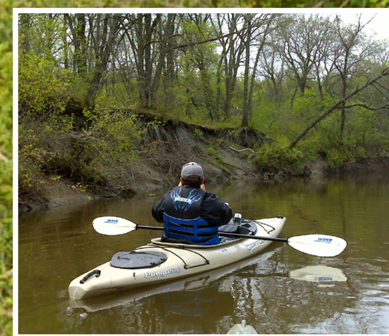

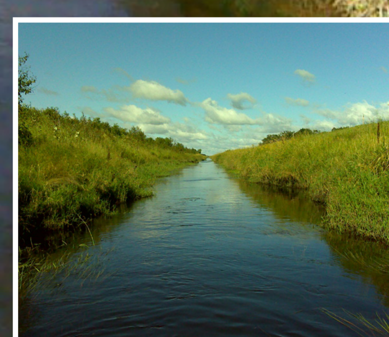

Thief River Comprehensive Watershed Management Plan

FEBRUARY 2020

Prepared for:
Thief River Planning Partnership through the One Watershed, One Plan Program

Prepared by:
Houston Engineering, Inc.

Funding provided from the Clean Water Fund

CLEAN WATER LAND & LEGACY AMENDMENT

3. MEASURABLE GOALS

4. TARGETED IMPLEMENTATION

5. IMPLEMENTATION PROGRAM

APPENDIX

Prepared for:
Thief River Planning Partnership through the
One Watershed, One Plan Program

Prepared by:
Houston Engineering, Inc.

GLOSSARY OF ABBREVIATIONS

1W1P	One Watershed, One Plan
AC	Advisory Committee
AIS	Aquatic Invasive Species
AUID	Assessment Unit Identification
BFE	Base Flood Elevation
BWSR	Board of Water and Soil Resources
CD	County Ditch
CFS	Cubic Feet per Second
DO	Dissolved Oxygen
DWSMA	Drinking Water Supply Management Area
ECS	Ecological Classification System
EDA	Environmental Data Access (MPCA Database)
EPA	Environmental Protection Agency
FDR	Flood Damage Reduction
FEMA	Federal Emergency Management Authority
FTPGW	Fail to Protect Groundwater
HEI	Houston Engineering, Inc.
HSPF	Hydrological Simulation Program - FORTRAN
HUC	Hydrologic Unit Code
IBA	Important Bird Area
IBI	Index of Biological Integrity
ISTS	Individual Sewage Treatment System
ITPHS	Imminent Threat to Public Health and Safety
JD	Judicial Ditch
LWRI	Land and Water Resources Inventory
MCBS	Minnesota County Biological Survey
MDA	Minnesota Department of Agriculture
MDH	Minnesota Department of Health
MnDNR	Minnesota Department of Natural Resources
MOA	Memorandum of Agreement
MPCA	Minnesota Pollution Control Agency

MPN	Most Probable Number
MSHA	Minnesota Stream Habitat Assessment
MWRPP	Major Watershed Restoration and Protection Plan
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
NWI	National Wetland Inventory
NWR	National Wildlife Refuge
PC	Policy Committee
PTMApp	Prioritize, Target, and Measure Application
PWG	Planning Work Group
RRBC	Red River Basin Commission
RLWD	Red Lake Watershed District
SD	State Ditch
SOM	Soil Organic Matter
SSTS	Subsurface Sewage Treatment Systems
SWAA	Source Water Assessment Area
SWB	Soil-Water Balance
SWCD	Soil and Water Conservation District
TALU	Tiered Aquatic Life Use
TMDL	Total Maximum Daily Load
TP	Total Phosphorus
TSS	Total Suspended Solids
USDA	US Department of Agriculture
USFWS	US Fish and Wildlife Service
USGS	US Geological Survey
WASCOBS	Water and Sediment Control Basins
WEQ	Wind Erosion Equation
WEPS	Wind Erosion Prediction System
WHAF	Watershed Health Assessment Framework
WHPA	Wellhead Protection Area
WRAPS	Watershed Restoration and Protection Strategy

DEFINITIONS

Measurable Goal Category—The organizational framework for measurable goals. Includes the priority resource issues addressed, short- and long-term measurable goals, and metrics for measuring progress towards attainment.

Measurable Goal—A statement of intended accomplishment for each priority issue. Goals are meant to be simply stated and achievable, can be quantitative or qualitative, can be long- or short-term, and are meant to be measurable through the implementation of actions to attain a desired outcome.

Metric—A feature, attribute, characteristic, amount, or quantity that forms the unit by which progress is measured towards attaining a measurable goal in a given time frame. For this plan, two time frames are used: short-term (covering the 10-year plan period) and long-term (following the 10-year plan period).

Priority Issue—Issues categorized, through the prioritization process (Section 2.0), as Priority Level A or B issues. Priority issues will be the focus of this comprehensive plan.

Resource Category—A resource category, or "resource," is defined as a natural, economic, educational, biotic, aesthetic, land, or similar asset. Resources are generally considered something that can be managed, and are generally broad, such as surface water or groundwater.

Resource Concern—A resource concern, or "concern," is defined as a physical, biological, chemical, or geological subset or component of a resource. For example, the resource "surface water" can be further refined into several components, including wetlands and drainage systems.

Resource Issue—A resource issue, or "issue," affecting a concern is defined as a factor, stressor, pollutant or difficulty resulting in an adverse consequence for a concern. A concern can have one or many issues. For instance, nitrate nitrogen causing the contamination of drinking water supply could be an issue (i.e. nitrate nitrogen) affecting a concern (i.e. drinking water supplies).

REFERENCES

"One Watershed, One Plan – Plan Content Requirements". (2016). Minnesota Board of Water and Soil Resources.

"60-Day Notification Responses". (2017). Minnesota Pollution Control Agency.

"Rural Land Stewardship Analysis". (2019). Houston Engineering, Inc.

EXECUTIVE SUMMARY

The Thief River Watershed One Watershed, One Plan (1W1P) represents an evolution from traditional water planning to watershed-based planning for northwestern Minnesota. The 1W1P is a statewide effort, aimed to transform the way local entities plan for resource management. The implementation-focused 1W1P combines local entities that focus on what resource issues are most important locally. In the Thief River Watershed, this brings three counties, three soil and water conservation districts, and one watershed district together into one cohesive and comprehensive water planning document.

The Thief River Watershed 1W1P Planning Group previously entered into a formal agreement through a Memorandum of Agreement to lead the 1W1P planning process for the Thief River Watershed. The parties are drafting a revised Memorandum of Agreement for implementing this plan. Expectations are that the roles of the local Policy Committee, Planning Work Group, and Advisory Committee will shift and change focus during plan implementation. Ultimately, the goal of this plan is to use local and state resources to efficiently manage, restore, and protect water resources in the Thief River Watershed. This plan is a ten-year guide to assist local governments to coordinate implementation efforts through annual work planning, improve efficiencies, and reduce redundancies in local water resource management.

The Thief River One Watershed, One Plan (1W1P) planning area is in northwest Minnesota, encompassing portions of Beltrami, Marshall and Pennington counties and the Red Lake Watershed District (RLWD). The Thief River Watershed is endowed with productive agricultural land as well as invaluable habitat for aquatic life, deer, waterfowl, shorebirds, and other migrating birds. The Thief River Watershed planning area drains approximately 1,048 square miles (sq. mi.) or 671,024 acres. Fourtown, Goodridge, Grygla, Holt, and Thief River Falls are the only municipalities in the watershed.

A watershed is an area of land where all the water drains to a common point. In the case of the Thief River Watershed, this common point is at the confluence of the Thief River and the Red Lake River. The Thief River Watershed is part of the larger Red River Basin. It contributes flow downstream through the Red Lake River, to the Red River of the North, and eventually to Lake Winnipeg and Hudson Bay in Manitoba, Canada. It is a headwaters watershed, meaning that no water flows into the Thief River Watershed from anywhere else. As a headwaters watershed, the Thief River Watershed is located within an area of the Red River Basin that the Red River Basin Flood Damage Reduction Work Group identified as a strategic area to retain water. The watershed also has large expanses of prime wetland habitat, primarily in the Agassiz National Wildlife Refuge and the Thief Lake Wildlife Management Area.

The Thief River runs along the western side of the watershed, beginning at Thief Lake down through Agassiz National Wildlife Refuge to the Red Lake River in Thief River Falls. Within the planning regions and tributaries, portions of the Thief River are also legal drainage ditches—State Ditch 83 and Judicial Ditch 21. The Thief River receives water from the east from the Moose River (Judicial Ditch 21), the Mud River (Judicial Ditch 11), Branch 200 of Judicial Ditch 11 (Lost River), Marshall County Ditch 20, and Judicial Ditch 30. Just as the Thief River Watershed is part of the larger Red River Basin, these rivers and drainage ditch systems are also considered smaller watersheds, or subwatersheds, within the Thief River Watershed. These watersheds, along with three subwatersheds along the path of the Thief River (Upper Thief River/ SD 83, Middle Thief River/ SD 83, and Lower Thief River/ SD 83) are referred to as "planning regions" throughout this document and are shown in **Figure ES-1**.

As a result of its position in the Red River Basin and the abundance of state and federally protected wildlife habitat, there are more than 30 impoundments and reservoirs in the watershed. These impoundments are managed for the flood damage reduction benefits they provide to the watershed and the Red River Basin as well as for wildlife. *This plan acknowledges the multiple benefits for flood protection and wildlife that are provided by impoundments but recommends additional actions that local landowners can implement on a voluntary basis through partnerships with local, state, and federal entities to reduce runoff locally and downstream, improve water quality, and manage water resources in a balanced and cooperative manner.*

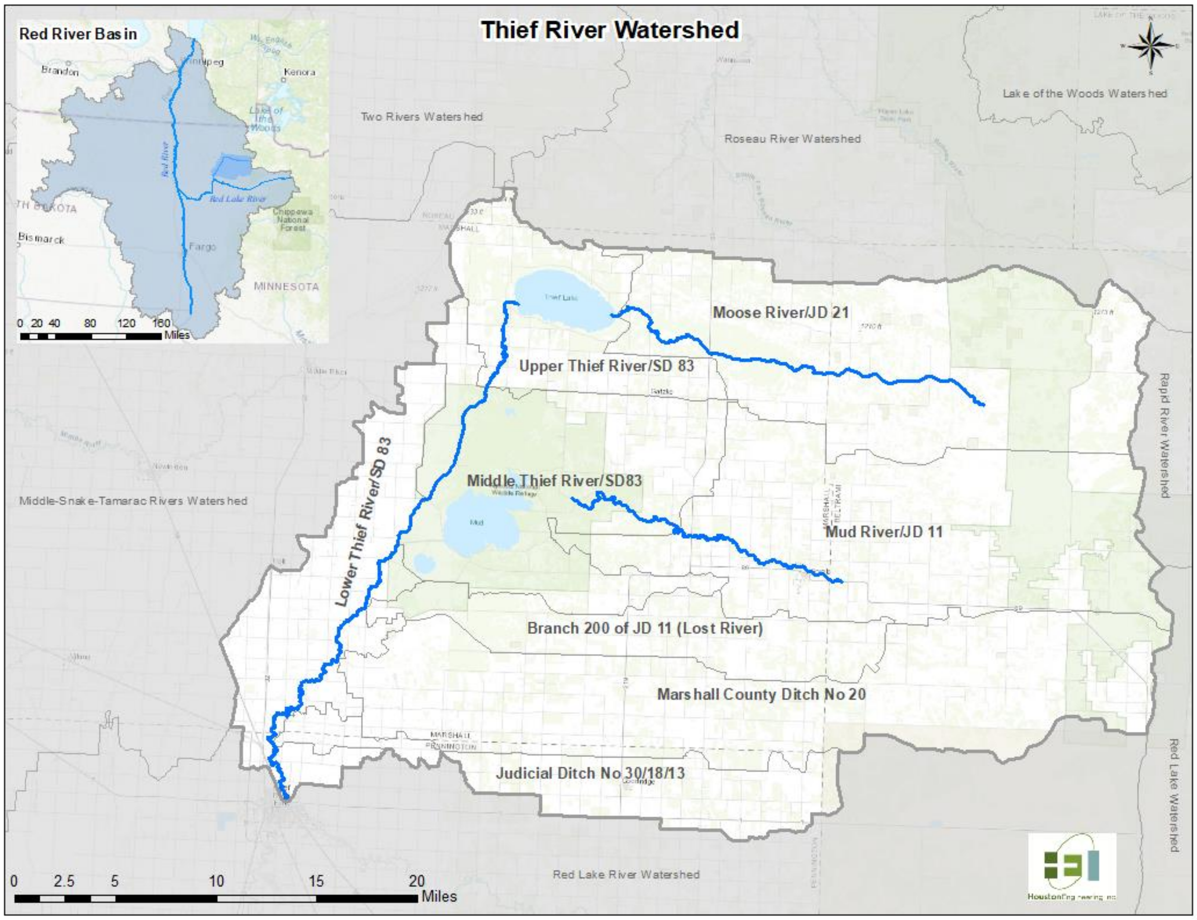

Figure ES-1: Thief River Watershed 1W1P Plan Area and Planning Regions

In 2017, members of the three counties, three soil and water conservation districts (SWCDs) and one watershed district within the Thief River Watershed joined together to create the Thief River 1W1P Planning Group. The purpose of the Thief River 1W1P Planning Group was to unite local entities that would otherwise have separate local water management plans under one comprehensive watershed management plan, creating a cohesive vision for implementing actions to improve locally prioritized issues. To address these issues, this plan establishes measurable goals and actions to be implemented on a voluntary basis through partnerships between local, state, and federal entities and private landowners. This plan hopes to unlock noncompetitive watershed-based state funding for implementation as recommended by the State of Minnesota Clean Water Council. It does not supersede nor replace existing statutes, rules, and local ordinances that regulate water resource management. Rather, it is a guide for local governments to work together in coordination with landowners to efficiently address water resource issues in the watershed. This plan is the result of that vision and a significant step toward accelerating prioritized, targeted, and measurable implementation efforts in the Thief River Watershed.

ADMINISTRATION AND COORDINATION

The Planning Work Group, Advisory Committee, and Policy Committee structures from the plan development process will be maintained throughout the lifespan of the plan. The Planning Work Group and Policy Committee will meet on a quarterly basis, and the Advisory Committee will meet annually. A Plan Coordinator at the direction of the Policy Committee will become responsible for completing annual work planning and submitting annual reports. The RLWD will serve as the central fiscal agent.

IDENTIFYING AND PRIORITIZING ISSUES

The Thief River Watershed is home to a diverse range of resources, including:

- a network of streams, rivers, and agricultural drainage systems;
- approximately 330,223 acres of wetlands;
- more than 30 impoundments;
- unique habitat areas for aquatic and terrestrial species; and
- urban and rural land uses.

With all these resources, there are many issues to manage. In recognition of staff, time, and resource limitations, the Thief River 1W1P Planning Group needed to prioritize issues as the focus of implementation efforts during the 10-year lifespan of this plan.

The Thief River 1W1P Planning Group developed a comprehensive inventory of 14 resources and 46 issues (Table 2-1) impacting the watershed using a combination of existing reports, data, and stakeholder input. This comprehensive inventory was used to prioritize issues to be addressed through implementation efforts. Issues were prioritized and designated as an A, B, C, or unranked priority tier based on input from the public and professional judgment.

From this initial inventory, 27 issues emerged as priority issues. These priority issues ended up being ranked as either Priority Tier A (**Table ES-1)** or B (**Table ES-2**). They will be the focus of initial implementation efforts within the Thief River 1W1P planning area.

Table ES-1: Priority Tier A Issues

Resource Category	Resource Concern	Issue
Priority Tier A		
2. Surface Waters: Water resulting from excess precipitation leaving the landscape and collecting in ditches, streams, rivers, creeks, wetlands, lakes and ponds.		
2. Surface Waters	2.1 Aquatic Life and Recreation	2.1.1: Water Quality: Elevated concentrations of suspended solids, sediment, and total phosphorus approaching (protection) or exceeding (restoration) water quality standards for aquatic life, which can lead to aquatic life impairments.
		2.1.2: Water Quality: Elevated concentrations of bacteria approaching (protection) or exceeding (restoration) water quality standards for aquatic recreation, which can impact beneficial uses.
		2.1.7 Water Quality: Decreased stream channel stability driven by hydrologic changes that increase erosion and sediment transport, which can decrease beneficial uses of streams, rivers, and lakes.
	2.2 Surface Runoff and Flooding	2.2.1: Water Quantity: Changes in natural water storage and vegetative cover on the landscape, including natural depressional areas, wetlands, loss of vegetative cover and soil organic matter, which can cause an increase in the volume of runoff, peak discharges, and water levels, causing flooding and flood damages to agricultural land, wildlife habitat, transportation systems, buildings, and structures.
		2.2.2: Water Quantity: High peak flows causing flood damages to agricultural land and public infrastructure, homes and other structures, rerouted flows, and accelerated bank erosion to artificial and natural waterways; low flows which can impact aquatic life and aquatic recreation.

Resource Category	Resource Concern	Issue
	2.3 Drainage Management Systems	2.3.1: Increased erosion and sedimentation resulting from bank failure and slumping, and gully formation prevents the proper function of drainage systems and increases maintenance costs.
	2.5 Drinking Water	2.5.1: Water Quality: Elevated concentrations of sediment, and organic matter have a detrimental impact on drinking water quality.
	2.6 Wetlands	2.6.1: Sediment deposition in wetlands degrades hydrologic function, contributes to nonnative plant species succession, and contributes to sediment and highly organic/low dissolved oxygen water to downstream waterways.
3. Fish and Wildlife Habitat and Unique Natural Features: Visible natural features and characteristics of the landscape, which are often prominent or unique.		
3. Fish and Wildlife Habitat	3.1 Aquatic Habitat for Fish, Macroinvertebrates, Wildlife, and Aquatic Life	3.1.3: Degradation of aquatic habitat, aquatic vegetation, and riparian habitat associated with increased drainage, channelization, ditch maintenance, and development, and the physical damage to the banks and beds of creeks, streams and rivers from higher and faster flows pose public lands and waters management challenges.
	3.2 Shoreland and Riparian Zones	3.2.1: Quantity and quality of vegetation along waterways, including riparian forests and buffers along ditches in shorelines, that filter pollutants, retain soil, improve water quality, and restore wildlife habitat.
5. Local Development and Land Stewardship: The management of urban and rural land use through sustainable development.		
5. Local Development and Land Stewardship	5.2 Healthy Rural Landscapes	5.2.1: Reduced soil health, soil protection, excess loss of fertilizers or pesticides, and its impact on agricultural productivity, surface water quality and quantity, sedimentation in water features, and water holding capacity.
		5.2.3: Improperly installed or poorly functioning subsurface sewage treatment systems (SSTS) and individual sewage treatment system (ISTS) increase the potential for ground and surface water contamination, adversely impacting human health and water quality.

Table ES-2: Priority Tier B Issues

Resource Category	Resource Concern	Issue
Priority Tier B		
1. Groundwater: Water which is held underground within the pores of rocks and soils.		
1. Groundwater	1.1 Drinking Water	1.1.1: Water Quality: Protection of generally good quality groundwater supplies from elevated levels of nitrates, arsenic, or other contaminants which, if excessive, can result in implications to human health and treatment costs for public and private wells. Protection is particularly important in vulnerable DWSMAs.
		1.1.2: Water Quality: A limited amount of data available for nitrate, arsenic, and other types of groundwater contamination, which can lead to poorly informed management decisions.

2. Surface Waters: Water resulting from excess precipitation leaving the landscape and collecting in ditches, streams, rivers, creeks, wetlands, lakes and ponds.		
2. Surface Waters	2.1 Aquatic Life and Recreation	2.1.3: Water Quality: Reduced concentrations of dissolved oxygen approaching (protection) or exceeding (restoration) tolerable levels that can affect the diversity of quality of aquatic life.
	2.2 Surface Runoff and Flooding	2.2.3: Regional and basin wide flood issues that might not be addressed by local actions, which can impact local infrastructure, natural resources, agricultural lands and communities.
	2.4 Impoundments and Reservoirs	2.4.1: Increased erosion and sedimentation resulting in reduced storage capacity, invasive species takeover, and ultimately, wildlife habitat degradation.
	2.6 Wetlands	2.6.2: Wetlands have been altered or drained for agricultural production, resulting in a loss of wildlife habitat and temporary water storage on the landscape.
3. Fish and Wildlife Habitat and Unique Natural Features: Visible natural features and characteristics of the landscape, often which are prominent or unique.		
3. Fish and Wildlife Habitat	3.1 Aquatic Habitat for Fish, Macroinvertebrates, Wildlife and Aquatic Life	3.1.1: Modification of waterways, culverts, and dams at impoundment outlets reduce hydrologic connectivity and altered the flow regime resulting in the reduced potential of waterways to support quality fish populations.
	3.3 Terrestrial Habitat for Wildlife	3.3.1: Increased habitat fragmentation and loss of habitat providing food, shelter, terrestrial ecological corridors, and breeding territory for both protected (e.g. endangered, threatened, special concern, and Species of Greatest Conservation Need) and unprotected species.
4. Local Knowledge Base and Technical Capacity: The collective understanding of water related matters within the community and the ability to respond to and resolve water related issues.		
4. Local Knowledge Base and Technical Capacity	4.1 Public Knowledge of and Behavior Relative to Water Issues	4.1.1: Increase public awareness and knowledge of water management issues including general citizens down through school aged children.
		4.1.3: Increase regular input from stakeholders to guide future efforts related to this plan.

	4.2 Data Collection	4.2.1: Information needed to understand baseline conditions for resources to better inform management decisions.
5. Local Development and Land Stewardship: The management of urban and rural land use through sustainable development.		
5. Local Development and Land Stewardship	5.1 Healthy Urban Landscapes	5.1.1: Downstream water quality consequences from stormwater runoff due to increased impervious surface area around water bodies such as lake, streams, and wetlands.
		5.1.4: High levels of E. coli in water monitoring data at stormwater outlets in Thief River Falls, which can impact the beneficial use of downstream resources.
	5.2 Healthy Rural Landscapes	5.2.2: Increased sheet, rill, and wind erosion, and its impact on agricultural productivity, surface water quality, and deposits in drainage systems.
		5.2.4: The impact of feedlots on surface and groundwater quality.

Though these issues will be the initial focus of implementation, this does not restrict local governments from addressing other lower-tier issues identified in the plan or issues that arise in the future. There are also opportunities for issue prioritization to be reviewed and revised during the five-year and 10-year updates to the plan. **Plan Section 2: Identification and Prioritization of Resource Categories, Concerns, and Issues** provides an in-depth description of resource concerns, issues and the process for identifying priority issues.

ESTABLISHING MEASURABLE GOALS

Thirteen measurable goal categories were developed to address the priority issues identified in the Thief River Watershed. Measurable Goal Categories describe a desired condition for a resource being impacted by an issue or multiple issues and are subdivided into one or more short-term goals and long-term goals:

- Short-term measurable goals describe the interim conditions to accomplish or make progress toward during the 10-year lifespan of this plan.
- Long-term measurable goals describe the desired future conditions to accomplish, regardless of timeframe.

In some instances, measurable goals are focused on either protecting resources in good condition or restoring resources that have deteriorated. Within each measurable goal category, short-term and long-term goals set milestones for resource improvement and allow for resource management flexibility during implementation efforts. In order to account for the variation of the urgency and impact of an issue within the watershed, some measurable goals are set at the planning region scale. A variety of information sources were utilized in the development of the measurable goal categories, including:

- goals from existing management plans, studies, reports, data, and information, including WRAPS, TMDLs, local water plans, state strategies, and similar documents;
- input from Advisory Committee members;
- input from Policy Committee members; and
- the knowledge of local water and resource managers provided by the Planning Work Group.

Plan Section 3: Establishment of Measurable Goals provides a detailed description of measurable goal categories and outlines the process of their development. There are 13 measurable goal categories for this plan, which collectively address all the locally prioritized issues. Short-term Goal(s) refer to interim conditions to accomplish during the 10-year lifespan of this plan. Long-term Goal(s) are for the desired future condition to accomplish, regardless of time frame. **Table ES-3** outlines the goals that were developed for the Thief River 1W1P.

Table ES-3: Short- and Long-Term Goals

	Issue: Measurable Goal Categories	**Short-term Goal(s)**	**Long-term Goal(s)**
1	Drinking Water – Reduce Nitrate Contamination	Nitrates: Progress made towards long-term goal	Nitrates: • **Protection – Vigilance Goal**: Maintain unaffected private drinking water supply wells with nitrogen concentrations at or near a concentration representative of background and transitional levels (0-4.9 mg/L) • **Protection – Threatened Goal**: Reduce the number of private drinking water supplies that have nitrate-nitrogen concentrations at risk for nitrate impairment (≥ 5 mg/L but < 9.9 mg/L). • **Restoration – Treatment Goal**: Restore private drinking water supplies that have nitrate-nitrogen concentrations that currently represent a health concern(≥ 10 mg/L)
2	Aquatic Life and Aquatic Recreation – Reduce Sediment and Phosphorus Delivery and Load	• **Planning Region scale (Total Phosphorus):** Use the phosphorus reduction targets outlined by HSPF and the Thief River Watershed 1W1P Advisory Committee in each planning region: ○ **Protection:** Judicial Ditch 30/18/13: 5% or 559 lbs./yr. ○ **Protection:** Branch 200 of JD 11 (Lost River): 5% or 333 lbs./yr. ○ **Protection:** Lower Thief River/SD 83: 5% or 5,091 lbs./yr. ○ **Protection:** Marshall County Ditch 20: 5% or 1,135 lbs./yr. ○ **Protection:** Middle Thief River/SD 83: 5% or 2,177 lbs./yr. ○ **Protection:** Moose River/JD 21: 5% or 811 lbs./yr. ○ **Protection:** Mud River/JD 11: 5% or 1,878 lbs./yr. ○ **3Protection:** Upper Thief River/SD 83: 5% or 574 lbs./yr. • **Planning Region Scale (Sediment):** Use the sediment reduction targets	• **Planning Region Scale (Phosphorus):** ○ Extend short-term protection and restoration goals • **Planning Region Scale (Sediment):** ○ Extend short-term protection and restoration goals

	Issue: Measurable Goal Categories	Short-term Goal(s)	Long-term Goal(s)
		outlined by the TMDL, HSPF and the Thief River 1W1P Advisory Committee in each planning region: ○ **Protection (Highest Quality):** Judicial Ditch 30/18/13: 5% or 70 tons/yr. ○ **Protection (Highest Quality):** Lost River: 5% or 34 tons/yr. ○ **Restoration (Impaired):** Lower Thief River/SD 83**:** 15% or 2,335 tons/yr. ○ **Protection (Highest Quality):** Marshall County Ditch 20: 5% or 128 tons/yr. ○ **Restoration (Potential Impairment):** Middle Thief River/SD 83: 15% or 653 tons/yr. ○ **Protection (Highest Quality):** Moose River/JD 21: 5% or 49 tons/yr. ○ **Protection (Nearly Impaired):** Mud River/JD 11: 10% or 290 tons/yr. ○ **Protection (Highest Quality):** Upper Thief River/SD 83: 5% or 103 tons/yr.	
3	Aquatic Life and Aquatic Recreation – Reduce Bacteria Delivery and Load	• **Planning Region Scale:** ○ **Protection (Highest Quality)**: Judicial Ditch 30/18/13: Maintain current conditions ○ **Protection (Nearly Impaired)**: Lower Thief River/SD 83: Maintain current conditions ○ **Protection (Highest Quality):** Lost River: Maintain current conditions ○ **Protection (Highest Quality)**: Marshall County Ditch 20: Maintain current conditions ○ **Protection (Nearly Impaired):** Middle Thief River/SD 83: Maintain current conditions ○ **Protection (Highest Quality)**: Moose River/JD 21: Maintain current conditions ○ **Protection (Nearly Impaired):** Upper Thief River/SD 83: Maintain current conditions • **Reach-specific scale**: ○ **Restoration:** Mud River/JD 11: Reduction in the length of streams classified as impaired by meeting the state water quality standard	• **Planning Region Scale:** ○ **Protection**: Extend short-term goal • **Reach-specific scale**: ○ **Restoration:** Mud River/JD 11: Reduction in the length of streams classified as impaired by meeting the state water quality standard (where a TMDL has been completed)

	Issue: Measurable Goal Categories	Short-term Goal(s)	Long-term Goal(s)
		(where a TMDL has been completed)	
4	Aquatic Life and Aquatic Recreation – Increase Dissolved Oxygen Concentration	• **Planning Region Scale:** ○ **Protection (Highest Quality):** Judicial Ditch 30/18/13: >95% of readings are above or equal to daily minimum of 5 mg/L ○ **Protection (Highest Quality):** Lower Thief River/SD 83: >95% of readings are above or equal to daily minimum of 5 mg/L ○ **Restoration (Potential Impairment)**: Lost River: >90% of readings are above or equal to daily minimum of 5 mg/L; maintain base flow within channel ○ **Protection (Nearly Impaired):** Marshall County Ditch 20: >90% of readings are above or equal to daily minimum of 5 mg/L ○ **Protection (Nearly Impaired):** Middle Thief River/SD 83: >90% of readings are above or equal to daily minimum of 5 mg/L ○ **Restoration (Impaired):** Moose River/JD 21: >90% of readings are above or equal to daily minimum of 5 mg/L; maintain measurable flow within channel during late summer ○ **Restoration (Impaired):** Mud River/JD 11: >90% of readings are above or equal to daily minimum of 5 mg/L; maintain >5 CFS of flow at Hwy 89 during late summer ○ **Protection (Highest Quality):** Upper Thief River/SD 83: >95% of readings are above or equal to daily minimum of 5 mg/L	• **Planning Region Scale:** ○ Extend short-term goal • **Reach-specific scale**: ○ Extend short-term goal
5	Surface Runoff and Flooding – Reduce Damages from Peak Flows and Overland Flooding	• Judicial Ditch 30/18/13: Reduce average annual runoff by 0.125 inches (442 ac-ft) • Lower Thief River/SD 83: Reduce average annual runoff by 0.125 inches (649 ac-ft) • Lost River: Reduce average annual runoff by 0.125 inches (438 ac-ft) • Marshall County Ditch 20: Reduce average annual runoff by 0.125 inches (1396 ac-ft)	• Judicial Ditch 30/18/13: Reduce average annual runoff by 0.5 inch (1,750 ac-ft) • Lower Thief River/SD 83: Reduce average annual runoff by 0.5 inch (2,600 ac-ft) • Lost River: Reduce average annual runoff by 0.5 inch (1,750 ac-ft) • Marshall County Ditch 20: Reduce average annual runoff by 0.5 inch (5,600 ac-ft)

	Issue: Measurable Goal Categories	Short-term Goal(s)	Long-term Goal(s)
		• Middle Thief River/SD 83: No net increase in average annual runoff • Moose River/JD 21: No net increase in average annual runoff • Mud River/JD 11: No net increase in average annual runoff • Upper Thief River/SD 83: No net increase in average annual runoff	• Middle Thief River/SD 83: No net increase in average annual runoff • Moose River/JD 21: No net increase in average annual runoff • Mud River/JD 11: No net increase in average annual runoff • Upper Thief River/SD 83: No net increase in average annual runoff
6	Drainage Management Systems – Erosion and Sedimentation Reduction	• Stabilize 20% of the 26 miles of drainage ditches, using multipurpose drainage management, in subwatersheds with high BANCS erosion estimates: Lower Thief River/SD 83, Moose River/JD 21, Mud River/JD 11, and County Ditch 20 • Provide adequate drainage to meet the design guidance objectives for a 10-year, 24-hour summer rainfall event in the Lower Thief, Marshall County Ditch 20, Moose River/JD 21, and Mud River/JD 11 planning regions	• Stabilize 26 miles of drainage ditch using multipurpose drainage management in subwatersheds with high BANCS erosion estimates: Lower Thief River/SD 83, Moose River/JD 21, Mud River/JD 11, and County Ditch 20 • Extend short-term goal for providing adequate drainage based on design guidance objectives
7	Shoreland and Riparian Areas – Improve and Increase Vegetative Cover	• Achieve 100% compliance of Minnesota State Buffer Law within 1W1P area, increasing riparian vegetation, structure, and habitat and decreasing overland sediment and nutrient runoff	• Continue 100% Minnesota Buffer Law compliance
8	Habitat for Wildlife – Enhance Connectivity and Cover	• Maintain and enhance the number of large terrestrial habitat blocks with the minimum size necessary to sustain ecosystem services representative of a terrestrial landscape within the plan area • No net loss of wetlands	• Extend short-term goal
9	Aquatic Habitat for Fish, Macroinvertebrates and Aquatic Life – Restore Connectivity, Habitat, Moderated Flow Regimes and Promoted Vegetated Banks and Buffers	• Branch 200 of Judicial Ditch 11 (Lost River): Improve MSHA score of 34.5 (poor) by 15% • Judicial Ditch No. 30/18/13: Improve MSHA score of 36 (poor) by 15% • Lower Thief River/SD 83 (Agassiz Pool to Red Lake River): Improve MSHA score of 22.25 (poor) by 15% • Marshall County Ditch 20: Improve MSHA score of 34.5 (poor) by 15%	• Extend short-term goal

	Issue: Measurable Goal Categories	Short-term Goal(s)	Long-term Goal(s)
		• Middle Thief River/SD 83: Improve MSHA score of 24.5 (poor) by 15% • Moose River/JD 21: Improve MSHA score of 38 (poor) by 15% • Mud River/JD 11: Improve MSHA score of 40.5 (poor) by 15% • Upper Thief River/SD 83: Improve MSHA score of 51.5 (fair) by 10%	
10	Public Knowledge of and Behavior Related to Water Resources – Increase Stakeholder Participation	• Increase enrollment in programs outlined in Section 5 of plan	• Extend short-term goal(s)
11	Data Collection – Enhance Knowledge of Baseline Conditions	• Altered Hydrology ○ Collect 10 years of continuous flow monitoring data at pour points of all eight subwatersheds • Groundwater Quantity ○ Collect 10 years of groundwater level monitoring data to establish a watershedwide baseline • Groundwater Quality ○ Arsenic: Collect 10 years of arsenic data in private wells to establish a watershedwide baseline • Bacteria: Collect 10 years of *E. coli* data in private wells to establish a watershedwide baseline • Nitrates: Collect 10 years of nitrate data in private wells to establish a watershedwide baseline • Tile Drainage ○ Develop records and spatial data of tiled acres within the watershed	• Extend short-term goals or develop new goals if short-term goals are attained
12	Healthy Rural Landscapes – Improve Agricultural Soil Health	• Implement management practices in 5% (13,198 acres) of all cropland areas in the watershed to increase SOM content 1%. Areas to be managed are cropland areas categorized as rural stewardship “Probability Low” and “Probability Depends on Practice Effectiveness” that have SOM content of >1% and ≤4%.	• Implement management practices in 41.5% (109,688 acres) of all cropland areas in the watershed to increase SOM content by 1%. Areas to be managed are cropland areas categorized as rural stewardship “Probability Low” and “Probability Depends on Practice Effectiveness” that have SOM content of >1% and ≤4%.
13	Healthy Rural Landscapes - Reduce Surface	• 100% of septic systems that are ITPHS are brought into compliance	• Extend short-term goals

	Issue: Measurable Goal Categories	Short-term Goal(s)	Long-term Goal(s)
	and Groundwater Contamination	• 30% of septic systems that are FTPGW are upgraded • Maintain feedlot compliance if determined to be no known compliance issues	

TARGETING IMPLEMENTATION EFFORTS AND IMPLEMENTATION PROGRAMS

Targeting means implementing the most cost-effective and measurable actions to make progress toward measurable goals.

The Thief River Watershed 1W1P Planning Group used the **Prioritize, Target, and Measure Application (PTMApp)** to estimate the locations, annual cost, water quality value (sediment, total nitrogen, and total phosphorous load reductions), and progress toward measurable goals arising from implementing the best structural practices that make up the targeted implementation approach. The Thief River Watershed 1W1P targeted implementation approach was designed to select the most cost-effective practices for removing sediment and nutrients (total phosphorus and total nitrogen) at the field edge until the cost of practices equaled what planning partners are currently spending annually on structural projects within each planning region.

The Thief River Watershed 1W1P Planning Group also designed the targeted implementation approach to select the widest range of practices in order to provide the most flexibility for local governments and landowners. These include a variety of practices preferred by landowners. Examples of locally accepted practices include storage practices (such as water and sediment control basins and drainage water management), management practices (such as nutrient management plans), and protection practices (such as grade stabilization and side water inlets). Designing the targeted implementation approach in this way identifies the most cost-effective practices in the plan area that are most likely to lead to voluntary implementation.

Targeted actions are housed within the **targeted implementation schedule**, which contains:

- a brief description of each action;
- the planning region where the action occurs;
- how much of the action will be implemented;
- how the action will be measured;
- when implementation will occur within the 10-year timeframe of the plan;
- the entities responsible and each one's role(s) in implementing the action;
- the estimated cost of the action; and
- the measurable goal corresponding to the action.

Many actions can be implemented in the Thief River Watershed to make progress toward goals. These actions are grouped into six categories:

- Implementation of ***structural practices*,** such as water and sediment control basins (WASCOBS), grade stabilization structures, filter strips, and grassed waterways
- Implementation of ***management practices*,** including planting cover crops, using conservation tillage methods, and fertilizer management methods
- Delivering ***education and outreach*** to increase public engagement, improve communication, and increase understanding
- Developing information to fill ***data gaps*** and complete ***research***, and continue monitoring efforts;
- Executing local or state ***regulatory*** responsibilities
- Implementation of large, physical ***capital improvement*** projects, including multipurpose drainage management projects, two-stage ditches, and stream stabilization

Actions pertaining to education and outreach, data gaps and research, and regulatory responsibilities are implemented watershedwide to create consistency and opportunity for shared services. Actions dealing with capital improvement, structural, and management practices vary by planning region because the physical landscape and measurable goals differ among the planning regions. **Planning region implementation profiles (Section 4)** summarize current resource conditions within each planning region and present information about the number, type, and location of structural and management practices for within each planning region. These profiles also present information about the relationship between the cost to implement practices and the potential progress practices can make toward measurable goals.

The ability and timing to achieve measurable goals largely depends on the amount of funding available to implement actions. However, the amount of funding for implementing this plan is uncertain. To address this challenge, there is more than one implementation funding scenario summarized in the targeted implementation schedule:

- The **Baseline** funding level is an annual and ten-year estimate of current LGU funding available for the plan area. This is the anticipated level of funding for implementation if no additional or outside funding sources are available.
- The **Level 1 Moderate** implementation funding level identifies actions for implementation if watershed-based noncompetitive grants are made available by the state. Estimates for funding are included if available/applicable for actions in this implementation funding level. If additional funding becomes available, these actions would be prioritized for implementation.
- The **Level 2 High** implementation funding level identifies actions for implementation if funding levels for the Baseline and Level 1 Moderate implementation funding levels are met. This level would fund projects that require greater investment of resources, have an implementation timeframe longer than the ten-year lifespan of the plan, or are important but not the highest priority.

In Section 4, all three implementation funding scenarios show increases in funding and relative increased progress toward plan goals. **Plan Section 5.2** and **Table ES-4** outline the most commonly used programs and grants for implementing the implementation program described by this plan and used within the targeted implementation schedule.

Table ES-4: Budget for the Baseline Implementation Funding Level for the Thief River Watershed One Watershed, One Plan

Implementation Program	Local		State		Federal		NGOs		All Sources	
	Annual	Total	Annual	Total	Annual	Total	Annual	Total	Annual	Total
Projects and Practices[1]	$47,026	$470,026	$92,725	$927,250	TBD	TBD	TBD	TBD	$139,751	$1,397,276
Regulatory[2]	$28,736	$287,360	$34,667	$346,670					$63,403	$634,030
Research and Monitoring	$24,826	$248,260	$780	$7,800					$25,606	$256,060
Education and Outreach	$17,553	$175,530	$1,115	$11,150					$18,668	$186,680
Plan Administration[3]	$19,272	$192,720	$15,429	$154,290					$34,701	$347,010
Capital Improvements[4]	$76,277	$762,277	$25,000	$250,000					$101,277	$1,012,770
TOTAL	**$213,690**	**$2,136,173**	**$169,716**	**$1,697,160**	**-**	**-**	**-**	**-**	**$383,406**	**$3,833,333**

[1] Projects and Practices Cost Share amount based on current amount for all counties, and includes baseline costs for management practices and structural BMPs

[2] Assumes local fiscal support of local implementation of statutory obligations and ordinances remains unchanged.

[3] Plan administration budgets like current local expenditures by individual counties. Estimated at 10% of annual baseline implementation budget. Does not include staffing for Research and Monitoring; Education and Outreach

[4] Capital Improvement program includes expenditures for operations and maintenance of drainage ditches and impoundments.

[*] Collaborative grants assumed to be provided to the Thief River Watershed 1W1P as one or more non-competitive implementation block grant

Table ES-5: Level 1 Funding Summary

Level 1 Funding Summary Program	Total
Projects and Practices[1]	$8,480,189
Research and Monitoring	$531,500
Education and Outreach	$10,000
Capital Improvements[2]	$12,591,393

[1] Projects and Practices Cost Share amount based on current amount for all counties, and includes baseline costs for management practices and structural BMPs

[2] Capital Improvement program includes expenditures for operations and maintenance of drainage ditches and impoundments

[*] Collaborative grants assumed to be provided to the Thief River Watershed 1W1P as one or more non-competitive implementation block grant

Table ES-6: Summary of Structural and Management Practices, Implementation Approach

Projects and Practices Summary						
Planning Region	**Priority Tier**	**Action Level**	**Estimated Cost**	**PTMApp Treatment Group**	**Sediment Load Reduction (tons/yr)**	**Total Phosphorus Load Reduction (lbs/yr)**
Lower Thief River/SD 83	1	Baseline	$100,732	Filtration	800	162
			$3,477	Protection	15	1
			$59,716	Storage	207	44
			$76,858	Source Reduction	1,428	269
		Level 1 Moderate	$118,101	Filtration	227	53
			$2,086,246	Storage	3,662	957
			$245,067	Source Reduction	1,957	1,208
		Level 2 High	--	Biofiltration	74	37
			--	Filtration	60	11
			--	Protection	2,212	792
			--	Storage	1,312	360
			--	Source Reduction	3,101	1,380
Mud River/JD 11	1	Baseline	$66,956	Filtration	375	87
			$54,921	Storage	159	37
			$119,854	Source Reduction	1,276	451
		Level 1 Moderate	$31,403	Biofiltration	2	4
			$30,321	Filtration	52	15
			$1,687,443	Protection	663	235
			$234,758	Storage	246	71
			$92,702	Source Reduction	765	331
		Level 2 High	--	Biofiltration	15	8
			--	Protection	919	311
			--	Storage	25	6
			--	Source Reduction	683	328
Marshall County Ditch No. 20	1	Baseline	$57,692	Filtration	476	96
			$59,940	Storage	187	41
			$121,716	Source Reduction	1,106	510
		Level 1 Moderate	$22,243	Filtration	43	10
			$601,992	Storage	920	218
			$80,646	Protection	31	17
			$63,436	Source Reduction	603	248

Projects and Practices Summary						
Planning Region	**Priority Tier**	**Action Level**	**Estimated Cost**	**PTMApp Treatment Group**	**Sediment Load Reduction (tons/yr)**	**Total Phosphorus Load Reduction (lbs/yr)**
Upper Thief River/SD 83	2	Baseline	$38,659	Filtration	78	28
			$52,276	Storage	64	28
			$4,849	Protection	2	1
			$96,658	Source Reduction	1,083	403
		Level 1 Moderate	$64,845	Biofiltration	1	10
			$6,851	Filtration	3	1
			$307,332	Protection	141	49
			$5,096	Storage	3	1
			$15,348	Source Reduction	134	61
Branch 200 of JD 11 (Lost River)	2	Baseline	$7,786	Filtration	21	5
			$90,785	Protection	27	10
			$15,829	Storage	22	6
			$78,251	Source Reduction	438	178
		Level 1 Moderate	$629,220	Protection	142	42
			$33,076	Source Reduction	151	60
		Level 2 High	--	Infiltration	92	10
			--	Filtration	3	1
			--	Protection	90	30
			--	Storage	6	2
Judicial Ditch No 30/18/13	2	Baseline	$16,897	Filtration	161	31
			$79,068	Storage	216	59
			$95,790	Source Reduction	948	399
		Level 1 Moderate	$112,481	Storage	286	71
Middle Thief River/SD 83	3	Baseline	$34,726	Filtration	13	25
			$445	Storage	1	0
			$37,059	Source Reduction	247	59
		Level 1 Moderate	$73,564	Filtration	63	20
			$692,197	Storage	221	59
			$313,166	Source Reduction	1,152	512
		Level 2 High	--	Biofiltration	22	13
			--	Infiltration	212	23
			--	Protection	1,185	423
			--	Source Reduction	2,387	1,330

Projects and Practices Summary						
Planning Region	**Priority Tier**	**Action Level**	**Estimated Cost**	**PTMApp Treatment Group**	**Sediment Load Reduction (tons/yr)**	**Total Phosphorus Load Reduction (lbs/yr)**
Moose River/ JD 21	3	Baseline	$22,961	Filtration	109	47
			$12,634	Storage	42	10
			$36,264	Source Reduction	334	154
		Level 1 Moderate	$12,605	Filtration	18	6
			$792,519	Protection	287	115
			$88,471	Storage	97	29
			$39,060	Source Reduction	368	160
		Level 2 High	--	Biofiltration	3	1
			--	Infiltration	71	10
			--	Protection	439	119
			--	Storage	14	4
			--	Source Reduction	446	219

For additional information regarding this information refer to Section 4. *Baseline* funding is an annual and ten-year estimate of current LGU funding available for a plan area. This is the anticipated level of funding for implementation if no additional or outside funding sources are available. *Level 1 Moderate* implementation funding identifies actions for implementation if watershed based noncompetitive grants are made available by the State. Estimates for funding are included if available and/or applicable for actions in this implementation funding level. If additional funding becomes available, these actions would be prioritized for implementation. *Level 2 High* implementation funding level identifies actions for implementation if funding levels for the Baseline and Level 1 Moderate levels are met. This level would fund projects that require greater investment of resources, have an implementation timeframe longer than the ten-year lifespan of the plan, or are important but not the highest priority.

If the actions of the targeted implementation approach could be successfully completed, they would result in the implementation and anticipated load reduction benefits from all structural practices within each planning region. Actions in the targeted implementation approach are also inclusive of actions to implement management practices, develop a consistent education and outreach activities for the watershed area, implement research to close data gaps and expand monitoring efforts, continue regulatory implementation, and construct capital improvement projects.

The Thief River Watershed 1W1P Planning Group previously entered into a formal agreement through a Memorandum of Agreement to lead the 1W1P planning process for the Thief River Watershed. The parties are drafting a revised Memorandum of Agreement for implementing this plan. Expectations are that the roles of the local Policy Committee, Planning Work Group, and Advisory Committee will shift and change focus during plan implementation.

Ultimately, the goal of this plan is to use local and state resources to efficiently manage, restore, and protect water resources in the Thief River Watershed. This plan is a ten-year guide to assist local governments to coordinate implementation efforts through annual work planning, improve efficiencies, and reduce redundancies in local water resource management.

1.0 INTRODUCTION

The Thief River Watershed One Watershed, One Plan (1W1P) represents an evolution from traditional water planning to watershed-based planning for northwestern Minnesota. The 1W1P is a statewide effort, aimed to transform the way local entities plan for resource management. The implementation-focused 1W1P combines local entities that would otherwise have separate local plans into one combined planning effort to address resource issues that are most important locally. In the Thief River Watershed, this brings three counties, three soil and water conservation districts, and one watershed district together into one cohesive and comprehensive water planning document.

The Thief River Watershed 1W1P planning area is located in northwestern Minnesota and is largely within Beltrami, Marshall, and Pennington Counties (97.8%); the remainder being within Roseau County (<3%). The Thief River Watershed is entirely within the Red Lake Watershed District. The planning area drains 671,024 acres or 1,048 square miles. A map of the planning area is shown in **Figure 1-1**.

The Thief River Watershed 1W1P planning area is a major hydrologic unit code (HUC) 8 watershed comprised of eight minor (HUC 10) watersheds:

- Moose River/Judicial Ditch (JD) 21 (0902030401)
- Upper Thief River/State Ditch (SD) 83 (0902030402)
- Mud River/JD 11 (0902030403)
- Middle Thief River/SD 83 (0902030404) (Agassiz National Wildlife Refuge)
- Branch 200 of JD 11 (Lost River) (0902030405)
- Marshall County Ditch 20 (0902030406)
- Judicial Ditch 30/18/13 (0902030407)
- Lower Thief River/SD 83 (0902030408)

These HUC 10 watersheds comprise the eight planning regions in the plan area. Planning regions account for variation of resources and issues in the watershed. Measurable Goals (**Plan Section 3**) and Implementation Actions (**Plan Section 4**) are tailored to each planning region. Furthermore, planning regions are prioritized based on priority issues identified in **Plan Section 2**.

Surrounding watersheds are Snake and Tamarac to the west, Two Rivers and Roseau to the north, Rapid River and Upper and Lower Red Lake to the east, and the Red Lake River to the south. The Thief River Watershed is part of the Red Lake Watershed District. A headwaters watershed, the Thief River begins at the outlet of Thief Lake and flows along the western boundary. Mostly channelized streams and ditches beginning in the east of the watershed flow west and eventually contribute to the Thief River. Much of this water is temporarily stored in impoundments. The Thief River flows into the Red Lake River at Thief River Falls. The Red Lake River flows into the Red River of the North at East Grand Forks. Ultimately, water from the Thief River Watershed contributes to Lake Winnipeg and Huron Bay. See the Red Lake Watershed District website for more information (http://www.rlwdwatersheds.org/tr-watershed-info).

Currently, land use in the Thief River Watershed is dominated by cropland (36%) and wetlands (45%). The remaining land cover distribution in the watershed is approximately as follows: 8% pasture/hay (52,288 acres), 7% forest (44,840 acres), 3% developed (18,981 acres), 2% open water (11,387 acres), and <1% barren/mining (421 acres) (MPCA, 2014). Four Town, Goodridge, Grygla, Holt, and Thief River Falls are the only municipalities in the watershed. Thief River Falls is the only municipality that derives their source of drinking water from surface water. As such, their drinking water is vulnerable to many of the same surface water quality impairments that affect the Thief River and Red Lake River and their tributaries.

The Land and Water Resources Inventory (LWRI) (**Appendix A**) provides a comprehensive review of the characteristics of the Thief River Watershed 1W1P area.

1.1 PLAN OVERVIEW

The Thief River Watershed 1W1P process is intended to result in a more unified, effective, and science-based approach to address resources that are most important locally. The information contained within this plan came from a compilation of existing local water management plans, studies, reports, models, scientific data, and state strategy documents. This comprehensive plan addresses more than just surface water management, also considering groundwater, water quantity, habitat and natural features, local knowledge, and land stewardship. There are a wide variety of actions included in the plan's targeted implementation schedule, aimed to protect and improve these resources and make progress towards stated goals.

This plan is organized into five plan sections:

- *Section 1: Introduction*—contains background information about the 1W1P, the Thief River Watershed, and the plan development process
- *Section 2: Analysis and Prioritization of Resources and Issues*—summarizes priorities that will be addressed within the lifespan of the plan
- *Section 3: Establishment of Measurable Goals*—assigns measurable goals to each priority issue
- *Section 4: Targeted Implementation Schedule*—contains the "to-do" list of the plan, which includes a description of strategies and actions, where and when actions will occur, who will implement the action, the cost of implementation, and how progress will be measured
- *Section 5: Implementation Programs*—describes the overarching implementation programs that will be used to fund and support the implementation of actions included within the schedule

1.2 PLANNING PARTNERS AND PLAN DEVELOPMENT

The Thief River Watershed 1W1P Planning Group includes all local planning partners primarily involved in developing the Thief River Watershed 1W1P. The Thief River Watershed 1W1P Planning Group was developed under and through a Memorandum of Agreement (MOA) (**Appendix B**) adopted by the governing boards of the participating entities:

- The counties of Beltrami, Marshall, and Pennington by and through their respective County Boards of Commissioners
- The Beltrami, Marshall, and Pennington SWCDs, by and through their respective SWCD Boards of Supervisors
- The Red Lake Watershed District, by and through their Board of Managers

During plan development, the Thief River Watershed 1W1P Planning Group was subdivided into three local planning committees: the Planning Work Group (PWG), the Advisory Committee (AC), and the Policy Committee (PC).

The PWG was responsible for preparing the plan. The PWG was composed of local SWCD, county, and Red Lake Watershed District staff; regional Board of Soil and Water Resources (BWSR) staff; and consultant planning staff. The PWG was responsible for the logistical and day-to-day decision-making in the planning process. Members of the PWG were responsible for providing information needed for the planning process, reviewing and approving draft plan related information, and assisting in plan development. The Thief River Watershed Planning Group contracted with Houston Engineering, Inc. (HEI) to assist with meeting facilitation for all committees, plan assessment, and plan writing.

The AC served to make recommendations on plan content and the planning process, including processes for identifying the range of resource concerns and issues, prioritizing potential concerns, and defining and describing protection strategies. The AC was composed of 29 representatives from the State's main water and/or plan review agencies, agricultural and recreation groups, and municipalities/townships. AC members were expected to communicate plan-related activities to their respective organizations and identify practical concerns during the plan development process. Members also served a role in speaking about the plan within the community and assisting the PC in ensuring a credible process.

The PC was made up of seven primary committee members and six alternates. The primary committee members included one county commissioner and one SWCD board supervisor, appointed from each of the participating counties in the watershed, plus a manager from the Red Lake Watershed District. The PC made all final decisions about the content of the plan and its submittal to and approval by BWSR. The PC retained ultimate responsibility for plan direction, decisions, and content.

Lastly, the public played an essential role during the development of the Thief River Watershed 1W1P. The public were engaged during the plan development process primarily through an initial public kickoff meeting, the final public hearing, and the planning website. The intent of the public kickoff meeting—held on January 9th, 2018 (Thief River Falls, MN), and January 10th, 2018 (Grygla, MN)—was to ensure a complete list of resource issues and concerns was developed and to rank issues impacting their community and the watershed. An additional role of the public is to review and comment upon the final plan prior to its adoption. The public was also represented during the planning process through the inclusion of 1W1P updates at local county and SWCD board meetings.

1.3 INCORPORATING COMMENTS INTO THE PLAN

The Thief River Watershed 1W1P Stakeholder Engagement Plan was developed to create a clear process for soliciting input and obtaining comments during plan development. Throughout plan development, comments received from the general public and local committees were documented and used to guide adjustments in plan content.

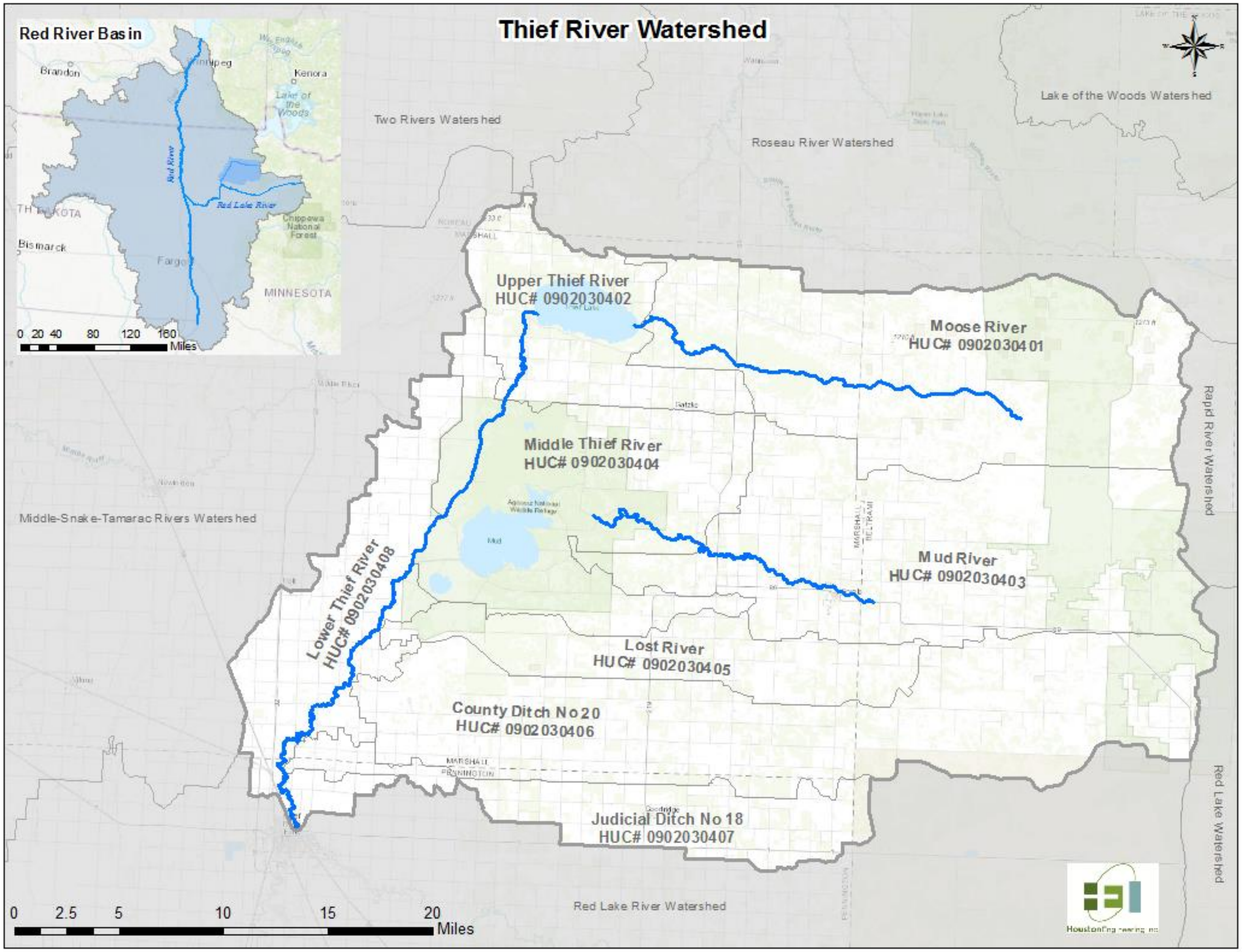

Figure 1-1. Thief River Watershed 1W1P Location

2.0 IDENTIFICATION AND PRIORITIZATION OF RESOURCE CATEGORIES, CONCERNS, AND ISSUES

This plan is a comprehensive watershed management plan as described by *One Watershed, One Plan: Plan Content* (**"One Watershed", 2016**). According to BWSR guidance, the analysis and prioritization portion of the plan:

> *"…is intended to summarize the process that the planning partners used to reach agreement on the watershed resource issues that will be addressed within the lifespan of the plan. Prioritizing is needed because not all identified issues can be addressed in the timeframe of a ten-year plan—some will be addressed before others."*

To adhere to this guidance, this plan section identifies the following:

- The steps used to identify resource categories, concerns, and issues
- A list of the resource categories, concerns, and issues considered for prioritization
- A final list of priority issues
- The reasons for selecting those priority issues

The outcome from these efforts is a targeted implementation schedule focused on achieving goals associated with the prioritized issues.

2.1 IDENTIFICATION AND SUMMARY OF RESOURCE CATEGORIES, CONCERNS AND ISSUES

The process for identifying and describing the resource categories, concerns, and issues affecting those concerns included gathering and reviewing the following:

- Existing management plans, studies, reports, data, and information, including those within the Thief River Watershed Restoration and Protection Strategy (WRAPS), existing total maximum daily loads (TMDLs), existing county water plans and watershed district plans, and similar documents (a list of the information reviewed is included in **Appendix D**)
- 60-day notification response letters (**"60-Day", 2017**)
- Input from members of the Advisory Committee, Policy Committee, and Planning Work Group
- The knowledge of local water and resource managers, including SWCD, county, and watershed district staff

Resource categories, concerns, and issues were identified and inventoried (in no particular order) within an "Issues Table" prior to prioritization. The Issues Table (**Table 2-1**) illustrates how resource concerns are refinements of a resource category, and how multiple issues can impact each resource concern. The Issues Table was used to confirm that all issues impacting resources within the Thief River Watershed were identified prior to issue prioritization. **Table 2-1** shows the complete list of all resource categories, concerns, and issues that were inventoried and considered for plan development.

Maps were developed for each mappable resource concern and issue identified within the Issues Table. This mapping was done to tell a story of the watershed and its issues, geographically map where resource concerns and issues were located, and allow for the development of a targeted implementation schedule focused on specific locations of issues and resources on the landscape. For readability purposes, these maps are included at the end of this plan section (**Figures 2-4 through 2-15**). A data dictionary in **Appendix E** documents the source data for all map layers.

The issue prioritization process and the resulting priority issues are provided in the following subsections.

Table 2-1: Resource Categories, Resource Concerns, and Issues Affecting Those Resource Concerns within the Thief River Watershed

Resource Category	Resource Concern	Issue
1. Groundwater: Water that is held underground within the pores of rocks and soils.		
1. Groundwater	1.1 Drinking Water	1.1.1: Water Quality: Protection of generally good quality groundwater supplies from elevated levels of nitrates, arsenic, or other contaminants which if excessive can result in implications to human health and treatment costs for public and private wells. Protection is particularly important in vulnerable DWSMAs.
		1.1.2: Water Quality: A limited amount of data available for nitrate, arsenic, and other types of groundwater contamination, which can lead to poorly informed management decisions.
		1.1.3: Water Quality: Current and future land use (and associated potential contaminants) can negatively impact DWSMAs and groundwater recharge areas. Protection is particularly important in vulnerable DWSMAs.
2. Surface Waters: Water resulting from excess precipitation leaving the landscape and collecting in ditches, streams, rivers, creeks, wetlands, lakes, and ponds.		
2. Surface Waters	2.1 Aquatic Life and Recreation	2.1.1: Water Quality: Elevated concentrations of suspended solids, sediment, and total phosphorus approaching (protection) or exceeding (restoration) water quality standards for aquatic life, which can lead to aquatic life impairments.
		2.1.2: Water Quality: Elevated concentrations of bacteria approaching (protection) or exceeding (restoration) water quality standards for aquatic recreation, which can impact beneficial uses.
		2.1.3: Water Quality: Reduced concentrations of dissolved oxygen approaching (protection) or exceeding (restoration) tolerable levels that can affect the diversity of quality of aquatic life.
		2.1.4: Water Quality: Elevated concentrations of nitrate-nitrite and ammonia approaching (protection) water quality standards for aquatic life, which can impact the beneficial uses of the water body.
		2.1.5: Water Quality: Biochemical oxygen demand and dissolved oxygen fluctuation approaching (protection) or exceeding (restoration) water quality standards for aquatic life, which can impact beneficial uses of the water body.
		2.1.6: Aquatic Life use assessments needed for channelized reaches now that Tiered Aquatic Life Use (TALU) standards are in place.
		2.1.7: Water Quality: Decreased stream channel stability driven by hydrologic changes that increase erosion and sediment transport, which can decrease beneficial uses of streams, rivers, and lakes.
		2.1.8: Elevated concentrations of algal toxins that can impact aquatic life and aquatic recreation uses.
	2.2 Surface Runoff and Flooding	2.2.1: Water Quantity: Changes in natural water storage and vegetative cover on the landscape, including natural depressional areas, wetlands, loss of vegetative cover and soil organic matter, which can cause an Increase in the volume of runoff, peak discharges, and water levels, causing flooding and flood damages to agricultural land, wildlife habitat, transportation systems, buildings, and structures.
		2.2.2: Water Quantity: High peak flows causing flood damages to agricultural land and public infrastructure, homes and other structures, rerouted flows, and accelerated bank erosion to artificial and natural waterways; low flows which can impact aquatic life and aquatic recreation.
		2.2.3: Regional and basin wide flood issues that might not be addressed by local actions, which can impact local infrastructure, natural resources, agricultural lands and communities.
	2.3 Drainage Management Systems	2.3.1: Increased erosion and sedimentation resulting from bank failure and slumping, and gully formation prevents the proper function of drainage systems and increases maintenance costs.

		2.3.2: Water Quantity: Changes in the timing and magnitude of runoff delivery related to drainage management systems and the effects on surface runoff, which impacts flooding, ditch maintenance, wildlife habitat, and agricultural productivity.
		2.3.3: Altered Hydrology: Extreme flow fluctuations, peak discharges, erosion and sedimentation from bank failure, slumping, and gully formation, and stream instability, because of changes in watershed hydrology.
		2.3.4: Nitrates entering tile drainage and impacting aquatic life and drinking water supplies of downstream resources.
	2.4 Impoundments and Reservoirs	2.4.1: Increased erosion and sedimentation resulting in reduced storage capacity, invasive species takeover, and ultimately, wildlife habitat degradation.
		2.4.2: Need for increased coordination for management of waters released from impoundments and reservoirs needed to balance interests of natural resources management, agricultural productivity, and flood damage reduction.
		2.4.3: Levels controlled by water control structures and its impact on aquatic life, development, recreation, and the local economy.
	2.5 Drinking Water	2.5.1: Water Quality: Elevated concentrations of sediment, and organic matter have a detrimental impact on drinking water quality.
		2.5.2: Water Quality: Protect surface water intakes, the inner-emergency response area, and outer source water management area from potential contaminants and sediment to protect the source and quality of drinking water.
		2.5.3: Water Quality: Excess hydrogen sulfide gas resulting in foul odors during certain winter conditions.
	2.6 Wetlands	2.6.1: Sediment deposition in wetlands degrades hydrologic function, contributes to nonnative plant species succession, and contributes to sediment and highly organic/low dissolved oxygen water to downstream waterways.
		2.6.2: Wetlands have been altered or drained for agricultural production, resulting in a loss of wildlife habitat and temporary water storage on the landscape.
3. Fish and Wildlife Habitat and Unique Natural Features: Visible natural features and characteristics of the landscape, which are often prominent or unique.		
3. Fish and Wildlife Habitat	3.1 Aquatic Habitat for Fish, Macroinvertebrates, Wildlife, and Aquatic Life	3.1.1: Modification of waterways, culverts, and dams at impoundment outlets reduce hydrologic connectivity and altered the flow regime resulting in the reduced potential of waterways to support quality fish populations.
		3.1.2: Elevated nutrient loads coming into aquatic habitat contribute to algal blooms as well as the growth of invasive species (e.g., hybrid cattail).
		3.1.3: Degradation of aquatic habitat, aquatic vegetation, and riparian habitat associated with increased drainage, channelization, ditch maintenance, and development, and the physical damage to the banks and beds of creeks, streams, and rivers from higher and faster flows pose public lands and waters management challenges.
	3.2 Shoreland & Riparian Zones	3.2.1: Quantity and quality of vegetation along waterways, including riparian forests and buffers along ditches in shorelines, that filter pollutants, retain soil, improve water quality, and restore wildlife habitat.
	3.3 Terrestrial Habitat for Wildlife	3.3.1: Increased habitat fragmentation and loss of habitat providing food, shelter, terrestrial ecological corridors, and breeding territory for both protected (e.g. endangered, threatened, special concern, and Species of Greatest Conservation Need) and unprotected species.
		3.3.2: Presence of noxious weeds threatening the quality of native plant communities.

4. Local Knowledge Base and Technical Capacity: The collective understanding of water related matters within the community and the ability to respond to and resolve water related issues.		
4. Local Knowledge Base and Technical Capacity	4.1 Public Knowledge of and Behavior Relative to Water Issues	4.1.1: Increase public awareness and knowledge of water management issues including general citizens down through school-aged children.
		4.1.2: Engage citizen participation in sampling and data collection in standardized monitoring program.
		4.1.3: Increase regular input from stakeholders to guide future efforts related to this plan.
		4.1.4: Need for recognition of the fiscal impact of agricultural, conservation practices, and other economically important land uses in the context of individual landowners, taxpayers, and government entities that could be addressed through education, fiscal benefits, and incentives.
	4.2 Data Collection	4.2.1: Information needed to understand baseline conditions for resources to better inform management decisions.
5. Local Development and Land Stewardship: The management of urban and rural land use through sustainable development.		
5. Local Development and Land Stewardship	5.1 Healthy Urban Landscapes	5.1.1: Downstream water quality consequences from stormwater runoff due to increased impervious surface area around water bodies such as lakes, streams, and wetlands.
		5.1.2: The frequency of flooding and its impact on commercial, residential and infrastructure areas.
		5.1.3: Point sources and their impact on surface water quality.
		5.1.4: High levels of E. coli in water monitoring data at stormwater outlets in Thief River Falls, which can impact the beneficial use of downstream resources.
	5.2 Healthy Rural Landscapes	5.2.1: Reduced soil health, soil protection, excess loss of fertilizers or pesticides, and its impact on agricultural productivity, surface water quality and quantity, sedimentation in water features, and water holding capacity.
		5.2.2: Increased sheet, rill, and wind erosion, and its impact on agricultural productivity, surface water quality, and deposits in drainage systems.
		5.2.3: Improperly installed or poorly functioning subsurface sewage treatment systems (SSTS) and individual sewage treatment system (ISTS) increase the potential for ground and surface water contamination, adversely impacting human health and water quality.
		5.2.4: The impact of feedlots on surface and groundwater quality.
		5.2.5: Frequency of use and public access to quality outdoor recreation experiences.

2.2 ISSUE PRIORITIZATION PROCESS

As described by BWSR guidance, this plan is not expected to address all identified issues during its ten-year lifespan. This plan does not "reject" any issues, but rather places them into priority levels based on importance or impact to resources in the watershed. These priority levels are used to guide creation of measurable goals aimed at priority issues and the timeline and aggressiveness of implementation within the targeted implementation schedule.

During plan development, participants followed a thorough and rigorous process to prioritize the identified issues within **Table 2-1**. Issues were prioritized by soliciting stakeholders' input on which issues were most important to them.

Two public meetings were held to gather public input on the Thief River Watershed priority issues:

- Thief River Falls Joint Operations Facility on January 9, 2018 (6:00 PM – 9:00 PM)
- Grygla Community Center on January 10, 2018 (9:00 AM to 12:00 PM)

At each meeting, residents from the watershed were given 10 orange stickers, which they could place next to issues that they felt were the most important in the watershed. Residents could place as many stickers as they liked on an issue. Water professionals (local, state, nongovernmental organizations (NGO), and federal staff) were given the same opportunity to provide input but were issued 10 blue stickers instead of orange. The intent was to separate input from water professionals from that of the general residents of the watershed.

Responses were totaled and ranked by watershed residents, watershed professionals, and as an aggregated group. Issues were ranked in order based on the number of stickers placed on each issue. **Issues were then preliminarily categorized as A, B, or C Tier priorities based on total number of stickers. Issues that received no votes were categorized as unranked (Table 2-2)**.

Table 2-2: Priority tiers and the ranks used to determine how issues were attributed to each tier

Priority Tier	Rank of issue votes as a fraction of total votes
Tier A	Above 70th percentile
Tier B	40th – 70th percentile
Tier C	Below 40th percentile
Unranked	No votes received

The Planning Work Group and Advisory Committee reviewed the preliminary prioritization results and provided a recommendation for the Policy Committee to establish the final plan priorities. This recommendation was based on public input as well as professional judgment. As a result, the recommended rankings of priorities changed from the original results of the public input process. However, >65% of the rankings remained unchanged. The Advisory Committee requested that the Planning Work Group provide a detailed rationale providing justification of all changes to the final plan priority rankings. This rationale is found in **Appendix F** of the plan. The Policy Committee unanimously voted to assign final plan priority rankings based on input from the public and the professional judgment of the Planning Work Group and Advisory Committee members. Public ranking of issues is in **Table 2-3** below.

In Table 2-3, each column represents the number of stickers placed on each issue during the public meetings. Agency Input is all working conversation professionals who are not public residents of the watershed. Public Input is all residents of the watershed present at the meetings who provided input by placing sticky dots on issues.

