Sunrise River Watershed

(Lower St. Croix River Watershed)

Watershed Restoration and Protection Strategy Report

September 2014

*** Disclaimer**

The science, analysis and strategy development described in this report began before the accountability provisions were added to the Clean Water Legacy Act in 2013 (MS114D); thus, this report does not address all of those provisions. When this watershed is revisited (according to the 10-year cycle), the information will be updated according to the statutorily required elements of a Watershed Restoration and Protection Strategy Report.

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Minnesota Department of Transportation

St. Croix Watershed Research Station

Sunrise River Watershed Management Organization

US Army Corps of Engineers

US Department of Agriculture Natural Resource Conservation Service

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Table of Contents

Key Terms

Assessment Unit Identifier (AUID): The unique water body identifier for each river reach comprised of the United State Geologic Service (USGS) eight-digit Hydrologic Unit Code (HUC) plus a three-character code unique within each HUC.

Aquatic life impairment: The presence and vitality of aquatic life is indicative of the overall water quality of a stream. A stream is considered impaired for impacts to aquatic life if the fish Index of Biotic Integrity (IBI), macroinvertebrate IBI, dissolved oxygen, turbidity, or certain chemical standards are not met. Aquatic life is denoted as AQL throughout the WRAPS Report.

Aquatic recreation impairment: Streams are considered impaired for impacts to aquatic recreation if fecal bacteria standards are not met. Lakes are considered impaired for impacts to aquatic recreation if total phosphorus, chlorophyll-a, or Secchi disc depth standards are not met. Aquatic recreation is denoted as AQR throughout the WRAPS Report.

Hydrologic Unit Code (HUC): A Hydrologic Unit Code (HUC) is assigned by the USGS for each watershed. HUCs are organized in a nested hierarchy by size. For example, the St. Croix River Basin is assigned a HUC-4 of 0703 and the Sunrise River Watershed is assigned a HUC-8 of 07030005.

Impairment: Water bodies are listed as impaired if water quality standards are not met for designated uses including: aquatic life, aquatic recreation, and aquatic consumption.

Index of Biotic integrity (IBI): A method for describing water quality using characteristics of aquatic communities, such as the types of fish and invertebrates found in the waterbody. It is expressed as a numerical value between 0 (lowest quality) to 100 (highest quality).

Protection: This term is used to characterize actions taken in watersheds of waters not known to be impaired to maintain conditions and beneficial uses of the waterbodies.

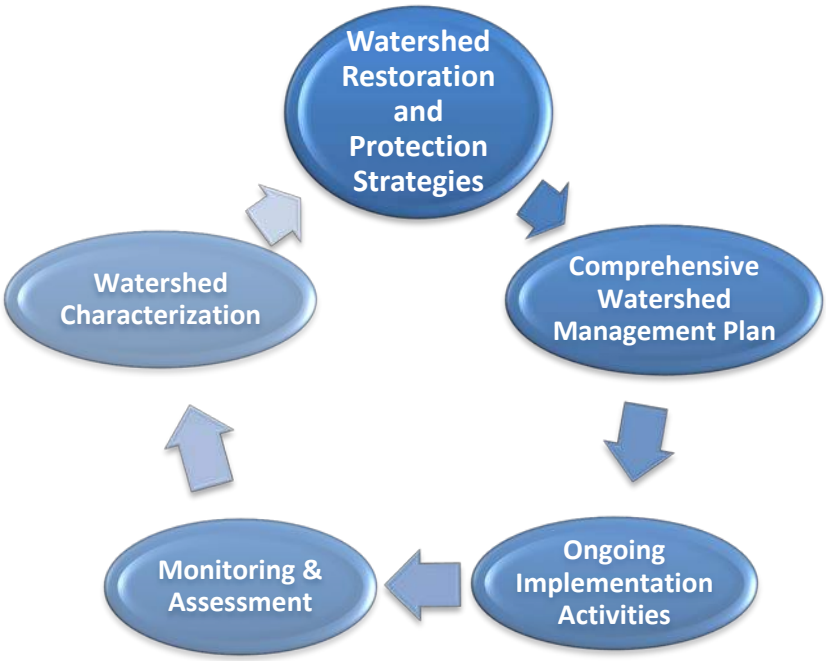
Restoration: This term is used to characterize actions taken in watersheds of impaired waters to improve conditions, eventually to meet water quality standards and achieve beneficial uses of the waterbodies.

Source (or Pollutant Source): This term is distinguished from 'stressor' to mean only those actions, places or entities that deliver/discharge pollutants (e.g., sediment, phosphorus, nitrogen, pathogens).

Stressor (or Biological Stressor): This is a broad term that includes both pollutant sources and non-pollutant sources or factors (e.g., altered hydrology, dams preventing fish passage) that adversely impact aquatic life.

Total Maximum Daily Load (TMDL): A calculation of the maximum amount of a pollutant that may be introduced into a surface water and still ensure that applicable water quality standards for that water are met. A TMDL is the sum of the wasteload allocation for point sources, a load allocation for nonpoint sources and natural background, an allocation for future growth (i.e., reserve capacity), and a margin of safety as defined in the Code of Federal Regulations.

What is the WRAPS Report?



The State of Minnesota has adopted a "watershed approach" to address the state's 81 "major" watersheds (denoted by 8-digit hydrologic unit code or HUC). This watershed approach incorporates **water quality assessment, watershed analysis, civic engagement, planning**, **implementation**, and **measurement of results** into a 10-year cycle that addresses both restoration and protection.

As part of the watershed approach, waters not meeting state standards are still listed as impaired and Total Maximum Daily Load (TMDL) studies are performed, as they have been in the past, but in addition the watershed approach process facilitates a more cost-effective and comprehensive characterization of multiple water bodies and overall watershed health. A key aspect of this effort is to develop and utilize watershed-scale models and other tools to help state agencies, local governments and other watershed stakeholders determine how to best proceed with restoring and protecting lakes and streams. This report summarizes past assessment and diagnostic work and outlines ways to prioritize actions and strategies for continued implementation.

Purpose

- Support local working groups and jointly develop scientifically-supported restoration and protection strategies to be used for subsequent implementation planning
- List of the Watershed Approach work done to date, as well as other reports:
  - *Lower St. Croix Watershed Monitoring and Assessment*
  - *Lower St. Croix Watershed Biotic Stressor Identification*
  - *Sunrise River Watershed Total Maximum Daily Load*
  - *Sunrise River Watershed SWAT Modeling Report*
  - *Army Corps of Engineers Watershed Study Report for the Sunrise River Watershed*

Scope

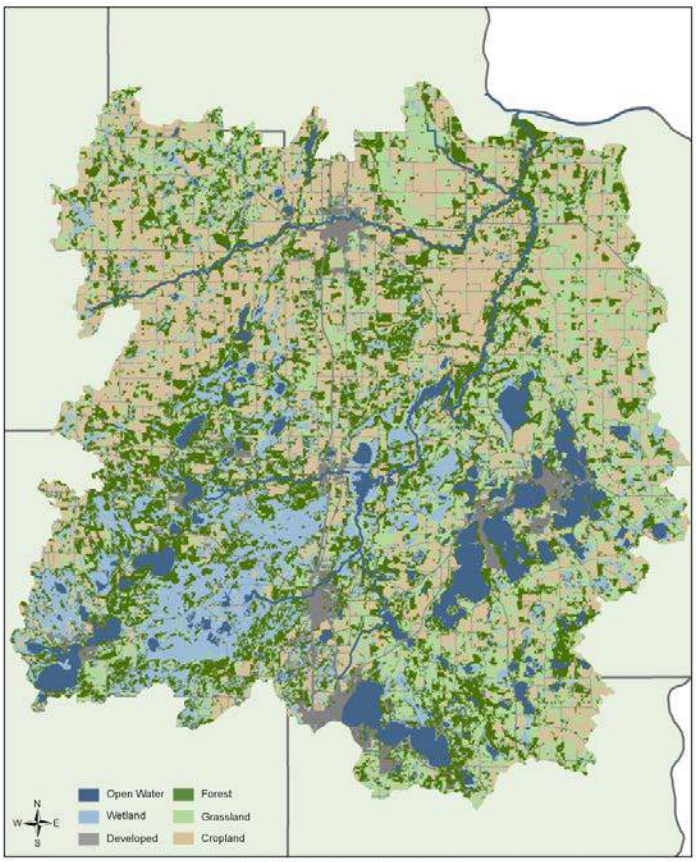
- Impacts to aquatic recreation and impacts to aquatic life in streams
- Impacts to aquatic recreation in lakes
- Create strategies for restoration and protection of watershed resources such as forested land, wetlands, native and endangered plant and biotic communities, and other priority natural resources and ecosystems

Audience

- Local working groups (local governments, SWCDs, watershed management groups, etc.)
- State agencies (Minnesota Pollution Control Agency, Department of Natural Resources, Board of Water and Soil Resources, etc.)

1. Watershed Background & Description

The Sunrise River Watershed is approximately 385 square miles and is located in parts of four counties (Anoka, Chisago, Isanti, and Washington) with the largest area in Chisago County. The area includes eight incorporated cities (North Branch, Stacy, Wyoming, Forest Lake, East Bethel, Chisago City, Lindstrom, and Center City) and covers portions of nineteen townships. Several smaller streams combine to form the Sunrise River: the North Branch, which begins in Isanti County and flows east to its confluence with the main branch in Sunrise Township; the West Branch of the Sunrise River begins in Anoka County and flows east to the confluence with the main stem in Stacy, MN; the headwaters of the main branch of the Sunrise River is located in northern Washington County; and the main branch flows north and east to its confluence with the St. Croix River at Sunrise Township.



Sunrise Watershed Landcover
2006 National Land Cover Data Set
Chisago SWCD 2012

The Sunrise River Watershed is a high priority subwatershed of the St. Croix River. The waters within the Sunrise River Watershed boundary outlet to the St. Croix River near the town of Sunrise in Wild River State Park. This project will not only address the impairments within the Sunrise River Watershed, but will also aid in understanding the phosphorus loading to Lake St. Croix. Lake St. Croix was listed on the 2008 303(d) Impaired Waters List for excess phosphorus. The Sunrise River was identified as one of the greatest contributors of phosphorus and sediment to the St. Croix River (U.S. Geological Survey, 1999) and was allocated a 33% reduction in phosphorus loading by the Lake St. Croix Total Maximum Daily Load Study.

Due to the geographic proximity to the Sunrise River Watershed, it was decided that the area that drains directly to the St. Croix River should be included in the protection portion of this study. This area includes Dry Creek North, Dry Creek South, Lawrence Creek, many smaller tributaries, and a few small lakes. The area is approximately 79 square miles and is located in Chisago County. The area is known to be very steep and is known as The Escarpment in Chisago County.

North Central Hardwood Forest Ecoregion:

The watershed is part of the North Central Hardwood Forest ecoregion. According to the Minnesota Pollution Control Agency this ecoregion is an area of transition between the forested areas to the north and east and the agricultural areas to the south and west. The terrain varies from rolling hills to smaller plains. Upland areas are forested by hardwoods and conifers. Plains include livestock pastures, hay fields and row crops such as potatoes, beans, peas and corn.

The watershed contains many lakes and streams. The lakes range in size from 10 acres to over 1,000 acres. A mixture of intermittent streams and perennial streams scatter across the landscape.

Unique Watershed Characteristics:

Sunrise River Watershed

- This watershed is 385 square miles (246,450 acres) in East Central Minnesota. The watershed is on the edge of the 7-County Metropolitan Area.
- 7 small cities are entirely within the watershed boundary. The largest of these is the city of North Branch, who is a regulated Municipal Separate Storm Sewer System (MS4) community.

Table 1 - Sunrise River Watershed Land Cover

Land Cover	Total Acres	% of Watershed
FOREST	63,650	26 %
DEVELOPED	19,900	8 %
GRASSLAND	43,600	18 %
CROPLAND	59,700	24 %
WETLAND	42,550	17 %
OPEN WATER	17,050	7 %
	246,450	

Direct Drainage to the St. Croix River

- This area is 79 square miles (50,570 acres) along the St. Croix National Scenic Riverway.
- The direct drainage to the St. Croix River watershed includes the cities of Taylors Falls and Shafer.
- Very steep bluffs along the river from Wild River State Park to the Chisago County line.

Table 2 - Direct Drainage to the St. Croix River Land Cover

Land Cover	Total Acres	% of Watershed
FOREST	9,608	19 %
DEVELOPED	4,046	8 %
GRASSLAND	20,228	40 %
CROPLAND	11,125	22 %
WETLAND	4,046	8 %
OPEN WATER	1,517	3 %
	50,570	

2. Watershed Conditions

The watershed has a mixture of residential, agriculture, and forested land. Water quality varies throughout the whole watershed.

As part of the Watershed Approach, streams and lakes throughout the watershed were monitored for impacts to aquatic recreation and aquatic life. From this monitoring data, several water bodies were assessed as impaired and several as not impaired (referred to as supporting). However, not all water bodies were monitored or assessed at this time due to: being classified as limited use resources, being predominately channelized, or time or budget constraints. Of the water bodies monitored, not all could be assessed due to insufficient data. Through continuing work and future iterations of the watershed approach, additional water bodies may be monitored and assessed.

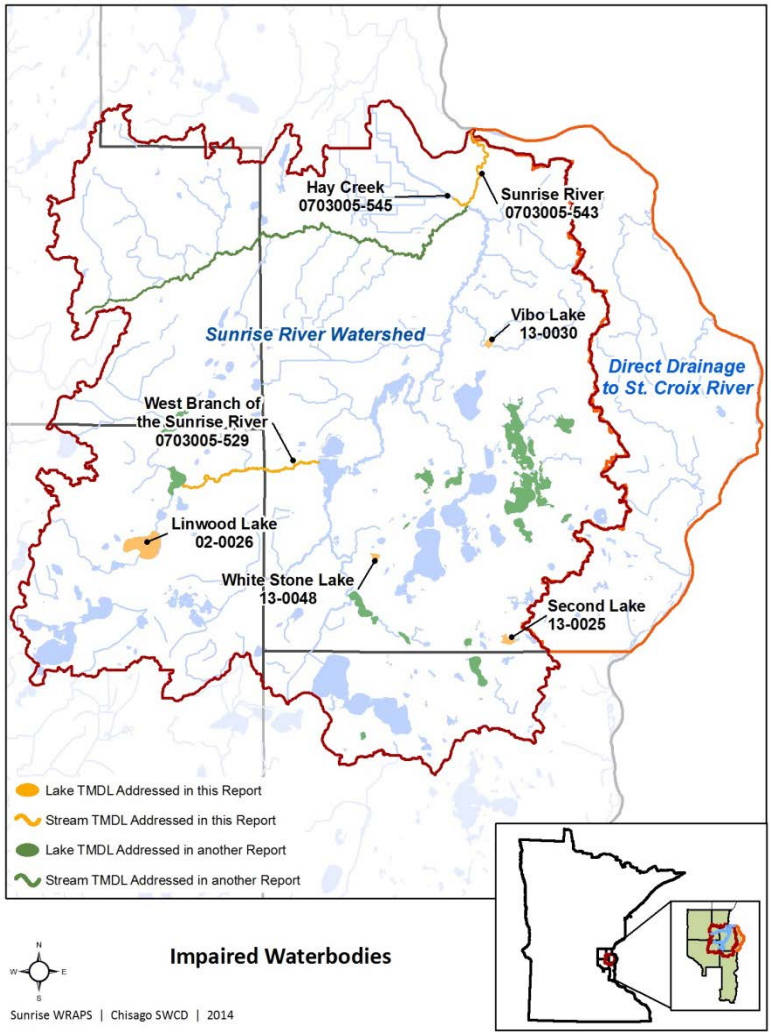


Figure 1. Impaired Waterbodies in the Sunrise River Watershed.

This report addresses impairments to aquatic recreation and aquatic life in stream reaches and lakes but does not address impairments to aquatic consumption (human consumption of fish) or impaired wetlands. Impairments to aquatic consumption are addressed in the *Minnesota Statewide Mercury TMDL (*http://www.pca.state.mn.us/index.php/view-document.html?gid=8507). Impaired wetlands are not addressed due to an evolving understanding of wetland processes relative to impairment status. The Minnesota Pollution Control Agency (MPCA) recently completed a Metro Chloride Feasibility study to obtain a better understanding of the extent, magnitude, and causes of chloride contamination to surface waters in the seven county Twin Cities Metropolitan Area and to explore options and strategies for addressing chloride impairments and other impacts to water resources.

Of the 140 lakes (over 10 acres in size) in the watershed, 46 lakes (or bays) have been monitored for impairments to aquatic recreation (Figure 2). 22 of the monitored lakes are deemed “Not Supporting” by the MPCA. Of the over 100 stream reaches (many reaches can make up one stream) within the region, 5 were found to be fully supporting for Aquatic Life (Figure 4) and 2 for Aquatic Recreation (these reaches are not impaired) (Figure 3). Ten reaches were found to be not supporting for Aquatic

Life (AQL) and 7 for Aquatic Recreation (AQR). Many of the other reaches were monitored some, but did not have sufficient data to completely assess them. Many of these non-supporting waterbodies have approved TMDLs, and some have approved implementation plans. A list of these reports, as well as a link to them can be found in Table 11.

The ecoregion contains many lakes, and water clarity and nutrient levels are moderate. Land surrounding many of these lakes has been developed for housing and recreation, and the densely populated metropolitan area dominates the eastern portion of this region. Water quality problems that face many of the water bodies in this area are associated with contaminated runoff from paved surfaces and lawns. (http://www.pca.state.mn.us/wfhye42) Water quality is also impacted by agricultural runoff; of which is largely in row crop production.

Additional Sunrise River Watershed Resources

Past MPCA studies regarding assessment, Stressor Identification, TMDLs, and implementation in the Sunrise River Watershed can be found at: http://www.pca.state.mn.us/lupgdd5

Minnesota (DNR) Watershed Assessment Mapbook for the Sunrise River Watershed: http://files.dnr.state.mn.us/natural_resources/water/watersheds/tool/watersheds/wsmb37.pdf

Natural Resources Conservation Service's (NRCS) Rapid Watershed Assessment: http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_022726.pdf

2.1 Condition Status

This section summarizes impairment assessments for streams and lakes in the Sunrise River Watershed. Waters that are not listed as impaired will be subject to protection efforts (See Section 2.5). Some of the waterbodies in the Sunrise River Watershed are impaired by mercury and Polychlorinated Biphenyls (PCBs) in fish tissue; however, this report does not cover toxic pollutants. For more information on mercury impairments see the statewide mercury TMDL at: http://www.pca.state.mn.us/wfhy9ef.

Streams

Streams are assessed for aquatic life and aquatic recreation uses. Aquatic life impairments include: fish index of biotic integrity (Fish IBI), macroinvertebrate index of biotic integrity (Invert IBI), dissolved oxygen (DO), turbidity/total suspended solids (TSS), pH, and chlorides. Aquatic recreation use impairments include: E. coli. Table 3 summarizes the stream impairment assessment by total stream length in miles and the total number of individual assessment unit IDs (AUIDs). Appendix A includes a summary of the stream impairment assessment by designated use and pollutants for all assessed AUIDs.

Table 3. MPCA 2012 Stream Impairment Assessment Summary

Impairment Assessment	Stream Length (mi)		Stream AUIDs (#)	
	Aquatic Life	Aquatic Recreation	Aquatic Life	Aquatic Recreation
Fully Supporting (FS)	13.2	9.4	3	2
Not Supporting (NS)	61.3	35.4	10	7
Insufficient Information (IF)	37.9	43.1	15	18
Not Assessed (NA)	642.6	667.3	88	89
Total	755.1		116	

Lakes

Lakes are assessed for aquatic recreation uses based on ecoregion specific water quality standards for total phosphorus (TP), chlorophyll-a (chl-*a*), and secchi transparency depth. To be listed as impaired, a lake must not meet water quality standards for TP and either chl-*a* or secchi depth. Table 4 summarizes the lake impairment assessment by total lake surface area and total number of lakes (split between DNR Public Water Basins (Lakes) and Wetlands). Appendix A includes a summary of the lake impairments by individual lake.

Table 4. MPCA 2012 Lake Impairment Assessment Summary

Aquatic Recreation (Eutrophication)	DNR Public Water Basin		DNR Public Water Wetland	
	Surface area (ac)	Count (#)	Surface area (ac)	Count (#)
Fully Supporting (FS)	8,604	13	58	1
Not Supporting (NS)	4,253	15	145	4
Insufficient Information (IF)	1,935	9	252	7
Not Assessed (NA)	15,139	55	4,215	138
Total	29,931	92	4,670	150

Figure 2. MPCA Lake Assessment Trophic Status Map.

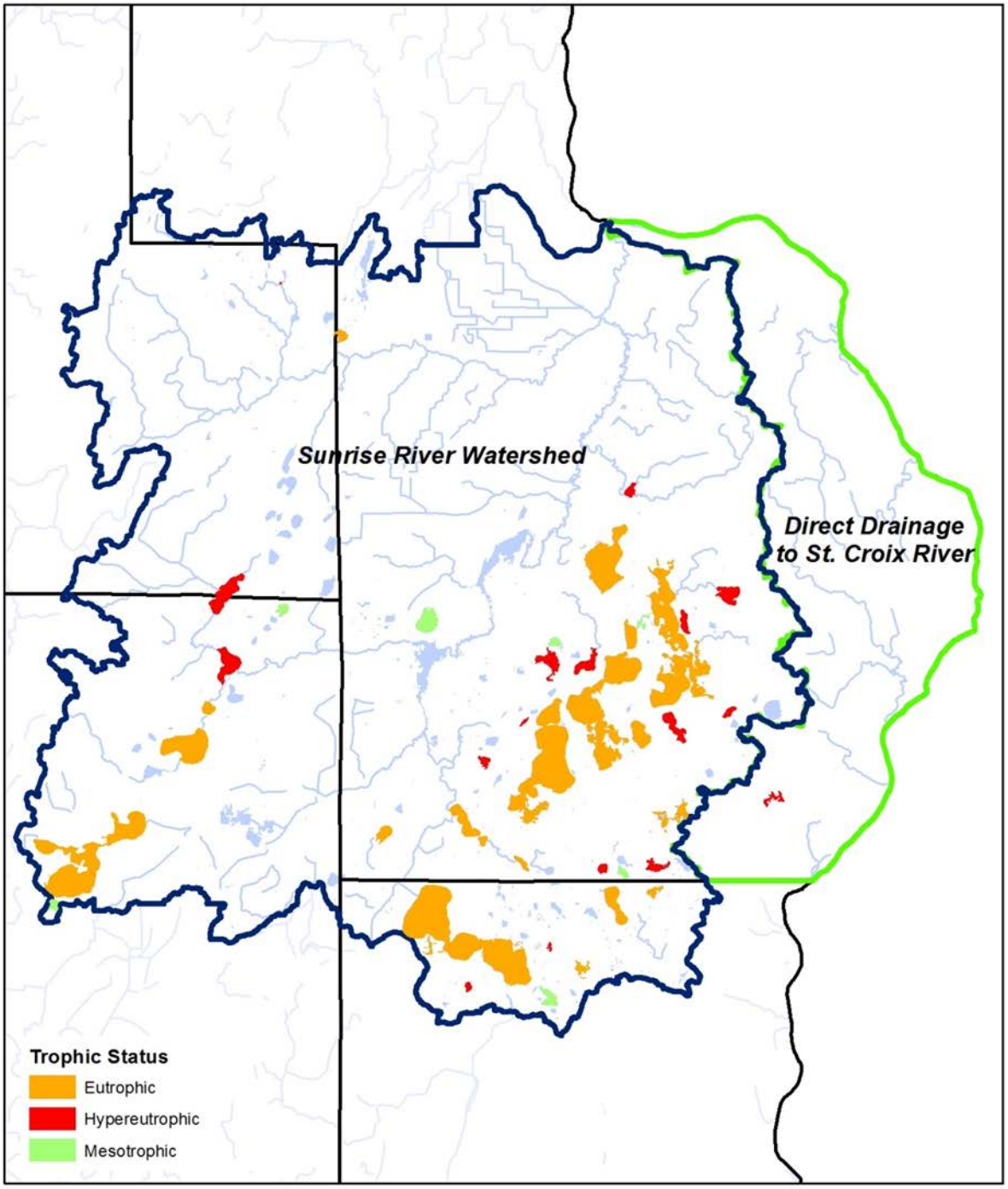


Figure 3. MPCA Aquatic Recreation Stream Assessment Map.

