St. Louis River Watershed Restoration and Protection Strategy Report

MINNESOTA POLLUTION CONTROL AGENCY

TETRA TECH

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Key Terms

Assessment Unit Identifier (AUID): The unique waterbody identifier for each river reach comprised of the USGS eight-digit 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 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.

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 Lake Superior Basin is assigned a HUC-4 of 0401 and the St. Louis River Watershed is assigned a HUC-8 of 04010201.

Impairment: Waterbodies 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 numeric 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.

Executive Summary

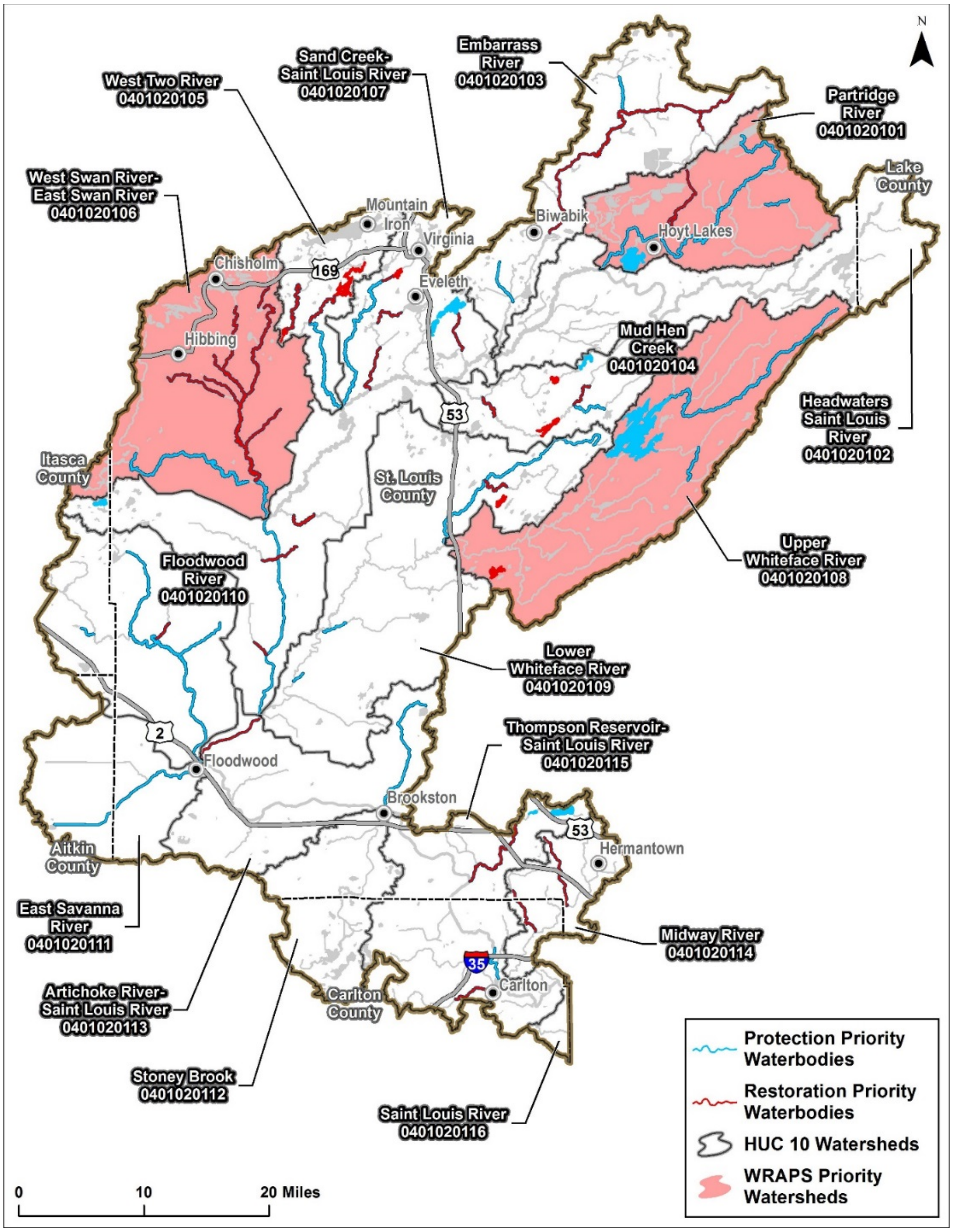
The St. Louis River Watershed (SLRW) is located in northeastern Minnesota, in the Lake Superior Basin and in the Northern Lakes and Forests ecoregion. The watershed covers portions of St. Louis, Carlton, Pine, Aitkin, and Itasca counties. This report addresses the portion of the watershed in Minnesota upstream of the Fond du Lac dam. The urban streams below the Fond du Lac dam in the urbanized Duluth area are being addressed as part of a separate effort, as is the Cloquet River Watershed. The Fond du Lac Band of Lake Superior Chippewa has federal Clean Water Act jurisdiction for waters of the reservation, which is located in the downstream portion of the SLRW. The Fond du Lac Band has established water quality standards for its waters, and implements a water quality monitoring, assessment, protection, and restoration program on the reservation. Waterbodies within the Fond du Lac Band are not addressed in this Watershed Restoration and Protection Strategy (WRAPS) report.

The dominant land cover in the SLRW is forest and shrub, followed by wetlands. Pastureland, developed land, open water, and barren land each make up less than 5% of the watershed as a whole. Much of the watershed is undeveloped, but the watershed does contain multiple cities, including numerous small cities in the Mesabi Iron Range.

Stream biology, water chemistry, and flow monitoring data collection for the WRAPS effort began in the watershed in 2009. This WRAPS report summarizes those data and culminates in a table of implementation strategies designed to help restore areas where pollutants violate standards, and/or help protect areas that currently meet water quality standards. Of the 75 streams and 25 lakes evaluated, 32 streams and 7 lakes do not meet water quality standards for sediment, bacteria (*Escherichia coli*, or *E. coli*), nutrient levels, dissolved oxygen (DO), and/or fish and invertebrate assemblages. They are the focus of restoration activities. 43 streams and 18 lakes meet all criteria for healthy conditions and are the focus of protection efforts. Priorities for protection are based on identifying waters that are particularly threatened or vulnerable.

High concentrations of phosphorus, sediment, and *E. coli* have been found in the Swan River Watershed, which has a history of disturbance from mining and from development of cities along the Iron Range. Sediment concentrations outside of the Swan River Subwatershed are typically low, owing to the flat, wetland-dominated nature of many parts of the watershed. Many stressors influence the biological assemblages in the impaired streams, including sediment, DO, habitat, altered hydrology, temperature, and nitrate toxicity. Other potential stressors include ammonia and sulfate toxicity, iron precipitate, and specific conductance.

Three priority subwatersheds for strategy implementation over the next 10 years were selected by members of the SLRW Core Team, a group of primarily municipal, county, state, and federal natural resource staff. The Swan River Subwatershed is a priority for restoration activities, the Upper Whiteface River Subwatershed is a priority for protection activities, and the Partridge River Subwatershed is identified as a priority for both restoration and protection activities. The individual waterbodies that were identified as priorities for restoration or protection that are located in any of these three priority subwatersheds are designated as those waters where strategies outlined in this report will be focused over the next 10 years (see map below).



Priority watersheds for protection and restoration activities.

The Minnesota Pollution Control Agency (MPCA) and the members of the Core Team recommend a number of actions to restore and protect waterbodies in the watershed. The recommended strategies address in-stream improvements; private wastewater systems; in-lake improvements; wetland, agriculture, forestry, and stormwater management; point sources; monitoring and research; planning and ordinances; and education.

What is the Watershed Restoration and Protection Strategy (WRAPS) Report?

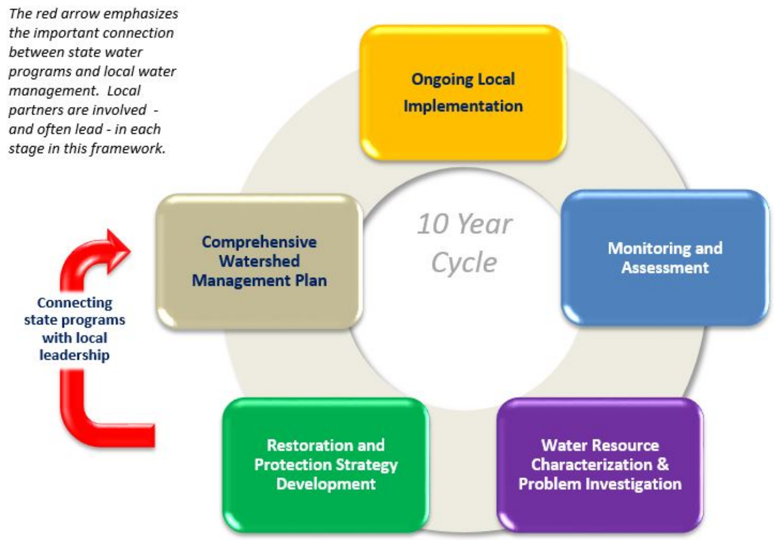


Figure 1. Minnesota's watershed approach.

Minnesota has adopted a watershed approach to address the state's 80 major watersheds (denoted by 8-digit hydrologic unit code or HUC). The Minnesota 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 (Figure 1).

Along with the watershed approach, the Minnesota Pollution Control Agency (MPCA) developed a process to identify and address threats to water quality in each of these major watersheds. This process is called Watershed Restoration and Protection Strategy (WRAPS) development. WRAPS reports have two parts: impaired waters have strategies for restoration, and waters that are not impaired have strategies for protection. Waters not meeting state standards are listed as impaired and Total Maximum Daily Load (TMDL) studies are performed for them, as they have been in the past, and are incorporated into WRAPS.

In addition, the watershed approach process facilitates a more cost-effective and comprehensive characterization of multiple water bodies and overall watershed health, including both protection and restoration efforts. A key aspect of this effort is to develop and utilize watershed-scale models and other tools to identify strategies and actions for point and nonpoint source pollution that will cumulatively achieve water quality targets. For nonpoint source pollution, this report informs local planning efforts, but ultimately the local partners decide what work will be included in their local plans. This report also serves to at least partially address the U.S. Environmental Protection Agency's (EPA's) Nine Minimum Elements of water planning, helping to qualify applicants for eligibility for Clean Water Act Section 319 implementation funds.

Purpose	• Support local working groups and jointly develop scientifically-supported restoration and protection strategies to be used for subsequent implementation planning
	• Summarize Watershed Approach work done to date including the following reports:
	    • *St. Louis River Watershed Monitoring and Assessment Report*
	    • *St. Louis River Watershed Biotic Stressor ID Report*
	    • *St. Louis River Watershed Total Maximum Daily Load*

Scope	• Impacts to aquatic recreation and impacts to aquatic life in streams • Impacts to aquatic recreation in lakes
Audience	• Local working groups (local governments, SWCDs, watershed management groups, etc.) • State agencies (MPCA, DNR, BWSR, etc.)

1. Watershed Background & Description

The St. Louis River Watershed (SLRW) is in northeastern Minnesota (Figure 2) in the Lake Superior Basin, and in the Northern Lakes and Forests ecoregion. The watershed is 2,926 square miles and covers portions of St. Louis, Carlton, Pine, Aitkin, and Itasca counties. The Fond du Lac Band of Lake Superior Chippewa has federal Clean Water Act jurisdiction for waters of the reservation, which is located in the downstream portion of the SLRW, adjacent to the Wisconsin border, and is active in watershed management and water quality restoration in the area. The Fond du Lac Band has established water quality standards for its waters, and implements a water quality monitoring, assessment, protection, and restoration program on the reservation. Waterbodies under jurisdiction of the Fond du Lac Band (Figure 3) are not addressed in this WRAPS report[1]. In this report, "St. Louis River Watershed" and "SLRW" refers to the portion of the

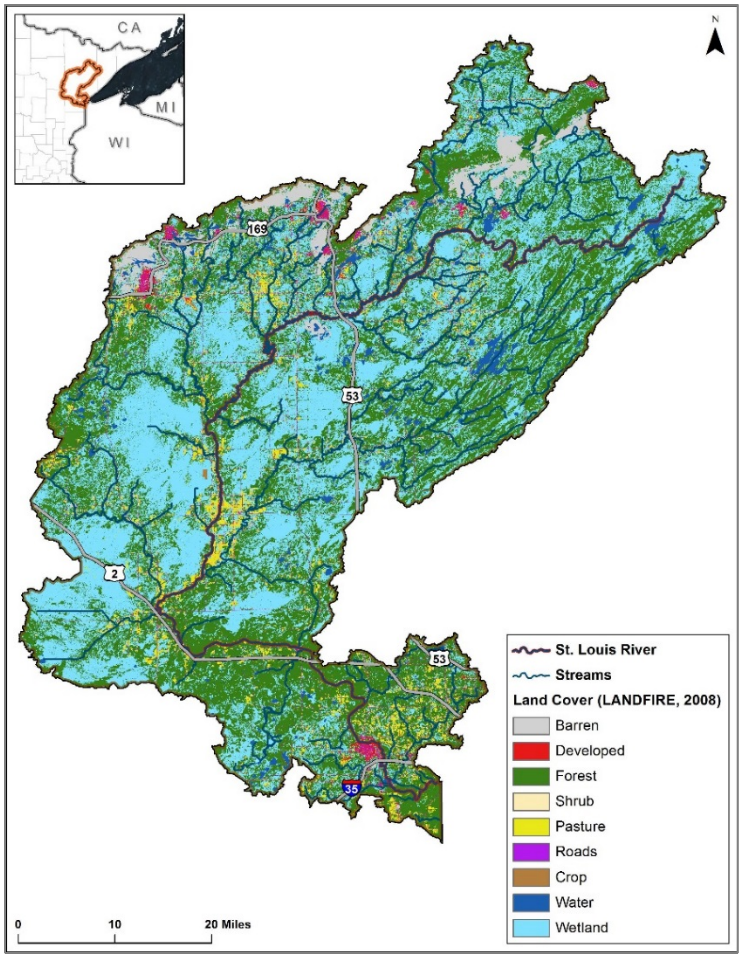


Figure 2. St. Louis River Watershed land cover.

[1] For more information please see the following websites:

- Fond du Lac Band of Lake Superior Chippewa Resource Management, Water Quality: http://www.fdlrez.com/RM/waterquality.htm
- Water Quality Standards Regulations, EPA: https://www.epa.gov/wqs-tech/water-quality-standards-regulations-fond-du-lac-band-minnesota-chippewa-tribe
- The Fond du Lac Band of the Minnesota Chippewa Tribe Water Quality Standards https://www.epa.gov/sites/production/files/2014-12/documents/chippewa-tribe.pdf

watershed in Minnesota upstream of the Fond du Lac dam (Figure 4). The urban streams below the Fond du Lac dam in the urbanized Duluth area are being addressed as part of a separate effort (labeled as Duluth WRAPS in Figure 4), as is the Cloquet River Watershed. The estuary and surrounding areas in the Duluth region are designated as a Great Lakes Area of Concern, and pollution remediation efforts are actively underway under the Great Lakes Restoration Initiative.

The dominant land cover in the SLRW is forest and shrub, followed by wetlands (Figure 2). Pastureland, developed land, open water, and barren land each make up less than 5% of the watershed as a whole. Much of the watershed is undeveloped but the watershed does contain multiple cities, including numerous small cities in the Mesabi Iron Range.

Additional St. Louis River Watershed Resources

USDA Natural Resources Conservation Service (NRCS) Rapid Watershed Assessment for the St. Louis River Watershed: http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_021795.pdf

Minnesota Department of Natural Resources (DNR) Watershed Assessment Mapbook for the St. Louis River Watershed: http://files.dnr.state.mn.us/natural_resources/water/watersheds/tool/watersheds/wsmb3.pdf

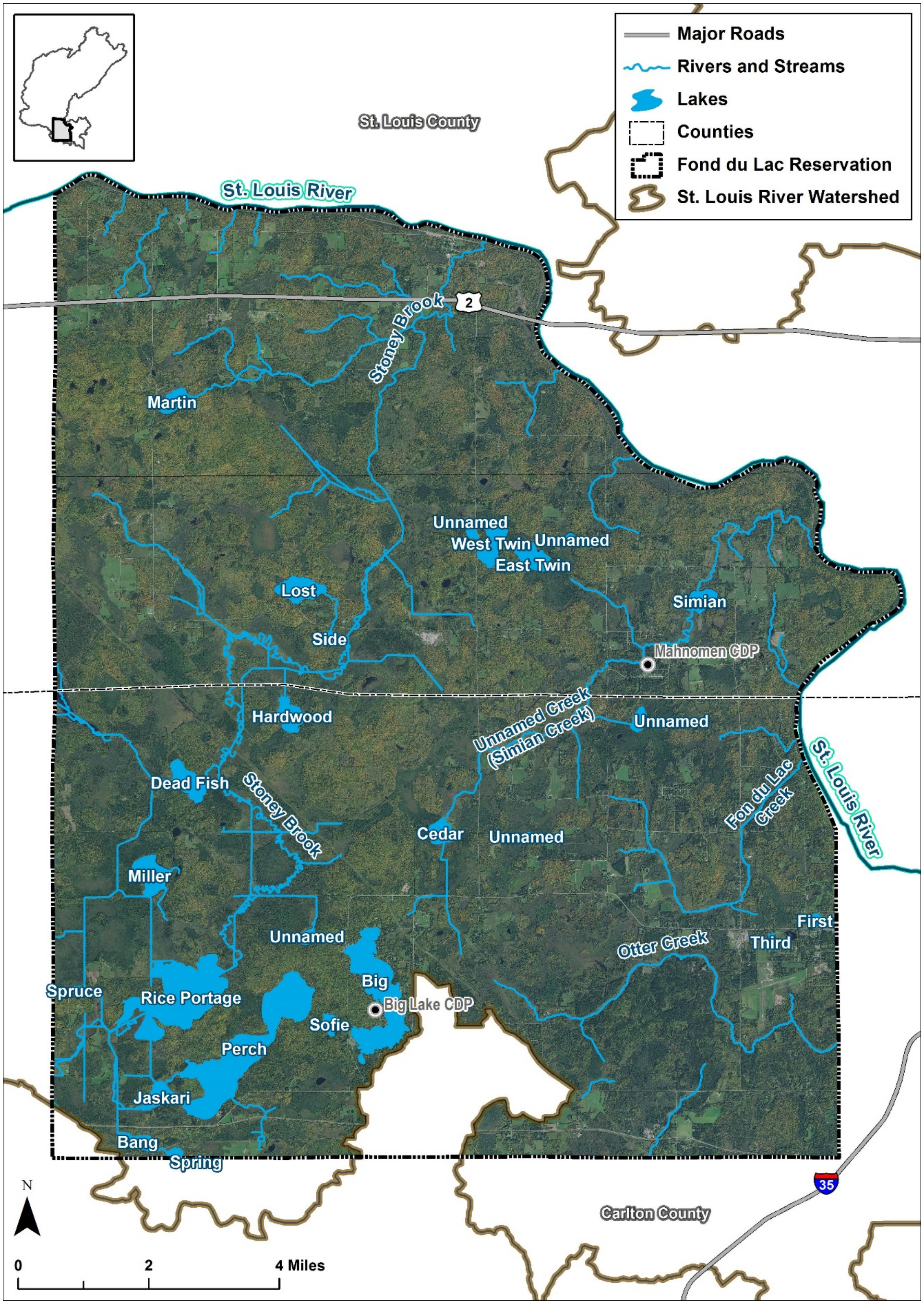


Figure 3. Waters in the Fond du Lac Band of Lake Superior Chippewa Reservation

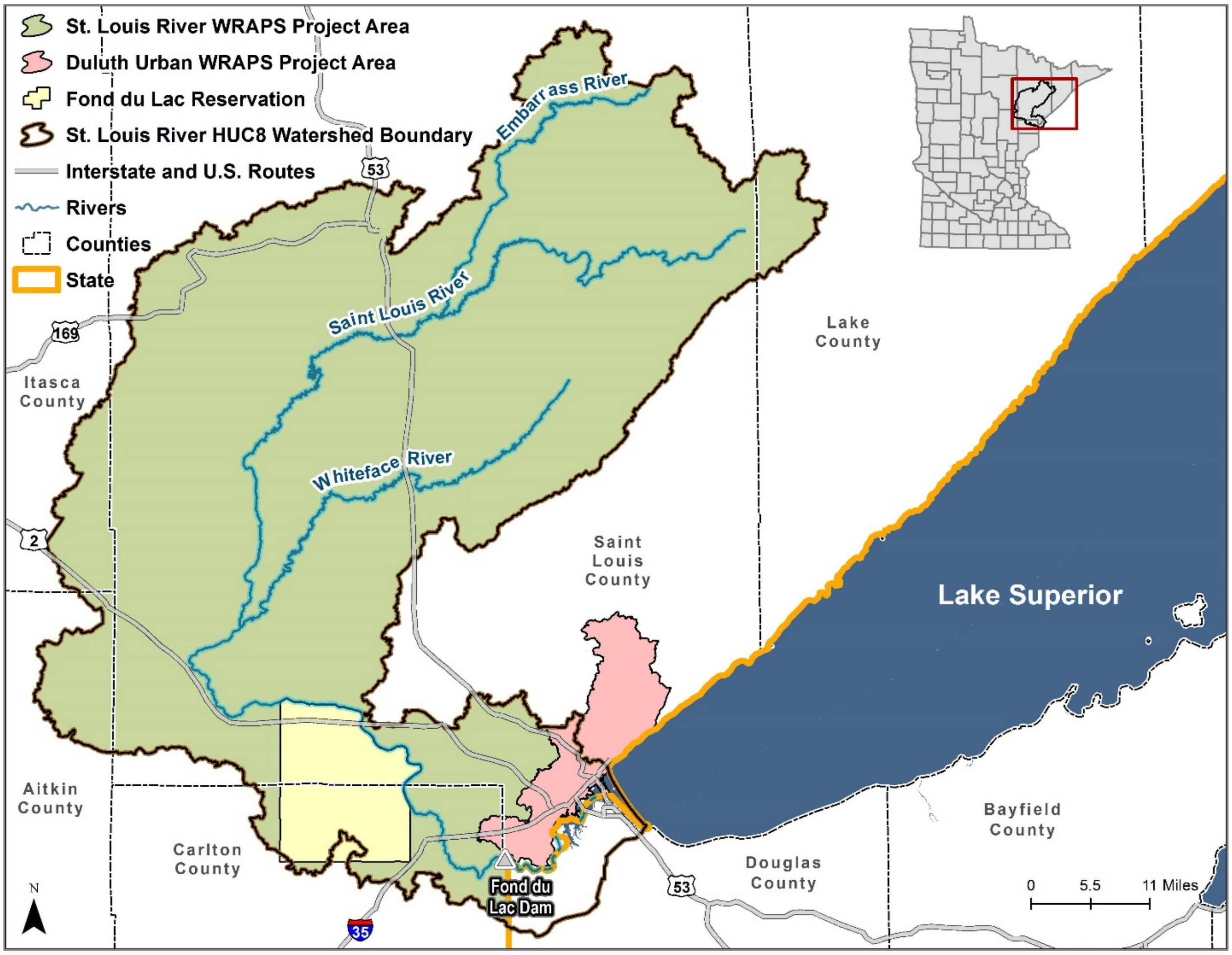


Figure 4. SLRW WRAPS project area.

2. Watershed Conditions

The SLRW is one of the largest watersheds in northern Minnesota, and the largest single contributing watershed to Lake Superior. Large areas of forest and wetlands that still exist help to sustain areas of exceptional water quality. However, historic and current land use changes throughout the watershed have degraded many lakes, rivers, and streams. Mining of iron ore in the Iron Range has dramatically altered natural hydrology (surface and subsurface) in the area, most significantly in several of the headwater watersheds.

The St. Louis River drops 1,067 feet from its highest elevation of 1,669 feet at Seven Beaver Lake (at the St. Louis County–Lake County border) to 602 feet at Lake Superior. Eighty-three percent of the river's total drop occurs along 30% of its course—within the upper section from Seven Beaver Lake to the Partridge River and from the city of Cloquet to the Fond du Lac Reservoir. In contrast to the high slope areas, the wetland dominated portions of the watershed are extremely flat.

2.1 Condition Status

The MPCA assesses the water quality of streams and lakes based on each waterbody's ability to support aquatic life (e.g., fish and macroinvertebrates) and aquatic recreation (e.g., fishing and swimming). Data from the waterbodies are compared to state standards and targets. Waterbodies that meet the targets are considered to be unimpaired and are the focus of protection efforts; waterbodies that do not meet at least one target are considered to be impaired and are the focus of restoration efforts. Waters that are not yet assessed continue through a process of data collection and evaluation and can be candidates for protection work.

Some of the waterbodies in the SLRW are impaired due to mercury; however, this report does not cover toxic pollutants. For more information on mercury impairments see the statewide mercury TMDL, which partially addresses the waterbodies in the SLRW that have aquatic consumption impairments due to high levels of mercury. For about 10% of Minnesota lakes and streams (including those in the SLRW), the 93% reduction defined in the statewide mercury TMDL will not result in water quality standards being fully achieved (i.e. mercury levels in fish will decrease for those waters, but not all the way below the water quality standard). The MPCA has been working with researchers and partners to figure out what are the key drivers of the higher mercury levels in fish in those 10% of waters, and what can be done about those higher levels. This information will help inform the next steps, such as the possibility of additional TMDLs, for the SLRW and other lakes and streams that are not anticipated to be fully restored by meeting the statewide mercury TMDL.

Streams

Seventy-five stream assessment units in the SLRW were assessed by the MPCA to identify impaired waters and waters in need of protection. Waters that do not meet targets for fish assemblage, macroinvertebrate assemblage, DO, turbidity, chloride, pH, or ammonia are considered to not meet the aquatic life beneficial use. Waters that do not meet the targets for fecal indicator bacteria do not meet the aquatic recreation beneficial use; levels of the bacteria *Escherichia coli* (*E. coli*) are used to approximate the amount of fecal contamination in surface waters. Waters that meet water quality standards and provide beneficial uses will be the focus of protection efforts. Of the assessed stream segments, 32 are the focus of restoration efforts (Figure 5) and 43 are the focus of protection efforts (Table 1).

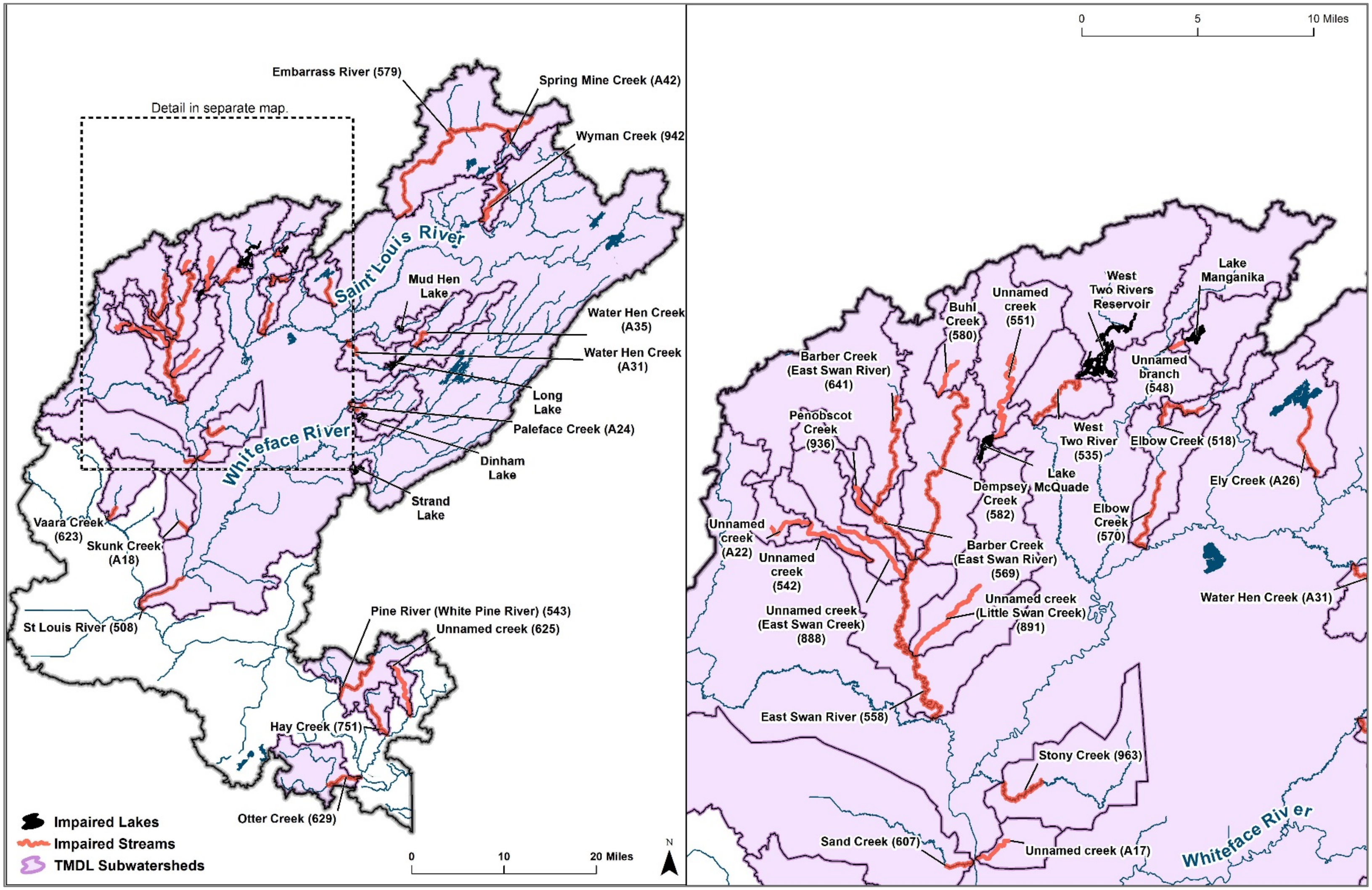


Figure 5. St. Louis River Watershed impairments.

Table 1. Assessment status of stream reaches in the SLRW

HUC-10 Subwatershed	AUID (Last 3 digits)	Stream	Reach Description	Aquatic Life								Aquatic Recreation
				Fish Index of Biotic Integrity	Macroinvertebrate Index of Biotic	Dissolved Oxygen	Turbidity/Total Suspended Solids	Chloride	pH	NH_3	Pesticides	Bacteria (*E. coli*)
Partridge River (401020101)	552	Partridge River	Headwaters to St. Louis River	Sup	Sup	Sup	Sup	Sup	Sup	Sup	NA	Sup
	587	Unnamed Creek	Unnamed Creek to Unnamed Creek	Sup	Sup	NA	NA	NA	NA	Sup	NA	IF
	942	Wyman Creek	Headwaters to Colby Lake	Imp	Sup	NA	NA	NA	NA	NA	NA	NA
	946	Colvin Creek	Cranberry Creek to Partridge River	Sup	Sup	NA	NA	NA	NA	NA	NA	NA
Headwaters St. Louis River (401020102)	526	St. Louis River	Partridge River to Embarrass River	Sup	Sup	NA	NA	NA	NA	NA	NA	NA
	644	St. Louis River	T58 R13WS35, east line to Partridge River	Sup	Sup	NA	NA	NA	NA	NA	NA	NA
Embarrass River (401020103)	577	Embarrass River	Embarrass Lake to St. Louis River	Sup	Sup	NA	Sup	Sup	NA	Sup	NA	Sup
	579	Embarrass River	Headwaters to Embarrass Lake	Imp	Sup	NA	Sup	NA	NA	NA	NA	NA
	583	Unnamed Creek	Headwaters to Embarrass River	Sup	Sup	NA	NA	NA	NA	NA	NA	NA

HUC-10 Subwatershed	AUID (Last 3 digits)	Stream	Reach Description	Aquatic Life								Aquatic Recreation
				Fish Index of Biotic Integrity	Macroinvertebrate Index of Biotic	Dissolved Oxygen	Turbidity/Total Suspended Solids	Chloride	pH	NH_3	Pesticides	Bacteria (*E. coli*)
	A40	Bear Creek	Unnamed Creek to Embarrass River	Sup	Sup	NA	NA	NA	NA	NA	NA	NA
	A42	Spring Mine Creek	Ridge Creek to Embarrass River	Imp	Imp	NA	NA	NA	NA	NA	NA	NA
Mud Hen Creek (401020104)	A28	Mud Hen Creek	Unnamed Creek to St. Louis River	Sup	Sup	Sup	Sup	Sup	Sup	Sup	NA	IF
	A30	Mud Hen Creek	Unnamed Creek to Water Hen Creek	Sup	Sup	NA	NA	NA	NA	NA	NA	NA
	A31	Water Hen Creek	Unnamed Creek to Mud Hen Creek	Sup	Imp	NA	NA	NA	NA	NA	NA	NA
	A35	Water Hen Creek	Unnamed Creek to South Branch Water Hen Creek	Sup	Imp	NA	NA	NA	NA	NA	NA	NA
	A36	Water Hen Creek, South Branch	Unnamed Creek to Water Hen Creek	Sup	Sup	NA	NA	NA	NA	NA	NA	NA
West Two River (401020105)	534	West Two River	McQuade Lake outlet to St. Louis River	Sup	Sup	Sup	Sup	Sup	IF	Sup	NA	Sup
	535	West Two River	West Two River Reservoir to McQuade Lake outlet	Sup	Imp	NA	NA	NA	NA	NA	NA	NA

HUC-10 Subwatershed	AUID (Last 3 digits)	Stream	Reach Description	Aquatic Life								Aquatic Recreation
				Fish Index of Biotic Integrity	Macroinvertebrate Index of Biotic	Dissolved Oxygen	Turbidity/Total Suspended Solids	Chloride	pH	NH_3	Pesticides	Bacteria (*E. coli*)
	551	Unnamed Creek	Unnamed Creek to McQuade Lake	Sup	Imp	NA	NA	NA	NA	NA	NA	NA
West Swan River–East Swan River (401020106)	542	Unnamed Creek	Unnamed Creek to T56 R20WS9, east line	Sup	Sup	Sup	Sup	NA	Sup	NA	NA	Imp
	557	Swan River	Confluence of East and West Swan River to St. Louis River	– [a]	Sup	NA	Sup	Sup	Sup	Sup	NA	Sup
	558	East Swan River	Barber Creek to Swan River	NA	NA	NA	Imp	Sup	NA	NA	NA	NA
	559	West Swan River	T55 R21WS4, north line to T55 R20WS14, east line	Sup	Sup	Sup	Sup	Sup	Sup	Sup	NA	Sup
	569	Barber Creek (East Swan River)	T57 R20WS28, east line to Dempsey Creek	Sup	Sup	Sup	Sup	Sup	Sup	Sup	NA	Imp
	580	Buhl Creek	T58 R19WS30, east line to Six Mile Lake	NA	NA	NA	NA	NA	NA	NA	NA	Imp
	582	Dempsey Creek	Six Mile Lake to T56 R20WS12, west line	Sup	Sup	Sup	Sup	Sup	Sup	Sup	NA	Imp
	641	Barber Creek (East Swan River)	T57 R20WS2, north line to T57 R20WS27, west line	Sup	Sup	Imp	Sup	NA	Sup	Sup	NA	Imp

HUC-10 Subwatershed	AUID (Last 3 digits)	Stream	Reach Description	Aquatic Life								Aquatic Recreation
				Fish Index of Biotic Integrity	Macroinvertebrate Index of Biotic	Dissolved Oxygen	Turbidity/Total Suspended Solids	Chloride	pH	NH_3	Pesticides	Bacteria (*E. coli*)
	888	Unnamed Creek (East Swan Creek)	T56 R20WS5, north line to East Swan River	Sup	Imp	Sup	Sup	Sup	Sup	Sup	NA	Imp
	891	Unnamed Creek (Little Swan Creek)	Headwaters to East Swan River	Imp	NA	NA	NA	NA	NA	NA	NA	Sup
	936	Penobscot Creek	T57 R20WS28, north line to East Swan River	NA	NA	Sup	IF	NA	Sup	Sup	NA	Imp
	A22	Unnamed Creek	Unnamed Creek to Unnamed Creek	NA	NA	NA	NA	NA	NA	NA	NA	Imp
	A23	Unnamed Creek	Headwaters to Barber Creek	NA	NA	NA	NA	NA	NA	NA	NA	Sup
Sand Creek– St. Louis River (401020107)	510	St. Louis River	West Two River to Swan River	Sup	Sup	NA	Sup	NA	NA	NA	NA	NA
	511	St. Louis River	Embarrass River to East Two River	Sup	Sup	IF	Sup	Sup	Sup	Sup	NA	Sup
	518	Elbow Creek	T57 R18WS12, north line to Elbow Lake	Imp	Imp	NA	NA	NA	NA	Sup	NA	IF
	525	St. Louis River	Swan River to Whiteface River	Sup	Sup	NA	NA	NA	NA	Sup	NA	IF

HUC-10 Subwatershed	AUID (Last 3 digits)	Stream	Reach Description	Aquatic Life								Aquatic Recreation
				Fish Index of Biotic Integrity	Macroinvertebrate Index of Biotic	Dissolved Oxygen	Turbidity/Total Suspended Solids	Chloride	pH	NH_3	Pesticides	Bacteria (*E. coli*)
	548	Unnamed Branch	Manganika Lake to East Two River	Imp	Imp	NA	NA	NA	NA	NA	NA	NA
	555	East Two River	Unnamed Branch to St. Louis River	Sup	Sup	NA	NA	NA	NA	NA	NA	NA
	570	Elbow Creek	Unnamed Ditch to St. Louis River	Sup	Imp	NA	NA	NA	NA	NA	NA	NA
	607	Sand Creek	Unnamed Creek to St. Louis River	Imp	Sup	NA	NA	NA	NA	NA	NA	NA
	963	Stony Creek	Unnamed Creek to Unnamed Creek	Imp	Imp	NA	NA	NA	NA	NA	NA	NA
	A17	Unnamed Creek	Unnamed Ditch to St. Louis River	Sup	Imp	NA	NA	NA	NA	NA	NA	NA
	A18	Skunk Creek	Unnamed Creek to St. Louis River	Imp	Imp	NA	NA	NA	NA	NA	NA	NA
	A26	Ely Creek	Headwaters (Ely 69-0660-00) to Unnamed Creek	Imp	Sup	NA	NA	NA	NA	Sup	Sup	IF
Upper Whiteface River (401020108)	528	Whiteface River	Bug Creek to Paleface River	Sup	Sup	NA	Sup	Sup	NA	Sup	NA	Sup
	529	Whiteface River	Whiteface Reservoir to Bug Creek	Sup	Sup	NA	Sup	Sup	Sup	Sup	NA	Sup

HUC-10 Subwatershed	AUID (Last 3 digits)	Stream	Reach Description	Aquatic Life								Aquatic Recreation
				Fish Index of Biotic Integrity	Macroinvertebrate Index of Biotic	Dissolved Oxygen	Turbidity/Total Suspended Solids	Chloride	pH	NH_3	Pesticides	Bacteria (*E. coli*)
	545	Bug Creek	Headwaters to Whiteface River	Sup	Sup	NA	NA	NA	NA	Sup	NA	IF
	549	Whiteface River, North Branch	Headwaters to Whiteface Reservoir	Sup	Sup	NA	NA	NA	NA	NA	NA	NA
	600	Whiteface River, South Branch	Unnamed Creek to Unnamed Creek	Sup	Sup	NA	NA	NA	NA	Sup	NA	NA
	766	Whiteface River, South Branch	Ryan Creek to Unnamed Creek	Sup	Sup	NA	NA	NA	NA	Sup	NA	NA
	A37	Shiver Creek	Headwaters to Little Shiver Creek	Sup	Sup	NA	NA	NA	NA	NA	NA	NA
Lower Whiteface River (401020109)	509	Whiteface River	Paleface River to St. Louis River	Sup	Sup	NA	Sup	Sup	Sup	Sup	NA	Sup
	550	Paleface River	Headwaters to Whiteface River	Sup	Sup	IF	Sup	Sup	Sup	Sup	NA	IF
	617	Spider Creek (Spider Muskrat Creek)	Unnamed Creek to Whiteface River	Sup	Sup	NA	NA	NA	NA	NA	NA	NA
	959	Unnamed Creek (Otter Creek)	Unnamed Creek to Whiteface River	Sup	Sup	NA	NA	NA	NA	NA	NA	NA

HUC-10 Subwatershed	AUID (Last 3 digits)	Stream	Reach Description	Aquatic Life								Aquatic Recreation
				Fish Index of Biotic Integrity	Macroinvertebrate Index of Biotic	Dissolved Oxygen	Turbidity/Total Suspended Solids	Chloride	pH	NH_3	Pesticides	Bacteria (*E. coli*)
	A24	Paleface Creek	Unnamed Creek to Paleface River	Imp	Imp	NA	NA	NA	NA	NA	NA	NA
Floodwood River (401020110)	560	Floodwood River	Headwaters (Floodwood Lake 69-0884-00) to St. Louis River	Sup	Sup	Sup	Sup	Sup	Sup	Sup	NA	IF
	623	Vaara Creek	Unnamed Creek to Floodwood River	Imp	Imp	NA	NA	NA	NA	NA	NA	NA
	A11	Unnamed Creek	Unnamed Lake (31-1035-00) to W Branch Floodwood River	Sup	Sup	NA	NA	NA	NA	NA	NA	NA
	A16	Joula Creek	Headwaters to Floodwood River	Sup	Sup	NA	NA	NA	NA	NA	NA	NA
East Savanna River (401020111)	561	East Savanna River	Headwaters (Wolf Lake 01-0019-00) to St. Louis River	NA	NA	IF	Sup	Sup	Sup	Sup	NA	Sup
Artichoke River–St. Louis River (401020113)	506	St. Louis River	East Savannah River to Artichoke River	Sup	NA	NA	NA	Sup	NA	NA	NA	NA
	508	St. Louis River	Whiteface River to Floodwood River	Sup	Imp	NA	Sup	Sup	NA	Sup	NA	Sup
	544	Artichoke River	Headwaters (Artichoke Lake 69-0623-00) to St. Louis River	Sup	Sup	NA	Sup	NA	NA	NA	NA	IF

HUC-10 Subwatershed	AUID (Last 3 digits)	Stream	Reach Description	Aquatic Life								Aquatic Recreation
				Fish Index of Biotic Integrity	Macroinvertebrate Index of Biotic	Dissolved Oxygen	Turbidity/Total Suspended Solids	Chloride	pH	NH_3	Pesticides	Bacteria (*E. coli*)
	A08	McCarty River	Unnamed Ditch to St. Louis River	Sup	Sup	NA	NA	NA	NA	NA	NA	NA
Midway River (401020114)	625	Unnamed Creek	T50 R16WS11, north line to Midway River	Sup	Sup	Sup	IF	NA	Sup	NA	NA	Imp
	636	Midway River	T49 R16WS28, north line to St. Louis River (Thomson Res)	Sup	Sup	Sup	Sup	Sup	Sup	NA	NA	IF
	751	Hay Creek	Unnamed Creek to Midway River	Sup	Sup	NA	NA	NA	NA	NA	NA	Imp
Thompson Reservoir–St. Louis River (401020115)	503	St. Louis River	Cloquet River to Pine River	Sup	NA	Sup	IF	Sup	Sup	Sup	NA	Sup
	515	St. Louis River	Scanlon Dam to Thomson Reservoir	Sup	Sup	Sup	Sup	Sup	Sup	Sup	NA	Sup
	543	Pine River (White Pine River)	T50 R16WS4, north line to St. Louis River	Sup	Sup	Sup	Sup	Sup	Sup	Sup	NA	Imp
	566	Silver Creek	Headwaters to St. Louis River	NA	NA	NA	NA	NA	NA	Sup	NA	Sup
	629	Otter Creek	Little Otter Creek to T48 R16WS7, east line	Sup	Imp	NA	NA	NA	NA	NA	NA	IF

HUC-10 Subwatershed	AUID (Last 3 digits)	Stream	Reach Description	Aquatic Life								Aquatic Recreation
				Fish Index of Biotic Integrity	Macroinvertebrate Index of Biotic	Dissolved Oxygen	Turbidity/Total Suspended Solids	Chloride	pH	NH_3	Pesticides	Bacteria (*E. coli*)
	737	Dutch Slough (Dutchess Slough Creek)	Unnamed Creek to Pine River	Sup	NA	NA	NA	NA	NA	NA	NA	NA

Sup = found to meet the water quality standard, Imp = does not meet the water quality standard and therefore, is impaired, IF = the data collected was insufficient to make a finding, NA = not assessed

a. The Swan River was assessed as impaired with respect to warmwater standards. However, the river is currently classified as a coldwater stream, with an expected use class change to warmwater. Because the use class change has not occurred yet, the impairment is not on the 2016 list of impaired waters and is not addressed in the TMDL report.

Lakes

Lakes are assessed for their ability to support aquatic recreation based on the level of eutrophication in the lake. Water transparency and levels of phosphorus and chlorophyll are used to evaluate eutrophication. Phosphorus is a nutrient that plants and algae need to grow, and chlorophyll is a measure of the amount of algae in the water. Water transparency is typically higher in lakes with less algae growth. However, many lakes in this region have naturally high levels of dissolved organic material, which decreases water transparency even in the absence of algal growth. These lakes are commonly referred to as "tea-stained" due to the brown coloration of the water from the organic matter present. Twenty-five lakes in the SLRW were assessed for their ability to support aquatic recreation (Table 2). Eighteen lakes were found to meet the eutrophication standards and will be the focus of protection efforts. Seven lakes do not meet the standards and will be the focus of restoration efforts.

Table 2. Assessment status of lakes in the SLRW

HUC-10 Subwatershed	Lake ID	Lake	Aquatic Recreation
Headwaters St. Louis River (401020102)	69-0044-00	Butterball	Sup
	69-0420-00	South Twin	Sup
	69-0553-00	Bass	Sup
Embarrass River (401020103)	69-0429-00	Sabin (Embarrass Mine)	Sup
	69-0496-00	Embarrass	Sup
	69-0565-00	Esquagama	Sup
	69-0611-00	Lost	Sup
Mud Hen Creek (401020104)	69-0426-00	Loon	Sup
	69-0494-00	Mud Hen	Imp
	69-0495-00	Long	Imp
	69-0550-00	Section Fourteen	Sup
	69-0562-00	Coe	Sup
West Two River (401020105)	69-0775-00	McQuade	Imp
	69-0994-00	West Two Rivers Reservoir	Imp
West Swan River–East Swan River (401020106)	31-0022-00	Little Island	Sup
	31-0023-00	Helen	Sup
Sand Creek–St. Louis River (401020107)	31-0028-00	Beauty	Sup
	69-0726-00	Manganika	Imp
Upper Whiteface River (401020108)	69-0114-00	Cadotte	Sup
	69-0375-00	Whiteface Reservoir	Sup
	69-0529-00	Strand	Imp
Lower Whiteface River (401020109)	69-0544-00	Dinham	Imp
	69-0627-00	Nichols	Sup
Floodwood River (401020110)	31-0001-00	Long	Sup
	31-0016-00	Pancake	Sup

Imp = impaired for impacts to aquatic recreation, Sup = fully supporting aquatic recreation

2.2 Water Quality Trends

Streams

Long-term phosphorus data were evaluated using a combined dataset of total phosphorus samples collected at the St. Louis River at Old USH-61 at Scanlon (site S000-046; 1974–2009) and at the CSAH-61 bridge, just east of Scanlon (site S005-089; 2008–2015). Results of Kendall Tau correlation analyses indicate significant ($p<0.05$) decreasing trends of growing season medians. A visual analysis of temporal trends (Figure 6) illustrates the decreasing trend, especially when comparing years with many samples (i.e., 1983, 2009–2010, 2014–2015). Results should be interpreted with caution due to the low sample size during many years of data collection. A spatial analysis (Figure 7) indicates a cluster of high mean phosphorus concentrations in the Swan River subwatershed. High concentrations of sediment and of *E. coli* have also been found in the Swan River subwatershed, which has a history of disturbance from mining and from development of cities along the Iron Range.

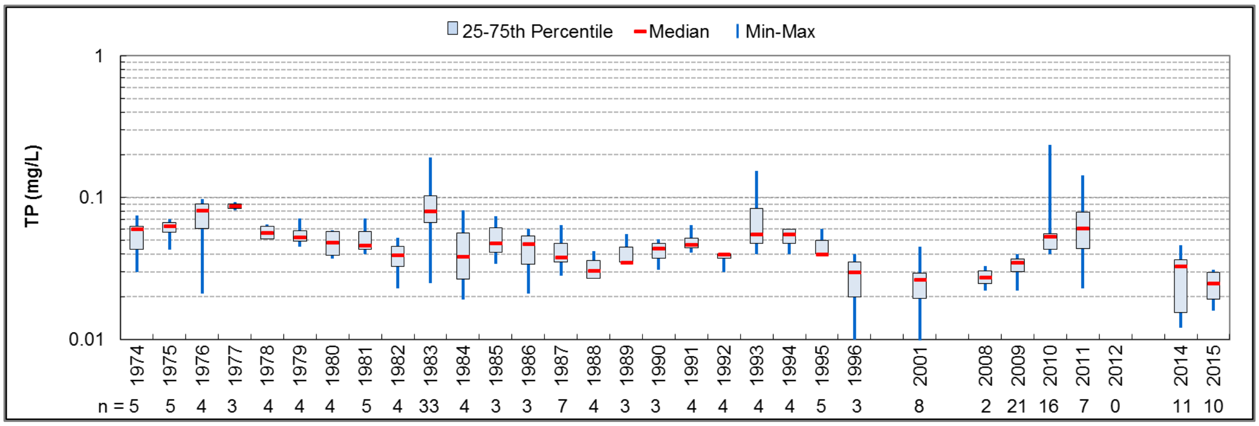


Figure 6. Summary of total phosphorus data (Jun–Sep) per year on the St. Louis River at Old USH-61 (at Scanlon; site S000-046) and CSAH-61 (east of Scanlon; site S005-089).

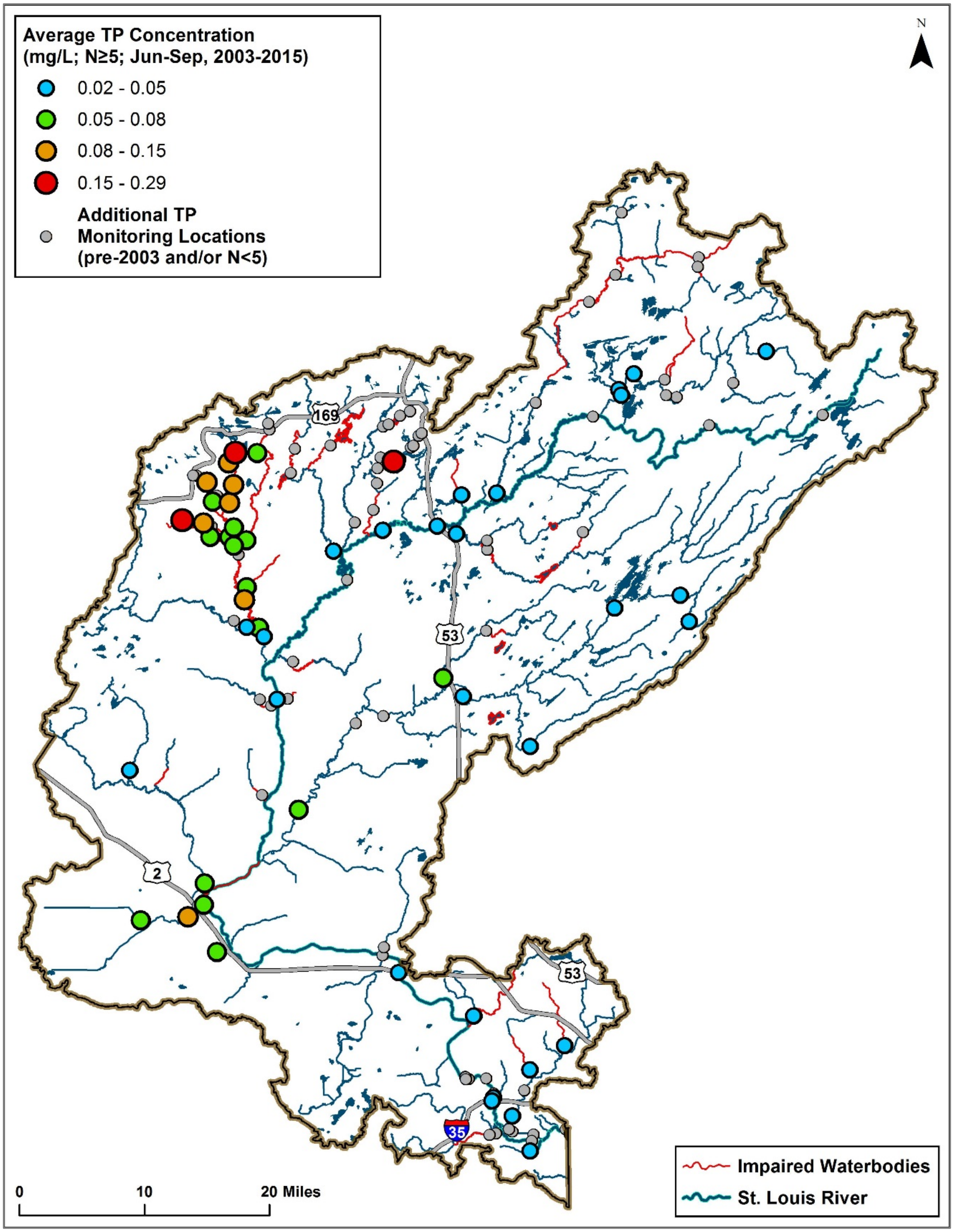


Figure 7. Mean total phosphorus concentrations by stream site.

Long-term total suspended solids (TSS) data were evaluated using a combined dataset of TSS samples collected on the St. Louis River at Old CSH-61 at Scanlon (site S000-046; 1974 through 2009) and at CSAH-61 BRG, just east of Scanlon (site S005-089; 2008 through 2015). TSS is high in some streams but is generally low in most streams. Results of Kendall Tau correlation analyses indicated no significant ($p>0.05$) trends using both annual means and annual medians of all data per year and of April through September data. A visual analysis of temporal trends (Figure 8) indicates no apparent trend and larger ranges of concentrations in recent years. Similar to phosphorus, a spatial analysis (Figure 9) indicates higher mean TSS concentrations in the Swan River Subwatershed. TSS concentrations outside of the Swan River subwatershed are typically low, owing to the flat, wetland-dominated nature of many parts of the watershed.

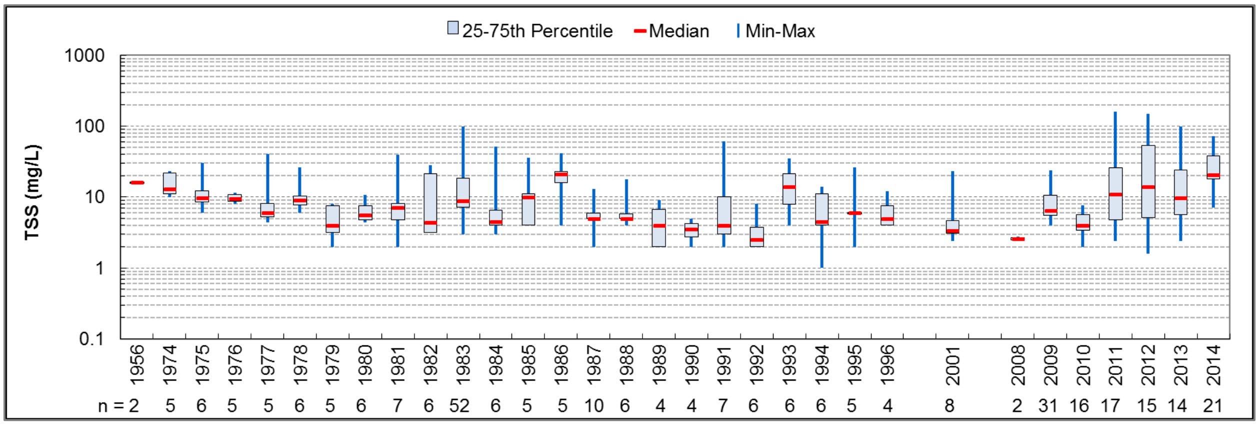


Figure 8. Summary of TSS data (Apr–Sep) per year on the St. Louis River at Old USH-61 (at Scanlon; site S000-046) and CSAH-61 (east of Scanlon; site S005-089).

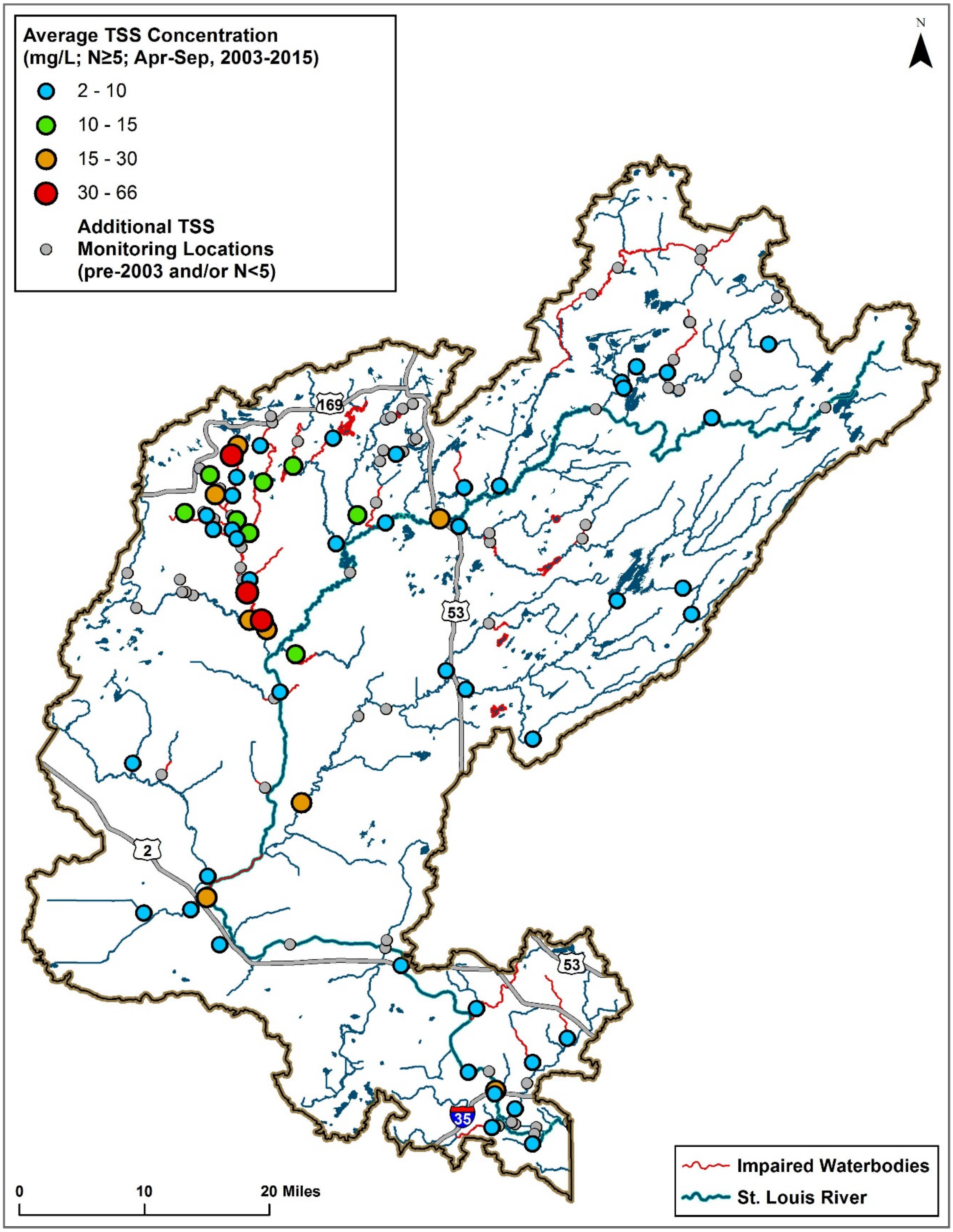


Figure 9. Mean TSS concentrations by stream site.

Long-term nitrate data are only available historically; sites with recent nitrate data do not have historic data. Whereas high nitrate concentrations have been observed locally in one stream (East Swan Creek), nitrate concentrations at other sites are below the state standard for drinking water protection.

The St. Louis River at Old CSH-61 at Scanlon (site S000-046; 1974 through 1996) was evaluated for nitrate trends. Results of Kendall Tau correlation analyses indicates no significant (p>0.05) trends using both annual means and annual medians of all data per year. A visual analysis of temporal trends (Figure 10) indicates no apparent trend; over time, nitrate has been detected within the same range of concentrations. Nitrate data were limited spatially and no trend was apparent.

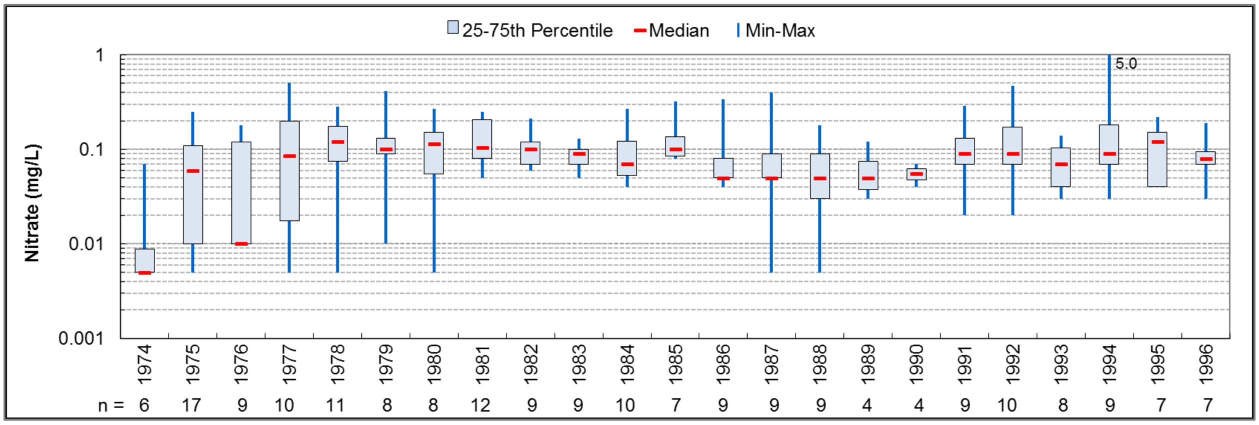


Figure 10. Summary of nitrate data per year on the St. Louis River at Old USH-61 (at Scanlon; site S000-046).

Most *E. coli* data were collected since 2000. Samples from the St. Louis River at the bridge at US-2, two miles southeast of Brookston (site S000-023), were collected in 1985 and recently. Kendall Tau correlation analyses indicate no significant (p>0.05) trends of geometric means of data collected between April and October each year. A visual analysis of temporal trends (Figure 11) indicates no apparent trend over time. Concentrations along the St. Louis River were typically low (Figure 12), while high concentrations occurred in the Swan River subwatershed and along the lowest reaches of the project area. The high levels of *E. coli* are likely due to a mix of sources, including aging wastewater infrastructure, stormwater runoff, livestock, and non-conforming septic systems.

Other water quality parameters are addressed in the discussion of stressors of biologically-impaired stream reaches in Section 2.3.

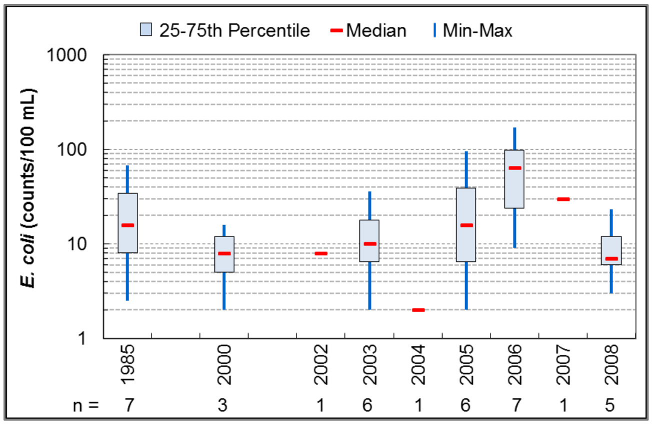


Figure 11. Summary of *E. coli* data per year (Apr–Oct) from the St. Louis River at the US-2 Bridge (site S000-023).

