Grand Marais Creek

Watershed Restoration and Protection Strategy Report

A report that identifies ways to restore and protect streams in the Grand Marais Creek Watershed

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Key Terms

Assessment Unit Identifier (AUID): The unique water body 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 or macroinvertebrate index of biological integrity, 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 (TP), chlorophyll-a, or Secchi disc depth standards are not met.

Civic Engagement: The process of collecting public and stakeholder input for the development of restoration and protection strategies.

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 Red River is assigned a HUC-4 of 0902 and the Grand Marais Creek Watershed is assigned a HUC-8 of 09020306.

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

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

Monitoring: The collection of water quality data in lakes and streams to assess their condition.

Prioritize, Target, and Measure (PTM): This term is used to describe the prioritization of resources and water quality concerns, and the targeting of implementation strategies to achieve measurable improvements in water 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.

Water Quality: The chemical and biological condition of lakes and streams that affects our ability to recreate and the ability of lakes and streams to support aquatic life, such as fish and macroinvertebrates.

Executive Summary

The Grand Marais Creek Watershed is located in northwest Minnesota within Marshall, Polk, and Pennington Counties. The watershed drains over 298,000 surface area acres (466 square miles) of land, and for the most part is very low gradient with a poorly defined floodplain. The majority of the area has been converted from tall-grass prairie to cropland over the last few hundred years (Figure 1-2). Today approximately 92% of the Grand Marais Creek Watershed is used for some form of crop production. Small towns including Fisher and Oslo make up about 5% of the watershed's land area. With such a large percentage of the land converted to row crop agriculture it is not surprising that soil loss from farm fields has long been a problem within the watershed. Soil is transported largely through field runoff, stream bank erosion, and wind erosion. Hydrological alteration of stream channels through ditching and destruction of the stream riparian zones exacerbates soil loss.

Water quality monitoring within the watershed has been occurring since the 1980s. Since 2003, at least 13 water quality monitoring stations have been established across nine stream reaches in the watershed through the joint and independent efforts of: the Minnesota Pollution Control Agency (MPCA), Red Lake Watershed District (RLWD), International Water Institute, River Watch, and Marshall County. These efforts are coordinated through programs like the Red River Basin Condition Monitoring Network, the RLWD long-term monitoring program, and SWAG grants. As part of a statewide effort launched by the MPCA to intensively monitor watersheds, efforts began in 2012 to collect additional data and investigate impairments within the Grand Marais Creek Watershed. In 2012, the MPCA sampled seven sites for fish and macroinvertebrates along four separate reaches, including one location on the cutoff channel portion of Grand Marais Creek, two county ditches, and one judicial ditch.

Rivers, streams, and ditches were most recently, formally assessed within the Grand Marais Creek HUC8 Major Watershed for the 2014 water quality assessment. Water quality data from 2004 through 2013 and some 2014 data were used for the assessment. Three *E. coli* impairments were found during the 2014 assessment and are addressed with TMDLs that calculate limits for *E. coli* bacteria pollution. Two reaches had low dissolved oxygen levels and two reaches had low fish and macroinvertebrate levels, and are considered impaired due to non-pollutant based stressors resulting from altered hydrology. These impairments will be addressed through watershed restoration projects. The water quality assessment results, including impaired waters, are shown in Table 2-1 and the impaired waters are mapped in Figure 2-1. More detailed information about the most recent water quality assessment results can be found in the Grand Marais Creek Watershed Monitoring and Assessment Report.

Based on output from modeling tools, One Watershed One Plan (1W1P) priority areas, and input from the Grand Marais Creek Watershed Restoration and Protections Strategy (WRAPS) technical advisory committee, locations of watershed implementation efforts were prioritized as follows:

Priority 1 – Restoration of Grand Marais Creek and protection of the headwaters (approximately east of Highway 75).

Priority 2 – Restoration of Judicial Ditch 75 and County Ditch 2.

Priority 3 – Restoration of the lake plain ditch system, JD 1, and the direct drainage of the Red Lake River.

The following implementation strategies will be used in the watershed to help restore and protect priority waterbodies:

1. Restoring stream and ditch connectivity to increase base flow, and remove/modify migration barriers such as beaver dams and flood control structures that are improperly sized or designed.
2. Increasing buffer width adjacent to waterbodies and crop rotation by encouraging operators with incentives and rewards.
3. Restoring the natural channel of Grand Marais Creek through habitat enrichment and erosion control projects.

What is the WRAPS Report?

Minnesota has adopted a watershed approach to address the state's 80 major watersheds. 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.

As part of 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 developed for them. TMDLs 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 for addressing 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 as the basis for addressing the U.S. Environmental Protection Agency's (EPA) Nine Minimum Elements of watershed plans, to help 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:
    - *Grand Marais Creek Watershed Monitoring and Assessment*
    - *Grand Marais Creek Watershed Biotic Stressor Identification*
    - *Grand Marais Creek Watershed Total Maximum Daily Load*
    - *Geomorphic and Hydrologic Influences on TMDL impairments in the Grand Marais Creek Watershed (AUID 09020306)*

Scope

- Impacts to aquatic recreation and impacts to aquatic life in streams
- Impacts to aquatic recreation in lakes

Audience

- Local working groups (local governments, including SWCDs, watershed districts, etc.)
- State agencies (MPCA, DNR, BWSR, etc.)

1. Watershed Background & Description

The Grand Marais Creek Watershed (Figure 1-1) is located in northwest Minnesota within Marshall, Polk, and Pennington Counties. The watershed drains over 298,000 surface area acres (466 square miles) of land, and for the most part is very low gradient with a poorly defined floodplain. The majority of the area has been converted from tall-grass prairie to cropland over the last few hundred years (Figure 1-2). Today approximately 92% of the Grand Marais Creek Watershed is used for some form of crop production. Small towns including Fisher and Oslo make up about 5% of the watershed's land area. With such a large percentage of the land converted to row crop agriculture it is not surprising that soil loss from farm fields has long been a problem within the watershed. Soil is transported largely through field runoff, stream bank erosion, and wind erosion. Hydrological alteration of stream channels through ditching and destruction of the stream riparian zones exacerbates soil loss.

Major rivers and streams within this watershed include the Red River, Grand Marais Creek, Judicial Ditch (JD) 1, Polk County Ditch (CD) 2, and JD 75. The Red River forms the western border of the Grand Marais Creek Watershed in Minnesota. Grand Marais Creek begins about 1.5 miles NW of Fisher, and parallels the Red Lake River for approximately 41 miles prior to its confluence with the Red River. Along its route, it receives surface water from its tributaries, which are nearly all human-made ditches and/or reaches that have been channelized to increase the drainage rate. Flow of these tributaries is primarily west in direction, as they drain the agricultural land to the east and eventually transport the surface water to Grand Marais Creek. These tributaries include CD 2, CD 126, and several unnamed ditches. Some of the county ditches start out as natural streams within the Inter-beach Sand Bar agro-ecoregion, and transition to low gradient, channelized ditches as they enter the Lake Agassiz floodplain.

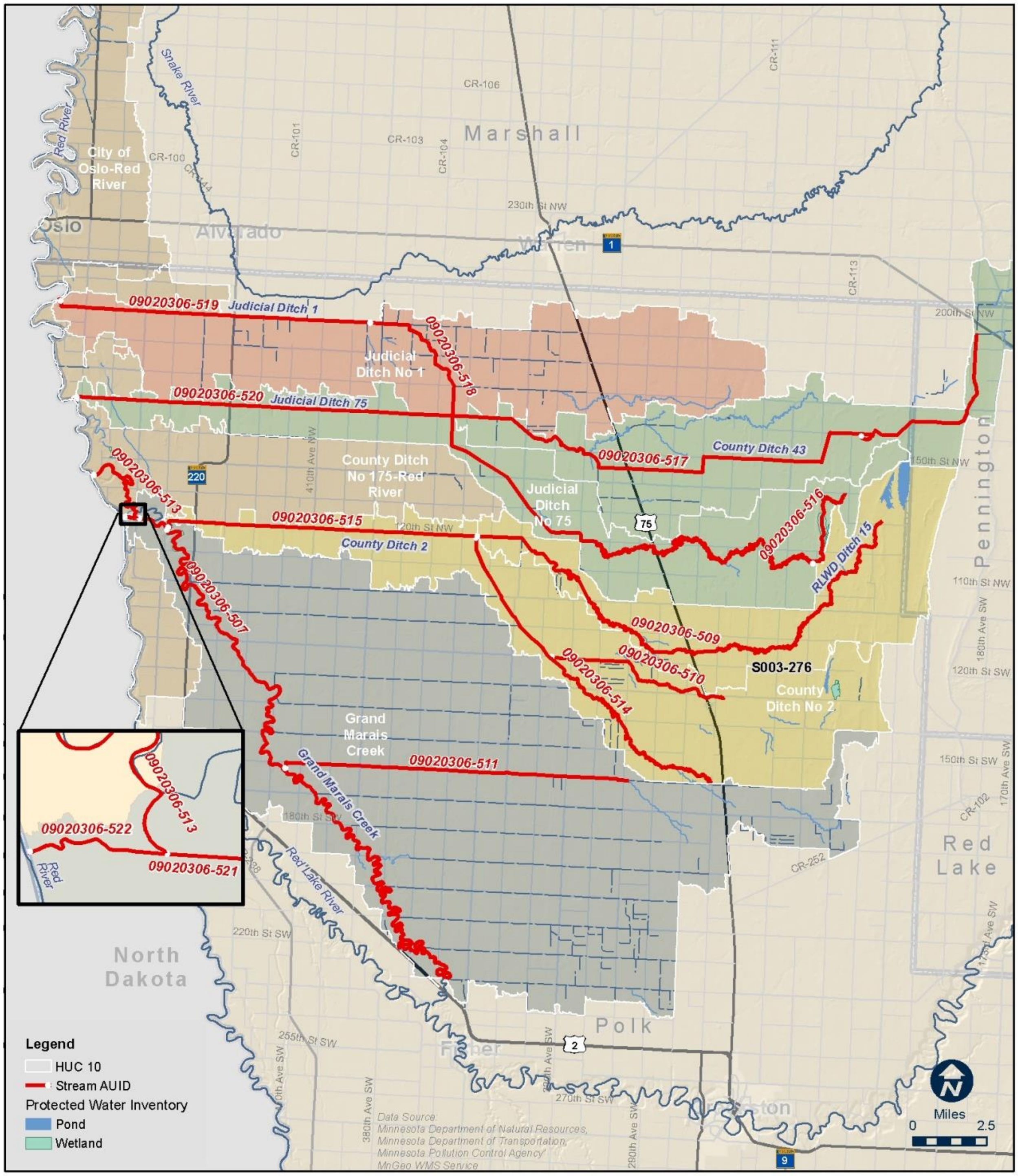


Figure 1-1. Grand Marais Creek Watershed.

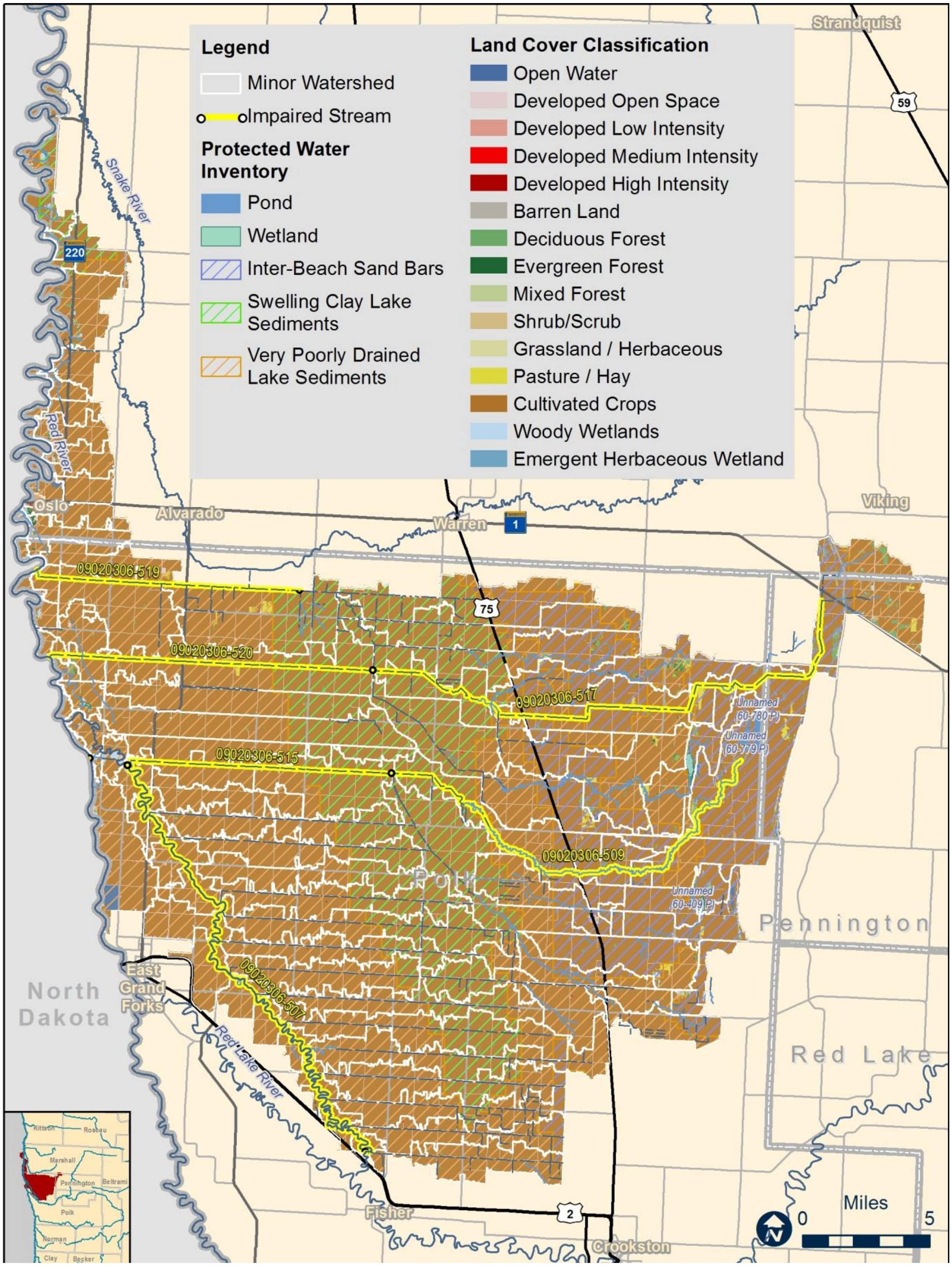


Figure 1-2. Land cover in the Grand Marais Creek Watershed (NLCD 2011)

Cultivated crops are the dominant land use and cover more than 91% of the watershed. The next largest land use is developed open space with 6.4% of the watershed area. Spring wheat, soybeans, corn, and sugar beets are the main crops grown in the watershed.

Some of the larger pools in the watershed are artificial impoundments including the Euclid, Parnell, and Brandt impoundments, which provide flood mitigation for downstream agricultural land. Several large wetland complexes exist that are important resources, as they provide wildlife habitat, flood storage, and water quality protection. Horseshoe Lake, an oxbow lake along the Red River of the North, is the only lake larger than 25 acres in the watershed, but it has not been monitored.

Artificial and altered natural watercourses are common in the Grand Marais Creek Watershed. Overall, 70% of the streams in the watershed have been channelized, ditched, or impounded. Between 1907 and 1909, the State and Polk County built State and Polk County Cooperative Ditch No. 2 to more effectually drain off the stagnant waters. This "cutoff channel" was the last legally established outlet for the Grand Marais River. The cutoff channel diverted nearly all Grand Marais River flow into a straight ditch that was approximately 1.25 miles long and essentially eliminated all but local runoff from more than 6 miles of natural channel. Recent water resources projects in the Grand Marais Creek Watershed have made great progress toward restoring natural hydrology. In 2015, the Red Lake Watershed District (RLWD), along with several state and local agencies completed a restoration project which restored flow to the historic stream channel (Figure 1-3). The cutoff channel (Figure 1-4) remains in place to convey local runoff and to divert excess flow during runoff events, but does not divert flow from Grand Marais Creek during normal flow events.

Figure 1-3. Aerial view of the completed Grand Marais Creek Outlet Restoration Project

Figure 1-4. Grand Marais Creek Cutoff Channel, looking upstream of County Road 64 before (left 2007) and after (right 2016) the Grand Marais Creek Cutoff Channel Stabilization Project.

Additional Grand Marais Creek Watershed Resources

USDA Natural Resources Conservation Service (NRCS) Rapid Watershed Assessment for the Grand Marais Creek Watershed: http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_022281.pdf

Minnesota Department of Natural Resources (DNR) Watershed Assessment Mapbook for the Grand Marais Creek Watershed.

2. Watershed Conditions

This section summarizes the current water quality of all streams in the watershed and identifies impaired waters, waters needing protection, point and nonpoint sources of pollution, pollutant load allocations, current loading, and needed reductions. Primary concerns are erosion of silty soils, artificial drainage alteration, and land uses dominated almost exclusively by cropland.

Monitoring programs like River Watch and the RLWD long-term monitoring program have regularly collected data in the Grand Marais Creek Watershed for many years. The County Ditch (CD) 2 Subwatershed was intensively sampled, starting in 2007, to evaluate the affect of newly constructed impoundments upon water quality. The MPCA Watershed Pollutant Load Monitoring Network has intensively sampled water quality near the pour point of the watershed. In 2012-2013, the MPCA conducted an Intensive Watershed Monitoring (IWM) sampling of the Grand Marais Creek Watershed. The intensive approach allows assessment of the watershed for aquatic life, aquatic recreation, and aquatic consumption use support of the state's streams in each of the state's 80 major watersheds on a rotating 10 year cycle. Biological communities (i.e. fish and macroinvertebrates), habitat, and water chemistry data were collected from streams and rivers and used to assess surface waters for aquatic life, aquatic recreation, and aquatic consumption. The IWM monitoring was completed by staff from the MPCA and Surface Water Assessment Grant (SWAG) project partners. No lakes in the Grand Marais Creek Watershed have been monitored or assessed.

Streams within the Grand Marais Creek Watershed have been severely altered through both ditching and tiling to better suit the agricultural land use. These alterations coupled with the fact that the area is naturally low gradient and not designed to transport water very quickly, have resulted in most streams being temporal and stagnant, with more wetland characteristics. All five reaches that were assessed for aquatic life use were found to be impaired (i.e. not meeting water quality standards) in some way. Three of the five reaches that were assessed for aquatic recreation are now designated as impaired because they exceeded state standards for *Escherichia Coli* (*E. coli*) bacteria.

2.1 Condition Status

This section summarizes impairment assessments for streams in the Grand Marais Creek Watershed at the HUC 10 subwatershed scale. Waters that are not listed as impaired will be subject to protection efforts (See Section 2.5 and 3.3). Some of the waterbodies in the Grand Marais Creek Watershed are impaired by mercury; however, this report does not cover toxic pollutants. For more information on mercury impairments, see the statewide mercury TMDL at: http://www.pca.state.mn.us/index.php/water/water-types-and-programs/minnesotas-impaired-waters-and-tmdls/tmdl-projects/special-projects/statewide-mercury-tmdl-pollutant-reduction-plan.html.

Water quality monitoring within the watershed has been occurring since the 1980s. Since 2003, at least 13 water quality monitoring stations have been established across nine stream reaches in the watershed through the joint and independent efforts of: the MPCA, RLWD, International Water Institute, River Watch, and Marshall County through programs like the Red River Basin Condition Monitoring Network, the RLWD long-term monitoring program, and SWAG grants. As part of a statewide effort launched by the MPCA to intensively monitor watersheds, efforts began in 2012 to collect additional data and investigate impairments within the Grand Marais Creek Watershed. In 2012, the MPCA sampled seven sites for fish and macroinvertebrates along four separate reaches, including one location on the cutoff channel portion of Grand Marais Creek, two county ditches, and one judicial ditch.

Not all waterbodies are monitored for the purpose of aquatic life or recreation assessment, and not all waterbodies have sufficient data for assessment. Local monitoring programs, for example, have limited resources. These monitoring efforts have focused on the pour points (outlets) of the watershed and large drainage systems like CD 2, JD 1, and JD 75. Less priority has been given to condition monitoring on ephemeral artificial watercourses. Furthermore, many sites were unable to be sampled in 2012 during the MPCA IWM effort due to lack of flow in the streams. Some of the watercourses in the northern portion of this HUC (JD 1, JD 75, and CD 43) have less data than sites along Grand Marais Creek and CD 2 because they do not lie within the jurisdiction of a local agency that has a long-term water quality monitoring program.

Rivers, streams, and ditches were most recently, formally assessed within the Grand Marais Creek HUC8 Major Watershed for the 2014 water quality assessment. Water quality data from 2004 through 2013 and some 2014 data were used for the assessment. The water quality assessment results, including impaired waters, are shown in Table 2-1, and the impaired waters are mapped in Figure 2-1. More detailed information about the most recent water quality assessment results can be found in the Grand Marais Creek Watershed Monitoring and Assessment Report at: https://www.pca.state.mn.us/sites/default/files/wq-ws3-09020306b.pdf.

Streams

Aquatic life use impairments include:

- **Low fish index of biotic integrity (F-IBI),** which means a fish community with undesirable species, low numbers of individuals, or lacking important species
- **Low macroinvertebrate index of biotic integrity (M-IBI),** which means a macroinvertebrate community with undesirable species, low numbers of individuals, or lacking important species
- **Low Dissolved oxygen (DO)** levels (<5 mg/l) that insufficiently or do not support aquatic life
- **High Turbidity/total suspended solids (TSS)** levels that do not support aquatic life

Aquatic recreation use impairments include *E. coli* (a bacterial indicator of fecal pollution) levels that are too high for safe human contact (wading or swimming).

