similar to the first sweeping of the spring season. These results highlight the degree to which fall sweeping is more cost-effective (in terms of dollars per pound of phosphorus recovered) than sweeping in the spring or summer.
- **Cost efficiency**: Table 3-5 shows a cost-benefit range of $170 to $830 per pound of TP recovery per year, generally increasing (i.e., becoming less efficient) as more seasonal sweeping is being conducted. This is because, as more sweeping is conducted, less pollutant is recovered per sweeping event. With that said, the methodology utilized in this study supports the conclusion that street sweeping is a highly cost-effective BMP for phosphorus reduction (Hobbie et al, 2020; EOR, 2022), especially in highly developed watersheds with limited opportunities for structural BMP implementation.

Table 3-5 Relative Cost-Benefit of TP Recovery and Reduction for watershed-wide Baseline Sweeping Scenario

Season	Sweeping	Conducted by Municipality		Contracted	
		Recovery ($/lb-TP/yr)	Reduction ($/lb-TP/yr)	Recovery ($/lb-TP/yr)	Reduction ($/lb-TP/yr)
Spring	1	$349.8	$504.2	$607.8	$876.1
Summer	1	$481.3	$693.8	$836.4	$1205.6
Fall	1	$171.7	$247.4	$298.3	$430.0
	2	$371.5	$535.6	$645.6	$930.6
Relative Total Annual Cost		**$242,863**		**$422,016**	

4 Street Sweeping for Chloride Management

In addition to evaluating the water quality benefits of street sweeping toward reducing TSS and TP loading, the Commission also wanted to understand the potential for street sweeping to reduce chloride loading to downstream waterbodies. More specifically, the BCWMC wanted to learn what research is being conducted on chloride management through street sweeping and how current sweeping practices across the watershed affect chloride loading.

4.1 Literature review

A brief literature review was conducted to explore existing research on chloride management through street sweeping. While many studies examined street sweeping efficiencies and chloride loading independently, very few directly investigated the impact of both variables. A summary of relevant sources is included below.

Chloride Content of Street Cleaning Waste and its Potential Environmental Impact (Gronba-Chyla, 2022)
This study investigated chloride concentrations in swept material in a midsized city in Poland, focusing on how seasonality and road area affect concentrations. Researchers found that chloride concentrations in swept material collected from roadways averaged around 35.4 mg/L in the fall and 321.6 mg/L in the spring, indicating a significant increase from winter de-icing events. Highest chloride concentrations were found around stormwater catch basins, averaging 1,468 mg/L in the spring. Prior to analysis, the swept material was dissolved in water and filtered, which differs from standard methods used by the MPCA (MPCA, 2022). This limits the ability to extrapolate results from this study to local reductions; however, results emphasize the seasonality of chloride loading and highlight the importance of spring management.

Sustainability Assessment of Heavy Metals and Road Maintenance Salts in Sweep Sand from Roadside Environment (Kazlauskienė et al., 2013)
The goal of this study was to examine chloride and heavy metal concentrations in swept material from a midsized city in Lithuania where a combination of road salt, sand, and brine are applied as de-icing agents. Samples were collected in the spring and chloride concentrations in the swept material ranged from 54-589 mg/kg. Researchers did not quantify the amount of chloride removed through sweeping in relation to annual loading, but the results provide a useful reference range for comparing chloride levels in locally swept material.

Chloride Contributions from Water Softeners and Other Domestic, Commercial, Industrial, and Agricultural Sources to Minnesota Waters (Overbo et al., 2019)

This publication presents a statewide chloride budget for Minnesota, identifying road salt as the largest contributor to chloride pollution in surface waters. An estimated 403,600 tons of chloride enters Minnesota's surface waterbodies annually, with over 150,000 tons originating from the Twin Cities Metro Area alone. This study also highlights the decline in road salt application over the past decade due to warming winters and increasing salt application efficiency. These reduction patterns were used to determine updated chloride loading rates in the BCWMC area.

Nine Mile Creek Watershed Chloride Total Maximum Daily Load Report (Barr, 2010)

This TMDL report was prepared for NMCWD to address the chloride impairment in Nine Mile Creek. Within the report, road salt application rates were estimated for municipalities in the district using a combination of road salt purchasing records, MS4 road mileage, and a chloride mass balance approach. Road salt application rates for the MS4s ranged from 680 to 3000 tons/year. The municipalities analyzed have similar characteristics and are in close proximity to municipalities in the BCWMC. Loadings from this report were adjusted based on findings from Overbo et al., (2019) and used to estimate chloride loading in the BCWMC area.

4.2 Salt use in BCWMC

A series of questions on winter road maintenance activities and de-icing practices was included within the street sweeping survey distributed to member cities, the county, and MnDOT as part of this study in order to gain insights on chloride usage within the BCWMC for the purposes of this analysis. Results from the street sweeping survey show that deicing applications vary between municipalities within the Commission, as summarized in Table 4-1.

Table 4-1 Municipal Winter Roadway Deicing Survey Responses

Municipality	Question: What are the primary materials used for deicing?	Question: Is there any data currently being collected on the amount of deicing material applied each year?	Reported annual salt application (tons)
Minneapolis	Rock salt, MgCl-infused rock salt, and brine	Yes, in our MS4 permit information.	2020: 9,807 2021: 11,184 2022: 11,293 2023: 3,213
St Louis Park	Brine and salt, we do not use sand	We track plow routes and measure the brine and salt usage for the trucks that use brine and salt.	--
Minnetonka	Untreated rock salt, brine, calcium chloride additives	Yes. For each snow event, the salt controllers on the trucks collect data for miles traveled, hours used, salt spreading distance, lbs salt applied, blast, average salt rate (lbs/mi), prewet distance and prewet gallons (if truck is outfitted with brine pump).	2020: 2,190 2021: 2,550 2022: 2,395 2023: 3,068 2024: 690
Golden Valley	Salt, Brine, and BEET HEET	Yes, we track this in a spreadsheet every year.	2023: 1,025 2024: 231
Hennepin County	Rock salt, brine, and potassium acetate	Yes	--
Plymouth	Rock salt and brine. Apex used below 15 degrees	Yes, we track salt and brine usage for all snow events	2020: 1,330 2021: 2,245 2022: 1,380 2023: 2,350 2024: 845
New Hope	Rock salt and brine	We track the total tonnage of deicing material applied.	2020: 331 2021: 443 2022: 512 2023: 306 2024: 151
Robbinsdale	Rock salt and brine	Yes	--
Crystal	Rock salt and salt brine	Yes	2025: 123
Medicine Lake	--	--	--

Results from the chloride reduction analysis show that chloride removal through street sweeping practices results in a small fraction of the total chloride applied annually. Survey responses, along with prior TMDL assumptions (Barr, 2010), were used to develop a high-level estimate of total chloride loads from winter road maintenance across the study area. To evaluate the potential impact of street sweeping, we incorporated pollutant concentration data from the City of Plymouth's swept material (City of Plymouth, 2023). Between 2007 and 2024, the average chloride concentration in Plymouth's dry swept material was 280 mg/kg. Using Barr's WQM model (Section 2.3) to estimate the total dry mass collected annually through street sweeping in the BCWMC, and applying Plymouth's average concentration data, we estimated that of the 12,600 tons of chloride loaded annually, only 190 lbs are removed through current street sweeping practices. This results in a 0.0007% chloride removal rate.

To further investigate seasonal efficiency in chloride removal, we utilized data from Plymouth's December 2023 samples, which showed significantly higher chloride concentrations, averaging 3,783 mg/kg. This concentration when paired with swept material totals from one spring sweep across the entire BCWMC area resulted in an estimated chloride removal rate of 0.004%.

4.3 Chloride reduction takeaways

Based on the available data on chloride loading and reduction, we can conclude that while street sweeping can be an important component of a city's larger effort for addressing chlorides and collecting excess salt before it's transported downstream to receiving waters, it is not an effective overall strategy for managing chloride loading. Under current practices, it's estimated that less than 0.01% of the chloride applied annually is removed through current sweeping practices in the BCWMC area. It is important to note that annual weather variability can significantly influence both chloride application rates and potential reductions. For example, in 2023 we had a severe winter with high snowfall, while 2024 was notably mild. These differences are reflected in Table 4-1, where all reporting municipalities showed a substantial decrease in salt applications between the two years. However, even under favorable conditions, such as low application rates combined with high material recovery, chloride reduction is still a fraction of the total load applied. While increasing winter sweeping frequencies could increase chloride reduction, there are challenges associated with this management option. Municipalities reported experiencing difficulties sweeping during icy conditions, ineffectiveness of filters during wet conditions, and concerns about equipment corrosion.

5 Conclusions and Recommendations

A modeling analysis was performed to evaluate water quality benefits from existing street sweeping operations within the BCWMC, plus an enhanced street sweeping scenario. Results of this analysis were used to evaluate the relative effectiveness of different street sweeping scenarios in terms of (a) stormwater pollutants recovered, (b) pollutant reduction to downstream waterbodies, and (c) seasonal cost-benefit. Additionally, results were used to develop street sweeping prioritization mapping, which can be used to identify high-priority areas (e.g., neighborhoods, major subwatersheds, etc.) for targeted, enhanced street sweeping efforts. A summary of the analysis presented in this technical report, including key conclusions and recommendations, is included below:

- Information obtained from member cities, Hennepin County, and MnDOT was used to evaluate and summarize existing street sweeping operations within the BCWMC. Information obtained was used to inform modeling of existing street sweeping operations (Section 2.1).
- A model was developed to evaluate the effectiveness of existing street sweeping operations throughout the watershed in terms of TSS and TP pollutant reduction and recovery. Results were processed to summarize and compare the relative effectiveness of street sweeping operations by municipality and by major subwatershed. Results were summarized both by pollutant recovery (i.e., the mass of pollutant recovered during street sweeping operations) and pollutant reduction (i.e., the mass of pollutant reduced from downstream receiving waterbodies, considering the impact of watershed BMPs). (Section 2.5)
- The model was used to evaluate the effectiveness of a watershed-wide enhanced street sweeping Baseline Scenario (one spring, one summer, and two fall sweepings) (Section 3.1). Results were used to develop street sweeping prioritization mapping which identifies areas throughout the watershed where modeling indicates street sweeping would be most effective for water quality improvement within the Commission's priority waterbodies. These high-priority

sweeping areas often correspond to locations with a high percentage of tree canopy cover overhanging road surfaces (Section 3.2).

- If the Baseline Scenario was used across the whole watershed, an estimated additional 114 pounds of total phosphorus (TP) and 4,528 pounds of total suspended solids (TSS) would be prevented from reaching priority waterbodies each year (Table 3.2).
- The watershed-wide enhanced street sweeping scenario results were compared to results of the existing street sweeping condition analysis to rank and prioritize the relative benefit of enhanced street sweeping operations by municipality and by major subwatershed (Section 3.2).
- A cost-benefit analysis was performed to evaluate and compare the cost effectiveness of existing street sweeping and enhanced street sweeping scenarios. The cost-benefit methodology utilized in this study supports the conclusion that street sweeping is a highly cost-effective BMP for phosphorus reduction (Hobbie et al, 2020; EOR, 2022), especially in highly developed watersheds with limited opportunities for structural BMP implementation (Section 3.3).
- Chloride management through street sweeping was evaluated using the street sweeping model, survey results from member cities, Hennepin County, and MnDOT, and results from testing of swept material completed by the City of Plymouth. The analysis (Section 4) showed that current street sweeping operations within the BCWMC recover a very small fraction (<0.01%) of the chloride being applied annually.