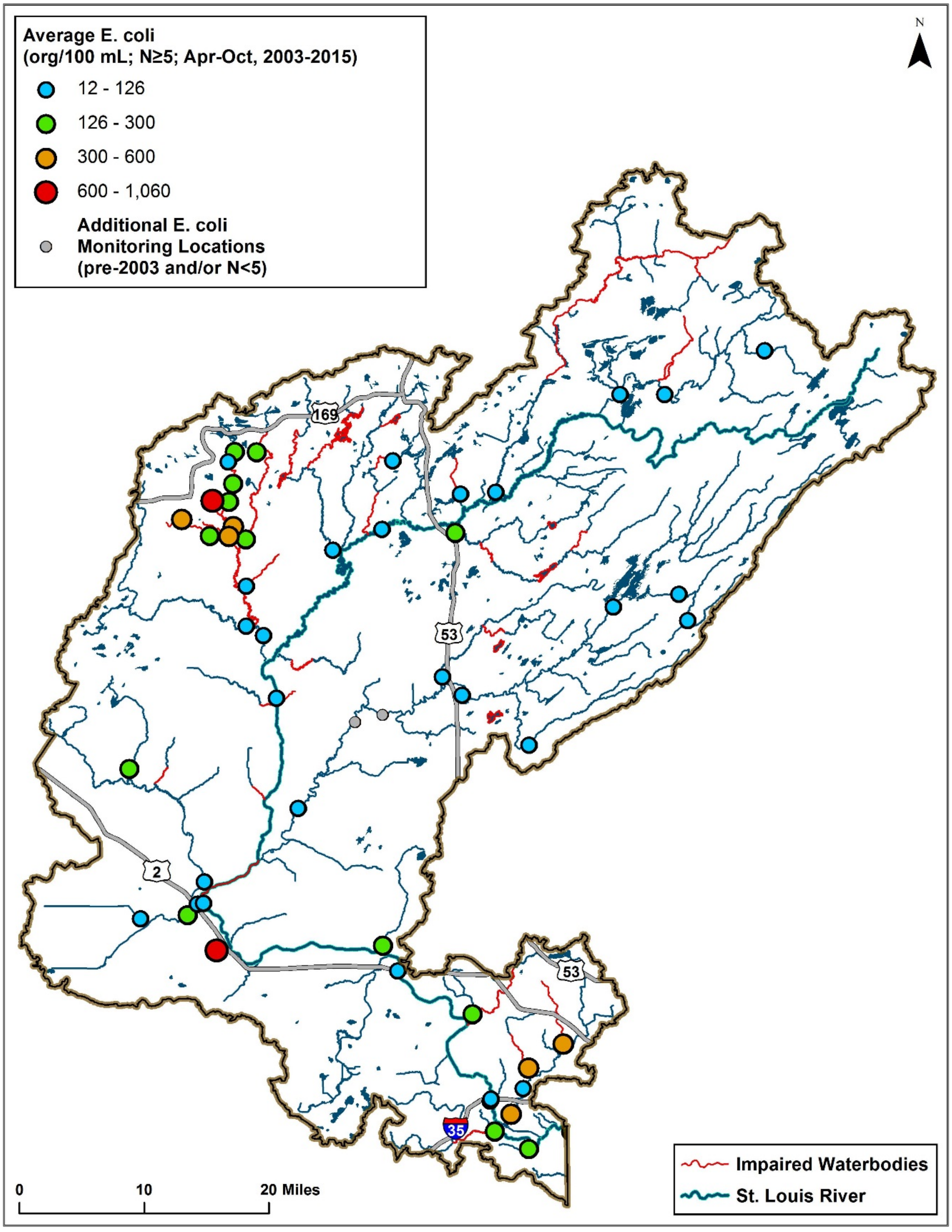


Figure 12. Mean *E. coli* concentrations (Apr–Oct) by stream site.

Lakes

Lake water quality varies across the watershed. Of the 18 lakes for which there are enough data to evaluate trends in water clarity, three lakes show evidence of an increasing trend, three lakes show evidence of a decreasing trend, and there is no evidence of a trend in twelve lakes (Table 3 and Figure 13). The trend analysis for these lakes provides lake specific information for interested stakeholders. Some of the lakes evaluated for the trend analysis were not part of the MPCA's monitoring and assessment effort and are not included in the strategies tables in Section 3.

Table 3. Lake water quality trends. Data from "Lakes of Phosphorus Sensitivity Significance" provided by interagency group.

Lake Name	Lake ID	Impaired	Average Total Phosphorus (µg/L)	Average Transparency (m)	Trend in Clarity [a]
Aerie	69070100	N	8	2.5	N
Bass	69055300	N	22	3.9	–
Beauty	31002800	N	17	2.1	N
Butterball	69004400	N	24	0.8	–
Cadotte	69011400	N	15	3.9	N
Carey	69085600	N	28	1.7	–
Coe	69056200	N	29	1.9	–
Colby	69024900	N	16	1.0	N
Dinham	69054400	Y	36	1.3	–
Ely	69066000	N	14	4.7	↓
Embarrass	69049600	N	24	1.3	–
Esquagama	69056500	N	16	2.3	N
Helen	31002300	N	15	2.3	–
Horseshoe	69065400	N	34	2.0	N
Little Island	31002200	N	9	3.2	–
Long	69065300	N	26	3.1	↑
Long	69049500	Y	51	0.9	–
Long	31000100	N	7	4.6	–
Loon	69042600	N	9	5.8	↓
Lost	69055600	N	8	3.9	N
Manganika	69072600	Y	309	0.8	–
Maple Leaf	69070000	N	27	2.6	↑
McQuade	69077500	Y	71	1.2	–
Mud Hen	69049400	Y	34	1.9	–
Nichols	69062700	N	24	2.1	–
Pancake	31001600	N	21	1.9	–
Pike	69049000	N	13	4.6	↑
Section Fourteen	69055000	N	15	2.6	–
South Twin	69042000	N	17	2.2	–
St. Louis River–Thomson Reservoir	09000100	N	149	0.8	–

Lake Name	Lake ID	Impaired	Average Total Phosphorus (µg/L)	Average Transparency (m)	Trend in Clarity [a]
St. Mary's	69065100	N	15	5.4	↓
Strand	69052900	Y	36	1.1	N
Torch Light	09002500	N	16	2.6	–
Upper Comstock	69041201	N	24	1.9	N
West Two Rivers Reservoir	69099400	Y	40	1.7	–
Whiteface Reservoir	69037500	N	24	1.2	N
Whitewater	69037600	N	13	3.3	–
Wynne	69043402	N	15	2.0	N

a. ↑: increasing trend
↓: decreasing trend
N: no evidence for a trend
–: insufficient data

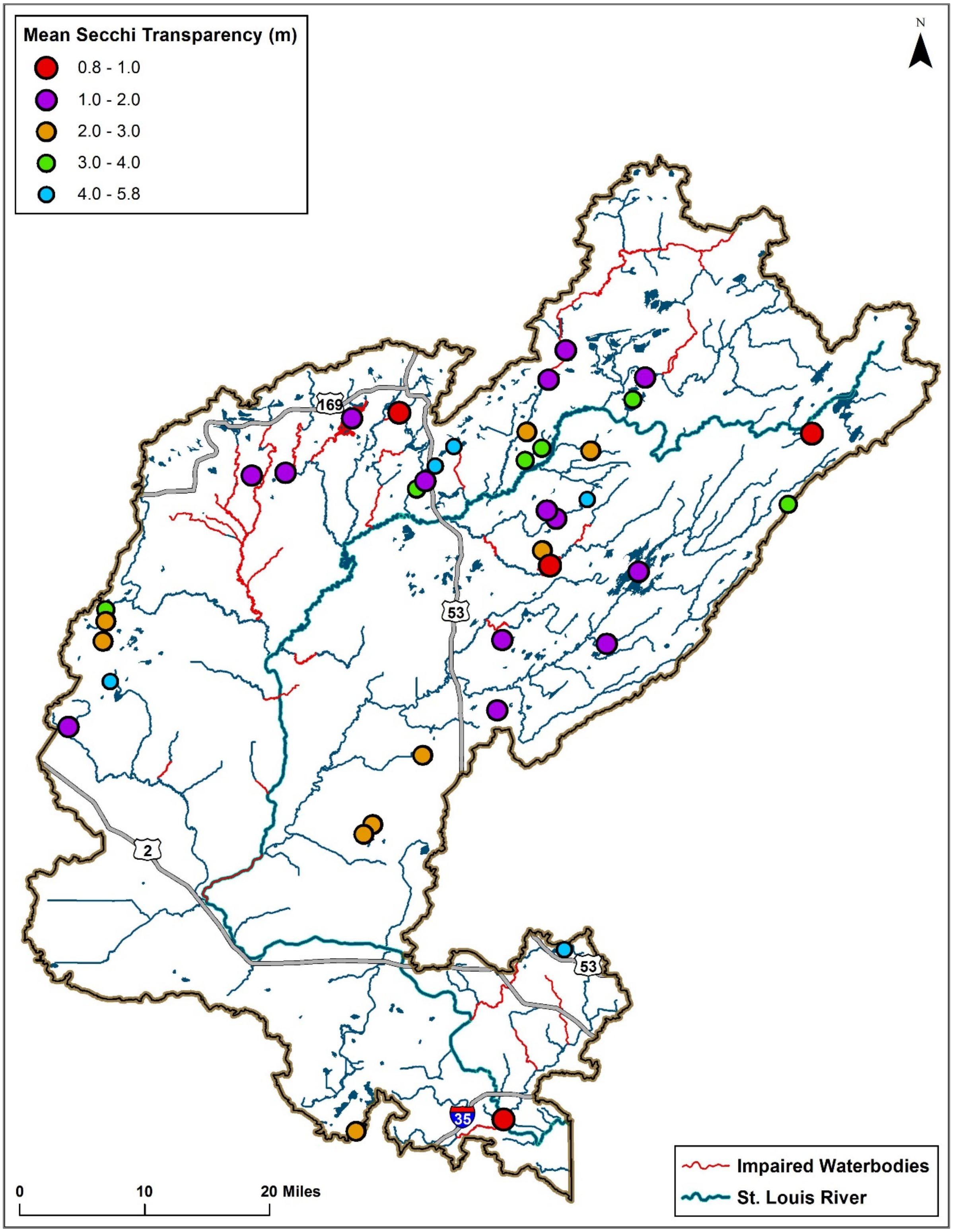


Figure 13. Mean Secchi transparency by lake.

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 stressors are identified for streams with either fish or macroinvertebrate biota impairments, and this stressor identification (SID) encompasses evaluation of pollutants and non-pollutant factors as potential stressors (e.g., altered hydrology, fish passage, habitat). Pollutant source assessments are completed where a biological SID process identifies a pollutant as a stressor; source assessments are also completed for the typical pollutant impairment listings. Section 3 provides further detail on stressors and pollutant sources.

Stressors of Biologically-Impaired Stream Reaches

The *St. Louis River Watershed Stressor Identification Report* (MPCA 2016) evaluated the stressors to the biological assemblages in the streams that have fish or macroinvertebrate biota impairments (Table 4). The following excerpts from the SID report explain the factors that act as stressors to the biota assemblages in at least one reach in the watershed:

- **Altered hydrology:** Only stream flow regimes that resulted in altered hydrology due to human activities are considered. Using GIS analyses of impaired streams, the MPCA determined that road crossings, channelization, impervious surfaces, and mine features are probable candidate causes of impairment that contribute to altered hydrology; the MPCA also found that channelization, impoundments, point source discharges, withdrawals, and mine features are potential causes of impairment.
- **Ammonia toxicity:** High ammonia concentrations in water can affect fish growth, gill condition, organ weights, and hematocrit. High pH shifts the balance of ammonia species to the more toxic form of ammonia. Ammonia toxicity was identified as a potential stressor in one of the streams.
- **DO** and **daily range in DO:** Human activities affect the factors that control in-stream DO (e.g., increasing nutrients due to human influence may result in excessive plant growth and declining DO concentrations). In the SLRW, "low DO concentrations and/or high DO flux are a widespread candidate cause for impairment," and some low DO conditions can be considered natural.
- **Habitat:** "Specific habitats that are required by a healthy biotic community can be minimized or altered by practices on the landscape by way of resource extraction, agriculture, forestry, urbanization, and industry." An MPCA assessment of habitat quality determined that many impaired streams have poor to marginal habitat quality, some of which can be considered natural.
- **Iron precipitate:** When oxygen is present, iron in water forms a rust colored precipitate. Additionally, there are some forms of bacteria that use iron for energy and secrete slime as a byproduct. The iron precipitate in streams can limit the distribution, abundance, and diversity of fish through accumulation in fish gills and alteration of benthic habitat.
- **Nitrate toxicity:** While nitrate is a natural component of the nitrogen cycle, excessive nitrate

concentrations, which can be due to anthropogenic activities, may be toxic to fish and macroinvertebrates. Nitrate concentrations exceeded natural background conditions in three streams in the SLRW; nitrate toxicity was identified as a primary stressor in one of the streams.

- **Specific conductance:** "There is debate as to the exact mechanisms responsible for toxicity associated with specific conductivity. Toxicity due to specific conductivity could result from disruption of organisms' osmotic regulation processes, decreases in bioavailability of essential elements, increases in availability of heavy metal ions, increases in particularly harmful ions, changes in ionic composition, absence of chemical constituents that offset impacts of harmful ions, a combination of the above, or other as yet unknown mechanisms. In some instances (perhaps the majority), increased specific conductivity causes shifts in community composition rather than mortality. Thus, specific conductivity, salinity, and TDS [total dissolved solids] levels may be associated with biological impairment and yet be below mortality thresholds."
- **Sulfate toxicity:** Sulfate is typically found in low concentrations in natural streams, and can be elevated due to mining or industrial processes and runoff from urban and agricultural areas. High sulfate concentrations are found in small streams near mining features in the SLRW.
- **Temperature:** "Fish and macroinvertebrate species are often restricted in their distribution based on the temperature ranges observed within streams, rivers, and lakes. [...] Several impaired streams in the Iron Range district of the watershed show lower maximum temperatures and noticeably narrower ranges between minimum and maximum temperatures. This is likely due to the influence of groundwater and mine pit dewatering to these streams." The SID identified water temperature to be a stressor of coldwater streams in the SLRW, and also concluded that water temperature did not impair warm or coolwater streams.
- **TSS:** Excess suspended solids can harm aquatic life through direct, physical effects on biota such as abrasion of gills, suppression of photosynthesis, and avoidance behaviors, or through indirect effects such as loss of visibility. In the SLRW, natural background conditions are distinguished by low TSS concentrations. In a few streams, TSS exceeds the coldwater and warmwater/coolwater water quality standards.

Many of the identified stressors are not load-based, and there is no pollutant on which to base the TMDL (i.e., poor habitat, altered hydrology, and low DO in certain cases). TMDLs were completed for impairments that identify high TSS, high DO flux due to eutrophication, and high temperature as primary stressors. TMDLs were not developed for streams for which specific conductance and/or sulfate toxicity were identified as stressors. Where specific conductance was evaluated, it was not confirmed as a stressor to the biota due to the possibility of confounding stressors (such as habitat quality and high swings in DO concentration) and/or an inconsistent response of the biota to high specific conductance. Where sulfate was evaluated, it was not confirmed as a stressor to the biota, and TMDLs were not developed for sulfate due to the lack of applicable Minnesota water quality standards.

Table 4. Primary stressors to aquatic life in biologically-impaired reaches in the St. Louis River Watershed

AUID (04010201-xxx)	Reach name	TSS	DO Flux	Habitat	DO	Altered Hydrology	Temperature	Nitrate Toxicity	No Diagnosed Stressors
508	St. Louis River			x					
518	Elbow Creek				x				
535	West Two River		x		x				
548	Manganika Creek	x			x				
551	Unnamed Tributary / Kinney Creek		x						
570	Elbow Creek			x					
579	Embarrass River				x				
607	Sand			x					
623	Vaara			x	x				
629	Otter								x
888	East Swan Creek							x	
891	Little Swan			x	x		x		
942	Wyman				x		x		
963	Stony	x		x	x				
A17	Unnamed Tributary			x					
A18	Skunk			x	x				
A24	Paleface				x				
A26	Ely Creek			x	x	x			
A31	Water Hen River				x				
A35	Water Hen Creek		x		x				
A42	Spring Mine		x						

Pollutant Sources

A watershed model (using the HSPF computer program) was developed to simulate watershed scale hydrology and water quality. Pollutant loading results are presented in this section with a focus on the impaired waterbodies; a list of all permitted point sources in the SLRW project area is in Appendix A. Point sources contribute 18% of the phosphorus load in the watershed, with the remaining load from nonpoint sources. Point sources contribute 21% of the nitrogen load, and 3% of the TSS load (Figure 14).

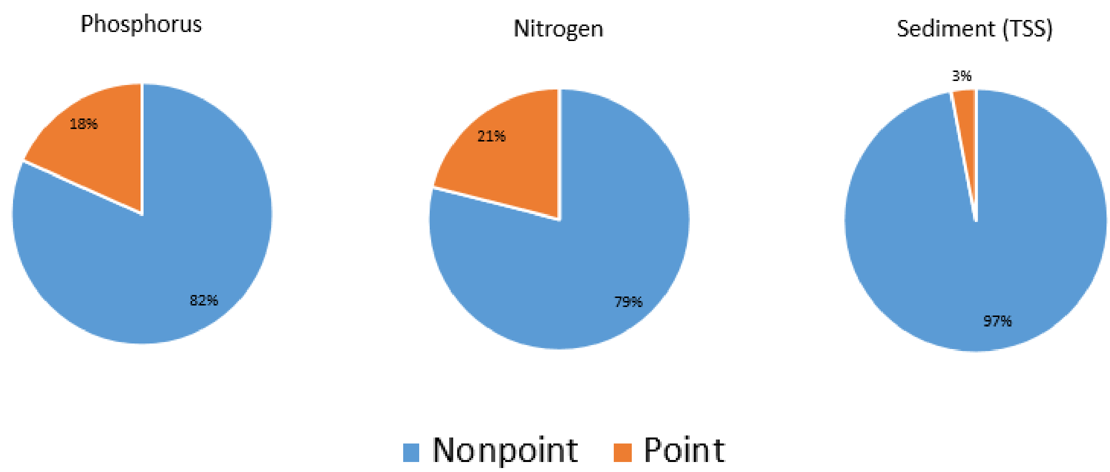


Figure 14. Overall breakdown of nonpoint vs. point sources in the St. Louis River Watershed.

Total phosphorus yields from watershed runoff and channel processes, and from point sources, are mapped in Figure 15 and Figure 16, respectively. Larger total phosphorus yields from watershed runoff and channel processes are evident in the western subwatersheds and the lowest portion of the project area. The subwatersheds with higher total phosphorus yields from point sources are located in the Iron Range.

The primary sources of phosphorus to Dinham Lake, one of the impaired lakes, are from watershed runoff and internal loading. Loading from shoreland development is not quantified but likely impacts lake water quality. Shoreland loading can be from impervious surfaces, lawns adjacent to the lake, and/or shoreline erosion. The primary sources of phosphorus to West Two Rivers Reservoir, another impaired lake, are watershed runoff, point sources, and internal loading. For each lake or reservoir, internal loading can be a substantial source in some years.

The impaired reach of West Two River is located immediately downstream from West Two Rivers Reservoir. Approximately half of the phosphorus load to West Two River is from the reservoir outlet, and the other half of the load is from watershed runoff.

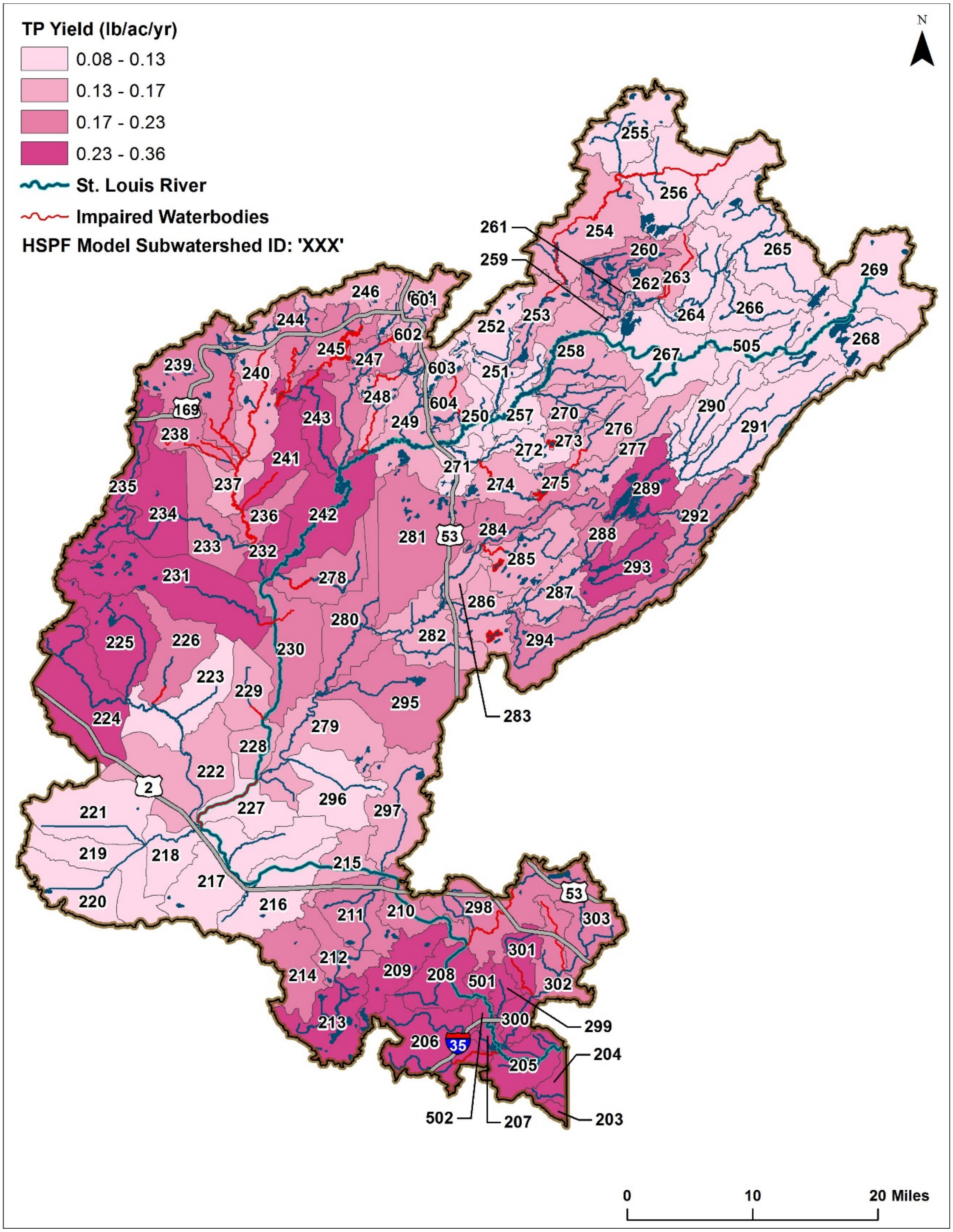


Figure 15. Total phosphorus yield from nonpoint source runoff as simulated in SLRW HSPF model.

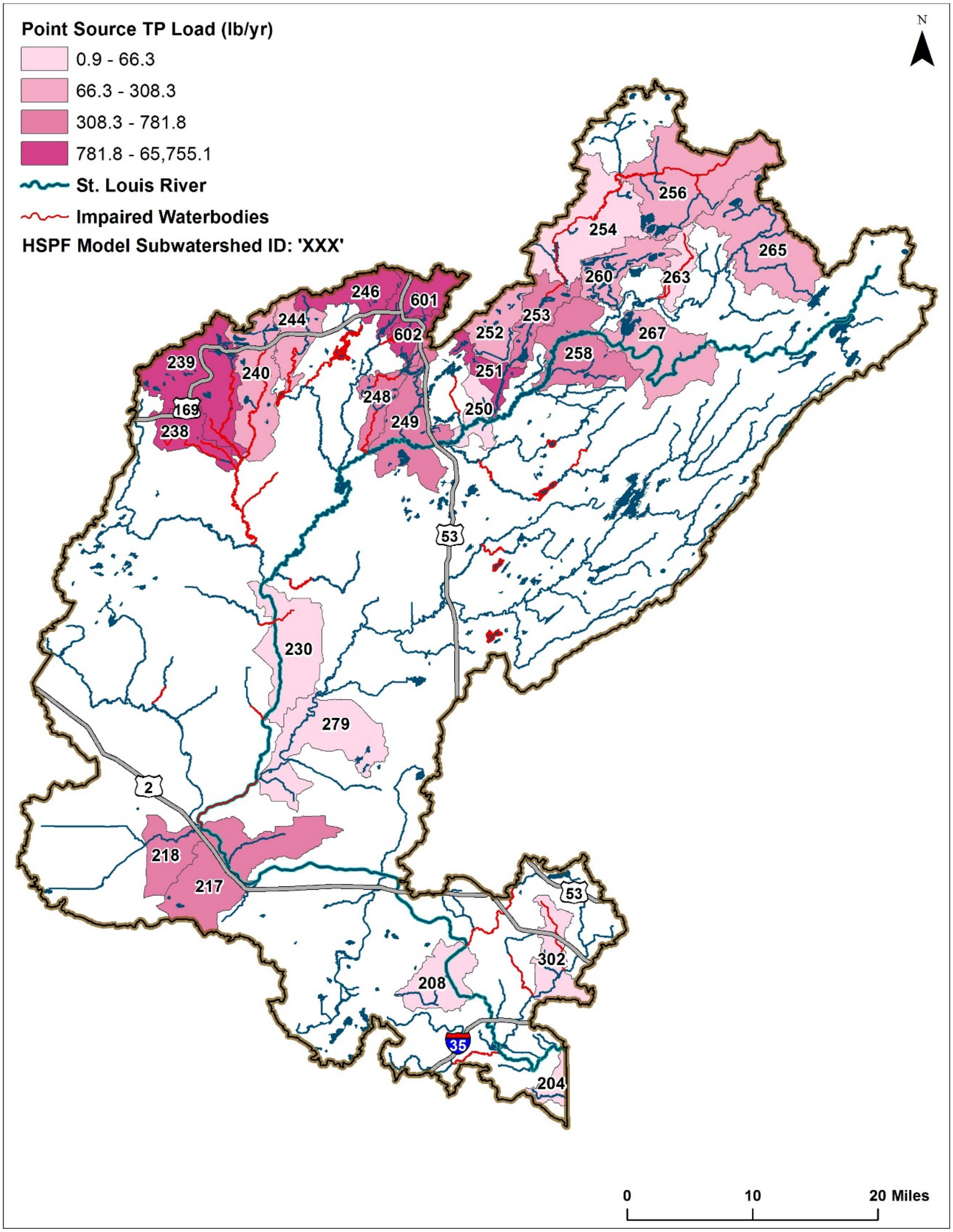


Figure 16. Total phosphorus yield from point sources simulated in SLRW HSPF model.

TSS yields from watershed runoff and channel processes, and from point sources, are mapped in Figure 17 and Figure 18, respectively. Larger TSS yields from watershed runoff and channel processes are evident in the northern and the lowest portion of the project area.

Sediment loads in the East Swan River subwatershed, which is impaired due to high sediment, are dominated by channel erosion and stormwater runoff from developed areas. Sediment loads in the Stony Creek Subwatershed are dominated by channel erosion and stormwater runoff from forested and developed areas. The developed areas in the Stony Creek Subwatershed primarily consist of roads. Indications of channel instability were observed in the SID study, including debris jams (MPCA 2016). Channel instabilities might be a result of increased peak flows from the channelized streams in the watershed or due to a “local base level drop in the St. Louis River that caused a headcut to migrate up through the Stony Creek Subwatershed.”

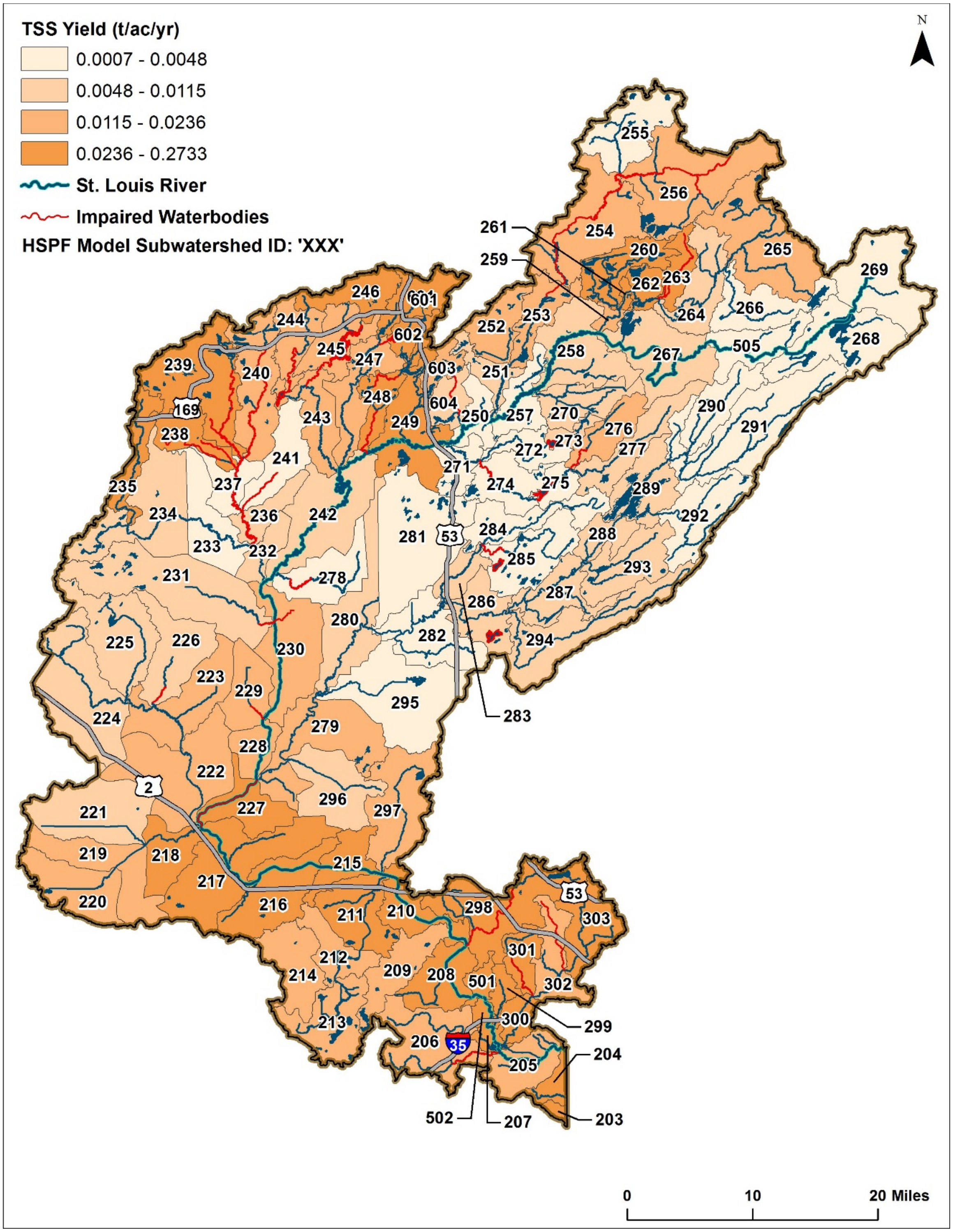


Figure 17. TSS yield from nonpoint source runoff as simulated in SLRW HSPF model.

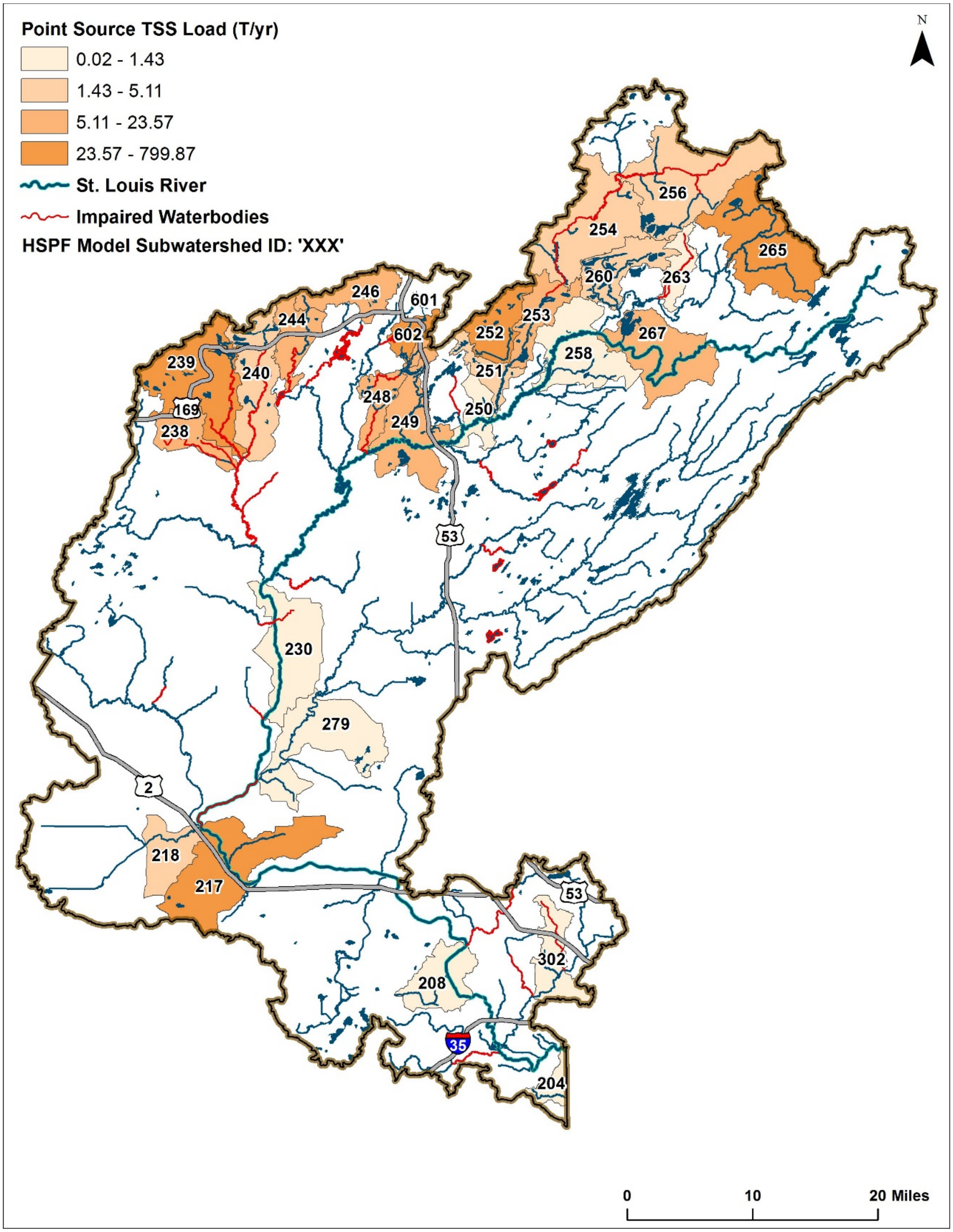


Figure 18. TSS yield from point sources simulated in SLRW HSPF model.

The monitoring data and source assessment suggest that the *E. coli* impairments are due to a mix of sources that occur during all flow regimes (Table 5). In the watersheds with developed areas, aging wastewater infrastructure and stormwater runoff have the potential to be primary sources. Livestock is the primary known source of concern in the three impaired watersheds in the southern portion of the SLRW (Pine River, Unnamed Creek/West Rocky Run, and Hay Creek).

Table 5. Summary of *E. coli* sources in impaired watersheds.

Impaired Reach	Livestock	Wildlife	Domestic Pets	Humans			Stormwater Runoff
				IPHT	WWTP	Aging Infrastructure	
Unnamed Creek (542)	●	○	●	○	–	●	●
Pine River (543)	●	○	○	○	–	–	○
Barber Creek (569)	–	○	○	○	○	●	●
Buhl Creek (580)	○	○	●	○	–	●	●
Dempsey Creek (582)	–	○	○	○	–	●	●
Unnamed Creek / West Rocky Run (625)	●	○	○	○	–	–	–
Barber Creek (641)	●	○	●	○	○	●	●
Hay Creek (751)	●	○	○	○	–	–	–
Unnamed Creek / East Swan Creek (888)	●	○	●	○	○	●	●
Penobscot Creek (936)	–	○	●	○	–	●	●
Unnamed Creek (A22)	●	○	○	○	–	–	–

● *E. coli* source that is a higher priority for targeting
○ *E. coli* source that is a lower priority for targeting
– Not an *E. coli* source

2.4 TMDL Summary

The Clean Water Act and EPA regulations require that TMDLs be developed for waters that do not support their designated uses. A TMDL is a plan to attain and maintain water quality standards in waters that are not currently meeting them. There are 32 impaired stream reaches (Table 1) and seven impaired lakes (Table 2) in the SLRW. *Escherichia coli* (*E. coli*) TMDLs were developed for the aquatic recreation impairments that are indicated by high *E. coli* concentrations. TSS TMDLs were developed for aquatic life use impairments due to turbidity or for which suspended solids were identified as a primary stressor. TMDLs were not developed for 11 assessment units with aquatic life use impairments that are likely derived from impaired habitat or altered hydrology; these streams do not require TMDLs because the causes are not due to a pollutant. TMDLs were deferred for aquatic life use impairments with the primary stressor of DO flux and nitrate toxicity or if no stressors were identified. Phosphorus TMDLs were developed for lakes with aquatic recreation impairments; TMDLs for the impaired shallow lakes are being deferred until standards specific to shallow lakes are developed. Table 6 lists the waterbodies with completed TMDLs, and Appendix B provides the current pollution loading, load reductions needed, and load and wasteload allocations from the TMDLs.

Table 6. Completed TMDLs in the SLRW

HUC-10 Subwater-shed	Stream/Reach (AUID) or Lake (ID)	Affected Designated Use	Cause/Indicator of Impairment	TMDL Pollutant
Partridge River (0401020101)	Wyman Creek (942)	Aquatic Life	Fish Index of Biotic Integrity	Temperature
West Two River (0401020105)	West Two Rivers Reservoir (69-0994-00)	Aquatic Recreation	Nutrient/Eutrophication Biological Indicators	Phosphorus
	West Two River (535)	Aquatic Life	Macroinvertebrate Index of Biotic Integrity	Phosphorus
West Swan River–East Swan River (0401020106)	Unnamed creek (542)	Aquatic Recreation	*Escherichia coli*	*E. coli*
	East Swan River (558)	Aquatic Life	Turbidity/TSS	TSS
	Barber Creek (569; East Swan River)	Aquatic Recreation	*Escherichia coli*	*E. coli*
	Buhl Creek (580)	Aquatic Recreation	*Escherichia coli*	*E. coli*
	Dempsey Creek (582)	Aquatic Recreation	*Escherichia coli*	*E. coli*
	Barber Creek (641)	Aquatic Recreation	*Escherichia coli*	*E. coli*
	Unnamed Creek (888; East Swan Creek)	Aquatic Recreation	*Escherichia coli*	*E. coli*
	Penobscot Creek (936)	Aquatic Recreation	*Escherichia coli*	*E. coli*
	Unnamed creek (A22)	Aquatic Recreation	*Escherichia coli*	*E. coli*
Sand Creek–St. Louis River (0401020107)	Stony Creek (963)	Aquatic Life	Fish Index of Biotic Integrity Macroinvertebrate Index of Biotic Integrity	TSS
Lower Whiteface	Dinham Lake (69-0544-00)	Aquatic Recreation	Nutrient/Eutrophication Biological Indicators	Phosphorus

HUC-10 Subwater-shed	Stream/Reach (AUID) or Lake (ID)	Affected Designated Use	Cause/Indicator of Impairment	TMDL Pollutant
River (0401020109)				
Midway River (0401020114)	Unnamed Creek (625)	Aquatic Recreation	*Escherichia coli*	*E. coli*
	Hay Creek (751)	Aquatic Recreation	*Escherichia coli*	*E. coli*
Thompson Reservoir–St. Louis River (0401020115)	Pine River (543; White Pine River)	Aquatic Recreation	*Escherichia coli*	*E. coli*

2.5 Protection Considerations

All waters in the SLRW require protection in some capacity, including those listed as impaired. For unimpaired waters, protection considerations are based on identifying those waters that are particularly threatened or vulnerable.

An analysis of streams was conducted based on index of biotic integrity (IBI) scores (Figure 19). In the figure below, the blue markers ("> upper confidence limit") indicate streams that are comfortably meeting the standards. The green markers ("> or < threshold") indicate streams with IBI scores that are close enough to the targets that the streams are considered threatened. The red markers ("< lower confidence limit") indicate streams that do not meet the standard. The streams that are near the expected target score for either fish or macroinvertebrate IBI (green markers in Figure 19) and are unimpaired are designated as priority protection waters due to their threatened nature. These streams (Table 7) are selected as priority protection waters because (1) they have a high potential for restoration and (2) they are potentially vulnerable to impairment in the future.

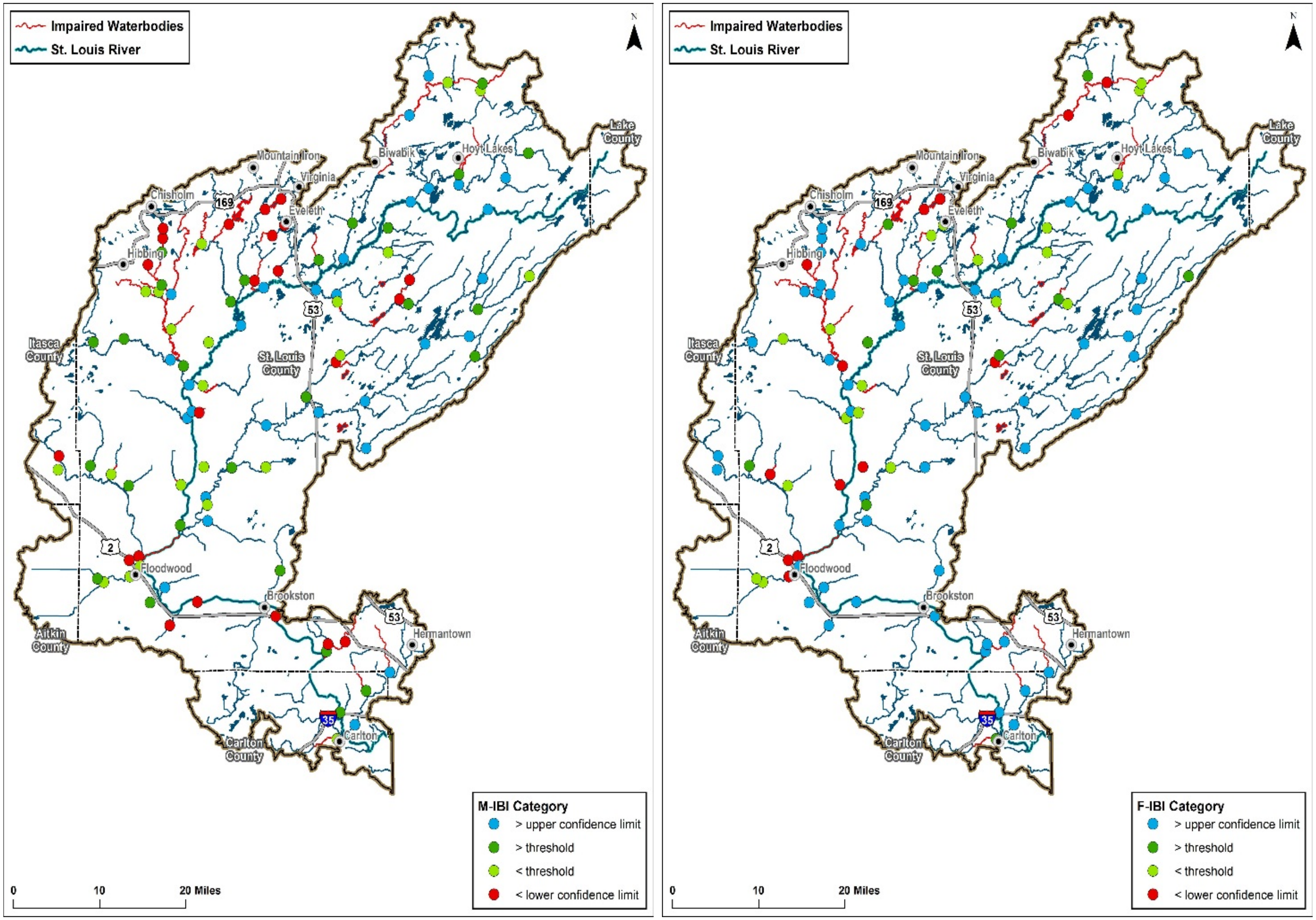


Figure 19. Index of biotic integrity scores.

Table 7. Stream reaches identified for protection.

HUC-10 Subwatershed	AUID (Last 3 digits)	Stream	Reach Description
Partridge River (401020101)	552	Partridge River	Headwaters to St. Louis River
	587	Unnamed Creek	Unnamed Creek to Unnamed Creek
Embarrass River (401020103)	583	Unnamed Creek	Headwaters to Embarrass River
	A40	Bear Creek	Unnamed Creek to Embarrass River
Mud Hen Creek (401020104)	A36	Water Hen Creek, South Branch	Unnamed Creek to Water Hen Creek
West Two River (401020105)	534	West Two River	McQuade Lake outlet to St. Louis River
West Swan River–East Swan River (401020106)	557	Swan River	Confluence of East and West Swan River to St. Louis River
	559	West Swan River	T55 R21WS4, north line to T55 R20WS14, east line
Sand Creek– St. Louis River (401020107)	525	St. Louis River	Swan River to Whiteface River
	555	East Two River	Unnamed Branch to St. Louis River
Upper Whiteface River (401020108)	549	Whiteface River, North Branch	Headwaters to Whiteface Reservoir
	766	Whiteface River, South Branch	Ryan Creek to Unnamed Creek
Lower Whiteface River (401020109)	550	Paleface River	Headwaters to Whiteface River
	616 [a]	Little Whiteface River	Unnamed Creek to Whiteface River
	959	Unnamed Creek (Otter Creek)	Unnamed Creek to Whiteface River
Floodwood River (401020110)	560	Floodwood River	Headwaters (Floodwood Lake 69-0884-00) to St. Louis River
	A11	Unnamed Creek	Unnamed Lake (31-1035-00) to W Branch Floodwood River
	A16	Joula Creek	Headwaters to Floodwood River
East Savanna River (401020111)	561	East Savanna River	Headwaters (Wolf Lake 01-0019-00) to St. Louis River
Artichoke River–St. Louis River (401020113)	544	Artichoke River	Headwaters (Artichoke Lake 69-0623-00) to St. Louis River
Thompson Reservoir–St. Louis River (401020115)	515	St. Louis River	Scanlon Dam to Thomson Reservoir

a. Stream reach not included within MPCA monitoring and assessment

Lakes were also identified for protection. An interagency group consisting of staff from the MPCA, Minnesota Department of Natural Resources (DNR), Board of Water and Soil Resources (BWSR), Minnesota Department of Agriculture (MDA), and Minnesota Department of Health (MDH) developed goals for lakes that meet water quality standards, identified unimpaired waters that are at greatest risk, and developed a preliminary priority ranking for protection efforts. The water quality risk is based on each lake's sensitivity to increased phosphorus loading, proximity to the water quality standard, the percent of disturbed land use in the watershed, lake size, existing phosphorus levels, and whether the lake shows a declining trend in water clarity. Several of the lakes were removed from the protection priority list due to a small number of data points between 1995 and 2015. The lakes identified in the highest tier of priority by the interagency group were selected for WRAPS protection. Whiteface Reservoir and Mud Lake were added to the highest priority lakes based on input from the Core Team—Whiteface Reservoir has exceptional water quality and is an important recreational resource, and Mud Lake has been invaded by zebra mussels. The resulting list represents the lakes identified for water quality protection (Table 8). Lake Superior is also identified as an important protection consideration due to its high value and exceptional water quality.

Figure 20 summarizes all of the protection and restoration waters in the SLRW; the protection waters are the streams and lakes identified in Table 7 and Table 8, respectively, and the restoration waters are the impaired waters.

Table 8. Lakes identified for water quality protection

Lake Name	Lake ID	Average Total Phosphorus (µg/L) [a]
Beauty	31002800	17
Ely	69066000 [b]	14
Loon	69042600	9
Mud Lake	69051200	–
Pike	69049000 [b]	13
St. Mary's	69065100 [b]	15
Whiteface Reservoir	69037500	24
Whitewater	69037600 [b]	13

a. Average total phosphorus concentration from all data in the MPCA's EQuIS database.

b. Lake not included within MPCA monitoring and assessment

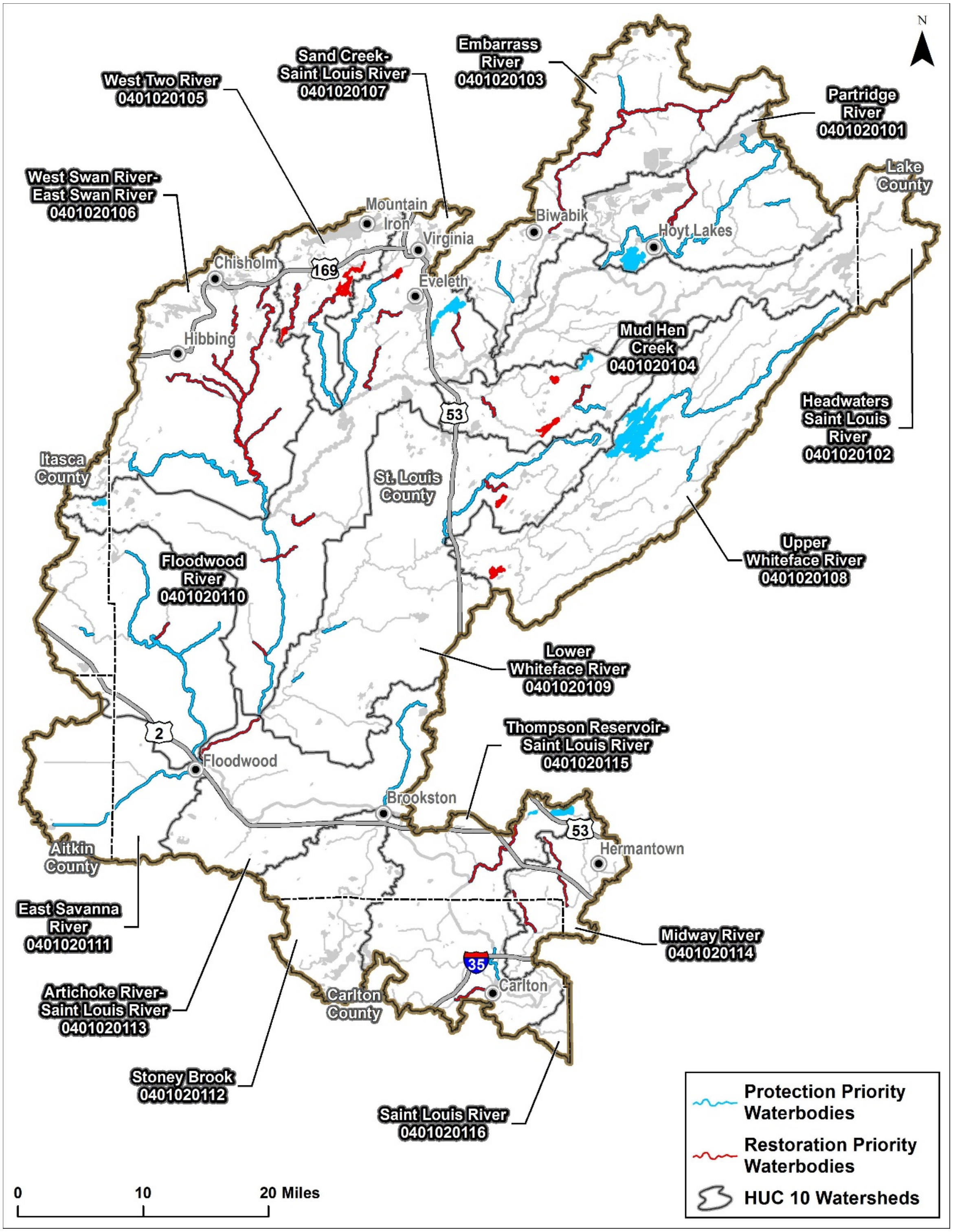


Figure 20. Priority protection and restoration waters.

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 a 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 initial prioritization and strategy development. Because many 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.

The implementation strategies, including associated scales of adoption and timelines, provided in this section are the result of technical input and professional judgement from Core Team members and related agency staff, based on what is known at this time and, thus, should be considered approximate. These strategies will be use to inform local water planning. Furthermore, many strategies are predicated on needed funding being secured. As such, the proposed actions outlined are subject to adaptive management—an iterative approach of implementation, evaluation, and course correction.

3.1 Targeting of Geographic Areas

The CWLA requires WRAPS to "**summarize … priority areas for targeting actions to improve water quality**" and "**identify nonpoint sources of pollution … with sufficient specificity to prioritize and geographically locate watershed restoration and protection actions**." A summary of point and nonpoint pollutant loading by subwatershed derived from watershed modeling results is provided in Section 2.3. The results identify areas with disproportionately high loading rates of various pollutants and can be used to focus implementation activities.

The approach used in the SLRW for WRAPS development has focused on Core Team leadership. Core Team input was the primary mechanism used to identify priority watersheds for strategy implementation over the next 10 years. The results of Core Team input are provided in Figure 21 and include the following priority subwatersheds: Swan River, Partridge River, and Upper Whiteface River. The Swan River Subwatershed is a priority for restoration activities, the Upper Whiteface River Subwatershed is a priority for protection activities, and the Partridge River Subwatershed is identified as a priority for both restoration and protection activities.

The individual waterbodies that were identified as priorities for restoration (all impaired waters) or protection (see Section 2.5) that are located in priority watersheds (Figure 21) are designated as those waters where strategies outlined in Section 3.4 will be focused over the next 10 years (Figure 22 through Figure 24).

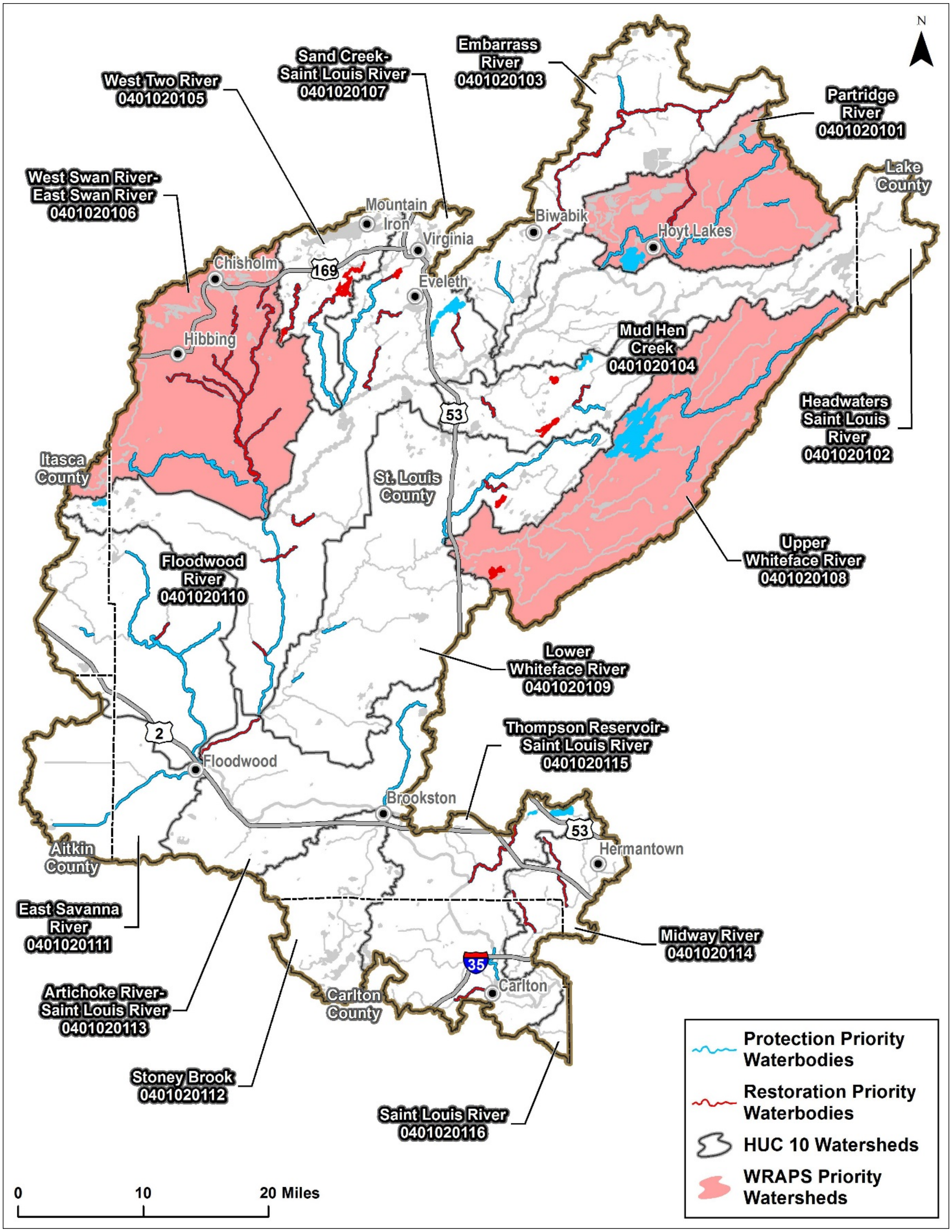


Figure 21. Priority subwatersheds in the SLRW.

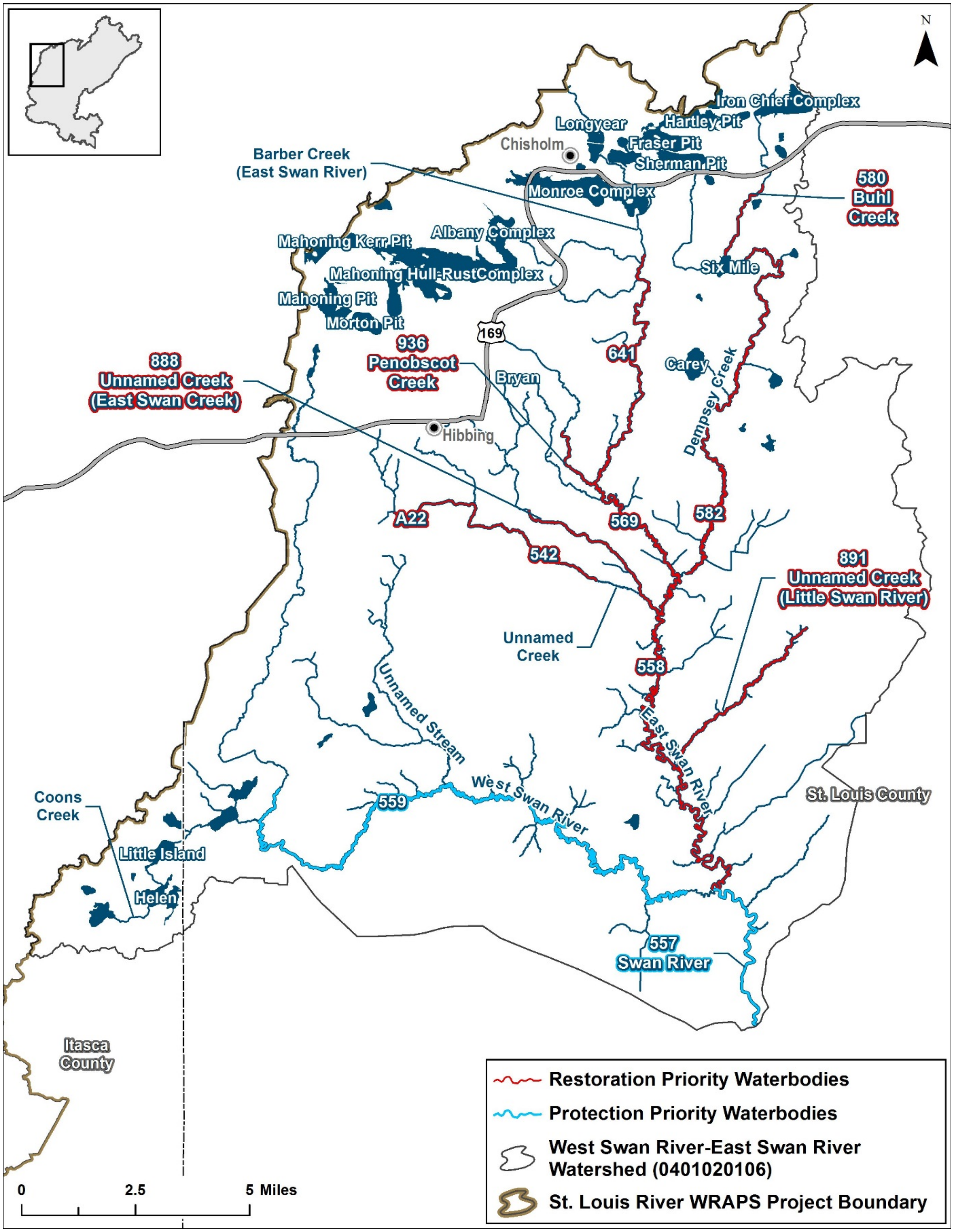


Figure 22. Swan River priority subwatershed.

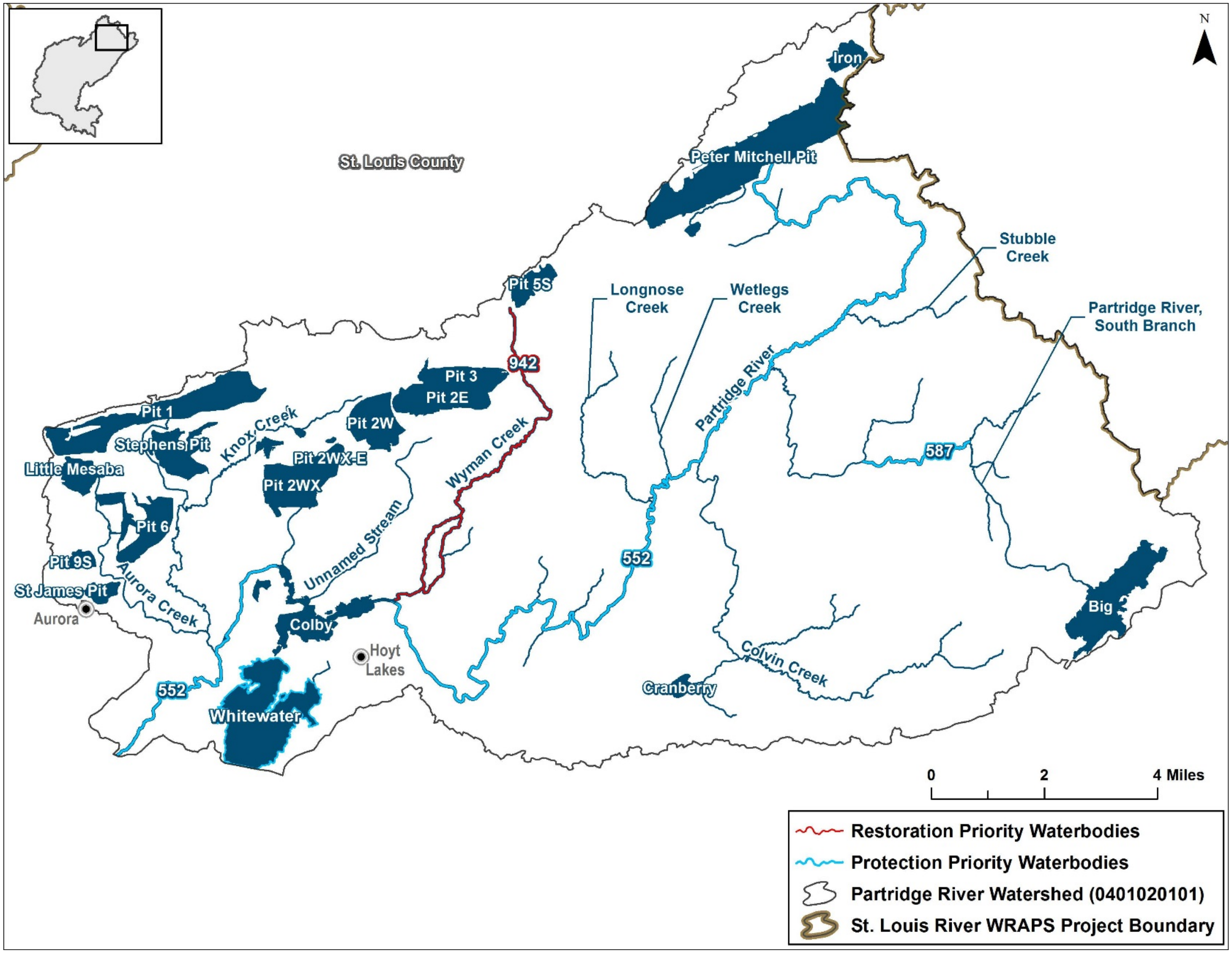


Figure 23. Partridge River priority subwatershed.