Table 2-3: Public Ranking of Priority Issues

ISSUE	Agency Input	Public Input	*Total*	% Rank Agency	% Rank Public	*% Rank TOTAL*	Original Category
2.3.1: Increased erosion and sedimentation resulting from bank failure and slumping, and gully formation prevents the proper function of drainage systems and increases maintenance costs.	3	81	*84*	0.64	1	*1*	A
2.2.2: Water Quantity: High peak flows causing flood damages to agricultural land and public infrastructure, homes and other structures, rerouted flows, and accelerated bank erosion to artificial and natural waterways; low flows which can impact aquatic life and aquatic recreation.	4	24	*28*	0.8	0.95	*0.97*	A
2.2.1: Water Quantity: Changes in natural water storage and vegetative cover on the landscape, including natural depressional areas, wetlands, loss of vegetative cover and soil organic matter, which can cause an increase in the volume of runoff, peak discharges, and water levels, causing flooding and flood damages to agricultural land, wildlife habitat, transportation systems, buildings, and structures.	1	26	*27*	0.37	0.97	*0.95*	A
1.1.1: Water Quality: Protection of generally good quality groundwater supplies from elevated levels of nitrates, arsenic, or other contaminants which, if excessive, can result in implications to human health and treatment costs for public and private wells.	6	18	*24*	0.88	0.93	*0.93*	A

ISSUE	Agency Input	Public Input	*Total*	% Rank Agency	% Rank Public	*% Rank TOTAL*	Original Category
Protection is particularly important in vulnerable DWSMAs.							
5.2.1: Reduced soil health, soil protection, excess loss of fertilizers or pesticides, and its impact on agricultural productivity, surface water quality and quantity, sedimentation in water features, and water holding capacity.	6	16	*22*	0.88	0.91	*0.91*	A
2.5.1: Water Quality: Elevated concentrations of sediment, and organic matter have a detrimental impact on drinking water quality.	11	10	*21*	1	0.8	*0.88*	A
3.2.1: Quantity and quality of vegetation along waterways, including riparian forests and buffers along ditches in shorelines, that filter pollutants, retain soil, improve water quality, and restore wildlife habitat.	2	15	*17*	0.51	0.86	*0.86*	A
4.1.3: Increase regular input from stakeholders to guide future efforts related to this plan.	0	15	*15*	0	0.86	*0.84*	A
2.1.7: Water Quality: Decreased stream channel stability driven by hydrologic changes that increase erosion and sediment transport, which can decrease beneficial uses of streams, rivers, and lakes.	2	11	*13*	0.51	0.82	*0.82*	A

ISSUE	Agency Input	Public Input	*Total*	% Rank Agency	% Rank Public	*% Rank TOTAL*	Original Category
4.1.4: Need for recognition of the fiscal impact of agricultural, conservation practices, and other economically important land uses in the context of individual landowners, taxpayers, and government entities that could be addressed through education, fiscal benefits, and incentives.	1	11	*12*	0.37	0.82	*0.8*	A
2.1.1: Water Quality: Elevated concentrations of suspended solids, sediment, and total phosphorus approaching (protection) or exceeding (restoration) water quality standards for aquatic life, which can lead to aquatic life impairments.	8	3	*11*	0.95	0.35	*0.73*	A
2.6.1: Sediment deposition in wetlands degrades hydrologic function, contributes to nonnative plant species succession, and contributes to sediment and highly organic/low dissolved oxygen water to downstream waterways.	10	1	*11*	0.97	0.2	*0.73*	A
3.1.3: Degradation of aquatic habitat, aquatic vegetation, and riparian habitat associated with increased drainage, channelization, ditch maintenance, and development, and the physical damage to the banks and beds of creeks, streams, and rivers from higher and faster flows pose public lands and waters management challenges.	5	6	*11*	0.86	0.71	*0.73*	A
5.2.3: Improperly installed or poorly functioning subsurface sewage treatment systems (SSTS) and individual sewage treatment system (ISTS) increase the potential for ground and surface water contamination, adversely impacting human health and water quality.	4	6	*10*	0.8	0.71	*0.71*	A

ISSUE	Agency Input	Public Input	*Total*	% Rank Agency	% Rank Public	*% Rank TOTAL*	Original Category
1.1.2: Water Quality: A limited amount of data available for nitrate, arsenic, and other types of groundwater contamination, which can lead to poorly informed management decisions.	2	7	*9*	0.51	0.75	*0.66*	B
5.1.1: Downstream water quality consequences from stormwater runoff due to increased impervious surface area around water bodies such as lake, streams, and wetlands.	0	9	*9*	0	0.77	*0.66*	B
5.2.2: Increased sheet, rill, and wind erosion, and its impact on agricultural productivity, surface water quality, and deposits in drainage systems.	6	2	*8*	0.88	0.31	*0.64*	B
2.4.1: Increased erosion and sedimentation resulting in reduced storage capacity, invasive species takeover, and ultimately, wildlife habitat degradation.	3	4	*7*	0.64	0.46	*0.62*	B
2.6.2: Wetlands have been altered or drained for agricultural production, resulting in a loss of wildlife habitat and temporary water storage on the landscape.	2	4	*6*	0.51	0.46	*0.53*	B
3.1.1: Modification of waterways, culverts, and dams at impoundment outlets reduce hydrologic connectivity and altered the flow regime, resulting in the reduced potential of waterways to support quality fish populations.	3	3	*6*	0.64	0.35	*0.53*	B
3.3.2: Presence of noxious weeds threatening the quality of native plant communities.	2	4	*6*	0.51	0.46	*0.53*	B
5.1.4: High levels of E. coli in water monitoring data at stormwater outlets in Thief River Falls, which can impact the beneficial use of downstream resources.	1	5	*6*	0.37	0.6	*0.53*	B

ISSUE	Agency Input	Public Input	*Total*	% Rank Agency	% Rank Public	*% Rank TOTAL*	Original Category
2.1.2: Water Quality: Elevated concentrations of bacteria approaching (protection) or exceeding (restoration) water quality standards for aquatic recreation, which can impact beneficial uses.	2	3	*5*	0.51	0.35	*0.4*	B
2.2.3: Regional and basin wide flood issues that might not be addressed by local actions, which can impact local infrastructure, natural resources, agricultural lands and communities.	0	5	*5*	0	0.6	*0.4*	B
3.3.1: Increased habitat fragmentation and loss of habitat providing food, shelter, terrestrial ecological corridors, and breeding territory for both protected (e.g. endangered, threatened, special concern, and Species of Greatest Conservation Need) and unprotected species.	0	5	*5*	0	0.6	*0.4*	B
5.1.3: Point sources and their impact on surface water quality.	0	5	*5*	0	0.6	*0.4*	B
5.2.4: The impact of feedlots on surface and groundwater quality.	0	5	*5*	0	0.6	*0.4*	B
5.2.5: Frequency of use and public access to quality outdoor recreation experiences.	1	4	*5*	0.37	0.46	*0.4*	B
2.1.3: Water Quality: Reduced concentrations of dissolved oxygen approaching (protection) or exceeding (restoration) tolerable levels that can affect the diversity of quality of aquatic life.	3	1	*4*	0.64	0.2	*0.26*	C
2.3.2: Water Quantity: Changes in the timing and magnitude of runoff delivery related to drainage management systems and the effects on surface runoff, which impacts flooding, ditch maintenance, wildlife habitat, and agricultural productivity.	0	4	*4*	0	0.46	*0.26*	C

ISSUE	Agency Input	Public Input	*Total*	% Rank Agency	% Rank Public	*% Rank TOTAL*	Original Category
2.3.3: Altered Hydrology: Extreme flow fluctuations, peak discharges, erosion and sedimentation from bank failure, slumping, and gully formation, and stream instability, as a result of changes in watershed hydrology.	4	0	*4*	0.8	0	*0.26*	C
2.4.2: Need for increased coordination for management of waters released from impoundments and reservoirs needed to balance interests of natural resources management, agricultural productivity, and flood damage reduction.	3	1	*4*	0.64	0.2	*0.26*	C
2.4.3: Levels controlled by water control structures and its impact on aquatic life, development, recreation, and the local economy.	0	4	*4*	0	0.46	*0.26*	C
2.5.2: Water Quality: Protect surface water intakes, the inner-emergency response area, and outer source water management area from potential contaminants and sediment to protect the source and quality of drinking water.	3	1	*4*	0.64	0.2	*0.26*	C
2.1.4: Water Quality: Elevated concentrations of nitrate-nitrite and ammonia approaching (protection) water quality standards for aquatic life, which can impact the beneficial uses of the water body.	0	3	*3*	0	0.35	*0.2*	C
2.3.4; Nitrates entering tile drainage and impacting aquatic life and drinking water supplies of downstream resources.	0	3	*3*	0	0.35	*0.2*	C
4.1.1: Increase public awareness and knowledge of water management issues including general citizens down through school-aged children.	3	0	*3*	0.64	0	*0.2*	C

ISSUE	Agency Input	Public Input	*Total*	% Rank Agency	% Rank Public	*% Rank TOTAL*	Original Category
4.2.1: Information needed to understand baseline conditions for resources to better inform management decisions.	1	1	*2*	0.37	0.2	*0.15*	C
5.1.2: The frequency of flooding and its impact on commercial, residential and infrastructure areas.	0	2	*2*	0	0.31	*0.15*	C
2.1.6: Aquatic Life use assessments needed for channelized reaches now that Tiered Aquatic Life Use (TALU) standards are in place.	1	0	*1*	0.37	0	*0.13*	C
1.1.3: Water Quality: Current and future land use (and associated potential contaminants) can negatively impact DWSMAs and groundwater recharge areas. Protection is particularly important in vulnerable DWSMAs.	0	0	*0*	0	0	*0*	Unranked
2.1.5: Water Quality: Biochemical oxygen demand and dissolved oxygen fluctuation approaching (protection) or exceeding (restoration) water quality standards for aquatic life, which can impact beneficial uses of the water body.	0	0	*0*	0	0	*0*	Unranked
2.1.8: Elevated concentrations of algal toxins that can impact aquatic life and aquatic recreation uses.	0	0	*0*	0	0	*0*	Unranked
2.5.3: Water Quality: Excess hydrogen sulfide gas resulting in foul odors during certain winter conditions.	0	0	*0*	0	0	*0*	Unranked
3.1.2: Elevated nutrient loads coming into aquatic habitat contribute to algal blooms as well as the growth of invasive species (e.g., hybrid cattail).	0	0	*0*	0	0	*0*	Unranked
4.1.2: Engage citizen participation in sampling and data collection in standardized monitoring program.	0	0	*0*	0	0	*0*	Unranked

The plan establishes priority issues consistent with guidance provided by BWSR. Because of issue prioritization, each issue was designated as an A, B, C or unranked tier issue. While all issues are important and worthy of local management efforts, there are limited resources for implementing solutions. Not all issues can be addressed within the timeframe of a ten-year plan. Therefore, priority tiers designate the timeline or aggressiveness of addressing issues with the plan. Those issues identified as Priority Tier A and B will be assigned measurable goals and will be the focus of initial implementation efforts. Those issues designated as Tier C or unranked are not anticipated to be directly addressed within this plan and therefore will not be assigned measurable goals or included directly within the targeted implementation schedule.

2.3 PRIORITY CONCERNS AND ISSUES

2.3.1 Priority Issues for Implementation

Priority Tier A issues were placed in the highest tier, indicating the highest expressed preference during the issue prioritization process, and were confirmed as the highest priority by the Policy Committee. Priority Tier B issues are considered the second priority for implementation. These priority issues received the second highest proportion of votes during the prioritization process and were confirmed by the Policy Committee as having the second highest priority. Priority Tier A and Tier B issues will be assigned a measurable goal and will be considered the focus for initial implementation efforts. **Table 2-4** provides a description of each priority issue in Priority Tier A. **Table 2-5** provides a description of each priority issue in Priority Tier B.

Table 2-4: Issues placed in the highest tier, Priority Tier A, during the issue prioritization process. Each of these issues will have a measurable goal established to address it.

Resource Category	Resource Concern	Issue – Priority Tier A
2. Surface Waters: Water resulting from excess precipitation leaving the landscape and collecting in ditches, streams, rivers, creeks, wetlands, lakes and ponds.		
2. Surface Waters	2.1 Aquatic Life and Recreation	2.1.1: Water Quality: Elevated concentrations of suspended solids, sediment, and total phosphorus approaching (protection) or exceeding (restoration) water quality standards for aquatic life, which can lead to aquatic life impairments.
		2.1.2: Water Quality: Elevated concentrations of bacteria approaching (protection) or exceeding (restoration) water quality standards for aquatic recreation, which can impact beneficial uses.
		2.1.7 Water Quality: Decreased stream channel stability driven by hydrologic changes that increase erosion and sediment transport, which can decrease beneficial uses of streams, rivers, and lakes.
	2.2 Surface Runoff and Flooding	2.2.1: Water Quantity: Changes in natural water storage and vegetative cover on the landscape, including natural depressional areas, wetlands, loss of vegetative cover and soil organic matter, which can cause an increase in the volume of runoff, peak discharges, and water levels, causing flooding and flood damages to agricultural land, wildlife habitat, transportation systems, buildings, and structures.
		2.2.2: Water Quantity: High peak flows causing flood damages to agricultural land and public infrastructure, homes and other structures, rerouted flows, and accelerated bank erosion to artificial and natural waterways; low flows which can impact aquatic life and aquatic recreation.

	2.3 Drainage Management Systems	2.3.1: Increased erosion and sedimentation resulting from bank failure and slumping, and gully formation prevents the proper function of drainage systems and increases maintenance costs.
	2.5 Drinking Water	2.5.1: Water Quality: Elevated concentrations of sediment, and organic matter have a detrimental impact on drinking water quality.
	2.6 Wetlands	2.6.1: Sediment deposition in wetlands degrades hydrologic function, contributes to nonnative plant species succession, and contributes to sediment and highly organic/low dissolved oxygen water to downstream waterways.
3. Fish and Wildlife Habitat and Unique Natural Features: Visible natural features and characteristics of the landscape, which are often prominent or unique.		
3. Fish and Wildlife Habitat	3.1 Aquatic Habitat for Fish, Macroinvertebrates, Wildlife, and Aquatic Life	3.1.3: Degradation of aquatic habitat, aquatic vegetation, and riparian habitat associated with increased drainage, channelization, ditch maintenance, and development, and the physical damage to the banks and beds of creeks, streams, and rivers from higher and faster flows pose public lands and waters management challenges.
	3.2 Shoreland and Riparian Zones	3.2.1: Quantity and quality of vegetation along waterways, including riparian forests and buffers along ditches in shorelines, that filter pollutants, retain soil, improve water quality, and restore wildlife habitat.
5. Local Development and Land Stewardship: The management of urban and rural land use through sustainable development.		
5. Local Development and Land Stewardship	5.2 Healthy Rural Landscapes	5.2.1: Reduced soil health, soil protection, excess loss of fertilizers or pesticides, and its impact on agricultural productivity, surface water quality and quantity, sedimentation in water features, and water holding capacity.
		5.2.3: Improperly installed or poorly functioning subsurface sewage treatment systems (SSTS) and individual sewage treatment system (ISTS) increase the potential for ground and surface water contamination, adversely impacting human health and water quality.

Table 2-5: Issues placed in the second highest tier, Priority Tier B, during the issue prioritization process. Each of these issues will have a measurable goal established to address it.

Resource Category	Resource Concern	Issue – Priority Tier B
1. Groundwater: Water which is held underground within the pores of rocks and soils.		
1. Groundwater	1.1 Drinking Water	1.1.1: Water Quality: Protection of generally good quality groundwater supplies from elevated levels of nitrates, arsenic, or other contaminants which if excessive can result in implications to human health and treatment costs for public and private wells. Protection is particularly important in vulnerable DWSMAs.
		1.1.2: Water Quality: A limited amount of data available for nitrate, arsenic, and other types of groundwater contamination, which can lead to poorly informed management decisions.
2. Surface Waters: Water resulting from excess precipitation leaving the landscape and collecting in ditches, streams, rivers, creeks, wetlands, lakes and ponds.		
2. Surface Waters	2.1 Aquatic Life and Recreation	2.1.3: Water Quality: Reduced concentrations of dissolved oxygen approaching (protection) or exceeding (restoration) tolerable levels that can affect the diversity of quality of aquatic life.
	2.2 Surface Runoff and Flooding	2.2.3: Regional and basin wide flood issues that might not be addressed by local actions, which can impact local infrastructure, natural resources, agricultural lands and communities.
	2.4 Impoundments and Reservoirs	2.4.1: Increased erosion and sedimentation resulting in reduced storage capacity, invasive species takeover, and ultimately, wildlife habitat degradation.
	2.6 Wetlands	2.6.2: Wetlands have been altered or drained for agricultural production, resulting in a loss of wildlife habitat and temporary water storage on the landscape.
3. Fish and Wildlife Habitat and Unique Natural Features: Visible natural features and characteristics of the landscape, often which are prominent or unique.		
3. Fish and Wildlife Habitat	3.1 Aquatic Habitat for Fish, Macroinvertebrates, Wildlife and Aquatic Life	3.1.1: Modification of waterways, culverts, and dams at impoundment outlets reduce hydrologic connectivity and altered the flow regime resulting in the reduced potential of waterways to support quality fish populations.
	3.3 Terrestrial Habitat for Wildlife	3.3.1: Increased habitat fragmentation and loss of habitat providing food, shelter, terrestrial ecological corridors, and breeding territory for both protected (e.g. endangered, threatened, special concern, and Species of Greatest Conservation Need) and unprotected species.

4. Local Knowledge Base and Technical Capacity: The collective understanding of water related matters within the community and the ability to respond to and resolve water related issues.		
4. Local Knowledge Base and Technical Capacity	4.1 Public Knowledge of and Behavior Relative to Water Issues	4.1.1: Increase public awareness and knowledge of water management issues including general citizens down through school-aged children.
		4.1.3: Increase regular input from stakeholders to guide future efforts related to this plan.
	4.2 Data Collection	4.2.1: Information needed to understand baseline conditions for resources to better inform management decisions.
5. Local Development and Land Stewardship: The management of urban and rural land use through sustainable development.		
5. Local Development and Land Stewardship	5.1 Healthy Urban Landscapes	5.1.1: Downstream water quality consequences from stormwater runoff due to increased impervious surface area around water bodies such as lakes, streams, and wetlands.
		5.1.4: High levels of E. coli in water monitoring data at stormwater outlets in Thief River Falls, which can impact the beneficial use of downstream resources.
	5.2 Healthy Rural Landscapes	5.2.2: Increased sheet, rill, and wind erosion, and its impact on agricultural productivity, surface water quality, and deposits in drainage systems.
		5.2.4: The impact of feedlots on surface and groundwater quality.

2.3.2 Lower Tier Issues

Tier C issues are considered the third priority. These issues received the lowest proportion of votes during the issue prioritization process and were confirmed by the Policy Committee as having a lower priority. As these issues were not designated as a priority (either A or B tiers), measurable goals will not be established for these issues, and actions will not be included in the targeted implementation schedule to directly address these issues in this plan. These or new issues may become higher priorities in future renditions of this plan and thus warrant establishment of measurable goals. **Table 2-6** provides a description of each issue ranked as a Tier C issue.

Table 2-6: Issues placed in Tier C during the issue prioritization process. Measurable goals will not be established for these issues as they were not identified as priority issues.

Resource Category	Resource Concern	Issue
2. Surface Waters: Water resulting from excess precipitation leaving the landscape and collecting in ditches, streams, rivers, creeks, wetlands, lakes and ponds		
2. Surface Waters	2.1 Aquatic Life and Recreation	2.1.4: Water Quality: Elevated concentrations of nitrate-nitrite and ammonia approaching (protection) water quality standards for aquatic life, which can impact the beneficial uses of the water body.
	2.3 Drainage Management Systems	2.3.2: Water Quantity: Changes in the timing and magnitude of runoff delivery related to drainage management systems and the effects on surface runoff, which impacts flooding, ditch maintenance, wildlife habitat, and agricultural productivity.
		2.3.3: Altered Hydrology: Extreme flow fluctuations, peak discharges, erosion and sedimentation from bank failure, slumping, and gully formation, and stream instability, because of changes in watershed hydrology.
		2.3.4; Nitrates entering tile drainage and impacting aquatic life and drinking water supplies of downstream resources.
	2.4 Impoundments and Reservoirs	2.4.2: Need for increased coordination for management of waters released from impoundments and reservoirs needed to balance interests of natural resources management, agricultural productivity, and flood damage reduction.
		2.4.3: Levels controlled by water control structures and its impact on aquatic life, development, recreation, and the local economy.
	2.5 Drinking Water	2.5.2: Water Quality: Protect surface water intakes, the inner-emergency response area, and outer source water management area from potential contaminants and sediment to protect the source and quality of drinking water.

3. Fish and Wildlife Habitat and Unique Natural Features: Visible natural features and characteristics of the landscape, which are often prominent or unique.		
3. Fish and Wildlife Habitat	3.3 Terrestrial Habitat for Wildlife	3.3.2: Presence of noxious weeds threatening the quality of native plant communities.
4. Local Knowledge Base and Technical Capacity: The collective understanding of water related matters within the community and the ability to respond to and resolve water related issues.		
4. Local Knowledge Base and Technical Capacity	4.1 Public Knowledge of and Behavior Relative to Water Issues	4.1.4: Need for recognition of the fiscal impact of agricultural, conservation practices, and other economically important land uses in the context of individual landowners, taxpayers, and government entities that could be addressed through education, fiscal benefits, and incentives.
5. Local Development and Land Stewardship: The management of urban and rural land use through sustainable development		
5. Local Development and Land Stewardship	5.1 Healthy Urban Landscapes	5.1.2: The frequency of flooding and its impact on commercial, residential and infrastructure areas.
		5.1.3: Point sources and their impact on surface water quality.
	5.2 Healthy Rural Landscapes	5.2.5: Frequency of use and public access to quality outdoor recreation experiences.

Table 2-7: Issues categorized as unranked during the issue prioritization process. Unranked issues did not receive any input. Measurable goals will not be established for these issues, as they were not identified as priority issues. These or new issues may become higher priorities in future renditions of this plan and will then warrant establishment of measurable goals.

Resource Category	Resource Concern	Issue
1. Groundwater: Water which is held underground within the pores of rocks and soils		
1. Groundwater	1.1 Drinking Water	1.1.3: Water Quality: Current and future land use (and associated potential contaminants) can negatively impact DWSMAs and groundwater recharge areas. Protection is particularly important in vulnerable DWSMAs.
2. Surface Waters: Water resulting from excess precipitation leaving the landscape and collecting in ditches, streams, rivers, creeks, wetlands, lakes and ponds		
2. Surface Waters	2.1 Aquatic Life and Recreation	2.1.5: Water Quality: Biochemical oxygen demand and dissolved oxygen fluctuation approaching (protection) or exceeding (restoration) water quality standards for aquatic life, which can impact beneficial uses of the water body.
		2.1.8: Elevated concentrations of algal toxins that can impact aquatic life and aquatic recreation uses.
	2.5 Drinking Water	2.5.3: Water Quality: Excess hydrogen sulfide gas resulting in foul odors during certain winter conditions.
3. Fish and Wildlife Habitat and Unique Natural Features: Visible natural features and characteristics of the landscape, which are often prominent or unique.		
3. Fish and Wildlife Habitat	3.1 Aquatic Habitat for Fish, Macroinvertebrates, Wildlife and Aquatic Life	3.1.2: Elevated nutrient loads coming into aquatic habitat contribute to algal blooms as well as the growth of invasive species (e.g., hybrid cattail).
4. Local Knowledge Base and Technical Capacity: The collective understanding of water related matters within the community and the ability to respond to and resolve water related issues.		
4. Local Knowledge Base and Technical Capacity	4.1 Public Knowledge of and Behavior Relative to Water Issues	4.1.2: Engage citizen participation in sampling and data collection in standardized monitoring program.

The Policy Committee established this plan's priority issues, reflecting their responsibility in developing this locally focused plan. However, as many issues are interconnected, this plan will have benefits to lower tier issues as well. An example is useful for illustration purposes: elevated concentrations of algal toxins were identified as a Tier C issue, meaning it was not given a high priority and will not have a measurable goal established to address it. Elevated algal toxins, though, is worsened by high nutrient loading. Reducing nutrient loading is identified as Priority Tier A and B issues. Therefore, actions focused on these Priority Tier A and B issues will have positive impacts toward improving other issues not explicitly prioritized.

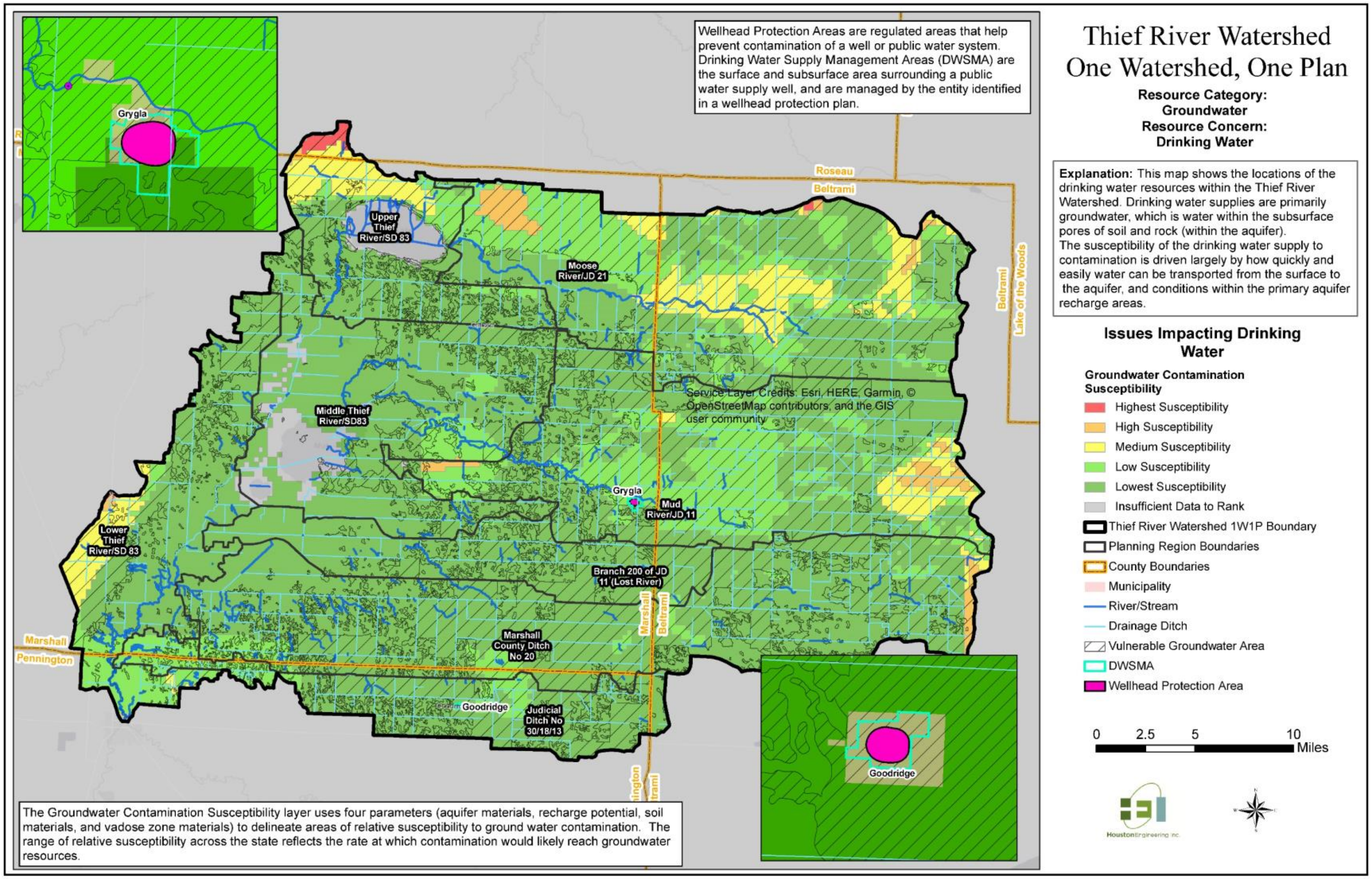

Figure 2-4: Locations of issues impacting drinking water (groundwater) within the Thief River Watershed

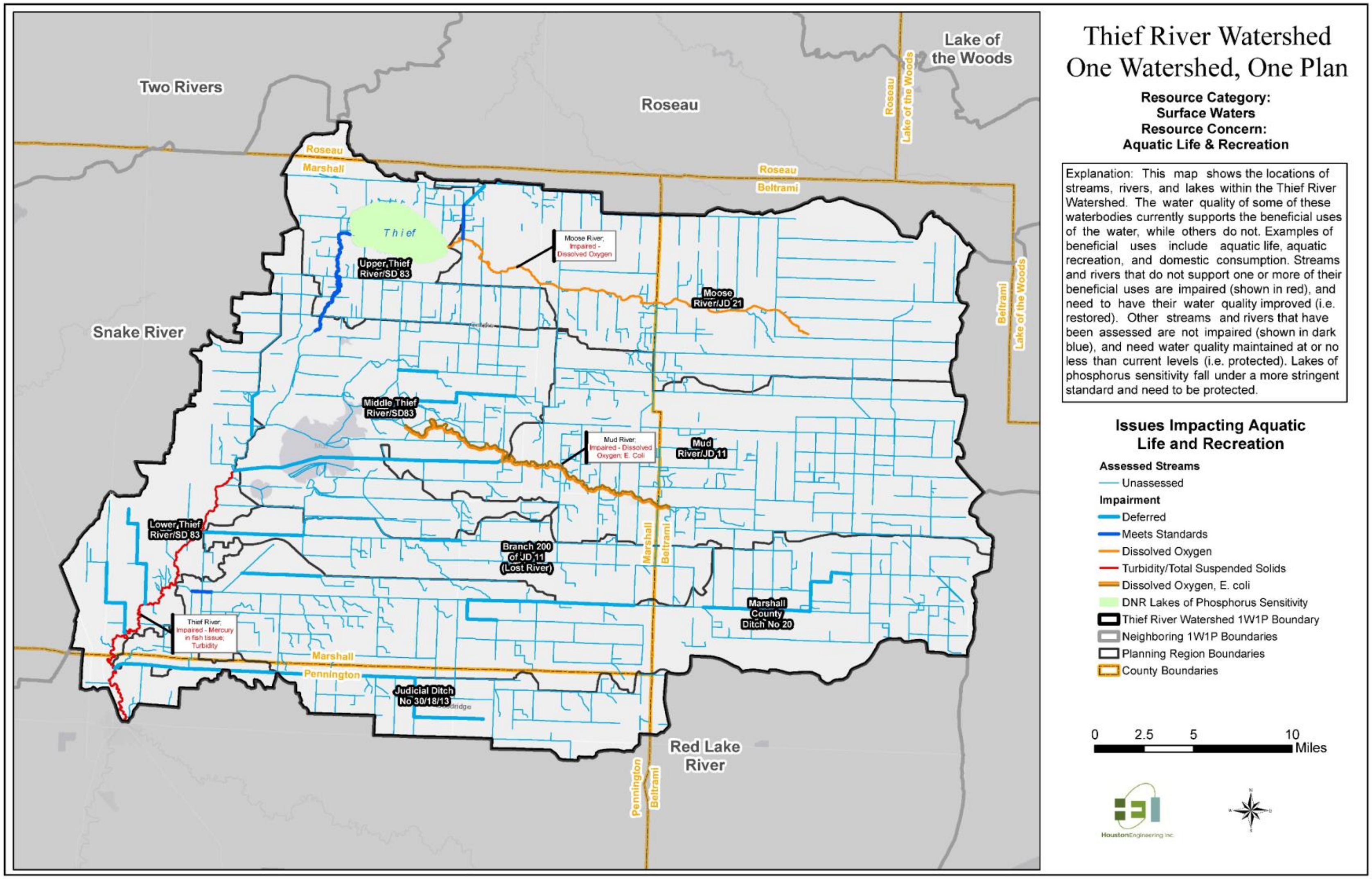

Figure 2-5: Locations of issues impacting aquatic life and recreation within the Thief River Watershed

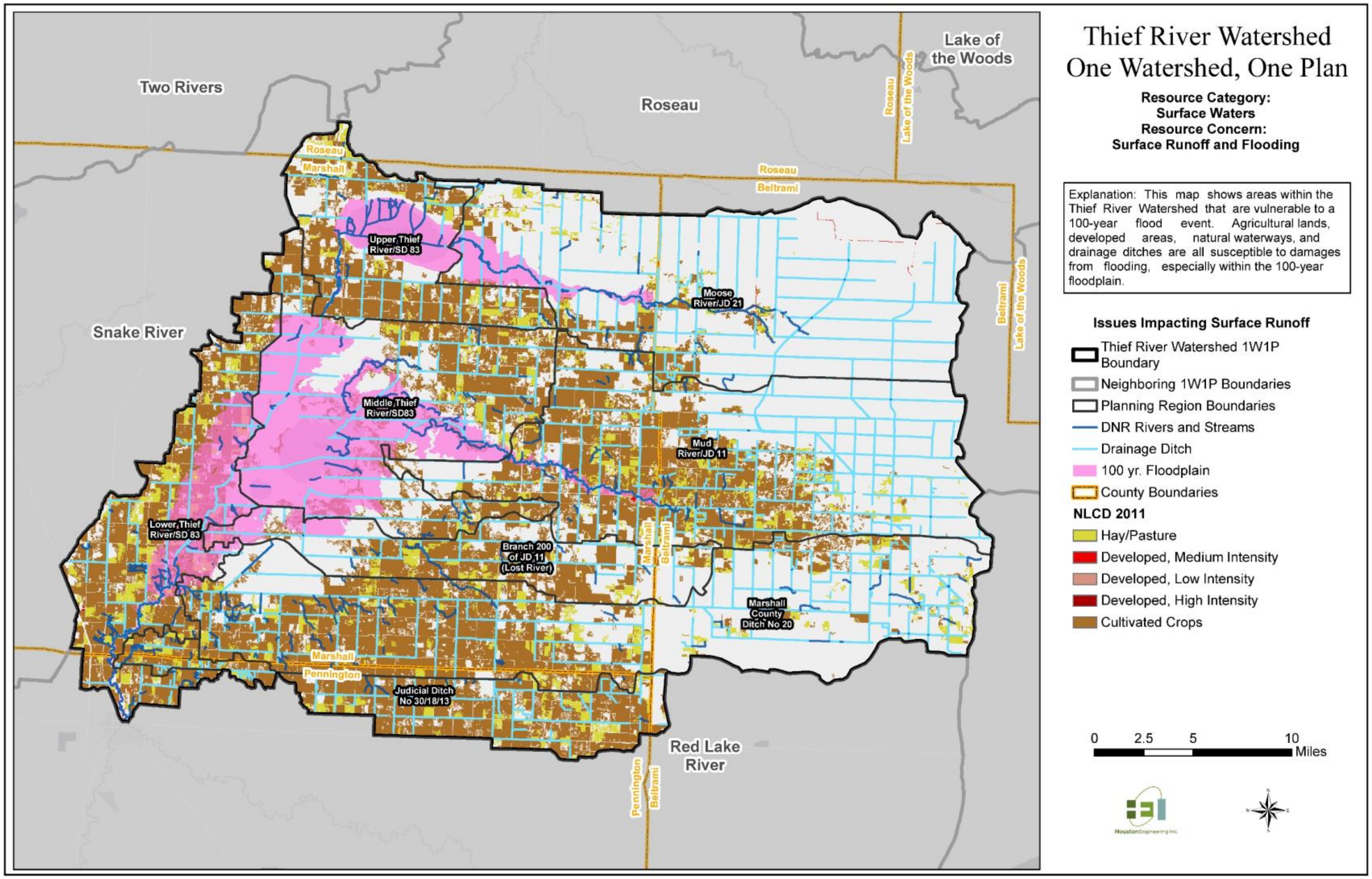

Figure 2-6: Locations of issues impacting surface runoff and flooding within the Thief River Watershed

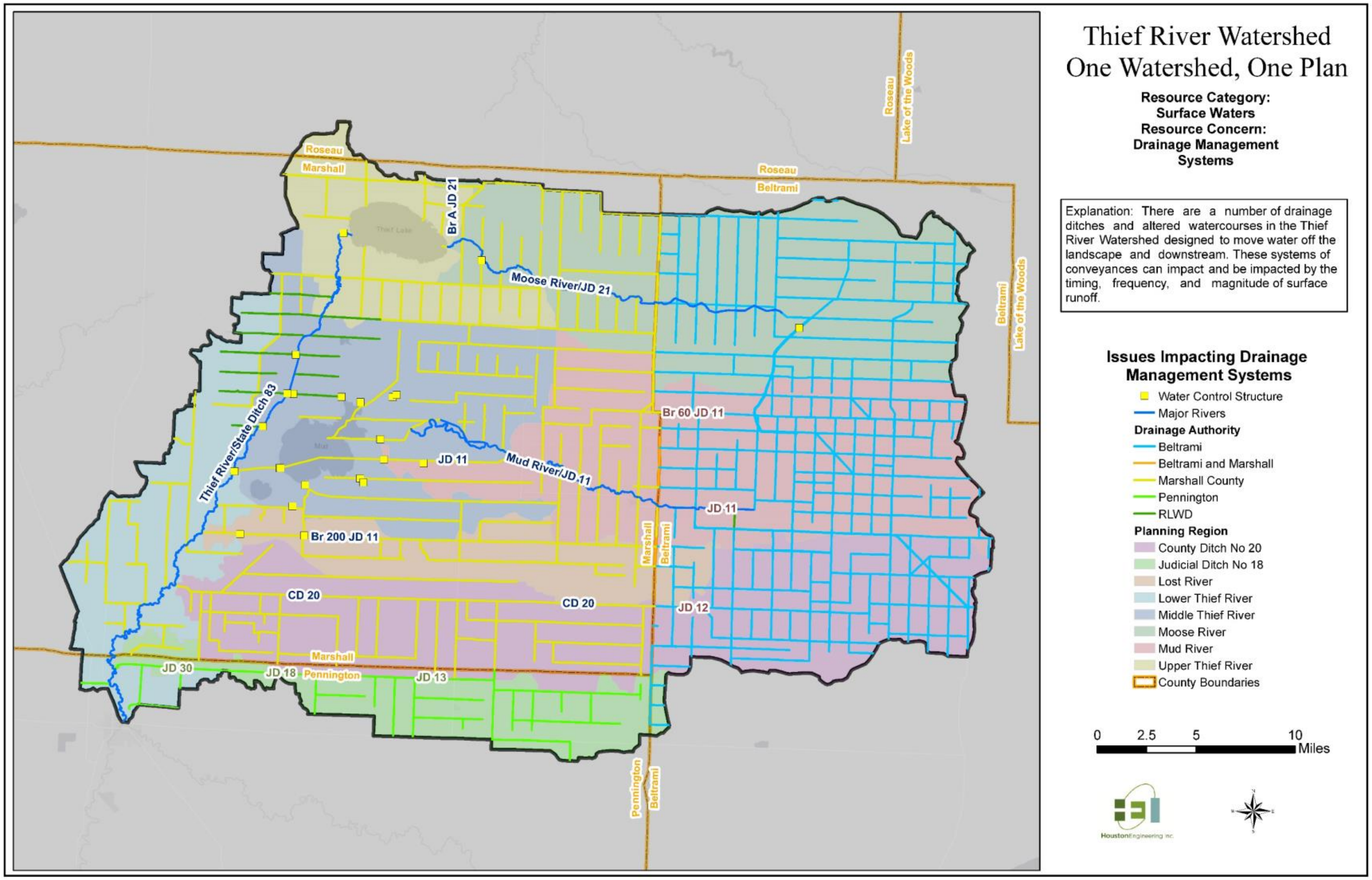

Figure 2-7: Locations of issues impacting drainage management systems within the Thief River Watershed

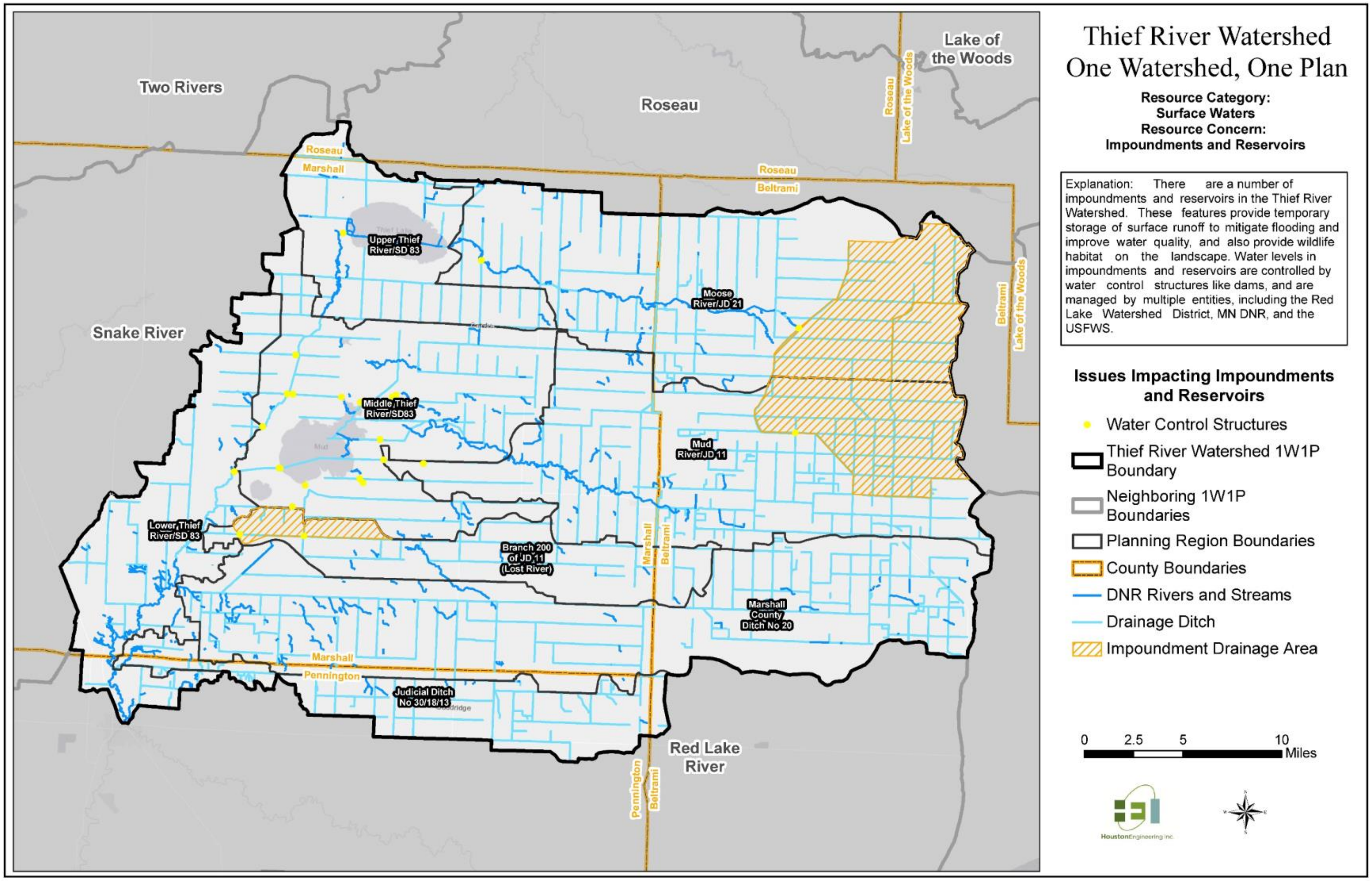

Figure 2-8: Locations of issues impacting impoundments and reservoirs within the Thief River Watershed

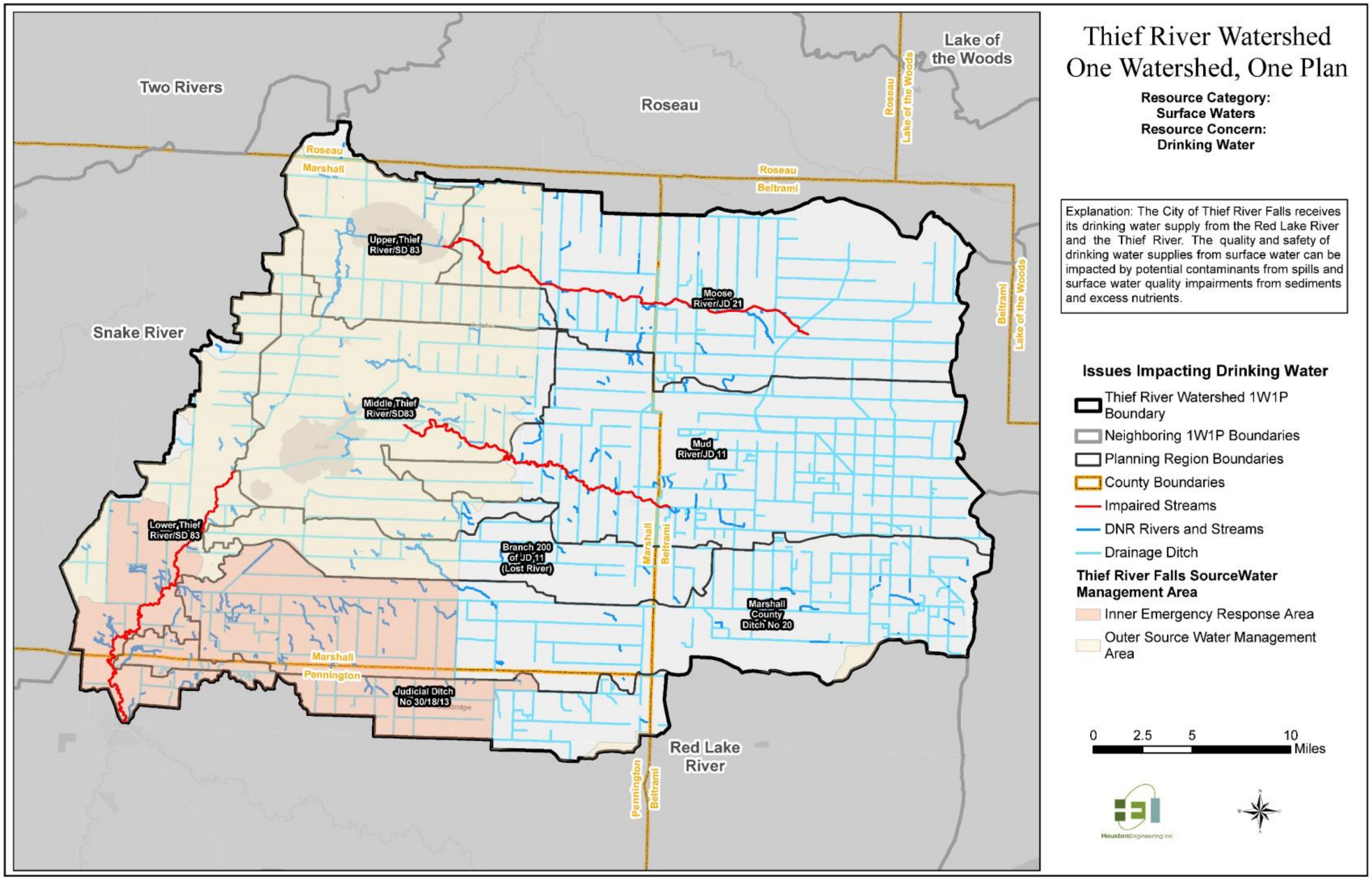

Figure 2-9: Locations of issues impacting drinking water from surface water sources within the Thief River Watershed

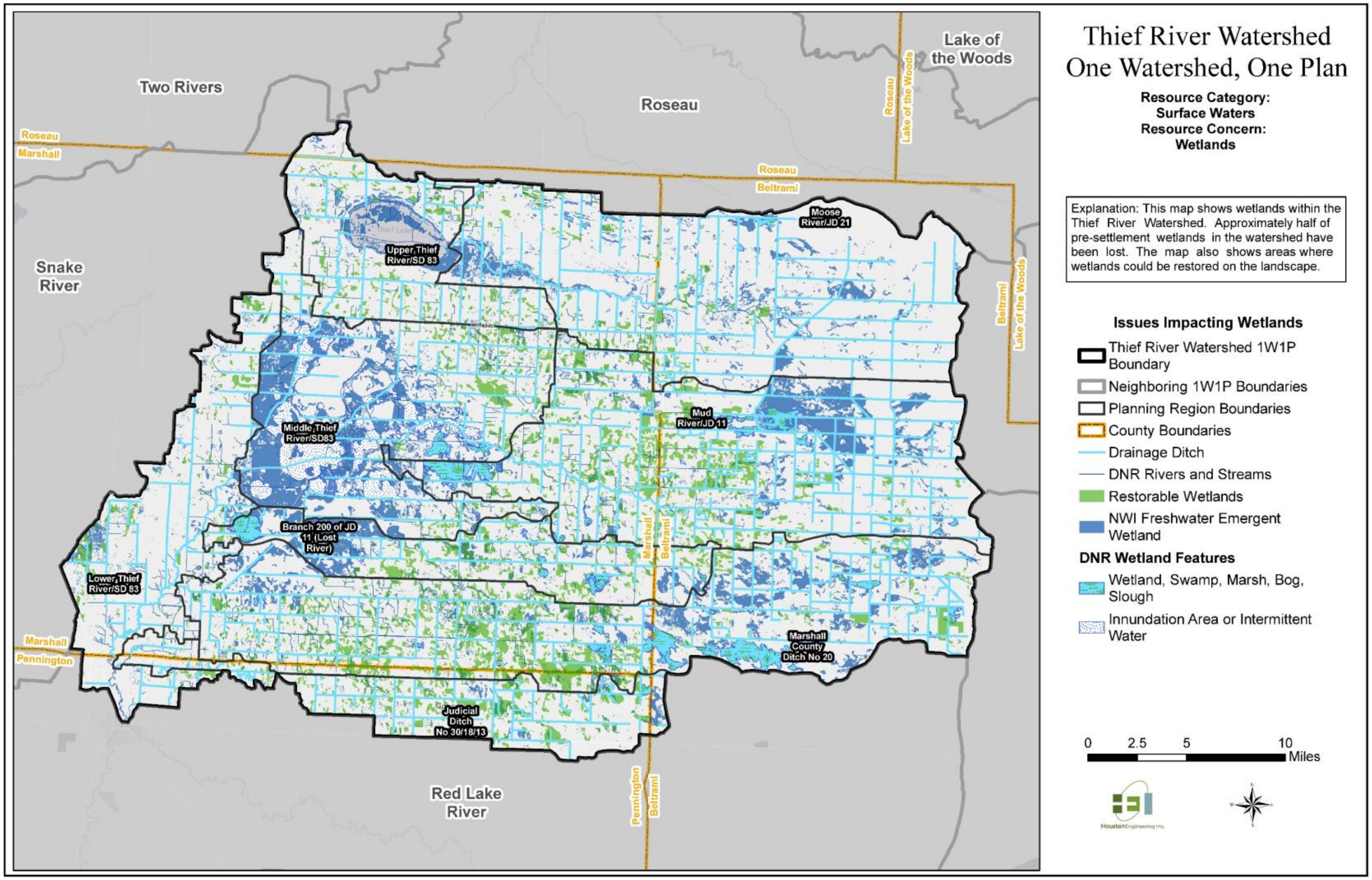

Figure 2-10: Locations of issues impacting wetlands within the Thief River Watershed

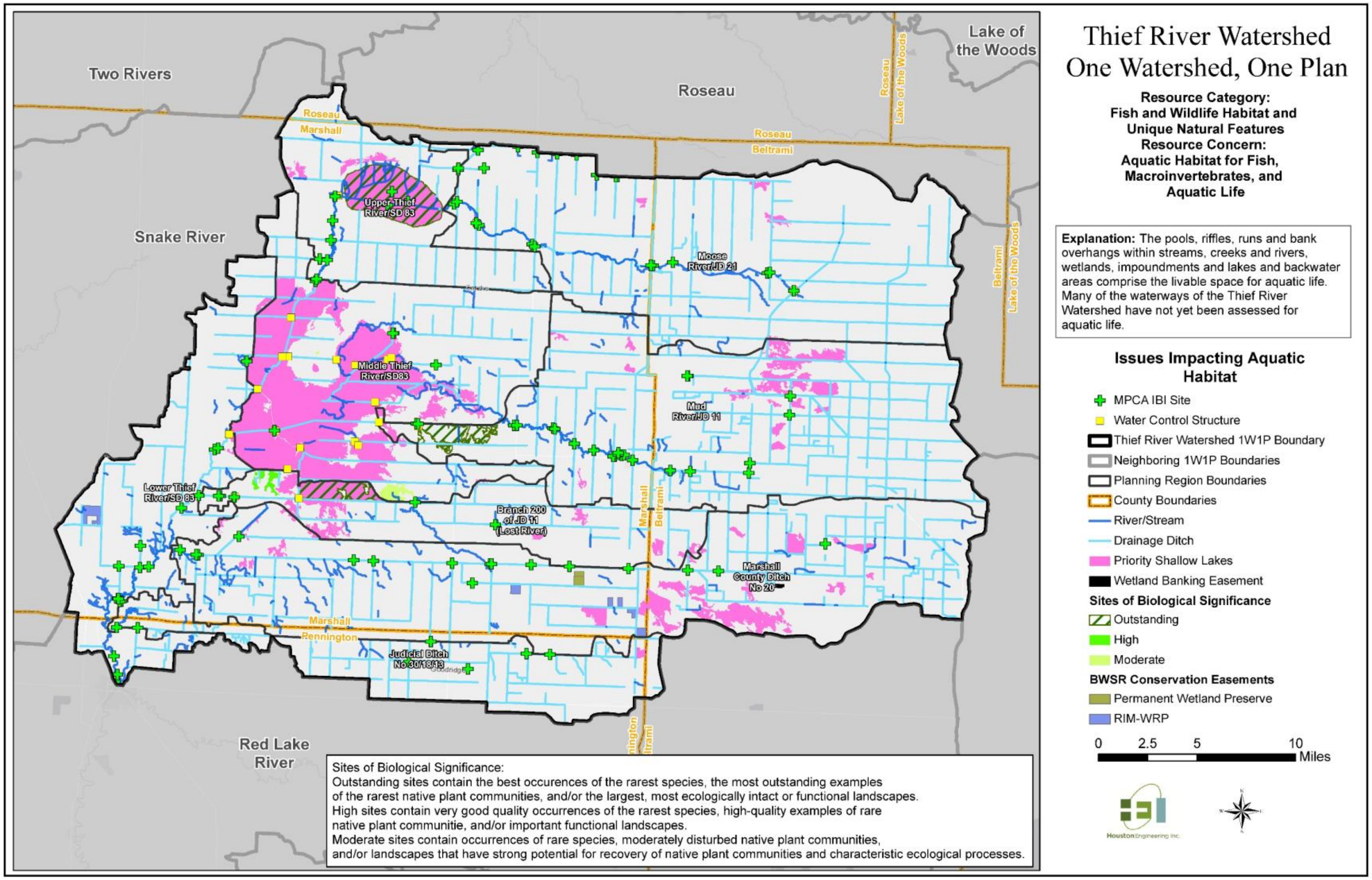

Figure 2-11: Locations of issues impacting aquatic habitat within the Thief River Watershed

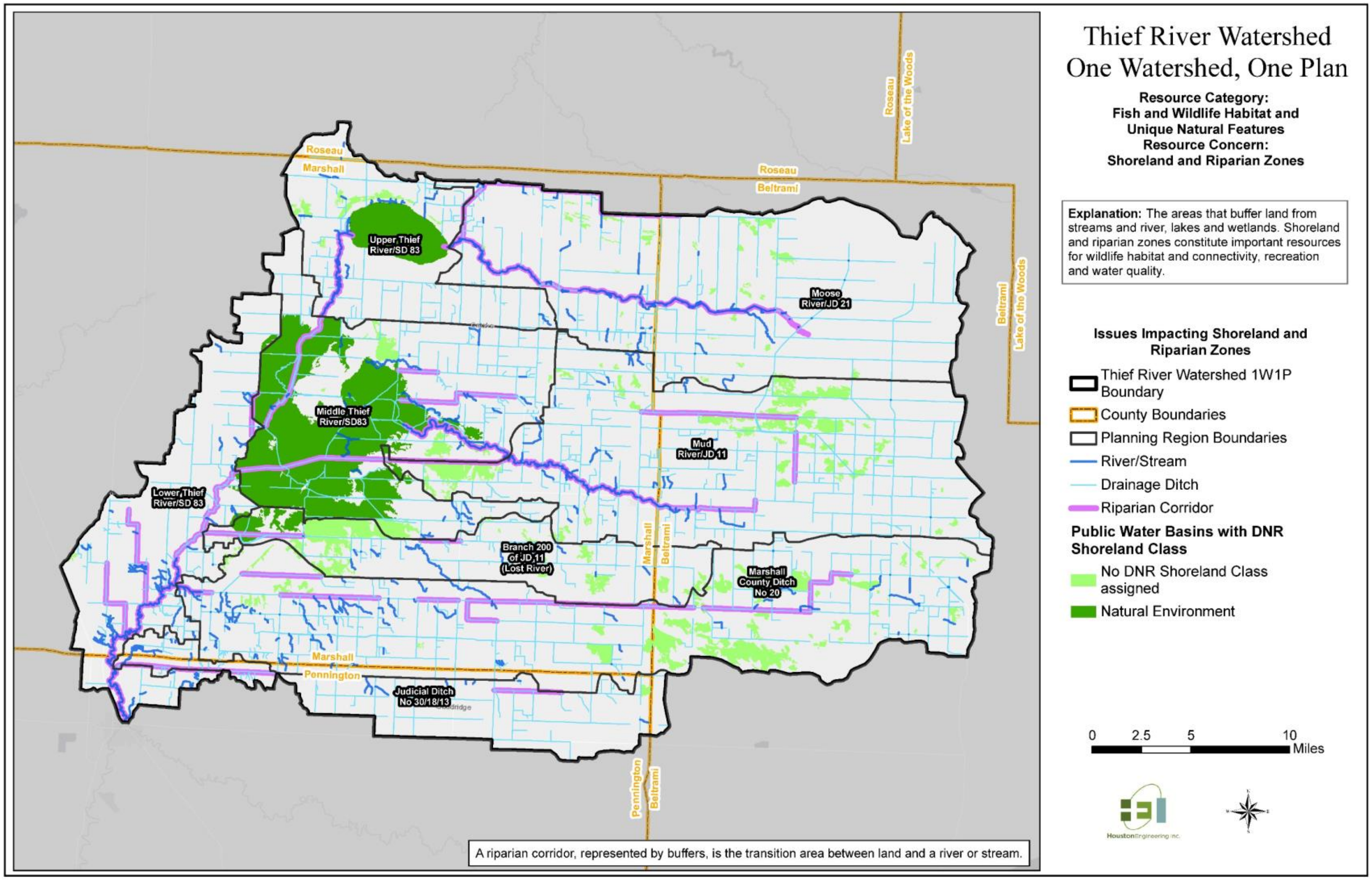

Figure 2-12: Locations of issues impacting shoreland and riparian zones within the Thief River Watershed

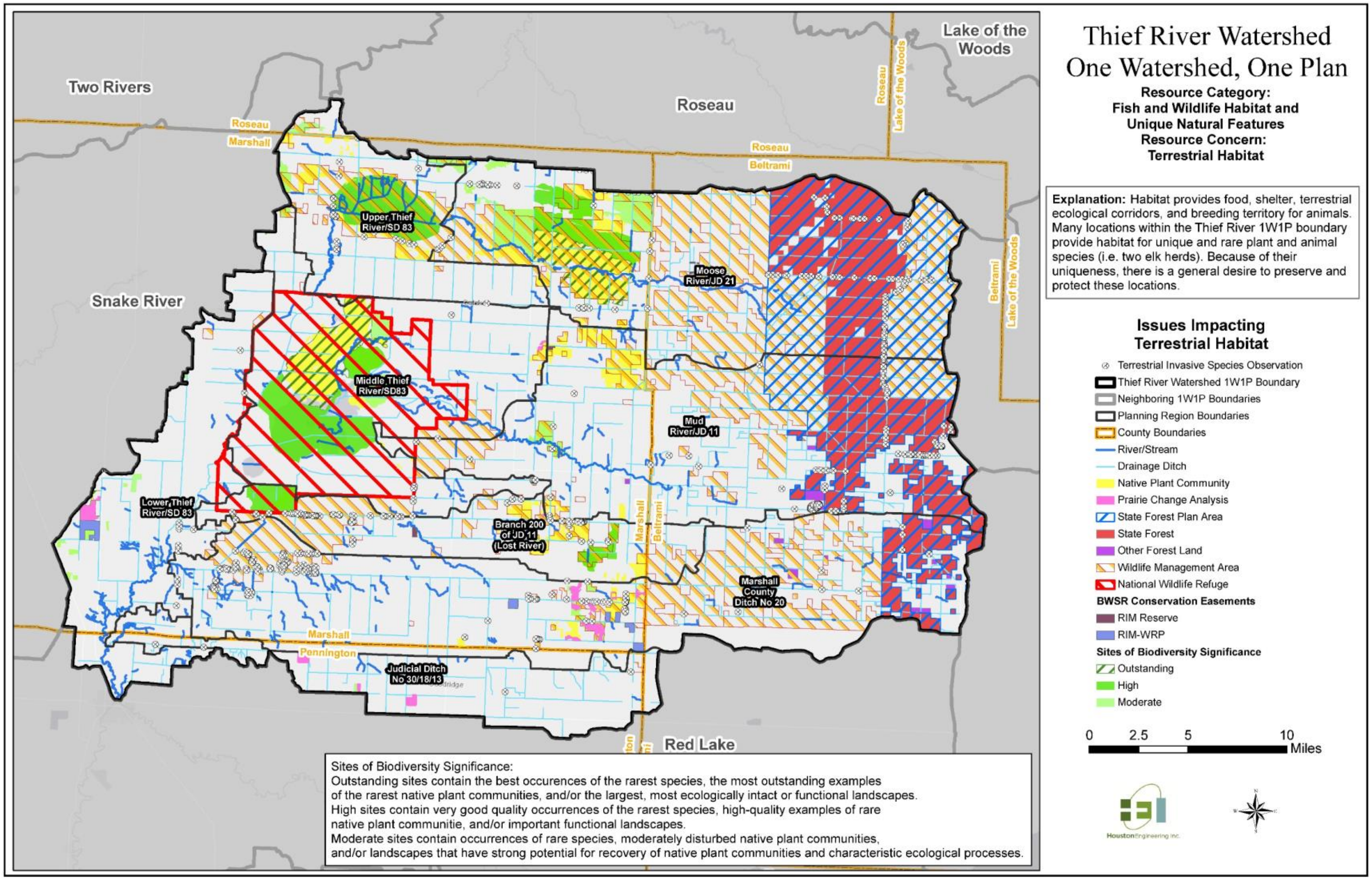

Figure 2-13: Locations of issues impacting terrestrial habitat within the Thief River Watershed

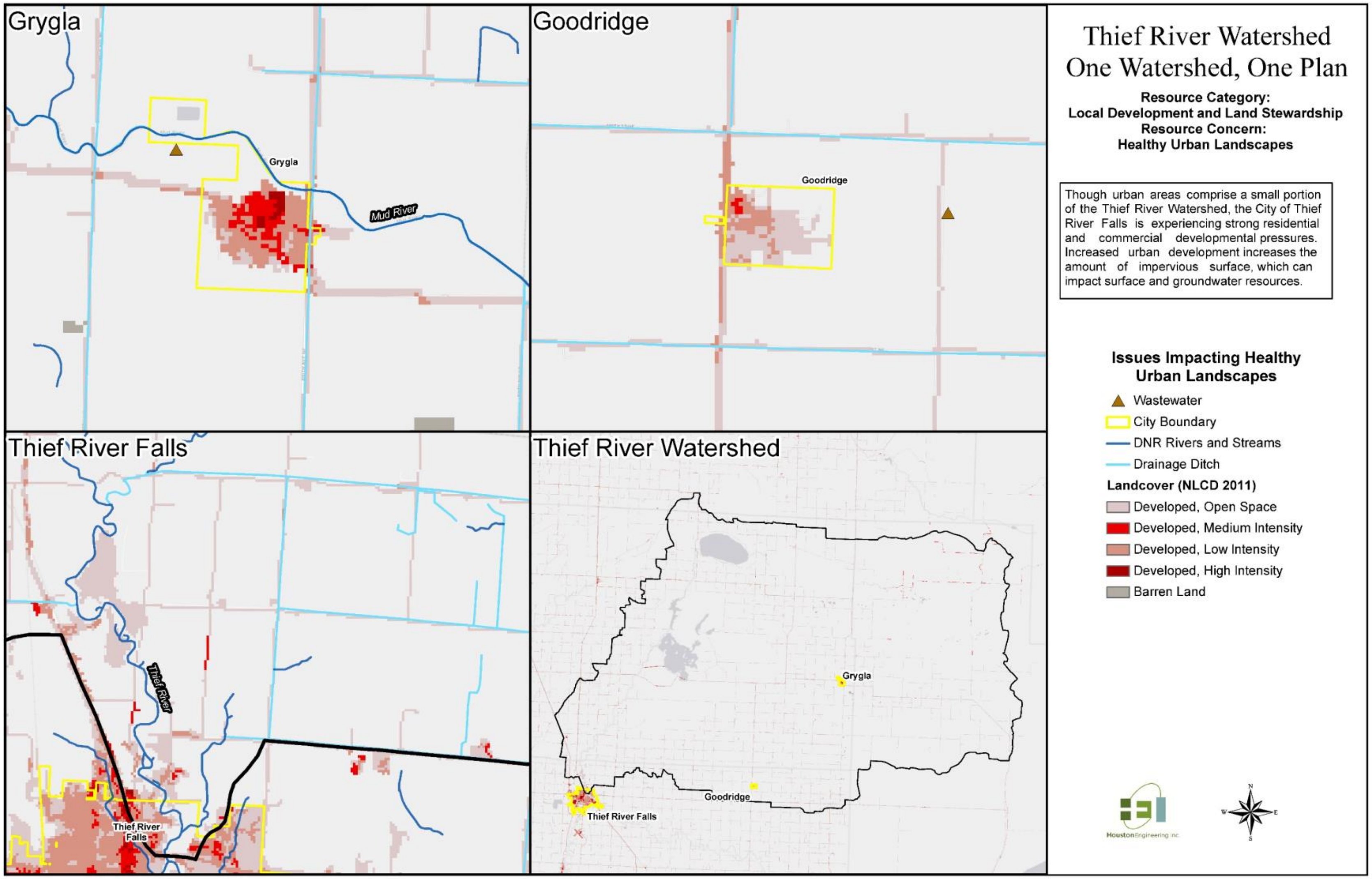

Figure 2-14: Locations of issues impacting urban land stewardship within the Thief River Watershed

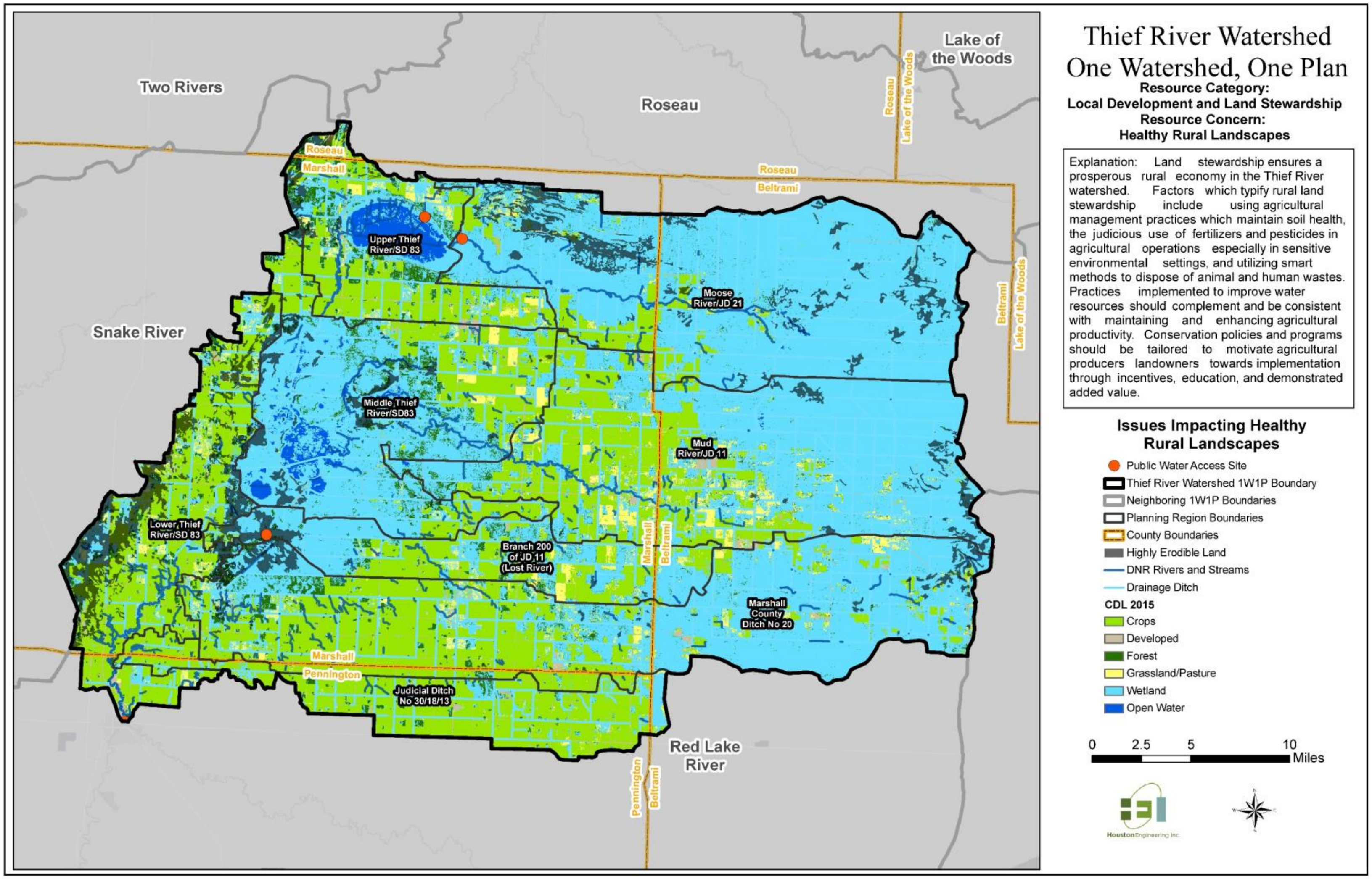

Figure 2-15: Locations of Issues Impacting Rural Land Stewardship within the Thief River Watershed

2.4 EMERGING ISSUES

This section presents an assessment of reasonably foreseeable or "emerging" issues. Emerging issues are those that lack detailed information, which are sometimes prominent in the media, and may affect the resources within the Thief River Watershed at some time in the future. The assessment of emerging issues has been compiled from a variety of sources, including:

- a review of previous studies, reports, and scientific papers;
- the collective experience of staff and technical advisors; and
- specific requests from the members of the Thief River Watershed 1W1P Committees.

The detail describing emerging issues varies depending on the source of the information. An emerging issue is described in greater detail when the source of information is a final scientific study or report. The amount of detail can be considerably less when the source of information is firsthand observation or previous experience with an issue of concern. Therefore, many of the emerging issues are only generally described to indicate the lack of detailed information.

The identification of emerging issues affects the content of this plan. Action items are included within the targeted implementation schedule (**Section 4**) to provide better clarity about the technical data needed to address emerging issues. Emerging issues are expected to be periodically monitored by plan participants, with respect to how they may affect plan implementation.

This section lays out a framework for addressing emerging issues during the lifespan of the plan. These issues include scientific and technical matters influencing the priority issues established by the plan, potential administration and fiscal limitations and barriers for implementing actions identified within the targeted implementation schedule, and improved water and resource policy to aid with plan implementation.

2.4.1 Scientific and Emerging Issues

2.4.1.1 Climate Change and Infrastructure Resilience

A report by the Minnesota DNR (DNR) using local data compiled from the Minnesota State Climatology Office, University of Minnesota (Boulay, 2016), (http://www.climate.umn.edu), and the National Climatic Data Center, National Oceanic and Atmospheric Administration (NOAA, 2016) (http://w2.weather.gov/climate), describes trends in temperature and precipitation for the Thief River Watershed. This analysis provides the most comprehensive, accurate, and detailed climate information available for the Thief River Watershed.

Northwest Minnesota has had average annual precipitation of 22.0 inches per year from 1895 to 2016. The average annual yearly (January to December) temperature is 38.3 degrees. There is a noticeable but slight increasing trend in both annual precipitation and annual temperature during the period of record (**Figure 2-1**). Precipitation trends in the Thief River Watershed are similar to those of the region (**Figure 2-2**). The annual average precipitation in the Thief River Watershed has been 22.36 inches from 1890 to 2015, which is actually less precipitation than bordering watersheds (Red Lake, Clearwater, and Roseau).

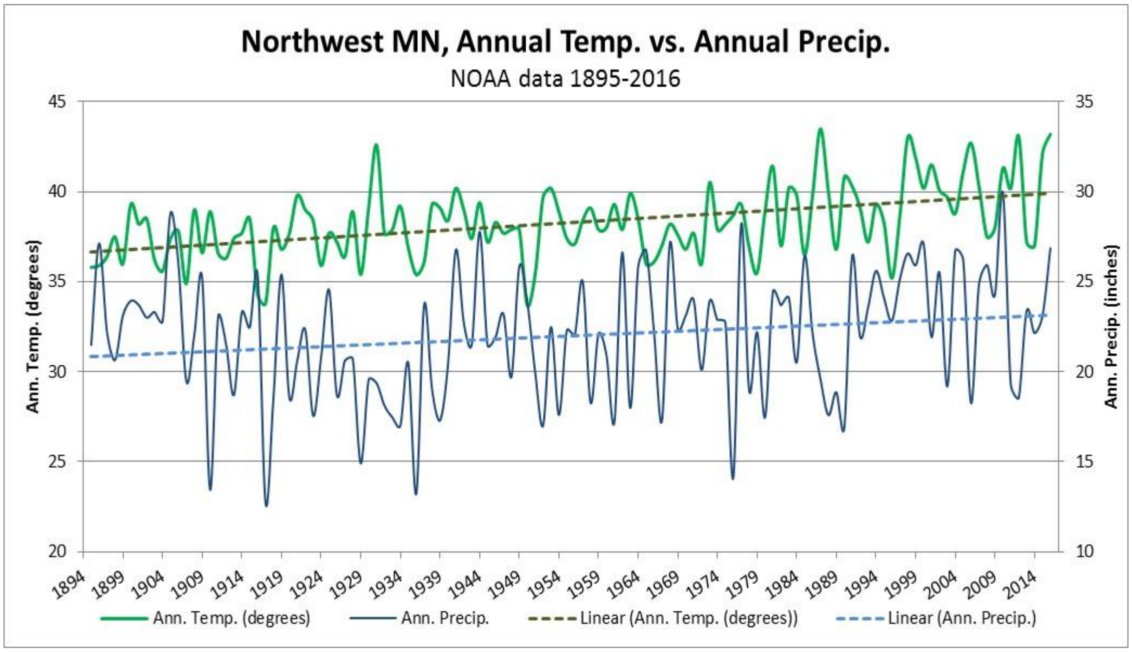

Figure 2-1*: Annual Temperature and Precipitation Trend for Northwest Minnesota from 1895-2016.*

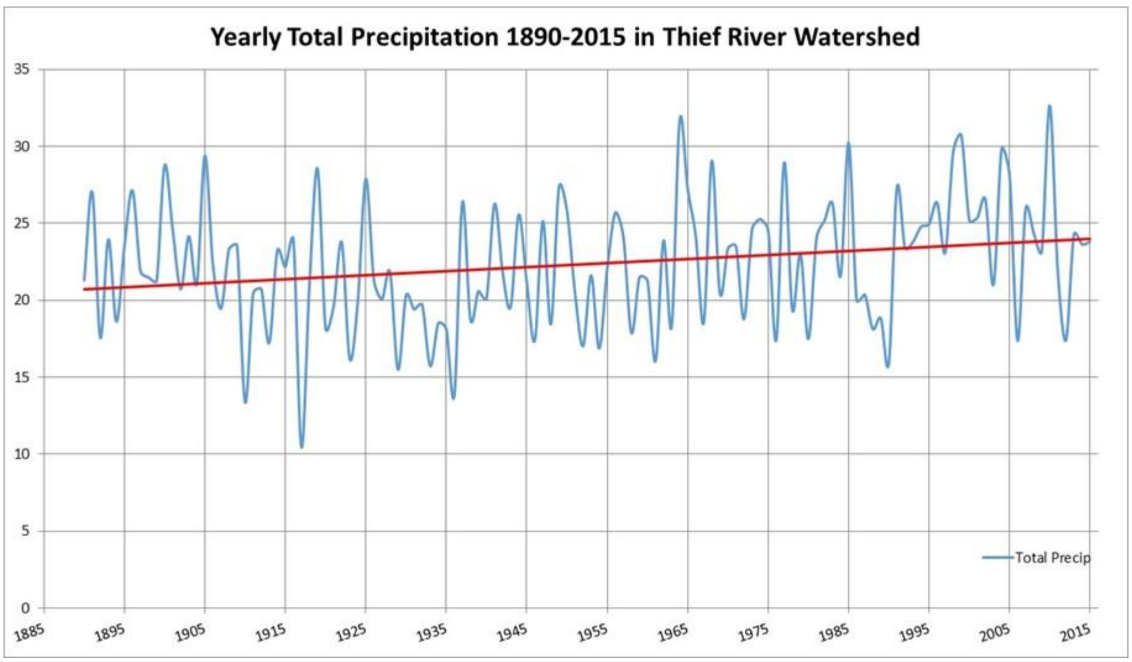

Figure 2-2*: Annual Total Precipitation in the Thief River Watershed from 1890-2015*

Average annual precipitation in the watershed has increased among climate periods within the period of record (**Figure 2-3**). Precipitation is 2.42 inches greater in the most recent 30-year period than in the early part of the 1900s, about 3.38 inches greater than the time period that included the 1930s era drought, and only about 1.29 inches greater than what was recorded from 1955-1984.

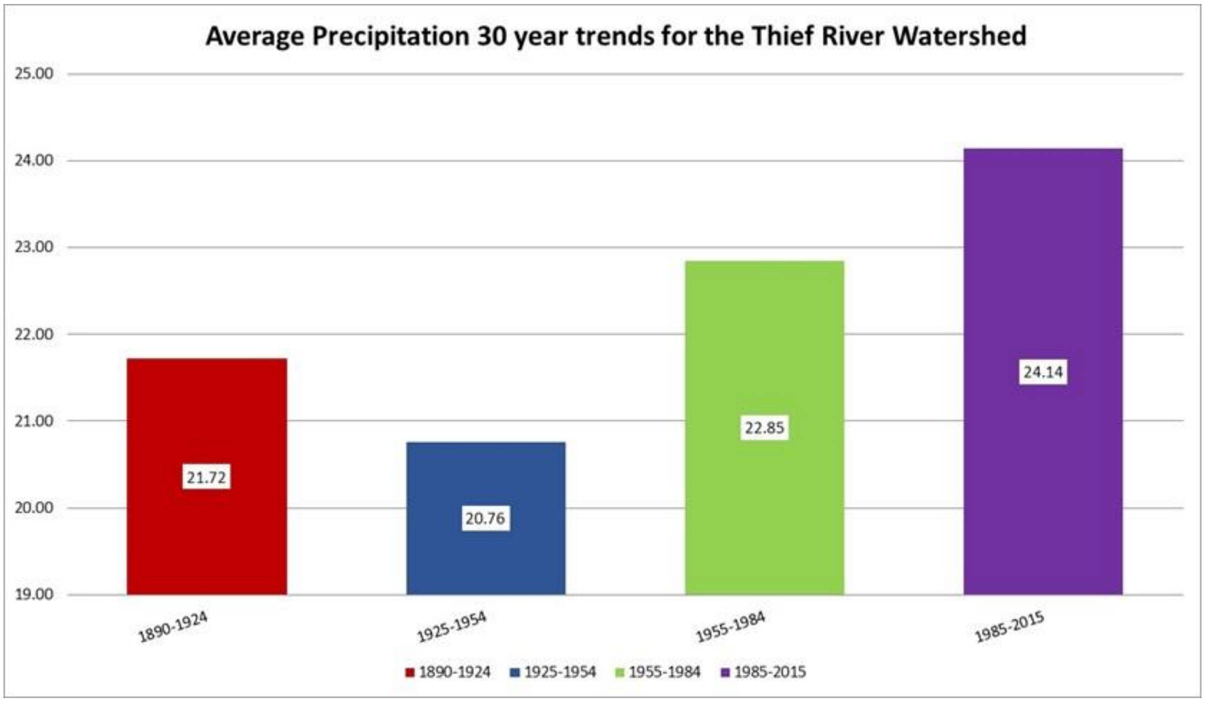

Figure 2-3: Average 30-year Precipitation Trends for the Thief River Watershed

The number of storm events with greater than two-inches of rainfall were similar between the two 30-year time periods, with no clear pattern. The long-term precipitation gage in the Agassiz National Wildlife Refuge (NWR) was used to assess storm intensity trends (1957-2017). Two-inch rain events at the Agassiz NWR gage were fairly consistent among the two time periods (11 and 13 events) with the 1984-2017 time period having two more events. The largest amount of precipitation recorded was over 7 inches, recorded on August 2, 1964; to date there has been no recorded 4- to 6-inch rainfalls. The most common are the 2- to 3-inch events. Intensity of other storm events were similar across climate periods (**Table 2-7**). Looking at when these intense storms occur, most occur during the summer months of June, July, and August (**Table 2-8**).