The following provides a summary of recommendations and next steps developed over the course of this study. Recommendations were developed based on coordination and review of key project results (e.g., cost-benefit analysis, prioritization results, etc.) over the duration of this project, discussion with BCWMC and member city staff, as well as from research and outreach activities conducted to develop the tools utilized in this and other similar studies.

- Mapping of prioritized street sweeping areas (Figure 3-1 and Figure 3-2) and tabular summaries comparing and ranking the relative effectiveness of evaluated sweeping scenarios (Table 3-3 and Table 3-4) can be used to develop potential enhanced street sweeping programs and policies in the BCWMC. Goals outlined in the BCWMC's draft 2026-2035 Watershed Management Plan should also be reviewed and considered when prioritizing enhanced sweeping efforts.
- BCWMC may consider review of their Capital Equipment Cost Share Policy to incorporate findings from this study. For example, to ensure that Commission funds are being allocated toward activities and priority sweeping areas that are anticipated to be most beneficial toward improving water quality within their priority waterbodies (Section 3.2, Table 3-4).
- Individual cities may review prioritization figures and tables described above to improve their own street sweeping efforts. For example, cities may review the relative ranking by city (Section 3.2, Table 3-3) to determine the value in increasing the number of seasonal street sweeping operations performed. They may also consider sharing cost-benefit information (Section 3.3) to internal stakeholders to demonstrate the value of enhanced street sweeping as a BMP for water quality improvement and/or achieving progress towards waste load allocations goals established by regional TMDLs.
- Cities should consider collection of material weight (e.g., wet mass of collected street sweeping material) for use within the MPCA Street Sweeping Calculator. Material collected during enhanced street sweeping efforts (i.e., street sweeping efforts above and beyond what was in

place during the time that the MPCA has defined as the TMDL “baseline condition” year) may be recorded during annual TMDL reporting as progress towards achieving City waste load allocation goals. Cities may also consider periodic sampling and testing of collected material to verify default moisture content and nutrient content assumptions within the MPCA Street Sweeping Calculator.

- BCWMC and member cities should consider continued coordination related to addressing barriers to enhanced street sweeping efforts within the watershed. During TAC meeting discussions, TAC members shared information related to current barriers and identified potential opportunities (e.g., sharing of screening equipment, waste disposal strategies, etc.) for future collaborations. Coordination among cities and with the BCWMC should be considered to encourage information sharing and working toward the development of solutions to common barriers.

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Appendix A

BCWMC Street Sweeping Survey Responses

Municipality	BCWMC Street Sweeping Survey Responses									
	1. Curb miles maintained	2. Sweepings per year	3. Certain areas more frequent	4. Sweeping on all road surfaces	4.a. Curbed road database	5. Sweeping on private roads	5.a. Private & public road database	6. Tracking	7. Data collected	8. Testing swept material
Minneapolis	1,900	Two comprehensive sweeps in the spring and fall, entertainment and event areas 7 day cycles, chain of lakes, parkways on a 15 day cycle through the summer. Commercial node and AD50 area 30 day cycle, and residential neighborhoods 3-5 times a summer.	Yes due to location to water bodies, economic, commercial activity, and number of people using the area.	Yes	Very few streets without curbs - less than 1 percent.	Perform work only on public streets. Private responsible for their own facility.	Only maintain public roads	Smart spreadsheet and established routes.	As part of their entry the driver notes the number of loads created. We also have a gross amount by what we haul out to secondary processing centers.	Yes, two studies with the U of M in the past five years and an overall analytical in the early 2000s.
St Louis Park	5,000 to 6,000 annually depending on snow cover	Typically early spring, late spring, summer, and fall	We have priority areas that are swept first and they are determined by traffic volumes, street slopes, and proximity to water bodies.	--	We sweep all streets and alleys in the city. We do not sweep private, county, or state roads, accept for simple crossings or turnings.	They provide their own sweeping, some private roads may compensate the city for sweeping.	We maintain a database of publically maintained roads.	GPS and hand written notes.	We measure collected volumes, CY, on an annual basis, based on material disposal.	We have tested in the past but it's not a routine practice.
Minnetonka	Approximately 495 miles	One citywide sweep in the spring, and one specialized sweeping area in a subwatershed in the fall in Nine Mile Creek Watershed.	One subwatershed area is swept in the fall as part of a water quality improvement project (Nine Mile Creek Watershed).	Yes	Yes	Private streets are not swept or maintained by the city. It is unknown if private streets are swept by the owners as there is no requirement to.	Yes	Sweeping is tracked using GPS devices in the three sweepers.	No	Since 2011, sweeping materials have been tested two times.
Golden Valley	240 miles per event	3 full sweeping events, Spring, Summer, and Fall	No, We do start in priority areas that drain directly to the creek.	Yes	All roads are curbed.	Yes. Varies based upon Maintenance agreements or other protocols.	Yes, in GIS. Usually filed with the property/ area's maintenance Agreements	We track material collected and hours in Cartegraph. Our Street Sweepers are also equipped with GPS. Also use sweeping zones.	We track the amount of material (weight) that we collect daily and enter it into Cartegraph. Approximately 2,000 CY of material collected.	Not currently, but intend to once we receive our new street sweeper.
Hennepin County	We sweep about 60 miles of curb on the county roads	We do a complete sweeping every spring and fall, with spot sweeping done throughout the year as needed.	--	Yes we also sweep rural roads that do not have curbs.	Yes	NA	Yes we have a database.	We track our street sweeping by city with logs.	Spring and fall there are weight tickets from the sweepings being disposed of, and for spot sweeping we have a log. See provided logs for 2024 spring and fall sweeping.	No
Plymouth	Approximately 1,200 curb miles	Sweep at least 3 times a year (spring, early summer and late summer/early fall) and try to get a 4th if possible. Sweep main roads that don't have residential properties off of them to collect leaves/debris. We do not sweep roads in residential areas in the fall for leaves, due to storage limitations of that debris. Also do special event/main roads, etc but we didn't account for that.	Yes, we typically sweep some trouble spots after heavier rain events. Most are around Medicine Lake.	Yes	Yes	Yes, maintenance is unknown.	Yes	We have sweeping zones and GPS. The sweeping work labor and time is tracked in our Asset Management system, Cartegraph.	Yes. We take random samples from all sweeping events to determine the composition of the material collected. On average, we take 4-6 random samples for each sweeping event.	Yes, please see attached spreadsheet with documentation of all sweeping analysis to date.
New Hope	126 curb miles	The city completes one city wide sweeping in the spring, and one city wide sweeping in the fall. We sweep both the Meadow Lake and Northwood Lake areas at least once per month. If we have a big storm event that drops leaves/debris, we will sweep these areas again, so that would be the "or more" situation.	Aside from these city wide contracted sweepings, the city operates one sweeper that sweeps Meadow Lake and Northwood Lake subwatersheds on a routine basis (monthly or more). As for the exact sweeping area for Northwood Lake, we sweep the local roads south of 42nd Ave N, west of Boone Ave N, north of 36th Ave N, and east of Hwy 169. Both 36th Ave N and Boone Ave N are local roads, so those are also hit during these sweepings.	It occurs on all city streets.	--	Private streets are the responsibility of the owner to maintain.	Yes, we maintain a database of public vs. private streets.	Tracked with GPS data. There are sweeping zones in the Northwood and Meadow Lake subwatersheds that are swept on a more frequent basis.	No	No
Robbinsdale	Roughly 100 miles. We have 52 miles of local roads and most of it has curb on both sides of the street.	Streets – These are swept 2 times in the spring, then approx. once each month after that until freeze. Usually twice in the fall. So, depending on spring melt, April-November, 7 to 9 times annually.	Yes, heavy traffic areas, mostly State Aid roads and streets near the lakes.	Unknown	Unknown	Yes, unknown	Unknown	No zones. GPS tracked and hand written on maps. Each map is filed when complete.	No	No
Crysal	176 curb miles	We typically sweep once in the spring and summer and two to three times in the fall, weather permitting.	We have an area by the lake that has become a priority area	We only have curbed roads. Hennepin County has some rural sections in Crystal.	--	We do not have maintain private streets	No	Our sweepers are tracked by GPS.	No	No
Medicine Lake	--	1 time in the spring; 1 time in the fall	--	--	--	--	--	--	--	--