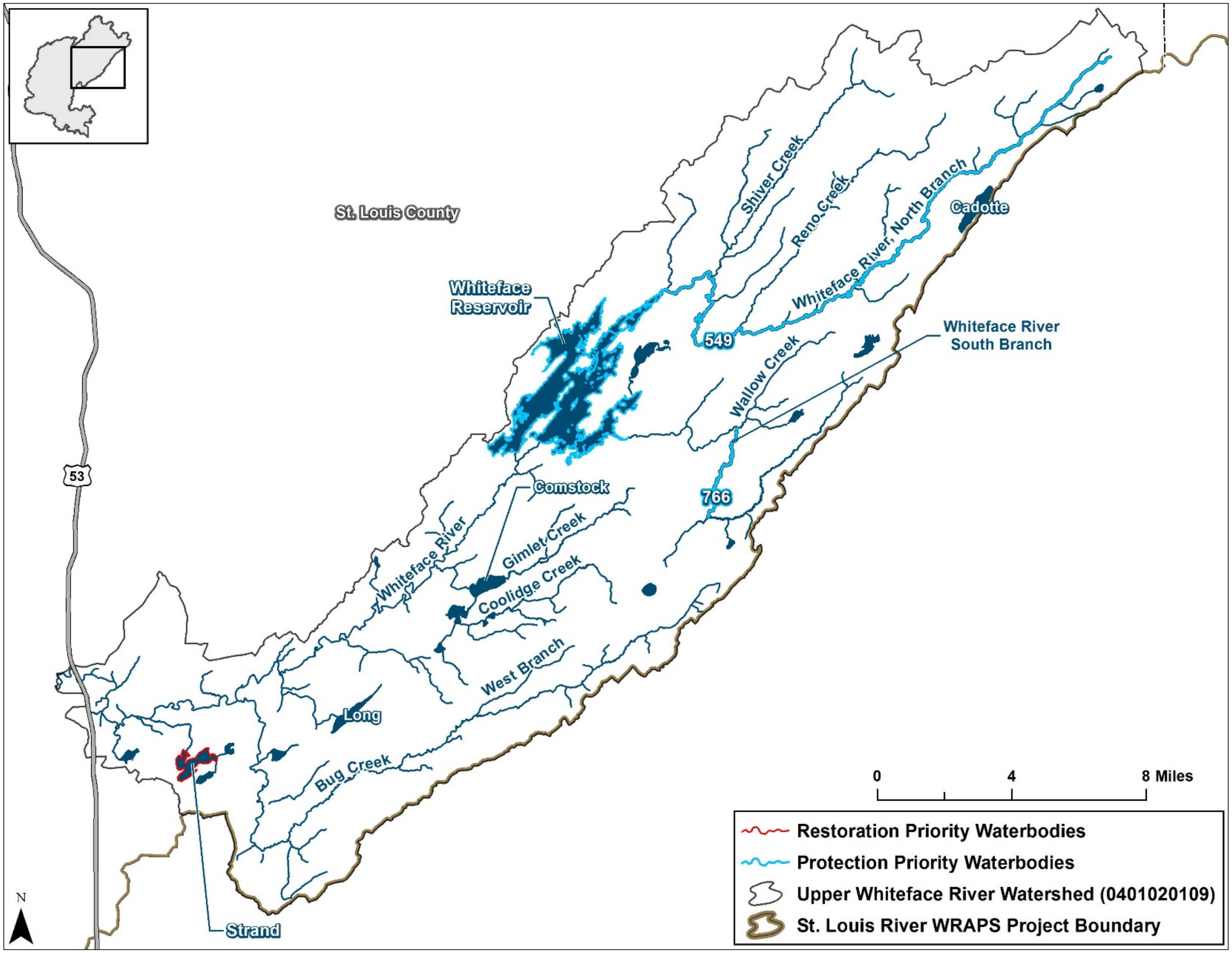


Figure 24. Upper Whiteface River priority subwatershed.

3.2 Civic Engagement

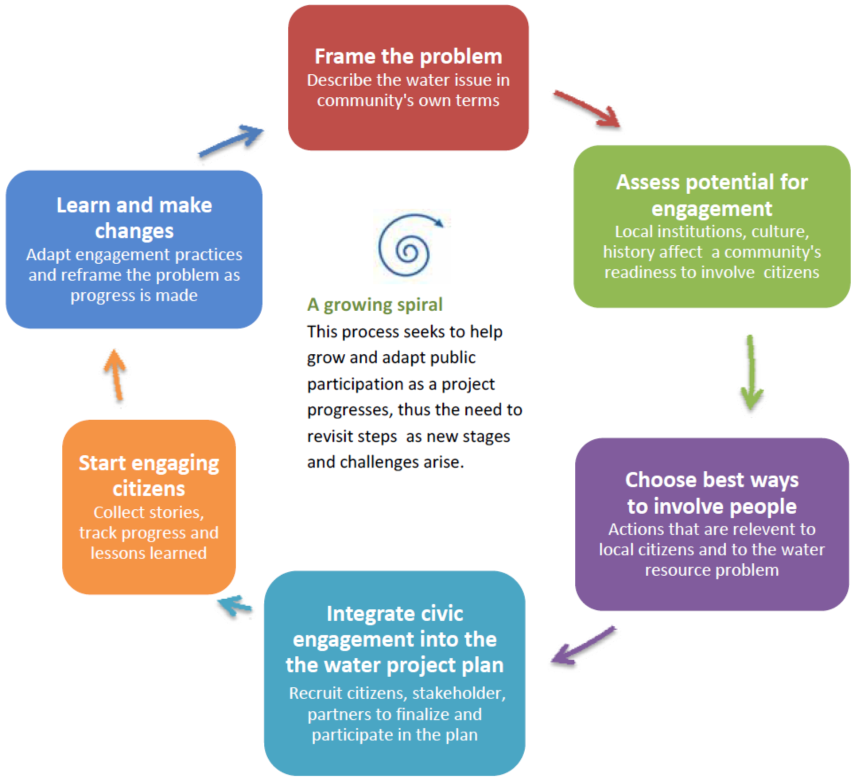
A key prerequisite for successful strategy development and on-the-ground implementation projects for restoring and protecting water quality is meaningful civic engagement. With approximately half of the land in the SLRW in private hands, the water quality in this watershed is ultimately dependent on how private landowners manage their land.

Civic engagement is distinguished from the broader term "public participation" in that civic engagement encompasses a higher, more interactive level of involvement. The University of Minnesota Extension's definition of civic engagement is "Making 'resourceFULL' decisions and taking collective action on public issues through processes that involve public discussion, reflection, and collaboration." Many local resource professionals in the SLRW, including the MPCA and SWCD staff, were formally trained by the University of Minnesota's Center for Community Vitality in this method of civic engagement in 2013 and 2014; therefore, this strategy informed much of the civic engagement efforts that took place in the SLRW for this first WRAPS cycle. More information on the University of Minnesota's civic engagement philosophy and methods are available at https://extension.umn.edu/community-development#leadership-development.

The St. Louis River WRAPS Civic Engagement team identified three goals for the civic engagement process in the watershed:

1. Introduce the public to the MPCA's new Watershed Approach to water quality assessment, the 10-year cycle, and the SLRW.
2. Start building a network of interested stakeholders within the watershed.
3. Convey the importance of having the public engaged and actively participating in the restoration and protection of the SLRW.

There are several levels of civic engagement identified by the International Association of Public Participation and used by the University of Minnesota in their civic engagement instruction modules: inform, consult, involve, collaborate, and empower. Each level provides for a deeper level of involvement from the public. Because this was the first ten-year cycle in this watershed, and because the WRAPS was a new process for the MPCA, civic engagement efforts were conducted on an informational and consulting level. During the second 10-year cycle, which begins in 2019, a deeper level of involvement from the public should be possible, given they are familiar with the watershed approach and their expected role in it.



There were three audiences for civic engagement efforts in the St. Louis River Watershed: citizens and landowners (the public), natural resources professionals making up a “Core Team,” and NPDES Permit holders.

A summary of the civic engagement activities and events that have been conducted thus far in the watershed are provided in Table 9 and Table 10. These events were led by the South St. Louis SWCD under contract with the MPCA. Staff from the MPCA and from the North St. Louis SWCD assisted.

The civic engagement process for the public was divided into three phases. These phases coincided with the three major documents that come out of the WRAPS process:

1. Monitoring and assessment report
2. Biotic SID Report
3. Final WRAPS document with TMDL calculations

A series of six public meetings, also called community conversations, were held across the watershed for each phase (Table 9).

Table 9. WRAPS public meeting dates and locations.

WRAPS Phase	Meeting Date	Meeting Location
Phase 1—Monitoring and Assessment Report	June, 2014	Giants Ridge, Biwabik
	June 4, 2014	Iron Range Resources and Rehabilitation Board Office, Virginia
	June 5, 2014	Inn on Lake Superior, Duluth
	June 5, 2014	Morgan Park Community Center, West Duluth
	June 7, 2014	MN Discovery Center, Chisholm
	June 10, 2014	Floodwood Elementary School, Floodwood
Phase 2—Biotic Stressor Identification Report	January 25, 2016	Duluth Heights Community Center, Duluth, in Cooperation with MN Sea Grant.
	June 25, 2016	Cloquet Forestry Center, Cloquet
	June 26, 2016	Canosia Town Hall, Pike Lake
	June 27, 2016	Mesabi Range College, Virginia
	June 28, 2016	Floodwood Elementary School, Floodwood
	June 30, 2016	Hoyt Lakes Community Center, Hoyt Lakes
Phase 3—WRAPS Report	October 3, 2017	Hoyt Lakes Community Center, Hoyt Lakes
	October 4, 2017	Range Regional Airport, Hibbing
	October 5, 2017	Hermantown Police Training Center, Hermantown

TMDLs were discussed at the public meetings listed above, and there were three meetings held for permit holders and lakeshore owners to address the TMDLs specifically (Table 10).

Table 10. TMDL public meeting dates, locations, and topics.

Date	Location	Topic/Audience
November 16, 2016	Iron Range Resources and Rehabilitation Board Office, Virginia	Draft TMDLs in the St. Louis River Watershed/Representatives from NPDES permit-holders in the watershed.
July 21, 2017	Miners Memorial Building, Virginia	Lake TMDLs–Impaired Lakes/ Lakeshore property owners and other interested parties.
July 21, 2017	Loon Lake Community Center	Lake TMDLs–Impaired Lakes/Lakeshore property owners and other interested parties.

The South St. Louis SWCD also provided updates and information about the St. Louis River WRAPS process in its outreach materials, including its ENews (seasonal) and Conservation News (annual) publications as noted below (see South St. Louis SWCD website for full texts):

- ENews, August 2013: “Hiking (and floating) rivers for the state”
- ENews, November 2013: “Field data collection keeps staff hoppin'”
- Conservation News 2014: “For the good of the ‘hood: watershed awareness begins with you”
- ENews, April 2014: “Watershed meetings set for June”
- ENews, August 2014: “June Watershed meetings well attended”
- Conservation News 2016: “SWCD continues to assist MPCA with investigating the health of area rivers and streams”
- ENews, June 2016: “St. Louis River Watershed 2016 Meeting Series”
- Conservation News 2017: “Duluth WRAPS”

The Core Team was an evolving concept in the development of the SLRW work. In early 2010, the Core Team consisted of South St. Louis SWCD staff and the MPCA staff with a focus on contractual management between the MPCA and the SWCD. However, by 2012, the concept of Core Teams in the MPCA’s watershed work was further developed to include municipal, county, state, and federal natural resource staff, as well as tribal natural resource partners and local environmental groups. Attendance by these various groups was sporadic, depending on the participant. Over time, the Core Team consisted of individuals from the following agencies and organizations:

- Aitkin County
- Carlton County
- City of Duluth
- Fond du Lac Band of Lake Superior Chippewa
- Itasca County SWCD
- Lake County SWCD
- BWSR
- MDA
- MDH
- DNR
- MPCA
- Natural Resource Conservation Services, Duluth Office
- North St. Louis SWCD
- South St. Louis SWCD
- St. Louis County
- St. Louis River Alliance
- EPA

- University of Minnesota–Duluth, Natural Resources Research Institute
- United States Forest Service

This group met 15 times between October 2012 and October 2017, with several additional, smaller focus meetings, to discuss the activities and decisions coming out of the WRAPS process. Meetings occurred on the following dates: 10/1/2012, 12/17/2012, 3/11/2013, 11/21/2013, 3/5/2014, 10/1/2014, 3/5/2015, 10/28/2015, 11/19/2015, 1/12/2016, 3/31/2016, 8/23/2016, 10/18/2016, 1/12/2017, and 2/7/2017.

Public Notice for Comments

An opportunity for public comment on the draft WRAPS report was provided via a public notice in the State Register from February 20, 2018, through March 22, 2018.

3.3 Technical and Financial Assistance

This section describes the technical and financial assistance needed to implement this plan.

Technical Assistance

Governmental units with primary implementation responsibility include the following entities:

- MPCA
- DNR
- BWSR
- Counties (St. Louis and Carlton)
- Soil and Water Conservation Districts (SWCDs); South St. Louis, North St. Louis, Carlton
- Municipalities

In addition, many other partners are anticipated to participate with implementation:

- 1854 Treaty Authority
- Fond du Lac Band of Lake Superior Chippewa
- Mining and forestry interests
- Non-profits (e.g., Trout Unlimited)
- Universities
- Land and business owners

Government agencies with secondary responsibilities include the MDA, MDH, USDA NRCS, USDA Forest Service, and Fish and Wildlife Service. These agencies will work with private landowners and other agencies and project partners to support implementation of this WRAPS.

Financial Assistance

The proposed WRAPS will rely on available funding sources to fund projects and programs. The level of implementation proposed for the first ten years is significantly higher than existing efforts, and will require new sources of funding for local capacity and capital improvement projects.

Potential funding sources for implementation activities in the SLRW include:

- Clean Water Fund, part of the Clean Water, Land, and Legacy Amendment
- Outdoor Heritage Fund, part of the Clean Water, Land, and Legacy Amendment
- Legislative-Citizen Commission on Minnesota Resources
- Conservation Partners Legacy Grants (DNR)
- Local government cost-share and loan programs
- Federal grants and technical assistance programs
- Conservation Reserve Program and NRCS cost-share programs
- Federal Clean Water Act Section 319 program for watershed improvements
- Great Lakes Restoration Initiative

3.4 Restoration & Protection Strategies

This section provides a summary of implementation strategies and actions for both restoration and protection. A summary of the general strategies applicable in the SLRW and example actions are provided in Table 11. Many of the strategies address more than one pollutant or stressor in the watershed, and therefore the table is organized by source or topic area.

Table 11. SLRW strategy key.

Strategy Description	Example Actions
Private Wastewater	
Address private wastewater systems (e.g., septic systems)	Inventory and assess the potential for septic systems/private wastewater systems to be sources of *E. coli* Replace all systems deemed Imminent Threat to Public Health (e.g., straight pipes, surface seepage) Provide for sewering around lakes; identify opportunities for cluster systems and work with landowners to implement Landowner focused education and outreach on septic system maintenance and compliance Support increased compliance inspections (in addition to current point of sale inspections); also required to get a building permit Additional setbacks in sensitive areas (e.g., lakeshore)
In-Stream Improvements	
Implement activities to address findings in the Swan River Subwatershed Geomorphic Study (SSLSWCD 2013, see Appendix C)	Properly size and place bridges and culverts for flow, stream stability, and fish passage Develop feasibility studies and direct restoration work on unstable streams Grade control above headcuts

	Install floodplain culverts where appropriate Stormwater retention BMPs Connect unstable or incised reaches to the existing or restored floodplain
Implement recommendations from the St. Louis River Watershed Connectivity Analysis (see Appendix D)	Repair or replace improperly sized culverts
Stream restoration and improved ditch management Altered watercourse improvements	Geomorphic assessment and feasibility study to determine restoration opportunities Restore channelized reaches (re-meander, connect to floodplains) Mitigate peak flows Restore natural meanders and complexity Address inadequate road crossings—crossings preventing fish passage, crossings that are not sized correctly/causing streambed and channel erosion Address channel incision (e.g., provide grade control) Address erosion in near-shore areas (bank stabilization, bioengineering, etc.) Improve connections with groundwater when needed
Stream crossing and culvert improvements Remove fish passage barriers	Properly size and place bridges and culverts for flow, stream stability, and fish passage Coordinate with local, county, and state transportation departments to ensure bridge or culvert replacements are designed and constructed to eliminate fish passage barriers and erosion problems DNR to meet annually with county transportation departments; ensure DNR has updated geomorphic assessments and fish passage data annually
Reduce effect of altered flow conditions	Evaluate the impact of Ely Lake water level management and develop recommendations for low flow/drought conditions
In-Lake Improvements	
Reduce internal release of phosphorus	Investigate sources of internal loading, such as resuspension of sediment from the lake bed Evaluate the potential drivers of internal loading and options to reduce Consider in-lake treatment once external sources of phosphorus have been controlled
Shallow lake standards	Continue to pursue shallow lakes standards for the Northern Lakes and Forests ecoregion
Protect and stabilize nearshore areas (lakeshores)	Shoreland survey—evaluate the shoreland and identify areas of disturbance, such as altered vegetation (e.g., lawns), bare soil, and shoreland erosion Use bioengineering practices and BMPs to prevent erosion and protect water quality
Invasive species management (zebra mussels)	Control zebra mussels Encourage watercraft inspections (see DNR aquatic invasive species program) Monitoring of lake clarity and food web
Wetlands	
Wetland management	Complete assessment of wetland functions Determine priority locations for functional uplift Identify priority areas for wetland restoration Promote wetland banking activities
Wetland restoration	Use ditch blocks and vegetation to restore ditched wetland and peatland areas
Agriculture	
Feedlot and livestock management	Update feedlot and livestock inventory every 10 years

	Open lot runoff management to meet 7020 rules Manure storage in ways that prevent runoff
Feedlot, pasture, and livestock management	Provide outreach and education to animal agriculture producers and animal hobby farm owners Riparian corridor survey for livestock exclusion, increase livestock exclusion Encourage rotational grazing Improve and expand riparian buffers adjacent to pasture and hay lands
Forestry	
Open lands management	Evaluate the effect of forestry practices on altered hydrology and develop recommendations for open land management Update open lands assessment
Forestry management	Develop and implement forest stewardship plans for private lands Education and outreach for publicly owned lands Updated forestry ordinances or guidelines; encourage compliance with MN Forest Resources Council Forest Management Guidelines Forest road management (active and inactive) Education, outreach and training Develop public-private partnerships to promote forest stewardship Encourage Reinvest in Minnesota-type activities (e.g., conservation easements) in forested areas
Stormwater	
Reduce urban bacteria from pets and stormwater	Pet waste management programs (in developed areas) BMPs to reduce pollutant loading, including pervious pavers and other volume control practices Stormwater control measures practices to reduce peak flows and volumes BMPs to reduce pollutant loading—see MPCA Stormwater Manual: http://stormwater.pca.state.mn.us/index.php/Information_on_pollutant_removal_by_BMPs Connecting imperviousness surfaces on the landscape to increase infiltration
Stockpile runoff controls	Ensure adequate erosion control BMPs Use liners and runoff capture
Point Sources	
Reduce industrial/municipal wastewater discharges	Address inflow/infiltration Upgrade leaky wastewater infrastructure in urban areas Investigate presence of untreated wastewater in stream(s) and correct upstream problems Plant upgrades/expansion Consider regionalized wastewater treatment solutions Reduce point source loading (per TMDL)
Monitoring	
Monitoring	Point source monitoring (wastewater and industrial) Conduct bio-assessments and collect water quality data at established in-stream sites

	Collect additional in-stream data to further evaluate sources and stressors (e.g., biochemical oxygen demand, nitrates, TSS , sulfate, total dissolved solids, specific conductivity, flow) Conduct longitudinal survey of *E. coli* concentrations to identify sources and target implementation activities Collect in-lake water quality data (e.g., phosphorus, chlorophyll-*a*); collect water quality and flow data on tributaries to lakes Continue to monitor biota and evaluate the effect of natural background conditions on impairments Evaluate DO flux as a stressor on biota in the watershed Study the potential causes of low DO and high DO flux and develop strategies to address source(s) Evaluate the success of completed stream restoration projects
Research	
Surface and groundwater interaction study	Surface water–groundwater interaction study to understand and address effects of mine dewatering and discharge (positive and negative) on regional groundwater and stream baseflow (current research is being conducted by the USGS and Fond du Lac)
Reduce effect of current and legacy mining activities Understand role of sulfur, specific conductivity, and iron in aquatic environments	Further evaluate effect of current and legacy mining activities on water quality and altered flow conditions (current research is being conducted by the USGS and Fond du Lac) Study the effect of iron, specific conductivity, and sulfur on biota impairments and determine source and cause of toxicity; develop strategies to address anthropogenic sources and causes (specific streams for inclusion include West Two River, Kinney Creek, Manganika Creek, Spring Mine Creek, Embarrass River, and Wyman Creek)
Account for and evaluate beaver activity and potential for stream restoration	Study effect of beaver activity on natural flow conditions and water quality and develop regional strategies. Streams with known beaver impacts include Water Hen Creek (A31 and A35), Elbow Creek, Unnamed (Little Swan) Creek, and Wyman Creek.
Planning and Ordinances	
Land use planning and ordinances	Land use planning and implementation of local and county water plans Ordinance development/revision and workshops
Conservation easements and acquisitions	Conservation easements to protect riparian, wetland, sensitive headwaters, and high quality upland areas Acquisition of land for enhancing/protecting habitat and water quality
Education	
Education and outreach	Education and outreach on best shoreland management practices Provide focused education and outreach to lake users on harmful algal blooms and lake water quality concerns Continued implementation of a watershed and water quality education and outreach program focused on: · Riparian users/owners (lakes and streams) · Municipal operations · Forestry activities · Septic system maintenance and compliance · Stakeholders and residents

Figure 25 through Figure 27 summarize the opportunities for watershed-wide strategies where there are spatial data to assist with identifying implementation opportunities (i.e., wetland management, feedlot and livestock management, and altered stream restoration). The restorable wetlands (Figure 25) are derived from a BWSR study completed in 2010 for northeastern Minnesota. In addition to this dataset, the National Wetlands Inventory (NWI) was recently updated for most of the SLRW. The updated NWI also identifies wetlands that are potentially degraded. Figure 26 includes data provided by the MPCA on registered feedlots in the watershed and additional information provided by St. Louis County. Figure 27 displays the altered streams as developed by the MPCA and Minnesota Geospatial Information Office as part of the statewide altered watercourse project. These streams are identified as altered or impounded and likely offer opportunities for restoration.

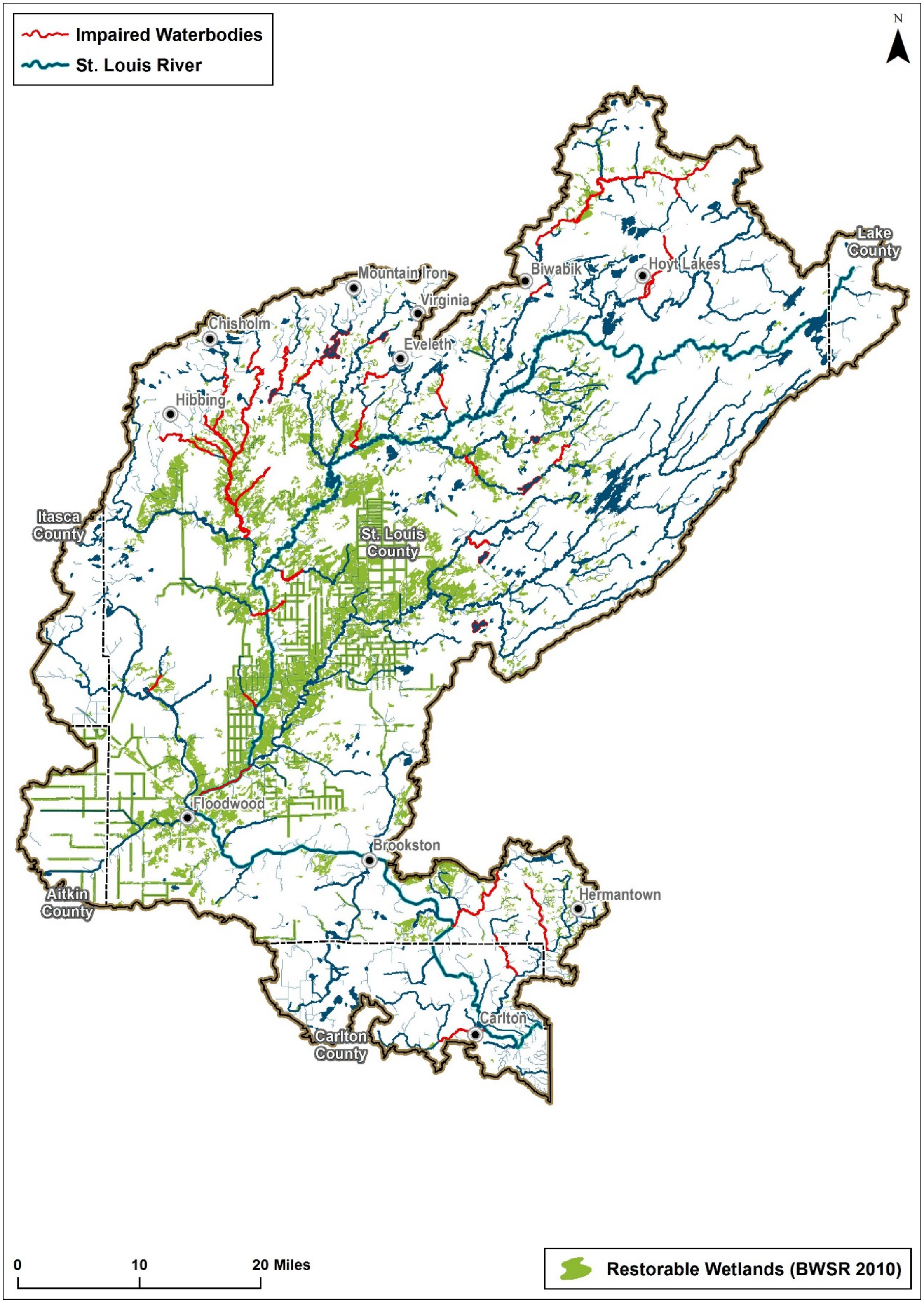


Figure 25. Restorable wetlands (BWSR 2010).

The restorable wetlands do not reflect the Fond du Lac wetland restoration analysis and prioritization for wetlands on the reservation.

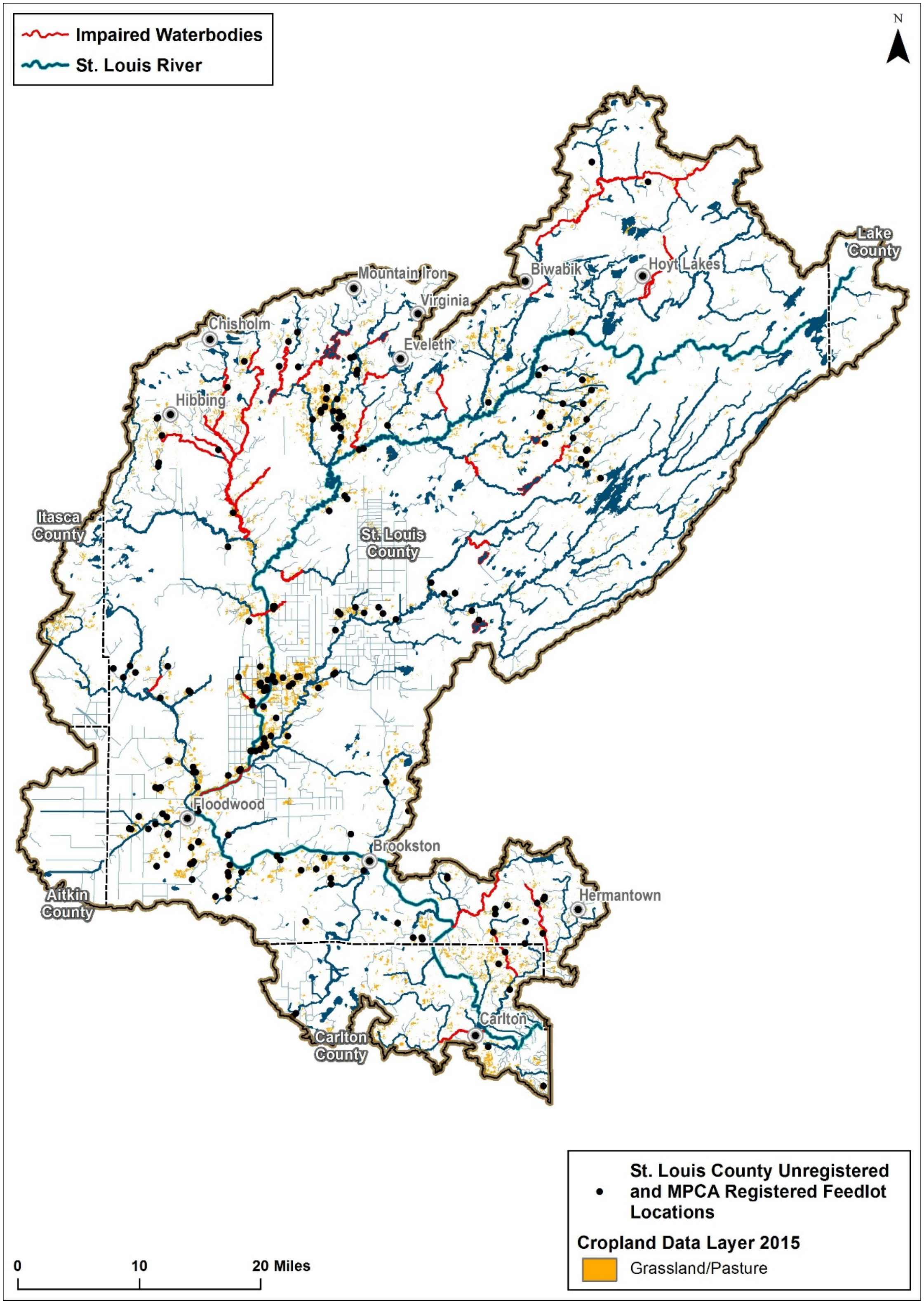


Figure 26. Feedlot and pasture locations.

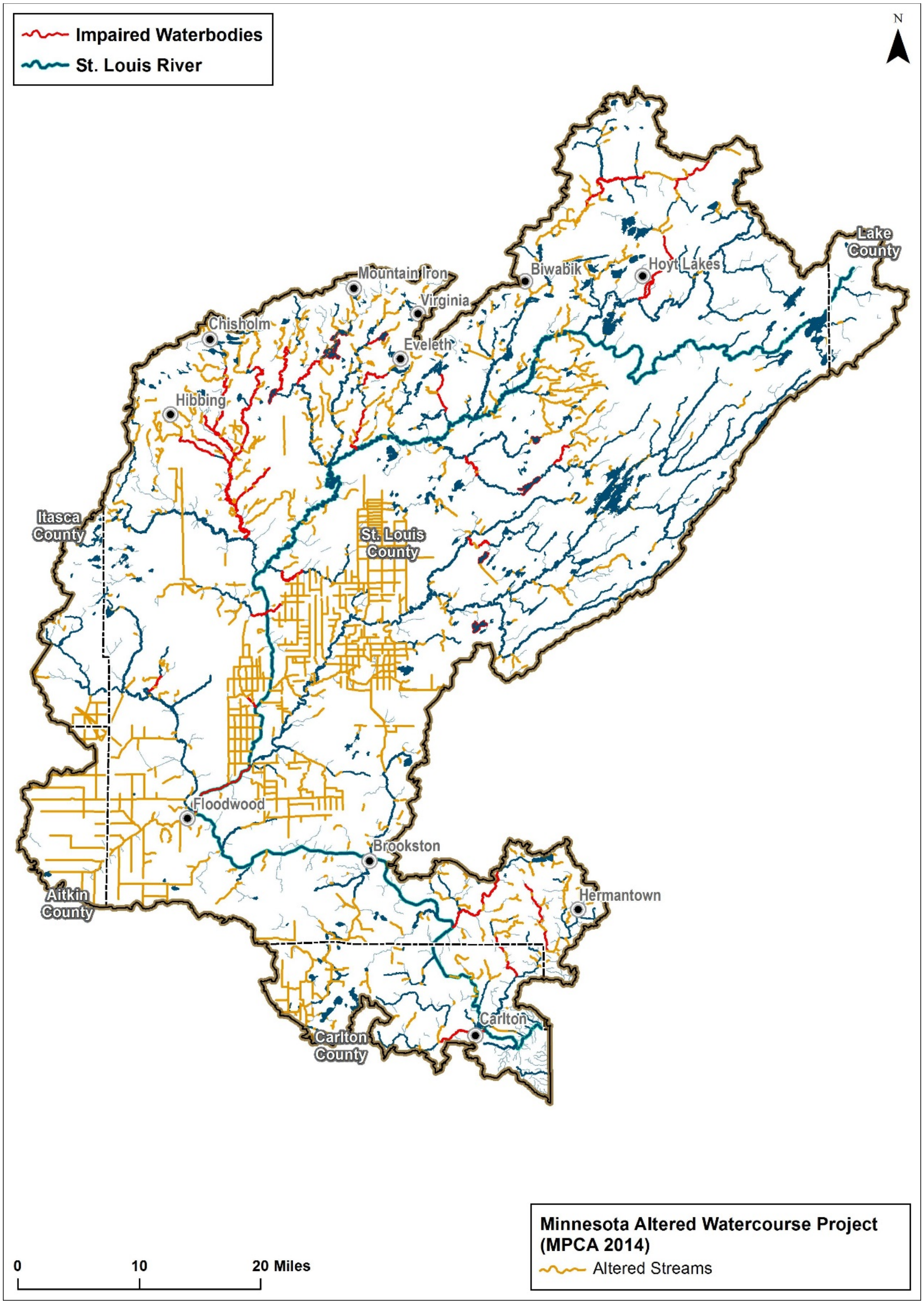


Figure 27. Altered streams.

There are several strategies that apply across the entire watershed; these are provided in a watershed-wide summary table (Table 12). The strategies in Table 11 are then provided at a reach (AUID) scale by HUC10 watershed in Sections 3.4.1 through 3.4.5. Each HUC10 watershed is grouped into one of five focus areas (Figure 28). For each focus area, a map and summary table are provided. The summary tables include the following information:

- ***Water Quality – Current Conditions:*** "Current" condition is interpreted as the baseline condition over the evaluation period for the pollutant or non-pollutant stressor identified in the previous column. Current loads are presented as concentration and load when applicable and represent available data sources.
- ***Water Quality – Goals / Targets:*** Includes a water quality concentration target that is derived from water quality standards or through the lake prioritization process presented in Section 2.5.
- ***Water Quality – Estimated % and Load Reduction by Flow Regime:*** Expressed in the same terms as Current Conditions and includes a load reduction and/or percent reduction of pollutant needed to meet the water quality goal/target.
- ***Strategies:*** This column provides the high-level strategies to be used for both protection and restoration as described in Table 11. Strategies outline the method, approach, or combination of approaches that could be taken to achieve water quality goals.
- ***Strategy Type and Estimated Scale of Adoption Needed to Meet Final Water Quality Target:*** This column ties to the strategies column and generally describes the magnitude of effort that it will take to achieve the water quality target. This estimate is meant to describe approximately "what needs to happen" but does not detail precisely "how" goal attainment will be achieved (the latter is left to subsequent local water planning steps). This is an approximation only and subject to adaptive management.
- ***10-yr Milestones:*** Describes progress to be made toward implementing the strategy in the first 10 years from completion of the WRAPS report. Note that some waterbodies do not have any planned activity during the first 10 years. These waterbodies are lower priority, and activities are expected to take place in the future.
- ***Suggested Goal:*** Describes the ultimate implementation goal.
- ***Governmental Units with Primary Responsibility:*** Identifies the governmental unit with primary responsibility. Other government entities as well as stakeholders, non-profits, and non-governmental organizations will likely support these strategies.
- ***Estimated Year to Achieve Water Quality Targets:*** This applies to the waterbody, specifically the year it is reasonably estimated that applicable water quality targets will be achieved.

Figure 28. WRAPS strategy focus areas in the SLRW.

Table 12. Watershed-wide strategies and actions proposed for the St. Louis River Watershed.

Parameter (incl. non-pollutant stressors)	Strategies (see key)	Example strategy types and estimated scale of adoption needed to meet final water quality target	10-year Milestone	Suggested Goal	MPCA	MN DNR	BWSR	SWCD	County	Municipalities	Estimated Year to Achieve Water Quality Target
As cited in the permit	Construction and Industrial Stormwater permittees—compliance with general permits				x						On-going
All	Wetland management	Complete assessment of wetland functions Determine priority locations for functional uplift Identify priority areas for wetland restoration activities (see Figure 25) Promote wetland banking activities	Wetland functional assessment and identified priorities	Implement wetland restoration activities in priority areas	x	x	x	x	x	x	On-going
	Stream restoration and improved ditch management Altered watercourse improvements	Geomorphic assessment and feasibility study to determine restoration opportunities (see Figure 27) Restore channelized reaches (re-meander, connect to floodplains) Mitigate peak flows Restore natural meander and complexity Address inadequate road crossings—crossings preventing fish passage, crossings that are not sized correctly/causing streambed and channel erosion Address channel incision (e.g., provide grade control) Restore riffle substrate where appropriate Address erosion in near-shore areas (bank stabilization, bioengineering, etc.) Improve connections with groundwater when needed	Identify best sites for potential restoration	Implement stream improvement and restoration projects in priority areas		x		x			On-going
	Protect and stabilize nearshore areas (lakeshore)	Shoreland surveys—evaluate the shoreland and identify areas of disturbance, such as altered vegetation (e.g., lawns), bare soil, and shoreland erosion Use bioengineering practices and BMPs to prevent erosion and protect water quality	–	Completed surveys Implement shoreline BMPs such that the majority of lakeshore owners are implementing BMPs		x		x			On-going
	Feedlot management	Update feedlot and livestock inventory every 10 years Open lot runoff management to meet 7020 rules Manure storage in ways that prevent runoff	Update livestock and feedlot inventory	Update livestock and feedlot inventory every 10 years All feedlots in compliance with 7020 Rules	x			x	x		On-going
	Reduce effect of current and legacy mining activities Understand role of sulfur, specific conductivity, and iron in aquatic environments	Further evaluate effect of current and legacy mining activities on water quality and altered flow conditions Study the effect of iron, specific conductivity, and sulfur on biota impairments and determine source and cause of toxicity; develop strategies to address anthropogenic sources and causes	Identify potential research opportunities Begin research and data collection	Completed studies and integrate findings into WRAPS process	x	x		x			2025
	Account for and evaluate beaver activity and potential for stream restoration	Study effect of beaver activity on natural flow conditions and water quality and develop regional strategies. Streams with known beaver impacts include Water Hen Creek (A31 and A35), Elbow Creek, Unnamed (Little Swan) Creek, and Wyman Creek.	Identify potential research opportunities Begin research and data collection	Completed study Integrate findings into WRAPS process		x		x			2025

Parameter (incl. non-pollutant stressors)	Strategies (see key)	Example strategy types and estimated scale of adoption needed to meet final water quality target	10-year Milestone	Suggested Goal	MPCA	MN DNR	BWSR	SWCD	County	Municipalities	Estimated Year to Achieve Water Quality Target
All	Forestry management	Updated open lands assessment Develop and implement forest stewardship plans for private lands Education and outreach for publicly owned lands Updated forestry ordinances or guidelines; encourage compliance with MN Forest Resources Council Forest Management Guidelines Forest road management (active and inactive) Education, outreach and training Develop public-private partnerships to promote forest stewardship Encourage Reinvest in Minnesota-type activities (e.g., conservation easements) in forested areas	Updated open lands assessment Develop 3 forest stewardship plans each year Adopt updated ordinance and guidelines at the county level	Develop 3 forest stewardship plans each year		x		x	x		2030
	Conservation easements and acquisitions	Conservation easements to protect riparian, wetland, sensitive headwaters, and high quality upland areas Acquisition of land for enhancing/protecting habitat and water quality	On-going			x	x		x		On-going
	Stream crossing and culvert improvements	Coordinate with local, county, and state transportation departments to ensure bridge or culvert replacements are designed and constructed to eliminate fish passage barriers and erosion problems DNR to meet annually with county transportation departments; ensure DNR has updated geomorphic assessments and fish passage data annually	Annual meetings between DNR and county transportation departments to crosswalk county plans and needed crossing upgrades			x		x	x		On-going
	Address private wastewater systems (e.g., septic systems)	Identify opportunities for cluster systems and work with landowners to implement Landowner focused education and outreach on septic system maintenance and compliance Support increased compliance inspections (in addition to current point of sale inspections); also required to get a building permit	Develop and implement program to complete inspections on all lakes Education and outreach materials for all shoreland owners with septic systems	Develop and implement program to complete inspections in all shoreland areas Update lake inspections every 10-years				x	x	x	On-going
	Education and outreach	Continued implementation of a watershed and water quality education and outreach program focused on: · Riparian users/owners (lakes and streams) · Municipal operations · Forestry activities · Septic system maintenance and compliance · Stakeholders and residents	On-going					x			On-going
	Land use planning and ordinances	Land use planning and implementation of local and county water plans Ordinance development/revision and workshops Drinking water protection planning and implementation (e.g., St. Mary's Lake)	Identify target year to begin One Water One Plan or updated Water Plan; integrate findings from WRAPS into updated Plan Host workshop on water quality and watershed ordinances Complete ordinance reviews and provide recommendations on updates	Approved One Water One Plan or Water Plan Updated ordinances as needed to achieve plan goals			x	x	x	x	2030

3.4.1 Headwaters St. Louis River

The major drainages in the Headwaters St. Louis River focus area are the Embarrass River, the Partridge River, the St. Louis River, and Mud Hen Creek (Figure 29). The Partridge River priority restoration and protection subwatershed (Section 3.1, Figure 21) is located in this focus area.

The dominant land covers are forest and wetlands, with some agricultural land uses. The northern portion of the focus area along the Iron Range includes historical and current mining operations that have substantially altered the landscape, including hydrologic modifications such as active mine pit pumping, resulting changes in the interaction between groundwater and surface waters, evaporation from inactive mine pits, and discharges that contain constituents such as sulfur, iron, and other dissolved elements. Future mining pressures exist in the north-northeast part of the focus area.

Several small cities are located in the focus area, including Hoyt Lakes, Aurora, Biwabik, and Gilbert. The remaining areas are relatively undisturbed, with large portions under state and federal ownership. Logging and forestry activities occur throughout this area.

Nutrient, sediment, and pathogen concentrations are low on average. Several streams have aquatic life impairments—the Embarrass River, Spring Mine Creek, Water Hen Creek, and Wyman Creek. The impaired reaches are relatively low gradient, moderately sinuous, and are wetland influenced. Beaver dams affect channel pattern, stream habitat, and the slope of the water surface, and habitat is limited due to fine substrates and a lack of riffle-run features. Mining activities play a significant role in the landscape of these impaired streams—Spring Mine Creek originates in Spring Mine Lake, which is located in an intensely mined area, and Wyman Creek originates from abandoned mine pits. Mud Hen Lake has an aquatic recreation impairment. The primary sources of phosphorus to Mud Hen Lake are from watershed runoff, including pasture and cropland runoff and shoreline development, in addition to internal loading.

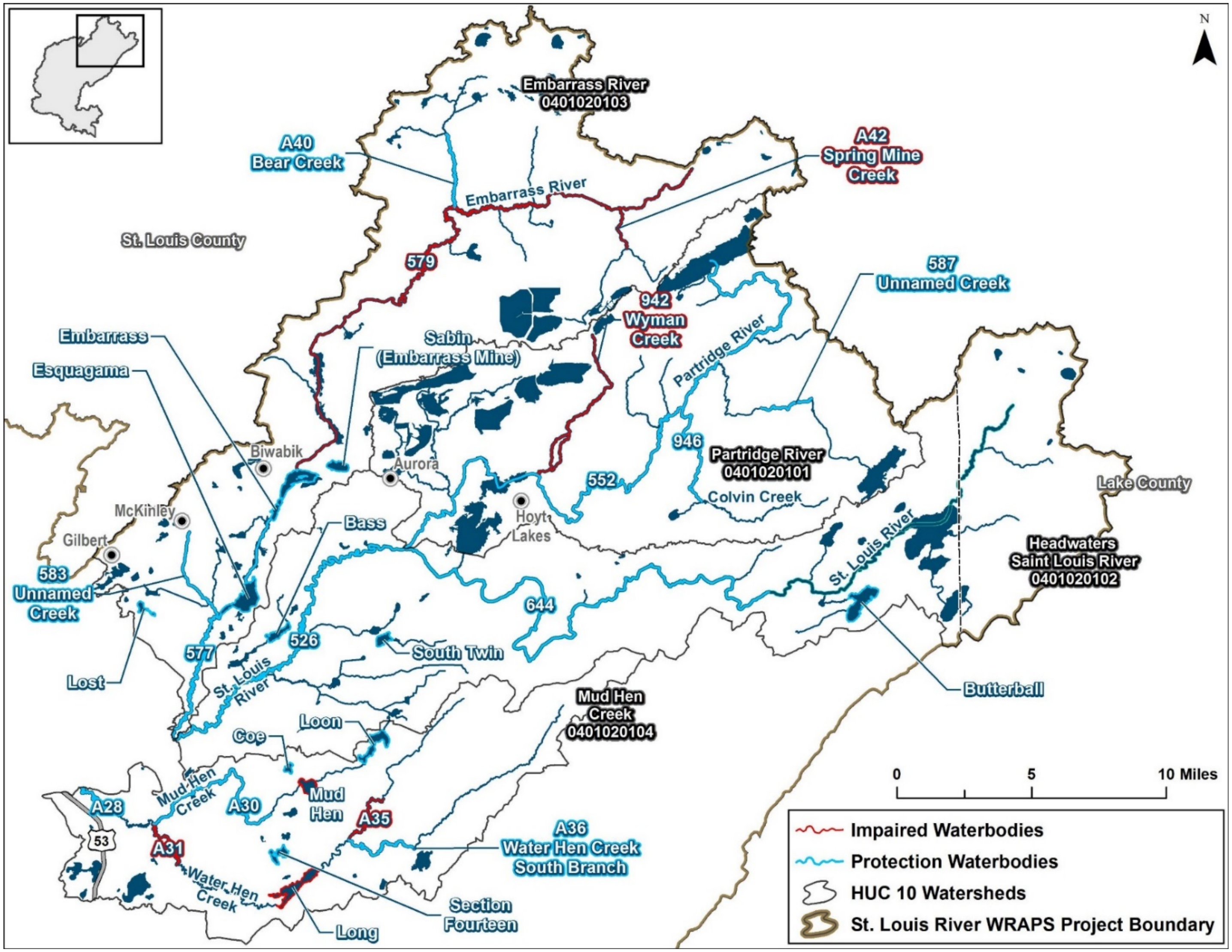


Figure 29. Headwaters St. Louis River WRAPS strategy focus area.

Table 13. Strategies and actions proposed for the Headwaters St. Louis River Focus Area, St. Louis River Watershed.

Partridge River Subwatershed is identified as a priority watershed; **BLUE** waterbodies are priority waters for protection; **RED** waterbodies are priority waters for restoration

HUC-10 Subwatershed	Waterbody	Location and Upstream Influence Counties	Parameter (incl. non-pollutant stressors)	Current Conditions: Concentration (load)	Goals / Targets	Estimated % and Load Reduction by Flow Regime	Strategies	Example strategy types and estimated scale of adoption needed to meet final water quality target	10-Year Milestone	Suggested Goal	MPCA	MN DNR	BWSR	SWCD	County	Municipalities	Estimated Year to Achieve Water Quality Target
Partridge River (401020101) – Priority Watershed	**Partridge River (552)**	St. Louis	–	Mean *E. coli* = 36 org/100 mL; Mean TP = 2 µg/L; Mean TSS = 4 mg/L	–	–	See watershed-wide strategies										
	Unnamed Creek (587)	St. Louis	–	Mean *E. coli* = 24 org/100 mL; Mean TP = 2 µg/L; Mean TSS = 3 mg/L	–	–											
	Whitewater (69-0376-00)	St. Louis	–	Mean TP = 13 µg/L; Mean transparency = 3.3 m	–	–											
	Colvin Creek (946)	St. Louis	–	–	–	–											
	Wyman Creek (942)	St. Louis	F-IBI, DO, temperature, altered hydrology/ connectivity, (habitat/iron precipitate, iron toxicity, sulfate toxicity) **Temperature TMDL**	Thermal regime is marginal to poor for supporting brook trout and other coldwater obligate fish species. DO concentrations are frequently < the 7 mg/L standard for extended periods of time.	Temperature ≤ 20 deg. C DO ≥ 7.0 mg/L	10% reduction in thermal loading	Increased forest cover in riparian areas	Riparian vegetative buffers Tree planting to increase shading Consider beaver removal and forest management to diversify forest cover and tree species within the stream corridor (to limit beavers)	No 10-year milestone; riparian management should take place following beaver dam removal	Shade in the lower reaches of Wyman Creek equals 57% on average Shade in the reach upstream of the braid such that temperatures are reduced to 19.7 degrees Celsius during critical conditions		X		X	X		2040
							Increase stream flow/reduce ponded water	Beaver dam removal; long-term beaver removal/management.	Beaver management plan Begin implementation of plan focused on reducing in-stream temperatures upstream of the braid	Beaver dam and beaver management necessary to achieve water quality goals, as determined through adaptive management and monitoring		X		X			On-going
							Beaver dam removal at headwater of braided stream	Removal of beaver dam creating braided stream in lower reaches (downstream end of reach 6).	Removal of dam	Flow re-routed to eastern arm of braid		X		X			2020
							See watershed-wide strategies										

HUC-10 Subwatershed	Waterbody	Location and Upstream Influence Counties	Parameter (incl. non-pollutant stressors)	Current Conditions: Concentration (load)	Goals / Targets	Estimated % and Load Reduction by Flow Regime	Strategies	Example strategy types and estimated scale of adoption needed to meet final water quality target	10-Year Milestone	Suggested Goal	MPCA	MN DNR	BWSR	SWCD	County	Municipalities	Estimated Year to Achieve Water Quality Target
Headwaters St. Louis River (401020102)	Butterball (69-0044-00)	Lake, St. Louis	–	–	–	–	See watershed-wide strategies										
	South Twin (69-0420-00)	Lake, St. Louis	–	–	–	–	See watershed-wide strategies										
	Bass (69-0553-00)	Lake, St. Louis	–	–	–	–	See watershed-wide strategies										
	St. Louis River (526)	Lake, St. Louis	–	–	–	–	See watershed-wide strategies										
	St. Louis River (644)	Lake, St. Louis	–	Mean TSS = 4 mg/L	–	–	See watershed-wide strategies										
Embarrass River (401020103)	Embarrass River (577)	St. Louis	–	Mean *E. coli* = 53 org/100 mL; Mean TP = 2 µg/L; Mean TSS = 3 mg/L	–	–	See watershed-wide strategies										
	Embarrass River (579)	St. Louis	F-IBI, DO, (altered hydrology) **No TMDL—Nonpollutant stressors**	>44% of the DO point measurements are less than the 5 mg/L water quality standard	–	–	Monitor and further evaluate	Continue to monitor and evaluate the effect of natural background conditions on low DO conditions and impairment	Complete updated assessment and update 303(d) list as appropriate	Complete updated assessment and update 303(d) list as appropriate	x						2027
							Reduce effect of current and legacy mining activities	Determine effect that moving the river had on biota and altered hydrology; identify mitigation measures	Identify potential research opportunities Begin research and data collection	Complete study and integrate findings into WRAPS process	x	x					2025
							Open lands management	Evaluate the effect of forestry practices on altered hydrology and develop recommendations for open land management Update open lands assessment	Updated open lands assessment	Ordinances or guidelines to implementation recommendations from open lands assessment		x		x	x		2030
							Implement recommendations from the St. Louis Connectivity Analysis	Repair or replace improperly sized culverts at crossings	–	Repair or replace improperly sized culverts		x			x		2035

HUC-10 Subwatershed	Waterbody	Location and Upstream Influence Counties	Parameter (incl. non-pollutant stressors)	Current Conditions: Concentration (load)	Goals / Targets	Estimated % and Load Reduction by Flow Regime	Strategies	Example strategy types and estimated scale of adoption needed to meet final water quality target	10-Year Milestone	Suggested Goal	MPCA	MN DNR	BWSR	SWCD	County	Municipalities	Estimated Year to Achieve Water Quality Target
Embarrass River (401020103), continued	**Spring Mine Creek (A42)**	St. Louis	F-IBI, M-IBI, DO, DO flux, (sulfate toxicity, specific conductivity, habitat) **TMDL deferred**	DO flux frequently > 5–6 mg/L	–	–	Monitor and further evaluate	Study the potential causes of low DO and high DO flux and develop strategies to address source(s)	Complete updated assessment and update 303(d) list as appropriate	Complete updated assessment and update 303(d) list as appropriate	x						2027
							Open lands management	Evaluate the effect of forestry practices on altered hydrology and develop recommendations for open land management Update open lands assessment	Updated open lands assessment	Ordinances or guidelines to implementation recommendations from open lands assessment		x		x	x		2030
							Surface and groundwater interaction study	Surface water-groundwater interaction study to understand and address effects of mine dewatering and discharge (positive and negative) on regional groundwater and stream baseflow (current research is being conducted by the USGS and Fond du Lac)	Identify potential research opportunities Begin research and data collection	Completed study and integrate findings into WRAPS process	x	x					2025
	Bear Creek (A40)	St. Louis	–	–	–	–	See watershed-wide strategies										
	Sabin (Embarrass Mine) (69-0429-00)	St. Louis	–	–	–	–	See watershed-wide strategies										
	Embarrass (69-0496-00)	St. Louis	–	–	–	–	See watershed-wide strategies										
	Esquagama (69-0565-00)	St. Louis	–	–	–	–	See watershed-wide strategies										
	Lost (69-0611-00)	St. Louis	–	–	–	–	See watershed-wide strategies										

HUC-10 Subwatershed	Waterbody	Location and Upstream Influence Counties	Parameter (incl. non-pollutant stressors)	Current Conditions: Concentration (load)	Goals / Targets	Estimated % and Load Reduction by Flow Regime	Strategies	Example strategy types and estimated scale of adoption needed to meet final water quality target	10-Year Milestone	Suggested Goal	MPCA	MN DNR	BWSR	SWCD	County	Municipalities	Estimated Year to Achieve Water Quality Target
Mud Hen Creek (401020104)	Unnamed Creek (583)	St. Louis	–	–	–	–	Pasture and livestock management	Riparian corridor survey for livestock exclusion, increase livestock exclusion Encourage rotational grazing		Riparian corridor survey complete All livestock and hobby farms practicing livestock exclusion and appropriate manure management				x			–
	Mud Hen Creek (A28)	St. Louis	–	Mean *E. coli* = 218 org/100 mL; Mean TP = 4 µg/L; Mean TSS = 3 mg/L	–	–	See watershed-wide strategies										
	Mud Hen Creek (A30) Water Hen Creek, South Branch (A36) Loon (69-0426-00) Section Fourteen (69-0550-00) Coe (69-0562-00)	St. Louis	–	–	–	–											
	Water Hen Creek (A31)	St. Louis	M-IBI, DO **No TMDL—Nonpollutant stressors**	DO frequently < 5 mg/L standard	–	–	Monitor and further evaluate	Continue to monitor and evaluate the effect of natural background conditions on low DO conditions and impairment	Complete updated assessment and update 303(d) list as appropriate	Complete updated assessment and update 303(d) list as appropriate	x			x			2027
							Long Lake restoration	Activities that reduce nutrients in Long Lake (see strategies for Long Lake 69-0495-00)			x	x		x	x		2040
	Water Hen Creek (A35)	St. Louis	M-IBI, DO, DO flux **TMDL deferred**	DO frequently < 5 mg/L standard; extremely high DO flux (> 9.0 mg/L) observed	–	–	Monitor and further evaluate	Continue to monitor and evaluate the effect of natural background conditions on low DO conditions and impairment Study the potential causes of high DO flux and develop strategies to address source(s)	Complete updated assessment and update 303(d) list as appropriate	Complete updated assessment and update 303(d) list as appropriate	x						2027

HUC-10 Subwatershed	Waterbody	Location and Upstream Influence Counties	Parameter (incl. non-pollutant stressors)	Current Conditions: Concentration (load)	Goals / Targets	Estimated % and Load Reduction by Flow Regime	Strategies	Example strategy types and estimated scale of adoption needed to meet final water quality target	10-Year Milestone	Suggested Goal	MPCA	MN DNR	BWSR	SWCD	County	Municipalities	Estimated Year to Achieve Water Quality Target
Mud Hen Creek (401020104), continued	**Mud Hen (69-0494-00)**	St. Louis	Nutrients **TMDL deferred**	Mean TP = 34 µg/L; Mean transparency = 1.9 m	–	–	Reduce internal release of phosphorus within lakes	Investigate sources of internal loading, such as resuspension of sediment from the lake bed Consider in-lake treatment once external sources of phosphorus have been controlled	–	Internal load management plan Implementation of internal load reduction projects	x	x		x			2040
							Address private wastewater systems (e.g., septic systems)	Inventory and assess the potential for septic systems/private wastewater systems to be sources of *E. coli* Replace all systems deemed Imminent Threat to Public Health (e.g., straight pipes, surface seepage) Provide for sewering around lakes; identify opportunities for cluster systems and work with landowners to implement Landowner focused education and outreach on septic system maintenance and compliance Support increased compliance inspections (in addition to current point of sale inspections); also required to get a building permit Additional setbacks in sensitive areas (e.g., lakeshore)	Complete inventory and upgrade 25% of non-compliant systems	0 remaining noncompliant septic systems					x		2035
							Pasture and livestock management	Riparian corridor survey for livestock exclusion, increase livestock exclusion Encourage rotational grazing	–	Riparian corridor survey complete All livestock and hobby farms practicing livestock exclusion and appropriate manure management				x			2030
							Protect and stabilize nearshore areas (lakeshore)	Shoreland survey—evaluate the shoreland and identify areas of disturbance, such as altered vegetation (e.g., lawns), bare soil, and shoreland erosion Use bioengineering practices and BMPs to prevent erosion and protect water quality	–	Completed survey Implement shoreline BMPs such that the majority of lakeshore owners are implementing BMPs		x		x			2035
							Monitoring	Monitoring of phosphorus and chlorophyll-*a*	Identify volunteer lake monitors Conduct seasonal monitoring	Conduct seasonal monitoring	x			x			2035
							Shallow lake standards	Continue to pursue shallow lakes standards for the Northern Lakes and Forests ecoregion	Updated lake standards	Updated lake standards	x						2025
							Education and outreach	Education and outreach on best shoreland management practices	Distribute education information bi-annually to lake residents	Majority of lakeshore owners practicing shoreland best management practices		x		x			2035

HUC-10 Subwatershed	Waterbody	Location and Upstream Influence Counties	Parameter (incl. non-pollutant stressors)	Current Conditions: Concentration (load)	Goals / Targets	Estimated % and Load Reduction by Flow Regime	Strategies	Example strategy types and estimated scale of adoption needed to meet final water quality target	10-Year Milestone	Suggested Goal	MPCA	MN DNR	BWSR	SWCD	County	Municipalities	Estimated Year to Achieve Water Quality Target
Mud Hen Creek (401020104), continued	**Long (69-0495-00)**	St. Louis	Nutrients **TMDL deferred**	Mean TP = 51 µg/L; Mean transparency = 0.9 m	–	–	Reduce internal release of phosphorus within lakes	Investigate sources of internal loading, such as resuspension of sediment from the lake bed Consider in-lake treatment once external sources of phosphorus have been controlled	–	Internal load management plan Implementation of internal load reduction projects	x	x		x			2040
							Address private wastewater systems (e.g., septic systems)	Inventory and assess the potential for septic systems/private wastewater systems to be sources of *E. coli* Replace all systems deemed Imminent Threat to Public Health (e.g., straight pipes, surface seepage) Provide for sewering around lakes; identify opportunities for cluster systems and work with landowners to implement Landowner focused education and outreach on septic system maintenance and compliance Support increased compliance inspections (in addition to current point of sale inspections); also required to get a building permit Additional setbacks in sensitive areas (e.g., lakeshore)	Complete inventory and upgrade 25% of non-compliant systems	0 remaining noncompliant septic systems					x		2035
							Protect and stabilize nearshore areas (lakeshore)	Shoreland survey—evaluate the shoreland and identify areas of disturbance, such as altered vegetation (e.g., lawns), bare soil, and shoreland erosion Use bioengineering practices and BMPs to prevent erosion and protect water quality	–	Completed survey Implement shoreline BMPs such that the majority of lakeshore owners are implementing BMPs		x		x			2035
							Monitoring	Monitoring of phosphorus and chlorophyll-*a*	Identify volunteer lake monitors Conduct seasonal monitoring	Conduct seasonal monitoring	x			x			2035
							Shallow lake standards	Continue to pursue shallow lakes standards for the Northern Lakes and Forests ecoregion	Updated lake standards	Updated lake standards	x						2025
							Education and outreach	Education and outreach on best shoreland management practices	Distribute education information bi-annually to lake residents	Majority of lakeshore owners practicing shoreland best management practices		x		x			2035

3.4.2 Swan River–St. Louis River

The major drainages in the Swan River–St. Louis River focus area are the Swan River, West Two River, East Two River, and the St. Louis River (Figure 30). The Swan River priority restoration subwatershed (Section 3.1, Figure 21) is located in this focus area. Many small Iron Range cities are located in the focus area, including Hibbing, Chisolm, Buhl, Mountain Iron, Virginia, and Eveleth, and portions of the area are highly modified from urban development and mining activities. The northern portion of the focus area along the Iron Range includes historical and current mining operations that have substantially altered the landscape, including hydrologic modifications such as active mine pit pumping, resulting changes in the interaction between groundwater and surface waters, removal or alteration of headwater streams, stream channelization (e.g., Elbow Creek), impounded reservoirs (e.g., West Two Rivers Reservoir), evaporation from inactive mine pits, and discharges that contain constituents such as sulfur, iron, and other dissolved elements. Future mining pressures exist in the focus area.