Table 2-7: Frequency (count) of storm events at Agassiz National Wildlife Refuge

Year	2 to 3" Rain Event in 24-hour period	3 - 4" Rain Event in 24-hour period	4 +" Rain Event in 24-hour period	Total
1955-1984	11	1	1	***13***
1985-2017	13	1	1	***15***
Total	***24***	***2***	***2***	***28***

Table 2-8: Monthly count of storm events with >2-inch rainfalls at Agassiz National Wildlife Refuge

Time Period	*April*	*May*	*June*	*July*	*Aug*	*Sept*	*Oct*
1955-1984			4	3	3	3	
1985-2017		2	7	2			
Total		***2***	***11***	***5***	***3***	***3***	

This plan recognizes the potential implications of climate change by encouraging the use of updated design standards for water resource infrastructure, based on National Oceanic and Atmospheric Administration (NOAA) Atlas 14.

2.4.1.2 Contaminants of Emerging Concern

A contaminant can generally be defined as a substance in a place where it doesn't belong. According to the Minnesota Department of Health (MDH), contaminants of emerging concern are substances that have been released to, found in, or have the potential to enter Minnesota waters (groundwater or surface water) and do not have Minnesota human health-based guidance (i.e., how much of a substance is safe to drink), pose a real or perceived health threat, or have new or changing health or exposure information (MDH, 2016).

In the last decade, national and statewide studies have revealed that many contaminants of emerging concern are found in the aquatic environment. They can include pharmaceuticals, pesticides, industrial effluents, personal care products that are washed down drains and processed by municipal wastewater treatment plants, and others (MDH, 2016). These contaminants are being found in Minnesota's waters, in part because there are better methods for finding substances at lower levels, additional substances are being looked for, new substances are being used, and old substances are being used in new ways (MDH, 2016). There is a growing concern that even at low concentrations, these contaminants, or mixtures of them, may adversely affect fish, wildlife, ecosystems, and possibly human health.

The MDH monitors for pesticides in the surface and groundwaters of northwest Minnesota. In groundwater, detections of pesticide breakdown products are more common than the parent pesticide, and all detections are very low when compared to applicable water quality reference values. For surface waters, herbicides are the most frequently detected pesticide compounds and are generally at low concentrations relative to water quality standards. Though insecticide detections, primarily chlorpyrifos, are infrequent, surrounding watersheds such as Grand Marais Creek and Tamarac-Stephens do have impairments for this insecticide (MDH, 2017). Additionally, upstream discharges, runoff, and scouring can introduce elevated levels of pathogens (*E. coli*, Giardia, Cryptosporidium) to the surface water intake, resulting in a detrimental impact to the safety of drinking water.

Blue-green algae and the potential presence of algal toxins have been an increased occurrence and concern, specifically in the communities of Grygla and Thief River Falls. Dogs have died from exposure to algal toxins in the Mud River in Grygla. A sign has been posted in the Gryla City Park where the dogs were exposed to the toxins to warn the public of the potential hazard. Since the death of the dogs in 2014, the RLWD began monitoring the Mud River in Gryla for the presence of algal toxins. In July 2018, the Thief River developed a severe, visible blue-green algae bloom within an upstream portion of the Thief River Falls Reservoir. The bloom resulted in closure of the city's beach, posting of warning signs, investigative sampling, media attention, and increased concern from citizens about water quality in the river.

Plan participants recognize the need to provide public water supplies free from contaminants of emerging concern. The plan addresses this emerging issue through actions that reduce the source of contaminants of emerging concern from entering water resources and the volume of water entering groundwater and surface water resources.

2.4.1.3 Invasive Species

Invasive species are species that are not native to the ecosystem under consideration and whose introduction causes, or is likely to cause, economic or environmental harm or harm to human health. These species are aggressive competitors, threatening the quality of high biodiversity areas and native communities. Invasive species can be aquatic or terrestrial in nature. In Minnesota, present and actively managed aquatic invasive species (AIS) include, but are not limited to, Eurasian watermilfoil, purple loosestrife, zebra mussels, spiny water fleas, and invasive carp. Though not a state-designated invasive species, hybrid cattail is an aggressive species that requires active management in impoundments, reservoirs, and other waters. Terrestrial invasive species in Minnesota include common buckthorn, gypsy moth, and Palmer amaranth. For an up-to-date list of current invasive species, visit the DNR's website on invasive species in Minnesota: https://www.dnr.state.mn.us/invasives/locations.html

While recreational lakes are not in abundance within the Thief River Watershed, it is important to consider the potential impacts of the spread of AIS. Fortunately, no AIS have been discovered within the Thief River watershed. Established AIS populations and newly discovered AIS in neighboring watersheds are cause for concern. An established population of Eurasian watermilfoil (*Myriophyllum spicatum*) is found in Union Lake just south of Erskine, MN, in the Sandhill River Watershed. Zebra mussels (*Dreissena polymorpha*) are slowly working their way north, hopping from lake to lake and flowing with the currents of the Red River of the North. Zebra mussels have been found in the Red River of the North in Grand Forks, ND. That City of Thief River Falls is concerned that the zebra mussels would clog municipal water intakes along the Red Lake River. In the summer of 2016, starry stonewort (*Nitellopsis obtusa*) was identified in Turtle Lake, north of Bemidji, MN. Starry stonewort was also discovered in a harbor on the eastern edge of Upper Red Lake near the town of Waskish, MN. To the north, spiny water flea is present in Lake of the Woods.

Minnesota has several state laws intended to minimize the introduction and spread of invasive species. It is illegal to transport any prohibited invasive species, such as Eurasian watermilfoil or zebra mussels, or to launch a boat or trailer with these species attached. The DNR is the main stakeholder statewide that addresses AIS issues, including educational and enforcement measures. In 2012, a statewide AIS Advisory Committee was created by the DNR designed to involve local stakeholders across the state in guiding legislative policy initiatives.

The counties along the Thief River (Pennington, Marshall, and Beltrami) have received funding and have been implementing plans to combat the spread of AIS. In 2014, a county tax bill was passed that provides funds for AIS prevention. Each year, Minnesota counties will receive funding to support AIS prevention programs. County board representatives designate a local government unit within each county to serve as their AIS program coordinator. The designated local government unit works closely with local, state, and federal governments as well as nonprofit and private organizations to develop and implement AIS prevention programs. Individual counties make decisions on how funds are to be used. Education, prevention, and early detection are some of the key strategies in keeping AIS out of the Thief River Watershed. Efforts from county AIS program coordinators are helping to push the "Clean, Drain, Dry" movement. Minnesota counties are flooding the markets with educational materials, hiring summer interns to help inspect watercrafts, purchasing decontamination stations, advertising on billboards, and distributing other educational materials.

This plan addresses this emerging concern through actions that will protect and enhance the integrity of surface water resources and wildlife habitat. These actions will increase the resiliency of these resources to invasive species and reduce the likelihood of their establishment.

2.4.1.4 Wind Erosion

Soil loss through wind erosion is a natural process that is accelerated by anthropogenic factors, including the replacement of small-grain crops with intensive agriculture crops such as soybeans and sugar beets; loss of pre-settlement forested areas and native grasslands; and the continued reduction in CRP lands, shelter belts, and conservation wind breaks. The Red River Valley in northwestern Minnesota is particularly vulnerable to soil loss through wind erosion, as the topography is relatively flat. This allows wind to pick up speed and intensity. The valley is heavily tilled, resulting in the breaking up of soil aggregates into finer particles, which are more easily transported by wind. Lastly, the valley has a general lack of vegetative cover, leaving topsoil exposed and unprotected for much of the year. Soil loss through wind erosion can impact water quality of downwind resources, damage crops, fill drainage ditches, and pose human health risks by impacting air quality. By stripping topsoil from agricultural fields, wind erosion can degrade soil health, leading to lower yields and increased need for inputs such as fertilizer.

The Minnesota statewide estimated average annual wind erosion rates on cultivated cropland, as estimated by the USDA-NRCS 1997 National Resources Inventory using the Wind Erosion Equation (WEQ), was 5.8 tons/acre/year. Though no current (within the last ten years) estimates exist for the Thief River Watershed, a wind erosion model, the Wind Erosion Prediction System (WEPS) for the Lower Red River (Joe, Middle-Snake-Tamarac, and Two Rivers watersheds), estimated an average erosive yield of 4.12 tons/acres/year due to wind erosion. Notably for the Thief River Watershed, the two most upwind subwatersheds (assuming predominantly northwesterly winds), the Lower and Upper Tamarack rivers, had estimated soil yield losses due to wind erosion of 6.25 and 9.25 tons/acres/year respectively. A 1996 NRSC Erosion and Sediment Yield Report estimated wind erosion for the Thief and Red Lake river basins to account for 94%, or 2,621,400 tons per year, of total gross erosion from cropland.

This plan recognizes the importance of managing and preventing soil loss through wind erosion. The plan addresses this emerging concern through actions that promote soil health and protect fields from wind erosion.

2.4.1.5 Groundwater-Fed Irrigation

Though groundwater is an important drinking water source for the Thief River Watershed, it is currently not a primary source for irrigation. Groundwater and surface waters in watersheds to the west and south have become a source of water for irrigation. It is not expected that the Thief River Watershed surface or groundwaters will be impacted by irrigation soon, but this does remain an area of emerging concern for the watershed districts and local units of government. Though precipitation is expected to increase in the Thief River Watershed, a drought frequency investigation for the Red River Valley predicts a strong probability of an extreme drought event occurring before 2050 (Meridian Environmental Technology, Inc. 2004). A prolonged drought event could have a pronounced impact on agricultural productivity, leading to a greater reliance on groundwater as a source of irrigation. Furthermore, with increased demands for water for crop production and yields and the increased installation of tile drainage, irrigation is frequently looked at for a way to boost production and control the amount of water applied, which leaves long-term impacts and water quality concerns about groundwater resources.

2.4.1.6 Tile Drainage

The amount of tile drainage within the Red River Valley has been on the rise, including in the Thief River Watershed. At the field scale, it is well documented that tile drainage has benefits for agricultural producers, including, but not limited to, increased profits, extended growing season, decreased plant stress, and increased land value. While the effects of tile at the field scale are relatively well understood, at the subwatershed or watershed scale, the effects of tile on water quantity and quality are more complex. It is also well documented that tile drainage increases annual water yield and can increase or decrease flood peaks depending on a variety of factors (BTSAC 2012). The effects of tile drainage on water quality are also complex and vary depending on the scale, magnitude, and timing of a runoff event (Blann et al 2009).

Monitoring by the Red Lake Watershed District (RLWD) found that tile drainage also includes potential water quality and quantity benefits, including, but not limited to, reductions in turbidity and TSS, total phosphorus, and—depending on the type of outlet, soil type, or other factors—temporary storage. Despite these positive impacts, tile drainage can increase nitrate and conductivity levels downstream (RLWD, 2009). The RLWD requires the following to obtain a permit for tile drainage:

- All subsurface tile drainage systems must protect from erosion and include RLWD approved erosion control measures.

- All subsurface tile outlets, including lift station pumps, must be located out of a legal drainage system and governmental roadway right of way unless approved by District and must be visibly marked.
- It is recommended that after harvest, tile outlet controls, including lift station pumps, be opened or turned on to remove water from the system unless downstream culverts are freezing.
- Obtaining a permit from the RLWD managers does not relieve the applicant from the responsibility of obtaining any other additional authorization or permits required by law (e.g., NRCS, SWCD, Township, County, State, etc.).
- Upon completion of the project, "As Built" plans must be provided to the District.
- Consideration must be made for turning off pumps for short periods of time during the summer so maintenance can be performed on public, legal, and private drainageways, such as road ditches or private natural field drains.

A permit application is available from the RLWD at http://www.redlakewatershed.org/permits/Tile%20Drainage%20Permit%20Final%20(ID%2013543)%20(ID%2013556). In addition, laws and regulations that protect wetlands must be followed.

This plan recognizes the importance of tile drainage in drainage water management, improving agricultural production and the complex role it plays in relation to water quantity and water quality at a variety of scales. It is also recognized in this plan that tile drainage may have potential for drainage water management in support of soil health. The plan addresses this emerging concern by considering actions related to tile drainage that will promote agricultural benefits while accounting for its effects on water quality and water quantity at the watershed scale.

2.4.2 Policy and Funding Emerging Issues

2.4.2.1 Funding for Plan Implementation

Funding is one of the primary constraints on executing the targeted implementation schedule. This plan shows that the ability to execute actions within the targeted implementation schedule and achieve the measurable goals requires more fiscal and staff resources at the local level than is available to the Thief River Watershed 1W1P Planning Group (**Section 4**). Additional outside resources are likely needed in order to accomplish goals laid out in this plan. The Thief River Watershed group anticipates funding resources will be available through sources like Clean Water Funding and non-competitive watershed-based funding. Because of their connection to landowners, the State envisions that the SWCDs, counties, and watershed districts are critical partners and the implementing agents as envisioned in WRAPS, TMDLs, and the Clean Water Accountability Act.

The targeted implementation schedule in this plan represents a coherent, comprehensive approach to mark progress towards measurable goals. Raising cost share dollars for state and federal grants is problematic. Although local agencies have had success in acquiring competitive grants, relying on those funding sources to achieve the measurable goals seems unreasonable and makes success tenuous. Therefore, block funding on an annual basis is needed. This plan includes actions to achieve a consistent funding mechanism and reasonably ensure implementation success.

2.4.2.2 Conservation Practice Delivery Mechanism

The effective delivery of conservation programs relies on dedicated funding, sound policy, state and local government resources, and landowner involvement. Both technical and financial resources at the local level to implement conservation programs are limited. Some agricultural policies encourage the agricultural producer to maximize yield in conflict with other policies. This plan recognizes the need to improve conservation delivery through implementation programs aimed to increase engagement with agricultural landowners and producer within the plan area.

2.4.2.3 Inconsistent Administration and Enforcement of Minnesota Rules and Statutes

Administration and enforcement of Minnesota administrative rules and statutes is an important aspect of managing and protecting the state's water quality. Examples of these rules and statutes include, but are not limited to, the regulation of animal feedlots (Minnesota Administrative Rules Chapter 7020), shoreland and floodplain management (Minnesota Administrative Rules Chapter 6120), and soil erosion (Minnesota Statutes Chapter 103F). Local governments provide for the administration and enforcement of these rules and statutes; however, there is commonly inconsistent administration and enforcement of these rules between jurisdictional boundaries. Negligent administration and enforcement in one jurisdictional boundary may negatively impact water quality and quantity of jurisdictional boundaries downstream.

Planning partners within the Thief River Watershed recognize the value that consistent application of Minnesota rules and statutes can have on water quality and quantity at a major watershed scale. The plan addresses this emerging issue in the targeted implementation schedule with actions that focus on identifying problem areas within the Thief River Watershed and the consistent application of existing rules and statutes within the entire plan area.

2.4.2.4 Farm Law Legislation (National and International)

Changes to international and national legislation have significant ramifications on the types, magnitude, and profitability of crops produced in the Minnesota. For example, legislation promoting corn growth for ethanol production may impact the amount of corn and rotation of crops in an agricultural area. Conversely, legislation incentivizing production of alternative crops (i.e. switchgrass) for alternative fuels may also impact cropping practices. Types and productivity of crops may also be impacted by legislative changes to crop insurance support (i.e. the farm bill).

This plan recognizes the impact that national and international legislation has on local agricultural production and the producer's economic vitality. The plan addresses this emerging issue by supporting standard practices for all producers (i.e. managing for good soil health) and is addressed throughout the plan by programs that encourage this.

2.4.2.5 Renewable Energy Legislation (State)

BWSR is preparing a feasibility study and plan for a Working Lands Watershed Restoration Program—a program to provide incentives for landowners to plant perennial and cover crops that will improve water quality. Crops include perennial grasses and winter annual cover crops that keep roots in the soil and vegetation on the land throughout the year, improving soil health, storing carbon, and capturing excess nitrogen. These crops can be grazed, used for livestock feed, or processed for electricity, thermal energy, advanced biofuels (such as bio-jet fuel), renewable chemicals, or similar applications. Some crops can even be grown for food or beverage production.

The study was directed by the 2016 Minnesota Legislature (Laws 2016, c. 189, s. 4) with the goal of improving water quality by increasing living cover on the landscape at a watershed scale. Related benefits include creating or improving habitat for pollinators and wildlife while improving soil health and carbon storage.

BWSR is coordinating this effort with stakeholders and other state agencies, including agricultural and resource conservation interests, commodity groups, watershed districts, soil and water conservation districts, the biofuels industry, landowners, researchers at the University of Minnesota, the Minnesota Pollution Control Agency, and the departments of Agriculture, Natural Resources, and Health.

2.4.3 Process for Addressing Emerging Issues and Data Gaps

Inevitably, issues emerge that lack sufficient data, research, or information. While a substantial effort was made to develop a comprehensive list of resources, concerns, and issues, it is possible that some issues were missed or that new issues will emerge during the lifespan of the plan. This might include the discovery of a new contaminant or aquatic invasive species within the Thief River Watershed or a change in the policies or administration of a member local government unit. Should an unanticipated issue emerge during the lifespan of the plan, the issue will be considered and addressed as necessary through annual evaluations (**Section 5**) and local work plan (**Section 5**) development. If the emerging issues are substantial enough, plan amendments will be considered based on procedures laid out in **Section 5** of this plan.

Gaps in technical knowledge continually need to be closed. Rather than delaying planning or implementation actives when these gaps arise, the Thief River Watershed will consider these gaps during self-assessments (**Section 5**) and develop action(s) to address them on an as-needed basis. These actions(s) could include specific implementation activities, support of additional research or data monitoring and collection, or increased education and outreach.

3.0 ESTABLISHMENT OF MEASURABLE GOALS

Measurable goal categories were established for each Thief River Watershed priority issue. Each measurable goal category includes the priority resource issues addressed, short- and long-term measurable goals, and metrics for measuring progress towards attainment.

A variety of information sources were utilized in the development of the measurable goals, including:

- goals from existing management plans, studies, reports, data, and information, including WRAPS, TMDLs, local water plans, state strategies, and similar documents (**Appendix D**);
- input from Advisory Committee members;
- input from Policy Committee members; and
- the knowledge of local water and resource managers provided by the Planning Work Group.

This section outlines and describes the **13 measurable goal categories for this comprehensive plan**, which collectively address all the priority issues. A single measurable goal category may apply to one priority issue or to several priority issues.

3.1 MEASURABLE GOAL DEVELOPMENT

Figure 3-1 provides a visual for measurable goals (using an example measurable goal from the plan) and the relationship to priority issues, resource concerns, and resource categories. Each priority issue is addressed by a measurable goal, but one measurable goal may address several priority issues. Grouping measurable goals in this way reduces redundancy in the plan and recognizes the multiple benefits of actions implemented to improve resources.

Subsection 3.1.1 describes the process of using protection and restoration strategies to develop and prioritize targeted measurable goals for each planning region. The purpose of including protection and restoration strategies in this plan section is to align measurable goals pertaining to surface water quality with Minnesota State strategies and funding sources. Within this framework, planning regions are categorized based on surface water impairment status and proximity to impairment thresholds, which impacts the magnitude of measurable water quality and habitat improvement goals. The tables and maps in **Subsection 3.1.1** help identify and prioritize planning regions and stream reaches in need of restoration or protection for water quality goals. Though the restoration and protection strategies are assigned at a stream reach scale, measurable goals are developed at the planning region scale recognizing that changes on the landscape will have an impact at the resource.

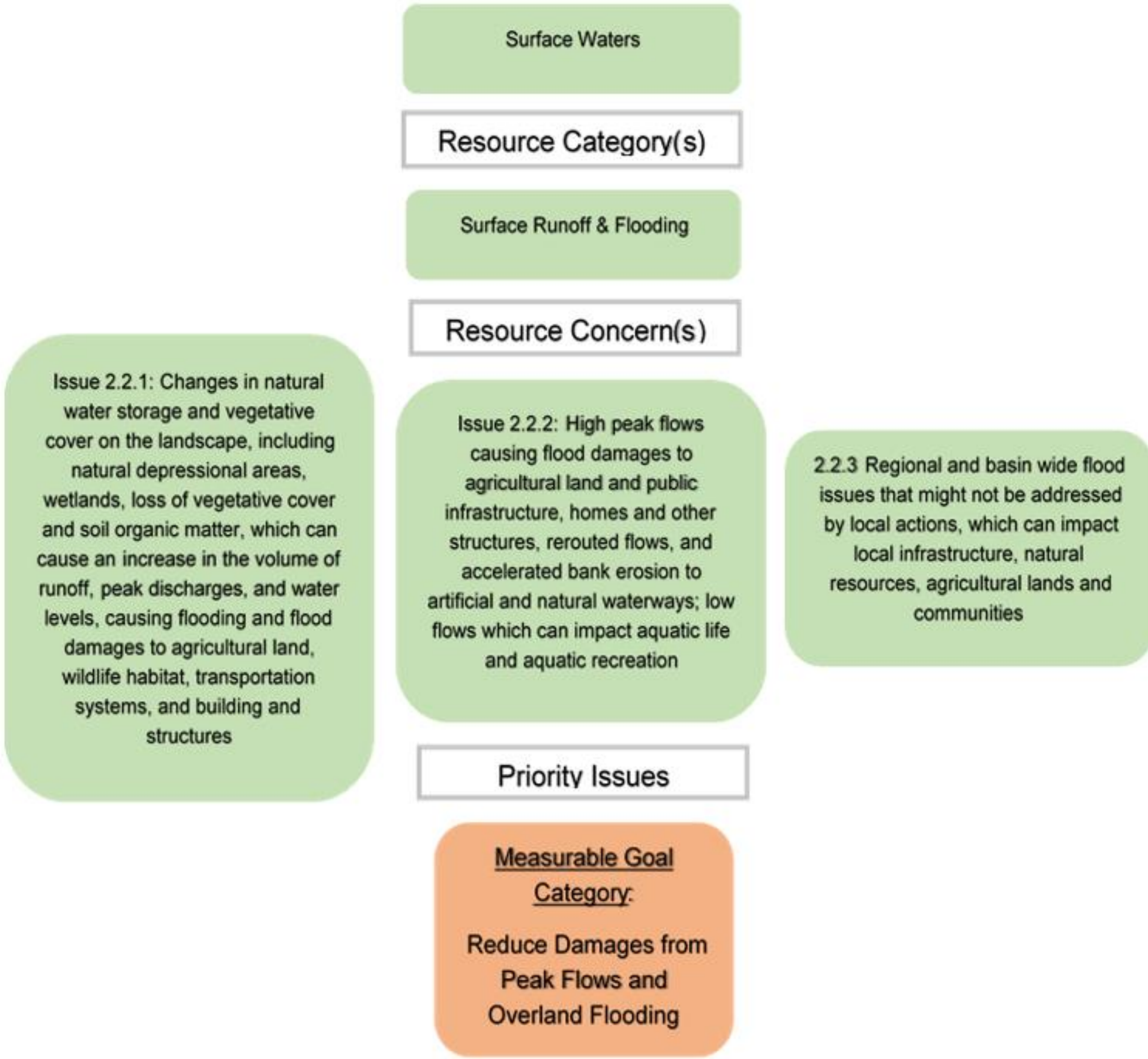

Figure 3-1: Organizational structure of measurable goals and relation to plan priority issues, resource concerns, and resource categories

3.1.1 Using Restoration and Protection Strategies to Achieve Water Quality Measurable Goals

This section provides a brief overview of using protection and restoration strategies to prioritize and attain progress towards measurable goals. Restoration and protection strategies align with the Thief River Watershed WRAPs and use water quality and biological data to identify waters in need of protection or restoration. River, stream, and ditch reaches were categorized into four restoration and protection classes:

- Restoration
- Potential Impairment
- Nearly Impaired
- Highest Quality

Table 3-1 describes the criteria for categorization into one of these four classes. **Table 3-2** describes protection and restoration categories at the planning region and reach scale by pollutant. Concentration-based numerical standards were used to assign a reach to a restoration or protection class. In some instances, to streamline implementation and leverage data from PTMApp (**Section 4**), the reach-based, concentration-based goals identified in the WRAPs have been aggregated to the planning region scale. Advisory Committee and Planning Work Group guidance was used to set load reduction goals as opposed to concentration-based goals for streams. Detailed information about the development of protection and restoration strategies is in **Appendix G**.

This plan also recognizes the importance of setting water quantity goals. The rationale(s) for setting targeted and measurable water quantity goals are described in **Measurable Goal Categories 3.2.5, 3.2.6, and 3.2.11**.

Table 3-1: Protection and Restoration Category Criteria for Streams in the Thief River Watershed

Classification of Streams for Protection and Restoration	Restoration	Potential Impairment	Nearly Impaired	Highest Quality	Numerical Standard and Other Details
Meets MPCA Minimum Data Requirements	Yes	Yes	Yes	Yes	20 TSS measurements 5 *E. coli* measurements/calendar month 20 DO measurements 12 TP measurements over 2 or more years
Assessment Period	2007-2016	2007-2016	2007-2016	2007-2016	
Included in the Draft 2018 List of Impaired	Yes	No	No	No	
Meets Standards?	No	No	Yes, borderline/uncertain	Yes, with confidence	
Total Suspended Solids (TSS)	>10% exceed the standard	>10% exceed the standard	7.5-10% exceed the standard	<7.5% exceed the standard	30 mg/L - Central River Nutrient Region 15 mg/L - North River Nutrient Region Uses April-September Daily Averages
E. coli Bacteria	>157.5 MPN/100ml	>126 MPN/100ml	>94.5 MPN/100ml	<94.5 MPN/100ml	126 MPN/100ml monthly geometric mean
Dissolved Oxygen (DO)	>10% of discrete daily minimums are <5 mg/L	>10% of discrete daily minimums are <5 mg/L	5-10% of discrete daily minimums are <5 mg/L	<5% of discrete daily minimums are <5 mg/L	5 mg/L May-September Daily Minimums All discrete data
	and >10% of pre-9am daily minimums are <5 mg/L		or >10% of pre-9am daily minimums are <5 mg/L	and <5% of pre-9am daily minimums are <5 mg/L	5 mg/L May-September Daily Minimums Continuous and discrete data recorded earlier than 9:00am
Total Phosphorus (TP)	None - not assessed in 2013	TP and at least one response variable exceed standards	>75 µg/L - Central >37.5 µg/L - North Response variables meet standards if TP exceeds the standard	<75 µg/L - Central <37.5 µg/L - North	Summer (June-September) Average 100 µg/L - Central River Nutrient Region 50 µg/L - North River Nutrient Region
Index of Biological Integrity (IBI)	None - not assessed in 2013	Score is lower than the lower confidence limit	Score is between the lower and upper confidence limits	Score is higher than the upper confidence limit	Varies by location +/- 10-point F-IBI confidence limits +/- 13.5-point M-IBI confidence limits

Table 3-2: Protection and Restoration Categories by AUID, Planning Region and Pollutant in the Thief River Watershed

Planning Region	Assessment Unit ID	Waterbody Name	Reach Description	River Nutrient Region (Applied to Local Planning)	Total Suspended Solids	*E. coli* Bacteria	Dissolved Oxygen	Total Phosphorus and River Eutrophication	Index of Biological Integrity
Lower Thief River	09020304-501	Thief River (Natural)	Agassiz Pool to Red Lake R	Central	Restoration (Impaired)	Nearly Impaired	Highest Quality	Highest Quality	Nearly Impaired
	09020304-501	Thief River (SD 83)		Central					Nearly Impaired
	09020304-550	Lat 1 JD 23	Headwaters to Thief River	Central					Nearly Impaired
	09020304-551	Main JD 23	Lat 2 JD 23 to Thief River	Central					Potential Impairment
	09020304-558	Marshall CD 35	Br 11 SD 83 to Thief River	Central					Nearly Impaired
Upper Thief R.	09020304-504	Thief River	Thief Lake to Agassiz Pool	Central	Highest Quality	Highest Quality	Highest Quality	Highest Quality	Nearly Impaired
Moose River	09020304-505	Moose River	Headwaters to Thief Lake	North	Highest Quality	Highest Quality	Restoration (Impaired)	Potential Impairment	Potential Impairment
	09020304-555	Branch A of JD 21	Br 6 of JD 21 To Moose River	North	Highest Quality	Nearly Impaired	Highest Quality	Highest Quality	Nearly Impaired
	09020304-557	Branch A of JD 21	410th Ave NE to Br 29 of JD 21	North					Nearly Impaired
Mud River	09020304-507	Mud River	Headwaters to Agassiz Pool	North	Nearly Impaired	Restoration (Impaired)	Restoration (Impaired)	Potential Impairment	Nearly Impaired
	09020304-527	Tributary to Branch 95 of JD 11	Unnamed ditch to Branch 95 of JD 11	North					Highest Quality
	09020304-521	Judicial Ditch 11	S. Pool outlet of Moose R. Imp. to unnamed ditch along Benville Rd	North			Highest Quality		
	09020304-535	Judicial Ditch 11	330th Ave NE (Mud R) to 290th Ave NE	North			Highest Quality		
Middle Thief River	09020304-536	Judicial Ditch 11	290th Ave NE, through Agassiz Pool, to the Thief R.	North					Nearly Impaired
	09020304-543	Br 1 of JD 11	Br 15 of JD 11 to Br 7 of JD 11	North			Nearly Impaired		Nearly Impaired
	09020304-559	Unnamed ditch	Headwaters to Mud Lake	Central					Nearly Impaired
Lost River	09020304-511	Br. 200 of JD 11	270th St NE (near Lost R Pool outlet) to 180th Ave NE ditch	North	Highest Quality	Highest Quality	Potential Impairment	Potential Impairment	Nearly Impaired
	09020304-534	Br. 200 of JD 11	CSAH 219 to 290th Ave NE	North			Potential Impairment		
County Ditch No 20	09020304-513	Marshall CD 20	400th Ave NE to CD 32	North			Nearly Impaired		Nearly Impaired
	09020304-519	Marshall CD 20	Branch A of CD 30 to Branch D of CD 20	North	Highest Quality	Highest Quality	Nearly Impaired	Nearly Impaired	Nearly Impaired
	09020304-548	County Ditch 20	Clifford Ln NW to an unnamed ditch east of Sharon Rd intersection	North					Potential Impairment
	09020304-549	Trib to Marshall CD 20	Bottom Rd NW to CD 20, near Jelle	North					Nearly Impaired
	09020304-552	County Ditch 27	Unnamed ditch to Br 3 CD 20	Central					Nearly Impaired
	09020304-554	Marshall Co. Ditch 32	E line of Sect. 19, Grand Plain Twp., Section 19 to CD 20	Central					Nearly Impaired
Judicial Ditch No 18	09020304-509	Judicial Ditch 30	T154 R42W S14, East Line (JD30) to Thief R	North	Highest Quality	Highest Quality	Highest Quality	Nearly Impaired	Potential Impairment
	09020304-537	Judicial Ditch 13	Br 3 of JD 13 to 330th Ave NE, north of Goodridge	North					Nearly Impaired
	09020304-540	Judicial Ditch 13	T154 R40W S16, east line to Br D of JD 18	North					Potential Impairment
	09020304-541	Judicial Ditch 18	T154 R40W S27, midpoint to T154 R42W S13, west line	North					Nearly Impaired

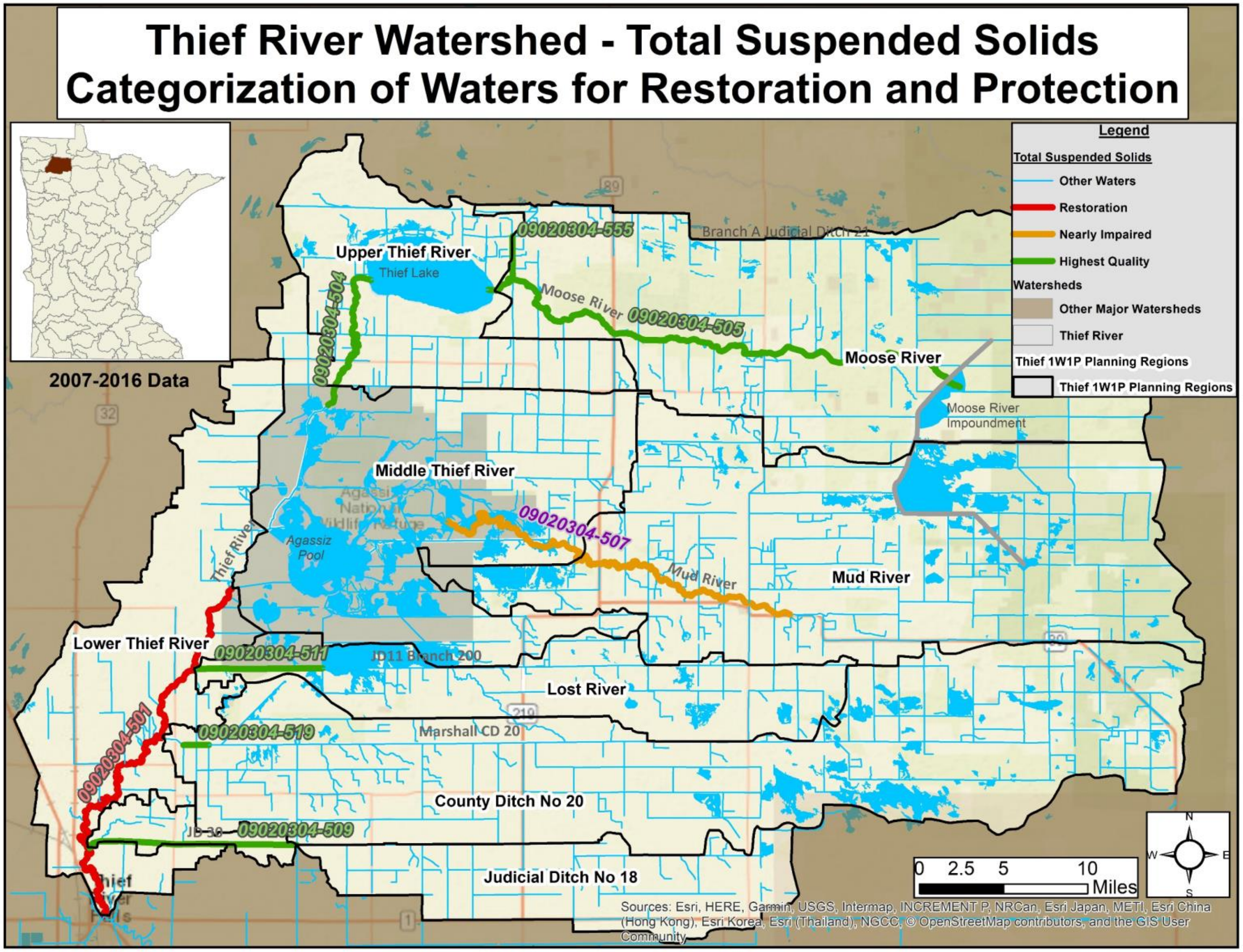

Figure 3-2: Protection and Restoration for Total Suspended Solids (TSS)

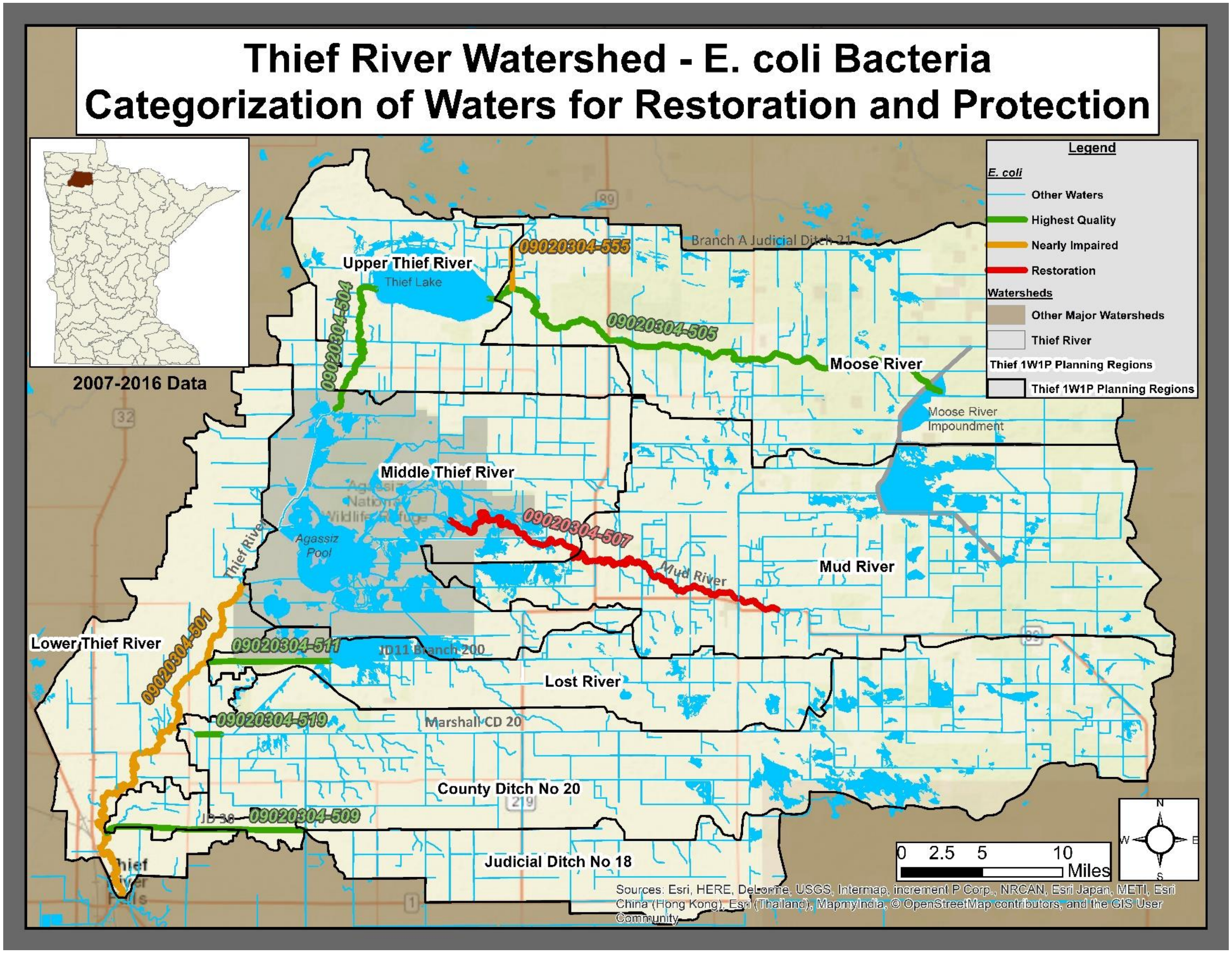

Figure 3-3: Protection and Restoration for *E. coli*

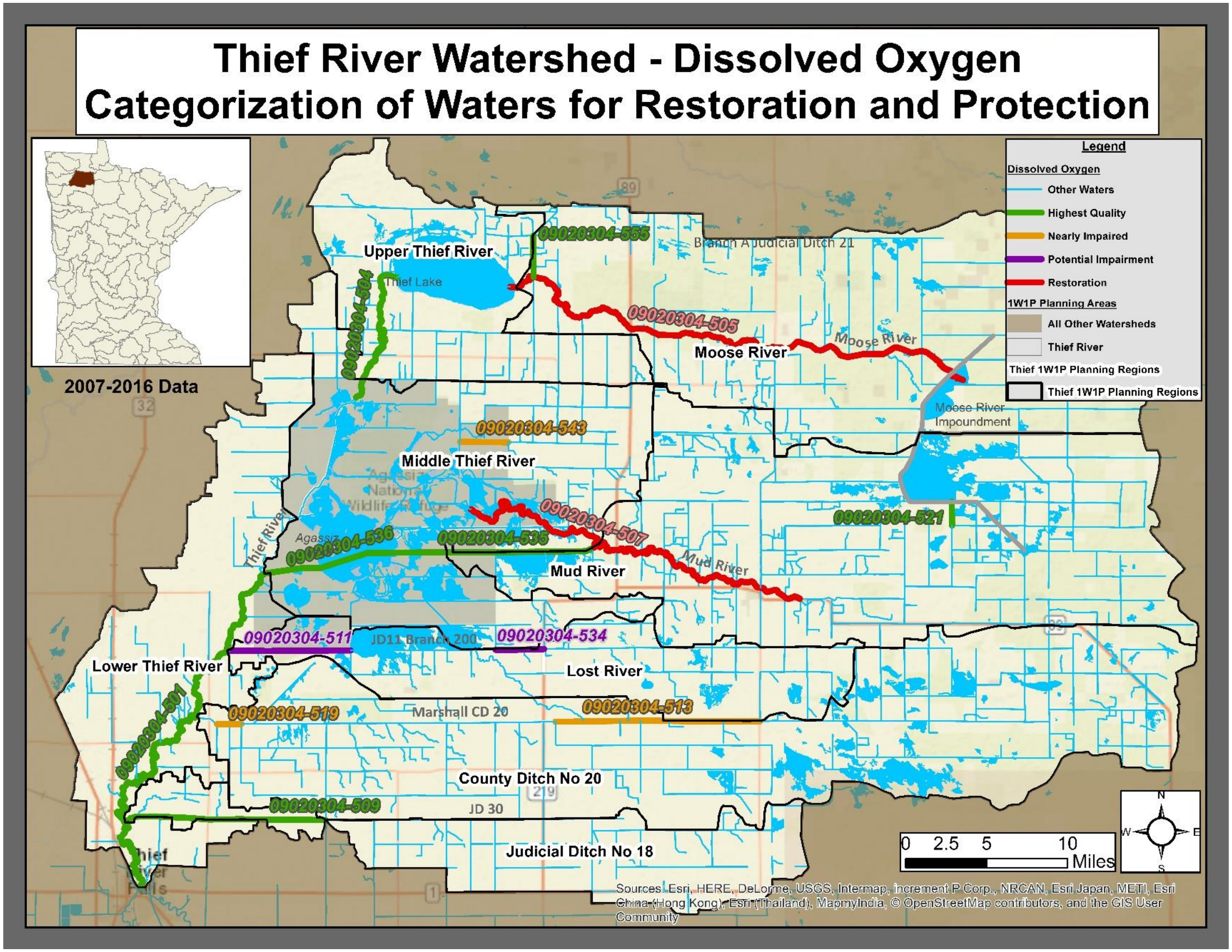

Figure 3-4: Protection and Restoration for Dissolved Oxygen (DO)

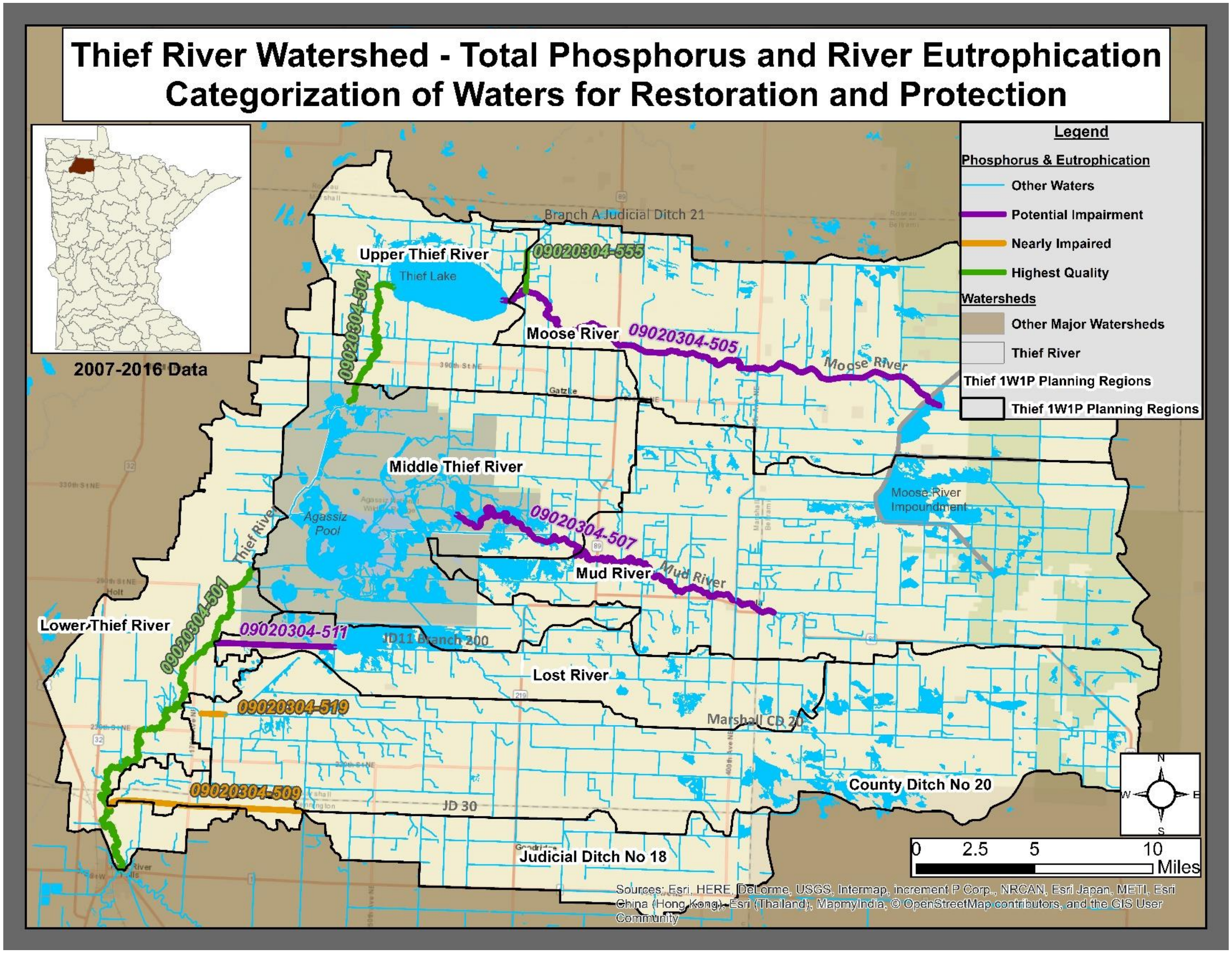

Figure 3-5: Protection and Restoration for Total Phosphorus and River Eutrophication

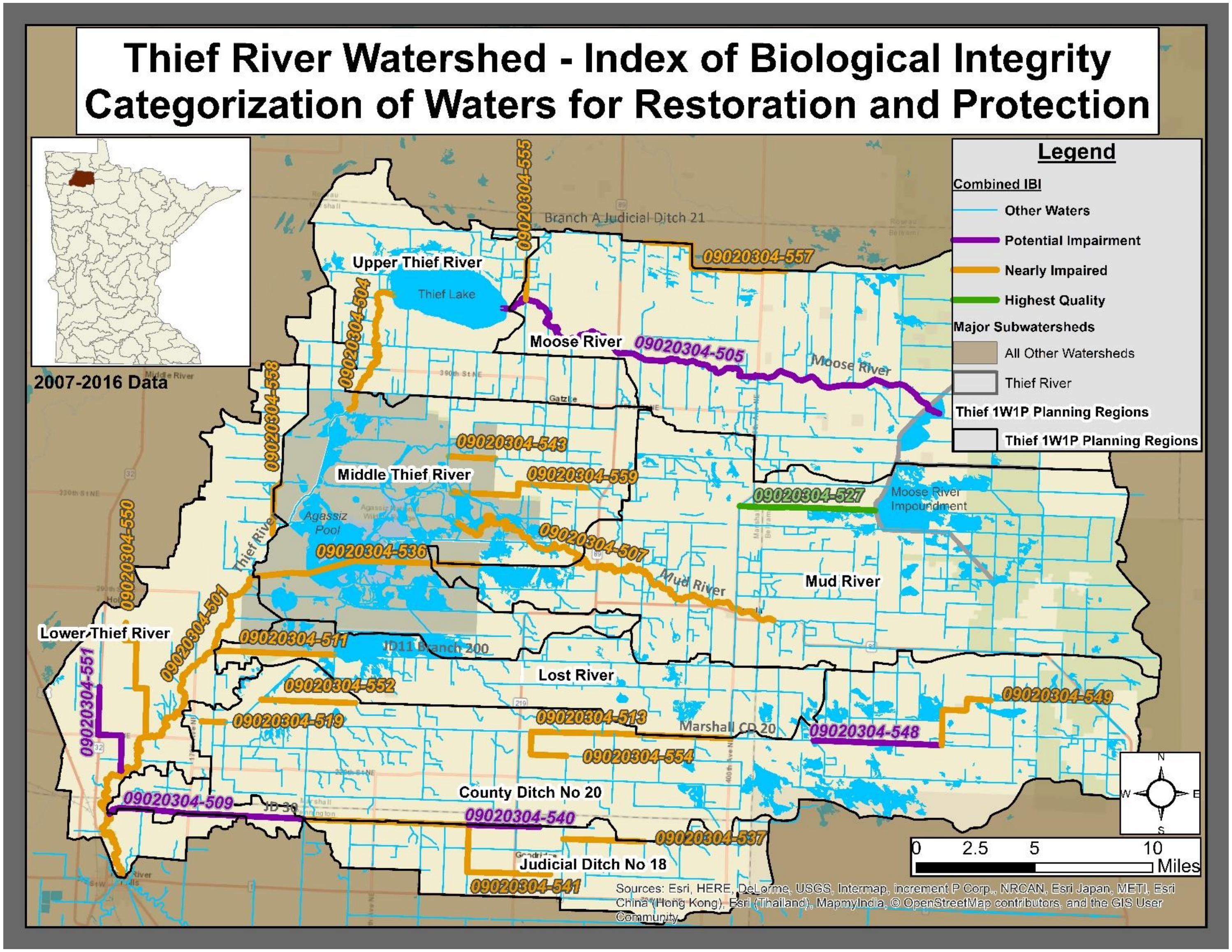

Figure 3-6: Protection and Restoration for Combined Fish and Macroinvertebrate Index of Biological Integrity (IBI)

3.2 PRIORITY ISSUE MEASURABLE GOAL CATEGORIES

Measurable goal categories contain a set of short- and long-term goals that describe a desired state or condition for a resource being impacted by a priority issue. In some instances, measurable goals within the measurable goal categories are framed around the concepts of “protection” and “restoration.” A priority issue is assigned to a protection measurable goal when the condition of the resource currently or during the ten-year duration of this plan is:

- better than the minimum condition defined by state or federal environmental standards and criteria (e.g., numeric water quality standards); or
- a component of the landscape, present in a limited amount, and provides essential ecosystem function and services at the landscape scale (e.g., habitat).

Priority issues are assigned a restoration measurable goal when the resource condition currently or during the ten-year duration of this plan is:

- poorer than the minimum condition defined by local, state or federal environmental standards and criteria (e.g., fails to meet numeric water quality standards); or
- a component of the landscape present in a limited amount and is providing an amount of essential ecosystem function and services below the needed amount at the landscape scale, and is therefore degraded (e.g., habitat fragmentation).

For purposes of this plan, measurable goal categories include both short-term or long-term goals, as defined below:

- ***Short-Term Goal(s):*** Interim conditions to accomplish during the 10-year lifespan of this plan
- ***Long-Term Goals(s):*** The desired future condition to accomplish, regardless of time frame

Short- and long-term goals are presented to align with WRAPS efforts, set milestones for resource improvement, and allow for resource management flexibility during implementation efforts.

Below are the **13 measurable goal categories** for this comprehensive plan, which collectively address all the locally prioritized issues.

3.2.1 Drinking Water – Reduce Contamination

This measurable goal category addresses one priority issue within the Drinking Water (Groundwater) resource concern:

- Issue 1.1.1: Protection of generally good quality groundwater supplies from elevated levels of nitrates, arsenic, or other contaminants which, if excessive, can result in implications to human health and treatment costs for public and private wells. Protection is particularly important in vulnerable DWSMAs.

The Minnesota Groundwater Protection Act established a prevention goal that groundwater be maintained in its natural condition, free from any degradation caused by human activity. Many state agencies are working to maintain and improve groundwater quality because of this act. The Minnesota Department of Health (MDH) is the lead agency protecting drinking water quality for public water systems. This authority applies to the Wellhead Protection Area (WHPA) (MN Statute, Chapter 103I.005 Subd. 24) and the federal Safe Drinking Water Act, both ensuring drinking water safety. Additionally, MDH manages the Minnesota Well Code governing construction, maintenance, and sealing of wells (MN Rules, Chapter 4720, Parts 4720.5100-5590). The Well Code is the primary authority protecting private wells at the time of installation; once installed, private well owners are responsible for ongoing operation and maintenance.

3.2.1.1 Nitrates

Nitrate is one of the most common water pollutants in Minnesota groundwater, affecting a large number of private wells and public water supplies. Elevated nitrate in drinking water can be harmful to human health, specifically to the health of infants. Because of its pervasive nature, the focus of the protection framework is based on the understanding of its occurrence and distribution in Minnesota groundwater resources. Factors linked to nitrate as an indicator of drinking water quality include:

- Concentrations above 3 milligrams per liter (mg/L) are considered from anthropogenic sources or human impact on the environment.
- Fertilizers, manure, and septic systems are major sources of nitrate pollution in Minnesota.
- Nitrate can be easily measured.
- There is potential for other contaminants, such as pesticides, when nitrate is present.
- The presence of nitrate indicates there is a pathway for contaminants from the lands surface to the drinking water supply.

Even though protection is considered anything below the drinking water standard of 10 mg/L for nitrate in drinking water, it is necessary to break nitrate thresholds down even further to help target efforts and establish management priorities. As nitrate concentrations increase, management approaches should change and become more intensive. **Table 3-3** demonstrates the expected level of management by each nitrate concentration classification (MDH, 2018).

Table 3-3: MDH Nitrate Protection Framework

Nitrate Protection Framework	Nitrate Concentration
Protection – Vigilance	0-4.9 mg/L
Protection – Threatened	5.0-9.9 mg/L
Restoration – Treatment	10 mg/L and above

The goal for nitrate has been developed to align with the MDH Nitrate Protection Framework. Due to a lack of baseline data for private well nitrate contamination, progress will need to be made towards **Measurable Goal Category 3.2.11** before working on this goal. However, progress can be made towards this goal as data on nitrate contamination in private wells is collected. While nitrate levels are generally within acceptable standards within the watershed, elevated levels of arsenic have been detected in the watershed. Plan section 3.2.11.4 provides a goal that addresses arsenic.

Short-Term Goal(s):

- Progress made towards long-term goal

Long-Term Goal(s):

- **Protection – Vigilance Goal:** Maintain unaffected private drinking water supply wells with nitrate-nitrogen concentrations at or near a concentration representative of background and transitional levels (0-4.9 mg/L).
- **Protection – Threatened Goal:** Reduce the number of private drinking water supplies that have nitrate-nitrogen concentrations at risk for nitrate impairment (≥ 5 mg/L but < 9.9 mg/L).
- **Restoration – Treatment Goal:** Restore private drinking water supplies that have nitrate-nitrogen concentrations that currently represent a health concern (≥ 10 mg/L)

Metric(s):

- Number of private water supplies with nitrate-nitrogen concentrations in each category of protection or restoration

3.2.2 Aquatic Life and Aquatic Recreation – Reduce Sediment and Phosphorus Delivery and Load

This measurable goal category addresses six priority issues within the Aquatic Life and Aquatic Recreation (Surface Waters), Drinking Water (Surface Waters), Impoundments and Reservoirs (Surface Waters), Healthy Urban Landscapes (Local Development and Land Stewardship), and Wetlands (Surface Waters) resource concerns:

- Issue 2.1.7: Decreased stream channel stability driven by hydrologic changes that increase erosion and sediment transport, which can decrease beneficial uses of streams, rivers, and lakes

- Issue 2.1.1: Elevated concentrations of suspended solids, sediment, and total phosphorus approaching (protection) or exceeding (restoration) water quality standards for aquatic life, which can lead to aquatic life impairments
- Issue 2.5.1: Water Quality: Elevated concentrations of sediment and organic matter have a detrimental impact on drinking water quality
- Issue 2.4.1: Increased erosion and sedimentation, resulting in reduced storage capacity, invasive species takeover, and, ultimately, wildlife habitat degradation
- Issue 2.6.1: Sediment deposition in wetlands degrades hydrologic function, contributes to nonnative plant species succession, and contributes to sediment and highly organic/low dissolved oxygen water to downstream waterways
- Issue 5.1.1: Downstream water quality consequences from stormwater runoff due to increased impervious surface area around water bodies such as lake, streams, and wetlands

This goal focuses on reducing elevated levels of sediment and phosphorus in rivers and streams by addressing upstream impacts that intensify water and sediment erosion on the landscape. Because phosphorus readily binds to sediment particles, a reduction in sediment loading will lead to a reduction in phosphorus loading. By addressing sediment issues, streambank and riverbank erosion will also be reduced through a decrease in peak discharge events and bank stabilization. The WRAPS report identifies several stressors related to sediment and phosphorus that impact aquatic life and drinking water from surface water sources. Excess suspended sediment and eutrophication from phosphorus loading negatively impacts dissolved oxygen levels and degrades habitat for aquatic life. Sediment loading to the Thief River also negatively impacts drinking water quality in Thief River Falls. Upstream discharges, runoff, and scouring can introduce elevated levels of pathogens (E. Coli, Giardia, Cryptosporidium), as well as sediment, organic matter, and TSS to the Thief River Falls Intake. This places an operational and financial burden on the Thief River Falls public water system, making it difficult to manage the drinking water system to avoid adverse public health outcomes. Therefore, the TSS impairment on the Lower Thief River Falls River can result in detrimental impacts to the safety of the City of Thief River Fall's drinking water.

In addition to streams and rivers, impoundments are also a prominent water feature within the Thief River Watershed. Although there are more than 30 impoundments and reservoirs in the watershed, a vast majority of them—such as Farmes Pool, Thief Lake, and Agassiz National Wildlife Refuge, along with the network of pools within Agassiz—were created for the primary purpose of wildlife habitat but ultimately provide flood damage reduction benefits as well. Impoundments such as the Moose River Impoundment and Lost River pool, which were constructed in 1988 and 1979, respectively, were constructed for the primary purpose of storing water for flood damage reduction along with a smaller degree of wildlife benefits.

Agassiz Pool, in the center of the Agassiz NWR, is the “hub” of the watershed, receiving all drainage from the Mud River/JD 11, Upper Thief River/SD 83, and Moose River/JD 21 subwatersheds and discharging to the Lower Thief River/SD 83.

The Thief River Falls Reservoir, located in the city of Thief River Falls, was constructed to generate hydroelectric power and also provides a water supply to the city. The reservoir is the direct recipient of sediment from the Thief River Watershed. Sedimentation is a recurring issue in many impoundments in the Thief River Watershed. Sedimentation reduces the ability of impoundments to store excess surface runoff and degrades habitat quality in pools managed for wildlife. Thief Lake, the Thief River Falls Reservoir, and Agassiz Pool are notable impoundments impacted by sedimentation. Sedimentation in the Agassiz Pool is especially significant due to impacts on wildlife habitat and downstream water quality. It is estimated that the Pool has received more than 1,840,000 metric tons of sediment since 1940 (St. Croix Watershed Research Station, 2001). Unlike other impoundments in the watershed like the Moose River Impoundment and Thief Lake, which have generally low TSS concentrations and good water clarity at the outlets, discharges from the Agassiz Pool can negatively impact downstream water quality, including drinking water quality in Thief River Falls. See the WRAPS study for additional details of the water quality impacts within the planning region. Several studies investigating this issue conclude that the amount of sediment leaving this impoundment is greater than other impoundments in the watershed due to:

- a radial gate outlet (opens from the bottom of the channel),
- remnants of JD11 that concentrate flow,
- full drawdowns,
- heavy precipitation events and spring snow melt runoff, and
- maintenance and cleaning of the old JD11 channel by the USFWS that moves sediment downstream.

Subsection 3.1.1 identifies streams that are impaired (**Restoration**), not officially impaired but fail to meet state standards (**Potential Impairment**), meet the water quality standard but are near the impairment threshold (**Nearly Impaired**), and meet water quality standards by a wide-margin (**Highest Quality**). Goals are set based on a review of local and regional nutrient and sediment reduction goals and further refined by the Planning Work Group and Advisory Committee to align with restoration and protection strategies and to prioritize implementation. A protection goal of **5%** sediment load reduction for the planning region is set for streams categorized as highest quality and a **10%** sediment load reduction for streams categorized as nearly impaired. The sediment load reduction goal for streams that need restoration (impaired) are assigned at the planning region level and align with the TMDL. A restoration goal of **15%** sediment load reduction for the planning region is set for streams that are not officially impaired but fail to meet state water quality standards (**Potential Impairment**). The planning region scale phosphorus goals were originally developed to align with the Minnesota Nutrient Reduction Strategy for the Lake Winnipeg Basin, which is a 10% reduction from 2003 conditions. However, water quality and BMP modeling estimated treatment of phosphorus from overland sources to be resource intensive and cost-prohibitive. Because there are no phosphorus impairments in the watershed, the Advisory Committee and Planning Work Group decided to set a protection-based 5% load reduction goal for each planning region. To streamline implementation and leverage data from PTMApp (**Section 4**), the assessment unit identification, concentration-based goals identified in the WRAPs have been aggregated to the planning region scale. Advisory Committee and Planning Work Group guidance was used to set load reduction goals as opposed to concentration-based goals for streams. The HSPF model and calculations used to develop the TMDL were also used to develop load reduction goals for phosphorus and sediment at the planning region scale. During implementation, results from PTMApp will be used to track the progress that practice implementation makes towards stated goals through treatment of overland runoff.

<u>Short-Term Goal(s):</u>
Short-term goals are set at planning region scales.

- **Planning Region scale (Total Phosphorus):** Use the phosphorus reduction targets outlined by HSPF and approved by the Thief River Watershed 1W1P Advisory Committee in each planning region:
  - **Protection:** Judicial Ditch 30/18/13: 5% or 559 lbs./yr.
  - **Protection:** Branch 200 of JD 11 (Lost River): 5% or 333 lbs./yr.
  - **Protection:** Lower Thief River/SD 83: 5% or 5,091 lbs./yr.
  - **Protection:** Marshall County Ditch 20: 5% or 1,135 lbs./yr.
  - **Protection:** Middle Thief River/SD 83: 5% or 2,177 lbs./yr.
  - **Protection:** Moose River/JD 21: 5% or 811 lbs./yr.
  - **Protection:** Mud River/JD 11: 5% or 1,878 lbs./yr.
  - **Protection:** Upper Thief River/SD 83: 5% or 574 lbs./yr.
- **Planning Region Scale (Sediment):** Use the sediment reduction targets outlined by the TMDL, HSPF and the Thief River 1W1P Advisory Committee in each planning region:
  - **Protection (Highest Quality):** Judicial Ditch 30/18/13: 5% or 70 tons/yr.

- **Protection (Highest Quality):** Lost River: 5% or 34 tons/yr.
- **Restoration (Impaired):** Lower Thief River/SD 83**:** 15% or 2,335 tons/yr.
- **Protection (Highest Quality):** Marshall County Ditch 20: 5% or 128 tons/yr.
- **Restoration (Potential Impairment):** Middle Thief River/SD 83: 15% or 653 tons/yr.
- **Protection (Highest Quality):** Moose River/JD 21: 5% or 49 tons/yr.
- **Protection (Nearly Impaired):** Mud River/JD 11: 10% or 290 tons/yr.
- **Protection (Highest Quality):** Upper Thief River/SD 83: 5% or 103 tons/yr.

Long-Term Goal(s):

- **Planning Region Scale (Phosphorus):**
  - Extend short-term protection goals
- **Planning Region Scale (Sediment):**
  - Extend short-term protection and restoration goals
  - Restoration (Impaired): Lower Thief River 36.942% or 2,507 tons/yr.
  - Restoration (Potential Impairment): Middle Thief River: 24% or 2,303 tons/yr.
  - Protection (Nearly Impaired): Mud River: 32.5% or 342 tons/yr.

The short-term goals were estimated utilizing the PTMApp, while long-term goals were derived from the WRAPS study. This resulted in differences in the mass reduction estimates for sediment.

Metric(s):

- **Planning Region Scale:** Load reduction anticipated from BMP implementation, as estimated by PTMApp and HSPF.

3.2.3 Aquatic Life and Aquatic Recreation – Reduce Bacteria Delivery and Load

This measurable goal category addresses two priority issues within the Aquatic Life and Aquatic Recreation (Surface Waters) and Healthy Urban Landscapes (Local Development and Land Stewardship) Resource Concerns:

- Issue 2.1.2: Elevated concentrations of bacteria approaching (protection) or exceeding (restoration) water quality standards for aquatic recreation, which can impact beneficial uses
- Issue 5.1.4: High levels of *E. coli* in water monitoring data at stormwater outlets in Thief River Falls, which can impact the beneficial use of downstream resources

Fecal bacteria in stream and river systems may lead to illnesses that make waterbodies unsafe for those that come in contact. Bacterial sources in the watershed identified in the WRAPs and TMDL include failing septic systems, livestock, birds, and minimal natural background sources. The WRAPs and TMDL identify a concentration-based water quality standard of <126 MPN/100ml for the maximum monthly mean. Use of this metric accounts for variability of *E. coli* sample results.

The bacteria measurable goal was developed to align with the percent load reduction goal for mid-range flow conditions in the TMDL. If a stream or river is categorized for restoration and does not have a completed TMDL study (**Potential Impairment**), the measurable goal for that stream or river is to reduce existing loads to meet state water quality standards at the planning region scale. No streams or rivers currently fall in this category. If a stream or river has a completed TMDL study (**Impaired**), such as the Mud River/JD 11, the measurable goal is to reduce existing concentrations below the state water quality standards at the reach scale. This goal is set at the reach scale due to greater variability of *E. coli* conditions in the Mud River/JD 11 planning area. The protection goal is to maintain current conditions for each planning region with a stream designated in the Subsection 3.1.1 Need of Protection Strategies (**Nearly Impaired or Highest Quality**).

Short-Term Goal(s):

- **Planning Region Scale:**
  - **Protection (Highest Quality)**: Judicial Ditch 30/18/13: Maintain current conditions

  - **Protection (Nearly Impaired)**: Lower Thief River/SD 83: Reduce maximum monthly geometric mean *E.coli* concentration by 24% or 30 MPN/100ml
  - **Protection (Highest Quality):** Lost River: Maintain current conditions
  - **Protection (Highest Quality)**: Marshall County Ditch 20: Maintain current conditions
  - **Protection (Not Assessed):** Middle Thief River/SD 83: Assess current conditions
  - **Protection (Highest Quality)**: Moose River/JD 21: Maintain current conditions in the Moose River/JD 21. Reduce maximum monthly geometric mean *E. coli* concentration in Branch A of JD 21 by 5% or 5 MPN/100ml
  - **Protection (Highest Quality):** Upper Thief River/SD 83: Maintain current conditions
- **Reach-specific scale**:
  - **Restoration:** Mud River/JD 11: Reduction in the length of streams classified as impaired by meeting the state water quality standard (where a TMDL has been completed) by 20 miles

Long-Term Goal(s):

- **Planning Region Scale:**
  - **Protection**: Extend short-term goal
- **Reach-specific scale**:
  - **Restoration:** Mud River/JD 11: Reduction in the length of streams classified as impaired by meeting the state water quality standard (where a TMDL has been completed) by 20 miles

Metric(s):

- **Planning Region Scale**: Maximum monthly geometric mean standard of 126 MPN/100ml
- **Reach-Specific Scale**: Length of streams classified as meeting state standards for water quality

3.2.4 Aquatic Life and Aquatic Recreation – Increase Dissolved Oxygen Concentration

This measurable goal category addresses one priority issue within the Aquatic Life and Recreation (Surface Waters) resource concern:

- Issue 2.1.3: Water Quality: Reduced concentrations of dissolved oxygen approaching (protection) or exceeding (restoration) tolerable levels that can affect the diversity of quality of aquatic life

Dissolved Oxygen (DO) is an important water quality indicator parameter for the protection and management of aquatic ecosystems. All higher life forms, such as vertebrates and macroinvertebrates, are dependent on minimum levels of oxygen for critical life cycle functions such as growth, maintenance, and reproduction. Inconsistent base flows, excess sediment, excess nutrients, and water temperature negatively impact DO levels in the Thief River Watershed. The DO goal was developed to align with the WRAPS, which identified lack of flow as a primary cause of lack of DO and the Protection and Restoration categories for each stream AUID. Goals were set at the planning region scale based on the stream with the lowest Protection and Restoration category in the planning region.

Short-Term Goal(s):

- **Planning Region Scale:**
  - **Protection (Highest Quality):** Judicial Ditch 30/18/13: >95% of readings are above or equal to daily minimum of 5 mg/L
  - **Protection (Highest Quality):** Lower Thief River/SD 83: >95% of readings are above or equal to daily minimum of 5 mg/L
  - **Restoration (Potential Impairment)**: Lost River: >90% of readings are above or equal to daily minimum of 5 mg/L; maintain base flow within channel
  - **Protection (Nearly Impaired):** Marshall County Ditch 20: >90% of readings are above or equal to daily minimum of 5 mg/L
  - **Protection (Nearly Impaired):** Middle Thief River/SD 83: >90% of readings are above or equal to daily minimum of 5 mg/L
  - **Restoration (Impaired):** Moose River/JD 21: >90% of readings are above or equal to daily minimum of 5 mg/L; maintain measurable flow within channel during late summer

  - **Restoration (Impaired):** Mud River/JD 11: >90% of readings are above or equal to daily minimum of 5 mg/L; maintain >5 CFS of flow at Hwy 89 during late summer
  - **Protection (Highest Quality):** Upper Thief River/SD 83: >95% of readings are above or equal to daily minimum of 5 mg/L

Long-Term Goal(s):

- **Planning Region Scale:**
  - Extend short-term goal
- **Reach-Specific Scale:**
  - Extend short-term goal

Metric(s):

- Percent of samples above the daily minimum of 5 mg/l

3.2.5 Surface Runoff and Flooding – Reduce Damages from Peak Flows and Overland Flooding

This measurable goal category addresses three priority issues within the Surface Runoff and Flooding (Surface Waters) resource concern:

- Issue 2.2.1: Changes in natural water storage and vegetative cover on the landscape, including natural depressional areas, wetlands, and loss of vegetative cover and soil organic matter (SOM), which can cause an increase in the volume of runoff, peak discharges, and water levels, causing flooding and flood damages to agricultural land, wildlife habitat, transportation systems, buildings, and structures
- Issue 2.2.2: High peak flows, causing flood damages to agricultural land, public infrastructure, homes, and other structures, rerouted flows, and accelerated bank erosion to artificial and natural waterways; low flows, which can impact aquatic life and aquatic recreation
- Issue 2.2.3: Regional and basin wide flood issues that might not be addressed by local actions, which can impact local infrastructure, natural resources, agricultural lands, and communities

Damages from overland flooding associated with high peak flows have negative impacts on agriculture, infrastructure, and natural resources in the Thief River Watershed. The measurable goals in this plan build on previous work, including the Red Lake Watershed District's 2013 distributed detention study, and is consistent with the Red River Basin Commission's Long Term Flood Reduction Strategy, which established a regional 20% flow reduction goal. These documents were developed to provide local, watershed, and Red River main stem benefits.

The short-term and long-term goals below also align with previous work in the Red Lake Watershed District Comprehensive Plan to provide an additional 10,000 ac-ft. of flood volume reduction within the eastern portions of the Thief River Watershed (RLWD, 2006 p. 122).

The goals for each planning region also take into consideration that several planning regions already have a large amount of existing water storage capacity. In these subwatersheds, a no net increase in runoff goal is proposed. In the other planning regions, runoff reduction goals were established. Each runoff reduction goal is presented in inches of runoff for the entire watershed area, which has also been converted to a volume in acre-feet (ac-ft) for convenience.

Short-Term Goal(s):

- Judicial Ditch 30/18/13: Reduce average annual runoff by 0.125 inches (442 ac-ft)
- Lower Thief River/SD 83: Reduce average annual runoff by 0.125 inches (649 ac-ft)
- Lost River: Reduce average annual runoff by 0.125 inches (438 ac-ft)
- Marshall County Ditch 20: Reduce average annual runoff by 0.125 inches (1396 ac-ft)
- Middle Thief River/SD 83: No net increase in average annual runoff
- Moose River/JD 21: No net increase in average annual runoff
- Mud River/JD 11: No net increase in average annual runoff

- Upper Thief River/SD 83: No net increase in average annual runoff

Long-Term Goal(s):

- Judicial Ditch 30/18/13: Reduce average annual runoff by 0.5 inch (1,750 ac-ft)
- Lower Thief River/SD 83: Reduce average annual runoff by 0.5 inch (2,600 ac-ft)
- Lost River: Reduce average annual runoff by 0.5 inch (1,750 ac-ft)
- Marshall County Ditch 20: Reduce average annual runoff by 0.5 inch (5,600 ac-ft)
- Middle Thief River/SD 83: No net increase in average annual runoff
- Moose River/JD 21: No net increase in average annual runoff
- Mud River/JD 11: No net increase in average annual runoff
- Upper Thief River/SD 83: No net increase in average annual runoff

Metric(s):

- Average annual runoff volume in ac-ft as modeled in HSPF and flow monitoring data

3.2.6 Drainage Management Systems – Erosion and Sedimentation Reduction

This measurable goal category addresses one priority issue within the Drainage Management Systems resource concern:

- Issue 2.3.1: Increased erosion and sedimentation, resulting from bank failure and slumping, and gully formation prevents the proper function of drainage systems and increases maintenance costs

Drainage management systems are defined as the series of conveyances constructed to transport water downstream. The Thief River Watershed has an extensive network of drainage ditches originally constructed to convert wetlands into agricultural land. According to the DNR Fluvial Geomorphology Report for the Thief River Watershed, 77% or 1,175 miles of watercourses in the watershed are intermittent or perennial drainage ditches. This includes portions of the Moose River/JD 21, Mud River/JD 11, and Thief River that have been modified or channelized.

Dredging and sediment cleanouts are common practices to keep higher flows within ditch channels and move water through the system more quickly. However, straightening of meandering river channels, inadequate buffers, heavy rain events, discharge rates from impoundments, and the confined nature of channels all contribute to increased erosion and subsequent downstream sedimentation.

Though the original purpose of drainage was to quickly and efficiently move water from farm fields to allow for crop production, traditional maintenance practices also impact hydrology, water quality, and habitat. It has become clear that drainage must be managed for multiple purposes. Multipurpose Drainage Management is the management of the drainage infrastructure to reduce downstream peak flows and flooding, provide adequate drainage system capacity, reduce erosion and sedimentation, and protect or improve water quality (Chapter 103E.015, Subd. 1). Before "Managing a drainage system", the drainage authority, in consultation with the SWCD where the project is located, will consider the other goals identified in this plan to manage the drainage system for multiple purposes including protecting and improving water quality, reducing erosion and sedimentation, and reducing downstream peak flows and flooding, while providing adequate drainage system capacity.

A review of available literature indicates most Red River Basin crops can tolerate standing water for a period of 24 to 48 hours. The goal of the Basin Technical and Scientific Advisory Committee (BTSAC) Briefing Paper #3, Water Management Options for Surface Drainage design guidance is to remove backwater from intensively farmed land over a period of about 24 hours following a 10-year, 24-hour summer rainfall event. The primary objectives of this design guidance include:

- removal of excess water from a field before it causes extensive crop damage,
- minimization of the potential for damages to roads, and

- prevention of overflow onto lands in ways likely to cause frequent and severe erosion of cultivated soil.

For larger than 10-year rainfall events, crop damages should be expected, but, in the interest of fairness, the damages should be distributed as equally as practical throughout the drainage system.

The DNR Fluvial Geomorphology Report also identifies 26 miles of drainage ditches in the Lower Thief River/SD 83, Marshall County Ditch 20, Moose River/JD 21, and Mud River/JD 11 with high erosion estimates according to the Bank Assessment for Non-point Source Consequences of Sediment (BANCS) Model, which suggests stream instability. Ditch segments with high BANCS erosion estimates can be used for prioritizing implementation to make progress towards measurable goals in this category.