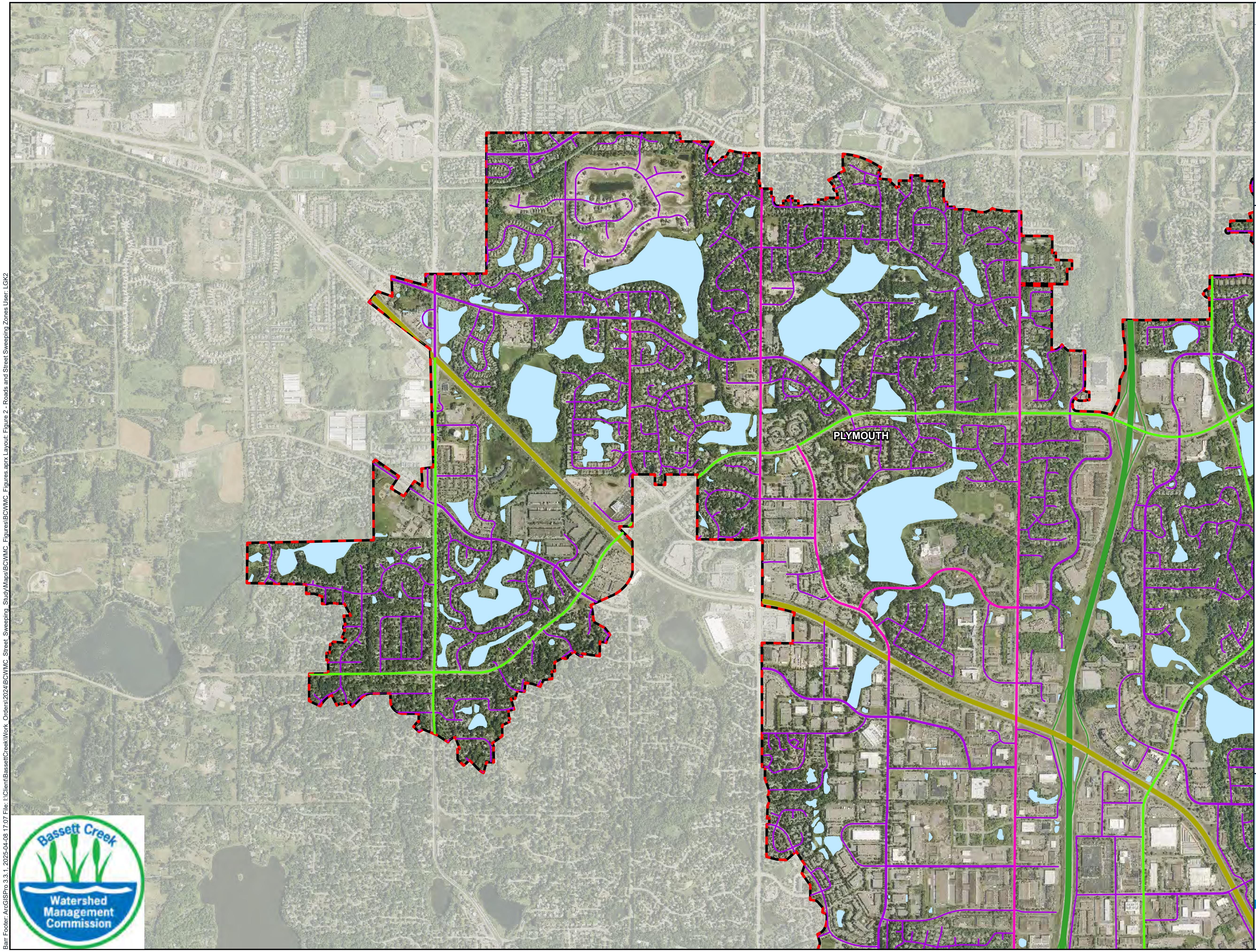
BCWMC Street Sweeping Survey Responses							
9. Sweeping in TMDL	**10. Annual staff hours**	**11. Annual expenses**	**12. Type and number of sweepers**	**13. Barriers**	**14. MPCA Street Sweeping calculator**	**15. Cost share options**	**16. Additional comments**
Yes	20,000 hours	$8.4 million	11 mechanical, 5 regenerative and two small vacuums for bike lanes.	On-street parking and sweeping transfer points for handling materials.	Yes just bring it online.	--	--
Yes	2,241 hours	$200,000	We have two mechanical sweepers. We also hire additional sweepers in the spring to sweep the entire city within a few days.	Typically seasonal conditions in the fall and spring, can't sweep the ice.	We use the MPCA calculator for addressing our TMDL requirements.	To offset existing costs.	--
We reference a couple targeted areas in our TMDL plan, not yet implemented.	Approximately 1,230 staff hours are used for the spring sweep each year (205 shift hours, 6 people on the sweeping crew). 2024 was the first year of the specialized fall sweeping area, and used 72 staff hours (12 shift hours, 6 people on sweeping crew).	Not tracked.	Three Elgin Pelican mechanical sweepers are used.	No significant barriers during sweeping operations. Frequency of sweeping is limited by available staff.	No, we do not currently use these tools.	We might use the funds to hire a contractor to peform additional street sweeping in priority areas. As current staff are at capacity, any significant additional sweeping would need to be contracted out.	--
Yes	685	$197,000	Mechanical Sweepers, Toolcats, loaders, trackless, dump trucks, a total of 12 pieces of equipment are used.	Weather, staff time and budget.	No, we are aware of tool, hoping to integrate into future operations	To hire additional staff	--
Our current sweeping program was in place at the time of all of the TMDL studies. We have considered adding additional sweepings as a way to make progress on our WLAs.	Our spring sweeping takes about 5 weeks with 6 pick up brooms, and 3 kick-off brooms. Fall sweep takes less time because we do the outsides curb and gutter. Second shift will go and do the other sweeping in the watersheds. Minneapolis sweeps it's own roads. We coordinate with the other cities when they do their sidewalks so we don't have to do it twice. We don't run non-stop in the summer.	--	Mechanical	On-street parking	A few staff do, we did some extra sweepings this past summer and plan to give the calculator a try for the first time.	--	--
Yes	Est. 2,000	Approximately $250k	2 mechanical pelicans, 1 regenerative Tymco	Garbage cans placed in the streets. We try to schedule not to sweep in garbage zones for that day.	Yes we are familiar with the workshop and tool. We have yet to use them on a city wide basis but plan to in the future.	The funds would be used to purchase additional sweeping equipment.	--
No	Based on the equipment hours we average 300-350 hours per year on our city owned sweeper. During the contracted spring and fall sweepings there is 320 sweeper hours, and 320 maintenance worker hours following those sweepers with a dump truck.	The city owned sweeper operation cost is roughly $30,000 annually. Labor expenses will range between $12,000-$15,000 annually. The contracted city wide sweepings and disposal costs are approximately $50,000. Total cost estimate for all sweepings is $92,000-95,000.	The city owns one dustless vacuum sweeper that is used by city staff throughout the year. Multiple mechanical sweepers are used during the two contracted city wide sweepings in the spring and fall.	Staff availability and budget	Familiar but not implemented in the city program.	Funds would be put towards equipment and repair costs. Maintenance of the sweeper is really expensive and required to keep it on the road as often as we do.	--
Unknown	600+ hours	Labor ($51,000) Equipment ($17,000) Disposal ($15,000)	1 mechanical sweeper	Staffing (it is hard to dedicate one person to this all the time as we have other work demands), on street parking is also a challenge for us. Screening and disposal is time consuming and expensive. (We just ordered a screener so this might get better?)	No	Potentially renting a sweeper to improve time spent on sweeping but then it takes another person to do so. Hiring a hauler to dispose of sweeping material versus hauling it ourselves.	--
NA	An estimated 500 hours.	--	One mechanical and one regenerative air.	Time and budget	No	We could sweep more if funds were provided.	--
--	--	--	--	--	--	--	Sweeping performed through contract by the City of Plymouth.

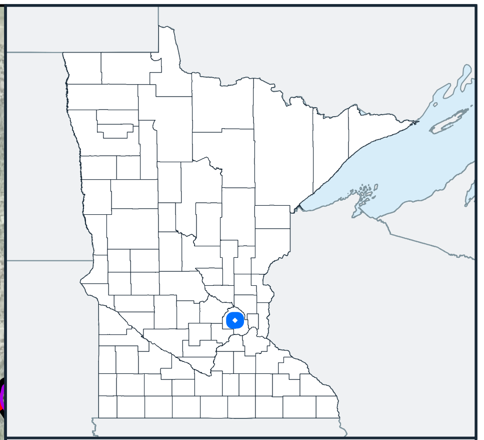
Municipality	BCWMC Chloride Survey Reponses				
	17. MPCA Smart Salt Assessment and Smart Salt Certified	18. Deicing materials	19. Equally deice roads	20. Other deiced surfaces	21. Data collected
Minneapolis	Yes and yes	Rock salt, Mgcl enfussed rock salt and brine.	Downtown is the high level of material use because of the number of turning, stopping, bike, and ped movements. Arterial is the next level as our service goal is travel lanes bare and parking to snow pack. Residential is to snow pack with hill, curves and control points treated.	Police and PW facilities plowed and treated using small vehiles or equipment for sidewalks and parking lots.	Yes in our MS4 permit information
St Louis Park	Yes	Brine and salt, we do not use sand.	No, trunk roads get brined, salt is generally limited to steep slopes and intersections. We do not salt walks and trails.	We only treat city parking lots that are considered critical infrastructure.	We track plow routes and measure the brine and salt usage for the trucks that use brine and salt.
Minnetonka	Yes and Yes, individuals within Public Works are certified, currently through 2026.	Untreated rock salt, brine, calcium chloride additives.	Collector roads: mostly bare pavement, residential streets: center of street bare pavement, cul-de-sacs: plowed but minimal salt use. Curves and hills: bare pavement.	Yes, Parking lots: treated with salt as needed. Sidewalks and trails: no deicing chemicals are used. Will apply sand as needed if severe icing conditions.	Yes. For each snow event, the salt controllers on the trucks collect data for miles traveled, hours used, salt spreading distance, lbs salt applied, blast, average salt rate (lbs/mi), prewet distance and prewet gallons (if truck is outfitted with brine pump).
Golden Valley	Yes and yes	Salt, Brine, and BEET HEET.	We have one road identified as bare pavement, all other roads are plowed and treated with the mains being checked twice. Our goal on residential roads is a bare strip on the crown, goal on mains is bare wheel path.	City hall and Fire station parking lots and sidewalks, parking lot main drive lanes are salted with the dump trucks, sidewalks are salted as needed.	Yes, we track this in a spreadsheet every year. 2022-23 1025 tons of salt, 74,845 gallons of brine, 2023-24 231 tons of salt, 59,372 gallons of brine
Hennepin County	Yes, all of our plow drivers are smart salt certified.	Rock salt , brine and potassium acetate.	Yes	Just County roadways	Yes
Plymouth	Yes, we have been previously Smart Salt certified and will be working on recertification.	Rock salt and brine. Apex used below 15 degrees.	Intersections, bridge decks, and icy trouble spots are de-iced more frequently. Also, mains and secondary roads are de-iced more frequently. Residential roads are not typically de-iced besides salting during full city plow.	Only major facilities owned by the City (fire stations, community center, city hall)	Yes, we track salt and brine usage for all snow events. If this data is needed for a specific reason, please ask
New Hope	We are aware of the smart salt assessment tool. Our individual staff members have completed smart salt training, but we are not a certified organization.	Rock salt and brine.	The city does not have a bare pavement policy. Salting is typically limited to hills and intersections, but that can change depending on weather conditions. The city also uses brine for anti-icing ahead of the storm on main roads.	The city manages deicing on city parking lots.	We track the total tonnage of deicing material applied.
Robbinsdale	Yes. Individuals are Smart Salt certified but not all of them. The entire organization is not Smart Salt certified.	Rock salt and brine.	State aid roads and roads with difficult topography see more treatment than the rest.	Parking lots and some sidewalks, use as little salt as possible, some times no salt is used.	Yes
Crysal	We do have staff that are Smart Salt certified.	Rock salt and salt brine	Roads with a higher traffic volume are treated more often than neighborhood roads.	We do have some parking lots that require salting.	For the winter of 2024-25 we used 123 tons of non treated salt, 95 tons of treated salt and 2,795 gallons of salt brine.
Medicine Lake	--	--	--	--	--