The dominant land covers in the headwaters of the focus area are forest, developed, and barren; the barren land covers represent mining areas along the Iron Range. Moving downstream, the land cover is predominantly wetlands, and land ownership is a mix of private and state. Agricultural land uses (e.g., pasture) are sprinkled throughout the focus area and are concentrated around the St. Louis River at the downstream end of the focus area near the Meadowlands wetland complex.

Based on the available data, water quality in many of the lakes and streams draining the cities and mining areas in the Iron Range is typically poor. Many sites in the Swan River have been monitored, indicating high sediment and phosphorus concentrations at multiple locations. The high sediment in the Swan River Subwatershed is likely due to channel instabilities in Barber Creek, Dempsey Creek, and the East Swan River. The Swan River Channel Stability and Geomorphic Assessment (SSLSCWD 2013) details the locations and potential causes of stream instability. *E. coli* concentrations are also high in the Swan River Subwatershed, potentially owing to stormwater runoff and aging wastewater collection infrastructure in the older communities. High nutrients in some waterbodies are also in part due to historical and current municipal wastewater effluent.

There are many impairments in the focus area, with aquatic life impairments on the East Swan River, Ely Creek, Sand Creek, Skunk Creek, Stony Creek, Elbow Creek, West Two River, Little Swan River, Manganika Creek, and two unnamed creeks; aquatic recreation impairments on Barber Creek, Buhl Creek, Dempsey Creek, Penobscot Creek, two unknown creeks, West Two Rivers Reservoir, Lake Manganika, and McQuade Lake; and both aquatic life and aquatic recreation impairments on East Swan Creek.

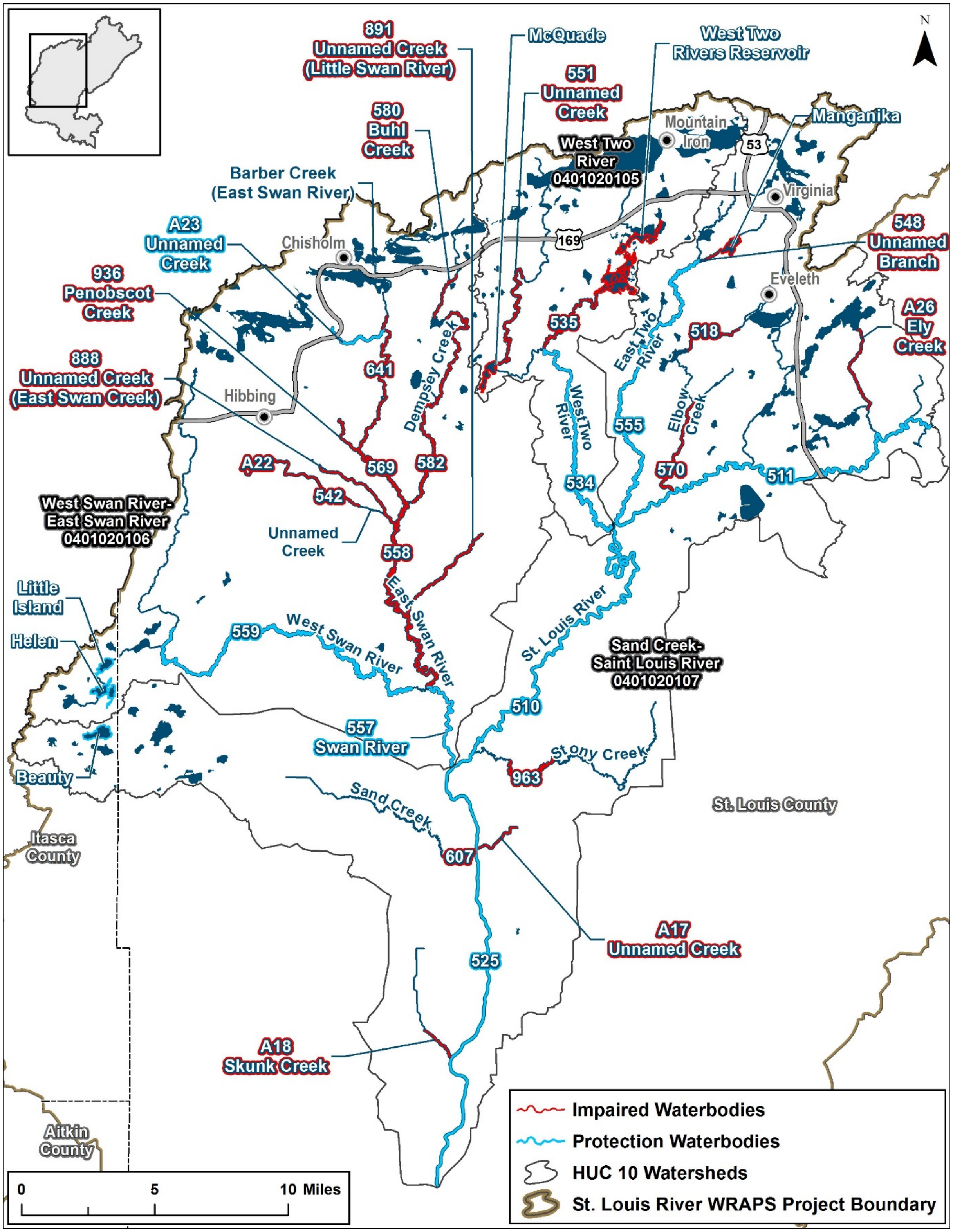


Figure 30. Swan River–St. Louis River WRAPS strategy focus area.

Table 14. Strategies and actions proposed for the Swan River–St. Louis River Focus Area, St. Louis River Watershed.

West Swan River–East Swan River Subwatershed is identified as a priority watershed; **BLUE** waterbodies are priority waters for protection; **RED** waterbodies are priority waters for restoration

HUC-10 Subwatershed	Waterbody	Location and Upstream Influence Counties	Parameter (incl. non-pollutant stressors)	Current Conditions: Concentration (load)	Goals / Targets	Estimated % and Load Reduction by Flow Regime	Strategies (see key below)	Example strategy types and estimated scale of adoption needed to meet final water quality target	10-year Milestone	Suggested Goal	MPCA	MN DNR	BWSR	SWCD	County	Municipalities	Estimated Year to Achieve Water Quality Target
West Two River (0401020105)	West Two River (534)	St. Louis	–	Mean *E. coli* = 77 org/100 mL; Mean TP = 3 µg/L; Mean TSS = 8 mg/L	–	–	See watershed-wide strategies										
	West Two River (535)	St. Louis	M-IBI, DO, DO flux, (altered hydrology, sulfate toxicity, specific conductivity)	–	**TP TMDL references West Two River Reservoir TMDL**	–	West Two Rivers Reservoir restoration	Activities that reduce nutrients in West Two Rivers Reservoir (see strategies for West Two Rivers Reservoir 69-0994-00)	See West Two Rivers Reservoir 69-0994-00								2040++
							Stream restoration and improved ditch management Altered watercourse improvements	Geomorphic assessment and feasibility study to determine restoration opportunities Restore channelized reaches (re-meander, connect to floodplains) Mitigate peak flows Restore natural meander and complexity Address inadequate road crossings—crossings preventing fish passage, crossings that are not sized correctly/causing streambed and channel erosion Address channel incision (e.g., provide grade control) Restore riffle substrate where appropriate Address erosion in near-shore areas (bank stabilization, bioengineering, etc.) Improve connections with groundwater when needed	–	Prioritize stream restoration activities and conduct additional geomorphic assessment and feasibility analysis Conduct priority restoration activities		x		x			2040
							Surface and groundwater interaction study	Surface water-groundwater interaction study to understand and address effects of mine dewatering and discharge (positive and negative) on regional groundwater and stream baseflow (current research is being conducted by the USGS and Fond du Lac)	Identify potential research opportunities Begin research and data collection	Completed study and integrate findings into WRAPS process	x	x					2025

HUC-10 Subwatershed	Waterbody	Location and Upstream Influence Counties	Parameter (incl. non-pollutant stressors)	Current Conditions: Concentration (load)	Goals / Targets	Estimated % and Load Reduction by Flow Regime	Strategies (see key below)	Example strategy types and estimated scale of adoption needed to meet final water quality target	10-year Milestone	Suggested Goal	MPCA	MN DNR	BWSR	SWCD	County	Municipalities	Estimated Year to Achieve Water Quality Target
West Two River (0401020105), continued	**West Two River (535), continued**	St. Louis	M-IBI, DO, DO flux, (altered hydrology, sulfate toxicity, specific conductivity)	–	**TP TMDL references West Two River Reservoir TMDL**	–	Implement recommendations from the St. Louis Connectivity Analysis	Repair or replace one undersized culvert at road crossings	–	Upgraded road crossing (one identified)		x		x	x		2030
							Wetland restoration	Use ditch blocks and vegetation to restore ditched wetland and peatland areas (see Figure 25)	–	Identify and prioritize opportunities for wetland restoration or enhancement as part of functional assessment Conduct restoration or enhancement activities to increase nutrient removal functions by 25% over existing.		x	x	x	x		2040

HUC-10 Subwatershed	Waterbody	Location and Upstream Influence Counties	Parameter (incl. non-pollutant stressors)	Current Conditions: Concentration (load)	Goals / Targets	Estimated % and Load Reduction by Flow Regime	Strategies (see key below)	Example strategy types and estimated scale of adoption needed to meet final water quality target	10-year Milestone	Suggested Goal	MPCA	MN DNR	BWSR	SWCD	County	Municipalities	Estimated Year to Achieve Water Quality Target
West Two River (0401020105), continued	**Unnamed / Kinney Creek (551)**	St. Louis	M-IBI, DO flux, (sulfate toxicity, specific conductivity) **TMDL deferred**	–	–	–	Stream restoration and improved ditch management Altered watercourse improvements	Geomorphic assessment and feasibility study to determine restoration opportunities Restore channelized reaches (re-meander, connect to floodplains) Mitigate peak flows Restore natural meander and complexity Address inadequate road crossings—crossings preventing fish passage, crossings that are not sized correctly/causing streambed and channel erosion Address channel incision (e.g., provide grade control) Restore riffle substrate where appropriate Address erosion in near-shore areas (bank stabilization, bioengineering, etc.) Improve connections with groundwater when needed	–	Prioritize stream restoration activities and conduct additional geomorphic assessment and feasibility analysis Conduct priority restoration activities		x		x			2040
							Surface and groundwater interaction study	Surface water-groundwater interaction study to understand and address effects of mine dewatering and discharge (positive and negative) on regional groundwater and stream baseflow (current research is being conducted by the USGS and Fond du Lac)	Identify potential research opportunities Begin research and data collection	Completed study and integrate findings into WRAPS process	x	x					2025
							Monitoring	Additional investigation into DO flux is needed to determine potential for DO flux to be a stressor on biota	Complete additional monitoring Update Stressor ID and 303(d) List as needed	–	x						2027
							Wetland restoration	Use ditch blocks and vegetation to restore ditched wetland and peatland areas (see Figure 25)	–	Identify and prioritize opportunities for wetland restoration or enhancement as part of functional assessment Conduct restoration or enhancement activities to increase functional significance by 25% over existing.		x	x	x			2040

HUC-10 Subwatershed	Waterbody	Location and Upstream Influence Counties	Parameter (incl. non-pollutant stressors)	Current Conditions: Concentration (load)	Goals / Targets	Estimated % and Load Reduction by Flow Regime	Strategies (see key below)	Example strategy types and estimated scale of adoption needed to meet final water quality target	10-year Milestone	Suggested Goal	MPCA	MN DNR	BWSR	SWCD	County	Municipalities	Estimated Year to Achieve Water Quality Target
West Two River (0401020105), continued	**McQuade (69-0775-00)**	St. Louis	Nutrients **TMDL deferred**	Mean TP = 67 µg/L Mean chl-*a* = 20 µg/L Mean transparency = 1.6 m	–	–	Protect and stabilize nearshore areas (lakeshores)	Shoreland survey—evaluate the shoreland and identify areas of disturbance, such as altered vegetation, bare soil, and shoreland erosion Use bioengineering practices and BMPs to prevent erosion and protect water quality	–	Completed survey Implement shoreline BMPs such that the majority of lakeshore owners are implementing BMPs		x		x			2035
							Monitoring	Investigate watershed sources of phosphorus; phosphorus monitoring of the lake tributaries	–	Updated source assessment with targeted implementation activities	x			x			2030
							Address private wastewater systems (e.g., septic systems)	Inventory and assess the potential for septic systems/private wastewater systems to be sources of *E. coli* Replace all systems deemed Imminent Threat to Public Health (e.g., straight pipes, surface seepage) Provide for sewering around lakes; identify opportunities for cluster systems and work with landowners to implement Landowner focused education and outreach on septic system maintenance and compliance Support increased compliance inspections (in addition to current point of sale inspections); also required to get a building permit Additional setbacks in sensitive areas (e.g., lakeshore)	Complete inventory and upgrade 25% of non-compliant systems	0 remaining noncompliant septic systems					x		2035
							Reduce internal release of phosphorus within lakes	Evaluate the potential drivers of internal loading in McQuade Lake (e.g., iron, sulfur, sediment phosphorus content, DO conditions, resuspension of sediment from the lake bed) Evaluate options to reduce internal loading	–	Internal load management plan Implementation of internal load reduction projects	x	x		x			2040
							Shallow lake standards	Continue to pursue shallow lakes standards for the Northern Lakes and Forests ecoregion	Updated lake standards	Updated lake standards	x						2025
							Education and outreach	Education and outreach on best shoreland management practices	Distribute education information bi-annually to lake residents	Majority of lakeshore owners practicing shoreland BMPs				x	x		2035

HUC-10 Subwatershed	Waterbody	Location and Upstream Influence Counties	Parameter (incl. non-pollutant stressors)	Current Conditions: Concentration (load)	Goals / Targets	Estimated % and Load Reduction by Flow Regime	Strategies (see key below)	Example strategy types and estimated scale of adoption needed to meet final water quality target	10-year Milestone	Suggested Goal	MPCA	MN DNR	BWSR	SWCD	County	Municipalities	Estimated Year to Achieve Water Quality Target
West Two River (0401020105), continued	**West Two Rivers Reservoir (69-0994-00)**	St. Louis	Nutrients **TP TMDL**	Mean TP = 40 µg/L Mean chl-*a* = 15 µg/L Mean transparency = 1.7 m	Mean TP = 30 µg/L	32% reduction, 1,070 lb/yr	Reduce internal release of phosphorus	Evaluate the potential drivers of internal loading in West Two Rivers Reservoir (e.g., iron, sulfur, sediment phosphorus content, DO conditions, resuspension of sediment from the lake bed) Evaluate potential options for internal load reduction following reductions in wastewater treatment plant phosphorus loading and long-term monitoring of inflows to lake	–	Internal load management plan Implementation of internal load reduction projects	x	x		x			2040++
							Education and outreach	Provide focused education and outreach to lake users on harmful algal blooms and lake water quality concerns	Provide targeted outreach materials to lake users Develop and install signage where appropriate Distribute education information bi-annually to lake residents	All lake users have updated information on lake water quality and safety	x	x		x	x		2040
							Reduce municipal wastewater phosphorus	Reductions in phosphorus loading from Mountain Iron Wastewater Treatment Plant (MN0040835) as prescribed in the TMDL Consider regionalized wastewater treatment solutions	Updated permit requirements per TMDL	Reduced phosphorus loading per TMDL	x					x	2030
West Swan River-East Swan River (401020106) – Priority Watershed	**All streams in the West Swan–East Swan River watershed**	St. Louis	TSS, habitat, connectivity, and altered hydrology	Varies	Varies	Varies	Implement activities to address findings in the Swan River Watershed Geomorphic Study (SSLSWCD 2013, see Appendix C)	Properly size and place bridges and culverts for flow, stream stability, and fish passage Develop feasibility studies and direct restoration work on unstable streams Grade control above headcuts Install floodplain culverts where appropriate Stormwater retention BMPs Connect unstable or incised reaches to the existing or restored floodplain	Prioritize recommended projects and develop implementation schedule Implement 3 projects	Complete implementation of all priority projects		x		x			2040
							Feedlot, pasture, and livestock management	Open lot runoff management to meet 7020 rules Manure storage in ways that prevent runoff Provide outreach and education to animal agriculture producers and animal hobby farm owners Riparian corridor survey for livestock exclusion, increase livestock exclusion Encourage rotational grazing	Complete riparian corridor survey Implement feedlot controls on 100% of feedlots to meet 7020 rules Complete projects on 50% of properties identified as needed enhancements (e.g., livestock exclusion, manure storage, pasture management)	All feedlots in compliance with 7020 Rules All livestock and hobby farms practicing livestock exclusion and appropriate manure management	x			x			2030

HUC-10 Subwatershed	Waterbody	Location and Upstream Influence Counties	Parameter (incl. non-pollutant stressors)	Current Conditions: Concentration (load)	Goals / Targets	Estimated % and Load Reduction by Flow Regime	Strategies (see key below)	Example strategy types and estimated scale of adoption needed to meet final water quality target	10-year Milestone	Suggested Goal	MPCA	MN DNR	BWSR	SWCD	County	Municipalities	Estimated Year to Achieve Water Quality Target
West Swan River–East Swan River (401020106) – Priority Watershed, continued	**Unnamed Creek (542)**	St. Louis	*E. coli* ***E. coli* TMDL**	*E. coli* load varies by flow condition: Very High = 271 org/100 mL (133 B org/d) High = 79 org/100 mL (13 B org/d) Mid-range = 107 org/100 mL (9 B org/d) Low = 125 org/100 mL (6 B org/d) Very Low = No data	Geometric mean ≤ 126 org/100mL; Apr–Oct	Very High = 45% (60 B org/d) High = 0% Mid-range = 0% Low = 0% Very Low = No data	Address private wastewater systems (e.g., septic systems)	Inventory and assess the potential for septic systems/private wastewater systems to be sources of *E. coli* in impaired streams Replace all systems deemed Imminent Threat to Public Health (e.g., straight pipes, surface seepage)	Complete inventory and upgrade 50% of non-compliant systems	0 remaining noncompliant septic systems					x		2030
							Reduce industrial/municipal wastewater discharges	Address inflow/infiltration Upgrade leaky wastewater infrastructure in urban areas	City-wide studies to evaluate current inflow/infiltration problems Continued progress to evaluate and repair sewer lines	Completion of sewer line upgrades to minimize inflow/infiltration	x					x	2040++
							Monitoring and source assessment	Conduct longitudinal survey of *E. coli* concentrations to identify sources and target implementation activities	Complete survey and identify priority areas for management	–						x	2022
							Reduce urban bacteria from pets and stormwater	Pet waste management programs (in developed areas) BMPs to reduce pollutant loading—see MPCA Stormwater Manual Disconnected imperviousness	Expand pet waste management programs to all city parks Identify stormwater BMP opportunities to address priority areas identified by monitoring and source assessment and implement projects on 4 sites	Address all priority areas with stormwater BMPs in urban areas (see Monitoring and source assessment)	x					x	2035
	Swan River (557)	Itasca, St. Louis	F-IBI, TSS, habitat, (altered hydrology and connectivity) **No TMDL, listing pending use class change**	Mean *E. coli* = 114 org/100 mL; Mean TP = 6 µg/L; Mean TSS = 32 mg/L	–	–	Increased stormwater management	BMPs to reduce pollutant loading, including pervious pavers and other volume control practices Stormwater control measures practices to reduce peak flows and volumes Disconnected imperviousness	Identification of treated and untreated areas (stormwater) and priority implementation areas for retrofits Implement stormwater projects on 4 sites in greater drainage area	Address all priority areas with stormwater BMPs in urban areas	x					x	2035
							Monitoring	Monitor suspended solids (total and volatile) discharging from Hibbing South Wastewater Treatment Plant for compliance with TMDL; adjust treatment level if needed	Conduct monitoring and update permit/processes as needed	–	x					x	2025

HUC-10 Subwatershed	Waterbody	Location and Upstream Influence Counties	Parameter (incl. non-pollutant stressors)	Current Conditions: Concentration (load)	Goals / Targets	Estimated % and Load Reduction by Flow Regime	Strategies (see key below)	Example strategy types and estimated scale of adoption needed to meet final water quality target	10-year Milestone	Suggested Goal	MPCA	MN DNR	BWSR	SWCD	County	Municipalities	Estimated Year to Achieve Water Quality Target
West Swan River–East Swan River (401020106) – Priority Watershed, continued	**East Swan River (558)**	St. Louis	TSS **TSS TMDL**	TSS load varies by flow condition: Very High = 150 mg/L (361 tons/d) High = 48 mg/L (16 tons/d) Mid-range = 21 mg/L (3 tons/d) Low = 6 mg/L (0.3 tons/d) Very Low = No data	TSS standard <10 mg/L > 90% of the time, April – Sept	Very High = 97% (350 tons/d) High = 81% (13 tons/d) Mid-range = 63% (2 ton/d) Low = 0% Very Low = No data	Increased stormwater management	BMPs to reduce pollutant loading, including pervious pavers and other volume control practices Stormwater control measures practices to reduce peak flows and volumes Disconnected imperviousness	Identification of treated and untreated areas (stormwater) and priority implementation areas for retrofits Implement stormwater projects on 4 sites	Address all priority areas with stormwater BMPs in urban areas	x					x	2035
							Wetland restoration	Use ditch blocks and vegetation to restore ditched wetland and peatland areas	Identify and prioritize opportunities for wetland restoration or enhancement as part of functional assessment	Conduct restoration or enhancement activities to increase functional significance by 25% over existing							2035
							Stream restoration and improved ditch management Altered watercourse improvements	Implementation of the recommendations provided in Swan River Channel Stability and Geomorphic Analysis (SSLSWCD 2013) Restore channelized reaches (re-meander, connect to floodplains) Restore natural meander and complexity Address inadequate road crossings—crossings preventing fish passage, crossings that are not sized correctly/causing streambed and channel erosion Address channel incision (e.g., provide grade control) and entrenchment Restore riffle substrate where appropriate Address erosion in near-shore areas (bank stabilization, bioengineering, etc.) Improve connections with groundwater when needed	Identify reaches of high erodibility where restoration would be most beneficial Prioritize stream restoration activities and conduct feasibility analysis Implement 1 stream restoration project	Conduct priority restoration activities for East Swan River Implement in-stream projects in East Swan segment 558 to reduce TSS loading by 3–4% annually (on average)		x		x			2040
							Implement recommendations from the St. Louis Connectivity Analysis	Repair or replace improperly sized culverts at road crossings including Hibbing M337	Upgrade crossing at Hibbing 3337	–		x			x	x	2027
							Monitoring	Monitor suspended solids (total and volatile) discharging from Hibbing South Wastewater Treatment Plant for compliance with TMDL; adjust treatment level if needed	Conduct monitoring and update permit/processes as needed	–	x					x	2025

HUC-10 Subwatershed	Waterbody	Location and Upstream Influence Counties	Parameter (incl. non-pollutant stressors)	Current Conditions: Concentration (load)	Goals / Targets	Estimated % and Load Reduction by Flow Regime	Strategies (see key below)	Example strategy types and estimated scale of adoption needed to meet final water quality target	10-year Milestone	Suggested Goal	MPCA	MN DNR	BWSR	SWCD	County	Municipalities	Estimated Year to Achieve Water Quality Target
West Swan River–East Swan River (401020106) – Priority Watershed, continued	**West Swan River (559)**	St. Louis, Itasca	–	Mean *E. coli* = 57 org/100 mL; Mean TP = 3 µg/L; Mean TSS = 16 mg/L	–	–	Stream restoration and improved ditch management Altered watercourse improvements	Properly size and place bridges and culverts for flow, stream stability, and fish passage including two culverts on unnamed, adjacent tributaries under County Road 442 Focus restoration efforts between South Town Line Road and confluence with Swan River, West Swan River is heavily incised and has eroding headcuts. Restore natural meander and complexity Address inadequate road crossings—crossings preventing fish passage, crossings that are not sized correctly/causing streambed and channel erosion Restore riffle substrate where appropriate Address erosion in near-shore areas (bank stabilization, bioengineering, etc.) Improve connections with groundwater when needed	Upgrade culverts under County Road 442 Conduct additional geomorphic assessment and feasibility analysis between South Town Line Road and confluence with Swan River	Conduct priority stream restoration activities for West Swan River Implement restoration projects between South Town Line Road and confluence with Swan River to stabilize stream		x			x		2035

HUC-10 Subwatershed	Waterbody	Location and Upstream Influence Counties	Parameter (incl. non-pollutant stressors)	Current Conditions: Concentration (load)	Goals / Targets	Estimated % and Load Reduction by Flow Regime	Strategies (see key below)	Example strategy types and estimated scale of adoption needed to meet final water quality target	10-year Milestone	Suggested Goal	MPCA	MN DNR	BWSR	SWCD	County	Municipalities	Estimated Year to Achieve Water Quality Target
West Swan River–East Swan River (401020106) – Priority Watershed, continued	**Barber Creek (East Swan River) (569)**	St. Louis	*E. coli* ***E. coli* TMDL**	*E. coli* load varies by flow condition: Very High = 671 org/100 mL (1,808 B org/d) High = 260 org/100 mL (189 B org/d) Mid-range = 241 org/100 mL (95 B org/d) Low = 232 org/100 mL (57 B org/d) Very Low = No data	Geometric mean ≤ 126 org/100mL; Apr–Oct	Very High = 79% (1,428 B org/d) High = 46% (86 B org/d) Mid-range = 53% (50 B org/d) Low = 58% (33 B org/d) Very Low = No data	Reduce urban bacteria from stormwater	BMPs to reduce pollutant loading—see MPCA Stormwater Manual Disconnected imperviousness	Identify stormwater BMP opportunities to address priority areas identified by monitoring and source assessment and implement projects on 4 sites	Address all priority areas with stormwater BMPs in urban areas (see Monitoring and source assessment)	x					x	2035
							Stream crossing and culvert improvements	Properly size and place bridges and culverts for flow, stream stability, and fish passage including crossing at Town Line Road	Upgrade crossing at Town Line Road	–		x			x	x	2027
							Monitoring and source assessment	Conduct longitudinal survey of *E. coli* concentrations to identify sources and target implementation activities.	Complete survey and identify priority areas for management	–						x	2022
							Address private wastewater systems (e.g., septic systems)	Inventory and assess the potential for septic systems/private wastewater systems to be sources of *E. coli* in impaired streams Replace all systems deemed Imminent Threat to Public Health (e.g., straight pipes, surface seepage)	Complete inventory and upgrade 50% of non-compliant systems	0 remaining noncompliant septic systems					x		2030
							Reduce industrial/municipal wastewater discharges	Address inflow/infiltration Upgrade leaky wastewater infrastructure in urban areas	City-wide studies to evaluate current inflow/infiltration problems Continued progress to evaluate and repair sewer lines	Completion of sewer line upgrades to minimize inflow/infiltration	x					x	2040++

HUC-10 Subwatershed	Waterbody	Location and Upstream Influence Counties	Parameter (incl. non-pollutant stressors)	Current Conditions: Concentration (load)	Goals / Targets	Estimated % and Load Reduction by Flow Regime	Strategies (see key below)	Example strategy types and estimated scale of adoption needed to meet final water quality target	10-year Milestone	Suggested Goal	MPCA	MN DNR	BWSR	SWCD	County	Municipalities	Estimated Year to Achieve Water Quality Target
West Swan River–East Swan River (401020106) – Priority Watershed, continued	**Buhl Creek (580)**	St. Louis	*E. coli* ***E. coli* TMDL**	*E. coli* load varies by flow condition: Very High = 136 org/100 mL (52 B org/d) High = 58 org/100 mL (6 B org/d) Mid-range = 419 org/100 mL (11 B org/d) Low = No data Very Low = No data	Geometric mean ≤ 126 org/100mL; Apr–Oct	Very High = 9% (5 B org/d) High = 0% Mid-range = 67% (8 B org/d) Low = No data Very Low = No data	Reduce urban bacteria from pets and stormwater	Pet waste management programs (in developed areas) BMPs to reduce pollutant loading—see MPCA Stormwater Manual Disconnected imperviousness	Expand pet waste management programs to all city parks Identify stormwater BMP opportunities to address priority areas identified by monitoring and source assessment and implement projects on 4 sites	Address all priority areas with stormwater BMPs in urban areas (see Monitoring and source assessment)	x					x	2035
							Monitoring and source assessment	Conduct longitudinal survey of *E. coli* concentrations to identify sources and target implementation activities.	Complete survey and identify priority areas for management	–						x	2022
							Address private wastewater systems (e.g., septic systems)	Inventory and assess the potential for septic systems/private wastewater systems to be sources of *E. coli* in impaired streams Replace all systems deemed Imminent Threat to Public Health (e.g., straight pipes, surface seepage)	Complete inventory and upgrade 50% of non-compliant systems	0 remaining noncompliant septic systems					x		2030
							Reduce industrial/municipal wastewater discharges	Address inflow/infiltration Upgrade leaky wastewater infrastructure in urban areas	City-wide studies to evaluate current inflow/infiltration problems Continued progress to evaluate and repair sewer lines	Completion of sewer line upgrades to minimize inflow/infiltration	x					x	2040++

HUC-10 Subwatershed	Waterbody	Location and Upstream Influence Counties	Parameter (incl. non-pollutant stressors)	Current Conditions: Concentration (load)	Goals / Targets	Estimated % and Load Reduction by Flow Regime	Strategies (see key below)	Example strategy types and estimated scale of adoption needed to meet final water quality target	10-year Milestone	Suggested Goal	MPCA	MN DNR	BWSR	SWCD	County	Municipalities	Estimated Year to Achieve Water Quality Target
West Swan River–East Swan River (401020106) – Priority Watershed, continued	**Dempsey Creek (582)**	St. Louis	*E. coli* ***E. coli* TMDL**	*E. coli* load varies by flow condition: Very High = 250 org/100 mL (398 B org/d) High = 76 org/100 mL (29 B org/d) Mid-range = 79 org/100 mL (11 B org/d) Low = 43 org/100 mL (3 B org/d) Very Low = No data	Geometric mean ≤ 126 org/100mL; Apr–Oct	Very High = 44% (176 B org/d) High = 0% Mid-range = 0% Low = 0% Very Low = No data	Stream crossing and culvert improvements	Properly size and place bridges and culverts for flow, stream stability, and fish passage including a perched culvert at County Road 642 downstream of 6 Mile Lake	Upgrade culvert crossing at County Road 642	–		x			x		2030
							Monitoring and source assessment	Conduct longitudinal survey of *E. coli* concentrations to identify sources and target implementation activities	Complete survey and identify priority areas for management	–						x	2022
							Reduce urban bacteria from stormwater	BMPs to reduce pollutant loading—see MPCA Stormwater Manual Disconnected imperviousness	Identify stormwater BMP opportunities to address priority areas identified by monitoring and source assessment and implement projects on 2 sites	Address all priority areas with stormwater BMPs in urban areas (see Monitoring and source assessment)	x					x	2030
							Address private wastewater systems (e.g., septic systems)	Inventory and assess the potential for septic systems/private wastewater systems to be sources of *E. coli* in impaired streams Replace all systems deemed Imminent Threat to Public Health (e.g., straight pipes, surface seepage)	Complete inventory and upgrade 50% of non-compliant systems	0 remaining noncompliant septic systems					x		2030
							Reduce industrial/municipal wastewater discharges	Address inflow/infiltration Upgrade leaky wastewater infrastructure in urban areas	City-wide studies to evaluate current inflow/infiltration problems Continued progress to evaluate and repair sewer lines	Completion of sewer line upgrades to minimize inflow/infiltration	x					x	2040++

HUC-10 Subwatershed	Waterbody	Location and Upstream Influence Counties	Parameter (incl. non-pollutant stressors)	Current Conditions: Concentration (load)	Goals / Targets	Estimated % and Load Reduction by Flow Regime	Strategies (see key below)	Example strategy types and estimated scale of adoption needed to meet final water quality target	10-year Milestone	Suggested Goal	MPCA	MN DNR	BWSR	SWCD	County	Municipalities	Estimated Year to Achieve Water Quality Target
West Swan River–East Swan River (401020106) – Priority Watershed, continued	**Barber Creek (East Swan River) (641)**	St. Louis	*E. coli* ***E. coli* TMDL**	*E. coli* load varies by flow condition: Very High = 269 org/100 mL (646 B org/d) High = 101 org/100 mL (65 B org/d) Mid-range = 100 org/100 mL (33 B org/d) Low = 68 org/100 mL (15 B org/d) Very Low = No data	Geometric mean ≤ 126 org/100mL; Apr–Oct	Very High = 53% (345 B org/d) High = 0% Mid-range = 0% Low = 0% Very Low = No data	Address private wastewater systems (e.g., septic systems)	Inventory and assess the potential for septic systems/private wastewater systems to be sources of *E. coli* in impaired streams Replace all systems deemed Imminent Threat to Public Health (e.g., straight pipes, surface seepage)	Complete inventory and upgrade 50% of non-compliant systems	0 remaining noncompliant septic systems					x		2030
							Monitoring and source assessment	Conduct longitudinal survey of *E. coli* concentrations to identify sources and target implementation activities	Complete survey and identify priority areas for management	–						x	2022
							Reduce urban bacteria from pets and stormwater	Pet waste management programs (in developed areas) BMPs to reduce pollutant loading—see MPCA Stormwater Manual Disconnected imperviousness	Expand pet waste management programs to all city parks Identify stormwater BMP opportunities to address priority areas identified by monitoring and source assessment and implement projects on 4 sites	Address all priority areas with stormwater BMPs in urban areas (see Monitoring and source assessment)	x					x	2035
							Reduce industrial/municipal wastewater discharges	Address inflow/infiltration Upgrade leaky wastewater infrastructure in urban areas Expand Central Iron Range Sanitary Sewer District's (MN0020117) disinfection period to include April, or monitor and expand disinfection period only if April impairment is found	City-wide studies to evaluate current inflow/infiltration problems Continued progress to evaluate and repair sewer lines Adjust CIRSSD's permit as needed	Completion of sewer line upgrades to minimize inflow/infiltration	x					x	2040++
	Unnamed Creek (East Swan Creek) (888)	St. Louis	M-IBI, *E. coli*, nitrate toxicity, (specific conductivity) ***E. coli* TMDL**	*E. coli* load varies by flow condition: Very High = 414 org/100 mL (522 B org/d) High = 190 org/100 mL (94 B org/d) Mid-range = 90 org/100 mL (31 B org/d) Low = 249 org/100 mL (72 B org/d) Very Low = No data	Geometric mean ≤ 126 org/100mL; Apr–Oct	Very High = 66% (344 B org/d) High = 31% (29 B org/d) Mid-range = 0% Low = 53% (38 B org/d) Very Low = No data	Monitoring and source assessment	Conduct longitudinal survey of *E. coli* concentrations to identify sources and target implementation activities	Complete survey and identify priority areas for management	–						x	2022

HUC-10 Subwatershed	Waterbody	Location and Upstream Influence Counties	Parameter (incl. non-pollutant stressors)	Current Conditions: Concentration (load)	Goals / Targets	Estimated % and Load Reduction by Flow Regime	Strategies (see key below)	Example strategy types and estimated scale of adoption needed to meet final water quality target	10-year Milestone	Suggested Goal	MPCA	MN DNR	BWSR	SWCD	County	Municipalities	Estimated Year to Achieve Water Quality Target
West Swan River–East Swan River (401020106) – Priority Watershed, continued	**Unnamed Creek (East Swan Creek) (888), continued**	St. Louis	M-IBI, *E. coli*, nitrate toxicity, (specific conductivity) ***E. coli* TMDL**	*E. coli* load varies by flow condition: Very High = 414 org/100 mL (522 B org/d) High = 190 org/100 mL (94 B org/d) Mid-range = 90 org/100 mL (31 B org/d) Low = 249 org/100 mL (72 B org/d) Very Low = No data	Geometric mean ≤ 126 org/100mL; Apr–Oct	Very High = 66% (344 B org/d) High = 31% (29 B org/d) Mid-range = 0% Low = 53% (38 B org/d) Very Low = No data	Address private wastewater systems (e.g., septic systems)	Inventory and assess the potential for septic systems/private wastewater systems to be sources of *E. coli* in impaired streams Replace all systems deemed Imminent Threat to Public Health (e.g., straight pipes, surface seepage)	Complete inventory and upgrade 50% of non-compliant systems	0 remaining noncompliant septic systems					x		2030
							Reduce urban bacteria from pets and stormwater	Pet waste management programs (in developed areas) BMPs to reduce pollutant loading—see MPCA Stormwater Manual Disconnected imperviousness	Expand pet waste management programs to all city parks Identify stormwater BMP opportunities to address priority areas identified by monitoring and source assessment and implement projects on 4 sites	Address all priority areas with stormwater BMPs in urban areas (see Monitoring and source assessment)	x					x	2035
							Surface and groundwater interaction study	Surface water–groundwater interaction study to understand and address effects of mine dewatering and discharge (positive and negative) on regional groundwater and stream baseflow (current research is being conducted by the USGS and Fond du Lac)	Identify potential research opportunities Begin research and data collection	Completed study and integrate findings into WRAPS process	x	x					2025
							Reduce industrial/municipal wastewater discharges	Address inflow/infiltration Upgrade leaky wastewater infrastructure in urban areas Investigate presence of untreated wastewater in stream and correct upstream problems Reduce nitrate loading to East Swan Creek through improved plant operation	City-wide studies to evaluate current inflow/infiltration problems Continued progress to evaluate and repair sewer lines Monitoring of sanitary sewer overflows (SSO) and development of a plan to address SSOs Implementation of solution address nitrate loading from WWTP	Completion of sewer line upgrades to minimize inflow/infiltration Implementation of plan to address SSOs	x					x	2040++
	Unnamed Creek (Little Swan Creek (891)	St. Louis	F-IBI, DO, habitat, temperature, (TSS) **No TMDL – non-pollutant stressors**	DO consistently < 7.0 mg/L standard	–	–	Implement recommendations from the St. Louis Connectivity Analysis	Repair or replace improperly sized culverts at road crossings including Hibbing M337 and Hibbing M407	Repair or replace improperly sized culverts at road crossings including Hibbing M337 and Hibbing M407	–		x		x	x	x	2027
							Open lands management	Evaluate the effect of forestry practices on altered hydrology and develop recommendations for open land management Update open lands assessment	Updated open lands assessment	Ordinances or guidelines to implementation recommendations from open lands assessment		x		x	x		2030

HUC-10 Subwatershed	Waterbody	Location and Upstream Influence Counties	Parameter (incl. non-pollutant stressors)	Current Conditions: Concentration (load)	Goals / Targets	Estimated % and Load Reduction by Flow Regime	Strategies (see key below)	Example strategy types and estimated scale of adoption needed to meet final water quality target	10-year Milestone	Suggested Goal	MPCA	MN DNR	BWSR	SWCD	County	Municipalities	Estimated Year to Achieve Water Quality Target
West Swan River–East Swan River (401020106) – Priority Watershed, continued	**Unnamed Creek (Little Swan Creek (891), continued**	St. Louis	F-IBI, DO, habitat, temperature, (TSS) **No TMDL – non-pollutant stressors**	DO consistently < 7.0 mg/L standard	–	–	Account for and evaluate beaver activity and potential for stream restoration	Study effect of beaver activity on natural flow conditions and water quality and develop regional strategies. Streams with known beaver impacts include Water Hen Creek (A31 and A35), Elbow Creek, Unnamed (Little Swan) Creek, and Wyman Creek.	Identify potential research opportunities Begin research and data collection	Completed study Integrate findings into WRAPS process		x		x			2025
							Monitor and further evaluate	Monitor and evaluate the effect of natural background conditions on low DO conditions and impairment	Complete updated assessment and update 303(d) list as appropriate	Complete updated assessment and update 303(d) list as appropriate	x						2027
	Penobscot Creek (936)	St. Louis	*E. coli* ***E. coli* TMDL**	*E. coli* load varies by flow condition: Very High = 413 org/100 mL (177 B org/d) High = 500 org/100 mL (37 B org/d) Mid-range = 997 org/100 mL (33 B org/d) Low = 811 org/100 mL (12 B org/d) Very Low = No data	Geometric mean ≤ 126 org/100mL; Apr–Oct	Very High = 76% (135 B org/d) High = 72% (27 B org/d) Mid-range = 90% (30 B org/d) Low = 92% (11 B org/d) Very Low = No data	Reduce industrial/municipal wastewater discharges	Address inflow/infiltration Upgrade leaky wastewater infrastructure in urban areas	City-wide studies to evaluate current inflow/infiltration problems Continued progress to evaluate and repair sewer lines	Completion of sewer line upgrades to minimize inflow/infiltration	x					x	2040++
							Monitoring and source assessment	Conduct longitudinal survey of *E. coli* concentrations to identify sources and target implementation activities.	Complete survey and identify priority areas for management	–						x	2022
							Reduce urban bacteria from pets and stormwater	Pet waste management programs (in developed areas) BMPs to reduce pollutant loading—see MPCA Stormwater Manual Disconnected imperviousness	Expand pet waste management programs to all city parks Identify stormwater BMP opportunities to address priority areas identified by monitoring and source assessment and implement projects on 4 sites	Address all priority areas with stormwater BMPs in urban areas (see Monitoring and source assessment)	x					x	2035
							Address private wastewater systems (e.g., septic systems)	Inventory and assess the potential for septic systems/private wastewater systems to be sources of *E. coli* in impaired streams Replace all systems deemed Imminent Threat to Public Health (e.g., straight pipes, surface seepage)	Complete inventory and upgrade 50% of non-compliant systems	0 remaining noncompliant septic systems					x		2030

HUC-10 Subwatershed	Waterbody	Location and Upstream Influence Counties	Parameter (incl. non-pollutant stressors)	Current Conditions: Concentration (load)	Goals / Targets	Estimated % and Load Reduction by Flow Regime	Strategies (see key below)	Example strategy types and estimated scale of adoption needed to meet final water quality target	10-year Milestone	Suggested Goal	MPCA	MN DNR	BWSR	SWCD	County	Municipalities	Estimated Year to Achieve Water Quality Target
West Swan River–East Swan River (401020106) – Priority Watershed, continued	**Unnamed Creek (A22)**	St. Louis	*E. coli* ***E. coli* TMDL**	*E. coli* load varies by flow condition: Very High = 158 org/100 mL (40 B org/d) High = 193 org/100 mL (11 B org/d) Mid-range = 22 org/100 mL (1 B org/d) Low = 6 org/100 mL (0.1 B org/d) Very Low = No data	Geometric mean ≤ 126 org/100mL; Apr–Oct	Very High = 14% (5 B org/d) High = 26% (3 B org/d) Mid-range = 0% Low = 0% Very Low = No data	Address private wastewater systems (e.g., septic systems)	Inventory and assess the potential for septic systems/private wastewater systems to be sources of *E. coli* in impaired streams Replace all systems deemed Imminent Threat to Public Health (e.g., straight pipes, surface seepage)	Complete inventory and upgrade 50% of non-compliant systems	0 remaining noncompliant septic systems					x		2030
							Monitoring and source assessment	Conduct longitudinal survey of *E. coli* concentrations to identify sources and target implementation activities	Complete survey and identify priority areas for management	–						x	2022
	Unnamed Creek (A23)	St. Louis	–	Mean *E. coli* = 101 org/100 mL; Mean TP = 11 µg/L; Mean TSS = 37 mg/L	–	–	See watershed-wide strategies										
	Little Island (31-0022-00) Helen (31-0023-00)	St. Louis	–	Little Island: Mean TP = 9 µg/L; Mean transparency = 3.2 m Helen: Mean TP = 15 µg/L; Mean transparency = 2.3 m	–	–	See watershed-wide strategies										
Sand Creek–St. Louis River (401020107)	St. Louis River (510) Beauty (31-0028-00)	Lake, St. Louis	–	Beauty: Mean TP = 17 µg/L; Mean transparency = 2.1 m	–	–	See watershed-wide strategies										
	Ely Lake (69-0660-00)	St. Louis	–	Mean TP = 14 µg/L; Mean transparency = 4.7 m	–	–	See watershed-wide strategies										
	St. Mary's Lake (69-0651-00)	St. Louis	–	Mean TP = 15 µg/L; Mean transparency = 5.4 m	–	–	See watershed-wide strategies										

HUC-10 Subwatershed	Waterbody	Location and Upstream Influence Counties	Parameter (incl. non-pollutant stressors)	Current Conditions: Concentration (load)	Goals / Targets	Estimated % and Load Reduction by Flow Regime	Strategies (see key below)	Example strategy types and estimated scale of adoption needed to meet final water quality target	10-year Milestone	Suggested Goal	MPCA	MN DNR	BWSR	SWCD	County	Municipalities	Estimated Year to Achieve Water Quality Target
Sand Creek–St. Louis River (401020107), continued	East Two River (555)	St. Louis	–	No *E. coli*, TP, or TSS data	–	–	Wetland restoration	Use ditch blocks and vegetation to restore ditched wetland and peatland areas (see Figure 25)	–	Identify and prioritize opportunities for wetland restoration or enhancement as part of functional assessment Conduct restoration or enhancement activities to increase functional significance by 10% over existing.		x	x	x			–
							Pasture and livestock management	Riparian corridor survey for livestock exclusion, increase livestock exclusion Encourage rotational grazing	–	Riparian corridor survey All livestock and hobby farms practicing livestock exclusion and appropriate manure management	x			x			–
	St. Louis River (511)	Lake, St. Louis	–	Mean *E. coli* = 31 org/100 mL; Mean TP = 3 µg/L; Mean TSS = 14 mg/L	–	–	Wetland restoration	Use ditch blocks and vegetation to restore ditched wetland and peatland areas (see Figure 25)	–	Identify and prioritize opportunities for wetland restoration or enhancement as part of functional assessment Conduct restoration or enhancement activities to increase functional significance by 10% over existing.		x	x	x			–

HUC-10 Subwatershed	Waterbody	Location and Upstream Influence Counties	Parameter (incl. non-pollutant stressors)	Current Conditions: Concentration (load)	Goals / Targets	Estimated % and Load Reduction by Flow Regime	Strategies (see key below)	Example strategy types and estimated scale of adoption needed to meet final water quality target	10-year Milestone	Suggested Goal	MPCA	MN DNR	BWSR	SWCD	County	Municipalities	Estimated Year to Achieve Water Quality Target
Sand Creek–St. Louis River (401020107), continued	Elbow Creek (518)	St. Louis	F-IBI, M-IBI, DO, (specific conductivity, sulfate toxicity, nitrate toxicity) **TMDL deferred**	DO commonly < 1 mg/L	–	–	Stream restoration and improved ditch management Altered watercourse improvements	Geomorphic assessment and feasibility study to determine restoration opportunities (see Figure 27) upstream of reach Restore channelized reaches upstream of reach (re-meander, connect to floodplains) Mitigate peak flows Restore natural meander and complexity Address inadequate road crossings—crossings preventing fish passage, crossings that are not sized correctly/causing streambed and channel erosion Address channel incision (e.g., provide grade control) Restore riffle substrate where appropriate Address erosion in near-shore areas (bank stabilization, bioengineering, etc.) Improve connections with groundwater when needed	–	Prioritize stream restoration activities and conduct additional geomorphic assessment and feasibility analysis Conduct priority restoration activities		x		x			2040
							Surface and groundwater interaction study	Surface water–groundwater interaction study to understand and address effects of mine dewatering and discharge (positive and negative) on regional groundwater and stream baseflow (current research is being conducted by the USGS and Fond du Lac)	Identify potential research opportunities Begin research and data collection	Completed study and integrate findings into WRAPS process	x	x					2025
							Stockpile runoff controls	Ensure adequate erosion control BMPs Use liners and runoff capture	–	All stockpiles have erosion control BMPs in place	x	x		x			2030
							Monitor and further evaluate	Continue to monitor and evaluate the effect of natural background conditions on impairment (e.g., wetlands and organic matter) Collect BOD data in stream Further monitoring of nitrate in the stream is needed	Complete updated assessment and update 303(d) list as appropriate	Complete updated assessment and update 303(d) list as appropriate	x						2027
							Implement recommendations from the St. Louis Connectivity Analysis	Repair or replace improperly sized culverts at identified crossings	–	Repair or replace improperly sized culverts (2 identified)		x			x		2035

HUC-10 Subwatershed	Waterbody	Location and Upstream Influence Counties	Parameter (incl. non-pollutant stressors)	Current Conditions: Concentration (load)	Goals / Targets	Estimated % and Load Reduction by Flow Regime	Strategies (see key below)	Example strategy types and estimated scale of adoption needed to meet final water quality target	10-year Milestone	Suggested Goal	MPCA	MN DNR	BWSR	SWCD	County	Municipalities	Estimated Year to Achieve Water Quality Target
Sand Creek–St. Louis River (401020107), continued	**Elbow Creek (518), continued**	St. Louis	F-IBI, M-IBI, DO, (specific conductivity, sulfate toxicity, nitrate toxicity) **TMDL deferred**	DO commonly < 1 mg/L	–	–	Reduce industrial/municipal wastewater discharges	Plant upgrades/expansion Reduce WWTP untreated (emergency) releases Evaluate potential for nitrate and BOD reduction from Eveleth wastewater	Monitor and evaluate data for potential permit updates	Updated permit as needed	x					x	2023
	St. Louis River (525)	Itasca, Lake, St. Louis	–	Mean *E. coli* = 22 org/100 mL; Mean TP = 3 µg/L; Mean TSS = 6 mg/L	–	–	Feedlot, pasture, and livestock management	Open lot runoff management to meet 7020 rules Manure storage in ways that prevent runoff Provide outreach and education to animal agriculture producers and animal hobby farm owners Riparian corridor survey for livestock exclusion, increase livestock exclusion Encourage rotational grazing	–	All feedlots in compliance with 7020 Rules Riparian corridor survey All livestock and hobby farms practicing livestock exclusion and appropriate manure management	x			x			–
							Stream restoration and improved ditch management Altered watercourse improvements	Geomorphic assessment and feasibility study to determine restoration opportunities (see Figure 27) Restore channelized reaches (re-meander, connect to floodplains) Mitigate peak flows Restore natural meander and complexity Address inadequate road crossings—crossings preventing fish passage, crossings that are not sized correctly/causing streambed and channel erosion Address channel incision (e.g., provide grade control) Restore riffle substrate where appropriate Address erosion in near-shore areas (bank stabilization, bioengineering, etc.) Improve connections with groundwater when needed	–	Prioritize stream restoration activities and conduct additional geomorphic assessment and feasibility analysis Conduct priority restoration activities		x		x			–

HUC-10 Subwatershed	Waterbody	Location and Upstream Influence Counties	Parameter (incl. non-pollutant stressors)	Current Conditions: Concentration (load)	Goals / Targets	Estimated % and Load Reduction by Flow Regime	Strategies (see key below)	Example strategy types and estimated scale of adoption needed to meet final water quality target	10-year Milestone	Suggested Goal	MPCA	MN DNR	BWSR	SWCD	County	Municipalities	Estimated Year to Achieve Water Quality Target
Sand Creek–St. Louis River (401020107), continued	**Unnamed Branch (Manganika Creek) (548)**	St. Louis	F-IBI, M-IBI, DO, TSS, (specific conductivity, sulfate toxicity, ammonia, pH, nitrate toxicity) **TMDL deferred pending Manganika Lake TMDL schedule**	DO is well below 5 mg/L standard for prolonged periods; DO diurnal flux > 4.0 mg/L; Mean TSS = 29 mg/L	–	–	Manganika Lake restoration	See strategies for Manganika 69-0726-00			x	x		x	x	x	2040++
							Surface and groundwater interaction study	Surface water–groundwater interaction study to understand and address effects of mine dewatering and discharge (positive and negative) on regional groundwater and stream baseflow (current research is being conducted by the USGS and Fond du Lac)	Identify potential research opportunities Begin research and data collection	Completed study and integrate findings into WRAPS process	x	x					2025
							Stockpile runoff controls	Ensure adequate erosion control BMPs Use liners and runoff capture	–	All stockpiles have erosion control BMPs in place	x	x		x			2030
							Implement recommendations from the St. Louis Connectivity Analysis	Repair or replace improperly sized culverts at road crossings including St. Louis County CSAH7	–	Repair or replace improperly sized culverts		x			x		2035
							Reduce municipal wastewater discharges	Reduce municipal wastewater phosphorus Monitor specific conductance from mine pit dewatering activities Monitor ammonia to evaluate effect of recent plant upgrades on biota over time	Permit compliance (see watershed-wide strategy) Consideration of regional wastewater solutions	Permit compliance (see watershed-wide strategy)	x					x	2023

HUC-10 Subwatershed	Waterbody	Location and Upstream Influence Counties	Parameter (incl. non-pollutant stressors)	Current Conditions: Concentration (load)	Goals / Targets	Estimated % and Load Reduction by Flow Regime	Strategies (see key below)	Example strategy types and estimated scale of adoption needed to meet final water quality target	10-year Milestone	Suggested Goal	MPCA	MN DNR	BWSR	SWCD	County	Municipalities	Estimated Year to Achieve Water Quality Target
Sand Creek–St. Louis River (401020107), continued	Elbow Creek (570)	St. Louis	M-IBI, habitat **No TMDL—Nonpollutant stressor**	Habitat scores show coarse grained substrates are moderately embedded by sand and other fine particles	–	–	Pasture and livestock management	Riparian corridor survey for livestock exclusion, increase livestock exclusion Encourage rotational grazing Improve and expand riparian buffers adjacent to pasture and hay lands	Riparian corridor survey complete Complete projects on 25% of properties identified as needed enhancements (e.g., livestock exclusion, manure storage, pasture management, buffers)	All livestock and hobby farms practicing livestock exclusion and appropriate manure management Perennial buffers established				x			2035
							Implement recommendations from the St. Louis Connectivity Analysis	Repair or replace improperly sized culverts at road crossings	–	Repair or replace improperly sized culverts		x			x		2035
							Stream restoration and improved ditch management Altered watercourse improvements	Geomorphic assessment and feasibility study to determine restoration opportunities (see Figure 27) Restore channelized reaches (re-meander, connect to floodplains) Mitigate peak flows Restore natural meander and complexity Address inadequate road crossings—crossings preventing fish passage, crossings that are not sized correctly/causing streambed and channel erosion Address channel incision (e.g., provide grade control) Restore riffle substrate where appropriate Address erosion in near-shore areas (bank stabilization, bioengineering, etc.) Improve connections with groundwater when needed	–	Prioritize stream restoration activities and conduct additional geomorphic assessment and feasibility analysis Conduct priority restoration activities		x		x			2040
							Surface and groundwater interaction study	Surface water–groundwater interaction study to understand and address effects of mine dewatering and discharge (positive and negative) on regional groundwater and stream baseflow (current research is being conducted by the USGS and Fond du Lac)	Identify potential research opportunities Begin research and data collection	Completed study and integrate findings into WRAPS process	x	x					2025
							Stream crossing and culvert improvements	Evaluate effectiveness of culvert crossing at Hwy 16 and potential negative effects (e.g., loss of grade control) of upgrading/replacing culvert	Complete geomorphic assessment and develop recommendation for Hwy 61 crossing	Implement recommendation for Hwy 61 crossing (e.g., upgrade crossing)		x			x		2030

HUC-10 Subwatershed	Waterbody	Location and Upstream Influence Counties	Parameter (incl. non-pollutant stressors)	Current Conditions: Concentration (load)	Goals / Targets	Estimated % and Load Reduction by Flow Regime	Strategies (see key below)	Example strategy types and estimated scale of adoption needed to meet final water quality target	10-year Milestone	Suggested Goal	MPCA	MN DNR	BWSR	SWCD	County	Municipalities	Estimated Year to Achieve Water Quality Target
Sand Creek–St. Louis River (401020107), continued	**Sand Creek (607)**	Itasca, St. Louis	F-IBI, habitat, (altered hydrology) **No TMDL – non-pollutant stressors**	Habitat rated as "poor"	–	–	Pasture and livestock management	Riparian corridor survey for livestock exclusion, increase livestock exclusion Encourage rotational grazing Improve and expand riparian buffers adjacent to pasture and hay lands	Riparian corridor survey complete Complete projects on 25% of properties identified as needed enhancements (e.g., livestock exclusion, manure storage, pasture management)	All livestock and hobby farms practicing livestock exclusion and appropriate manure management				x			2040
							Stream restoration and improved ditch management Altered watercourse improvements	Geomorphic assessment and feasibility study to determine restoration opportunities (see Figure 27) Restore channelized reaches (re-meander, connect to floodplains) Mitigate peak flows Address erosion in near-shore areas (bank stabilization, bioengineering, etc.) Improve connections with groundwater when needed	–	Prioritize stream restoration activities and conduct additional geomorphic assessment and feasibility analysis Conduct priority restoration activities							2040
							Monitoring	Additional sampling of flow and TSS to evaluate sediment as a stressor	Complete updated assessment and update 303(d) list as appropriate	Complete updated assessment and update 303(d) list as appropriate	x						2027
	Stony Creek (963)	St. Louis	F-IBI, M-IBI, DO, habitat, TSS, (altered hydrology) **TSS TMDL**	TSS load varies by flow condition: Very High = 19 mg/L (6 tons/d) High = 14 mg/L (0.9 tons/d) Mid-range = 16 mg/L (0.3 tons/d) Low = No data Very Low = No data	TSS standard <15 mg/L > 90% of the time, April – Sept	Very High = 68% (4 tons/d) High = 29% (0.3 tons/d) Mid-range = 0% Low = No data Very Low = No data	Implement recommendations from the St. Louis Connectivity Analysis	Repair or replace improperly sized culverts at road crossings including St. Louis County CSAH 83	–	Repair or replace improperly sized culverts		x			x		2035
							Monitor and further evaluate	Continue to monitor and evaluate the effect of natural background conditions on impairment (e.g., low gradient)	Complete updated assessment and update 303(d) list as appropriate	Complete updated assessment and update 303(d) list as appropriate	x						2027

HUC-10 Subwatershed	Waterbody	Location and Upstream Influence Counties	Parameter (incl. non-pollutant stressors)	Current Conditions: Concentration (load)	Goals / Targets	Estimated % and Load Reduction by Flow Regime	Strategies (see key below)	Example strategy types and estimated scale of adoption needed to meet final water quality target	10-year Milestone	Suggested Goal	MPCA	MN DNR	BWSR	SWCD	County	Municipalities	Estimated Year to Achieve Water Quality Target
Sand Creek–St. Louis River (401020107), continued	**Stony Creek (963), continued**	St. Louis	F-IBI, M-IBI, DO, habitat, TSS, (altered hydrology) **TSS TMDL**	TSS load varies by flow condition: Very High = 19 mg/L (6 tons/d) High = 14 mg/L (0.9 tons/d) Mid-range = 16 mg/L (0.3 tons/d) Low = No data Very Low = No data	TSS standard <15 mg/L > 90% of the time, April – Sept	Very High = 68% (4 tons/d) High = 29% (0.3 tons/d) Mid-range = 0% Low = No data Very Low = No data	Stream restoration and improved ditch management Altered watercourse improvements	Research historic landscape alteration and effect on St. Louis River and channel incision in Stony Creek Geomorphic assessment and feasibility study to determine restoration opportunities (see Figure 27) Restore channelized reaches (re-meander, connect to floodplains) Restore natural meander and complexity Address debris jams Address inadequate road crossings—crossings preventing fish passage, crossings that are not sized correctly/causing streambed and channel erosion Address channel incision (e.g., provide grade control) Restore riffle substrate where appropriate Address erosion in near-shore areas (bank stabilization, bioengineering, etc.) Improve connections with groundwater when needed	–	Develop and implement long-term monitoring program for channel erosion Research historic landscape alterations Prioritize stream restoration activities and conduct additional geomorphic assessment and feasibility analysis		x		x			2040
							Wetland restoration	Use ditch blocks and vegetation to restore ditched wetland and peatland areas (see Figure 25)	–	Identify and prioritize opportunities for wetland restoration or enhancement as part of functional assessment Conduct restoration or enhancement activities to increase functional significance by 25% over existing		x	x	x			2040
	Unnamed Creek (A17)	St. Louis	M-IBI, habitat, (altered hydrology and connectivity) **No TMDL – non-pollutant stressors**	Poor habitat characterized by sand and silt	–	–	Wetland restoration	Use ditch blocks and vegetation to restore ditched wetland and peatland areas (see Figure 25)	–	Identify and prioritize opportunities for wetland restoration or enhancement as part of functional assessment Conduct restoration or enhancement activities to increase functional significance by 25% over existing		x	x	x			2040

HUC-10 Subwatershed	Waterbody	Location and Upstream Influence Counties	Parameter (incl. non-pollutant stressors)	Current Conditions: Concentration (load)	Goals / Targets	Estimated % and Load Reduction by Flow Regime	Strategies (see key below)	Example strategy types and estimated scale of adoption needed to meet final water quality target	10-year Milestone	Suggested Goal	MPCA	MN DNR	BWSR	SWCD	County	Municipalities	Estimated Year to Achieve Water Quality Target
Sand Creek–St. Louis River (401020107), continued	**Unnamed Creek (A17), continued**	St. Louis	M-IBI, habitat, (altered hydrology and connectivity) **No TMDL – non-pollutant stressors**	Poor habitat characterized by sand and silt	–	–	Monitor and further evaluate	Continue to monitor and evaluate the effect of natural background conditions on impairment (e.g., low gradient, wetland-dominated) Hydrologic analysis to determine effect of wetland ditching and potential for restoration	Complete updated assessment and update 303(d) list as appropriate	Complete updated assessment and update 303(d) list as appropriate	x						2027
							Pasture and livestock management	Riparian corridor survey for livestock exclusion, increase livestock exclusion Encourage rotational grazing	Riparian corridor survey complete Complete projects on 50% of properties identified as needed enhancements (e.g., livestock exclusion, manure storage, pasture management)	All livestock and hobby farms practicing livestock exclusion and appropriate manure management				x			2040
							Stream restoration and improved ditch management Altered watercourse improvements	Geomorphic assessment and feasibility study to determine restoration opportunities (see Figure 27) Restore channelized reaches (re-meander, connect to floodplains) Mitigate peak flows Restore natural meander and complexity Address inadequate road crossings—crossings preventing fish passage, crossings that are not sized correctly/causing streambed and channel erosion Address channel incision (e.g., provide grade control) Restore riffle substrate where appropriate Address erosion in near-shore areas (bank stabilization, bioengineering, etc.) Improve connections with groundwater when needed	–	Feasibility study and geomorphic assessment Stream restoration activities in priority areas		x		x			2040
							Implement recommendations from the St. Louis Connectivity Analysis	Repair or replace improperly sized culverts at road crossings including St. Louis County CR230	–	Repair or replace improperly sized culverts		x			x		2035
							Remove fish passage barriers	Properly size and place bridges and culverts for flow, stream stability, and fish passage Repair or replace crossing at St. Louis County Road 52 to eliminate fish passage barrier	–	Upgrade crossing at County Road 52		x			x		2035

HUC-10 Subwatershed	Waterbody	Location and Upstream Influence Counties	Parameter (incl. non-pollutant stressors)	Current Conditions: Concentration (load)	Goals / Targets	Estimated % and Load Reduction by Flow Regime	Strategies (see key below)	Example strategy types and estimated scale of adoption needed to meet final water quality target	10-year Milestone	Suggested Goal	MPCA	MN DNR	BWSR	SWCD	County	Municipalities	Estimated Year to Achieve Water Quality Target
Sand Creek–St. Louis River (401020107), continued	**Skunk Creek (A18)**	St. Louis	F-IBI, M-IBI, DO, habitat, (altered hydrology) **No TMDL – non-pollutant stressors**	At one site, nearly all continuous DO measurements < 5 mg/L standard	–	–	Monitor and further evaluate	Continue to monitor and evaluate the effect of natural background conditions on impairment (e.g., wetlands and organic decomposition)	Complete updated assessment and update 303(d) list as appropriate	Complete updated assessment and update 303(d) list as appropriate	x						2027
							Pasture and livestock management	Riparian corridor survey for livestock exclusion, increase livestock exclusion Encourage rotational grazing	Riparian corridor survey complete Complete projects on 50% of properties identified as needed enhancements (e.g., livestock exclusion, manure storage, pasture management)	All livestock and hobby farms practicing livestock exclusion and appropriate manure management				x			2040
							Stream restoration and improved ditch management Altered watercourse improvements	Address channel incision (e.g., provide grade control) downstream of CR 196 Geomorphic assessment and feasibility study to determine restoration opportunities (see Figure 27) Restore channelized reaches (re-meander, connect to floodplains) Mitigate peak flows Restore natural meander and complexity Address inadequate road crossings—crossings preventing fish passage, crossings that are not sized correctly/causing streambed and channel erosion Address channel incision (e.g., provide grade control) Restore riffle substrate where appropriate Address erosion in near-shore areas (bank stabilization, bioengineering, etc.) Improve connections with groundwater when needed	–	Feasibility study and geomorphic assessment Stream restoration activities in priority areas including downstream of CR 196		x		x	x		2040
							Implement recommendations from St. Louis Connectivity Analysis	Repair or replace improperly sized culverts at 2 crossings including St. Louis County CR196	–	Repair or replace improperly sized culverts (2 identified)		x			x		2035
							Remove fish passage barriers	Properly size and place bridges and culverts for flow, stream stability, and fish passage Evaluate bridge at CR 196 to determine feasibility of eliminating fish passage barrier while still maintaining grade control.	–	Evaluate CR 196 bridge and implement recommendations		x			x		2030

HUC-10 Subwatershed	Waterbody	Location and Upstream Influence Counties	Parameter (incl. non-pollutant stressors)	Current Conditions: Concentration (load)	Goals / Targets	Estimated % and Load Reduction by Flow Regime	Strategies (see key below)	Example strategy types and estimated scale of adoption needed to meet final water quality target	10-year Milestone	Suggested Goal	MPCA	MN DNR	BWSR	SWCD	County	Municipalities	Estimated Year to Achieve Water Quality Target
Sand Creek–St. Louis River (401020107), continued	**Ely Creek (A26)**	St. Louis	F-IBI, DO, habitat, altered hydrology **No TMDL – non-pollutant stressors**	DO consistently < 1.0 mg/L during early morning hours in one data collection period	–	–	Implement recommendations from the St. Louis Connectivity Analysis	Repair or replace improperly sized culverts at road crossings including St. Louis County CSA H95 and St. Louis County T1243	–	Repair or replace improperly sized culverts (2 identified)		x			x		2035
							Stream restoration and improved ditch management Altered watercourse improvements	Geomorphic assessment and feasibility study to determine restoration opportunities (see Figure 27) Restore channelized reaches (re-meander, connect to floodplains) Mitigate peak flows Restore natural meander and complexity Address inadequate road crossings—crossings preventing fish passage, crossings that are not sized correctly/causing streambed and channel erosion Address channel incision (e.g., provide grade control) Restore riffle substrate where appropriate Address erosion in near-shore areas (bank stabilization, bioengineering, etc.)		Implement stream improvement and restoration projects in priority areas		x		x			2040
							Reduce effect of altered flow conditions	Evaluate the impact of Ely Lake water level management and develop recommendations for low flow/drought conditions	Complete study of Ely Lake outflow and implement recommendations for lake level management	Complete study of Ely Lake outflow and implement recommendations for lake level management		x		x			2027
							Surface and groundwater interaction study	Surface water–groundwater interaction study to understand and address effects of mine dewatering and discharge (positive and negative) on regional groundwater and stream baseflow (current research is being conducted by the USGS and Fond du Lac)	Identify potential research opportunities Begin research and data collection	Completed study and integrate findings into WRAPS process	x	x					2025

HUC-10 Subwatershed	Waterbody	Location and Upstream Influence Counties	Parameter (incl. non-pollutant stressors)	Current Conditions: Concentration (load)	Goals / Targets	Estimated % and Load Reduction by Flow Regime	Strategies (see key below)	Example strategy types and estimated scale of adoption needed to meet final water quality target	10-year Milestone	Suggested Goal	MPCA	MN DNR	BWSR	SWCD	County	Municipalities	Estimated Year to Achieve Water Quality Target
	Lake Manganika (69-0726-00)	St. Louis	Nutrients **TMDL deferred**	Mean TP = 309 µg/L; Mean chl-*a* = 67 µg/L; Mean transparency = 0.8 m	–	–	Wastewater treatment	Reduce the phosphorus load from the Virginia WWTP to meet the water quality based effluent limit	Permit compliance (see watershed-wide strategy) Consideration of regional wastewater solutions	Permit compliance (see watershed-wide strategy)	x					x	2023
							Shallow lake standards	Continue to pursue shallow lakes standards for the Northern Lakes and Forests ecoregion	Updated lake standards	Updated lake standards	x						2025
							Reduce internal release of phosphorus within lakes	Evaluate the potential drivers of internal loading in Lake Manganika (e.g., iron, sulfur, sediment phosphorus content, DO conditions) Evaluate options to reduce internal loading after the load from the Virginia WWTP is reduced	–	Internal load management plan Implement internal load reduction projects	x	x		x	x	x	2040++

3.4.3 Lower Whiteface River

The major drainages in the Lower Whiteface River focus area are the Whiteface River and Paleface River (Figure 31). The Upper Whiteface River priority protection subwatershed (Section 3.1, Figure 21) is located in this focus area. Whiteface Reservoir is a regional recreational resource in the Superior National Forest.