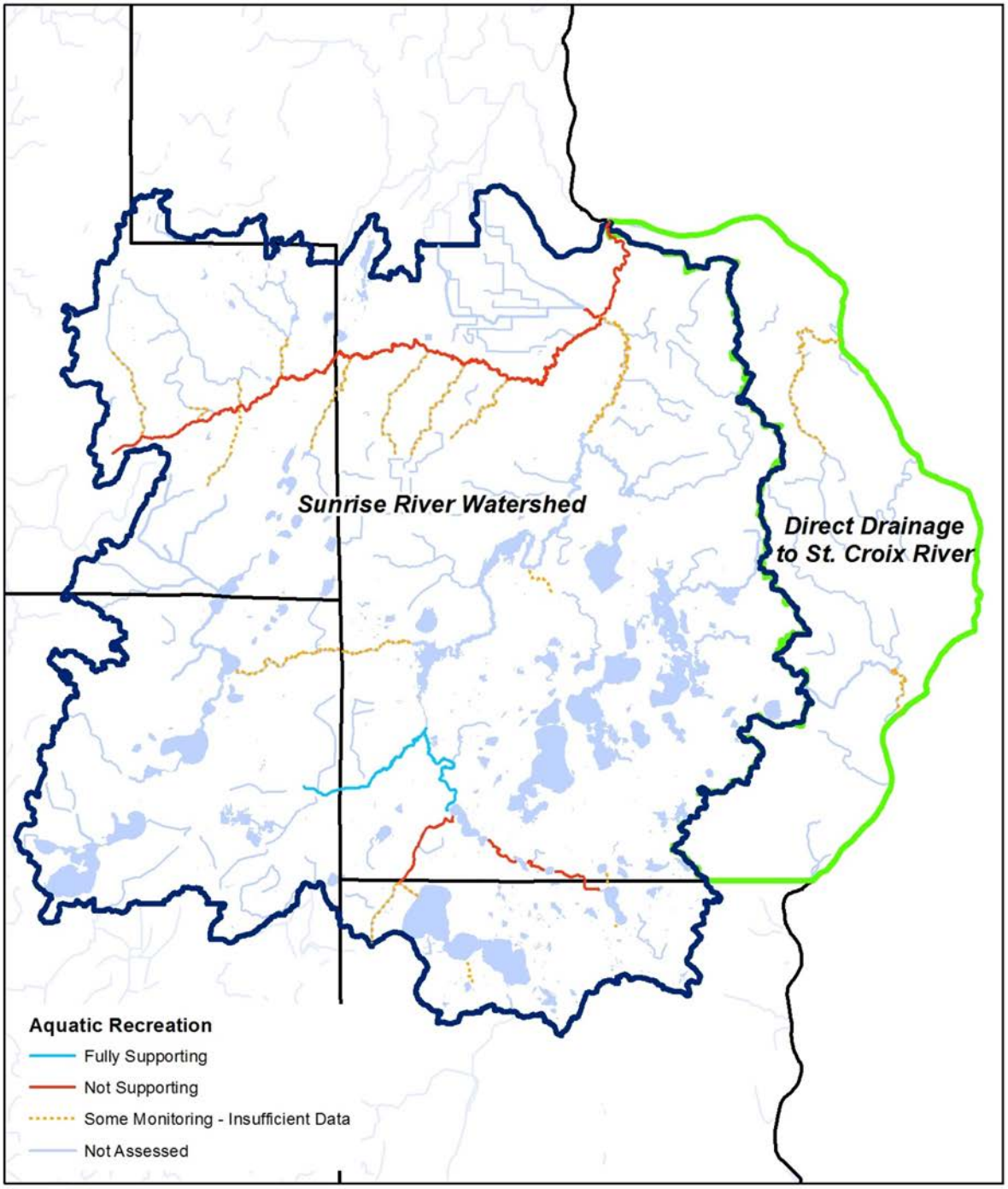
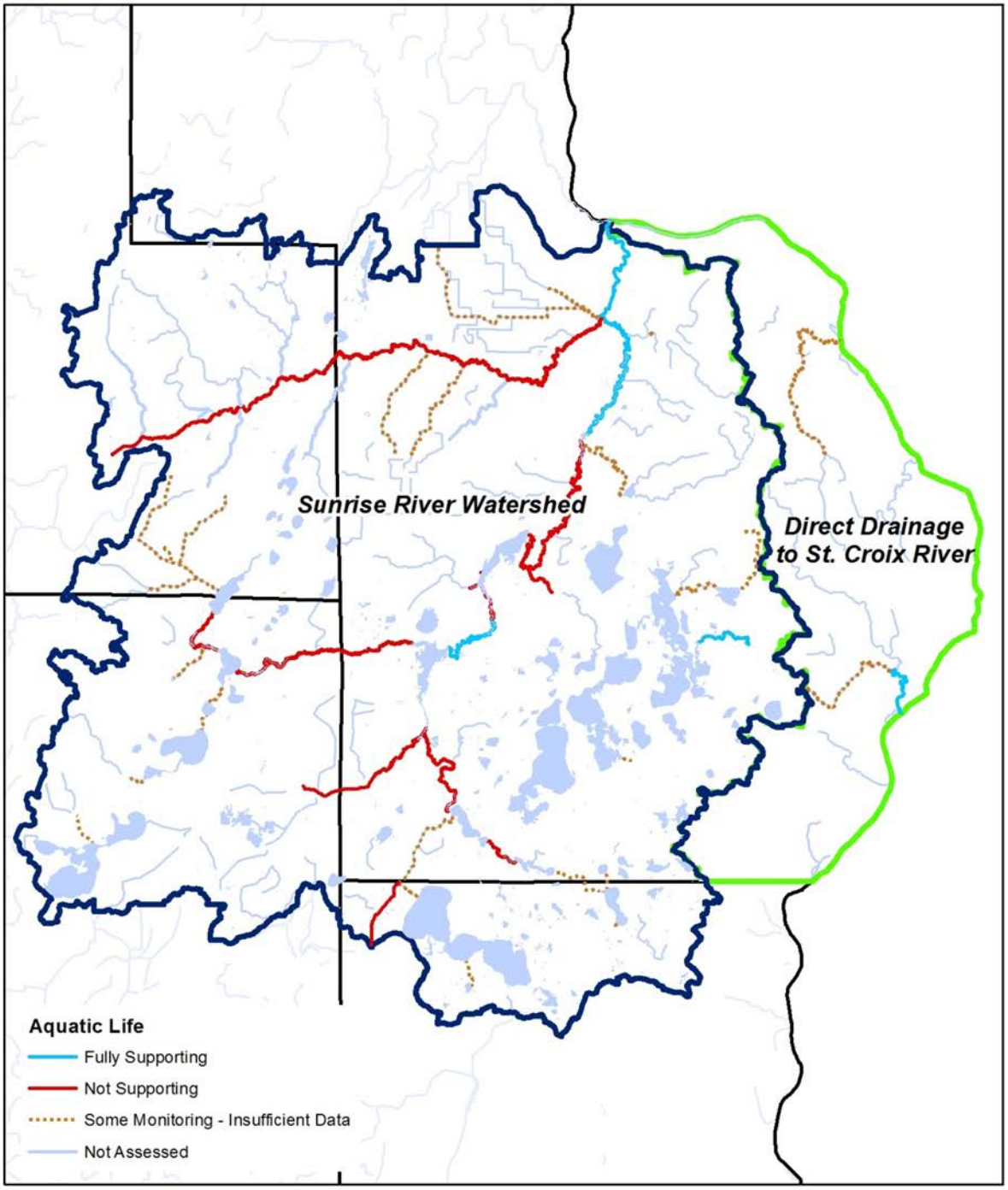


Figure 4. MPCA Aquatic Life Stream Assessment Map.



2.2 Water Quality Trends

Temporal and spatial trends in water quality are useful for identifying potential watershed-scale changes in pollutant loading or hydrology that affect lake and stream water quality. Long-term statistical trend analyses require a long, mostly continuous, monitoring record (25 years or more). Sufficient data was available to conduct a long-term statistical trend analysis for Secchi transparency depth, an overall indicator of water quality in lakes and the most frequently collected water quality parameter, for 18 lakes in the Sunrise River Watershed. Long-term trends were calculated using the GSI Mann-Kendall Toolkit (GSI Environmental Inc., Houston, Texas, www.gsi-net.com) and are presented in Table 5 below. Insufficient data was available to conduct long-term statistical trend analyses for streams in the Sunrise River Watershed.

All but 2 lakes showed a stable trend (not variable), no trend (variable but not increasing or decreasing) or improving trend in water quality, indicating an overall reduction or maintenance of current phosphorus loading rates. The two lakes showing decreasing trends in water quality were rated as "probably decreasing", indicating that these trends were not severe.

Table 5. Long-term lake transparency trends based on growing season mean secchi depth (m)

The Mann-Kendall Statistic indicates whether the Secchi transparency depth trend versus time is generally increasing (positive value) or decreasing (negative value). The confidence factor indicates the degree of confidence in the trend result, as in "Decreasing" vs. "Probably Decreasing" and is given a numeric value and text description. Increasing transparency trends indicate an increasing trend, or improvement, in water quality. Red rows highlight decreasing trends; blue rows highlight increasing trends; and white rows highlight stable trends (not variable) or no trend (variable).

Lake	Period	Mann-Kendall Statistic	Confidence Factor	Trend Description
Bone	1975-2011	15	60.8%	No Trend
Chisago North	1986-2010	10	72.7%	No Trend
Chisago South	1985-2011	0	46.0%	Stable
Comfort	1987-2011	-41	90.2%	Probably Decreasing
Coon	1973-2011	200	>99.9%	Increasing
Fawn	1974-2011	27	87.7%	No Trend
Forest	1980-2011	-10	57.0%	Stable
Little Green	1986-2011	50	88.7%	No Trend
Green	1986-2011	74	95.6%	Increasing
Sylvan/Halfbreed	1974-2011	248	>99.9%	Increasing
Kroon	1994-2010	24	84.7%	No Trend
Linwood	1975-2011	-19	69.2%	Stable
Martin	1975-2011	94	93.4%	Probably Increasing
North Center	1986-2011	66	99.4%	Increasing
Shields	1989-2010	-17	69.6%	Stable
South Center	1985-2011	20	69.0%	No Trend
South Lindstrom	1975-2011	41	95.0%	Probably Increasing
Typo	1974-2007	-25	92.7%	Probably Decreasing

Spatial trends in lake water quality were analyzed for 45 lakes using mean Carlson Trophic State Index (TSI) based on water quality collected from 2001-2010. The Carlson TSI gives a standardized measure of lake fertility based on the secchi depth, total phosphorus concentration and chlorophyll A measurements, Two thirds of the lakes in the Sunrise River Watershed were classified as eutrophic with periods of algal bloom episodes that impede aquatic recreation. Nine lakes were classified as hypereutrophic with potential severe algal blooms. Only six lakes were classified as oligo-/meso-trophic with good water quality.

Table 6. Spatial trends in lake trophic state.
Mean Carlson TSI Index based on 10-year growing season mean TP, Chl-a, and Secchi transparency depth from 2001-2010

Lake ID	Lake Name	Mean Carlson TSI	Predicted Water Quality
02-0035-00	FAWN	38	Oligotrophic
82-0080-00	SYLVAN/HALFBREED	41	Mesotrophic
02-0048-00	SOUTH COON	44	Mesotrophic
13-0024-00	THIRD	47	Mesotrophic
13-0043-00	MATTSON	48	Mesotrophic
82-0056-00	UNNAMED (GERMAN)	49	Mesotrophic
13-0066-00	MUD	51	Eutrophic
13-0035-00	NORTH LINDSTROM	53	Eutrophic
13-0047-00	ELLEN	53	Eutrophic
02-0022-00	ISLAND	54	Eutrophic
13-0028-00	SOUTH LINDSTROM	54	Eutrophic
13-0053-00	COMFORT	55	Eutrophic
13-0054-00	LITTLE COMFORT	55	Eutrophic
02-0042-00	COON	56	Eutrophic
13-0012-01	CHISAGO (NORTH BAY)	56	Eutrophic
82-0159-00	FOREST	56	Eutrophic
13-0041-01	GREEN (LITTLE GREEN)	56	Eutrophic
13-0041-02	GREEN (MAIN BASIN)	57	Eutrophic
13-0031-00	SUNRISE	57	Eutrophic
13-0013-00	KROON	58	Eutrophic
13-0019-00	SPIDER	59	Eutrophic
82-0054-00	BONE	60	Eutrophic
13-0012-02	CHISAGO (SOUTH BAY)	60	Eutrophic
13-0056-00	HEIMS	61	Eutrophic
02-0026-00	LINWOOD	61	Eutrophic
13-0027-00	SOUTH CENTER	61	Eutrophic
13-0032-02	NORTH CENTER POND	61	Eutrophic
13-0025-00	SECOND	62	Eutrophic
13-0057-00	SCHOOL	62	Eutrophic
82-0053-00	SEA	63	Eutrophic
13-0011-00	OGRENS	64	Eutrophic
13-0048-00	WHITE STONE	64	Eutrophic
13-0032-01	NORTH CENTER	65	Eutrophic
13-0042-00	BIRCH	65	Eutrophic

Lake ID	Lake Name	Mean Carlson TSI	Predicted Water Quality
02-0034-00	MARTIN	68	Eutrophic
82-0162-00	SHIELDS	70	Eutrophic
13-0023-00	MOODY	71	Hypereutrophic
13-0034-00	PIONEER	72	Hypereutrophic
13-0033-00	LITTLE	72	Hypereutrophic
13-0014-00	LINN	74	Hypereutrophic
13-0044-00	SCHOOL	76	Hypereutrophic
13-0030-00	VIBO	79	Hypereutrophic
13-0046-00	EMILY	79	Hypereutrophic
13-0029-00	WALLMARK	80	Hypereutrophic
30-0009-00	TYPO	85	Hypereutrophic

Stream Trends and Pollutant Loadings

Water quality trends and loadings across a watershed are useful in tracking the overall health of the watershed, and determining if on the ground actions are actually being reflected in local water quality. Within the Sunrise River watershed stream monitoring has been not consistent enough at this time to determine overall trends on every stream within the watershed. While monitoring throughout the watershed has not been consistent, the Watershed Districts and Watershed Management Organizations have been collecting stream data, but do not yet have enough to establish trends. As for the rest of the waterbodies outside these areas, their ability to collect a consistent amount of data on every reach for the numerous years necessary to establish trends currently exceeds their available staff time and funding.

However, while local resources may be currently limited the MPCA has been collecting data in the watershed through a few of its programs. One program with some longer term trends is the Milestones Monitoring Program. This program has been monitoring on the North Branch of the Sunrise River for several decades. The overall trends of this data can be found on the Milestone Trends by Decade Spreadsheet on the MPCA's Minnesota Milestone River Monitoring Program website. Another program that was started in the watershed in 2007 was the MPCA's Pollutant Load Monitoring Program. This program has been collecting samples and stream flow year round on the Sunrise River at the town of Sunrise. Table 7 shows the average pollutant loads and Flow Weighted Mean Concentrations at the site from 2007 – 2011. More information on this site, and others around the state, can be found on the MPCA Pollutant Load Monitoring website.

Table 7. Average Pollutant Loads, Yields, and Flow Weighted Means for the Sunrise River at CR88 from 2007 - 2011

Parameter	Avg FWMC (mg/L)	Average Mass (kg)	Average Volume (acre-ft)	Average Yield (lbs/acre)
Dissolved Ortho-Phosphorus (OP)	0.039	6,182	125,739	0.056
Nitrate + Nitrite Nitrogen (NO_2+NO_3)	1.02	149,289		1.35
Total Kjeldahl Nitrogen (TKN)	1.00	160,306		1.45
Total Phosphorus (TP)	0.096	14,709		0.133
Total Suspended Solids (TSS)	13	2,201,783		19.9

2.3 Stressors and Sources

In order to develop appropriate strategies for restoring or protecting waterbodies the stressors and/or sources impacting or threatening them must be identified and evaluated. Biological stressor identification is done for streams with dissolved oxygen, fish, or macroinvertebrate biota impairments and encompasses both evaluation of pollutants and non-pollutant-related factors as potential stressors (e.g. altered hydrology, fish passage, habitat). Pollutant source assessments are done where a biological stressor ID process identifies a pollutant as a stressor as well as for the typical pollutant impairment listings. Section 3 provides further detail on stressors and pollutant sources.

Stressors of Biologically-Impaired Stream Reaches

Stressors were identified for six streams in the Sunrise River Watershed with biological impairments, shown in Table 8. The most common stressors are stream eutrophication, indicated by high phosphorus and low dissolved oxygen stressors, and altered habitat. Likely causes of stream eutrophication are high rates of watershed phosphorus loading from cropland and impacted wetlands, or upstream impaired lakes. Likely causes of altered habitat are ditched stream channels and impoundments.

Table 8: Primary stressors to aquatic life in biologically-impaired reaches in the Sunrise River Watershed

Subwater-shed	AUID (Last 3 digits)	Stream	Reach Description	Biological Impairment	Primary Stressors						
					Dissolved Oxygen	Nitrate	Phosphorus	Turbidity	Fish Passage (dams)	Altered Hydrology	Altered Habitat
Comfort - Forest Lake	527	Sunrise River	Comfort Lk to Pool 1	Fish, Invert., DO	●		●		●		●
West Branch	529	Sunrise R, West Br	Martin Lk to Sunrise Pool 1	Fish, Invert., Turbidity, pH	●		●	●			●
South Branch	528	Sunrise R, South Br	02-0500-00 to Sunrise R	DO		●	●				
Chisago Chain of Lakes	723	Bloomquist Creek	T34 R21W S24, east line to Sunrise R	Fish			●				
Carlos Avery	540	Sunrise River	Pool 3 to Kost Dam Reservoir	Fish	●		●		●		●
North Branch	501	Sunrise R, North Br	Headwaters to Sunrise R	Fish	●		●		●		●

Pollutant sources

Pollutant sources were identified for point and non-point sources in the Sunrise River Watershed. There are 12 municipal wastewater point sources, one industrial wastewater point source, and four regulated municipal stormwater communities in the Sunrise River Watershed (Table 9). None of the point sources require pollutant reductions beyond their current permit conditions or limits for any of the Sunrise River Watershed TMDL. However, many did receive phosphorus limits as part of the Lake St. Croix TMDL.

The Chisago Lake Joint Sewage Treatment Facility for instance, was recently reissued a updated permit with new permit limits for un-ionized ammonia and a new permit limit for discharging Phosphorus. Fertilizer and manure runoff were identified as common non-point pollutant sources to streams and lakes. In addition, failing septic systems and in-lake sediment phosphorus release were identified as common non-point pollutant sources to lakes.

Table 9: Point Sources in the Sunrise River Watershed.

Subwatershed	Point Source			Notes
	Name	Permit #	Type	
Chisago Chain of Lakes	Smith Metal Products – Industrial Storm Water	MNRNE34W9	Industrial wastewater	
	Chisago Lakes Joint Sewage Treatment Facility (STF)	MN0055808	Municipal wastewater	Recently updated permit
	Blue Waters Leisure Park	MN0050091	Municipal wastewater	No surface water discharge
Comfort Lake Forest Lake	The Preserve at Birch Lake WWTP	MN0066362	Municipal wastewater	No surface water discharge
	Birchwood Terrace Mobile Home Park	MN0064670	Municipal wastewater	No surface water discharge
	Wyldewood Acres WWTP	MN0066567	Municipal wastewater	No surface water discharge
	Liberty Ponds	MN0067466	Municipal wastewater	No surface water discharge
	Forest Lake, City	MS400262	Municipal Stormwater	
West Branch, Sunrise River	John Iacarella - Linwood Terrace Co	MN0054372	Municipal wastewater	
	Independent School District 831 – Linwood Elementary School	MN0050474	Municipal wastewater	No surface water discharge
	East Bethel, City	MS400087	Municipal Stormwater	

Subwatershed	Point Source			Notes
West Branch, Sunrise River	Ham Lake, City	MS400092	Municipal Stormwater	
North Branch, Sunrise River	North Branch WWTP	MN0024350	Municipal wastewater	
	North Branch, City	MS400260	Municipal Stormwater	
Direct Drainage to the St. Croix River	Taylors Falls WWTP	MNG580218	Municipal wastewater	
	Shafer WWTP	MN0030848	Municipal wastewater	
Sunrise River Main Branch	Trophy Lake Estates III	MN0067474	Municipal wastewater	No surface water discharge

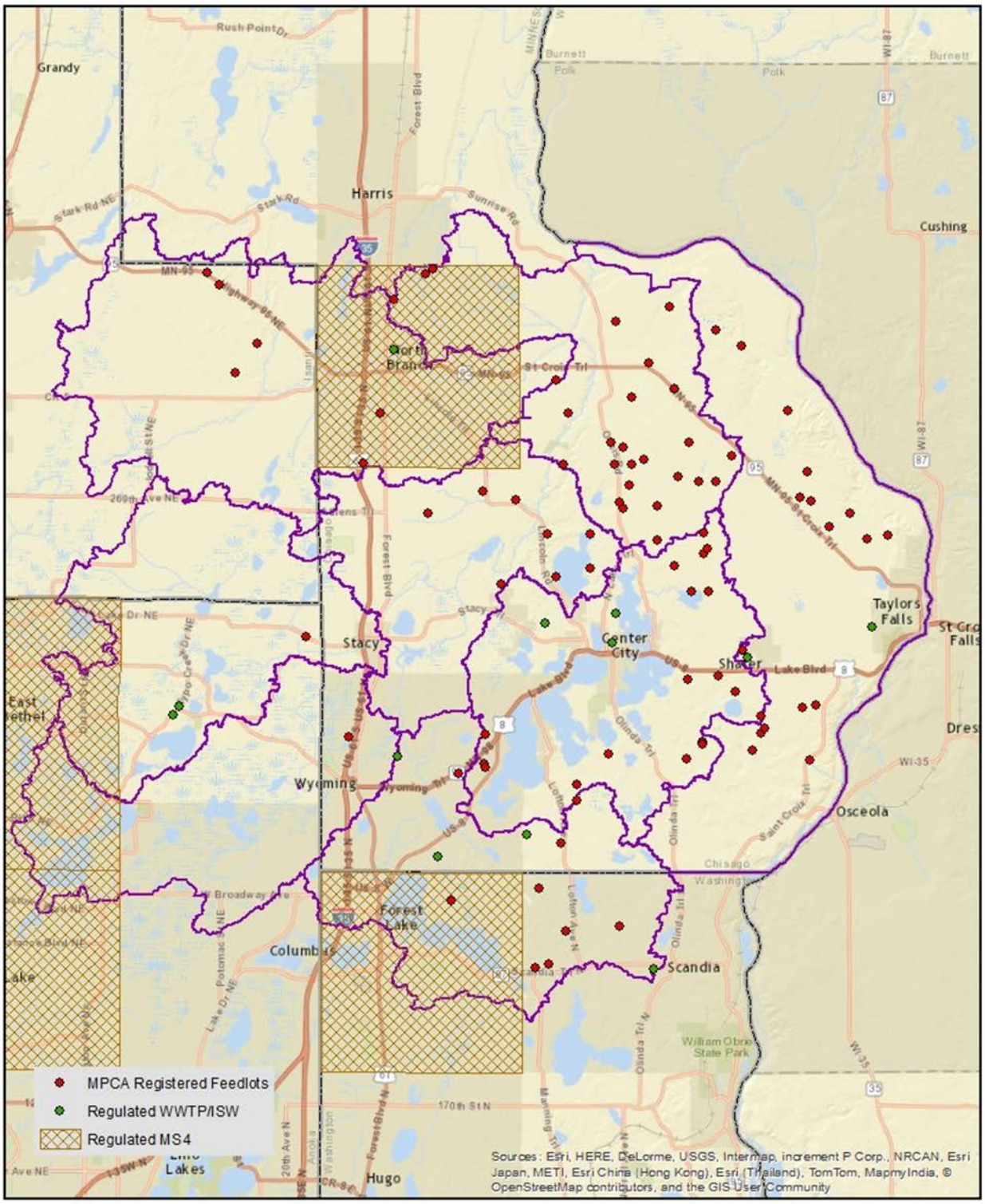
Table 10: Nonpoint Sources in the Sunrise River Watershed. Relative magnitudes of contributing sources are indicated.

Subwatershed	Type	Pollutant	Stream Pollutant Sources*							Lake Pollutant Sources*			
			Fertilizer & manure run-off	Livestock overgrazing in riparian	Failing septic systems	Wildlife	Poor riparian vegetation cover	Upland soil erosion	Upstream lake effluent	Lake Sediment P release	Fertilizer & manure runoff	Failing septic systems	Atmospheric
South Branch Sunrise River	Streams	Bacteria	●			○							
		TP	⭘			○							
	Lakes	TP				○				●	⭘	●	○
West Branch Sunrise River	Streams	Bacteria	●		⭘								
		TP			⭘								
	Lakes	TP	⭘						●	●	⭘	●	○
Carlos Avery	Streams	Bacteria	●			○							
		TP				○							
	Lakes	TP						○		○	○	○	○
Sunrise River, Main Branch	Streams	Bacteria	⭘		⭘	●							
		TP	○			○		○					
	Lakes	TP								●	●	○	○
Comfort Lake-Forest Lake*	Streams	Bacteria											
		TP	●					●					
	Lakes	TP					○						
Chisago Chain of Lakes	Streams	Bacteria	●										
		TP	○					●					
	Lakes	TP	○				○	●		●	⭘	⭘	○
North Branch Sunrise River	Streams	Bacteria	●	⭘	○								
		TP	●	⭘	○								
	Lakes	TP											

Key: ● = High ⭘ = Moderate ○ = Low

* All sources listed in the table are present in the Sunrise River watershed; the symbols in the table differentiate the relative ranking of implementation targeting for the more significant sources within each subwatershed. Refer to Table 11 for links to further information regarding specific sources.

Figure 5. Sunrise River Watershed Regulated MS4s, Wastewater Treatment Facilities, and Registered Feedlots.



Sunrise River WRAPS

Regulated MS4s, Wastewater Treatment Facilities, and Registered Feedlots.

2.4 TMDL Summary

There are 21 impaired lakes and 4 impaired streams in the Sunrise River Watershed with completed Total Maximum Daily Load studies (Table 11). Table 12 and Table 13 describe the current pollution loadings and load reductions needed for each source or source category to meet water quality standards and goals, including wasteload and load allocations.