BCWMC Chloride Survey Reponses				
22. Chloride BMPs	**23. Street sweeping for chloride management**	**23.a. Operations and experiences**	**24. Material storage and disposal**	**25. Additional comments**
Training all users in smart salting techniques, snow plow operator training, and tracking material use by buckets of material used for each truck.	If we have a dry winter period we will sweeps and if get a report of excess materials usage we will sweep if weather premits.	Since it is dry sweeping dust is created and some materials do not lift as easily.	Transfer to our yard than when resources are available we transfer it as ground cover to a demolition landfill.	--
Calibrate machines, brine when we can, limit use or use admixtures when really cold, salt storage and material transfer practices.	We typically clean up spills on roadways as feasible.	It is difficult to effectively sweep when snow and icey conditions exist.	Sweeping tailings are stored at our storage facility and dispose of when staff ability allows.	--
Council Policy Number 11.17 Snow and Ice Control of Municipal Streets, Trails, and Sidewalks https://www.minnetonkamn.gov/home/showpublisheddocument/11003/638422195115770000#page=192	No	--	N/A	--
Mechanical removal of snow first then apply chemical on second pass, anti-icing, liquid deicing, 20-30 gal/ton prewet rates, follow the application rate chart in the snow and ice control handbook,	Sometimes. Excess salt is swept up after storm events on sidewalks and parking lots.	If a truck spills some over the tailgate and leaves a pile, we will scoop or sweep it up. Also, we have swept up extra salt on the sidewalks when weather is not expected for a while.	Transported to our storage yard and stock piled on site, we dispose of this material mixed with other fill annually.	--
Pre treat roads bridges and hills with brine. Stay at 200 lbs per lane mile.	No	--	Vonco landfill	--
--	--	Yes, this is one of the main goals of the first spring sweep. For our first sweep we do two shifts for 3 weeks straight to get the most amount of sweeping done in the shortest amount of time.	Our sweepings are temporarily stored at our maintenance facility. The sweepings are screened in the fall. Waste is disposed of at Dem-Con	--
The city recently purchased new plow trucks with brining capabilities, and a brine production system was recently installed in the Public Works addition in 2024. We anti-ice main roads with brine ahead of the storm, which leads to better mechanical removal while plowing. Routinely recalibrate equipment to verify proper application.	The city uses street sweeping if there was an equipment issue, and excess salt was applied or spilled from the box on the plow truck.	Due to snow and ice build up in curblines, we are typically unable to sweep curb to curb during the winter. The vacuum sweepers do not work well if there is moisture or ice on the road. Moisture causes filter issues, and sweeping up salt on a more routine basis would increase corrosion on the equipment.	Since our sweeper is a dustless vacuum style machine the conditions have to be dry with no ice curb to curb. We do have a lined hopper to help with the early spring sweeps but salt destroys equipment so we rarely complete winter sweeping. Fall sweepings are brought to the Maple Grove Compost Site. Spring and summer sweepings are brought to Superior Sand and Gravel/Crow Pit in Greenfield, MN.	--
Smart salt training for operators, using brine for prewetting and anti-icing, keeping salt covered in a salt shed, using treated salt for low temperatures	No. How do you protect your sweeper from getting eaten by salt. If there is a large pile left behind we clean it by machine first then sweep the rest by hand.	--	Stored in the yard, screened and hauled to Vonco for disposal.	--
We calibrate our trucks each year.	No	--	They are stored at our storage/dump site and then hauled to the landfill.	--
--	--	--	--	--

Appendix B

Roadways and Street Sweeping Frequency (Finer-Scale Maps)





- BCWMC Jurisdictional Boundary
- Municipal Boundaries
- Waterbodies

Street Sweeping Zones

- PLYMOUTH RESIDENTIAL - 2 Sp/1 Su/0 F
- PLYMOUTH NONRESIDENTIAL - 2 Sp/1 Su/1 F
- HENNEPIN COUNTY - 1 Sp/0 Su/1 F
- STATE HIGHWAY - 0 Sp/0 Su/0 F
- INTERSTATE - 0 Sp/0 Su/0 F

N

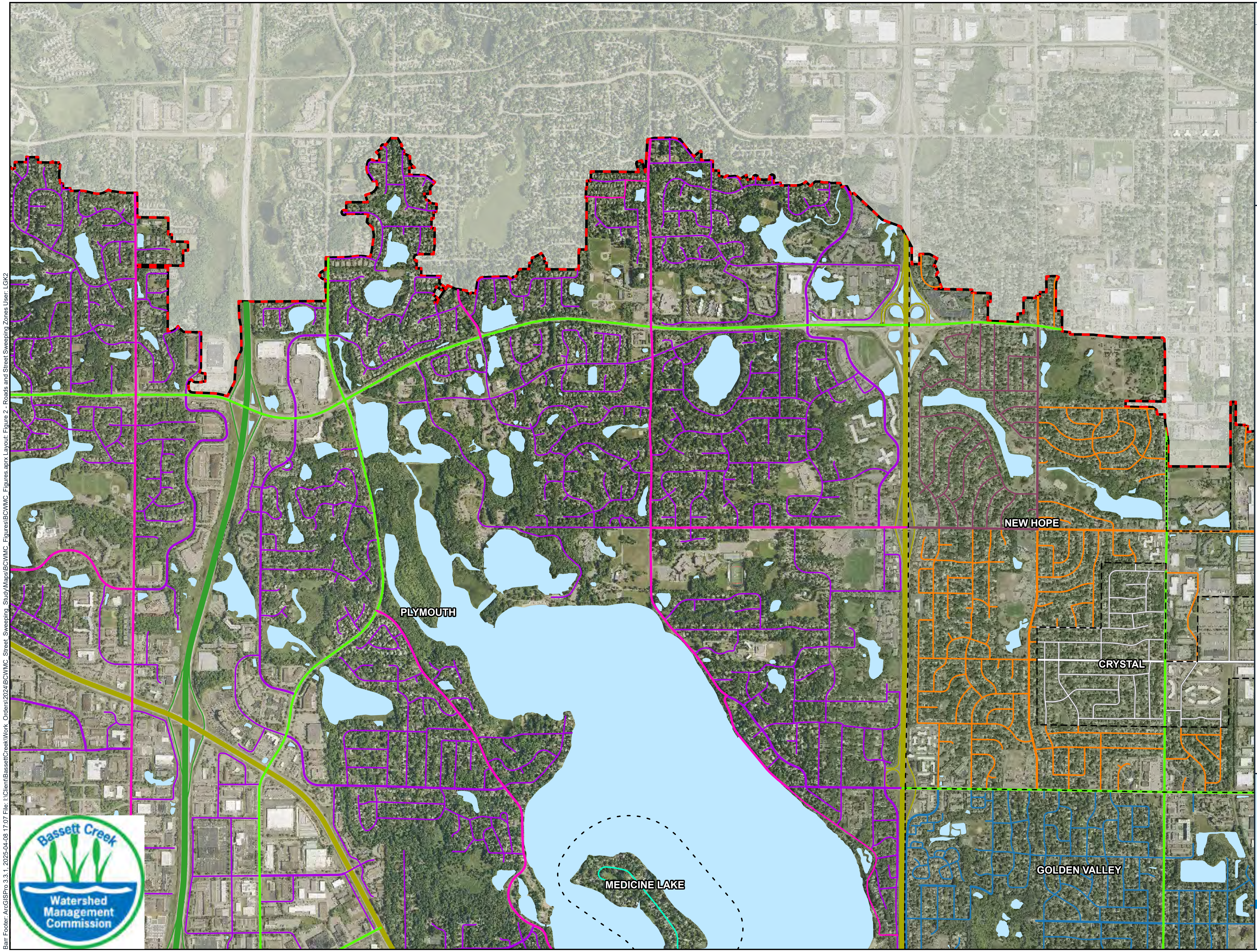
0 1,000 2,000
Feet

Road Areas and Existing Street Sweeping Frequency
Bassett Creek Watershed Management Commission

FIGURE B-1.1

Bassett Creek Watershed Management Commission

BARR



BCWMC Jurisdictional Boundary
Municipal Boundaries
Waterbodies

Street Sweeping Zones

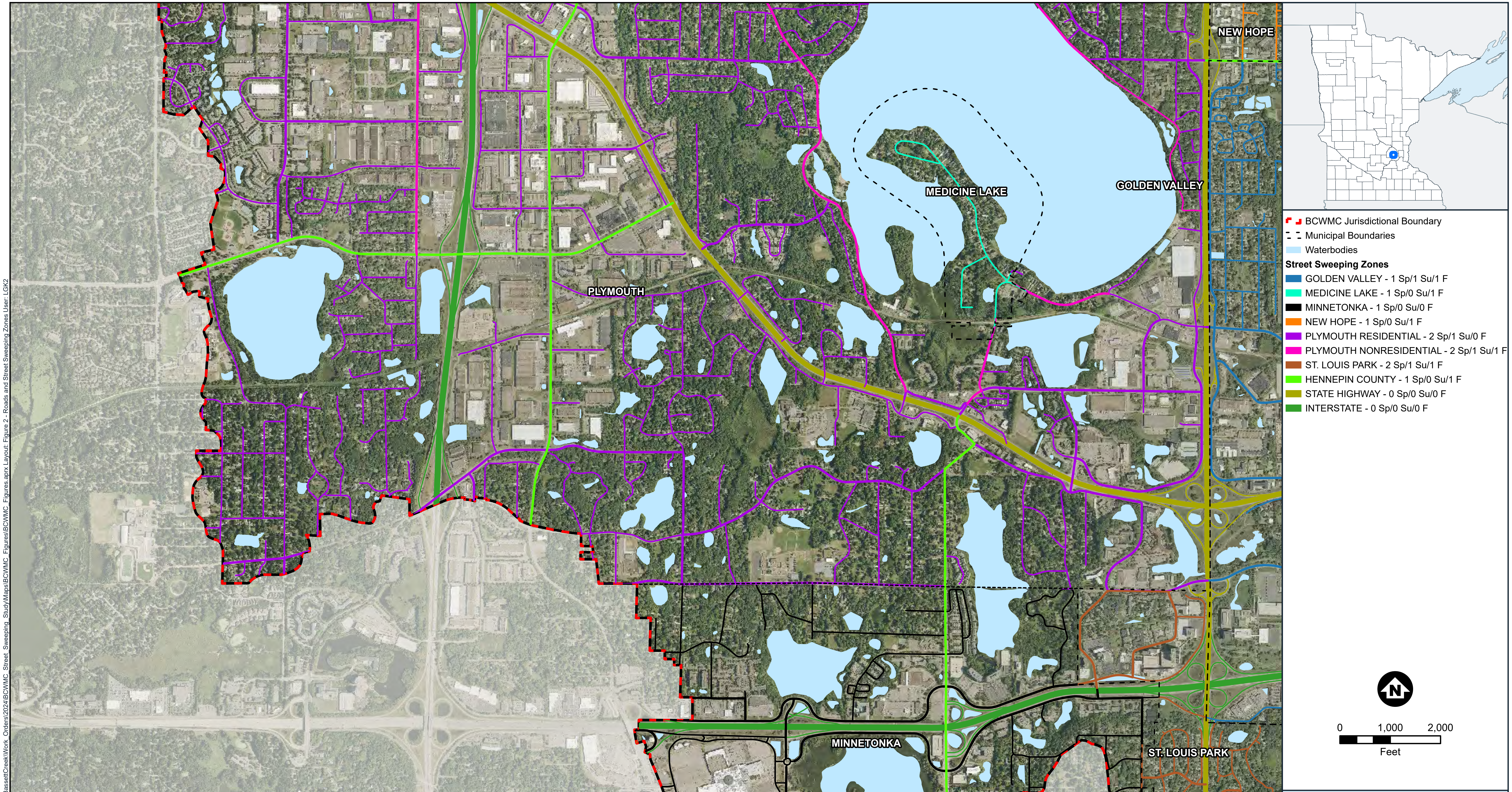
- CRYSTAL - 1 Sp/1 Su/2 F
- GOLDEN VALLEY - 1 Sp/1 Su/1 F
- MEDICINE LAKE - 1 Sp/0 Su/1 F
- NEW HOPE - 1 Sp/0 Su/1 F
- NEW HOPE/NORTHWOOD LAKE - 4 Sp/4 Su/4 F
- PLYMOUTH RESIDENTIAL - 2 Sp/1 Su/0 F
- PLYMOUTH NONRESIDENTIAL - 2 Sp/1 Su/1 F
- HENNEPIN COUNTY - 1 Sp/0 Su/1 F
- STATE HIGHWAY - 0 Sp/0 Su/0 F
- INTERSTATE - 0 Sp/0 Su/0 F