The dominant land covers in the focus area are forest and wetlands, with pasture/hay land covers (Figure 26) concentrated around the lower portion of the Whiteface River near the small city of Meadowlands, which is the only city in the focus area. To the northeast and south of the city, many wetland areas were historically ditched and drained in an attempt to farm the area. Peat mining has also occurred in this area. The wetland complex remains ditched but not actively farmed. The altered hydrology associated with these drained wetland complexes may be impacting aquatic life; however, additional research is needed on this topic. Land ownership is a mix of public and private lands.

Nutrient, sediment, and pathogen concentrations are low on average. Paleface Creek, which has an aquatic life impairment, is the only impaired stream in the focus area. Low DO in Paleface Creek is likely due to the wetland dominated, flat landscape. Dinham Lake and Strand Lake have aquatic recreation impairments; primary phosphorus sources include watershed runoff, shoreland development, septic systems, and internal loading.

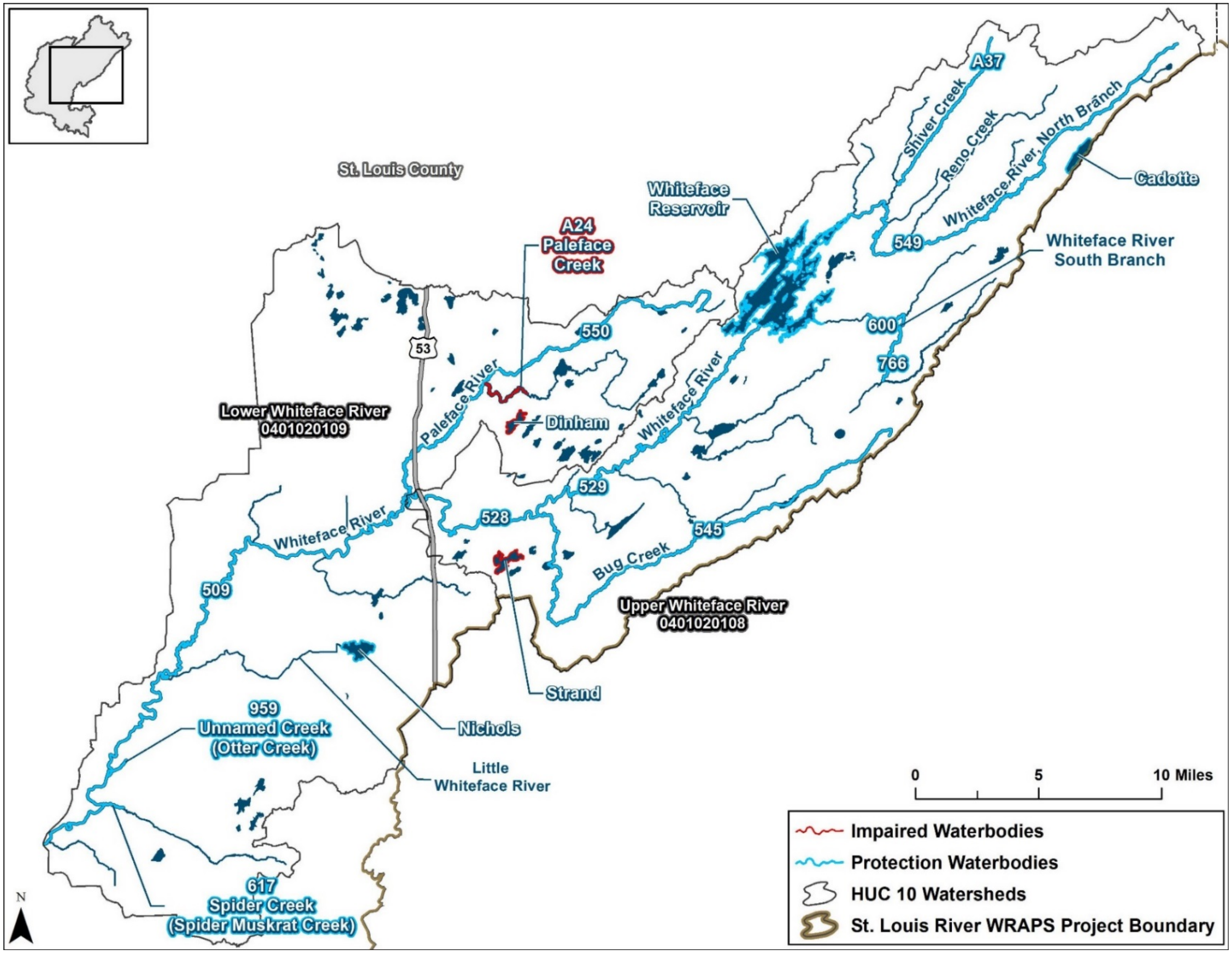


Figure 31. Lower Whiteface River WRAPS strategy focus area.

Table 15. Strategies and actions proposed for the Lower Whiteface River Focus Area, St. Louis River Watershed.

Upper Whiteface River Subwatershed is identified as a priority watershed; **BLUE** waterbodies are priority waters for protection; **RED** waterbodies are priority waters for restoration

HUC-10 Subwatershed	Waterbody (AUID)	Location and Upstream Influence Counties	Parameter (incl. non-pollutant stressors)	Current Conditions: Concentration (load)	Goals / Targets	Estimated % and Load Reduction by Flow Regime	Strategies (see key below)	Example strategy types and estimated scale of adoption needed to meet final water quality target	10-Year Milestone	Suggested Goal	MPCA	MN DNR	BWSR	SWCD	County	Municipalities	Estimated Year to Achieve Water Quality Target
Upper Whiteface River (401020108) – Priority Watershed	Whiteface River (528)	St. Louis	–	Mean *E. coli* = 61 org/100 mL; Mean TP = 2 µg/L; Mean TSS = 3 mg/L	–	–	See watershed-wide strategies										
	Shiver Creek (A37) Cadotte (69-0114-00) **Whiteface Reservoir (69-0375-00)**	St. Louis	–	No *E. coli* or TSS data Whiteface: Mean TP = 24 µg/L; Mean transparency = 1.2 m	–	–											
	Whiteface River, South Branch (600)	St. Louis	–	Mean *E. coli* = 39 org/100 mL; Mean TP = 2 µg/L; Mean TSS = 3 mg/L	–	–											
	Whiteface River, South Branch (766)	St. Louis	–	Mean *E. coli* = 18 org/100 mL; Mean TP = 2 µg/L; Mean TSS = 4 mg/L	–	–											
	Bug Creek (545)	St. Louis	–	Mean *E. coli* = 75 org/100 mL; Mean TP = 3 µg/L; Mean TSS = 4 mg/L	–	–											
	Whiteface River, North Branch (549)	St. Louis	–	No *E. coli*, TP, or TSS data	–	–											
	Whiteface River (529)	St. Louis	–	Mean *E. coli* = 18 org/100 mL; Mean TP = 2 µg/L; Mean TSS = 2 mg/L	–	–											

HUC-10 Subwatershed	Waterbody (AUID)	Location and Upstream Influence Counties	Parameter (incl. non-pollutant stressors)	Current Conditions: Concentration (load)	Goals / Targets	Estimated % and Load Reduction by Flow Regime	Strategies (see key below)	Example strategy types and estimated scale of adoption needed to meet final water quality target	10-Year Milestone	Suggested Goal	MPCA	MN DNR	BWSR	SWCD	County	Municipalities	Estimated Year to Achieve Water Quality Target
Upper Whiteface River (401020108) – Priority Watershed, continued	**Strand (69-0529-00)**	St. Louis	Nutrients **TMDL deferred**	Mean TP = 36 µg/L; Mean transparency = 1.1 m	**TMDL deferred – shallow lake**	–	Protect and stabilize nearshore areas (lakeshores)	Shoreland survey—evaluate the shoreland and identify areas of disturbance, such as altered vegetation (e.g., lawns), bare soil, and shoreland erosion Use bioengineering practices and BMPs to prevent erosion and protect water quality	Completed survey Implement 3 demonstration projects	Implement shoreline BMPs such that the majority of lakeshore owners are implementing BMPs		x		x			2030
							Monitoring and source assessment	Monitoring of perennial stream inlets for nutrients and sediment	Monitoring complete, source assessment updated Updated implementation activities	Integrate findings into WRAPS process	x			x			2027
							Address private wastewater systems (e.g., septic systems)	Inventory and assess the potential for septic systems/private wastewater systems to be sources of *E. coli* Replace all systems deemed Imminent Threat to Public Health (e.g., straight pipes, surface seepage) Provide for sewering around lakes; identify opportunities for cluster systems and work with landowners to implement Landowner focused education and outreach on septic system maintenance and compliance Support increased compliance inspections (in addition to current point of sale inspections); also required to get a building permit Additional setbacks in sensitive areas (e.g., lakeshore)	Complete inventory and upgrade 50% of non-compliant systems	0 remaining noncompliant septic systems					x		2030
							Education and outreach	Education and outreach on best shoreland management practices	Distribute education information bi-annually to lake residents	Majority of lakeshore owners practicing shoreland best management practices		x		x			2035
							Shallow lake standards	Continue to pursue shallow lakes standards for the Northern Lakes and Forests ecoregion	Updated lake standards	Updated lake standards	x						2025
							Reduce internal release of phosphorus within lakes	Investigate sources of internal loading, such as resuspension of sediment from the lake bed Consider in-lake treatment once external sources of phosphorus have been controlled	Internal load management plan	Implementation of internal load reduction projects	x	x		x			2035

HUC-10 Subwatershed	Waterbody (AUID)	Location and Upstream Influence Counties	Parameter (incl. non-pollutant stressors)	Current Conditions: Concentration (load)	Goals / Targets	Estimated % and Load Reduction by Flow Regime	Strategies (see key below)	Example strategy types and estimated scale of adoption needed to meet final water quality target	10-Year Milestone	Suggested Goal	MPCA	MN DNR	BWSR	SWCD	County	Municipalities	Estimated Year to Achieve Water Quality Target
Lower Whiteface River (0401020109)	Whiteface River (509)	St. Louis	–	Mean *E. coli* = 49 org/100 mL; Mean TP = 6 µg/L; Mean TSS = 23 mg/L	–	–	Pasture and livestock management	Riparian corridor survey for livestock exclusion, increase livestock exclusion Encourage rotational grazing	–	Riparian corridor survey All livestock and hobby farms practicing livestock exclusion and appropriate manure management				x			–
							Stream restoration and improved ditch management Altered watercourse improvements	Geomorphic assessment and feasibility study to determine restoration opportunities (see Figure 27) Restore channelized reaches (re-meander, connect to floodplains) Mitigate peak flows Restore natural meander and complexity Address inadequate road crossings—crossings preventing fish passage, crossings that are not sized correctly/causing streambed and channel erosion Address channel incision (e.g., provide grade control) Restore riffle substrate where appropriate Address erosion in near-shore areas (bank stabilization, bioengineering, etc.) Improve connections with groundwater when needed	–	Feasibility study and geomorphic assessment Stream restoration activities in priority areas		x		x			2040
	Paleface River (550)	St. Louis	–	Mean *E. coli* = 112 org/100 mL; Mean TP = 5 µg/L; Mean TSS = 5 mg/L	–	–	See watershed-wide protection strategies										
	Spider Creek (Spider Muskrat Creek) (617)	St. Louis	–	No *E. coli*, TP, or TSS data	–	–	See watershed-wide protection strategies										
	Unnamed Creek (Otter Creek) (959) Nichols (69-0627-00)	St. Louis	–	–	–	–	Pasture and livestock management	Riparian corridor survey for livestock exclusion, increase livestock exclusion Encourage rotational grazing	–	Riparian corridor survey All livestock and hobby farms practicing livestock exclusion and appropriate manure management				x			–
	Paleface Creek (A24)	St. Louis	F-IBI, M-IBI, DO **No TMDL – Nonpollutant stressor**	Severely low DO (< 1 mg/L) is common in mid-summer and early fall	–	–	Monitor and further evaluate	Continue to monitor and evaluate the effect of natural background conditions on impairment (e.g., wetlands and organic decomposition)	Complete updated assessment and update 303(d) list as appropriate	Complete updated assessment and update 303(d) list as appropriate	x						2027
							Dinham Lake restoration	Activities that reduce nutrients in Dinham Lake (see strategies for Dinham 69-0544-00)			x	x		x	x		2040

HUC-10 Subwatershed	Waterbody (AUID)	Location and Upstream Influence Counties	Parameter (incl. non-pollutant stressors)	Current Conditions: Concentration (load)	Goals / Targets	Estimated % and Load Reduction by Flow Regime	Strategies (see key below)	Example strategy types and estimated scale of adoption needed to meet final water quality target	10-Year Milestone	Suggested Goal	MPCA	MN DNR	BWSR	SWCD	County	Municipalities	Estimated Year to Achieve Water Quality Target
Lower Whiteface River (0401020109), continued	**Dinham (69-0544-00)**	St. Louis	Nutrients **TP TMDL**	Mean TP = 36 µg/L Mean chl-*a* = 20 µg/L Mean transparency = 1.3 m	Mean TP = 30 µg/L	19% reduction, 216 lb/yr	Reduce internal release of phosphorus	Investigate sources of internal loading, such as resuspension of sediment from the lake bed Consider in-lake treatment once external sources of phosphorus have been controlled	–	Internal load management plan Implementation of internal load reduction projects	x	x		x			2040
							Protect and stabilize nearshore areas (lakeshores)	Shoreland survey—evaluate the shoreland and identify areas of disturbance such as altered vegetation (e.g., lawns), bare soil, and shoreland erosion Use bioengineering practices and BMPs to prevent erosion and protect water quality	–	Completed survey Implement shoreline BMPs such that the majority of lakeshore owners are implementing BMPs		x		x			2035
							Education and outreach	Education and outreach on best shoreland management practices	Distribute education information bi-annually to lake residents	Majority of lakeshore owners practicing shoreland best management practices		x		x			2035
							Address private wastewater systems (e.g., septic systems)	Inventory and assess the potential for septic systems/private wastewater systems to be sources of *E. coli* Replace all systems deemed Imminent Threat to Public Health (e.g., straight pipes, surface seepage) Provide for sewering around lakes; identify opportunities for cluster systems and work with landowners to implement Landowner focused education and outreach on septic system maintenance and compliance Support increased compliance inspections (in addition to current point of sale inspections); also required to get a building permit Additional setbacks in sensitive areas (e.g., lakeshore)	Complete inventory and upgrade 25% of non-compliant systems	0 remaining noncompliant septic systems					x		2035

3.4.4 Artichoke River–St. Louis River

The major drainages in the Artichoke River–St. Louis River focus area are the Floodwood River, East Savanna River, Artichoke River, and St. Louis River (Figure 32). The dominant land cover upstream of the city of Floodwood is wetlands, and the dominant land covers downstream of Floodwood are forests, wetlands, and pasture/hay (Figure 26). The city of Floodwood is the only city in the focus area. Land ownership is a mix of public and private lands. Streams are typically rich in tannins ("tea-stained") due to the influence of wetlands, many of which are ditched in this area.

Sediment, phosphorus, and *E. coli* concentrations are slightly elevated around Floodwood. Two streams—Vaara Creek and the St. Louis River—have aquatic life impairments. Low DO in Vaara Creek is likely due to the wetland dominated, flat landscape, and degraded habitat is due to channel instabilities and sedimentation. The impaired reach of the St. Louis River lacks habitat heterogeneity due to a low gradient, wide channel with a lack of riffle and glide habitats. There are no impaired lakes in this focus area.

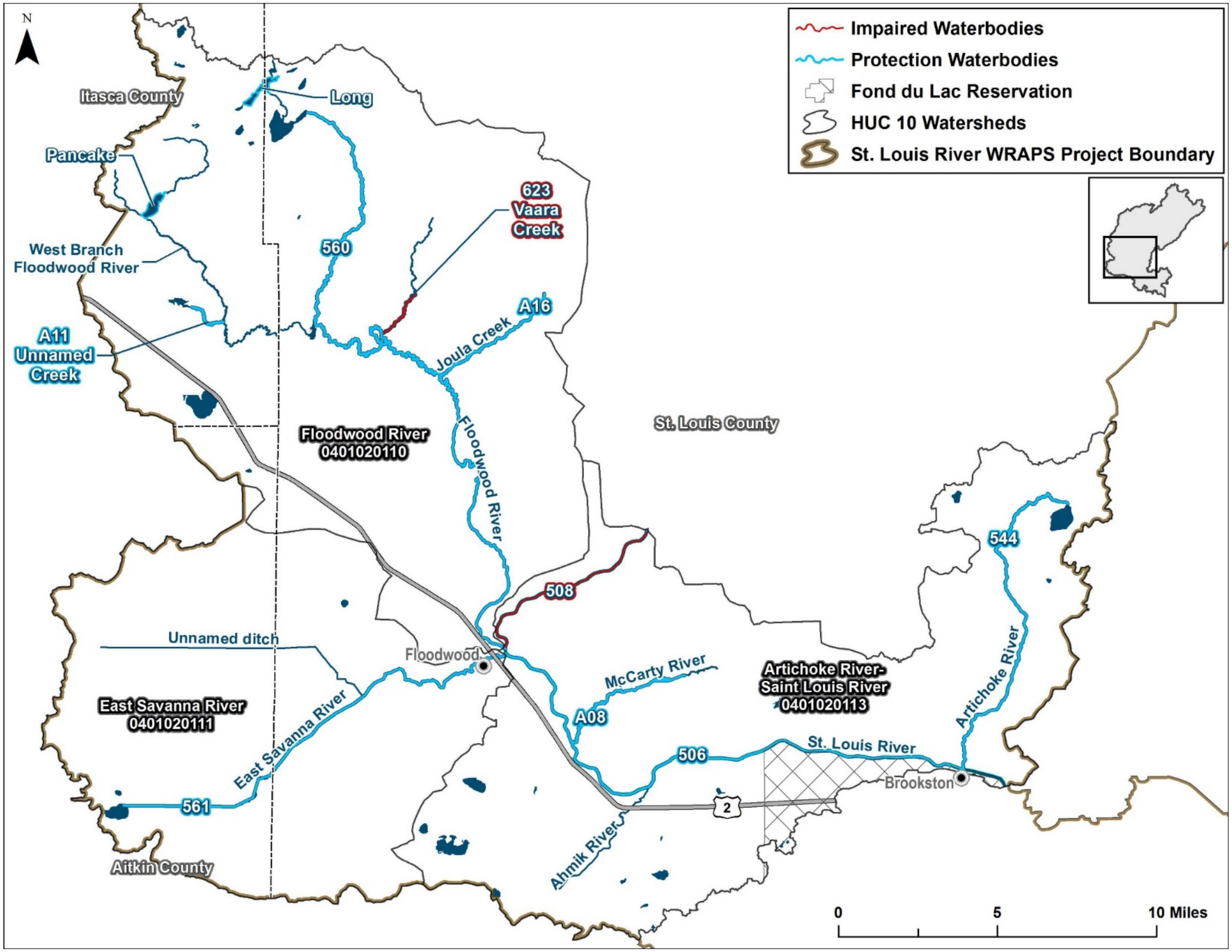


Figure 32. Artichoke River–St. Louis River WRAPS strategy focus area.

Table 16. Strategies and actions proposed for the Artichoke River–St. Louis River Focus Area, St. Louis River Watershed.
RED waterbodies are priority waters for restoration

HUC-10 Subwatershed	Waterbody	Location and Upstream Influence Counties	Parameter (incl. non-pollutant stressors)	Current Conditions: Concentration (load)	Goals / Targets	Estimated % and Load Reduction by Flow Regime	Strategies (see key below)	Example strategy types and estimated scale of adoption needed to meet final water quality target	10-Year Milestone	Suggested Goal	MPCA	MN DNR	BWSR	SWCD	County	Municipalities	Estimated Year to Achieve Water Quality Target
Floodwood River (401020110)	Joula Creek (A16) Long (31-0001-00) Pancake (31-0016-00) Unnamed Creek (A11)	Itasca, St. Louis	–	–	–	–	See watershed-wide strategies										
	Floodwood River (560)	Itasca, St. Louis	–	Mean *E. coli* = 111 org/100 mL; Mean TP = 5 µg/L; Mean TSS = 4 mg/L	–	–	Pasture and livestock management	Riparian corridor survey for livestock exclusion, increase livestock exclusion Encourage rotational grazing	–	Riparian corridor survey All livestock and hobby farms practicing livestock exclusion and appropriate manure management	x			x			–
	Vaara Creek (623)	St. Louis	F-IBI, M-IBI, DO, habitat, (altered hydrology) **No TMDL—Nonpollutant stressors**	DO is consistently < 5 mg/L standard during summer low flows	–	–	Monitor and further evaluate	Continue to monitor biota and evaluate the effect of natural background conditions on low DO conditions and impairment	Complete updated assessment and update 303(d) list as appropriate	Complete updated assessment and update 303(d) list as appropriate	x						2027
East Savanna River (401020111)	East Savanna River (561)	Aitkin, St. Louis	–	Mean *E. coli* = 169 org/100 mL; Mean TP = 9 µg/L; Mean TSS = 5 mg/L	–	–	Pasture and livestock management	Riparian corridor survey for livestock exclusion, increase livestock exclusion Encourage rotational grazing	–	Riparian corridor survey All livestock and hobby farms practicing livestock exclusion and appropriate manure management				x			–
							Stream restoration and improved ditch management Altered watercourse improvements	Geomorphic assessment and feasibility study to determine restoration opportunities (see Figure 27) Restore channelized reaches (re-meander, connect to floodplains) Restore natural meander and complexity Address inadequate road crossings—crossings preventing fish passage, crossings that are not sized correctly/causing streambed and channel erosion Restore riffle substrate where appropriate	–	Prioritize stream restoration activities and conduct additional geomorphic assessment and feasibility analysis Conduct priority restoration activities		x		x			2040

HUC-10 Subwatershed	Waterbody	Location and Upstream Influence Counties	Parameter (incl. non-pollutant stressors)	Current Conditions: Concentration (load)	Goals / Targets	Estimated % and Load Reduction by Flow Regime	Strategies (see key below)	Example strategy types and estimated scale of adoption needed to meet final water quality target	10-Year Milestone	Suggested Goal	MPCA	MN DNR	BWSR	SWCD	County	Municipalities	Estimated Year to Achieve Water Quality Target
Floodwood River (401020110)	Joula Creek (A16) Long (31-0001-00) Pancake (31-0016-00) Unnamed Creek (A11)	Itasca, St. Louis	–	–	–	–	See watershed-wide strategies										
	Floodwood River (560)	Itasca, St. Louis	–	Mean *E. coli* = 111 org/100 mL; Mean TP = 5 µg/L; Mean TSS = 4 mg/L	–	–	Pasture and livestock management	Riparian corridor survey for livestock exclusion, increase livestock exclusion Encourage rotational grazing	–	Riparian corridor survey All livestock and hobby farms practicing livestock exclusion and appropriate manure management	x			x			–
	Vaara Creek (623)	St. Louis	F-IBI, M-IBI, DO, habitat, (altered hydrology) **No TMDL—Nonpollutant stressors**	DO is consistently < 5 mg/L standard during summer low flows	–	–	Monitor and further evaluate	Continue to monitor biota and evaluate the effect of natural background conditions on low DO conditions and impairment	Complete updated assessment and update 303(d) list as appropriate	Complete updated assessment and update 303(d) list as appropriate	x						2027
Artichoke River–St. Louis River (0401020113)	St. Louis River (506)	Aitkin, Itasca, Lake, St. Louis	–	No *E. coli*, TP, or TSS data	–	–	Pasture and livestock management	Riparian corridor survey for livestock exclusion, increase livestock exclusion Encourage rotational grazing	–	Riparian corridor survey All livestock and hobby farms practicing livestock exclusion and appropriate manure management				x			–
	McCarty River (A08)	St. Louis	–	No *E. coli*, TP, or TSS data	–	–	See watershed-wide strategies										
	St. Louis River (508)	Aitkin, Itasca, Lake, St. Louis	M-IBI, habitat **No TMDL—Nonpollutant stressors**	Mean *E. coli* = 28 org/100 mL; Mean TP = 6 µg/L; Mean TSS = 27 mg/L	–	–	Monitor and further evaluate	Continue to monitor biota and evaluate the effect of natural background conditions on impairment	Complete updated assessment and update 303(d) list as appropriate	Complete updated assessment and update 303(d) list as appropriate	x						2025
							Pasture and livestock management	Riparian corridor survey for livestock exclusion, increase livestock exclusion Encourage rotational grazing	–	Riparian corridor survey All livestock and hobby farms practicing livestock exclusion and appropriate manure management				x			2040
	Artichoke River (544)	St. Louis	–	Mean *E. coli* = 167 org/100 mL	–	–	See watershed-wide strategies										

3.4.5 St. Louis River

The major drainage in the St. Louis River focus area is the St. Louis River itself, with multiple tributaries such as the Pine River and Hay Creek (Figure 33). The dominant land covers are wetlands, forest, pasture/hay, and developed areas. Development is denser in this focus area due to the proximity to the Duluth metropolitan area. Several cities are located in the focus area, including Brookston, Cloquet, Scanlon, Carlton, Thomson, Wrenshall, and Hermantown. Lands of the Fond du Lac Band of Lake Superior Chippewa covers the western half of the focus area.

Nutrient and sediment concentrations are typically low in this focus area; however, one monitoring site has had slightly elevated sediment concentrations. *E. coli* concentrations are elevated at several sites in the focus area, potentially due to livestock and wastewater. Hay Creek, Pine River, and West Rocky Run have aquatic recreation impairments, and Otter Creek has an aquatic life impairment. There are no impaired lakes in this focus area.

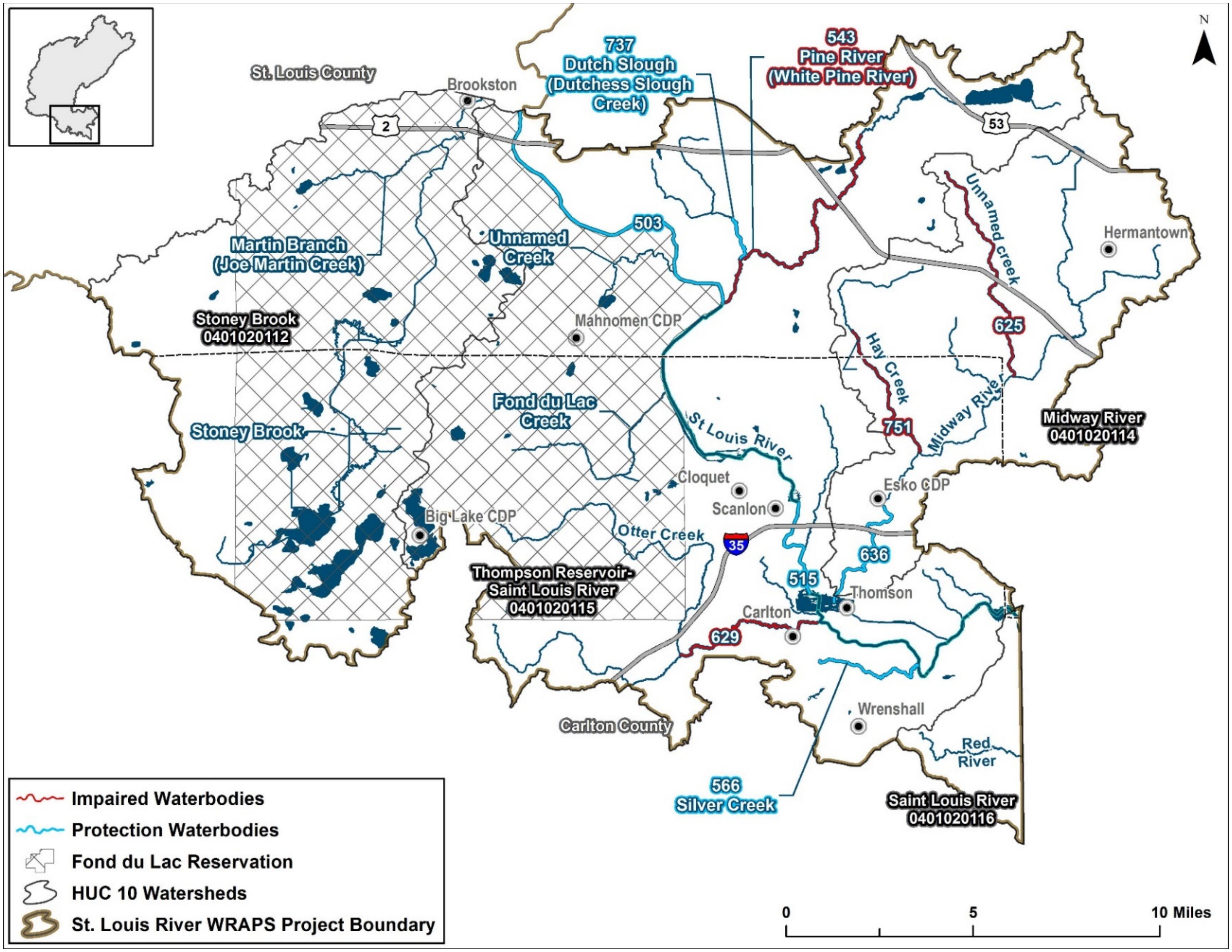


Figure 33. St. Louis River WRAPS strategy focus area.

Table 17. Strategies and actions proposed for the St. Louis River Focus Area, St. Louis River Watershed.

RED waterbodies are priority waters for restoration

HUC-10 Subwatershed	Waterbody	Location and Upstream Influence Counties	Parameter (incl. non-pollutant stressors)	Current Conditions: Concentration (load)	Goals / Targets	Estimated % and Load Reduction by Flow Regime	Strategies (see key below)	Example strategy types and estimated scale of adoption needed to meet final water quality target	10-year Milestone	Suggested Goal	MPCA	MN DNR	BWSR	SWCD	County	Municipalities	Estimated Year to Achieve Water Quality Target
Midway River (401020114)	**Unnamed Creek (625)**	St. Louis	*E. coli* ***E. coli* TMDL**	*E. coli* load varies by flow condition: Very High = 1,026 org/100 mL (3,843 B org/d) High = 196 org/100 mL (33 B org/d) Mid-range = 203 org/100 mL (13 B org/d) Low = 125 org/100 mL (2 B org/d) Very Low = No data	Geometric mean ≤ 126 org/100mL; Apr–Oct	Very High = 98% (3,780 B org/d) High = 42% (14 B org/d) Mid-range = 40% (5 B org/d) Low = 0% Very Low = No data	Feedlot, pasture, and livestock management	Open lot runoff management to meet 7020 rules Manure storage in ways that prevent runoff Provide outreach and education to animal agriculture producers and animal hobby farm owners Riparian corridor survey for livestock exclusion, increase livestock exclusion Encourage rotational grazing	Complete riparian corridor survey Implement feedlot controls on 100% of feedlots to meet 7020 rules Complete projects on 25% of properties identified as needing enhancements (e.g., livestock exclusion, manure storage, pasture management)	All feedlots in compliance with 7020 Rules Riparian corridor survey All livestock and hobby farms practicing livestock exclusion and appropriate manure management	x			x			2040
							Monitoring and source assessment in *E. coli*-impaired watersheds	Conduct longitudinal survey of *E. coli* concentrations to identify sources and target implementation activities	Complete survey and identify priority sources of *E. coli*	Integrate findings into WRAPS process	x			x			2025
							Address private wastewater systems (e.g., septic systems)	Inventory and assess the potential for septic systems/private wastewater systems to be sources of *E. coli* in impaired streams Replace all systems deemed Imminent Threat to Public Health (e.g., straight pipes, surface seepage)	Complete inventory and upgrade 25% of non-compliant systems	0 remaining noncompliant septic systems					x		2035

HUC-10 Subwatershed	Waterbody	Location and Upstream Influence Counties	Parameter (incl. non-pollutant stressors)	Current Conditions: Concentration (load)	Goals / Targets	Estimated % and Load Reduction by Flow Regime	Strategies (see key below)	Example strategy types and estimated scale of adoption needed to meet final water quality target	10-year Milestone	Suggested Goal	MPCA	MN DNR	BWSR	SWCD	County	Municipalities	Estimated Year to Achieve Water Quality Target
Midway River (401020114), continued	**Hay Creek (751)**	Carlton, St. Louis	*E. coli* ***E. coli* TMDL**	*E. coli* load varies by flow condition: Very High = 1,540 org/100 mL (7,771 B org/d) High = 91 org/100 mL (21 B org/d) Mid-range = 141 org/100 mL (12 B org/d) Low = 45 org/100 mL (1 B org/d) Very Low = No data	Geometric mean ≤ 126 org/100mL; Apr–Oct	Very High = 99% (7,686 B org/d) High = 0% Mid-range = 15% (2 B org/d) Low = 0% Very Low = No data	Feedlot, pasture, and livestock management	Open lot runoff management to meet 7020 rules Manure storage in ways that prevent runoff Provide outreach and education to animal agriculture producers and animal hobby farm owners Riparian corridor survey for livestock exclusion, increase livestock exclusion Encourage rotational grazing	Complete riparian corridor survey Implement feedlot controls on 100% of feedlots to meet 7020 rules Complete projects on 25% of properties identified as needing enhancements (e.g., livestock exclusion, manure storage, pasture management)	All feedlots in compliance with 7020 Rules Riparian corridor survey All livestock and hobby farms practicing livestock exclusion and appropriate manure management	x			x			2040
							Monitoring and source assessment in *E. coli*-impaired watersheds	Conduct longitudinal survey of *E. coli* concentrations to identify sources and target implementation activities	Complete survey and identify priority sources of *E. coli*	Integrate findings into WRAPS process	x			x			2025
							Address private wastewater systems (e.g., septic systems)	Inventory and assess the potential for septic systems/private wastewater systems to be sources of *E. coli* in impaired streams Replace all systems deemed Imminent Threat to Public Health (e.g., straight pipes, surface seepage)	Complete inventory and upgrade 25% of non-compliant systems	0 remaining noncompliant septic systems					x		2035
	Midway River (636)	Carlton, St. Louis	–	Mean *E. coli* = 366 org/100 mL; Mean TP = 3 µg/L; Mean TSS = 3 mg/L	–	–	See watershed-wide strategies										
Thompson Reservoir–St. Louis River (401020115)	Dutch Slough (Dutchess Slough Creek) (737)	St. Louis	–	No *E. coli*, TP, or TSS data	–	–	Pasture and livestock management	Riparian corridor survey for livestock exclusion, increase livestock exclusion Encourage rotational grazing	–	Riparian corridor survey All livestock and hobby farms practicing livestock exclusion and appropriate manure management				x			–
	Pike (69-0490-00)	St. Louis	–	Mean TP = 13 µg/L; Mean transparency = 4.6 m	–	–	Invasive species management (zebra mussels)	Control of zebra mussels Encourage watercraft inspections (see DNR aquatic invasive species program) Monitoring and assessment of lake clarity and food web to determine impact of zebra mussels	–	Aquatic invasive control that prevents the spread of zebra mussels		x		x	x		–
	St. Louis River (503)	Aitkin, Itasca, Lake, St. Louis	–	Mean *E. coli* = 33 org/100 mL; Mean TP = 4 µg/L; Mean TSS = 6 mg/L	–	–	See watershed-wide strategies										
	St. Louis River (515)	Aitkin, Carlton, Itasca, Lake, St. Louis	–	Mean *E. coli* = 38 org/100 mL; Mean TP = 4 µg/L; Mean TSS = 13 mg/L	–	–											

HUC-10 Subwatershed	Waterbody	Location and Upstream Influence Counties	Parameter (incl. non-pollutant stressors)	Current Conditions: Concentration (load)	Goals / Targets	Estimated % and Load Reduction by Flow Regime	Strategies (see key below)	Example strategy types and estimated scale of adoption needed to meet final water quality target	10-year Milestone	Suggested Goal	MPCA	MN DNR	BWSR	SWCD	County	Municipalities	Estimated Year to Achieve Water Quality Target
Thompson Reservoir–St. Louis River (401020115), continued	Silver Creek (566)	Carlton	–	Mean *E. coli* = 159 org/100 mL; Mean TP = 3 µg/L; Mean TSS = 7 mg/L	–	–	Pasture and livestock management	Riparian corridor survey for livestock exclusion, increase livestock exclusion Encourage rotational grazing	–	Riparian corridor survey All livestock and hobby farms practicing livestock exclusion and appropriate manure management				x			–
	Pine River (White Pine River) (543)	St. Louis	*E. coli* ***E. coli* TMDL**	*E. coli* load varies by flow condition: Very High = 31 org/100 mL (64 B org/d) High = 131 org/100 mL (89 B org/d) Mid-range = 114 org/100 mL (32 B org/d) Low = 107 org/100 mL (10 B org/d) Very Low = No data	Geometric mean ≤ 126 org/100mL; Apr–Oct	Very High = 0% High = 0% Mid-range = 0% Low = 0% Very Low = No data 32% overall reduction from unregulated sources	Feedlot, pasture, and livestock management	Open lot runoff management to meet 7020 rules Manure storage in ways that prevent runoff Provide outreach and education to animal agriculture producers and animal hobby farm owners Riparian corridor survey for livestock exclusion, increase livestock exclusion Encourage rotational grazing	Implement feedlot controls on 100% of feedlots to meet 7020 rules Complete projects on 25% of properties identified as needed enhancements (e.g., livestock exclusion, manure storage, pasture management)	All feedlots in compliance with 7020 Rules Riparian corridor survey All livestock and hobby farms practicing livestock exclusion and appropriate manure management	x			x			2040
							Monitoring and source assessment	Conduct longitudinal survey of *E. coli* concentrations to identify sources and target implementation activities	Complete survey and identify priority sources of *E. coli*	Completed survey Targeted sources of bacteria are mitigated	x			x			2025
							Address private wastewater systems (e.g., septic systems)	Inventory and assess the potential for septic systems/private wastewater systems to be sources of *E. coli* in impaired streams Replace all systems deemed Imminent Threat to Public Health (e.g., straight pipes, surface seepage)	Complete inventory and upgrade 25% of non-compliant systems	0 remaining noncompliant septic systems					x		2035
	Otter Creek (629)	Carlton	M-IBI, (temperature, habitat) **No TMDL – impairment listing under evaluation**	–	–	–	Land use planning	Land use planning and implementation of local and county water plans Ordinance development/revision and workshops	Identify target year to begin One Water One Plan or updated Carlton County Water Plan Host workshop on water quality and watershed ordinances Complete ordinance reviews and provide recommendations on updates	Approved One Water One Plan or Water Plan Updated ordinances as needed to achieve plan goals			x	x	x	x	2030
							Monitor and further evaluate	Continue to monitor biota and evaluate the effect of natural background conditions on impairment; explore delisting following additional monitoring	Complete updated assessment and update 303(d) list as appropriate	Complete updated assessment and update 303(d) list as appropriate	x						2027

4. Monitoring Plan

Monitoring is crucial to evaluating progress towards meeting water quality goals in the watershed. The overall schedule for implementation is 2017 through 2040 (note that the TMDL baseline year is 2012). During this time period, it is expected that on average, water quality pollutant concentrations will decline each year equivalent to approximately 2% to 4% of the starting (i.e., long-term) pollutant load reduction. This progress benchmark will generally result in meeting water quality standards by 2040 for the majority of waterbodies.

Factors that may contribute to slower progress include: limits in funding or landowner acceptance, implementation challenges (e.g., invasive species, accessibility) and unfavorable climatic factors. Conversely, there may be faster progress for some waters, especially where high-impact fixes are likely to occur such as point source reductions. This section outlines a plan for ongoing water quality monitoring to fill data gaps, determine changing conditions, and gage implementation effectiveness. Implementation of the monitoring plan is contingent on resources available and prioritization of those resources.

Existing Monitoring Efforts

The MPCA conducted intensive monitoring throughout the watershed during 2009 and 2010 as part of the Watershed Approach. These efforts are summarized in the monitoring and assessment report (MPCA 2013). It is anticipated that the next round of intensive monitoring will begin in 2019. In addition, the MPCA and partners have established several sites in the watershed as part of the state's Watershed Pollutant Load Monitoring Network (WPLMN) program including:

- St. Louis River at Scanlon
- St. Louis River at Floodwood, CSAH8
- Whiteface River near Meadowlands, CSAH5
- Swan River near Toivola, CSAH5
- St. Louis River near Forbes, US53
- Second Creek near Aurora, 0.6 miles upstream of CSAH110

The long-term WPLMN measures and compares data on pollutant loads from Minnesota's rivers and streams and tracks water quality trends. WPLMN data will be used to assist with assessing impaired waters, watershed modeling, determining pollutant source contributions, developing watershed and water quality reports, and measuring the effectiveness of water quality restoration efforts.

DNR Fisheries staff also collect various data in support of fishery establishment and monitoring. It is anticipated that data will be collected into the future. In addition, there are many other project-specific monitoring efforts throughout the watershed.

Monitoring Needs

Monitoring of flow and water quality are needed throughout the watershed to refine source assessments and inform implementation. Specific monitoring recommendations are provided in the tables within Section 3.4.

Monitoring and data collection are needed to address many different issues in the watershed including:

- Lack of understanding of the impact of naturally high iron concentration and mining-related pollutants on biota
- Source assessment and implementation targeting in *E. coli*-impaired streams; longitudinal surveys are needed as well as chemistry data during all flow regimes
- Need for better understanding of natural background conditions and the sources and biotic impacts of low DO and DO flux in the watershed
- Model refinement and source assessments for near-channel sources of sediment; bank erosion and channel migration information is needed for the Swan River system in particular
- Long-term seasonal lake data (phosphorus, chlorophyll-*a*, and transparency). Inflow data to lakes (flow and chemistry) to better understand lake water quality
- Flow data on smaller streams and tributaries to refine model calibration in these streams
- Impact of point sources, both municipal wastewater and industrial discharges, on streams and lakes

As implementation activities are conducted in the watershed, an evaluation of the before and after conditions can be useful to aid in future project planning. In addition to flow and water quality monitoring, a broader assessment of ecological function and restoration could be used to assess various components of the stream system and overall effectiveness of the implementation activity.

5. References and Further Information

Minnesota Pollution Control Agency (MPCA). 2013. *St. Louis River Watershed Monitoring and Assessment Report*. Prepared by the Minnesota Pollution Control Agency, St. Paul, MN. Document number wq-ws3-04010201b.

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St. Louis River Watershed Reports

Many St. Louis River Watershed Reports referenced in this watershed report are available at https://www.pca.state.mn.us/water/watersheds/st-louis-river.

Appendix A. Point Sources in the SLRW

HUC-10 Subwatershed	Point Source			Pollutant reduction needed beyond current permit conditions/limits to meet TMDL WLA?	Notes
	Name	Permit #	Type		
Partridge River (401020101)	Cliffs Erie - Hoyt Lakes Mining Area	MN0042536	Industrial Wastewater	No	
	Floe International Inc - Hoyt Lakes	MNRNE39QK	Industrial Stormwater	No	
	Hoyt Lakes Sanitary Landfill	MNRNE3BWZ	Industrial Stormwater	No	
	Hoyt Lakes WWTP	MN0020206	Municipal Wastewater	No	
	Mesabi Mining Area	MN0069078	Industrial Wastewater	No	
	Mesabi Nugget Delaware LLC	MN0067687	Industrial Wastewater	No	
	Minnesota Power - Laskin Energy Center	MN0000990	Industrial Wastewater	No	
	Minnesota Power - Laskin Energy Center	MNR053B5V	Industrial Stormwater	No	
	Northshore Mining Co - Peter Mitchell	MN0046981	Industrial Wastewater	No	
	Red Top Construction LLC	MNR053CY2	Industrial Stormwater	No	
Headwaters St. Louis River (401020102)	Aurora WWTP	MN0020494	Industrial Wastewater	No	
	Hudson Sanitary Landfill	MNRNE3BX2	Industrial Stormwater	No	
	Mesabi Bituminous Inc	MNG490021	Industrial Stormwater	No	
	Mesabi Mining Area	MN0069078	Industrial Wastewater	No	

HUC-10 Subwatershed	Point Source			Pollutant reduction needed beyond current permit conditions/limits to meet TMDL WLA?	Notes
	Name	Permit #	Type		
Embarrass River (401020103)	ArcelorMittal Minorca Mine Inc - Laurentian	MN0059633	Industrial Wastewater	No	
	Aurora (Hudson) Transfer Station	MNR053B7Y	Industrial Stormwater	No	
	Babbitt WWTP	MN0020656	Municipal Wastewater	No	
	Biwabik WWTP	MN0053279	Municipal Wastewater	No	
	Cliffs Erie - HL Tailings Basin Area	MN0054089	Industrial Wastewater	No	
	Cliffs Erie - Hoyt Lakes Mining Area	MN0042536	Industrial Wastewater	No	
	Dyno Nobel Inc	MN0060704	Industrial Wastewater Industrial Stormwater	No	
	East Range Ready Mix	MNR0539R5	Industrial Stormwater	No	
	Gilbert WWTP	MN0020125	Municipal Wastewater	No	
	McKinley Sanitary Landfill	MNRNE3BXY	Industrial Stormwater	No	
	McKinley WWTP	MN0024031	Municipal Wastewater	No	
	Mesabi Bituminous Inc	MNG490021	Industrial Stormwater	No	
	Mesabi Mining Area	MN0069078	Industrial Wastewater	No	
	Ulland Brothers - Aggregate	MNG490069	Industrial Stormwater	No	
	Buria Auto Salvage	MNR0534DX	Industrial Stormwater	No	

HUC-10 Subwatershed	Point Source			Pollutant reduction needed beyond current permit conditions/limits to meet TMDL WLA?	Notes
	Name	Permit #	Type		
West Two River (401020105)	Lehman's Machine Inc	MNRNE38WX	Industrial Stormwater	No	
	Mining Resources LLC	MNRNE3CVG	Industrial Stormwater	No	
	Mining Resources Skubic Basin	MNRNE3CTZ	Industrial Stormwater	No	
	Mountain Iron WWTP	MN0040835	Municipal Wastewater	No	
	Ulland Brothers - Aggregate	MNG490069	Industrial Stormwater	No	
	US Steel - Minntac Mining Area	MN0052493	Industrial Wastewater Industrial Stormwater	No	
West Swan River-East Swan River (401020106)	BNSF Kelly Lake	MNR053CBS	Industrial Stormwater	No	
	Central Iron Range Sanitary Sewer District WWTP	MN0020117	Municipal Wastewater	Yes	To comply with the CIRSSD's WLA, the MPCA has future permit discretion to 1) expand the fecal coliform effluent limit effective period to include April, or 2) require the permittee to conduct a stream monitoring program to determine whether Barber Creek is impaired for *E. coli* in April and implement an expanded disinfection period only if the impairment occurs in April. Further reductions in *E. coli* load, beyond the extension of the disinfection months, are not needed. In addition, it is assumed that if the facility's non-volatile suspended solids concentration is less than 10 mg/L it is also meeting the TSS

HUC-10 Subwatershed	Point Source			Pollutant reduction needed beyond current permit conditions/limits to meet TMDL WLA?	Notes
	Name	Permit #	Type		
					WLA. Monitoring is needed to show compliance with the TSS WLA.
	City of Hibbing S WWTP	MNR053CSJ	Industrial Stormwater	No	
	City of Hibbing South WWTP	MNR053CSJ, MNRNE3D3M	Industrial Stormwater	No	
	Delta Air Lines Global Services (HIB)	MNRNE38G5	Industrial Stormwater	No	
	Detroit Reman-DMR	MNRNE3CVJ	Industrial Stormwater	No	
	Electric Power Door	MNR053CJY	Industrial Stormwater	No	
	FedEx Express-HIBA	MNRNE38BF	Industrial Stormwater	No	
	Hibbing City MS4	MS400270	Municipal Stormwater	Yes	Reductions in *E. coli* loading required to meet TMDL WLAs for the following AUIDs: 04010201-542, 569, 641, 888 and 936. Reductions in TSS loading required to meet TMDL WLAs for the following AUIDs: 04010201-558.
	Hibbing Public Utilities Commission	MNR0538VR	Industrial Stormwater	No	
	Hibbing Salvage & Supply Inc	MNR0539JF	Industrial Stormwater	No	
	Hibbing Sanitary Landfill	MNRNE3BW3	Industrial Stormwater	No	
	Hibbing Taconite Co - Mining Area	MN0001465	Industrial Stormwater	No	

HUC-10 Subwatershed	Point Source			Pollutant reduction needed beyond current permit conditions/limits to meet TMDL WLA?	Notes
	Name	Permit #	Type		
	Hibbing Transfer Station	MNR053B89	Industrial Stormwater	No	
	Hibbing WWTP South Plant	MN0030643	Municipal Wastewater	No	Monitoring needed to show compliance with WLA. It is assumed that if the facility's non-volatile suspended solids concentration is less than 10 mg/L it is also meeting the TSS WLA.
	Industrial Rubber Applicators Inc	MNR05398M	Industrial Stormwater	No	
	Iracore International Inc	MNR05398K	Industrial Stormwater	No	
	Irathane Systems Inc	MNR05398L	Industrial Stormwater	No	
	Jack & Don's Service	MNR053BJT	Industrial Stormwater	No	
	Kubena Sand & Gravel	MNG490202	Industrial Stormwater	No	
	L & M Radiator Inc	MNR0538GM	Industrial Stormwater	No	
	MDNR Air Tanker Base - Hibbing	MNR0538V7	Industrial Stormwater	No	
	Mesabi Bituminous Inc	MNG490021	Industrial Stormwater	No	
	Midwest Aircraft Refinishing	MNRNE387K	Industrial Stormwater	No	
	Minnesota Diversified Industries	MNRNE387D	Industrial Stormwater	No	
	MNDNR - Forestry	MNG490239	Industrial Stormwater	No	
	Northern Foundry LLC	MNR0538XS	Industrial Stormwater	No	

HUC-10 Subwatershed	Point Source			Pollutant reduction needed beyond current permit conditions/limits to meet TMDL WLA?	Notes
	Name	Permit #	Type		
	Radko Iron & Supply Corp	MNR053B4D	Industrial Stormwater	No	
	Range Regional Airport	MNR05386T	Industrial Stormwater	No	
	SB Son Inc	MNG490033	Industrial Stormwater	No	
	Seppi Bros Concrete - Hibbing Plant	MNR053BDR	Industrial Stormwater	No	
	St Louis County Land Dept - Aggregate	MNG490177	Industrial Stormwater	No	
	TNT Airworks LLC	MNRNE38HT	Industrial Stormwater	No	
	Viking Explosives Inc	MNRNE35BF	Industrial Stormwater	No	
	Vonco 6 Demolition Landfill	MNRNE3BTJ	Industrial Stormwater	No	
Sand Creek- St. Louis River (401020107)	ArcelorMittal Minorca Mine Inc - Laurentian	MN0059633	Industrial Wastewater	No	
	Eveleth WTP	MNG640031	Water Treatment	No	
	Eveleth WWTP	MN0023337	Municipal Wastewater	No	
	Holmes Recycling Services Inc - Iron	MNR053CFS	Industrial Stormwater	No	
	Iron Junction WWTP	MNG580049	Municipal Wastewater	No	
	Joy Global Surface Mining Inc	MNR0539Q7	Industrial Stormwater	No	
	Laurentian Aggregate LLC	MNG490302	Industrial Stormwater	No	

HUC-10 Subwatershed	Point Source			Pollutant reduction needed beyond current permit conditions/limits to meet TMDL WLA?	Notes
	Name	Permit #	Type		
	Mesabi Bituminous Inc	MNG490021	Industrial Stormwater	No	
	Nexlink Communications	MNRNE38G8	Industrial Stormwater	No	
	NTT of Minnesota Inc	MNR053937	Industrial Stormwater	No	
	OSI Environmental Inc - Eveleth	MNR053B8P	Industrial Stormwater	No	
	Saint Louis County Regional Landfill	MNR053BGB	Industrial Stormwater	No	
	Seppi Brothers Concrete Products Corp	MNR053BDT	Industrial Stormwater	No	
	Spee Dee Delivery Service Inc - Mt Iron	MNRNE39CY	Industrial Stormwater	No	
	Spee Dee Delivery SVC Inc	MNRNE39MJ	Industrial Stormwater	No	
	St Louis County Land Dept - Aggregate	MNG490177	Industrial Stormwater	No	
	Stone Transport, Virginia MN Terminal	MNRNE3CPD	Industrial Stormwater	No	
	Ulland Brothers - Aggregate	MNG490069	Industrial Stormwater	No	
	United Taconite Fairlane/Tailings Basin	MN0052116	Industrial Wastewater	No	
	United Taconite Fairlane/Tailings Basin	MN0052116	Industrial Stormwater	No	
	United Taconite LLC - Thunderbird Mine	MN0044946	Industrial Wastewater	No	
	UPS - Virginia	MNRNE3BBX	Industrial Stormwater	No	

HUC-10 Subwatershed	Point Source			Pollutant reduction needed beyond current permit conditions/limits to meet TMDL WLA?	Notes
	Name	Permit #	Type		
	Virginia Dept of Public Utilities	MN0003379	Industrial Wastewater	No	
	Virginia WWTP	MN0030163	Municipal Wastewater	No	
	WA Fisher Co	MNRNE39SZ	Industrial Stormwater	No	
	Waupaca NorthWoods LLC	MN0061549	Industrial Wastewater	No	
	Wayne Transports, Virginia	MNR053CPG	Industrial Stormwater	No	
	Wisconsin Central Ltd - Keenan Yard	MNR053BDJ	Industrial Stormwater	No	
	Wisconsin Central Ltd - Virginia Yard	MNR053BDH	Industrial Stormwater	No	
Upper Whiteface River (401020108)	MNDNR - Forestry	MNG490239	Industrial Stormwater	No	
	St Louis County Highway Dept	MNG490140	Industrial Stormwater	No	
	St Louis County Land Dept - Aggregate	MNG490177	Industrial Stormwater	No	
Lower Whiteface River (401020109)	Cotton Area Sanitary Landfill	MNRNE3BTV	Industrial Stormwater	No	
	Ferweda General Contracting	MN0063061	Industrial Wastewater	No	
	Meadowlands WWTP	MNG580034	Municipal Wastewater	No	
	St Louis County Highway Dept	MNG490140	Industrial Stormwater	No	
	St Louis County Land Dept - Aggregate	MNG490177	Industrial Stormwater	No	

HUC-10 Subwatershed	Point Source			Pollutant reduction needed beyond current permit conditions/limits to meet TMDL WLA?	Notes
	Name	Permit #	Type		
Floodwood River (401020110)	Enbridge Energy Ltd - Clearbrook	MN0056324	Industrial Stormwater	No	
East Savanna River (401020111)	Floodwood WWTP	MNG580048	Municipal Wastewater	No	
Stoney Brook (401020112)	Brookston Area Modified Landfill	MNRNE3BTL	Industrial Stormwater	No	
Artichoke River-St. Louis River (401020113)	Conrad Fafard Inc	MN0057428	Industrial Wastewater	No	
	Enbridge Energy Ltd - Clearbrook	MN0056324	Industrial Stormwater	No	
	Floodwood Modified Sanitary Landfill	MNRNE3BVQ	Industrial Stormwater	No	
Midway River (401020114)	Arrowhead Concrete Works Inc	MNR053BWH	Industrial Stormwater	No	
	Canosia Township MS4 [a]	– [a]	Municipal Stormwater	No	
	Duluth City MS4	MS400086	Municipal Stormwater	No	
	FedEx Freight East Inc - Duluth	MNR053C6T	Industrial Stormwater	No	
	Hermantown City MS4	MS400093	Municipal Stormwater	No	
	Lauri Koski Inc dba Koski Ready Mix & Koski Oil Inc	MNR053CVH	Industrial Stormwater	No	
	Midway Township MS4	MS400146	Municipal Stormwater	No	

HUC-10 Subwatershed	Point Source			Pollutant reduction needed beyond current permit conditions/limits to meet TMDL WLA?	Notes
	Name	Permit #	Type		
	Minnesota Power - Arrowhead HVDC	MN0046256	Industrial Wastewater	No	
	MNDOT Outstate District MS4	MS400180	Municipal Stormwater	No	
	Nelson's	MNR053CGB	Industrial Stormwater	No	
	St Louis County MS4	MS400158	Municipal Stormwater	No	
	Thomson Township MS4	Future	Municipal Stormwater	No	
Thompson Reservoir- St. Louis River (401020115)	AJ's Aggregate & Trucking Gravel Pit	MNG490225	Industrial Stormwater	No	
	Alanen Pre Cast Concrete	MNR053BZS	Industrial Stormwater	No	
	Andy's Auto Recycling Inc	MNR053CFH	Industrial Stormwater	No	
	Brenny Dahl Block Co Inc	MNR053BW6	Industrial Stormwater	No	
	Brookston Transfer Station	MNR053B8R	Industrial Stormwater	No	
	Canosia Township MS4 [a]	– [a]	Municipal Stormwater	No	
	Carlton County Transportation Dept	MNG490138	Industrial Stormwater	No	
	Carlton Transfer Station and HHW Facility	MNRNE3BTN	Industrial Stormwater	No	
	Cloquet - Carlton County Airport	MNR053CWG	Industrial Stormwater	No	
	Cloquet City MS4	MS400267	Municipal Stormwater	No	

HUC-10 Subwatershed	Point Source			Pollutant reduction needed beyond current permit conditions/limits to meet TMDL WLA?	Notes
	Name	Permit #	Type		
	Cloquet Demolition Landfill	MNRNE3CFX	Industrial Stormwater	No	
	Cloquet Sanitary Service	MNR0538T2	Industrial Stormwater	No	
	Coon's Aggregate Supply Co LLC	MNG490251	Industrial Stormwater	No	
	Duluth City MS4	MS400086	Municipal Stormwater	No	
	Duluth Ready Mix - Saginaw	MNG490287	Industrial Stormwater	No	
	Duluth Ready Mix Concrete - Cloquet	MNR053CXW	Industrial Stormwater	No	
	Grand Lake Township MS4 [a]	– [a]	Municipal Stormwater	No	
	Hammerlund Construction	MNG490279	Industrial Stormwater	No	
	Hermantown City MS4	MS400093	Municipal Stormwater	No	
	Jarden Home Brands	MN0000337	Industrial Wastewater	No	
	KGM Contractors Inc	MNG490090	Industrial Stormwater	No	
	Moose Lake - Carlton County Airport	MNR053CWF	Industrial Stormwater	No	
	Northern Natural Gas Co	MN0050041	Industrial Wastewater Industrial Stormwater	No	
	Northland Crushing Inc	MNG490095	Industrial Stormwater	No	
	Pope-Douglas Ash Landfill	MNR053BQF	Industrial Stormwater	No	

HUC-10 Subwatershed	Point Source			Pollutant reduction needed beyond current permit conditions/limits to meet TMDL WLA?	Notes
	Name	Permit #	Type		
	Print Corp	MNRNE3C2Z	Industrial Stormwater	No	
	Safety-Kleen Systems Inc - Cloquet	MNRNE39WJ	Industrial Stormwater	No	
	Sappi Cloquet LLC	MN0001431	Industrial Wastewater	No	
	Sappi Cloquet LLC	MNR053C6B	Industrial Stormwater	No	
	Sappi Cloquet LLC	MNR053C6C	Industrial Stormwater	No	
	Sappi Cloquet LLC	MNR053C6D	Industrial Stormwater	No	
	Savanna Pallets - Cloquet Plant	MNR05398D	Industrial Stormwater	No	
	Shamrock Environmental Landfill	MNR05399B	Industrial Stormwater	No	
	Thomson Township MS4 [a]	– [a]	Municipal Stormwater	No	
	Tire Aggregate LLC	MNR053CRL	Industrial Stormwater	No	
	Ulland Brothers - Aggregate	MNG490069	Industrial Stormwater	No	
	USG Interiors LLC - Cloquet	MNG250102	Industrial Wastewater	No	
	USG Interiors LLC - Cloquet	MNR053BQG	Industrial Stormwater	No	
St. Louis River (401020116)	Duluth City MS4	MS400086	Municipal Stormwater	No	

a. Not currently regulated but expected to come under permit coverage in the next permit cycle.