Table 11. Completed Total Maximum Daily Load studies in the Sunrise River Watershed

Total Maximum Daily Load Study	Impaired Waters	Online Access to the TMDL Report
North Branch Sunrise River Fecal Coliform (NBSR) EPA Approval: December 2006	Sunrise R. North Branch (07030005-501)	http://www.pca.state.mn.us/qzqha00
Comfort Lake-Forest Lake Watershed District Six Lakes Nutrients (CLFL6) EPA Approval: March 2010	Moody Lake (13-0023-00) Bone Lake (82-0054-00) School Lake (13-0057-00) Little Comfort Lake (13-0054-00) Shields Lake (82-0162-00) Comfort Lake (13-0053-00)	http://www.pca.state.mn.us/tchy9f8
Typo Lake and Martin Lake Nutrients (TLML) EPA Approval: February 2012	Typo Lake (30-0009-00) Martin Lake (02-0034-00)	http://www.pca.state.mn.us/pyri9fd
Chisago Lakes Chain of Lakes Watershed Nutrients (CLCLW) EPA Approval: February 2013	North Center Lake (13-0032-00) South Center Lake (13-0027-00) Emily Lake (13-0046-00) Linn Lake (13-0014-00) Little Lake (13-0033-00) Ogren Lake (13-0011-00) Pioneer Lake (13-0034-00) School Lake (13-0044-00) Wallmark Lake (13-0029-00)	http://www.pca.state.mn.us/wfhya0a
Sunrise River Watershed Nutrients and *E. coli* (SRWS) EPA Approval: April 2014	Linwood Lake (02-0026-00) Second Lake (13-0025-00) Vibo Lake (13-0030-00) White Stone Lake (13-0048-00) Sunrise R. West Branch (07030005-529) Sunrise River (07030005-543) Hay Creek (07030005-545)	http://www.pca.state.mn.us/zihya01

Table 12. Allocation summary for all completed lake TMDLs in the Sunrise River watershed.

Lake/Stream (ID)	Pollutant	Allocations (lbs/year)										Percent Reduction
		Wasteload Allocation			Load Allocation					MOS	RC	
		WWTFs	Construction & Industrial Stormwater	MS4 Communities	Watershed Load	Internal Load	Upstream Lakes	Septic Systems	Atmosphere	Margin of Safety	Reserve Capacity	
Sunrise River Watershed TMDL												
Linwood (02-0026-00)	TP	--	7.4	21.3	762	277.9	--	86.4	152.3	145.3	--	21%
Second (13-0025-00)	TP	--	0.14	--	80.9	--	--	6.2	22.7	12.2	--	40%
Vibo (13-0030-00)	TP	--	0.8	--	698.0	28	--	6.6	15.4	82.9	--	93%
White Stone (13-0048-00)	TP	--	0.06	--	7.7	23.9	--	10	13	6.1	--	59%
Sunrise River, West Branch (07030005-529)	TP	--	108	--	6,832	1,356	--	--	362	456	--	74%
Typo Lake and Martin Lake TMDL												
Typo (13-0030-00)	TP	--	4.6	--	1078	303	--	0	78	163	--	81%
Martin (13-0030-00)	TP	47	40	7.0	1,790	--	1,868	0	64	424	--	41%
Comfort Lake Forest Lake Watershed District Six Lakes TMDL												
Moody	TP	--	1.1	--	142.9							86%
Bone	TP	--	5	--	664							46%
School	TP	0	3.3	1.1*	447.6							51%
Little Comfort	TP	0	3.5	113*	460							54%
Shields	TP	--	1.5	18	175.5					--	--	83%
Comfort	TP	--	14	1,081*	1,244					--	--	5%
Chisago Lakes Chain of Lakes TMDL												
North Center	TP	--	2.4	--	723	3,000	980	--	200	545	--	18%
South Center	TP	--	2.6	--	840	3,292	490	--	240	541	--	21%
Lake Emily	TP	--	.020	--	6.2	16	--	--	4.6	3	--	93%
Linn	TP	--	0.32	--	97	178	--	--	49	36	--	88%
Little	TP	--	0.48	--	148	104	--	--	44	33	--	90%

Lake/Stream (ID)	Pollutant	Allocations (lbs/year)										Percent Reduction
		Wasteload Allocation			Load Allocation					MOS	RC	
		WWTFs	Construction & Industrial Stormwater	MS4 Communities	Watershed Load	Internal Load	Upstream Lakes	Septic Systems	Atmosphere	Margin of Safety	Reserve Capacity	
Ogren	TP	--	1.38	--	429	133	--	--	13	64	--	45%
Pioneer	TP	--	0.002	--	0.61	50	--	--	21	8	--	96%
School	TP	--	0.26	--	81	77	19	--	39	24	--	88%
Wallmark	TP	--	0.15	--	46	103	--	--	40	24	--	95%

***** Includes Wasteload Allocations for future Regulated MS4 Communities.

Table 13. Allocation summary for all completed stream TMDLs in the Sunrise River watershed.

Stream/Reach (AUID)	Pollutant	Flow Zone	E. coli/Fecal Coliform Allocations (billions organisms/day) Total Phosphorus (lbs/year)				Percent Reduction
			Wasteload Allocation		Load Allocation	MOS	
			WWTFs	Regulated Stormwater (CSW/ISW/MS4)	Watershed Load	Margin of Safety	
North Branch of the Sunrise River TMDL							
Sunrise River, North Branch	Fecal Coliform	High	6	286	608	305	52%
		Wet	6	149	317	147	
		Mid	6	107	228	228	
		Dry	6	71	151	151	
		Low	6	50	106	106	
Sunrise River Watershed TMDL							
Sunrise River, West Branch 07030005-529	TP	High	--	8.2	60.2	7.6	0%
		Wet	--	3.58	26.3	3.32	0%
		Mid	--	1.98	14.6	1.84	12%
		Dry	--	1.16	8.47	1.07	18%
		Low	--	0.74	5.4	0.68	0%
Sunrise River 07030005-543	Fecal coliform	High	11.7	--	1384.3	155.1	0%
		Wet	11.7	--	598.7	67.8	19%
		Mid	11.7	--	325.8	37.5	0%
		Dry	11.7	--	185.3	21.9	38%
		Low	11.7	--	113.5	13.9	0%
Hay Creek* 07030005-545	Fecal coliform	High	--	1.4	54.4	6.2	NA
		Wet	--	0.61	23.8	2.71	44%
		Mid	--	0.34	13.2	1.5	67%
		Dry	--	0.2	7.67	0.88	87%
		Low	--	0.13	4.87	0.56	67%

*Loading capacities and allocations based on a limited amount of data: July and August only.

2.5 Protection Considerations

The following is a description of how the items in the table portion of the Subwatershed Implementation Plan figures were calculated. Refer to Section 3 for Subwatershed Implementation Plan figures.

Groundwater Pollution Sensitivity

Groundwater's sensitivity to pollution was determined by combining layers of data in ArcGIS. The protocol was replicated from MNDNR's Geologic Atlas Program procedure to determine the length of time potentially polluted water could reach a groundwater source. Data from each county was combined to determine hydrologic soil groups, surficial geology, and transmission rates from textural classes. Hydrologic Soil Group determines the time it takes water to move through the first 3 feet, the travel time for feet 3-10 is determined by the underlying surficial geology. In this report, it was broken down into 3 equal groups of High, Medium, and Low – following the MNDNR's draft guidelines.

Slope

Slope data was derived from the Sunrise River Soil and Water Assessment Tool (SWAT) Model completed by the St. Croix Watershed Research Station (Almendinger, 2010). The value "Slo1" was used in determining an area weighted mean from the SWAT subbasins database to the eight subwatersheds used in this report.

Average Slope = ∑ (Area * Slo1) / ∑ (Area)

Animal Operation Numbers

It was determined that for the Sunrise River Watershed and the Direct Drainage to the St. Croix River area that the Minnesota Pollution Control Agency data and GIS shapefiles were not accurate enough to display. Because of this, windshield surveys of animal numbers were used where available. The Chisago SWCD has completed windshield surveys for portions of the watershed. These surveys were then verified with knowledge of animal operations within the office. Animals within the watershed include: beef cattle, dairy cattle, bison, red deer, horse, poultry, and swine. Poultry and swine numbers were converted to animal units.

BWSR Soil Erosion/Water Quality Risk

A visual assessment of the Board of Water and Soil Resources Soil Erosion and Water Quality Risk layers was used to determine risk value. These data can be downloaded from the Board of Water and Soil Resources Ecological Ranking Tool website. (http://www.bwsr.state.mn.us/ecological_ranking/). The raster layers were displayed in quantile classification to show one-third of the values in each level of low, medium, and high. By displaying the data in this fashion, it was easy to assign a value of high, medium, or low for each subwatershed.

SWAT TP/TSS Output

The Total Phosphorus (TP) and Total Suspended Solids (TSS) Soil and Water Assessment Tool (SWAT) output calculations were derived from the Sunrise River SWAT Model completed by the St. Croix Watershed Research Station (Almendinger, 2010). The TP and TSS values were used to create an area weighted mean from the SWAT model database to the eight subwatersheds used in this report.

SWAT Average TSS = ∑ (Area * TSS) / ∑ (Area)

SWAT Average TP = ∑ (Area * TP) / ∑ (Area)

Altered Wetland Hydrology

The Altered Wetland Hydrology percentage was calculated using the National Wetland Inventory (NWI) modifiers. The freshwater wetland classification system includes special modifiers to show manipulation to wetlands. These modifications include: b - beavers, d - partially ditched/drained, f - farmed, h - diked/impounded, r - artificial, s - spoil, and x - excavated. The NWI was clipped to each of the eight subbasins.

% Altered Wetland Hydrology = Area of Modified Wetlands / Total Subbasin Area

Additional information on altered wetland hydrology can be found in the Army Corp of Engineers Sunrise River Watershed Study.

Dominant Hydrologic Soil Group

A visual assessment of this layer was used to determine dominant hydrologic soil group. Soils are given a classification of A, B, C, or D based on their ability to infiltrate water and potential to have runoff from them. Some soils are classified as A/D soils – these are D soils that, if ditched, would achieve A soil quality. Most of the subwatersheds clearly fit in one hydrologic soil group. The lower Sunrise area fit in two distinct soil groups: west of the Sunrise River is D soils that are drained for agriculture (thus fitting into hydrologic group A); the area east of the Sunrise River is predominantly B soils.

Permitted Wastewater Discharges

Permitted wastewater discharge locations are from the MPCA Municipal Industrial Division database. These locations are discharge permits for wastewater treatment facilities. All permits are through the National Pollutant Discharge Elimination System (NPDES) permits or NPDES/State Disposal System – these could include large dischargers like the Chisago Lakes Joint Sewage Treatment Commission or smaller systems like a LSTS (large subsurface sewage treatment system).

3. Prioritizing and Implementing Restoration and Protection

The Clean Water Legacy Act (CWLA) requires that WRAPS reports summarize priority areas for targeting actions to improve water quality, identify point sources and identify nonpoint sources of pollution with sufficient specificity to prioritize and geographically locate watershed restoration and protection actions. In addition, the CWLA requires including an implementation table of strategies and actions that are capable of cumulatively achieving needed pollution load reductions for point and nonpoint sources.

This section of the report provides the results of such prioritization and strategy development. Because much of the nonpoint source strategies outlined in this section rely on voluntary implementation by landowners, land users and residents of the watershed it is imperative to create social capital (trust, networks and positive relationships) with those who will be needed to voluntarily implement best management practices. Thus, effective ongoing civic engagement is fully a part of the overall plan for moving forward.

3.1 Targeting of Geographic Areas

The Priority Consideration figures in this document are designed to put many layers of information that is relevant to water quality and water use in one location. These figures include a map and a table for each of the seven subwatersheds used throughout the WRAPS Report. These maps visually show the connections between recreation, water quality, invasive species, public land, and downstream waters. The tables on the right side of the figure show important facts about the subwatershed. These items are defined in Section 2.5 Priority Consideration Figure Methodology.

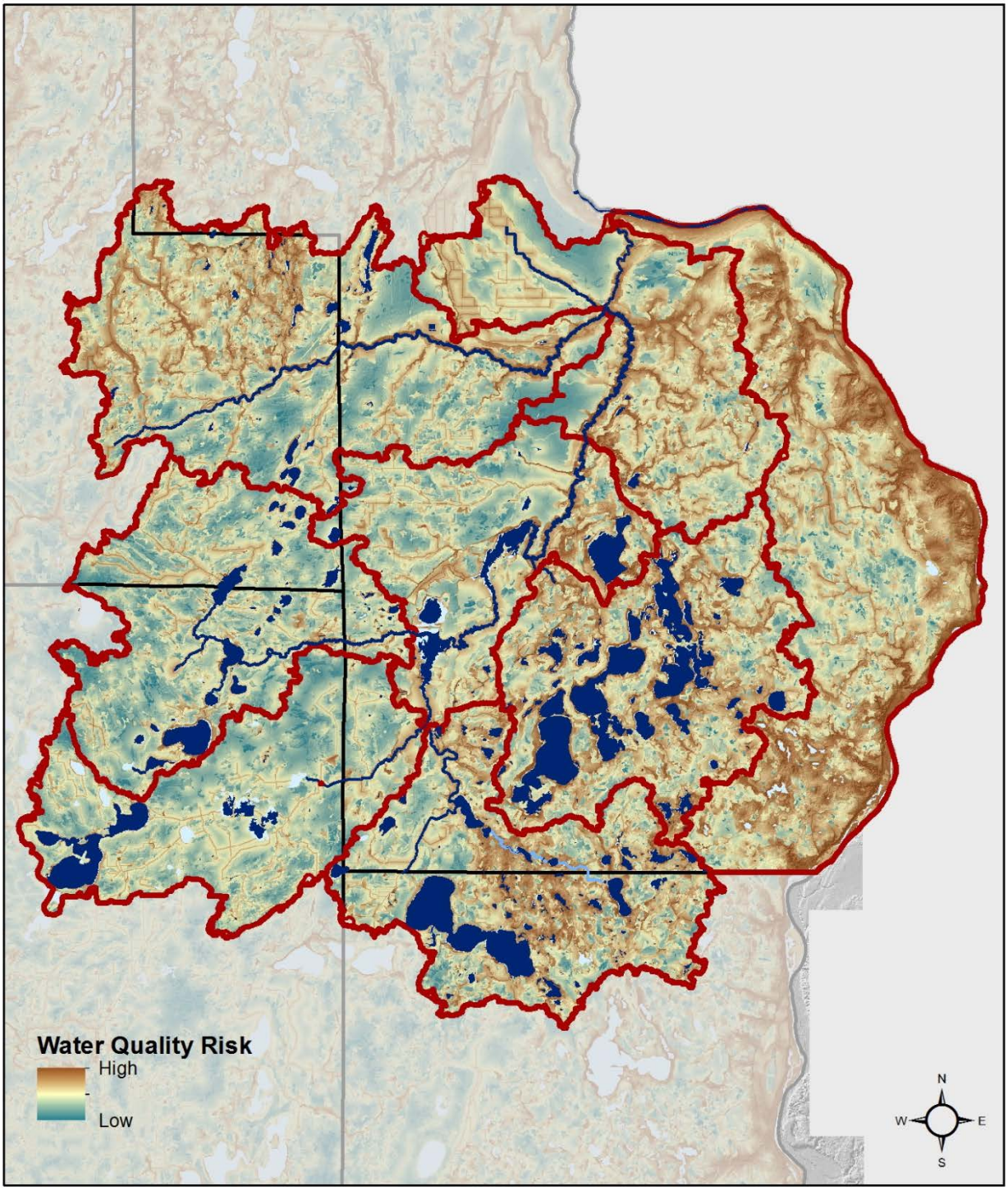
Priority areas or factors affecting priorities are different for each subwatershed. For example, one subwatershed may have increased pressure of aquatic invasive species and would benefit from watercraft inspections, while another subwatershed has a high Board of Water and Soil Resources Soil Erosion/Water Quality Risk, Board of Water and Soil Resources EBI Top 5% Priority Areas, high SWAT Outputs, or a large percentage or urban land or row crop agriculture and would benefit from concentrating BMP efforts in high priority locations. Many different scenarios of priorities are possible depending on the area of interest of the reader.

Local water resource professionals, city staff, watershed staff, and stakeholder groups can use these figures and tables in a variety of ways. The intention of these resources is that locals will be able to use the figures and tables while planning for future development, future projects, and other natural resource planning.

Table 14 - Prioritization Tools Used in this Document

Tool	Description	How can the tool be used?	Notes	Link to Information and data
Ecological Ranking Tool (Environmental Benefit Index - EBI)	Three GIS layers containing: soil erosion risk, water quality risk, and habitat quality. Locations on each layer are assigned a score from 0-100. The sum of all three layer scores (max of 300) is the EBI score. This higher the score, the higher the value in applying restoration or protection.	Any one of the three layers can be used separately or the sum of the layers (EBI) can be used to identify areas that are in line with local priorities. Raster calculator allows a user to make their own sum of the layers to better reflect local values.	GIS layers are available on the Board of Water and Soil Resources website.	*BWSR*
Light Detection and Ranging (LiDAR)	Elevation data in a digital elevation model (DEM) GIS layer. Created from remote sensing technology that uses laser light to detect and measure surface features on the earth.	General mapping and analysis of elevation/terrain. These data have been used for: erosion analysis, water storage and flow analysis, siting and design of BMPs, wetland mapping, and flood control mapping. A specific application of the data set is to delineate small catchments.	The layers are available on the MN Geospatial Information website for most counties.	*MGIO*
Subwatershed Stormwater Retrofit Assessments	Identifying small catchments, pollution reduction, appropriate best management practices, and associated costs to make the best bang for the buck water quality improvements.	A cost-benefit analysis of identified best management practices will help local decision makers identify the best projects that should be completed to achieve the largest pollution reductions.	Many locations in Anoka, Chisago, and Washington Counties have been completed by the Conservation Districts	
Sunrise River SWAT (Soil and Water Assessment Tool) Model	Computer model of watershed processes to show where pollution may originate and which mitigation strategies are most effective.	This model shows the amount of phosphorus and sediment that is coming off the landscape. After these calculations are completed, the data can be used to determine scenarios for pollution reduction on a subwatershed scale.		*Sunrise SWAT*

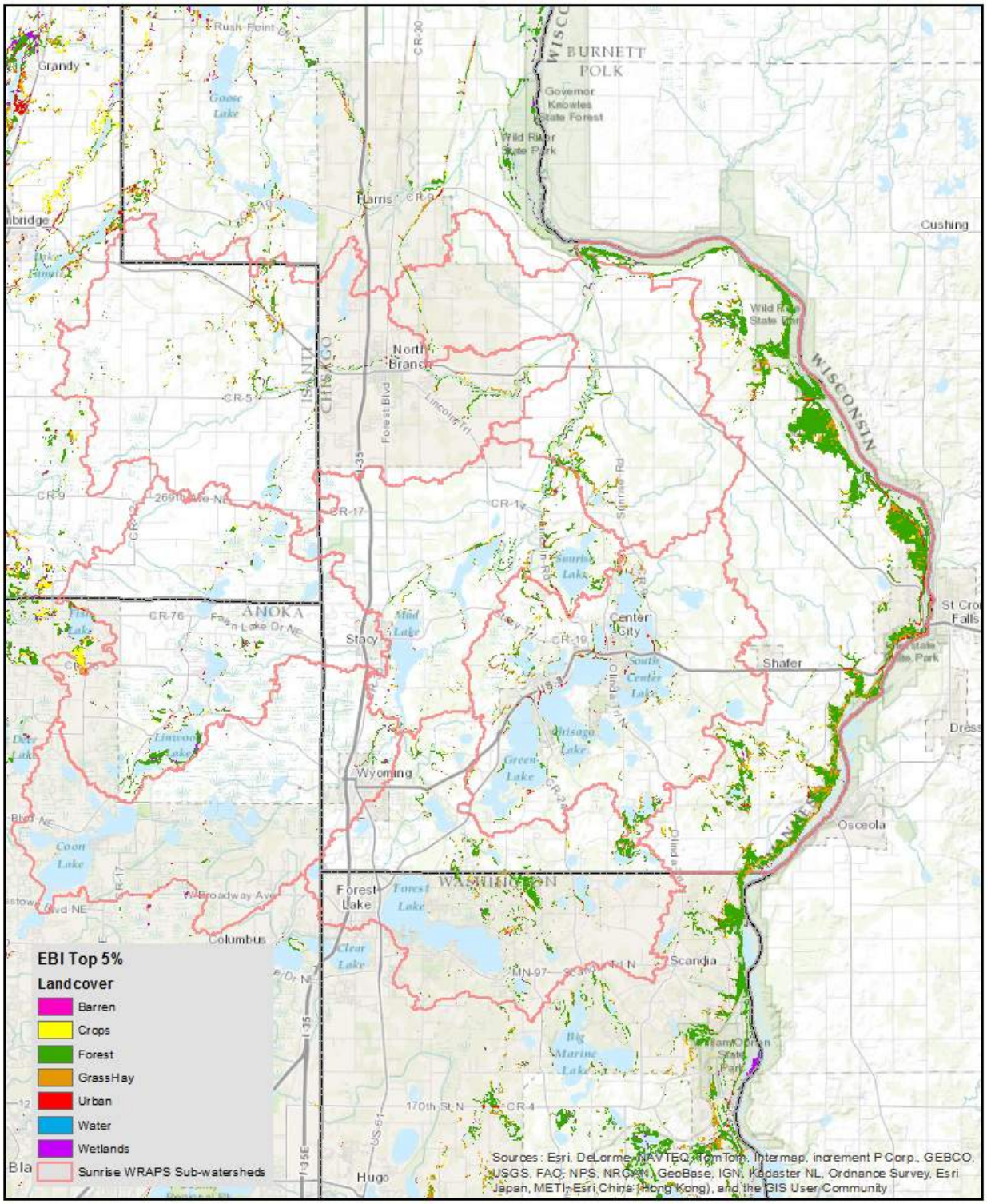
Figure 6. BWSR Water Quality Risk Map.



Sunrise River WRAPS

BWSR Environmental Benefits Index - Water Quality Risk

Figure 7. Environmental Benefits Index Top Areas for Restoration and Protection



Top Areas for Restoration and Protection
BWSR Environmental Benefits Index

Figure 8. Subwatershed Stormwater Retrofit and Rural Assessments for North Center Lake (from the Chisago Lakes Chain of Lakes TMDL Restoration and Protection Plan, Approved February 2013).