Short-Term Goal(s):

- Stabilize 20% of the 26 miles of drainage ditches, using multipurpose drainage management, in subwatersheds with high BANCS erosion estimates: Lower Thief River/SD 83, Moose River/JD 21, Mud River/JD 11, and County Ditch 20
- Provide adequate drainage to meet the design guidance objectives for a 10-year, 24-hour summer rainfall event in the Lower Thief, Marshall County Ditch 20, Moose River/JD 21, and Mud River/JD 11 planning regions

Long-Term Goal(s):

- Stabilize 26 miles of drainage ditch using multipurpose drainage management in subwatersheds with high BANCS erosion estimates: Lower Thief River/SD 83, Moose River/JD 21, Mud River/JD 11, and County Ditch 20
- Extend short-term goal for providing adequate drainage based on design guidance objectives

Metric(s):

- Length of ditch segments meeting design guidance objectives
- Length of ditch segments stabilized, using multipurpose benefit assessment

3.2.7 Shoreland and Riparian Areas – Improve and Increase Vegetative Cover

This measurable goal category addresses one priority issue within the Shoreland and Riparian Zones (Fish and Wildlife Habitat) resource concern:

- Issue 3.2.1: Quantity and quality of vegetation along waterways, including riparian forests and buffers along ditches in shorelines, that filter pollutants, retain soil, improve water quality, and restore wildlife habitat

The Buffer and Soil Loss Legislation (Minn. Stat. §103F.48), commonly referred to as the Minnesota Buffer Law, was signed into law in June of 2015 and was amended in April of 2016. The legislation requires a 50-foot average continuous buffer of perennial vegetation with a 30-foot minimum width around all public waters and a 16.5-foot minimum width continuous buffer of perennial vegetation along all public drainage systems. The SWCDs will be relied upon for implementation and assessing compliance with the buffer legislation. SWCDs are also likely to provide technical assistance and provide guidance about financial assistance options. Landowners have the option of working with their SWCD to determine if other alternative practices aimed at protecting water quality can be used rather than a buffer. The Minnesota Buffer Law is a regulatory mechanism already in place to address issues associated with shoreland and riparian degradation and serves as the basis for goal development.

Short-Term Goal(s):

- Achieve 100% compliance with Minnesota State Buffer Law within 1W1P area, increasing riparian vegetation, structure, and habitat and decreasing overland sediment and nutrient runoff

Long-Term Goal(s):

- Continue 100% Minnesota Buffer Law compliance

Metric(s):

- Percentage of area not in Buffer Law compliance
- Number of enforcements for Buffer Law compliance

3.2.8 Habitat for Wildlife – Enhance Connectivity and Cover

This measurable goal category addresses one priority issue within the Terrestrial Habitat for Wildlife (Fish and Wildlife Habitat) and one priority issue from the Wetlands (Surface Waters) resource concerns:

- Issue 3.3.1: Increased habitat fragmentation and loss of habitat providing food, shelter, terrestrial ecological corridors, and breeding territory for both protected (e.g. endangered, threatened, special concern, and Species of Greatest Conservation Need) and unprotected species
- Issue 2.6.2: Wetlands have been altered or drained for agricultural production, resulting in a loss of wildlife habitat and temporary water storage on the landscape

Wetland loss and modification, as well as habitat fragmentation due to disturbance (development, agriculture, roads, etc.), are ongoing concerns for several local, state, and federal agencies and non-profit organizations. In addition to the habitat provided to animals and migratory birds, these areas of perennial cover help hold soil, reduce runoff and increase infiltration. Enhancing existing protected land and, where there is opportunity (especially on lands adjacent to DNR and USFWS lands), connecting habitat fragments will provide water quality and quantity benefits in addition to quality wildlife habitat.

Short-Term Goal(s):

- Maintain and enhance the number of large terrestrial habitat blocks with the minimum size necessary to sustain ecosystem services representative of a terrestrial landscape within the plan area
- No net loss of wetlands

Long-Term Goal(s):

- Extend short-term goal

Metric(s):

- Acres of maintained and/or enhanced terrestrial habitat
- Acres of wetlands

3.2.9 Aquatic Habitat for Fish, Macroinvertebrates and Aquatic Life – Restore Connectivity and Habitat, Moderate Flow Regimes, and Promote Vegetated Banks and Buffers

This measurable goal category addresses two priority issues within the Aquatic Habitat for Fish, Macroinvertebrates, and Aquatic Life (Fish and Wildlife Habitat) resource concern:

- Issue 3.1.1: Modification of waterways, culverts, and dams at impoundment outlets reduce hydrologic connectivity and alter the flow regime, resulting in the reduced potential of waterways to support quality fish populations
- Issue 3.1.3: Degradation of aquatic habitat, aquatic vegetation, and riparian habitat associated with increased drainage, channelization, ditch maintenance, and development and the physical damage to the banks and beds of creeks, streams, and rivers from higher and faster flows pose public lands and waters management challenges

According to the DNR Fish Habitat Plan, healthy aquatic habitat provides living organisms in the channel and along the floodplain with areas of variable flow, depth, and cover, such as overhanging vegetation, woody debris, or deep pools. Water quality, along with temperature, sediment load, and nutrient concentrations, determine what species of aquatic life a stream will support. As with lakes, the physical and chemical characteristics of the water are a reflection of what is happening on the land. All these variables interact to determine the health of a stream or water body (DNR, 2013). Protection of healthy aquatic habitat is also important for threatened or endangered species. Conversely, a loss of habitat by redevelopment or instability can stress aquatic populations and affect the biological integrity of surface waters.

A full Stressor Identification Report has not been written for the watershed because no formal aquatic life impairments were listed during the last assessment period. A report will be completed during the next assessment cycle when the TALU framework is in place. However, some biological monitoring has been conducted in the watershed by the MPCA and the Red Lake Watershed District. This information is available in the WRAPs report and can provide a basis for setting and making progress towards a goal for this issue. This goal was developed to align with the WRAPs and the Minnesota Stream Habitat Assessment (MSHA) conducted during the MPCA Intensive Watershed Monitoring process initiated in 2011 and completed in 2013. Thus, this goal will be addressed after the completion of the Stressor Identification Report. **Riparian and vegetated banks-related goals are addressed by Goal 3.2.7**.

The MSHA is a qualitative assessment that evaluates the habitat of a section of stream sampled for biology and can provide indication of potential stressors impacting fish and macroinvertebrate communities. The MSHA total score consists of five scoring categories: adjacent land use, riparian zone, substrate, fish cover, and channel morphology, summed for a total maximum score of 100. Scores are categorized into three classes based on a range of scores:

- Good: MSHA score above the median of the least-disturbed sites (MSHA >66)
- Fair: MSHA score between the median of the least-disturbed sites and the median of the most disturbed sites (MSHA >45 and ≤66)
- Poor: MSHA score below the median of the most-disturbed sites (MSHA ≤45)

The 2014 Thief River Watershed Monitoring and Assessment Report provides detailed MSHA scores for each HUC 11 subwatershed.

Like the restoration and protection strategies used for prioritizing Measurable Goal Categories 3.2.2, 3.2.3 and 3.2.4, this measurable goal category prioritizes planning reaches based on a tiered improvement goal system recommended by the Advisory Committee. In order to further refine targeting for implementation within each planning region, the minimum MSHA score for a stream reach is used to set the measurable goal as opposed to the average of all assessed reaches within a given planning region. The measurable goal for a planning region with a **good** MSHA score (>66) is a **5%** score increase; with a **fair** MSHA score (>45 and ≤66) is a **10%** score increase; and with a **poor** MSHA score (≤45) is a **15%** score increase. **Table 3-2** contains reach and planning region scale MSHA score information.

After this section of the plan was developed, it was learned that the MPCA had begun assessing previously deferred, channelized reaches within the Thief River Watershed for aquatic life (fish index of biological integrity, macroinvertebrate index of biologic integrity, dissolved oxygen). New impairments are expected. MPCA staff have met with local staff to discuss the Use Attainment Analysis for each assess reach. A Professional Judgement Group meeting was scheduled for July 2019 where members of the PWG will meet with the MPCA and representatives of other stakeholder agencies to discuss the results of the assessment. More information will be available on this topic as time pursues.

Planning Region Scale:

- Branch 200 of Judicial Ditch 11 (Lost River): Improve MSHA score of 34.5 (poor) by 15%
- Judicial Ditch No. 30/18/13: Improve MSHA score of 36 (poor) by 15%
- Lower Thief River/SD 83 (Agassiz Pool to Red Lake River): Improve MSHA score of 22.25 (poor) by 15%
- Marshall County Ditch 20: Improve MSHA score of 34.5 (poor) by 15%
- Middle Thief River/SD 83: Improve MSHA score of 24.5 (poor) by 15%
- Moose River/JD 21: Improve MSHA score of 38 (poor) by 15%
- Mud River/JD 11: Improve MSHA score of 40.5 (poor) by 15%
- Upper Thief River/SD 83: Improve MSHA score of 51.5 (fair) by 10%

Long-Term Goal(s): Watershed-wide

- Extend short-term goal

Metric(s):

- % MSHA score improvement

3.2.10 Public Knowledge of and Behavior Related to Water Resources – Increase Stakeholder Participation

This measurable goal category addresses two priority issues within the Public Knowledge of and Behavior Related to Water Resources (Local Knowledge Base and Technical Capacity) resource concerns:

- Issue 4.1.1: Increase public awareness and knowledge of water management issues, including general citizens down through school-age children
- Issue 4.1.3: Increase regular input from stakeholders to guide future efforts related to this plan

Public awareness and knowledge of water management issues is an essential component to improving water resources in the Thief River Watershed. In a watershed where land ownership is divided evenly between private and public entities, increased engagement between water resource professionals and the public is necessary to address water management issues. Education and outreach serve as important strategies to engage citizens in understanding, protecting, and enjoying water resources. It also provides the public with opportunities to actively engage in the process of water resource management. The Thief River Watershed Public Participation Strategy Document, developed by RMB Labs in 2013, is the basis for development of this goal. The document outlined the following Thief River Watershed Civic Engagement Goals related to this measurable goal:

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

Short-Term Goal(s):

- Increase enrollment in programs outlined in Section 5 of plan

Long-Term Goal(s):

- Extend short-term goal(s)

Metric(s):

- Increase in program enrollment

3.2.11 Data Collection – Enhance Knowledge of Baseline Conditions

This measurable goal category addresses one priority issue within the Public Knowledge of and Behavior Related to Water Resources (Local Knowledge Base and Technical Capacity) and one priority issue within the Drinking Water (Groundwater) resource concerns:

- Issue 4.2.1: Information needed to understand baseline conditions for resources to better inform management decisions
- Issue 1.1.2: Water Quality: A limited amount of data available for nitrate, arsenic, and other types of groundwater contamination, which can lead to poorly informed management decisions

There is a wealth of data collected and information produced for surface water quality and quantity in the Thief River Watershed. The Red Lake Watershed District administers a robust water quality monitoring program. Due to the high amount of state and federal land in the watershed, state agencies and the USFWS contribute to data collection and knowledge generation in the watershed. However, there are data gaps that need to be addressed: altered hydrology, groundwater quantity, and tile drainage. These are all emerging issues in plan Section 2.4.1, so further investigation is paramount to addressing these issues into the future. The appropriate state agencies will be consulted during the development and implementation of future monitoring plans. The following goals are to address sections 3.2.11.1 through 3.2.11.7.

Short-Term Goal(s):

- Altered Hydrology
  - Collect 10 years of continuous flow monitoring data at pour points of all eight subwatersheds
- Groundwater Quantity
  - Collect 10 years of groundwater level monitoring data to establish a watershedwide baseline
- Groundwater Quality
  - Arsenic: Collect 10 years of arsenic data in private wells—32 wells per year—to establish a watershedwide baseline
  - Bacteria: Collect 10 years of *E. coli* data in private wells—32 wells per year—to establish a watershedwide baseline
  - Nitrates: Collect 10 years of nitrate data in private wells—32 wells per year—to establish a watershedwide baseline
- Tile Drainage
  - Develop records and spatial data of tiled acres within the watershed

Long-Term Goal(s):

- Extend short-term goals or develop new goals if short-term goals are attained

Metric(s):

- Altered Hydrology
  - Years of continuous flow monitoring data
- Groundwater Quantity
  - Years of groundwater level monitoring data
- Groundwater Quality
  - Years of groundwater quality monitoring data
  - Monitoring 32 wells per year
- Tile Drainage
  - Data collected of tiled acres

3.2.11.1 Altered Hydrology

The 1W1P partners explored the feasibility of conducting an altered hydrology analysis for the watershed. This analysis requires streamflow gage data for a historic period of record to determine a benchmark condition for flow in the watershed. The only available long-term gaging station in the Thief River Watershed with a long enough record to perform the altered hydrology analysis is the USGS station near Thief River Falls, MN (USGS ID 05076000). This gaging station is downstream of the Agassiz National Wildlife Refuge, where flow is heavily regulated. Since the flow through and upstream of the refuge is regulated, results from the downstream gage most likely are not a good representation of what is occurring in the upstream reaches. Thus, continuing to monitor continuous flow at all major tributaries in the Thief River Watershed is required to build the more robust and long-term dataset needed to conduct the altered hydrology analysis.

3.2.11.2 Groundwater Quantity

Groundwater quantity is another resource concern that requires further study and understanding in the Thief River Watershed. Though groundwater is an important drinking water source, it is not a primary source of irrigation in most of the watershed. Despite increasing precipitation trends, a risk of a long-term drought exists, leading to increased reliance on groundwater for agricultural production and human consumption. More data is needed to understand trends in groundwater supplies with regards to trends, interaction with surface waters, and long-term viability.

3.2.11.3 Groundwater Quality

Though groundwater quality is understood to be generally good in the Thief River Watershed, further study is needed to evaluate quality and risk to private wells. Arsenic, nitrate, and bacteria are all contaminants that pose risks to drinking water obtained through private wells.

3.2.11.4 Arsenic

Arsenic can occur in groundwater just about anywhere in Minnesota. Groundwater from the Twin Cities to the South Dakota border and north along Minnesota's border with the Dakotas is more likely to contain elevated levels of arsenic. However, arsenic levels can vary from one well to the next, even within a very small area.

Most arsenic in Minnesota groundwater is thought to come from rock deposits that were eroded and re-deposited with clay by glaciers thousands of years ago. Arsenic is present in all soil and rock, but more arsenic dissolves into groundwater under certain conditions. In some areas, water from wells just below a layer of clay at least 10 feet thick can have higher levels of natural arsenic than water from deeper wells. Some groundwater in Minnesota has natural arsenic levels as high as 150 micrograms per liter. One microgram per liter is the same as 1 part per billion. The federal drinking water standard for arsenic is 10 micrograms per liter. Though regulation exists for public water suppliers, there is no arsenic regulation for private wells.

Studies of groundwater in Minnesota and some other states suggest that natural arsenic concentrations exceeding 10 micrograms per liter are more common than previously recognized. Based on existing monitoring data, it is now estimated that about 10 percent of all wells in Minnesota have natural arsenic levels of 10 micrograms per liter or more (Source: MDH http://www.health.state.mn.us/divs/eh/wells/waterquality/arsenic.html).

3.2.11.5 Bacteria

Bacterial contamination in drinking water wells can lead to several waterborne diseases and is a threat to human health from both operational and nonoperational wells (MDH, 2005). Nonoperational wells are wells that have outlived their useful life but may still pose a risk to drinking water sources by providing an open channel for bacteria to reach aquifers if a well remains unsealed. Due to a lack of existing data on the extent of bacterial contamination in drinking water throughout the Thief River Watershed, a comprehensive action plan is needed to better establish the extent of the problem across the plan area. A comprehensive action plan is also necessary to:

- determine the number of operational wells with samples that have tested positive for fecal coliform or *E. coli;*
- assess the number of nonoperational, unsealed wells posing a risk to drinking water sources; and
- identify actions to ensure drinking water free of bacterial contamination.

3.2.11.6 Nitrates

The risks nitrates pose to groundwater are described as part of **Measurable Goal Category 3.2.1**. Though a protection goal has been established based on the MDH Nitrate Prevention Framework, further study is necessary to establish a baseline assessment of nitrate contamination in private wells.

3.2.11.7 Tile Drainage

Understanding of the extent and impacts of tile drainage in the watershed is hampered by a lack of data. The Red Lake Watershed District conducted a study in 2009 on the effects of tile on water quality. However, more data is needed regarding the effect of tile on surface runoff as well as the timing and magnitude of peak flows downstream. The impact of tile on base flows is also a needed piece of information. Above all, data on the extent of tile drainage in the watershed is needed to better understand wider implications on water quality and quantity.

3.2.12 Healthy Rural Landscapes – Improve Agricultural Soil Health

This measurable goal category addresses two priority issues within the Healthy Rural Landscapes (Local Development and Land Stewardship) resource concern:

- Issue 5.2.1: Reduced soil health, soil protection, excess loss of fertilizers or pesticides, and its impact on agricultural productivity, surface water quality and quantity, sedimentation in water features, and water holding capacity
- Issue 5.2.2: Increased sheet, rill, and wind erosion and its impact on agricultural productivity, surface water quality, and deposits in drainage systems

Soil health is an important factor for both maintaining soil productivity and for reducing overland erosion on agricultural fields. Therefore, benefits to farmers that preserve healthy soils on their fields are both environmental and economical. Management practices such as cover crops, conservation tillage, and permanent cover have consistently been found to be some of the most cost-effective options to reduce sediment and nutrient erosion and increase soil health.

The Land Stewardship Analysis is an assessment that evaluates a cropland parcel against a set of criteria pertaining to soil loss and agronomic value (expressed through percent SOM content). This analysis was used to develop the short- and long-term measurable goals for improving soil health. More information on the Land Stewardship Analysis is available in **("Rural", 2019)**. To increase the SOM by 1% for these acres, management practices such as cover crops, conservation tillage to increase residue, and permanent cover (e.g., alfalfa, prairie grass) could be implemented. Therefore, the watershedwide measurable goal for rural stewardship has been defined as the following:

<u>Short-Term Goal(s):</u>

- Implement management practices in 5% (13,198 acres) of all cropland areas in the watershed to increase SOM content 1%. Areas to be managed are cropland areas categorized as rural stewardship "Probability Low" and "Probability Depends on Practice Effectiveness" that have SOM content of >1% and ≤4%.

<u>Long-Term Goal(s):</u>

- Implement management practices in 41.5% (109,688 acres) of all cropland areas in the watershed to increase SOM content by 1%. Areas to be managed are cropland areas categorized as rural stewardship "Probability Low" and "Probability Depends on Practice Effectiveness" that have SOM content of >1% and ≤4%.

<u>Metric(s):</u>

- Percentage of applicable cropland acres treated with management practices.

3.2.13 Healthy Rural Landscapes – Reduce Surface and Groundwater Contamination

This measurable goal category addresses two priority issues within the Healthy Rural Landscapes (Local Development and Land Stewardship) resource concern:

- Issue 5.2.3: Improperly installed or poorly functioning subsurface sewage treatment systems (SSTS) and individual sewage treatment system (ISTS) increase the potential for ground and surface water contamination, adversely impacting human health and water quality
- Issue 5.2.4: The impact of feedlots on surface and groundwater quality

In Minnesota there are an estimated 24,000 livestock feedlots registered under the state's feedlot rule. They range in size from small farms to large-scale commercial livestock operations. Agriculture, including livestock, comprises a major portion of the state's economy. Many organizations and programs work with livestock producers to ensure that Minnesota continues to have a healthy livestock industry and a healthy natural environment.

There are two primary concerns about feedlots in protecting water in our agricultural areas:

- Ensuring that manure on a feedlot or manure storage area does not run into water
- Ensuring that nutrient-rich manure is applied to cropland at a rate, time, and method that prevents nutrients and other possible contaminants from entering streams, lakes, and ground water

The MPCA works with farmers to make sure their feedlots are environmentally safe. Staff provide technical assistance to farmers and conduct inspections at feedlots to be certain they comply with environmental requirements. Some of those requirements for feedlots include:

- construction specifications for manure storage areas;
- manure management plans for medium- and large-sized feedlots; and
- land application of manure on fields.

Feedlot rules have been in effect in Minnesota since the early 1970s. In October 2000 a major revision of the feedlot rule (Minn. R. Ch. 7020) went into effect, followed by an update in 2014. The main goals are to:

- register all feedlots capable of holding 50 or more animal units (10 in shoreland areas),
- focus on animal feedlots and manure storage areas that have the greatest potential for environmental impact,
- support the role of delegated counties in the feedlot program, and
- maintain agency and delegated county staff field presence.

The feedlot rule does not specifically regulate pasture operations; however, pasture operators still must abide by Minnesota Rules Chapter 7050 prohibiting pollution of state waters (MPCA, 2017).

Though the number of feedlots in the Thief River Falls Watershed is declining, 100% compliance with MPCA regulations is necessary to minimize their impact on water quality.

Residents in areas without access to public sewer systems maintain their own septic systems or SSTS. A poorly functioning septic system is a threat to human health and the environment because it may not remove pathogens, nutrients, and other chemicals from the used water before it enters groundwater or lakes. For example, human fecal DNA markers were discovered in samples collected from the Mud River/JD 11 in Grygla.

Local units of government—including cities, counties, townships, and sewer districts—enforce Minnesota SSTS rules through ordinances and issue permits for systems designed for flows up to 10,000 gallons per day. Local SSTS ordinances vary across the state. Some require SSTS compliance inspections prior to property transfer, require permits for SSTS repair and septic tank maintenance, and may have other requirements that are stricter than the state regulations.

This measurable goal was developed to align with MPCA SSTS rules (Chapters 7080; 7081; 7082; 7083) and Minnesota State Statute §115.55.

There are three categories of compliance for SSTS in Minnesota:

1. Imminent Threat to Public Health and Safety (ITPHS)
    - Systems that discharge sewage to the surface (e.g., overflow pipes, seeping areas in the yard, connected to agricultural drain tile)
    - Systems that chronically back up sewage into the structure
    - Systems that are unsafe (e.g., cracked tank lids and improper electrical wiring)
2. Fail to Protect Groundwater (FTPGW)
    - Seepage pits, cesspools, or other types of pits
    - Septic tanks that leak below their operating depths
    - Systems with an inadequate thickness of suitable soil beneath the soil dispersal system to bedrock or seasonally saturated soil (i.e., the water table)

3. Compliant

Short-Term Goal(s):

- 100% of septic systems that are ITPHS are brought into compliance
- 30% of septic systems that are FTPGW are upgraded
- Maintain feedlot compliance if determined to be no known compliance issues

Long-Term Goal(s):

- Extend short-term goals

Metric(s):

- % of compliant ITPHS septic systems
- % of upgraded FTPGW septic systems
- # of compliant feedlots

4.0 TARGETED IMPLEMENTATION

4.1 PURPOSE AND STRUCTURE

Targeting implementation is the process of identifying the most cost-effective and measurable actions that can be implemented to make progress towards achieving short-term and long-term measurable goals for priority issues. There are many kinds of actions that can be implemented. To organize this section, similar actions are categorized into one of five implementation components, reflecting how actions make progress towards goals:

1. ***Structural and Management Practices***: This includes actions focused on delivering conservation on the ground and constructing projects. Typical structural BMPs include water and sediment control basins (WASCOBS), grade stabilization structures, filter strips, and grass waterways. Management practices describe an activity, technique, or methodology that can be thought of as an industry- or sector-accepted standard operating procedure and can include cover crops, tillage management, and fertilizer management.
2. ***Education and Outreach***: This includes actions that address a priority issue by increasing public engagement, improving communication, and working toward better understanding.
3. ***Data Gaps and Research***: This includes actions that are focused on research activities that fill data gaps and continue existing monitoring activities.
4. ***Regulatory***: This includes actions that pertain to common and consistent administration and enforcement of statutory responsibilities, local regulations, and local ordinances.
5. ***Capital Improvement:*** This includes actions that consist of major non-recurring expenditures for the construction, repair, retrofit, or increased utility or function of physical facilities, infrastructure, or environmental features. Operations and maintenance, like the repair of ditches and maintenance of impoundments, is a component of capital improvements. Capital improvement actions do not include the construction of large-scale flood damage reduction impoundments.

A **targeted implementation schedule** comprises a list of actions that, when implemented, are expected to make reasonable progress toward plan measurable goals. The targeted implementation schedule is organized and broken up by each implementation component and contains:

- a brief description of each action,
- the action's primary planning region focus,
- the measurable output of implementing the action,
- the metric for measuring the action output,
- the role and entities responsible for implementing the action,
- when implementation will occur within the 10-year timeframe of the plan, and
- the measurable goal the action is intended to make progress towards.

Locations for implementing actions may be watershedwide or targeted within a specific planning region. Actions in the education and outreach, data gaps and research, and regulatory implementation components are implemented watershedwide to ensure consistency and effectiveness at a watershed scale. However, actions in the capital improvement and structural and management implementation components vary by planning region because the types of priority issues and (at times) aggressiveness of measurable goals, as well as implementation opportunities, differ among the planning regions. Numbers and locations for implementing structural and management practices are geographically defined within each planning region in **planning region implementation profiles**.

Roles and responsibilities for implementation are identified by assigning a lead entity and partners to each action:

- **Implementation Lead Entity:** The lead entity is the specific agency or local governmental unit (LGU) responsible for implementing the action; the lead entity does not assume sole responsibility for completing the action.

- **Implementation Partners:** Partners are also assigned to recognize collaborative efforts for implementation. Listed partner entities within the targeted implementation schedule are not all-inclusive.

It is important to note that structural and management actions are voluntary and thus require landowner buy-in for implementation to proceed. Landowners are valuable partners in the management of water resources in the Thief River Watershed. Structural and management implementation actions should strike a balance between meeting landowner needs and making progress towards plan goals.

Implementation programs provide funding for groups of similar actions and are described in more detail within **Section 5**. The ability to achieve measurable goals—and the speed at which they are realized—depends on the local capacity to complete the actions within the implementation schedule and, therefore, the amount of funding available. The amount of funding is uncertain. Therefore, the level of effort for implementation (i.e., numbers of actions and practices) is assumed to be like the current expenditure of resources within the plan area. Should additional funding be available, the number and extent of actions implemented is increased.

This plan identifies three funding levels for implementation:

- Baseline
- Level 1 Moderate
- Level 2 High

The **Baseline** funding level is an annual and ten-year estimate of current LGU funding available for the plan area. This is the anticipated level of funding for implementation if no additional or outside funding sources are available.

The **Level 1 Moderate** implementation funding level identifies actions for implementation if watershed-based noncompetitive grants are made available by the State. Estimates for funding are included if available and/or applicable for actions in this implementation funding level. If additional funding becomes available, these actions would be prioritized for implementation.

The **Level 2 High** implementation funding level identifies actions for implementation if funding levels for the Baseline and Level 1 Moderate levels are met. This level would fund projects that require greater investment of resources, have an implementation timeframe longer than the ten-year lifespan of the plan, or are important but not the highest priority.

4.2 IMPORTANCE OF WORK COMPLETED BY OTHERS

Success in addressing all priority issues cannot be achieved solely by local government and requires the participation of state agencies, federal agencies, NGOs, private entities, and those residing within and beyond the plan boundary. A great deal of work has been done by NGOs, state agencies, federal agencies, and others within the plan area. Much of this work has been used in developing this plan.

There are considerable similarities between the priority issues established by this plan and the priorities, goals, and objectives of NGOs, state agencies, and federal agencies. This plan represents an opportunity to clarify roles and facilitate the cooperation and the streamlining of implementation efforts to get work done by multiple organizations within the plan area. Although this plan largely reflects local priorities, in no way is the plan intended to supplant or replace the importance of efforts of other organizations with complementary goals and objectives. The work of other organizations is expected to continue during plan implementation and into the future and is reflected within the targeted implementation schedule. The Thief River Watershed 1W1P Planning Group will continue to foster an environment that enhances cooperation and coordination with other organizations to the maximum extent possible throughout the implementation of the plan **Section 5.3.2**.

The state has invested in the completion of multiple studies, reports, and strategies that are pertinent to the plan area. Many of these reports—such as the MPCA TMDL, WRAPs, and DNR Fluvial Geomorphology Report—were developed by or with significant input from LGUs. This investment has generated valuable information, which has been heavily leveraged in the development of this plan. **Table 4-1** summarizes the resulting state documents and how they have been considered and incorporated into the plan.

Table 4-1: State Documents and Relation to the Thief River Watershed 1W1P

State Agency	Document Name	Use in the Plan
Minnesota Department of Agriculture	*Minnesota Nitrogen Fertilizer Management Plan*	• Actions for nutrient management and reduction
Minnesota Department of Health	*Goodridge and Grygla Wellhead Protection Plans*	• Issues impacting drinking water quality and priority concerns • Actions to protect drinking water quality
Minnesota Department of Health	*Thief River Falls Surface Water Assessment*	• Issues impacting drinking water quality and priority concerns
Minnesota Pollution Control Agency	*The Minnesota Nutrient Reduction Strategy*	• Actions for nutrient reduction • Benchmarks used as surrogate for assessing progress at a planning region scale towards statewide nutrient reduction goals
Minnesota Pollution Control Agency	*Thief River Watershed Monitoring and Assessment Report*	• Monitoring data • Condition of surface waters
Minnesota Pollution Control Agency	*Thief River Watershed Restoration and Protection Strategy (WRAPS)*	• Issues impacting water quality potential and priority concerns • Actions within targeted implementation schedule
Minnesota Pollution Control Agency	*Thief River Watershed Total Maximum Daily Load (TMDL)*	• Setting measurable water quality goals
Minnesota Department of Natural Resources	*Geomorphology Report*	• Actions and goals for watercourse stability

Investments in data, reports, and studies done by the International Water Institute (IWI), the Red River Watershed Management Board (RRWMB), and the Red River Basin Commission have also contributed to the development of this plan.

4.2.1 Guiding Implementation: Tools for Targeting

The Thief River 1W1P Planning Group used the Prioritize, Target, and Measure Application (PTMApp) to prioritize and target the implementation of structural and management practices identified within planning region implementation profiles (**Section 4.5 Planning Region Implementation Profiles**).

4.2.1.1 Prioritize, Target, and Measure Application (PTMApp)

The underlying theory, algorithms, and application of PTMApp is documented on the PTMApp website1. PTMApp requires several data inputs, including a hydro-conditioned Digital Elevation Model (DEM). Detailed hydroconditioning and the PTMApp analysis were completed by staff at the Red Lake Watershed District in 2017-2018.

PTMApp is a computer model that uses the best available data to estimate the amount of sediment, total nitrogen (TN), and total phosphorus (TP) leaving the landscape and moving to a resource downstream. The model can also predict pollutant reductions by simulating the suitability and effectiveness of BMPs and CPs on the landscape. LGU staff and landowners can use PTMApp to model a variety of different

[1] https://ptmapp.bwsr.state.mn.us

conservation scenarios from a watershed-wide down to a field scale. The cost-effectiveness of practices can also be evaluated.

PTMApp can be used to develop a strategy for improving an impaired stream reach. For example, the Lower Thief River/SD 83 is impaired for excess sediment. Water quality practitioners can use PTMApp to estimate the amount of sediment coming to the Lower Thief River/SD 83 from the landscape, target the most cost-effective BMPs and CPs to reduce excess sediment, and measure the results of implementation.

Examples of PTMApp products for the watershed are forthcoming from Red Lake Watershed District. The standard information products are categorized according to their use in a typical watershed planning process. These uses include:

- describing conditions within the watershed;
- prioritizing the locations of water quality concerns;
- completing a source assessment to identify the largest overland sources of sediment and nutrients;
- evaluating potential locations where structural and management practices appear to be technically feasible;
- estimating the water quality benefits of specific structural and management practices; and
- targeting the preferred locations for practices based on cost-effectiveness, cost, absolute load reduction, or some other metric.

The standard information products can then be assembled during the watershed planning process to:

- develop a targeted implementation approach identifying probable management and structural practice locations and make deliberate conservation recommendations;
- estimate the combined water quality benefits for all the practices working together, expressed as annual estimated load reduction;
- estimate the amount of progress that can be made toward the water quality goals for many locations within the watershed from the entire set of management and structural practices; and
- estimate the total cost for implementation.

Results from these standard information products showing results of the Thief River Watershed 1W1P targeted implementation approach are summarized within each planning region implementation profile in **Section 4.5**.

The products from PTMApp can also be used during conversations with landowners to facilitate discussions about opportunities to implement conservation. Products useful for discussion of implementation are available at the field scale. These products are suitable for describing the movement of water across the land, locations where practices are feasible, the benefits of practices, and the probable concept level cost of practices. Maps showing the estimated amount of sediment and nutrients that leave the field by surface flow, the amount that reaches the edge of field, and the feasibility for implementing structural and management practices can be used to guide discussions aimed at increasing implementation of voluntary practices on the ground. Five maps showing example products representing different needs have been generated using example fields (based on Common Land Unit polygons) within the watershed. The maps will be included as part of a project report completed during the development of the plan.

Structural and management practices within PTMApp are placed into one of six treatment groups:

1. Storage
2. Filtration
3. Biofiltration
4. Infiltration
5. Protection
6. Source reduction

Within this plan, structural BMPs include storage, filtration, biofiltration, infiltration, and protection practices. Management practices are summarized by source reduction practices. Examples of practices in each treatment group are shown in **Table 4-2**.

Table 4-2: Structural and Management Practice PTMApp Treatment Groups

Treatment Group	Primary Treatment Process	Form of Treatment	Examples of Practices
Storage	Sedimentation	Particulate	• WASCOB • Wetland Restoration • Pond for Water Use • Drainage Water Management
Filtration	Sedimentation	Particulate	• Grassed Waterways • Filter Strips • Conservation Cover
Bio-Filtration	Sedimentation & biological	Particulate	• Saturated buffers
Infiltration	Volume abstraction	Dissolved	• Alternative Tile Intakes
Protection	Physical protection of the landscape	Total (Dissolved & Particulate)	• Grade Stabilization Structure • Critical Area Planting • Streambank and Shoreline Protection • Grazing/Use Exclusion
Source Reduction	Reduction of Mass Potential	Total (Dissolved & Particulate)	• Conservation Tillage • Nitrogen Management Plan

4.2.1.2 PTMApp Limitations

While the best available data and information have been used to develop this plan, no plan is perfect. There are limitations with this model; recognizing these limitations is important because they influence implementation. For example, PTMApp was not programmed to analyze bacterial issues impacting surface and groundwater resources. For this reason, bacteria was not included in the PTMApp assessment.

Another important limitation is that PTMApp only analyzes sediment and nutrient sources from the surface of the land and does not consider near-channel or in-channel sediment sources, shoreland erosion, point sources, or contributions from individual septic treatment systems. Many of the action items within the targeted implementation schedule are focused on implementing structural and management practices to reduce the amount of sediment and nutrients leaving the landscape and entering drainage systems, streams, and rivers. Action items focused on mitigating surface runoff are also expected to provide benefits in reducing the amount of near-channel sediment loss, although the amount is not quantified within the plan.

4.3 WATERSHEDWIDE IMPLEMENTATION

Actions in the education and outreach, data gaps and research, and regulatory components are implemented watershedwide to ensure consistency and effectiveness at a watershed scale:

- ***Education and Outreach***: This includes actions that aim to increase public engagement, improve communication, and help understanding to improve a priority issue. These actions are funded by the Education and Outreach Program (**Section 5.1.2**).

- ***Data Gaps and Research***: This includes actions that are focused on research activities aimed to close a data gap and continue existing monitoring activities. These actions are funded by the Data Gaps and Research Program (**Section 5.1.3**).
- ***Regulatory***: This includes actions that pertain to common and consistent administration and enforcement of statutory responsibilities, local regulations, and local ordinances. These actions already occur as part of the Thief River Watershed 1W1P Planning Group's individual roles. These actions are funded by existing budgets (**Section 5.1.5**).

Table 4-3 lists the measurable goal categories (MGC) for reference to corresponding actions in the implementation schedules. These goals were developed for priority issues and are listed by there number system within the implementation tables below. The purpose for listing these goal numbers are so that each action can be traced back to the measurable goals that they will benefit.

Table 4-3: Measurable Goal Category Key

Measurable Goal Category Key
3.2.1: Drinking Water – Reduce Nitrate Contamination
3.2.2: Aquatic Life and Aquatic Recreation – Reduce Sediment and Phosphorus Delivery and Load
3.2.3: Aquatic Life and Aquatic Recreation – Reduce Bacteria Delivery and Load
3.2.4: Aquatic Life and Aquatic Recreation – Increase Dissolved Oxygen Concentration
3.2.5: Surface Runoff and Flooding – Reduce Damages from Peak Flows and Overland Flooding
3.2.6: Drainage Management Systems – Erosion and Sedimentation Reduction
3.2.7: Shoreland and Riparian Areas – Improve and Increase Vegetative Cover
3.2.8: Habitat for Wildlife – Enhance Connectivity and Cover
3.2.9: Aquatic Habitat for Fish, Macroinvertebrates, and Aquatic Life – Restore Connectivity and Habitat, Moderate Flow Regimes, and Promote Vegetated Banks and Buffers
3.2.10: Public Knowledge of and Behavior Related to Water Resources – Increase Stakeholder Participation
3.2.11: Data Collection – Enhance Knowledge of Baseline Conditions
3.2.12: Healthy Rural Landscapes – Improve Agricultural Soil Health
3.2.13: Healthy Rural Landscapes – Reduce Surface and Groundwater Contamination

Location: Watershedwide																							
				Timeline								Measurable Goals											
Action Level	Implementation Actions: Education and Outreach	Measurable Output	Metric	2020-2021	2022-2023	2024-2025	2026-2027	2028-2029	Lead Entity	Partner	Estimated Cost	MGC 3.2.1	MGC 3.2.2	MGC 3.2.3	MGC 3.2.4	MGC 3.2.5	MGC 3.2.6	MGC 3.2.7	MGC 3.2.8	MGC 3.2.9	MGC 3.2.10	MGC 2.2.11	MGC 3.2.12	MGC 3.2.13
B	Conduct cooperative education efforts and demonstration projects related to advancing plan goals	1 workshop	workshop/yr.	x	x	x	x	x	SWCD/Extension	WD, NRCS, MDA, MPCA, Crop Advisors	$10,000	x	x	x	x	x	x	x	x	x	x	x	x	x
	Annually solicit stakeholder input about plan activities from advisory committee(s)	1 meeting/yr.	# meetings	x	x	x	x	x	WD/SWCD/County	BWSR, USFWS, DNR, MDH, MDA	$5,670										x	x		
	Work with local, regional, national US Fish and Wildlife Service staff to address water quality leaving Agassiz Pool to address downstream impacts on drinking water supplies and water quality impairments.	1 meeting/yr.	# meetings	x	x	x	x	x	WD/SWCD/County	BWSR, USFWS, DNR, MDH, MDA	$5,670										x	x		
	The Policy Committee will participate in any public input processes for the USFWS management strategies for lands within the planning boundary.	1 meeting/yr.	# meetings	x	x	x	x	x	Policy Committee	Advisory Committee and Steering Team	$5,670										x	x		
	Update the Source Water Assessment Plan and investigate doing a surface source water assessment	2 complete plans	Completed plans				x	x	MDH	WD/SWCD/County\BWSR, DNR, USFWS	NA										x	x		

Measurable Goal Key:
3.2.1: Drinking Water – Reduce Nitrate Contamination
3.2.2: Aquatic Life and Aquatic Recreation – Reduce Sediment and Phosphorus Delivery and Load
3.2.3: Aquatic Life and Aquatic Recreation – Reduce Bacteria Delivery and Load
3.2.4: Aquatic Life and Aquatic Recreation – Increase Dissolved Oxygen Concentration
3.2.5: Surface Runoff and Flooding – Reduce Damages from Peak Flows and Overland Flooding
3.2.6: Drainage Management Systems – Erosion and Sedimentation Reduction
3.2.7: Shoreland and Riparian Areas – Improve and Increase Vegetative Cover
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3.2.10: Public Knowledge of and Behavior Related to Water Resources – Increase Stakeholder Participation
3.2.11: Data Collection – Enhance Knowledge of Baseline Conditions
3.2.12: Healthy Rural Landscapes – Improve Agricultural Soil Health
3.2.13 Healthy Rural Landscapes – Reduce Surface and Groundwater Contamination

Location: Watershedwide																									
				Timeline								Measurable Goals													
Action Level	Implementation Actions: Education and Outreach	Measurable Output	Metric	2020-2021	2022-2023	2024-2025	2026-2027	2028-2029	Lead Entity	Partner	Estimated Cost	MGC 3.2.1	MGC 3.2.2	MGC 3.2.3	MGC 3.2.4	MGC 3.2.5	MGC 3.2.6	MGC 3.2.7	MGC 3.2.8	MGC 3.2.9	MGC 3.2.10	MGC 2.2.11	MGC 3.2.12	MGC 3.2.13	
	The steering team and advisory committee will participate in annual impoundment management meetings	1 meeting/yr.	# meetings	x	x	x	x	x	Policy Committee	Advisory Committee and Steering Team	$5,670										x	x			
	Continue to support and expand the River Watch Program	1 new participating school	# participating schools	x	x	x	x	x	WD	IWI	$9,000										x		x		
	Implement an education/outreach program for the responsible use, storage, and disposal of pesticides	1 newsletter article/spring	# newsletter article/yr.	x	x	x	x	x	County/MDA	SWCD, Extension	$5,000										x			x	
	Implement an education/outreach program on well-sealing cost-share	1 workshop	# workshops	x	x	x	x	x	SWCD/BWSR	County/MDH	$20,000	x									x			x	
	Promote Minnesota Agricultural Water Quality Certification Program through targeted outreach to potentially interested landowners	20 landowner contracts	# contracts	x	x	x	x	x	SWCD	WD, MDA	$20,000		x	x		x		x	x		x		x		
	Provide educational and technical assistance to landowners regarding state and federal programs to advance plan goals	150 conservation plans developed	# conservation plans	x	x	x	x	x	County/SWCD	WD, DNR, Extension, NRCS, USFWS	$70,000	x	x	x	x	x	x	x	x	x	x	x	x	x	

Measurable Goal Key:
3.2.1: Drinking Water – Reduce Nitrate Contamination
3.2.2: Aquatic Life and Aquatic Recreation – Reduce Sediment and Phosphorus Delivery and Load
3.2.3: Aquatic Life and Aquatic Recreation – Reduce Bacteria Delivery and Load
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3.2.10: Public Knowledge of and Behavior Related to Water Resources – Increase Stakeholder Participation
3.2.11: Data Collection – Enhance Knowledge of Baseline Conditions
3.2.12: Healthy Rural Landscapes – Improve Agricultural Soil Health
3.2.13 Healthy Rural Landscapes – Reduce Surface and Groundwater Contamination

Location: Watershedwide																									
Action Level	Implementation Actions: Education and Outreach	Measurable Output	Metric	Timeline								Measurable Goals													
				2020-2021	2022-2023	2024-2025	2026-2027	2028-2029	Lead Entity	Partner	Estimated Cost	MGC 3.2.1	MGC 3.2.2	MGC 3.2.3	MGC 3.2.4	MGC 3.2.5	MGC 3.2.6	MGC 3.2.7	MGC 3.2.8	MGC 3.2.9	MGC 3.2.10	MGC 2.2.11	MGC 3.2.12	MGC 3.2.13
	Provide cooperative education efforts and demonstration projects to promote agricultural BMPs, including, but not limited to, nutrient management, conservation tillage, buffers, soil testing, pesticide application, etc.	1 workshop/yr.	# workshops	x	x	x	x	x	SWCD	MDA, BWSR, WD	$15,000		x	x	x	x		x			x		x	
	Promote education for solid and hazardous waste disposal and awareness of existing regulations, rules, and ordinances pertaining to proper waste disposal to reduce chemical and nutrient contamination of water	1 workshop/yr.	# workshops	x	x	x	x	x	County	SWCD, WD, MPCA	$10,000			x							x			x
	Educate and promote aquatic invasive species (AIS) awareness and prevention	100% public accesses have signage	% public access sites with signage	x	x	x	x	x	SWCD/WD/County	DNR	$5,000									x				
1	Provide educational materials, consultations, and workshops to landowners and agricultural producers about public drainage and public water statutes	1 workshop	# workshops			x	x	x	Drainage Authorities	SWCD, BWSR, USFWS	$5,000					x	x				x			

Measurable Goal Key:
3.2.1: Drinking Water – Reduce Nitrate Contamination
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3.2.3: Aquatic Life and Aquatic Recreation – Reduce Bacteria Delivery and Load
3.2.4: Aquatic Life and Aquatic Recreation – Increase Dissolved Oxygen Concentration
3.2.5: Surface Runoff and Flooding – Reduce Damages from Peak Flows and Overland Flooding
3.2.6: Drainage Management Systems – Erosion and Sedimentation Reduction
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3.2.8: Habitat for Wildlife – Enhance Connectivity and Cover
3.2.9: Aquatic Habitat for Fish, Macroinvertebrates and Aquatic Life – Restore Connectivity, Habitat, Moderated Flow Regimes and Promoted Vegetated Banks and Buffers
3.2.10: Public Knowledge of and Behavior Related to Water Resources – Increase Stakeholder Participation
3.2.11: Data Collection – Enhance Knowledge of Baseline Conditions
3.2.12: Healthy Rural Landscapes – Improve Agricultural Soil Health
3.2.13 Healthy Rural Landscapes – Reduce Surface and Groundwater Contamination

Location: Watershedwide

Action Level	Implementation Actions: Education and Outreach	Measurable Output	Metric	Timeline								Measurable Goals												
				2020-2021	2022-2023	2024-2025	2026-2027	2028-2029	Lead Entity	Partner	Estimated Cost	MGC 3.2.1	MGC 3.2.2	MGC 3.2.3	MGC 3.2.4	MGC 3.2.5	MGC 3.2.6	MGC 3.2.7	MGC 3.2.8	MGC 3.2.9	MGC 3.2.10	MGC 2.2.11	MGC 3.2.12	MGC 3.2.13
	Develop a factsheet to summarize and share information about the causes of water quality problems in the Thief River that are affecting drinking water in the city of Thief River Falls.	1 factsheet	# of factsheets		x				SD/SWCD	MDH, MPCA, DNR	$5,000	x	x				x							
	Increase local awareness and capacity to use water resource management technology and tools	1 training	# trainings/yr.	x	x	x	x	x	SWCD/WD	County, City, Crop Advisors, DNR, MPCA, MDA, BWSR	$5,000										x			
2	Promote increased public use of natural features, such as streams and public lands	*N/A: Action Level 2 Implementation Funding Required*							DNR	USWFS, WD, County	N/A										x			

B = Baseline funding level

1 = Moderate funding level

2 = High funding level

Location: Watershedwide

Action Level	Implementation Actions: Data Gaps & Research	Measurable Output	Metric	Timeline					Implementation Responsibilities and Cost			Measurable Goals												
				2020-2021	2022-2023	2024-2025	2026-2027	2028-2029	Lead Entity	Partner	Estimated Cost	MGC 3.2.1	MGC 3.2.2	MGC 3.2.3	MGC 3.2.4	MGC 3.2.5	MGC 3.2.6	MGC 3.2.7	MGC 3.2.8	MGC 3.2.9	MGC 3.2.10	MGC 2.2.11	MGC 3.2.12	MGC 3.2.13
B	Utilize models and tools to identify upland sediment and nutrient sources, target BMPs, and measure progress towards goals	N/A – existing	N/A – existing	x	x	x	x	x	WD/SWCD	BWSR, DNR, MPCA	$10,060		x				x					x	x	

Measurable Goal Key:

3.2.1: Drinking Water – Reduce Nitrate Contamination
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3.2.3: Aquatic Life and Aquatic Recreation – Reduce Bacteria Delivery and Load
3.2.4: Aquatic Life and Aquatic Recreation – Increase Dissolved Oxygen Concentration
3.2.5: Surface Runoff and Flooding – Reduce Damages from Peak Flows and Overland Flooding
3.2.6: Drainage Management Systems – Erosion and Sedimentation Reduction
3.2.7: Shoreland and Riparian Areas – Improve and Increase Vegetative Cover
3.2.8: Habitat for Wildlife – Enhance Connectivity and Cover
3.2.9: Aquatic Habitat for Fish, Macroinvertebrates and Aquatic Life – Restore Connectivity, Habitat, Moderated Flow Regimes and Promoted Vegetated Banks and Buffers
3.2.10: Public Knowledge of and Behavior Related to Water Resources – Increase Stakeholder Participation
3.2.11: Data Collection – Enhance Knowledge of Baseline Conditions
3.2.12: Healthy Rural Landscapes – Improve Agricultural Soil Health
3.2.13 Healthy Rural Landscapes – Reduce Surface and Groundwater Contamination

Location: Watershedwide																									
Action Level	Implementation Actions: Data Gaps & Research	Measurable Output	Metric	Timeline					Implementation Responsibilities and Cost			Measurable Goals												
				2020-2021	2022-2023	2024-2025	2026-2027	2028-2029	Lead Entity	Partner	Estimated Cost	MGC 3.2.1	MGC 3.2.2	MGC 3.2.3	MGC 3.2.4	MGC 3.2.5	MGC 3.2.6	MGC 3.2.7	MGC 3.2.8	MGC 3.2.9	MGC 3.2.10	MGC 2.2.11	MGC 3.2.12	MGC 3.2.13
	Monitor precipitation and increase the number of volunteer rain gauge readers	1 volunteer per twp.	# volunteers	x	x	x	x	x	SWCD	County, State Climatology	$6,000										x	x		
	Inventory and prioritize locations of unstable watercourses and identify the root cause of the instability; continue this work based on 2015 DNR Geomorphology Report	completed inventory	inventory/report		x	x	x	x	DNR	WD, SWCD, MPCA	$50,000		x				x			x		x		
	Continue surface water quality and hydrologic monitoring program	all AUIDs sampled	# AUIDs sampled	x	x	x	x	x	SWCD /WD	IWI, MPCA	$190,000		x	x	x	x	x			x		x		
1	Develop an inventory of abandoned or unused wells using county well records and aerial imagery review	1 inventory	inventory	x	x	x	x	x	SWCD/County	MDH	$10,000	x										x		x
	Investigate opportunities for sediment reduction in the middle Thief River planning region	1 study	Completed study		x	x			WD/SWCD	USFWS, DNR	$40,000		x	x	x							x		x
	Complete inventory consistent with statewide standards on crossings of perennial streams and ditches	100/yr.	# crossings inventoried	x	x	x			WD/County	USWFS, DNR Township, DOT	$50,000				x	x	x		x		x			
	Develop a side water inlet (SWI) needs inventory	1 inventory	inventory	x	x				SWCD/WD	County, BWSR	$30,000		x		x	x	x						x	
	Develop and implement a targeted program to identify the number of imminent public health threat Subsurface Sewage Treatment Systems (SSTS)	1 program	program	x	x	x	x	x	County/SWCD	WD, BWSR, MPCA, Township	$10,000		x	x	x							x		x
	Monitor arsenic, nitrate, and bacteria levels in existing private wells	32 wells sampled/yr.	# wells sampled/yr.	x	x	x	x	x	SWCD	City, County, Township, MDH	$136,000	x										x		x
	Develop and maintain an inventory of locations on the landscape that are damaged by floods	1 inventory	inventory	x	x	x	x	x	County/City/Township	SWCD, WD, DNR, Landowners, HSEM	$100,000					x						x		

Measurable Goal Key:
3.2.1: Drinking Water – Reduce Nitrate Contamination
3.2.2: Aquatic Life and Aquatic Recreation – Reduce Sediment and Phosphorus Delivery and Load
3.2.3: Aquatic Life and Aquatic Recreation – Reduce Bacteria Delivery and Load
3.2.4: Aquatic Life and Aquatic Recreation – Increase Dissolved Oxygen Concentration
3.2.5: Surface Runoff and Flooding – Reduce Damages from Peak Flows and Overland Flooding
3.2.6: Drainage Management Systems – Erosion and Sedimentation Reduction
3.2.7: Shoreland and Riparian Areas – Improve and Increase Vegetative Cover
3.2.8: Habitat for Wildlife – Enhance Connectivity and Cover
3.2.9: Aquatic Habitat for Fish, Macroinvertebrates and Aquatic Life – Restore Connectivity, Habitat, Moderated Flow Regimes and Promoted Vegetated Banks and Buffers
3.2.10: Public Knowledge of and Behavior Related to Water Resources – Increase Stakeholder Participation
3.2.11: Data Collection – Enhance Knowledge of Baseline Conditions
3.2.12: Healthy Rural Landscapes – Improve Agricultural Soil Health
3.2.13 Healthy Rural Landscapes – Reduce Surface and Groundwater Contamination

Location: Watershedwide																							
Action Level	Implementation Actions: Data Gaps & Research	Measurable Output	Metric	Timeline					Implementation Responsibilities and Cost			Measurable Goals												
				2020-2021	2022-2023	2024-2025	2026-2027	2028-2029	Lead Entity	Partner	Estimated Cost	MGC 3.2.1	MGC 3.2.2	MGC 3.2.3	MGC 3.2.4	MGC 3.2.5	MGC 3.2.6	MGC 3.2.7	MGC 3.2.8	MGC 3.2.9	MGC 3.2.10	MGC 2.2.11	MGC 3.2.12	MGC 3.2.13
	Continue to develop and maintain a database inventory of existing BMPs with associated costs of implementation	1 database	database	x	x	x	x	x	SWCD	County, City, NRCS, BWSR, MPCA	$50,000											x		
	Expand surface water quality and hydrologic monitoring program	1 flow monitoring site, 1 water quality site, 1 DO logger/yr.	# sites/yr.	x	x	x	x	x	SWCD / WD	IWI, MPCA	$45,500		x	x	x	x	x					x		
	Delineate the 10-year 24-hr summer rainfall event floodplain and target BMP implementation	50% delineation	% floodplain delineated		x	x	x	x	WD	County, SWCD, DNR	$10,000					x			x	x		x		
	Update drainage records in accordance with Drainage Records Modernization	100% drainage records updated	% drainage records update	x	x				Drainage Authorities	BWSR	$50,000						x					x		
2	Monitor surface water for pesticides and/or other contaminants	*N/A: Action Level 2 Implementation Funding Required*							MDA	SWCD, County Extension	*N/A*									x		x		
2	Develop geologic atlases for all the counties in the watershed	*N/A: Action Level 2 Implementation Funding Required*							DNR/MGS	SWCD, WD, County	*N/A*	x								x		x		x
2	Fill gaps in the groundwater level observation well network by installing additional, strategically located long-term groundwater observation wells	*N/A: Action Level 2 Implementation Funding Required*							DNR	MGS, MDH, MDA	*N/A*											x		x
2	Develop a map of field tile drainage locations in the plan area	*N/A: Action Level 2 Implementation Funding Required*							WD/SWCD/County	Crop Advisors, NRCS, Landowners, BWSR	*N/A*	x				x						x		
2	Develop and maintain a local GIS data clearinghouse	*N/A: Action Level 2 Implementation Funding Required*							County	SWCD, WD, City	*N/A*										x	x		
2	Request MnDOT to complete a flood vulnerability assessment	*N/A: Action Level 2 Implementation Funding Required*							MnDOT	County, WD, SWCD, DNR, State Climatology	*N/A*					x	x				x	x		

Measurable Goal Key:
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Location: Watershedwide																									
Action Level	Implementation Actions: Data Gaps & Research	Measurable Output	Metric	Timeline					Implementation Responsibilities and Cost			Measurable Goals													
				2020-2021	2022-2023	2024-2025	2026-2027	2028-2029	Lead Entity	Partner	Estimated Cost	MGC 3.2.1	MGC 3.2.2	MGC 3.2.3	MGC 3.2.4	MGC 3.2.5	MGC 3.2.6	MGC 3.2.7	MGC 3.2.8	MGC 3.2.9	MGC 3.2.10	MGC 2.2.11	MGC 3.2.12	MGC 3.2.13
	Estimate source yield losses due to wind erosion using the Wind Erosion Prediction System (WEPS) or similar model/tool	*N/A: Action Level 2 Implementation Funding Required*							SWCD	County, WD	*N/A*		x									x	x	

B = Baseline funding level
1 = Moderate funding level
2= High funding level

Location: Watershedwide																									
Action Level	Implementation Actions: Regulatory	Measurable Output	Metric	Timeline					Implementation Responsibilities and Cost			Measurable Goals													
				2020-2021	2022-2023	2024-2025	2026-2027	2028-2029	Lead Entity	Partner	Estimated Cost	MGC 3.2.1	MGC 3.2.2	MGC 3.2.3	MGC 3.2.4	MGC 3.2.5	MGC 3.2.6	MGC 3.2.7	MGC 3.2.8	MGC 3.2.9	MGC 3.2.10	MGC 2.2.11	MGC 3.2.12	MGC 3.2.13
B	Administer Watershed District rules	100% compliance	% compliance	X	X	X	X	X	WD	N/A	$73,400													
	Administer Minnesota Rules Chapter 7080 through 7083 managing SSTSs	100% 30%	% ITPHS brought into compliance % FTPGW upgraded	x	x	x	x	x	County/SWCD	MPCA, MDA	$110,600	x		x										x
	Maintain compliance with National Point Discharge Elimination System (NPDES) permits for point sources	100% compliance	% permits in compliance	x	x	x	x	x	MPCA	EPA	$25,000	x	x	x										
	Administer Minnesota Rules Chapter 6120, Shoreland Rules	100% compliance	% compliance	x	X	x	x	x	SWCD/County/City	DNR, BWSR	$111,000		x	x		x		x	x	x				
	Administer Minnesota Statute 103F.48 Riparian Protection and Water Quality Practices (Buffer Law) and Minnesota Statutes 103F.401-455 Soil Erosion Law	100% compliance	buffer/alternative practice compliance	x	x	x	x	x	SWCD/County/WD	BWSR, DNR	$78,343		x				x	x	x	x				

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Location: Watershedwide																								
	Administer Minnesota Rules Chapter 7020 managing feedlots and target inspections first in planning regions classified as Restoration or Nearly Impaired for *E. coli*	100% compliance	% feedlot compliance	x	x	x	x	x	SWCD/County/MPCA	N/A	$18,142	x		x										x
	Seal abandoned and unused wells, particularly those wells that may impact public or private drinking water supplies, such as those found within DWSMAs or multi-aquifer wells (Minnesota Statutes Section 103I.301)	50 wells	# wells	x	x	x	x	x	SWCD/County	MDH	$50,000	x												x
	Administer the floodplain management ordinance and approvals to minimize the likelihood of future flood damages	100% compliance	% compliance	x	x	x	x	x	County/SWCD	City, WD, DNR, ACOE	$46,190					x								
	Administer the Wetland Conservation Act (WCA) to retain wetland quantity, function, and value	no net loss of wetlands	acres of wetlands	x	x	x	x	x	County/SWCD	City, DNR, BWSR, ACOE	$101,355		x			x			x	x				x
	Administer the Noxious Weed Law (Minnesota Statutes Sections 18.76 to 18.91)	100% compliance	% compliance	x	x	x	x	x	County/SWCD	DNR	$15,000							x	x					
	Review WD Rules' culvert design requirements for consistency with BTSAC and MESBOAC guidance and amend as needed	1 review	# rules reviews			x			WD	SWCD, County, DNR, BWSR	$5,000					x	x			x				

B = Baseline funding level
1 = Moderate funding level
2 = High funding level

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Soil Health
Groundwater Contamination

4.4 PLANNING REGION IMPLEMENTATION

Planning region implementation profiles summarize current resource conditions and present information about the potential number, location, and types of structural and management practices for implementation. The implementation profile also presents information about the relationship between the fiscal investment to implement structural and management practices relative to the United States Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS) Environmental Quality Incentives Program (EQIP) cost-share and the progress implementation makes towards plan measurable goals. The information within the implementation profile is useful for understanding whether measurable goals are achievable through activities that affect surface runoff with the current expenditure of resources within the plan area.

Presented below is the targeted implementation schedule for the implementation of structural and management practices, as well as capital improvement projects, within the Thief River Watershed plan area by planning region. Capital improvement actions consist of a major non-recurring expenditure for the construction, repair, retrofit, or increased utility or function of physical facilities, infrastructure, or environmental features. These actions are given project names, scopes, budgets, and timelines within **Section 5.1.4**. Details, such as the number and locations of structural and management practices and progress towards plan measurable goals, are presented in planning region implementation profiles in **Section 4.5**.

The Planning Work Group recommended the following targeting approach for projects and practices implementation in the Thief River Watershed. This approach informs the implementation profiles as well as the targeted implementation schedule. The best individual structural and management practices were selected based on their ability to reduce sediment and TP at the outlet of each planning region. Because of this, targeting for downstream planning regions will contain best practices in upstream planning regions. Implementation of these practices will produce benefits to downstream planning regions, which ultimately may lower implementation costs. Due to sediment impairments in the watershed, the approach targets sediment using PTMApp data to identify the most cost-effective practices for treating sediment. The Planning Work Group used BMP targeting criteria to ensure a diversity of cost-effective practices for treating sediment were identified (**Table 4-4**). The sediment goals for many planning regions are achievable using the portion of baseline funding that is available for projects and practices. In these planning regions, Level 1 and Level 2 funding is used to target planning region TP reduction goals. Level 1 funding roughly targets 50% and Level 2 roughly 100% of the TP goal. In Planning regions where the sediment goal is not achievable using baseline funding, Level 1 funding is used to meet the goal and TP goal is met using additional Level 1 or Level 2 funding. In several cases, Level 2 funding was not required to meet load reduction goals. **Table 4-5** shows sediment and TP goal achievability within the parameters of the targeted approach by funding level. The achievability of the goals for planning region varies due to different levels of protection and restoration goals, planning region land use, hydrologic position (upstream vs. downstream), and size.

Table 4-4: BMP Targeting Criteria

Practice Type	Sediment Reduction Efficiency (tons/yr.)	TP Reduction Efficiency (lbs./yr.)	Minimum Size (acres)	Minimum Contributing Drainage Area Size (acres)	% Runoff Treated
Management Practices	>0.5	>0.5	>10	n/a	>50%
Structural Practices	>0.5	>0.5	>0.5	>40	>50%

Table 4-5: Achievability of Planning Region Goals by Implementation Funding Level

Planning Region	Sediment Goal (tons/yr.)	TP Goal (lbs./yr.)	Funding Level Required to Meet Goal	
			Sediment Goal	TP Goal
JD 30/18/13	70 (Protection)	559 (Protection)	Baseline	Level 1
Branch 200 of JD 11 (Lost River)	34 (Protection)	333 (Protection)	Baseline	Level 2
Lower Thief River/SD 83	2,335 (Restoration)	5,091 (Protection)	Baseline	Level 2
Marshall CD 20	846 (Protection)	2,270 (Protection)	Baseline	Level 1
Middle Thief River/SD 83	653 (Restoration)	2,177 (Protection)	Level 1	Level 2
Moose/JD 21	49 (Protection)	811 (Protection)	Baseline	Level 2
Mud/JD 11	290 (Protection)	2,187 (Protection)	Baseline	Level 2
Upper Thief River/SD 83	103 (Protection)	574 (Protection)	Baseline	Level 1

The planning group reviewed the number of priority issues present in each planning region and established priority planning regions. The Lower Thief River/SD 83, Marshall CD 20, and Mud River/JD 11 watershed are the highest priority subwatersheds; JD 30/18/13, Branch 200 of JD 11 (Lost River), and the Upper Thief River/SD 83 are the second highest priority planning regions; the Middle Thief River/SD 83 and Moose River/JD 21 planning regions are the lowest priority planning regions. This ranking is used to inform baseline implementation funding allocation in the implementation schedules as well as annual work planning for projects and practices and capital projects in each planning region. See **Appendix H** for a detailed summary of the planning region prioritization process. **Figure 4-1** shows a map of the prioritized planning regions.

Table 5-6 in **Plan Section 5.2** lists the estimated 10-year baseline funding for projects and practices to be $144,751 annually (or $1,447,510 over the 10-year plan lifespan) and $101,277 annually (or $1,012,770 over the 10-year plan lifespan) for capital projects watershedwide. **Table 4-6** depicts the distribution of funds by planning region.

Table 4-6: Planning Region Funding Distribution for Projects and Practices and Capital Projects Implementation Based on Priority Tier Ranking

Planning Region	Priority Tier Ranking	Baseline Projects and Practices Implementation Funding (Annual)	Baseline Projects and Practices Implementation Funding (10 yr.)	Baseline Capital Projects Implementation Funding (Annual)	Baseline Capital Projects Implementation Funding (10 yr.)
Lower Thief River/SD 83	1	$24,125	$241,251	$16,880	$168,795
Marshall CD 20		$24,125	$241,251	$16,880	$168,795
Mud/JD 11		$24,125	$241,251	$16,880	$168,795
Branch 200 of JD 11 (Lost River)	2	$19,300	$193,001	$13,503	$135,036
JD 30/18/13		$19,300	$193,001	$13,503	$135,036
Upper Thief River/SD 83		$19,300	$193,001	$13,503	$135,036
Middle Thief River/SD 83	3	$7,237	$72,375	$5,064	$50,639
Moose/JD 21		$7,237	$72,375	$5,064	$50,639

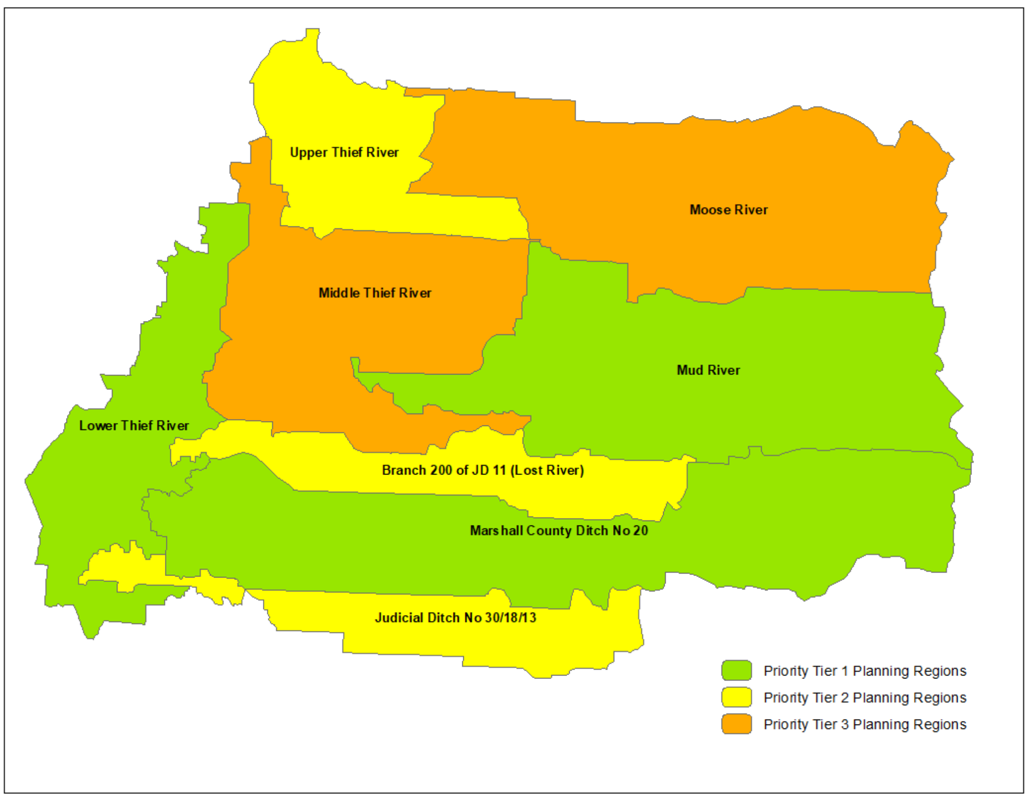

Figure 4-1: Thief River 1W1P Planning Region Priority Tiers

4.4.1 Planning Region Targeted Implementation Schedules

Table 4-8 Judicial Ditch 30/18/13 Structural Practice Implementation Schedule.