Appendix B. TMDL Summaries

The following tables summarize the TMDLs for impaired waterbodies in the SLRW.

Total Phosphorus (Streams)

The biota impairment in West Two River is due to the high algal growth that is generated in West Two Rivers Reservoir, located immediately upstream of the impaired reach, and restoration of the reservoir will lead to improvement in the DO concentration and daily fluctuations in the river and subsequent improvement in the aquatic macroinvertebrate assemblage. It is assumed that the stream biota in West Two River will meet the stream targets when the reservoir meets the lake standards. Therefore, the only phosphorus reductions needed to restore the biota in West Two River are the reductions needed to restore West Two Rivers Reservoir (Table 31).

Total Suspended Solids

Table 18 and Table 19 summarize the TSS pollutant load allocations, wasteload allocations, current loading, and load reductions needed to meet water quality standards.

Table 18. TSS TMDL summary, East Swan River (04010201-558).

<table>
<tr><th colspan="3" rowspan="3">TMDL Parameter
(NPDES permit number, where applicable)</th><th colspan="5">Flow Regime</th></tr>
<tr><th>Very High</th><th>High</th><th>Mid-Range</th><th>Low</th><th>Very Low</th></tr>
<tr><th colspan="5">TSS Load (ton/day)</th></tr>
<tr><td rowspan="6">Wasteload Allocation</td><td colspan="2">Construction Stormwater (MNR100001) [a]</td><td>0.0018</td><td>0.00044</td><td>0.00014</td><td>0.000047</td><td>0.000019</td></tr>
<tr><td rowspan="2">Industrial Stormwater</td><td>Industrial Stormwater General Permits (MNR050000 and MNG490000) [a b]</td><td rowspan="2">0.0018</td><td rowspan="2">0.00044</td><td rowspan="2">0.00014</td><td rowspan="2">0.000047</td><td rowspan="2">0.000019</td></tr>
<tr><td>Hibbing Taconite - Mining Area (MN0001465) [a]</td></tr>
<tr><td colspan="2">Hibbing City MS4 (MS400270)</td><td>6.0</td><td>1.6</td><td>0.64</td><td>– [c]</td><td>– [c]</td></tr>
<tr><td colspan="2">Hibbing South WWTP [d] (MN0030643)</td><td>0.19</td><td>0.19</td><td>0.19</td><td>0.19</td><td>0.19</td></tr>
<tr><td colspan="2">Central Iron Range Sanitary Sewer District [d] (MN0020117)</td><td>0.10</td><td>0.10</td><td>0.10</td><td>0.10</td><td>0.10</td></tr>
<tr><td colspan="3">Load Allocation [e]</td><td>3.6</td><td>0.81</td><td>0.15</td><td>0.26</td><td>0.11</td></tr>
<tr><td colspan="3">MOS</td><td>1.1</td><td>0.30</td><td>0.12</td><td>0.061</td><td>0.044</td></tr>
<tr><td colspan="3">Loading Capacity [f]</td><td>11</td><td>3.0</td><td>1.2</td><td>0.61</td><td>0.44</td></tr>
<tr><td colspan="3">Existing Load</td><td>361</td><td>16</td><td>3.2</td><td>0.34</td><td>-</td></tr>
<tr><td colspan="3">Percent Load Reduction</td><td>97%</td><td>81%</td><td>63%</td><td>0%</td><td>-</td></tr>
</table>

a. It is assumed that loads from permitted construction and industrial stormwater sites that operate in compliance with the permits are meeting the WLA.
b. General Permit MNR050000 for Industrial Stormwater Multi-Sector and General Permit MNG490000 for Nonmetallic Mining and Associated Activities.
c. MS4 WLAs are not provided for the low and very low flow zones because stormwater runoff is not expected to occur under these low flow conditions.
d. WLAs for the two WWTPs apply from April 1 through September 30. It is assumed that the facilities' 30 mg/L TSS effluent limit is sufficient to ensure that effluent NVSS concentrations will not exceed the 10 mg/L inorganic TSS concentration which is the basis for the water quality standard. Effluent monitoring may be required to confirm this assumption.
e. Applies to channel erosion and unregulated watershed runoff.
f. Loading capacities are rounded to two significant digits, except in the case of values greater than 100, which are rounded to the nearest whole number.

Table 19. TSS TMDL summary, Stony Creek (04010201-963).

TMDL Parameter		Flow Regime				
		Very High	High	Mid-Range	Low	Very Low
		TSS Load (tons/d)				
Wasteload Allocation	Construction Stormwater General Permit (MNR100001) [a]	0.00034	0.00010	0.000046	0.000020	0.0000072
	Industrial Stormwater General Permit (MNR050000) [a]	0.00034	0.00010	0.000046	0.000020	0.0000072
Load Allocation		1.8	0.56	0.25	0.10	0.038
MOS		0.20	0.062	0.027	0.012	0.0043
Loading Capacity [b]		2.0	0.62	0.28	0.11	0.042
Existing Load		6.4	0.88	0.26	-	-
Percent Load Reduction		69%	30%	0%	-	-

a. It is assumed that loads from permitted construction and industrial stormwater sites that operate in compliance with the permits are meeting the WLA.
b. Loading capacities are rounded to two significant digits.

E. coli

Table 20 through Table 30 summarize the *E. coli* pollutant load allocations, wasteload allocations, current loading, and load reductions needed to meet water quality standards.

Table 20. *E. coli* TMDL summary, Buhl Creek (04010201-580).

TMDL Parameter (Permit #)	Flow Regime				
	Very High	High	Mid-Range	Low	Very Low
	E. coli Load (billion org/day)				
Wasteload Allocation: Hibbing City MS4 (MS400270)	0.201	0.0481	0.0156	0.00494	0.000631
Load Allocation	41.9	10.0	3.26	1.03	0.132
MOS	4.68	1.12	0.364	0.115	0.0147
Loading Capacity [a]	46.8	11.2	3.64	1.15	0.147
Existing Load	51.7	5.71	11.1	-	-
Percent Load Reduction	9%	0%	67%	-	-
Percent Load Reduction for Regulated MS4 [b]	0%	0%	0%	0%	0%
Percent Load Reduction for Unregulated Sources	19%	0%	71%	-	-

a. Loading capacities are rounded to three significant digits.
b. Runoff from the regulated MS4 does not contribute to the impairment, and MS4 load reductions are not required.

Table 21. *E. coli* TMDL summary, Dempsey Creek (04010201-582).

TMDL Parameter (Permit #)	Flow Regime				
	Very High	High	Mid-Range	Low	Very Low
	E. coli Load (billion org/day)				
Wasteload Allocation: Hibbing City MS4 (MS400270)	4.11	0.984	0.301	0.0892	0.0221
Load Allocation	196	46.9	14.3	4.22	1.08
MOS	22.2	5.32	1.62	0.479	0.122
Loading Capacity [a]	222	53.2	16.2	4.79	1.22
Existing Load	398	29.0	10.7	2.98	-
Percent Load Reduction	44%	0%	0%	0%	-
Percent Load Reduction for Regulated MS4 [b]	0%	0%	0%	0%	0%
Percent Load Reduction for Unregulated Sources	50%	0%	0%	0%	-

a. Loading capacities are rounded to three significant digits.
b. Runoff from the regulated MS4 does not contribute to the impairment, and MS4 load reductions are not required.

Table 22. *E. coli* TMDL summary, Barber Creek (04010201-641).

TMDL Parameter (Permit #)		Flow Regime				
		Very High	High	Mid-Range	Low	Very Low
		E. coli Load (billion org/day)				
Wasteload Allocation	Hibbing City MS4 (MS400270)	6.97	1.69	0.593	0.198	0.0503
	Central Iron Range Sanitary Sewer District (MN0020117) [a]	11.9	11.9	11.9	11.9	11.9
Load Allocation		252	61.2	21.4	7.16	1.82
MOS		30.1	8.31	3.77	2.14	1.53
Loading Capacity [b]		301	83.1	37.7	21.4	15.3
Existing Load		646	64.6	32.5	15.0	-
Percent Load Reduction		53%	0%	0%	0%	-
Watershed Percent Load Reduction [c]		59%	0%	0%	0%	-

a. To comply with the CIRSSD's WLA, the MPCA has future permit discretion to 1) expand the fecal coliform effluent limit effective period to include April or 2) require the permittee to conduct a stream monitoring program to determine whether Barber Creek is impaired for *E. coli* in April and implement an expanded disinfection period only if the impairment occurs in April. Further reductions in *E. coli* load, beyond the extension of the disinfection months, are not needed.
b. Loading capacities are rounded to three significant digits.
c. The watershed percent reductions apply to the regulated MS4s and the unregulated watershed runoff in the LA.

Table 23. *E. coli* TMDL summary, Penobscot Creek (04010201-936).

TMDL Parameter (Permit #)	Flow Regime				
	Very High	High	Mid-Range	Low	Very Low
	E. coli Load (billion org/day)				
Wasteload Allocation: Hibbing City MS4 (MS400270)	12.6	3.12	1.00	0.306	0.0443
Load Allocation	24.9	6.15	1.98	0.603	0.0871
MOS	4.17	1.03	0.331	0.101	0.0146
Loading Capacity [a]	41.7	10.3	3.31	1.01	0.146
Existing Load	177	37.1	32.8	12.1	-
Percent Load Reduction	76%	72%	90%	92%	-
Watershed Percent Load Reduction [b]	79%	75%	91%	93%	-

a. Loading capacities are rounded to three significant digits.
b. The watershed percent reductions apply to the regulated MS4s and the unregulated watershed runoff in the LA.

Table 24. *E. coli* TMDL summary, Barber Creek (04010201-569).

TMDL Parameter (Permit #)		Flow Regime				
		Very High	High	Mid-Range	Low	Very Low
		E. coli Load (billion org/day)				
Wasteload Allocation	Hibbing City MS4 (MS400270)	21.3	5.23	1.74	0.555	0.110
	Central Iron Range Sanitary Sewer District (MN0020117) [a]	11.9	11.9	11.9	11.9	11.9
Load Allocation		309	75.6	26.7	9.14	2.66
MOS		38.0	10.3	4.48	2.40	1.63
Loading Capacity [b]		380	103	44.8	24.0	16.3
Existing Load		1,810	189	94.9	57.4	-
Percent Load Reduction		79%	46%	53%	58%	-
Watershed Percent Load Reduction [c]		82%	54%	66%	79%	-

a. To comply with the CIRSSD's WLA, the MPCA has future permit discretion to 1) expand the fecal coliform effluent limit effective period to include April or 2) require the permittee to conduct a stream monitoring program to determine whether Barber Creek is impaired for *E. coli* in April and implement an expanded disinfection period only if the impairment occurs in April. Further reductions in *E. coli* load, beyond the extension of the disinfection months, are not needed.
b. Loading capacities are rounded to three significant digits.
c. The watershed percent reductions apply to the regulated MS4s and the unregulated watershed runoff in the LA.

Table 25. *E. coli* TMDL summary, Unnamed Creek (04010201-A22).

TMDL Parameter (Permit #)	Flow Regime				
	Very High	High	Mid-Range	Low	Very Low
	E. coli Load (billion org/day)				
Wasteload Allocation: Hibbing City MS4 (MS400270)	2.51	0.599	0.179	0.049	0.00762
Load Allocation	28.3	6.75	2.02	0.548	0.0860
MOS	3.42	0.817	0.244	0.0663	0.0104
Loading Capacity [a]	34.2	8.17	2.44	0.663	0.104
Existing Load	39.6	11.0	0.511	0.0681	-
Percent Load Reduction	14%	26%	0%	0%	-
Percent Load Reduction for Regulated MS4 [b]	0%	0%	0%	0%	0%
Percent Load Reduction for Unregulated Sources	22%	33%	0%	0%	-

a. Loading capacities are rounded to three significant digits.
b. Runoff from the regulated MS4 does not contribute to the impairment, and MS4 load reductions are not required.

Table 26. *E. coli* TMDL summary, unnamed creek (04010201-542).

TMDL Parameter (Permit #)	Flow Regime				
	Very High	High	Mid-Range	Low	Very Low
	E. coli Load (billion org/day)				
Wasteload Allocation: Hibbing City MS4 (MS400270)	9.19	2.48	1.05	0.606	0.414
Load Allocation	56.7	16.0	7.36	4.72	3.44
MOS	7.32	2.05	0.934	0.592	0.428
Loading Capacity [a]	73.2	20.5	9.34	5.92	4.28
Existing Load	133	12.5	8.98	5.88	-
Percent Load Reduction	45%	0%	0%	0%	-
Watershed Percent Load Reduction [b]	51%	0%	0%	0%	-

a. Loading capacities are rounded to three significant digits.
b. The watershed percent reductions apply to the regulated MS4s and the unregulated watershed runoff in the LA.

Table 27. *E. coli* TMDL summary, Unnamed Creek (04010201-888).

TMDL Parameter (Permit #)		Flow Regime				
		Very High	High	Mid-Range	Low	Very Low
		E. coli Load (billion org/day)				
Wasteload Allocation	Hibbing City MS4 (MS400270)	27.4	7.37	3.12	1.82	1.21
	Hibbing WWTP South (MN0030643) [a]	21.5	21.5	21.5	21.5	21.5
Load Allocation		111	29.8	12.6	7.37	4.83
MOS		17.8	6.52	4.14	3.41	3.06
Loading Capacity [b]		178	65.2	41.4	34.1	30.6
Existing Load		522	94.5	30.7	71.7	-
Percent Load Reduction		66%	31%	0%	52%	-
Watershed Percent Load Reduction [c]		72%	49%	0%	82%	-

a. Reductions in *E. coli* load from Hibbing WWTP South are not needed to meet the WLA.
b. Loading capacities are rounded to three significant digits.
c. The watershed percent reductions apply to the regulated MS4s and the unregulated watershed runoff in the LA.

Table 28. *E. coli* TMDL summary, Pine River (04010201-543).

TMDL Parameter (Permit #)		Flow Regime				
		Very High	High	Mid-Range	Low	Very Low
		E. coli Load (billion org/day)				
Wasteload Allocation	Hermantown City MS4 (MS400093)	0.273	0.0833	0.0330	0.0107	0.00295
	Cloquet City MS4 (MS400267)	0.119	0.0362	0.0143	0.00464	0.00128
	Canosia Township MS4 [a]	1.46	0.445	0.176	0.0570	0.0158
	Grand Lake Township MS4 [a]	2.68	0.816	0.323	0.105	0.0289
	Mn/DOT MS4 (MS400180)	0.448	0.136	0.0540	0.0175	0.00483
	St. Louis County MS4 (MS400158)	0.383	0.117	0.0463	0.0150	0.00414
Load Allocation		299	91.1	36.1	11.7	3.23
MOS		33.8	10.3	4.08	1.32	0.365
Loading Capacity [b]		338	103	40.8	13.2	3.65
Existing Load		64.1	88.7	32.1	10.5	-
Percent Load Reduction [c]		0%	0%	0%	0%	-
Percent Load Reduction for Regulated MS4s [d]		0%	0%	0%	0%	0%
Percent Load Reduction for Unregulated Sources [c]		32%				

a. Not currently regulated but expected to come under permit coverage in the next permit cycle.
b. Loading capacities are rounded to three significant digits.
c. When comparing the geometric mean *E. coli* concentration of each flow regime to the geometric mean standard, the Pine River does not require a load reduction. However, the monthly geometric mean standard was violated based on July data. Using the July *E. coli* geometric mean of 184 organisms per 100 mL, a 32 percent reduction is needed for the Pine River to meet water quality standards in July, and should come primarily from reduction in *E. coli* loading from livestock; the primary known source of *E. coli* to the Pine River is livestock.
d. Regulated MS4s do not contribute to the impairment and are not required to reduce *E. coli* loading.

Table 29. *E. coli* TMDL summary, Hay Creek (04010201-751).

TMDL Parameter	Flow Regime				
	Very High	High	Mid-Range	Low	Very Low
	E. coli Load (billion org/day)				
Wasteload Allocation: Thomson Township MS4 [a]	1.23	0.376	0.151	0.0511	0.0152
Load Allocation	75.1	23.0	9.21	3.13	0.930
MOS	8.48	2.60	1.04	0.353	0.105
Loading Capacity [b]	84.8	26.0	10.4	3.53	1.05
Existing Load	7,770	21.5	12.2	0.925	-
Percent Load Reduction	99%	0%	15%	0%	-
Percent Load Reduction for Regulated MS4 [c]	0%	0%	0%	0%	0%
Percent Load Reduction for Unregulated Sources	99%	0%	23%	0%	-

a. Not currently regulated but expected to come under permit coverage in the next permit cycle.
b. Loading capacities are rounded to three significant digits.
c. Runoff from the regulated MS4 does not contribute to the impairment, and MS4 load reductions are not required.

Table 30. *E. coli* TMDL summary, Unnamed Creek / West Rocky Run (04010201-625).

TMDL Parameter (Permit #)		Flow Regime				
		Very High	High	Mid-Range	Low	Very Low
		E. coli Load (billion org/day)				
Wasteload Allocation	Hermantown City MS4 (MS400093)	0.885	0.271	0.109	0.0368	0.0110
	Midway City MS4 (MS400146)	0.0834	0.0255	0.0103	0.00347	0.00103
Load Allocation		55.7	17.1	6.86	2.32	0.692
MOS		6.30	1.93	0.775	0.262	0.0782
Loading Capacity [a]		63.0	19.3	7.75	2.62	0.782
Existing Load		3,840	33.3	13.0	1.91	-
Percent Load Reduction		98%	42%	40%	0%	-
Percent Load Reduction for Regulated MS4 [b]		0%	0%	0%	0%	0%
Percent Load Reduction for Unregulated Sources		99%	48%	46%	0%	-

a. Loading capacities are rounded to three significant digits.
b. Runoff from the regulated MS4s does not contribute to the impairment, and MS4 load reductions are not required.

Total Phosphorus (Lakes)

Table 31 and Table 32 summarize the TP pollutant load allocations, wasteload allocations, current loading, and load reductions needed to meet water quality standards.

Table 31. West Two Rivers Reservoir (69-0994-00) total phosphorus TMDL summary.

TMDL Parameter			TP TMDL Load (lbs/yr)	TP TMDL Load (lbs/day)
WLA	Mountain Iron WWTP (MN0040835) [a]		385	1.1
	US Steel Corp–Reservoir (MN0052493) wastewater [b]		94	0.26
	Construction stormwater (MNR100001) [c]		0.26	0.00071
	Industrial Stormwater	US Steel Corp–Reservoir (MN0052493) stormwater [c]	0.26	0.00071
		Industrial Stormwater General Permits (MNR050000 and MNG490000) [c d]		
Load Allocation			1,607	4.4
MOS			232	0.64
Loading Capacity [e]			**2,319**	**6.4**
Existing Load			3,389	9.3
Load Reduction			1,070	2.9
Percent Load Reduction			32%	

a. The WLA for Mountain Iron WWTP is based on the TP concentration of 0.23 mg/L and the facility's average wet weather design flow.

b. The WLA for US Steel Corp–Reservoir is equal to their existing load, calculated as the product of the average effluent discharge volume and the observed phosphorus concentration in the effluent. The load from US Steel Corp–Reservoir is allowed to exceed the WLA if the increase is due to higher discharge volumes at the phosphorus concentration on which the WLA is based (0.005 mg/L TP).

c. It is assumed that loads from permitted construction and industrial stormwater sites that operate in compliance with the permits are meeting the WLA.

d. General Permit MNR050000 for Industrial Stormwater Multi-Sector and General Permit MNG490000 for Nonmetallic Mining and Associated Activities.

e. Loading capacities are rounded to whole numbers (annual load) or one decimal place (daily load).

Table 32. Dinham Lake (69-0544-00) total phosphorus TMDL summary.

TMDL Parameter	TP Load (lbs/yr)	TP Load (lbs/day)
WLA: Construction stormwater (MNR100001)	0.14	0.00038
WLA: Industrial Stormwater (MNR050000)	0.14	0.00038
Load Allocation	816	2.2
MOS	91	0.25
Loading Capacity [a]	**907**	**2.5**
Existing Load	1,123	3.1
Load Reduction	216	0.6
Percent Load Reduction	19%	19%

a. Loading capacities are rounded to whole numbers (annual load) or one decimal place (daily load).

Appendix C. Swan River Watershed Geomorphic Study

The following study was developed by the South St. Louis SWCD (2013).

Connectivity Analysis on St Louis River Watershed Impaired Streams

The following maps analyze the connectivity of the impaired reaches in the St Louis River Watershed. Each map reviews a different impaired reach, locating its culvert and bridge crossings. These features were identified and measured using St Louis County pictometry and aerial imagery.

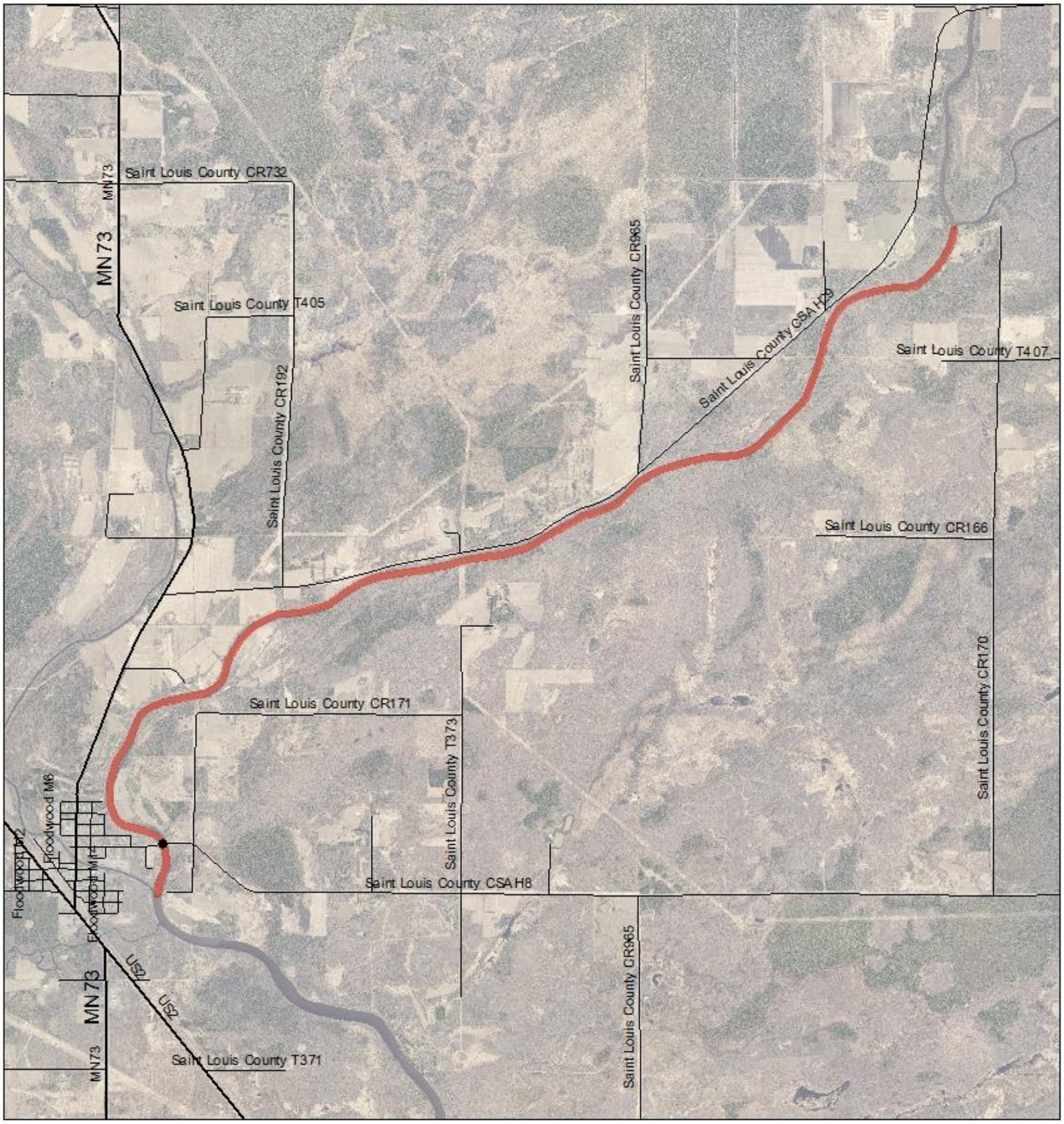
Culverts were then evaluated by comparing their measured width with a predicted bankfull width. Bankfull width was predicted by determining drainage area using Stream Stats (http://water.usgs.gov/osw/streamstats/minnesota.html) and referencing the Eastern MN regional curve, which uses the drainage area to estimate bankfull dimensions (area, width, and depth) and discharge. Culverts under 75% of the bankfull width were identified as 'Undersized' and over 125% as 'Oversized.' Culverts between 75% and 125% were identified as 'Correctly Sized.'

78 culverts were located in all of the impaired reaches. According to our designated parameters, 20 of these were undersized, 35 were correctly sized, and 18 were oversized. 5 were left undefined because they were not visible or measurable using the pictometry and aerial photography.

All bridges, including pedestrian and vehicle bridges, were located on the impaired reaches are marked using black dots. 80 bridges were identified for all of the impaired reaches.

St Louis River Watershed Impairments - Connectivity Summary

Impairments		**Bridges**	**Culverts**				Total	Crossings	% Correct
Name	Length (miles)		Undersized	Correctly Sized	Oversized	Undefined	Crossings	Per Mile	Culverts
St. Louis River	6.9	1	0	0	0	0	1	0.1	NA
Elbow Creek	4.1	0	2	2	0	0	4	1.0	50%
West Two River	6.1	1	1	0	0	0	2	0.3	0%
Manganika Creek	1.1	0	1	0	0	0	1	0.9	0%
trib to McQuade Lake	8.2	4	0	2	0	0	6	0.7	100%
Swan River	19.5	4	0	0	0	0	4	0.2	NA
Elbow Creek	6.9	2	2	3	0	0	7	1.0	60%
Embarrass River	36.9	16	1	0	0	0	17	0.5	0%
Sand Creek	2.5	0	0	0	0	0	0	0.0	NA
Vaara Creek	6.3	0	0	2	0	0	2	0.3	100%
Stony Creek	5.8	0	1	0	0	0	1	0.2	0%
Unnamed Creek	6.2	0	0	0	1	1	2	0.3	0%
Skunk Creek	46.5	0	1	1	1	0	3	0.1	33%
Paleface Creek	4.6	3	0	0	0	0	3	0.6	NA
Ely Creek	4.7	3	3	2	0	0	8	1.7	40%
Water Hen Creek	4.2	3	0	0	0	0	3	0.7	NA
Water Hen Creek	3.7	4	0	0	0	0	4	1.1	NA
Spring Mine Creek	2.1	1	0	1	0	2	4	1.9	100%
Miller Creek	8.6	14	6	7	7	2	36	4.2	35%
Kingsbury Creek	6.7	14	1	6	6	0	27	4.0	46%
Otter Creek	6.0	4	0	1	0	0	5	0.8	100%
East Swan Creek	5.9	0	0	4	0	0	4	0.7	100%
Little Swan Creek	7.2	3	0	1	2	0	6	0.8	33%
Wyman Creek	9.3	3	1	3	1	0	8	0.9	60%
	Total	**80**	**20**	**35**	**18**	**5**			
			78						



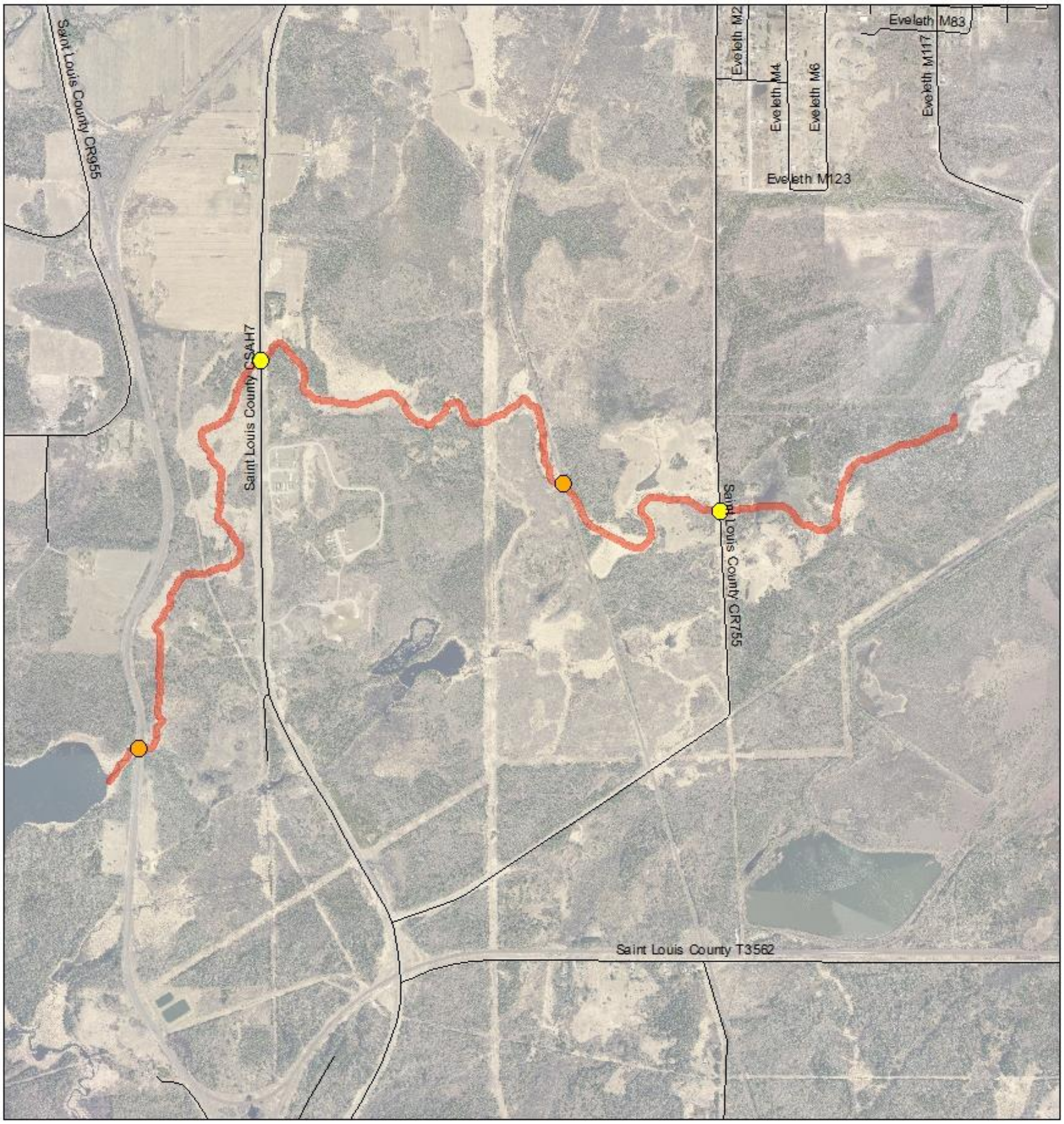
Impared Reach Crossings

- Bridge
- Undersized
- Correctly Sized
- Oversized
- Undefined
- Impared Reaches

St Louis River

0 0.4 0.8 1.6 Miles

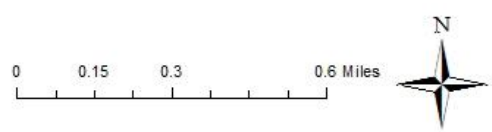
N

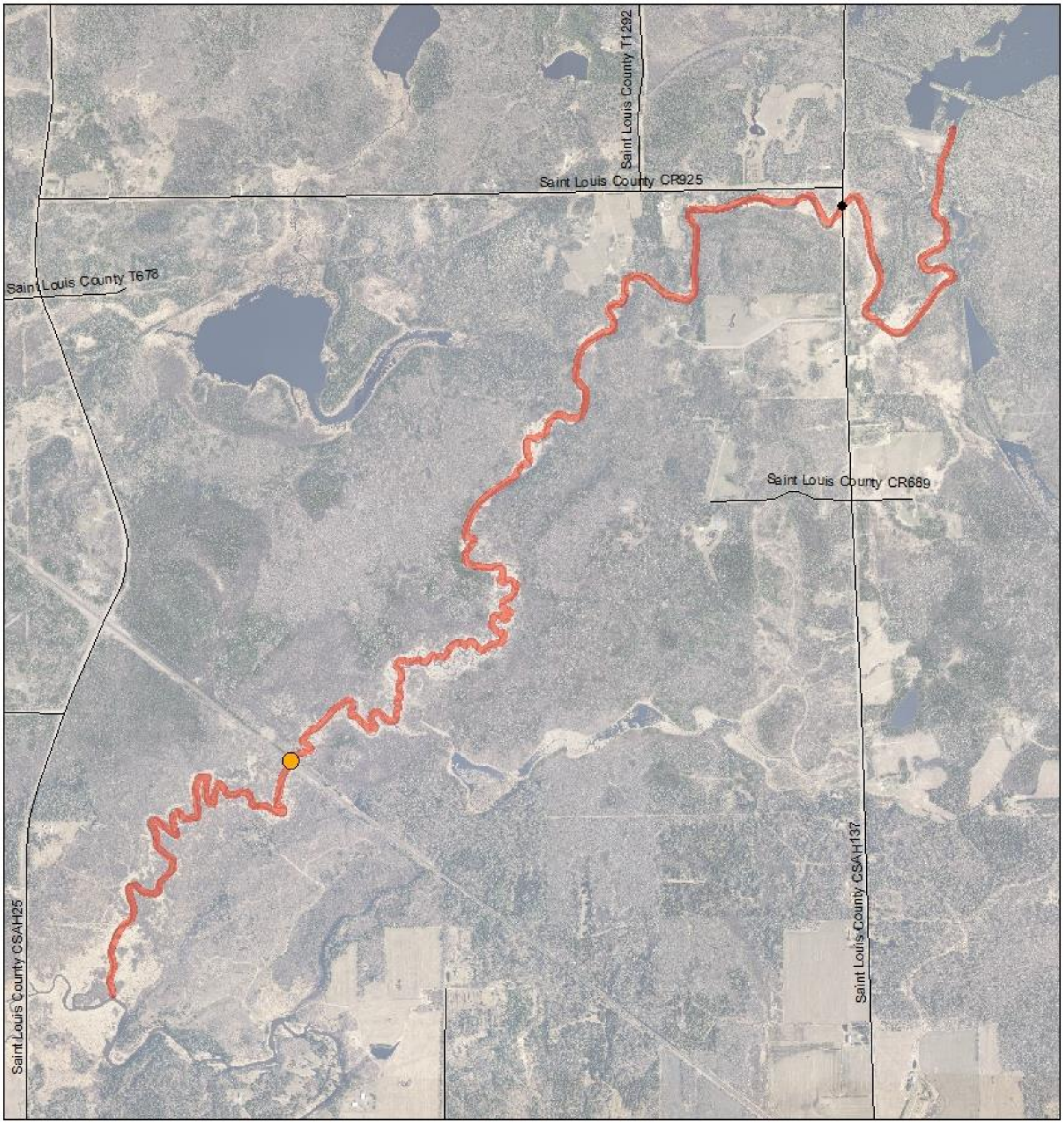


Impared Reach Crossings

- Bridge
- Undersized
- Correctly Sized
- Oversized
- Undefined
- Impared Reaches

Elbow Creek





West Two River

Impared Reach Crossings

- Bridge
- Undersized
- Correctly Sized
- Oversized
- Undefined
- Impared Reaches

0 0.175 0.35 0.7 Miles

N

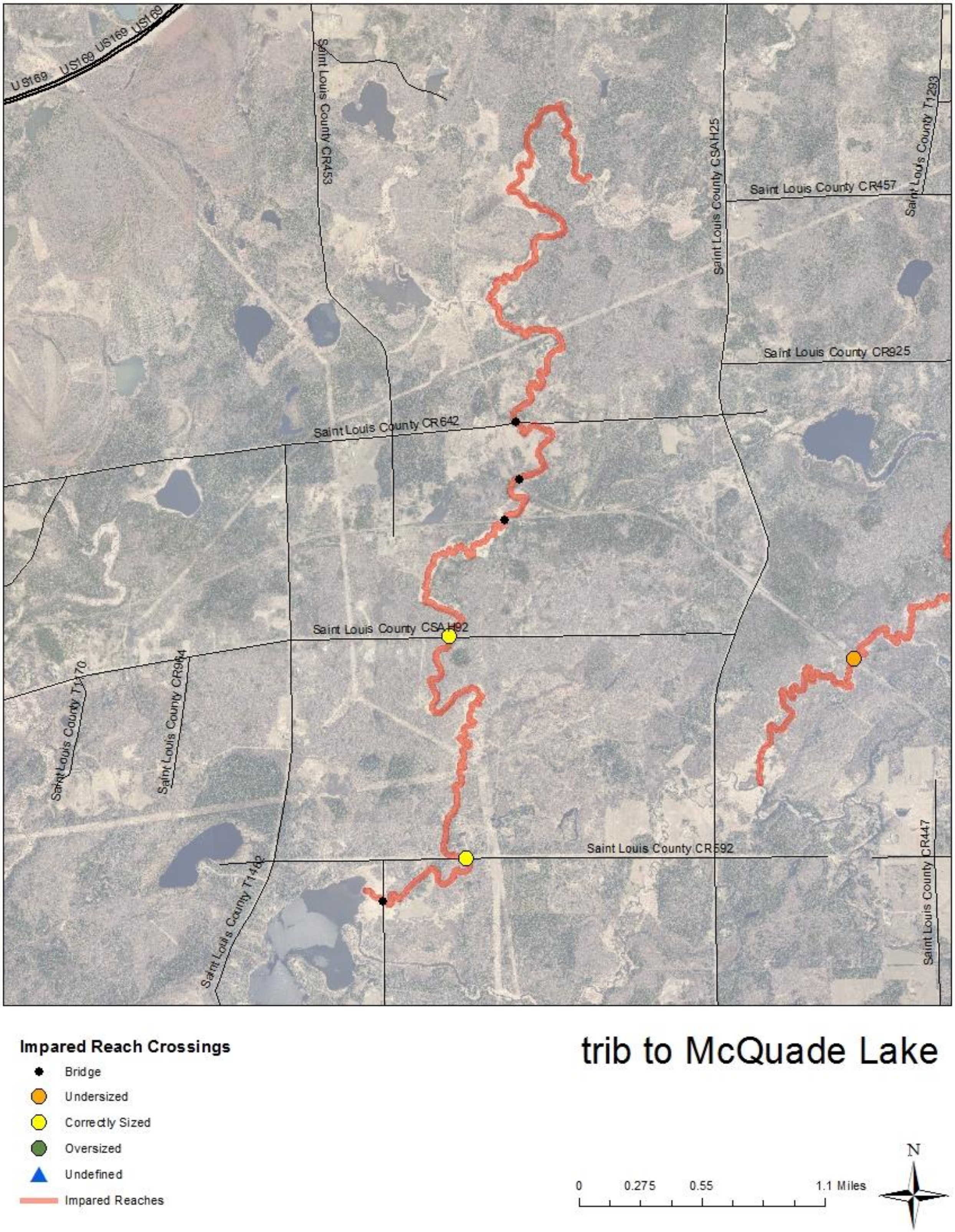
Impared Reach Crossings

- Bridge
- Undersized
- Correctly Sized
- Oversized
- Undefined
- Impared Reaches

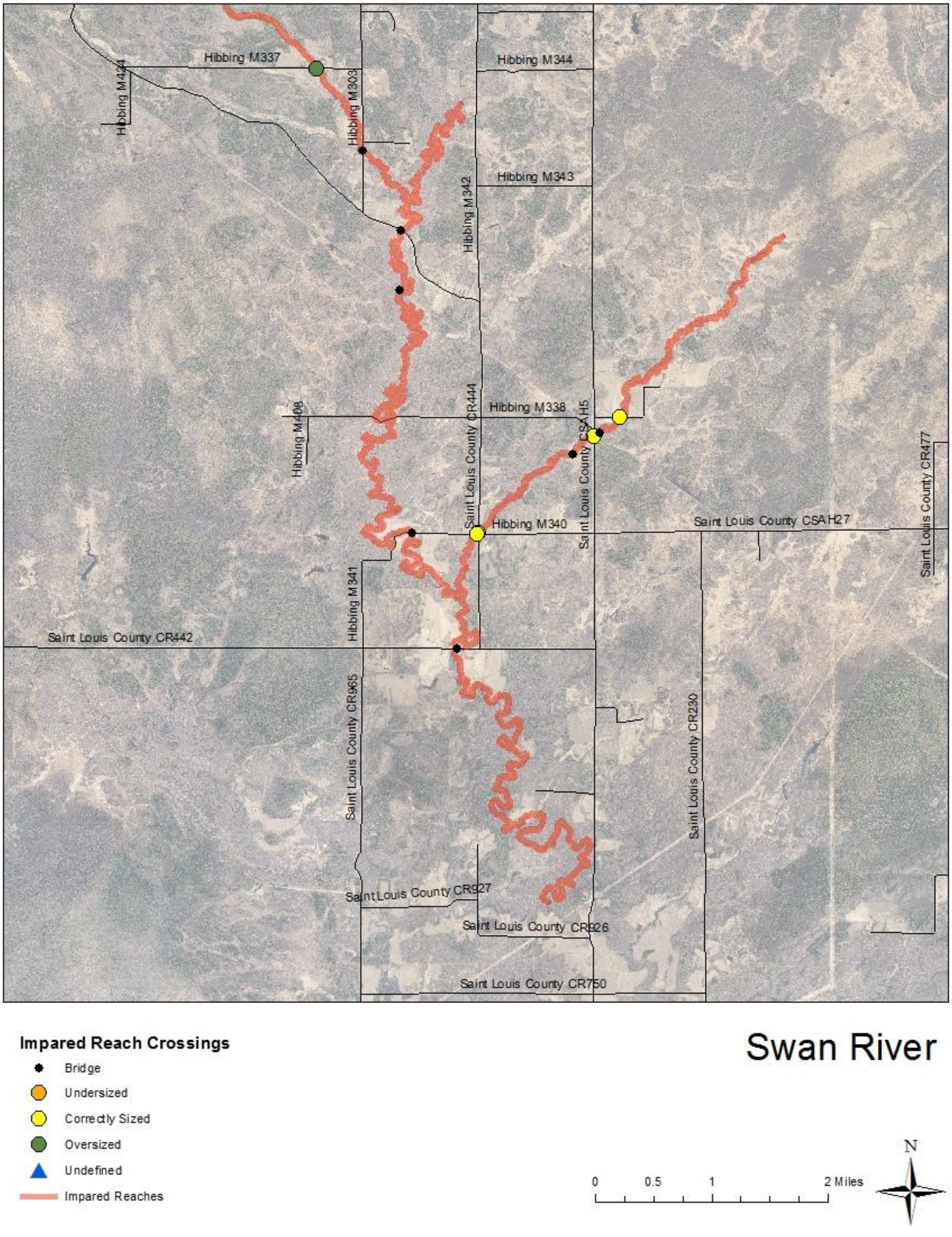
Manganika Creek

0 0.05 0.1 0.2 Miles

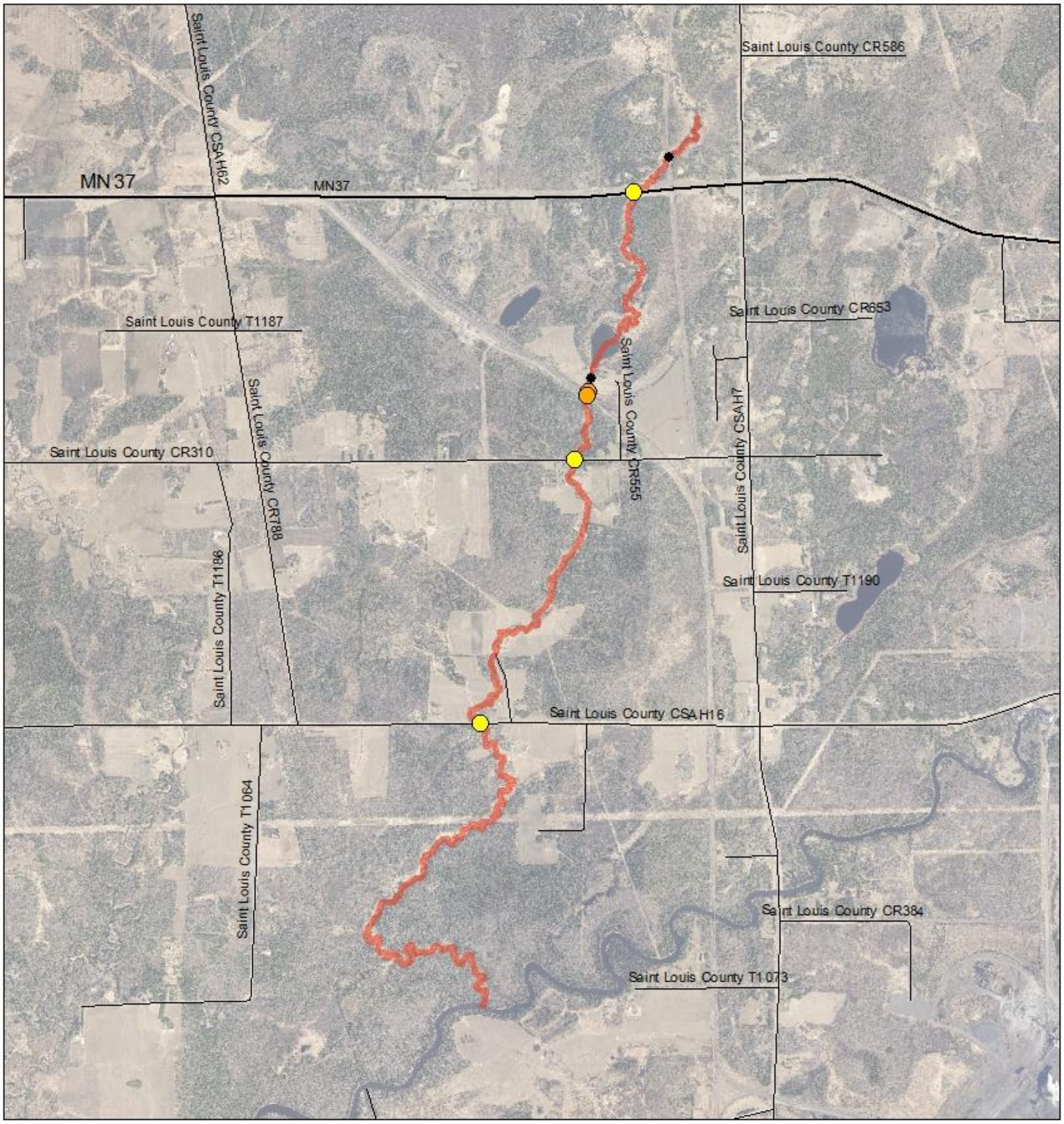
N



trib to McQuade Lake


Hibbing M337
Hibbing M424
Hibbing M303
Hibbing M344
Hibbing M343
Hibbing M342
Hibbing M408
Hibbing M338
Saint Louis County CR444
Saint Louis County CSAH5
Hibbing M340
Saint Louis County CSAH27
Saint Louis County CR477
Hibbing M341
Saint Louis County CR442
Saint Louis County CR965
Saint Louis County CR230
Saint Louis County CR927
Saint Louis County CR926
Saint Louis County CR750
Impared Reach Crossings
Bridge
Undersized
Correctly Sized
Oversized
Undefined
Impared Reaches
0
0.5
1
2 Miles
N

Swan River



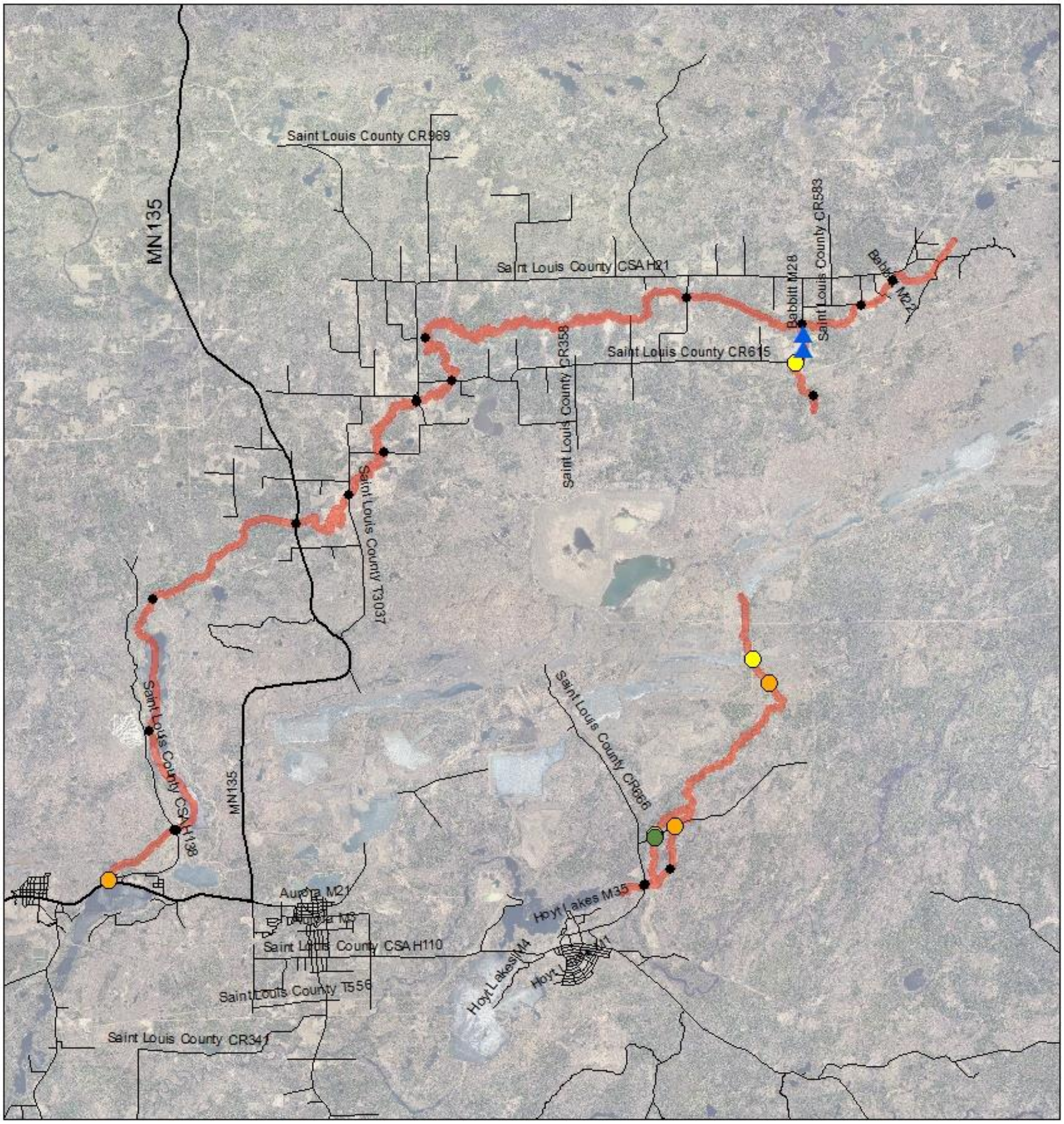
Impared Reach Crossings

- Bridge
- Undersized
- Correctly Sized
- Oversized
- Undefined
- Impared Reaches

Elbow Creek

0 0.275 0.55 1.1 Miles

N



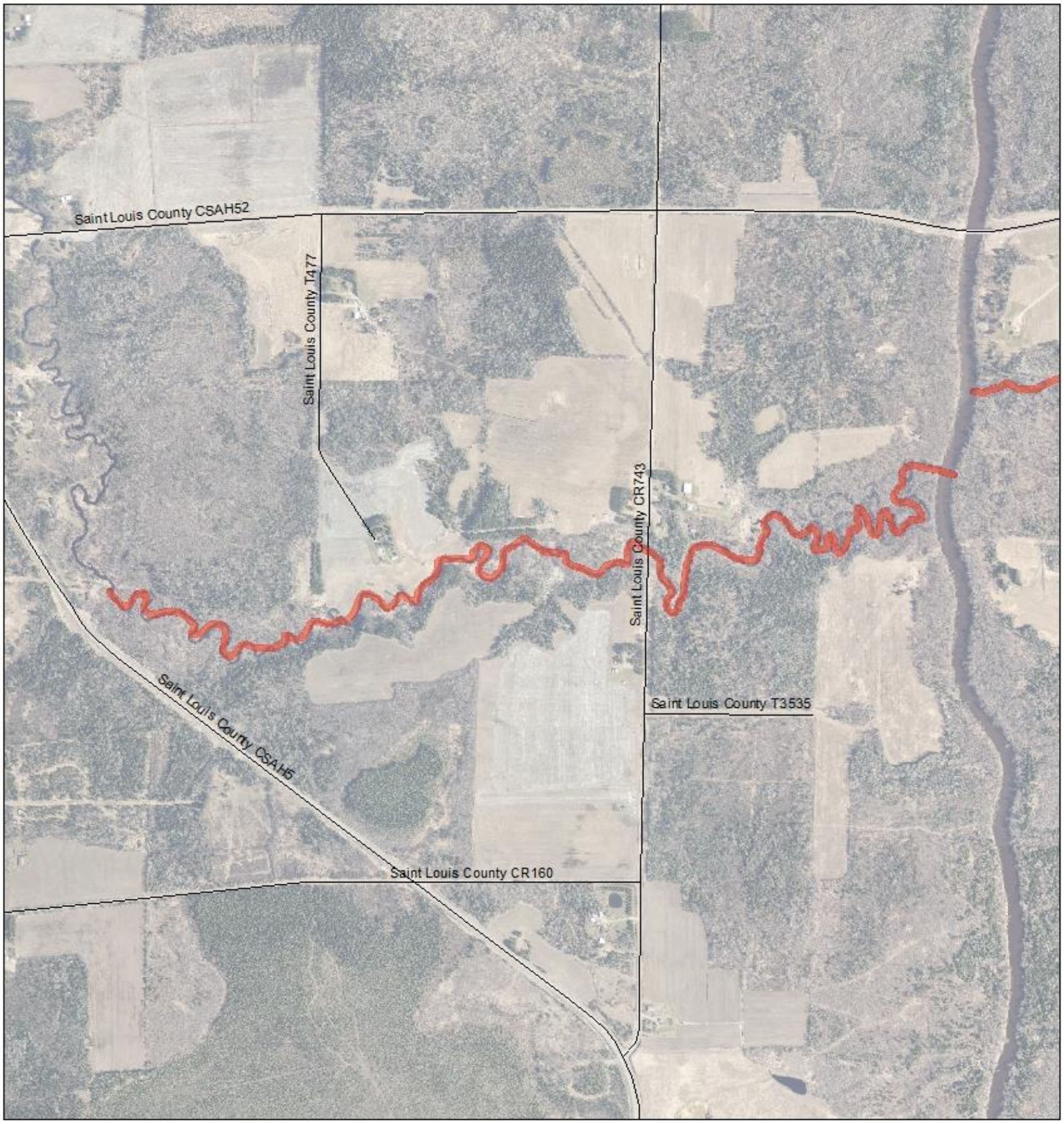
Embarrass River

Impared Reach Crossings

- Bridge
- Undersized
- Correctly Sized
- Oversized
- Undefined
- Impared Reaches

0 1.25 2.5 5 Miles

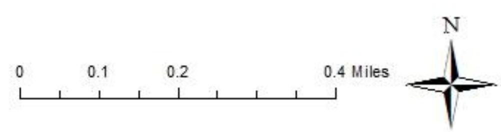
N

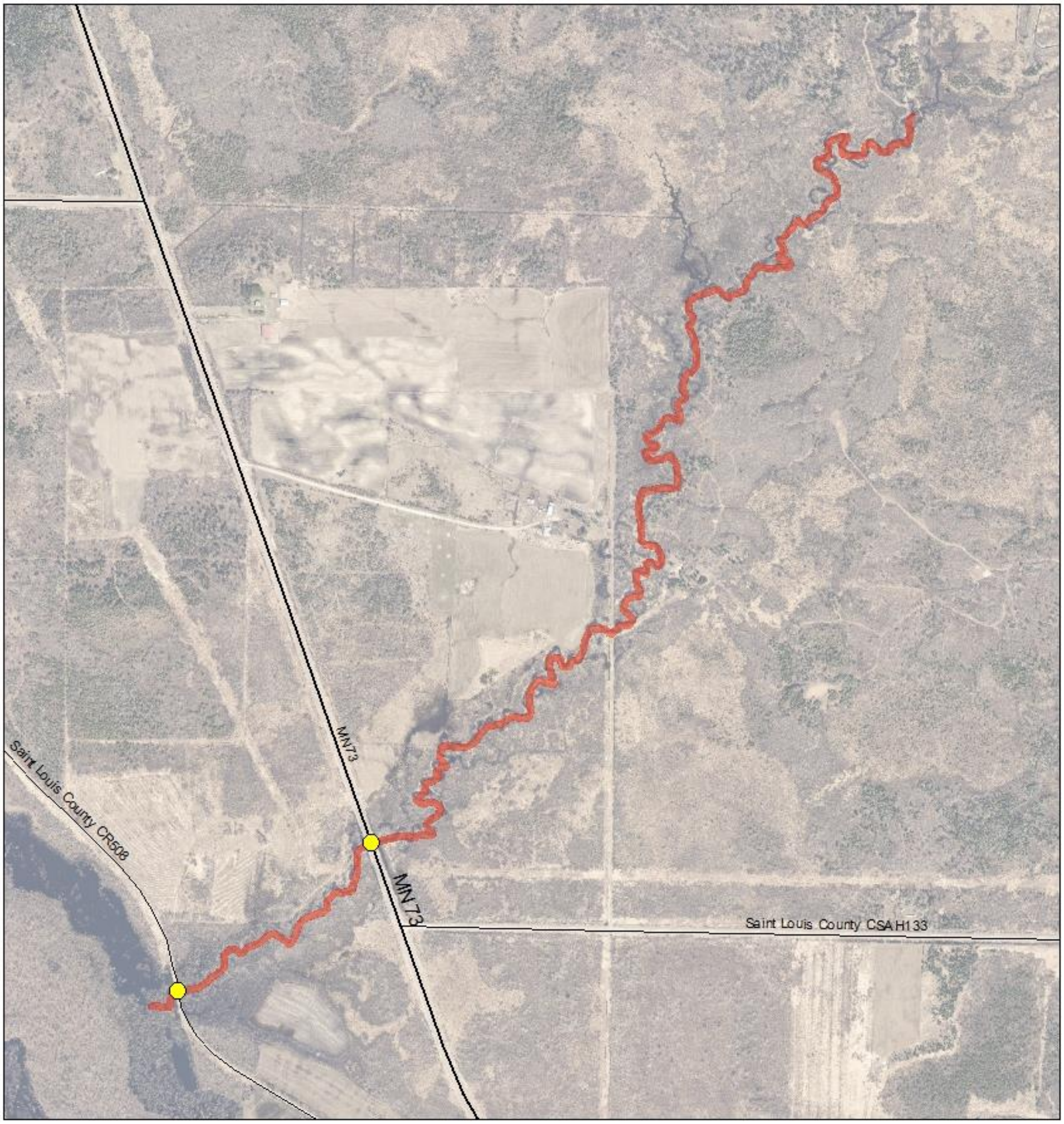


Impared Reach Crossings

- Bridge
- Undersized
- Correctly Sized
- Oversized
- Undefined
- Impared Reaches

Sand Creek





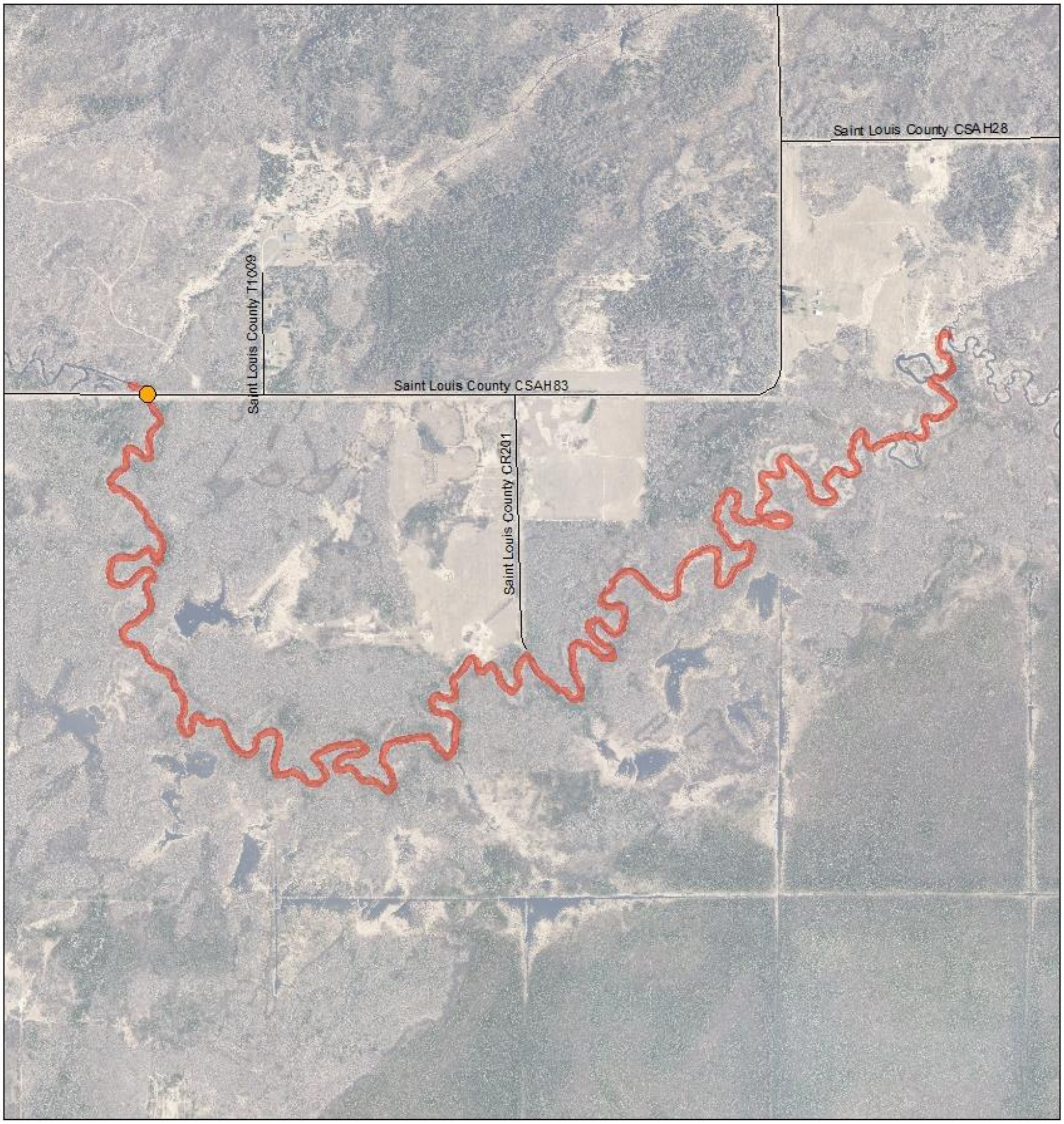
Impared Reach Crossings

- Bridge
- Undersized
- Correctly Sized
- Oversized
- Undefined
- Impared Reaches