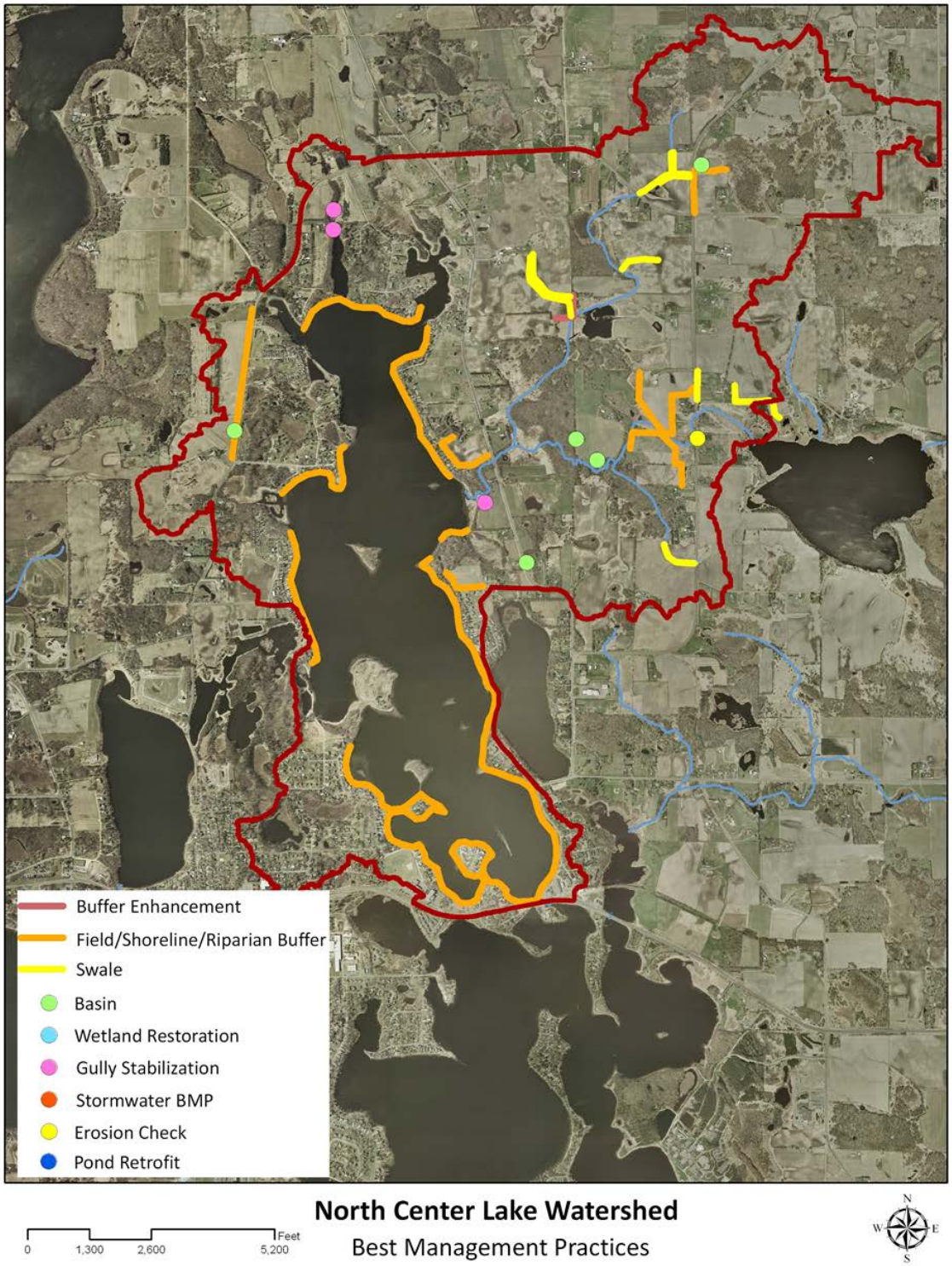


Figure 9 – Sunrise River Watershed SWAT average modeled subbasin yields of sediment (tons/hectare), 2000-2009 (Source: Almendinger and Ulrich 2010)

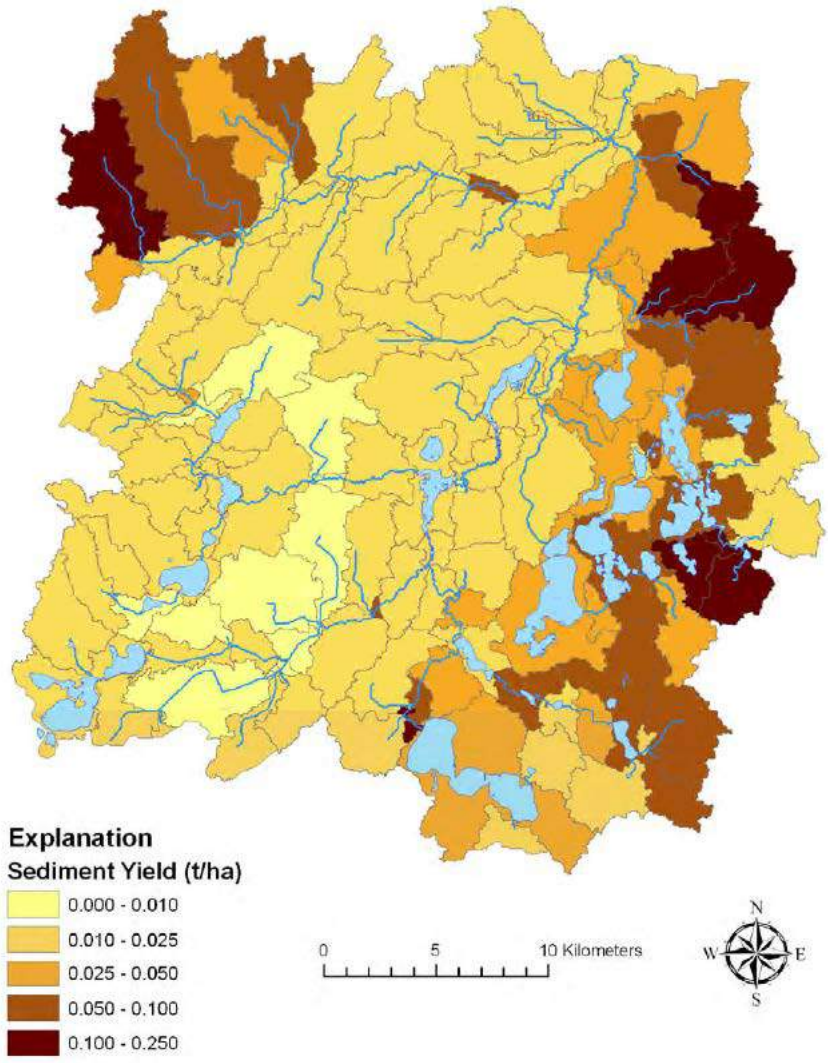


Figure 16. Average modeled subbasin yields of sediment in the Sunrise River watershed, 2000-09.

Figure 10 – Sunrise River Watershed SWAT average modeled subbasin yields of total phosphorus, 2000-2009 (Source: Almendinger and Ulrich 2010)

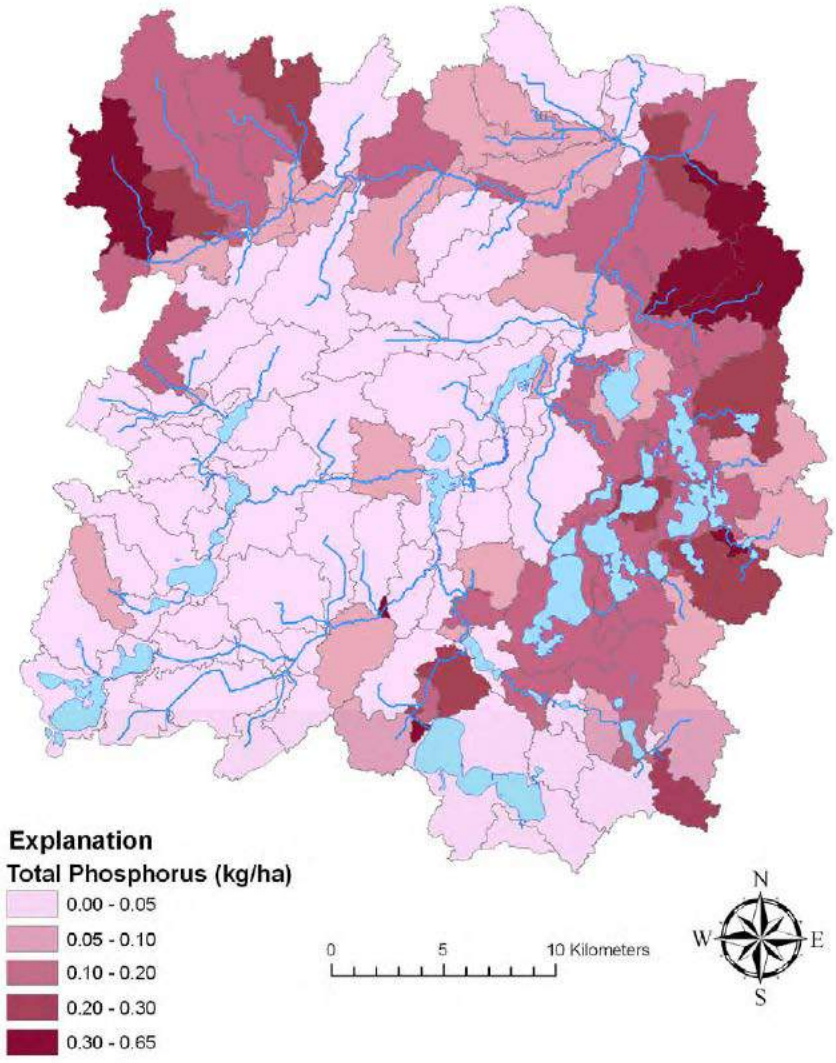
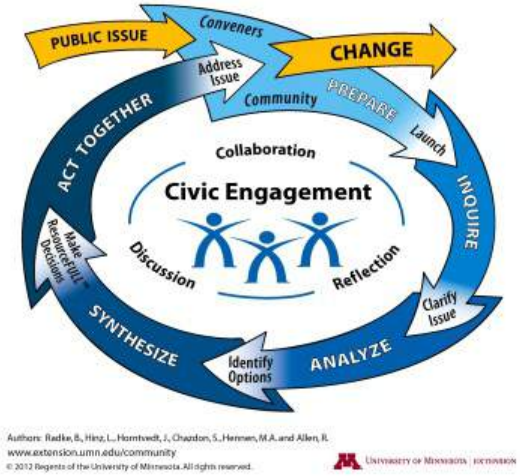


Figure 17. Average modeled subbasin yields of total phosphorus in the Sunrise River watershed, 2000-09.

Examples are shown above of ways to prioritize Best Management Practices based on modeled loading and erosion rates. These models give local water quality professionals a base to start working on projects in the most vulnerable locations. We use many types of prioritization strategies to determine where our work load should take place.

3.2 Civic Engagement



Many key partners have been brought together to make this WRAPS Report a useable document that will ultimately help us to meet the goals of the Sunrise River Watershed and the Direct Drainage to the St. Croix River. These groups include: Anoka CD, Chisago SWCD, Isanti SWCD, Washington CD, Chisago County, MN DNR (Fisheries and Eco/Waters), MPCA, City of North Branch, City of Stacy, City of Wyoming, City of Shafer, City of Taylors Falls, USDA NRCS, Sunrise River Water Management Organization, Comfort Lake-Forest Lake Watershed District, Chisago Lakes Lake Improvement District, Linwood Lake Association, and Friends of the Sunrise River. These groups have collaborated with the Chisago SWCD to provide comments and additions specific to their subwatersheds. This collaboration will prove to be pivotal in applying for funding in the future to complete projects in each constituent's jurisdiction.

Accomplishments

- Farmer Focus Group – A group of local agricultural producers gather with staff from the SWCD and NRCS to discuss solutions to common problems the producers have concerning water quality. This includes discussing barriers to implementing practices.
- Friends of the Sunrise River – two members of the FSR group have been appointed to be involved in the steering committee. These representatives have been involved in review of the document and will relay information to/from the group.
- Sunrise River Watershed Management Organization will continue to promote BMPs and provide cost-share for projects such as: rain gardens, shoreline buffers, and erosion control projects.
- Many of the Cities within the watershed have adopted stormwater management ordinance and/or review guidance.
- Comfort Lake Forest Lake Watershed District works with the East Metro Water Resource Education Program (http://www.mnwcd.org/emwrep/) for water quality education.
- The Chisago Lakes Lake Improvement District has been successful in implementing many BMPs across the watershed. The LID and SWCD have secured CWF grants for BMPs since 2011.

Future Plans

- Linwood Lake Association will continue to promote BMPs such as: rain gardens, shoreline buffers, and septic system upgrades within their watershed.
- Complete inventories throughout the watershed for restorable wetland locations, gully stabilizations, stormwater retrofit BMP locations, streambank corridors, etc.

- Increase education opportunities for urban and rural landowners to provide more information about best management practices for all locations.
- Determine locations and protections strategies for high quality natural communities and areas of high biological significance.

Continuing to build momentum for water quality projects, water quality improvement, and water quality protection will be important in the future. These groups and activities will benefit the individual bodies of water and the watershed as a whole.

3.3 Restoration & Protection Strategies

Specific strategies have been developed to restore the impaired waters within the watershed and for protecting the quality of the waters within the watershed that are not impaired. The subwatershed-based implementation strategy tables that follow outline the strategies and actions that are capable of cumulatively achieving the needed pollution load reductions for point and non-point sources. The tables were developed by thoroughly reviewing the specific conditions affecting each of the waters and collecting input from watershed stakeholders. As this WRAPS Report includes waters that have been previously addressed by past TMDLs, specific implementation plans have already been developed for many of the waters. In these cases, links to the past work are provided in the table. Similarly, many of the waters within the Sunrise River Watershed are actively being managed by local organizations including the Comfort Lake Forest Lake Watershed District and the Chisago Lakes Lake Improvement District (see section 3.2 for a complete list of the entities managing waters in the watershed). In these cases, detailed management plans have been written that establish goals for these waters and detailed implementation activities have been identified and are scheduled to be completed. Links to these watershed management plans are included in the implementation strategies table. For the impaired lakes included in the Sunrise River Watershed TMDL detailed implementation plans are included that describe the in-lake and watershed improvements that are needed to meet the goal of the TMDL. The analysis includes a specific BMP selection and siting based on the specific nature of each of the waters and watersheds. The lake implementation project tables are included following the appropriate subwatershed proposed implementation strategies and actions tables.

Watershed-wide Reductions in Phosphorus from Agricultural BMPs

The Sunrise River Soil and Water Assessment Tool (SWAT) Model completed by the St. Croix Watershed Research Station (Almendinger, 2010) evaluated the reduction s in phosphorus that could be achieved through implementation of various agricultural BMPs either singly or in combinations. The BMPs that were evaluated include conversion of conventional tilling practices to no-till, installation of vegetated buffer strips and grassed waterways, decreasing soil phosphorus levels and converting daily haul manure applications to seasonal chisel-plow incorporated applications. The findings are summarized in Table 15. Reductions in phosphorus are expressed in terms of percent reduction from the baseline condition.

The Sunrise River Soil and Water Assessment Tool (SWAT) Model was also used to evaluate various urban residential area scenarios but the model was ineffective due to the nature of its coding.

Table 15: Phosphorus reductions from various scenarios of agricultural BMPs

Scenario Description	Phosphorus Reduction
1- Conversion of ½ the grain corn/soybean and silage corn/alfalfa rotations to no-till	1.9%
2- Conversion of all of the grain corn/soybean and silage corn/alfalfa rotations to no-till	3.9%
3- Conversion of ½ the grain corn/soybean rotations to switchgrass	18%
4- Conversion of grain corn/soybean rotations found on steep slopes to switchgrass	0.6%
5- Installing a vegetated filter strip to ½ the grain corn/soybean rotations	5.6%
6- Installing a vegetated filter strip to all of the grain corn/soybean rotations	9.7%
7- Installing a vegetated filter strip to all of the grain corn/soybean rotations and all of the silage corn/alfalfa rotations	11.1%
8- Installing grassed waterways on ½ the grain corn/soybean rotations	7.9%
9- Installing grassed waterways on all of the grain corn/soybean rotations	14.7%
10- Installing grassed waterways on all of the grain corn/soybean rotations and all of the silage corn/alfalfa rotations	17.6%
11- Reducing soil phosphorus on grain corn/soybean and silage corn/alfalfa rotations with high levels (60 ppm) down to medium levels (40 ppm)	4.1%
12- Reducing soil phosphorus level on grain corn/soybean rotations with medium levels (40 ppm) down to 20 ppm and silage corn/alfalfa rotations with medium levels (40 ppm) down to 30 ppm	17.4%
13- Reducing soil phosphorus level in grass hay fields and pastures with high levels (60 ppm) down to 40 ppm	0.4%
14- Reducing soil phosphorus level in grass hay fields and pastures with high levels (60 ppm) down to 20 ppm	1.2%
15- Reducing soil phosphorus levels for all grain corn/soybean rotations, silage corn/alfalfa rotations and grass hay fields and pastures down to 20 ppm	19.7%
16- Converting all daily haul manure operations on grain corn/soybean rotations to seasonal chisel-plow incorporated	2.1%

Watershed-wide Reductions in Phosphorus from Wetland Creation

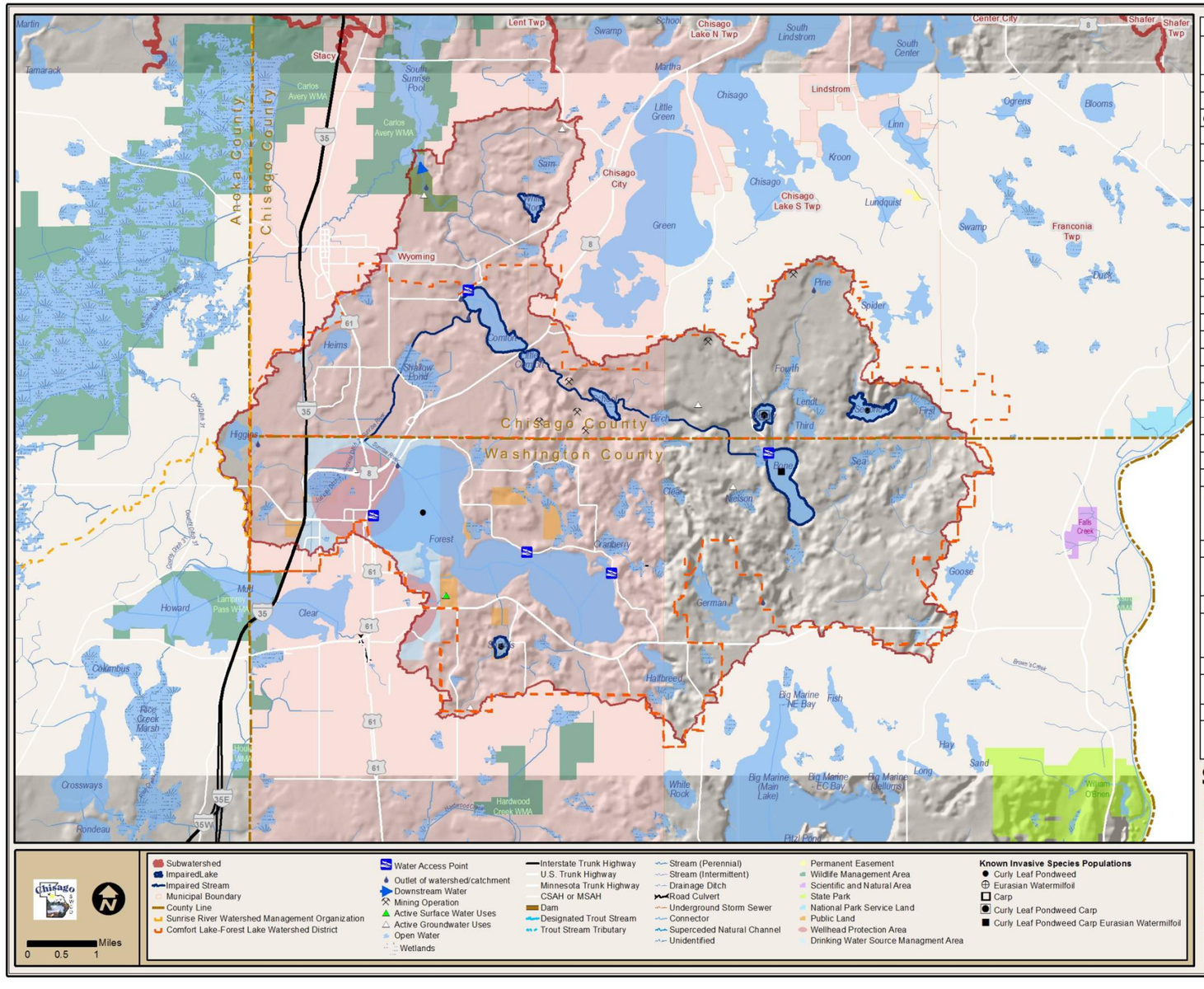
The Sunrise River Soil and Water Assessment Tool (SWAT) Model completed by the St. Croix Watershed Research Station (Almendinger, 2010) also evaluated the reduction s in phosphorus that could be achieved through creation of additional wetlands. Specifically the model evaluated the phosphorus removal for adding wetlands downstream of the north pool and found that by increasing the extent of wetland by 25% resulted in a 9% reduction in phosphorus and by increasing the extent of wetland by 50% resulted in a 19% reduction in phosphorus.

The Natural Resources Research Institute at the University of Minnesota Duluth, along with the Minnesota Pollution Control Agency and through funding by the Clean Water Land & Legacy Amendment developed a Restorable Wetland Prioritization. The tool enables users to prioritize areas for maximizing water quality improvements, in the form of nitrogen or phosphorus removal, and/or habitat and for restoring or protecting high functioning sustainable wetlands and can be found at https://beaver.nrri.umn.edu/MPCAWLPri/

Watershed-wide Protection of High Quality Ecological Resources

The Sunrise River watershed contains a large proportion of high quality natural communities and areas of high biological significance. Protecting the quality of these upland ecological assets is an important protection consideration in the Sunrise River watershed because water quality is intimately linked to the health of aquatic organisms and the connection between land and water habitats.

Comfort Lake-Forest Lake Subwatershed Strategies



Sunrise River WRAPS	
Subwatershed Name	**Comfort Lake-Forest Lake**
Major Watershed Name	Sunrise
Area (sq. miles)	54
Groundwater Pollution Sensitivity	Low
% Slope (avg.)	3.6
# of Animals	Second-18, Wh Stone-6
Permitted Waste Discharges	Liberty Ponds, Preserve, Birchwood Terrace, Wyldwood Ac.
Impaired Lake Shoreline Septics	221
Dominant Hydrologic Soil Group	B
BWSR Soil Erosion Risk	High
BWSR Water Quality Risk	High
SWAT Output TP (lb/ac)	0.30
SWAT Output TSS (ton/ac)	0.017
Altered Wetland Hydrology	23.6 %
Public Land	1 %
Subwatershed Land Cover	
Developed	18 %
Forested	14 %
Cropland	21 %
Grassland	12 %
Wetlands	24 %
Open Water	11 %
Watershed Entities	
Chisago SWCD, Chisago Co, Washington CD, Washington Co, Comfort Lake-Forest Lake Watershed District, Forest Lake, Wyoming, New Scandia Township, Chisago Lakes Township	
Major Water Resources	
Forest, Comfort, Bone Lakes	
Impairments	
1 stream chloride, 1 stream fish and macroinvertebrate bioassessment, 3 stream DO, 4 stream E. coli, 6 lake nutrient	
Important Natural Resources	
Next Downstream Waterbody/Subwatershed	
Sunrise River/Carlos Avery-Sunrise Unit Subwatershed	

Sunrise Watershed

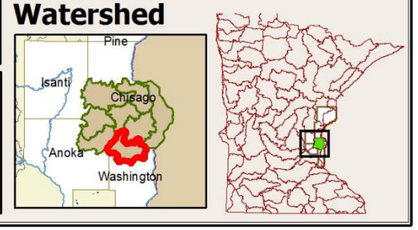


Table 16: COMFORT LAKE-FOREST LAKE SUBWATERSHED Proposed Implementation Strategies and Actions

Waterbody (ID) Location	Location and Upstream Influence Counties	Parameter	Water Quality		Strategies	Estimated Scale of Adoption Needed	Entities with Primary Involvement and Responsibility								Timeline for Achievement of Water Quality Goals	Interim 10-yr Milestones
			Current Conditions	Water Quality Target			Watershed District*	SWCD/NRCS	MPCA	DNR	Property Owners	Cities/Townships	County	BWSR		
Judicial Ditch 2 (-525) Headwaters to Sunrise R	**Chisago** Washington	Chloride	>230 ug/L	<230 ug/L	Detailed strategies have been developed for these resources by the Comfort Lake Forest Lake Watershed District. Refer to the District's **2012-2021 Watershed Management Plan (October 2011)** for details. Specifically refer to the implementation tables which define the projects, partners and timelines that are proposed. (http://www.clflwd.org/) Volume I – Goals & Implementation [http://www.clflwd.org/documents/CLFLWDWMPVolumeIGoalsandImplementation_000.pdf} Volume II – Resources Inventories & Assessments [http://www.clflwd.org/documents/CLFLWDWMPVolumeIIResourceInventory_000.pdf] Also refer to the Comfort Lake Forest Lake stormwater rules for the controls that have been established for future land use changes. [http://www.clflwd.org/resources_permits.php] These rules have also been adopted by most of the communities within the District. The City of Wyoming, for example, has developed a Water Guidance Document that incorporates the requirements of the District. In addition, The Minnesota Pollution Control Agency (MPCA) recently completed a Metro Chloride Feasibility study to obtain a better understanding of the extent, magnitude, and causes of chloride contamination to surface waters in the seven county Twin Cities Metropolitan Area and to explore options and strategies for addressing chloride impairments and other impacts to water resources. In the next phase of the project, the MPCA will work with the multi-agency team and local stakeholders to develop a chloride restoration and protection plan which will satisfy total maximum daily load requirements for impaired waters, address waters not yet listed, and protect waters that are not yet impaired. This plan will also include implementation activities for road salt and chloride load reductions in the seven county Twin Cities Metropolitan Area. Refer to http://www.pca.state.mn.us/index.php/water/water-types-and-programs/minnesotas-impaired-waters-and-tmdls/tmdl-projects/special-projects/metro-area-chloride-project/metro-area-chloride-project-history.html for more information. Moody Lake, Shields Lake, Little Comfort Lake, Comfort Lake, Bone Lake, and School Lake were all include in the Comfort Lake Forest Lake Watershed District Six Lakes TMDL, and have a MPCA approved implementation plan that lays out the actions needed to achieve their necessary reductions. This report can be found online at: http://www.pca.state.mn.us/tchy9f8									
Sunrise River (-526) Upstream from Comfort Lk		*E. coli*	>126 orgs/100 mL	<126 orgs/100 mL												
Unnamed creek (-641) Unnamed Lk to Birch Lk		*E. coli*	>126 orgs/100 mL	<126 orgs/100 mL												
Unnamed creek (-521) Birch Lk to School Lk	**Chisago** Washington	DO	<5mg/L	>5 mg/L												
		E. coli	>126 orgs/100 mL	<126 orgs/100 mL												
Unnamed creek (-522) School Lk to Little Comfort Lk	**Chisago** Washington	DO	<5mg/L	>5 mg/L												
		E. coli	>126 orgs/100 mL	<126 orgs/100 mL												
Sunrise River (-527) Comfort Lk to Pool 1	**Chisago** Washington	Fish IBI	33	>50												
		Invertebrate IBI	42	>47												
		DO	<5mg/L	>5 mg/L												
		E. coli	>126 orgs/100 mL	<126 orgs/100 mL												
Unnamed creek (-643) Shields Lk to Forest Lk Unnamed ditch (-533) Heims Lk to Sunrise River	**Washington**	All conventional parameters	Insufficient Data/Not Assessed	Maintain or improve water quality												
Third (13-0024-00)	**Chisago**	All conventional parameters	32 ug/L TP	Maintain or improve water quality												
Sea (82-0053-00)	**Washington**		Insufficient Data													
Heims (13-0056-00)	**Chisago**		Insufficient Data													
Sylvan/Halfbreed (82-0080-00)	**Washington**		20 ug/L TP													
Higgins (02-0002-00)	**Anoka**		Not Assessed													
German (82-0056-00)	**Washington**		26 ug/L TP													
Forest (82-0159-00)	**Washington**		35 ug/L TP													
Bone (82-0054-00)	**Washington**	Phosphorus	In-lake TP = 61 ug/L	In-lake TP < 40 ug/L												
Shields (82-0162-00)			In-lake TP = 234 ug/L	In-lake TP < 60 ug/L												
Little Comfort (13-0054-00)			In-lake TP = 63 ug/L	In-lake TP < 40 ug/L												
School (13-0057-00)	**Chisago**		In-lake TP = 67 ug/L	In-lake TP < 40 ug/L												
Comfort (13-053-00)			In-lake TP = 37 ug/L	In-lake TP < 40 ug/L												
Moody (13-0023-00)			In-lake TP = 167 ug/L	In-lake TP < 40 ug/L												

White Stone (13-0048-00)	**Chisago**	Phosphorus	In-lake TP = 97 ug/L	In-lake TP < 60 ug/L	Buffer Strips	20% of Streambank and Lakeshore buffered	●	●		●	●				2044	10 shoreline buffers installed
					Stormwater management	Install BMPs to treat stormwater runoff on 20% of properties	●	●			●	●	●	●	2044	Install 20 BMPs
					Stormwater Rule Compliance/MIDS	All comminuties within watershed	●	●	●			●	●		2034	Introduce new concepts to all communities
					Monitoring	Monitor monthly at current locations		●	●				●		Ongoing	Monitor monthly at current locations
					Conservation Easements/Property Acquisition	Acquire easements/property as needed	●	●		●		●	●	●	Ongoing	Acquire easements/property as needed
					Manage Aquatic Species	All Lakes		●		●		●	●		2024	Assessment of all lakes for AIS status
					Lakeshore/Streambank Lawn care	All parcels	●	●		●		●	●		Ongoing	Education on websites, press releases, newsletters, etc.
					Nutrient/Manure Management	Plans established with 50% of producers		●		●		●	●		2044	Plans written for 5 producers
Second (13-0025-00)	**Chisago**	Phosphorus	In-lake TP = 77 ug/L	In-lake TP < 60 ug/L	Buffer Strips	20% of Streambank and Lakeshore buffered	●	●		●	●				2044	10 shoreline buffers installed
					Stormwater management	Install BMPs to treat stormwater runoff on 20% of properties	●	●			●	●	●	●	2044	Install 20 BMPs
					Stormwater Rule Compliance/MIDS	All comminuties within watershed	●	●	●			●	●		2034	Introduce new concepts to all communities
					Monitoring	Monitor monthly at current locations		●	●				●		Ongoing	Monitor monthly at current locations
					Conservation Easements/Property Acquisition	Acquire easements/property as needed	●	●		●		●	●	●	Ongoing	Acquire easements/property as needed
					Manage Aquatic Species	All Lakes		●		●		●	●		2024	Assessment of all lakes for AIS status
					Lakeshore/Streambank Lawn care	All parcels	●	●		●		●	●		Ongoing	Education on websites, press releases, newsletters, etc.
					Nutrient/Manure Management	Plans established with 50% of producers		●		●		●	●		2044	Plans written for 5 producers

Key: Red rows = impaired waters requiring restoration; Green rows = unimpaired waters requiring protection.