Location: Judicial Ditch 30/18/13 Planning Region

Priority Tier 2 Planning Region

Action Level	PTMApp Treatment Group	Implementation Action: Structural Practices	Measurable Output	Metric	Estimated Cost	Timeline					Implementation Responsibility		Measurable Goals												
						2020-21	2022-23	2024-25	2026-27	2028-29	Lead Entity	Partner	MGC 3.2.1	MGC 3.2.2	MGC 3.2.3	MGC 3.2.4	MGC 3.2.5	MGC 3.2.6	MGC 3.2.7	MGC 3.2.8	MGC 3.2.9	MGC 3.2.10	MGC 3.2.11	MGC 3.2.12	MGC 3.2.13
B	*Filtration*	Implement practices (e.g. filter strips, grassed waterways) within priority locations that reduce bacteria, sediment, and nutrient loading to waterbodies by treating surface and shallow-surface runoff before entering ditches and streams	161 tons/yr. sediment; 31 lbs./yr. TP	annual tons sediment and lbs. TP load reduction	$16,897		x	x			SWCD/WD	BWSR, DNR, NRCS, Landowners		x	x	x	x	x	x	x	x				x
B	*Storage*	Implement and maintain BMPs that provide runoff reduction for flood mitigation as well as reduce sediment and TP load for aquatic life	216 tons/yr. sediment; 59 lbs./yr. TP	annual tons sediment and lbs. TP load reduction	$79,068			x	x		SWCD/WD	BWSR, DNR, NRCS, Landowners		x		x	x	x							x
1	*Storage*	Implement and maintain additional BMPs that provide runoff reduction for flood mitigation as well as reduce sediment and TP load for aquatic life	286 tons/yr. sediment; 71 lbs./yr. TP	annual tons sediment and lbs. TP load reduction	$112,481			x	x		SWCD/WD	BWSR, DNR, NRCS, Landowners		x	x	x	x	x							x

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3.2.4: Aquatic Life and Aquatic Recreation – Increase Dissolved Oxygen Concentration
3.2.5: Surface Runoff and Flooding – Reduce Damages from Peak Flows and Overland Flooding
3.2.6: Drainage Management Systems – Erosion and Sedimentation Reduction
3.2.7: Shoreland and Riparian Areas – Improve and Increase Vegetative Cover
3.2.8: Habitat for Wildlife – Enhance Connectivity and Cover
3.2.9: Aquatic Habitat for Fish, Macroinvertebrates and Aquatic Life – Restore Connectivity, Habitat, Moderated Flow Regimes and Promoted Vegetated Banks and Buffers
3.2.10: Public Knowledge of and Behavior Related to Water Resources – Increase Stakeholder Participation
3.2.11: Data Collection – Enhance Knowledge of Baseline Conditions
3.2.12: Healthy Rural Landscapes – Improve Agricultural Soil Health
3.2.13 Healthy Rural Landscapes – Reduce Surface and Groundwater Contamination

Table 4-9: Judicial Ditch 30/18/13 Management Practice Implementation Schedule

Location: Judicial Ditch 30/18/13 Planning Region																									
Priority Tier 2 Planning Region																									
						Timeline					**Implementation Responsibilities**		**Measurable Goals**												
Action Level	**PTMApp Treatment Group**	**Implementation Actions: Management Practices**	**Measurable Output**	**Metric**	**Estimated Cost**	**2020-21**	**2022-23**	**2024-25**	**2026-27**	**2028-29**	**Lead Entity**	**Partner**	**MGC 3.2.1**	**MGC 3.2.2**	**MGC 3.2.3**	**MGC 3.2.4**	**MGC 3.2.5**	**MGC 3.2.6**	**MGC 3.2.7**	**MGC 3.2.8**	**MGC 3.2.9**	**MGC 3.2.10**	**MGC 3.2.11**	**MGC 3.2.12**	**MGC 3.2.13**
B	*Source Reduction*	Implement practices that are focused on and maintain soil health, including but not limited to conservation tillage and residue management, crop rotation methods, and/or the use of cover crops	3,058 acres with management practices; 948 tons/yr. sediment reduction; 399 lbs./yr. TP load reduction	# acres; annual tons sediment and lbs. TP load reduction	$95,790		x	x			SWCD	MDA, NRCS, Crop Advisors, Landowner		x		x	x	x	x		x			x	x

Table 4-10: Judicial Ditch 30/18/13 Projects and Practices Summary

Judicial Ditch 30/18/13 Projects and Practices Summary				
Priority Tier 2 Planning Region				
Action Level	**PTMApp Treatment Group**	**# Practices**	**Sediment Load Reduction (tons/yr.)**	**Total Phosphorus Load Reduction (lbs./yr.)**
Baseline	Filtration	16	161	31
	Storage	19	216	59
	Source Reduction	91	948	399
	Total	**126**	**1,325**	**489**
Level 1	**Storage**	36	286	71
	Grand Total	**162**	**1,611**	**561**

Measurable Goal Key:
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3.2.11: Data Collection – Enhance Knowledge of Baseline Conditions
3.2.12: Healthy Rural Landscapes – Improve Agricultural Soil Health
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Table 4-11: Judicial Ditch 30/18/13 Capital Projects Implementation Schedule

Location: Judicial Ditch 30/18/13 Planning Region																								
Priority Tier 2 Planning Region																								
Action Level	**Implementation Action: Capital Improvement/ Operations and Maintenance**	**Measurable Output**	**Metric**	**Estimated Cost**	**Timeline**					**Implementation Responsibility**		**Measurable Goals**												
					2020-21	**2022-23**	**2024-25**	**2026-27**	**2028-29**	**Lead Entity**	**Partner**	**MGC 3.2.1**	**MGC 3.2.2**	**MGC 3.2.3**	**MGC 3.2.4**	**MGC 3.2.5**	**MGC 3.2.6**	**MGC 3.2.7**	**MGC 3.2.8**	**MGC 3.2.9**	**MGC 3.2.10**	**MGC 3.2.11**	**MGC 3.2.12**	**MGC 3.2.13**
B – OM	Maintain public drainage infrastructure to provide adequate drainage while minimizing upstream and downstream flood damages and impacts on water quality	75 miles of drainage infrastructure maintained	miles	$33,759	x	x	x	x	x	Drainage Authorities	DNR, MPCA, SWCD, City, MnDOT, ACOE		x			x	x			x				
B – CP	Implement a series of runoff reduction BMPs to reduce average annual runoff by 0.125 inches	% progress towards 443 acre-feet runoff reduction goal	acre-feet runoff reduction	$101,277			x	x	x	WD	RRWMB, DNR, BWSR		x			x	x		x	x				x
1 – OM	Maintain ditch systems in accordance with multi-purpose drainage goals as stated in MS 103E.015	75 miles of drainage infrastructure maintained	miles	$100,000		x	x	x		Drainage Authorities	SWCD, BWSR, DNR		x			x	x	x		x				x
1 – CP	Stabilize 3 miles of JD 30 by re-sloping the ditch banks or constructing a 2-stage ditch; the project will also include side water inlet structures where needed	3 miles of ditch stabilized	miles	$900,000			x	x		Drainage Authorities	SWCD, BWSR, DNR		x		x	x	x							
	Continue to implement a series of runoff reduction BMPs to reduce average annual runoff by 0.125 inches	% progress towards 443 acre-feet runoff reduction goal	acre-feet runoff reduction	$1,000,000			x	x	x	WD	RRWMB, DNR, BWSR		x			x	x		x	x				x
2 – CP	Protect the natural meandering of streams and promote the restoration/repair of straightened streams/ditches to maintain stream/ditch capacity for reducing flood impacts and enhancing recreational, agricultural, and fish and wildlife habitat value	*N/A: Action Level 2 Implementation Funding Required*								County/WD	DNR, SWCD, USFWS, TNC		x	x	x	x	x	x	x	x				x

Measurable Goal Key:
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B - OM = Baseline funding level for Operations and Maintenance of Capital Projects
B - CP = Baseline funding level for Capital Projects
1 -OM = Moderate funding level for Operations and Maintenance of Capital Projects
1- CP = Moderate funding level - Capital Projects
2 - CP = High funding level - Capital Projects

Table 4-12: Branch 200 of Judicial Ditch 11 (Lost River) Structural Practice Implementation Schedule

Location: Branch 200 of JD 11 (Lost River) Planning Region																									
Priority Tier 2 Planning Region																									
Action Level	PTMApp Treatment Group	Implementation Action: Structural Practices	Measurable Output	Metric	Estimated Cost	Timeline					Implementation Responsibility		Measurable Goals												
						2020-21	2022-23	2024-25	2026-27	2028-29	Lead Entity	Partner	MGC 3.2.1	MGC 3.2.2	MGC 3.2.3	MGC 3.2.4	MGC 3.2.5	MGC 3.2.6	MGC 3.2.7	MGC 3.2.8	MGC 3.2.9	MGC 3.2.10	MGC 3.2.11	MGC 3.2.12	MGC 3.2.13
B	*Filtration*	Implement practices (e.g. filter strips, grassed waterways) within priority locations that reduce bacteria, sediment, and nutrient loading to waterbodies by treating surface and shallow-surface runoff before entering ditches and streams	21 tons/yr. sediment 5 lbs./yr. TP reduction	annual tons sediment and lbs.TP load reduction	$7,786		x	x			SWCD/WD	BWSR, DNR, NRCS, Landowners		x	x	x	x	x	x	x	x				x
B	*Protection*	Implement grade stabilization practices to provide protection from sediment loading, reduce bacteria and nutrient loading to waterbodies, and maintain stability and function of drainage ditches and streams	27 tons/yr. sediment 10 lbs./yr. TP reduction	annual tons sediment and lbs.TP load reduction	$90,785			x	x	x	SWCD/WD	BWSR, DNR, NRCS, Landowners		x	x	x		x			x				x
B	*Storage*	Implement and maintain BMPs that provide runoff reduction for flood mitigation as well as reduce sediment and TP load for aquatic life	22 tons/yr. sediment; 6 lbs./yr. TP reduction	annual tons sediment and lbs.TP load reduction	$15,829			x	x		SWCD/WD	BWSR, DNR, NRCS, Landowners		x	x	x	x	x							x
1	*Protection*	Implement additional grade stabilization practices to provide protection from sediment loading, reduce bacteria and nutrient loading to waterbodies, and maintain stability and function of drainage ditches and streams	142 tons/yr. sediment; 42 lbs./yr. TP reduction	annual tons sediment and lbs.TP load reduction	$629,220			x	x	x	SWCD/WD	BWSR, DNR, NRCS, Landowners		x	x	x		x			x				x

Measurable Goal Key:
3.2.1: Drinking Water – Reduce Nitrate Contamination
3.2.2: Aquatic Life and Aquatic Recreation – Reduce Sediment and Phosphorus Delivery and Load
3.2.3: Aquatic Life and Aquatic Recreation – Reduce Bacteria Delivery and Load
3.2.4: Aquatic Life and Aquatic Recreation – Increase Dissolved Oxygen Concentration
3.2.5: Surface Runoff and Flooding – Reduce Damages from Peak Flows and Overland Flooding
3.2.6: Drainage Management Systems – Erosion and Sedimentation Reduction
3.2.7: Shoreland and Riparian Areas – Improve and Increase Vegetative Cover
3.2.8: Habitat for Wildlife – Enhance Connectivity and Cover
3.2.9: Aquatic Habitat for Fish, Macroinvertebrates and Aquatic Life – Restore Connectivity, Habitat, Moderated Flow Regimes and Promoted Vegetated Banks and Buffers
3.2.10: Public Knowledge of and Behavior Related to Water Resources – Increase Stakeholder Participation
3.2.11: Data Collection – Enhance Knowledge of Baseline Conditions
3.2.12: Healthy Rural Landscapes – Improve Agricultural Soil Health
3.2.13 Healthy Rural Landscapes – Reduce Surface and Groundwater Contamination

Location: Branch 200 of JD 11 (Lost River) Planning Region																										
Priority Tier 2 Planning Region																										
						Timeline					Implementation Responsibility		Measurable Goals													
Action Level	PTMApp Treatment Group	Implementation Action: Structural Practices	Measurable Output	Metric	Estimated Cost	2020-21	2022-23	2024-25	2026-27	2028-29	Lead Entity	Partner	MGC 3.2.1	MGC 3.2.2	MGC 3.2.3	MGC 3.2.4	MGC 3.2.5	MGC 3.2.6	MGC 3.2.7	MGC 3.2.8	MGC 3.2.9	MGC 3.2.10	MGC 3.2.11	MGC 3.2.12	MGC 3.2.13
2	*Infiltration*	Implement practices (e.g. multi-stage ditch) to treat surface drainage runoff for nutrients (e.g. nitrogen and phosphorus) and sediment and to reduce runoff volume	92 tons/yr. sediment; 10 lbs./yr. TP reduction	annual tons sediment and lbs.TP load reduction	*N/A: Action Level 2 Implementation Funding Required*						SWCD/WD	BWSR, DNR, NRCS, Landowners		x	x	x	x	x	x	x	x				x
	Filtration	Implement additional practices (e.g. riparian herbaceous cover) that provide perennial vegetative cover within riparian corridors	3 tons/yr. sediment; 1 lbs./yr. TP reduction	annual tons sediment and lbs.TP load reduction	*N/A: Action Level 2 Implementation Funding Required*						SWCD/WD	BWSR, DNR, NRCS, Landowners		x	x	x	x	x	x	x	x				x
	Protection	Implement additional grade stabilization practices to provide protection from sediment loading, reduce bacteria and nutrient loading to waterbodies, and maintain stability and function of drainage ditches and streams	90 tons/yr. sediment; 30 lbs./yr. TP reduction	annual tons sediment and lbs.TP load reduction	*N/A: Action Level 2 Implementation Funding Required*						SWCD/WD	BWSR, DNR, NRCS, Landowners		x	x	x		x			x				x
	Storage	Implement and maintain additional BMPs that provide runoff reduction for flood mitigation as well as reduce sediment and TP load for aquatic life	6 tons/yr. sediment; 2 lbs./yr. TP reduction	annual tons sediment and lbs.TP load reduction	*N/A: Action Level 2 Implementation Funding Required*						SWCD/WD	BWSR, DNR, NRCS, Landowners		x	x	x	x	x							x

Measurable Goal Key:
3.2.1: Drinking Water – Reduce Nitrate Contamination
3.2.2: Aquatic Life and Aquatic Recreation – Reduce Sediment and Phosphorus Delivery and Load
3.2.3: Aquatic Life and Aquatic Recreation – Reduce Bacteria Delivery and Load
3.2.4: Aquatic Life and Aquatic Recreation – Increase Dissolved Oxygen Concentration
3.2.5: Surface Runoff and Flooding – Reduce Damages from Peak Flows and Overland Flooding
3.2.6: Drainage Management Systems – Erosion and Sedimentation Reduction
3.2.7: Shoreland and Riparian Areas – Improve and Increase Vegetative Cover
3.2.8: Habitat for Wildlife – Enhance Connectivity and Cover
3.2.9: Aquatic Habitat for Fish, Macroinvertebrates and Aquatic Life – Restore Connectivity, Habitat, Moderated Flow Regimes and Promoted Vegetated Banks and Buffers
3.2.10: Public Knowledge of and Behavior Related to Water Resources – Increase Stakeholder Participation
3.2.11: Data Collection – Enhance Knowledge of Baseline Conditions
3.2.12: Healthy Rural Landscapes – Improve Agricultural Soil Health
3.2.13 Healthy Rural Landscapes – Reduce Surface and Groundwater Contamination

Table 4-13: Branch 200 of Judicial Ditch 11 (Lost River) Management Practice Implementation Schedule

Location: Branch 200 of JD 11 (Lost River) Planning Region																									
Priority Tier 2 Planning Region																									
						Timeline					Implementation Responsibilities		Measurable Goals												
Action Level	PTMApp Treatment Group	Implementation Actions: Management Practices	Measurable Output	Metric	Estimated Cost	2020-21	2022-23	2024-25	2026-27	2028-29	Lead Entity	Partner	MGC 3.2.1	MGC 3.2.2	MGC 3.2.3	MGC 3.2.4	MGC 3.2.5	MGC 3.2.6	MGC 3.2.7	MGC 3.2.8	MGC 3.2.9	MGC 3.2.10	MGC 3.2.11	MGC 3.2.12	MGC 3.2.13
B	*Source Reduction*	Implement practices that are focused on and maintain soil health, including but not limited to conservation tillage and residue management, crop rotation methods, and/or the use of cover crops	2,464 acres with management practices; 400 tons/yr. sediment reduction; 178 lbs./yr. TP load reduction	# acres; annual tons sediment and lbs. TP load reduction	$78,251	x	x	x	x	x	SWCD	MDA, NRCS, Crop Advisors, Landowners		x		x	x	x	x		x			x	x
1	*Source Reduction*	Implement additional practices which are focused on and maintain soil health, including but not limited to conservation tillage and residue management, crop rotation methods, and/or the use of cover crops	1,071 acres with management practices; 151 tons/yr. sediment reduction; 60 lbs./yr. TP load reduction	# acres; annual tons sediment and lbs. TP load reduction	$33,076	x	x	x	x	x	SWCD	MDA, NRCS, Crop Advisors, Landowners		x		x	x	x	x		x			x	x

Measurable Goal Key:
3.2.1: Drinking Water – Reduce Nitrate Contamination
3.2.2: Aquatic Life and Aquatic Recreation – Reduce Sediment and Phosphorus Delivery and Load
3.2.3: Aquatic Life and Aquatic Recreation – Reduce Bacteria Delivery and Load
3.2.4: Aquatic Life and Aquatic Recreation – Increase Dissolved Oxygen Concentration
3.2.5: Surface Runoff and Flooding – Reduce Damages from Peak Flows and Overland Flooding
3.2.6: Drainage Management Systems – Erosion and Sedimentation Reduction
3.2.7: Shoreland and Riparian Areas – Improve and Increase Vegetative Cover
3.2.8: Habitat for Wildlife – Enhance Connectivity and Cover
3.2.9: Aquatic Habitat for Fish, Macroinvertebrates and Aquatic Life – Restore Connectivity, Habitat, Moderated Flow Regimes and Promoted Vegetated Banks and Buffers
3.2.10: Public Knowledge of and Behavior Related to Water Resources – Increase Stakeholder Participation
3.2.11: Data Collection – Enhance Knowledge of Baseline Conditions
3.2.12: Healthy Rural Landscapes – Improve Agricultural Soil Health
3.2.13 Healthy Rural Landscapes – Reduce Surface and Groundwater Contamination

Table 4-14: Branch 200 of Judicial Ditch 11 (Lost River) Projects and Practices Summary

Branch 200 of Judicial Ditch 11 (Lost River) Projects and Practices Summary				
Priority Tier 2 Planning Region				
Action Level	**PTMApp Treatment Group**	**# Practices**	**Sediment Load Reduction (tons/yr.)**	**Total Phosphorus Load Reduction (lbs./yr.)**
Baseline	Filtration	5	21	5
	Protection	10	27	10
	Storage	5	22	6
	Source Reduction	70	438	178
	Total	***90***	***508***	***198***
Level 1	Protection	39	142	42
	Source Reduction	25	151	60
	Total	***64***	***293***	***102***
Level 2	Infiltration	14	92	10
	Filtration	2	3	1
	Protection	52	90	30
	Storage	7	6	2
	Total	***75***	***191***	***43***
	Grand Total	**229**	**992**	**343**

Measurable Goal Key:
3.2.1: Drinking Water – Reduce Nitrate Contamination
3.2.2: Aquatic Life and Aquatic Recreation – Reduce Sediment and Phosphorus Delivery and Load
3.2.3: Aquatic Life and Aquatic Recreation – Reduce Bacteria Delivery and Load
3.2.4: Aquatic Life and Aquatic Recreation – Increase Dissolved Oxygen Concentration
3.2.5: Surface Runoff and Flooding – Reduce Damages from Peak Flows and Overland Flooding
3.2.6: Drainage Management Systems – Erosion and Sedimentation Reduction
3.2.7: Shoreland and Riparian Areas – Improve and Increase Vegetative Cover
3.2.8: Habitat for Wildlife – Enhance Connectivity and Cover
3.2.9: Aquatic Habitat for Fish, Macroinvertebrates and Aquatic Life – Restore Connectivity, Habitat, Moderated Flow Regimes and Promoted Vegetated Banks and Buffers
3.2.10: Public Knowledge of and Behavior Related to Water Resources – Increase Stakeholder Participation
3.2.11: Data Collection – Enhance Knowledge of Baseline Conditions
3.2.12: Healthy Rural Landscapes – Improve Agricultural Soil Health
3.2.13 Healthy Rural Landscapes – Reduce Surface and Groundwater Contamination

Table 4-15: Branch 200 of Judicial Ditch 11 (Lost River) Capital Projects Implementation Schedule

Location: Branch 200 of JD11 (Lost River) Planning Region																								
Priority Tier 2 Planning Region																								
					Timeline					Implementation Responsibility		Measurable Goals												
Action Level	Implementation Action: Capital Improvement/ Operations and Maintenance	Measurable Output	Metric	Estimated Cost	2020-21	2022-23	2024-25	2026-27	2028-29	Lead Entity	Partner	MGC 3.2.1	MGC 3.2.2	MGC 3.2.3	MGC 3.2.4	MGC 3.2.5	MGC 3.2.6	MGC 3.2.7	MGC 3.2.8	MGC 3.2.9	MGC 3.2.10	MGC 3.2.11	MGC 3.2.12	MGC 3.2.13
B – OM	Maintain public drainage infrastructure to provide adequate drainage while minimizing upstream and downstream flood damages and impacts on water quality	51 miles of drainage infrastructure maintained	miles	$20,000	x	x	x	x	x	Drainage Authorities	DNR, MPCA, SCWD, City, MnDOT, ACOE		x			x	x			x				
B – CP	Implement a series of runoff reduction BMPs to reduce average annual runoff by 0.125 inches	% progress towards 438 acre-feet runoff reduction goal	acre-feet runoff reduction	$101,277			x	x	x	WD	RRWMB, DNR, BWSR		x			x	x		x	x				x
1 – OM	Maintain ditch systems in accordance with multi-purpose drainage goals as stated in MS 103E.015	51 miles of drainage infrastructure maintained	miles	$70,000	x	x	x	x	x	Drainage Authorities	SWCD, BWSR, DNR		x			x	x	x		x				x
1 – CP	Continue to implement a series of runoff reduction BMPs to reduce average annual runoff by 0.125 inches	% progress towards 438 acre-feet runoff reduction goal	acre-feet runoff reduction	$1,000,000			x	x	x	WD	RRWMB, DNR, BWSR		x			x	x		x	x				x
2 – CP	Protect the natural meandering of streams and promote the restoration/repair of straightened streams/ditches to maintain stream/ditch capacity for reducing flood impacts and enhancing recreational, agricultural, and fish and wildlife habitat value	*N/A: Action Level 2 Implementation Funding Required*								County/WD	DNR, SWCD, USFWS, TNC		x	x	x	x	x	x	x	x				x

B - OM = Baseline funding level for Operations and Maintenance of Capital Projects
B - CP = Baseline funding level for Capital Projects
1 -OM = Moderate funding level for Operations and Maintenance of Capital Projects
1- CP = Moderate funding level - Capital Projects
2 - CP = High funding level - Capital Projects

Measurable Goal Key:
3.2.1: Drinking Water – Reduce Nitrate Contamination
3.2.2: Aquatic Life and Aquatic Recreation – Reduce Sediment and Phosphorus Delivery and Load
3.2.3: Aquatic Life and Aquatic Recreation – Reduce Bacteria Delivery and Load
3.2.4: Aquatic Life and Aquatic Recreation – Increase Dissolved Oxygen Concentration
3.2.5: Surface Runoff and Flooding – Reduce Damages from Peak Flows and Overland Flooding
3.2.6: Drainage Management Systems – Erosion and Sedimentation Reduction
3.2.7: Shoreland and Riparian Areas – Improve and Increase Vegetative Cover
3.2.8: Habitat for Wildlife – Enhance Connectivity and Cover
3.2.9: Aquatic Habitat for Fish, Macroinvertebrates and Aquatic Life – Restore Connectivity, Habitat, Moderated Flow Regimes and Promoted Vegetated Banks and Buffers
3.2.10: Public Knowledge of and Behavior Related to Water Resources – Increase Stakeholder Participation
3.2.11: Data Collection – Enhance Knowledge of Baseline Conditions
3.2.12: Healthy Rural Landscapes – Improve Agricultural Soil Health
3.2.13 Healthy Rural Landscapes – Reduce Surface and Groundwater Contamination

Table 4-16: Lower Thief River/SD 83 Structural Practice Implementation Schedule

Location: Lower Thief River/SD 83 Planning Region																									
Priority Tier 1 Planning Region																									
Action Level	PTMApp Treatment Group	Implementation Action: Structural Practices	Measurable Output	Metric	Estimated Cost	Timeline					Implementation Responsibility		Measurable Goals												
						2020-21	2022-23	2024-25	2026-27	2028-29	Lead Entity	Partner	MGC 3.2.1	MGC 3.2.2	MGC 3.2.3	MGC 3.2.4	MGC 3.2.5	MGC 3.2.6	MGC 3.2.7	MGC 3.2.8	MGC 3.2.9	MGC 3.2.10	MGC 3.2.11	MGC 3.2.12	MGC 3.2.13
B	*Filtration*	Implement practices (e.g. filter strips, grassed waterways) within priority locations that reduce bacteria, sediment, and nutrient loading to waterbodies by treating surface and shallow-surface runoff before entering ditches and streams	800 tons/yr. sediment 162 lbs./yr. TP	annual tons sediment and lbs.TP load reduction	$100,732	x	x				SWCD/WD	BWSR, DNR, NRCS, Landowners		x	x	x	x	x	x	x	x				x
B	*Protection*	Implement grade stabilization practices to provide protection from sediment loading, reduce bacteria and nutrient loading to waterbodies, and maintain stability and function of drainage ditches and streams	15 tons/yr. sediment 1 lbs./yr. TP	annual tons sediment and lbs.TP load reduction	$3,477	x	x							x	x	x		x			x				x
B	*Storage*	Implement and maintain BMPs that provide runoff reduction for flood mitigation as well as reduce sediment and TP load for aquatic life	207 tons/yr. sediment; 44 lbs./yr. TP	annual tons sediment and lbs.TP load reduction	$59,716	x	x				SWCD/WD	BWSR, DNR, NRCS, Landowners		x	x	x	x	x							x
1	*Filtration*	Implement practices (e.g. riparian herbaceous cover) that provide perennial vegetative cover within riparian corridors	227 tons/yr. sediment; 53 lbs./yr. TP reduction;	annual tons sediment and lbs.TP load reduction	$118,101	x	x	x			SWCD/WD	BWSR, DNR, NRCS, Landowners		x	x	x	x	x	x	x	x				x

Measurable Goal Key:
3.2.1: Drinking Water – Reduce Nitrate Contamination
3.2.2: Aquatic Life and Aquatic Recreation – Reduce Sediment and Phosphorus Delivery and Load
3.2.3: Aquatic Life and Aquatic Recreation – Reduce Bacteria Delivery and Load
3.2.4: Aquatic Life and Aquatic Recreation – Increase Dissolved Oxygen Concentration
3.2.5: Surface Runoff and Flooding – Reduce Damages from Peak Flows and Overland Flooding
3.2.6: Drainage Management Systems – Erosion and Sedimentation Reduction
3.2.7: Shoreland and Riparian Areas – Improve and Increase Vegetative Cover
3.2.8: Habitat for Wildlife – Enhance Connectivity and Cover
3.2.9: Aquatic Habitat for Fish, Macroinvertebrates and Aquatic Life – Restore Connectivity, Habitat, Moderated Flow Regimes and Promoted Vegetated Banks and Buffers
3.2.10: Public Knowledge of and Behavior Related to Water Resources – Increase Stakeholder Participation
3.2.11: Data Collection – Enhance Knowledge of Baseline Conditions
3.2.12: Healthy Rural Landscapes – Improve Agricultural Soil Health
3.2.13 Healthy Rural Landscapes – Reduce Surface and Groundwater Contamination

Location: Lower Thief River/SD 83 Planning Region																									
Priority Tier 1 Planning Region																									
Action Level	PTMApp Treatment Group	Implementation Action: Structural Practices	Measurable Output	Metric	Estimated Cost	Timeline					Implementation Responsibility		Measurable Goals												
						2020-21	2022-23	2024-25	2026-27	2028-29	Lead Entity	Partner	MGC 3.2.1	MGC 3.2.2	MGC 3.2.3	MGC 3.2.4	MGC 3.2.5	MGC 3.2.6	MGC 3.2.7	MGC 3.2.8	MGC 3.2.9	MGC 3.2.10	MGC 3.2.11	MGC 3.2.12	MGC 3.2.13
	Storage	Implement and maintain additional BMPs that provide runoff reduction for flood mitigation as well as reduce sediment and TP load for aquatic life	3,662 tons/yr. sediment; 957 lbs./yr. TP reduction;	annual tons sediment and lbs.TP load reduction	$2,086,246	x	x	x			SWCD/WD	BWSR, DNR, NRCS, Landowners		x	x	x	x	x							x
2	*Biofiltration*	Implement practices (e.g. saturated buffers) to treat subsurface drainage runoff for nutrients (e.g. nitrogen and phosphorus)	74 tons/yr. sediment; 37 lbs./yr. TP reduction	annual tons sediment and lbs.TP load reduction	*N/A: Action Level 2 Implementation Funding Required*						SWCD/WD	BWSR, DNR, NRCS, Landowners		x	x	x	x	x	x	x	x				x
2	*Filtration*	Implement additional practices (e.g. riparian herbaceous cover) that provide perennial vegetative cover within riparian corridors.	60 tons/yr. sediment; 11 lbs./yr. TP reduction	annual tons sediment and lbs.TP load reduction	*N/A: Action Level 2 Implementation Funding Required*						SWCD/WD	BWSR, DNR, NRCS, Landowners		x	x	x	x	x	x	x	x				x
2	*Protection*	Implement additional grade stabilization practices to provide protection from sediment loading, reduce bacteria and nutrient loading to waterbodies, and maintain stability and function of drainage ditches and streams	2,212 tons/yr. sediment; 792 lbs./yr. TP reduction	annual tons sediment and lbs.TP load reduction	*N/A: Action Level 2 Implementation Funding Required*						SWCD/WD	BWSR, DNR, NRCS, Landowners		x	x	x		x			x				x
2	*Storage*	Implement and maintain additional BMPs that provide runoff reduction for flood mitigation as well as reduce sediment and TP load for aquatic life	1,312 tons/yr. sediment; 360 lbs./yr. TP reduction	annual tons sediment and lbs.TP load reduction	*N/A: Action Level 2 Implementation Funding Required*						SWCD/WD	BWSR, DNR, NRCS, Landowners		x	x	x	x	x							x

Measurable Goal Key:
3.2.1: Drinking Water – Reduce Nitrate Contamination
3.2.2: Aquatic Life and Aquatic Recreation – Reduce Sediment and Phosphorus Delivery and Load
3.2.3: Aquatic Life and Aquatic Recreation – Reduce Bacteria Delivery and Load
3.2.4: Aquatic Life and Aquatic Recreation – Increase Dissolved Oxygen Concentration
3.2.5: Surface Runoff and Flooding – Reduce Damages from Peak Flows and Overland Flooding
3.2.6: Drainage Management Systems – Erosion and Sedimentation Reduction
3.2.7: Shoreland and Riparian Areas – Improve and Increase Vegetative Cover
3.2.8: Habitat for Wildlife – Enhance Connectivity and Cover
3.2.9: Aquatic Habitat for Fish, Macroinvertebrates and Aquatic Life – Restore Connectivity, Habitat, Moderated Flow Regimes and Promoted Vegetated Banks and Buffers
3.2.10: Public Knowledge of and Behavior Related to Water Resources – Increase Stakeholder Participation
3.2.11: Data Collection – Enhance Knowledge of Baseline Conditions
3.2.12: Healthy Rural Landscapes – Improve Agricultural Soil Health
3.2.13 Healthy Rural Landscapes – Reduce Surface and Groundwater Contamination

Table 4-17: Lower Thief River/SD 83 Management Practice Implementation Schedule

Location: Lower Thief River/SD 83 Planning Region																									
Priority Tier 1 Planning Region																									
						Timeline					**Implementation Responsibilities**		**Measurable Goals**												
Action Level	**PTMApp Treatment Group**	**Implementation Actions: Management Practices**	**Measurable Output**	**Metric**	**Estimated Cost**	**2020-21**	**2022-23**	**2024-25**	**2026-27**	**2028-29**	**Lead Entity**	**Partner**	**MGC 3.2.1**	**MGC 3.2.2**	**MGC 3.2.3**	**MGC 3.2.4**	**MGC 3.2.5**	**MGC 3.2.6**	**MGC 3.2.7**	**MGC 3.2.8**	**MGC 3.2.9**	**MGC 3.2.10**	**MGC 3.2.11**	**MGC 3.2.12**	**MGC 3.2.13**
B	***Source Reduction***	Implement practices that are focused on and maintain soil health, including but not limited to conservation tillage and residue management, crop rotation methods, and/or the use of cover crops	2,490 acres with management practices; 1,428 tons/yr. sediment reduction; 269 lbs./yr. TP load reduction	# acres; annual tons sediment and lbs. TP load reduction	$76,858	x	x				SWCD	MDA, NRCS, Crop Advisors, Landowner		x		x	x	x	x		x			x	x
1	***Source Reduction***	Implement additional practices that are focused on and maintain soil health, including but not limited to conservation tillage and residue management, crop rotation methods, and/or the use of cover crops	7,939 acres with management practices; 1,957 tons/yr. sediment reduction; 1,208 lbs./yr. TP load reduction	# acres; annual tons sediment and lbs. TP load reduction	$245,067	x	x	x			SWCD	MDA, NRCS, Crop Advisors, Landowner		x		x	x	x	x		x			x	x
2	***Source Reduction***	Implement additional practices that are focused on and maintain soil health, including but not limited to conservation tillage and residue management, crop rotation methods, and/or the use of cover crops	11,608 acres with management practices; 3,101 tons/yr. sediment reduction; 1,380 lbs./yr. TP load reduction	# acres; annual tons sediment and lbs. TP load reduction	*N/A: Action Level 2 Implementation Funding Required*						SWCD	MDA, NRCS, Crop Advisors, Landowner		x		x	x	x	x		x			x	x

Measurable Goal Key:
3.2.1: Drinking Water – Reduce Nitrate Contamination
3.2.2: Aquatic Life and Aquatic Recreation – Reduce Sediment and Phosphorus Delivery and Load
3.2.3: Aquatic Life and Aquatic Recreation – Reduce Bacteria Delivery and Load
3.2.4: Aquatic Life and Aquatic Recreation – Increase Dissolved Oxygen Concentration
3.2.5: Surface Runoff and Flooding – Reduce Damages from Peak Flows and Overland Flooding
3.2.6: Drainage Management Systems – Erosion and Sedimentation Reduction
3.2.7: Shoreland and Riparian Areas – Improve and Increase Vegetative Cover
3.2.8: Habitat for Wildlife – Enhance Connectivity and Cover
3.2.9: Aquatic Habitat for Fish, Macroinvertebrates and Aquatic Life – Restore Connectivity, Habitat, Moderated Flow Regimes and Promoted Vegetated Banks and Buffers
3.2.10: Public Knowledge of and Behavior Related to Water Resources – Increase Stakeholder Participation
3.2.11: Data Collection – Enhance Knowledge of Baseline Conditions
3.2.12: Healthy Rural Landscapes – Improve Agricultural Soil Health
3.2.13 Healthy Rural Landscapes – Reduce Surface and Groundwater Contamination

Table 4-18: Lower Thief River/SD 83 Projects and Practices Summary

Lower Thief River/SD 83 Projects and Practices Summary				
Priority Tier 1 Planning Region				
Action Level	**PTMApp Treatment Group**	**# Practices**	**Sediment Load Reduction (tons/yr.)**	**Total Phosphorus Load Reduction (lbs./yr.)**
Baseline	Filtration	87	800	162
	Protection	2	15	1
	Storage	27	207	44
	Source Reduction	106	1,428	269
	Total	***222***	***2,450***	***476***
Level 1	Filtration	59	227	53
	Storage	633	3,662	957
	Source Reduction	208	1,957	1,208
	Total	***900***	***5,846***	***2,218***
Level 2	Biofiltration	6	74	37
	Filtration	20	60	11
	Protection	451	2,212	792
	Storage	296	1,312	360
	Source Reduction	331	3,101	1,380
	Total	***1,104***	***6,759***	***2,580***
Grand Total		2,226	15,055	5,274

Measurable Goal Key:
3.2.1: Drinking Water – Reduce Nitrate Contamination
3.2.2: Aquatic Life and Aquatic Recreation – Reduce Sediment and Phosphorus Delivery and Load
3.2.3: Aquatic Life and Aquatic Recreation – Reduce Bacteria Delivery and Load
3.2.4: Aquatic Life and Aquatic Recreation – Increase Dissolved Oxygen Concentration
3.2.5: Surface Runoff and Flooding – Reduce Damages from Peak Flows and Overland Flooding
3.2.6: Drainage Management Systems – Erosion and Sedimentation Reduction
3.2.7: Shoreland and Riparian Areas – Improve and Increase Vegetative Cover
3.2.8: Habitat for Wildlife – Enhance Connectivity and Cover
3.2.9: Aquatic Habitat for Fish, Macroinvertebrates and Aquatic Life – Restore Connectivity, Habitat, Moderated Flow Regimes and Promoted Vegetated Banks and Buffers
3.2.10: Public Knowledge of and Behavior Related to Water Resources – Increase Stakeholder Participation
3.2.11: Data Collection – Enhance Knowledge of Baseline Conditions
3.2.12: Healthy Rural Landscapes – Improve Agricultural Soil Health
3.2.13 Healthy Rural Landscapes – Reduce Surface and Groundwater Contamination

Table 4-19: Lower Thief River/SD 83 Capital Projects Implementation Schedule

Location: Lower Thief River/SD 83 Planning Region																									
Priority Tier 1 Planning Region																									
					Timeline					Implementation Responsibility		Measurable Goals													
Action Level	Implementation Action: Capital Improvement/ Operations and Maintenance	Measurable Output	Metric	Estimated Cost	2020-21	2022-23	2024-25	2026-27	2028-29	Lead Entity	Partner	MGC 3.2.1	MGC 3.2.2	MGC 3.2.3	MGC 3.2.4	MGC 3.2.5	MGC 3.2.6	MGC 3.2.7	MGC 3.2.8	MGC 3.2.9	MGC 3.2.10	MGC 3.2.11	MGC 3.2.12	MGC 3.2.13
B – OM	Maintain public drainage infrastructure to provide adequate drainage while minimizing upstream and downstream flood damages and impacts on water quality	108 miles of drainage infrastructure maintained	miles	$42,198	x	x	x	x	x	Drainage Authorities	DNR, MPCA, SCWD, City, MnDOT, ACOE		x			x	x			x				
B – CP	Implement a series of runoff reduction BMPs to reduce average annual runoff by 0.125 inches	% progress towards 650 acre-feet runoff reduction	acre-feet runoff reduction	$126,596	x	x				WD	RRWMB, DNR, BWSR		x			x	x		x	x				x
1 – OM	Maintain ditch systems in accordance with multi-purpose drainage goals as stated in MS 103E.015	108 miles of drainage infrastructure maintained	miles	$150,000	x	x	x	x	x	Drainage Authorities	SWCD, BWSR, DNR		x			x	x	x		x				x
1 – CP	Stabilize actively eroding riverbanks between Agassiz NWR and Thief River Falls	0.5 miles bank stabilized	miles	$300,000	x	x	x			County/WD	DNR, SWCD, USFWS, TNC	x	x	x			x	x	x	x				
1 – CP	Continue to implement a series of runoff reduction BMPs to reduce average annual runoff by 0.125 inches	% progress towards 650 acre-feet runoff reduction	acre-feet runoff reduction	$3,000,000	x	x	x			WD	RRWMB, DNR, BWSR		x			x	x		x	x				x
2 – CP	Protect the natural meandering of streams and promote the restoration/repair of straightened streams/ditches to maintain stream/ditch capacity for reducing flood impacts and enhancing recreational, agricultural, and fish and wildlife habitat value	*N/A: Action Level 2 Implementation Funding Required*								County/WD	DNR, SWCD, USFWS, TNC		x	x	x	x	x	x	x	x				x

B - OM = Baseline funding level for Operations and Maintenance of Capital Projects
B - CP = Baseline funding level for Capital Projects
1 -OM = Moderate funding level for Operations and Maintenance of Capital Projects
1- CP = Moderate funding level - Capital Projects
2 - CP = High funding level - Capital Projects

Measurable Goal Key:
3.2.1: Drinking Water – Reduce Nitrate Contamination
3.2.2: Aquatic Life and Aquatic Recreation – Reduce Sediment and Phosphorus Delivery and Load
3.2.3: Aquatic Life and Aquatic Recreation – Reduce Bacteria Delivery and Load
3.2.4: Aquatic Life and Aquatic Recreation – Increase Dissolved Oxygen Concentration
3.2.5: Surface Runoff and Flooding – Reduce Damages from Peak Flows and Overland Flooding
3.2.6: Drainage Management Systems – Erosion and Sedimentation Reduction
3.2.7: Shoreland and Riparian Areas – Improve and Increase Vegetative Cover
3.2.8: Habitat for Wildlife – Enhance Connectivity and Cover
3.2.9: Aquatic Habitat for Fish, Macroinvertebrates and Aquatic Life – Restore Connectivity, Habitat, Moderated Flow Regimes and Promoted Vegetated Banks and Buffers
3.2.10: Public Knowledge of and Behavior Related to Water Resources – Increase Stakeholder Participation
3.2.11: Data Collection – Enhance Knowledge of Baseline Conditions
3.2.12: Healthy Rural Landscapes – Improve Agricultural Soil Health
3.2.13 Healthy Rural Landscapes – Reduce Surface and Groundwater Contamination

Table 4-20: Marshall County Ditch 20 Structural Practice Implementation Schedule

Location: Marshall County Ditch 20 Planning Region																										
Priority Tier 1 Planning Region																										
						Timeline					Implementation Responsibility		Measurable Goals													
Action Level	PTMApp Treatment Group	Implementation Action: Structural Practices	Measurable Output	Metric	Estimated Cost	2020-21	2022-23	2024-25	2026-27	2028-29	Lead Entity	Partner	MGC 3.2.1	MGC 3.2.2	MGC 3.2.3	MGC 3.2.4	MGC 3.2.5	MGC 3.2.6	MGC 3.2.7	MGC 3.2.8	MGC 3.2.9	MGC 3.2.10	MGC 3.2.11	MGC 3.2.12	MGC 3.2.13
B	*Filtration*	Implement practices (e.g. filter strips, grassed waterways) within priority locations that reduce bacteria, sediment, and nutrient loading to waterbodies by treating surface and shallow-surface runoff before entering ditches and streams	476 tons/yr. sediment 96 lbs./yr. TP	annual tons sediment and lbs.TP load reduction	$57,692	x	x				SWCD/WD	BWSR, DNR, NRCS, Landowners		x	x	x	x	x	x	x	x				x
B	*Storage*	Implement and maintain BMPs that provide runoff reduction for flood mitigation as well as reduce sediment and TP load for aquatic life.	187 tons/yr. sediment 41 lbs./yr. TP	annual tons sediment and lbs.TP load reduction	$59,940	x	x				SWCD/WD	BWSR, DNR, NRCS, Landowners		x	x	x	x	x							x

Measurable Goal Key:
3.2.1: Drinking Water – Reduce Nitrate Contamination
3.2.2: Aquatic Life and Aquatic Recreation – Reduce Sediment and Phosphorus Delivery and Load
3.2.3: Aquatic Life and Aquatic Recreation – Reduce Bacteria Delivery and Load
3.2.4: Aquatic Life and Aquatic Recreation – Increase Dissolved Oxygen Concentration
3.2.5: Surface Runoff and Flooding – Reduce Damages from Peak Flows and Overland Flooding
3.2.6: Drainage Management Systems – Erosion and Sedimentation Reduction
3.2.7: Shoreland and Riparian Areas – Improve and Increase Vegetative Cover
3.2.8: Habitat for Wildlife – Enhance Connectivity and Cover
3.2.9: Aquatic Habitat for Fish, Macroinvertebrates and Aquatic Life – Restore Connectivity, Habitat, Moderated Flow Regimes and Promoted Vegetated Banks and Buffers
3.2.10: Public Knowledge of and Behavior Related to Water Resources – Increase Stakeholder Participation
3.2.11: Data Collection – Enhance Knowledge of Baseline Conditions
3.2.12: Healthy Rural Landscapes – Improve Agricultural Soil Health
3.2.13 Healthy Rural Landscapes – Reduce Surface and Groundwater Contamination

Location: Marshall County Ditch 20 Planning Region

Priority Tier 1 Planning Region

Action Level	PTMApp Treatment Group	Implementation Action: Structural Practices	Measurable Output	Metric	Estimated Cost	Timeline					Implementation Responsibility		Measurable Goals												
						2020-21	2022-23	2024-25	2026-27	2028-29	Lead Entity	Partner	MGC 3.2.1	MGC 3.2.2	MGC 3.2.3	MGC 3.2.4	MGC 3.2.5	MGC 3.2.6	MGC 3.2.7	MGC 3.2.8	MGC 3.2.9	MGC 3.2.10	MGC 3.2.11	MGC 3.2.12	MGC 3.2.13
1	*Filtration*	Implement practices (e.g. riparian herbaceous cover) that provide perennial vegetative cover within riparian corridors	43 tons/yr. sediment 10 lbs./yr. TP	annual tons sediment and lbs.TP load reduction	$22,243	x	x	x			SWCD/WD	BWSR, DNR, NRCS, Landowners		x	x	x	x	x	x	x	x				x
	Storage	Implement and maintain additional BMPs that provide runoff reduction for flood mitigation as well as reduce sediment and TP load for aquatic life	920 tons/yr. sediment 218 lbs./yr. TP	annual tons sediment and lbs.TP load reduction	$601,992	x	x	x			SWCD/WD	BWSR, DNR, NRCS, Landowners		x	x	x	x	x							x
	Protection	Implement grade stabilization practices to provide protection from sediment loading, reduce bacteria and nutrient loading to waterbodies, and maintain stability and function of drainage ditches and streams	31 tons/yr. sediment 17 lbs./yr. TP	annual tons sediment and lbs.TP load reduction	$80,646	x	x	x	x	x	SWCD/WD	BWSR, DNR, NRCS, Landowners		x	x	x		x			x				x

Measurable Goal Key:
3.2.1: Drinking Water – Reduce Nitrate Contamination
3.2.2: Aquatic Life and Aquatic Recreation – Reduce Sediment and Phosphorus Delivery and Load
3.2.3: Aquatic Life and Aquatic Recreation – Reduce Bacteria Delivery and Load
3.2.4: Aquatic Life and Aquatic Recreation – Increase Dissolved Oxygen Concentration
3.2.5: Surface Runoff and Flooding – Reduce Damages from Peak Flows and Overland Flooding
3.2.6: Drainage Management Systems – Erosion and Sedimentation Reduction
3.2.7: Shoreland and Riparian Areas – Improve and Increase Vegetative Cover
3.2.8: Habitat for Wildlife – Enhance Connectivity and Cover
3.2.9: Aquatic Habitat for Fish, Macroinvertebrates and Aquatic Life – Restore Connectivity, Habitat, Moderated Flow Regimes and Promoted Vegetated Banks and Buffers
3.2.10: Public Knowledge of and Behavior Related to Water Resources – Increase Stakeholder Participation
3.2.11: Data Collection – Enhance Knowledge of Baseline Conditions
3.2.12: Healthy Rural Landscapes – Improve Agricultural Soil Health
3.2.13 Healthy Rural Landscapes – Reduce Surface and Groundwater Contamination

Table 4-21: Marshall County Ditch 20 Management Practice Implementation Schedule

Location: Marshall County Ditch 20 Planning Region																									
Priority Tier 1 Planning Region																									
Action Level	PTMApp Treatment Group	Implementation Actions: Management Practices	Measurable Output	Metric	Estimated Cost	Timeline					Implementation Responsibilities		Measurable Goals												
						2020-21	2022-23	2024-25	2026-27	2028-29	Lead Entity	Partner	MGC 3.2.1	MGC 3.2.2	MGC 3.2.3	MGC 3.2.4	MGC 3.2.5	MGC 3.2.6	MGC 3.2.7	MGC 3.2.8	MGC 3.2.9	MGC 3.2.10	MGC 3.2.11	MGC 3.2.12	MGC 3.2.13
B	*Source Reduction*	Implement practices that are focused on and maintain soil health, including but not limited to conservation tillage and residue management, crop rotation methods, and/or the use of cover crops	3,943 acres with management practices; 1,106 tons/yr. sediment reduction; 510 lbs./yr. TP load reduction	# acres; annual tons sediment and lbs. TP load reduction	$121,716	x	x				SWCD	MDA, NRCS, Crop Advisors, Landowner		x		x	x	x	x		x			x	x
1	*Source Reduction*	Implement additional practices that are focused on and maintain soil health, including but not limited to conservation tillage and residue management, crop rotation methods, and/or the use of cover crops	2,055 acres with management practices; 603 tons/yr. sediment reduction; 248 lbs./yr. TP load reduction	# acres; Annual tons Sediment and lbs. TP load reduction	$63,436	x	x	x			SWCD	MDA, NRCS, Crop Advisors, Landowner		x		x	x	x	x		x			x	x

Measurable Goal Key:
3.2.1: Drinking Water – Reduce Nitrate Contamination
3.2.2: Aquatic Life and Aquatic Recreation – Reduce Sediment and Phosphorus Delivery and Load
3.2.3: Aquatic Life and Aquatic Recreation – Reduce Bacteria Delivery and Load
3.2.4: Aquatic Life and Aquatic Recreation – Increase Dissolved Oxygen Concentration
3.2.5: Surface Runoff and Flooding – Reduce Damages from Peak Flows and Overland Flooding
3.2.6: Drainage Management Systems – Erosion and Sedimentation Reduction
3.2.7: Shoreland and Riparian Areas – Improve and Increase Vegetative Cover
3.2.8: Habitat for Wildlife – Enhance Connectivity and Cover
3.2.9: Aquatic Habitat for Fish, Macroinvertebrates and Aquatic Life – Restore Connectivity, Habitat, Moderated Flow Regimes and Promoted Vegetated Banks and Buffers
3.2.10: Public Knowledge of and Behavior Related to Water Resources – Increase Stakeholder Participation
3.2.11: Data Collection – Enhance Knowledge of Baseline Conditions
3.2.12: Healthy Rural Landscapes – Improve Agricultural Soil Health
3.2.13 Healthy Rural Landscapes – Reduce Surface and Groundwater Contamination

Table 4-22: Marshall County Ditch 20 Projects and Practices Summary

Marshall County Ditch 20 Projects and Practices Summary				
Priority Tier 1 Planning Region				
Action Level	**PTMApp Treatment Group**	**# Practices**	**Sediment Load Reduction (tons/yr.)**	**Total Phosphorus Load Reduction (lbs./yr.)**
Baseline	Filtration	37	476	96
	Storage	35	187	41
	Source Reduction	125	1,106	510
	Total	***197***	***1,769***	***647***
Level 1	Filtration	7	43	10
	Storage	164	920	218
	Protection	12	31	17
	Source Reduction	46	603	248
	Total	***229***	***1,597***	***493***
	Grand Total	**426**	**3,366**	**1,140**

Measurable Goal Key:
3.2.1: Drinking Water – Reduce Nitrate Contamination
3.2.2: Aquatic Life and Aquatic Recreation – Reduce Sediment and Phosphorus Delivery and Load
3.2.3: Aquatic Life and Aquatic Recreation – Reduce Bacteria Delivery and Load
3.2.4: Aquatic Life and Aquatic Recreation – Increase Dissolved Oxygen Concentration
3.2.5: Surface Runoff and Flooding – Reduce Damages from Peak Flows and Overland Flooding
3.2.6: Drainage Management Systems – Erosion and Sedimentation Reduction
3.2.7: Shoreland and Riparian Areas – Improve and Increase Vegetative Cover
3.2.8: Habitat for Wildlife – Enhance Connectivity and Cover
3.2.9: Aquatic Habitat for Fish, Macroinvertebrates and Aquatic Life – Restore Connectivity, Habitat, Moderated Flow Regimes and Promoted Vegetated Banks and Buffers
3.2.10: Public Knowledge of and Behavior Related to Water Resources – Increase Stakeholder Participation
3.2.11: Data Collection – Enhance Knowledge of Baseline Conditions
3.2.12: Healthy Rural Landscapes – Improve Agricultural Soil Health
3.2.13 Healthy Rural Landscapes – Reduce Surface and Groundwater Contamination

Table 4-23: Marshall County Ditch 20 Capital Projects Implementation Schedule

Location: Marshall County Ditch 20 Planning Region

Priority Tier 1 Planning Region

Action Level	Implementation Action: Capital Improvement/ Operations and Maintenance	Measurable Output	Metric	Estimated Cost	Timeline 2020-21	2022-23	2024-25	2026-27	2028-29	Implementation Responsibility Lead Entity	Partner	Measurable Goals MGC 3.2.1	MGC 3.2.2	MGC 3.2.3	MGC 3.2.4	MGC 3.2.5	MGC 3.2.6	MGC 3.2.7	MGC 3.2.8	MGC 3.2.9	MGC 3.2.10	MGC 3.2.11	MGC 3.2.12	MGC 3.2.13
B – OM	Maintain public drainage infrastructure to provide adequate drainage while minimizing upstream and downstream flood damages and impacts on water quality	120 miles of drainage infrastructure maintained	miles	$42,198	x	x	x	x	x	Drainage Authorities	DNR, MPCA, SCWD, City, MnDOT, ACOE		x			x	x			x				
B – CP	Implement a series of runoff reduction BMPs to reduce average annual runoff by 0.125 inches	% progress towards 1400 acre-feet runoff reduction goal	acre-feet runoff reduction	$126,596	x	x				WD	RRWMB, DNR, BWSR		x			x	x		x	x				x
1 – OM	Maintain ditch systems in accordance with multi-purpose drainage goals as stated in MS 103E.015	120 miles of drainage infrastructure maintained	miles	$120,000	x	x	x	x	x	Drainage Authorities	SWCD, BWSR, DNR		x			x	x	x		x				x
1 – CP	Continue to implement a series of runoff reduction BMPs to reduce average annual runoff by 0.125 inches	% progress towards 1400 acre-feet runoff reduction goal	acre-feet runoff reduction	$3,000,000	x	x	x	x	x	WD	RRWMB, DNR, BWSR		x			x	x		x	x				x
2 – CP	Protect the natural meandering of streams and promote the restoration/repair of straightened streams/ditches to maintain stream/ditch capacity for reducing flood impacts and enhancing recreational, agricultural, and fish and wildlife habitat value	*N/A: Action Level 2 Implementation Funding Required*								County/WD	DNR, SWCD, USFWS, TNC		x	x	x	x	x	x	x	x				x

B - OM = Baseline funding level for Operations and Maintenance of Capital Projects
B - CP = Baseline funding level for Capital Projects
1 -OM = Moderate funding level for Operations and Maintenance of Capital Projects
1- CP = Moderate funding level - Capital Projects
2 - CP = High funding level - Capital Projects

Measurable Goal Key:
3.2.1: Drinking Water – Reduce Nitrate Contamination
3.2.2: Aquatic Life and Aquatic Recreation – Reduce Sediment and Phosphorus Delivery and Load
3.2.3: Aquatic Life and Aquatic Recreation – Reduce Bacteria Delivery and Load
3.2.4: Aquatic Life and Aquatic Recreation – Increase Dissolved Oxygen Concentration
3.2.5: Surface Runoff and Flooding – Reduce Damages from Peak Flows and Overland Flooding
3.2.6: Drainage Management Systems – Erosion and Sedimentation Reduction
3.2.7: Shoreland and Riparian Areas – Improve and Increase Vegetative Cover
3.2.8: Habitat for Wildlife – Enhance Connectivity and Cover
3.2.9: Aquatic Habitat for Fish, Macroinvertebrates and Aquatic Life – Restore Connectivity, Habitat, Moderated Flow Regimes and Promoted Vegetated Banks and Buffers
3.2.10: Public Knowledge of and Behavior Related to Water Resources – Increase Stakeholder Participation
3.2.11: Data Collection – Enhance Knowledge of Baseline Conditions
3.2.12: Healthy Rural Landscapes – Improve Agricultural Soil Health
3.2.13 Healthy Rural Landscapes – Reduce Surface and Groundwater Contamination

Table 4-24: Middle Thief River/SD 83 Structural Practice Implementation Schedule

Location: Middle Thief River/SD 83 Planning Region																								
Priority Tier 3 Planning Region																								
Action Level	PTMApp Treatment Group	Implementation Action: Structural Practices	Measurable Output	Metric	Estimated Cost	Timeline					Implementation Responsibility		Measurable Goals												
						2020-21	2022-23	2024-25	2026-27	2028-29	Lead Entity	Partner	MGC 3.2.1	MGC 3.2.2	MGC 3.2.3	MGC 3.2.4	MGC 3.2.5	MGC 3.2.6	MGC 3.2.7	MGC 3.2.8	MGC 3.2.9	MGC 3.2.10	MGC 3.2.11	MGC 3.2.12	MGC 3.2.13
B	*Filtration*	Implement practices (e.g. filter strips, grassed waterways) within priority locations that reduce bacteria, sediment, and nutrient loading to waterbodies by treating surface and shallow-surface runoff before entering ditches and streams	131 tons/yr. sediment 25 lbs./yr. TP	annual tons sediment and lbs.TP load reduction	$34,726			x	x	x	SWCD/WD	BWSR, DNR, NRCS, Landowners		x	x	x	x	x	x	x	x				x

Measurable Goal Key:
3.2.1: Drinking Water – Reduce Nitrate Contamination
3.2.2: Aquatic Life and Aquatic Recreation – Reduce Sediment and Phosphorus Delivery and Load
3.2.3: Aquatic Life and Aquatic Recreation – Reduce Bacteria Delivery and Load
3.2.4: Aquatic Life and Aquatic Recreation – Increase Dissolved Oxygen Concentration
3.2.5: Surface Runoff and Flooding – Reduce Damages from Peak Flows and Overland Flooding
3.2.6: Drainage Management Systems – Erosion and Sedimentation Reduction
3.2.7: Shoreland and Riparian Areas – Improve and Increase Vegetative Cover
3.2.8: Habitat for Wildlife – Enhance Connectivity and Cover
3.2.9: Aquatic Habitat for Fish, Macroinvertebrates and Aquatic Life – Restore Connectivity, Habitat, Moderated Flow Regimes and Promoted Vegetated Banks and Buffers
3.2.10: Public Knowledge of and Behavior Related to Water Resources – Increase Stakeholder Participation
3.2.11: Data Collection – Enhance Knowledge of Baseline Conditions
3.2.12: Healthy Rural Landscapes – Improve Agricultural Soil Health
3.2.13 Healthy Rural Landscapes – Reduce Surface and Groundwater Contamination

Location: Middle Thief River/SD 83 Planning Region

Priority Tier 3 Planning Region

Action Level	PTMApp Treatment Group	Implementation Action: Structural Practices	Measurable Output	Metric	Estimated Cost	Timeline					Implementation Responsibility		Measurable Goals												
						2020-21	2022-23	2024-25	2026-27	2028-29	Lead Entity	Partner	MGC 3.2.1	MGC 3.2.2	MGC 3.2.3	MGC 3.2.4	MGC 3.2.5	MGC 3.2.6	MGC 3.2.7	MGC 3.2.8	MGC 3.2.9	MGC 3.2.10	MGC 3.2.11	MGC 3.2.12	MGC 3.2.13
	Storage	Implement and maintain BMPs that provide runoff reduction for flood mitigation as well as reduce sediment and TP load for aquatic life	1 tons/yr. sediment; 0 lbs./yr. TP	annual tons sediment and lbs.TP load reduction	$445				x	x	SWCD/WD	BWSR, DNR, NRCS, Landowners		x	x	x	x	x							x
1	*Filtration*	Implement practices (e.g. riparian herbaceous cover) that provide perennial vegetative cover within riparian corridors (10)	63 tons/yr. sediment; 20 lbs./yr. TP	annual tons sediment and lbs.TP load reduction	$73,564				x	x	SWCD/WD	BWSR, DNR, NRCS, Landowners		x	x	x	x	x	x	x	x				x
	Storage	Implement and maintain additional BMPs that provide runoff reduction for flood mitigation as well as reduce sediment and TP load for aquatic life (18)	221 tons/yr. sediment; 59 lbs./yr. TP	annual tons sediment and lbs.TP load reduction	$692,197				x	x	SWCD/WD	BWSR, DNR, NRCS, Landowners		x	x	x	x	x							x

Measurable Goal Key:
3.2.1: Drinking Water – Reduce Nitrate Contamination
3.2.2: Aquatic Life and Aquatic Recreation – Reduce Sediment and Phosphorus Delivery and Load
3.2.3: Aquatic Life and Aquatic Recreation – Reduce Bacteria Delivery and Load
3.2.4: Aquatic Life and Aquatic Recreation – Increase Dissolved Oxygen Concentration
3.2.5: Surface Runoff and Flooding – Reduce Damages from Peak Flows and Overland Flooding
3.2.6: Drainage Management Systems – Erosion and Sedimentation Reduction
3.2.7: Shoreland and Riparian Areas – Improve and Increase Vegetative Cover
3.2.8: Habitat for Wildlife – Enhance Connectivity and Cover
3.2.9: Aquatic Habitat for Fish, Macroinvertebrates and Aquatic Life – Restore Connectivity, Habitat, Moderated Flow Regimes and Promoted Vegetated Banks and Buffers
3.2.10: Public Knowledge of and Behavior Related to Water Resources – Increase Stakeholder Participation
3.2.11: Data Collection – Enhance Knowledge of Baseline Conditions
3.2.12: Healthy Rural Landscapes – Improve Agricultural Soil Health
3.2.13 Healthy Rural Landscapes – Reduce Surface and Groundwater Contamination

Location: Middle Thief River/SD 83 Planning Region																									
Priority Tier 3 Planning Region																									
						Timeline					Implementation Responsibility		Measurable Goals												
Action Level	PTMApp Treatment Group	Implementation Action: Structural Practices	Measurable Output	Metric	Estimated Cost	2020-21	2022-23	2024-25	2026-27	2028-29	Lead Entity	Partner	MGC 3.2.1	MGC 3.2.2	MGC 3.2.3	MGC 3.2.4	MGC 3.2.5	MGC 3.2.6	MGC 3.2.7	MGC 3.2.8	MGC 3.2.9	MGC 3.2.10	MGC 3.2.11	MGC 3.2.12	MGC 3.2.13
2	***Biofiltration***	Implement practices (e.g. saturated buffers) to treat subsurface drainage runoff for nutrients (e.g. nitrogen and phosphorus)	22 tons/yr. sediment; 13 lbs./yr. TP	annual tons sediment and lbs.TP load reduction	*N/A: Action Level 2 Implementation Funding Required*						SWCD/WD	BWSR, DNR, NRCS, Landowners		x	x	x	x	x	x	x	x				x
	Infiltration	Implement practices (e.g. multi-stage ditch) to treat surface drainage runoff for nutrients (e.g. nitrogen and phosphorus) and sediment and to reduce runoff volume	212 tons/yr. sediment; 23 lbs./yr. TP reduction	annual tons sediment and lbs.TP load reduction	*N/A: Action Level 2 Implementation Funding Required*						SWCD/WD	BWSR, DNR, NRCS, Landowners		x	x	x	x	x	x	x	x				x
	Protection	Implement grade stabilization practices to provide protection from sediment loading, reduce bacteria and nutrient loading to waterbodies, and maintain stability and function of drainage ditches and streams	1,185 tons/yr. sediment; 423 lbs./yr. TP	annual tons sediment and lbs.TP load reduction	*N/A: Action Level 2 Implementation Funding Required*						SWCD/WD	BWSR, DNR, NRCS, Landowners, USFWS		x	x	x		x			x				x

Measurable Goal Key:
3.2.1: Drinking Water – Reduce Nitrate Contamination
3.2.2: Aquatic Life and Aquatic Recreation – Reduce Sediment and Phosphorus Delivery and Load
3.2.3: Aquatic Life and Aquatic Recreation – Reduce Bacteria Delivery and Load
3.2.4: Aquatic Life and Aquatic Recreation – Increase Dissolved Oxygen Concentration
3.2.5: Surface Runoff and Flooding – Reduce Damages from Peak Flows and Overland Flooding
3.2.6: Drainage Management Systems – Erosion and Sedimentation Reduction
3.2.7: Shoreland and Riparian Areas – Improve and Increase Vegetative Cover
3.2.8: Habitat for Wildlife – Enhance Connectivity and Cover
3.2.9: Aquatic Habitat for Fish, Macroinvertebrates and Aquatic Life – Restore Connectivity, Habitat, Moderated Flow Regimes and Promoted Vegetated Banks and Buffers
3.2.10: Public Knowledge of and Behavior Related to Water Resources – Increase Stakeholder Participation
3.2.11: Data Collection – Enhance Knowledge of Baseline Conditions
3.2.12: Healthy Rural Landscapes – Improve Agricultural Soil Health
3.2.13 Healthy Rural Landscapes – Reduce Surface and Groundwater Contamination

Table 4-25: Middle Thief River/SD 83 Management Practice Implementation Schedule

Location: Middle Thief River/SD 83 Planning Region

Priority Tier 3 Planning Region

Action Level	PTMApp Treatment Group	Implementation Actions: Management Practices	Measurable Output	Metric	Estimated Cost	Timeline					Implementation Responsibilities		Measurable Goals												
						2020-21	2022-23	2024-25	2026-27	2028-29	Lead Entity	Partner	MGC 3.2.1	MGC 3.2.2	MGC 3.2.3	MGC 3.2.4	MGC 3.2.5	MGC 3.2.6	MGC 3.2.7	MGC 3.2.8	MGC 3.2.9	MGC 3.2.10	MGC 3.2.11	MGC 3.2.12	MGC 3.2.13
B	***Source Reduction***	Implement practices that are focused on and maintain soil health, including but not limited to conservation tillage and residue management, crop rotation methods, and/or the use of cover crops	1,200 acres with management practices; 247 tons/yr. sediment reduction; 59 lbs./yr. TP load reduction	# acres; annual tons sediment and lbs. TP load reduction	$37,059				x	x	SWCD	MDA, NRCS, Crop Advisors, Landowner		x		x	x	x	x		x			x	x
1	***Source Reduction***	Implement additional practices that are focused on and maintain soil health, including but not limited to conservation tillage and residue management, crop rotation methods, and/or the use of cover crops	10,145 acres with management practices; 1,152 tons/yr. sediment reduction; 512 lbs./yr. TP load reduction	# acres; annual tons sediment and lbs. TP load reduction	$313,166				x	x	SWCD	MDA, NRCS, Crop Advisors, Landowner		x		x	x	x	x		x			x	x
2	***Source Reduction***	Implement additional practices that are focused on and maintain soil health, including but not limited to conservation tillage and residue management, crop rotation methods, and/or the use of cover crops	25,529 acres with management practices; 2,387 tons/yr. sediment reduction; 1,330 lbs./yr. TP load reduction	# acres; annual tons sediment and lbs. TP load reduction	*N/A: Action Level 2 Implementation Funding Required*						SWCD	MDA, NRCS, Crop Advisors, Landowner		x		x	x	x	x		x			x	x

Measurable Goal Key:
3.2.1: Drinking Water – Reduce Nitrate Contamination
3.2.2: Aquatic Life and Aquatic Recreation – Reduce Sediment and Phosphorus Delivery and Load
3.2.3: Aquatic Life and Aquatic Recreation – Reduce Bacteria Delivery and Load
3.2.4: Aquatic Life and Aquatic Recreation – Increase Dissolved Oxygen Concentration
3.2.5: Surface Runoff and Flooding – Reduce Damages from Peak Flows and Overland Flooding
3.2.6: Drainage Management Systems – Erosion and Sedimentation Reduction
3.2.7: Shoreland and Riparian Areas – Improve and Increase Vegetative Cover
3.2.8: Habitat for Wildlife – Enhance Connectivity and Cover
3.2.9: Aquatic Habitat for Fish, Macroinvertebrates and Aquatic Life – Restore Connectivity, Habitat, Moderated Flow Regimes and Promoted Vegetated Banks and Buffers
3.2.10: Public Knowledge of and Behavior Related to Water Resources – Increase Stakeholder Participation
3.2.11: Data Collection – Enhance Knowledge of Baseline Conditions
3.2.12: Healthy Rural Landscapes – Improve Agricultural Soil Health
3.2.13 Healthy Rural Landscapes – Reduce Surface and Groundwater Contamination

Table 4-26: Middle Thief River/SD 83 Projects and Practices Summary

Middle Thief River/SD 83 Projects and Practices Summary				
Priority Tier 3 Planning Region				
Action Level	**PTMApp Treatment Group**	**# Practices**	**Sediment Load Reduction (tons/yr.)**	**Total Phosphorus Load Reduction (lbs./yr.)**
Baseline	Filtration	31	131	25
	Storage	1	1	0
	Source Reduction	49	247	59
	Total	***81***	***379***	***84***
Level 1	Filtration	29	63	20
	Storage	75	221	59
	Source Reduction	279	1,152	512
	Total	***383***	***1,436***	***591***
Level 2	Biofiltration	9	22	13
	Infiltration	28	212	23
	Protection	536	1,185	423
	Source Reduction	704	2,387	1,330
	Total	***1,277***	***3,806***	***1,789***
	Grand Total	1,741	5,620	2,464

Measurable Goal Key:
3.2.1: Drinking Water – Reduce Nitrate Contamination
3.2.2: Aquatic Life and Aquatic Recreation – Reduce Sediment and Phosphorus Delivery and Load
3.2.3: Aquatic Life and Aquatic Recreation – Reduce Bacteria Delivery and Load
3.2.4: Aquatic Life and Aquatic Recreation – Increase Dissolved Oxygen Concentration
3.2.5: Surface Runoff and Flooding – Reduce Damages from Peak Flows and Overland Flooding
3.2.6: Drainage Management Systems – Erosion and Sedimentation Reduction
3.2.7: Shoreland and Riparian Areas – Improve and Increase Vegetative Cover
3.2.8: Habitat for Wildlife – Enhance Connectivity and Cover
3.2.9: Aquatic Habitat for Fish, Macroinvertebrates and Aquatic Life – Restore Connectivity, Habitat, Moderated Flow Regimes and Promoted Vegetated Banks and Buffers
3.2.10: Public Knowledge of and Behavior Related to Water Resources – Increase Stakeholder Participation
3.2.11: Data Collection – Enhance Knowledge of Baseline Conditions
3.2.12: Healthy Rural Landscapes – Improve Agricultural Soil Health
3.2.13 Healthy Rural Landscapes – Reduce Surface and Groundwater Contamination

Table 4-27: Middle Thief River/SD 83 Capital Projects Implementation Schedule

Location: Middle Thief River/SD 83 Planning Region																								
Priority Tier 3 Planning Region																								
Action Level	Implementation Action: Capital Improvement/ Operations and Maintenance	Measurable Output	Metric	Estimated Cost	Timeline					Implementation Responsibility		Measurable Goals												
					2020-21	2022-23	2024-25	2026-27	2028-29	Lead Entity	Partner	MGC 3.2.1	MGC 3.2.2	MGC 3.2.3	MGC 3.2.4	MGC 3.2.5	MGC 3.2.6	MGC 3.2.7	MGC 3.2.8	MGC 3.2.9	MGC 3.2.10	MGC 3.2.11	MGC 3.2.12	MGC 3.2.13
B – OM	Maintain public drainage infrastructure to provide adequate drainage while minimizing upstream and downstream flood damages and impacts on water quality	150 miles of drainage infrastructure maintained	miles	$50,639	x	x	x	x	x	Drainage Authorities	DNR, MPCA, SCWD, City, MnDOT, ACOE		x		x	x	x			x				
2 – CP	Protect the natural meandering of streams and promote the restoration/repair of straightened streams/ditches to maintain stream/ditch capacity for reducing flood impacts and enhancing recreational, agricultural, and fish and wildlife habitat value	*N/A: Action Level 2 Implementation Funding Required*								County/WD	DNR, SWCD, USFWS, TNC		x	x	x	x	x	x	x	x				x

B - OM = Baseline funding level for Operations and Maintenance of Capital Projects	
B - CP = Baseline funding level for Capital Projects	
1 -OM = Moderate funding level for Operations and Maintenance of Capital Projects	
1- CP = Moderate funding level - Capital Projects	
2 - CP = High funding level - Capital Projects	

Measurable Goal Key:
3.2.1: Drinking Water – Reduce Nitrate Contamination
3.2.2: Aquatic Life and Aquatic Recreation – Reduce Sediment and Phosphorus Delivery and Load
3.2.3: Aquatic Life and Aquatic Recreation – Reduce Bacteria Delivery and Load
3.2.4: Aquatic Life and Aquatic Recreation – Increase Dissolved Oxygen Concentration
3.2.5: Surface Runoff and Flooding – Reduce Damages from Peak Flows and Overland Flooding
3.2.6: Drainage Management Systems – Erosion and Sedimentation Reduction
3.2.7: Shoreland and Riparian Areas – Improve and Increase Vegetative Cover
3.2.8: Habitat for Wildlife – Enhance Connectivity and Cover
3.2.9: Aquatic Habitat for Fish, Macroinvertebrates and Aquatic Life – Restore Connectivity, Habitat, Moderated Flow Regimes and Promoted Vegetated Banks and Buffers
3.2.10: Public Knowledge of and Behavior Related to Water Resources – Increase Stakeholder Participation
3.2.11: Data Collection – Enhance Knowledge of Baseline Conditions
3.2.12: Healthy Rural Landscapes – Improve Agricultural Soil Health
3.2.13 Healthy Rural Landscapes – Reduce Surface and Groundwater Contamination

Table 4-28: Moose River/JD 21 Structural Practice Implementation Schedule

Location: Moose River/JD 21 Planning Region																									
Priority Tier 3 Planning Region																									
Action Level	PTMApp Treatment Group	Implementation Action: Structural Practices	Measurable Output	Metric	Estimated Cost	Timeline					Implementation Responsibility		Measurable Goals												
						2020-21	2022-23	2024-25	2026-27	2028-29	Lead Entity	Partner	MGC 3.2.1	MGC 3.2.2	MGC 3.2.3	MGC 3.2.4	MGC 3.2.5	MGC 3.2.6	MGC 3.2.7	MGC 3.2.8	MGC 3.2.9	MGC 3.2.10	MGC 3.2.11	MGC 3.2.12	MGC 3.2.13
B	*Filtration*	Implement practices (e.g. filter strips, grassed waterways) within priority locations that reduce bacteria, sediment, and nutrient loading to waterbodies by treating surface and shallow-surface runoff before entering ditches and streams	109 tons/yr. sediment 47 lbs./yr. TP	annual tons sediment and lbs. TP load reduction	$22,961				x	x	SWCD/WD	BWSR, DNR, NRCS, Landowners		x	x	x	x	x	x	x	x				x
	Storage	Implement and maintain BMPs that provide runoff reduction for flood mitigation as well as reduce sediment and TP load for aquatic life	42 tons/yr. sediment 10 lbs./yr. TP	annual tons sediment and lbs. TP load reduction	$12,634				x	x	SWCD/WD	BWSR, DNR, NRCS, Landowners		x	x	x	x	x							x
1	*Filtration*	Implement practices (e.g. riparian herbaceous cover) that provide perennial vegetative cover within riparian corridors	18 tons/yr. sediment 6 lbs./yr. TP	annual tons sediment and lbs. TP load reduction	$12,605				x	x	SWCD/WD	BWSR, DNR, NRCS, Landowners		x	x	x	x	x	x	x	x				x

Measurable Goal Key:
3.2.1: Drinking Water – Reduce Nitrate Contamination
3.2.2: Aquatic Life and Aquatic Recreation – Reduce Sediment and Phosphorus Delivery and Load
3.2.3: Aquatic Life and Aquatic Recreation – Reduce Bacteria Delivery and Load
3.2.4: Aquatic Life and Aquatic Recreation – Increase Dissolved Oxygen Concentration
3.2.5: Surface Runoff and Flooding – Reduce Damages from Peak Flows and Overland Flooding
3.2.6: Drainage Management Systems – Erosion and Sedimentation Reduction
3.2.7: Shoreland and Riparian Areas – Improve and Increase Vegetative Cover
3.2.8: Habitat for Wildlife – Enhance Connectivity and Cover
3.2.9: Aquatic Habitat for Fish, Macroinvertebrates and Aquatic Life – Restore Connectivity, Habitat, Moderated Flow Regimes and Promoted Vegetated Banks and Buffers
3.2.10: Public Knowledge of and Behavior Related to Water Resources – Increase Stakeholder Participation
3.2.11: Data Collection – Enhance Knowledge of Baseline Conditions
3.2.12: Healthy Rural Landscapes – Improve Agricultural Soil Health
3.2.13 Healthy Rural Landscapes – Reduce Surface and Groundwater Contamination

Location: Moose River/JD 21 Planning Region																										
Priority Tier 3 Planning Region																										
						Timeline					Implementation Responsibility		Measurable Goals												
Action Level	PTMApp Treatment Group	Implementation Action: Structural Practices	Measurable Output	Metric	Estimated Cost	2020-21	2022-23	2024-25	2026-27	2028-29	Lead Entity	Partner	MGC 3.2.1	MGC 3.2.2	MGC 3.2.3	MGC 3.2.4	MGC 3.2.5	MGC 3.2.6	MGC 3.2.7	MGC 3.2.8	MGC 3.2.9	MGC 3.2.10	MGC 3.2.11	MGC 3.2.12	MGC 3.2.13
	Storage	Implement and maintain additional BMPs that provide runoff reduction for flood mitigation as well as reduce sediment and TP load for aquatic life	97 tons/yr. sediment 29 lbs./yr. TP	annual tons sediment and lbs. TP load reduction	$88,471				x	x	SWCD/WD	BWSR, DNR, NRCS, Landowners		x	x	x	x	x							x
	Protection	Implement grade stabilization practices to provide protection from sediment loading, reduce bacteria and nutrient loading to waterbodies, and maintain stability and function of drainage ditches and streams	287 tons/yr. sediment 115 lbs./yr. TP	annual tons sediment and lbs. TP load reduction	$792,519				x	x	SWCD/WD	BWSR, DNR, NRCS, Landowners		x	x	x		x			x				x
2	*Biofiltration*	Implement practices (e.g. saturated buffers) to treat subsurface drainage runoff for nutrients (e.g. nitrogen and phosphorus)	3 tons/yr. sediment 1 lbs./yr. TP	annual tons sediment and lbs. TP load reduction	*N/A: Action Level 2 Implementation Funding Required*						SWCD/WD	BWSR, DNR, NRCS, Landowners		x	x	x	x	x	x	x	x				x
2	*Infiltration*	Implement practices (e.g. multi-stage ditch) to treat surface drainage runoff for nutrients (e.g. nitrogen and phosphorus) and sediment and to reduce runoff volume	71 tons/yr. sediment 10 lbs./yr. TP	annual tons sediment and lbs. TP load reduction	*N/A: Action Level 2 Implementation Funding Required*						SWCD/WD	BWSR, DNR, NRCS, Landowners		x	x	x	x	x	x	x	x				x

Measurable Goal Key:
3.2.1: Drinking Water – Reduce Nitrate Contamination
3.2.2: Aquatic Life and Aquatic Recreation – Reduce Sediment and Phosphorus Delivery and Load
3.2.3: Aquatic Life and Aquatic Recreation – Reduce Bacteria Delivery and Load
3.2.4: Aquatic Life and Aquatic Recreation – Increase Dissolved Oxygen Concentration
3.2.5: Surface Runoff and Flooding – Reduce Damages from Peak Flows and Overland Flooding
3.2.6: Drainage Management Systems – Erosion and Sedimentation Reduction
3.2.7: Shoreland and Riparian Areas – Improve and Increase Vegetative Cover
3.2.8: Habitat for Wildlife – Enhance Connectivity and Cover
3.2.9: Aquatic Habitat for Fish, Macroinvertebrates and Aquatic Life – Restore Connectivity, Habitat, Moderated Flow Regimes and Promoted Vegetated Banks and Buffers
3.2.10: Public Knowledge of and Behavior Related to Water Resources – Increase Stakeholder Participation
3.2.11: Data Collection – Enhance Knowledge of Baseline Conditions
3.2.12: Healthy Rural Landscapes – Improve Agricultural Soil Health
3.2.13 Healthy Rural Landscapes – Reduce Surface and Groundwater Contamination

Location: Moose River/JD 21 Planning Region																										
Priority Tier 3 Planning Region																										
Action Level	PTMApp Treatment Group	Implementation Action: Structural Practices	Measurable Output	Metric	Estimated Cost	Timeline					Implementation Responsibility		Measurable Goals													
						2020-21	2022-23	2024-25	2026-27	2028-29	Lead Entity	Partner	MGC 3.2.1	MGC 3.2.2	MGC 3.2.3	MGC 3.2.4	MGC 3.2.5	MGC 3.2.6	MGC 3.2.7	MGC 3.2.8	MGC 3.2.9	MGC 3.2.10	MGC 3.2.11	MGC 3.2.12	MGC 3.2.13
	Protection	Implement additional grade stabilization practices to provide protection from sediment loading, reduce bacteria and nutrient loading to waterbodies, and maintain stability and function of drainage ditches and streams	439 tons/yr. sediment 119 lbs./yr. TP	annual tons sediment and lbs. TP load reduction	*N/A: Action Level 2 Implementation Funding Required*						SWCD/WD	BWSR, DNR, NRCS, Landowners		x	x	x		x			x				x
	Storage	Implement and maintain additional BMPs that provide runoff reduction for flood mitigation as well as reduce sediment and TP load for aquatic life	14 tons/yr. sediment 4 lbs./yr. TP	annual tons sediment and lbs. TP load reduction	*N/A: Action Level 2 Implementation Funding Required*						SWCD/WD	BWSR, DNR, NRCS, Landowners		x	x	x	x	x							x

Measurable Goal Key:
3.2.1: Drinking Water – Reduce Nitrate Contamination
3.2.2: Aquatic Life and Aquatic Recreation – Reduce Sediment and Phosphorus Delivery and Load
3.2.3: Aquatic Life and Aquatic Recreation – Reduce Bacteria Delivery and Load
3.2.4: Aquatic Life and Aquatic Recreation – Increase Dissolved Oxygen Concentration
3.2.5: Surface Runoff and Flooding – Reduce Damages from Peak Flows and Overland Flooding
3.2.6: Drainage Management Systems – Erosion and Sedimentation Reduction
3.2.7: Shoreland and Riparian Areas – Improve and Increase Vegetative Cover
3.2.8: Habitat for Wildlife – Enhance Connectivity and Cover
3.2.9: Aquatic Habitat for Fish, Macroinvertebrates and Aquatic Life – Restore Connectivity, Habitat, Moderated Flow Regimes and Promoted Vegetated Banks and Buffers
3.2.10: Public Knowledge of and Behavior Related to Water Resources – Increase Stakeholder Participation
3.2.11: Data Collection – Enhance Knowledge of Baseline Conditions
3.2.12: Healthy Rural Landscapes – Improve Agricultural Soil Health
3.2.13 Healthy Rural Landscapes – Reduce Surface and Groundwater Contamination

Table 4-29: Moose River/JD 21 Management Practice Implementation Schedule

Location: Moose River/JD 21 Planning Region																									
Priority Tier 3 Planning Region																									
						Timeline					Implementation Responsibilities		Measurable Goals												
Action Level	PTMApp Treatment Group	Implementation Actions: Management Practices	Measurable Output	Metric	Estimated Cost	2020-21	2022-23	2024-25	2026-27	2028-29	Lead Entity	Partner	MGC 3.2.1	MGC 3.2.2	MGC 3.2.3	MGC 3.2.4	MGC 3.2.5	MGC 3.2.6	MGC 3.2.7	MGC 3.2.8	MGC 3.2.9	MGC 3.2.10	MGC 3.2.11	MGC 3.2.12	MGC 3.2.13
B	*Source Reduction*	Implement practices that are focused on and maintain soil health, including but not limited to conservation tillage and residue management, crop rotation methods, and/or the use of cover crops	1,151 acres with management practices; 334 tons/yr. sediment reduction; 154 lbs./yr. TP load reduction	# acres; annual tons sediment and lbs. TP load reduction	$36,264				x	x	SWCD	MDA, NRCS, Crop Advisors, Landowner		x		x	x	x	x		x			x	x
1	*Source Reduction*	Implement additional practices that are focused on and maintain soil health, including but not limited to conservation tillage and residue management, crop rotation methods, and/or the use of cover crops	1,123 acres with management practices; 368 tons/yr. sediment reduction; 160 lbs./yr. TP load reduction	# acres; annual tons sediment and lbs. TP load reduction	$39,060				x	x	SWCD	MDA, NRCS, Crop Advisors, Landowner		x		x	x	x	x		x			x	x
2	*Source Reduction*	Implement additional practices that are focused on and maintain soil health, including but not limited to conservation tillage and residue management, crop rotation methods, and/or the use of cover crops	1,488 acres with management practices; 446 tons/yr. sediment reduction; 219 lbs./yr. TP load reduction	# acres; annual tons sediment and lbs. TP load reduction	*N/A: Action Level 2 Implementation Funding Required*						SWCD	MDA, NRCS, Crop Advisors, Landowner		x		x	x	x	x		x			x	x