The insecticide chlorpyrifos (trade name Lorsban and others) was discovered in the cutoff channel prior to completion of the Grand Marais Creek Outlet Restoration Project. Although the cutoff channel (formerly AUID 09020306-512, now AUID 09020306-522) is not currently assessed for conventional water chemistry parameters, the chlorpyrifos impairment will remain for the cutoff channel, as the pesticides could have originated from the watershed upstream of the cutoff channel.

Completion of this report in late 2018 provides an opportunity to briefly report on recent changes in water quality that have been identified by ongoing monitoring efforts. Regular monitoring has continued in the Grand Marais Creek Watershed since the 2014 water quality assessment. Regular water quality sampling at S002-126 on the 09020306-522 cutoff channel reach ceased after 2016. The RLWD began monitoring a new reach, 09020306-513, to characterize water quality within the restored outlet channel and the pour point of the watershed. As of 2018, there was insufficient data to assess that reach. Early results show that low DO, high TSS, high total phosphorus (TP), and high *E. coli* concentrations have all been documented at Station S008-904 on Assessment Unit (AUID) 09020306-513. Enough high *E. coli* concentrations have been recorded in October along AUID 09020306-507 of Grand Marais Creek to exceed the 126 org/100mL standard, with a 175 org/100mL geometric mean in 2008-2017 data. The July *E. coli* geometric mean for AUID 09020306-507 on Grand Marais Creek is approaching the standard in 2008-2017 data (123 org/100mL).

A significant data gap for this WRAPS was a lack of continuous DO data from the watershed. Continuous DO loggers were deployed by the RLWD in 2017 and 2018 in AUIDs 09020306-507 and 09020306-513 of Grand Marais Creek and AUID 09020306-515 of CD 2. The data from those deployments will be submitted to the MPCA to inform the 2024 assessment process. Continuous DO data from Grand Marais Creek has revealed that low flows in the late summer have led to frequently low DO levels. The DO levels in CD 2 were all above 5 mg/L while water was flowing in 2017. Stage and flow monitoring will be conducted so that data can be filtered to exclude no-flow conditions during the 2024 assessment.

Table 2-1. Assessment status of stream reaches in the Grand Marais Creek Watershed.

AUID	Stream Name Description	Aquatic Life							Aq. Rec.
		Fish Index of Biotic Integrity	Macroinvertebrate Index of Biotic Integrity	Dissolved Oxygen	Turbidity/TSS	Chloride	pH	Ammonia	*E. coli* (Bacteria)
09020306-507	**Grand Marais Creek** Headwaters to CD 2	--	--	IMP	SUP	--	SUP	SUP	SUP
09020306-509	**Unnamed Creek (RLWD 15)** Headwaters to CD 66	--	--	IMP	SUP	--	--	--	--
09020306-513	**Grand Marais Creek Restoration** CD 2 to Red River	--	--	--	--	--	--	--	--
09020306-515	**County Ditch 2** CD 66 to Grand Marais Creek	IMP	IMP	SUP	SUP	SUP	IF	SUP	IMP
09020306-517	**County Ditch 43** Unnamed Ditch to CD 7	IMP	IMP	IF	--	--	IF	--	--
09020306-519	**Judicial Ditch 1** County Ditch 7 to Red River	--	--	SUP	IF	SUP	SUP	SUP	IMP
09020306-520	**Judicial Ditch 75** CD 7 to Red River	IMP	SUP	SUP	SUP	SUP	SUP	SUP	IMP
09020306-522	**Grand Marais Creek Cutoff Channel** Grand Marais Crk to Red R	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

SUP = fully supporting; IMP = Impaired, not supporting; IF = insufficient data to assess; -- = no monitoring data
n/a = not assessed

Figure 2-1. Stream impairments in the Grand Marais Creek Watershed

2.2 Water Quality Trends

Stream and lake sampling locations with long term datasets (minimum of 10 years) are needed to confidently establish a numerical trend. The only stations in the watershed with at least 10 years of data are located at the Grand Marais Creek pour point (MPCA station S002-126 on the cutoff channel and S008-904 on the restored outlet), and Polk CD 2 at CR 62 (MPCA station S004-131).

Historically, the majority of Grand Marais Creek and CD 2 flows were diverted to the Red River via the cutoff channel. A significant amount of monitoring data has been collected at the CR 64 crossing (MPCA station S002-126) of the cutoff channel to characterize water quality conditions at the pour point (outlet) of the watershed. Flow was restored to the natural channel by the Grand Marais Creek Outlet Restoration Project in 2015. The cutoff channel only receives water from the natural channel of Grand Marais Creek during high flow events and is no longer formally assessed for aquatic life. Regular sampling at the new pour point crossing (S008-904) on the restored outlet channel (AUID 09020306-513) began in 2016.

At the Grand Marais Creek pour point, there are strong improving trends in the annual average concentration of TSS and pH, an improving trend in the annual average concentration of TP, and a declining trend (getting worse) in the annual average concentration of DO. The 2016 average TSS concentration (39.6 mg/L) was the lowest annual average recorded at the pour point of the watershed for years with multiple sampling events. The 2016 maximum concentration was still high at 239 mg/L, but much lower than the >1,000 mg/L concentrations that have been recorded in the past. The cutoff channel was a diversion ditch built in the early 1900s as a State and County drainage project. This cutoff channel diverted water from the natural six-mile meandering outlet, which flows to the northwest. Since the construction of the cutoff channel, the area had seen increased erosion with estimates from the channel alone approaching 700 tons of sediment annually. The Grand Marais Creek Outlet Restoration Project (RLWD Project 60F) has recently been completed, to restore the abandoned six-mile stretch of natural meandering outlet. This project likely is contributing to the improving (decreasing) trends in TSS and TP at the outlet. The unstable banks along the cutoff channel likely contributed to the high TSS concentrations that were recorded at S002-126. In addition, load monitoring at S002-126 focused on runoff events, which may have resulted in a bias toward higher concentrations of pollutants.

The only observed trend on CD 2 at CR 62 (S004-131) was an increase (getting worse) in the annual maximum TP concentration. This same trend was not detected for the annual average TP concentration of all months. Monitoring should continue at this site to determine whether this trend continues or becomes stronger.

Table 2-2. Seasonal Water Quality Trends from Seasonal Mann-Kendall Analysis for the Grand Marais Creek Pour Point

Seasonal Water Quality Trends from Seasonal Mann-Kendall Analysis				
Grand Marais Creek Pour Point (S002-126, S008-904)	**Total Suspended Solids**	**Dissolved Oxygen**	**pH**	**Total Phosphorus**
Years	2003-2016	2003-2016	2003-2016	2003-2016
Annual Avg (All Months)	↓+	↓ (red)	↓+	↓
Annual Max (All Months)	X	X	↓	↓
Annual Min (All Months)	X	X	X	X
May - September Avg.	X	X	↓	X
April	↓	X	↓	X
May	↓+	X	X	↓
June	↓	X	X	↓
July	X	X	X	X
August	Data <10	Data <10	Data <10	Data <10
September	Data <10	Data <10	Data <10	Data <10
October	Data <10	Data <10	Data <10	Data <10

X = No Trend

Data <10 = There are fewer than 10 data points - not analyzed.

↓ (red) = Downward Trend (Getting Worse)

↓ = Downward Trend (Improvement)

↓+ = Strong Downward Trend (Getting Significantly Better)

Table 2-3. Seasonal Water Quality Trends from Seasonal Mann-Kendall Analysis for Polk County Ditch 2 at County Road 62

Seasonal Water Quality Trends from Seasonal Mann-Kendall Analysis				
Polk County Ditch 2 at CR 62 (S004-131)	**Total Suspended Solids**	**Dissolved Oxygen**	**Total Phosphorus**	***E. coli***
Years	2006-2016	2006-2016	2006-2016	2008-2016
Annual Avg (All Months)	X	X	X	Data <10
Annual Max (All Months)	X	X	↑ (red)	Data <10
Annual Min (All Months)	X	X	X	Data <10
May - September Avg.	X	X	X	Data <10
April	Data <10	Data <10	Data <10	Data <10
May	X	X	X	Data <10
June	X	X	X	Data <10
July	Data <10	Data <10	Data <10	Data <10
August	Data <10	Data <10	Data <10	Data <10
September	Data <10	Data <10	Data <10	Data <10
October	Data <10	Data <10	Data <10	Data <10

X = No Trend

Data <10 = There are fewer than 10 data points - not analyzed.

↑ (red) = Upward Trend (Getting Worse)

2.3 Stressors and Sources

To develop appropriate strategies for restoring or protecting waterbodies, the stressors and/or sources impacting or threatening them must be identified and evaluated. Biological stressor identification is done for streams with either fish or macroinvertebrate biota impairments, and encompasses both evaluation of pollutants and non-pollutant-related factors as potential stressors. Pollutant source assessments are done where a biological stressor ID process identifies a pollutant as a stressor, as well as for the typical pollutant impairment listings. Section 3 provides further detail on stressors and pollutant sources. Stressor identification is a key component of the major watershed restoration and protection projects being carried out under Minnesota's Clean Water Legacy Act. For more details on the Grand Marais Creek Watershed stressors and the process used to identify the stressors causing the biological impairments, please consult the 2015 Grand Marais Creek Watershed Stressor Identification Report. This report summarizes five candidate causes that were evaluated in each of the subwatersheds.

Stressors of Biologically-Impaired Stream Reaches

A stressor identification study was conducted to identify the factors (i.e., stressors) that are causing the fish and macroinvertebrate community impairments in the Grand Marais Creek Watershed. The primary stressor identified in all three streams with aquatic life impairments in the Grand Marais Creek Watershed was a lack of base flow, particularly in late summer.

Table 2-4. Stressors to aquatic life in biologically-impaired reaches in the Grand Marais Creek Watershed

AUID	Stream Name Description	Biological Impairment	Primary Stressor				
			Loss of Physical Connectivity	Lack of Base Flow	Lack of instream habitat	High Suspended Sediment	Low Dissolved Oxygen
09020306-515	**County Ditch 2** CD66 to Grand Marais Creek	F-IBI	●	●	●		○
		M-IBI		●		○	○
09020306-517	**County Ditch 43** Unnamed Ditch to County Ditch 7	F-IBI	●	●	●	○	○
		M-IBI		●		○	○
09020306-520	**Judicial Ditch 75** CD 7 to Red River	Fish	●	●	●		○

● = Primary stressor; ○ = Secondary stressor; *Source: 2015 Grand Marais Creek Watershed Stressor ID Report*

The lack of base flow (stagnant water) during these late-summer periods also makes these reaches prone to periods of low DO. Additional stressors include a lack of in-stream habitat within channelized, trapezoidal ditch channels that flow through an extremely flat setting (glacial lake plain). High TSS loads derived from the predominately agricultural landscape are a contributing factor to the macroinvertebrate impairments, while a loss of physical connectivity due to the presence of improperly sized or designed culverts and other water control structures is a contributing factor to the fish impairment in some cases. Because the stressor identification report identified excess sediment as a stressor, the state should confer with local resource managers and experts to review the TSS standard assignments in the Grand Marais Creek Watershed prior to the 2024 assessment. Long-term sampling efforts are needed to more accurately characterize sediment concentrations in the biologically impaired reach CD 43.

Pollutant sources

This section summarizes the sources of pollutants (such as TP, bacteria or TSS) in the Grand Marais Creek Watershed. There are no point sources (such as sewage treatment plants) that discharge directly to streams in the watershed. Therefore, all the known sources of pollution in Grand Marais Creek are nonpoint sources. Runoff from the landscape and in-channel processes contribute to the TSS, *E. coli,* and nutrient concentrations that have been documented in streams and ditches within this watershed.

Nonpoint Sources

Nonpoint sources of pollution, unlike pollution from industrial and sewage treatment plants come from many diffuse sources. Nonpoint source pollution is caused by rainfall or snowmelt moving over and through the ground. As the runoff moves, it picks up and carries away natural and human-made pollutants, finally depositing them into lakes and streams. Nonpoint sources of sediment, nutrient, and fecal pollution are listed below. Table 2-5 shows the relative impact of *E. coli* sources that were identified in the Grand Marais Creek TMDL.

- **Upland soil erosion**: Soil erosion delivers sediment and nutrients to lakes and streams. Previous studies have shown that field erosion is a dominant source of TSS in small streams in portions of the Red River Basin (EOR 2009 and Lauer et al. 2006). A geomorphic study conducted in the watershed in 2014 identified gully erosion as a likely pathway of sediment transport to small streams and ditches in the watershed (EOR 2014). Gullies have concentrated flow occurring in a narrow channel that often originates in farm fields. Wind erosion (Figure 2-2) is another dominant source of sediment to streams. Removal of tree rows has exacerbated wind erosion and public safety issues during winter storms (more blowing snow, reduced visibility).

- **Artificial drainage and stream morphometry:** An increase in artificial drainage combined with stream channelization can lead to streambank instability, reduced base flow, and longer periods of intermittent flow.

- **Poor vegetative cover:** Soils without good vegetation cover can erode and deliver sediment containing TSS and TP to lakes, wetlands, and streams. Vegetative buffers, which can improve soil stability along streambanks and floodplains, are lacking or insufficient in much of the Grand Marais Creek Watershed.

- **Fertilizer runoff**: Fertilizer contains high concentrations of phosphorus, nitrogen, and bacteria (in manure) that can runoff into lakes and streams when not properly managed.

- **Livestock in riparian areas**: Livestock activity can destabilize and/or erode streambanks and deliver sediment containing TSS, bacteria, and TP to the stream.

- **Failing septic systems**: Septic systems that are not maintained or failing near a lake or stream can contribute excess TP, nitrogen, and bacteria.
- **Wildlife fecal runoff**: Dense or localized populations of wildlife, such as beaver, geese, or bridge-dwelling cliff swallows can contribute TP and bacteria pollutants to streams or ponds.

Table 2-5. Relative magnitude of nonpoint sources of bacteria to impaired streams in the Grand Marais Creek Watershed

AUID	Stream Name Description	Pollutant	Pollutant Sources						
			Artificial drainage & stream morphology	Fertilizer & manure run-off	Livestock over-grazing in riparian	Failing septic systems	Poor riparian vegetation cover	Upland soil erosion	Wildlife
09020306-515	**County Ditch 2** CD66 to Grand Marais Crk	*E. coli*	○	◉	○		○	○	●
09020306-519	**Judicial Ditch 1** County Ditch 7 to Red R	*E. coli*	○	◉			○	○	●
09020306-520	**Judicial Ditch 75** CD 7 to Red River	*E. coli*	○	◉	○	○	○	○	●

Key: ● = High ◉ = Moderate ○ = Low

Figure 2-2. Muddy spring runoff from CD 32 into Grand Marais Creek (left) and sediment deposition in a ditch from wind erosion (right)

2.4 TMDL Summary

A TMDL is a calculation of how much pollutant a lake or watercourse can receive before it does not allow recreational uses or support aquatic life. TMDL studies are required by the Clean Water Act for all impaired waters that fail to meet water quality standards during a formal assessment. Three *E. coli* impairments were found during the 2014 assessment and are addressed with TMDLs that calculate limits for *E. coli* bacteria pollution. Table 2-6 summarizes the individual bacteria TMDL wasteload/load allocations and the reductions needed to meet water quality standards for each impaired reach.

Grand Marais Creek currently meets state TSS standards and the turbidity impairment has been proposed for removal from the list of impaired waters. Biological and DO impairments can sometimes be linked back to a pollutant like TP, but those links were not identifiable for six reaches in the Grand Marais Creek's Watershed. Non-pollutant stressors of biology and DO are described in Section 2.3. Restoration of DO and biological impairments will require strategies other than pollutant reduction. A list of the aquatic life use impairments not addressed by TMDL calculations in this report are provided in Table 2-7. These impairments will be addressed through restoration strategies identified in Section 3.3.

Table 2-6. Allocation summary for completed stream *E. coli* TMDLs in the Grand Marais Creek Watershed

Stream/ Reach (AUID)	Pollutant	Flow Zone	Allocations (*E. coli* in billions organisms/day)					Monthly Load Reduction Needed to Achieve 126 org/100 mL*	
			Wasteload Allocation		Load Allocation		Margin of Safety		
			WWTPs	Regulated Stormwater	Upstream Outflow	Watershed Runoff			
County Ditch 2, CD66 to Grand Marais Creek (09020306-515)	*E. coli*	Very High	--	--	--	358.1	39.8	July (32%)	August (54%)
		High	--	--	--	48.2	5.4		
		Mid	--	--	--	8.6	0.9		
		Low	--	--	--	2.1	0.2		
		Very Low	--	--	--	0.18	0.02		
Judicial Ditch 1 (09020306-519)	*E. coli*	Very High	--	--	--	341.4	37.9	July (22%)	
		High	--	--	--	28.5	3.2		
		Mid	--	--	--	5.7	0.6		
		Low	--	--	--	1.6	0.2		
		Very Low	--	--	--	0.1	0.0		
Judicial Ditch 75, CD7 to Red River (09020306-520)	*E. coli*	Very High	--	--	--	405.9	45.1	June (5%)	July (25%)
		High	--	--	--	60.5	6.7		
		Mid	--	--	--	8.0	0.9		
		Low	--	--	--	1.7	0.2		
		Very Low	--	--	--	0.09	0.01		

* Paired flow data (observed or modeled) were available for only a limited number of water quality samples; therefore, estimated reductions were based on the observed geometric mean *E. coli* concentration for each impaired reach.

Table 2-7. Grand Marais Creek Watershed aquatic life use impairments not addressed by TMDLs

<table>
<tr><th colspan="2">Rationale for Aquatic Life Use Impairments Not Addressed by TMDLs</th></tr>
<tr><th>AUID/ Waterbody Name/
Listed Pollutant or Stressor</th><th>Reason</th></tr>
<tr><td>09020306-507

Grand Marais Creek, Headwaters to CD2

Dissolved Oxygen</td><td>Dissolved Oxygen: Low DO in Grand Marais Creek was primarily caused by late-summer low flow and stagnant conditions that were exacerbated by altered hydrology. Low and stagnant flows are a result of the formation of headwater oxbow wetlands from the historic alteration of flow from Red Lake River away from the Grand Marais Creek channel, flashy ditch systems in the watershed, and ponding upstream of road crossings. The headwaters portion of Grand Marais Creek channel is essentially a chain of wetlands with little contributing flow. Low DO conditions are also likely exacerbated by warm temperatures in the mid to late summer.</td></tr>
<tr><td>09020306-507

Grand Marais Creek, Headwaters to CD2

Turbidity</td><td>Turbidity: The aquatic life impairment due to excess turbidity in this reach of Grand Marais Creek was first listed in 2006. Water quality data no longer support an impairment listing for TSS under the new water quality standards. The turbidity impairment will be removed from the 303(d) list during the next assessment cycle.</td></tr>
<tr><td>09020306-509

RLWD Ditch 15, Headwaters to CD66

Dissolved Oxygen</td><td>The primary cause of low DO in RLWD Ditch 15 was altered hydrology, which results in low flow and stagnant conditions in late summer months. Low and stagnant flows are a result of the flashy, flat ditch systems in the watershed with low base flow and ponded water. Low DO levels are also likely exacerbated by warm temperatures in the mid-to-late summer.</td></tr>
<tr><td>09020306-515

CD 2, CD 66 to Grand Marais Creek

Fish & Macroinvertebrate Bioassessments</td><td>Available evidence convincingly supports lack of base flow as a stressor, and strongly supports loss of physical connectivity (for fish) and lack of instream habitat as stressors. TSS and sediment affect aquatic life to some extent, but the streams meet the State’s TSS standard. And since flow has no mass-based pollutant load surrogate that can be regulated by a TMDL, it is recommended that this stressor be addressed in the following ways:
Prevent or mitigate activities that further alter watershed hydrology.
Consider opportunities and options to reduce peak flows and increase base flows throughout the watershed.
Incorporate the principles of natural channel design into stream restoration and ditch maintenance activities.
Increase quantity/quality of instream habitat throughout the watershed.
Establish and/or protect riparian corridors along all waterways, including ditches, using native vegetation whenever possible.
Remove or retrofit physical connectivity barriers to enable fish passage at a greater range of flow conditions.
Conduct an inventory of culverts that are limiting fish passage.
Set local goals for further reduction of sediment concentrations</td></tr>
</table>

2.5 Protection Considerations

This section provides a short description of the major water quality concerns in the Grand Marais Creek Watershed that were developed based on input from local partners and the public. Protection strategies were identified in Section 3.3 for each of the specific areas and/or water resources listed below.

Minnesota Prairie Conservation Plan

The 2017 Red Lake River One Watershed One Plan (1W1P) includes measurable goals related to terrestrial habitat improvements from the DNR 2011 Minnesota Prairie Conservation Plan. Opportunities for restoration of prairie areas were identified in this plan through a 25-year strategy. The plan identifies three approaches to conservation:

1. Core areas and complexes with a high concentration of native prairie, other grasslands, and wetlands:
    - Work to ensure a minimum of 40% grassland and 20% wetland with the remainder in cropland or other uses.
2. Habitat corridor connecting core areas that include grassland/wetland assemblages of nine square miles in size at six-mile intervals along and within the corridors:
    - A goal of 40% grassland and 20% wetland was set within the corridor complexes
    - For the remainder of the corridors, 10% of each legal land section is to be maintained in permanent perennial cover.
3. Remainder of the Prairie Region:
    - A goal to maintain 10% of each Land Type Association in perennial native vegetation was established.

Prairie Plan Zones within the Grand Marais Creek Watershed from Figure 4-5 of the 2017 Red Lake River 1W1P are shown in Figure 2-4.