Road Areas and Existing Street Sweeping Frequency
Bassett Creek Watershed Management Commission

FIGURE B-1.2

BARR

Bassett Creek Watershed Management Commission

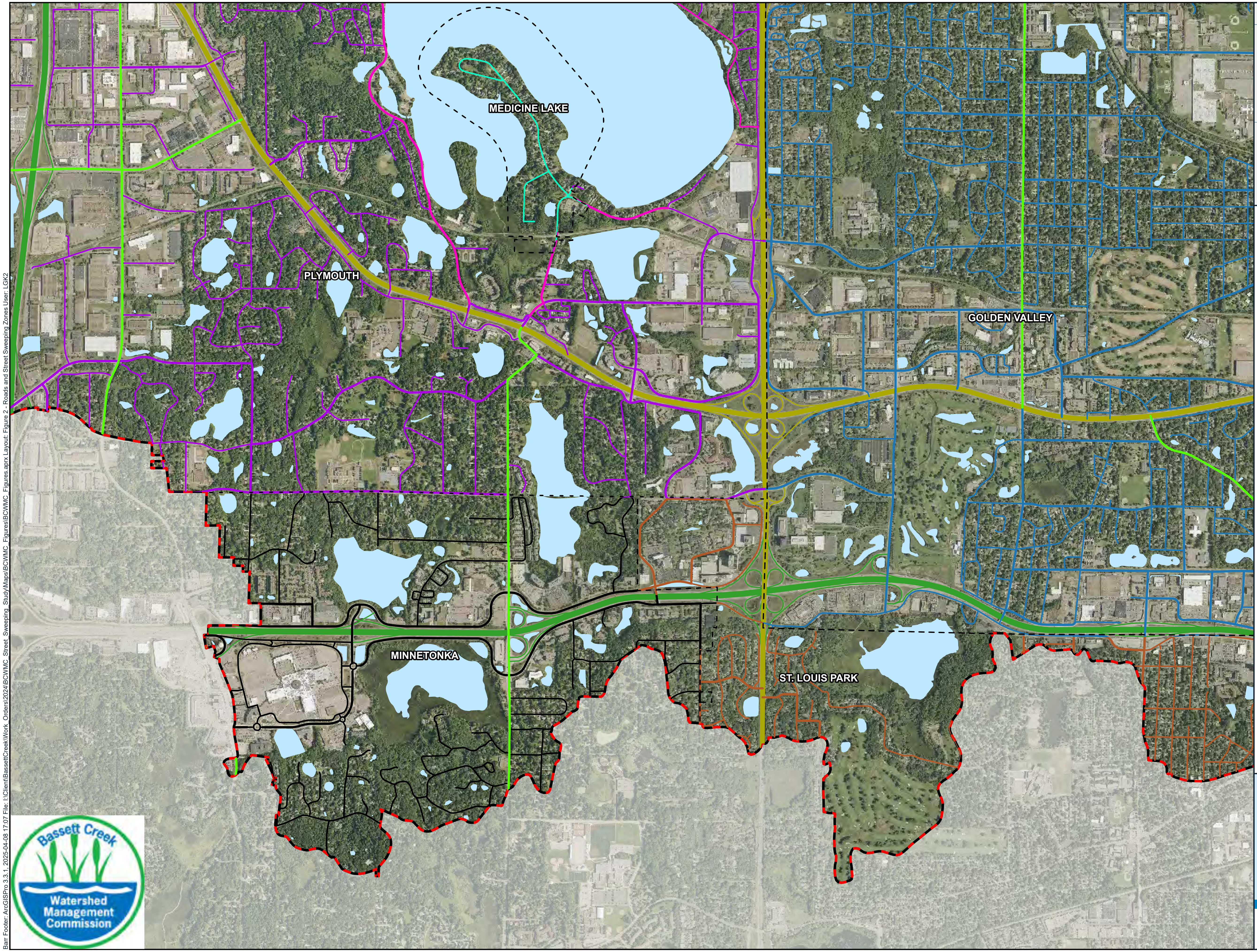


Road Areas and Existing Street Sweeping Frequency

Bassett Creek Watershed Management Commission

FIGURE B-1.3

BARR



- BCWMC Jurisdictional Boundary
- Municipal Boundaries
- Waterbodies

Street Sweeping Zones

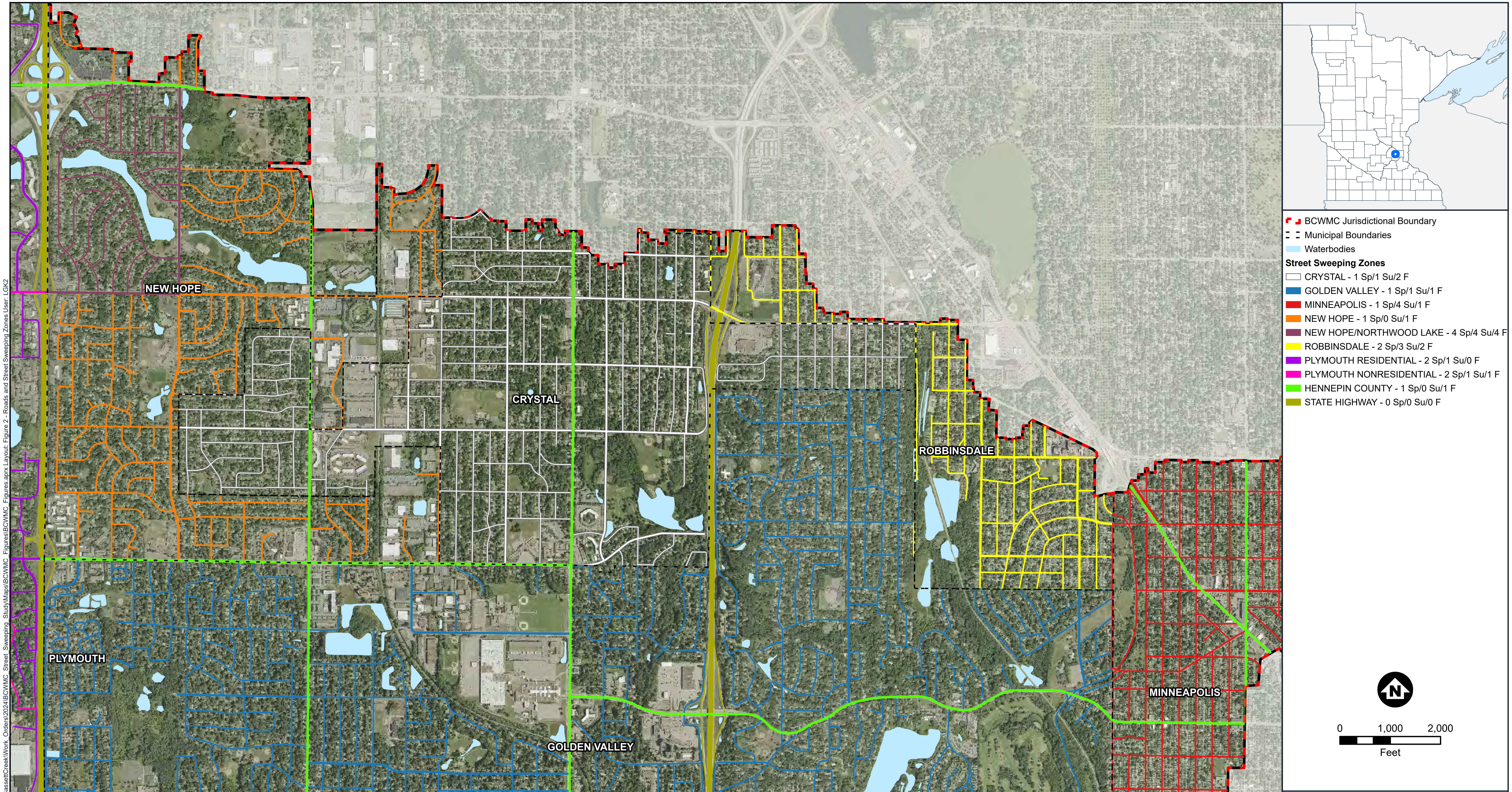
- GOLDEN VALLEY - 1 Sp/1 Su/1 F
- MEDICINE LAKE - 1 Sp/0 Su/1 F
- MINNETONKA - 1 Sp/0 Su/0 F
- PLYMOUTH RESIDENTIAL - 2 Sp/1 Su/0 F
- PLYMOUTH NONRESIDENTIAL - 2 Sp/1 Su/1 F
- ST. LOUIS PARK - 2 Sp/1 Su/1 F
- HENNEPIN COUNTY - 1 Sp/0 Su/1 F
- STATE HIGHWAY - 0 Sp/0 Su/0 F
- INTERSTATE - 0 Sp/0 Su/0 F

0 1,000 2,000
Feet

Road Areas and Existing Street Sweeping Frequency
Bassett Creek Watershed Management Commission