Table 17: Potential White Stone Lake Restoration Projects.

WHITE STONE LAKE IMPLEMENTATION PROJECTS CURRENT TP = 97 µg/L		Treated Area [ac]	Treated Area [% Watershed]	Estimated TP Load Reduction [lb P/yr]	Estimated TP Load Reduction [% Total Needed]	Potential Granting Organization	Project Partners	Estimated 30-year Costs
IN-LAKE	**Load Reduction Needed:**			**40**				
	Load Reduction Achieved:			**45**	**56%**			
Trophic state alteration	Includes complete fish kill and/or gamefish fish stocking.			45	56%			Variable
WATERSHED	**Load Reduction Needed:**			**40**				
	Load Reduction Achieved:			**35**	**44%**			
Biofilters	Buffer strips (2,250 feet total)	3	1.3%	0.4	0.5%	NRCS; CWF	NRCS; SWCD; LA; LO	$-$$
Lawn management	Maintaining turfgrass and preventing transport of leaves and clippings on 100% of all parcels	4	1.7%	0.8	1.0%	Existing programs	City; SWCD; LA	$$
Septic system upgrades	Convert all failing to conforming	N/A	N/A	7	9.2%	CWF	County; Cities; LO	$
	Convert all ITPHSS to conforming (completed)	N/A	N/A	0	0.0%		County, LO	
Bioretention & Infiltration	One rain garden on 100% of all parcels (29 total)	N/A	N/A	15	18.1%	CWF; LID	SWCD; LA; LO	$$-$$$
Sedimentation	Sedimentation ponds (5)	50	22.8%	8	9.9%	NRCS; CWF; City; LID	NRCS; SWCD; City; LO	$$
Agricultural BMPs	Collection, storage, and treatment of manure (assumes 75% reduction of load)	N/A	N/A	0	0.0%	NRCS; Ag BMP; CWF	NRCS; SWCD; LO	$-$$
	100% of cropland with conservation tillage	31	14.0%	4.1	5.1%	NRCS; Ag BMP	NRCS; SWCD; LO	Variable
TOTAL	**Load Reduction Needed:**			**80**				
	Load Reduction Achieved:			**80**	**100%**			

Symbol key

Ag BMP	MDA Agricultural BMP Loan Program	LID	Lake Improvement District	$ < $500/lb TP removed/yr
CWF	Clean Water Fund	LO	Landowners	$$ = $500-$1500/lb TP removed/yr
CWP	Clean Water Partnerships/ 319 Grants	NRCS	Natural Resources Conservation Service	$$$ > $1500 lb TP removed/yr
LA	Lake Associations	SWCD	Soil and Water Conservation District	

***Note** - a 100% implementation rate for lawn management, rain gardens, and conservation tillage is required to meet the TMDL goal.

Table 18: Potential Second Lake Restoration Projects

SECOND LAKE IMPLEMENTATION ACTIVITES CURRENT TP = 77 µg/L		Treated Area [ac]	Treated Area [% Watershed]	Estimated TP Load Reduction [lb P/yr]	Estimated TP Load Reduction [% Total Needed]	Potential Granting Organization	Project Partners	Estimated 30-year Costs
IN-LAKE	**Load Reduction Needed:**			**0**				
	Load Reduction Achieved:			**48**	**66.8%**			
Trophic state alteration*	Includes gamefish stocking, complete fish kill, and/or curlyleaf pondweed management.			48				
WATERSHED	**Load Reduction Needed:**			**72**				
	Load Reduction Achieved:			**24**	**33.2%**			
Biofilters	Buffer strips (800 feet total)	2	0.4%	0.3	0.4%	NRCS; CWF	NRCS; CLFLWD; SWCD; LA; LO	$-$$
Lawn management	Maintaining turfgrass and preventing transport of leaves and clippings on 25% of all parcels	1.875	0.4%	0.1	0.2%	Existing programs	City; SWCD; LA	$$
Septic system upgrades	Convert all failing to conforming	N/A	N/A	4	5.2%	CWF	County; Cities; LO	$
	Convert all ITPHSS to conforming (completed)	N/A	N/A	1	1.3%		County, LO	
Bioretention & Infiltration	One rain garden on 10% of all parcels (2 total)	N/A	N/A	1	1.0%	CWF; LID	SWCD; CLFLWD; LA; LO	$$-$$$
Sedimentation	Sedimentation ponds (9)	90	17.3%	17	22.9%	NRCS; CWF; City; LID	NRCS; SWCD; LID; City; LO	$$
Agricultural BMPs	Collection, storage, and treatment of manure (assumes 75% reduction of load)	N/A	N/A	1	1.6%	NRCS; Ag BMP; CWF	NRCS; SWCD; LO	$-$$
	10% of cropland with conservation tillage	2	0.4%	0.3	0.4%	NRCS; Ag BMP	NRCS; SWCD; LO	Variable
TOTAL	**Load Reduction Needed:**			**72**				
	Load Reduction Achieved:			**72**	**100%**			

Symbol key

Ag BMP	MDA Agricultural BMP Loan Program	CLFLWD	Comfort Lake Forest Lake Watershed District	$ < $500/lb TP removed/yr
CWF	Clean Water Fund	LO	Landowners	$$ = $500-$1500/lb TP removed/yr
CWP	Clean Water Partnerships/ 319 Grants	NRCS	Natural Resources Conservation Service	$$$ > $1500 lb TP removed/yr
LA	Lake Associations	SWCD	Soil and Water Conservation District	

* No internal load reductions were identified in the TMDL modeling. However, local knowledge of the watershed suggests that watershed loading problems do not currently exist. Curly-leaf pondweed and lack of game fish may be causing a food web imbalance resulting in poor water quality.

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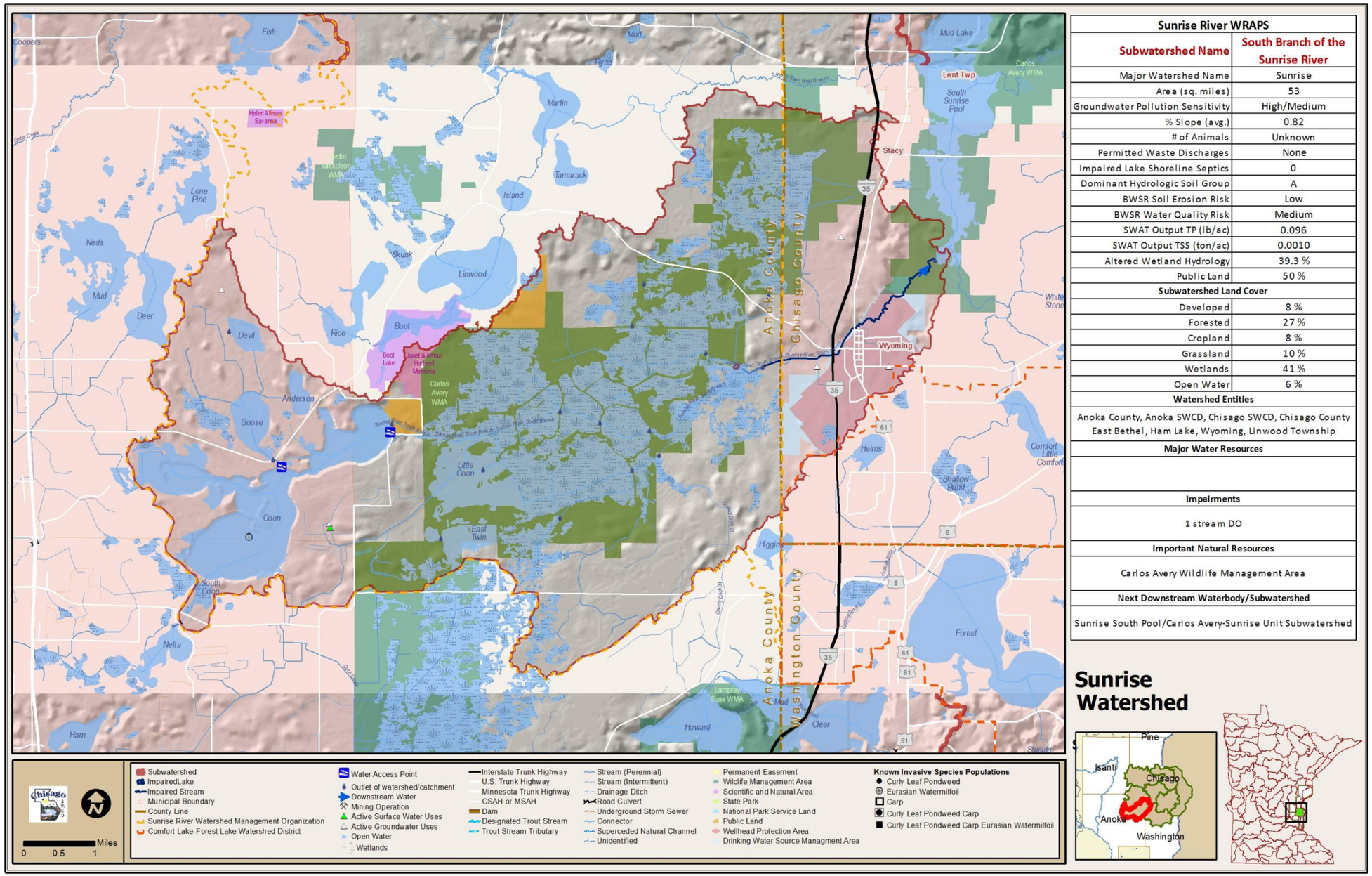
South Branch of the Sunrise River Subwatershed Strategies



Sunrise River WRAPS	
Subwatershed Name	**South Branch of the Sunrise River**
Major Watershed Name	Sunrise
Area (sq. miles)	53
Groundwater Pollution Sensitivity	High/Medium
% Slope (avg.)	0.82
# of Animals	Unknown
Permitted Waste Discharges	None
Impaired Lake Shoreline Septics	0
Dominant Hydrologic Soil Group	A
BWSR Soil Erosion Risk	Low
BWSR Water Quality Risk	Medium
SWAT Output TP (lb/ac)	0.096
SWAT Output TSS (ton/ac)	0.0010
Altered Wetland Hydrology	39.3 %
Public Land	50 %
Subwatershed Land Cover	
Developed	8 %
Forested	27 %
Cropland	8 %
Grassland	10 %
Wetlands	41 %
Open Water	6 %
Watershed Entities	
Anoka County, Anoka SWCD, Chisago SWCD, Chisago County East Bethel, Ham Lake, Wyoming, Linwood Township	
Major Water Resources	
Impairments	
1 stream DO	
Important Natural Resources	
Carlos Avery Wildlife Management Area	
Next Downstream Waterbody/Subwatershed	
Sunrise South Pool/Carlos Avery-Sunrise Unit Subwatershed	

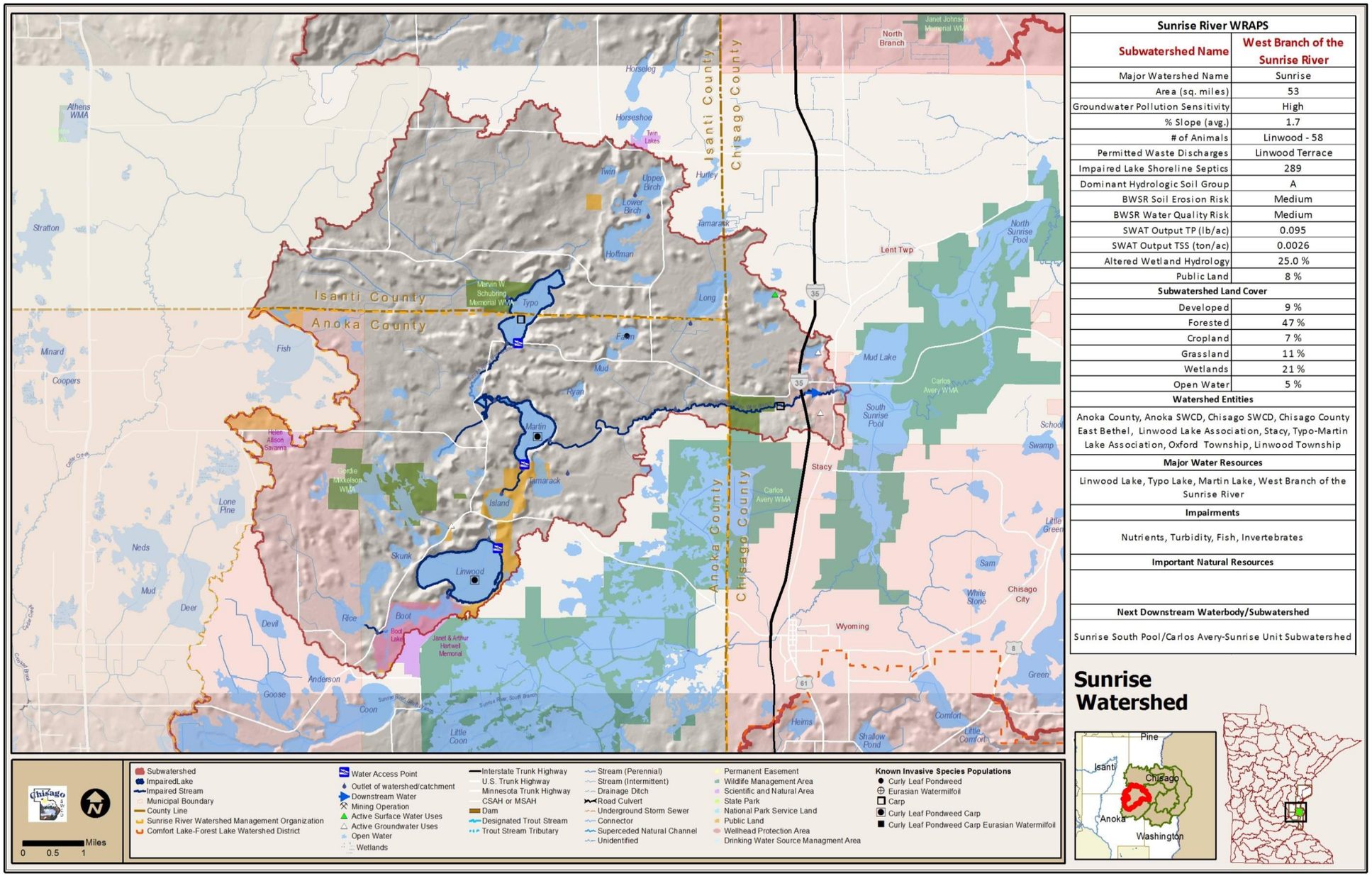
Table 19: SOUTH BRANCH OF THE SUNRISE RIVER SUBWATERSHED Proposed Implementation Strategies and Actions

Waterbody (ID) Location	Location and Upstream Influence Counties	Parameter	Water Quality		Strategies	Estimated Scale of Adoption Needed	Entities with Primary Involvement and Responsibility								Timeline for Achievement of Water Quality Goals	Interim 10-yr Milestones
			Current Conditions	Water Quality Target			Watershed District*	SWCD/NRCS	MPCA	DNR	Property Owners	Cities/Townships	County	BWSR		
Sunrise River, S Br (-528) 02-0500-00 to Sunrise R	**Chisago** Anoka	DO	< 5 mg/L DO Daily Minimum	> 5 mg/L DO Daily minimum	Complete wetland restoration feasibility study	Wetland restoration feasibility study	●	●	●	●	●	●	●		2044	Feasibility Study completed
					Continued Monitoring	Monitor monthly at current locations		●	●				●		Ongoing	Monitor monthly at current locations
					Stormwater management	Implement actions of City of Wyoming Water Management Guidance Document	●	●	●		●	●	●	●	2024	Review stormwater plan, implement 10 strategies
					Refer to the Sunrise River WMO Watershed Management Plan http://www.srwmo.org/images/SRWMO/Reports/SRWMO_Plan_Final_2011_amendments.pdf specifically Chapter 5 for the types of implementation activities that the WMO will be undertaking for their resources. Lessen the DO impact caused by wetlands (mainly background conditions) in watershed. Low DO, ditching and high organic matter soils within wetlands.										
Unnamed Creek (-627) Headwaters to S Br Sunrise South Coon (02-0048-00) Anderson (02-0063-00) Devil (02-0058-00) Goose (02-0062-00)	**Anoka**	All conventional parameters	Insufficient Data/Not Assessed	Maintain or improve water quality <60 ug/L Phosphorus	Buffer Strips	20% of Streambank and Lakeshore buffered	●	●		●	●				2044	10 shoreline buffers installed
					Stormwater management	Install BMPs to treat stormwater runoff on 20% of properties	●	●			●	●	●	●	2044	Install 20 BMPs
					Stormwater Rule Compliance/MIDS	All communities within watershed	●	●	●			●	●		2034	Introduce new concepts to all communities
					Monitoring	Monitor monthly at current locations		●	●				●		Ongoing	Monitor monthly at current locations
					Conservation Easements/Property Acquisition	Acquire easements/property as needed	●	●		●		●	●	●	Ongoing	Acquire easements/property as needed
					Manage Aquatic Species	All Lakes		●		●		●	●		2024	Assessment of all lakes for AIS status
					Internal Load Management	Assessment of all lakes to determine if excessive internal loading exists				●		●	●		2024	Completed
					Lakeshore/Streambank Lawn care	All parcels	●	●		●		●	●		Ongoing	Education on websites, press releases, newsletters, etc.
					Nutrient/Manure Management	Plans established with 50% of producers		●		●		●	●		2054	Plans written for 5 producers
Coon (02-0042-00)	**Anoka**	All conventional parameters	34 ug/L TP	Maintain 34 ug/L TP	Buffer Strips	20% of Streambank and Lakeshore buffered	●	●		●	●				2044	10 shoreline buffers installed
					Stormwater management	Install BMPs to treat stormwater runoff on 20% of properties	●	●			●	●	●	●	2044	Install 20 BMPs
					Stormwater Rule Compliance/MIDS	All communities within watershed	●	●	●			●	●		2034	Introduce new concepts to all communities
					Monitoring	Monitor monthly at current locations		●	●				●		Ongoing	Monitor monthly at current locations

					Conservation Easements/Property Acquisition	Acquire easements/property as needed	●	●		●		●	●	●	Ongoing	Acquire easements/property as needed
					Manage Aquatic Species	All Lakes		●		●		●	●		2024	Assessment of all lakes for AIS status
					Internal Load Management	Assessment of all lakes to determine if excessive internal loading exists				●		●	●		2024	Completed
					Lakeshore/Streambank Lawn care	All parcels	●	●		●		●	●		Ongoing	Education on websites, press releases, newsletters, etc.
					Nutrient/Manure Management	Plans established with 50% of producers		●		●		●	●		2054	Plans written for 5 producers
					Refer to Coon Lake Subwatershed Retrofit Assessment for specific strategies around Coon Lake.	Implement top 20 projects in the assessment	●	●	●			●	●	●	2024	Implement 20 BMPs
Carlos Avery WMA Waterbodies: West Twin (02-0033-00) East Twin (02-0020-00) Little Coon (02-0032-00	**Anoka**	All conventional parameters	Not Assessed	Maintain or improve water quality <60 ug/L Phosphorus	Maintain no increase in volume	All outlets				●					Ongoing	Determine best volumes and maintain
					Protect rare wetland species	All public land inventoried for rare species				●					2034	Public land rare species inventory funding secured
					Protect waterfowl habitat	Manage and protect areas known as waterfowl habitat				●					Ongoing	Inventory locations of best habitat
					Protect wild rice production	Manage water levels for optimal production				●					2034	Determine extent of wild rice populations
					Manage Aquatic Species	All Lakes		●		●		●	●		2024	Assessment of all lakes for AIS status
					Internal Load Management	Assessment of all lakes to determine if excessive internal loading exists				●		●	●		2024	Completed

Key: Red rows = impaired waters requiring restoration; Green rows = unimpaired waters requiring protection. *Watershed District/Lake Association/Lake Improvement District/Watershed Management Organization

West Branch of the Sunrise River Subwatershed Strategies



Sunrise River WRAPS	
Subwatershed Name	**West Branch of the Sunrise River**
Major Watershed Name	Sunrise
Area (sq. miles)	53
Groundwater Pollution Sensitivity	High
% Slope (avg.)	1.7
# of Animals	Linwood - 58
Permitted Waste Discharges	Linwood Terrace
Impaired Lake Shoreline Septics	289
Dominant Hydrologic Soil Group	A
BWSR Soil Erosion Risk	Medium
BWSR Water Quality Risk	Medium
SWAT Output TP (lb/ac)	0.095
SWAT Output TSS (ton/ac)	0.0026
Altered Wetland Hydrology	25.0 %
Public Land	8 %
Subwatershed Land Cover	
Developed	9 %
Forested	47 %
Cropland	7 %
Grassland	11 %
Wetlands	21 %
Open Water	5 %
Watershed Entities	
Anoka County, Anoka SWCD, Chisago SWCD, Chisago County East Bethel, Linwood Lake Association, Stacy, Typo-Martin Lake Association, Oxford Township, Linwood Township	
Major Water Resources	
Linwood Lake, Typo Lake, Martin Lake, West Branch of the Sunrise River	
Impairments	
Nutrients, Turbidity, Fish, Invertebrates	
Important Natural Resources	
Next Downstream Waterbody/Subwatershed	
Sunrise South Pool/Carlos Avery-Sunrise Unit Subwatershed	

Sunrise Watershed

Table 20: WEST BRANCH OF THE SUNRISE RIVER SUBWATERSHED Proposed Implementation Strategies and Actions