Lakes of Biological Significance

The DNR conducted a statewide analysis of lakes of biological significance in 2015 based on dedicated biological sampling. All lakes were rated and grouped into three biological significance classes. Two unnamed lakes located within the Pembina Wildlife Management Area (WMA) in the Grand Marais Creek Watershed were analyzed for biological significance, one of which was classified as having a high ranking (Figure 2-5). Lakes with high biological significance displayed one or more of the following characteristics:

- Two of the following: high aquatic plant richness, high floristic quality (ecological integrity based on its plant species composition), or a population of an endangered or threatened plant species or;
- populations of more than one fish species of special concern and/or Species of Greatest Conservation Need or;

- one or more of the following: colonial water bird nesting area, history of endangered or threatened colonial water bird nesting, presence of endangered, threatened, or special concern lake bird species, or five lake bird Species of Greatest Conservation Need.

The lakes of biological significance located within the WMA were rated high and moderate under the water bird criteria. They are classified as freshwater emergent and freshwater forested/shrub wetlands with smaller areas classified as freshwater ponds in the U.S. Fish and Wildlife Service National Wetlands Inventory (NWI).

Wildlife Management Areas

Four WMAs exist within the watershed, including a portion of the Pembina WMA in section 12 Brandt Township, Polk County, which encompasses almost 4,000 acres of open terrain consisting of wet prairie, sedge meadow, brush thickets, open waters, and scattered groves of Aspen (Figure 2-6). These WMAs are open to the public and provide excellent recreational opportunities including hunting, trapping, wildlife viewing, hiking, and nature photography while also providing water quality benefits. Conservation easements located on lands adjacent to these WMA s will benefit both wildlife and water quality.

The Pembina WMA in Section 12 of Brandt Township in Polk County has not been adequately draining for approximately eight years (since 2009). Water has been backing onto upstream farmland (see Figure 2-3) and caused a reduction in rentable acres and income. Improving the ability to drain the excess water from the WMA will likely be needed in order to gain public buy-in for a larger grass corridor. Drainage of the WMA must consider and address accompanying sediment discharge issues.

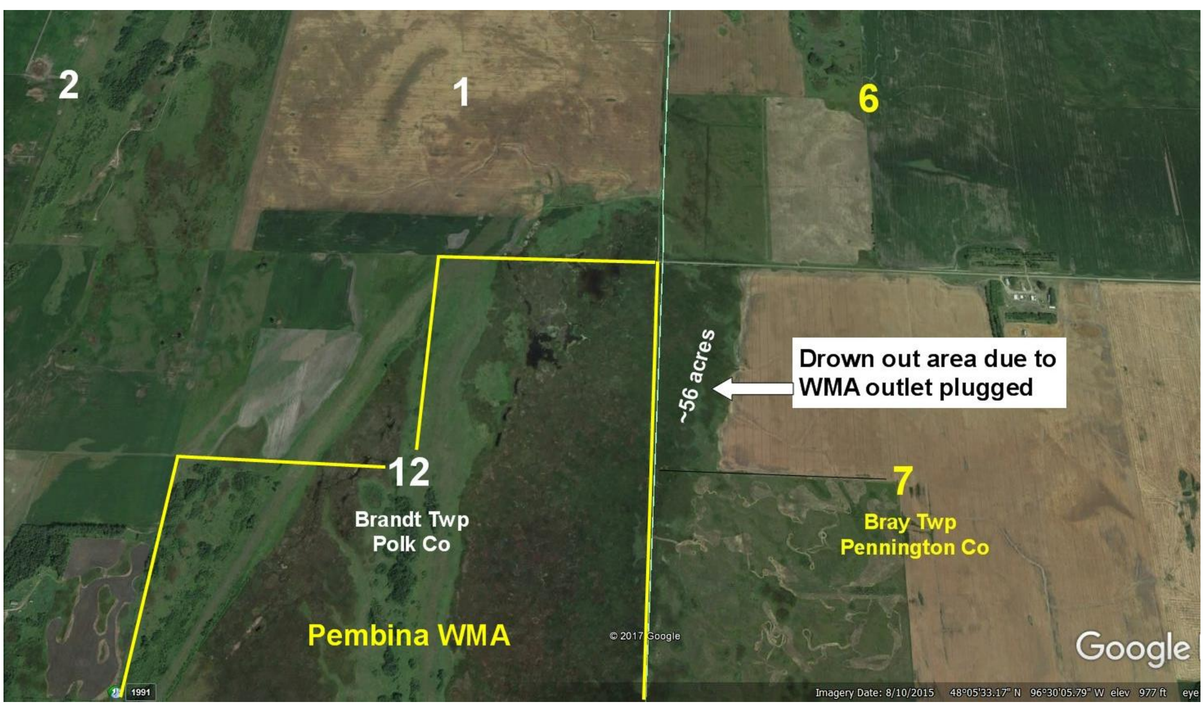


Figure 2-3. Aerial photograph illustrating improper drainage in the Pembina WMA (Google Earth imagery, 8/10/2015)

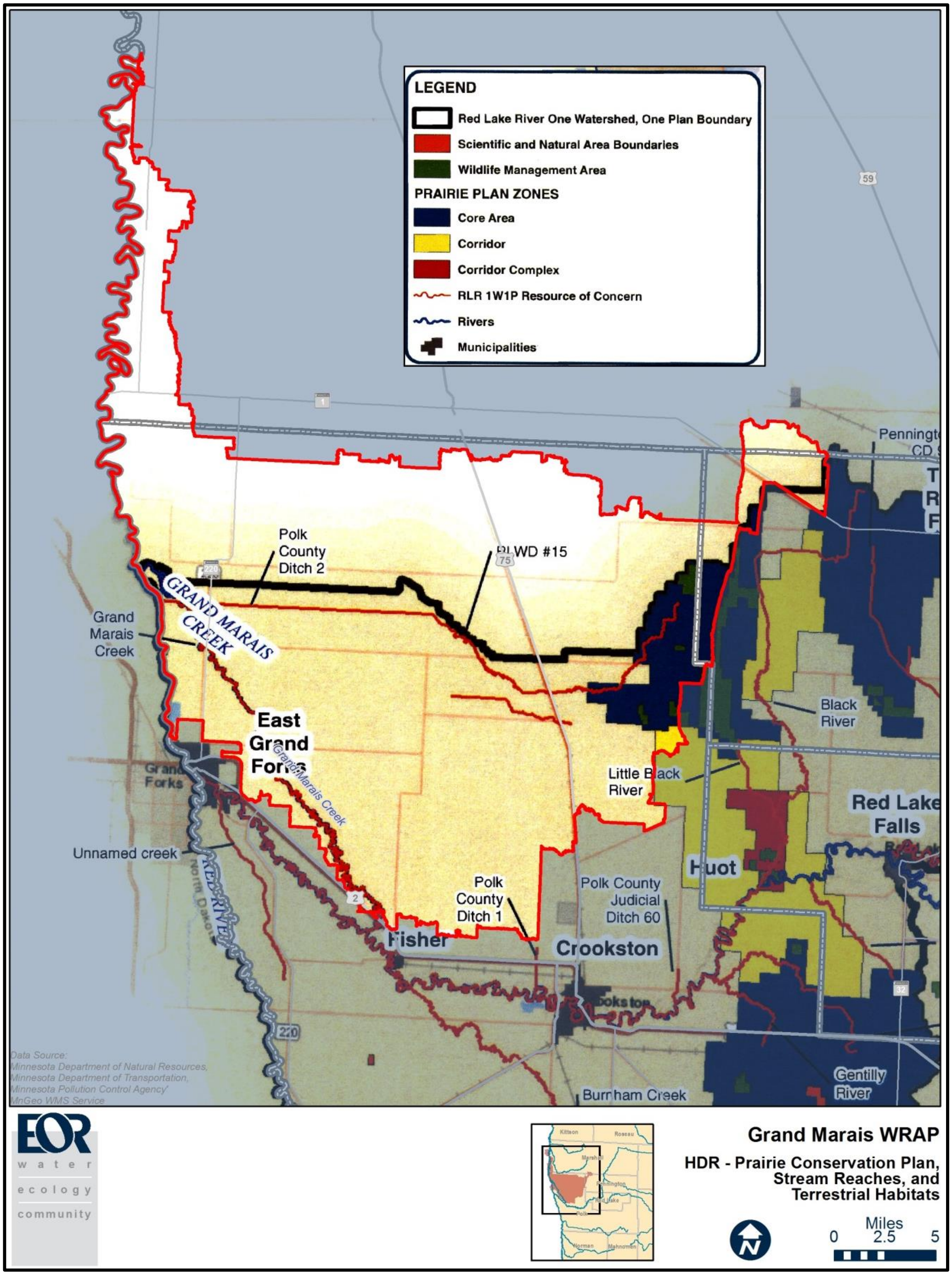


Figure 2-4. Prairie Conservation Plan Zones in the Grand Marais Creek Watershed (Figure 4-5 from the June 2016 Draft Red Lake River 1W1P)

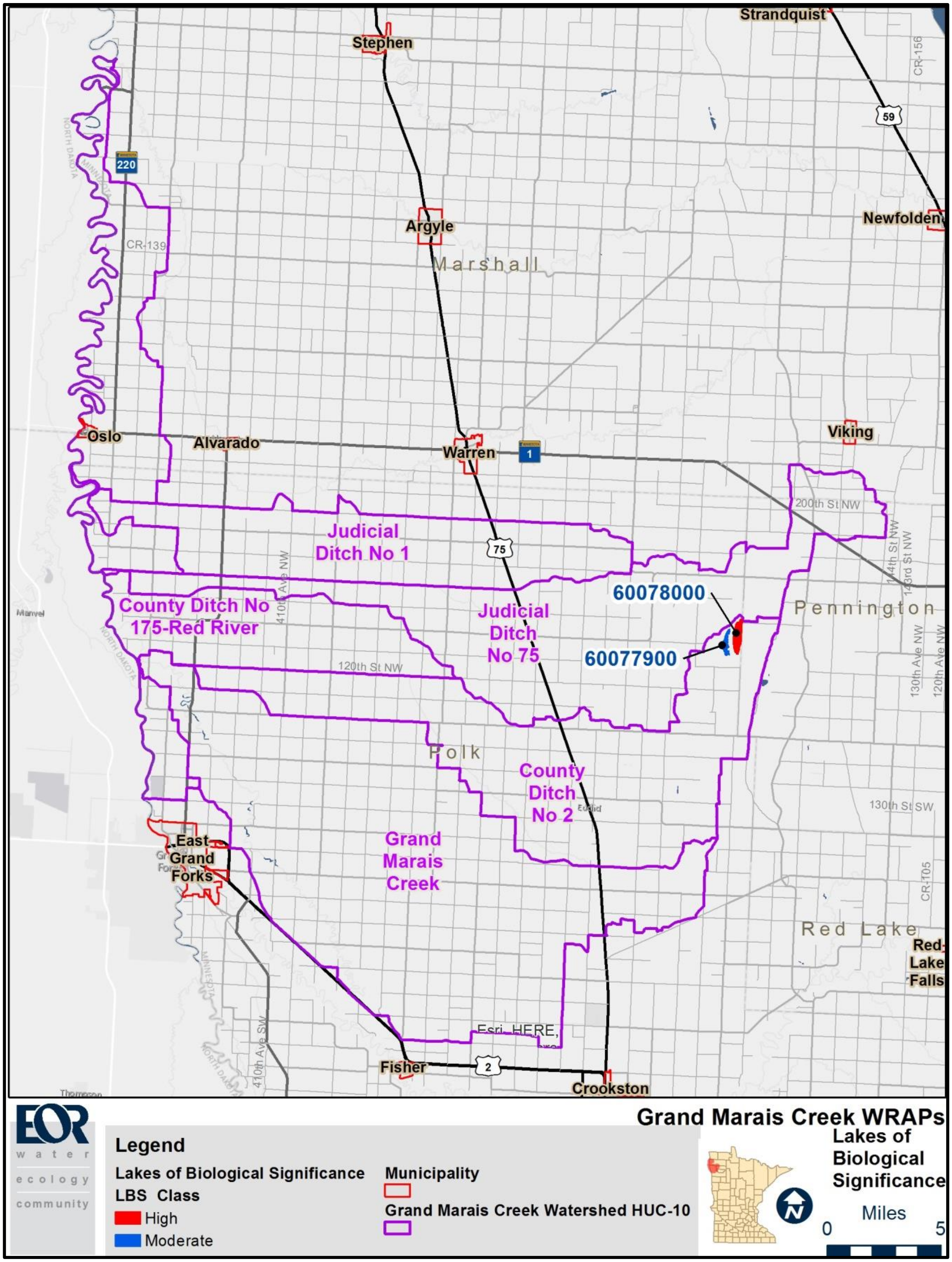


Figure 2-5. Grand Marais Creek Watershed Lakes of Biological Significance.

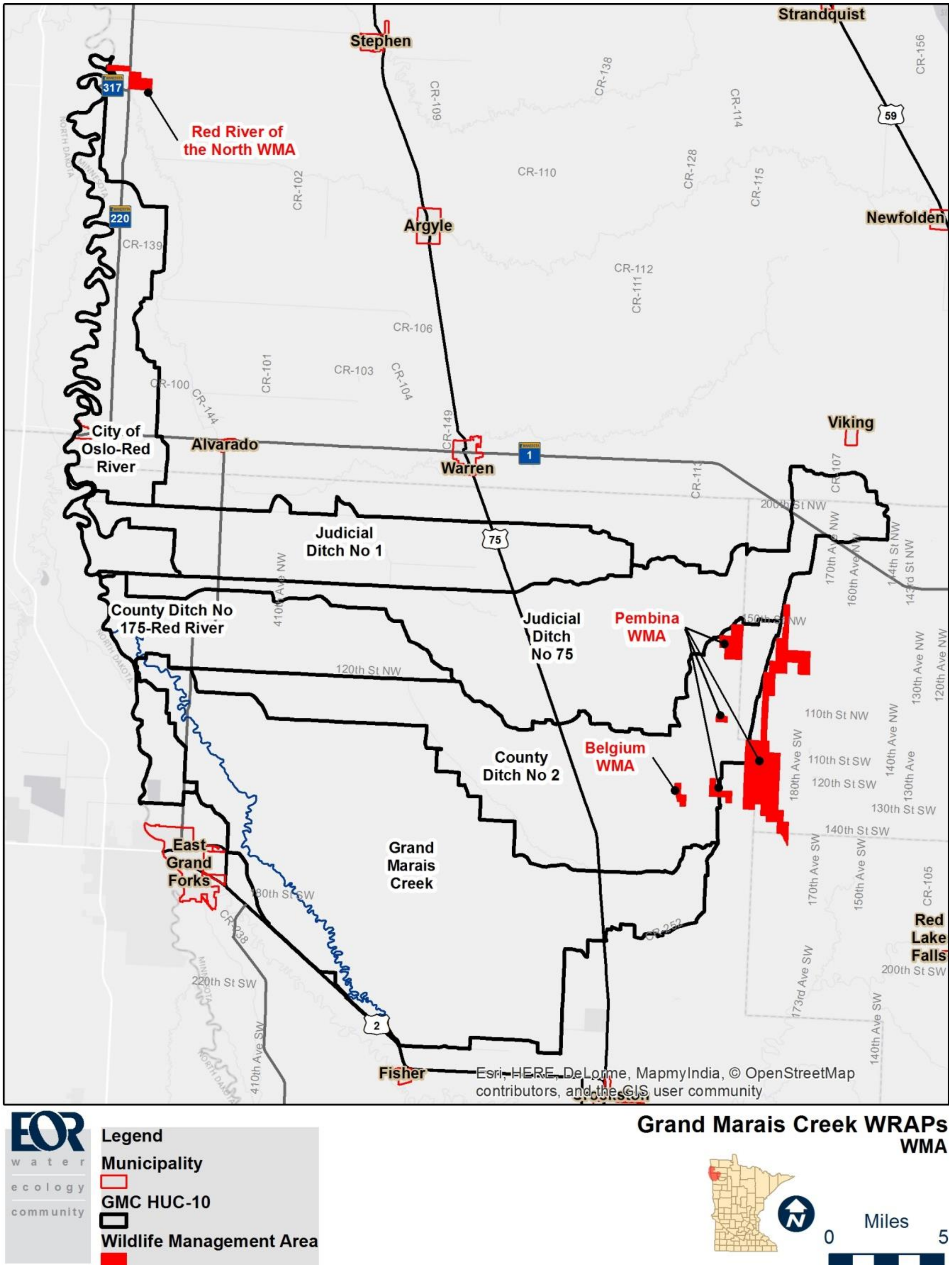


Figure 2-6. Wildlife Management Areas within the Grand Marais Creek Watershed.

Proximity to Water Quality Standards

In order to highlight and prioritize waters that are most in need of protection for each of the major parameters (DO, TP, TSS, and *E. coli*), assessment metrics (exceedance rate, summer average, and geometric mean) are compared to impairment thresholds in Table 2-9 through Table 2-12. Streams are ranked according to the proximity of their current (2005 through 2014) condition to the impairment threshold. Streams with TSS exceedance rates in the high single-digits (i.e., within ± 10% of the impairment threshold), for example, need protection efforts so that they don't exceed the impairment threshold in future assessments. For example, a reach that is exceeding the TSS standard in 8.1% of samples is within two percentage points of becoming impaired. There are reaches of CD 2 and CD 43 where sediment may be negatively affecting macroinvertebrates and fish and sediment reductions would be recommended despite the lack of a TSS impairment. Those reaches would likely be a high priority for protection efforts. Streams that greatly exceed impairment thresholds, even if not on the 303(d) list for that parameter, need restoration efforts. The following tables also identify streams where monitoring data is lacking.

A summary of all streams and their status for each parameter is shown in Table 2-8 below. CD 2, JD 1, and JD 75 need protection for two parameters. Grand Marais Creek, RLWD Ditch 15, Branch C of CD 66, and the cutoff channel need protection for one parameter. The cutoff channel will no longer be assessed for aquatic life or recreation, but maintenance of channel stability and BMPs will help minimize sediment contributions to the Red River of the North. CD 126 and CD 43 need monitoring to meet DO data requirements or assessment and have no data for the other parameters. Sampling for TSS, at a minimum, is recommended for CD 43 because excess sediment was identified as a likely stressor of aquatic life in that ditch.

Table 2-8. Streams needing protection efforts due to close proximity to water quality impairment thresholds

AUID	Reach Name	DO	TP	TSS	*E. coli*
09020306-507	Grand Marais Creek	Restoration	Restoration	Protection	Monitoring
09020306-509	RLWD Ditch 15	Protection	Restoration	Monitoring	Monitoring
09020306-510	Branch C of CD 66	Restoration	Protection	Monitoring	--
09020306-511	County Ditch 126	Monitoring	--	--	--
09020306-515	County Ditch 2	Protection	Restoration	Protection	Restoration
09020306-517	County Ditch 43 (JD 25-2)	Monitoring	--	Monitoring	--
09020306-519	Judicial Ditch 1	Protection	Restoration	Restoration	Protection
09020306-520	Judicial Ditch 75	Protection	Restoration	Restoration	Protection
09020306-522*	Grand Marais Creek Cutoff Channel*	Restoration*	Restoration*	Restoration*	Protection

-- = No data; Restoration = red shading; Protection = yellow shading; Monitoring = blue shading

* Future long-term monitoring of the cutoff channel is unlikely following the Outlet Restoration Project

Dissolved Oxygen

Table 2-9. Stream 2005-2014 water quality data proximity to dissolved oxygen impairment thresholds

AUID	Name	Reach Description	Percentage of values <5 mg/l and Total number of samples (N)					
			DO12_All		DO5_All		DO5_9am	
			%	N	%	N	%	N
09020306-507	Grand Marais Crk	Headwaters to CD 2	31%	79	43%	21	67%	3
09020306-509	RLWD Ditch 15	Headwaters to CD 66	26%	74	35%	51	0%	1
09020306-510	Branch C of CD 66	Headwaters to CD 66	12%	25	19%	16	--	--
09020306-511	County Ditch 126	Unnamed crk to Grand Marais Crk	0%	4	0%	3	--	--
09020306-515	County Ditch 2	CD 66 to Grand Marais Creek	5%	119	6%	89	0%	1
09020306-517	Judicial Ditch 75	Unnamed ditch to CD 7	0%	3	0%	3	--	--
09020306-519	Judicial Ditch 1	CD 7 to Red River	8%	49	9%	43	--	--
09020306-520	Judicial Ditch 75	CD 7 to Red River	2%	56	2%	50	--	--
09020306-522	Grand Marais Crk Cutoff Channel*	CD 2 to Red River	11%	174	13%	125	0%	7

-- = No data; Restoration = red shading; Protection = yellow shading; Monitoring = blue shading

* Future long-term monitoring of the cutoff channel is unlikely following the Outlet Restoration Project

Total Suspended Solids

Table 2-10. Stream 2005-2014 water quality data proximity to total suspended solids impairment thresholds (65 mg/L standard)

AUID	Name	Reach Description	High TSS Rate	N (2005-2014)
09020306-507	Grand Marais Creek	Headwaters to CD 2	3%	39
09020306-509	RLWD Ditch 15	Headwaters to CD 66	0%	35
09020306-510	Branch C of CD 66	Headwaters to CD 66	0%	22
09020306-515	County Ditch 2	CD 66 to Grand Marais Creek	6%	53
09020306-519	Judicial Ditch 1	CD 7 to Red River	13%	30
09020306-520	Judicial Ditch 75	CD 7 to Red River	13%	31
09020306-522*	Cutoff Channel*	CD 2 to Red River (Retired AUID)*	43%*	124*

-- = No data; Restoration = red shading; Protection = yellow shading; Monitoring = blue shading

* Future long-term monitoring of the cutoff channel is unlikely following the Outlet Restoration Project

Total Phosphorus

Summer average TP values exceed the South River Nutrient Region standard of 150 µg/L (0.15 mg/L) in all the monitored reaches. However, no river eutrophication impairments have been identified due to a lack of response variable data (chlorophyll-a, diel DO flux, or biochemical oxygen demand).