Measurable Goal Key:
3.2.1: Drinking Water – Reduce Nitrate Contamination
3.2.2: Aquatic Life and Aquatic Recreation – Reduce Sediment and Phosphorus Delivery and Load
3.2.3: Aquatic Life and Aquatic Recreation – Reduce Bacteria Delivery and Load
3.2.4: Aquatic Life and Aquatic Recreation – Increase Dissolved Oxygen Concentration
3.2.5: Surface Runoff and Flooding – Reduce Damages from Peak Flows and Overland Flooding
3.2.6: Drainage Management Systems – Erosion and Sedimentation Reduction
3.2.7: Shoreland and Riparian Areas – Improve and Increase Vegetative Cover
3.2.8: Habitat for Wildlife – Enhance Connectivity and Cover
3.2.9: Aquatic Habitat for Fish, Macroinvertebrates and Aquatic Life – Restore Connectivity, Habitat, Moderated Flow Regimes and Promoted Vegetated Banks and Buffers
3.2.10: Public Knowledge of and Behavior Related to Water Resources – Increase Stakeholder Participation
3.2.11: Data Collection – Enhance Knowledge of Baseline Conditions
3.2.12: Healthy Rural Landscapes – Improve Agricultural Soil Health
3.2.13 Healthy Rural Landscapes – Reduce Surface and Groundwater Contamination

Table 4-30: Moose River/JD 21 Projects and Practices Summary

Moose River/JD 21 Projects and Practices Summary				
Priority Tier 3 Planning Region				
Action Level	**PTMApp Treatment Group**	**# Practices**	**Sediment Load Reduction (tons/yr.)**	**Total Phosphorus Load Reduction (lbs./yr.)**
Baseline	Filtration	18	109	47
	Storage	12	42	10
	Source Reduction	37	334	154
	Total	***67***	***485***	***211***
Level 1	Filtration	5	18	6
	Protection	67	287	115
	Storage	31	97	29
	Source Reduction	33	368	160
	Total	***136***	***770***	***310***
Level 2	Biofiltration	1	3	1
	Infiltration	6	71	10
	Protection	106	439	119
	Storage	15	14	4
	Source Reduction	48	446	219
	Total	***176***	***973***	***353***
	Grand Total	**379**	**2,228**	**874**

Measurable Goal Key:
3.2.1: Drinking Water – Reduce Nitrate Contamination
3.2.2: Aquatic Life and Aquatic Recreation – Reduce Sediment and Phosphorus Delivery and Load
3.2.3: Aquatic Life and Aquatic Recreation – Reduce Bacteria Delivery and Load
3.2.4: Aquatic Life and Aquatic Recreation – Increase Dissolved Oxygen Concentration
3.2.5: Surface Runoff and Flooding – Reduce Damages from Peak Flows and Overland Flooding
3.2.6: Drainage Management Systems – Erosion and Sedimentation Reduction
3.2.7: Shoreland and Riparian Areas – Improve and Increase Vegetative Cover
3.2.8: Habitat for Wildlife – Enhance Connectivity and Cover
3.2.9: Aquatic Habitat for Fish, Macroinvertebrates and Aquatic Life – Restore Connectivity, Habitat, Moderated Flow Regimes and Promoted Vegetated Banks and Buffers
3.2.10: Public Knowledge of and Behavior Related to Water Resources – Increase Stakeholder Participation
3.2.11: Data Collection – Enhance Knowledge of Baseline Conditions
3.2.12: Healthy Rural Landscapes – Improve Agricultural Soil Health
3.2.13 Healthy Rural Landscapes – Reduce Surface and Groundwater Contamination

Table 4-31: Moose River/JD 21 Capital Projects Implementation Schedule

Location: Moose River/JD 21 Planning Region																								
Priority Tier 3 Planning Region																								
Action Level	Implementation Action: Capital Improvement/Operations and Maintenance	Measurable Output	Metric	Estimated Cost	Timeline					Implementation Responsibility		Measurable Goals												
					2020-21	2022-23	2024-25	2026-27	2028-29	Lead Entity	Partner	MGC 3.2.1	MGC 3.2.2	MGC 3.2.3	MGC 3.2.4	MGC 3.2.5	MGC 3.2.6	MGC 3.2.7	MGC 3.2.8	MGC 3.2.9	MGC 3.2.10	MGC 3.2.11	MGC 3.2.12	MGC 3.2.13
B – OM	Maintain public drainage infrastructure to provide adequate drainage while minimizing upstream and downstream flood damages and impacts on water quality	20 miles of drainage infrastructure maintained	miles	$7,660	x	x	x	x	x	Drainage Authorities	DNR, MPCA, SCWD, City, MnDOT, ACOE		x			x	x			x				
	Review and revise operating plan for Moose River/JD 21 Impoundment to improve Moose River/JD 21 base flows	one revised plan	plan	$5,000	x	x				WD	DNR				x					x				
B – CP	Survey, design, and install grade control structures along the Moose River/JD 21 upstream of CSAH 54	package of three projects	# projects	$37,989				x	x	WD	RRWMB, DNR, BWSR		x	x	x		x			x				x
1 – OM	Maintain ditch systems in accordance with multi-purpose drainage goals as stated in MS 103E.015	120 miles of drainage infrastructure maintained	miles	$120,000				x	x	Drainage Authorities	SWCD, BWSR, DNR		x			x	x	x		x				x
1 – CP	Address bank sloughing along the Moose River/JD 21 upstream of CSAH #54 and downstream of the Moose River/JD 21 Impoundment	6.5 miles	miles	$500,000				x	x	Drainage Authorities	DNR, SWCD, USFWS, TNC		x	x	x		x			x				x
	Survey, design, and install additional grade control structures along the Moose River/JD 21 upstream of CSAH 54	package of 12 projects	# projects	$162,011				x	x	WD	RRWMB, DNR, BWSR		x	x	x		x			x				x
2 – CP	Protect the natural meandering of streams and promote the restoration/repair of straightened waterways to maintain stream/ditch capacity for reducing flood impacts and enhancing recreational and fish and wildlife habitat value.	*N/A: Action Level 2 Implementation Funding Required*								County/WD	DNR, SWCD, USFWS, TNC		x		x			x	x	x				x

B - OM = Baseline funding level for Operations and Maintenance of Capital Projects
B - CP = Baseline funding level for Capital Projects
1 -OM = Moderate funding level for Operations and Maintenance of Capital Projects
1- CP = Moderate funding level - Capital Projects
2 - CP = High funding level - Capital Projects

Measurable Goal Key:
3.2.1: Drinking Water – Reduce Nitrate Contamination
3.2.2: Aquatic Life and Aquatic Recreation – Reduce Sediment and Phosphorus Delivery and Load
3.2.3: Aquatic Life and Aquatic Recreation – Reduce Bacteria Delivery and Load
3.2.4: Aquatic Life and Aquatic Recreation – Increase Dissolved Oxygen Concentration
3.2.5: Surface Runoff and Flooding – Reduce Damages from Peak Flows and Overland Flooding
3.2.6: Drainage Management Systems – Erosion and Sedimentation Reduction
3.2.7: Shoreland and Riparian Areas – Improve and Increase Vegetative Cover
3.2.8: Habitat for Wildlife – Enhance Connectivity and Cover
3.2.9: Aquatic Habitat for Fish, Macroinvertebrates and Aquatic Life – Restore Connectivity, Habitat, Moderated Flow Regimes and Promoted Vegetated Banks and Buffers
3.2.10: Public Knowledge of and Behavior Related to Water Resources – Increase Stakeholder Participation
3.2.11: Data Collection – Enhance Knowledge of Baseline Conditions
3.2.12: Healthy Rural Landscapes – Improve Agricultural Soil Health
3.2.13 Healthy Rural Landscapes – Reduce Surface and Groundwater Contamination

Table 4-32: Mud River/JD 11 Structural Practice Implementation Schedule

Location: Mud River/JD 11 Planning Region																									
Priority Tier 1 Planning Region																									
Action Level	PTMApp Treatment Group	Implementation Action: Structural Practices	Measurable Output	Metric	Estimated Cost	Timeline					Implementation Responsibility		Measurable Goals												
						2020-21	2022-23	2024-25	2026-27	2028-29	Lead Entity	Partner	MGC 3.2.1	MGC 3.2.2	MGC 3.2.3	MGC 3.2.4	MGC 3.2.5	MGC 3.2.6	MGC 3.2.7	MGC 3.2.8	MGC 3.2.9	MGC 3.2.10	MGC 3.2.11	MGC 3.2.12	MGC 3.2.13
B	*Filtration*	Implement practices (e.g. filter strips, grassed waterways) within priority locations that reduce bacteria, sediment, and nutrient loading to waterbodies by treating surface and shallow-surface runoff before entering ditches and streams	375 tons/yr. sediment 87 lbs./yr. TP	annual tons sediment and lbs. TP load reduction	$66,956	x	x				SWCD/WD	BWSR, DNR, NRCS, Landowners		x	x	x	x	x	x	x	x				x
B	*Storage*	Implement and maintain BMPs that provide runoff reduction for flood mitigation as well as reduce sediment and TP load for aquatic life	159 tons/yr. sediment 37 lbs./yr. TP	annual tons sediment and lbs. TP load reduction	$54,921	x	x				SWCD/WD	BWSR, DNR, NRCS, Landowners		x	x	x	x	x							x
1	*Biofiltration*	Implement practices (e.g. saturated buffers) to treat subsurface drainage runoff for nutrients (e.g. nitrogen and phosphorus)	2 tons/yr. sediment 4 lbs./yr. TP	annual tons sediment and lbs. TP load reduction	$31,403	x	x	x			SWCD/WD	BWSR, DNR, NRCS, Landowners		x	x	x	x	x	x	x	x				x
1	*Filtration*	Implement practices (e.g. riparian herbaceous cover) that provide perennial vegetative cover within riparian corridors	52 tons/yr. sediment 15 lbs./yr. TP	annual tons sediment and lbs. TP load reduction	$30,321	x	x	x			SWCD/WD	BWSR, DNR, NRCS, Landowners		x	x	x	x	x	x	x	x				x
1	*Storage*	Implement and maintain additional BMPs that provide runoff reduction for flood mitigation as well as reduce sediment and TP load for aquatic life	246 tons/yr. sediment 71 lbs./yr. TP	annual tons sediment and lbs. TP load reduction	$234,758	x	x	x			SWCD/WD	BWSR, DNR, NRCS, Landowners		x	x	x	x	x							x

Measurable Goal Key:
3.2.1: Drinking Water – Reduce Nitrate Contamination
3.2.2: Aquatic Life and Aquatic Recreation – Reduce Sediment and Phosphorus Delivery and Load
3.2.3: Aquatic Life and Aquatic Recreation – Reduce Bacteria Delivery and Load
3.2.4: Aquatic Life and Aquatic Recreation – Increase Dissolved Oxygen Concentration
3.2.5: Surface Runoff and Flooding – Reduce Damages from Peak Flows and Overland Flooding
3.2.6: Drainage Management Systems – Erosion and Sedimentation Reduction
3.2.7: Shoreland and Riparian Areas – Improve and Increase Vegetative Cover
3.2.8: Habitat for Wildlife – Enhance Connectivity and Cover
3.2.9: Aquatic Habitat for Fish, Macroinvertebrates and Aquatic Life – Restore Connectivity, Habitat, Moderated Flow Regimes and Promoted Vegetated Banks and Buffers
3.2.10: Public Knowledge of and Behavior Related to Water Resources – Increase Stakeholder Participation
3.2.11: Data Collection – Enhance Knowledge of Baseline Conditions
3.2.12: Healthy Rural Landscapes – Improve Agricultural Soil Health
3.2.13 Healthy Rural Landscapes – Reduce Surface and Groundwater Contamination

Location: Mud River/JD 11 Planning Region

Priority Tier 1 Planning Region

Action Level	PTMApp Treatment Group	Implementation Action: Structural Practices	Measurable Output	Metric	Estimated Cost	Timeline					Implementation Responsibility		Measurable Goals												
						2020-21	2022-23	2024-25	2026-27	2028-29	Lead Entity	Partner	MGC 3.2.1	MGC 3.2.2	MGC 3.2.3	MGC 3.2.4	MGC 3.2.5	MGC 3.2.6	MGC 3.2.7	MGC 3.2.8	MGC 3.2.9	MGC 3.2.10	MGC 3.2.11	MGC 3.2.12	MGC 3.2.13
	Protection	Implement grade stabilization practices to provide protection from sediment loading, reduce bacteria and nutrient loading to waterbodies, and maintain stability and function of drainage ditches and streams	663 tons/yr. sediment 235 lbs./yr. TP	annual tons sediment and lbs. TP load reduction	$1,687,443	x	x	x			SWCD/WD	BWSR, DNR, NRCS, Landowners		x	x	x		x			x				x
2	*Biofiltration*	Implement additional practices (e.g. saturated buffers) to treat subsurface drainage runoff for nutrients (e.g. nitrogen and phosphorus)	15 tons/yr. sediment 8 lbs./yr. TP	annual tons sediment and lbs. TP load reduction	*N/A: Action Level 2 Implementation Funding Required*						SWCD/WD	BWSR, DNR, NRCS, Landowners		x	x	x	x	x	x	x	x				x
	Protection	Implement additional grade stabilization practices to provide protection from sediment loading, reduce bacteria and nutrient loading to waterbodies, and maintain stability and function of drainage ditches and streams	919 tons/yr. sediment 311 lbs./yr. TP	annual tons sediment and lbs. TP load reduction	*N/A: Action Level 2 Implementation Funding Required*						SWCD/WD	BWSR, DNR, NRCS, Landowners		x	x	x		x			x				x
	Storage	Implement and maintain additional BMPs that provide runoff reduction for flood mitigation as well as reduce sediment and TP load for aquatic life	25 tons/yr. sediment 6 lbs./yr. TP	annual tons sediment and lbs. TP load reduction	*N/A: Action Level 2 Implementation Funding Required*						SWCD/WD	BWSR, DNR, NRCS, Landowners		x	x	x	x	x							x

Measurable Goal Key:
3.2.1: Drinking Water – Reduce Nitrate Contamination
3.2.2: Aquatic Life and Aquatic Recreation – Reduce Sediment and Phosphorus Delivery and Load
3.2.3: Aquatic Life and Aquatic Recreation – Reduce Bacteria Delivery and Load
3.2.4: Aquatic Life and Aquatic Recreation – Increase Dissolved Oxygen Concentration
3.2.5: Surface Runoff and Flooding – Reduce Damages from Peak Flows and Overland Flooding
3.2.6: Drainage Management Systems – Erosion and Sedimentation Reduction
3.2.7: Shoreland and Riparian Areas – Improve and Increase Vegetative Cover
3.2.8: Habitat for Wildlife – Enhance Connectivity and Cover
3.2.9: Aquatic Habitat for Fish, Macroinvertebrates and Aquatic Life – Restore Connectivity, Habitat, Moderated Flow Regimes and Promoted Vegetated Banks and Buffers
3.2.10: Public Knowledge of and Behavior Related to Water Resources – Increase Stakeholder Participation
3.2.11: Data Collection – Enhance Knowledge of Baseline Conditions
3.2.12: Healthy Rural Landscapes – Improve Agricultural Soil Health
3.2.13 Healthy Rural Landscapes – Reduce Surface and Groundwater Contamination

Table 4-33: Mud River/JD 11 Management Practice Implementation Schedule

Location: Mud River/JD 11 Planning Region																									
Priority Tier 1 Planning Region																									
Action Level	PTMApp Treatment Group	Implementation Actions: Management Practices	Measurable Output	Metric	Estimated Cost	Timeline					Implementation Responsibilities		Measurable Goals												
						2020-21	2022-23	2024-25	2026-27	2028-29	Lead Entity	Partner	MGC 3.2.1	MGC 3.2.2	MGC 3.2.3	MGC 3.2.4	MGC 3.2.5	MGC 3.2.6	MGC 3.2.7	MGC 3.2.8	MGC 3.2.9	MGC 3.2.10	MGC 3.2.11	MGC 3.2.12	MGC 3.2.13
B	***Source Reduction***	Implement practices that are focused on and maintain soil health, including but not limited to conservation tillage and residue management, crop rotation methods, and/or the use of cover crops	3,883 acres with management practices; 1,276 tons/yr. sediment reduction; 451 lbs./yr. TP load reduction	# acres; annual tons sediment and lbs. TP load reduction	$119,854	x	x				SWCD	MDA, NRCS, Crop Advisors, Landowner		x		x	x	x	x		x			x	x
1	***Source Reduction***	Implement additional practices that are focused on and maintain soil health, including but not limited to conservation tillage and residue management, crop rotation methods, and/or the use of cover crops	3,003 acres with management practices; 765 tons/yr. sediment reduction; 331 lbs./yr. TP load reduction	# acres; annual tons sediment and lbs. TP load reduction	$92,702	x	x				SWCD	MDA, NRCS, Crop Advisors, Landowner		x		x	x	x	x		x			x	x
2	***Source Reduction***	Implement additional practices that are focused on and maintain soil health, including but not limited to conservation tillage and residue management, crop rotation methods, and/or the use of cover crops	3,066 acres with management practices; 683 tons/yr. sediment reduction; 328 lbs./yr. TP load reduction	# acres; annual tons sediment and lbs. TP load reduction	*N/A: Action Level 2 Implementation Funding Required*						SWCD	MDA, NRCS, Crop Advisors, Landowner		x		x	x	x	x		x			x	x

Measurable Goal Key:
3.2.1: Drinking Water – Reduce Nitrate Contamination
3.2.2: Aquatic Life and Aquatic Recreation – Reduce Sediment and Phosphorus Delivery and Load
3.2.3: Aquatic Life and Aquatic Recreation – Reduce Bacteria Delivery and Load
3.2.4: Aquatic Life and Aquatic Recreation – Increase Dissolved Oxygen Concentration
3.2.5: Surface Runoff and Flooding – Reduce Damages from Peak Flows and Overland Flooding
3.2.6: Drainage Management Systems – Erosion and Sedimentation Reduction
3.2.7: Shoreland and Riparian Areas – Improve and Increase Vegetative Cover
3.2.8: Habitat for Wildlife – Enhance Connectivity and Cover
3.2.9: Aquatic Habitat for Fish, Macroinvertebrates and Aquatic Life – Restore Connectivity, Habitat, Moderated Flow Regimes and Promoted Vegetated Banks and Buffers
3.2.10: Public Knowledge of and Behavior Related to Water Resources – Increase Stakeholder Participation
3.2.11: Data Collection – Enhance Knowledge of Baseline Conditions
3.2.12: Healthy Rural Landscapes – Improve Agricultural Soil Health
3.2.13 Healthy Rural Landscapes – Reduce Surface and Groundwater Contamination

Table 4-34: Mud River/JD 11 Management Projects and Practices Summary

Mud River/JD 11 Projects and Practices Summary				
Priority Tier 1 Planning Region				
Action Level	**PTMApp Treatment Group**	**# Practices**	**Sediment Load Reduction (tons/yr.)**	**Total Phosphorus Load Reduction (lbs./yr.)**
Baseline	Filtration	49	375	87
	Storage	62	159	37
	Source Reduction	119	1,276	451
	Total	***230***	***1,810***	***575***
Level 1	Biofiltration	1	2	4
	Filtration	9	52	15
	Protection	116	663	235
	Storage	98	246	71
	Source Reduction	82	765	331
	Total	***306***	***1,728***	***656***
Level 2	Biofiltration	2	15	8
	Protection	181	919	311
	Storage	5	25	6
	Source Reduction	76	683	328
	Total	***264***	***1,642***	***653***
	Grand Total	**800**	**5,180**	**1,884**

Measurable Goal Key:
3.2.1: Drinking Water – Reduce Nitrate Contamination
3.2.2: Aquatic Life and Aquatic Recreation – Reduce Sediment and Phosphorus Delivery and Load
3.2.3: Aquatic Life and Aquatic Recreation – Reduce Bacteria Delivery and Load
3.2.4: Aquatic Life and Aquatic Recreation – Increase Dissolved Oxygen Concentration
3.2.5: Surface Runoff and Flooding – Reduce Damages from Peak Flows and Overland Flooding
3.2.6: Drainage Management Systems – Erosion and Sedimentation Reduction
3.2.7: Shoreland and Riparian Areas – Improve and Increase Vegetative Cover
3.2.8: Habitat for Wildlife – Enhance Connectivity and Cover
3.2.9: Aquatic Habitat for Fish, Macroinvertebrates and Aquatic Life – Restore Connectivity, Habitat, Moderated Flow Regimes and Promoted Vegetated Banks and Buffers
3.2.10: Public Knowledge of and Behavior Related to Water Resources – Increase Stakeholder Participation
3.2.11: Data Collection – Enhance Knowledge of Baseline Conditions
3.2.12: Healthy Rural Landscapes – Improve Agricultural Soil Health
3.2.13 Healthy Rural Landscapes – Reduce Surface and Groundwater Contamination

Table 4-35: Mud River/JD 11 Capital Projects Implementation Schedule

Location: Mud River/JD 11 Planning Region

Priority Tier 1 Planning Region

Action Level	Implementation Action: Capital Improvement/ Operations and Maintenance	Measurable Output	Metric	Estimated Cost	Timeline					Implementation Responsibility		Measurable Goals												
					2020-21	2022-23	2024-25	2026-27	2028-29	Lead Entity	Partner	MGC 3.2.1	MGC 3.2.2	MGC 3.2.3	MGC 3.2.4	MGC 3.2.5	MGC 3.2.6	MGC 3.2.7	MGC 3.2.8	MGC 3.2.9	MGC 3.2.10	MGC 3.2.11	MGC 3.2.12	MGC 3.2.13
B – OM	Maintain public drainage infrastructure to provide adequate drainage while minimizing upstream and downstream flood damages and impacts on water quality	120 miles of drainage infrastructure maintained	miles	$42,198	x	x	x	x	x	Drainage Authorities	DNR, MPCA, SCWD, City, MnDOT, ACOE		x			x	x			x				
B – CP	Stabilize actively eroding streambanks along the Mud River/JD 11 between Grygla and Agassiz NWR	Package of 11 projects	# projects	$126,596	x	x				WD	RRWMB, DNR, BWSR		x			x	x		x					
1 – OM	Maintain ditch systems in accordance with multi-purpose drainage goals as stated in MS 103E.015	120 miles of drainage infrastructure maintained	miles	$120,000	x	x				Drainage Authorities	SWCD, BWSR, DNR		x			x	x	x		x				x
1 – CP	Continue to stabilize actively eroding streambanks along the Mud River/JD 11 between Grygla and Agassiz NWR	package of two projects	# projects	$23,404	x	x				WD	RRWMB, DNR, BWSR		x			x	x		x					
	Restore flow to approximately 5 miles of the historical Mud River/JD 11 Channel in the Agassiz NWR	5 miles restored	miles	$2,000,000	x	x	x			USFWS	DNR, WD, SWCD, ACOE		x		x	x		x		x				
2 – CP	Mud River/JD 11 Restoration or two-stage ditch upstream of Grygla	*N/A: Action Level 2 Implementation Funding Required*								County / WD	DNR, SWCD, RRWMB		x		x			x	x	x				
2 – CP	Protect the natural meandering of streams and promote the restoration/repair of straightened streams/ditches to maintain stream/ditch capacity for reducing flood impacts and enhancing recreational, agricultural, and fish and wildlife habitat value	*N/A: Action Level 2 Implementation Funding Required*								County/WD	DNR, SWCD, USFWS, TNC		x	x	x	x	x	x	x	x				x

B - OM = Baseline funding level for Operations and Maintenance of Capital Projects
B - CP = Baseline funding level for Capital Projects
1 -OM = Moderate funding level for Operations and Maintenance of Capital Projects
1- CP = Moderate funding level - Capital Projects
2 - CP = High funding level - Capital Projects

Measurable Goal Key:
3.2.1: Drinking Water – Reduce Nitrate Contamination
3.2.2: Aquatic Life and Aquatic Recreation – Reduce Sediment and Phosphorus Delivery and Load
3.2.3: Aquatic Life and Aquatic Recreation – Reduce Bacteria Delivery and Load
3.2.4: Aquatic Life and Aquatic Recreation – Increase Dissolved Oxygen Concentration
3.2.5: Surface Runoff and Flooding – Reduce Damages from Peak Flows and Overland Flooding
3.2.6: Drainage Management Systems – Erosion and Sedimentation Reduction
3.2.7: Shoreland and Riparian Areas – Improve and Increase Vegetative Cover
3.2.8: Habitat for Wildlife – Enhance Connectivity and Cover
3.2.9: Aquatic Habitat for Fish, Macroinvertebrates and Aquatic Life – Restore Connectivity, Habitat, Moderated Flow Regimes and Promoted Vegetated Banks and Buffers
3.2.10: Public Knowledge of and Behavior Related to Water Resources – Increase Stakeholder Participation
3.2.11: Data Collection – Enhance Knowledge of Baseline Conditions
3.2.12: Healthy Rural Landscapes – Improve Agricultural Soil Health
3.2.13 Healthy Rural Landscapes – Reduce Surface and Groundwater Contamination

Table 4-36: Upper Thief River/SD 83 Structural Practice Implementation Schedule

Location: Upper Thief River/SD 83 Planning Region																													
Priority Tier 2 Planning Region																													
Action Level	PTMApp Treatment Group	Implementation Action: Structural Practices	Measurable Output	Metric	Estimated Cost	Timeline					Implementation Responsibility		Measurable Goals													
						2020-21	2022-23	2024-25	2026-27	2028-29	Lead Entity	Partner	MGC 3.2.1	MGC 3.2.2	MGC 3.2.3	MGC 3.2.4	MGC 3.2.5	MGC 3.2.6	MGC 3.2.7	MGC 3.2.8	MGC 3.2.9	MGC 3.2.10	MGC 3.2.11	MGC 3.2.12	MGC 3.2.13
B	*Filtration*	Implement practices (e.g. filter strips, grassed waterways) within priority locations that reduce bacteria, sediment, and nutrient loading to waterbodies by treating surface and shallow-surface runoff before entering ditches and streams	78 tons/yr. sediment 28 lbs./yr. TP	annual tons sediment and lbs. TP load reduction	$38,659			x	x		SWCD/WD	BWSR, DNR, NRCS, Landowners		x	x	x	x	x	x	x	x				x
	Protection	Implement grade stabilization practices to provide protection from sediment loading, reduce bacteria and nutrient loading to waterbodies, and maintain stability and function of drainage ditches and streams	2 tons/yr. sediment; 1 lbs./yr. TP	annual tons sediment and lbs. TP load reduction	$4,849			x	x		SWCD/WD	BWSR, DNR, NRCS, Landowners		x	x	x		x			x				x
	Storage	Implement and maintain BMPs that provide runoff reduction for flood mitigation as well as reduce sediment and TP load for aquatic life.	64 tons/yr. sediment; 22 lbs./yr. TP	annual tons sediment and lbs. TP load reduction	$52,276			x	x		SWCD/WD	BWSR, DNR, NRCS, Landowners		x	x	x	x	x							x

Measurable Goal Key:
3.2.1: Drinking Water – Reduce Nitrate Contamination
3.2.2: Aquatic Life and Aquatic Recreation – Reduce Sediment and Phosphorus Delivery and Load
3.2.3: Aquatic Life and Aquatic Recreation – Reduce Bacteria Delivery and Load
3.2.4: Aquatic Life and Aquatic Recreation – Increase Dissolved Oxygen Concentration
3.2.5: Surface Runoff and Flooding – Reduce Damages from Peak Flows and Overland Flooding
3.2.6: Drainage Management Systems – Erosion and Sedimentation Reduction
3.2.7: Shoreland and Riparian Areas – Improve and Increase Vegetative Cover
3.2.8: Habitat for Wildlife – Enhance Connectivity and Cover
3.2.9: Aquatic Habitat for Fish, Macroinvertebrates and Aquatic Life – Restore Connectivity, Habitat, Moderated Flow Regimes and Promoted Vegetated Banks and Buffers
3.2.10: Public Knowledge of and Behavior Related to Water Resources – Increase Stakeholder Participation
3.2.11: Data Collection – Enhance Knowledge of Baseline Conditions
3.2.12: Healthy Rural Landscapes – Improve Agricultural Soil Health
3.2.13 Healthy Rural Landscapes – Reduce Surface and Groundwater Contamination

Location: Upper Thief River/SD 83 Planning Region

Priority Tier 2 Planning Region

Action Level	PTMApp Treatment Group	Implementation Action: Structural Practices	Measurable Output	Metric	Estimated Cost	Timeline					Implementation Responsibility		Measurable Goals												
						2020-21	2022-23	2024-25	2026-27	2028-29	Lead Entity	Partner	MGC 3.2.1	MGC 3.2.2	MGC 3.2.3	MGC 3.2.4	MGC 3.2.5	MGC 3.2.6	MGC 3.2.7	MGC 3.2.8	MGC 3.2.9	MGC 3.2.10	MGC 3.2.11	MGC 3.2.12	MGC 3.2.13
1	*Biofiltration*	Implement practices (e.g. saturated buffers) to treat subsurface drainage runoff for nutrients (e.g. nitrogen and phosphorus)	1 ton/yr. sediment; 10 lbs./yr. TP	annual tons sediment and lbs. TP load reduction	$64,845			x	x		SWCD/WD	BWSR, DNR, NRCS, Landowners		x	x	x	x	x	x	x	x				x
	Filtration	Implement practices (e.g. riparian herbaceous cover) that provide perennial vegetative cover within riparian corridors	3 tons/yr. sediment; 1 lbs./yr. TP	annual tons sediment and lbs. TP load reduction	$6,851			x	x		SWCD/WD	BWSR, DNR, NRCS, Landowners		x	x	x	x	x	x	x	x				x
	Storage	Implement and maintain additional BMPs that provide runoff reduction for flood mitigation as well as reduce sediment and TP load for aquatic life	3 tons/yr. sediment; 1 lbs./yr. TP	annual tons sediment and lbs. TP load reduction	$5,096			x	x		SWCD/WD	BWSR, DNR, NRCS, Landowners		x	x	x	x	x							x
	Protection	Implement additional grade stabilization practices to provide protection from sediment loading, reduce bacteria and nutrient loading to waterbodies, and maintain stability and function of drainage ditches and streams	141 tons/yr. sediment; 49 lbs./yr. TP	annual tons sediment and lbs. TP load reduction	$307,332			x	x		SWCD/WD	BWSR, DNR, NRCS, Landowners		x	x	x		x			x				x

Measurable Goal Key:
3.2.1: Drinking Water – Reduce Nitrate Contamination
3.2.2: Aquatic Life and Aquatic Recreation – Reduce Sediment and Phosphorus Delivery and Load
3.2.3: Aquatic Life and Aquatic Recreation – Reduce Bacteria Delivery and Load
3.2.4: Aquatic Life and Aquatic Recreation – Increase Dissolved Oxygen Concentration
3.2.5: Surface Runoff and Flooding – Reduce Damages from Peak Flows and Overland Flooding
3.2.6: Drainage Management Systems – Erosion and Sedimentation Reduction
3.2.7: Shoreland and Riparian Areas – Improve and Increase Vegetative Cover
3.2.8: Habitat for Wildlife – Enhance Connectivity and Cover
3.2.9: Aquatic Habitat for Fish, Macroinvertebrates and Aquatic Life – Restore Connectivity, Habitat, Moderated Flow Regimes and Promoted Vegetated Banks and Buffers
3.2.10: Public Knowledge of and Behavior Related to Water Resources – Increase Stakeholder Participation
3.2.11: Data Collection – Enhance Knowledge of Baseline Conditions
3.2.12: Healthy Rural Landscapes – Improve Agricultural Soil Health
3.2.13 Healthy Rural Landscapes – Reduce Surface and Groundwater Contamination

Table 4-37: Upper Thief River/SD 83 Management Practice Implementation Schedule

Location: Upper Thief River/SD 83 Planning Region																									
Priority Tier 2 Planning Region																									
						Timeline					Implementation Responsibilities		Measurable Goals												
Action Level	PTMApp Treatment Group	Implementation Actions: Management Practices	Measurable Output	Metric	Estimated Cost	2020-21	2022-23	2024-25	2026-27	2028-29	Lead Entity	Partner	MGC 3.2.1	MGC 3.2.2	MGC 3.2.3	MGC 3.2.4	MGC 3.2.5	MGC 3.2.6	MGC 3.2.7	MGC 3.2.8	MGC 3.2.9	MGC 3.2.10	MGC 3.2.11	MGC 3.2.12	MGC 3.2.13
B	***Source Reduction***	Implement practices that are focused on and maintain soil health, including but not limited to conservation tillage and residue management, crop rotation methods, and/or the use of cover crops	3,131 acres with management practices; 1,028 tons/yr. sediment reduction; 403 lbs./yr. TP load reduction	# acres; annual tons sediment and lbs. TP load reduction	$96,658			x	x		SWCD	MDA, NRCS, Crop Advisors, Landowner		x		x	x	x	x		x			x	x
1	***Source Reduction***	Implement additional practices that are focused on and maintain soil health, including but not limited to conservation tillage and residue management, crop rotation methods, and/or the use of cover crops	497 acres with management practices; 134 tons/yr. sediment reduction; 61 lbs./yr. TP load reduction	# acres; annual tons sediment and lbs. TP load reduction	$15,348			x	x		SWCD	MDA, NRCS, Crop Advisors, Landowner		x		x	x	x	x		x			x	x

Measurable Goal Key:
3.2.1: Drinking Water – Reduce Nitrate Contamination
3.2.2: Aquatic Life and Aquatic Recreation – Reduce Sediment and Phosphorus Delivery and Load
3.2.3: Aquatic Life and Aquatic Recreation – Reduce Bacteria Delivery and Load
3.2.4: Aquatic Life and Aquatic Recreation – Increase Dissolved Oxygen Concentration
3.2.5: Surface Runoff and Flooding – Reduce Damages from Peak Flows and Overland Flooding
3.2.6: Drainage Management Systems – Erosion and Sedimentation Reduction
3.2.7: Shoreland and Riparian Areas – Improve and Increase Vegetative Cover
3.2.8: Habitat for Wildlife – Enhance Connectivity and Cover
3.2.9: Aquatic Habitat for Fish, Macroinvertebrates and Aquatic Life – Restore Connectivity, Habitat, Moderated Flow Regimes and Promoted Vegetated Banks and Buffers
3.2.10: Public Knowledge of and Behavior Related to Water Resources – Increase Stakeholder Participation
3.2.11: Data Collection – Enhance Knowledge of Baseline Conditions
3.2.12: Healthy Rural Landscapes – Improve Agricultural Soil Health
3.2.13 Healthy Rural Landscapes – Reduce Surface and Groundwater Contamination

Table 4-38: Upper Thief River/SD 83 Projects and Practices Summary

Upper Thief River/SD 83 Projects and Practices Summary				
Priority Tier 2 Planning Region				
Action Level	**PTMApp Treatment Group**	**# Practices**	**Sediment Load Reduction (tons/yr.)**	**Total Phosphorus Load Reduction (lbs./yr.)**
Baseline	Filtration	26	78	28
	Storage	34	64	28
	Protection	1	2	1
	Source Reduction	98	1,083	403
	Total	***159***	***1,226***	***454***
Level 1	Biofiltration	2	1	10
	Filtration	2	3	1
	Protection	32	141	49
	Storage	4	3	1
	Source Reduction	15	134	61
	Total	***55***	***281***	***122***
Grand Total		**214**	**1,507**	**576**

Measurable Goal Key:
3.2.1: Drinking Water – Reduce Nitrate Contamination
3.2.2: Aquatic Life and Aquatic Recreation – Reduce Sediment and Phosphorus Delivery and Load
3.2.3: Aquatic Life and Aquatic Recreation – Reduce Bacteria Delivery and Load
3.2.4: Aquatic Life and Aquatic Recreation – Increase Dissolved Oxygen Concentration
3.2.5: Surface Runoff and Flooding – Reduce Damages from Peak Flows and Overland Flooding
3.2.6: Drainage Management Systems – Erosion and Sedimentation Reduction
3.2.7: Shoreland and Riparian Areas – Improve and Increase Vegetative Cover
3.2.8: Habitat for Wildlife – Enhance Connectivity and Cover
3.2.9: Aquatic Habitat for Fish, Macroinvertebrates and Aquatic Life – Restore Connectivity, Habitat, Moderated Flow Regimes and Promoted Vegetated Banks and Buffers
3.2.10: Public Knowledge of and Behavior Related to Water Resources – Increase Stakeholder Participation
3.2.11: Data Collection – Enhance Knowledge of Baseline Conditions
3.2.12: Healthy Rural Landscapes – Improve Agricultural Soil Health
3.2.13 Healthy Rural Landscapes – Reduce Surface and Groundwater Contamination

Table 4-39: Upper Thief River/SD 83 Capital Projects Implementation Schedule

Location: Upper Thief River/SD 83 Planning Region																								
Priority Tier 2 Planning Region																								
Action Level	Implementation Action: Capital Improvement/ Operations and Maintenance	Measurable Output	Metric	Estimated Cost	Timeline					Implementation Responsibility		Measurable Goals												
					2020-21	2022-23	2024-25	2026-27	2028-29	Lead Entity	Partner	MGC 3.2.1	MGC 3.2.2	MGC 3.2.3	MGC 3.2.4	MGC 3.2.5	MGC 3.2.6	MGC 3.2.7	MGC 3.2.8	MGC 3.2.9	MGC 3.2.10	MGC 3.2.11	MGC 3.2.12	MGC 3.2.13
B – OM	Maintain public drainage infrastructure to provide adequate drainage while minimizing upstream and downstream flood damages and impacts on water quality	100 miles of drainage infrastructure maintained	miles	$37,989	x	x	x	x	x	Drainage Authorities	DNR, MPCA, SCWD, City, MnDOT, ACOE		x			x	x			x				
B – OM	Maintain ditch systems in accordance with multi-purpose drainage goals as stated in MS 103E.015	100 miles of drainage infrastructure maintained	miles	$100,000						Drainage Authorities	SWCD, BWSR, DNR		x		x	x	x	x	x	x				
1 – CP	Remove spoil piles from historical channelization out of riparian areas	3 miles of spoil piles removed	miles	$150,000				x	x	WD	RRWMB, DNR, BWSR		x			x	x	x		x				x
2 – CP	Protect the natural meandering of streams and promote the restoration/repair of straightened streams/ditches to maintain stream/ditch capacity for reducing flood impacts and enhancing recreational, agricultural, and fish and wildlife habitat value	*N/A: Action Level 2 Implementation Funding Required*								County/WD	DNR, SWCD, USFWS, TNC		x		x			x	x	x				

B - OM = Baseline funding level for Operations and Maintenance of Capital Projects
B - CP = Baseline funding level for Capital Projects
1 -OM = Moderate funding level for Operations and Maintenance of Capital Projects
1- CP = Moderate funding level - Capital Projects
2 - CP = High funding level - Capital Projects

Measurable Goal Key:
3.2.1: Drinking Water – Reduce Nitrate Contamination
3.2.2: Aquatic Life and Aquatic Recreation – Reduce Sediment and Phosphorus Delivery and Load
3.2.3: Aquatic Life and Aquatic Recreation – Reduce Bacteria Delivery and Load
3.2.4: Aquatic Life and Aquatic Recreation – Increase Dissolved Oxygen Concentration
3.2.5: Surface Runoff and Flooding – Reduce Damages from Peak Flows and Overland Flooding
3.2.6: Drainage Management Systems – Erosion and Sedimentation Reduction
3.2.7: Shoreland and Riparian Areas – Improve and Increase Vegetative Cover
3.2.8: Habitat for Wildlife – Enhance Connectivity and Cover
3.2.9: Aquatic Habitat for Fish, Macroinvertebrates and Aquatic Life – Restore Connectivity, Habitat, Moderated Flow Regimes and Promoted Vegetated Banks and Buffers
3.2.10: Public Knowledge of and Behavior Related to Water Resources – Increase Stakeholder Participation
3.2.11: Data Collection – Enhance Knowledge of Baseline Conditions
3.2.12: Healthy Rural Landscapes – Improve Agricultural Soil Health
3.2.13 Healthy Rural Landscapes – Reduce Surface and Groundwater Contamination

4.5 PLANNING REGION IMPLEMENTATION PROFILES

This plan presents an implementation profile for each planning region to target the implementation of structural and management practices within the targeted implementation schedule. Each implementation profile summarizes the following:

- The locations of technically feasible practices
- The estimated cost[2] for the technically feasible practices relative to the measurable goals
- The types and probable locations of best structural practices (physical BMPs placed on the landscape) that comprise the targeted implementation approach
- The location of the BMPs (source reduction BMPs implemented through land management) aimed at the most critical areas on the landscape
- The anticipated benefits arising from implementation, relative to sediment and TP goals

Benefits from implementation of structural and management practices are estimated through PTMApp. Benefits are expressed as the mass load reduction of sediment and TP arising from implementation. Load reduction benefits are summarized in the implementation profiles at the planning region outlet. However, load reduction benefits can be evaluated from the edge of field as well. It is important to note that the estimated sediment and TP loading to each planning region outlet and the load reduction goal was derived from HSPF, which includes in-channel and upland sources. PTMApp only estimates loading and load reductions from upland sources. Thus, the following implementation profiles do not consider implementation opportunities for in-channel sources. Moreover, PTMApp uses an empirical approach for estimating sediment, the Revised Universal Soil Loss Equitation (RUSLE), and nutrient, literature values with 1st order loss transport, to estimate reductions. Therefore, it is difficult to compare the numbers. However, the relative percent reductions should provide a guide for making progress towards management goals.

To create the list of the best structural and management BMPs comprising the targeted implementation approach, structural BMPs in each planning region were ranked from most to least cost-effective. Because the sediment load reduction goal for each planning region was the most feasibly attainable, BMPs were selected based on their abilities to remove sediment cost-effectively until the sediment goal was met. Subsequent BMPs were selected based on their abilities to remove TP the most cost effectively. The Thief River Watershed 1W1P targeted implementation approach was designed to select the best practices for removing sediment and TP at the outlet of each planning region until the short-term load reduction goal was met. The Thief River Watershed 1W1P planning partners also designed the targeted implementation approach to select as many types of structural and management practices available with PTMApp in order to keep all implementation options on the table. To maintain a balance of approaches to implementation and to ensure a multiple-benefits approach, BMPs were selected so that structural and management practices contributed 50% each to the estimated load reductions from overland sources needed to meet the goals. Designing the targeted implementation approach in this way recommends the best practices in the plan area that will give practitioners and landowners flexibility when tailoring implementation. A list of the top ten practices by treatment group for each planning region is in **Appendix I**.

Cost-effectiveness curves were developed to provide a picture of the estimated cost of implementation in the watershed versus the anticipated cumulative load reduction benefit gained, compared to a load reduction goal. The cost-effectiveness curves also show if implementation of the best, most cost-effective practices in the targeted implementation approach can attain load reduction goals through treatment of surface runoff alone. The cost-effectiveness curves represent the ideal condition between the USDA NRCS EQIP cost share and annual estimated load reductions. Practically, the effectiveness of implementation will operate below this curve. Therefore, other lines of evidence, including continued

[2] Costs calculated within PTMApp were based on estimated 2016 USDA – NRCS EQIP Costs.

water quality monitoring at the field edge and watershed scales, will be needed to assess and confirm progress toward measurable goals.

Maps were created for each planning region's targeted implementation profile (shown below) to depict suitable locations to implement the most cost-effective structural and management best practices (BMPs) estimated to meet the sediment load reduction goals for each planning region.

- **Judicial Ditch 30/18/13 Planning Region**: Although relatively little investment is needed to meet the planning region sediment reduction goal, a significant investment is required to meet the TP load reduction goal. Because the planning region is primarily a drainage ditch system, practices to stabilize ditch channels and outlets should be targeted.
- **Lost River (Branch 200 of JD 11) Planning Region**: Although relatively little investment is needed to meet the planning region sediment reduction goal, a significant investment is required to meet the TP load reduction goal. Because land use is primarily wetlands, there are fewer opportunities to implement practices in this planning region.
- **Lower Thief River Planning Region**: BMPs within the Planning Region as well as practices upstream that provide downstream benefits to the Planning Region outlet are needed. Because the Lower Thief River is the most downstream Planning Region in the Thief River Watershed, meeting sediment and TP reduction goals will require a significant conservation investment watershedwide.
- **Marshall County Ditch 20 Planning Region**: Although relatively little investment is needed to meet the planning region sediment reduction goal, a significant investment is required to meet the TP load reduction goal. Because the planning region is primarily a drainage ditch system, practices to stabilize ditch channels and outlets should be targeted.
- **Middle Thief River Planning Region**: BMPs within the Planning Region as well as practices upstream that provide downstream benefits to the Planning Region outlet are needed. Due to the presence of Agassiz National Wildlife Refuge, the United States Fish and Wildlife Service should be a significant partner in implementation conservation practices in and around the refuge.
- **Moose River Planning Region**: Although relatively little investment is needed to meet the planning region sediment reduction goal, a significant investment is required to meet the TP load reduction goal.
- **Mud River Planning Region**: Although relatively little investment is needed to meet the planning region sediment reduction goal, a significant investment is required to meet the TP load reduction goal.
- **Upper Thief River Planning Region**: Although relatively little investment is needed to meet the planning region sediment reduction goal, a significant investment is required to meet the TP load reduction goal.

Targeted Implementation Profile: JD 30/18/13

MEASURABLE GOAL

Goals and Loading Source: Thief River Watershed TMDL/HSPF

Existing Sediment Load at Planning Region Outlet: 1,394 tons/yr.

Targeted Sediment Load Reduction at Outlet: 70 tons/yr.

Existing Total Phosphorus Load at Planning Region Outlet: 11,173 lbs./yr.

Targeted Total Phosphorus Load Reduction at Outlet: 559 lbs./yr.

Estimated Funding Needed to Meet Sediment Goal: $2,692

Estimated Funding Needed to Meet Total Phosphorus Goal: $304,237

TARGETING APPROACH

Management Practices:

- **Sediment Reduction > 0.5 tons/yr.**
- **Total Phosphorus Reduction > 0.5 tons/yr.**
- **Size > 10 acre**

Structural Practices:

- **Filtration Practices: Total Phosphorus Reduction > 0.5 lbs./yr.; contributing drainage area > 40 acres**
- **Protection Practices: Contributing drainage area > 40 acres**
- **Storage Practices: Sediment Reduction > 0.5 tons/yr.**
- **Biofiltration Practices: Total Phosphorus Reduction > 0.5 lbs./yr.; contributing drainage area > 40 acres**

All Practices:

- **Surface Area of Practice > 0.5 acres**
- **Treat > = 50% of runoff to practice**

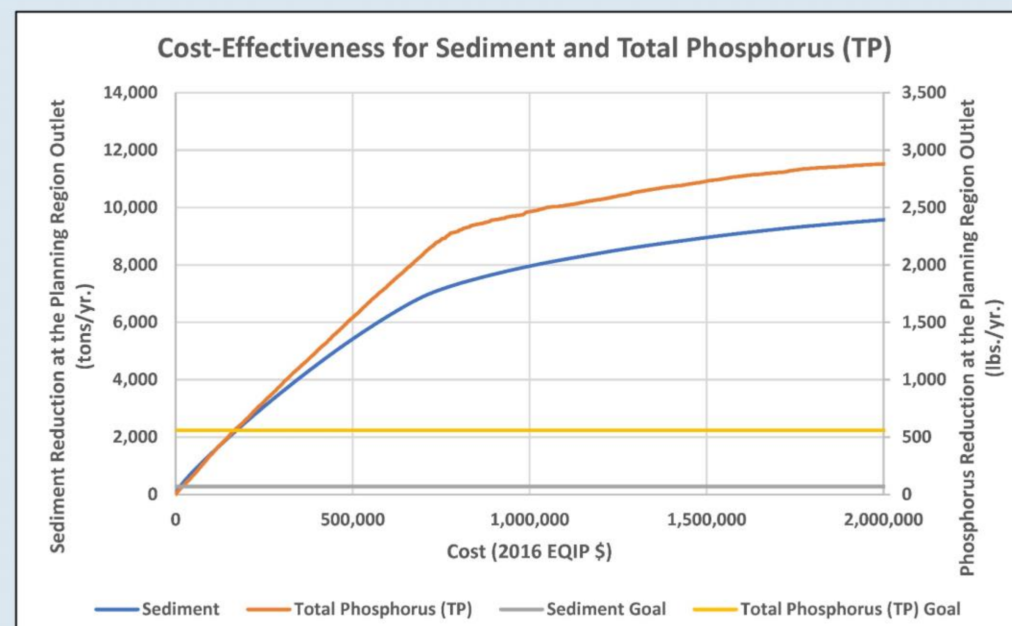
EVALUATING CONSERVATION GOALS

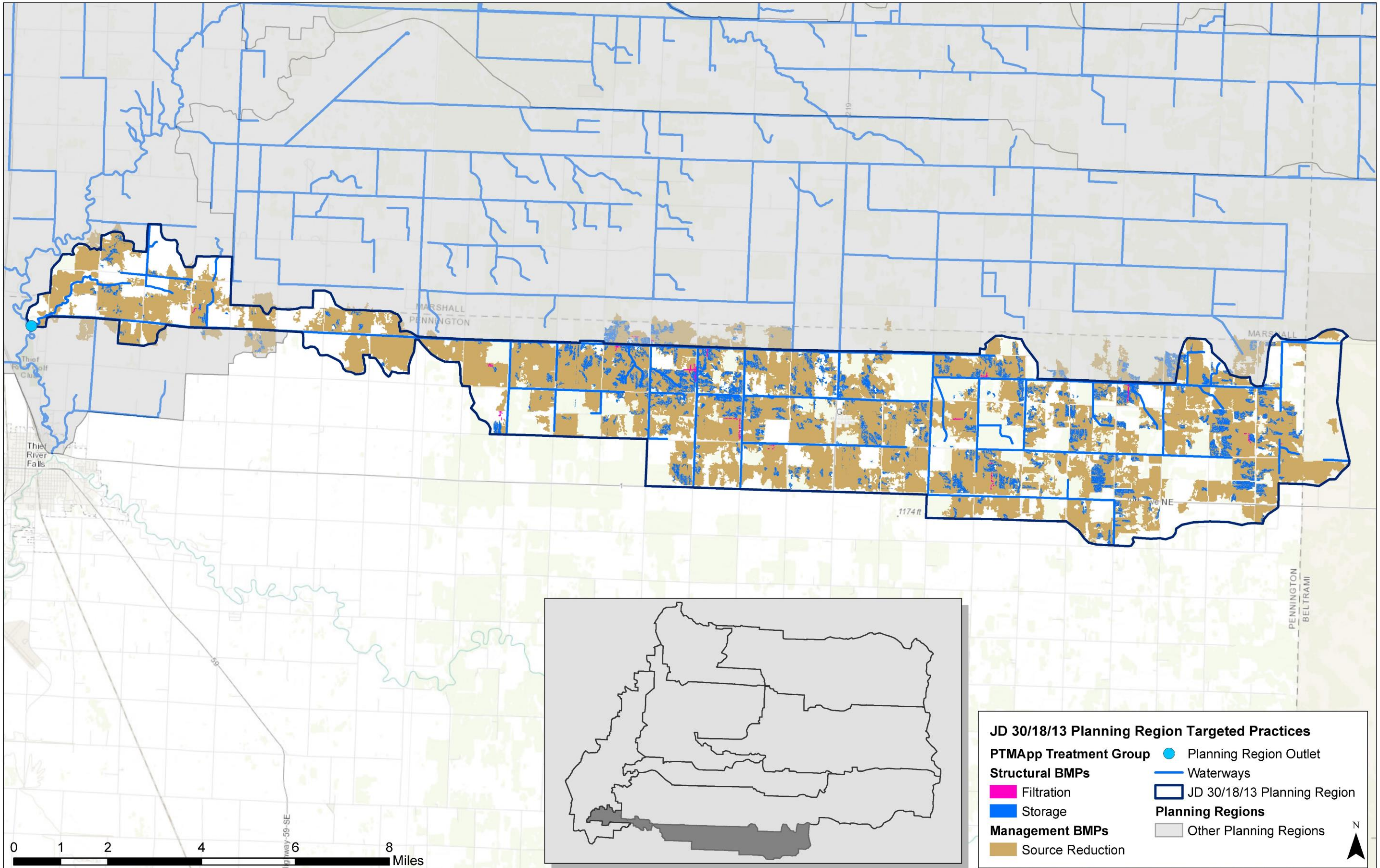
The Cost-Effectiveness Curve shows the optimal efficiency for implementation of actions to achieve load reduction goals. The curve is based on the most cost-effective and efficient management and structural practices as estimated by PTMApp. The curves show that it is possible to achieve load reduction goals through implementation of the targeted approach.

PRACTICE SUMMARY

Below is a summary of targeted conservation practices based on aggregated individual benefits and costs, and the specific types of practices that will be targeted within treatment groups.

	Treatment Group			
	Filtration	Storage	Source Reduction	Totals
Count	**16**	**55**	**91**	**162**
Sediment Reduction (tons/yr.)	**161**	**502**	**948**	**1,611**
Total Phosphorus Reduction (lbs./yr.)	**31**	**131**	**399**	**561**
Avg. Cost-Effectiveness ($/tons of sed/yr.)	**155**	**415**	**178**	**256**
Standard Deviation of Cost Effectiveness	**157**	**144**	**433**	**357**
Practice Types	Conservation Cover; Cover Crop; Filter Strips; Grassed Waterway; Riparian Buffers	Drainage Water Management; Wetland Restoration; Water Control Structures; Water and Sediment Control Basins; Diversion	Residue and Tillage Management; Nutrient Management	




MARSHALL
PENNINGTON
Thief River Falls
1174 ft
PENNINGTON
BELTRAMI
0 1 2 4 6 8
Miles
JD 30/18/13 Planning Region Targeted Practices
PTMApp Treatment Group
Structural BMPs
Filtration
Storage
Management BMPs
Source Reduction
Planning Region Outlet
Waterways
JD 30/18/13 Planning Region
Planning Regions
Other Planning Regions
N

Targeted Implementation Profile: Branch 200 of JD 11 (Lost River)

MEASURABLE GOAL

Goals and Loading Source: Thief River Watershed TMDL/HSPF

Existing Sediment Load at Planning Region Outlet: 683 tons/yr.

Targeted Sediment Load Reduction at Outlet: 34 tons/yr.

Existing Total Phosphorus Load at Planning Region Outlet: 6,655 lbs./yr.

Targeted Total Phosphorus Load Reduction at Outlet: 333 lbs./yr.

Estimated Funding Needed to Meet Sediment Goal: $19,116

Estimated Funding Needed to Meet Total Phosphorus Goal: $3,167,265

TARGETING APPROACH

Management Practices:

- **Sediment Reduction > 0.5 tons/yr.**
- **Total Phosphorus Reduction > 0.5 tons/yr.**
- **Size > 10 acre**

Structural Practices:

- **Filtration Practices: Total Phosphorus Reduction > 0.5 lbs./yr.; contributing drainage area > 40 acres**
- **Protection Practices: Contributing drainage area > 40 acres**
- **Storage Practices: Sediment Reduction > 0.5 tons/yr.**
- **Biofiltration Practices: Total Phosphorus Reduction > 0.5 lbs./yr.; contributing drainage area > 40 acres**

All Practices:

- **Surface Area of Practice > 0.5 acres**
- **Treat > = 50% of runoff to practice**

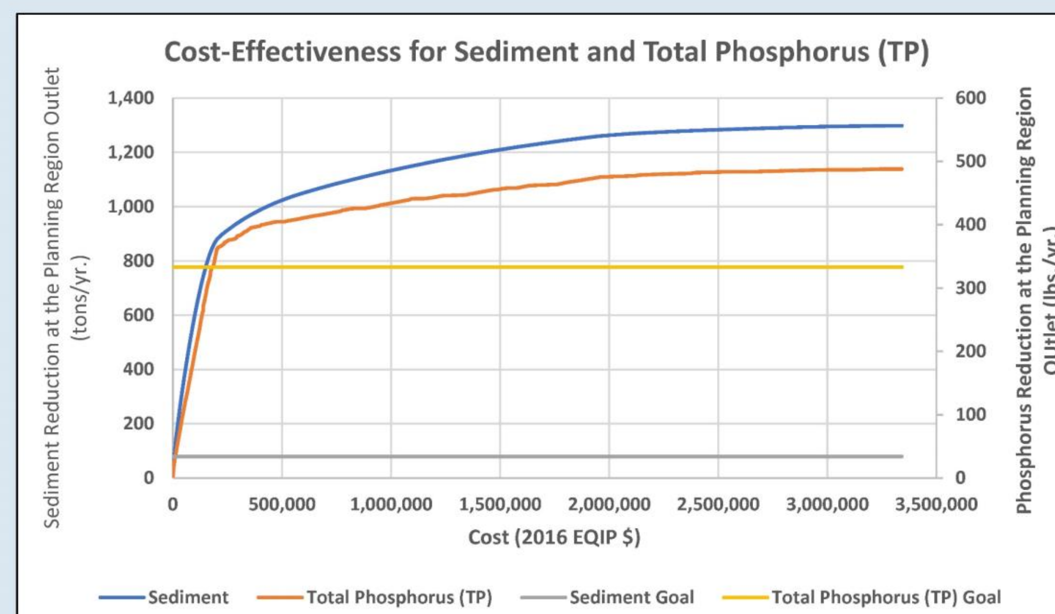
EVALUATING CONSERVATION GOALS

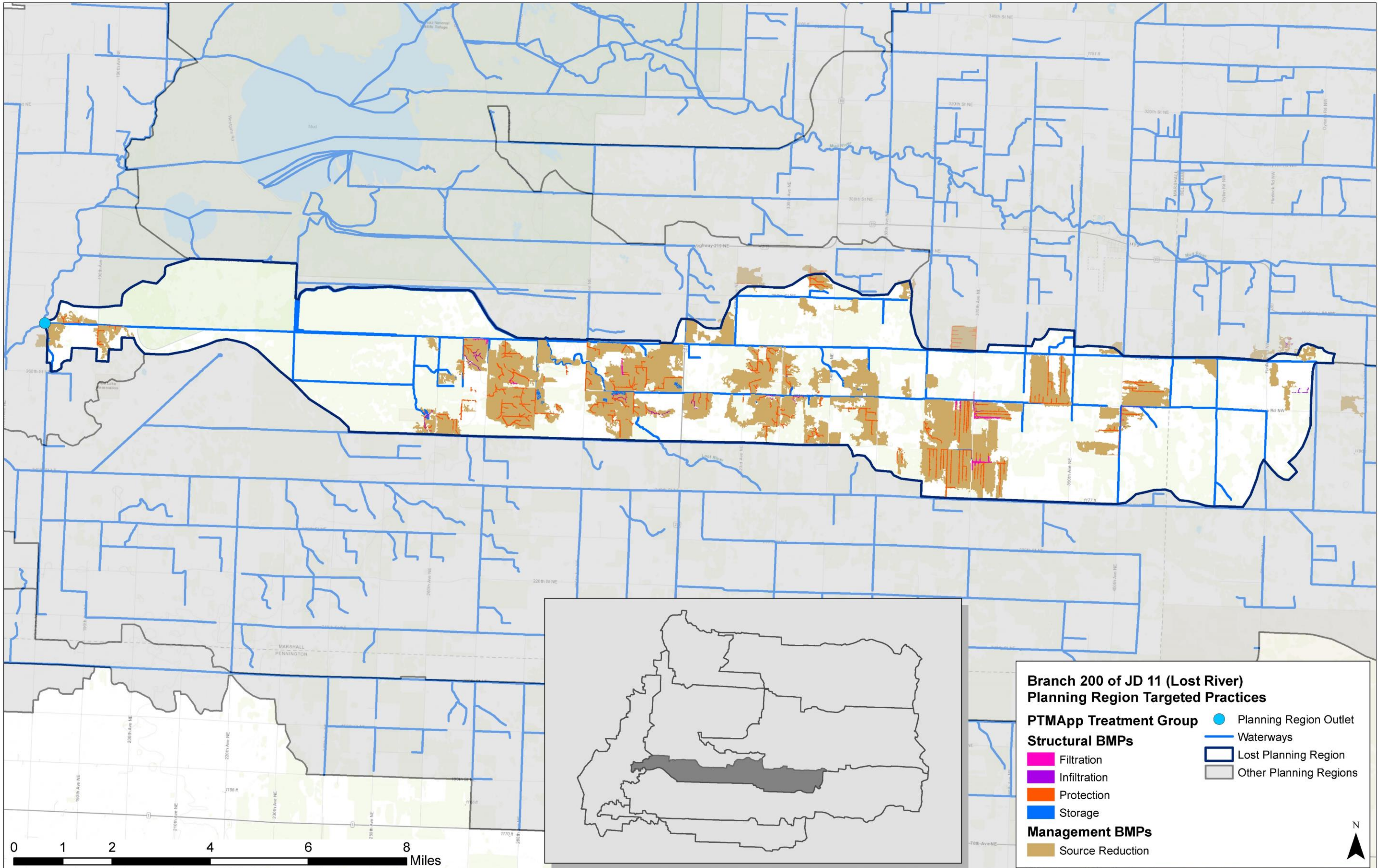
The Cost-Effectiveness Curve shows the optimal efficiency for implementation of actions to achieve load reduction goals. The curve is based on the most cost-effective and efficient management and structural practices as estimated by PTMApp. The curves show that it is possible to achieve load reduction goals through implementation of the targeted approach.

PRACTICE SUMMARY

Below is a summary of targeted conservation practices based on aggregated individual benefits and costs, and the specific types of practices that will be targeted within treatment groups.

	Treatment Group					
	Filtration	Infiltration	Protection	Storage	Source Reduction	Totals
Count	7	14	101	12	95	229
Sediment Reduction (tons/yr.)	24	92	259	28	588	993
Total Phosphorus Reduction (lbs./yr.)	5	10	82	8	238	344
Avg. Cost-Effectiveness ($/tons of sed/yr.)	1,337	39,761	11,532	6,652	250	8,010
Standard Deviation of Cost Effectiveness	1,658	46,038	13,375	7,597	168	17,208
Practice Types	Conservation Cover; Cover Crop; Filter Strips; Grassed Waterway; Riparian Buffers	Multi-stage Ditch; Infiltration Trench or Small Basin	Grade Stabilization; Grassed Waterway; Critical Planting Area; Shoreline Restoration/Protection	Drainage Water Management; Wetland Restoration; Water Control Structures; Water and Sediment Control Basins; Diversion	Residue and Tillage Management; Nutrient Management	




Branch 200 of JD 11 (Lost River)
Planning Region Targeted Practices
PTMApp Treatment Group
Structural BMPs
Filtration
Infiltration
Protection
Storage
Management BMPs
Source Reduction
Planning Region Outlet
Waterways
Lost Planning Region
Other Planning Regions
0 1 2 4 6 8
Miles
N

Targeted Implementation Profile: Lower Thief River

MEASURABLE GOAL

Goals and Loading Source: Thief River Watershed TMDL/HSPF

Existing Sediment Load at Planning Region Outlet: 15,566 tons/yr.

Targeted Sediment Load Reduction at Outlet: 2,335 tons/yr.

Existing Total Phosphorus Load at Planning Region Outlet: 101,823 lbs./yr.

Targeted Total Phosphorus Load Reduction at Outlet: 5,091 lbs./yr.

Estimated Funding Needed to Meet Sediment Goal: $253,428

Estimated Funding Needed to Meet Total Phosphorus Goal: $10,847,528

TARGETING APPROACH

Management Practices:

- **Sediment Reduction > 0.5 tons/yr.**
- **Total Phosphorus Reduction > 0.5 tons/yr.**
- **Size > 10 acre**

Structural Practices:

- **Filtration Practices: Total Phosphorus Reduction > 0.5 lbs./yr.; contributing drainage area > 40 acres**
- **Protection Practices: Contributing drainage area > 40 acres**
- **Storage Practices: Sediment Reduction > 0.5 tons/yr.**
- **Biofiltration Practices: Total Phosphorus Reduction > 0.5 lbs./yr.; contributing drainage area > 40 acres**

All Practices:

- **Surface Area of Practice > 0.5 acres**
- **Treat > = 50% of runoff to practice**

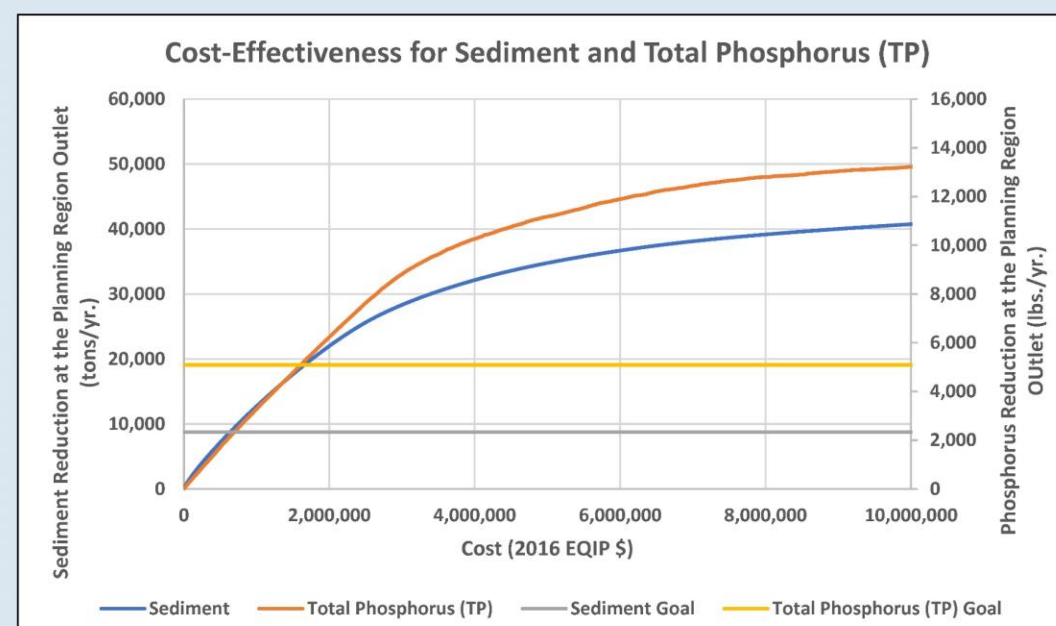
EVALUATING CONSERVATION GOALS

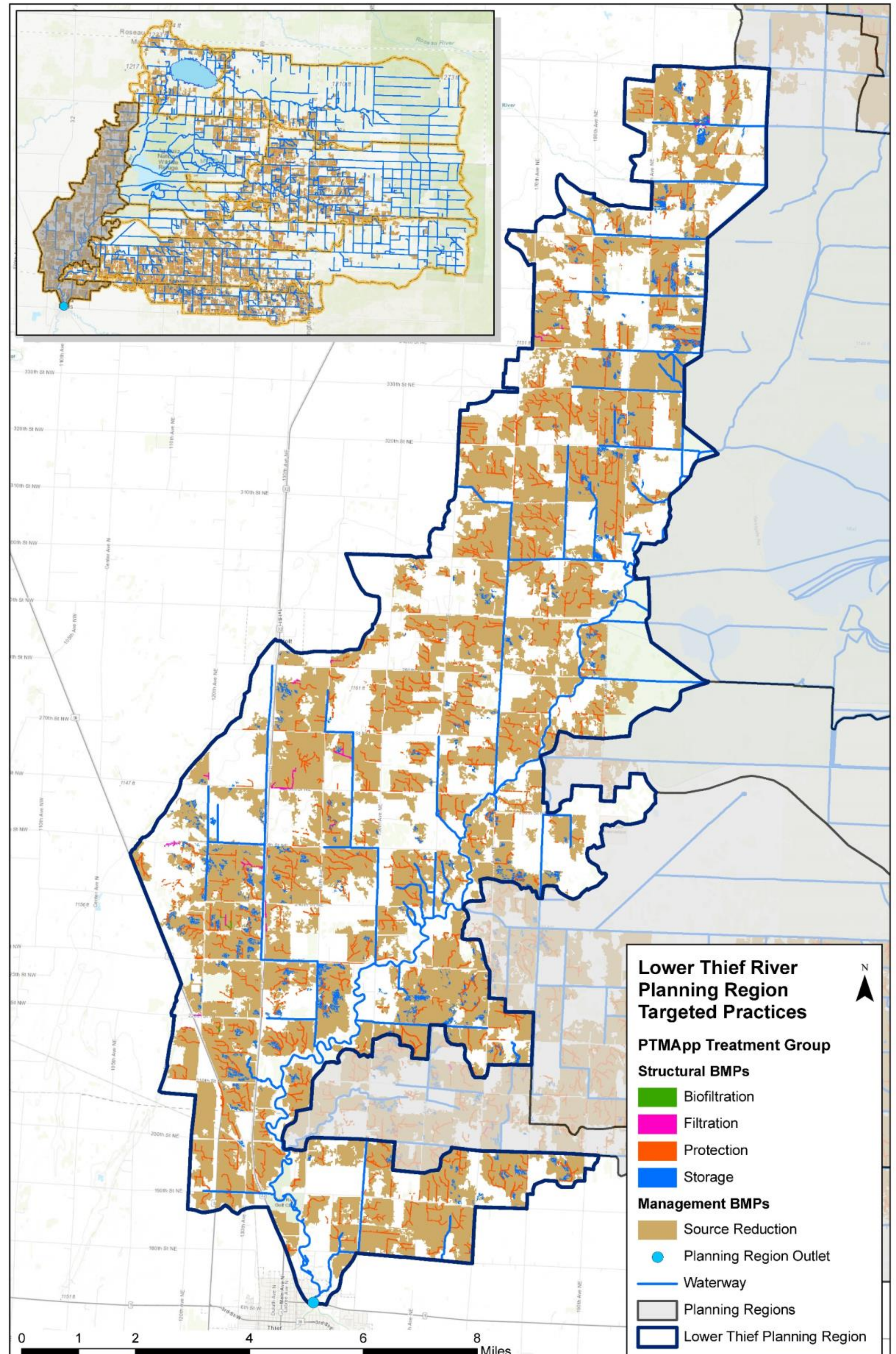
The Cost-Effectiveness Curve shows the optimal efficiency for implementation of actions to achieve load reduction goals. The curve is based on the most cost-effective and efficient management and structural practices as estimated by PTMApp. The curves show that it is possible to achieve load reduction goals through implementation of the targeted approach.

PRACTICE SUMMARY

Below is a summary of targeted conservation practices based on aggregated individual benefits and costs, and the specific types of practices that will be targeted within treatment groups.

	Treatment Group					
	Biofiltration	Filtration	Protection	Storage	Source Reduction	Totals
Count	6	166	453	956	601	2,226
Sediment Reduction (tons/yr.)	74	1,086	2,228	5,181	6,486	15,055
Total Phosphorus Reduction (lbs./yr.)	37	226	793	1,361	2,857	5,274
Avg. Cost-Effectiveness ($/tons of sed/yr.)	3,748	554	3,486	1,072	162	1,290
Standard Deviation of Cost Effectiveness	3,042	742	2,972	1,864	293	2,207
Practice Types	Saturated Buffer	Conservation Cover; Cover Crop; Filter Strips; Grassed Waterway; Riparian Buffers	Critical Area Planting; Grad Stabilization Structure; Tree/Shrub Establishment; Well Sealing; Septic System Upgrades; Upland Wildlife Habitat Management; Restoration and Management of Rare/ Declining Habitat; Prescribed Burning; Gravel Pit Reclamation	Drainage Water Management; Wetland Restoration; Water Control Structures; Water and Sediment Control Basins; Diversion	Residue and Tillage Management; Nutrient Management	




Lower Thief River
Planning Region
Targeted Practices
PTMApp Treatment Group
Structural BMPs
Biofiltration
Filtration
Protection
Storage
Management BMPs
Source Reduction
Planning Region Outlet
Waterway
Planning Regions
Lower Thief Planning Region
N
0 1 2 4 6 8 Miles

Targeted Implementation Profile: Marshall County Ditch 20

MEASURABLE GOAL

Goals and Loading Source: Thief River Watershed TMDL/HSPF

Existing Sediment Load at Planning Region Outlet: 2,555 tons/yr.

Targeted Sediment Load Reduction at Outlet: 128 tons/yr.

Existing Total Phosphorus Load at Planning Region Outlet: 22,703 lbs./yr.

Targeted Total Phosphorus Load Reduction at Outlet: 1,135 lbs./yr.

Estimated Funding Needed to Meet Sediment Goal: $3,519

Estimated Funding Needed to Meet Total Phosphorus Goal: $1,007,665

TARGETING APPROACH

Management Practices:

- **Sediment Reduction > 0.5 tons/yr.**
- **Total Phosphorus Reduction > 0.5 tons/yr.**
- **Size > 10 acre**

Structural Practices:

- **Filtration Practices: Total Phosphorus Reduction > 0.5 lbs./yr.; contributing drainage area > 40 acres**
- **Protection Practices: Contributing drainage area > 40 acres**
- **Storage Practices: Sediment Reduction > 0.5 tons/yr.**
- **Biofiltration Practices: Total Phosphorus Reduction > 0.5 lbs./yr.; contributing drainage area > 40 acres**

All Practices:

- **Surface Area of Practice > 0.5 acres**
- **Treat > = 50% of runoff to practice**

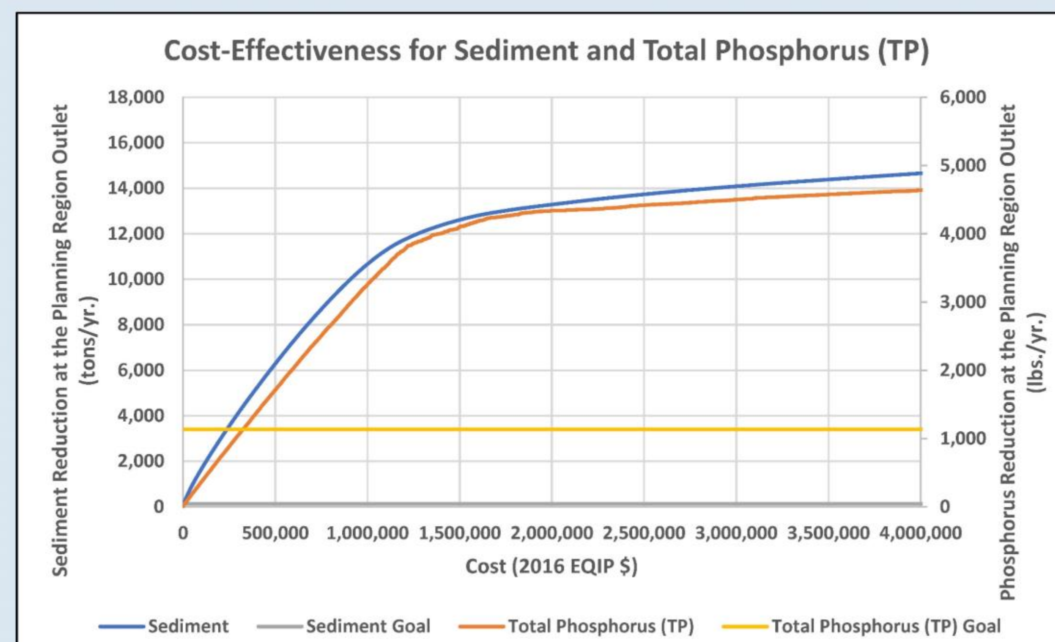
EVALUATING CONSERVATION GOALS

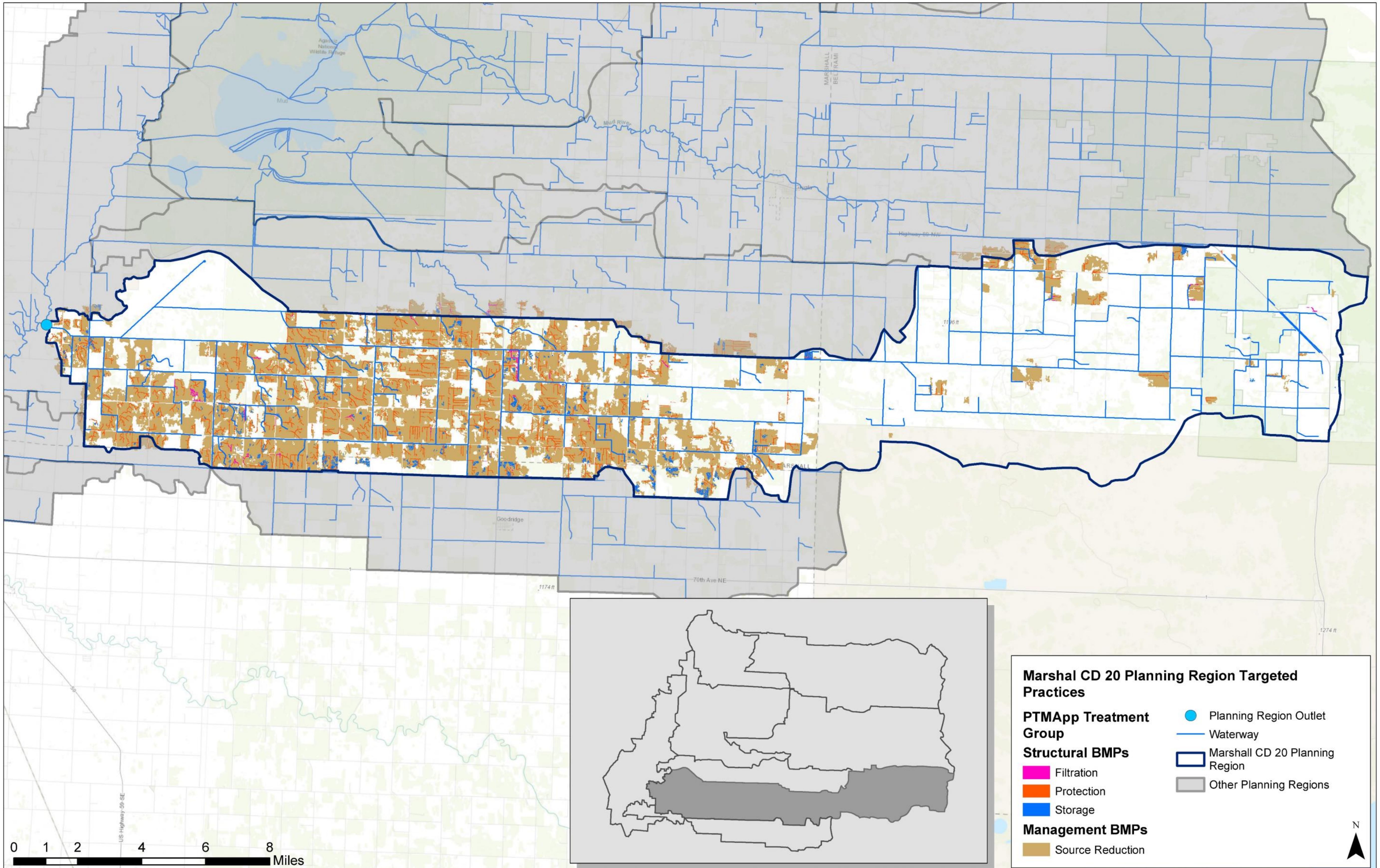
The Cost-Effectiveness Curve shows the optimal efficiency for implementation of actions to achieve load reduction goals. The curve is based on the most cost-effective and efficient management and structural practices as estimated by PTMApp. The curves show that it is possible to achieve load reduction goals through implementation of the targeted approach.