Waterbody (ID) Location	Location and Upstream Influence Counties	Parameter	Water Quality		Strategies	Estimated Scale of Adoption Needed	Entities with Primary Involvement and Responsibility								Timeline for Achievement of Water Quality Goals	Interim 10-yr Milestones
			Current Conditions	Water Quality Target			Watershed District*	SWCD/NRCS	MPCA	DNR	Property Owners	Cities/Townships	County	BWSR		
Sunrise River, West Branch (-563) Typo Lk to Martin Lk	**Anoka** Isanti	Turbidity	>25 NTU	TP < 100 ug/L (Turb and pH impairments due to elevated TP)	Refer to: **TMDL Implementation Plan for Martin and Typo Lakes and the West Branch of the Sunrise River between the lakes (August 2012)** (http://www.pca.state.mn.us/pyri9fd) Specifically Table 7 that describes eleven strategies for phosphorus reduction; • Plugging County Ditch 20 Lateral Ditches • Data Creek Water Treatment Facility • Rough Fish Control • Drawdown Typo Lake • Lakeshore Septic System Updates • Lakeshore Restorations • Martin Lake Stormwater Retrofits • Stormwater and Erosion Control Permits and Regulations • Agricultural Best Management Practices (BMPs) • Education • Effectiveness Monitoring Also see the Martin Lake Sub-watershed Retrofit Assessment for specific strategies around Martin Lake (http://www.anokaswcd.org/images/AnokaSWCD/Reports/MartinLakeSWAssmtRptAppendixA.pdf)											
		pH	<6.5													
Martin Lake Inlet (-579) Island Lk to Martin Lk County Ditch 13 (-561) Headwaters to Typo Lk Unnamed creek (-583) Headwaters to Typo Lk	**Anoka Isanti**	All conventional parameters	Insufficient Data/Not Assessed	Maintain or improve water quality												
Martin (02-0034-00)	**Anoka**	Phosphorus	92 ug/L	<40 ug/L												
Typo (30-0009-00)	**Anoka/ Isanti**	Phosphorus	242 ug/L	<60 ug/L												
Sunrise River, West Branch (-529) Martin Lk to Pool 1	**Anoka Isanti**	Fish IBI Invertebrate IBI Turbidity pH	20 47 >25 NTU <6.5	TP < 100 ug/L (Turb and pH impairments due to elevated TP)	Nutrient Management	Nutrient management plans for 20% of cropland	•	•	•	•	•	•	•		2044	200 acres of new nutrient management
					Buffer Strips	20% of Streambank buffered	•	•		•	•				2044	2 shoreline buffers installed
					Streambank restoration	20% of Streambanks restored to reduce erosion and increase habitat		•		•	•				2034	100 feet of streambank restored
					Riparian Corridor Protection/Improvement	Locate areas with decent riparian buffers and improve	•	•	•	•	•	•	•		2044	Locations found
Linwood (02-0026-00)	**Anoka**	Phosphorus	In-lake TP = 44	In-lake TP <40 (21% Reduction)	Refer to Linwood Lake implementation projects detailed in Table 21 for more detail on the strategies provided below:											
					Internal Load Management	Evaluate boat motor restrictions, carp management, aquatic plant management	•	•		•			•		2044	Develop work plan
					Septic System Upgrades	Convert all failing and Imminent Threat to Public Health systems to compliant	•				•	•	•		2044	Develop work plan, document upgrades
					Conservation Tillage	10% of cropland converted to conservation tillage		•							2044	400 acres of cropland converted
					Manure Management	Collection, storage, and treatment of manure at 2 sites		•							2034	Manure storage facility at 1 site
					Lakeshore Lawn care	25% off all parcels with turf grass maintained and limit runoff	•	•				•	•		2034	Education to all landowners 5% of parcels converted
					Determine Boot Lake's impact on Linwood Lake	Watershed of Boot Lake studied, monitored, and reported	•	•							2024	Start monitoring Boot Lake inlet and outlet

					Determine connection of Fertilizer to Shallow Groundwater	Complete study to determine connection	●		●	●					2024	Study completed
					Buffer strips	22 acres of buffer strips	●	●				●	●	●	2034	4 acres of buffer strips installed
					Sedimentation Ponds	130 acres treated	●	●				●	●	●	2044	Sites chosen
					Bioretention & Infiltration	BMPs on 36% of all parcels	●	●				●	●	●	2044	Linwood Lake Watershed BMP program and funding in place
County Ditch 16 (-711) Unnamed ditch to Rice Lk Boot Lake Inlet (-576) Rice Lk to Boot Lk Island Lake Inlet (-578) Linwood Lk to Island Lk Unnamed ditch (-582) Headwaters to W Br Sunrise Unnamed creek (-581) Unnamed ditch to W Br Unnamed creek (-580) Headwaters to W Br Judicial Ditch 2 (-775) Long Lk to W Br	**Anoka** **Isanti**	All conventional parameters	Insufficient Data/Not Assessed	Maintain or improve water quality	Buffer Strips	20% of Streambank buffered	●	●		●	●				2044	7 shoreline buffers installed
					Stormwater management	Install BMPs to treat stormwater runoff on 20% of properties	●	●			●	●	●	●	2044	Install 10 BMPs
					Stormwater Rule Compliance/MIDS	All communities within watershed	●	●	●			●	●		2034	Introduce new concepts to all communities
					Monitoring	Monitor monthly at current locations		●	●				●		Ongoing	Monitor monthly at current locations
					Conservation Easements/Property Acquisition	Acquire easements/property as needed	●	●		●		●	●	●	Ongoing	Acquire easements/property as needed
					Streambank Lawn care	All parcels	●	●		●		●	●		Ongoing	Education on websites, press releases, newsletters, etc.
					Nutrient/Manure Management	Plans established with 50% of producers		●		●		●	●		2044	Plans written for 2 producers
Fawn (02-0035-00) Twin (30-0004-00) Lower Birch (30-0007-00) Upper Birch (30-0005-00) Tamarack (30-0001-00) Hoffman (30-0008-00) Long (30-0002-00) Island (02-0022-00) Tamarack (02-0021-00) Boot (02-0028-00) Rice (02-004300) Fish (02-0065-00)	**Anoka** **Isanti**	All conventional parameters	Insufficient Data/Not Assessed	Maintain or improve water quality	Buffer Strips	20% of Lakeshore buffered	●	●		●	●				2044	7 shoreline buffers installed
					Stormwater management	Install BMPs to treat stormwater runoff on 20% of properties	●	●			●	●	●	●	2044	Install 10 BMPs
					Stormwater Rule Compliance/MIDS	All communities within watershed	●	●	●			●	●		2034	Introduce new concepts to all communities
					Monitoring	Monitor monthly at current locations		●	●				●		Ongoing	Monitor monthly at current locations
					Conservation Easements/Property Acquisition	Acquire easements/property as needed	●	●		●		●	●	●	Ongoing	Acquire easements/property as needed
					Manage Aquatic Species	All Lakes		●		●		●	●		2024	Assessment of all lakes for AIS status
					Internal Load Management	Assessment of all lakes to determine if excessive internal loading exists				●		●	●		2024	Completed
					Lakeshore Lawn care	All parcels	●	●		●		●	●		Ongoing	Education on websites, press releases, newsletters, etc.
					Nutrient/Manure Management	Plans established with 50% of producers		●		●		●	●		2044	Plans written for 2 producers

Key: Red rows = impaired waters requiring restoration; Green rows = unimpaired waters requiring protection. *Watershed District/Lake Association/Lake Improvement District/Watershed Management Organization

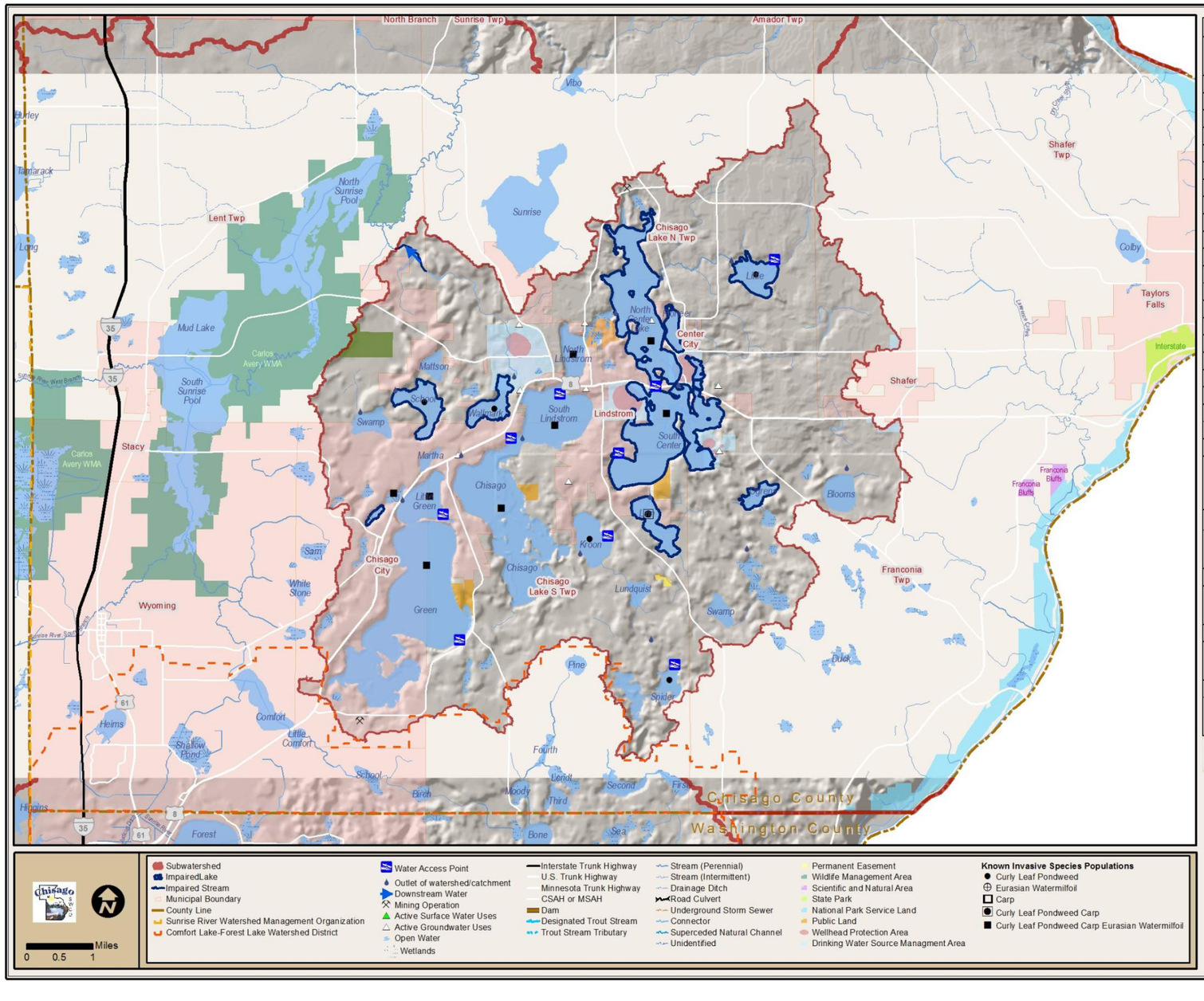
Table 21: Potential Linwood Lake Restoration Projects

LINWOOD LAKE IMPLEMENTATION ACTIVITES CURRENT TP = 44 µg/L		Treated Area [ac]	Treated Area [% Watershed]	Estimated TP Load Reduction [lb P/yr]	Estimated TP Load Reduction [% Total Needed]	Potential Granting Organization	Project Partners	Estimated 30-year Costs
IN-LAKE	**Load Reduction Needed:**			**29**				
	Load Reduction Achieved:			**29**	**8.5%**			
Trophic state alteration	Including, but not limited to, carp management and/or curly-leaf pondweed management.			29	8.5%			
WATERSHED	**Load Reduction Needed:**			**312**				
	Load Reduction Achieved:			**313**	**91.7%**			
Biofilters	Buffer strips (9,415 feet total)	22	0.3%	2	0.6%	NRCS; CWF	NRCS; LID; SWCD; LA; LO	$-$$
Lawn management	Maintaining turfgrass and preventing transport of leaves and clippings on 25% of all parcels	118	1.7%	4	1.2%	Existing programs	City; SWCD; LA	$$
Septic system upgrades	Convert all failing to conforming	N/A	N/A	114	33.6%	CWF	County; Cities; LO	$
	Convert all ITPHSS to conforming (completed)	N/A	N/A	0	0.0%		County, LO	
Bioretention & Infiltration	Infiltration basins and large bioretention facilities (equivalent to one individual rain gardens on 36% of all parcels, or 336)	N/A	N/A	168	49.2%	CWF; LID	SWCD; LID; LA; LO	$$-$$$
Sedimentation	Sedimentation ponds (13)	130	1.9%	14	4.0%	NRCS; CWF; City; LID	NRCS; SWCD; LID; City; LO	$$
Agricultural BMPs	Collection, storage, and treatment of manure (assumes 75% reduction of load)	N/A	N/A	2	0.5%	NRCS; Ag BMP; CWF	NRCS; SWCD; LO	$-$$
	10% of cropland with conservation tillage	102	1.5%	9	2.6%	NRCS; Ag BMP	NRCS; SWCD; LO	Variable
TOTAL	**Load Reduction Needed:**			**341**				
	Load Reduction Achieved:			**342**	**100%**			

Symbol key

Ag BMP	MDA Agricultural BMP Loan Program	LID	Lake Improvement District	$ < $500/lb TP removed/yr
CWF	Clean Water Fund	LO	Landowners	$$ = $500-$1500/lb TP removed/yr
				$$$ > $1500 lb TP
CWP	Clean Water Partnerships/ 319 Grants	NRCS	Natural Resources Conservation Service	removed/yr
LA	Lake Associations	SWCD	Soil and Water Conservation District	

Chisago Lakes Subwatershed Strategies



Sunrise River WRAPS	
Subwatershed Name	**Chisago Lakes Chain of Lakes**
Major Watershed Name	Sunrise
Area (sq. miles)	56
Groundwater Pollution Sensitivity	Low
% Slope (avg.)	3.3
# of Animals	1480
Permitted Waste Discharges	CLJSTC, Blue Waters
Impaired Lake Shoreline Septics	353
Dominant Hydrologic Soil Group	B
BWSR Soil Erosion Risk	High
BWSR Water Quality Risk	High
SWAT Output TP (lb/ac)	0.38
SWAT Output TSS (ton/ac)	0.030
Altered Wetland Hydrology	6.7 %
Public Land	0.5 %
Subwatershed Land Cover	
Developed	4 %
Forested	18 %
Cropland	45 %
Grassland	7 %
Wetlands	7 %
Open Water	19 %
Watershed Entities	
Chisago SWCD, Chisago County, Chisago Lakes LID, Center City, Chisago City, Lindstrom, Wyoming, Chisago Lakes Township, Shafer Township, Franconia Township	
Major Water Resources	
N. Center, S. Center, N. Lindstrom, S. Lindstrom, Chisago, Green, Little Green, Kroon, Linn, Little Lakes	
Impairments	
1 stream fish bioassessment 9 lake nutrient	
Important Natural Resources	
Next Downstream Waterbody/Subwatershed	
Sunrise River/Carlos Avery-Sunrise Unit Subwatershed	

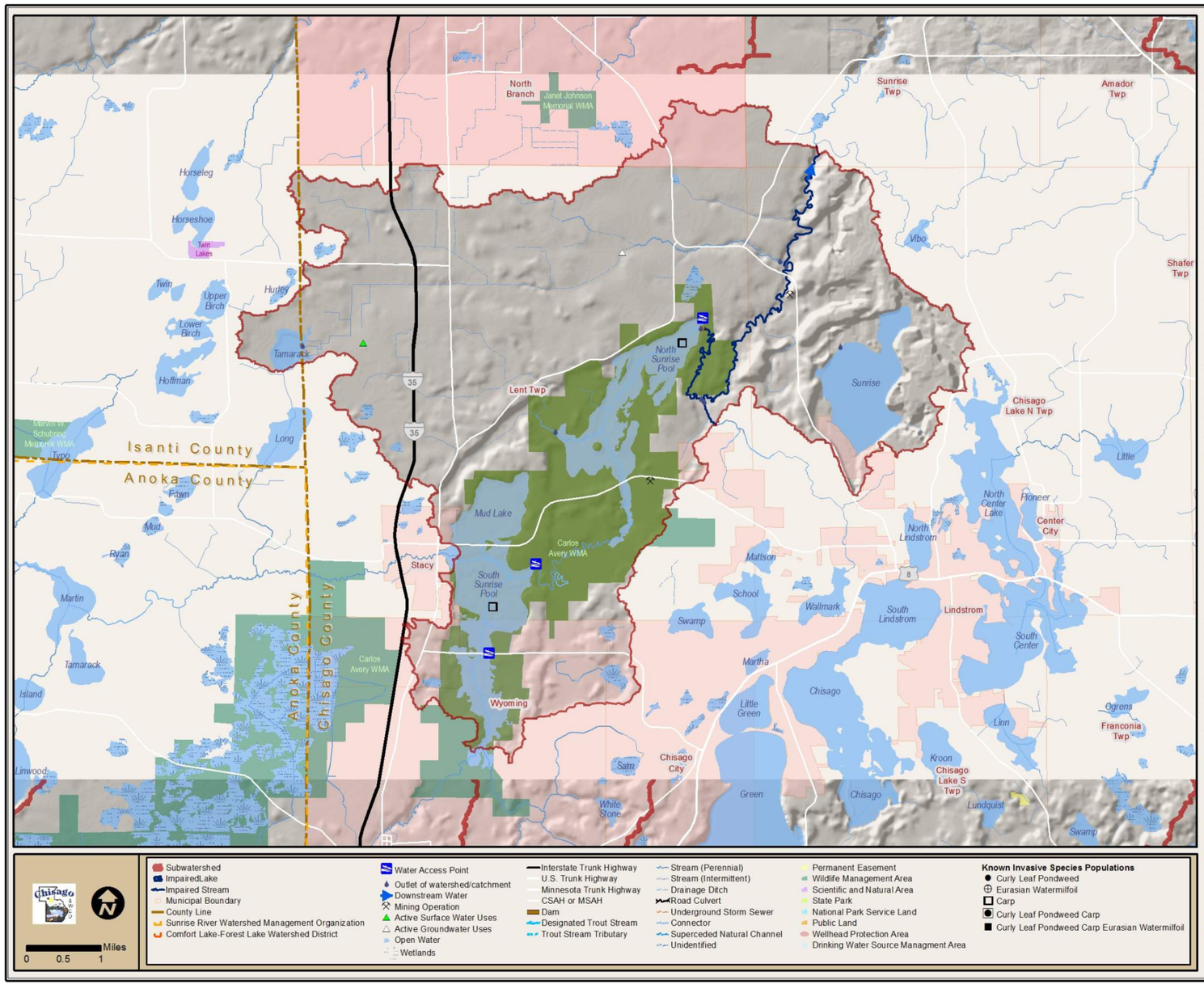
Sunrise Watershed

Table 22: CHISAGO LAKES SUBWATERSHED Proposed Implementation Strategies and Actions

Waterbody (ID) Location	Location and Upstream Influence Counties	Parameter	Water Quality		Strategies	Estimated Scale of Adoption Needed	Entities with Primary Involvement and Responsibility								Timeline for Achievement of Water Quality Goals	Interim 10-yr Milestones
			Current Conditions	Water Quality Target			Watershed District*	SWCD/NRCS	MPCA	DNR	Property Owners	Cities/Townships	County	BWSR		
Bloomquist Creek (-723) T34 R21 S24, east line to Sunrise River	**Chisago**	Fish	Excess Ammonia/Low DO	Fully Support aquatic life; Fish	Monitor the effect of the Chisago Lake Joint Sewage Treatment Facility permit update.	Chisago Lakes Joint Sewage Treatment Commission - whole facility management			●		●	●	●		In progress	Meet permit standards
					Refer to: Chisago Lakes Chain of Lakes Watershed Restoration and Protection Plan (2013) (http://www.pca.state.mn.us/wfhya0a)											
Unnamed Ditch (-722) Wallmark Lk to T34 R20W S19, west line Unnamed Creek (-719) Headwaters to Little Lk Unnamed Creek (-721) Little Lk to North Center Lk Unnamed Creek (-572) Headwaters to S. Center Lk Unnamed Creek (-715) Headwaters to Unnamed Creek	**Anoka**	All conventional parameters	Insufficient Data/Not Assessed	Maintain or improve water quality	Buffer Strips	20% of Streambank and Lakeshore buffered	●	●		●	●				2044	10 shoreline buffers installed
					Stormwater management	Install BMPs to treat stormwater runoff on 20% of properties	●	●			●	●	●	●	2044	Install 20 BMPs
					Stormwater Rule Compliance/MIDS	All communities within watershed	●	●	●			●	●		2034	Introduce new concepts to all communities
					Monitoring	Monitor monthly at current locations		●	●				●		Ongoing	Monitor monthly at current locations
					Conservation Easements/Property Acquisition	Acquire easements/property as needed	●	●		●		●	●	●	Ongoing	Acquire easements/property as needed
					Manage Aquatic Species	All Lakes		●		●		●	●		2024	Assessment of all lakes for AIS status
					Lakeshore/Streambank Lawn care	All parcels	●	●		●		●	●		Ongoing	Education on websites, press releases, newsletters, etc.
					Nutrient/Manure Management	Plans established with 50% of producers		●		●		●	●		2044	Plans written for 5 producers
North Center (13-0032-01)	**Chisago**	Phosphorus	In-lake TP = 70 ug/L	In-lake TP < 60 ug/L	**Refer to: Chisago Lakes Chain of Lakes Watershed Restoration and Protection Plan (2013)** (http://www.pca.state.mn.us/wfhya0a), specifically section 3.4 Implementation Activitied: Selection and Justification for a detailed description of the specific implementation actions recommended for each lake.											
South Center (13-0027-00)			In-lake TP = 50 ug/L	In-lake TP < 40 ug/L												
Emily (13-0046-00)			In-lake TP = 341 ug/L	In-lake TP < 60 ug/L												
Ogrens (13-0011-00)			In-lake TP = 64 ug/L	In-lake TP < 40 ug/L												
Pioneer (13-0034-00)			In-lake TP = 345 ug/L	In-lake TP < 60 ug/L												
Wallmark (13-0029-00)			In-lake TP = 322 ug/L	In-lake TP < 60 ug/L												
Linn (13-0014-00)			In-lake TP = 217 ug/L	In-lake TP < 60 ug/L												
Little (13-0033-00)			In-lake TP = 173 ug/L	In-lake TP < 40 ug/L												
School (13-0044-00)			In-lake TP = 216 ug/L	In-lake TP < 60 ug/L												
North Chisago (13-0012-01)	**Chisago**	All conventional parameters	Fully Supporting	Maintain or improve water quality	**Refer to: Chisago Lakes Chain of Lakes Watershed Restoration and Protection Plan (2013)** (http://www.pca.state.mn.us/wfhya0a), specifically section 4 which describes the specific implementation actions for protection of each of the lakes currently meeting State standards.											
South Chisago (13-0012-02)			Fully Supporting													
Ellen (13-0047-00)			Insufficient Data													
Green (13-0041-02)			Fully Supporting													
Little Green (13-0041-01)			Fully Supporting													
Kroon (13-0013-00)			Insufficient Data													
North Lindstrom (13-0035-00)			Fully Supporting													
South Lindstrom (13-0028-00)			Fully Supporting													
Mattson (13-0043-00)			Insufficient Data													
Spider (13-0019-00)			Fully Supporting													

Key: Red rows = impaired waters requiring restoration; Green rows = unimpaired waters requiring protection. *Watershed District/Lake Association/Lake Improvement District/Watershed Management Organization

Carlos Avery Subwatershed Strategies



Sunrise River WRAPS	
Subwatershed Name	**Carlos Avery - Sunrise Unit**
Major Watershed Name	Sunrise
Area (sq. miles)	42
Groundwater Pollution Sensitivity	High
% Slope (avg.)	2.1
# of Animals	164
Permitted Waste Discharges	None
Impaired Lake Shoreline Septics	0
Dominant Hydrologic Soil Group	A
BWSR Soil Erosion Risk	Medium
BWSR Water Quality Risk	Medium
SWAT Output TP (lb/ac)	0.14
SWAT Output TSS (ton/ac)	0.0055
Altered Wetland Hydrology	21.6 %
Public Land	24 %
Subwatershed Land Cover	
Developed	4 %
Forested	32 %
Cropland	8 %
Grassland	31 %
Wetlands	18 %
Open Water	7 %
Watershed Entities	
Chisago SWCD, Chisago County, Friends of the Sunrise River, North Branch, Wyoming, Lent Township, Chisago Lakes Township	
Major Water Resources	
Sunrise South Pool, Sunrise North Pool	
Impairments	
1 stream DO 1 stream fish bioassessment	
Important Natural Resources	
Wild Rice, Carlos Avery Wildlife Management Area	
Next Downstream Waterbody/Subwatershed	
Kost Dam Pool/Sunrise River Subwatershed	