Table 2-11. Stream 2005-2014 water quality data proximity to total phosphorus impairment thresholds.

AUID	Name	Reach Description	TP Std (mg/L)	Summer Avg TP (mg/L)	Proximity to TP Std	N (2005-2014)
09020306-507	Grand Marais Creek	Headwaters to CD 2	0.15	**0.481**	220%	54
09020306-509	RLWD Ditch 15	Headwaters to CD 66	0.15	**0.210**	40%	37
09020306-510	Branch C of CD 66	Headwaters to CD 66	0.15	0.123	-16%	22
09020306-515	County Ditch 2	CD 66 to Grand Marais Crk	0.15	**0.160**	6%	50
09020306-519	Judicial Ditch 1	CD 7 to Red River	0.15	**0.605**	303%	20
09020306-520	Judicial Ditch 75	CD 7 to Red River	0.15	**0.240**	60%	21
09020306-522	Cutoff Channel*	CD 2 to Red River	0.15	**0.444**	196%	134

-- = No data; Restoration = red shading; Protection = yellow shading; Monitoring = blue shading

* Future long-term monitoring of the cutoff channel is unlikely following the Outlet Restoration Project

Escherichia coli

Table 2-12. Stream 2005-2014 water quality data proximity to *E. coli* impairment thresholds

AUID	Name	Reach Description	Geometric Average (org/100mL) Compare to 126 org/100ml Standard							N (2005-2014)
			April	May	June	July	Aug	Sept	Oct	
09020306-507	Grand Marais Crk	Headwaters to CD2	--	21	43	71	80	31	73	45
09020306-509	RLWD Ditch 15	Headwaters to CD66	--	--	--	--	--	--	--	4
09020306-515	County Ditch 2	CD66 to Grand Marais Creek	--	--	62	**184**	**274**	--	--	34
09020306-519	Judicial Ditch 1	CD7 to Red River	--	--	79	**129**	**130**	--	--	28
09020306-520	Judicial Ditch 75	CD7 to Red River	--	--	115	**140**	93	--	--	30
09020306-522	Cutoff Channel*	CD2 to Red River	--	--	104	86	123	--	--	40

-- = Insufficient data Restoration = red shading; Protection = yellow shading; Monitoring = blue shading

* Future long-term monitoring of the cutoff channel is unlikely following the Outlet Restoration Project

3. Prioritizing and Implementing Restoration and Protection

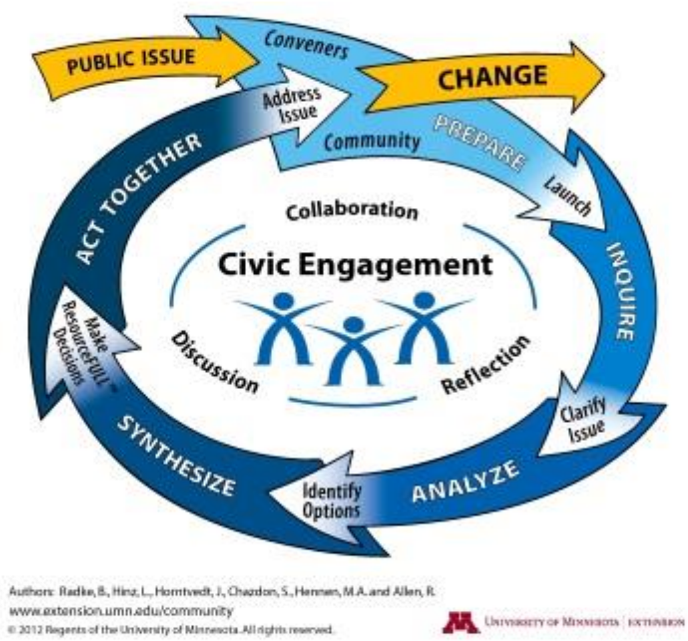
The Clean Water Legacy Act (CWLA) requires that WRAPS reports summarize priority areas for targeting actions to improve water quality, and identify point and nonpoint sources of pollution with enough specificity to prioritize and geographically locate restoration and protection actions. In addition,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

Subsections 3.1 and 3.2 of this report provide the results of such prioritization and strategy development. Because much of the nonpoint source strategies outlined in this section rely on voluntary implementation by landowners, land users and residents of the watershed, it is imperative to create social capital (trust, networks and positive relationships) with those who will be needed to voluntarily implement best management practices. Thus, effective ongoing civic engagement is fully a part of the overall plan for moving forward.

Restoration and protection strategies presented in this report will be refined and applied as targeted activities by local units of government and partners in the Grand Marais Creek River Watershed. This information will be utilized in local water plans and by local groups to apply for state and federal grants.

3.1 Civic Engagement

A key prerequisite for successful strategy development and on-the-ground implementation is meaningful civic engagement. This is distinguished from the broader term 'public participation' in that civic engagement encompasses a higher, more interactive level of involvement. The MPCA has coordinated with the University of Minnesota Extension Service for years on developing and implementing civic engagement approaches and efforts for the watershed approach. Specifically, 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." Extension defines a resourceFULL decision as one based on diverse sources of information and supported with buy-in, resources (including human), and competence. Further information on civic engagement is available at: https://extension.umn.edu/community-development/leadership-and-civic-engagement.



Technical Advisory Committee Meetings

A series of three working meetings were held with the Technical Advisory Committee (TAC) to discuss the format of and provide input on the development of the WRAPS plan (Table 3-1). The TAC was comprised of representatives from the RLWD, MSTRWD, West Polk SWCD, Marshall County, MPCA, DNR, MDH, BWSR, and NRCS. Several work plan discussions were also held over the phone, as this is a small watershed with fewer partners than neighboring watersheds.

Members of the Grand Marais Creek WRAPS TAC were also involved in the development of the Red Lake River 1W1P. The Red Lake River 1W1P area includes the Red Lake River Watershed and the land that drains to Grand Marais Creek, but excludes the northern ditches that flow directly to the Red River of the North (CD 175, JD 75, JD 1, and City of Oslo-Red River Subwatersheds). There was an overlap in the timing of the two processes. The Red Lake River 1W1P planning process and final report informed the Grand Marais Creek WRAPS development and planning process. The Red Lake River 1W1P consolidates policies, programs and implementation strategies from existing data, studies and plans, and incorporates input from multiple planning partners to provide a single plan for management of the watershed. This Plan serves as county and watershed district planning by combining existing and new content within one document. The plan focuses on targeted and measurable implementation efforts. It describes specific actions to manage water quantity, water quality, natural habitat, recreation, and drinking water in the watershed. For more information on the 1W1P process and final report, visit: http://westpolkswcd.com/1w1p.html.

Table 3-1. Grand Marais Creek Watershed Technical Advisory Committee Meetings

Date	Location	Meeting Focus
4/18/2013	Cabela's, East Grand Forks	Impairment and Data Summary; Communications Plan
3/9/2015	Public Library, East Grand Forks	Stressor ID and Geomorphic Survey Results; 1W1P Overview; TMDL and WRAPS Kick-off
4/13/2016	Red Lake Watershed District Office, Thief River Falls	Resource Prioritization and Strategy Brainstorming

Public Meetings and Accomplishments

The Grand Marais Creek WRAPS local partner team engaged with various stakeholders to guide the development of restoration and protection strategies. Previous and ongoing efforts were refocused into the WRAPS process. Members of the WRAPS group have provided technical assistance to local government partners and citizens, providing a watershed wide network of connections to build from. These pre-existing civic connections provided a strong base to develop additional more non-traditional partners as part of the watershed protection and restoration process. Public meetings were hosted by the Local Partner Team in conjunction with the April 18, 2013 and March 9, 2015 TAC meetings shown in Table 3-1, above. Public meetings were publicized in local newspapers and online (Table 3-2). Informational presentations and display boards were prepared for each of the public meetings.

Table 3-2. Grand Marais Creek Watershed Public Meetings & Communication

Date	Location	Meeting/ Press Release Focus
4/16/2013	Crookston Times Newspaper Article	"Grand Marais Creek due for a wellness checkup"
8/26/2013	Warren Sheaf Press Release	"Stream and Ditch Assessment Field Work is Being Done"
8/29/2013	Red Lake Watershed District Press Release	"Field Surveyors Collect Stream and Ditch Data on the Grand Marais Creek Watershed"
4/18/2013	Cabela's, East Grand Forks	Current Water Quality Conditions and TMDL/WRAPS Process Introduction
3/9/2015	Public Library, East Grand Forks	Impairments and Strategies in the Watershed Held in conjunction with a Red Lake River 1W1P Open House

Future Plans

The RLWD, MSTRWD, and other local government units need to continue the public outreach efforts that were initiated during the WRAPS and 1W1P development processes.

Measurable goals for future civic engagement efforts in the Grand Marais Creek Watershed include:

1. Increase volunteer participation in natural resource monitoring.
2. Increase the number of watershed residents participating in water quality discussions.
3. Find effective ways to engage citizens in a meaningful way.
4. Increase the resources utilized to communicate water quality activities within the watershed.
5. Create a document with contact information for local resources, specific to certain water quality concerns or funding sources.

Most local agencies publish annual reports that document accomplishments from the past year. Local government units may continue to host open house style events that will facilitate one-on-one discussions with residents and other stakeholders. Booths at county fairs and community events are another way to connect with the public. The RLWD Water Quality Coordinator writes monthly water quality reports that originated as reports to the RLWD Board of Managers, as a means of documenting project progress throughout the year. The reports are also available to the public on the RLWD website (www.redlakewatershed.org) and shared on social media.

The public can be kept informed of water related news, water quality problems, solutions to water issues, and opportunities for involvement in water-related programs through several different means.

- Websites of local government units
  - Red Lake Watershed District
    - www.redlakewatershed.org (official website)
    - www.rlwdwatersheds.org (watershed-based information website)
  - West Polk County Soil and Water Conservation District

        - http://westpolkswcd.com/index.html
    - Middle-Snake-Tamarac Rivers Watershed District
        - http://mstrwd.org/
    - Pennington County Soil and Water Conservation District
        - http://www.penningtonswcd.org/
    - Red Lake County Soil and Water Conservation District
        - http://redlakecountyswcd.org/index.html
    - MPCA
        - http://www.pca.state.mn.us/
        - https://www.pca.state.mn.us/water/watersheds/red-river-north-grand-marais-creek
- Mailings to individual landowners
- Radio interviews
- Informational brochures and displays
- Press releases and advertisements with local media contacts
- SWCD newsletters
- RLWD Annual Report: http://redlakewatershed.org/Annual_Reports.html
- RLWD Monthly Water Quality Reports: http://redlakewatershed.org/monthwq.html
- Organization of events to bring attention to the resource
- Presentations for local civic groups

Local government can gain insight on water issues by consulting the public. The public can provide useful feedback on analysis, alternatives, and/or decisions. Working directly with the public throughout the process helps ensure that public concerns and aspirations are consistently understood and considered.

- Public meetings
- A blog could be created for the Grand Marais Creek Watershed
- Social Media
    - Red Lake Watershed District Facebook page
    - West Polk SWCD Facebook page
    - Middle-Snake-Tamarac Rivers Watershed District Facebook page
- Public Comment period on final draft reports

- Open houses
- “World Café” style discussions

In addition, implementation activities will be streamlined due to the collaboration between landowners, local agencies, and funding sources.

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 January 7, 2019, through February 6, 2019.

3.2 Targeting of Geographic Areas

The following section describes the specific tools that were used by the Grand Marais Creek Watershed stakeholders to identify, locate and prioritize restoration and protection actions. Follow-up field reconnaissance will be the next part of the process to validate the identified areas potentially needing work.

Critical Area Identification

Three watershed modeling tools were used to identify critical areas for restoration and protection and are described in more detail in Table 11 below:

- **MPCA Grand Marais Watershed HSPF model**: HSPF is a large-basin, watershed model that simulates runoff and water quality in urban and rural landscapes. HSPF was used to predict the magnitude of TSS, total phosphorus (TP), and total nitrogen (TN) pollution generated in each subwatershed of the Grand Marais Creek Watershed. Sediment, phosphorus, and nitrogen critical areas identified from the HSPF model in the Grand Marais Creek Watershed are mapped in Figure 3-1 through Figure 3-3.
- **BWSR Ecological Ranking Tool (ERT)**: The BWSR ERT was used to calculate the weighted wildlife habitat benefit index. This index identifies areas with ecological functions such as nesting habitat, contain native plant communities, and support species of greatest concern. Critical areas of significant wildlife value are shown in dark brown in Figure 3-4.
- **Stream Power Index**: Stream Power Index (SPI) measures the erosive power of overland flow as a function of local slope and upstream drainage area. SPI was calculated for the Grand Marais Creek Watershed using the the Prioritize, Target and Measure Application (PTMApp) tool (see Section 3.3: Strategy Prioritization & Identification). Sediment erosion critical areas identified from SPI in the Grand Marais Creek Watershed are mapped by subwatershed in Appendix A.

Other priority areas were identified in the 2017 Red Lake River One Watershed One Plan:

- **Shoreland and Riparian Management Goals**: Shoreland and riparian measurable goals were formed using input from the DNR analysis of the Red Lake River Watershed, and prioritizing watercourses and riparian habitats in the Red Lake River Watershed for protection, restoration, and enhancement. Preliminary results from this effort were used to target riparian restoration and instream habitat reaches for restoration or protection. Preliminary work by DNR cited the Grand Marais Creek as an area to focus on for shoreland and riparian management**.**

- **Minnesota Buffer Initiative**: The Minnesota Buffer Initiative was signed into law during the 2015 Legislative session. The law is intended to establish new perennial vegetation buffers of 50-feet average (30-foot minimum) along public waters, public water wetlands and public ditches with a Shoreland classification. It also requires buffers of 16.5 feet on public 103E ditches with no Shoreland classification. Approved alternative practices may be implemented in lieu of buffers as well. The implementation schedule for the Buffer Initiative is listed in Table 3-3. A map showing buffer locations within the 1W1P boundary is shown in Figure 3-5.

Table 3-3. Minnesota Buffer Initiative Scheduled Implementation and History (Table 4-14 in the DRAFT August 2016 Red Lake River 1W1P Report)

Actions	Key Dates
The DNR used existing digital data to identify public waters that require a buffer.	Fall 2015
The DNR will coordinate with counties and watershed districts to transfer local information on public ditches within the benefited areas of public drainage systems into digital data. This will be used to identify public ditches that require a buffer.	Winter 2015 – 2016
BWSR Board review the implementation plan and authorize seeking request for input	March 23, 2016
BWSR Board considers approval of preliminary policies and guidance	June 22, 2016
The DNR will take the combined public water data and public ditch system data and produce a preliminary buffer protection map. Local units of government will review the preliminary map and provide comments to the DNR. The DNR will provide an efficient process for public comment on the preliminary buffer protection map.	July 12, 2016
BWSR Board considers approval of final policies and guidance	August 25, 2016
The DNR Commissioner will approve the buffer protection map that results from Phase III comments and refinements. The DNR will deliver buffer protection maps to the Board of Water and Soil Resources (BWSR), Soil and Water Conservation Districts (SWCDs), Drainage Authorities and other local governments for use in the implementation process.	Spring 2017
Counties and/or Watershed Districts must notice BWSR on their decision to assume jurisdiction	March 31, 2017
SWCDs provide a summary of watercourses to be included in 1W1P plans	July 2017
Buffers required for lands adjacent to public waters	November 2017
Buffers required on lands adjacent to public drainage ditches	November 2018

Table 3-4. Watershed modeling tools used to identify critical areas for restoration and protection in the Grand Marais Creek Watershed

Tool	Description	How can the tool be used?	Notes
Hydrological Simulation Program – FORTRAN (HSPF) Model	Simulation of watershed hydrology and water quality for both conventional and toxic organic pollutants from pervious and impervious land. Typically used in large watersheds (greater than 100 square miles).	Incorporates watershed-scale and non-point source models into a basin-scale analysis framework. Addresses runoff and constituent loading from pervious land surfaces, runoff and constituent loading from impervious land surfaces, and flow of water and transport/ transformation of chemical constituents in stream reaches.	Local or other partners can work with MPCA HSPF modelers to evaluate at the watershed scale: 1) the efficacy of different kinds or adoption rates of BMPs, and 2) effects of proposed or hypothetical land use changes.
BWSR Ecological Ranking Tool (Environmental Benefit Index - EBI)	Three GIS layers containing: soil erosion risk, water quality risk, and habitat quality. Locations on each layer are assigned a score from 0-100. The sum of all three layer scores (max of 300) is the EBI score. This higher the score, the higher the value in applying restoration or protection.	Any one of the three layers can be used separately or the sum of the layers (EBI) can be used to identify areas that are in line with local priorities. Raster calculator allows a user to make their own sum of the layers to better reflect local values.	GIS layers are available on the BWSR website.
Stream Power Index (SPI) and the PTMApp	A tool that allows users to build and measure the cost-effectiveness of prioritized and targeted implementation scenarios for improving water quality. This tool assesses the suitability, treatment potential, and costs of various best management strategies (protection, source reduction, storage, filtration and infiltration). The tool also calculates the SPI, or erosion potential for the watershed using a hydrologically corrected DEM.	PTMApp can be used in real-time by SWCDs, Watershed Districts, county local water planning, agency staff and decision-makers to: Prioritize resources and issues impacting them; Target specific fields to place CPs and BMPs; Measure water quality improvement by tracking expected nutrient and sediment load reduction to priority resources; Create reports documenting the prioritization, targeting, and measuring process; Establish tailored CPs and BMPs implementation scenarios for funding by BWSR and other agencies.	The PTMApp is the vision of a Public-Private Partnership led by the International Water Institute that includes the Red River Watershed Management Board, BWSR, and Houston Engineering Inc.

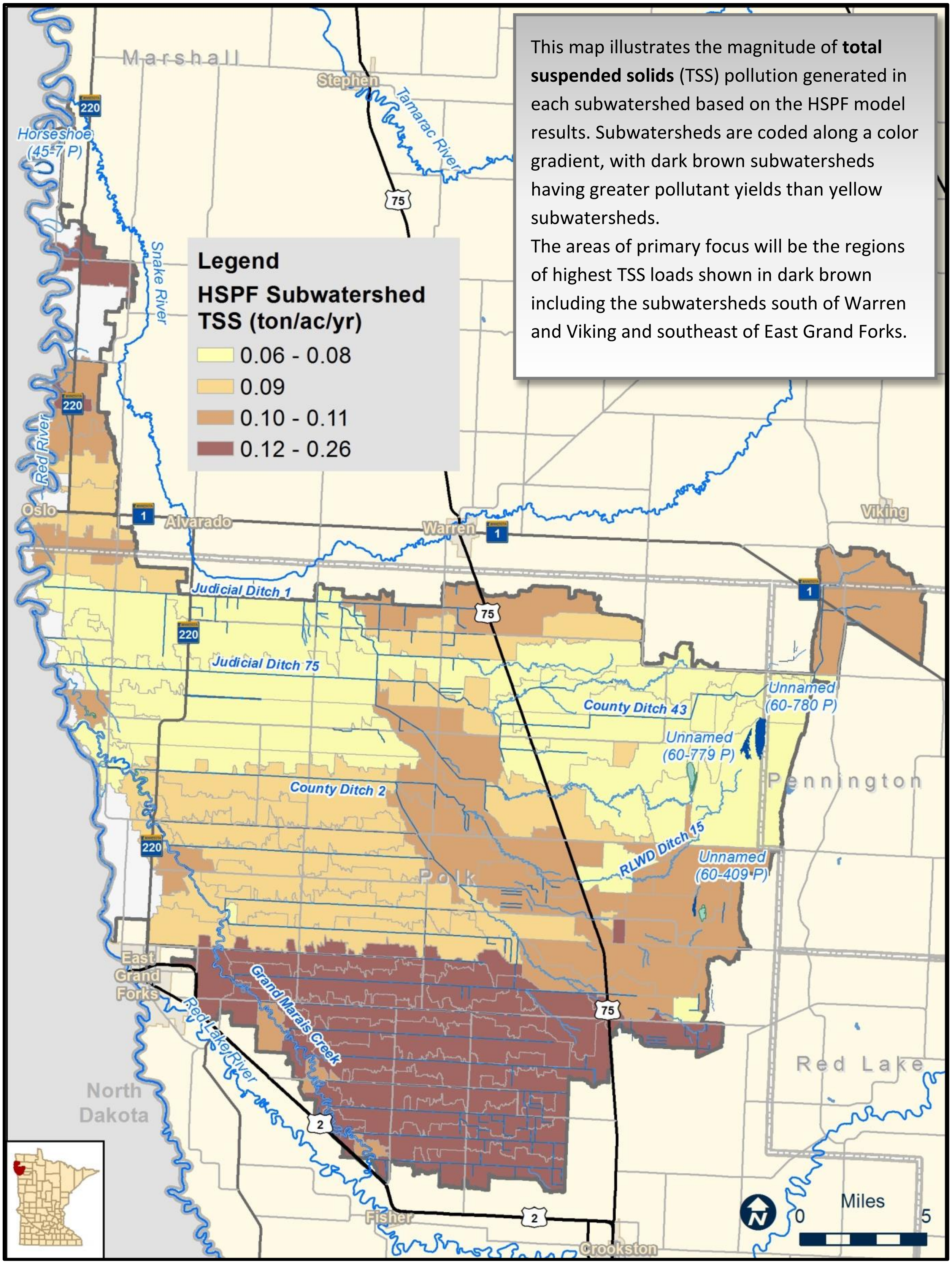


Figure 3-1. HSPF Subwatershed Total Suspended Solids Yields (tons/year)