PRACTICE SUMMARY

Below is a summary of targeted conservation practices based on aggregated individual benefits and costs, and the specific types of practices that will be targeted within treatment groups.

	Treatment Group				
	Filtration	Protection	Storage	Source Reduction	Totals
Count	44	12	1991	171	426
Sediment Reduction (tons/yr.)	519	31	1,107	1,709	3,366
Total Phosphorus Reduction (lbs./yr.)	106	17	259	758	1,140
Avg. Cost-Effectiveness ($/tons of sed/yr.)	233	3,303	718	199	533
Standard Deviation of Cost Effectiveness	281	2,005	516	402	766
Practice Types	Conservation Cover; Cover Crop; Filter Strips; Grassed Waterway; Riparian Buffers	Critical Area Planting; Grad Stabilization Structure; Tree/Shrub Establishment; Well Sealing; Septic System Upgrades; Upland Wildlife Habitat Management; Restoration and Management of Rare/ Declining Habitat; Prescribed Burning; Gravel Pit Reclamation	Drainage Water Management; Wetland Restoration; Water Control Structures; Water and Sediment Control Basins; Diversion	Residue and Tillage Management; Nutrient Management	




Marshal CD 20 Planning Region Targeted Practices
PTMApp Treatment Group
Structural BMPs
Filtration
Protection
Storage
Management BMPs
Source Reduction
Planning Region Outlet
Waterway
Marshall CD 20 Planning Region
Other Planning Regions
0 1 2 4 6 8
Miles
N

Targeted Implementation Profile: Middle Thief River

MEASURABLE GOAL

Goals and Loading Source: Thief River Watershed TMDL/HSPF

Existing Sediment Load at Planning Region Outlet: 4,351 tons/yr.

Targeted Sediment Load Reduction at Outlet: 653 tons/yr.

Existing Total Phosphorus Load at Planning Region Outlet: 50,381 lbs./yr.

Targeted Total Phosphorus Load Reduction at Outlet: 2,177 lbs./yr.

Estimated Funding Needed to Meet Sediment Goal: $251,161

Estimated Funding Needed to Meet Total Phosphorus Goal: $13,412,572

TARGETING APPROACH

Management Practices:

- **Sediment Reduction > 0.5 tons/yr.**
- **Total Phosphorus Reduction > 0.5 tons/yr.**
- **Size > 10 acre**

Structural Practices:

- **Filtration Practices: Total Phosphorus Reduction > 0.5 lbs./yr.; contributing drainage area > 40 acres**
- **Protection Practices: Contributing drainage area > 40 acres**
- **Storage Practices: Sediment Reduction > 0.5 tons/yr.**
- **Biofiltration Practices: Total Phosphorus Reduction > 0.5 lbs./yr.; contributing drainage area > 40 acres**

All Practices:

- **Surface Area of Practice > 0.5 acres**
- **Treat > = 50% of runoff to practice**

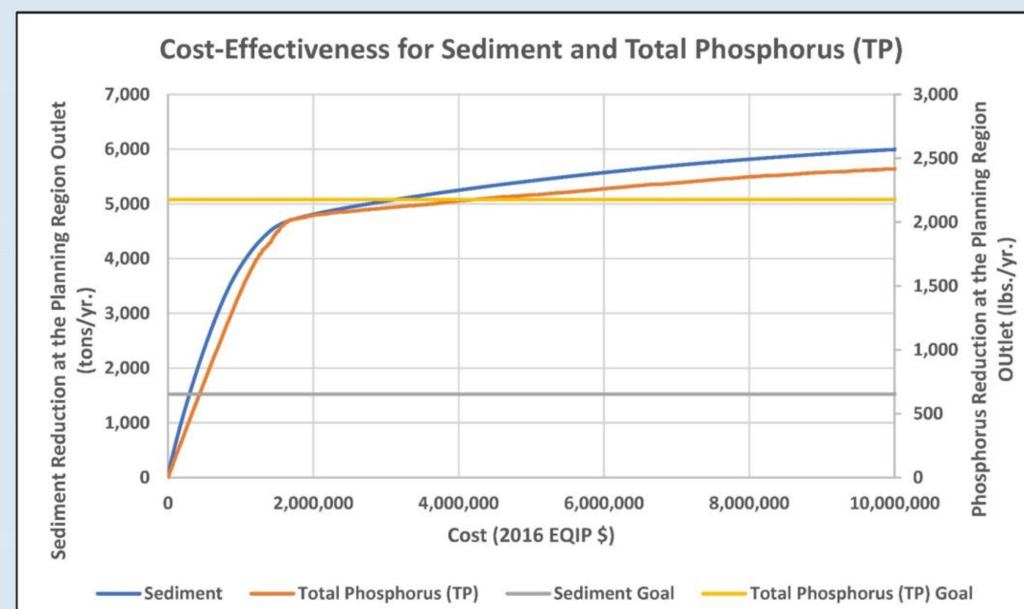
EVALUATING CONSERVATION GOALS

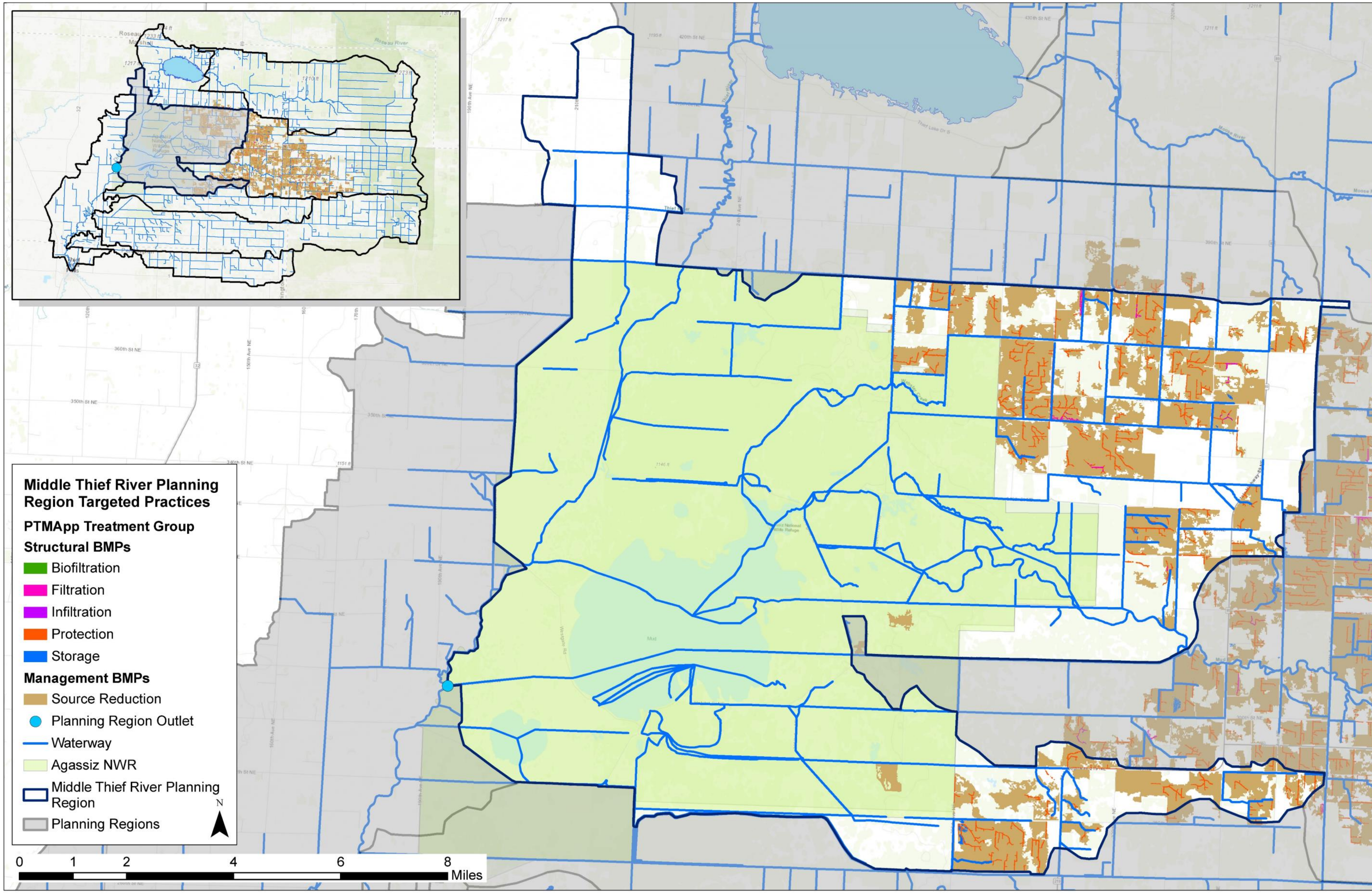
The Cost-Effectiveness Curve shows the optimal efficiency for implementation of actions to achieve load reduction goals. The curve is based on the most cost-effective and efficient management and structural practices as estimated by PTMApp. The curves show that it is possible to achieve load reduction goals through implementation of the targeted approach.

PRACTICE SUMMARY

Below is a summary of targeted conservation practices based on aggregated individual benefits and costs, and the specific types of practices that will be targeted within treatment groups.

	Treatment Group						
	Biofiltration	Filtration	Infiltration	Protection	Storage	Source Reduction	Totals
Count	9	60	28	536	76	1,032	1,741
Sediment Reduction (tons/yr.)	22	194	212	1,184	222	3,786	5,620
Total Phosphorus Reduction (lbs./yr.)	13	45	23	423	59	1,901	2,264
Avg. Cost-Effectiveness ($/tons of sed/yr.)	24,389	865	28,488	8,923	5,840	388	3,846
Standard Deviation of Cost Effectiveness	15,439	953	64,256	6,654	9,099	311	10,483
Practice Types	Saturated Buffer	Conservation Cover; Cover Crop; Filter Strips; Grassed Waterway; Riparian Buffers	Multi-stage Ditch; Infiltration Trench or Small Basin	Critical Area Planting; Grad Stabilization Structure; Tree/Shrub Establishment; Well Sealing; Septic System Upgrades; Upland Wildlife Habitat Management; Restoration and Management of Rare/ Declining Habitat; Prescribed Burning; Gravel Pit Reclamation	Drainage Water Management; Wetland Restoration; Water Control Structures; Water and Sediment Control Basins; Diversion	Residue and Tillage Management; Nutrient Management	




Middle Thief River Planning Region Targeted Practices
PTMApp Treatment Group
Structural BMPs
Biofiltration
Filtration
Infiltration
Protection
Storage
Management BMPs
Source Reduction
Planning Region Outlet
Waterway
Agassiz NWR
Middle Thief River Planning Region
Planning Regions
N
0 1 2 4 6 8
Miles

Targeted Implementation Profile: Moose River

MEASURABLE GOAL

Goals and Loading Source: Thief River Watershed TMDL/HSPF

Existing Sediment Load at Planning Region Outlet: 998 tons/yr.

Targeted Sediment Load Reduction at Outlet: 50 tons/yr.

Existing Total Phosphorus Load at Planning Region Outlet: 16,229 lbs./yr.

Targeted Total Phosphorus Load Reduction at Outlet: 811 lbs./yr.

Estimated Funding Needed to Meet Sediment Goal: $2,278

Estimated Funding Needed to Meet Total Phosphorus Goal: $2,744,851

TARGETING APPROACH

Management Practices:

- **Sediment Reduction > 0.5 tons/yr.**
- **Total Phosphorus Reduction > 0.5 tons/yr.**
- **Size > 10 acre**

Structural Practices:

- **Filtration Practices: Total Phosphorus Reduction > 0.5 lbs./yr.; contributing drainage area > 40 acres**
- **Protection Practices: Contributing drainage area > 40 acres**
- **Storage Practices: Sediment Reduction > 0.5 tons/yr.**
- **Biofiltration Practices: Total Phosphorus Reduction > 0.5 lbs./yr.; contributing drainage area > 40 acres**

All Practices:

- **Surface Area of Practice > 0.5 acres**
- **Treat > = 50% of runoff to practice**

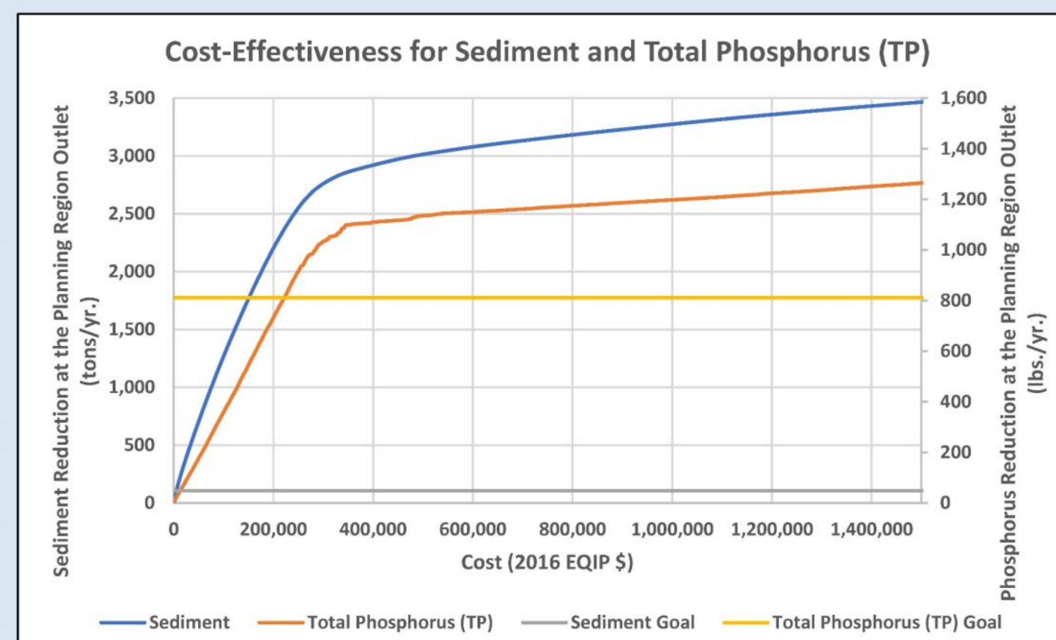
EVALUATING CONSERVATION GOALS

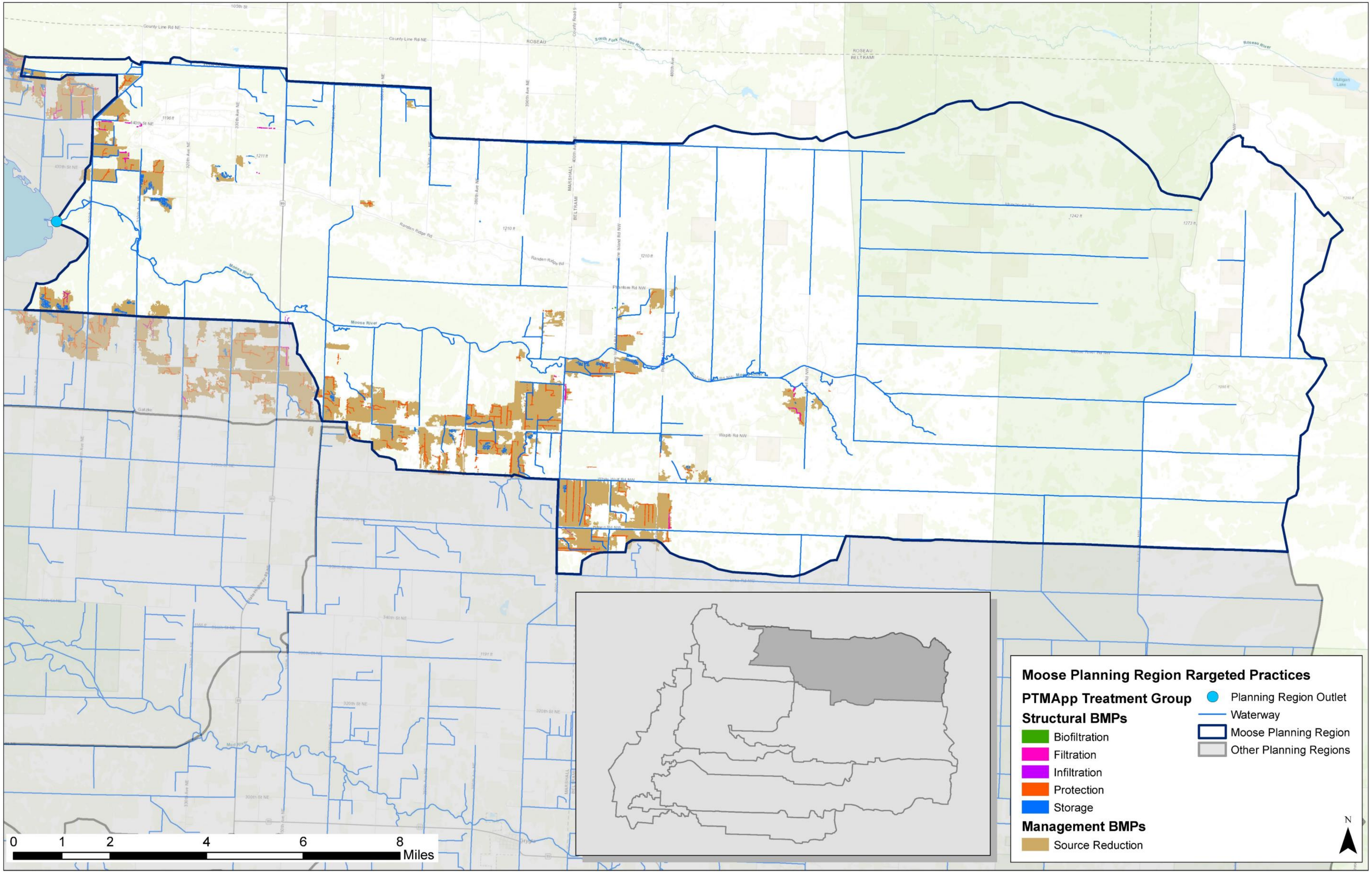
The Cost-Effectiveness Curve shows the optimal efficiency for implementation of actions to achieve load reduction goals. The curve is based on the most cost-effective and efficient management and structural practices as estimated by PTMApp. The curves show that it is possible to achieve load reduction goals through implementation of the targeted approach.

PRACTICE SUMMARY

Below is a summary of targeted conservation practices based on aggregated individual benefits and costs, and the specific types of practices that will be targeted within treatment groups.

	Treatment Group						
	Biofiltration	Filtration	Infiltration	Protection	Storage	Source Reduction	Totals
Count	1	23	6	173	58	118	379
Sediment Reduction (tons/yr.)	3	127	71	726	153	1,149	2,228
Total Phosphorus Reduction (lbs./yr.)	1	52	10	235	43	533	874
Avg. Cost-Effectiveness ($/tons of sed/yr.)	11,220	433	28,339	3,619	2,689	153	2,615
Standard Deviation of Cost Effectiveness	N/A	361	52,482	3,294	3,871	166	7,549
Practice Types	Saturated Buffer	Conservation Cover; Cover Crop; Filter Strips; Grassed Waterway; Riparian Buffers	Multi-stage Ditch; Infiltration Trench or Small Basin	Critical Area Planting; Grad Stabilization Structure; Tree/Shrub Establishment; Well Sealing; Septic System Upgrades; Upland Wildlife Habitat Management; Restoration and Management of Rare/ Declining Habitat; Prescribed Burning; Gravel Pit Reclamation	Drainage Water Management; Wetland Restoration; Water Control Structures; Water and Sediment Control Basins; Diversion	Residue and Tillage Management; Nutrient Management	




Moose Planning Region Rargeted Practices
PTMApp Treatment Group
Structural BMPs
Biofiltration
Filtration
Infiltration
Protection
Storage
Management BMPs
Source Reduction
Planning Region Outlet
Waterway
Moose Planning Region
Other Planning Regions
Moose River
0 1 2 4 6 8
Miles
N

Targeted Implementation Profile: Mud River

MEASURABLE GOAL

Goals and Loading Source: Thief River Watershed TMDL/HSPF

Existing Sediment Load at Planning Region Outlet: 2,897 tons/yr.

Targeted Sediment Load Reduction at Outlet: 290 tons/yr.

Existing Total Phosphorus Load at Planning Region Outlet: 37,554 lbs./yr.

Targeted Total Phosphorus Load Reduction at Outlet: 1,878

Estimated Funding Needed to Meet Sediment Goal: $16,180

Estimated Funding Needed to Meet Total Phosphorus Goal: $5,220,954

TARGETING APPROACH

Management Practices:

- **Sediment Reduction > 0.5 tons/yr.**
- **Total Phosphorus Reduction > 0.5 tons/yr.**
- **Size > 10 acre**

Structural Practices:

- **Filtration Practices: Total Phosphorus Reduction > 0.5 lbs./yr.; contributing drainage area > 40 acres**
- **Protection Practices: Contributing drainage area > 40 acres**
- **Storage Practices: Sediment Reduction > 0.5 tons/yr.**
- **Biofiltration Practices: Total Phosphorus Reduction > 0.5 lbs./yr.; contributing drainage area > 40 acres**

All Practices:

- **Surface Area of Practice > 0.5 acres**
- **Treat > = 50% of runoff to practice**

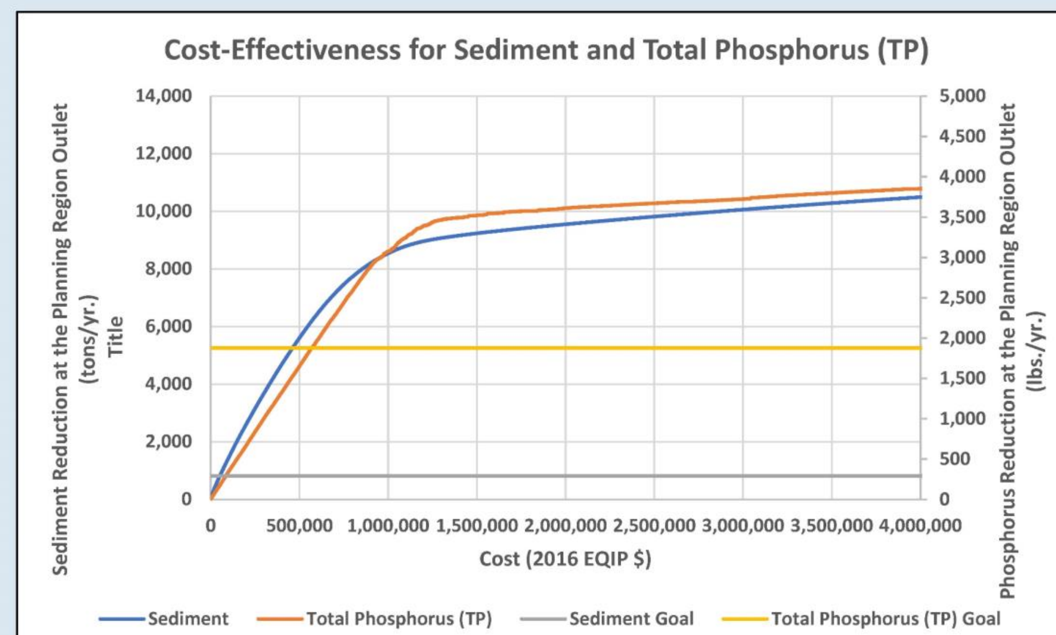
EVALUATING CONSERVATION GOALS

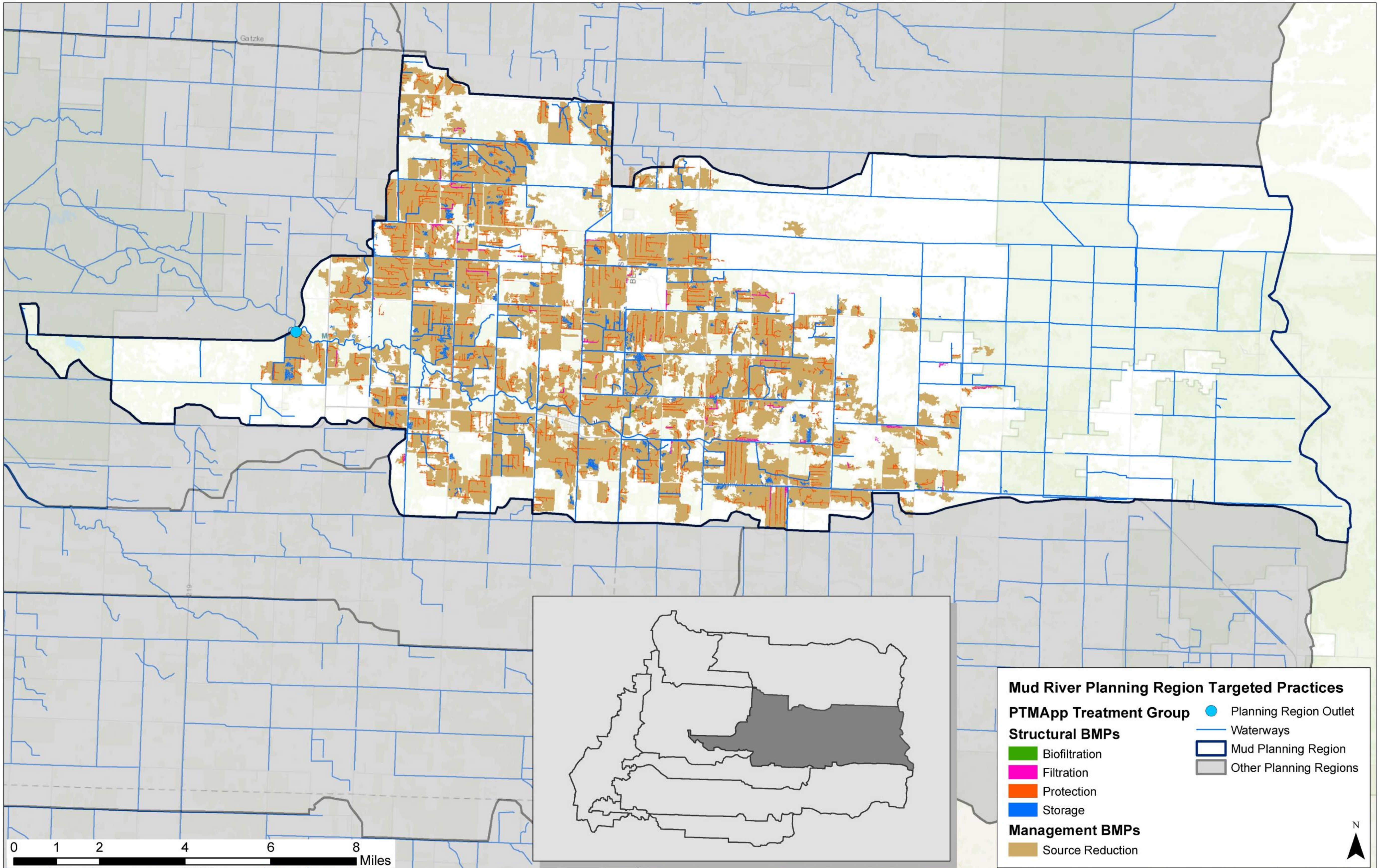
The Cost-Effectiveness Curve shows the optimal efficiency for implementation of actions to achieve load reduction goals. The curve is based on the most cost-effective and efficient management and structural practices as estimated by PTMApp. The curves show that it is possible to achieve load reduction goals through implementation of the targeted approach.

PRACTICE SUMMARY

Below is a summary of targeted conservation practices based on aggregated individual benefits and costs, and the specific types of practices that will be targeted within treatment groups.

	Treatment Group					
	Biofiltration	Filtration	Protection	Storage	Source Reduction	Totals
Count	**3**	**58**	**297**	**165**	**277**	**800**
Sediment Reduction (tons/yr.)	**17**	**427**	**1,582**	**430**	**2,724**	**5,180**
Total Phosphorus Reduction (lbs./yr.)	**12**	**103**	**546**	**113**	**1,093**	**1,884**
Avg. Cost-Effectiveness ($/tons of sed/yr.)	**9,926**	**467**	**3,794**	**986**	**165**	**1,740**
Standard Deviation of Cost Effectiveness	**7,350**	**776**	**3,896**	**1,957**	**210**	**3,085**
Practice Types	Saturated Buffer	Conservation Cover; Cover Crop; Filter Strips; Grassed Waterway; Riparian Buffers	Critical Area Planting; Grad Stabilization Structure; Tree/Shrub Establishment; Well Sealing; Septic System Upgrades; Upland Wildlife Habitat Management; Restoration and Management of Rare/ Declining Habitat; Prescribed Burning; Gravel Pit Reclamation	Drainage Water Management; Wetland Restoration; Water Control Structures; Water and Sediment Control Basins; Diversion	Residue and Tillage Management; Nutrient Management	




Mud River Planning Region Targeted Practices
PTMApp Treatment Group
Structural BMPs
Biofiltration
Filtration
Protection
Storage
Management BMPs
Source Reduction
Planning Region Outlet
Waterways
Mud Planning Region
Other Planning Regions
0 1 2 4 6 8
Miles
N

Targeted Implementation Profile: Upper Thief River

MEASURABLE GOAL

Goals Source: Thief River Watershed TMDL/HSPF

Existing Sediment Load at Planning Region Outlet: 2,055 tons/yr.

Targeted Sediment Load Reduction at Outlet: 103 tons/yr.

Existing Total Phosphorus Load at Planning Region Outlet: 11,487 lbs./yr.

Targeted Total Phosphorus Load Reduction at Outlet: 574 lbs./yr.

Estimated Funding Needed to Meet Sediment Goal: $14,995

Estimated Funding Needed to Meet Total Phosphorus Goal: $591,914

TARGETING APPROACH

Management Practices:

- **Sediment Reduction > 0.5 tons/yr.**
- **Total Phosphorus Reduction > 0.5 tons/yr.**
- **Size > 10 acre**

Structural Practices:

- **Filtration Practices: Total Phosphorus Reduction > 0.5 lbs./yr.; contributing drainage area > 40 acres**
- **Protection Practices: Contributing drainage area > 40 acres**
- **Storage Practices: Sediment Reduction > 0.5 tons/yr.**
- **Biofiltration Practices: Total Phosphorus Reduction > 0.5 lbs./yr.; contributing drainage area > 40 acres**

All Practices:

- **Surface Area of Practice > 0.5 acres**
- **Treat > = 50% of runoff to practice**

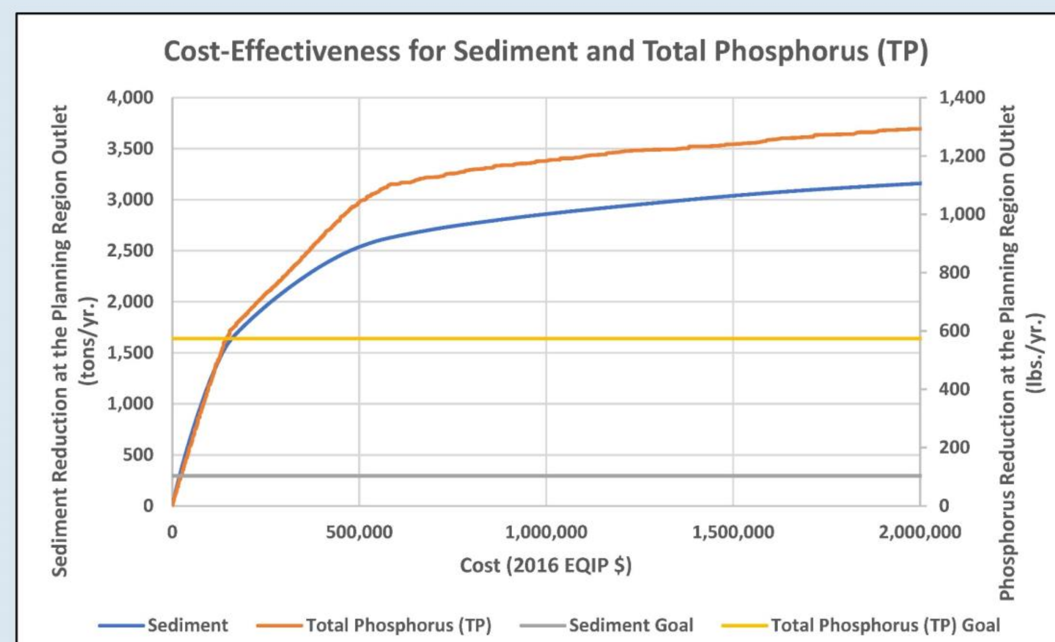
EVALUATING CONSERVATION GOALS

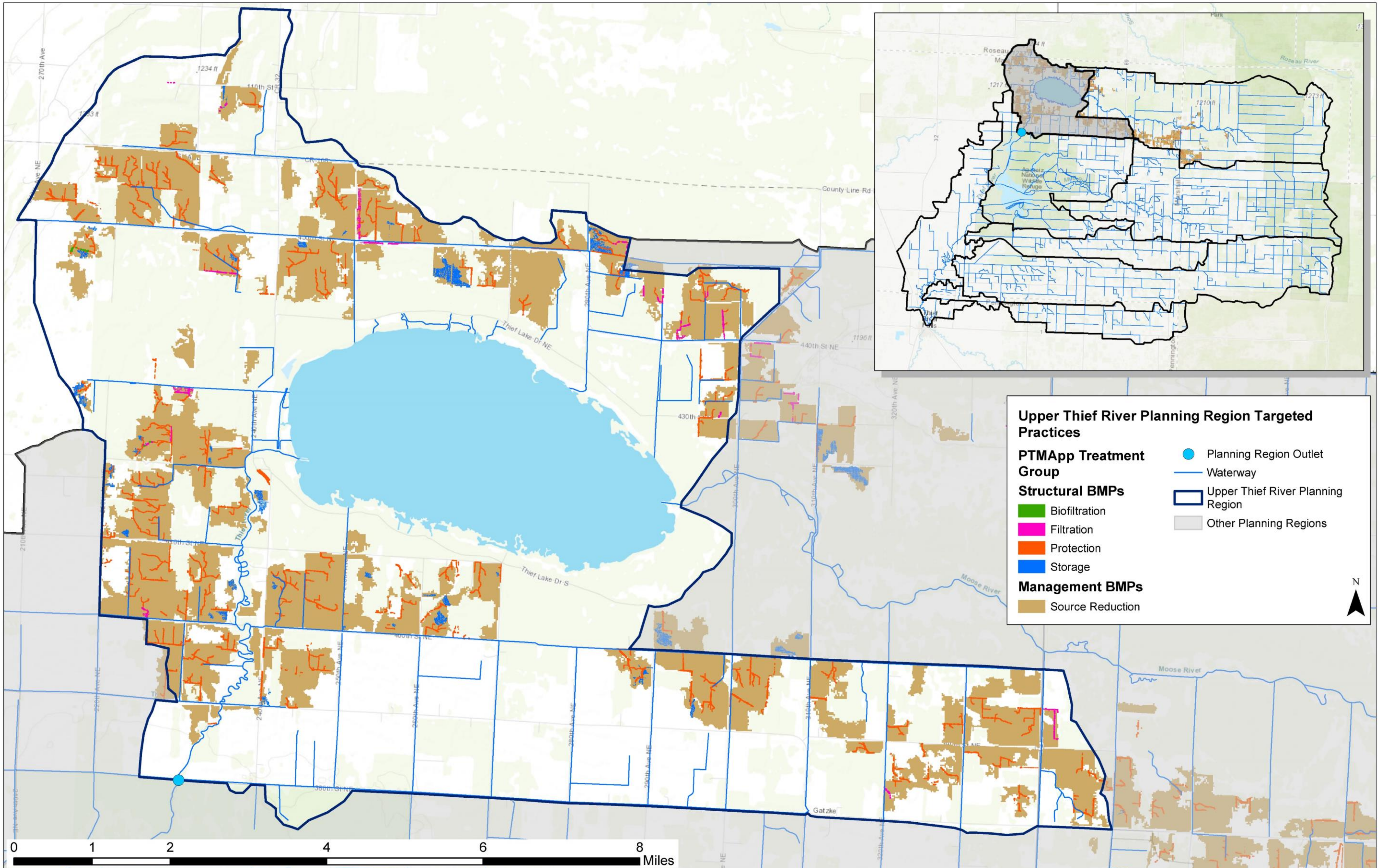
The Cost-Effectiveness Curve shows the optimal efficiency for implementation of actions to achieve load reduction goals. The curve is based on the most cost-effective and efficient management and structural practices as estimated by PTMApp. The curves show that it is possible to achieve load reduction goals through implementation of the targeted approach.

PRACTICE SUMMARY

Below is a summary of targeted conservation practices based on aggregated individual benefits and costs, and the specific types of practices that will be targeted within treatment groups.

	Treatment Group					
	Biofiltration	Filtration	Protection	Storage	Source Reduction	Totals
Count	2	28	33	38	113	214
Sediment Reduction (tons/yr.)	1	81	143	66	1,216	1,507
Total Phosphorus Reduction (lbs./yr.)	10	29	50	22	464	576
Avg. Cost-Effectiveness ($/tons of sed/yr.)	50,612	886	2,799	1,012	142	1,275
Standard Deviation of Cost Effectiveness	2,431	696	197	560	197	5,037
Practice Types	Saturated Buffer	Conservation Cover; Cover Crop; Filter Strips; Grassed Waterway; Riparian Buffers	Critical Area Planting; Grad Stabilization Structure; Tree/Shrub Establishment; Well Sealing; Septic System Upgrades; Upland Wildlife Habitat Management; Restoration and Management of Rare/ Declining Habitat; Prescribed Burning; Gravel Pit Reclamation	Drainage Water Management; Wetland Restoration; Water Control Structures; Water and Sediment Control Basins; Diversion	Residue and Tillage Management; Nutrient Management	




Upper Thief River Planning Region Targeted Practices
PTMApp Treatment Group
Structural BMPs
Biofiltration
Filtration
Protection
Storage
Management BMPs
Source Reduction
Planning Region Outlet
Waterway
Upper Thief River Planning Region
Other Planning Regions
N
0
1
2
4
6
8
Miles
Thief Lake Dr NE
Thief Lake Dr S
County Line Rd
Moose River
Gatzke

4.5.1 Critical Sediment and Phosphorus Areas

Additional opportunities for BMPs and conservation practices may arise outside of the areas identified in the targeting approach. These opportunities may come from a landowner, the identification of a new problem area in the watershed, or new data and studies. In order to account for these potential opportunities, critical sediment and phosphorus maps have been developed for the Thief River Watershed. These maps show the top 25% of areas with critical sediment and phosphorus loss from cultivated lands at the watershed scale. Critical area GIS layers will be available for use by LGUs. Potential projects and practices in these critical areas may be eligible for cost share.

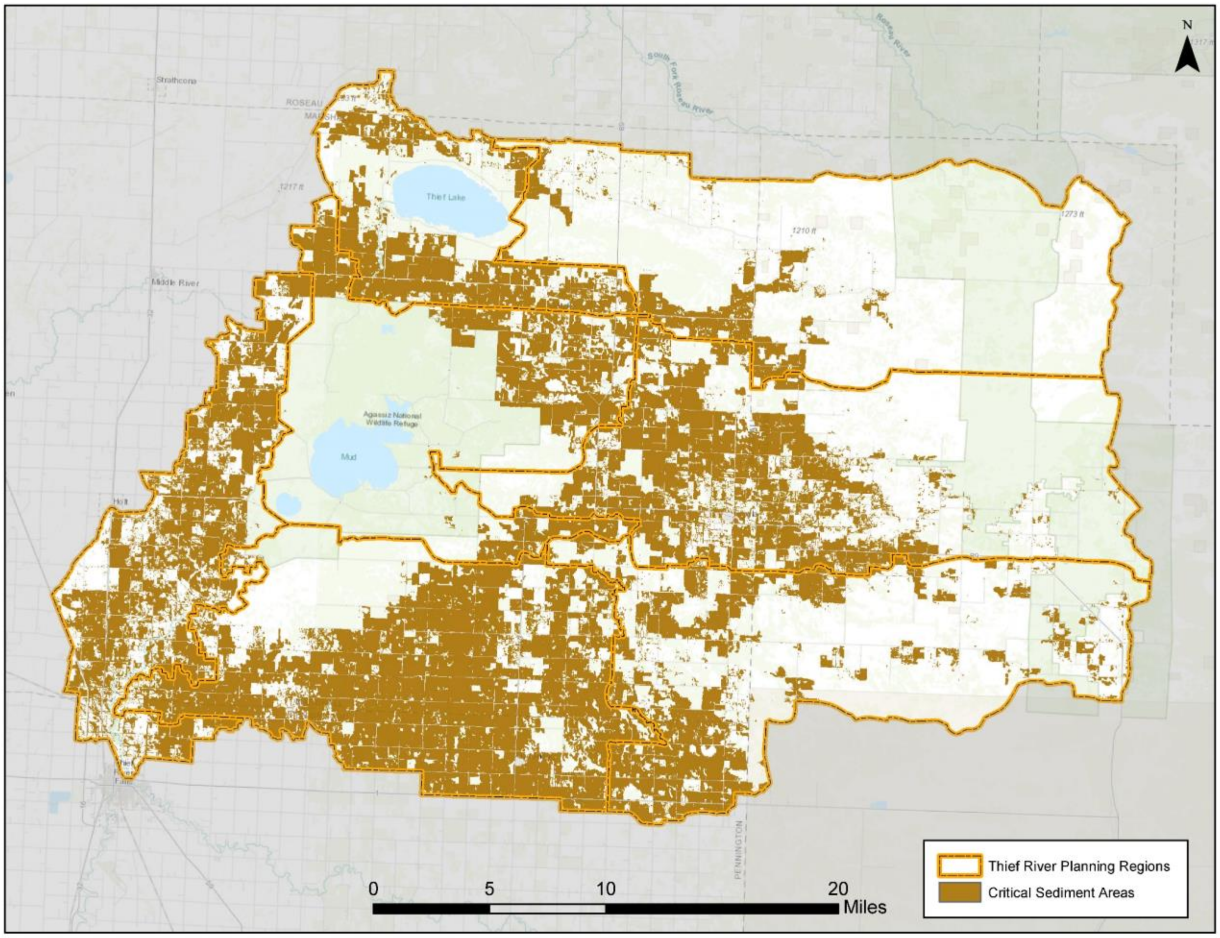


Figure 4-2: Critical Sediment Areas in the Thief River Watershed

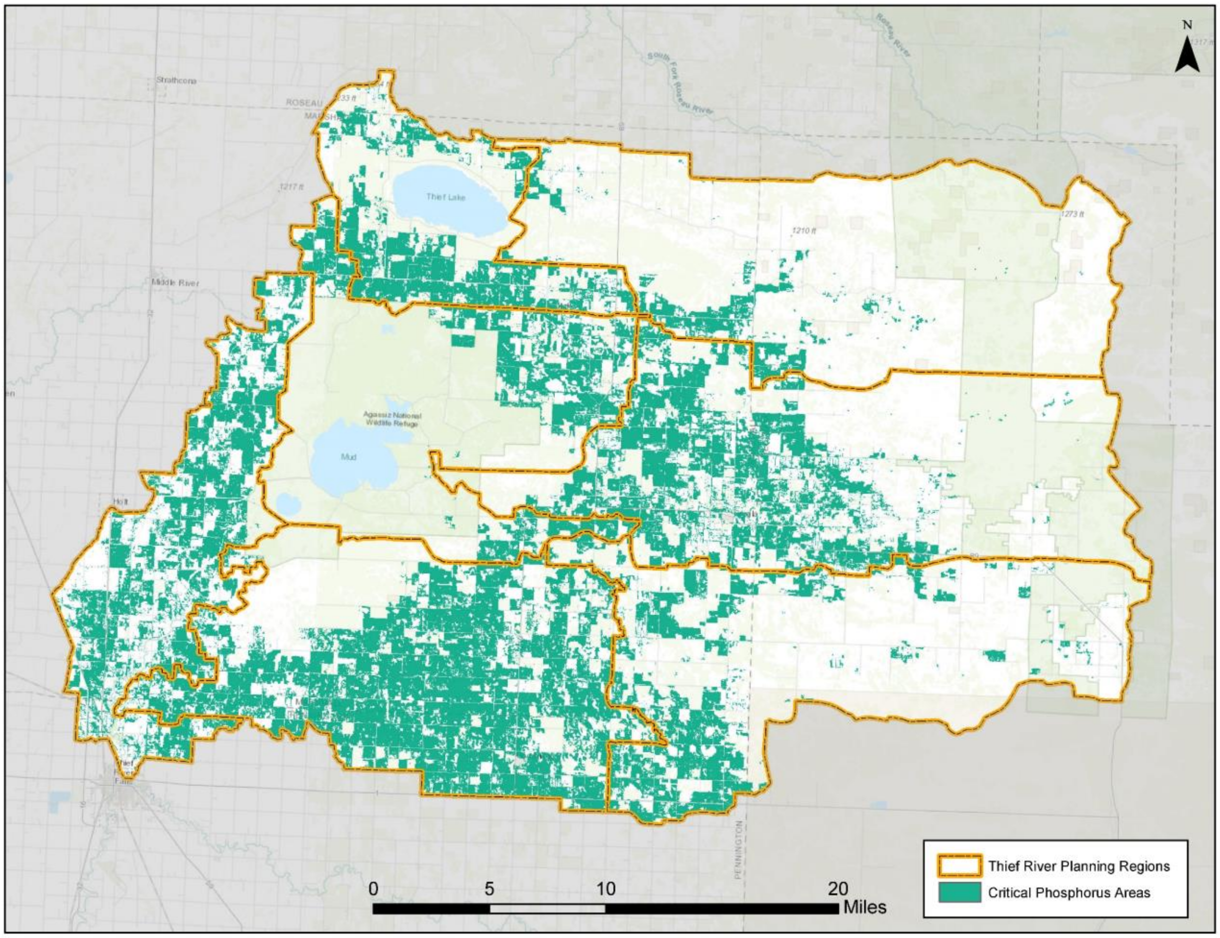


Figure 4-3: Critical Phosphorus Areas in the Thief River Watershed

5.0 IMPLEMENTATION PROGRAM

5.1 IMPLEMENTATION PROGRAMS

Plan implementation programs are a key component of the targeted implementation schedule presented in **Section 4**. In the targeted implementation schedule, each action is categorized as an implementation component (i.e. structural BMP, management practice, education and outreach, data gaps and research, regulatory, and capital improvement). These implementation components correspond to the implementation program that will be used to fund the action.

Implementation programs are the funding mechanism to implement actions and make progress toward achieving plan measurable goals. Previously, implementation programs were used by plan participants across the Thief River Watershed but lacked commonality. This plan establishes common implementation programs within the plan area[1] and describes them conceptually in this section. Specific details for execution may be needed before program use.

5.1.1 Projects and Practices

Within the targeted implementation schedule, actions assigned as management practice or structural BMP use the planning, design, and implementation of management practices (e.g. nutrient management, conservation tillage) and structural BMPs (e.g. grassed waterways, controlled drainage) on the landscape to make progress toward measurable goals. These actions are funded through the Projects and Practices Program. Examples of activities that are eligible for funding through the Projects and Practices Program include:

- soil testing and grid sampling (e.g., for organic matter content and to guide fertilizer recommendations);
- field scale cash flow/profitability analysis to identify low profitability locations and the intersection with opportunities for management practices and structural BMPs;
- field walkovers and consultations with property owners interested in implementing management practices or structural BMPs;
- structural BMP design;
- the construction of structural BMPs, including the cost associated with construction observation, construction materials, and actual construction;
- the administrative, engineering, and legal costs specific to implementing management practices or structural BMPs; and
- documentation costs for complying with grant or funding requirements.

Management practices and structural BMPs funded by the Projects and Practices Program are typically much smaller in size than a capital improvement project. Projects and practices funded are intended to reduce the amount of sediment and nutrients leaving the landscape and delivered downstream, thereby treating runoff near the pollutant source. This cost-share is also used to fund projects and practices that create live storage on the landscape. Any type of assistance (financial incentive, technical assistance, tax exemption, conservation easement, land acquisition) can be used to provide the Projects and Practices Program. Cost-share amounts will be set in annual work plans, typically between 75-90% for NRCS practices.

A typical budget breakdown for projects and practices is:

- 5% Project Development
- 15% Technical and Engineering
- 75% Construction
- 5% Administration

[1] Plan participants will continue to use financial incentives through their own programs to meet their own individualized needs within their jurisdiction.

Project development includes expenses such as landowner meetings, project mailings, and developing necessary agreements or contracts. LGU staff will work with the Ditch Authority and private landowners to discuss resource concerns and implementing BMPs. The Planning Workgroup and Policy Committee will develop cost-share policy for project implementation. There will also be cost-share contracts developed to provide assurance that the practice remains in place for the designed life expectancy.

Field walkovers, consultations to identify critical source areas, and other types of technical assistance will be provided to the landowner using the Projects and Practices Program up to a maximum amount as determined by funds available. The purpose of technical assistance is to evaluate how to best plan to fix a problem. Projects and Practices dollars can then be used to design and implement solutions to problems once identified. Technical assistance funded through the program can be performed by any qualified entity that undergoes sufficient training (SWCD or watershed district staff, agronomic advisor, consultant, etc.).

Technical and engineering includes survey, design, and construction inspection of structural and management practices, as appropriate, from a licensed engineer or staff with NRCS Job Approval Authority for the specific practice. Practices will follow the NRCS Field Office Technical Guide (FOTG) standards or other applicable standards approved by a Professional Engineer. County engineers and private engineers may also assist with survey, design, and construction inspection, depending on TSA and SWCD workload. A lesser design standard can be used to fund a project or practice, but the total allotted cost-share amount may be reduced. If a lesser design standard is used to plan and implement a management practice or structural BMP, the burden for replacement is shifted to the landowner.

The Projects and Practices Program is expected be funded through Clean Water Fund dollars and potentially dollars from federal and foundation grants[2] to pay for eligible activities. Grant applications to fund the Projects and Practices Program will be prepared jointly as the Thief River Watershed 1W1P Planning Group.

Prior to any grant application, each partnering entity will identify the number and locations of management and structural BMPs they wish to implement within a two-year period, consistent with the plan and according to technical capacity. Funding for Projects and Practices Program dollars is preferentially given to projects and practices that adhere to the prioritized numbers, types, and locations of projects and practices identified within the targeted implementation plan (see **Section 4**).

Grant dollars received by the Thief River Watershed 1W1P Planning Group will be distributed to plan participants planning, designing, or implementing the prioritized and funded management practices and structural BMPs. Decisions about practices considered but not funded (perhaps a landowner is unwilling to participate) should be maintained in a central location uses. Each plan participant that receives funding is responsible for reporting results and estimated benefits arising from dollars received.

The Thief River Watershed 1W1P Planning Work Group is responsible for managing the process, paperwork, and funds (including payment requests) of the Projects and Practices Program. The program will be coordinated through local units of government. Additional staff are likely to be needed because the amount of money available and number of practices constructed will increase. Implementing the program will require one or more qualified engineering technicians capable of designing the practices and working with landowners and county engineers.

[2] Private funding from private agribusinesses may be possible, provided the efforts support a sustainability claim.

Table 5-1: Probable list of management practices or structural BMPs eligible for funding under the Projects and Practices Cost Program List is not all inclusive. Management practices and structural BMPs are grouped by their Prioritize, Target, and Measure Application (PTMApp) treatment group.

Management Practice or Structural BMP	NRCS Code	PTMApp Treatment Group Category						
		Storage	Filtration	Biofiltration	Infiltration	Protection	Source Reduction	User Defined
Alternative Tile Intake – Dense Pattern Tiling	606				x			
Alternative Tile Intake – Gravel Inlet	606		x					
Alternative Tile Intake – Other Blind Intake	606		x					
Alternative Tile Intake – Perforated Riser Intake	606	x						
Anaerobic Digester	366							x
Bioretention Basin	N/A			x				
Conservation Cover	327		x					
Conservation Crop Rotation	328		x					
Conservation Tillage	329						x	
Constructed Wetlands	N/A	x						
Contour Buffer Strips	332		x					
Contour Farming	330						x	
Cover Crop	340		x					
Critical Area Planting	342					x		
Culvert Sizing	N/A	x						
Dam	402	x						
Drainage Water Management	554	x						
Filter Strips	393		x					
Forage and Biomass Planting	512						x	
Grade Stabilization Structure	410					x		
Grassed Waterways and Swales	412		x					
Infiltration Trench	N/A				x			
Irrigation Water Management	442						x	
Lined Waterway or Outlet	468				x			
Multi-stage Ditch	N/A				x			
Nutrient Management	590						x	
Pest Management	595							x

Management Practice or Structural BMP	NRCS Code	PTMApp Treatment Group Category						
		Storage	Filtration	Biofiltration	Infiltration	Protection	Source Reduction	User Defined
Pond for Water Use	378	x						
Prescribed Burning	338							x
Prescribed Grazing	556						x	
Riparian Forest Buffer	391		x					
Riparian Herbaceous Cover	322		x					
Roof Runoff Management	558							x
Rotational Grazing	N/A						x	
Sediment Basin	350	x						
Saturated Buffer	N/A			x				
Septic System Improvement	N/A							x
Stormwater Retention Basins	N/A	x						
Stream Channel Stabilization	584					x		
Streambank and Shoreline Protection	580					x		
Stripcropping	585				x			
Structure for Water Control	587	x						
Terrace	600		x					
Tree/Shrub Establishment	612					x		
Water and Sediment Control Basin	638	x						
Water Reuse	636							x
Wetland Creation	658	x						
Wetland Restoration	657	x						

5.1.2 Education and Outreach

Actions assigned as an education and outreach implementation component use education and outreach to make progress toward a measurable goal. The Education and Outreach Implementation Program funds the implementation of these actions. These actions are primarily targeted at two stakeholder groups:

1. The general public
2. Plan stakeholders (e.g., local staff, government agencies, landowners, and producers)

Thus, the Education and Outreach Program focuses efforts on these stakeholder groups through:

- coordinated public outreach
- stakeholder forum(s)

The Education and Outreach Implementation Program is operated through existing relationships and coordination among LGUs on education and outreach events. LGUs each have their own education and outreach programs as well as joint programs and events. Much of the materials and templates are already developed. LGUs will continue to collaborate on existing events and seek new opportunities to improve education and outreach in the watershed.

The stakeholder forum provides an opportunity for those with a vested interest in plan implementation and future plan development to provide input and gain knowledge of matters related to the implementation of the plan. The forum consists of regular meetings already occurring in the watershed. Consideration will be given to coordination of meetings among local governments to improve efficiency and consistency on delivering watershed updates to stakeholders.

5.1.2.1 Coordinated Public Outreach

The primary purpose of coordinated public outreach is to create positive and impactful education and outreach experiences the public, including general citizens down through school aged children. Plan partners collaborate with others to increase education and outreach and community engagement within the plan area. Collaboration with other entities is discussed more in **Section 5.3.2**.

Several activities are included as part of coordinated public outreach, such as the development of educational materials and newsletters; coordination of volunteer activities; presentations at schools, local organizations (Rotary, Lions, Jaycees, etc.), and producer group events; and hosting of public meetings to raise awareness and gain a better understanding of the consequences of individual decisions on water management. Also included are general media campaigns, citizen and local government unit surveys, and municipal training. Specific examples include:

- Pennington SWCD Outdoor Education Day
- Northwest Minnesota Water Festival in Warren
- River Watch (Grygla)
- River Explorers
- Envirothon
- Thief River Falls Community Expo
- Open houses as part of the MPCA WRAPs process

Online resources available also provide information on the Thief River Watershed:

- Red Lake Watershed District Annual Reports: http://www.redlakewatershed.org/Annual_Reports.html
- Red Lake Watershed District Monthly Water Quality Reports: http://www.redlakewatershed.org/monthwq.html
- Red Lake Watershed District Website: www.redlakewatershed.org
- Thief River Watershed Website: http://www.rlwdwatersheds.org/tr-watershed-info
- Beltrami County Website: http://www.co.beltrami.mn.us/
- Beltrami SWCD Website: http://www.co.beltrami.mn.us/Departments/SWCD/SWCD%20home.html
- Marshall County Website: http://www.co.marshall.mn.us/departments/water_and_land_office/index.php
- Marshall SWCD Website: http://www.marshallcounty-swcd.org/index.html
- Pennington County Website: http://co.pennington.mn.us/
- Pennington SWCD Website: https://www.penningtonswcd.org/
- Red Lake Watershed District Facebook Page: https://www.facebook.com/Red-Lake-Watershed-District-266521753412008/
- Pennington SWCD Facebook Page: https://www.facebook.com/penningtonswcd/

5.1.2.2 Stakeholder Forum

The stakeholder forum is tailored to agricultural landowners and operators, local staff, government agencies, and special interest groups within the plan area. The purpose of the stakeholder forum is to connect various groups with a vested interest in water resource management and promote meaningful dialogue around water in the Thief River Watershed. Currently, the stakeholder form consists of regular meetings of advisory committees relevant to the Thief River Watershed. The group will consider how meetings will be coordinated in the future. Current groups with regular meetings include:

- Red Lake Watershed District Overall Advisory Committee
- Marshall County Water Resources Advisory Committee
- NRCS/SWCD EQIP Local Work Group
- Pennington County Water Resources Advisory Committee
- Thief River 1W1P Advisory Committee

5.1.3 Research and Monitoring

Actions categorized as data gaps and research use research and monitoring to close information and data gaps and are funded by the Research and Monitoring Implementation Program. Closing data gaps allows for the conceptualization of tailored, science-based implementation strategies aimed to develop information to better address priority issues.

Plan participants have invested and will continue to invest in the collection and assembly of data and information. A large portion of these data and information are water quality monitoring data. The Research and Monitoring Implementation Program is dedicated to enhancing and maintaining the monitoring network in the Thief River Watershed to capture and document measurable water quality changes resulting from watershed implementation activities. The Red Lake Watershed District (RLWD), along with plan partners, have a robust surface and ground water monitoring network in place that continues to be refined. As part of this program, plan participants involved in data collection will continue to follow these standards:

- Conduct periodic analyses of data through the development of reports and studies
- Collect data consistent with state compatibility guidelines
- Commit to submit locally collected data to the appropriate state agency for entry into public databases (e.g. MPCA EQUIS)

There are many local plan participants that conduct monitoring in the Thief River Watershed, including but not limited to the RLWD. The RLWD has been conducting water quality monitoring since 1980. Pennington SWCD also conducts monthly water quality monitoring on the Thief River. The RLWD works closely with the Grygla River Watch Team, which, through an International Water Institute (IWI) Program, conducts monitoring in the northeast portion of the watershed. Intensive water quality monitoring has also been conducted in the Thief River Watershed through the Thief River Watershed Sediment Investigation and Agassiz NWR Water Quality study in 2012. Local entities continue to pursue funding to assess and monitor water quality in the Thief River Watershed to fill identified data gaps, measure progress toward implementation goals for both protection and restoration, and provide the basis for future planning and adaptive management.

There are several surface monitoring sites in the Thief River Watershed that are operated by the MPCA as part of the watershed monitoring approach. The watershed approach is a 10-year rotation for assessing waters of the state on the level of Minnesota’s 81 major watersheds (MPCA, 2012). This intensive monitoring is conducted for two years out of a ten-year interval in the watershed. In 2011, the MPCA undertook this intensive watershed monitoring effort of the Thief River Watershed surface waters (MPCA, 2014). These stations consist of stream, biological, and lake monitoring components. The MPCA also coordinates two programs as part of the watershed monitoring programs that are aimed at encouraging citizen surface water monitoring: (1) the Citizen Lake Monitoring Program and (2) the Citizen Stream Monitoring Program. The programs gain valuable long-term data, which can be used to evaluate trends.

The MPCA also operates sites in the Thief River Watershed as part of its Watershed Pollutant Load Monitoring Network (WPLMN). As part of the WPLMN, the IWI conducts monitoring on behalf of the MPCA at three sites: two on the Thief River (near Agassiz National Wildlife Refuge and at the outlet) and one on the Mud River/JD 11 (Hwy 89).

Flow monitoring is also conducted by the MPCA/DNR, USGS, USFWS, and RLWD throughout the watershed. The Thief River has two real-time gages: a USGS site north of Thief River Falls and a MPCA/DNR site on CSAH 7 near the Agassiz NWR. The Mud River/JD 11 is monitored for flow by the MPCA/DNR at Hwy 89.

During the plan development process, planning partners expressed a desire to conduct a study of altered hydrology in the watershed. The analysis requires a robust, long-term annual stream discharge dataset of at least 20 continuous years to establish a benchmark condition. The only available stream gage data in the watershed meeting the minimum criteria is immediately downstream of an area of heavily regulated flow. Thus, a program of continuous flow monitoring at all major tributaries in the watershed is required to conduct the altered hydrology analysis.

Despite the abundance of surface water quality monitoring and data for the Thief River Watershed, there is a significant data gap for groundwater quality and quantity. The MPCA conducted a baseline study of groundwater quality in 1998, and mandatory testing of newly constructed wells by the MDH provides limited information. The only information on groundwater quantity available is from DNR groundwater withdrawal permits. A program to monitor groundwater quantity and quality related to arsenic, bacteria, and nitrates is required to establish baseline datasets.

The practice of tile drainage, is becoming more common in the Red River Basin, including in the Thief River Watershed. Though the RLWD, Marshall SWCD, and Pennington SWCD have programs in place to research the impact of tile drainage on water quality and educate landowners about tile drainage, there is a data gap with regards to permitting and the extent of tile drainage in the Thief River Watershed. In order to fill this data gap and gain a better understanding of the impacts of tile drainage, the planning partners will consult with outside drainage authorities (e.g. county hwy. departments) and leverage existing programs related to education and water quality research.

During implementation, the Research and Monitoring Implementation Program will build on the data and information processes already established by plan participants. This program will also be used to fund implementation of actions aimed to build and maintain technical capacity to fully utilize new technology and tools for water resource management. The Research and Monitoring Implementation Program will be operated through the sharing of services. However, activities will be locally administered and implemented, with individual local entities operating as the fiscal agent.

5.1.4 Capital Improvements

A capital improvement is defined as a major non-recurring expenditure for the construction, repair, retrofit, or increased utility or function of physical facilities, infrastructure, or environmental features. Capital improvements are typically beyond the normal financial means of the Thief River Watershed 1W1P Planning Group and therefore could require external funding.

In the Red River Basin, large and complex projects have the option to use the Project Team process as outlined in the 1998 mediated agreement of the Red River Basin Flood Damage Reduction Work Group (FDRWG). Though traditionally used for watershed district projects, the process has value for the potential capital projects (as well as smaller scale projects) described in this plan. From project concept to development, construction, and monitoring, using the Project Team process offers a collaborative approach, regulatory coordination, and a dedicated forum for resolving issues associated with complex projects. More information is available in the Red River Basin FDRWG Project Team Handbook (http://www.rrwmb.org/Project_Team_Handbook/Project_Team_Handbook.pdf).

Table 5-2 shows proposed capital improvements within the Thief River Watershed. Additional discussions are needed among plan participants to develop the specific process for implementing capital improvements. Specifically, members of the Policy Committee or the Planning Work Group's individual and representative boards are expected to discuss the means and methods for funding new capital improvements, with potential funding partners, before an implementation timeline can be established.

Capital improvement projects completed through this plan will be operated and maintained by individual LGUs

Table 5-2: Potential Capital Improvement Projects in the Thief River Watershed One Watershed, One Plan Planning Area

Capital Improvement Project	Planning Region	Description	Lead Entity	Information Source	Years (Start and End)	Estimated Cost
Thief River Stream Bank Restoration	Lower-, Middle-, and Upper Thief River Planning Regions	Restore and stabilize banks and oxbows along the Thief River	RLWD	Thief River 1W1P	2018-2028	$2,000,000
Flood volume reduction within the downstream planning regions of the Thief River Watershed	Lower- and Middle Thief River Planning Regions	Create a series of runoff reduction BMPs in the Judicial Ditch 30/18/13; Lower Thief River/SD 83; Lost River; and Marshall County Ditch 20 Planning Regions to reduce average annual runoff by 0.125 inches	RLWD	RLWD 10-yr Comprehensive Plan	2018-2028	$8,500,000
Mud River/JD 11 restoration or two-stage ditch upstream of Grygla	Mud River and Branch 200 of JD 11 (Lost River) Planning Regions	Examine feasibility and alternatives; Construct a project that will result in sustainable channel stability along the Mud River/JD 11 upstream of Grygla	RLWD, Marshall/ Beltrami County Ditch Authority	WRAPS	2020-2030	$300,000

Capital Improvement Project	Planning Region	Description	Lead Entity	Information Source	Years (Start and End)	Estimated Cost
Mud River/JD 11 Restoration	Mud River and Branch 200 of JD 11 (Lost River) Planning Regions	Restore flow to approximately 5 miles of historic Mud River/JD 11 in Agassiz NWR	USFWS	Agassiz NWR	2020-2023	$2,000,000
Streambank stabilization along the Mud River/JD 11	Mud River and Branch 200 of JD 11 (Lost River) Planning Regions	Stabilize actively eroding streambanks along the Mud River/JD 11 between Grygla and Agassiz NWR	RLWD, SWCD	WRAPS	2020-2030	$150,000
Upper SD83/Thief River 2-Stage Ditch and Stabilization Project	Upper Thief River Planning Region	Convert 1.4 miles of channel between CSAH 6 and 380th St. NE to a two-stage ditch with a meandering low flow channel and setback levees to maintain flow capacity	RLWD	WRAPS and Geomorphology Report	2020-2030	$200,000
Streambank Stabilization along the Upper Thief River/ SD 83	Upper Thief River Planning Region	Stabilize actively eroding streambanks between 400th St NE and CSAH 6	RLWD, SWCD	WRAPS	2020-2030	$150,000
Upper Thief River/SD 83 floodplain restoration	Upper Thief River Planning Region	Spoil piles from historical channelization should be pulled back to the outside edge of the 300-ft wide riparian zone between CSAH 49 and 400th St. NE	RLWD	WRAPS and Geomorphology Report	2020-2030	$150,000
JD 30 Outlet Stabilization Project	Judicial Ditch No. 30/18/13 Planning Region	Stabilize 3 miles of JD 30 by re-sloping the ditch banks or constructing a 2-stage ditch. The project will also include side water inlet structures where needed.	Pennington County	Thief River 1W1P	2020-2030	$900,000

Capital Improvement Project	Planning Region	Description	Lead Entity	Information Source	Years (Start and End)	Estimated Cost
Moose River/JD 21 Stream Bank Stabilization Project	Moose River Planning Region	Address bank sloughing along the Moose River/JD 21 upstream of CSAH #54 and downstream of the Moose River/JD 21 Impoundment	RLWD	Thief River 1W1P	2018-2028	$500,000
Moose River/JD 21 grade stabilization.	Moose River Planning Region	Survey, design, and install grade control structures along the Moose River/JD 21 upstream of CSAH 54	RLWD, SWCD	WRAPS	2020-2030	$200,000

5.1.4.1 Operations and Maintenance

Operation and maintenance of legal ditches, impoundments, and small dams will continue under regular operations and maintenance plans of the entities with jurisdiction over these systems.

Impoundments in the Thief River Watershed are owned and operated by the RLWD, DNR, and USFWS (**Figure 5-1**). The RLWD operates the Moose River/JD 21 impoundment in the northeast extent of the plan area and the Elm and Lost River impoundments adjacent to the southern boundary of Agassiz NWR. These impoundments are primarily operated for flood control with natural resource enhancements as secondary benefits. More information about RLWD impoundments is available on the District website: http://www.redlakewatershed.org/engineering.html.

The USFWS operates a series of pools and drainage ditches within the Agassiz NWR. The Farmes Pool impoundment is a co-managed pool between the USFWS, DNR, and RLWD. The USFWS pools are primarily operated to benefit wildlife, particularly waterfowl and shorebird species, with flood control as a secondary benefit. More information about Agassiz NWR impoundments and drainage systems is available in the latest Comprehensive Conservation Plan: https://www.fws.gov/midwest/planning/agassiz/FinalCCP/finalCCP_AgassizNWR.pdf

In order to make progress towards Measurable Goal Category 3.2.4: Aquatic Life and Recreation – Increase Dissolved Oxygen Concentration, a coordinated effort between the RLWD and the USFWS is needed to manage flow from impoundments under their jurisdiction.

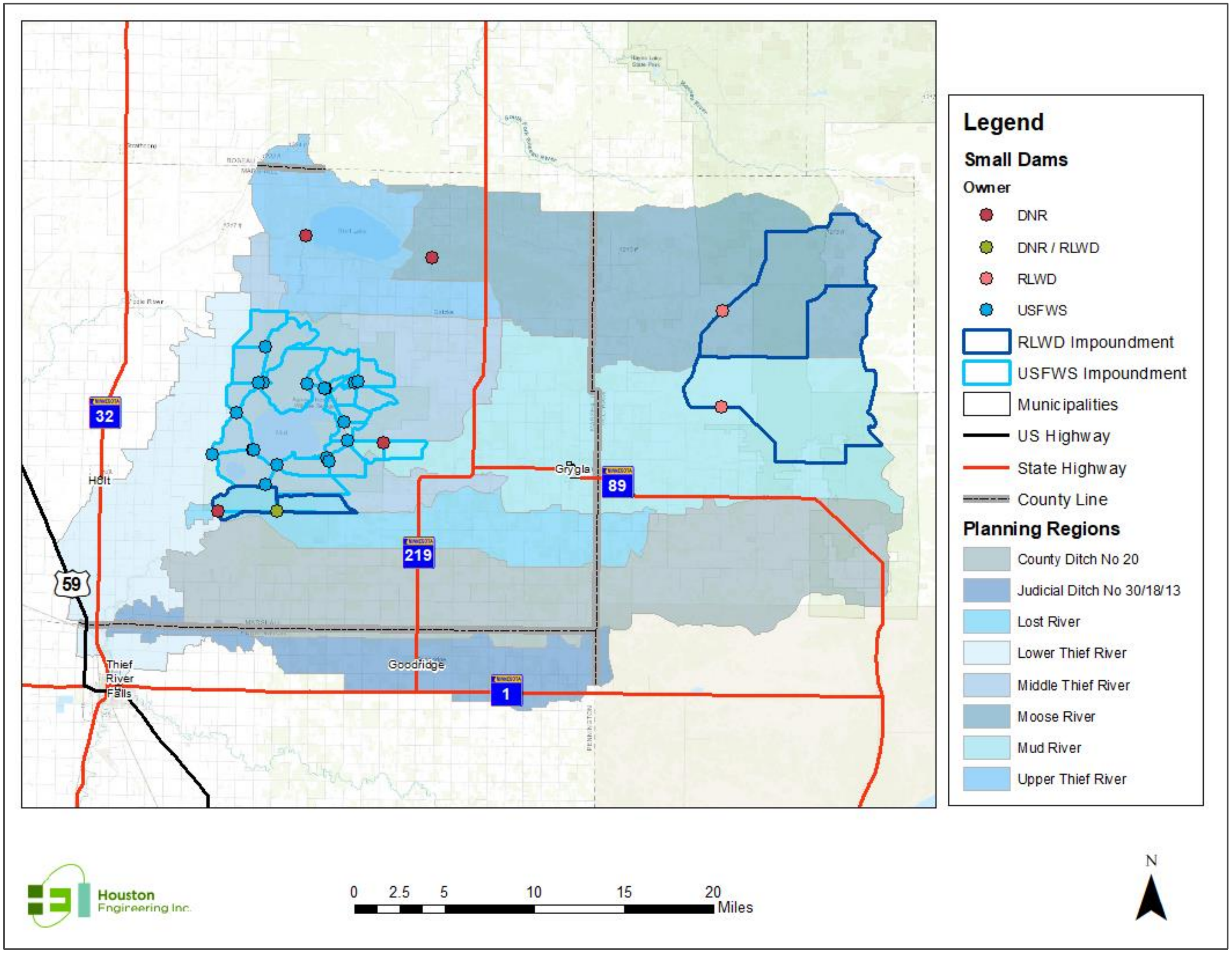


Figure 5-1: Impoundments and Dams in the Thief River Watershed

There are a number of small dams in the Thief River Watershed owned and operated by the DNR, RLWD, and USFWS. The majority of these dams are associated with impoundment outlet structures and fall under the purvey of impoundment operators. Thief Lake Dam, at the outlet of Thief Lake in the northwest corner of the watershed, is used to manage the lake for wildlife. Shorebirds and waterfowl require shallow lakes with exposed shoreland to feed on invertebrate species. These invertebrates, in turn, thrive in waters free of fish species. Thus, the dam serves the purposes of managing lake levels and preventing upstream fish passage. Flood control is a secondary benefit.

Drainage authority in the Thief River Watershed primarily lies with the Counties. The RLWD has authority over State Ditch 83 and a short section of Ditch 9 east of Grygla in Beltrami County. **Figure 5-2** depicts public drainage systems and authorities in the Thief River Watershed. Drainage authorities are responsible for operation and regular maintenance of public drainage systems.