Vaara Creek

0 0.1 0.2 0.4 Miles

N



Stony Creek

Impared Reach Crossings

- Bridge
- Undersized
- Correctly Sized
- Oversized
- Undefined
- Impared Reaches

0 0.125 0.25 0.5 Miles

N

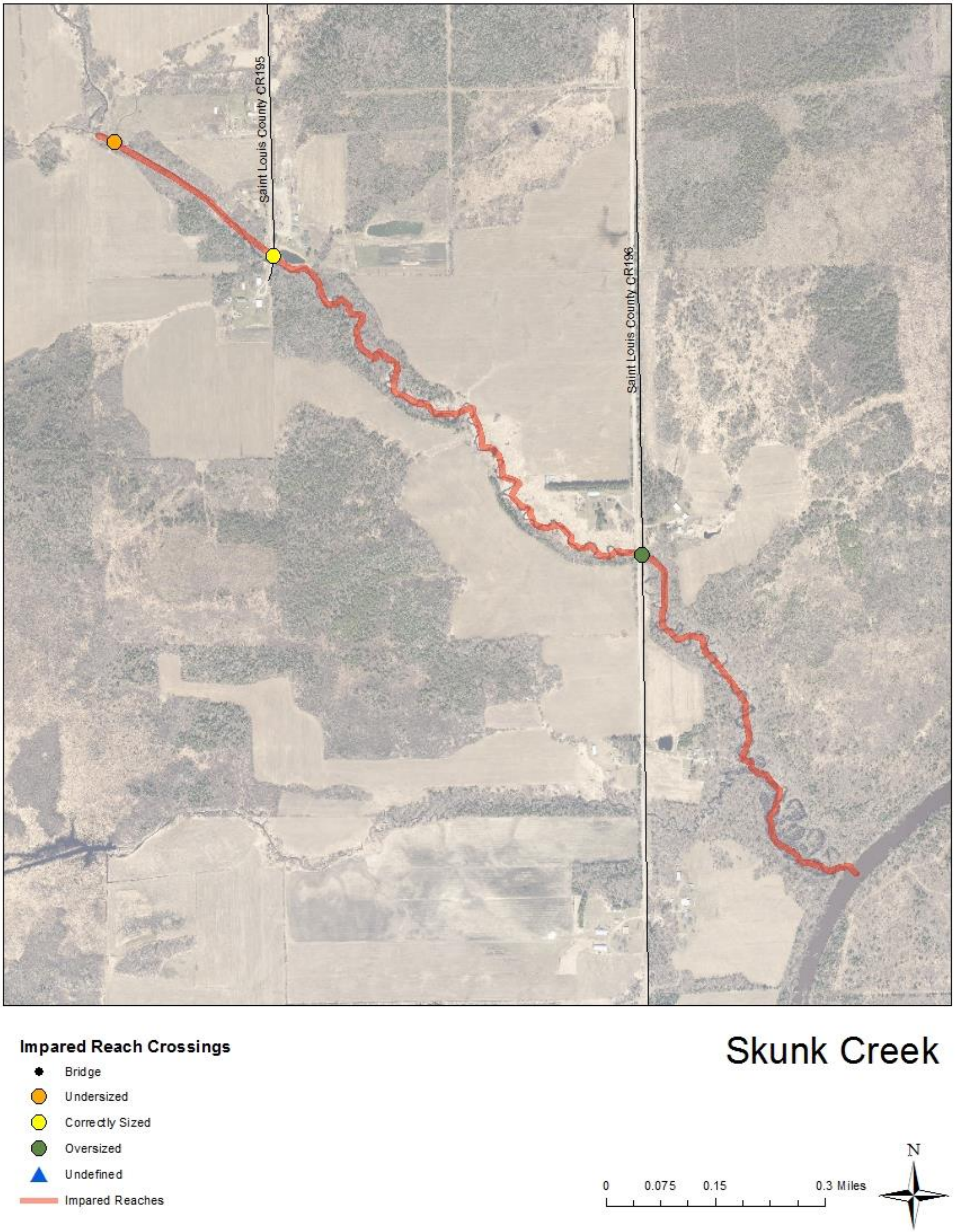
Impared Reach Crossings

- Bridge
- Undersized
- Correctly Sized
- Oversized
- Undefined
- Impared Reaches

Unnamed creek

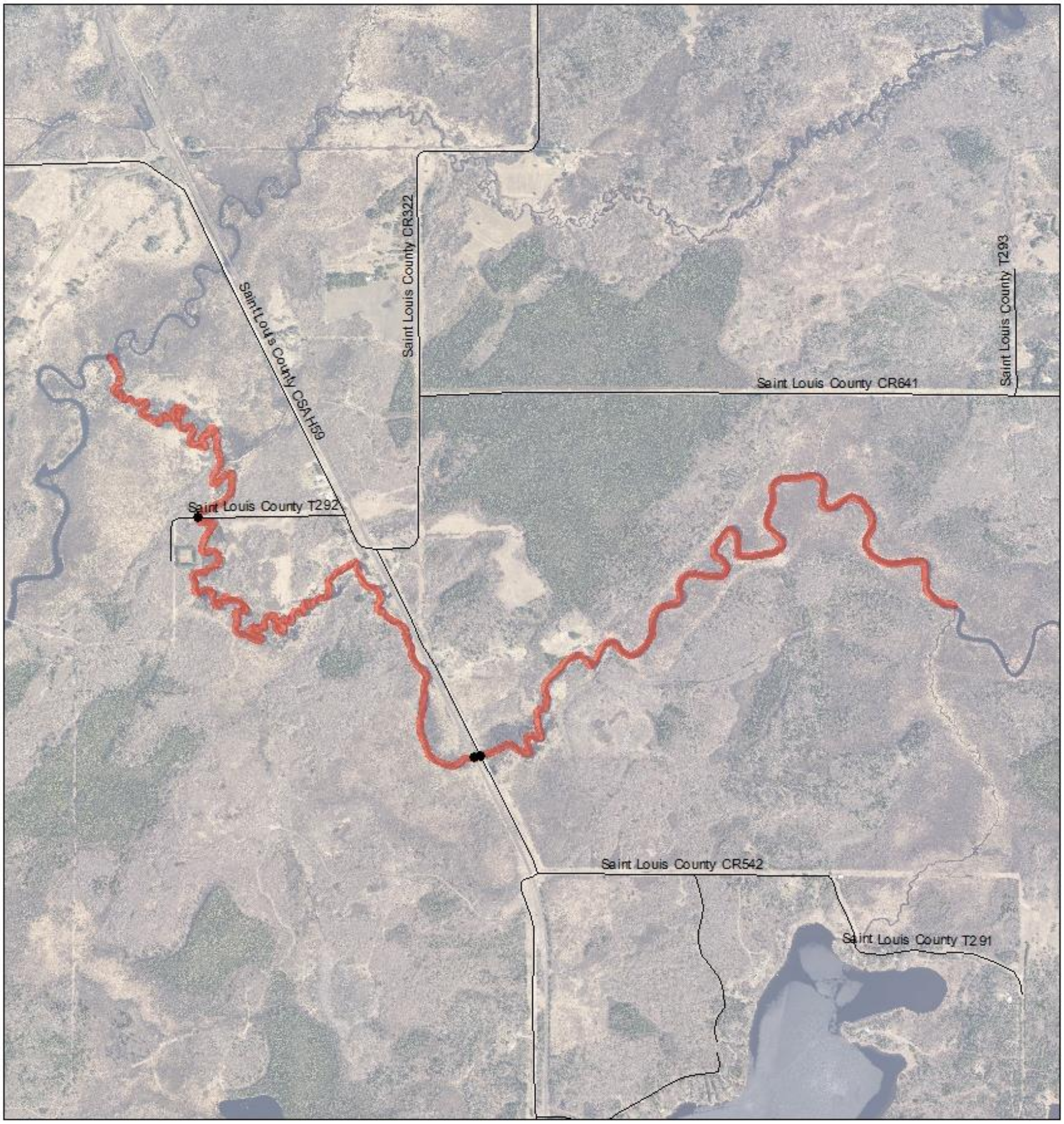
0 0.125 0.25 0.5 Miles

N



Saint Louis County CR195
Saint Louis County CR196
Impared Reach Crossings
Bridge
Undersized
Correctly Sized
Oversized
Undefined
Impared Reaches
0
0.075
0.15
0.3 Miles
N

Skunk Creek



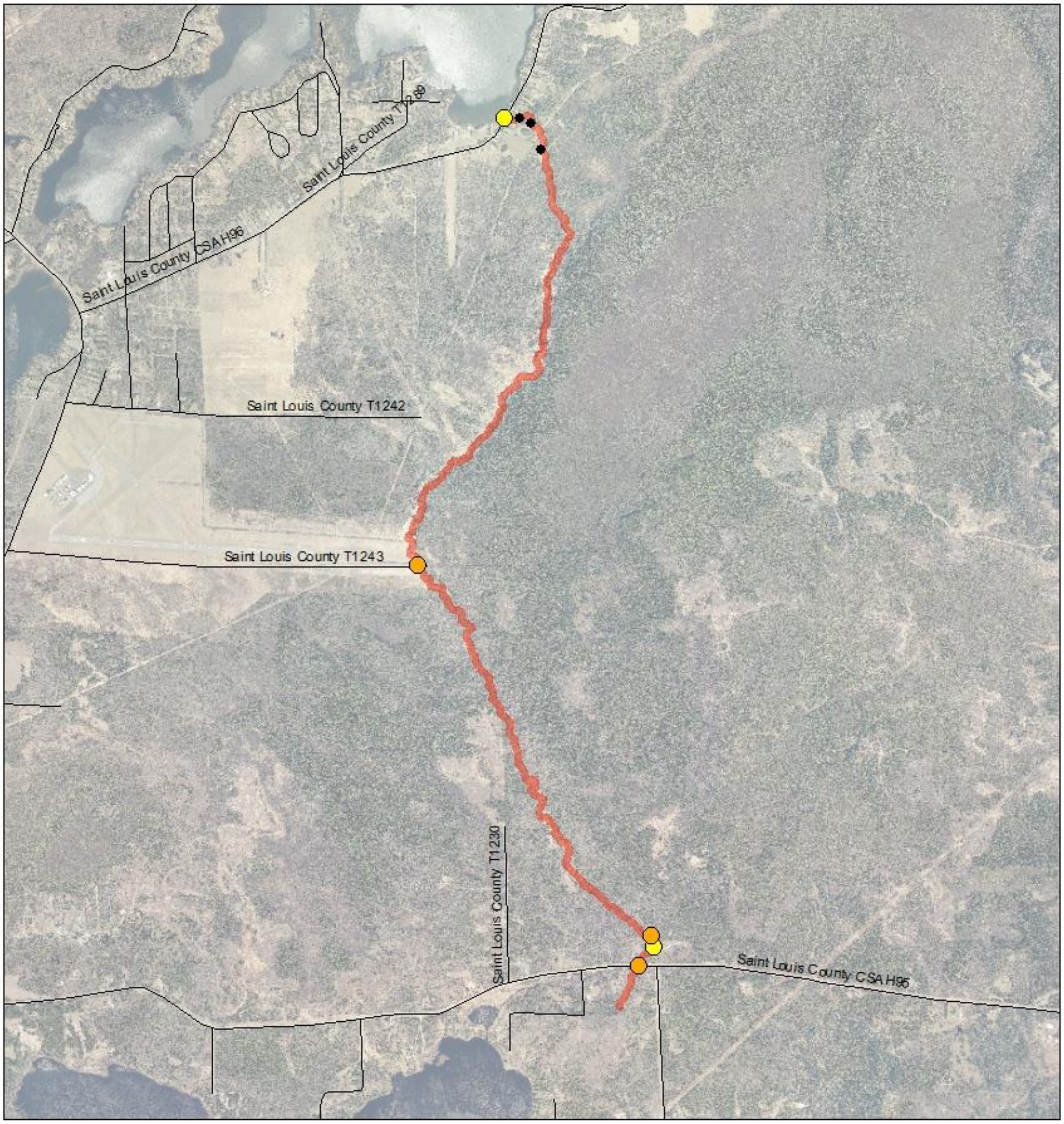
Impared Reach Crossings

- Bridge
- Undersized
- Correctly Sized
- Oversized
- Undefined
- Impared Reaches

Paleface Creek

0 0.15 0.3 0.6 Miles

N



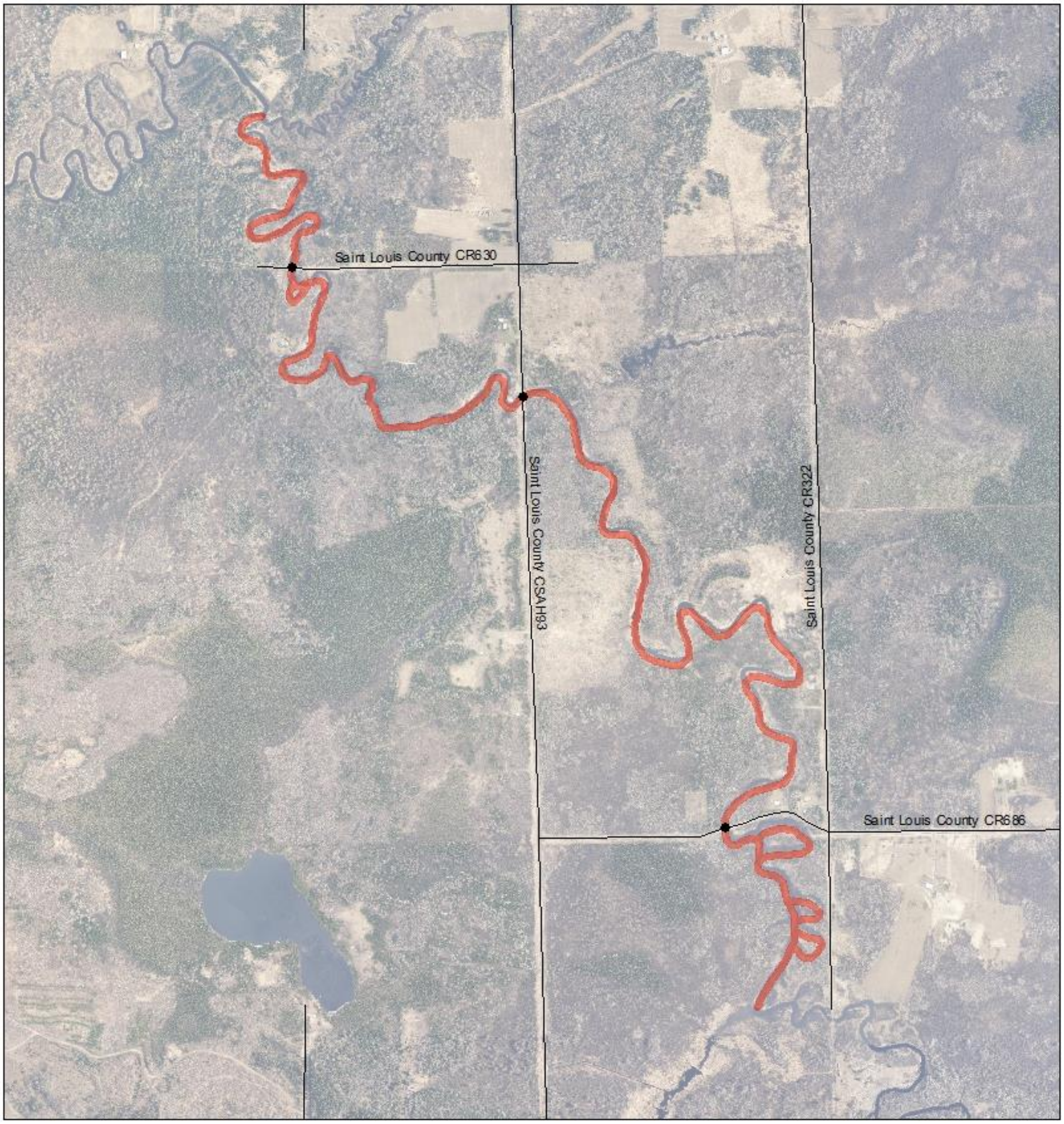
Impared Reach Crossings

- Bridge
- Undersized
- Correctly Sized
- Oversized
- Undefined
- Impared Reaches

Ely Creek

0 0.25 0.5 1 Miles

N



Impared Reach Crossings

- Bridge
- Undersized
- Correctly Sized
- Oversized
- Undefined
- Impared Reaches

Water Hen Creek

0 0.125 0.25 0.5 Miles

N

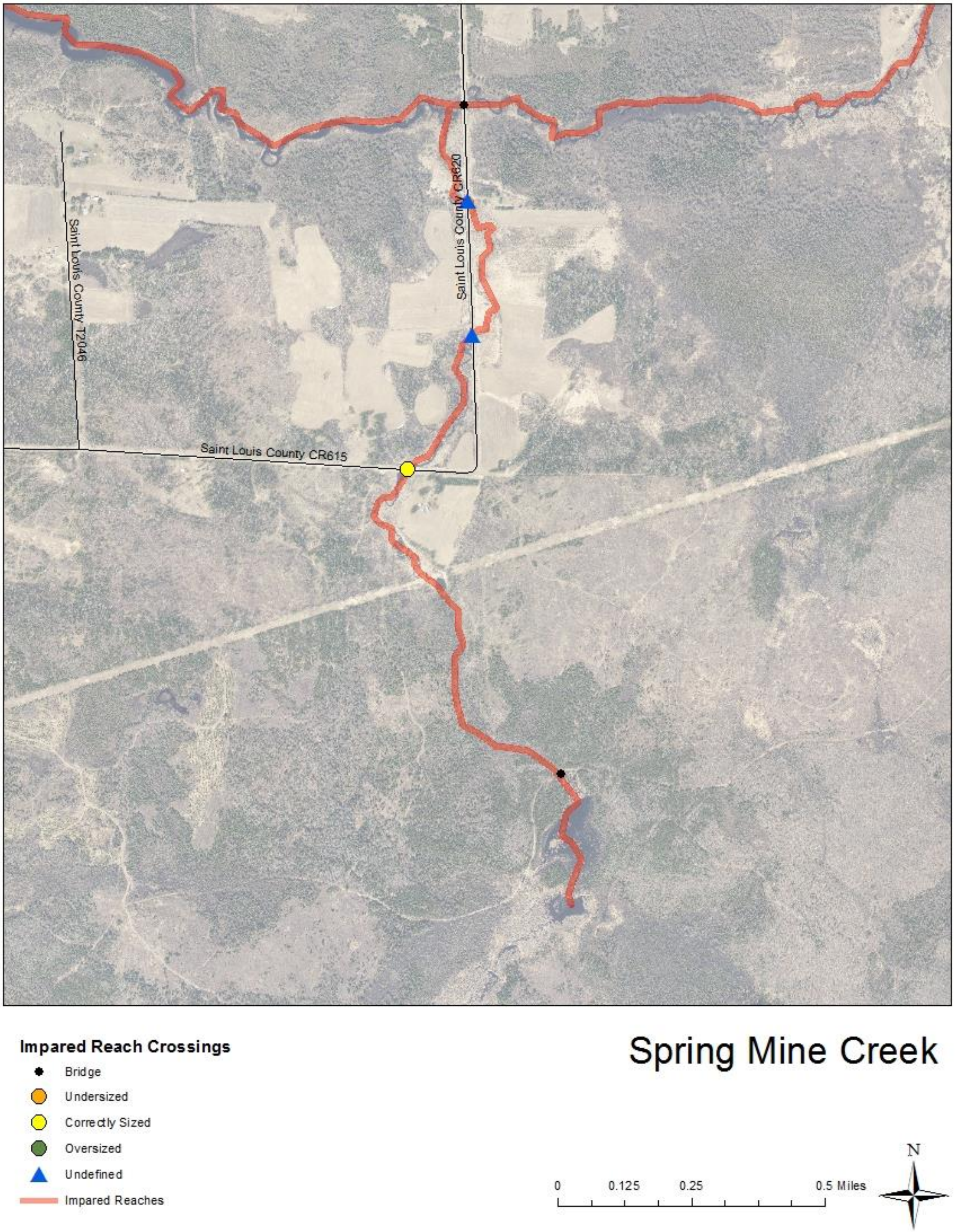
Impared Reach Crossings

- Bridge
- Undersized
- Correctly Sized
- Oversized
- Undefined
- Impared Reaches

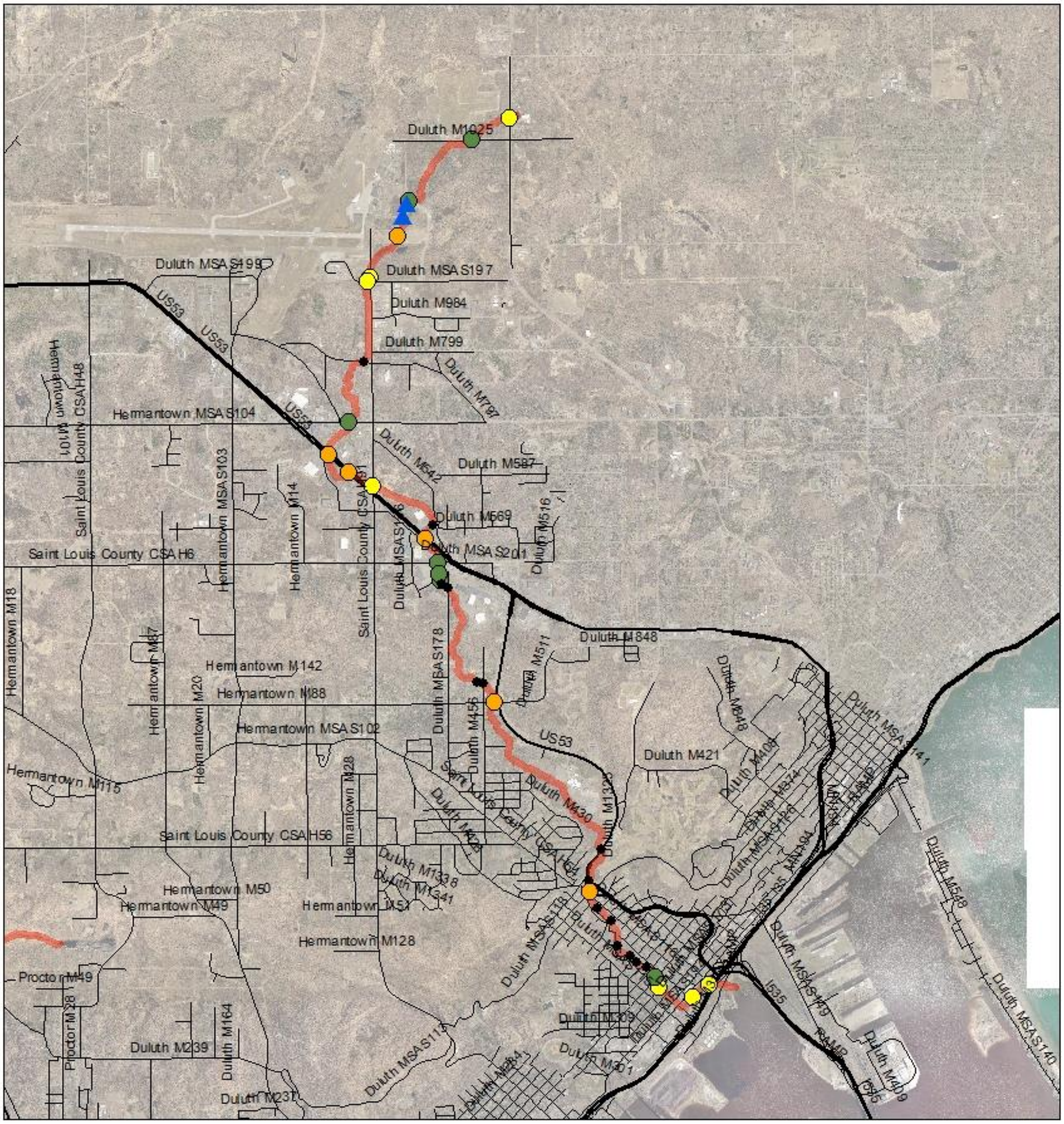
Water Hen Creek

0 0.125 0.25 0.5 Miles

N



Spring Mine Creek



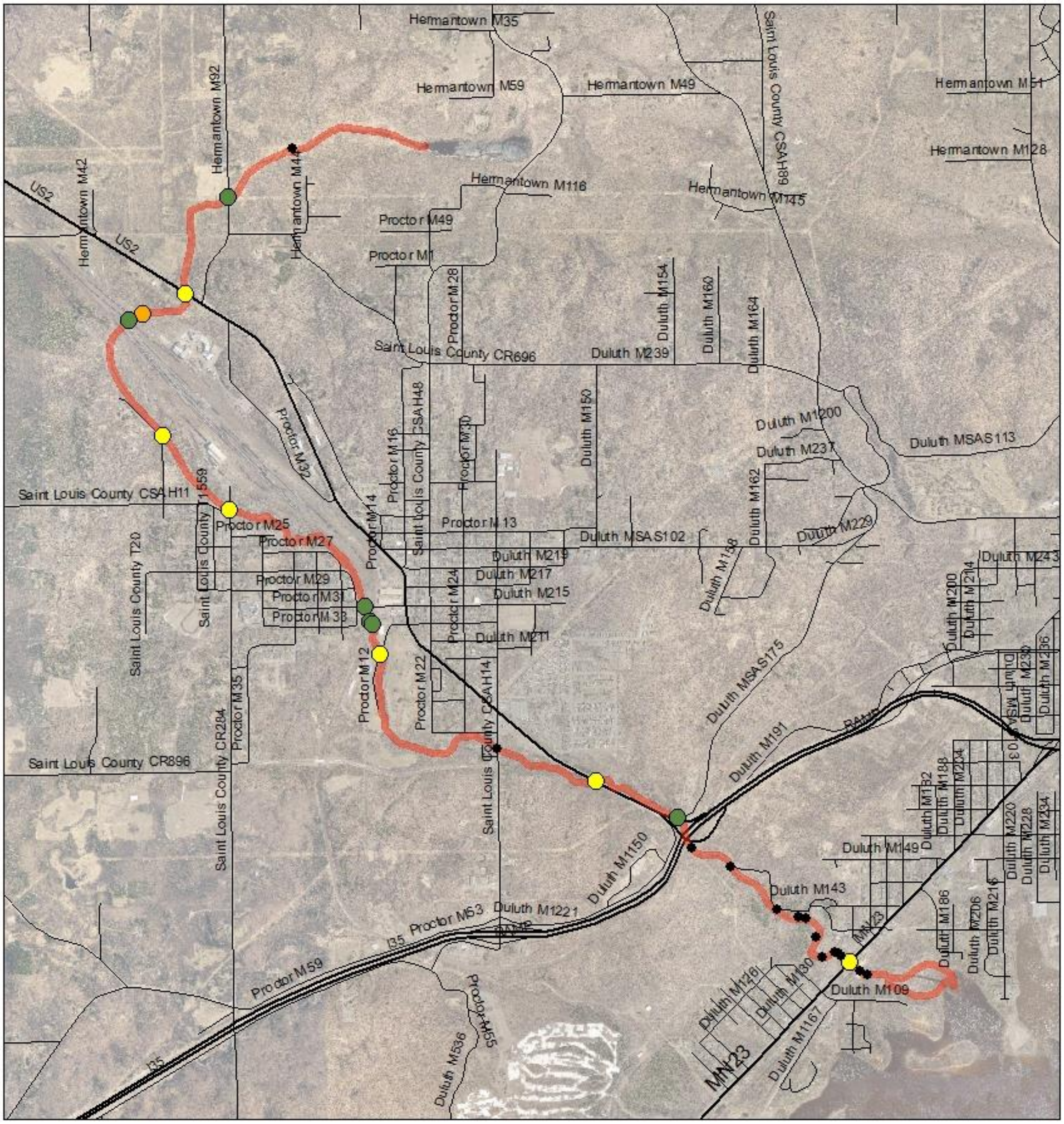
Impared Reach Crossings

- Bridge
- Undersized
- Correctly Sized
- Oversized
- Undefined
- Impared Reaches

Miller Creek

0 0.5 1 2 Miles

N



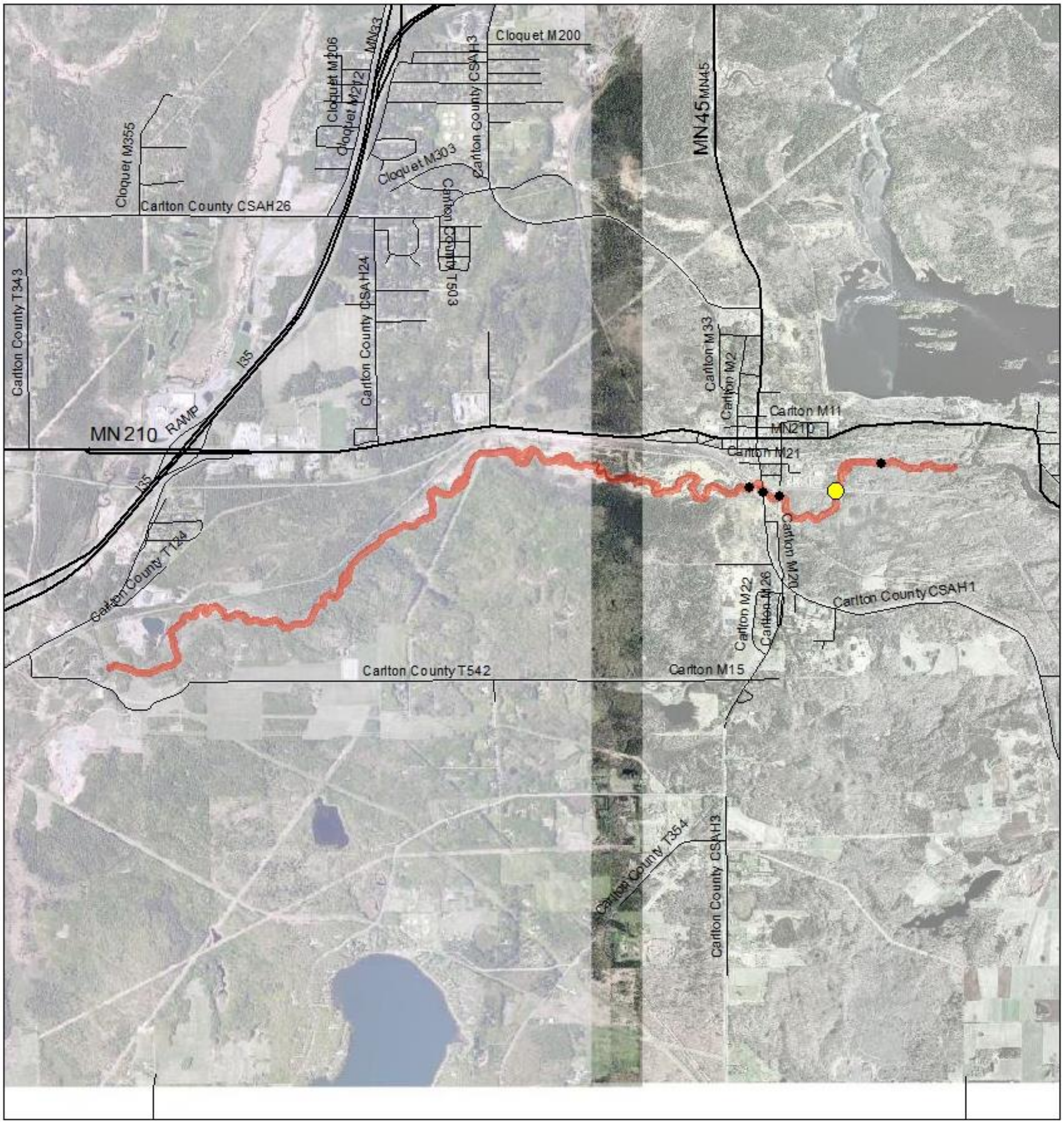
Impared Reach Crossings

- Bridge
- Undersized
- Correctly Sized
- Oversized
- Undefined
- Impared Reaches

Kingsbury Creek

0 0.275 0.55 1.1 Miles

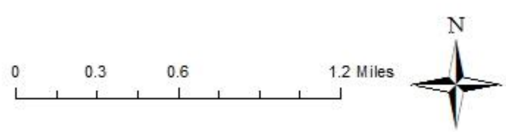
N

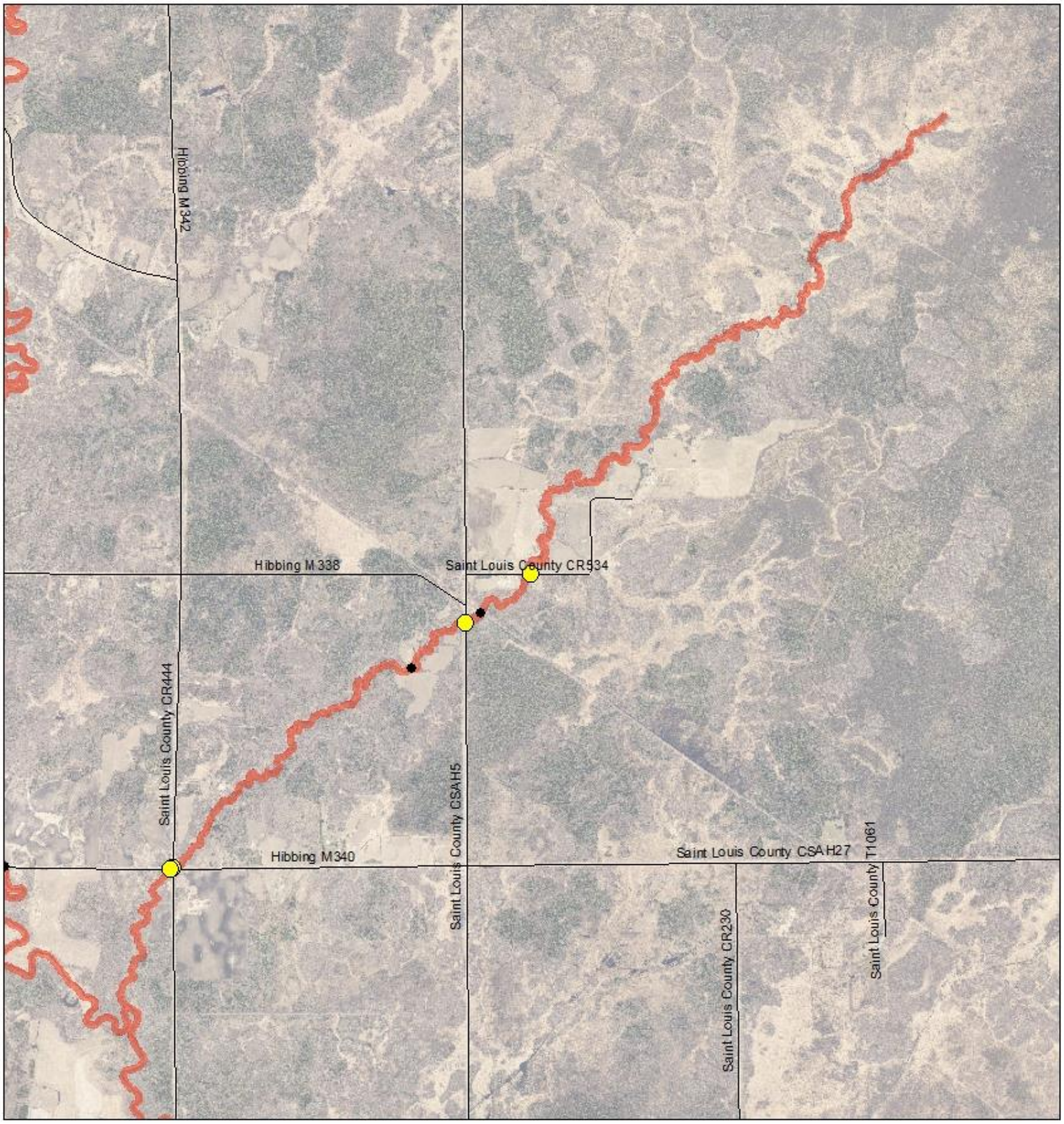


Impared Reach Crossings

- Bridge
- Undersized
- Correctly Sized
- Oversized
- Undefined
- Impared Reaches

Otter Creek





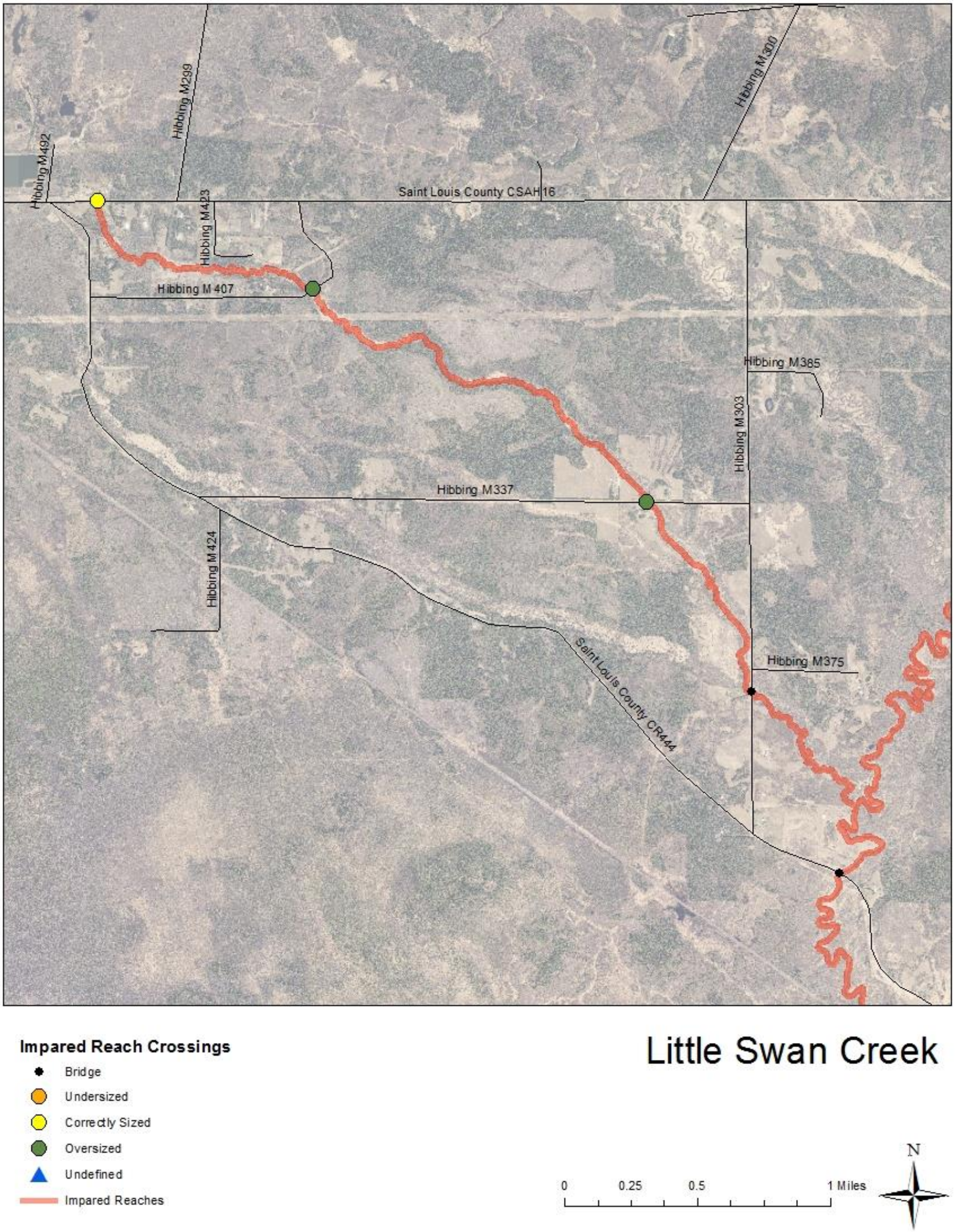
Impared Reach Crossings

- Bridge
- Undersized
- Correctly Sized
- Oversized
- Undefined
- Impared Reaches

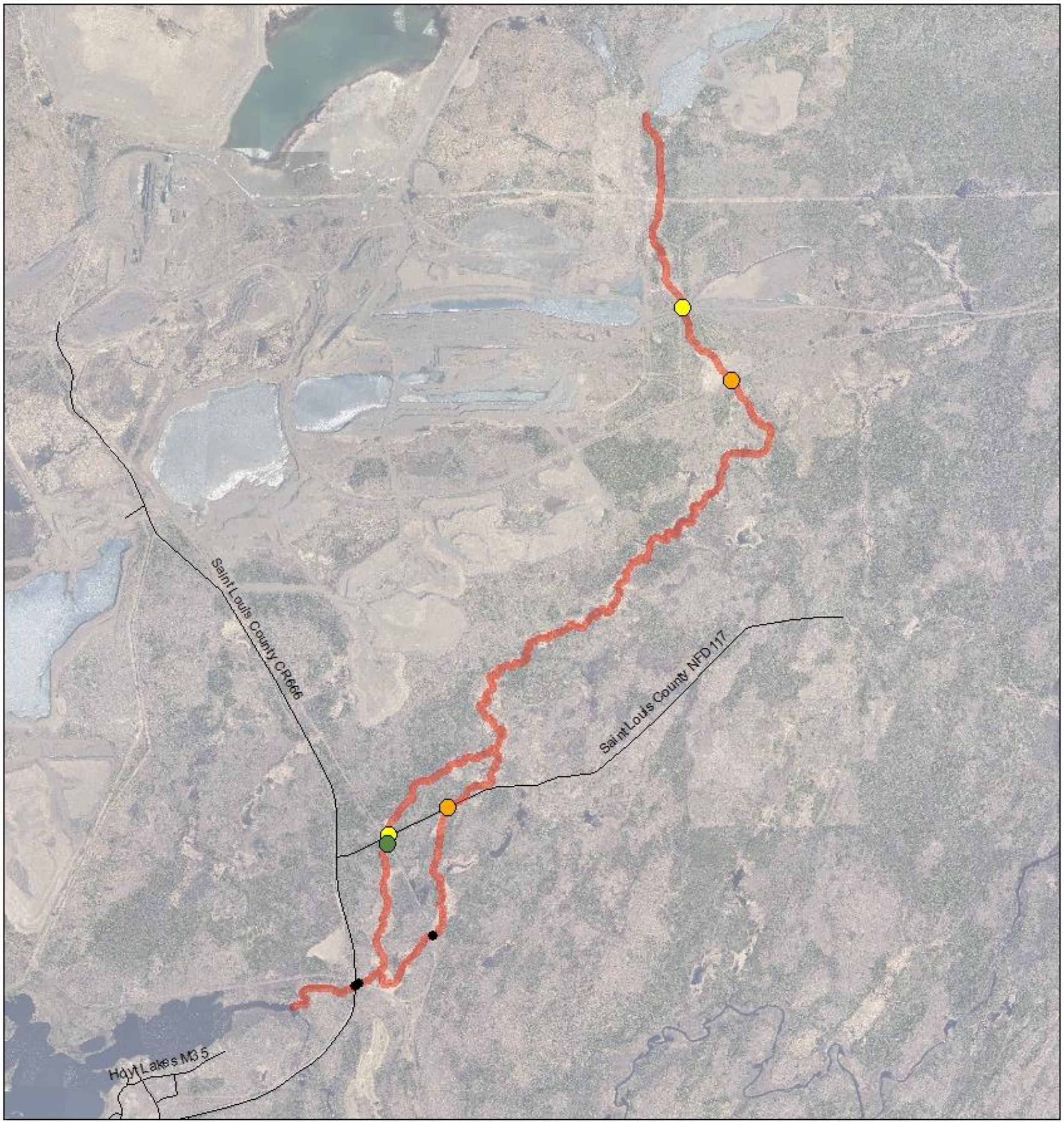
East Swan Creek

0 0.25 0.5 1 Miles

N



Little Swan Creek



Impared Reach Crossings

- Bridge
- Undersized
- Correctly Sized
- Oversized
- Undefined
- Impared Reaches

Wyman Creek

0 0.425 0.85 1.7 Miles

N

Appendix D. St. Louis Connectivity Analysis

The following connectivity analysis was developed by the South St. Louis SWCD (2016).

Connectivity Analysis on St Louis River Watershed Impaired Streams

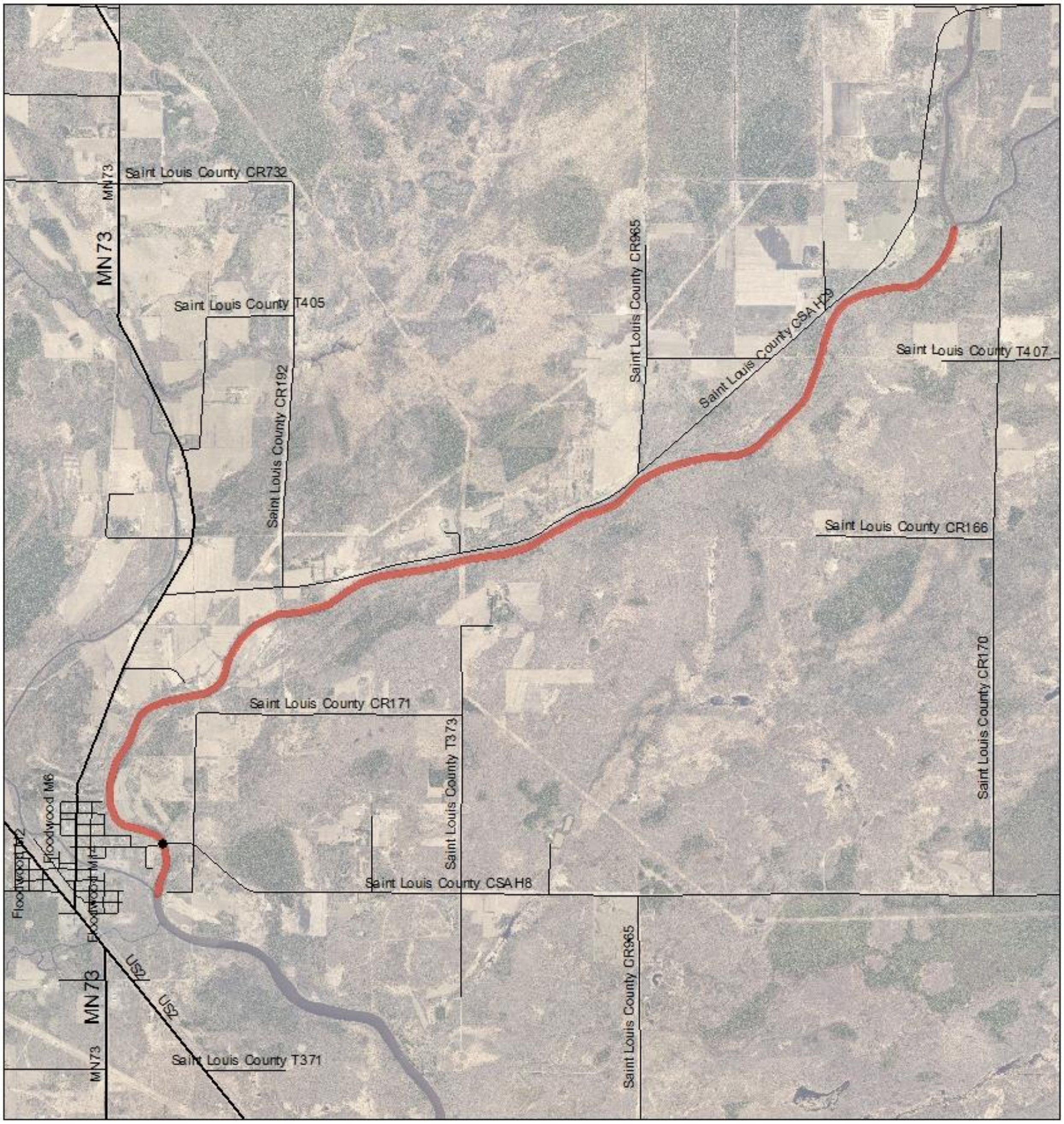
The following maps analyze the connectivity of the impaired reaches in the St Louis River Watershed. Each map reviews a different impaired reach, locating its culvert and bridge crossings. These features were identified and measured using St Louis County pictometry and aerial imagery.

Culverts were then evaluated by comparing their measured width with a predicted bankfull width. Bankfull width was predicted by determining drainage area using Stream Stats (http://water.usgs.gov/osw/streamstats/minnesota.html) and referencing the Eastern MN regional curve, which uses the drainage area to estimate bankfull dimensions (area, width, and depth) and discharge. Culverts under 75% of the bankfull width were identified as 'Undersized' and over 125% as 'Oversized.' Culverts between 75% and 125% were identified as 'Correctly Sized.'

78 culverts were located in all of the impaired reaches. According to our designated parameters, 20 of these were undersized, 35 were correctly sized, and 18 were oversized. 5 were left undefined because they were not visible or measurable using the pictometry and aerial photography.

All bridges, including pedestrian and vehicle bridges, were located on the impaired reaches are marked using black dots. 80 bridges were identified for all of the impaired reaches.

St Louis River Watershed Impairments - Connectivity Summary										
Impairments		**Bridges**	**Culverts**				Total	Crossings	% Correct
Name	Length (miles)		Undersized	Correctly Sized	Oversized	Undefined	Crossings	Per Mile	Culverts
St. Louis River	6.9	1	0	0	0	0	1	0.1	NA
Elbow Creek	4.1	0	2	2	0	0	4	1.0	50%
West Two River	6.1	1	1	0	0	0	2	0.3	0%
Manganika Creek	1.1	0	1	0	0	0	1	0.9	0%
trib to McQuade Lake	8.2	4	0	2	0	0	6	0.7	100%
Swan River	19.5	4	0	0	0	0	4	0.2	NA
Elbow Creek	6.9	2	2	3	0	0	7	1.0	60%
Embarrass River	36.9	16	1	0	0	0	17	0.5	0%
Sand Creek	2.5	0	0	0	0	0	0	0.0	NA
Vaara Creek	6.3	0	0	2	0	0	2	0.3	100%
Stony Creek	5.8	0	1	0	0	0	1	0.2	0%
Unnamed Creek	6.2	0	0	0	1	1	2	0.3	0%
Skunk Creek	46.5	0	1	1	1	0	3	0.1	33%
Paleface Creek	4.6	3	0	0	0	0	3	0.6	NA
Ely Creek	4.7	3	3	2	0	0	8	1.7	40%
Water Hen Creek	4.2	3	0	0	0	0	3	0.7	NA
Water Hen Creek	3.7	4	0	0	0	0	4	1.1	NA
Spring Mine Creek	2.1	1	0	1	0	2	4	1.9	100%
Miller Creek	8.6	14	6	7	7	2	36	4.2	35%
Kingsbury Creek	6.7	14	1	6	6	0	27	4.0	46%
Otter Creek	6.0	4	0	1	0	0	5	0.8	100%
East Swan Creek	5.9	0	0	4	0	0	4	0.7	100%
Little Swan Creek	7.2	3	0	1	2	0	6	0.8	33%
Wyman Creek	9.3	3	1	3	1	0	8	0.9	60%
	Total	**80**	**20**	**35**	**18**	**5**			
			78						



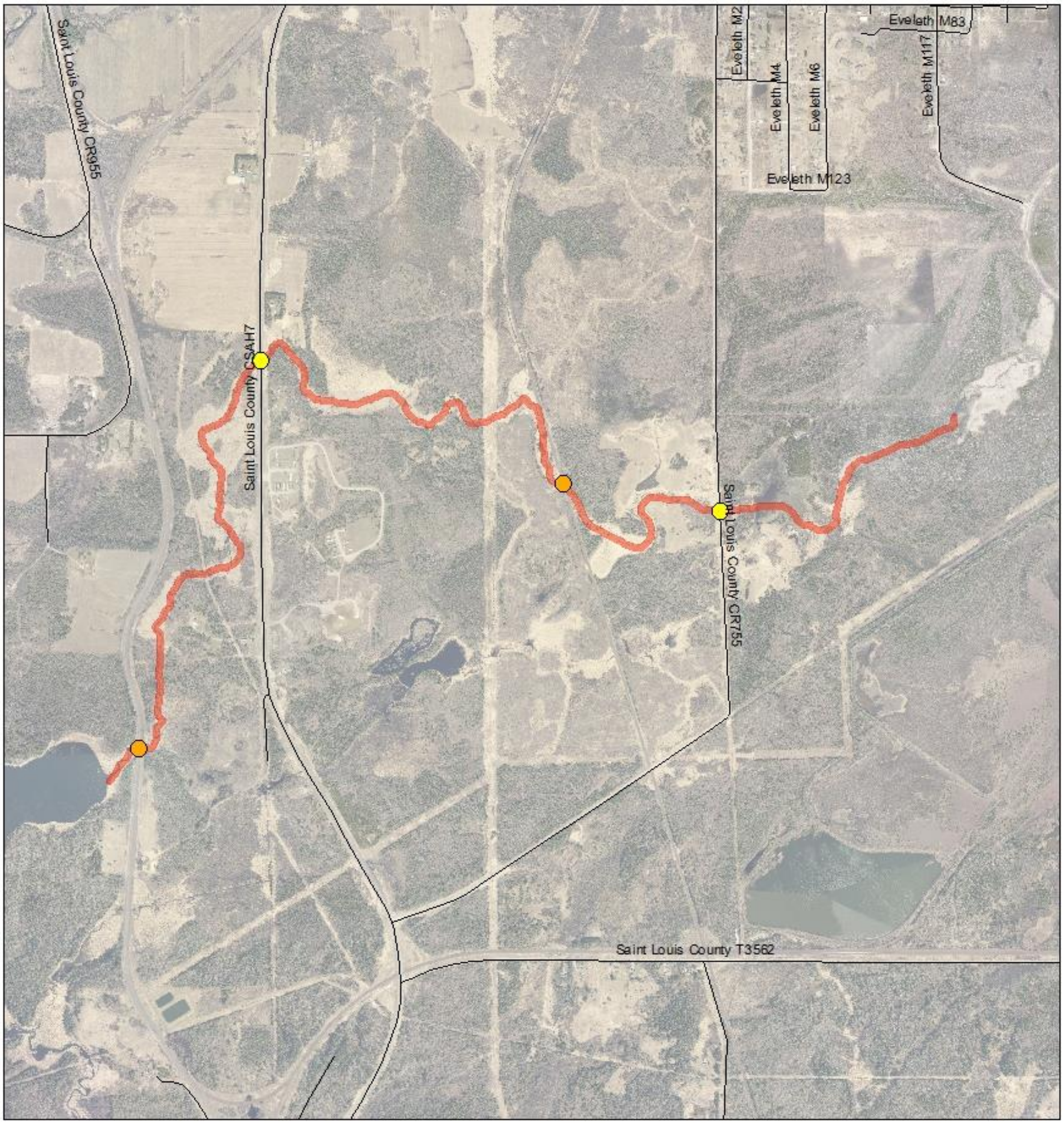
Impared Reach Crossings

- Bridge
- Undersized
- Correctly Sized
- Oversized
- Undefined
- Impared Reaches

St Louis River

0 0.4 0.8 1.6 Miles

N



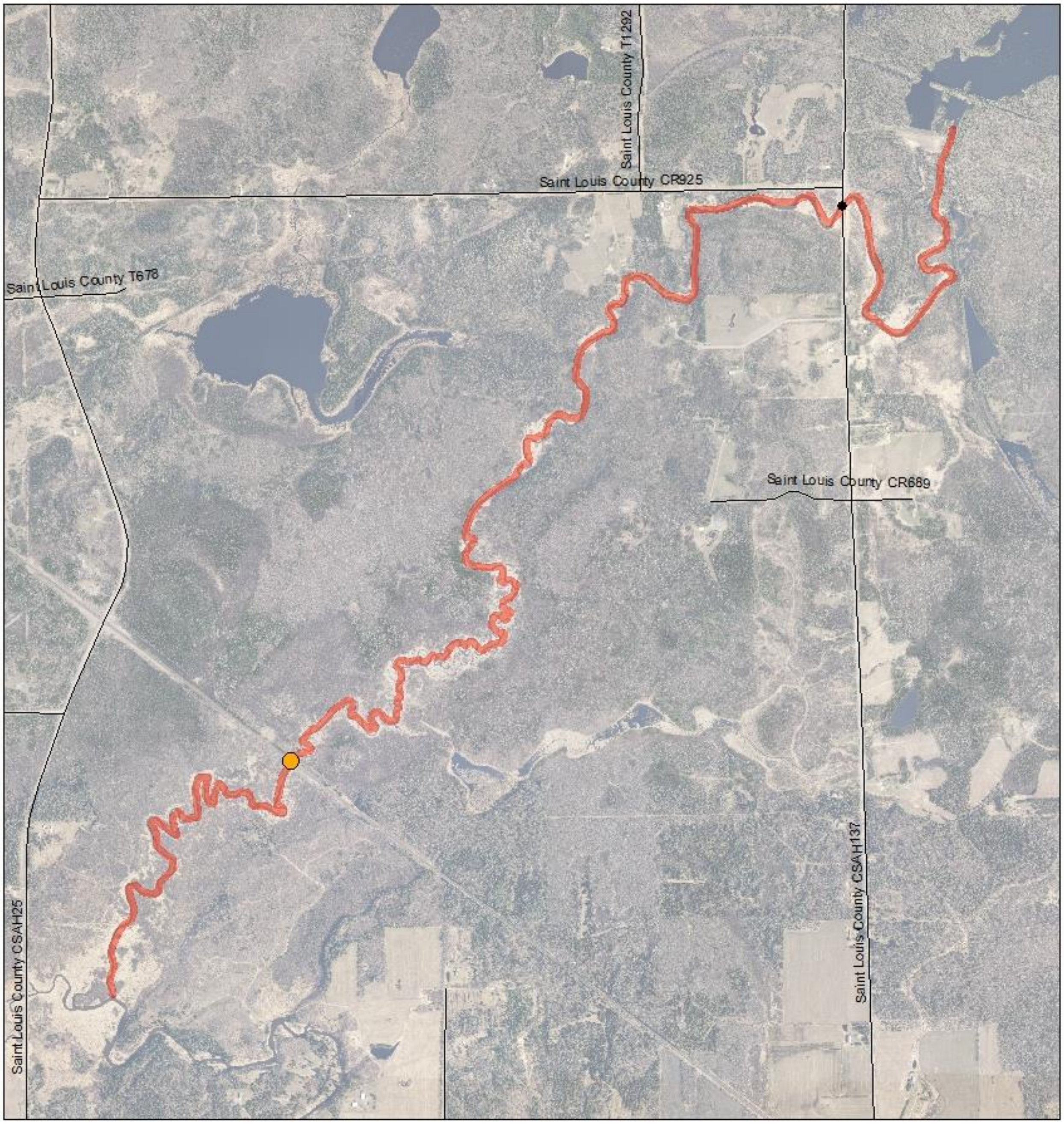
Impared Reach Crossings

- Bridge
- Undersized
- Correctly Sized
- Oversized
- Undefined
- Impared Reaches

Elbow Creek

0 0.15 0.3 0.6 Miles

N



Impared Reach Crossings

- Bridge
- Undersized
- Correctly Sized
- Oversized
- Undefined
- Impared Reaches

West Two River

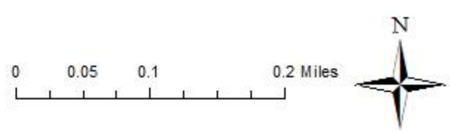
0 0.175 0.35 0.7 Miles

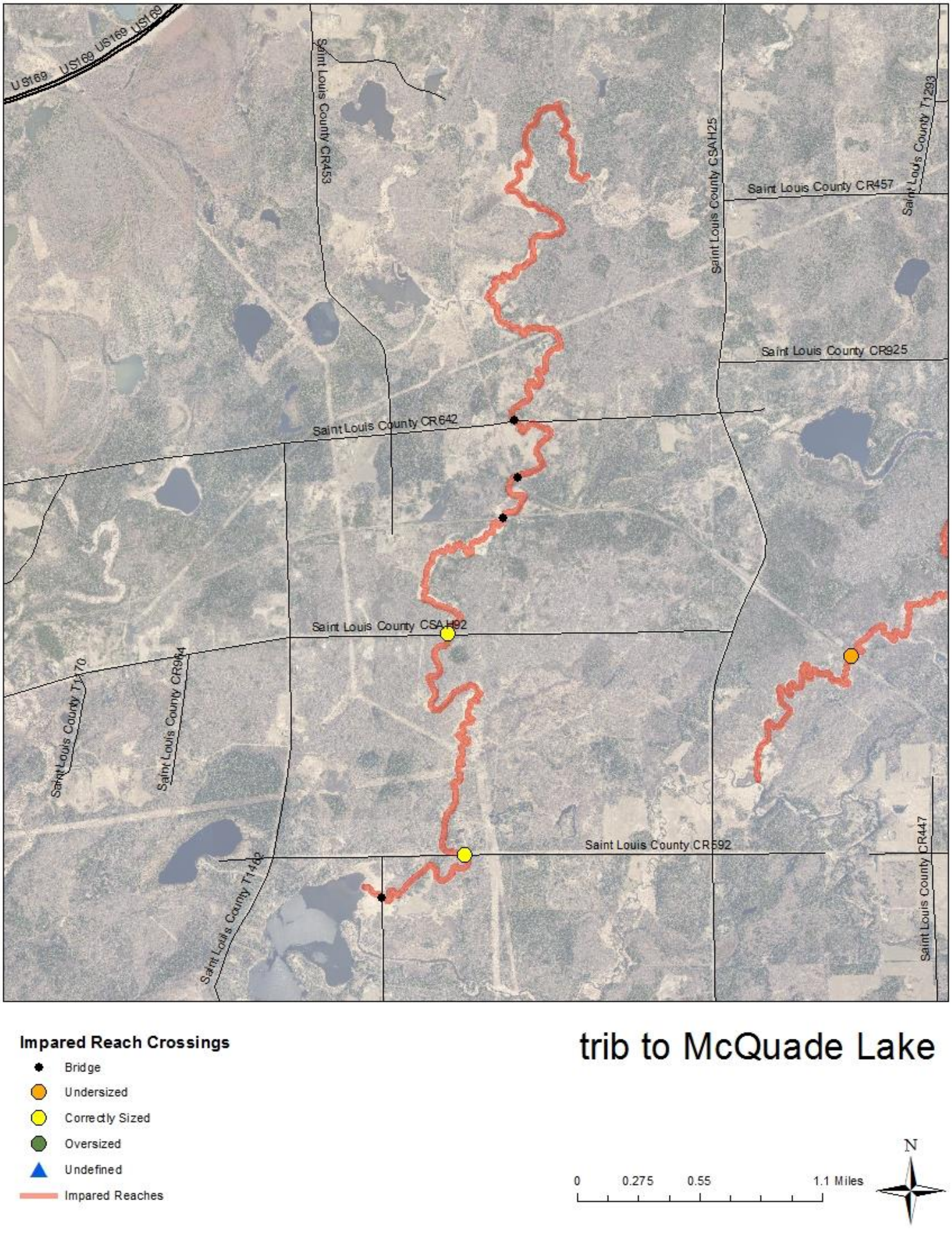
N

Impared Reach Crossings

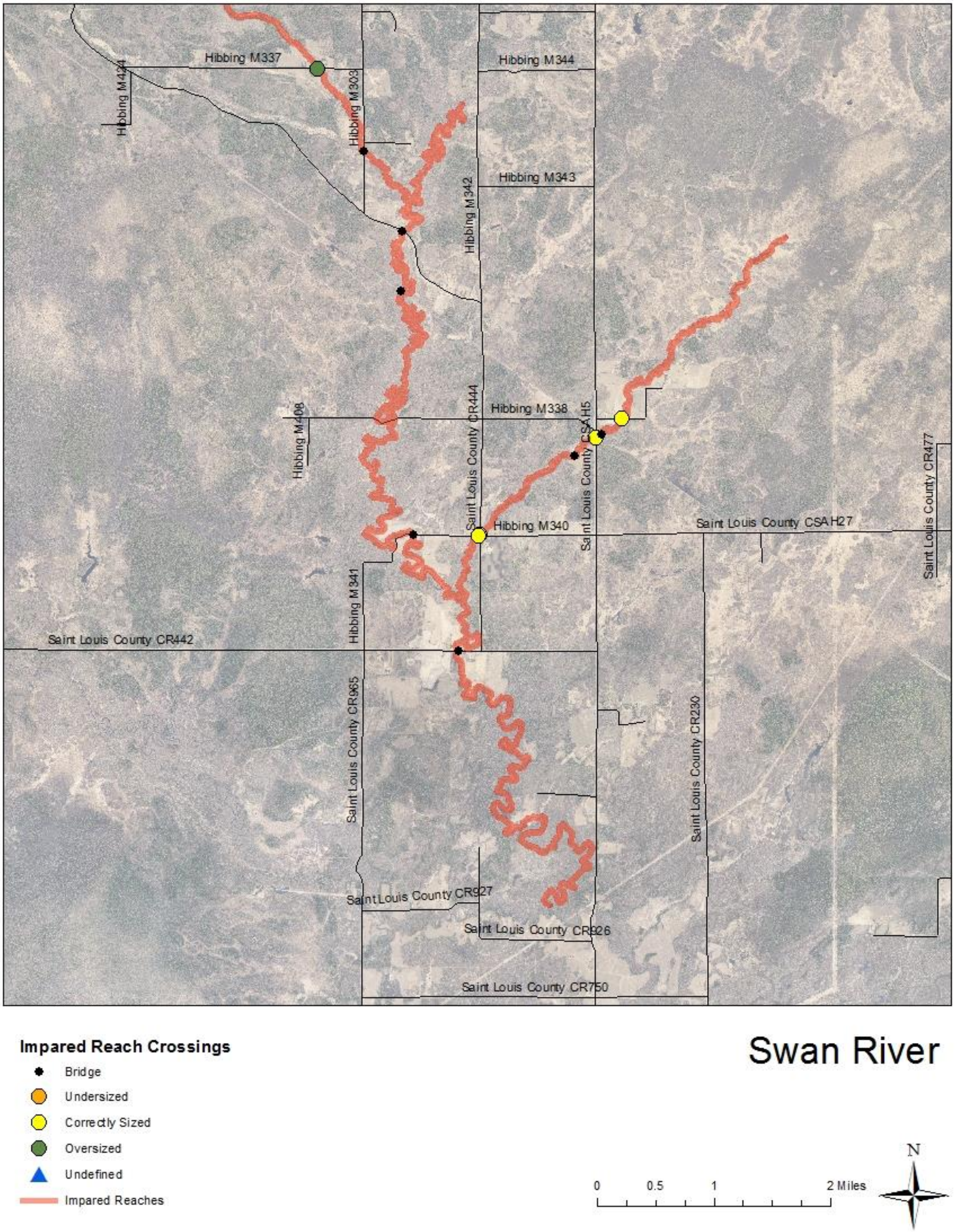
- Bridge
- Undersized
- Correctly Sized
- Oversized
- Undefined
- Impared Reaches