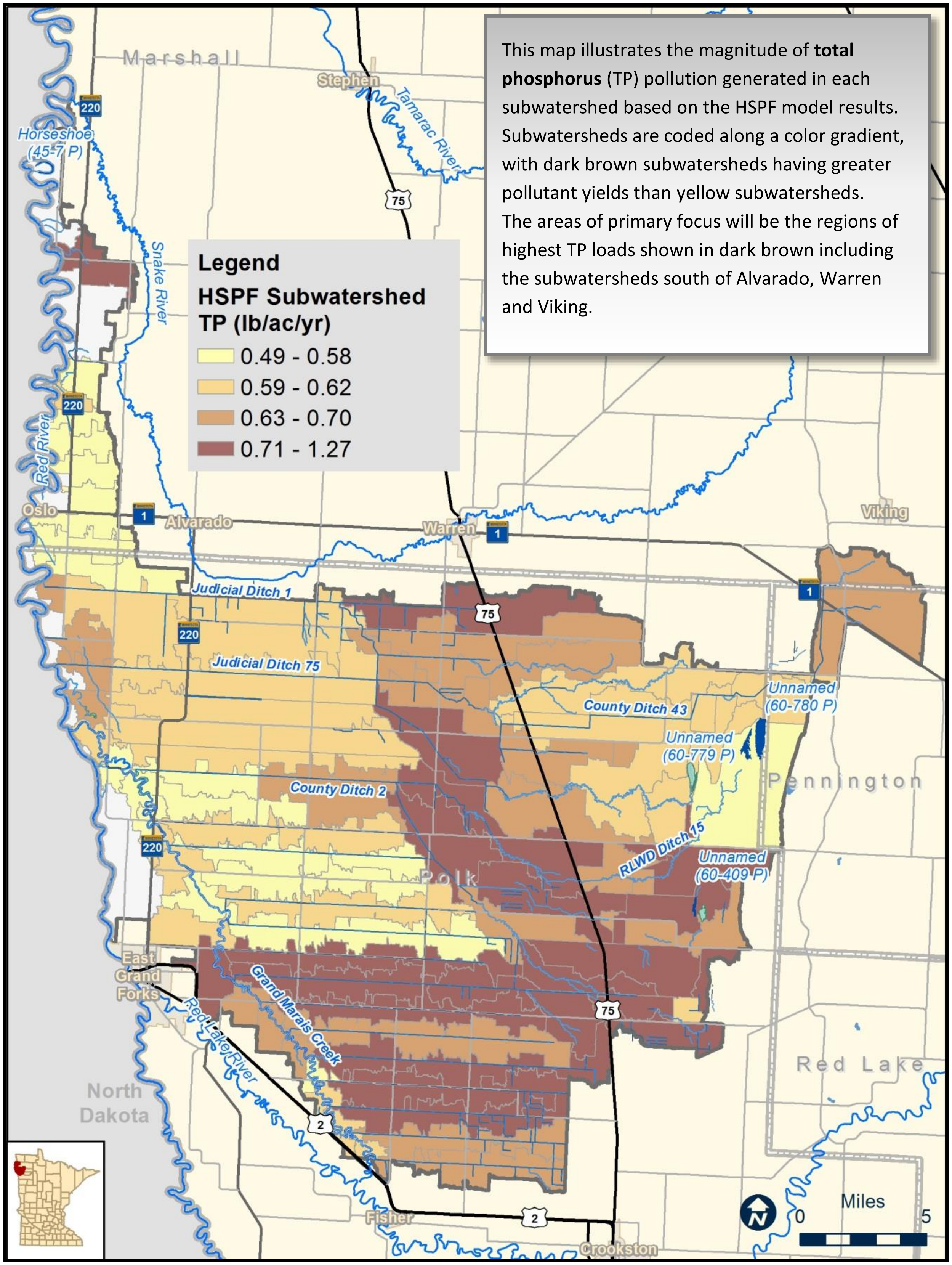


Figure 3-2. HSPF Subwatershed Total Phosphorus Yields (pounds/year)

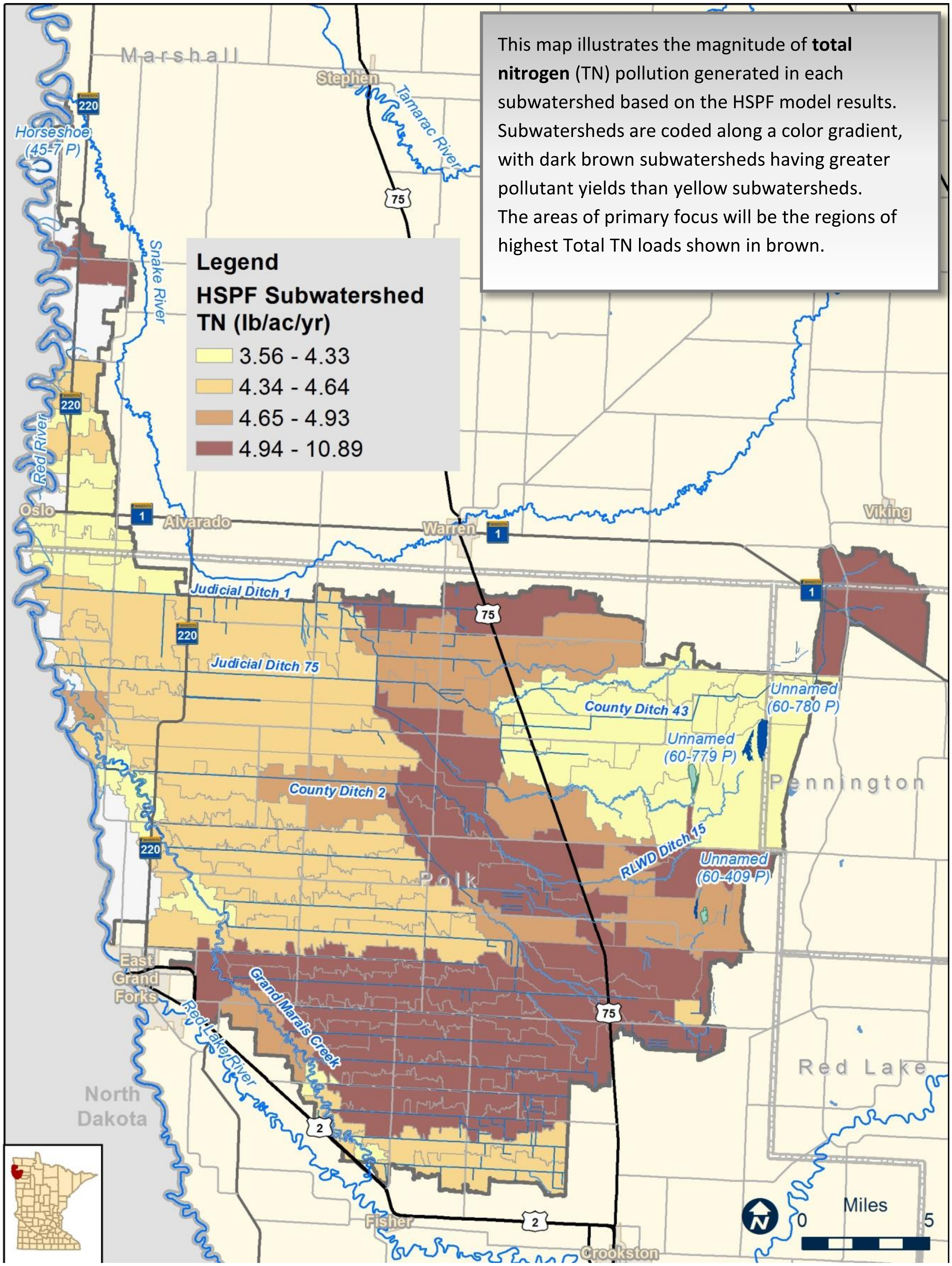


Figure 3-3. HSPF Subwatershed Total Nitrogen Load Yields (pounds/year)

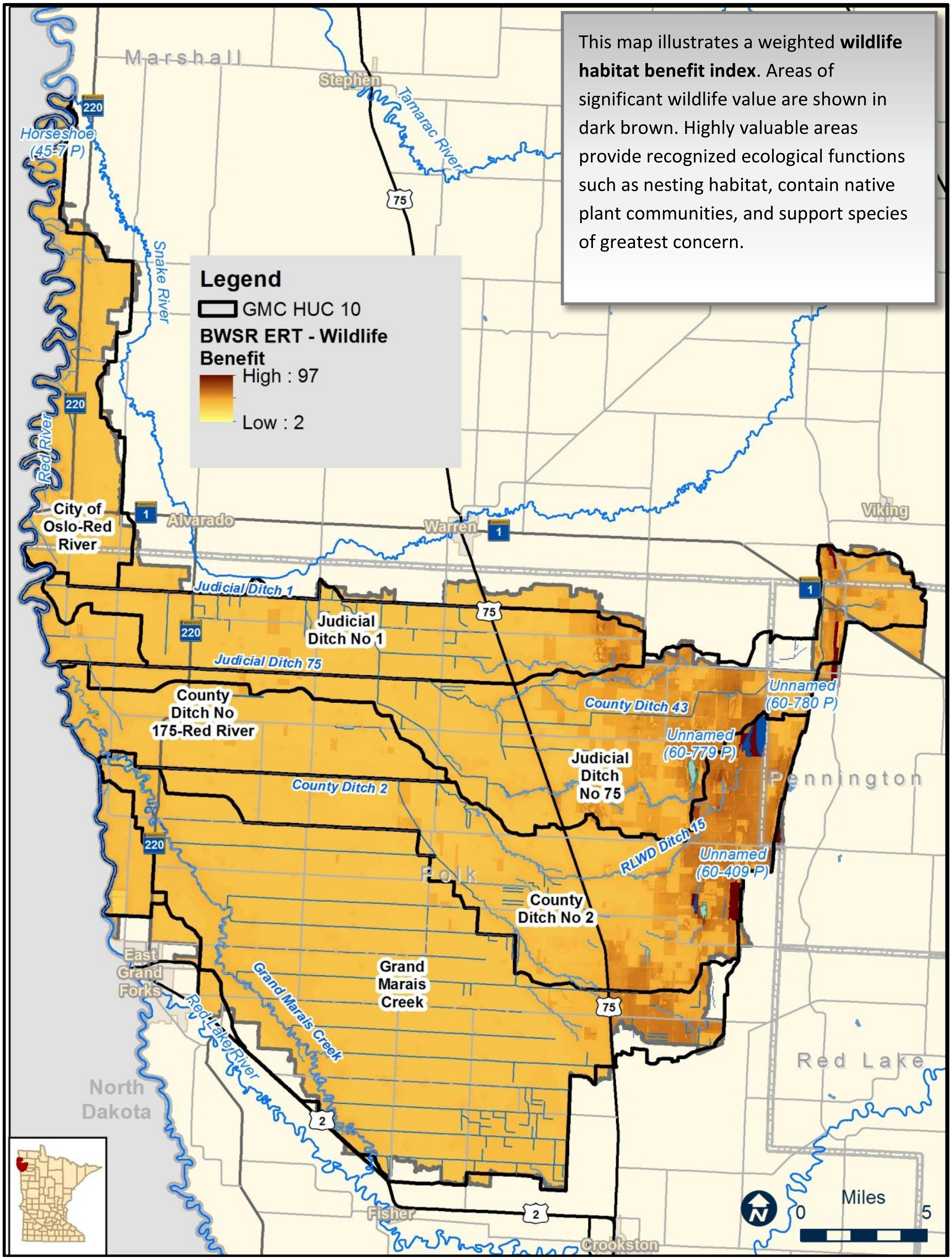


Figure 3-4. Grand Marais Creek Watershed Wildlife Benefit Ranking

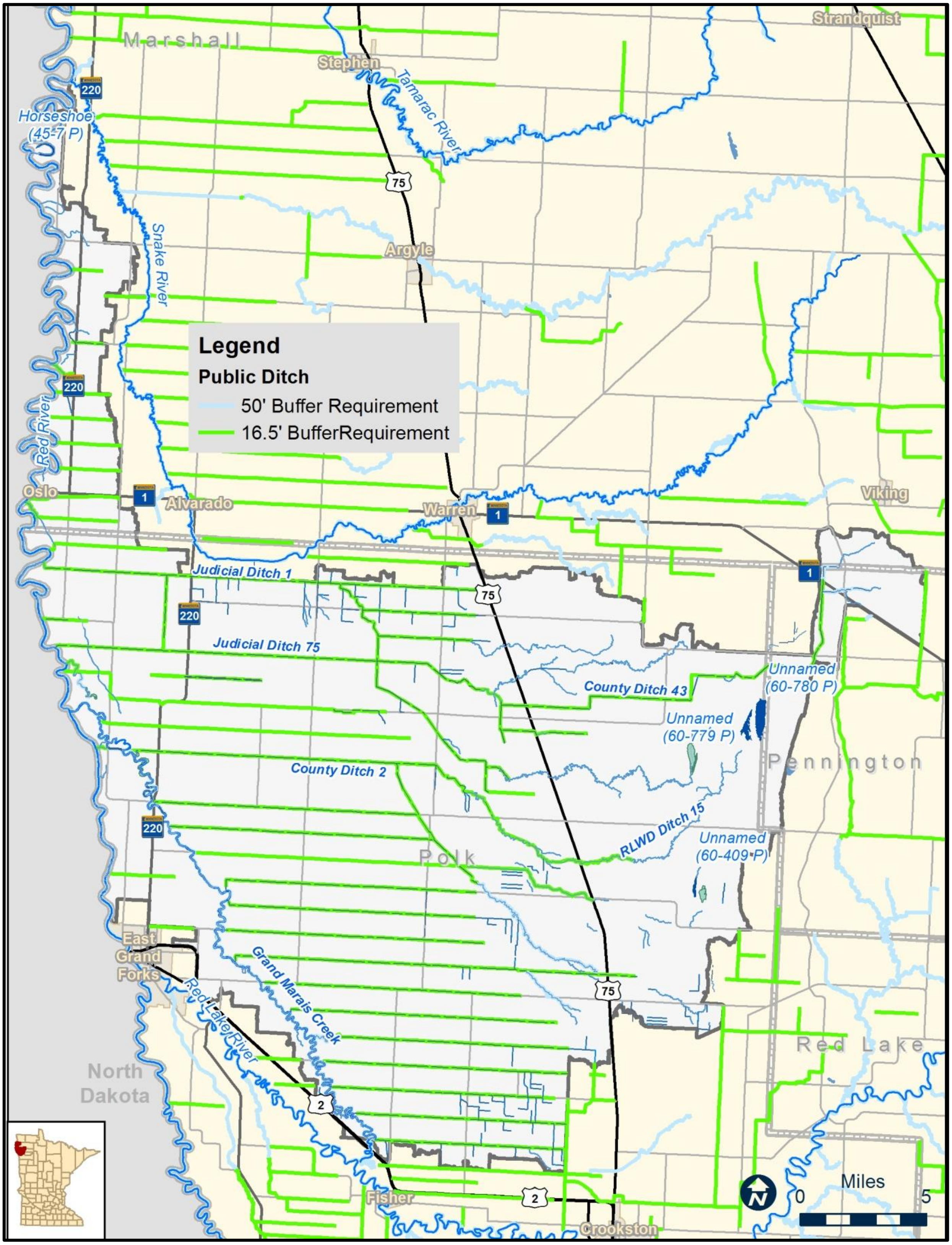


Figure 3-5. Grand Marais Creek Watershed Preliminary Buffer Protection Map (4/12/2017)

Priority Ranking

Modeling tool products, 1W1P priority areas, and input from the Grand Marais Creek WRAPS TAC at the April 2016 meeting in Thief River Falls informed the ranking of areas that will be targeted for implementation efforts. The priority areas are listed below and shown in Figure 3-6.

1. **Priority 1**: Restoration of **Grand Marais Creek** and protection of the **headwaters** (approximately east of Highway 75) were identified by the TAC as the highest priority. Grand Marais Creek suffers from stagnant water conditions, resulting from a high number of artificial stream crossings creating pools of water. A large-scale stream restoration is a priority project to restore the natural channel and hydrology of Grand Marais Creek. Protection of the hydrology of the headwaters was identified as a priority due to its benefit to downstream resources and impairments.
2. **Priority 2**: Restoration of **JD 75** was identified as the second highest priority by the Grand Marais Creek WRAPS TAC. JD 75 has local support for implementation of multi-purpose flood control structures that manage flow, nutrients and sediment. In addition, restoration of **CD 2** was identified as a resource of concern by the Red Lake River 1W1P TAC, and was therefore assigned a ranking of second highest priority as part of the WRAPS.
3. **Priority 3**: Restoration of the lake plain ditch system, JD 1, and the direct drainage of the Red Lake River were identified as the lowest priority by the Grand Marais Creek WRAPS. These areas are heavily modified by drainage systems, with little base flow and few opportunities for restoration due to intensive agricultural land use. The cost to benefit ratio for projects in these areas would be very low.

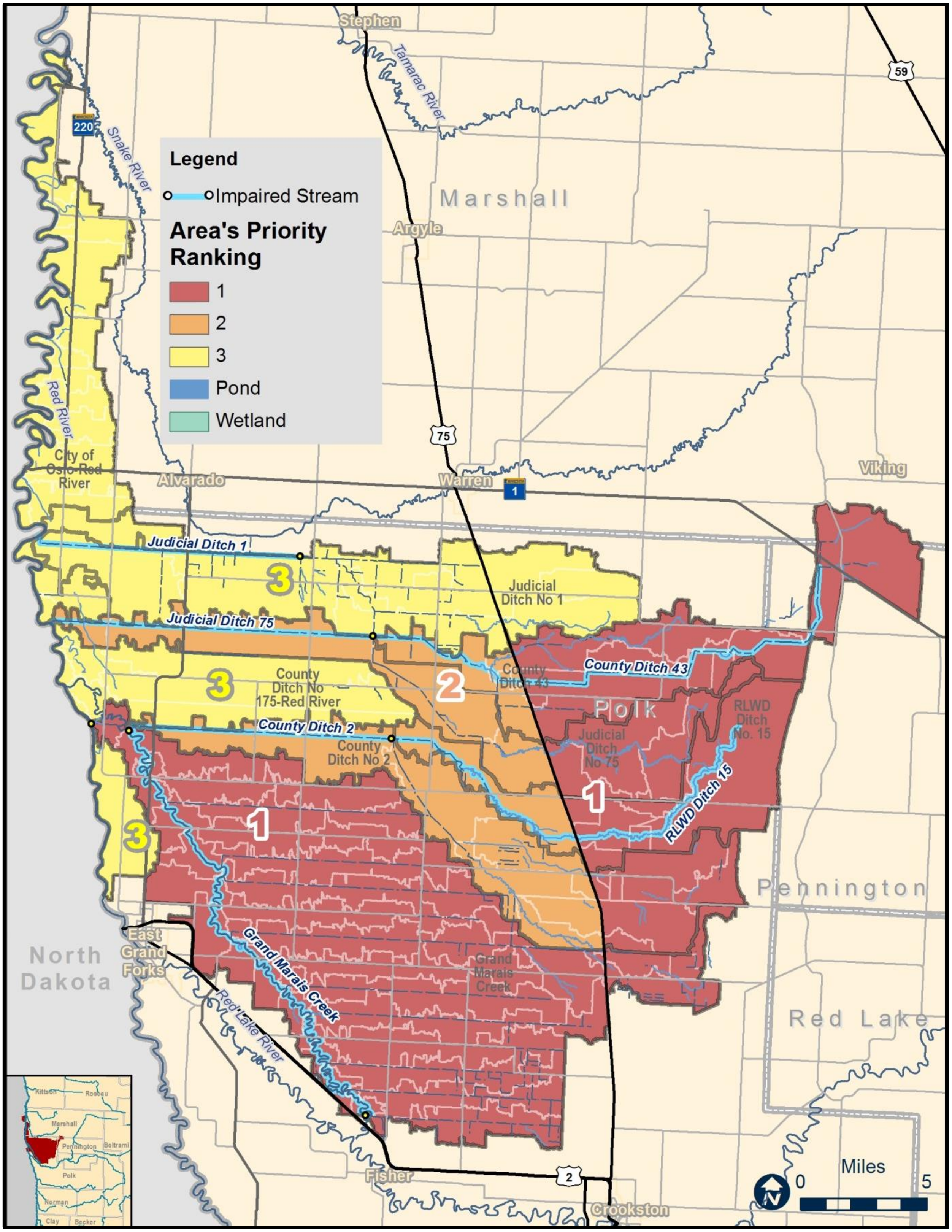


Figure 3-6. Grand Marais Creek Watershed Implementation Priority Ranking

3.3 Restoration & Protection Strategies

This section includes a detailed table (Table 3-6) identifying restoration and protection strategies for individual stream direct drainage areas that restore or protect water quality. Due to the uniformly, highly altered nature of the watershed, many strategies were identified on a watershed-wide basis. These projects include the following information:

- County location
- Water quality conditions and goals
- Strategies
- Estimated scale of adoption needed for each strategy to achieve the water quality goal
- Governmental units with primary responsibility
- Estimated timeline for full implementation of strategy
- Interim 10-year milestones for implementation of strategy

Strategy Prioritization & Identification

Local Partner Input

The following list describes the priority implementation strategies in the Grand Marais Creek Watershed based on input from local partners during the April 2016 WRAPS TAC meeting in Thief River Falls, Minnesota:

- **Restoring stream/ditch connectivity** to increase base flow and remove/modify migration barriers, such as:
    - Beaver dams: management of beavers and the impoundments (dams) they create has diminished over the years. Low fur prices and a decreasing number of trappers have magnified this problem.
    - Culverts: There is a need to review culvert sizing and consider the feasibility of better culvert designs to improve fish passage, habitat and increase connectivity.
    - Flood control structures: This strategy is especially important in the Grand Marais Creek Headwaters (east of Highway 75). Multi-purpose flood control structures, which manage flow, nutrients and sediment (such as the North Ottawa Impoundment in the Bois de Sioux Watershed), are a high priority water quality improvement strategy in the Red River Basin because of the fundamental need to manage high flow periods. In addition, base flow augmentation could be incorporated into the operating plans of impoundments.