FIGURE B-1.4

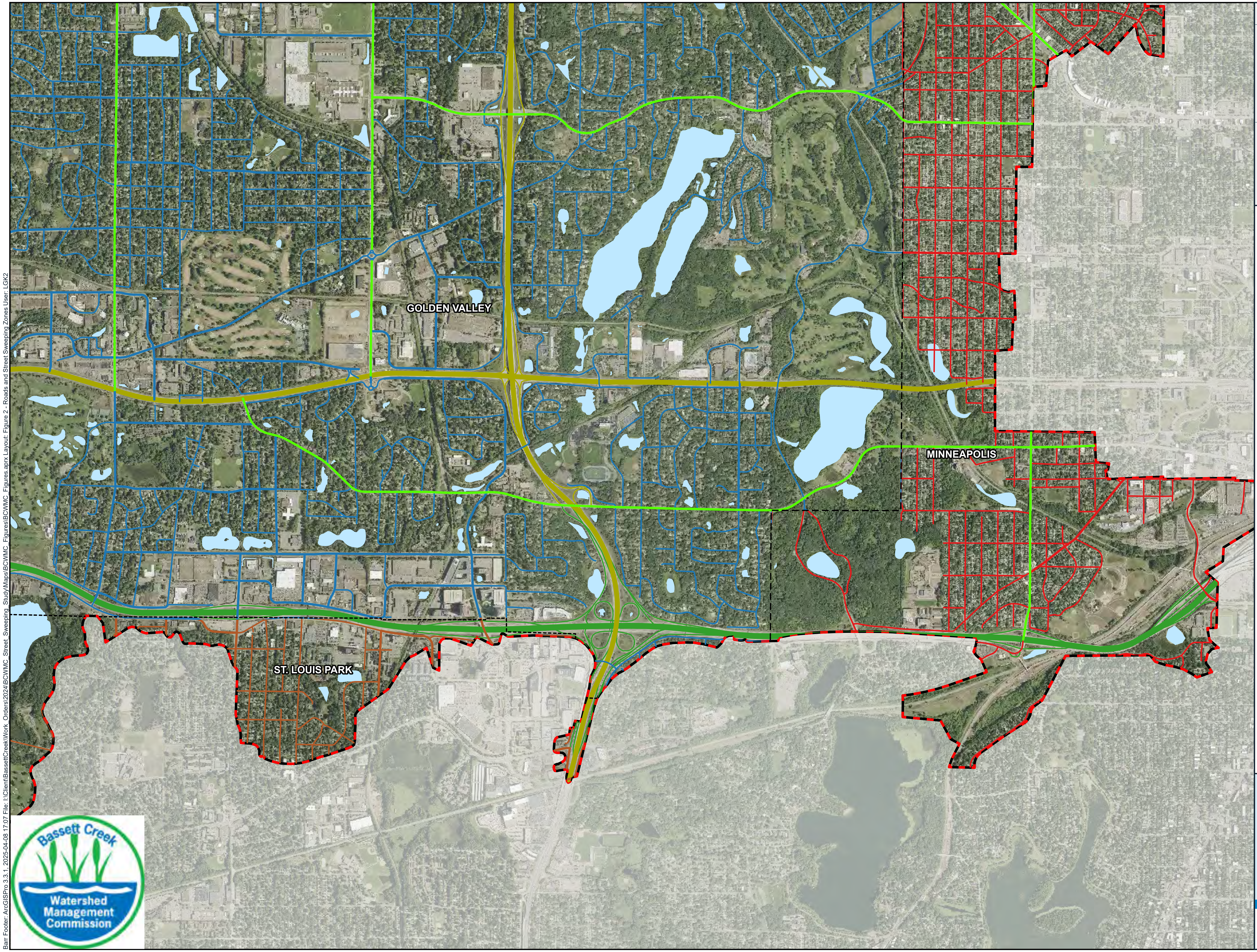
BARR

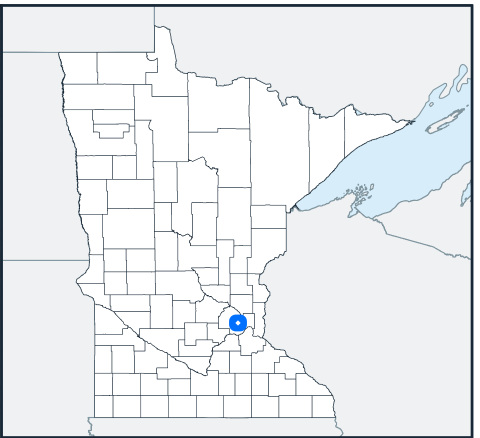


Road Areas and Existing Street Sweeping Frequency
Bassett Creek Watershed Management Commission

FIGURE B-1.5

BARR





- BCWMC Jurisdictional Boundary
- Municipal Boundaries
- Waterbodies

Street Sweeping Zones

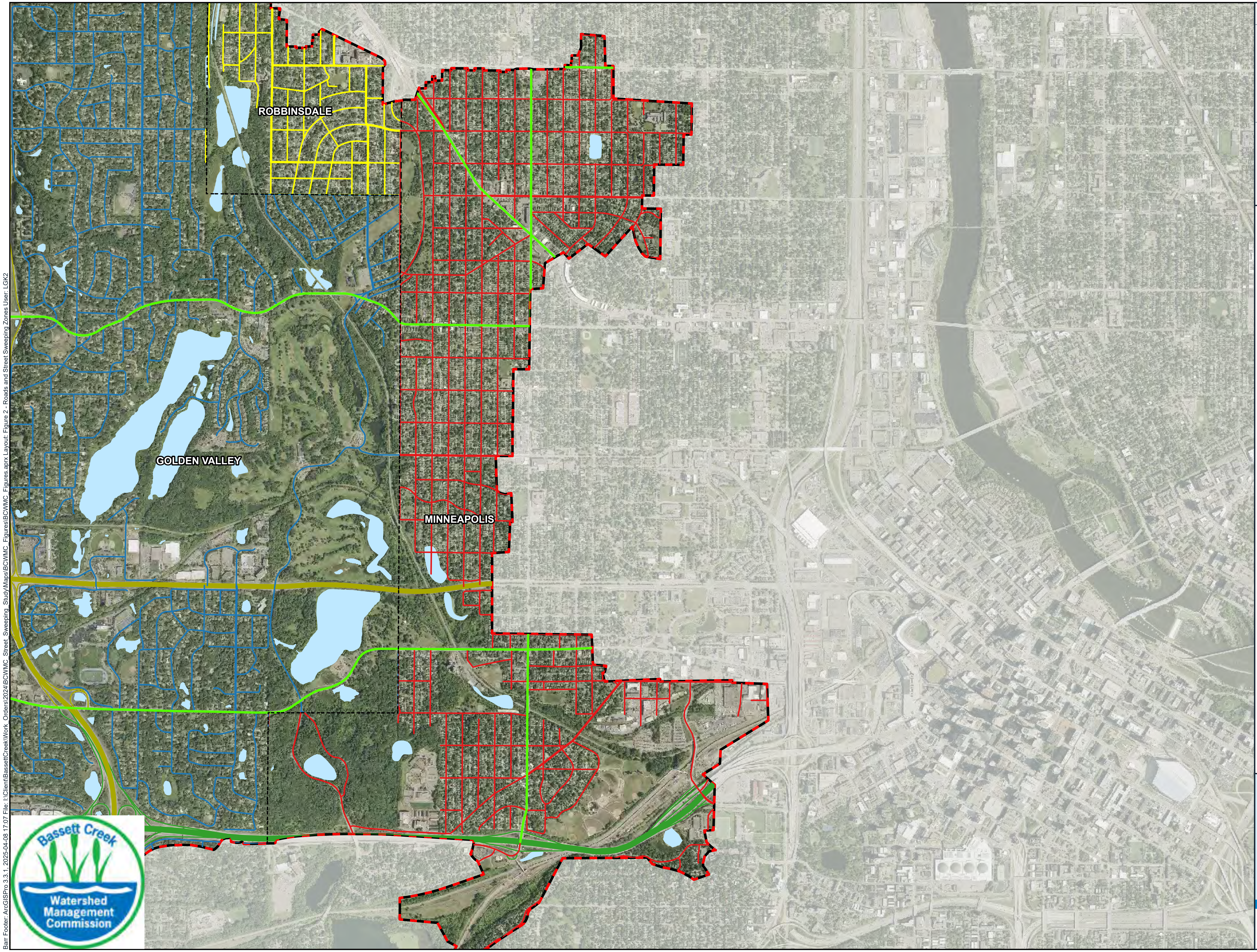
- GOLDEN VALLEY - 1 Sp/1 Su/1 F
- MINNEAPOLIS - 1 Sp/4 Su/1 F
- ST. LOUIS PARK - 2 Sp/1 Su/1 F
- HENNEPIN COUNTY - 1 Sp/0 Su/1 F
- STATE HIGHWAY - 0 Sp/0 Su/0 F
- INTERSTATE - 0 Sp/0 Su/0 F

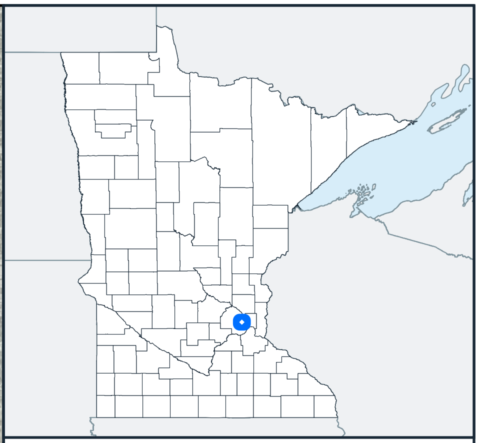
Road Areas and Existing Street Sweeping Frequency
Bassett Creek Watershed Management Commission

FIGURE B-1.6

BARR

Bassett Creek Watershed Management Commission





BCWMC Jurisdictional Boundary
Municipal Boundaries
Waterbodies

Street Sweeping Zones
- GOLDEN VALLEY - 1 Sp/1 Su/1 F
- MINNEAPOLIS - 1 Sp/4 Su/1 F
- ROBBINSDALE - 2 Sp/3 Su/2 F
- ST. LOUIS PARK - 2 Sp/1 Su/1 F
- HENNEPIN COUNTY - 1 Sp/0 Su/1 F
- STATE HIGHWAY - 0 Sp/0 Su/0 F
- INTERSTATE - 0 Sp/0 Su/0 F

N

0 1,000 2,000
Feet

Road Areas and Existing Street Sweeping Frequency
Bassett Creek Watershed Management Commission

FIGURE B-1.7

BARR

Bassett Creek Watershed Management Commission

Appendix C

Street Sweeping Recovery and Reduction Calculation Results

Table C1 BCWMC Existing Street Sweeping Performance: Pollutant Recovery and Reduction by Municipality

Municipality	Area (ac)	TP					TSS				
		Loading (lb/yr)	Recovery (lb/yr)	Recovery (%)	Reduction (lb/yr)	Reduction (%)	Loading (lb/yr)	Recovery (lb/yr)	Recovery (%)	Reduction (lb/yr)	Reduction (%)
Plymouth	11,625	7,787	158	2.0%	98	1.3%	2,349,774	46,397	2.0%	20,931	0.9%
Golden Valley	6,664	4,680	164	3.5%	124	2.7%	1,414,689	31,817	2.2%	18,675	1.3%
Minneapolis	1,838	1,429	148	10.4%	135	9.5%	433,304	15,729	3.6%	13,342	3.1%
Crystal	1,272	910	48	5.2%	39	4.3%	275,262	10,037	3.6%	7,234	2.6%
New Hope	1,233	900	35	3.9%	30	3.3%	272,376	7,158	2.6%	5,543	2.0%
Minnetonka	1,217	878	11	1.3%	4	0.4%	265,519	1,886	0.7%	89	0.0%
St. Louis Park	791	566	22	3.9%	13	2.4%	171,119	4,108	2.4%	1,362	0.8%
Robbinsdale	348	255	29	11.5%	10	4.1%	77,161	4,268	5.5%	290	0.4%
Medicine Lake	237	43	2	5.7%	2	4.8%	11,771	269	2.3%	218	1.8%

Table C2 BCWMC Existing Street Sweeping Performance: Pollutant Recovery and Reduction by Major Watershed