Manganika Creek

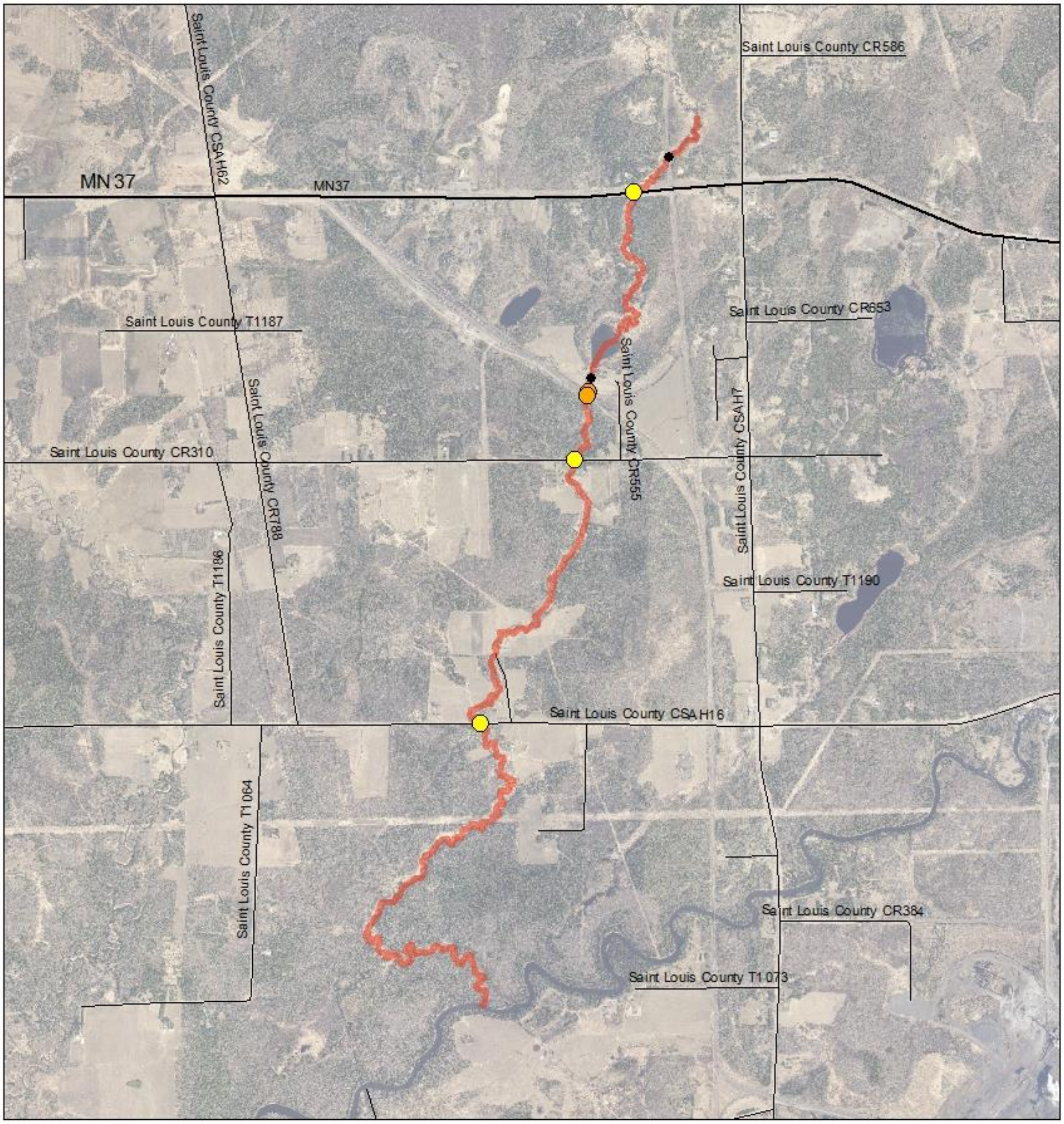




trib to McQuade Lake


Hibbing M337
Hibbing M424
Hibbing M303
Hibbing M344
Hibbing M343
Hibbing M342
Hibbing M338
Hibbing M408
Saint Louis County CR444
Saint Louis County CSAH5
Hibbing M340
Saint Louis County CSAH27
Saint Louis County CR477
Hibbing M341
Saint Louis County CR442
Saint Louis County CR965
Saint Louis County CR230
Saint Louis County CR927
Saint Louis County CR926
Saint Louis County CR750
Impared Reach Crossings
Bridge
Undersized
Correctly Sized
Oversized
Undefined
Impared Reaches
0
0.5
1
2 Miles
N

Swan River



Impared Reach Crossings

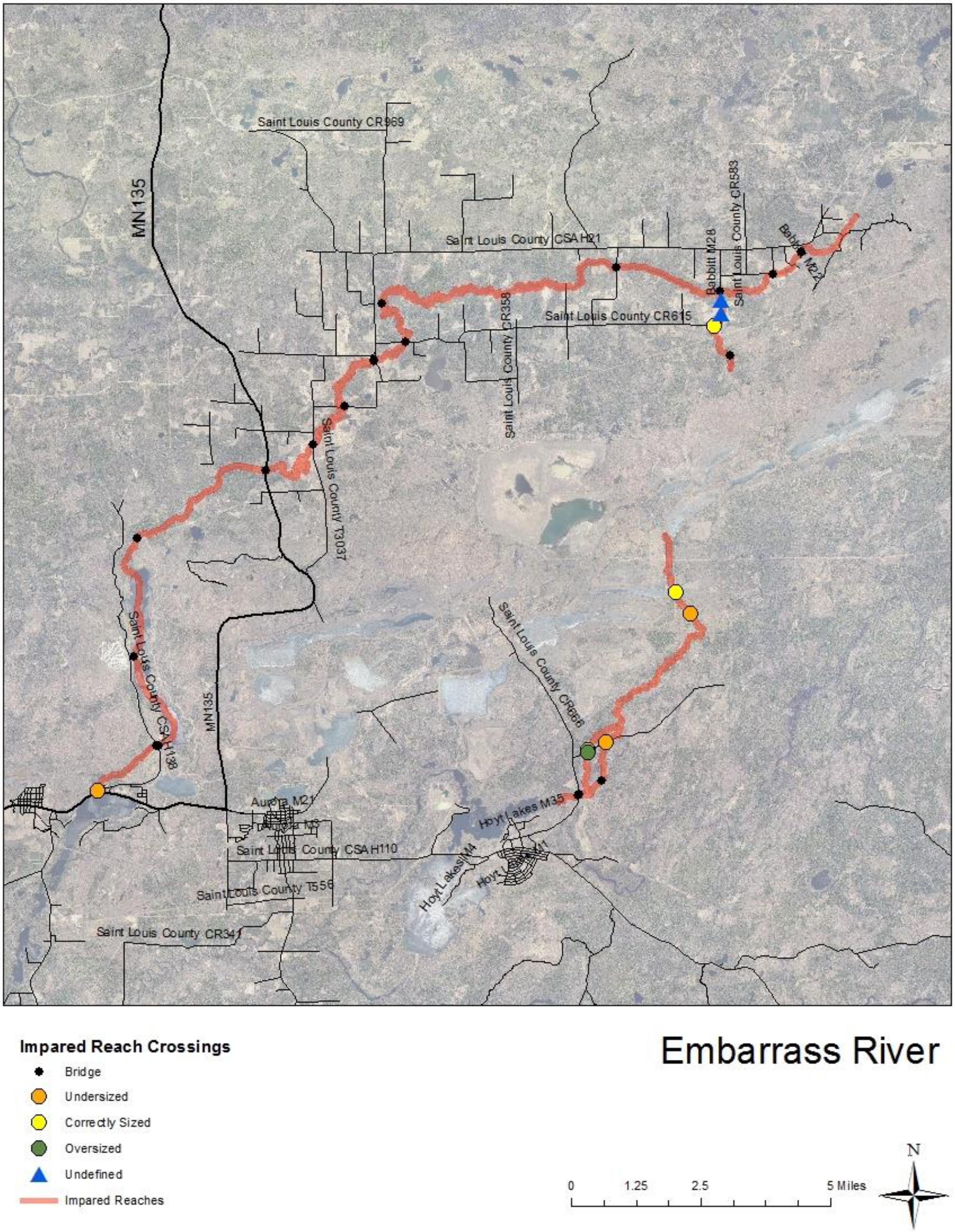
- Bridge
- Undersized
- Correctly Sized
- Oversized
- Undefined
- Impared Reaches

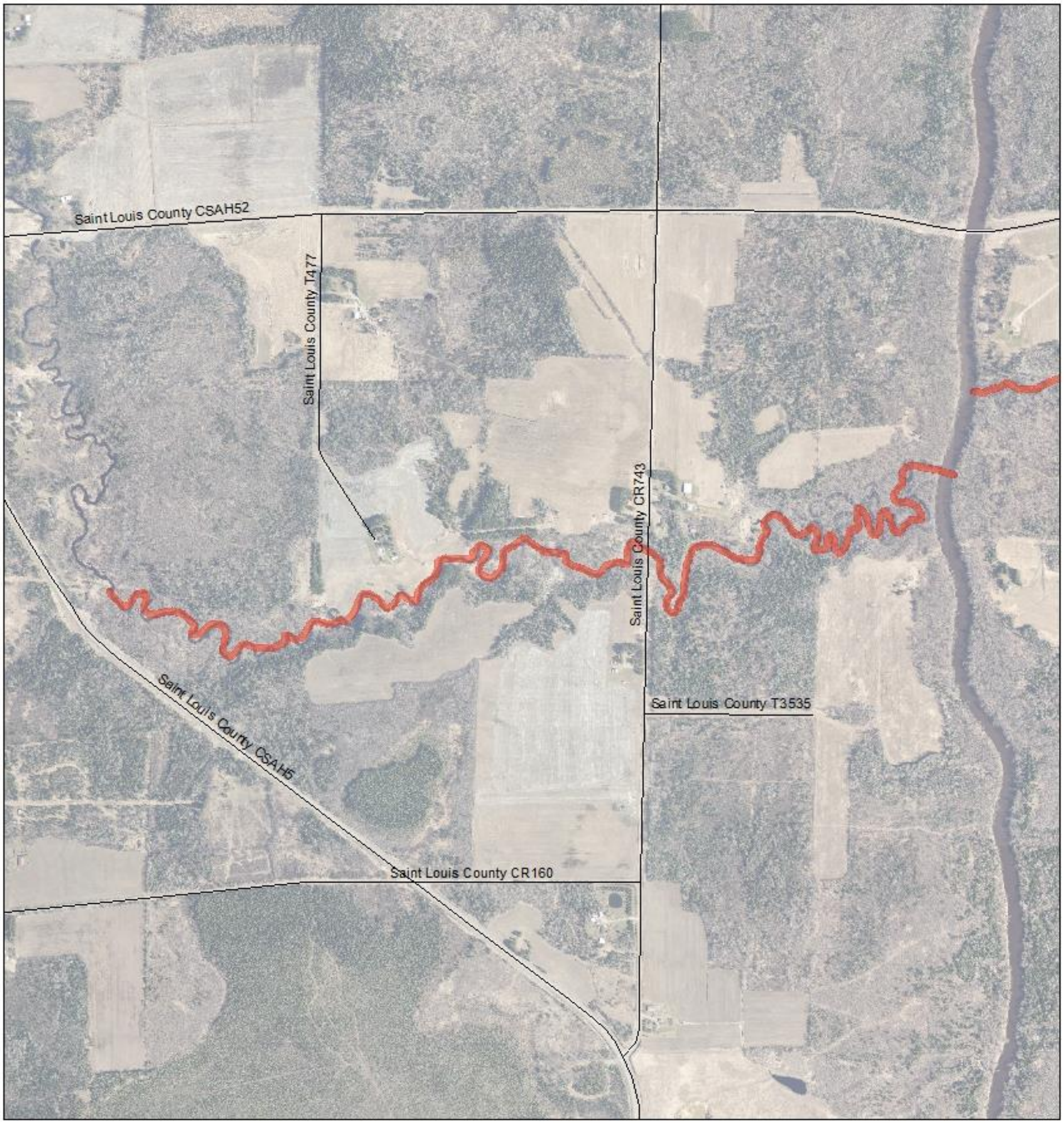
Elbow Creek

0 0.275 0.55 1.1 Miles

N

Embarrass River





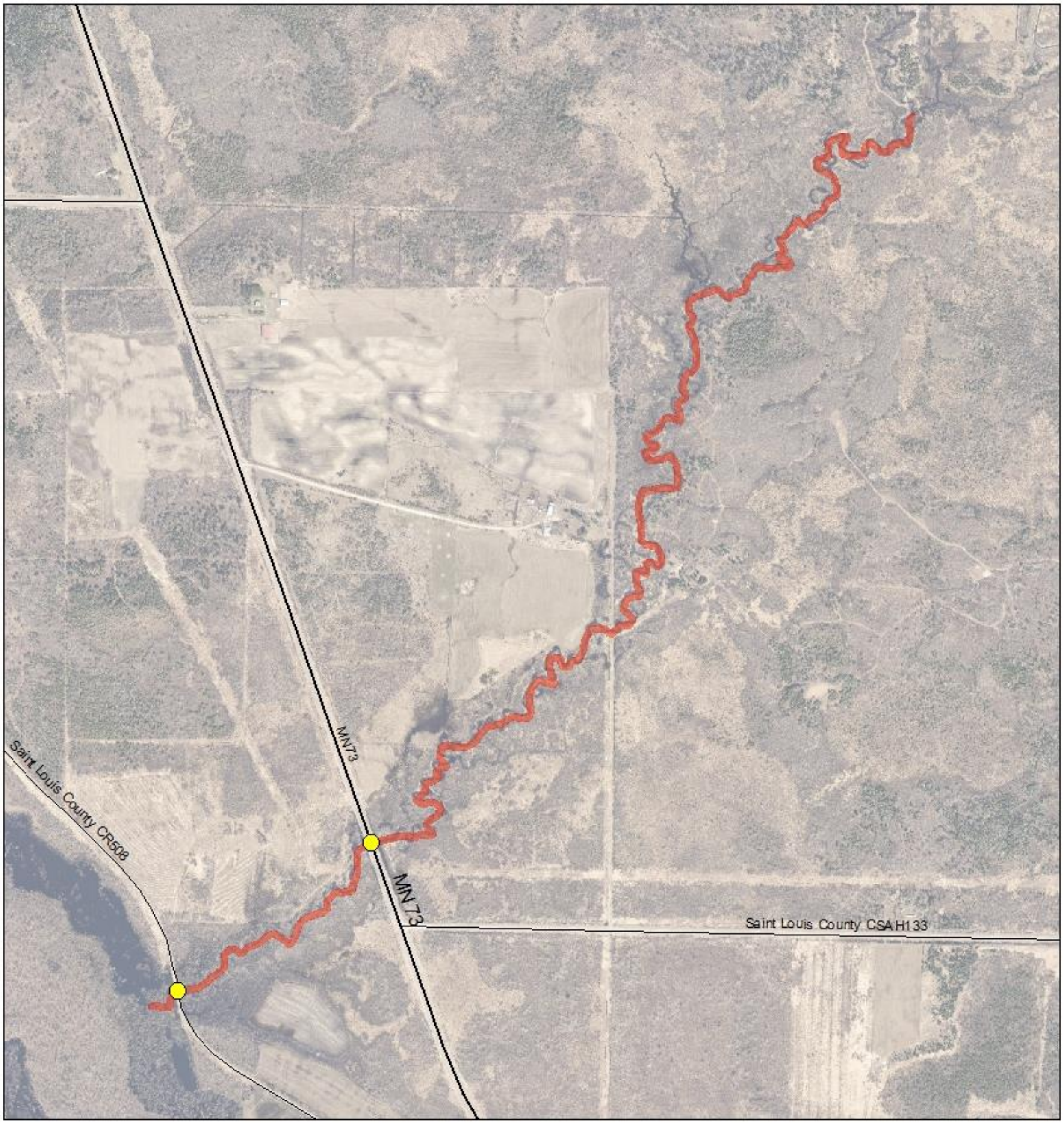
Impared Reach Crossings

- Bridge
- Undersized
- Correctly Sized
- Oversized
- Undefined
- Impared Reaches

Sand Creek

0 0.1 0.2 0.4 Miles

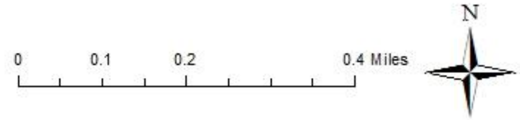
N

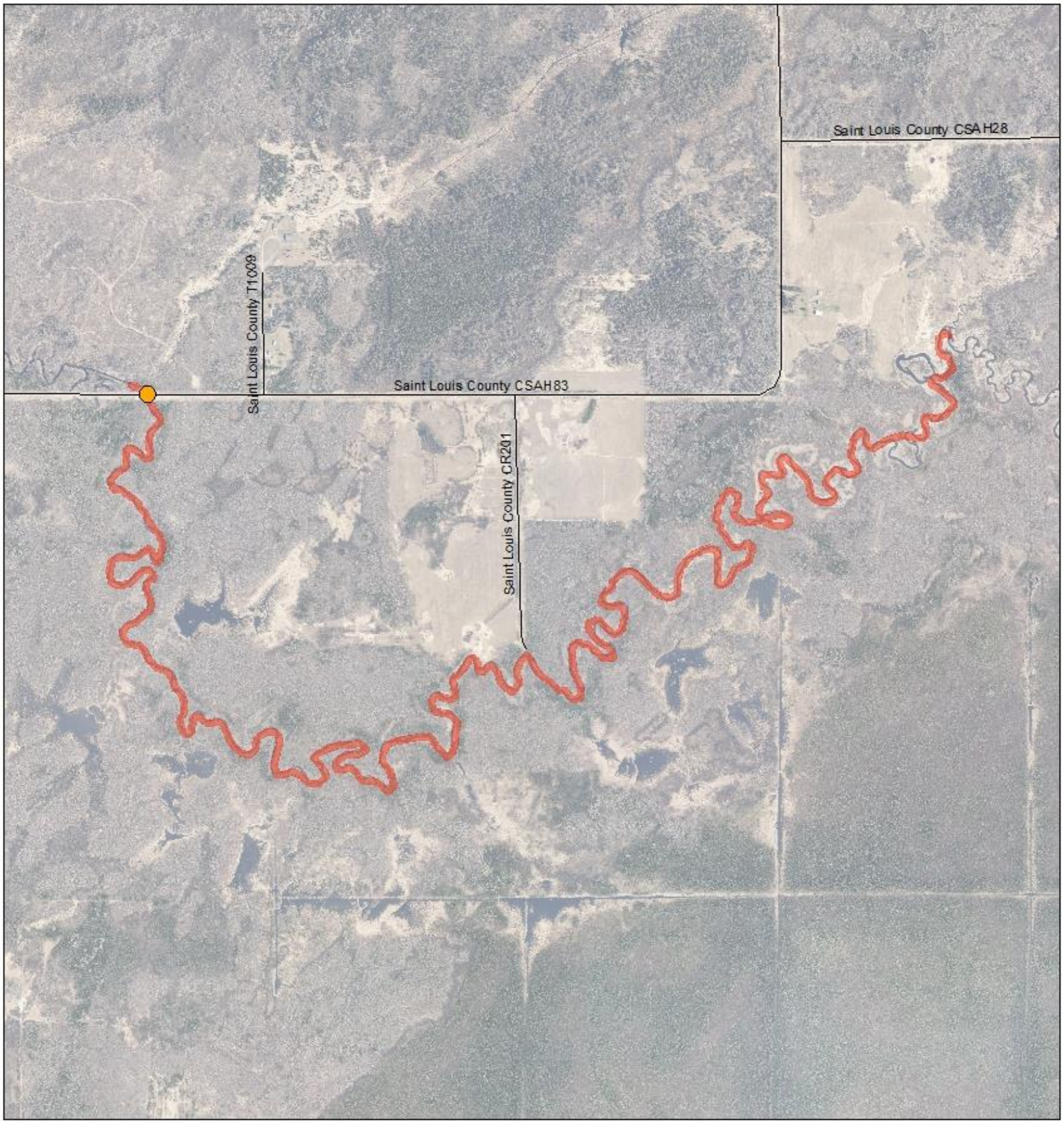


Impared Reach Crossings

- Bridge
- Undersized
- Correctly Sized
- Oversized
- Undefined
- Impared Reaches

Vaara Creek





Impared Reach Crossings

- Bridge
- Undersized
- Correctly Sized
- Oversized
- Undefined
- Impared Reaches

Stony Creek

0 0.125 0.25 0.5 Miles

N

Impared Reach Crossings

- Bridge
- Undersized
- Correctly Sized
- Oversized
- Undefined
- Impared Reaches

Unnamed creek

0 0.125 0.25 0.5 Miles

N

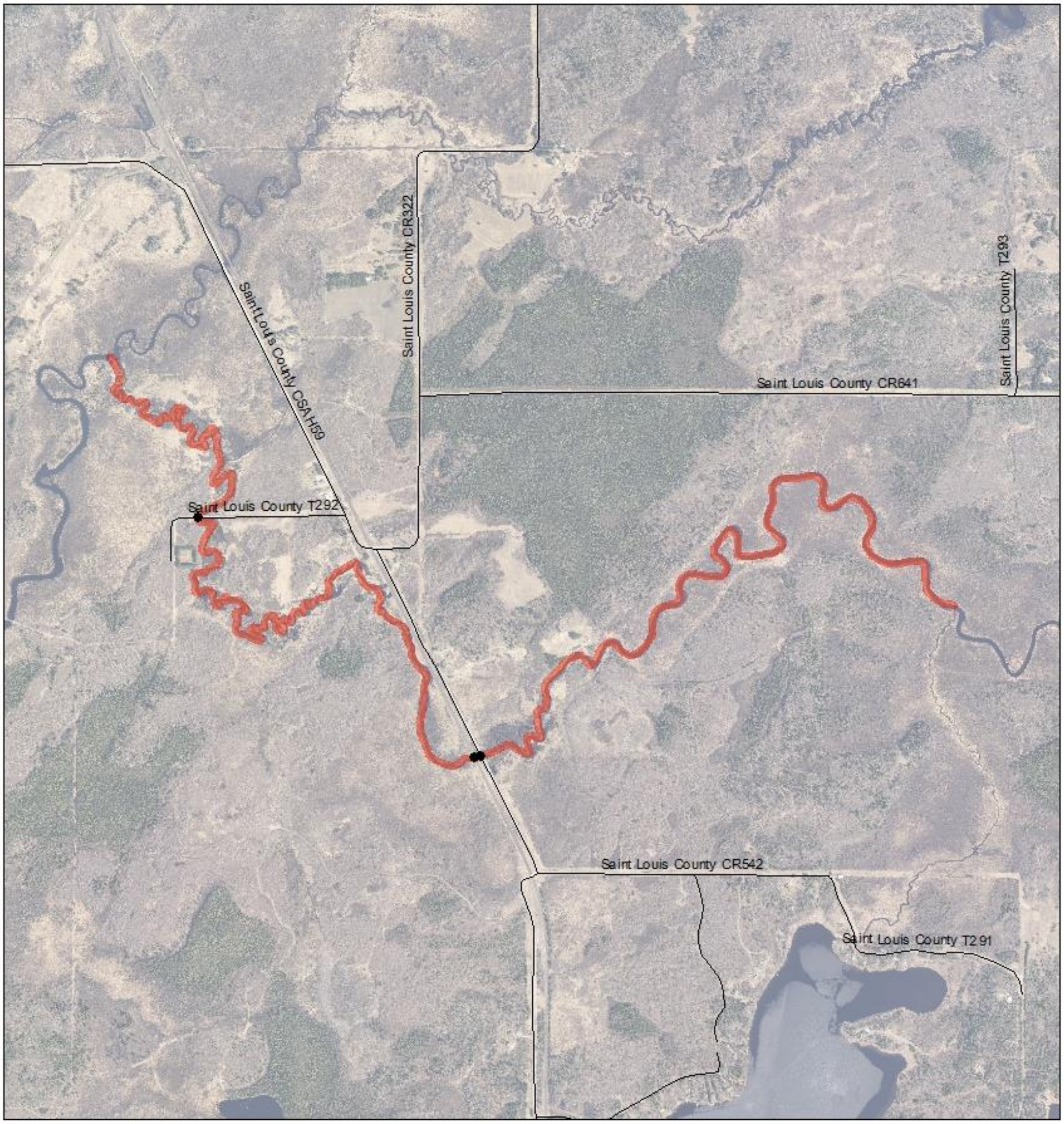
Impared Reach Crossings

- Bridge
- Undersized
- Correctly Sized
- Oversized
- Undefined
- Impared Reaches

Skunk Creek

0 0.075 0.15 0.3 Miles

N



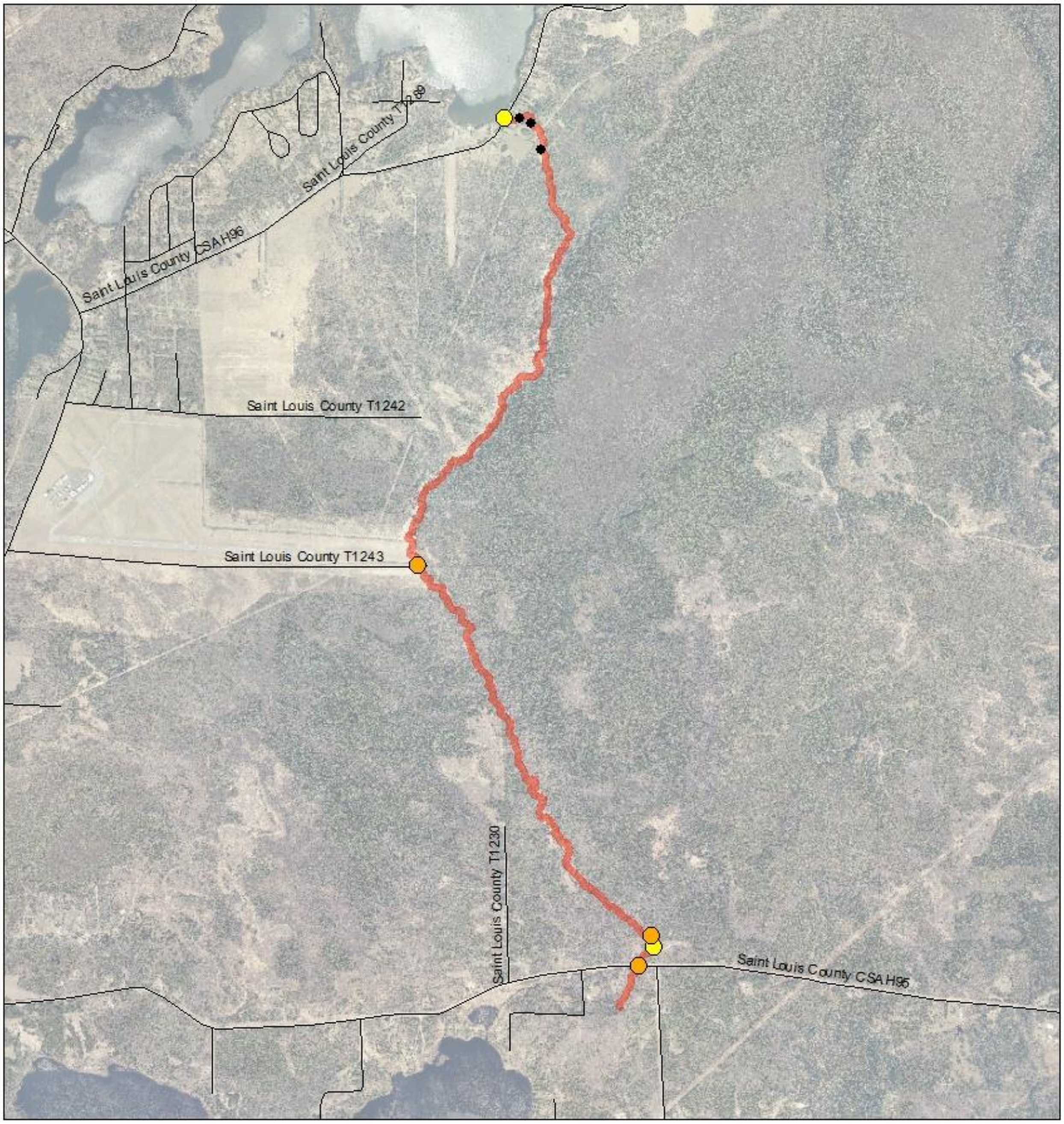
Impared Reach Crossings

- Bridge
- Undersized
- Correctly Sized
- Oversized
- Undefined
- Impared Reaches

Paleface Creek

0 0.15 0.3 0.6 Miles

N



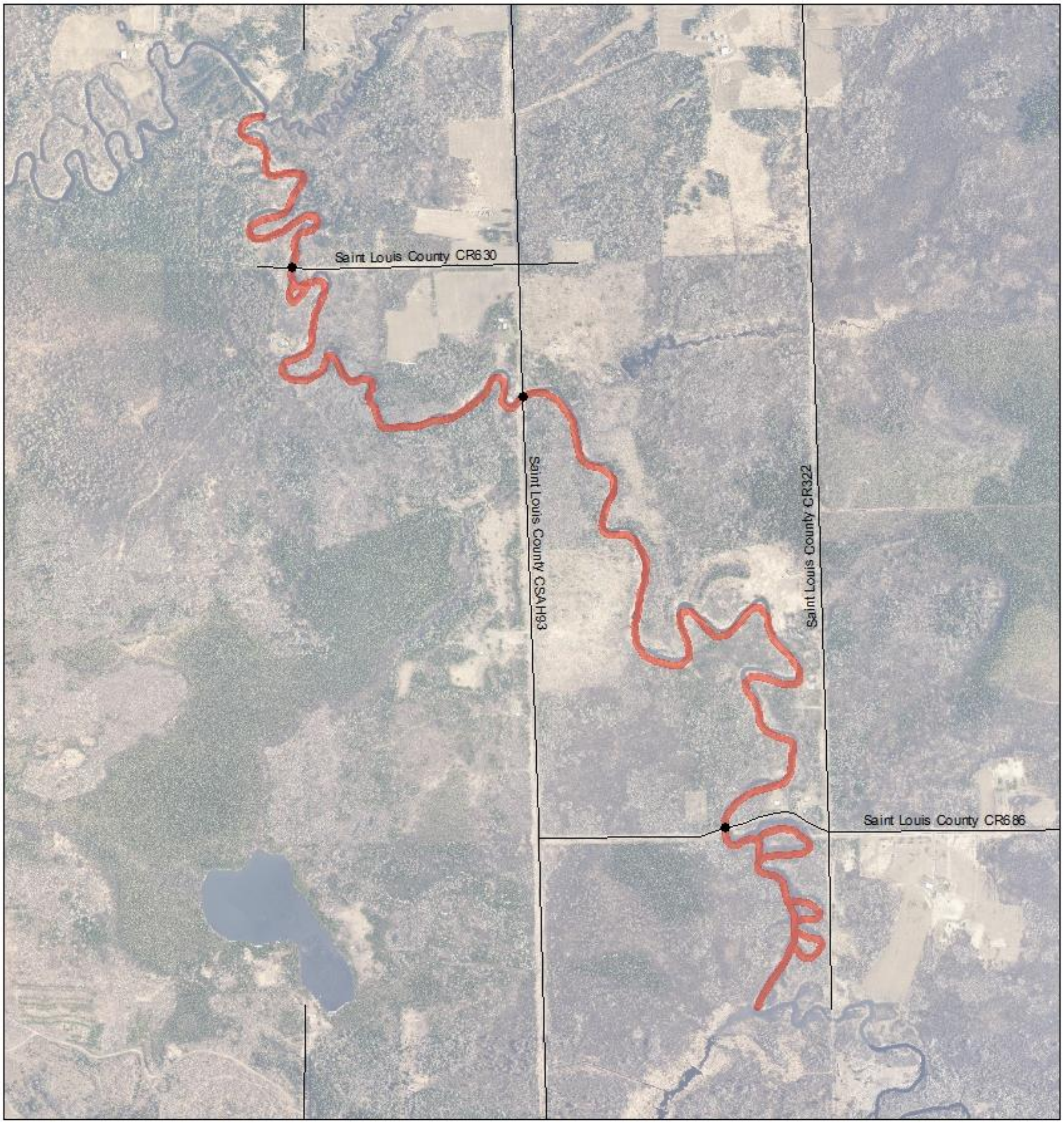
Impared Reach Crossings

- Bridge
- Undersized
- Correctly Sized
- Oversized
- Undefined
- Impared Reaches

Ely Creek

0 0.25 0.5 1 Miles

N



Impared Reach Crossings

- Bridge
- Undersized
- Correctly Sized
- Oversized
- Undefined
- Impared Reaches

Water Hen Creek

0 0.125 0.25 0.5 Miles

N

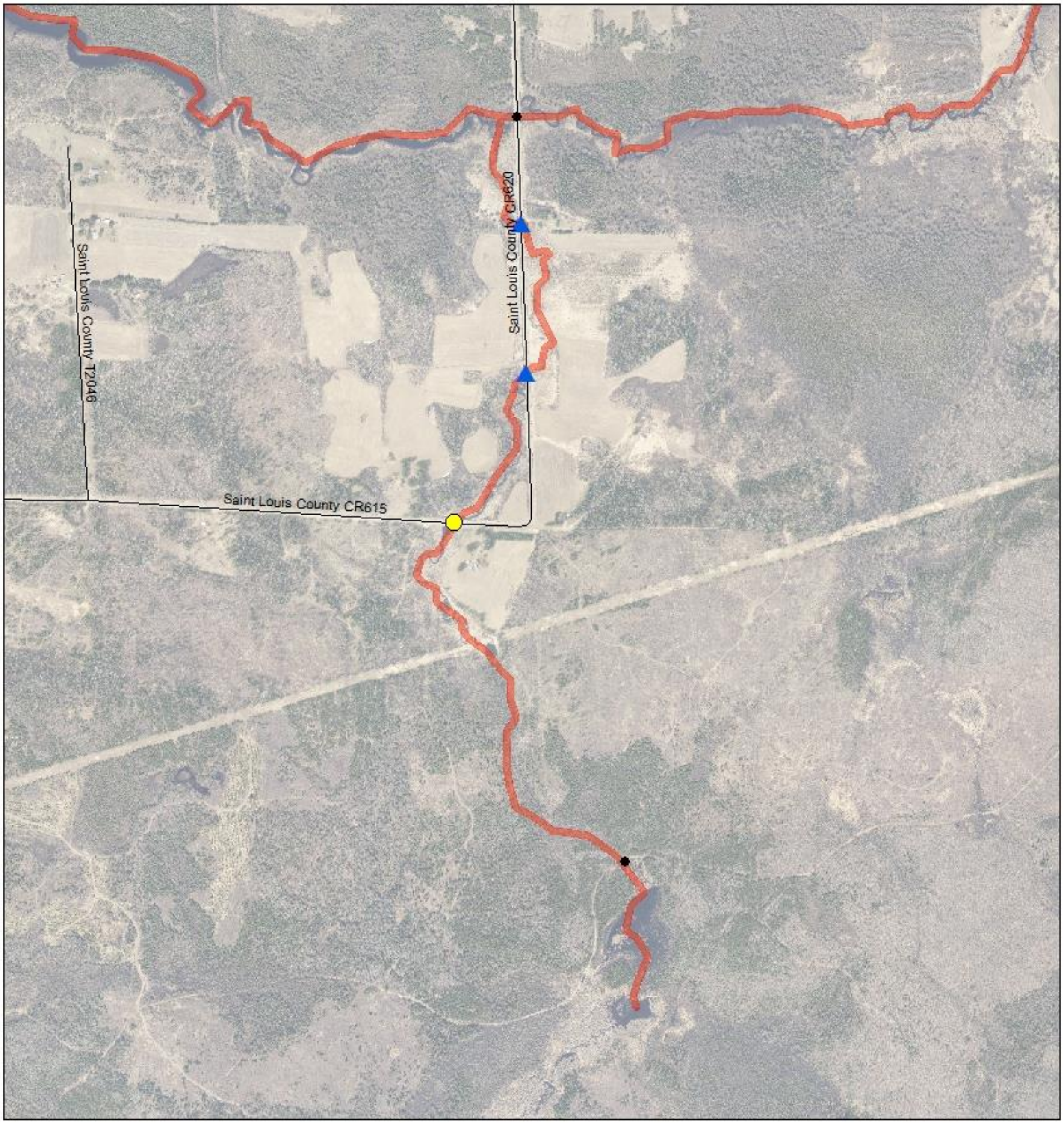
Water Hen Creek

Impared Reach Crossings

- Bridge
- Undersized
- Correctly Sized
- Oversized
- Undefined
- Impared Reaches

0 0.125 0.25 0.5 Miles

N



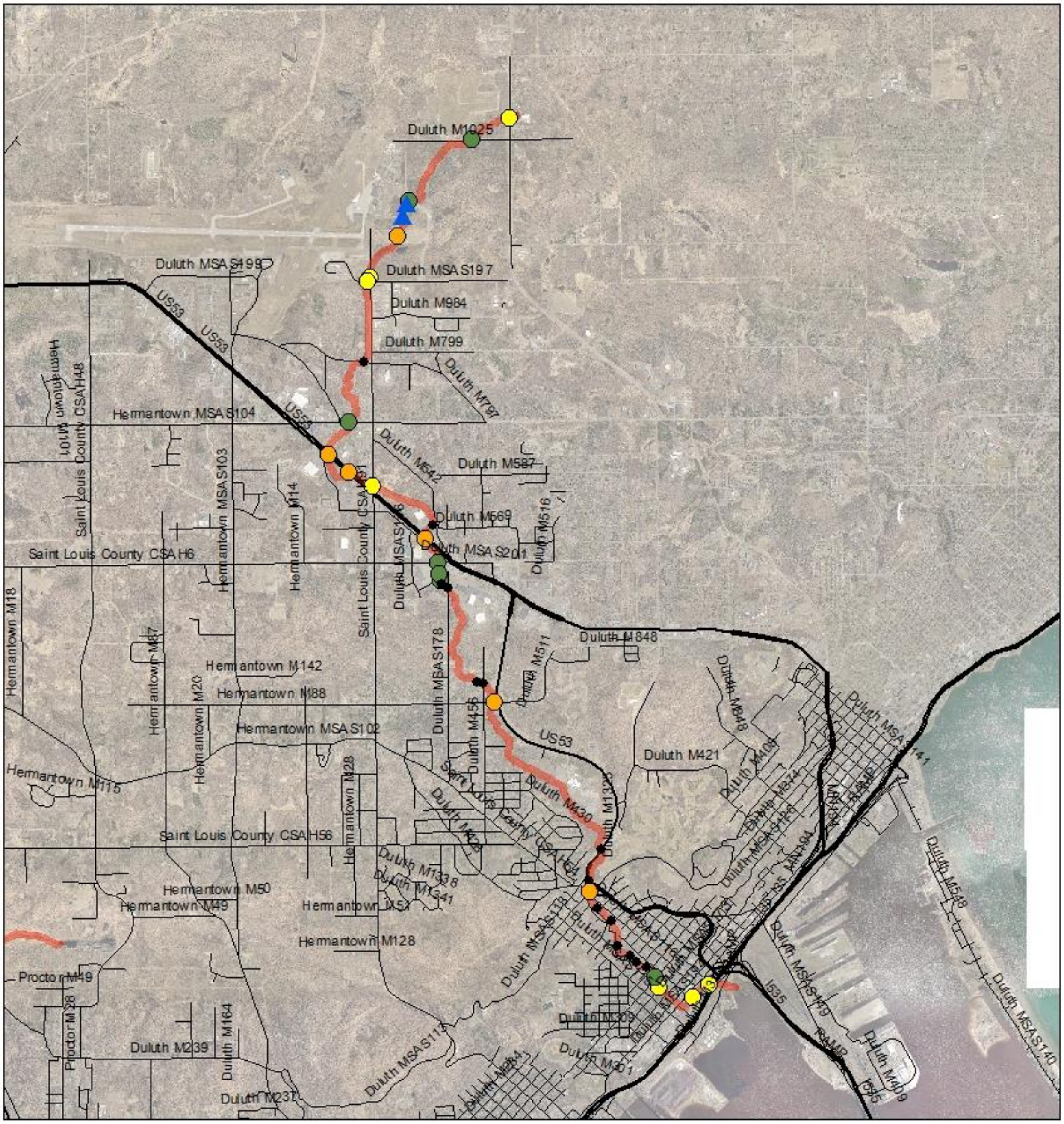
Impared Reach Crossings

- Bridge
- Undersized
- Correctly Sized
- Oversized
- Undefined
- Impared Reaches

Spring Mine Creek

0 0.125 0.25 0.5 Miles

N



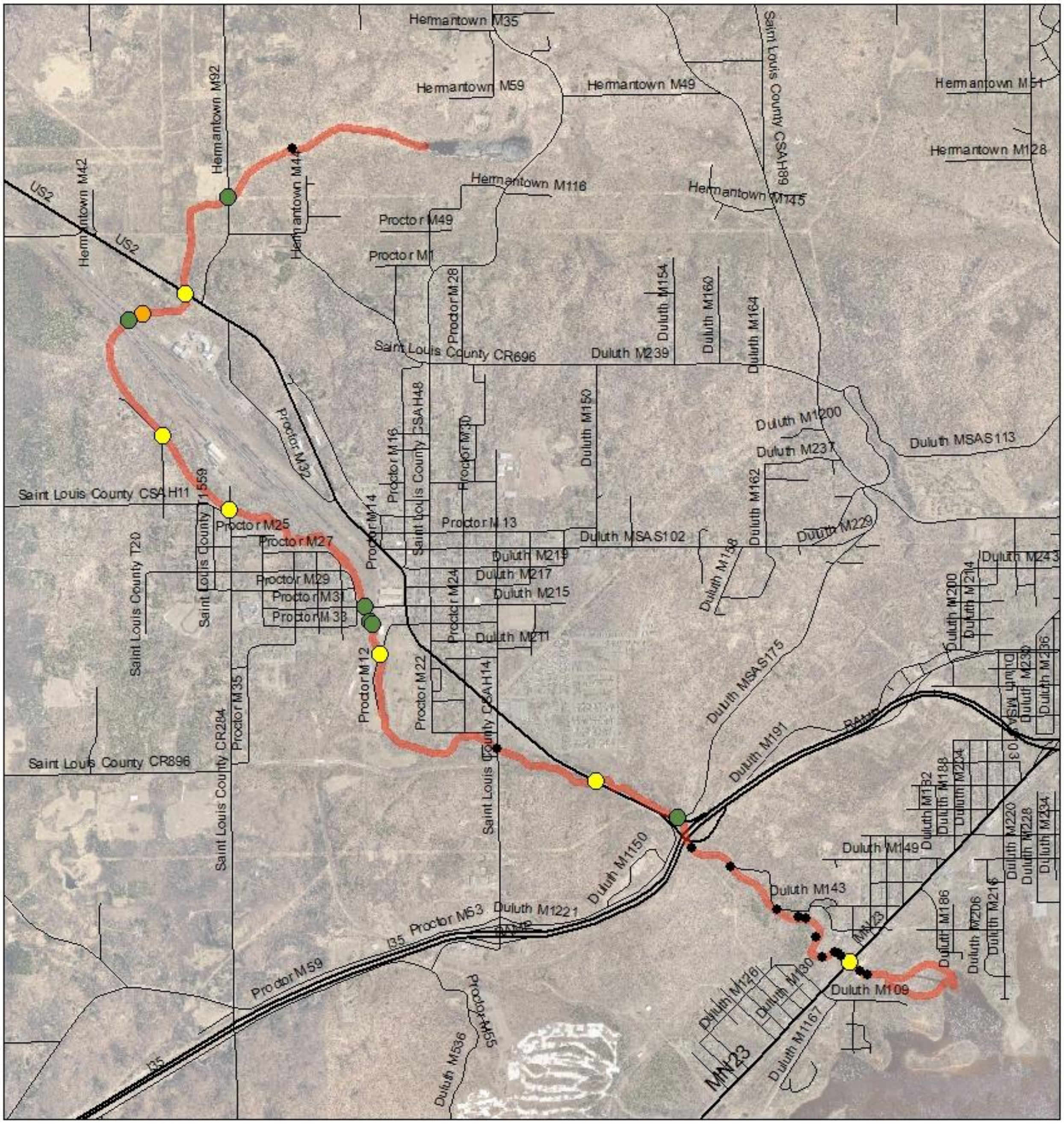
Impared Reach Crossings

- Bridge
- Undersized
- Correctly Sized
- Oversized
- Undefined
- Impared Reaches

Miller Creek

0 0.5 1 2 Miles

N



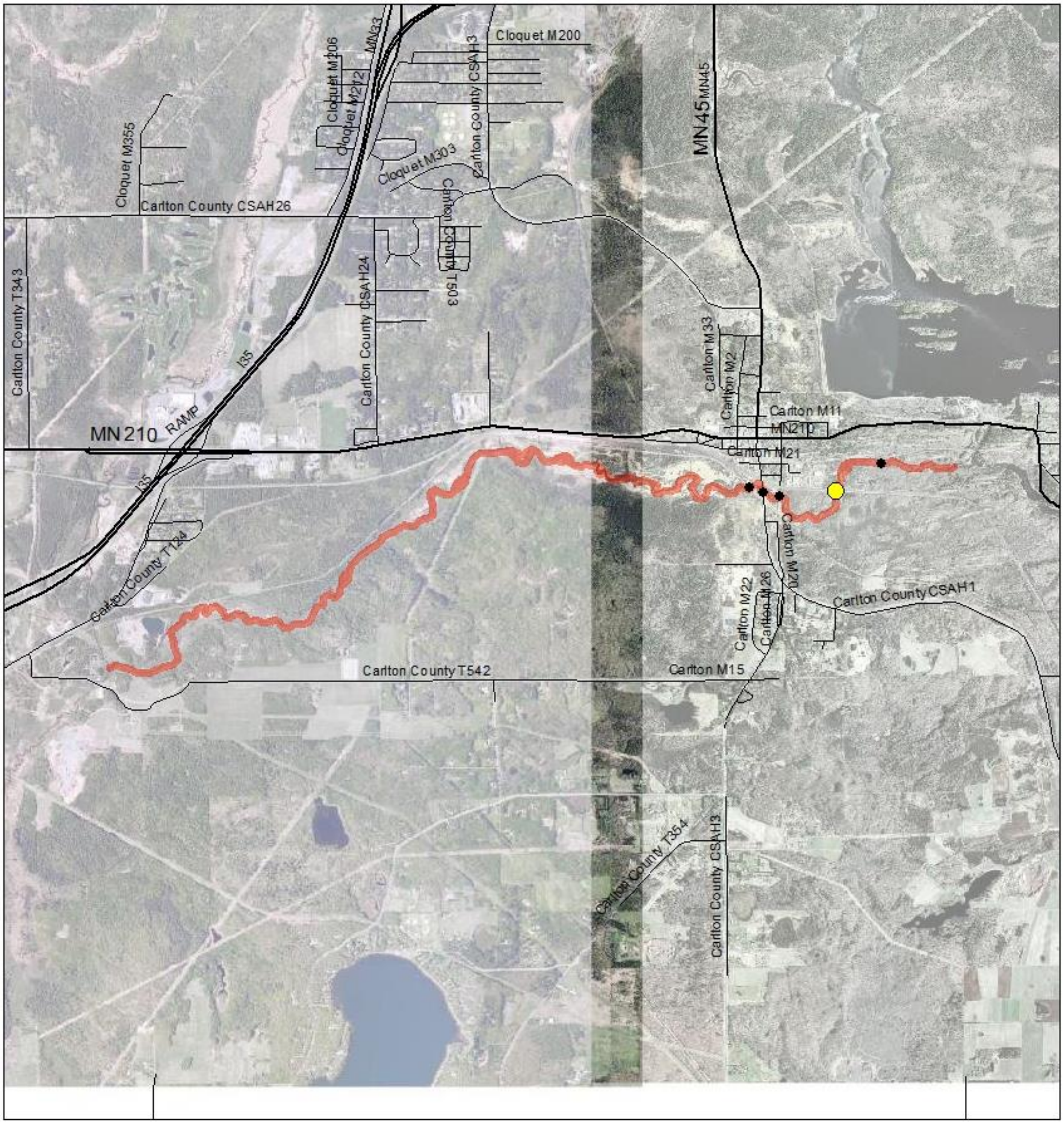
Impared Reach Crossings

- Bridge
- Undersized
- Correctly Sized
- Oversized
- Undefined
- Impared Reaches

Kingsbury Creek

0 0.275 0.55 1.1 Miles

N



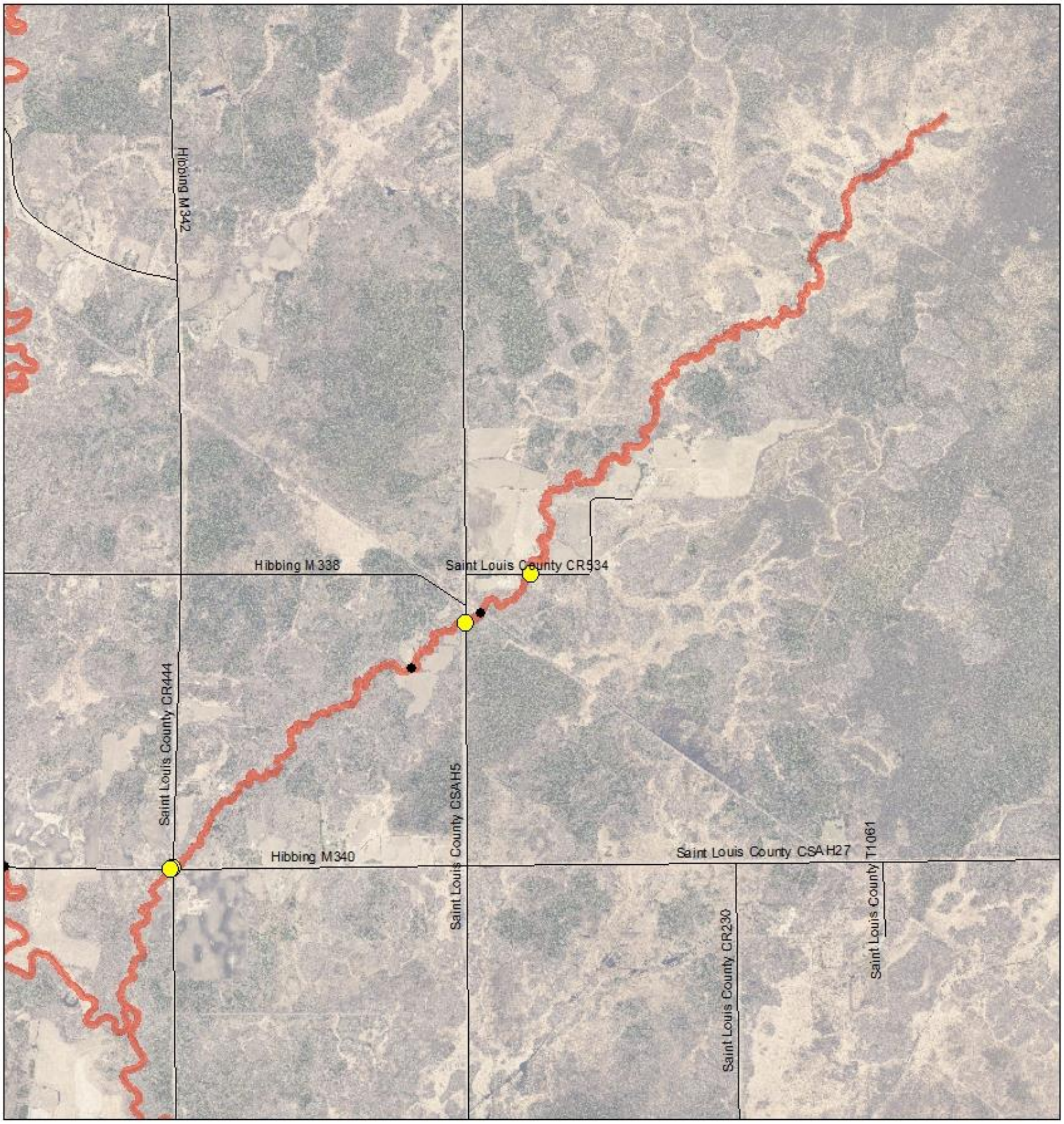
Impared Reach Crossings

- Bridge
- Undersized
- Correctly Sized
- Oversized
- Undefined
- Impared Reaches

Otter Creek

0 0.3 0.6 1.2 Miles

N



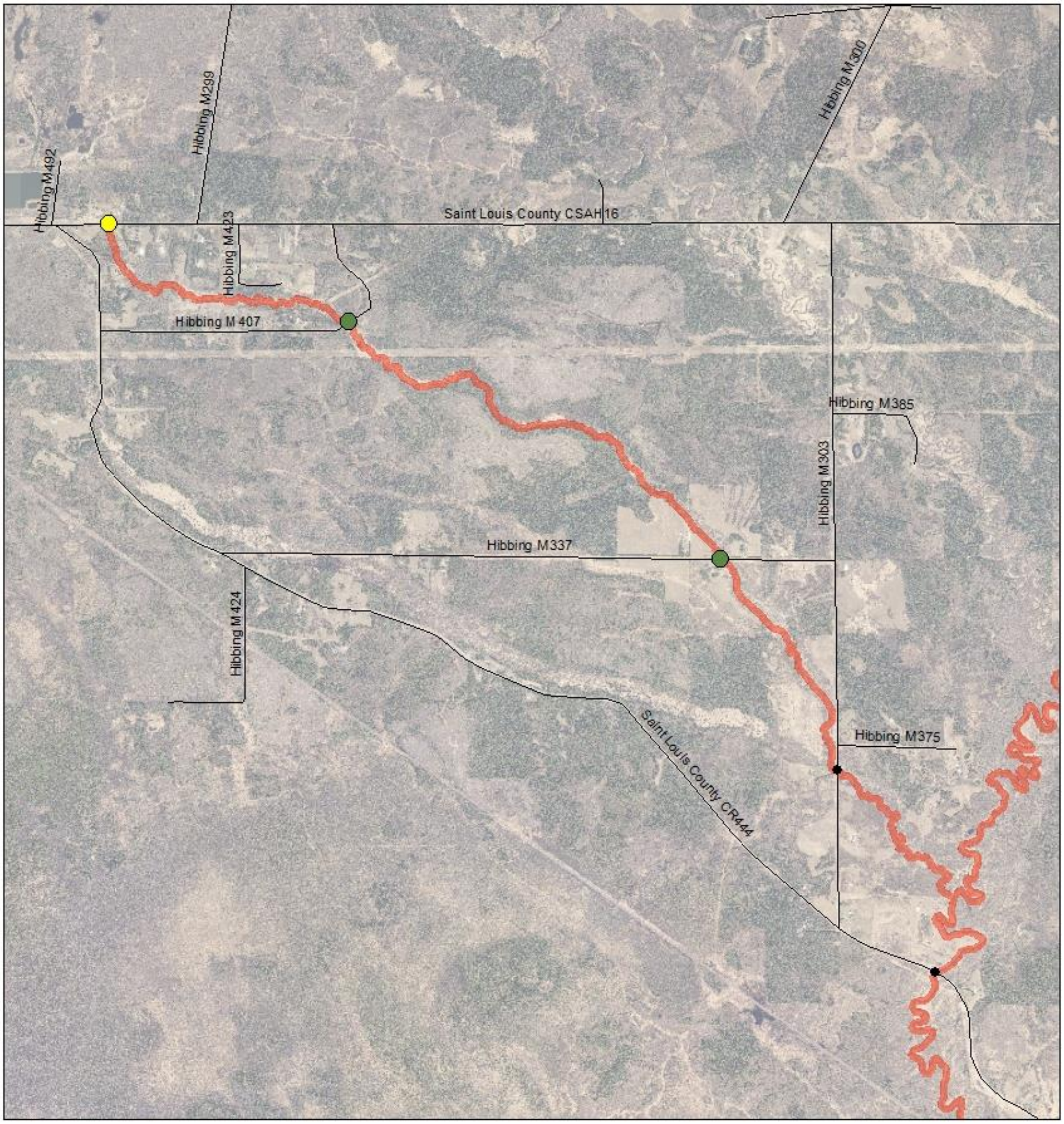
Impared Reach Crossings

- Bridge
- Undersized
- Correctly Sized
- Oversized
- Undefined
- Impared Reaches

East Swan Creek

0 0.25 0.5 1 Miles

N



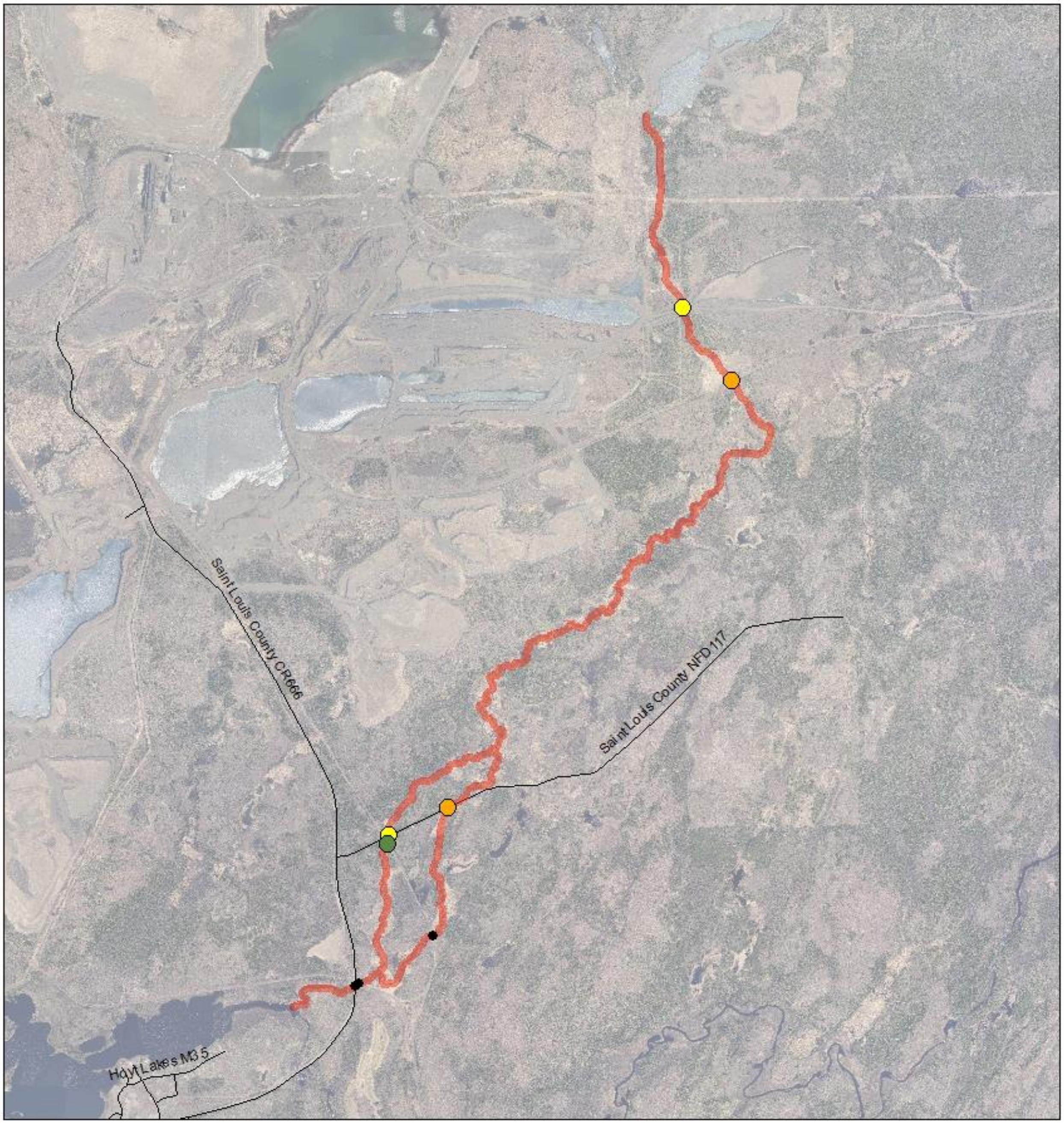
Impared Reach Crossings

- Bridge
- Undersized
- Correctly Sized
- Oversized
- Undefined
- Impared Reaches

Little Swan Creek

0 0.25 0.5 1 Miles

N



Impared Reach Crossings

- Bridge
- Undersized
- Correctly Sized
- Oversized
- Undefined
- Impared Reaches

Wyman Creek

0 0.425 0.85 1.7 Miles

N