      There are several existing flood detention facilities in the Grand Marais Creek Watershed that could be retrofit to enhance nutrient and sediment reduction, promote fish passage, and increase downstream base flow (Figure 3-7).

- **Encouraging landowners to increase buffer width** and creating an incentive program to reward landowners who increase buffer widths.
- **Encouraging operators to practice crop rotation strategies**.
- **Restoration of the natural channel of the Grand Marais Creek**. The Grand Marais Creek Outlet Restoration (Project 60) gained a lot of public support due to the integration of habitat and erosion components with improved drainage. There may be opportunities to build upon that success by expanding restoration efforts upstream. Most of the natural channel is already sinuous, but has a low gradient and resembles a wetland during much of the year. Several potential fish/flow barriers are visible in aerial photos. Fish passage could be improved with minimal disturbance to the natural areas of the channel by focusing on the small areas that are restricting flow and/or fish passage. It will be difficult to restore the upper reaches completely. The Red Lake River once carried larger amounts of flow through the Grand Marais Creek channel, but eventually abandoned the Grand Marais Creek channel for its current path. The oversized channel in the upper reaches of Grand Marais Creek now resembles a chain of wetlands.
- **Encourage landowners to plant windbreaks**. Removal of tree rows has exacerbated wind erosion and public safety issues during winter storms (more blowing snow, reduced visibility). A watershed-side implementation priority identified by the local partners was to work with landowners to establish windbreaks, shelterbelts, and living snow fences to reduce field erosion and sediment build-up in ditches

PTMApp

Additional implementation strategies were identified in the southern portion of the Grand Marais Creek Watershed as part of the Red Lake River 1W1P process using the PTMApp Tool, and are incorporated into the WRAPS restoration and protection strategy table. This Tool illustrates the potential sediment removal performance of best management practices placed at optimal locations within management areas, along with the cost-effectiveness of these scenarios to develop an implementation strategy. PTMApp defines various implementation-based management strategies including storage, filtration, biofiltration, infiltration, protection, and source (load) reduction. As part of the 1W1P planning process, stakeholders selected management strategies appropriate for the established goals

1W1P implementation strategies in the Grand Marais Creek Watershed were grouped into four planning zones (see Figure 3-8 through Figure 3-11): Lower 1 (L1), Lower 2 (L2), Middle 1 (M1), and Middle 2 (M2). These are described in more detail in Section 5: Lower Planning Zone and Section 6: Middle Planning Zone of the 2017 Red Lake River 1W1P, available online from the West Polk SWCD webpage: http://westpolkswcd.com/1w1p.html.

Figure 3-7. Existing Detention Sites for Potential Water Quality Retrofit in the Grand Marais Creek Watershed

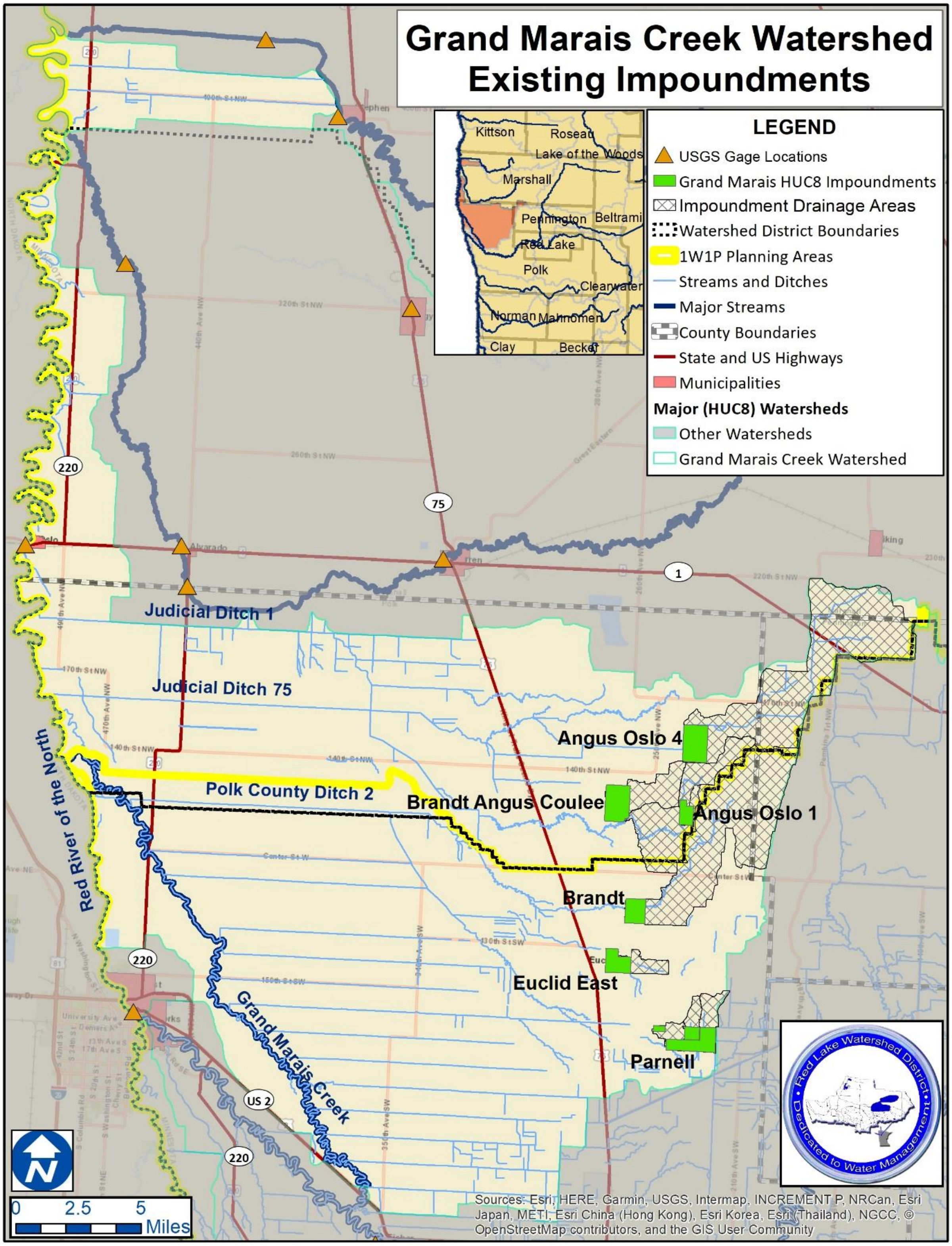


Figure 3-8. Red Lake River 1W1P Lower Planning Zone Infiltration BMP

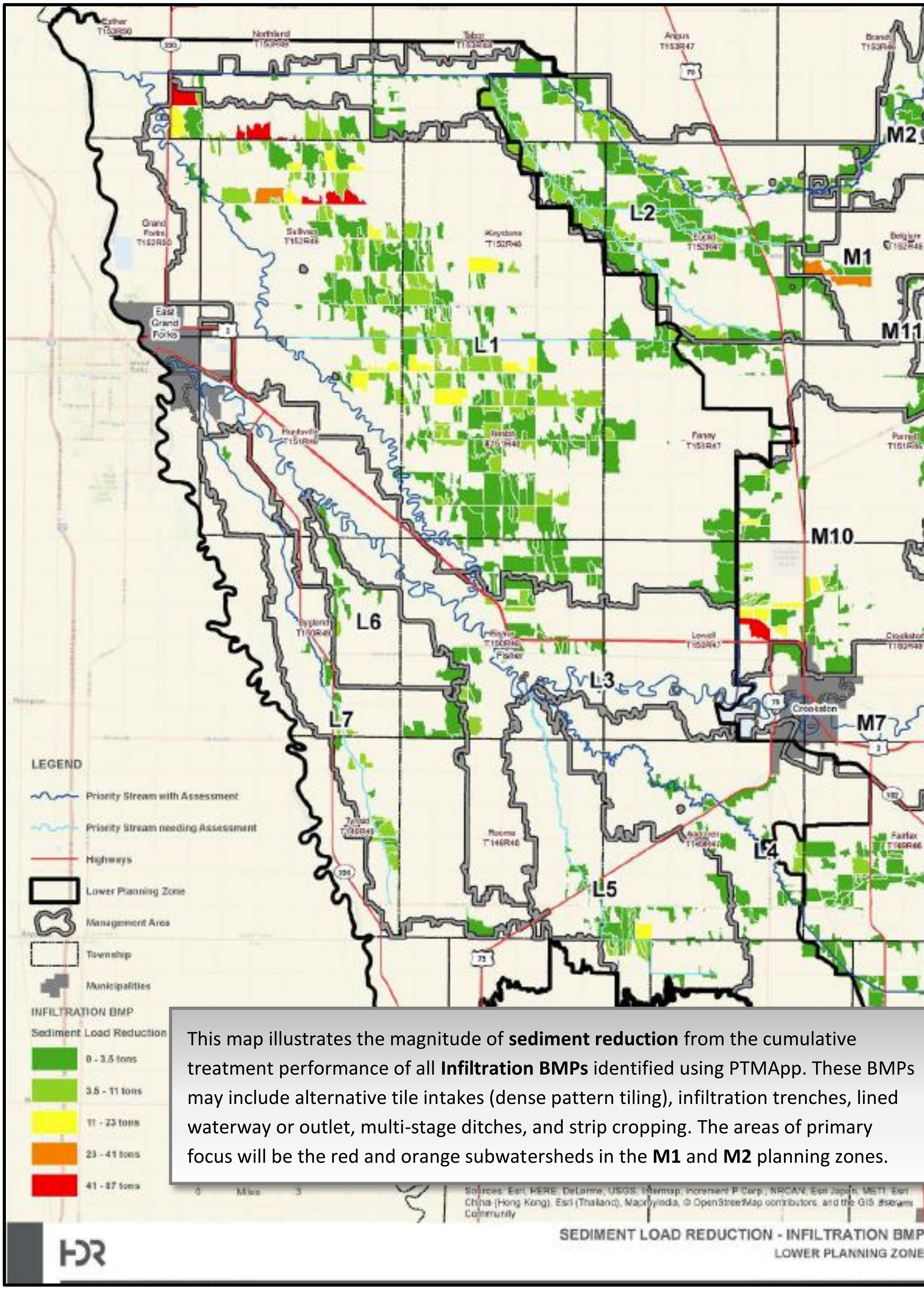


Figure 3-9. Red Lake River 1W1P Middle Planning Zone Source Reduction BMPs

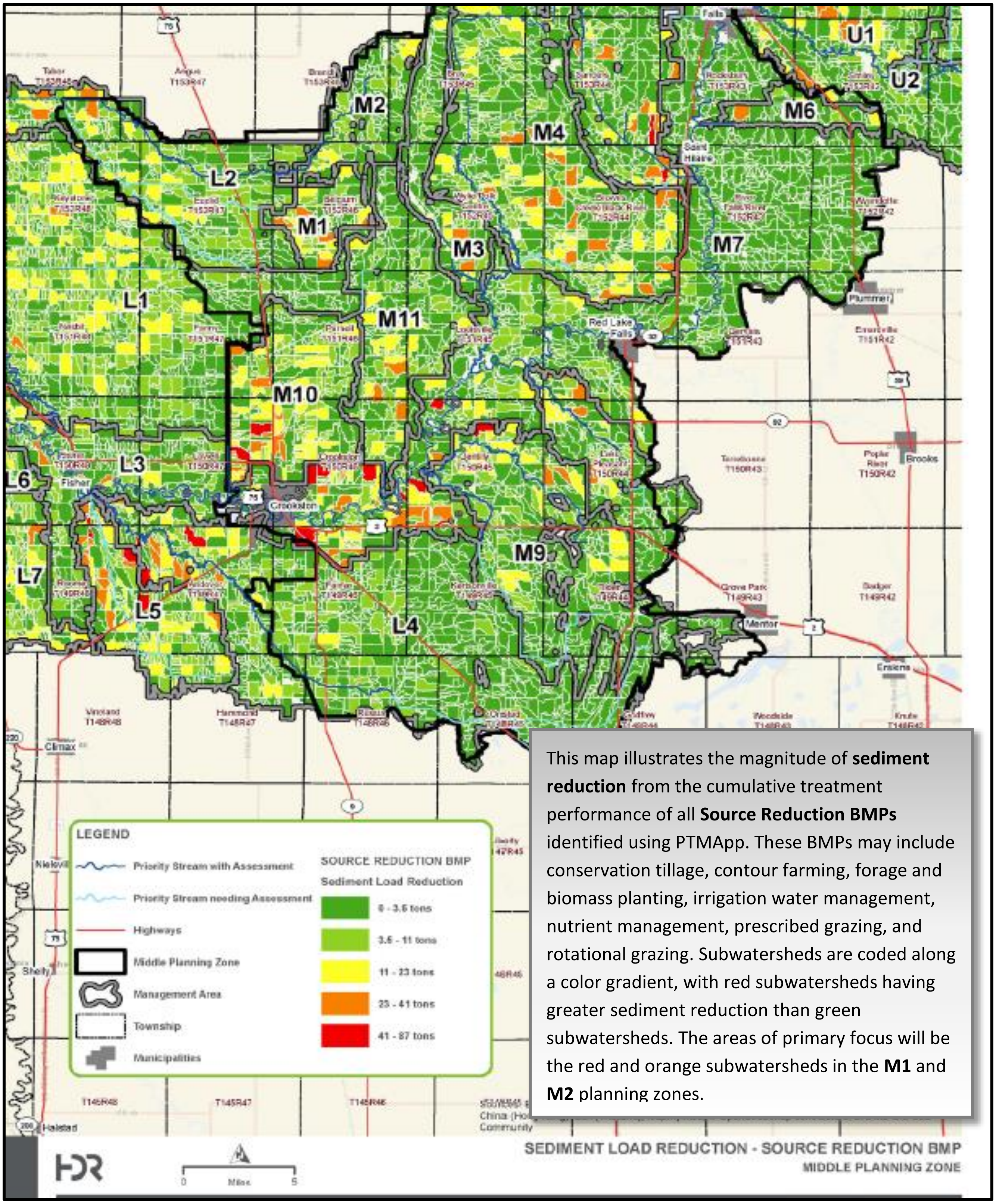


Figure 3-10. Red Lake River 1W1P Middle Planning Zone Infiltration BMPs

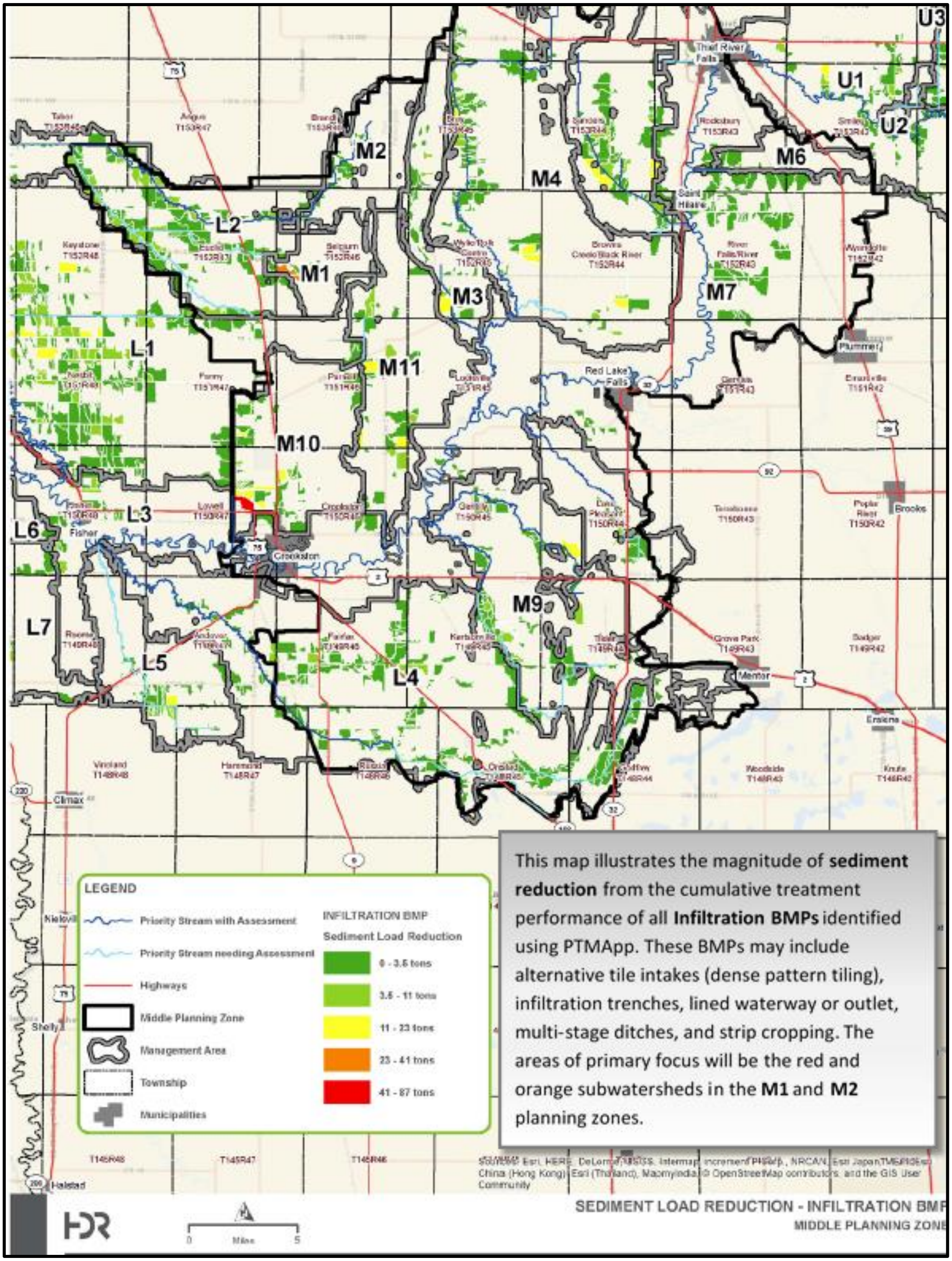
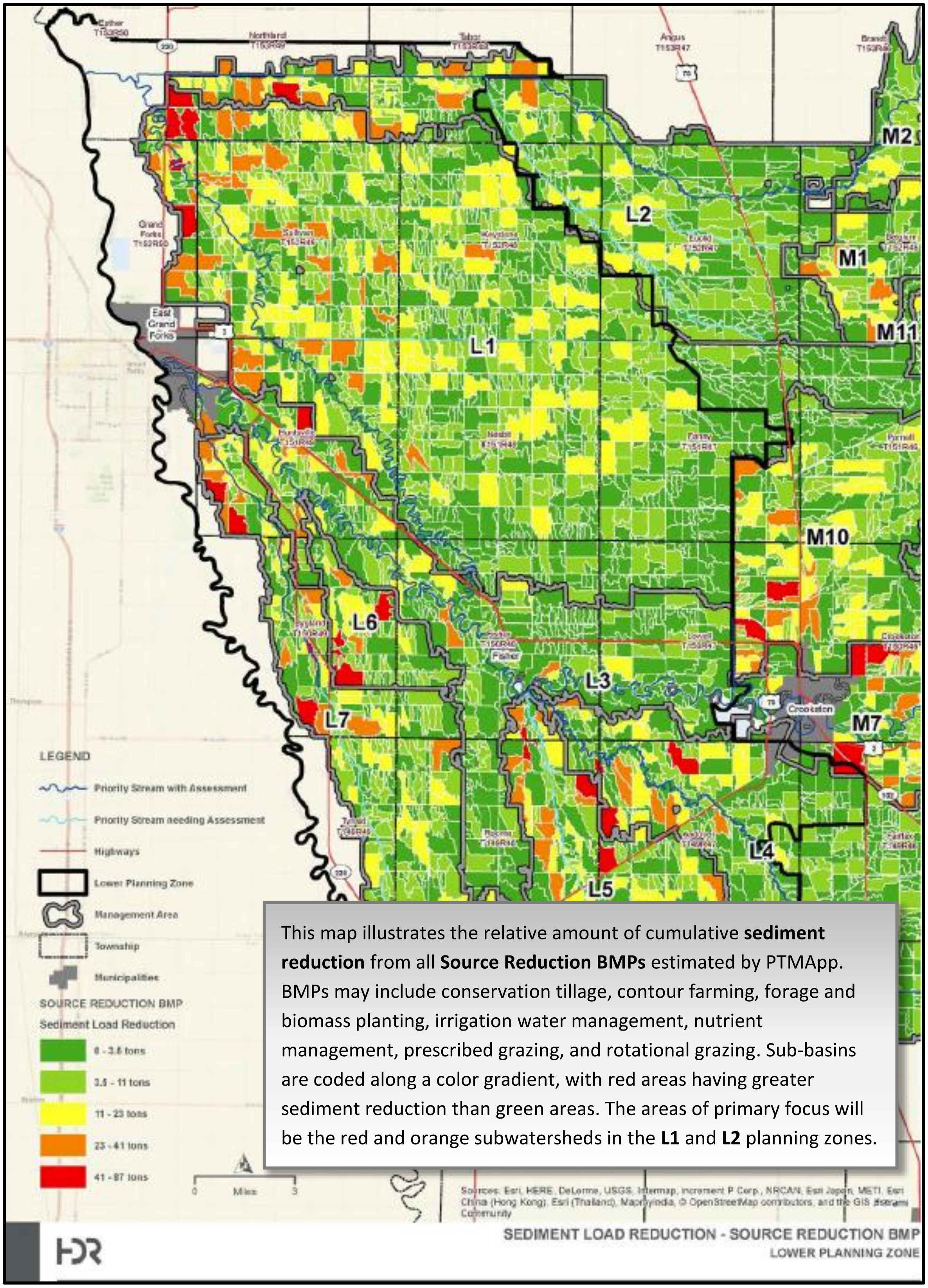


Figure 3-11. Red Lake River 1W1P Lower Planning Zone Source Reduction BMPs



Funding Sources

There are a variety of funding sources to help cover some of the cost to implement practices that reduce pollutants from entering surface waters and groundwater. There are several programs listed below that contain web links to the programs and contacts for each entity. The contacts for each grant program can assist in the determination of eligibility for each program as well as funding requirements and amounts available.