Major Watershed	Area (ac)	TP					TSS				
		Loading (lb/yr)	Recovery (lb/yr)	Recovery (%)	Reduction (lb/yr)	Reduction (%)	Loading (lb/yr)	Recovery (lb/yr)	Recovery (%)	Reduction (lb/yr)	Reduction (%)
Bassett Creek Main Stem (Downstream)	794	650	36	5.5%	34	5.2%	197,375	4,791	2.4%	4,089	2.1%
Bassett Creek Main Stem (Midstream)	2,416	1,537	149	9.7%	135	9.2%	463,022	18,341	4.0%	14,896	3.4%
Bassett Creek Main Stem (Upstream) East	2,852	2,218	62	2.8%	44	2.0%	672,845	13,817	2.1%	7,535	1.1%
Bassett Creek Main Stem (Upstream) West	1,064	959	13	1.3%	9	0.9%	292,026	3,504	1.2%	1,824	0.6%
Bassett Creek Park Pond	1,254	919	38	4.2%	36	3.9%	278,303	7,948	2.9%	6,934	2.5%
Crane Lake	566	397	5	1.4%	1	0.3%	120,121	784	0.7%	0	0.0%
Grimes Lake	499	323	36	11.1%	14	4.3%	97,301	5,259	5.4%	356	0.4%
Lost Lake	55	15	1	7.2%	1	6.2%	4,348	209	4.8%	74	1.7%
Medicine Lake Direct	2,506	986	37	3.7%	27	2.7%	289,740	8,335	2.9%	4,348	1.5%
Medicine Lake NE	665	313	10	3.3%	4	1.1%	92,950	3,118	3.4%	350	0.4%
Medicine Lake North	490	327	6	1.8%	2	0.7%	98,688	1,854	1.9%	256	0.3%
Medicine Lake South	934	479	12	2.6%	6	1.3%	142,894	2,901	2.0%	580	0.4%
Northwood Lake	1,324	915	34	3.7%	30	3.3%	276,444	8,243	3.0%	6,798	2.5%
Parkers Lake	1,065	1,001	14	1.4%	11	1.1%	305,265	4,126	1.4%	3,033	1.0%
Parkers Lake East Area	1,059	828	16	1.9%	3	0.4%	251,198	3,841	1.5%	330	0.1%
Plymouth Creek Central	801	475	12	2.6%	7	1.6%	142,537	4,322	3.0%	1,487	1.0%
Plymouth Creek East	2,045	1,884	26	1.4%	21	1.1%	574,200	8,003	1.4%	5,548	1.0%
Plymouth Creek West	1,059	637	13	2.0%	6	1.0%	191,479	4,367	2.3%	1,418	0.7%
Sweeney Lake	2,400	2,053	64	3.1%	50	2.5%	624,604	12,465	2.0%	7,244	1.2%
Turtle Lake	416	203	6	3.1%	2	1.2%	60,418	2,241	3.7%	187	0.3%

Major Watershed	Area (ac)	TP					TSS				
		Loading (lb/yr)	Recovery (lb/yr)	Recovery (%)	Reduction (lb/yr)	Reduction (%)	Loading (lb/yr)	Recovery (lb/yr)	Recovery (%)	Reduction (lb/yr)	Reduction (%)
Twin Lake	77	24	1	5.3%	1	2.4%	7,040	182	2.6%	1	0.0%
Westwood Lake	449	136	9	6.3%	3	2.7%	39,225	1,327	3.4%	63	0.2%
Wirth Lake	434	167	16	9.7%	7	4.7%	48,955	1,688	3.4%	333	0.7%

Table C3 Street Sweeping TP Recovery and Reduction Results for Existing Conditions vs. Baseline Scenario by Municipality

Municipality	Area (ac)	TP Loading (lb/yr)	Existing Conditions				Baseline Scenario (1-1-2)			
			Recovery (lb/yr)	Recovery (%)	Reduction (lb/yr)	Reduction (%)	Recovery (lb/yr)	Recovery (%)	Reduction (lb/yr)	Reduction (%)
Plymouth	11,625	7,787	158	2.0%	98	1.3%	295	3.8%	181	2.3%
Golden Valley	6,664	4,680	164	3.5%	124	2.7%	216	4.6%	163	3.6%
Minneapolis	1,838	1,429	148	10.4%	135	9.5%	125	8.8%	114	8.0%
Crystal	1,272	910	48	5.2%	39	4.3%	49	5.3%	40	4.4%
New Hope	1,233	900	35	3.9%	30	3.3%	39	4.3%	31	3.4%
Minnetonka	1,217	878	11	1.3%	4	0.4%	46	5.3%	15	1.7%
St. Louis Park	791	566	22	3.9%	13	2.4%	25	4.4%	15	2.7%
Robbinsdale	348	255	29	11.5%	10	4.1%	21	8.4%	8	3.0%
Medicine Lake	237	43	2	5.7%	2	4.8%	4	9.5%	3	7.8%

Table C4 Street Sweeping TSS Recovery and Reduction Results for Existing Conditions vs. Baseline Scenario by Municipality

Municipality	Area (ac)	TSS Loading (lb/yr)	Existing Conditions				Baseline Scenario (1-1-2)			
			Recovery (lb/yr)	Recovery (%)	Reduction (lb/yr)	Reduction (%)	Recovery (lb/yr)	Recovery (%)	Reduction (lb/yr)	Reduction (%)
Plymouth	11,625	2,349,774	46,397	2.0%	20,931	0.9%	53,496	2.3%	23,931	1.0%
Golden Valley	6,664	1,414,689	31,817	2.2%	18,675	1.3%	37,428	2.6%	21,992	1.6%
Minneapolis	1,838	433,304	15,729	3.6%	13,342	3.1%	13,065	3.0%	11,086	2.6%
Crystal	1,272	275,262	10,037	3.6%	7,234	2.6%	10,071	3.7%	7,276	2.6%
New Hope	1,233	272,376	7,158	2.6%	5,543	2.0%	8,036	3.0%	5,688	2.1%
Minnetonka	1,217	265,519	1,886	0.7%	89	0.0%	6,253	2.4%	301	0.1%
St. Louis Park	791	171,119	4,108	2.4%	1,362	0.8%	4,134	2.4%	1,370	0.8%
Robbinsdale	348	77,161	4,268	5.5%	290	0.4%	3,316	4.3%	225	0.3%
Medicine Lake	237	11,771	269	2.3%	218	1.8%	424	3.6%	343	2.9%

Table C5 Street Sweeping TP Recovery and Reduction Results for Existing Conditions vs. Baseline Scenario by Major Watershed

Major Watershed	Area (ac)	TP Loading (lb/yr)	Existing Conditions				Baseline Scenario (1-1-2)			
			Recovery (lb/yr)	Recovery (%)	Reduction (lb/yr)	Reduction (%)	Recovery (lb/yr)	Recovery (%)	Reduction (lb/yr)	Reduction (%)
Bassett Creek Main Stem (Downstream)	794	650	36	5.5%	34	5.2%	30	4.7%	28	4.4%
Bassett Creek Main Stem (Midstream)	2,416	1,537	149	9.7%	135	9.2%	142	9.2%	127	8.7%
Bassett Creek Main Stem (Upstream) East	2,852	2,218	62	2.8%	44	2.0%	81	3.7%	58	2.6%
Bassett Creek Main Stem (Upstream) West	1,064	959	13	1.3%	9	0.9%	28	3.0%	18	1.9%
Bassett Creek Park Pond	1,254	919	38	4.2%	36	3.9%	43	4.7%	40	4.4%
Crane Lake	566	397	5	1.4%	1	0.3%	23	5.9%	5	1.3%
Grimes Lake	499	323	36	11.1%	14	4.3%	30	9.2%	12	3.7%
Lost Lake	55	15	1	7.2%	1	6.2%	2	14.7%	2	12.6%
Medicine Lake Direct	2,506	986	37	3.7%	27	2.7%	59	6.0%	43	4.4%
Medicine Lake NE	665	313	10	3.3%	4	1.1%	20	6.3%	7	2.2%
Medicine Lake North	490	327	6	1.8%	2	0.7%	12	3.6%	4	1.4%
Medicine Lake South	934	479	12	2.6%	6	1.3%	29	6.1%	14	2.8%
Northwood Lake	1,324	915	34	3.7%	30	3.3%	41	4.4%	34	3.8%
Parkers Lake	1,065	1,001	14	1.4%	11	1.1%	27	2.7%	21	2.1%
Parkers Lake East Area	1,059	828	16	1.9%	3	0.4%	32	3.9%	7	0.8%
Plymouth Creek Central	801	475	12	2.6%	7	1.6%	22	4.7%	13	2.8%
Plymouth Creek East	2,045	1,884	26	1.4%	21	1.1%	48	2.5%	38	2.1%
Plymouth Creek West	1,059	637	13	2.0%	6	1.0%	25	3.9%	12	1.9%
Sweeney Lake	2,400	2,053	64	3.1%	50	2.5%	83	4.0%	64	3.2%
Turtle Lake	416	203	6	3.1%	2	1.2%	12	5.9%	5	2.2%

Major Watershed	Area (ac)	TP Loading (lb/yr)	Existing Conditions				Baseline Scenario (1-1-2)			
			Recovery (lb/yr)	Recovery (%)	Reduction (lb/yr)	Reduction (%)	Recovery (lb/yr)	Recovery (%)	Reduction (lb/yr)	Reduction (%)
Twin Lake	77	24	1	5.3%	1	2.4%	2	6.9%	1	3.2%
Westwood Lake	449	136	9	6.3%	3	2.7%	11	7.8%	4	3.1%
Wirth Lake	434	167	16	9.7%	7	4.7%	19	11.3%	9	5.8%

Table C6 Street Sweeping TSS Recovery and Reduction Results for Existing Conditions vs. Baseline Scenario by Major Watershed

Major Watershed	Area (ac)	TSS Loading (lb/yr)	Existing Conditions				Baseline Scenario (1-1-2)			
			Recovery (lb/yr)	Recovery (%)	Reduction (lb/yr)	Reduction (%)	Recovery (lb/yr)	Recovery (%)	Reduction (lb/yr)	Reduction (%)
Bassett Creek Main Stem (Downstream)	794	197,375	4,791	2.4%	4,089	2.1%	3,975	2.0%	3,396	1.7%
Bassett Creek Main Stem (Midstream)	2,416	463,022	18,341	4.0%	14,896	3.4%	17,435	3.8%	14,034	3.2%
Bassett Creek Main Stem (Upstream) East	2,852	672,845	13,817	2.1%	7,535	1.1%	16,318	2.4%	8,867	1.3%
Bassett Creek Main Stem (Upstream) West	1,064	292,026	3,504	1.2%	1,824	0.6%	5,105	1.7%	2,246	0.8%
Bassett Creek Park Pond	1,254	278,303	7,948	2.9%	6,934	2.5%	8,674	3.1%	7,538	2.7%
Crane Lake	566	120,121	784	0.7%	0	0.0%	2,832	2.4%	1	0.0%
Grimes Lake	499	97,301	5,259	5.4%	356	0.4%	4,480	4.6%	333	0.3%
Lost Lake	55	4,348	209	4.8%	74	1.7%	247	5.7%	88	2.0%
Medicine Lake Direct	2,506	289,740	8,335	2.9%	4,348	1.5%	9,894	3.4%	5,168	1.8%
Medicine Lake NE	665	92,950	3,118	3.4%	350	0.4%	3,593	3.9%	413	0.4%
Medicine Lake North	490	98,688	1,854	1.9%	256	0.3%	2,169	2.2%	299	0.3%
Medicine Lake South	934	142,894	2,901	2.0%	580	0.4%	4,257	3.0%	652	0.5%
Northwood Lake	1,324	276,444	8,243	3.0%	6,798	2.5%	8,272	3.0%	6,557	2.4%
Parkers Lake	1,065	305,265	4,126	1.4%	3,033	1.0%	4,785	1.6%	3,493	1.1%
Parkers Lake East Area	1,059	251,198	3,841	1.5%	330	0.1%	4,550	1.8%	389	0.2%
Plymouth Creek Central	801	142,537	4,322	3.0%	1,487	1.0%	4,912	3.4%	1,672	1.2%
Plymouth Creek East	2,045	574,200	8,003	1.4%	5,548	1.0%	9,153	1.6%	6,351	1.1%
Plymouth Creek West	1,059	191,479	4,367	2.3%	1,418	0.7%	5,113	2.7%	1,647	0.9%
Sweeney Lake	2,400	624,604	12,465	2.0%	7,244	1.2%	14,333	2.3%	8,404	1.4%
Turtle Lake	416	60,418	2,241	3.7%	187	0.3%	2,593	4.3%	216	0.4%