Sunrise Watershed

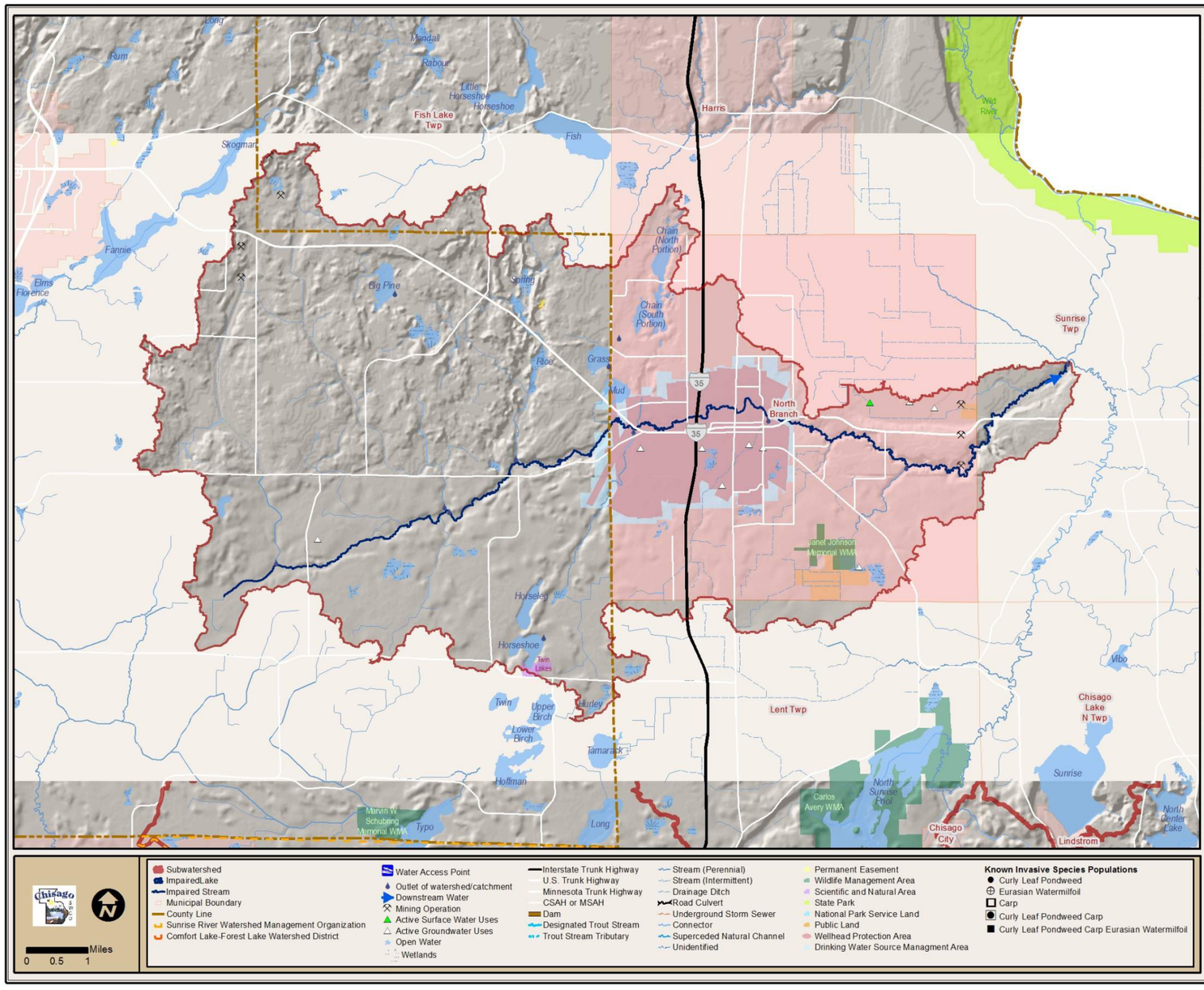
Table 23: CARLOS AVERY SUBWATERSHED Proposed Implementation Strategies and Actions

Waterbody (ID) Location	Location and Upstream Influence Counties	Parameter	Water Quality		Strategies	Estimated Scale of Adoption Needed	Entities with Primary Involvement and Responsibility								Timeline for Achievement of Water Quality Goals	Interim 10-yr Milestones
			Current Conditions	Water Quality Target			Watershed District*	SWCD/NRCS	MPCA	DNR	Property Owners	Cities/Townships	County	BWSR		
Sunrise River, S Br (-540) North Pool to Kost Dam	**Chisago**	Fish, DO	Elevated phosphorus levels	In-stream TP <100 ug/L	Buffer Strips	20% of Streambank buffered	●	●	●	●	●	●	●		2044	2 shoreline buffers installed
					Nutrient/Manure Management	Plans established with 50% of producers		●			●				2044	Plans written for 1 producer
					Soil health practices	Educate and work with agricultural producers on tillable acres		●			●				2044	Practices applied to 100 additional acres of cropland
			Sediment eroding from banks	Stabilize eroding banks	Reduce streambank erosion	Restoration of 10% of shorelines		●	●				●		2044	500 feet of eroding streambank stabilized
			< 5 mg/L DO Daily Minimum	> 5 mg/L DO Daily minimum	Dam operation and management feasibility study	Conduct water level and dam operation management feasibility study									2024	Complete study
					Wetland Restoration within watershed	Determine best locations for restoration, implement strategies		●			●	●			2044	Complete list of projects for restoration
			Poor connectivity	Increase Connectivity	Increase connectivity for fish passage within the watershed	Determine locations with limited connectivity, seek opportunities to improve			●		●	●	●		Ongoing	Determine locations that will increase connectivity
Carlos Avery WMA: South Pool (13-0059-01) North Pool (13-0059-03) Mud Lake (13-0059-02) Sunrise River (-528) South Pool to North Pool County Ditch 10 (-630) Headwaters to Unnamed Creek County Ditch 5 (-708, -709, -710) Unnamed Ditch to Sunrise River	**Chisago**	All conventional parameters	Insufficient Data/Not Assessed	Maintain or improve water quality	Maintain no increase in volume	All outlets				●	●	●			Ongoing	Determine best volumes and maintain
					Protect rare wetland species	All public land inventoried for rare species				●					2034	Public land rare species inventory funding secured
					Protect waterfowl habitat	Manage and protect areas known as waterfowl habitat				●					Ongoing	Inventory locations of best habitat
					Measure sediment accumulation rates	All dams within WMA				●					2034	Monitor accumulation rates and determine if removal is feasible
					Expand WMA Boundaries	Prioritize tax-forfeit land for purchase				●					Ongoing	Review tax-forfeit land as necessary
					Pool drawdowns	All pools that need maintenance and vegetation management as needed				●					Ongoing	Develop schedule for drawdowns
					Cattail Management	Conduct cattail management study, apply plan to all waterbodies				●					Ongoing	Develop cattail management study
					Monitoring	Monitor all drainage ditches that enter the WMA for pollutants				●					2034	Develop work plan for monitoring and determine locations of ditches.

Sunrise Lake (13-0031-00) County Ditch 10 (-630) Headwaters to Unnamed Creek County Ditch 5 (-708, -709, -710) Unnamed Ditch to Sunrise River	**Chisago**	All conventional parameters	Insufficient Data/Not Assessed	Maintain or improve water quality <60 ug/L Phosphorus	Buffer Strips	20% of Streambank and Lakeshore buffered	●	●		●	●				2044	5 shoreline buffers installed
					Stormwater management	Install BMPs to treat stormwater runoff on 20% of properties	●	●			●	●	●	●	2044	Install 2 BMPs
					Monitoring	Monitor monthly at current locations		●	●				●		Ongoing	Monitor monthly at current locations
					Conservation Easements/Property Acquisition	Acquire easements/property as needed	●	●		●		●	●	●	Ongoing	Acquire easements/property as needed
					Manage Aquatic Species	Sunrise Lake		●		●		●	●		2024	Assessment of lake for AIS status
					Internal Load Management	Assessment of lake to determine if excessive internal loading exists				●		●	●		2024	Completed
					Lakeshore/Streambank Lawn care	All parcels	●	●		●		●	●		Ongoing	Education on websites, press releases, newsletters, etc.
					Nutrient/Manure Management	Plans established with 50% of producers		●		●		●	●		2044	Plan written for 1 producer

Key: Red rows = impaired waters requiring restoration; Green rows = unimpaired waters requiring protection. *Watershed District/Lake Association/Lake Improvement District/Watershed Management Organization

North Branch of the Sunrise River Subwatershed Strategies



Sunrise River WRAPS	
Subwatershed Name	**North Branch of the Sunrise River**
Major Watershed Name	Sunrise
Area (sq. miles)	78
Groundwater Pollution Sensitivity	High
% Slope (avg.)	1.9
# of Animals	Unknown
Permitted Waste Discharges	North Branch
Impaired Lake Shoreline Septics	0
Dominant Hydrologic Soil Group	A/C
BWSR Soil Erosion Risk	High
BWSR Water Quality Risk	Medium
SWAT Output TP (lb/ac)	0.32
SWAT Output TSS (ton/ac)	0.013
Altered Wetland Hydrology	49.5 %
Public Land	1 %
Subwatershed Land Cover	
Developed	8 %
Forested	22 %
Cropland	40 %
Grassland	19 %
Wetlands	10 %
Open Water	1 %
Watershed Entities	
Chisago SWCD, Chisago County, Isanti SWCD, Isanti County, North Branch, North Branch Township, Oxford Township	
Major Water Resources	
North Branch of the Sunrise River	
Impairments	
1 stream E. coli, 1 stream fish bioassessment	
Important Natural Resources	
Next Downstream Waterbody/Subwatershed	
Sunrise River/Sunrise Subwatershed	

Sunrise Watershed

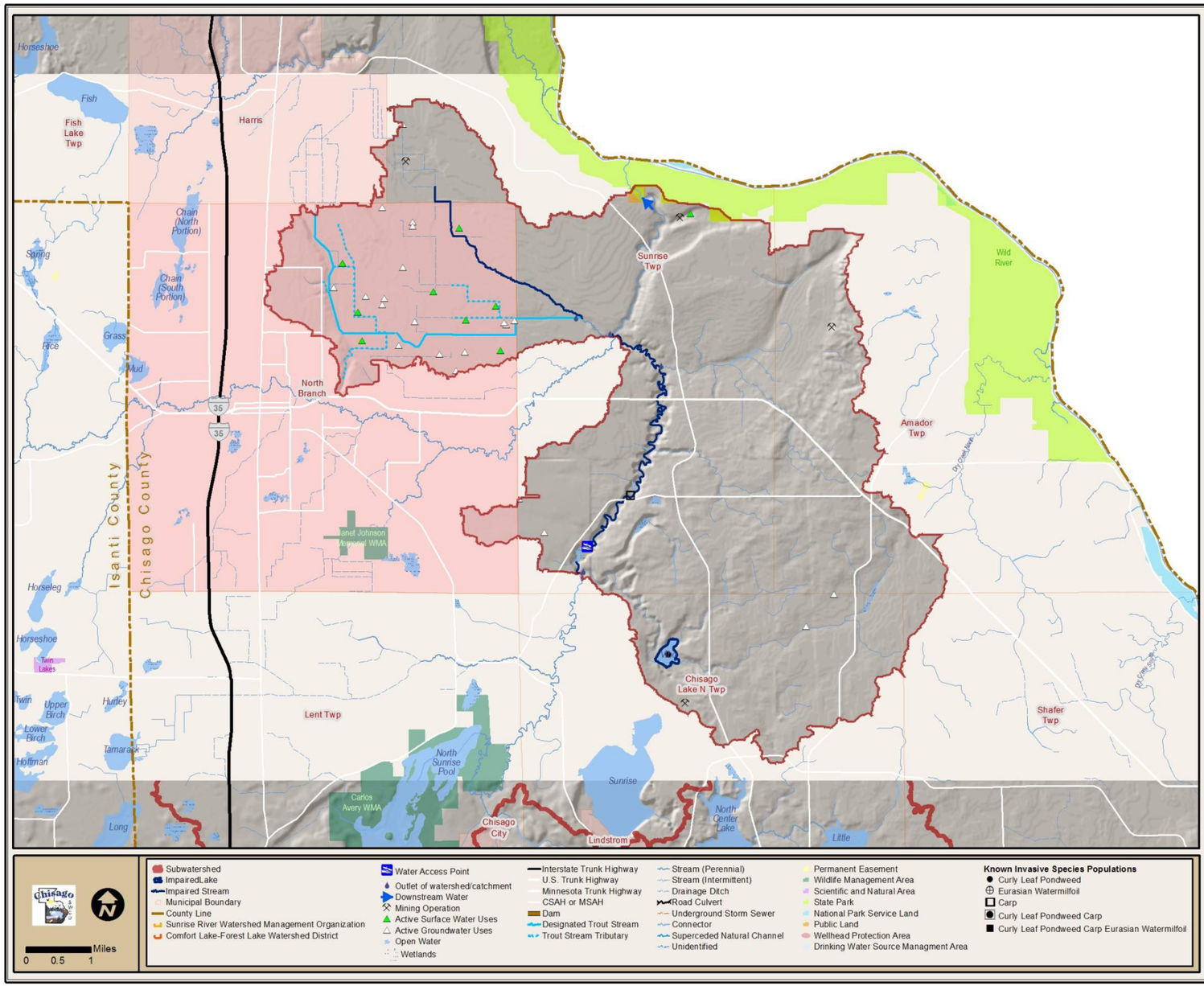
Table 24: NORTH BRANCH OF THE SUNRISE RIVER SUBWATERSHED Proposed Implementation Strategies and Actions

Waterbody (ID) Location	Location and Upstream Influence Counties	Parameter	Water Quality		Strategies	Estimated Scale of Adoption Needed	Entities with Primary Involvement and Responsibility								Timeline for Achievement of Water Quality Goals	Interim 10-yr Milestones
			Current Conditions	Water Quality Target			Watershed District*	SWCD/NRCS	MPCA	DNR	Property Owners	Cities/Townships	County	BWSR		
Sunrise River, North Branch (-501) Headwaters to Sunrise River	**Isanti** Chisago	E. coli	Fecal coliform = 420 org/mL	Fecal coliform <200 org/100 mL	**Refer to: North Branch of the Sunrise River Fecal Coliform TMDL Implementation Plan (February 2007)** (http://www.pca.state.mn.us/qzqha00) specifically section 4.1 for implementation actions related to livestock management, section 4.2 for actions related to septic systems and section 4.3 for actions specific to pet waste.										
		Fish	W of NB - IBI 34 E of NB - IBI 44	W of NB - IBI > 40 E of NB - IBI > 50	Inventory Streambank condition/Streambank restoration	20% of Streambanks restored to reduce erosion and increase habitat		●		●	●		●	●	2034	Inventory streambanks, 2 streambank restorations completed
County Ditch 19 (-728) Unnamed ditch to NBSR Unnamed Creek (-753) Headwaters to NBSR Judicial Ditch 4 (-556) Unnamed Cr to NBSR Hay Creek (-714) Mud Lk to NBSR Unnamed Creek (-569) Headwaters to NBSR Unnamed Creek (-755) Unnamed Ditch to NBSR	**Isanti Chisago**	All conventional parameters	Insufficient Data	Maintain or improve water quality	Buffer Strips	20% of Streambank buffered	●	●		●	●				2044	2 shoreline buffers installed
					Stormwater management	Install BMPs to treat stormwater runoff on 20% of properties	●	●			●	●	●	●	2044	Install 2 BMPs
					Stormwater Rule Compliance/MIDS	All communities within watershed	●	●	●			●	●		2034	Introduce new concepts to all communities
					Monitoring	Monitor monthly at current locations		●	●				●		Ongoing	Monitor monthly at current locations
					Conservation Easements/Property Acquisition	Acquire easements/property as needed	●	●		●		●	●	●	Ongoing	Acquire easements/property as needed
					Lakeshore/Streambank Lawn care	All parcels	●	●		●		●	●		Ongoing	Education on websites, press releases, newsletters, etc.
					Nutrient/Manure Management	Plans established with 50% of producers		●		●		●	●		2044	Plans written for 3 producers
Splittstoeser (30-00041-00) Mud (13-0066-00) Grass (30-0017-00) Horseleg (30-0012-00) Horseshoe (30-0003-00) Big Pine (30-0015-00) Chain North (13-0063-01) Chain South (13-0063-02)	**Isanti Chisago**	All conventional parameters	Insufficient Data/Not Assessed	Maintain or improve water quality <60 ug/L Phosphorus	Buffer Strips	20% of Lakeshore buffered	●	●		●	●				2044	1 shoreline buffers installed
					Stormwater management	Install BMPs to treat stormwater runoff on 20% of properties	●	●			●	●	●	●	2044	Install 1 BMPs
					Stormwater Rule Compliance/MIDS	All communities within watershed	●	●	●			●	●		2034	Introduce new concepts to all communities
					Monitoring	Monitor monthly at current locations		●	●				●		Ongoing	Monitor monthly at current locations
					Conservation Easements/Property Acquisition	Acquire easements/property as needed	●	●		●		●	●	●	Ongoing	Acquire easements/property as needed
					Manage Aquatic Species	All Lakes		●		●		●	●		2024	Assessment of all lakes for AIS status
					Lakeshore/Streambank Lawn care	All parcels	●	●		●		●	●		Ongoing	Education on websites, press releases, newsletters, etc.
					Nutrient/Manure Management	Plans established with 50% of producers		●		●		●	●		2044	Plan written for 1 producer

Key: Red rows = impaired waters requiring restoration; Green rows = unimpaired waters requiring protection.

*Watershed District/Lake Association/Lake Improvement District/Watershed Management Organization

Sunrise River Main Branch Subwatershed Strategies



Sunrise River WRAPS	
Subwatershed Name	**Sunrise River**
Major Watershed Name	Sunrise
Area (sq. miles)	51
Groundwater Pollution Sensitivity	West - High, East - Low
% Slope (avg.)	2.0
# of Animals	3143
Permitted Waste Discharges	Trophy Lakes Estates
Impaired Lakes Shoreline Septics	5
Dominant Hydrologic Soil Group	A/B
BWSR Soil Erosion Risk	Medium
BWSR Water Quality Risk	Medium
SWAT Output TP (lb/ac)	0.63
SWAT Output TSS (ton/ac)	0.055
Altered Wetland Hydrology	50.2 %
Public Land	0.2 %
Subwatershed Land Cover	
Developed	5 %
Forested	26 %
Cropland	28 %
Grassland	37 %
Wetlands	3 %
Open Water	1 %
Watershed Entities	
Chisago SWCD, Chisago County, Friends of the Sunrise River, North Branch, Sunrise Township, Chisago Lakes Township	
Major Resources	
Vibo Lake, Sunrise River, Hay Creek	
Impairments	
2 stream *E. coli* 1 lake nutrient	
Important Resources	
Endangered Mussels, Portions of Hay Creek are listed as a Trout Stream	
Next Downstream Waterbody/Subwatershed	
St. Croix River/Lower St. Croix Subwatershed	

Sunrise Watershed

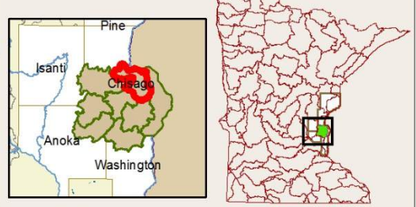


Table 25: SUNRISE RIVER MAIN BRANCH SUBWATERSHED Proposed Implementation Strategies and Actions

Waterbody (ID) Location	Location and Upstream Influence Counties	Parameter	Water Quality		Strategies	Estimated Scale of Adoption Needed	Entities with Primary Involvement and Responsibility								Timeline for Achievement of Water Quality Goals	Interim 10-yr Milestones
			Current Conditions	Water Quality Target			Watershed District*	SWCD/NRCS	MPCA	DNR	Property Owners	Cities/Townships	County	BWSR		
Hay Creek (-545) CD 3 to Sunrise River	**Chisago**	E. coli	Monthly geometric mean E. coli ranges from 94 to 609 org/100mL	E. coli <126 org/100 mL	Nutrient/Manure Management	Plans established with 50% of producers		•		•		•	•		2044	Plan written for 1 producer
					Livestock Exclusion	Exclude all livestock from lake and tributaries		•	•		•				2044	10% of livestock excluded
					Upgrade failing septic systems	Inventory the extent of failing septic systems						•	•		2044	10% of failing systems identified
					Locate and reduce illicit discharge points	Locate and reduce illicit discharge points			•			•	•		2034	Locate illicit discharges
					Streambank restoration	20% of Streambanks restored to reduce erosion and increase habitat		•		•	•				2034	100 feet of streambank restored
Sunrise River (-543) NBSR to St. Croix River	**Chisago**	E. coli	Monthly geometric mean E. coli ranges from 326 to 511 org/100mL	E. coli <126 org/100 mL	Nutrient/Manure Management	Plans established with 50% of producers		•		•		•	•		2044	Plan written for 1 producer
					Livestock Exclusion	Exclude all livestock from lakes and tributaries		•	•		•				2044	10% of livestock excluded
					Upgrade failing septic systems	Inventory the extent of failing septic systems				•	•		•		2044	10% of failing systems identified
					Locate and reduce illicit discharge points	Locate and reduce illicit discharge points			•				•		2034	Locate illicit discharges
					Streambank restoration	20% of Streambanks restored to reduce erosion and increase habitat		•		•	•				2034	100 feet of streambank restored, develop restoration plan for Wild River State Park-Sunrise River cutbank
Vibo Lake (13-0030-00)	**Chisago**	Phosphorus	In-lake TP = 516 ug/L	In-lake TP <60 ug/L	Buffer Strips	20% of Lakeshore buffered	•	•		•	•				2044	1 shoreline buffers installed
					Stormwater management	Install BMPs to treat stormwater runoff on 20% of properties	•	•			•	•	•	•	2044	Install 2 BMPs

					Monitoring	Monitor monthly at current locations		●	●				●		Ongoing	Monitor monthly at current locations
					Conservation Easements	Acquire easements as needed	●			●			●		Ongoing	Acquire easements as needed
					Manage Aquatic Species	Entire lake		●		●		●	●		2024	Assessment of lake for AIS status
					Lakeshore/Streambank Lawn care	All parcels	●	●		●		●	●		Ongoing	Education on websites, press releases, newsletters, etc.
					Nutrient/Manure Management	Plans established with 50% of producers		●		●		●	●		2044	Plan written for 1 producer

Key: Red rows = impaired waters requiring restoration; Green rows = unimpaired waters requiring protection. *Watershed District/Lake Association/Lake Improvement District/Watershed Management Organization

Table 26: Potential Vibo Lake Restoration Projects

VIBO IMPLEMENTATION PROJECTS CURRENT TP = 516 µg/L		Treated Area [ac]	Treated Area [% Watershed]	Estimated TP Load Reduction [lb P/yr]	Estimated TP Load Reduction [% Total Needed]	Potential Granting Organization	Project Partners	Estimated 30-year Costs
IN-LAKE	**Load Reduction Needed:**			**1,175**				
	Load Reduction Achieved:			**902**	**9.3%**			
Trophic state alteration	Includes complete fish kill, gamefish fish stocking, and/or lake drawdown.			902	9.3%	CWF; LID; LA	LID; LA; SWCD	$
WATERSHED	**Load Reduction Needed:**			**8,543**				
	Load Reduction Achieved:			**8,816**	**90.7%**			
Biofilters	Buffer strips (38,325 feet total)	79	1.0%	48	0.5%	NRCS; CWF	NRCS; LID; SWCD; LA; LO	$-$$
Lawn management	Maintaining turfgrass and preventing transport of leaves and clippings on 100% of all parcels	70	0.9%	68	0.7%	Existing programs	City; SWCD; LA	$$
Septic system upgrades	Convert all failing to conforming	N/A	N/A	65	0.7%	CWF	County; Cities; LO	$
	Convert all ITPHSS to conforming (completed)	N/A	N/A	11	0.1%		County, LO	
Bioretention & Infiltration	One rain garden on 100% of all parcels (562 total)	N/A	N/A	281	2.9%	CWF; LID	SWCD; LID; LA; LO	$$-$$$
Sedimentation	Sedimentation ponds (78)	780	10.2%	571	5.9%	NRCS; CWF; City; LID	NRCS; SWCD; LID; City; LO	$$
	Gully stabilization (7)	N/A	N/A					#REF!
Agricultural BMPs	Collection, storage, and treatment of manure (assumes 75% reduction of load)	N/A	N/A	53	0.5%	NRCS; Ag BMP; CWF	NRCS; SWCD; LO	$-$$
	100% of cropland with conservation tillage	2,840	37.0%	1,711	17.6%	NRCS; Ag BMP	NRCS; SWCD; LO	Variable
Inlet Chemical Treatment		N/A	N/A	6,009	61.8%			
TOTAL	**Load Reduction Needed:**			**9,718**				
	Load Reduction Achieved:			**9,718**	**100%**			

Symbol key

Ag BMP	MDA Agricultural BMP Loan Program	LID	Lake Improvement District	$ < $500/lb TP removed/yr
CWF	Clean Water Fund	LO	Landowners	$$ = $500-$1500/lb TP removed/yr
				$$$ > $1500 lb TP
CWP	Clean Water Partnerships/ 319 Grants	NRCS	Natural Resources Conservation Service	removed/yr
LA	Lake Associations	SWCD	Soil and Water Conservation District	

***Note** - implementation of all potential watershed best management practice does not achieve the load reductions needed to meet the TMDL without chemical treatment.

An in-line chemical treatment facility could be considered at Vibo Lake to reduce TP loads to the Sunrise River and St. Croix River. A more detailed feasibility study would be needed.