On November 4, 2008, Minnesota voters approved the Clean Water, Land & Legacy Amendment to the constitution to:

- Protect drinking water sources;
- Protect, enhance, and restore wetlands, prairies, forests, and fish, game, and wildlife habitat;
- Preserve arts and cultural heritage;
- Support parks and trails;
- Protect, enhance, and restore lakes, rivers, streams, and groundwater.

The Clean Water, Land, and Legacy funds have several grant and loan programs that could potentially be used for implementation of the BMPs and education and outreach activities.

The various programs and sponsoring agencies related to clean water funding and other sources of funding are listed below in hyperlinks. In addition, a table of programs and related funding sources included in the 2017 Red Lake River 1W1P is reproduced in Table 3-5.

- Agriculture BMP Loan Program (MDA)
- Clean Water Fund Grants (BWSR)
- Lessard-Sams Outdoor Heritage Fund (Lessard-Sams Outdoor Heritage Council)
- Clean Water Partnership (MPCA)
- Environment and Natural Resources Trust Fund (Legislative-Citizen Commission on Minnesota Resources)
- Environmental Assistance Grants Program (MPCA)
- Phosphorus Reduction Grant Program (Minnesota Public Facilities Authority)
- Section 319 Grant Program (MPCA)
- Small Community Wastewater Treatment Construction Loans & Grants (Minnesota Public Facilities Authority)
- Source Water Protection Grant Program (Minnesota Department of Health)
- Surface Water Assessment Grants (MPCA)
- Wastewater and storm water financial assistance (MPCA)

- Conservation Partners Legacy Grant Program (DNR)
- Environmental Quality Incentives Program (Natural Resources Conservation Service)
- Conservation Reserve Program (USDA)
- Clean Water State Revolving Fund (EPA)

Table 3-5. Programs and related funding sources (Table 8-3 from the 2017 Red Lake River One Watershed One Plan)

Source	Organization	Program/ Grant Name	Primary Assistance Type
FEDERAL	NRCS	Conservation Innovation Grant (CIG)	Financial
		Conservation Stewardship Program (CSP)	Financial/Technical
		Environmental Quality Incentives Program (EQIP)	Financial/Technical
		Agricultural Conservation Easement Program (ACEP)	Easement
	FSA	Conservation Reserve Program (CRP)	Easement
		Conservation Reserve Enhancement Program (CREP)	Easement
		Farmable Wetlands Program (FWP)	Easement
		Grasslands Reserve Program (GRP)	Easement
	FSA/USDA/NRWA	Source Water Protection Program (SWPP)	Technical
	PCA	Federal Clean Water Act Section 319 Grants	Financial
	EPA	Water Pollution Control Program Grants(Section 106)	Financial
		State Revolving Fund (SRF)	Loan
		Drinking Water State Revolving Fund	Loan
		(DWSRF)Aquatic Invasive Species Control Grant Program	Financial/Technical
STATE	MnDNR	Conservation Partners Legacy Grant Program	Financial
		Working Lands Initiative	Financial
		Flood Hazard Mitigation Grant Assistance	Financial
		Forest Stewardship Program	Technical
		Reinvest in Minnesota (RIM)	Financial/Easement
		Outdoor Heritage	Easement
		Lessard Sams	Financial
		Observation well Funding	Financial
	BWSR	Clean Water Fund Grants	Financial/Technical
		Erosion Control and Management Program	Financial/Technical
		SWCD Local Capacity	Financial/Technical
		Cooperative Weed Management Area	Financial/Technical
		Buffer Law	Financial/Technical
		Natural Resources Block Grant	Financial
		Reinvest in Minnesota (RIM)	Easement/Financial
	MPCA	Surface Water Assessment Grants (SWAG)	Financial
		Clean Water Partnership	Financial
	MDH	Source Water Protection Grant Program	Financial
	MDA	Agriculture Best Management Practices (BMP) Loan Program and Sustainable Ag Demo grants	Financial

Table 3-6. Strategies and actions proposed for the Grand Marais Creek Watershed.

Waterbody and Location			Parameter (incl. non-pollutant stressors)	Water Quality		Strategies	Strategy scenario showing estimated scale of adoption to meet 10 yr milestone and final water quality targets. Scenarios and adoption levels may change with additional local planning, research showing new BMPs, changing financial support and policies, and experience implementing the plan.			Governmental Units with Primary Responsibility								Estimated Year to Achieve Water Quality Target
								Estimated Adoption Rate										
Stream Priority	Stream AUID	Location and Upstream Influence Counties		Current Conditions (load or concentration)	Goals / Targets and Estimated % Reduction		Strategy Type	Interim 10-year Milestone	Suggested Goal	Watershed Districts	W Polk SWCD	NRCS	County/ Envtal Svcs	Pheasants Forever	ACOE	DNR	BWSR	
n/a	All Streams	Polk, Pennington, Marshall	TP, TSS, DO, Bacteria, Altered Hydrology	n/a	10% TP reduction (MPCA Nutrient Strategy for the Red River Basin); Increased base flow; Increased connectivity; Decreased bacteria levels; Daily minimum DO > 5 mg/L	Improve riparian vegetation	Establish and/or protect riparian corridors along waterways, including ditches, using native vegetation if possible	25% of channel	100% of channel	X	X		X				X	2041
							Establish and maintain adequate buffers according to the requirements of the Buffer Law.	Public waters are in compliance by November 1, 2017. Public ditches are in compliance by November 1, 2018.	The requirements of the Buffer Law continue to be enforced.	X	X		X				X	
						Improve connectivity	Beaver dam removal and deterrence, review culvert sizing, implement side water inlet structures or other alternative practices, modify flood control structures, and remove other obstructions in channel	Review watershed for obstructions and complete culvert survey for watershed. Restore connectivity in the "Glacial Ridge"	Restore connectivity throughout the watershed	X	X		X			X		
						Address failing septics	Replace all systems deemed Imminent Threat to Public Health (e.g., straight pipes, surface seepage), and promote education of proper SSTS maintenance	Complete SSTS survey of area to ensure proper septic systems are used (no straight pipes to ditches)	100% compliance with SSTS regulations		X		X					
						Protect, restore, and enhance grasslands and wetlands	Land conversion/ conservation easement	Prairie Core: 40% grassland and 20% wetland within remainder of cropland or other uses Prairie Corridor: 10% of each legal land section is to be maintained in permanent perennial cover Remainder of Prairie Region: maintain 10% of each Land Type Association in perennial native vegetation	Prairie Core: 40% grassland and 20% wetland within remainder of cropland or other uses Prairie Corridor: 10% of each land section is to be maintained in permanent perennial cover Remainder of Prairie Region: maintain 10% of each Land Type Association in perennial native vegetation		X	X		X				

Waterbody and Location			Parameter (incl. non-pollutant stressors)	Water Quality		Strategies	Strategy scenario showing estimated scale of adoption to meet 10 yr milestone and final water quality targets. Scenarios and adoption levels may change with additional local planning, research showing new BMPs, changing financial support and policies, and experience implementing the plan.			Governmental Units with Primary Responsibility								Estimated Year to Achieve Water Quality Target
								Estimated Adoption Rate										
Stream Priority	Stream AUID	Location and Upstream Influence Counties		Current Conditions (load or concentration)	Goals / Targets and Estimated % Reduction		Strategy Type	Interim 10-year Milestone	Suggested Goal	Watershed Districts	W Polk SWCD	NRCS	County/ Envtal Svcs	Pheasants Forever	ACOE	DNR	BWSR	
n/a	All Streams	Polk, Pennington, Marshall	TP, TSS, DO, Bacteria, Altered Hydrology	n/a	10% TP reduction (MPCA Nutrient Strategy for the Red River Basin); Increased base flow; Increased connectivity; Decreased bacteria levels; Daily minimum DO > 5 mg/L	Restore channel	Re-meander stream channels where possible	Complete 1 full stream that was natural before agricultural use/drainage in the beach ridge area	Complete 1 full stream that was natural before agricultural use/drainage	X	X		X		X	X	X	2041
							Manage ditch bed and banks (& spoil piles) after ditch clean outs	Ensure that Ditch Authorities are following proper Ditch law	Revegetate ditch bed and banks (& spoil piles) after ditch clean outs	X	X		X					
						Improve base flow	Augment flows during low/no flow conditions for cooler water and flow for fish	Identify feasible impoundments	All impoundments	X					X	X		
						Restore altered hydrology	Protect disconnected, non-contributing drainage areas from future altered hydrology leading to a connection to downstream water resources.	No new drainage from 10-year non-contributing areas	No new drainage from 10-year non-contributing areas	X	X		X					
							Assure long-term maintenance of multi-purpose flood control structures	Develop and adopt a Flood Damage Reduction Control Structure Operation and Maintenance Policy and Guidance	Develop and adopt a Flood Damage Reduction Control Structure Operation and Maintenance Policy and Guidance	X			X		X			
						Encourage incentives programs	Encourage operators to increase buffer width and practice crop rotations through incentives program	Establish incentives program through co-ops. Complete 30 windbreak, shelterbelt, or living snow fence plantings.	Ongoing	X	X	X						
						Improve drainage system management	Permit and improve tiling	Continue to permit tiling in the watershed and look at conservation tiling instead of open tile systems	Implement conservation tiling	X	X	X						
							Retrofit or install new surface and subsurface drainage using current conservation drainage practices	Develop or enhance incentive program as well as regulatory language	Develop or enhance incentive program as well as regulatory language	X		X						
							Utilize information collected from the drainage ditch inventories to prioritize and install side water	Side water inlet prioritization and implementation plan	100% of priority side water inlets installed	X	X	X					X	

Waterbody and Location			Parameter (incl. non-pollutant stressors)	Water Quality		Strategies	Strategy scenario showing estimated scale of adoption to meet 10 yr milestone and final water quality targets. Scenarios and adoption levels may change with additional local planning, research showing new BMPs, changing financial support and policies, and experience implementing the plan.			Governmental Units with Primary Responsibility								Estimated Year to Achieve Water Quality Target
								Estimated Adoption Rate										
Stream Priority	Stream AUID	Location and Upstream Influence Counties		Current Conditions (load or concentration)	Goals / Targets and Estimated % Reduction		Strategy Type	Interim 10-year Milestone	Suggested Goal	Watershed Districts	W Polk SWCD	NRCS	County/ Envtal Svcs	Pheasants Forever	ACOE	DNR	BWSR	
							inlets to ensure adequate support of agriculture without negative downstream ecological and economic impacts.											
						Reduce nutrient runoff	Reduce fertilizer inputs to fields (source reduction)	Consult with crop advisors about fertilizer inputs	Reduce the amount of fertilizers used by 50%		X	X						
n/a	All Streams	Polk, Pennington, Marshall	TP, TSS, DO, Bacteria, Altered Hydrology	n/a	10% TP reduction (MPCA Nutrient Strategy for the Red River Basin); Increased base flow; Increased connectivity; Decreased bacteria levels; Daily minimum DO > 5 mg/L	Reduce Nutrient Runoff	Ensure that buffers are installed and BMPs are used to reduce risk of sedimentation	Utilize PTMApp or other tools that help with targeting BMPs in watershed (SWI, Cover crops, etc.)	Implement targeted BMPs	X	X	X					X	2041
						Reduce field erosion	Work with operators to establish windbreaks, shelterbelts, and living snow fences to reduce field erosion and sediment build-up in ditches	Contact 25% of operators	Contact all operators		X	X						
						Improve soil health	Crop residue management and no-till practices	Show an increase in % of acres under no-till to help reduce soil loss	25% of cropland	X	X	X						
High	Grand Marais Creek (09020306-507) Headwater to CD2	Polk	Dissolved Oxygen	35% of DO samples < 5 mg/L @ CSAH 220; 38% of DO samples < 5 mg/L @ CSAH 19	Exceed 5.0 mg/L DO as a daily minimum.	Improve connectivity	Stream restoration that removes/modifies private stream crossings that are acting as barriers to fish/flow and improves the quality of buffers.	Between 390th Ave SW and Polk CD 2.	Between 390th Ave SW and Polk CD 2.	X	X					X		2031
						Restore channel	Ensure that culverts are properly sized for sediment transport and not causing degradation/aggradation	Culvert survey for improperly sized culverts	Resize all improperly sized culverts	X	X		X			X		
						Improve baseflow	Implement projects that improve base flow	50% of flood control structures	All flood control structures	X			X		X			
						Restore channel	Modify (2-stage ditch) and/or stabilize outlets of tributary ditches.	100% complete	100% complete	X	X		X			X		

Waterbody and Location			Parameter (incl. non-pollutant stressors)	Water Quality		Strategies	Strategy scenario showing estimated scale of adoption to meet 10 yr milestone and final water quality targets. Scenarios and adoption levels may change with additional local planning, research showing new BMPs, changing financial support and policies, and experience implementing the plan.			Governmental Units with Primary Responsibility								Estimated Year to Achieve Water Quality Target
								Estimated Adoption Rate										
Stream Priority	Stream AUID	Location and Upstream Influence Counties		Current Conditions (load or concentration)	Goals / Targets and Estimated % Reduction		Strategy Type	Interim 10-year Milestone	Suggested Goal	Watershed Districts	W Polk SWCD	NRCS	County/ Envtal Svcs	Pheasants Forever	ACOE	DNR	BWSR	
			Sediment	TSS meet standards (Protection);	No more than 10% of TSS samples exceed 65 mg/L in future assessments.	PTMApp Protection Structural BMPs	Critical Area Planting	5 acres	Reduce total sediment export as modeled at L1 management area pour point in PTMApp by 10% with BMP implementation in Polk CD 31, 36 and 38 subwatersheds.		X					X		2026
							Grade Stabilization Structures	15		X	X							
							Tree/Shrub Establishment	25 acres			X					X		
							Well Sealing	10			X							
							Septic System Upgrades	5					X					
							Upland Wildlife Habitat Management	5,300 acres		X	X			X		X		
							Restoration & Management of Rare/Declining Habitat	200 acres		X	X			X				
							Prescribed Burning	300 acres		X	X			X		X		
							Gravel Pit Reclamation	20 acres		X	X		X	X		X		
High	Grand Marais Creek (09020306-507) Headwater to CD2	Polk	Sediment	TSS meet standards (Protection);	No more than 10% of TSS samples exceed 65 mg/L in future assessments.	PTMApp Source Reduction Structural BMPs	Residue and Tile Management	480 acres	Reduce total sediment export as modeled at L1 management area pour point in PTMApp by 10% with BMP implementation in Polk CD 31, 36 and 38 subwatersheds.	X	X	X						2026
							Nutrient Management	480 acres			X	X						
							Cover Crop	480 acres			X	X						
						PTMApp Storage Structural BMPs	Drainage Water Management (Tile)	40 acres		X	X	X						
							Wetland Restoration	10 acres		X	X					X		
							Water Control Structures	5		X		X						
							Water and Sediment Control Basins	5		X	X							
							Diversion	1		X	X							
						PTMApp Filtration Structural BMPs	Conservation Cover	2,400 acres			X	X				X		
							Cover Crop	2,400 acres			X	X						
							Filter Strips	50 miles		X	X							
							Grassed Waterway	30 miles		X	X							
							Riparian Buffers	10 miles		X	X							

Waterbody and Location			Parameter (incl. non-pollutant stressors)	Water Quality		Strategies	Strategy scenario showing estimated scale of adoption to meet 10 yr milestone and final water quality targets. Scenarios and adoption levels may change with additional local planning, research showing new BMPs, changing financial support and policies, and experience implementing the plan.			Governmental Units with Primary Responsibility								Estimated Year to Achieve Water Quality Target
								Estimated Adoption Rate										
Stream Priority	Stream AUID	Location and Upstream Influence Counties		Current Conditions (load or concentration)	Goals / Targets and Estimated % Reduction		Strategy Type	Interim 10-year Milestone	Suggested Goal	Watershed Districts	W Polk SWCD	NRCS	County/ Envtal Svcs	Pheasants Forever	ACOE	DNR	BWSR	
High	*Grand Marais Creek (Restoration) (09020306-513) Diversion ditch to Red River*	Polk	Dissolved Oxygen; F-IBI, M-IBI	Not assessed	Improved DO concentrations and IBI scores.	Restore channel	Maintain Project 60 restoration	Ongoing	Ongoing	X								2031
						Reduce nutrient runoff	Ensure that buffers are installed and BMPs are used to reduce risk of sedimentation	Utilize PTMApp or other tools that help with targeting BMPs in watershed (SWI, Cover crops, etc.)	Implement targeted BMPs	X	X	X						
						Improve connectivity	Remove barriers	Review watershed for channel blockages	Remove blockages where feasible	X	X		X			X		
						Monitoring	Continue water quality monitoring	Sufficient data to assess at least 8 reaches during in 2024.	Add AUID 513 to monitoring plans.	x								
						Improve riparian vegetation	Once weed control requirements are met, allow and promote the establishment of native, herbaceous, deep-rooted, broadleaf vegetation along with woody vegetation such as willows and shrubs.	Introduce woody vegetation into the channel	Mowing and weed control is no longer necessary. Desirable vegetation is allowed to fully grow and dominate.	X	X		X					
High (glacial ridge)	CD 43/ JD 25-2 (Headwaters of JD75) (09020306-517) Unnamed ditch to CD 7	Polk, Pennington	Connectivity, Base flow, Habitat, Dissolved Oxygen, F-IBI, M-IBI, TSS	Low F-IBI, M-IBI	F-IBI > 35; M-IBI > 22	Restore channel	Incorporate the principles of natural channel design into ditch maintenance activities	Enhance 1 mile of channel to decrease water temperatures	100% of channel	X	X		X					2031
						Improve base flow	Modify flood control structures to increase baseflow	50% of flood control structures	All flood control structures	X					X			
High (glacial ridge)	CD 43 (09020306-517) Unnamed ditch to CD 7	Polk, Pennington	Connectivity, Base flow, Habitat, DO, F-IBI, M-IBI, TSS	Low F-IBI, M-IBI	F-IBI > 35; M-IBI > 22	Restore channel	Design 2 stage ditch to get lower bench with vegetation and keep low flow channel	Buffer and check culverts for adequate sized to bankful widths, fix bank sloughing (if any)	Design 2 stage ditch to get lower bench with vegetation and keep low flow channel	X	X		X					2031
High (glacial ridge)	CD 44 (Headwaters of JD75) (09020306-516) Headwaters to CD 7	Polk	Altered Hydrology	Not assessed	Collect additional monitoring data	Restore channel	Maintain floodplain access, keep channel natural (no channelization), Buffer channel	Introduce woody vegetation into the channel	Enhance 1 mile of channel with woody vegetation to reduce water temperature	X	X		X					2026

Waterbody and Location			Parameter (incl. non-pollutant stressors)	Water Quality		Strategies	Strategy scenario showing estimated scale of adoption to meet 10 yr milestone and final water quality targets. Scenarios and adoption levels may change with additional local planning, research showing new BMPs, changing financial support and policies, and experience implementing the plan.			Governmental Units with Primary Responsibility								Estimated Year to Achieve Water Quality Target
								Estimated Adoption Rate										
Stream Priority	Stream AUID	Location and Upstream Influence Counties		Current Conditions (load or concentration)	Goals / Targets and Estimated % Reduction		Strategy Type	Interim 10-year Milestone	Suggested Goal	Watershed Districts	W Polk SWCD	NRCS	County/ Envtal Svcs	Pheasants Forever	ACOE	DNR	BWSR	
High (glacial ridge)	RLWD Ditch 15 (Headwaters of CD2) (09020306-509) Headwaters to CD 66	Polk, Pennington	Dissolved Oxygen	30% of DO samples < 5 mg/L @ Hwy 75	Improved IBI scores & DO levels. Decreased TSS & *E. coli*. Water quality at Highway 75 (S004-132) meets all standards. TSS exceedances occur in 0% of samples collected in April - September.	Improve connectivity	Beaver dam removal and deterrence to promote connectivity	50% of beaver dams	All beaver dams	X						X		2031
						Improve base flow	Modify the operation of flood control structures to increase base flow	50% of flood control structures	All flood control structures	X					X			
						Improve riparian vegetation	Maintain quality vegetation along the Brandt Outlet Channel.	Enhance 1 mile of channel with deep-rooted and woody vegetation to decrease water temperature.	Improve the quality of vegetation along RLWD Ditch 15 downstream of Highway 75.	X	X							
						Monitoring	Continue water quality monitoring	Sufficient data to assess at least 8 reaches during in 2024. Continuous DO data from at least 5 AUIDs	Add AUID 513 to monitoring plans.	x								
						Restore channel	Ensure that the natural channel stays natural	Maintain floodplain	Maintain floodplain	X	X	X		X		X		
High (glacial ridge)	Brandt Impoundment (Red Lake River 1W1P Planning Zone M1/M2) Headwaters of RLWD Ditch 15 and Br. CD 66	Polk, Pennington	Sediment	Meets Standards (Protection)	No more than 10% of TSS samples exceed 65 mg/L in future assessments	PTMApp Protection Structural BMPs PTMApp Source Reduction Structural BMPs	Critical Area Planting	2 acres	Reduce total sediment export as modeled at M1/M2 management area pour point in PTMApp by 25% with BMP implementation in Polk CD 31, 36 and 38 subwatersheds.		X							2026
							Grade Stabilization Structures	1		X	X	X						
							Tree/Shrub Establishment	30 acres			X							
							Well Sealing	3			X							
							Alternative Tile Intakes	2				X						
							Septic System Upgrades	1			X		X					
							Upland Wildlife Habitat Management	3,000 acres		X	X			X				
							Restoration & Management of Rare/Declining Habitat	500 acres		X	X			X				
							Prescribed Burning	200 acres		X	X			X				
							Residue and Tile Management	3,000 acres				X						
							Nutrient Management	3,000 acres				X						
							Conservation Cover	600 acres				X						