Major Watershed	Area (ac)	TSS Loading (lb/yr)	Existing Conditions				Baseline Scenario (1-1-2)			
			Recovery (lb/yr)	Recovery (%)	Reduction (lb/yr)	Reduction (%)	Recovery (lb/yr)	Recovery (%)	Reduction (lb/yr)	Reduction (%)
Twin Lake	77	7,040	182	2.6%	1	0.0%	215	3.1%	1	0.0%
Westwood Lake	449	39,225	1,327	3.4%	63	0.2%	1,449	3.7%	64	0.2%
Wirth Lake	434	48,955	1,688	3.4%	333	0.7%	1,871	3.8%	385	0.8%

Table C7 Street Sweeping TSS Reduction Ranking by Municipality

Municipality	Total Curb Length (miles)	Existing Conditions: TSS Reduction (lbs/curb-mile/year)	Baseline Scenario		
			Reduction (lbs/curb-mile/year)	Increase (lbs/curb-mile/year)	Reduction Increase Ranking (#)
Plymouth	398.05	52.58	60.12	7.54	3
Golden Valley	291.44	64.08	75.46	11.38	2
Minneapolis	103.47	128.94	107.14	-21.80	--
Crystal	67.86	106.61	107.23	0.62	6
New Hope	59.03	93.91	96.37	2.46	5
Minnetonka	47.00	1.89	6.41	4.51	4
St. Louis Park	35.65	38.20	38.42	0.22	7
Robbinsdale	22.65	12.79	9.95	-2.84	--
Medicine Lake	3.22	67.71	106.60	38.89	1

Table C8 Street Sweeping TSS Reduction Ranking by Major Watershed

Major Watershed	Total Curb Length (miles)	Existing Conditions: TSS Reduction (lbs/curb-mile/year)	Baseline Scenario (1-1-2)		
			Reduction (lbs/curb-mile/year)	Increase (lbs/curb-mile/year)	Reduction Increase Ranking (#)
Bassett Creek Main Stem (Downstream)	36	112.9	93.73	-19.14	--
Bassett Creek Main Stem (Midstream)	133	111.8	105.31	-6.46	--
Bassett Creek Main Stem (Upstream) East	123	61.1	71.90	10.80	4
Bassett Creek Main Stem (Upstream) West	39	46.7	57.47	10.79	5
Bassett Creek Park Pond	59	118.2	128.55	10.31	6
Crane Lake	20	0.0	0.04	0.03	19
Grimes Lake	30	11.7	10.99	-0.75	--
Lost Lake	2	42.3	50.01	7.69	8
Medicine Lake Direct	71	61.4	72.97	11.57	3
Medicine Lake NE	26	13.7	16.16	2.47	12
Medicine Lake North	19	13.3	15.45	2.20	14
Medicine Lake South	31	19.0	21.34	2.35	13
Northwood Lake	62	110.1	106.24	-3.90	--
Parkers Lake	32	95.1	109.56	14.44	1
Parkers Lake East Area	39	8.5	10.05	1.51	16
Plymouth Creek Central	33	44.6	50.16	5.57	10
Plymouth Creek East	69	80.9	92.58	11.70	2
Plymouth Creek West	40	35.4	41.13	5.71	9
Sweeney Lake	122	59.5	69.05	9.53	7
Turtle Lake	17	10.8	12.55	1.70	15
Twin Lake	2	0.3	0.40	0.06	18
Westwood Lake	11	5.9	6.01	0.07	17
Wirth Lake	14	23.0	26.60	3.56	11

Table C9 Street Sweeping TSS Recovery Ranking by Municipality

Municipality	Total Curb Length (miles)	Existing Conditions: TSS Recovery (lbs/curb-mile/year)	Baseline Scenario		
			Recovery (lbs/curb-mile/year)	Increase (lbs/curb-mile/year)	Recovery Increase Ranking (#)
Plymouth	398.05	117	134	18	4
Golden Valley	291.44	109	128	19	3
Minneapolis	103.47	152	126	-26	--
Crystal	67.86	148	148	1	7
New Hope	59.03	121	136	15	5
Minnetonka	47.00	40	133	93	1
St. Louis Park	35.65	115	116	1	6
Robbinsdale	22.65	188	146	-42	--
Medicine Lake	3.22	84	132	48	2

Table C10 Street Sweeping TSS Recovery Ranking by Major Watershed

Major Watershed	Total Curb Length (miles)	Existing Conditions: TSS Recovery (lbs/curb-mile/year)	Baseline Scenario (1-1-2)		
			Recovery (lbs/curb-mile/year)	Increase (lbs/curb-mile/year)	Recovery Increase Ranking (#)
Bassett Creek Main Stem (Downstream)	36	132	110	-23	--
Bassett Creek Main Stem (Midstream)	133	138	131	-7	--
Bassett Creek Main Stem (Upstream) East	123	112	132	20	9
Bassett Creek Main Stem (Upstream) West	39	90	131	41	3
Bassett Creek Park Pond	59	136	148	12	18
Crane Lake	20	40	144	104	1
Grimes Lake	30	173	148	-26	--
Lost Lake	2	119	140	22	5
Medicine Lake Direct	71	118	140	22	4
Medicine Lake NE	26	122	141	19	11
Medicine Lake North	19	96	112	16	15
Medicine Lake South	31	95	139	44	2
Northwood Lake	62	134	134	0	20
Parkers Lake	32	129	150	21	7
Parkers Lake East Area	39	99	118	18	12
Plymouth Creek Central	33	130	147	18	13
Plymouth Creek East	69	117	133	17	14
Plymouth Creek West	40	109	128	19	10
Sweeney Lake	122	102	118	15	16
Turtle Lake	17	130	150	20	8
Twin Lake	2	118	139	21	6
Westwood Lake	11	125	136	11	19
Wirth Lake	14	117	129	13	17

Table C11 Street Sweeping TP Recovery and Reduction Ranking by Municipality Normalized by Curb Miles

Municipality	Existing Conditions: TP Recovery (lbs/curb-mile/year)	Baseline Scenario (1-1-2)			Existing Conditions: TP Reduction (lbs/curb-mile/year)	Baseline Scenario (1-1-2)		
		Recovery (lbs/curb-mile/year)	Increase (lbs/curb-mile/year)	Recovery Increase Ranking (#)*		Reduction (lbs/curb-mile/year)	Increase (lbs/curb-mile/year)	Reduction Increase Ranking (#)*
Plymouth	0.40	0.74	0.35	3	0.25	0.45	0.21	3
Golden Valley	0.56	0.74	0.18	4	0.42	0.56	0.13	4
Minneapolis	1.43	1.21	-0.22	--	1.30	1.10	-0.20	--
Crystal	0.70	0.72	0.02	7	0.58	0.59	0.01	6
New Hope	0.59	0.65	0.06	6	0.51	0.52	0.01	7
Minnetonka	0.23	0.99	0.75	1	0.08	0.31	0.24	2
St. Louis Park	0.61	0.70	0.08	5	0.38	0.43	0.05	5
Robbinsdale	1.29	0.94	-0.35	--	0.46	0.34	-0.12	--
Medicine Lake	0.77	1.27	0.50	2	0.64	1.05	0.41	1

* 1 = highest priority (based on projected increased benefit per curb miles); 7 = lowest priority; -- = already sweeping more than baseline scenario

Table C12 Street Sweeping TP Recovery and Reduction Ranking by Major Subwatershed Normalized by Curb Miles

MajorSubwatershed	Existing Conditions: Recovery (lbs/curb-mile/year)	Baseline Scenario (1-1-2)			Existing Conditions: Reduction (lbs/curb-mile/year)	Baseline Scenario (1-1-2)		
		Recovery (lbs/curb-mile/year)	Increase (lbs/curb-mile/year)	Recovery Increase Ranking (#)*		Reduction (lbs/curb-mile/year)	Increase (lbs/curb-mile/year)	Reduction Increase Ranking (#)*
Bassett Creek Main Stem (Downstream)	0.99	0.84	-0.15	--	0.93	0.78	-0.14	--
Bassett Creek Main Stem (Midstream)	1.12	1.06	-0.06	--	1.01	0.96	-0.06	--
Bassett Creek Main Stem (Upstream) East	0.50	0.66	0.16	17	0.36	0.47	0.11	15
Bassett Creek Main Stem (Upstream) West	0.32	0.73	0.40	6	0.22	0.47	0.24	4
Bassett Creek Park Pond	0.65	0.74	0.08	20	0.61	0.68	0.07	18
Crane Lake	0.27	1.18	0.91	1	0.06	0.26	0.20	7
Grimes Lake	1.18	0.98	-0.20	--	0.45	0.39	-0.06	--
Lost Lake	0.62	1.27	0.65	2	0.54	1.09	0.56	1
Medicine Lake Direct	0.52	0.83	0.31	10	0.38	0.61	0.23	6
Medicine Lake NE	0.41	0.77	0.36	7	0.14	0.27	0.13	10
Medicine Lake North	0.31	0.61	0.30	13	0.12	0.23	0.11	16
Medicine Lake South	0.41	0.95	0.55	3	0.21	0.44	0.23	5
Northwood Lake	0.55	0.66	0.11	19	0.49	0.56	0.07	19
Parkers Lake	0.43	0.84	0.41	5	0.35	0.67	0.32	2
Parkers Lake East Area	0.42	0.84	0.42	4	0.09	0.17	0.09	17
Plymouth Creek Central	0.37	0.67	0.30	12	0.22	0.40	0.18	8
Plymouth Creek East	0.38	0.69	0.32	9	0.31	0.56	0.25	3
Plymouth Creek West	0.32	0.63	0.31	11	0.16	0.31	0.15	9
Sweeney Lake	0.53	0.68	0.15	18	0.41	0.53	0.12	13
Turtle Lake	0.36	0.70	0.34	8	0.14	0.26	0.13	11

MajorSubwatershed	Existing Conditions: Recovery (lbs/curb-mile/year)	Baseline Scenario (1-1-2)			Existing Conditions: Reduction (lbs/curb-mile/year)	Baseline Scenario (1-1-2)		
		Recovery (lbs/curb-mile/year)	Increase (lbs/curb-mile/year)	Recovery Increase Ranking (#)*		Reduction (lbs/curb-mile/year)	Increase (lbs/curb-mile/year)	Reduction Increase Ranking (#)*
Twin Lake	0.84	1.09	0.25	14	0.38	0.50	0.12	14
Westwood Lake	0.81	1.00	0.19	15	0.33	0.39	0.06	20
Wirth Lake	1.12	1.31	0.19	16	0.50	0.62	0.12	12

* 1 = highest priority (based on projected increased benefit per curb miles); 7 = lowest priority; -- = already sweeping more than baseline scenario