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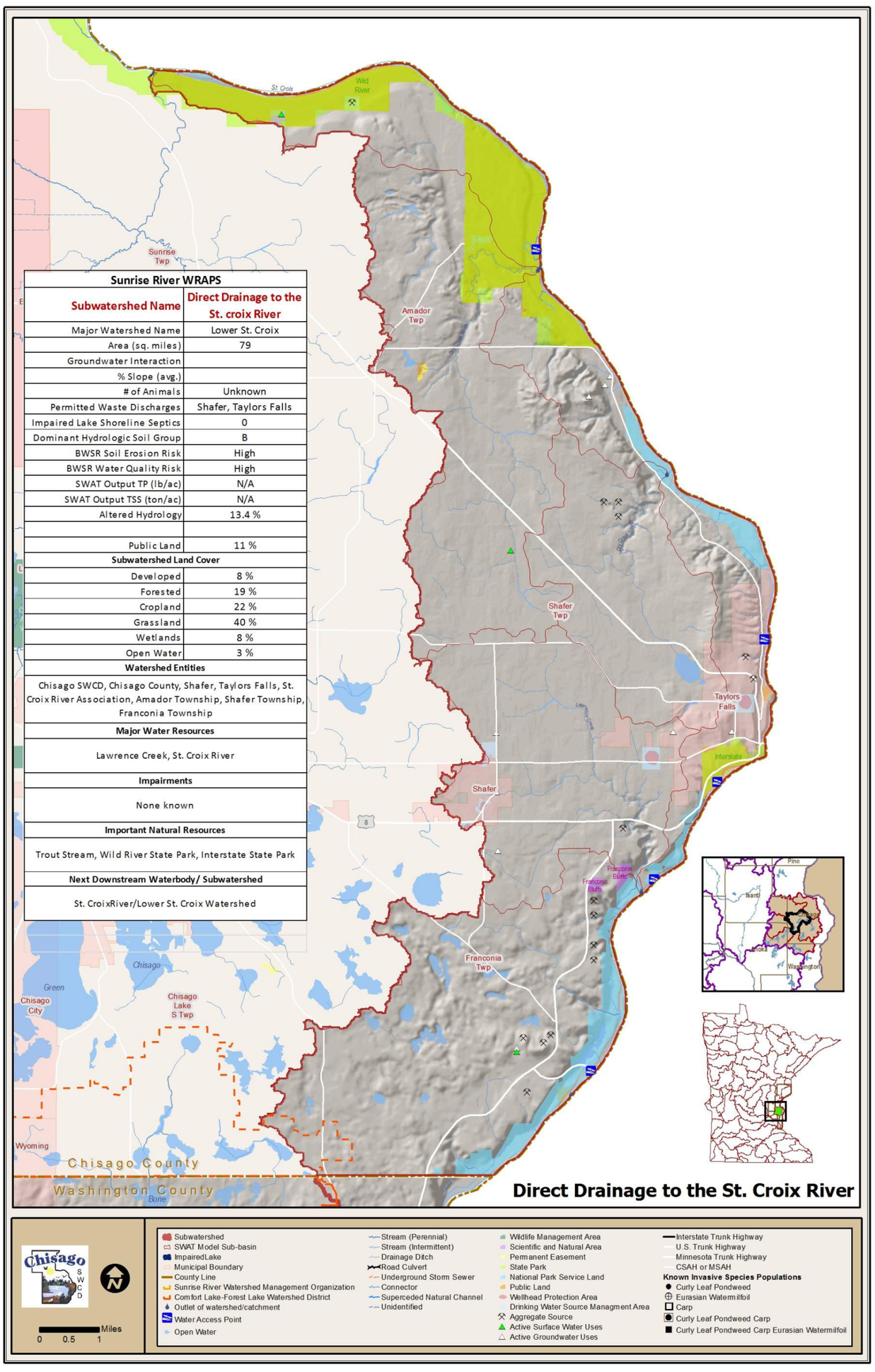

Sunrise River WRAPS	
Subwatershed Name	**Direct Drainage to the St. croix River**
Major Watershed Name	Lower St. Croix
Area (sq. miles)	79
Groundwater Interaction	
% Slope (avg.)	
# of Animals	Unknown
Permitted Waste Discharges	Shafer, Taylors Falls
Impaired Lake Shoreline Septics	0
Dominant Hydrologic Soil Group	B
BWSR Soil Erosion Risk	High
BWSR Water Quality Risk	High
SWAT Output TP (lb/ac)	N/A
SWAT Output TSS (ton/ac)	N/A
Altered Hydrology	13.4 %
Public Land	11 %
Subwatershed Land Cover	
Developed	8 %
Forested	19 %
Cropland	22 %
Grassland	40 %
Wetlands	8 %
Open Water	3 %
Watershed Entities	
Chisago SWCD, Chisago County, Shafer, Taylors Falls, St. Croix River Association, Amador Township, Shafer Township, Franconia Township	
Major Water Resources	
Lawrence Creek, St. Croix River	
Impairments	
None known	
Important Natural Resources	
Trout Stream, Wild River State Park, Interstate State Park	
Next Downstream Waterbody/ Subwatershed	
St. CroixRiver/Lower St. Croix Watershed	

Table 27: DIRECT DRAINAGE TO THE ST. CROIX SUBWATERSHED Proposed Implementation Strategies and Actions

Waterbody (ID) Location	Location and Upstream Influence Counties	Parameter	Water Quality		Strategies	Estimated Scale of Adoption Needed	Entities with Primary Involvement and Responsibility								Timeline for Achievement of Water Quality Goals	Interim 10-yr Milestones
			Current Conditions	Water Quality Target			Watershed District*	SWCD/NRCS	MPCA	DNR	Property Owners	Cities/Townships	County	BWSR		
Dry Creek (-570) Unnamed Creek to St. Croix River Lawrence Creek (-574) T33 R19W S3, north line to St. Croix River Unnamed Creek (-553) Headwaters to Lawrence Creek	**Chisago**	All conventional parameters	Insufficient Data	Maintain or improve water quality	Strembank Restoration	20% of Streambank restored		●		●	●				2044	200 feet of shoreline restored
					Stormwater management	Install BMPs to treat stormwater runoff on 20% of properties	●	●			●	●	●	●	2044	Install 5 BMPs
					Stormwater Rule Compliance/MIDS	All communities within watershed	●	●	●			●	●		2034	Introduce new concepts to all communities
					Monitoring	Monitor monthly at current locations		●	●				●		Ongoing	Monitor monthly at current locations
					Conservation Easements/Property Acquisition	Acquire easements/property as needed	●	●		●		●	●	●	Ongoing	Acquire easements/property as needed
					Streambank Lawn care	All parcels	●	●		●		●	●		Ongoing	Education on websites, press releases, newsletters, etc.
					Nutrient/Manure Management	Plans established with 50% of producers		●		●		●	●		2044	Plans written for 2 producers
Duck Lake (13-0005-00)	**Chisago**	All conventional parameters	Insufficient Data/Not Assessed	Maintain or improve water quality <60 ug/L Phosphorus	Buffer Strips	20% of Lakeshore buffered	●	●		●	●				2044	1 shoreline buffer installed
					Stormwater management	Install BMPs to treat stormwater runoff on 20% of properties	●	●			●	●	●	●	2044	Install 1 BMP
					Stormwater Rule Compliance/MIDS	All communities within watershed	●	●	●			●	●		2034	Introduce new concepts to all communities
					Monitoring	Monitor monthly at current locations		●	●				●		Ongoing	Monitor monthly at current locations
					Conservation Easements/Property Acquisition	Acquire easements/property as needed	●	●		●		●	●	●	Ongoing	Acquire easements/property as needed
					Manage Aquatic Species	Duck Lake		●		●		●	●		2024	Assessment of lake for AIS status
					Lakeshore Lawn care	All parcels	●	●		●		●	●		Ongoing	Education on websites, press releases, newsletters, etc.
					Nutrient/Manure Management	Plans established with 50% of producers		●		●		●	●		2044	Plan written for 1 producer

Key: Red rows = impaired waters requiring restoration; Green rows = unimpaired waters requiring protection.

*Watershed District/Lake Association/Lake Improvement District/Watershed Management Organization

Table 28: Key for Strategies Column

Strategy	Description
Nonpoint Source	
Wetland Restoration (657)	The return of a wetland and its functions to a close approximation of its original condition as it existed prior to disturbance on a former or degraded wetland site.
Channel Bed Stabilization (584)	Used to stabilize the bed or bottom of a channel.
Filter Strip (393)	A strip or area of herbaceous vegetation that removes contaminants from overland flow.
Grade Stabilization Structure (410)	A structure used to control the grade and head cutting in a natural or artificial channel.
Bioretention (712M)	Capture and treatment of stormwater runoff through a series of layers in a created depression in the landscape – also called a rain garden.
Grassed Waterway (412)	A shaped or graded channel that is established with suitable vegetation to carry surface water at a non-erosive velocity to a stable outlet.
Water and Sediment Control Basin (638)	An earth embankment or a combination ridge and channel generally constructed across the slope and minor watercourses to for a sediment trap and water detention basin.
Streambank and Shoreline Protection (580)	Treatment used to stabilize and protect banks of streams or constructed channels and shorelines of lakes, reservoirs, or estuaries.
Residue Management (329/345)	Managing the amount, orientation, and distribution of crop and other plant residue on the soil surface year-round, while limiting the soil disturbing activities used to grow crops in systems where the entire field surface is tilled prior to planting.
Nutrient Management (590)	Managing the amount, source, placement, form and timing of the applications of plant nutrients and soil amendments.
Prescribed Grazing (528)	Managing the harvest of vegetation with grazing and/or browsing animals.
Lined Waterway and Outlet (438)	A waterway or outlet having an erosion-resistant lining or concrete, stone, synthetic turf reinforcement fabric, or other permanent material.
Ag Waste Facility (313)	A waste storage impoundment made by constructing an embankment and/or excavating a pit, or by fabricating a structure to temporarily store waste and contaminated runoff.
Soil Health Practices (327, 328, 340)	Soil health practices are a group of BMPs that improve viability, reduce soil erosion potential, increase production, and enhance wildlife habitat. Main practices include: Conservation Cover (327), Conservation Crop Rotation (328), and Cover Crop (340).
Drainage Water Management (554)	The process of managing water discharges from surface or subsurface agricultural drainage systems.
Structure for Water Control (587)	A structure in a water management system that conveys water, controls direction or rate, maintains a desired water surface elevation or measures water. This can include a bioreactor.
Irrigation Water Management (449)	The process of determining and controlling the volume, frequency and application rate of irrigation water in a planned, efficient manner.
Access Control (472)	The temporary or permanent exclusion of animals, people, vehicles and/or equipment of an area.
Point Source	
NPDES point source compliance	All NPDES-permitted sources shall comply with conditions of their permits, which are written to be consistent with any assigned wasteload allocations.
Watershed District stormwater rule compliance	

4. Monitoring Plan

Many organizations within the watershed do monitoring. Please refer to their websites for specific plans.

Stream Monitoring

Each stream reach within the Sunrise River Watershed has a different monitoring schedule depending on who monitors the site.

Many Sunrise River Watershed sites in Anoka, Chisago, Isanti, and Washington Counties have been monitored through the years. There is currently not a watershed wide stream monitoring program. The pour point site (AUID 07030005-543) for the Sunrise that is in Sunrise, MN is monitored every year by MPCA's Load Monitoring Program that is funded through the Clean Water Fund for a variety of parameters including: continuous flow, total suspended solids, total phosphorus, total Kjeldahl nitrogen, and nitrates.

If funding is available, the SWCDs will set up a monitoring program to monitor for nutrients, E. coli, and flow. Ideally, it would be a twice per month plus storm event program designed to take samples at many tributaries and branches of the Sunrise River. If funding is not available for new monitoring programs, the monitoring that is completed will be done following MPCA's 10-year monitoring cycle.

Currently, streams in the direct drainage to the St. Croix River area are not being monitored on a regular basis. Some of these streams have had some monitoring in the past, but no formal plans are in place to make permanent monitoring stations.

Table 29 - Ideal stream monitoring scenarios

Stream	Parameters	Frequency	Goal	Responsible Party
Sunrise River Main Stem	TP, TSS, N+N, E. coli, DO, Temp, Stage	Once monthly: April – October. Storm events when possible.	Minimum 3 locations along the river, more if possible	MPCA, SWCD, County
North Branch of the Sunrise River	TP, TSS, N+N, E. coli, DO, Temp, Stage	Once monthly: April – October. Storm events when possible.	Up to two locations. Keystone Ave., CR 13	MPCA, SWCD, County
West Branch of the Sunrise River	TP, TSS, N+N, DO, Temp, Stage	Once monthly: April – October. Storm events when possible.	One location, Lyon's St.	MPCA, SWCD, County
Bloomquist Creek (CLLID Outlet to Sunrise)	TP, TSS, N+N, Ammonia Nitrate, DO, Temp, Stage	Once monthly: April – October. Storm events when possible.	One location, Ivywood Trail	MPCA, SWCD, County
Lawrence Creek	TP, TSS, N+N, DO, Temp, Stage	Once monthly: April – October. Storm events when possible.	One location, Franconia Trail	MPCA, SWCD, County

Lake Monitoring

Linwood Lake has been monitored by volunteers and staff over the years. This monitoring is planned to continue approximately every third year to keep a record of the changing water quality. The Lake is generally monitored for chlorophyll-a, total phosphorus, and Secchi disk transparency.

Second Lake is within the CLFLWD, the District has planned to do some investigative monitoring of surface total phosphorus, chlorophyll-a, Secchi disk transparency, dissolved oxygen profile, sediment sampling, and biological data collection in 2020 and 2021. Information on monitoring schedules for other lakes within the CLFLWD can be found in the Comfort Lake Forest Lake Watershed District 2012 Comprehensive Monitoring Plan.

No monitoring plans exist for White Stone Lake or Vibo Lake. Lakeshore owners and volunteers will be encouraged to monitor through the MPCA Citizen Assisted Monitoring Program in the future or have lakes added to a County wide monitoring program to be set up in the future.

Chisago County currently monitors 10 lakes at 13 locations within the Sunrise River Watershed. These include: Chisago Lake (2 locations), Green Lake, Kroon Lake, Little Green Lake, Little Lake, North Center Lake (2 locations), North Lindstrom Lake, South Center Lake, South Lindstrom Lake, and Spider Lake (2 locations). These lakes are monitored for total phosphorus, chlorophyll-*a*, ammonia nitrogen, transparency, and temperature. These lakes are monitored once per month from May-September.

In Anoka County, monitoring is completed by a variety of groups. Island Lake is monitored annually by Anoka county Parks Department through MPCA's volunteers program. The Anoka Conservation District and Sunrise River Watershed Management Organization monitor Fawn, Typo, Martin, and Linwood Lake every third year, or after major water quality projects are completed. Coon Lake is monitored by the ACD and SRWMO every other year and the Coon Lake Improvement District monitors on the opposite years. All lakes are monitored every other week from May to September (ten times per year). Monitoring parameters include: total phosphorus, chlorophyll-*a*, pH, specific conductivity, turbidity, temperature, and dissolved oxygen. All of these locations are monitored at a depth of 1 meter.

No known monitoring locations or programs exist within the Isanti County portion of the Sunrise River Watershed.

The MN DNR will continue to conduct macrophyte and fish surveys as allowed by their regular schedule. Currently fish surveys are conducted every 5 years and macrophyte surveys are conducted as staffing and funding allow on a 10-year rotation, unless there are special situations – this mostly applies to Linwood Lake. The smaller lakes without public access are surveyed if the opportunity arises.

BMP Monitoring

On-site monitoring of implementation practices should also take place in order to better assess BMP effectiveness. A variety of criteria such as land use, soil type, and other watershed characteristics, as well as monitoring feasibility, will be used to determine which BMPs to monitor. Under these criteria, monitoring of a specific type of implementation practice can be accomplished at one site but can be applied to similar practices under similar criteria and scenarios. Effectiveness of other BMPs can be extrapolated based on monitoring results.

All BMP monitoring will be done in accordance with funding availability. Currently no BMP monitoring or monitoring programs are in place in Anoka, Chisago, or Isanti Counties. The Comfort Lake Forest Lake Watershed District is currently monitoring an Iron-Enhanced Sand Filter in the City of Forest Lake, MN. This monitoring will be conducted a minimum of 7 times following storm events each year from 2013 to 2015. Monitoring parameters include: total phosphorus, dissolved phosphorus, and total suspended solids.

BMP effectiveness monitoring is currently not being done widespread due to funding. There are not many funding opportunities to encourage this type of practice on the local level. It would be viewed as beneficial by the local implementers if the opportunity was available.

5. References and Further Information

Almendinger, J.E. and J. Ulrich. 2010. Constructing a SWAT model of the Sunrise River watershed, eastern Minnesota. St. Croix Watershed Research Station, Science Museum of Minnesota and Department of Bioproducts and Biosystems Engineering, University of Minnesota.

Sunrise River Watershed Reports

All Sunrise River Watershed reports referenced in this watershed report are available at the Lower St. Croix River Watershed webpage: http://www.pca.state.mn.us/lupgdd5

Appendix A – Assessment Status

Table 30. Assessment status of stream reaches in the Sunrise River watershed, presented (mostly) from headwaters to outlet

Subwatershed	AUID (Last 3 digits)	Stream	Reach Description	Aquatic Life Impairments						Aq Rec
				Fish	Invert	DO	TSS	pH	CLd	E. coli
Comfort Lake-Forest Lake	643	Unnamed creek	Shields Lk to Forest Lk	IF						IF
	525	Judicial Ditch 2	Headwaters to Sunrise R						NS	IF
	533	Unnamed ditch	Heims Lk to Sunrise R	NA						NA
	526	Sunrise River	Upstream from Comfort Lk	IF						NS
	641	Unnamed creek	Unnamed lk to Birch Lk	IF						NS
	521	Unnamed creek	Birch Lk to School Lk			NS				NS
	522	Unnamed creek	School Lk to Little Comfort Lk			NS				NS
	527	Sunrise River	Comfort Lk to Pool 1	NS	NS	NS				FS
South Branch Sunrise River	627	Unnamed creek	Headwaters to S Br Sunrise	NA						NA
	528	Sunrise River, S Br	02-0500-00 to Sunrise R			NS				FS
West Branch Sunrise River	711	County Ditch 16	Unnamed ditch to Rice Lk	NA						NA
	576	Boot Lake Inlet	Rice Lk to Boot Lk	NA						NA
	578	Island Lake Inlet	Linwood Lk to Island Lk	NA						NA
	579	Martin Lake Inlet	Island Lk to Martin Lk	NA						NA
	561	County Ditch 13	Headwaters to Typo Lk	IF						NA
	582	Unnamed ditch	Headwaters to W Br Sunrise	IF						NA
	581	Unnamed creek	Unnamed ditch to W Br	IF						NA
	583	Unnamed creek	Headwaters to Typo Lk	NA						NA
	580	Unnamed creek	Headwaters to W Br	NA						NA
	775	Judicial Ditch 2	Long Lk to W Br	NA						NA
	563	Sunrise River, West Branch	Typo Lk to Martin Lk				NS	NS		NA
	529	Sunrise River, West Branch	Martin Lk to Sunrise Pool 1	NS	NS		NS	NS		IF

Subwatershed	AUID (Last 3 digits)	Stream	Reach Description	Aquatic Life Impairments						Aq Rec
				Fish	Invert	DO	TSS	pH	CLd	E. coli
Chisago Chain of Lakes	723	Bloomquist Creek	T34 R21W S24, east line to Sunrise River	NS						IF
	722	Unnamed ditch	Wallmark Lk to T34 R20W S19, west line	NA						NA
	719	Unnamed creek	Headwaters to Little Lk	IF						NA
	721	Unnamed creek	Little Lk to North Center Lk	IF						NA
	572	Unnamed creek	Headwaters to S Center Lk	FS						NA
	715	Unnamed creek	Headwaters to unnamed cr	NA						NA
Carlos Avery	538	Sunrise River	Pool 1 to Pool 3	NA						NA
	630	County Ditch 10	Headwaters to unnamed cr	NA						NA
	708 709 710	County Ditch 5	Unnamed ditch to Sunrise R	NA						NA
	540	Sunrise River	Pool 3 to Kost Dam Reservoir	NS		NS				NA
North Branch Sunrise River	501	Sunrise River, North Branch	Headwaters to Sunrise R	NS						NS
	728	County Ditch 19	Unnamed ditch to N Br	NA						IF
	753	Unnamed creek	Headwaters to N Br	NA						IF
	556	Judicial Ditch 4	Unnamed cr to N Br	NA						IF
	707	Unnamed creek	Unnamed cr to N Br	NA						IF
	714	Hay Creek	Mud Lk to N Br Sunrise R	NA						IF
	514	County Ditch 7	Unnamed cr to N Br Sunrise	IF						IF
	569	Unnamed creek	Headwaters to N Br	IF						IF
	755	Unnamed creek	Unnamed ditch to N Br	NA						IF
Sunrise River, Main Branch	598	Unnamed creek	Unnamed cr to Vibo Lk	NA						NA
	571	Unnamed creek	Vibo Lk to Sunrise R	IF						NA
	596	Unnamed creek	Unnamed cr to unnamed cr	IF						NA
	542	Sunrise River	Kost Dam to N Br Sunrise R	FS						IF
	546	Beaver Cr (CD 3)	Unnamed ditch to Hay Cr	IF						NA
	592	Unnamed ditch	T35 R21W S12, west line to Beaver Cr (CD 3)	NA						NA
	771	Hay Creek	Headwaters to T35 R21W S12, east line	NA						NA
	770	Hay Creek	T35 R20W S7, west line to CD3	IF						NA

Subwatershed	AUID (Last 3 digits)	Stream	Reach Description	Aquatic Life Impairments						Aq Rec
				Fish	Invert	DO	TSS	pH	CLd	E. coli
	545	Hay Creek	CD 3 to Sunrise River	IF						NS
	543	Sunrise River	N Br Sunrise R to St Croix R	FS						NS
Direct Drainage to the St. Croix	570	Dry Creek	Unnamed Cr to St. Croix R			IF	FS	FS		IF
	574	Lawrence Creek	T33 R19W S3, north line to St Croix R	FS	FS	IF	FS	FS	FS	IF
	553	Unnamed Creek	Headwaters to Lawrence Cr				FS			NA

Table 31. Assessment status of lakes in the Sunrise River Watershed

Presented by subwatershed (mostly) from headwaters to outlet, and in order of increasing lake surface area within each subwatershed.

Subwatershed	Lake ID	Lake Name	Acres	AQR
Comfort Lake - Forest Lake	13-0018-00	Pine	45	NA
	13-0023-00	Moody	46	NS
	82-0162-00	Shields	32	NS
	13-0042-00	Birch	33	IF
	13-0054-00	Little Comfort	35	IF
	13-0057-00	School	47	NS
	13-0048-00	White Stone	49	NS
	13-0024-00	Third	62	FS
	82-0053-00	Sea	62	IF
	13-0025-00	Second	86	NS
	13-0056-00	Heims	88	IF
	82-0080-00	Sylvan/Halfbreed	97	FS
	02-0002-00	Higgins	110	NA
	82-0056-00	German	143	FS
	13-0053-00	Comfort	216	IF
	82-0054-00	Bone	222	NS
	82-0159-00	Forest	2,313	FS
South Branch Sunrise River	02-0511-03	Avery Pond	6	NA
	02-0033-00	West Twin	22	NA
	02-0048-00	South Coon	56	IF
	02-0063-00	Anderson	89	NA
	02-0058-00	Devil	106	NA
	02-0020-00	East Twin	201	NA
	02-0062-00	Goose	227	NA
	02-0032-00	Little Coon	564	NA
	02-0042-00	Coon	1,983	FS
West Branch Sunrise River	30-0004-00	Twin	57	NA
	02-0035-00	Fawn	58	FS
	30-0007-00	Lower Birch	84	NA
	02-0022-00	Island	99	FS
	30-0005-00	Upper Birch	106	NA
	02-0021-00	Tamarack	121	NA
	30-0001-00	Tamarack	140	NA
	30-0008-00	Hoffman	179	NA
	02-0028-00	Boot	184	NA
	30-0002-00	Long	213	NA
	02-004300	Rice	255	NA
	02-0034-00	Martin	264	NS

AQR = aquatic recreation impairment due to excess nutrients/eutrophication.
NS = not supporting (red),
IF = insufficient information to assess (yellow),
FS = fully supporting (blue)
NA = not assessed (white).

Subwatershed	Lake ID	Lake Name	Acres	AQR
	30-0009-00	Typo	320	NS
	02-0065-00	Fish	541	NA
	02-0026-00	Linwood	596	NS
Chisago Chain of Lakes	13-0032-02	North Center Pond	8	IF
	13-0046-00	Emily	19	NS
	13-0047-00	Ellen	27	IF
	13-0043-00	Mattson	68	IF
	13-0011-00	Ogrens	74	NS
	13-0034-00	Pioneer	77	NS
	13-0035-00	North Lindstrom	148	FS
	13-0029-00	Wallmark	149	NS
	13-0014-00	Linn	178	NS
	13-0033-00	Little	178	NS
	13-0019-00	Spider	195	FS
	13-0044-00	School	196	NS
	13-0013-00	Kroon	198	IF
	13-0041-01	Little Green	232	FS
	13-0028-00	South Lindstrom	505	FS
	13-0012-01	North Chisago	544	FS
	13-0012-02	South Chisago	595	FS
	13-0032-01	North Center	807	NS
	13-0027-00	South Center	998	NS
	13-0041-02	Green	1,688	FS
Carlos Avery	13-0059-02	Mud Lake	431	IF
	13-0031-00	Sunrise	822	IF
	13-0059-03	North Sunrise Pool	958	NA
	13-0059-01	South Sunrise Pool	1,048	NA
North Branch Sunrise River	30-0041-00	Splittstoeser	31	NA
	13-0066-00	Mud	70	IF
	30-0017-00	Grass	83	NA
	30-0012-00	Horseleg	85	NA
	30-0003-00	Horseshoe	108	NA
	30-0015-00	Big Pine	110	NA
	13-0063-01	Chain (North Portion)	113	NA
	13-0063-02	Chain (South Portion)	122	NA
Sunrise River, Main Branch	13-0030-00	Vibo	59	NS
Direct Drainage to St. Croix	13-0005-00	Duck	56	FS