Waterbody and Location: Stream Priority	Waterbody and Location: Stream AUID	Waterbody and Location: Location and Upstream Influence Counties	Parameter (incl. non-pollutant stressors)	Water Quality: Current Conditions (load or concentration)	Water Quality: Goals / Targets and Estimated % Reduction	Strategies	Strategy Type	Estimated Adoption Rate: Interim 10-year Milestone	Estimated Adoption Rate: Suggested Goal	Watershed Districts	W Polk SWCD	NRCS	County/ Envtal Svcs	Pheasants Forever	ACOE	DNR	BWSR	Estimated Year to Achieve Water Quality Target
							Strategy scenario showing estimated scale of adoption to meet 10 yr milestone and final water quality targets. Scenarios and adoption levels may change with additional local planning, research showing new BMPs, changing financial support and policies, and experience implementing the plan.			Governmental Units with Primary Responsibility								
High (glacial ridge)	Brandt Impoundment, Br C CD 66	Polk, Pennington	Sediment	Meets Standards (Protection)	<10% of TSS >65 mg/L	PTMApp Storage BMPs	Drainage Water Management (Tile)	60 acres	Reduce total sediment export by 25% at M1/M2 pour point	X		X						
						PTMApp Filtration Structural BMPs	Conservation Cover	3,000 acres				X						
							Cover Crop	10,000 acres				X						
							Filter Strips	5 miles		X	X	X						
							Grassed Waterway	0.25 miles		X	X	X						
							Field Borders	4 miles				X						
Medium	JD 75 (09020306-520) CD7 to Red River	Polk	Connectivity, Base flow, Habitat, Dissolved Oxygen, F-IBI, M-IBI	Low F-IBI; Monthly geometric average *E. coli* > 126 org/100mL in June and July	F-IBI > 35; Monthly geometric average *E. coli* < 126 org/100mL	Restore channel	Incorporate the principles of natural channel design into ditch maintenance activities	25% of channel	100% of channel	X	X		X					2036
						Improve base flow	Modify FDR structures to increase base flow	50% of flood control structures	All flood control structures	X					X			
						Restore altered hydrology	FDR structures with multifunctional design	Map of suitable potential flood control projects	Retrofit all priority flood control structures with multifunctional design	X								
						Reduce wildlife fecal contributions	Beaver dam removal and deterrence Road overpass bird nesting deterrence	All beaver dams removed	Deterrence practices implemented at all observed beaver dam and bird nesting sites							X		
						Identify bacteria sources	Use molecular biomarker testing	Source of fecal pollution confirmed with molecular biomarkers	Source of fecal pollution confirmed with molecular biomarkers	X								
						Stabilize banks	Stabilize ditch banks near Red River	Half mile of two-stage ditch	1 mile of two-stage ditch	X	X		X			X		
						Restore channel	Design 2 stage ditch to get lower bench with vegetation and keep low flow channel	Buffer and check culverts for adequate sized to bankful widths, fix bank sloughing (if any)	Enhance 1 mile of channel to decrease water temperature	X	X		X			X		
Medium	CD 2 (09020306-515) CD 66 to Grand Marais Creek	Polk	Connectivity, Base flow, Habitat, Dissolved Oxygen, F-IBI, M-IBI; *E. coli*	Low F-IBI, Low M-IBI, Monthly geometric average *E. coli* > 126 org/100mL	Increase F-IBI to > 35; Increase M-IBI to > 22; Monthly geometric *E.*	Restore channel	Incorporate the principles of natural channel design into ditch maintenance activities	25% of channel	100% of channel	X	X		X			X		2036
						Stabilize banks	Stabilize ditch banks	Ensure buffers are installed and bank sloughing is addressed properly	Restore any bank sloughing and evaluate for 2-stage ditch design	X	X		X					

Waterbody and Location			Parameter (incl. non-pollutant stressors)	Water Quality		Strategies	Strategy scenario showing estimated scale of adoption to meet 10 yr milestone and final water quality targets. Scenarios and adoption levels may change with additional local planning, research showing new BMPs, changing financial support and policies, and experience implementing the plan.			Governmental Units with Primary Responsibility								Estimated Year to Achieve Water Quality Target
								Estimated Adoption Rate										
Stream Priority	Stream AUID	Location and Upstream Influence Counties		Current Conditions (load or concentration)	Goals / Targets and Estimated % Reduction		Strategy Type	Interim 10-year Milestone	Suggested Goal	Watershed Districts	W Polk SWCD	NRCS	County/ Envtal Svcs	Pheasants Forever	ACOE	DNR	BWSR	
					coli average < 126 org/100mL	Improve base flow	Modify flood control structures to increase base flow	50% of flood control structures	All flood control structures	X					X			
						Improve connectivity	Remove or modify barriers leading to periods of intermittent flow, including beaver dams and culverts	50% of barriers	All barriers	X			X			X		
Medium	CD 2 (09020306-515) CD 66 to Grand Marais Creek	Polk	Connectivity, Base flow, Habitat, Dissolved Oxygen, F-IBI, M-IBI; *E. coli*	Low F-IBI, Low M-IBI, Monthly geometric average *E. coli* > 126 org/100mL	Increase F-IBI to > 35; Increase M-IBI to > 22; Monthly geometric *E. coli* average < 126 org/100mL	Identify bacteria sources	Use molecular biomarker testing to confirm beaver and bird sources of fecal pollution or identify alternative sources	Source of fecal pollution confirmed with molecular biomarkers	Source of fecal pollution confirmed with molecular biomarkers	X								2036
						Stabilize banks	Address stream bank stability problems.	Grade/bank stabilization project has been completed.	Banks are stable, TSS concentrations are trending downward.	X	X		X			X		
						Grade Stabilization	Repair/replace/modify failed grade stabilization structure at 48.049550 -97.041086. The structure was a fish barrier prior to failure and is a cause of accelerated erosion	A project has completed to fix the problem.	There is neither a fish barrier nor an erosion problem at this location.	X	X		X			X		
							Targeted grade/bank stabilization downstream of Hwy 220	A project has completed to fix the problem.	There is neither a fish barrier nor an erosion problem at this location.	X	X		X			X		
						Monitoring	Continue water quality monitoring	Sufficient data to assess at least 2 AUIDs	Add site to AUID 509	x								
						Improve riparian vegetation	Improve the buffer along the S side of the ditch	Introduce woody vegetation into the channel	100% complete	X	X		X					
Medium	CD 2/ RLWD Ditch 15/ CD 66/ Br. CD 66 (09020306-515, -509, -514, and -510) Red Lake River 1W1P	Polk, Pennington	Sediment	Meets Standards (Protection)	No more than 10% of TSS samples exceed 65 mg/L in future assessments	PTMApp Protection Structural BMPs	Critical Area Planting	5 acres	Reduce total sediment export as modeled at L2 management area pour point in PTMApp by 10% with BMP implementation in Polk CD 31, 36 and 38 subwatersheds.		X							2026
							Grade Stabilization Structures	10		X	X							
							Tree/Shrub Establishment	10 acres			X							
							Well Sealing	5			X							

Waterbody and Location			Parameter (incl. non-pollutant stressors)	Water Quality		Strategies	Strategy scenario showing estimated scale of adoption to meet 10 yr milestone and final water quality targets. Scenarios and adoption levels may change with additional local planning, research showing new BMPs, changing financial support and policies, and experience implementing the plan.			Governmental Units with Primary Responsibility								Estimated Year to Achieve Water Quality Target
								Estimated Adoption Rate										
Stream Priority	Stream AUID	Location and Upstream Influence Counties		Current Conditions (load or concentration)	Goals / Targets and Estimated % Reduction		Strategy Type	Interim 10-year Milestone	Suggested Goal	Watershed Districts	W Polk SWCD	NRCS	County/ Envtal Svcs	Pheasants Forever	ACOE	DNR	BWSR	
	Planning Zone L2						Septic System Upgrades	3					X					
							Upland Wildlife Habitat Management	4,000 acres		X	X			X				
							Restoration & Management of Rare/Declining Habitat	100 acres		X	X			X				
							Prescribed Burning	200 acres		X	X			X				
						PTMApp Source Reduction Structural BMPs	Residue and Tile Management	800 acres			X	X						
							Nutrient Management	800 acres			X	X						
							Rotational and Prescribed Grazing	320 acres			X	X						
							Conservation Cover	320 acres			X	X						
Medium	CD 2/ RLWD Ditch 15/ CD 66/ Br. CD 66 (09020306-515, -509, -514, and -510) Red Lake River 1W1P Planning Zone L2	Polk, Pennington	Polk, Pennington	Meets Standards (Protection)	No more than 10% of TSS samples exceed 65 mg/L in future assessments	PTMApp Storage Structural BMPs	Drainage Water Management (Tile)	40 acres	Reduce total sediment export as modeled at L2 management area pour point in PTMApp by 10% with BMP implementation in Polk CD 31, 36 and 38 subwatersheds.	X	X	X					X	2026
							Wetland Restoration	20 acres		X	X	X						
							Water Control Structures	5		X	X	X						
							Water and Sediment Control Basins	10		X	X							
							Diversion	1		X	X							
						PTMApp Filtration Structural BMPs	Conservation Cover	1,600 acres			X	X						
							Cover Crop	1,600 acres			X	X						
							Filter Strips	10 miles		X	X	X						
							Grassed Waterway	10 miles		X	X	X						
							Riparian Buffers	5 miles		X	X							
Low	JD 1 (09020306-519)	Polk	Altered Hydrology; *E. coli*	Monthly geometric average *E. coli* > 126	Monthly geometric average *E. coli*	Reduce wildlife fecal contributions	Beaver dam removal and deterrence Road overpass bird nesting deterrence	All beaver dams removed	Deterrence practices implemented at all observed beaver dam and bird nesting sites	X			X			X		2026

Waterbody and Location			Parameter (incl. non-pollutant stressors)	Water Quality		Strategies	Strategy scenario showing estimated scale of adoption to meet 10 yr milestone and final water quality targets. Scenarios and adoption levels may change with additional local planning, research showing new BMPs, changing financial support and policies, and experience implementing the plan.			Governmental Units with Primary Responsibility								Estimated Year to Achieve Water Quality Target
								Estimated Adoption Rate										
Stream Priority	Stream AUID	Location and Upstream Influence Counties		Current Conditions (load or concentration)	Goals / Targets and Estimated % Reduction		Strategy Type	Interim 10-year Milestone	Suggested Goal	Watershed Districts	W Polk SWCD	NRCS	County/ Envtal Svcs	Pheasants Forever	ACOE	DNR	BWSR	
	CD 7 to Red River			org/100mL in June, July and August	< 126 org/100mL	Identify bacteria sources	Use molecular biomarker testing to ID sources	Source of fecal pollution confirmed with molecular biomarkers	Source of fecal pollution confirmed with molecular biomarkers	X								
						Stabilize banks	Stabilize ditch banks near Red River	Half mile of two-stage ditch	1 mile of two-stage ditch	X			X					
						Restore channel	Design 2 stage ditch to get lower bench with vegetation and keep low flow channel	Buffer and check culverts for adequate sized to bankful widths, fix bank sloughing (if any)	Enhance 1 mile of channel to decrease water temperature	X			X					
Low	CD 7 (09020306-518) CD 43 to JD 1	Polk	Altered Hydrology	Not assessed	Collect additional monitoring data	Improve riparian vegetation	Keep channel natural, introduce woody vegetation to shade channel	Buffer and check culverts for adequate sized to bankful widths	Enhance 1 mile of channel to decrease water temperature				X					2026
Low	Unnamed Ditch (Br. CD 66) (09020306-510) Headwaters (Euclid Township) to CD 2	Polk	Altered Hydrology	Not assessed	IBI scores meet standards.	Improve base flow	Adjust the operation of impoundments to maintain base flows	100% complete	100% complete	X								2036
						Restore channel	Two-stage ditch design is incorporated into any significant future ditch projects.	Review culvert sizes and investigate channel for buffer	Funding for 2-stage ditch design for future clean-outs or improvement projects. Improved buffers. Culverts are adequately sized with bankfull widths	X	X		X			X	X	
						Improve riparian veg	Enhance channel with woody vegetation to	1 mile	Keep channel natural. Lower water temps	X	X		X			X		
						Address failing septics	Ensure that septic systems are in compliance (Euclid)	LGU staff have reviewed records and/or conducted an inventory of septic systems in the town	*E. coli* concentrations continue to be at acceptable levels.		X		X					
Low	CD 66 (09020306-514) Headwaters to CD 66	Polk	Altered Hydrology	Not assessed	Collect additional monitoring data	Restore channel	Improve buffers and culverts along ditch	Avoid disturbance of the channel (water quality is currently good).	The ditch is left undisturbed, with improved buffers and properly sized culverts.	X	X		X					2036
						Restore channel	2-stage ditch design is incorporated into future ditch project to create lower bench with vegetation and keep low flow channel.	Recreate ditch for 1 mile, planting native vegetation.	Funding is acquired to allow for the application of 2-stage ditch design during future petitioned clean-outs or improvement projects.	X	X		X			X		

Waterbody and Location			Parameter (incl. non-pollutant stressors)	Water Quality		Strategies	Strategy scenario showing estimated scale of adoption to meet 10 yr milestone and final water quality targets. Scenarios and adoption levels may change with additional local planning, research showing new BMPs, changing financial support and policies, and experience implementing the plan.			Governmental Units with Primary Responsibility								Estimated Year to Achieve Water Quality Target
								Estimated Adoption Rate										
Stream Priority	Stream AUID	Location and Upstream Influence Counties		Current Conditions (load or concentration)	Goals / Targets and Estimated % Reduction		Strategy Type	Interim 10-year Milestone	Suggested Goal	Watershed Districts	W Polk SWCD	NRCS	County/ Envtal Svcs	Pheasants Forever	ACOE	DNR	BWSR	
Low	CD 126 (09020306-511) Unnamed Creek to Grand Marais Creek	Polk	Altered Hydrology	Not assessed	Collect additional monitoring data	Restore channel	Two-stage ditch design is incorporated into any significant future ditch projects.	The ditch is left undisturbed, with improved buffers. Enhance 1 mile of channel.	Funding is acquired to allow for the application of 2-stage ditch design during future petitioned clean-outs or improvement projects.	X	X		X			X		2041
						Stabilize banks	Stabilize ditch banks	Review channel for bank sloughing and that inputs to the ditch are properly protected from excessive sedimentation (SWI)	Culverts, SWI review and bank sloughing areas are fixed	X	X		X					
						Stabilize banks	Road overtopping and erosion at 47.93466 -96.701315 is addressed	The site has been assessed by qualified personnel. Solutions have been proposed and implemented.	Stream bank remains vegetated, measures implemented to reduce road overtopping.	X	X		X			X		
						Grade Stabilization	Install side water inlets.	An inventory of the ditch has been completed to determine the number of SWIs that are needed. A project/initiative has been completed to install SWIs where needed.	TSS concentrations in Grand Marais Creek are trending downward.	X	X	X	X					
						Grade Stabilization	Stabilize the outlet to reduce erosion within the ditch, reduce headcutting, and reduce sedimentation	A stabilization project has been completed.	The outlet remains stable. Vegetation is established on the banks. TSS concentrations are trending downward.	X	X		X					
Low	Grand Marais Crk (09020306-521) CD 2 to diversion ditch	Polk	Altered Hydrology	Not assessed		Improve riparian vegetation	Maintain cutoff channel with woody debris/vegetation along channel	Maintain current conditions	No new problems have been identified. The quality of the riparian buffer has not been degraded.	X	X		X					2041
Low	Grand Marais Creek Cutoff Channel (09020306-522) Grand Marais Crk to Red R	Polk	Altered Hydrology	Not assessed		Stabilize banks	Monitor and improve stream bank stability. Allow growth of willows, shrubs, and deep-rooted vegetation to add structural stability and to consume moisture.	Maintain cutoff channel & floodplain	Stream banks have not sloughed.	X	X		X					2041

4. Monitoring Plan

Stream Monitoring

As part of the MPCA IWM strategy, four stream sites were monitored for biology (fish and macroinvertebrates) and water chemistry: JD 75 at CR 22, CD 2 at CR 62, Grand Marais Creek at CR 64, and JD 1 at CR 22. The MPCA collected biological samples in 2012, which was a dry year. Fewer sites were sampled for biology during this round of IWM due to no water in many streams. Additional sites will likely be sampled in the next 10-year IWM cycle. Details about the MPCA IWM strategy can be found in the Grand Marais Creek Watershed Monitoring and Assessment Report: https://www.pca.state.mn.us/sites/default/files/wq-ws3-09020306b.pdf

The RLWD has been collecting water quality samples in the Grand Marais Creek Watershed for its long-term monitoring program since 1980. Field measurements of DO, temperature, turbidity, specific conductivity, pH, and stage are collected during each site visit (if there is water). Four rounds of samples are also collected and analyzed for TP, OP, TSS, total dissolved solids, total Kjeldahl nitrogen, ammonia nitrogen, nitrates + nitrites, and *E. coli* at most of the sites. For the past few years, biochemical oxygen demand analysis has been added for the sites that are located on reaches that have had low DO levels. BOD was replaced with chemical oxygen demand analysis in 2014 because too many BOD levels were too low to be measured. Sampling months are alternated each year with the goal of collecting at least five samples per calendar month within a 10-year period. Within the Grand Marais Creek Watershed, the RLWD monitors:

1. Grand Marais Creek at Polk County Road 35 (130th St. NW, S008-903)
2. Grand Marais Creek at 110th St. NW (S008-902)
3. Polk CD 2 at Polk County Road 62 (S004-131)
4. RLWD Ditch 15 at CSAH 20 (S008-897)

River Watch is a volunteer monitoring program that gives high school students the opportunity to collect water quality data. This data is collected using the same methods that are used by professionals and is stored in the EQuIS database along with all other data that is collected within the watershed. Students from East Grand Forks (Sacred Heart High School) and Fisher High School have participated in the program and collected data within the Grand Marais Creek Watershed. RLWD and International Water Institute staff should continue to work with those schools and encourage the inclusion of Grand Marais Creek Watershed sites in their monitoring repertoire.

Overall, less data has been collected in the Grand Marais Creek Watershed compared to other watersheds. Additional data needs, contingent on funding and priorities, could include long-term flow monitoring on Grand Marais Creek upstream of CD2, continuous DO data collection on streams with biological impairments, and regular water quality monitoring on all assessed AUIDs.

The collection of continuous DO data is essential, at most sites, for the collection of DO measurements prior to 9:00 a.m. Moreover, the new MPCA river eutrophication assessment (DO flux) now requires a minimum of two DO logger deployments over separate years within the assessment window. The MPCA requires a record of pre-9 a.m. DO readings to declare that the waterway contains enough DO to fully support aquatic life. Deployed instruments can collect regular DO measurements (e.g. every 15 or 30 minutes) while deployed in a waterway. Equipment is deployed for a maximum of two weeks before it is retrieved for data retrieval, cleaning, and re-calibration. Prior to the next formal water quality assessment of the Grand Marais Creek Watershed, continuous DO monitoring would be needed to fully assess the capacity of key reaches in the watershed to support aquatic life. Priority should be given to reaches and sites that are too remotely located from LGU offices for pre-9am measurements.

Contingent on funding and priorities, it is recommended that continuous, long-term flow monitoring stations be established to improve future load calculations and assess how altered hydrology impacts impairments in this watershed:

1. Grand Marais Creek at S008-897
2. County Ditch 2 at S004-131
3. County Ditch 2 at S008-897
4. Judicial Ditch 1 at S005-571
5. Judicial Ditch 75 at S005-570)

Contingent on funding and priorities, bolstered data collection efforts at key sites would aid with pre/post project and BMP evaluation:

1. RLWD Ditch 15 (Brandt Channel) at Highway 75 (S004-132) for evaluation of the effects of the Brandt Impoundment and outlet restoration project.
2. RLWD Ditch 15 at CSAH 20 (S008-897) as a pour-point monitoring site for AUID 09020306-509.
3. Polk CD 2 at Polk CR 62 (S004-131) to evaluate the effects of the Brandt Impoundment, Euclid Impoundment, Brandt Outlet Channel Restoration Project, and the Ditch 15 project.
4. Grand Marais Creek at Polk CR 35 (130th St. NW, S008-903) to evaluate the effects of the Grand Marais Creek Outlet Restoration Project.
5. Grand Marais at 110th St. NW (S008-902) as a pour-point monitoring site for the Headwaters to CD 2 reach (09020306-507) of Grand Marais Creek.
6. JD 75, JD1, and CD 43 are three ditches with impairments, but are not currently part of a long-term monitoring program. The MSTRWD and/or the West Polk SWCD could use these impairments (and others) as motivation for developing long-term water quality sampling programs.
7. Microbial source tracking samples and longitudinal samples should be collected to identify sources of bacteria along AUID 09020306-507. Those sources should be addressed prior to the 2024 assessment to avoid a new impairment designation.

BMP Monitoring

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

5. References and Further Information

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Lauer, W., Wong, M. and Mohseni, O. 2006. *Sediment Production Model for the South Branch of the Buffalo River Watershed*. Project Report No. 473. University of Minnesota, St. Anthony Falls Laboratory. Minneapolis, Minnesota

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Grand Marais Creek Watershed Reports

All Grand Marais Creek reports referenced in this watershed report are available at the Grand Marais Creek Watershed webpage: https://www.pca.state.mn.us/water/watersheds/red-river-north-grand-marais-creek