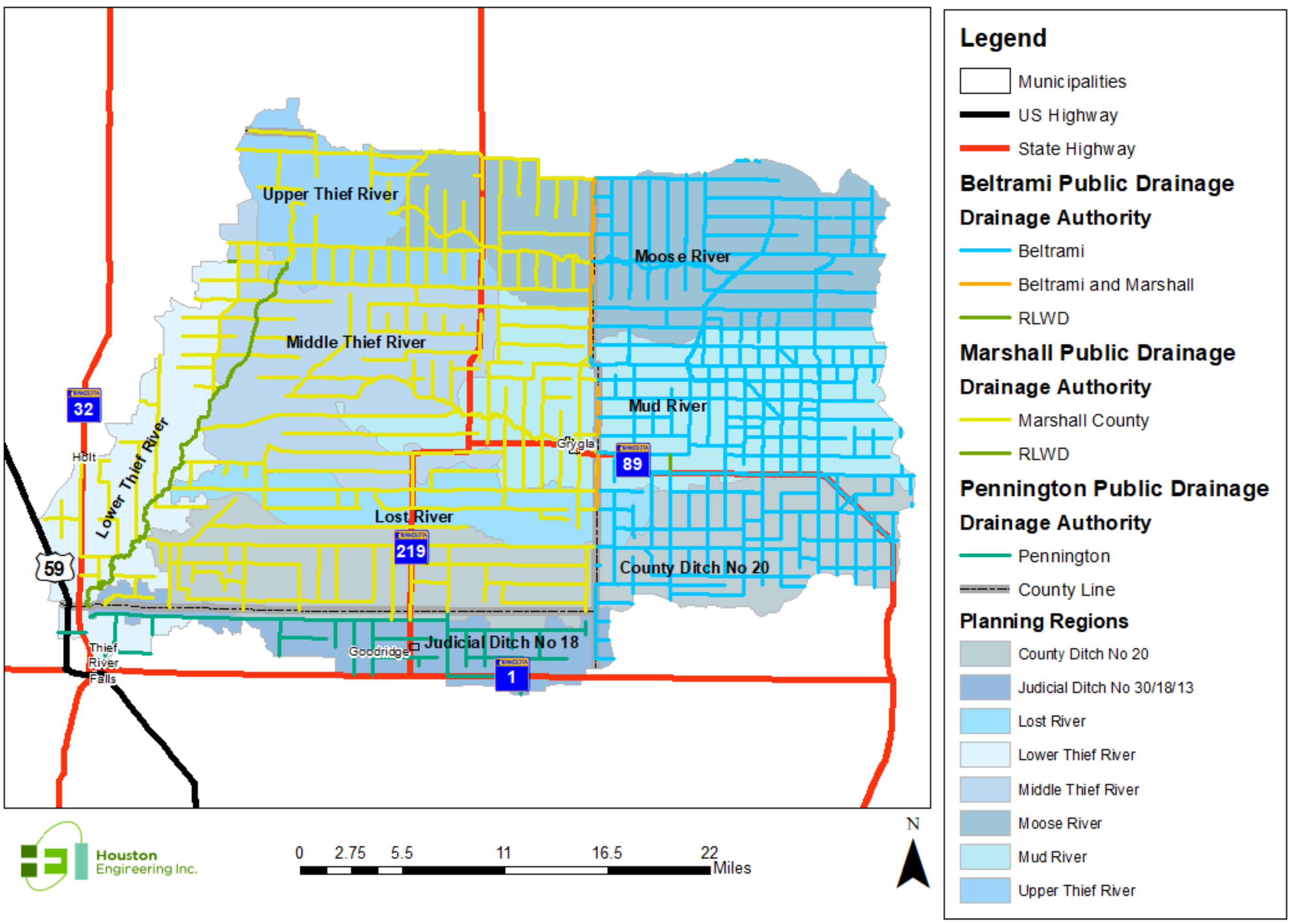


Figure 5-2: Public Drainage Systems and Authorities in the Thief River Watershed

Table 5-3: Public Drainage Systems and Authorities in the Thief River Watershed

Public Drainage Authority	Public Drainage System
Beltrami	Judicial Ditch 12
	Judicial Ditch 25
	Judicial Ditch 34
	Judicial Ditch 37
	Judicial Ditch 39
	Judicial Ditch 40
Beltrami-Marshall	Judicial Ditch 11*
	Judicial Ditch 21*
Marshall	County Ditch 2
	County Ditch 6
	County Ditch 11
	County Ditch 20
	County Ditch 24
	County Ditch 25
	County Ditch 27
	County Ditch 28
	County Ditch 30
	County Ditch 31
	County Ditch 32
	County Ditch 33
	County Ditch 35
	County Ditch 46
	Judicial Ditch 35
	Judicial Ditch 23
Roseau-Marshall	Judicial Ditch 63**
Pennington	County Ditch 33
	County Ditch 44
	County Ditch 46
	County Ditch 70
Pennington-Marshall	Judicial Ditch 13***
	Judicial Ditch 18***
	Judicial Ditch 30***
Red Lake Watershed District	Beltrami County Ditch 9
	State Ditch 83
*Beltrami and Marshall Counties have joint authority of Judicial Ditches 11 and 21 along the county line	
**Roseau and Marshall Counties have joint authority of Judicial Ditch 63 along the county line.	
*** Pennington and Marshall Counties have joint authority of Judicial Ditches 30/18/13 along the county line	

5.1.5 Regulatory Administration

Many of the issues affecting priority issues can be addressed in part through the administration of statutory responsibilities and ordinances. These actions are categorized as regulatory in the targeted implementation schedule e and are funded by the Regulatory Administration Implementation Program. **Table 5-4** shows the relationship between statutory obligations and ordinances administered by the counties and the Red Lake Watershed District within the Thief River Watershed.

5.1.5.1 Statutory Responsibilities

The State Statutes administered by the counties, SWCDs, and Watershed District involved in this plan are described below. In many cases, local regulations and ordinances have been adopted to conform to the standards and requirements of the state statutes (**Table 5-4**). Each county will be responsible for meeting statutory obligations within their respective county boundaries.

WETLAND CONSERVATION ACT (WCA)

The Minnesota Legislature passed the Wetland Conservation Act of 1991 (MN Rules 8420), which is intended to result in "no net loss" of wetlands through regulation of filling, draining, excavating, or converting wetlands to other uses. LGUs are responsible for administering, regulating, and educating landowners on the WCA. Duties of administration:

- WCA Coordinator provides educational materials to landowners regarding the Minnesota State WCA Rules and Regulations
- Attend WCA training opportunities
- Provide wetland site investigations, including, but not limited to, wetland delineation, wetland mitigation, and wetland restoration requests
- Assist landowners with technical/administrative assistance requirements of wetland replacement/no loss/exemptions
- Coordinate with federal/state/local agencies on wetland technical issues
- Use soil/vegetation/hydrology for wetland determinations and review wetland delineations
- Report WCA Program activities, time tracking, and fund accountability
- Serve on Technical Evaluation Panel (TEP)
- Protect existing wetlands to retain water storage, calcareous fen protection, and provide filtration of sediment and pollutants.

BUFFER AND SOIL LOSS LEGISLATION

Minnesota's Soil Erosion Law (Minnesota Statute 103F.401-.455), enacted in 1984, set forth a broad public policy regarding excessive soil loss. It simply states that "[a] person may not cause, conduct, contract for, or authorize an activity that causes excessive soil loss". Excessive soil loss is defined as soil loss that is greater than the soil loss limits, and soil loss limits are defined as meaning the maximum amount of soil loss from water or wind erosion, expressed in tons per acre per year, that is allowed by local regulations on a particular soil. Agricultural soil loss limits (often referred to as "T") are set forth in the USDA NRCS FOTG. In Minnesota, "T" ranges from 3 to 5 tons/acre/year.

During the 2015 legislative session, the State of Minnesota passed the Buffer and Soil Loss Legislation (Minnesota Statue 2014, section 103F.48), commonly referred to as the Minnesota Buffer Law. The legislation requires a 50-foot average continuous buffer of perennial vegetation with a 30-foot minimum width around all public waters and a 16.5-foot minimum width continuous buffer of perennial vegetation along all public drainage systems. The SWCDs will be relied upon for implementation and assessing compliance of the buffer legislation. SWCDs are also likely to provide technical assistance and provide guidance about financial assistance options. Landowners also have the option of working with their SWCD to determine if other alternative practices aimed at protecting water quality can be used in place of a buffer. Watershed districts and counties also have a role in buffer law implementation. They must amend comprehensive plans to incorporate SWCD recommendations and provide landowners with a list of corrective actions needed to come into compliance along with a practical timeline to meet the requirements when notified by the SWCD that a landowner is not in compliance. Watershed districts and counties may also adopt an administrative penalty order plan.

SHORELAND MANAGEMENT

The Minnesota Legislature has delegated responsibility to LGUs to regulate the subdivision, use, and development of shorelands along public waters to preserve and enhance the quality of surface waters, conserve the economic and natural environmental values of shorelands, and provide for the wise use of waters and related land resources pursuant to the Shoreland Management Program (MN Rules 6120.2500-3900). This statute is administered and enforced as a zoning ordinance requiring a 50-foot buffer around public waters. The following are included in the duties of administration:

- Provide educational materials regarding the state shoreland statutes and rules along with the county ordinances
- Attend shoreland training
- Conduct site reviews and issues permits when needed
- Conduct permit compliance checks
- Work with the county attorneys and commissioners to enforce state statutes and rules and the county ordinance
- Determine setback and compliance relating to bluff and shoreland setbacks with assistance from the RRV CSA Engineer
- Assist landowners and coordinate with county commissioners on variance requests
- Report Shoreland Program activities, time tracking, and fund accountability
- Coordinate county shoreland ordinance updates so ordinances are similar across county boundaries

FLOODPLAIN MANAGEMENT

Floodplain zoning regulations are intended to guide development in the floodplain consistent with the magnitude of the flood threat to minimize loss of life and property, disruption of commerce and governmental services, extraordinary public expenditure for public protection and relief, and interruption of transportation and communication, all of which adversely affect public health, safety, and general welfare. The DNR has statutory (Chapters 103F and Chapter 394/462) oversight of the floodplain program and administers it in Beltrami County. Marshall and Pennington counties have ordinances. Administration duties include the following:

- Provide floodplain maps to landowners
- Assist landowners with determining floodplain boundaries and base flood elevations when requested
- Provide other technical assistance to landowners regarding floodplain questions
- Coordinate county floodplain ordinance updates so ordinances are similar across county boundaries
- Use new LiDAR data to update floodplain maps

INDIVIDUAL SUBSURFACE SEWAGE TREATMENT SYSTEMS (ISSTS)

Counties participating in the 1W1P administer Minnesota Rules Chapters 7080 through 7083 for individual SSTSs. The program provides technical assistance, education, plan review, and inspections to protect water quality, prevent and control water-borne diseases, and prevent or eliminate nuisance conditions for dwellings or other establishments generating volumes less than 10,000 gallons per day. The MPCA oversees county programs and also does enforcement on licensed inspectors, designers, and maintainers. ISSTS regulations entail:

- minimum technical standards for individual and mid-size SSTS (Chapter 7080 and 7081),
- a framework for local administration of SSTS programs (Chapter 7082), and
- statewide licensing and certification of SSTS professionals, SSTS product review and registration, and establishment of the SSTS Advisory Committee. (Chapter 7083).

Counties can adopt more restrictive rules and performance standards. **Table 5-4** contains local ordinances for ISSTS. Program Administrator duties include the following:

- SSTS Administrator provides educational materials to landowners
- Providing continuing education training
- Monitoring a data collection at locations before construction
- Permitting requirements and site investigation before, during, and after construction
- Seeking funding opportunities to assist with septic systems compliance issues
- Working with the County Attorney to enforce the SSTS ordinance, state rules, and statutes.
- Responding to citizen complaints
- Reporting SSTS Program activities, time tracking, and fund accountability

MUNICIPAL WASTEWATER TREATMENT FACILITIES

Two municipal wastewater treatment facilities (Grygla and Goodridge) are found in the Thief River Watershed. The MPCA regulates and monitors municipal wastewater treatment facilities.

SOLID WASTE MANAGEMENT

Counties participating in the Thief River Watershed 1W1P operate solid waste management systems as directed by Minnesota Statutes Chapters 115A and 400. The MPCA oversees the county programs. These programs may include:

- waste reduction and waste education programs,
- curbside recycling and publicly owned and operated recycling center,
- yard waste composting sites, and
- regional hazardous waste management facility.

STORMWATER RUNOFF

The MPCA regulates construction, municipal, and industrial stormwater through administration of the federal National Pollutant Discharge Elimination System (NPDES) with oversight from the US Environmental Protection Agency (EPA). Stormwater is regulated under Minnesota Statute Chapter 7090.

WELL MANAGEMENT

The Minnesota Department of Health (MDH) administers the state wellhead protection rule—Minnesota Rules, Chapter 4720.5100 – 4720.5590—that sets standards for wellhead protection planning. Municipalities within the Thief River Watershed have completed or will be completing wellhead protection plans. The most recent listing of completed wellhead protection plans can be obtained from MDH.

HAZARD MANAGEMENT

Section 104 of the Disaster Mitigation Act of 2000 (DMA 2000), Public Law 106-390, codified at 42 USC Sections 5121 et seq. Hazard Mitigation Planning, 44 CFR Part 201, established criteria for state and local hazard mitigation planning. Counties participating in the 1W1P have developed hazard mitigation plans because of DMA 2000.

FEEDLOTS

Feedlot rules, regulations, and programs were established under Minnesota Rules 7020 and is administered through the MPCA. Marshall and Pennington counties provide feedlot regulatory oversight and technical assistance programs and maintain a feedlot inventory. Beltrami County is not a delegated county for the feedlot program. The MPCA is the regulating authority in that county. Feedlot administration duties include the following:

- Provide educational information and technical assistance to producers in regards to MPCA Feedlot Program Statutes and Rules
- Provide information on the registration, re-registration, inspection, and permitting process as requested
- Attend feedlot training

- Conduct inspections and issue permits in accordance with MPCA Inspection policies and procedures
- Provide technical assistance for manure management plans and manure application.
- Implement grazing management strategies
- Enter data into TEMPO
- Respond to citizen complaints
- Coordinate with producers, SWCD, NRCS, and other funding sources to provide financial assistance to achieve compliance
- Report Feedlot Program activities, time tracking, and fund accountability
- Coordinate county feedlot ordinance updates so ordinances are similar across county boundaries
- Seek cost share assistance to assist with feedlot compliance

5.1.5.2 Local Ordinances

Local ordinances are used by the counties in the Thief River Watershed to address issues specific to their county. **Table 5-4** shows the counties which have ordinances related to managing water and resources. The responsibility for implementing these ordinances will remain with the respective counties. **Table 5-5** shows differences in administering and enforcing ordinances among the LGUs participating in the plan. Participating counties do not have local controls for aggregate management, agricultural erosion control, preservation of natural drainage, forestry, wetland management plans, or stormwater management. Rules and regulations fall under the purvey of the State of Minnesota or the federal government.

5.1.5.3 Rules

The Thief River Watershed is within the jurisdictional boundary of the RLWD. The RLWD has a system of rules for the management of water within the District. The need for new, and implementation of existing, rules and regulations within the Thief River Watershed will continue through the RLWD. **Table 5-4** shows existing rules and regulations within the RLWD as they relate to statutory responsibilities and local county ordinances.

SURFACE DRAINAGE AND FLOOD MITIGATION

Actions impacting public drainage systems are regulated by rules within the RLWD. The following actions require a permit from the RLWD to proceed:

- Water is to be diverted from one watershed to another
- Water is to be drained into a legal ditch
- A ditch is to be repaired
- A marsh is to be drained
- A dike is to be constructed or altered
- A reservoir is to be drained or constructed
- A bridge, culvert, or drain is to be installed or changed
- Construction is to be done near a waterway, lake, or marsh

SUBSURFACE TILE DRAINAGE

The intent of the subsurface tile drainage rule is to minimize downstream flooding impacts and maximize soil storage and agricultural productivity. Installation and/or construction of tile drainage requires a permit from the RLWD meeting these criteria:

- Subsurface drainage must protect from erosion and include RLWD-approved erosion control measures
- Subsurface tile outlets, including lift station pumps, must be located outside of a legal drainage system and governmental road right-of-way unless approved by RLWD and visibly marked
- The recommendation that after harvest, tile outlet controls, including lift station pumps, be opened or turned on to remove water from the system unless downstream culverts are frozen

- Obtaining a permit from RLWD Managers does not relieve the applicant from the responsibility of obtaining any other additional authorization or permits required by law (e.g. NRCS, SWCD, township, county, state, etc.)
- Upon completion of the project, as-built plans must be provided to RLWD
- Consideration must be made for turning off pumps for a short period of time during the summer so maintenance can be performed on public, legal, and private drainageways

Table 5-4: Statutory Responsibilities and Regulations, Rules, and Ordinances Administered by the Counties and the Watershed District Participating in the Thief River One Watershed, One Plan (Note: list is not intended to be all-inclusive)

	Rule, Ordinance or Statute Name	Beltrami County	Marshall County	Pennington County	RLWD
Statutory Responsibilities	**Shoreland Management**	Shoreland Management Ordinance (#6)	Shoreland Ordinance (MC Env. Serv.)	Shoreland Ordinance (Pennington SWCD)	
	Floodplain Management		Floodplain Ordinance (MC Env. Serv.)	Floodplain Ordinance (Pennington SWCD)	
	Individual Sewage Treatment Systems (ISTS)	Sewage and Wastewater Treatment Ordinance (#32)	SSTS Ordinance (MC Env. Serv.)	Sewage and Wastewater Treatment Systems Ordinance (Pennington SWCD)	
	Solid Waste Management	Solid Waste Management Ordinance (#13)		Solid Waste Management Plan	
	Hazard Management		Hazard Mitigation Plan (MC Env. Serv)	Pennington County Hazard Mitigation Plan	
	Feedlots		Feedlot Ordinance (MC Ag. Serv.)	Feedlot Ordinance (Pennington SWCD)	
	Buffers	Buffer Ordinance (#48)	Buffer Ordinance (MC Hwy. Dpt.)	Buffer Ordinance (Penn Co. Hwy Dept.)	
Local Regulations, Rules, and Ordinances	**Agricultural Soil Erosion**			Critical Area Soil Erosion Control Policy (1992)	
	Tile Drainage				Subsurface Tile Drainage District Rule
	Public Drainage Systems: Establishment, Improvement, Rerouting, Repairs, Impoundments, Buffer Compliance	Beltrami County *Chapter 103E Drainage*	Marshall County Chapter 103E Drainage	Pennington County *Chapter 103E Drainage*	Surface Drainage and Flood Mitigation District Rule; and RLWD Chapter 103E Drainage
	City Ordinances/Code			Thief River Falls *City Code Title: IX General Regulations*	
	Land Use Controls			North Township	

Table 5-5: Differences Between Statutory Responsibilities and Regulations, Rules, and Ordinances Administered by the Counties and the Watershed District Participating in the Thief River One Watershed, One Plan (Note: list is not intended to be all-inclusive)

Ordinance or other local controls	Pennington	Marshall	Beltrami	RLWD
SSTS	2014	2014	2013	
	• Using alternative local standards for soil separation – 2 feet • No Point of Sale Inspection requirement • Ordinance based on 2006 Rules • 2011 Rules for tank sizing and soil loading rates • Licensed inspectors cannot inspect properties in which they have an ownership interest in the property	• Using alternative local standards for soil separation – 2 feet • No Point of Sale Inspection requirement • Ordinance based on 2006 Rules • Allow holding tanks	• 2008 Rules except for rapidly permeable soils based on 2006 Rules • Transfer of property – Point of Sale Inspection required • Building permits require certificate of compliance • Allow holding tanks • Issue administrative variances • Land application of septage standards	
Shoreland	2017	2017	2006	
	• Increased setback for new lots based on vertical height of bank • Require septic inspections for permit • Require 30-foot minimum buffer regardless if alternative practices apply under buffer law		• New ordinance in process of being updated: Shoreland Ordinance—written mostly for lakes and urban type development around major recreation areas and City of Bemidji • Only two rivers in the watershed in Beltrami County • Regulate vegetation removal within setback (100 feet)—can remove 50% of brush and 25% of trees • Earthmoving requires a permit • No extractive use (gravel pits) within shoreland for rivers	

Ordinance or other local controls	Pennington	Marshall	Beltrami	RLWD
Floodplain	2014	2012		
	• Use best available data for floodplain mapping	• Use best available data for floodplain mapping • Basement exemption in the flood fringe if a conditional use permit is approved with specific criteria	• No floodplain maps or ordinance • Shoreland Ordinance requires lowest floor elevation to be 3 feet above flood of record or OHW or engineered to comply with State Rules	
Buffer	2017	2018		2017
	• 30 foot minimum on public waters even if alternative practices qualify • Landowner can appeal a corrective action notice and a Technical Evaluation Panel will review the appeal and make a recommendation to the Board of Adjustment			• RLWD approved a resolution accepting, "A Resolution Regarding the Election of Jurisdiction for the Minnesota Buffer Law".
Feedlot	2008	2007		
	• Shoreland Ordinance states that no new feedlots are allowed within the shoreland for rivers		• Shoreland Ordinance states that no new feedlots are allowed within the shoreland for rivers	
Subdivision Ordinance			2005	
			• Minimum lot size of 150-foot width and 45,000 square feet of upland area	

5.2 FUNDING

This section describes how the plan will be funded***.*** Plan participants expect to pursue grant opportunities collaboratively to fund implementation of the targeted implementation schedule. Within the targeted implementation schedule outlined in **Plan Section 4**, actions are assigned to implementation programs. **Table 5-6** shows the sources of baseline funding that will be used to implement and administer the implementation programs.

This plan sets an ambitious implementation schedule. Baseline funding, described in **Plan Section 4**, as the estimate of consistent expenditures by plan participants within the Thief River Watershed, will not be sufficient to meet the targeted implementation schedule. As such, the success of implementing the plan will depend on collaboratively sought competitive state, federal, and private grant dollars. As an alternative to reliance on competitive grants, this plan envisions successful legislation to allow for reliable block grant dollars for plan implementation.

Table 5-7 shows the most commonly used programs and grants for implementing the implementation program described by this plan and used within the targeted implementation schedule. These funding grants and programs are cross-referenced to the Projects and Practices, Education and Outreach, and Research and Monitoring implementation programs, thereby showing potential sources of revenue for implementation.

Table 5-6: Budget for the Baseline Implementation Funding Level for the Thief River Watershed One Watershed, One Plan

Implementation Program	Local		State		Federal		NGOs		All Sources	
	Annual	Total	Annual	Total	Annual	Total	Annual	Total	Annual	Total
Projects and Practices[1]	$47,026	$470,026	$92,725	$927,250	TBD	TBD	TBD	TBD	$139,751	$1,397,276
Regulatory[2]	$28,736	$287,360	$34,667	$346,670					$63,403	$634,030
Research and Monitoring	$24,826	$248,260	$780	$7,800					$25,606	$256,060
Education and Outreach	$17,553	$175,530	$1,115	$11,150					$18,668	$186,680
Plan Administration[3]	$19,272	$192,720	$15,429	$154,290					$34,701	$347,010
Capital Improvements[4]	$76,277	$762,277	$25,000	$250,000					$101,277	$1,012,770
TOTAL	**$213,690**	**$2,136,173**	**$169,716**	**$1,697,160**	**-**	**-**	**-**	**-**	**$383,406**	**$3,833,333**

[1] Projects and Practices Cost Share amount based on current amount for all counties, and includes baseline costs for management practices and structural BMPs

[2] Assumes local fiscal support of local implementation of statutory obligations and ordinances remains unchanged.

[3] Plan administration budgets like current local expenditures by individual counties. Estimated at 10% of annual baseline implementation budget. Does not include staffing for Research and Monitoring; Education and Outreach

[4] Capital Improvement program includes expenditures for operations and maintenance of drainage ditches and impoundments.

Table 5-7: Level 1 Funding Summary

Level 1 Funding Summary	
Program	Total
Projects and Practices[1]	$8,480,189
Research and Monitoring	$531,500
Education and Outreach	$10,000
Capital Improvements[2]	$12,591,393

[1] Projects and Practices Cost Share amount based on current amount for all counties, and includes baseline costs for management practices and structural BMPs
[2] Capital Improvement program includes expenditures for operations and maintenance of drainage ditches and impoundments
* Collaborative grants assumed to be provided to the Thief River Watershed 1W1P as one or more non-competitive implementation block grant

Table 5-8: Implementation Programs and Related Funding Sources (Note: This table lists examples of funding sources and is not intended to be all-inclusive)

Source	Organization	Program/ Grant Name	Primary Assistance Type	Projects and Practices	Research and Monitoring	Education and Outreach
Federal	NRCS	**Conservation Innovation Grant (CIG)**	Financial	x		
		Conservation Stewardship Program (CSP)	Financial / Technical	x		
		Environmental Quality Incentives Program (EQIP)	Financial / Technical	x		
		Agricultural Conservation Easement Program (ACEP)	Easement	x		
	FSA	**Conservation Reserve Program (CRP)**	Easement	x		
		Conservation Reserve Enhancement Program (CREP)	Easement	x		
		Farmable Wetlands Program (FWP)	Easement	x		
		Grasslands Reserve Program (GRP)	Easement	x		
	FSA/ USDA / NRWA	**Source Water Protection Program (SWPP)**	Technical			x
	USFWS	**Partners for Fish and Wildlife Program (PFW)**	Financial / Technical	x		
	PCA	**Federal Clean Water Act Section 319 Grants**	Financial	x		
	FEMA	**Hazard Mitigation Grant Program (HMGP)**	Financial	x		
		Pre-Disaster Mitigation (PDM)	Financial	x		
		Flood Mitigation Assistance (FMA)	Financial	x		
		Risk Mapping, Assessment, and Planning	Technical	x		
	EPA	**Water Pollution Control Program Grants (Section 106)**	Financial			x
		State Revolving Fund (SRF)	Loan	x		
		Drinking Water State Revolving Fund (DWSRF)	Loan	x		
		Section 319 Grant Program (Administered by MPCA)	Financial	x	x	

Source	Organization	Program/ Grant Name	Primary Assistance Type	Projects and Practices	Research and Monitoring	Education and Outreach
State	DNR	**Aquatic Invasive Species Control Grant Program**	Financial / Technical	x		
		Conservation Partners Legacy Grant Program	Financial	x		
		Cooperative Groundwater Monitoring	Financial		x	
		Pheasant Habitat Improvement Program (PHIP)	Financial	x		
		Flood Hazard Mitigation Grant Assistance	Financial	x		x
		Forest Stewardship Program	Technical	x		
		Reinvest in Minnesota (RIM)	Financial / Easement	x		
		Aquatic Management Area Program	Easement	x		
		Wetland Tax Exemption Program	Financial	x		
	BWSR	**Clean Water Fund Grants**	Financial	x	x	x
		Erosion Control and Management Program	Financial	x		
		SWCD Capacity Funding	Financial	x	x	x
		Natural Resources Block Grant	Financial	x		
		Reinvest in Minnesota (RIM) Reserve Services	Financial	x		
	MPCA	**Surface Water Assessment Grants (SWAG)**	Financial		x	x
		Watershed Pollutant Load Monitoring Network	Financial / Technical		x	
		Clean Water Partnership	Financial	x		
	MDH	**Source Water Protection Grant Program**	Financial	x		x
	MDA	**Agriculture Best Management Practices (BMP) Loan Program**	Financial	x		
		Agricultural Water Quality Certification Program	Financial / Technical	x		x
	Pheasants Forever	**Pheasants Forever**	Financial / Easement	x		x
	Ducks Unlimited	**Ducks Unlimited**	Financial / Easement	x	x	x

*Disclaimer: This is not an all-inclusive list of funding opportunities but instead provides examples of funding opportunities and their primary relation to Thief River Watershed 1W1P implementation programs.

5.2.1 Local Funding

The annual amount of funding needed to implement the plan from local sources is an estimated $211,989 and $2,119,890 for the ten-year plan life cycle. Local revenue is defined as money derived from either the local property tax base or in-kind services of any personnel funded from the local tax base. Local funding excludes general operating funds obtained from BWSR and grants or partnership agreements with the federal government or other conservation organizations.

These funds will be used for locally focused initiatives where opportunities for state and federal funding are lacking because of misalignment of an initiatives purpose with state or federal objectives. These funds will also be used for matching grants. Examples of applicable local funding authorities are included in the BWSR Local Funding Authorities Guidance in **Appendix J**.

The Red River Watershed Management Board has also developed programs that may provide funding opportunities within the planning boundary. Where applicable, this plan will align with the mission of the Red River Watershed Management Board and take advantage of funding opportunities provided.

5.2.1.1 Establishment of MS 103D.729 Water Management Districts

OVERVIEW

At the May 9, 2018, meeting in Grygla, MN, the Policy Committee, at the request of the RLWD, authorized the establishment of eight water management districts (WMD) through this plan. This funding option can only be used to collect charges to pay costs for projects initiated under MS 103D.601, 103D.605, 103D.611, or 103D.730. To use this funding method, Minnesota law (MS 103D.729) requires that the area to be included in the WMD be described, the amount to be charged identified, the methods used to determine the charges be described, and the length of time the WMD is expected to remain in force specified.

DESCRIPTION OF WATER MANAGEMENT DISTRICTS

This plan establishes the eight planning regions **(See Section 1)** as the WMDs. The District may create different WMDs under future plan amendments.

ANNUAL CHARGE AMOUNT

The maximum WMD revenue limit within each WMD is based on 0.10% of the taxable market value within each planning region. This value will change each year as property values increase or decrease over time.

METHOD TO DETERMINE CHARGES

The methods proposed to establish the charges will be based upon the proportion of the total annual runoff volume and/or solids load contributed by a parcel or may be based on the drainage area of the parcel within a WMD.

Option 1: The runoff volume method will:

- use soils and land use data to determine the existing curve number for each parcel within a WMD;
- use the curve number for each parcel and the annual average precipitation depth to compute the annual runoff volume for each parcel;
- sum the annual average runoff volumes for all parcels within a WMD to determine the total annual runoff volume; and
- compute the percentage of the annual runoff volume from each parcel as the ratio of the annual average runoff volume from the parcel and the total annual average runoff volume for the WMD (i.e., the “runoff ratio”).

Option 2: The solids load contribution method will:

- use the Revised Universal Soil Loss Equation and a sediment delivery ratio representing the portion of the solids and sediment reaching a watercourse to compute the annual average sediment and solids load for each parcel;
- sum the annual average solids and sediment loads for all parcels within a WMD to determine the total annual average sediment and solids load; and
- compute the percentage of the annual average sediment and solids load from each parcel as the ratio of the annual average sediment and solids load from the parcel and the total annual average sediment and solids load for the WMD (i.e., the "sediment ratio").

Option 3: The combination runoff volume and solids load method. This method is used to consider both runoff volume and solids load contribution and would follow the methodologies listed above for both solids contribution and runoff volume.

Calculation of charges for **Options 1 through 3** would be determined as follows:

- Add the runoff ratio and/or the sediment ratio to compute the charge ratio for each parcel within the WMD. The amount charged to a specific parcel is the sum of the runoff ratio and the sediment ratio for the parcel divided by the sum of the runoff ratio and the sediment ratio for all parcels within the WMD.
- Apply the charge ratio to the total amount of revenue needed for the WMD to carry out the stormwater related projects, programs, and activities described by the plan to achieve the stormwater related goals within that WMD.

Option 4: The drainage area method will:

- Determine the drainage area of each parcel of land within the planning region.

Calculation of charges for **Option 4** would be determined as follows:

- The amount charged to a specific parcel is determined based on the charge ratio. The charge ratio is determined by taking the drainage area of that parcel within the planning region divided by the total area of the planning region.
- Apply the charge ratio to the total amount of revenue needed for the WMD to carry out the stormwater related projects and programs described by the plan to achieve the stormwater-related goals within that WMD.

Selection of the appropriate process of determining charges will be established and further refined in Step 3 of the process described in **Process to Be Used to Create Water Management Districts.**

DURATION FOR EXISTENCE OF THE WATER MANAGEMENT DISTRICTS

The Policy Committee anticipates that the WMDs will provide funding to assist with the implementation of a variety of stormwater (runoff and/or water quality) related projects. The WMDs will remain in existence in perpetuity. Annual assessment of charges could vary from no charges to the maximum WMD revenue limit of the planning region.

USE OF FUNDS

The primary use of the funds collected from charges within WMDs will support stormwater runoff and water quality projects that help achieve the goals of the planning regions, which benefits residents within a WMD.

PROCESS TO BE USED TO CREATE WATER MANAGEMENT DISTRICTS

BWSR has provided guidance as to the process of creating a WMD. The process involves eight steps. The first two steps are addressed through this Comprehensive Watershed Management Plan developed according to the BWSR One Watershed, One Plan Operating Procedures (March 23, 2016). Steps 3 through 8 must be completed prior to any collection of charges in any WMD.

Step 1. Amend comprehensive watershed management plan to create a WMD
Amendment must include:
- Description of area to be in the WMD
- The amount to be raised by charges (total amount is necessary if fixed time for WMD to be in force, otherwise annual maximum (cap) amount)
- The method that will be used to determine the charges
- The length of time the WMD will be in force (perpetuity is acceptable)

Step 2. Approval of plan amendment under M.S. § 103D.411 or as part of a revised plan under M.S. § 103D.405
- Revised plan, or petition and amendment, sent to BWSR
- BWSR gives legal notice, and holds hearing if requested
- BWSR orders approval or prescribes plan or amendment
- BWSR notifies Watershed District managers, counties, cities, SWCDs

Step 3. Watershed District establishes project(s) in the WMD
- Project(s) implemented must be ordered by the Watershed District managers
- Order for project(s) must specify funding method(s)
- Watershed District must notify counties, cities, and townships within the affected area at least 10 days prior to hearing or decision on projects(s) implemented under this section of statute

Step 4. Watershed District refines methodology for computing charges based on final project scope

Step 5. Watershed District determines and sets charges for all properties within the WMD after identifying scope of project and deciding method(s) of funding

Step 6. Watershed District develops collection mechanism
- Request county or counties to collect,
- Contract with a private vendor (e.g. electric cooperative), or
- Billing and collection by Watershed District

Step 7. Watershed District establishes a separate fund for proceeds collected from the fee or stormwater utility charges

Step 8. Resolution of disputes—local governments may request BWSR to resolve disputes pursuant to M.S. § 103D.729, Subd. 4, except a local appeal process must be completed first for disputes involving WMDs established in perpetuity

LOCAL APPEAL

Local Appeal Procedure: Because WMDs established under this plan are proposed to be perpetual, the following local appeal procedure is established from the resolution adopting the plan establishing a WMD:

1. Upon receipt of the order of BWSR approving the plan establishing a WMD, the Watershed District shall publish notice of its resolution adopting the plan in a newspaper in general circulation in the 1W1P area.
2. Any landowner affected by the WMD may, within 30 days of first publication of notice of the resolution, appeal the establishment of the WMD to the Watershed District by filing a letter stating the basis for the appeal.
3. Within 30 days of receiving a letter of appeal, the Watershed District shall hold a hearing on the appeal, giving the appellant an opportunity to be heard and to present evidence why the WMD should not be established. The hearing shall be noticed as required for a special meeting under statutes chapter 103D.
4. The hearing shall be recorded in order to preserve a record for further review. The record of the appeal shall include the recording, any documentary evidence provided by the appellant, and all records related to the establishment of the WMD.

5. Within 30 days of the hearing, the Watershed District shall adopt and mail findings and an order on the appeal to the appellant and the BWSR.
6. Further appeal, if any, shall be as provided in Statutes Chapter 103D and existing authorities and procedures of the BWSR Board.

5.2.2 State Funding

The annual amount of baseline funding needed for plan implementation from state sources is $169,716 annually and $1,697,160 for the ten-year plan life cycle. State funding includes all funds derived from the State tax base for state cost-share regulatory purposes. State funding excludes grants or partnership agreements with the federal government.

5.2.3 Federal Funding Sources

Federal funding includes all funds derived from the federal tax base. For example, this includes programs such as the Environmental Quality Incentives Program (EQIP), Conservation Reserve Program (CRP), and Conservation Innovation Grants (CIG). The EPA also has Section 319 funds, which traditionally have been used for implementation to improve water quality. Federal funding excludes general operating funds obtained from BWSR, counties, fees for service, and grants or partnership agreements with state government or other conservation organizations.

Federal agencies need to be more effectively engaged following the approval of this plan and prior to implementation to create an avenue to access federal resources for implementation. An opportunity may exist to leverage state dollars through some form of federal cost-share program. Where the purpose of an intitiative or campaign aligns with the objectives of various federal agencies, federal dollars will be used to help fund the programs described by this plan.

5.2.4 Other: Non-Governmental Organizations and Private Entities

This category of funding excludes general operating funds obtained from BWSR, counties, fees for service, local funding sources, and grants or partnership agreements with the state or federal government or other conservation organizations.

Several non-governmental funding sources may provide technical assistance and fiscal resources to implement the Thief River Watershed 1W1P targeted implementation schedule. For example, Ducks Unlimited would be a potential funding source that differs from the other categories. This plan should be provided to all non-governmental organizations (NGOs) as a means of exploring opportunities to fund specific aspects of the targeted implementation schedule.

Private sector companies, including those specifically engaged in agribusiness, are often overlooked as a potential source of funding for implementation. Many agribusiness companies are working to improve water quality. Some of the agribusiness companies are providing technical or financial support for the implementation of management and structural BMPs because they are interested in agricultural sustainability. Most often this is through Field to Market (https://calculator.fieldtomarket.org/fieldprint-calculator/). This plan could be used to explore with private sector companies whether the estimated water quality benefits have monetary value and may therefore provide access to funding from the private sector.

5.3 PLAN ADMINISTRATION & COORDINATION

5.3.1 Decision-Making and Staffing

The Planning Work Group, Advisory Committee, and Policy Committee structures from the plan development process will be maintained throughout the lifespan of the plan. The Planning Work Group and Policy Committee will meet on a quarterly basis, and the Advisory Committee will meet annually. Because the administration and implementation of this plan requires coordination and consistency among LGUs, a Plan Coordinator will act as a central hub for plan implementation. At the direction of the Policy

Committee, the Plan Coordinator will become responsible for completing the annual work planning process and completing and submitting annual reports. The RLWD will serve as the central fiscal agent on behalf of the Thief River Watershed 1W1P. Expectations are that the roles of the Policy Committee, Planning Work Group, and Advisory Committee will shift and change focus. **Table 5-9** shows the probable roles and functions related to plan implementation.

Table 5-9: Anticipated Roles for Thief River Watershed 1W1P Implementation

Committee Name	Primary Implementation Role / Functions
Policy Committee	• Local funding commitments for implementation • Approve annual work plan • Approve annual fiscal reports • Approve annual reports submitted to BWSR • Annual review and confirmation of Planning Work Group priority issue recommendations • Direction to Planning Work Group on addressing emerging issues • Approve plan amendments • Implement county ordinances and state statutory responsibilities separately from plan implementation • Approve grant applications • Approve annual assessment
Advisory Committee	• Review of and input on annual work plan • Identification of collaborative funding opportunities • Recommendations to Planning Work Group and Plan Coordinator on program adjustments • Assist with execution of the targeted implementation schedule
Planning Work Group	• Identify local funding needs for implementation • Annual review and confirmation of priority issues • Evaluate and recommend response to emerging issues • Prepare plan amendments • Implement the targeted implementation schedule • Note: the LGU that initiates a plan amendment is responsible for coordinating and public hearings
Plan Coordinator	• Convene committee meetings • Coordinate with LGUs on progress of projects and grants • Prepare the annual work plan • Prepare annual reports submitted to BWSR • Work with fiscal agent to develop budget and reports • Prepare and submit grant applications / funding requests • Compile annual results for annual assessment • Seek outside funding

Committee Name	Primary Implementation Role / Functions
Fiscal Agent	• Prepare final reports • Review and pay bills • Prepare budgets • Enter into grant agreements • Take meeting minutes

5.3.2 Collaboration

5.3.2.1 Collaboration with Other Units of Government

The Thief River Watershed 1W1P Planning Group will continue coordination and cooperation with other governmental units at all levels. This cooperation and coordination is both horizontal and vertical. Vertical coordination between the Thief River Watershed 1W1P Planning Group and agencies such as BWSR, the US Army Corps of Engineers, the DNR, and the MPCA are mandated through legislative and permit requirements. Horizontal cooperation between the Thief River Watershed 1W1P Planning Group and comparable units of government such as municipalities, township boards, county boards, the Watershed District board, and other water management authorities are a practical necessity to facilitate watershedwide activities. Opportunities for collaboration also exist with regional governmental units and programs, including the Red River Watershed Management Board on basin-wide water management and the Red River Valley Conservation Service Area (RRVSCA) on technical assistance to landowners through SWCD support.

The Thief River Watershed 1W1P Planning Group will exercise intergovernmental coordination and cooperation as an absolute necessity for it to perform its required functions. The Thief River Watershed 1W1P Planning Group will continue to foster an environment that enhances coordination and cooperation to the maximum extent possible throughout the implementation of this plan.

The Thief River Watershed 1W1P Planning Group has identified that agency goals, objectives, directions, and strategies are generally compatible with the content of this plan. The implementation actions and goals were predominantly defined through a collaborative effort. However, some agency goals, objectives, directions, and strategies for resource management within the plan area have not been selected as priority issues. The responsibility for achieving the goals associated with resource issues considered "C" level or unranked priorities remains with the respective agency or organization.

The Thief River Watershed 1W1P Planning Group and the Plan Coordinator will act as the lead for the implementation of this plan's identified priority issues. Due to local funding, technological, and other capacities, the lower-ranked issues that were not prioritized are encouraged to be implemented with agency-led efforts, including but not limited to funding. The Thief River Watershed 1W1P Planning Group will continue to cooperate and collaborate with other governmental units at all levels but may retain a cooperator or facilitator role with implementation of addressing issues that were not prioritized by Thief River Watershed 1W1P Planning Group as A- or B-level priorities.

There are opportunities in the Thief River Watershed for LGUs to develop a suite of shared services in order to maintain consistency and increase efficiency. In addition to the the Plan Coordinator and Fiscal Agent, potential shared services include:

- ditch inspection/buffer enforcement,
- data collection/monitoring database management,
- SSTS inspections,
- GIS services,
- Conservation planner,
- Engineering services,
- Wetland Conservation Act, and

- public information specialist.

The Plan Coordinator role and responsibilities could also encapsulate some of these shared services.

5.3.2.2 Collaboration with Others

Plan partners expect to continue and build on existing collaboration with others, including NGOs, while implementing this plan. Organizations include but are not limited to the Red River Basin Commission (RRBC), the International Water Institute (IWI), the National Association of Conservation Districts (NACD), and Pheasants Forever (PF).

5.3.3 Work Planning

This plan envisions collaborative implementation. Therefore, annual work planning is envisioned to align the priority issues addressed, the availability of funds, and the roles and responsibilities for implementation.

5.3.3.1 Local Purpose

An annual work plan will be developed by the Plan Coordinator based on the targeted implementation schedule and any adjustments made through an annual review (see **Section 5.3.4**). Specifically, the project prioritization process will include the following:

- Verifying the project is in a priority subwatershed in the plan
- Developing a project request form to add projects to the hopper
- Discussion by the Planning Work Group
- Opportunity – leveraging other funding, project readiness
- Cost/benefit (PTMApp results), zonation hotspots
- Some consideration for equitable split among partners

The work plan will then be presented to the Policy Committee, who will ultimately be responsible for approval. The intent of these work plans will be to maintain collaborative progress toward completing the targeted implementation schedule. Cost-share policies will also be reviewed and revised as part of the work plan process.

5.3.3.2 State Purpose

The Plan Coordinator, in collaboration with the fiscal agent, will collaboratively develop, review, and submit a Biennial Budget Request (BBR) from this plan to BWSR. This BBR will be submitted to and ultimately approved by the Policy Committee prior to submittal to BWSR. The BBR will be developed based on the targeted implementation schedule and any adjustments made through self-assessments (see **Section 5.3.4**). The BBR is intended to utilize local water management priorities to drive state appropriation requests. The Thief River 1W1P Planning Group intends to pursue block grant requests and other funding based on the BBR to meet goals and plan implementation schedules.

5.3.4 Assessment and Evaluation

5.3.4.1 Annual Evaluation

Each year the Plan Coordinator will provide the Policy Committee with an annual update on the progress of the plan's implementation in accordance with BWSR's Level 1 performance standards. During this annual review process, feedback will be solicited from the boards, the Planning Work Group, the Policy Committee, and the Advisory Committee. This feedback will be presented to the Policy Committee to set the coming year's priorities for achieving the plan's goals and to decide the direction for grant submittals. In addition, this feedback will be documented and incorporated into five-year evaluations. As part of the evaluation, the Plan Coordinator will pull project information on projects from eLink and check the frequency of MPCA BMP tracking database updates.

5.3.4.2 Five-Year Evaluation

This plan has a ten-year life cycle beginning in 2020. Over the course of the plan life cycle, progress towards reaching goals and completing the implementation schedule may vary. In addition, new issues may emerge and/or new monitoring data, models, or research may become available. For instance, projects completed before the five-year mark of the plan will be incorporated into PTMApp and/or HSPF-SAMs models in order to assess project impact. As such, in 2024, a five-year evaluation will be undertaken to determine if the current course of actions is sufficient to reach the goals of the plan or if a change in the course of actions is necessary.

5.3.4.3 Reporting

LGUs have a number of annual reporting requirements. A number of these reporting requirements will remain a responsibility of the LGU (**Table 5-9).** However, reporting related to grants and programs developed collaboratively and administered under this plan will be reported by the Plan Coordinator. In addition to annual reports, the Plan Coordinator will also develop an annual State of the Watershed Report. This report will document progress toward reaching goals and completing the targeted implementation schedule and will describe any new emerging issues or priorities. The information needed to annually update the State of the Watershed Report will be developed through the annual evaluation process.

Table 5-10: Examples of Annual LGU Reporting Responsibilities

Report	Local Governmental Unit Responsibility
Annual Report	Plan Coordinator
Ditch Buffer Strip Annual Report	Drainage Authority
Farm Bill Assistance Report	SWCD
Financial Reports	Fiscal Agent
Technical Approval Authority (TAA)	SWCD
Website Compliance: (Checklist)	All Grantees
WCA Annual Report	All WCA LGUs
Feedlot Report	All Feedlot LGUs

5.3.5 Plan Amendment Process

This plan extends through 2029. Revision of the plan may be needed through an amendment prior to the plan update if significant changes emerge in the priorities, goals, policies, administrative procedures, or plan implementation programs. Revision may also be needed if issues emerge that are not addressed in the plan.

All amendments to this plan will follow the procedures set forth in this section. This plan will remain in full effect until a revision is approved by BWSR. Plan amendments may be proposed by any agency, person, city, county, or Watershed District to the Policy Committee, but only the Policy Committee can initiate the amendment process. All recommended plan amendments must be submitted to the Policy Committee along with a statement of the problem and need, the rationale for the amendment, and an estimate of the cost to complete the amendment.

Preparers of this plan recognize it may need to be periodically amended to remain useful as a long-term planning tool. However, the structure and intent of this plan is to provide flexibility to respond to short-term emerging issues and opportunities. The Policy Committee will review and revise its long-range work plan and/or implementation programs through the annual budget and Annual and Short-Range Work Plan.

Technical information (especially water quality data) will require frequent updating, such as when new, site-specific data is generated by state, federal, and regional agencies, counties, cities, or individuals. Generally, these technical updates and studies are considered part of the normal course of operations consistent with the intent of this plan and not a trigger for a plan amendment. However, when the technical information results in a policy that is a significant change of direction from the plan or the implementation of a projects or implementation programs, a plan amendment may be required.

5.3.5.1 Criteria and Format for an Amendment

Plan participants recognize the large work effort required to manage water-related issues. The plan provides the framework to implement this work by identifying priority issues, measurable goals, and action items.

Plan amendment criteria includes the following:

- Any LGU can propose an amendment.
- Costs are covered by the LGU who proposes the amendment unless Policy Committee decides to split costs out because there is mutual benefit among multiple partners
- Policy Committee decides to move forward with amendment through a resolution with a majority vote
- Policy Committee holds the hearing
- Majority vote of Policy Committee to submit plan to BWSR for review and approval – doesn't need prior approval by each individual LGU

If the Policy Committee or BWSR decides that a plan amendment is needed, the Policy Committee will follow a process similar to the County and Watershed District plan amendment processes:

Step 1: Consult—Policy Committee consults with the BWSR Board Conservationist to review the water plan amendment process. Determine the extent of the amendment and review process and the correlated level of effort needed. Extensive amendments typically take 18 months to complete. Set a due date for amendment completion and work backward to develop an internal timeline. Discuss the participants who will be involved with the amendment review and the level of involvement, which depends on the nature of the amendment.

Step 2: Self-Assessment and Develop Proposed Amendment—Policy Committee performs self-assessment to evaluate progress on current plan. This should include a review of Performance Review and Assistance Program (PRAP) reports and other related information. Policy Committee reviews current plan sections and develops a list of sections to amend, noting areas where information is missing or out of date. Review state reports/plans for the area where the amendment is proposed, such as Groundwater Restoration and Protection Strategies (GRAPS) and Watershed Restoration and Protections Strategies (WRAPS), for possible inclusion into the plan. The BWSR website contains information on how to use the WRAPS reports in water plans. At the discretion of the Policy Committee, drafts of proposed plan amendments may be sent to all plan review authorities for input before beginning the formal review process. Examples of situations where a plan amendment may be required include the following:

- Addition of a capital improvement project that is not described by the plan
- Addition or modification of a WMD
- Addition of new programs or other initiatives that have the potential to create significant financial impacts or controversy when inconsistent with the issues, goals, and policies

Step 3: Submit Petition—Policy Committee submits a petition to the BWSR. The petition to amend the water plan can be in the form of a letter or memo to the BWSR Board Conservationist. The petition may be submitted electronically. The petition should contain background on the water plan, the purpose(s) for the amendment, and a general summary of the amendment (areas of the plan that will be amended and scope of the amendment if known). The petition should include the proposed amendment, the date of the public hearing, and a copy of the signed resolution passed by the Policy Committee board indicating the intent to amend the water plan. The Resolution to Amend template is located on the BWSR website. BWSR Board Conservationist consults with the BWSR Regional Manager, other BWSR staff, and board members and provides feedback to the Policy Committee regarding the petition and proposed amendment.

Step 4: Notify—The Policy Committee will maintain a distribution list for copies of the plan and, within 30 days of adopting an amendment, distribute copies of the amendment to the distribution list. Generally, electronic copies of the amendment will be provided or documents made available for public access on the RLWD website (http://www.redlakewatershed.org). Printed copies will be made available upon written request and printed at the cost of the requester.

5.3.6 Formal Agreements

The Thief River Watershed 1W1P Planning Group is a coalition of counties, SWCD, and a watershed district within northwest Minnesota. The Thief River Watershed 1W1P Planning Group previously entered into a formal agreement through a Memorandum of Agreement for planning the 1W1P for the Thief River Watershed (**Appendix B)**. This agreement does not preclude plan participants from entering into additional formal agreements necessary to obtain implementation funding or to develop share-services. The parties have drafted a revised **Memorandum of Agreement** for purposes of implementing this plan.

Maple Grove, MN | HEI No. 17_3655_004
March 22nd 2018

Thief River Watershed – Land & Water Resources Inventory

One Watershed, One Plan

Land and Water Resources Inventory

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List of Acronyms

AUID	Assessment Unit Identification
BFE	Base Flood Elevation
BWSR	Board of Water and Soil Resources
CFS	Cubic Feet per Second
DNR	Minnesota Department of Natural Resources
DO	Dissolved Oxygen
EDA	Environmental Data Access (MPCA Database)
ECS	Ecological Classification System
FDR	Flood Damage Reduction
FEMA	Federal Emergency Management Authority
HUC	Hydrologic Unit Code
IBA	Important Bird Area
MCBS	Minnesota County Biological Survey
MDA	Minnesota Department of Agriculture
MDH	Minnesota Department of Health
MPCA	Minnesota Pollution Control Agency
MWRPP	Major Watershed Restoration and Protection Plan
NPDES	National Pollutant Discharge Elimination System
NWI	National Wetland Inventory
1W1P	One Watershed, One Plan
RRBC	Red River Basin Commission
RLWD	Red Lake Watershed District

SWAA	Source Water Assessment Area
SWB	Soil-Water Balance
TMDL	Total Maximum Daily Load
WHAF	Watershed Health Assessment Framework
WHPA	Wellhead Protection Area
WRAPS	Watershed Restoration and Protection Strategy

1. INTRODUCTION

The Thief River Watershed (Thief River Watershed) One Watershed, One Plan (1W1P) boundary **(Figure 1)** encompasses a 1048-square-mile (671,024 acres) area that includes parts of Beltrami, Marshall, and Pennington counties (97.8% of the watershed) and Roseau County (<3% of the watershed). The Thief River Watershed (8-digit HUC 09020304) is divided into the following eight 10-digit HUC subwatersheds, which also serve as planning regions for the purposes of the 1W1P **(Figure 1)**:

- Moose River (090203040401)
- Upper Thief River (090203040402)
- Mud River (090203040403)
- Middle Thief River (090203040404) (Agassiz National Wildlife Refuge)
- Lost River (090203040405) (Branch 200 of JD11)
- Marshall County Ditch 20 (090203040406)
- Judicial Ditch 18 (090203040407)
- Lower Thief River (090203040408)

Surrounding watersheds are Snake River and Tamarac River to the west, Two Rivers and Roseau River to the north, Rapid River and Red Lakes to the east, and the Red Lake River to the south. The Thief River Watershed is part of the Red Lake Watershed District and is a subwatershed of the Red Lake River watershed within the Red River Basin. Fourtown, Goodridge, Grygla, Holt, and Thief River Falls are the only municipalities in the watershed.

Most of the Thief River Watershed lies within the Lake Agassiz Plain Level III Ecoregion, with the eastern half extending into the Northern Minnesota Wetlands (NMW) ecoregion. Water resources include 11 stream segments or Assessment Unit IDs (AUIDs), Thief and Mud lakes, impoundments, drainage ditches, and extensive wetlands (approximately 330,223 acres). There is little relief in the watershed as it drains from the northeast to southwest (Figure 2). Due to the flat, low-lying topography and poorly drained soils, much of the watershed is prone to severe flooding and historically was unsuitable for crop production. In order to support agricultural production and mitigate flooding, the watershed is heavily managed with channelized rivers and streams as well as man-made ditches. More than 30 impoundments have been constructed in the watershed. Some of the impoundments were built to address flooding concerns and some are operated primarily for wildlife habitat management (MPCA, 2017a).

The Thief River Watershed has very fertile soils and has an important agricultural economy rich in crop production and livestock operations. It is also abundant in fish and wildlife habitat, despite several stream and river impairments for aquatic life. Agassiz National Wildlife Refuge and Thief Lake Wildlife Management Area are important stopover and breeding grounds for waterfowl, shorebirds, and migratory birds. These areas also provide opportunities for hunting, fishing, and other forms of outdoor recreation.

Several issues have impacted resources within the Thief River Watershed as described in this inventory. Issues in the watershed include, but are not limited to, surface water quality and runoff, altered hydrology, groundwater quality, erosion and sedimentation, flooding, aquatic and terrestrial habitat quality, point source pollution, stewardship, recreation, and tourism.

The information contained within this Land and Water Resources Inventory is largely transcribed from the Minnesota Pollution Control Agency (MPCA), *Thief River Watershed Restoration and Protection Strategies (Draft December 21, 2017)*, the MPCA *Thief River Watershed Total Maximum Daily Load (Draft July 2016),* MPCA *Thief River Watershed Monitoring and Assessment Report* (July 2014), the Red Lake Watershed District *10-year Comprehensive Plan (2006),* the Minnesota DNR (DNR) *Thief River Watershed Fluvial Geomorphology Report*, and the DNR *Watershed Context Report: Thief River (April 2016).* This information is intended to provide background information on the existing water resources and physical factors affecting the water resources within the watershed for the Thief River Watershed 1W1P.

Figure 1: Thief River Watershed 1W1P Boundary and Planning Regions

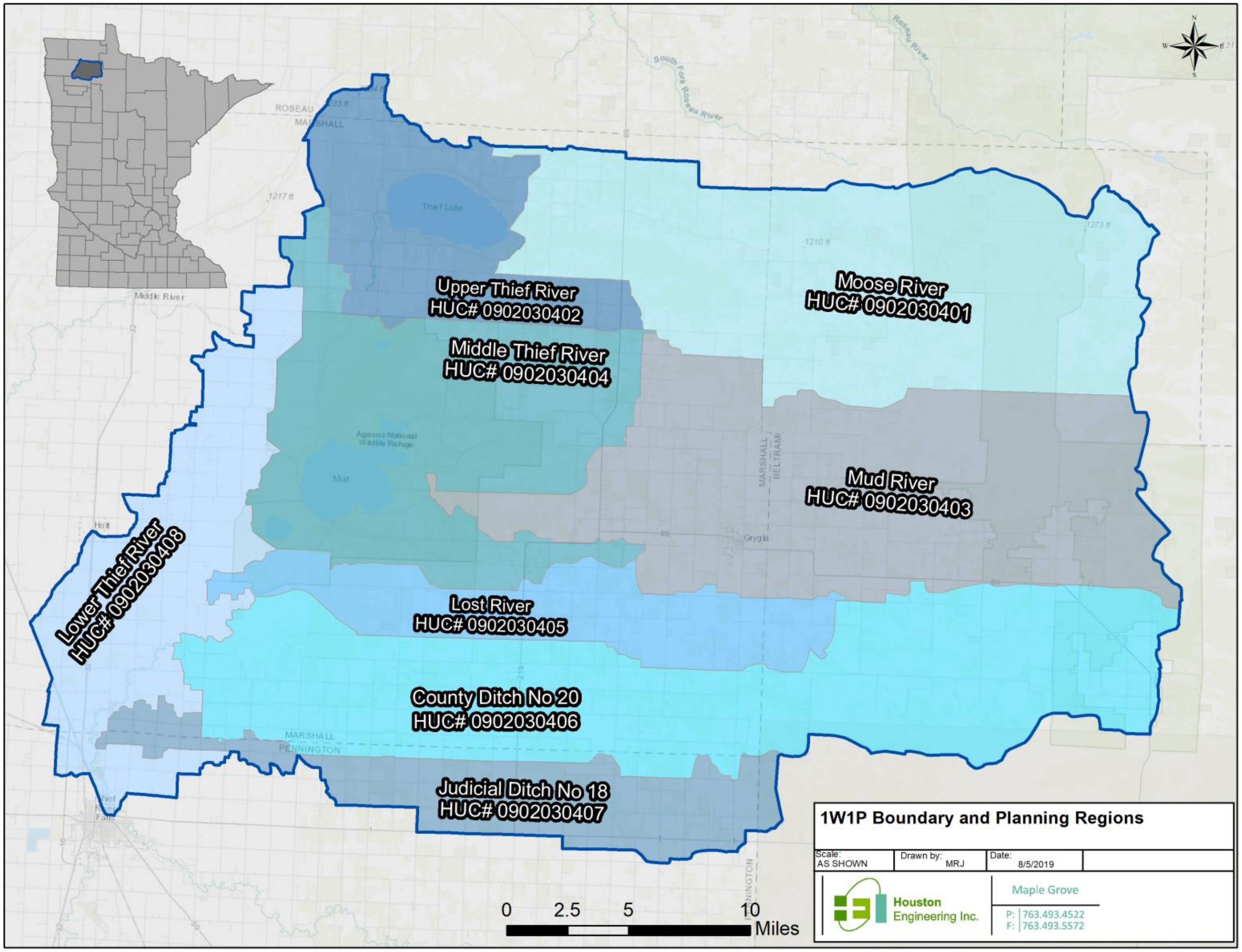
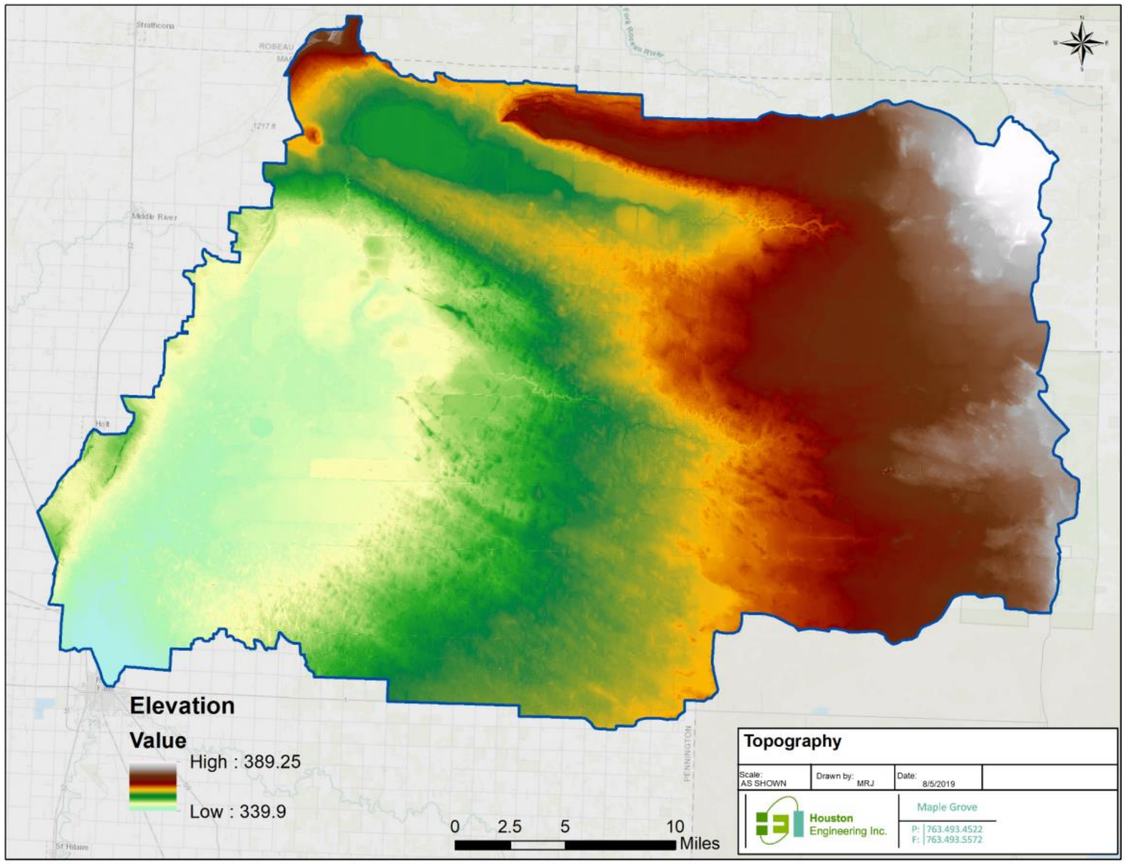
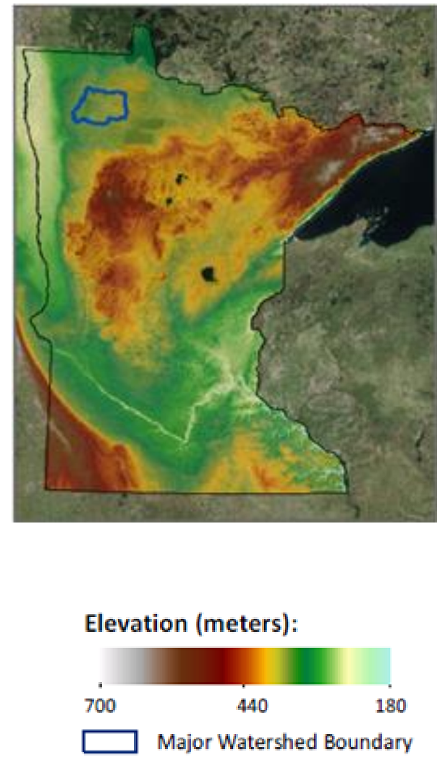


Figure 2: Thief River Watershed Topography





Source: Minnesota Dept. of Natural Resources Watershed Health Assessment – Setting the Context Thief River, p. 1. 2016. www.dnr.state.mn.us/whaf

2. LAND USE LAND COVER & DEVELOPMENT

Prior to western settlement, the Thief River Watershed was dominated by vast areas of tall grass prairie, low-lying wetlands, and conifer bogs and swamps **(Figure 3)**. Around the turn of the century, agricultural demands increased, and many of the watershed's natural prairies and wetlands were altered or removed for crop production. Due to the flat topography and silt-clayey lake washed till, most of the watershed is classified as poorly drained and prone to severe flooding. To increase drainage potential for agricultural purposes, most of the rivers and streams were ditched and the watershed was channelized (MPCA, 2014).

In the early 1900s, much of the watershed was thriving from agriculture. Marshall County approved a multi-million-dollar project to improve drainage and drain the Mud Lake area for farming. After the project proved to be unsuccessful, the state Legislature protected the county from bankruptcy by approving a land transfer to the National Wildlife Refuge (NWR) System. Today, this area is home to the 61,500-acre Agassiz NWR. Originally named the Mud Lake Migratory Waterfowl Refuge, the primary goal for the refuge is waterfowl production (MPCA, 2014).

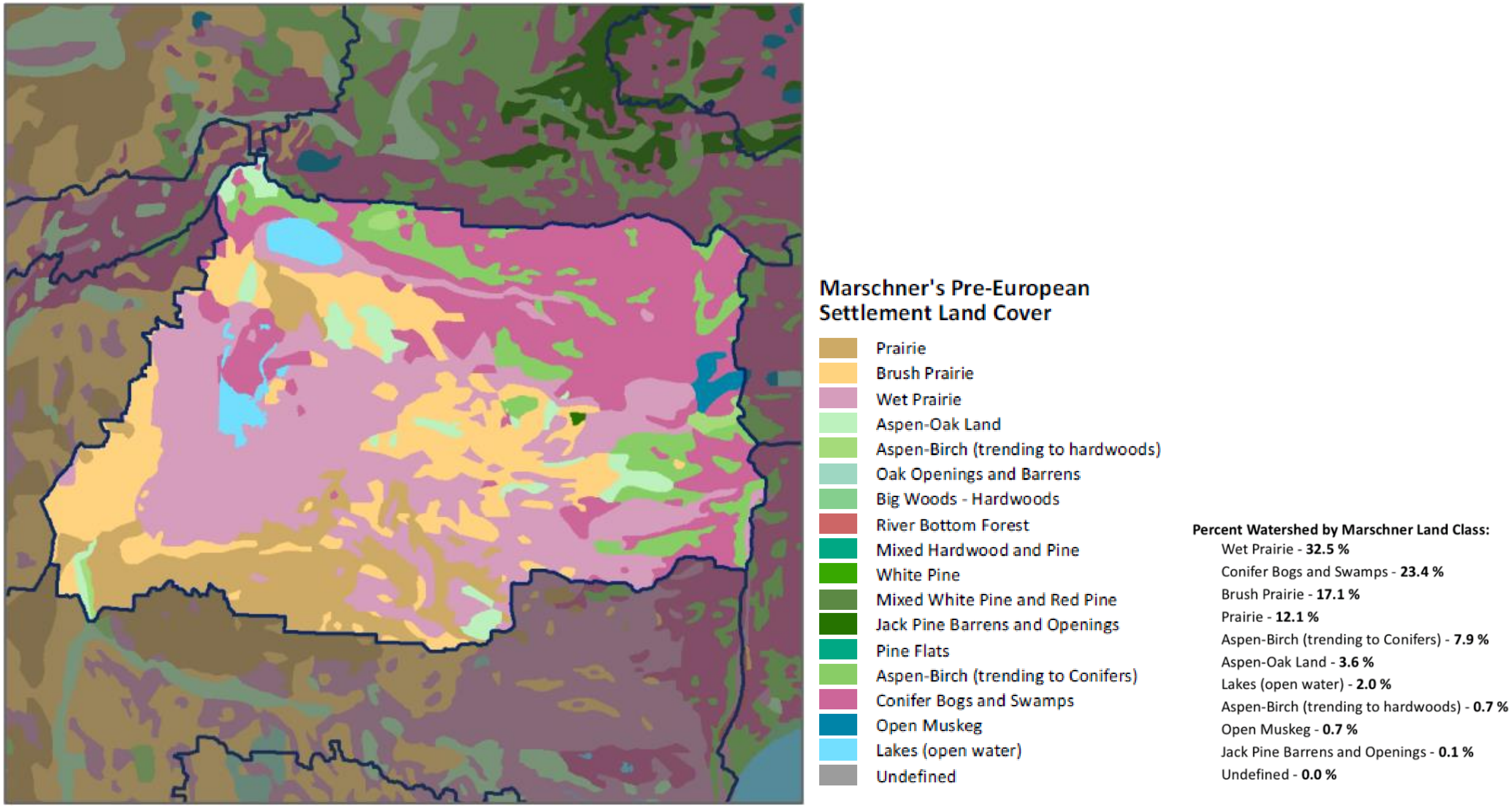
Changes in land use from pre-settlement to today are largely the result of conversion of prairie and draining wetlands for agricultural production. Currently, land use in the Thief River Watershed is dominated by cropland (36.0%) and wetlands (44.9%). The remaining land cover distribution in the watershed is as follows:

- 7.8% range (52,288 acres)
- 6.7% forest (44,840 acres)
- 2.8% developed (18,981 acres)
- 1.7% open water (11,387 acres)
- 0.6% barren/mining (421 acres)

(Figure 4) (MPCA, 2014)

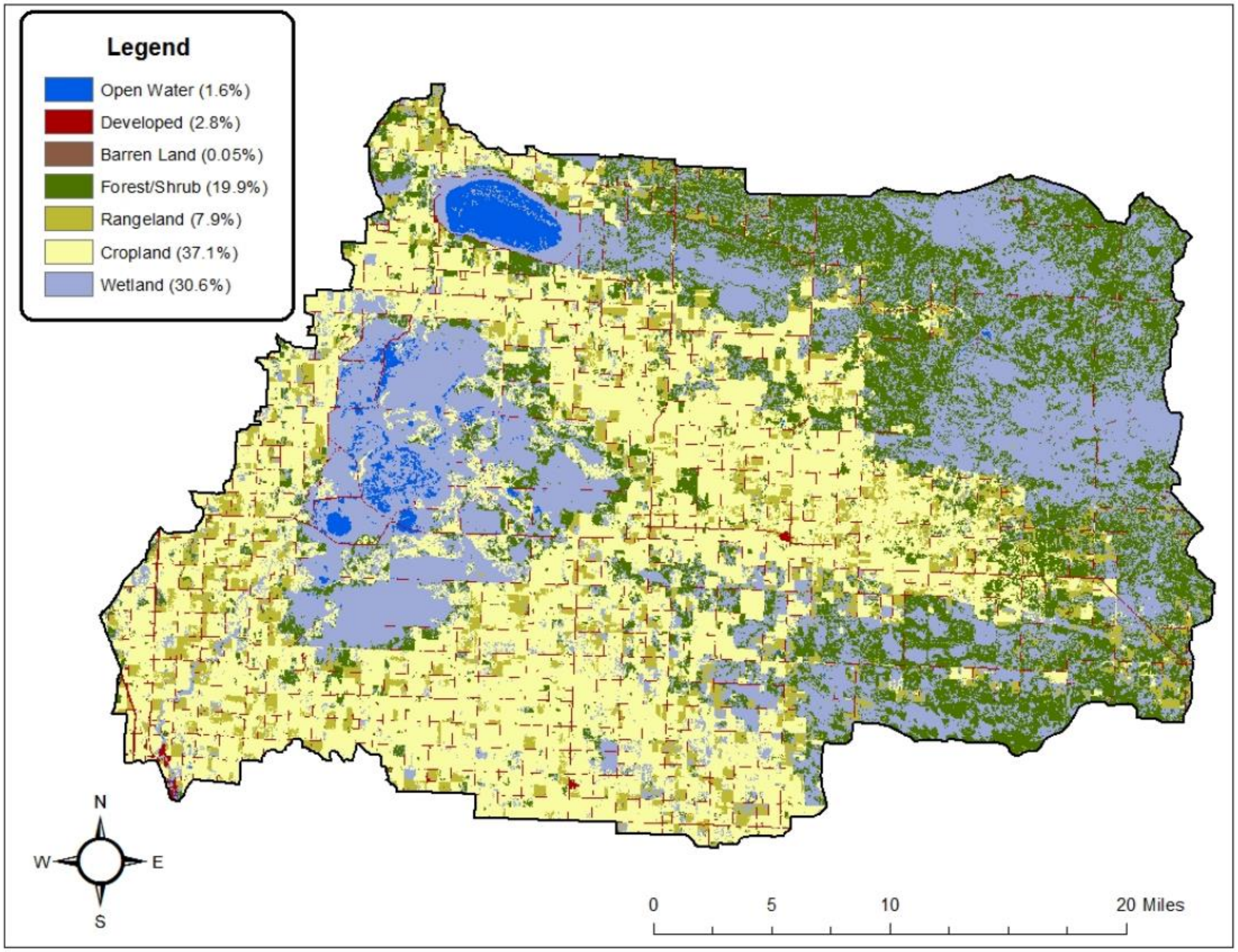
Land ownership in the Thief River Watershed is dominated by private land (309,530 acres) and state land (245,000 acres). The remaining land ownership consists of federal (61,628 acres), tribal (8,061 acres), corporate (120 acres), county (40 acres), and miscellaneous public land (40 acres) (NRCS, 2007).

Figure 3: Thief River Watershed Pre-Settlement Land Cover



Source: Minnesota Dept. of Natural Resources Watershed Health Assessment – Setting the Thief River, p. 9. 2016. www.dnr state.mn.us/whaf

Figure 4: Current Land Use for the Thief River Watershed



Source: MPCA Thief River Watershed Monitoring and Assessment Report, p. 13. 2014.

Agricultural land use in the Thief River Watershed has changed significantly over the past decade, showing a transition from pasture and small grains to corn and soybeans. **Figure 5** and **Figure 6** depict this change.

Figure 5: 2006 Agricultural Land Use in the Thief River Watershed

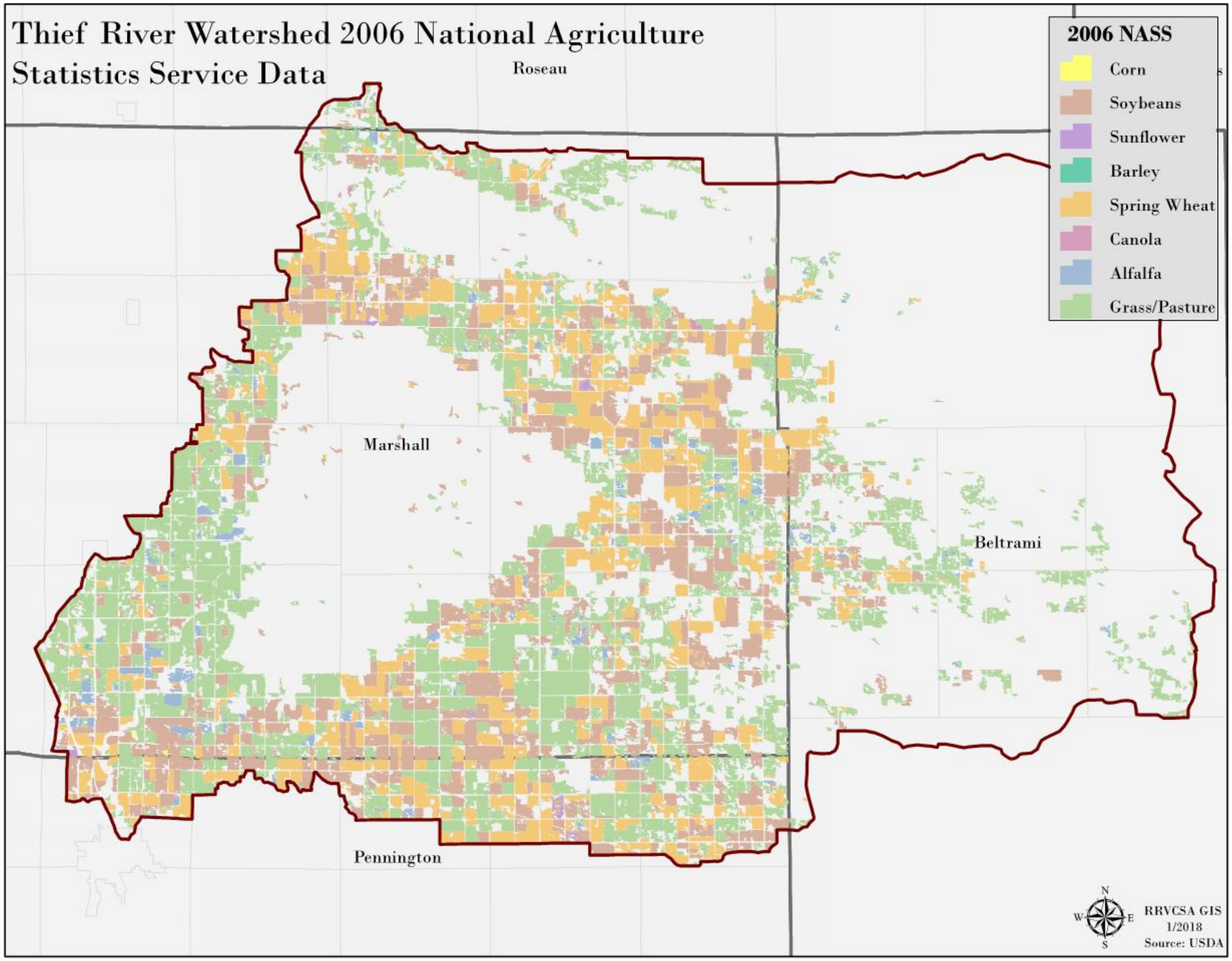
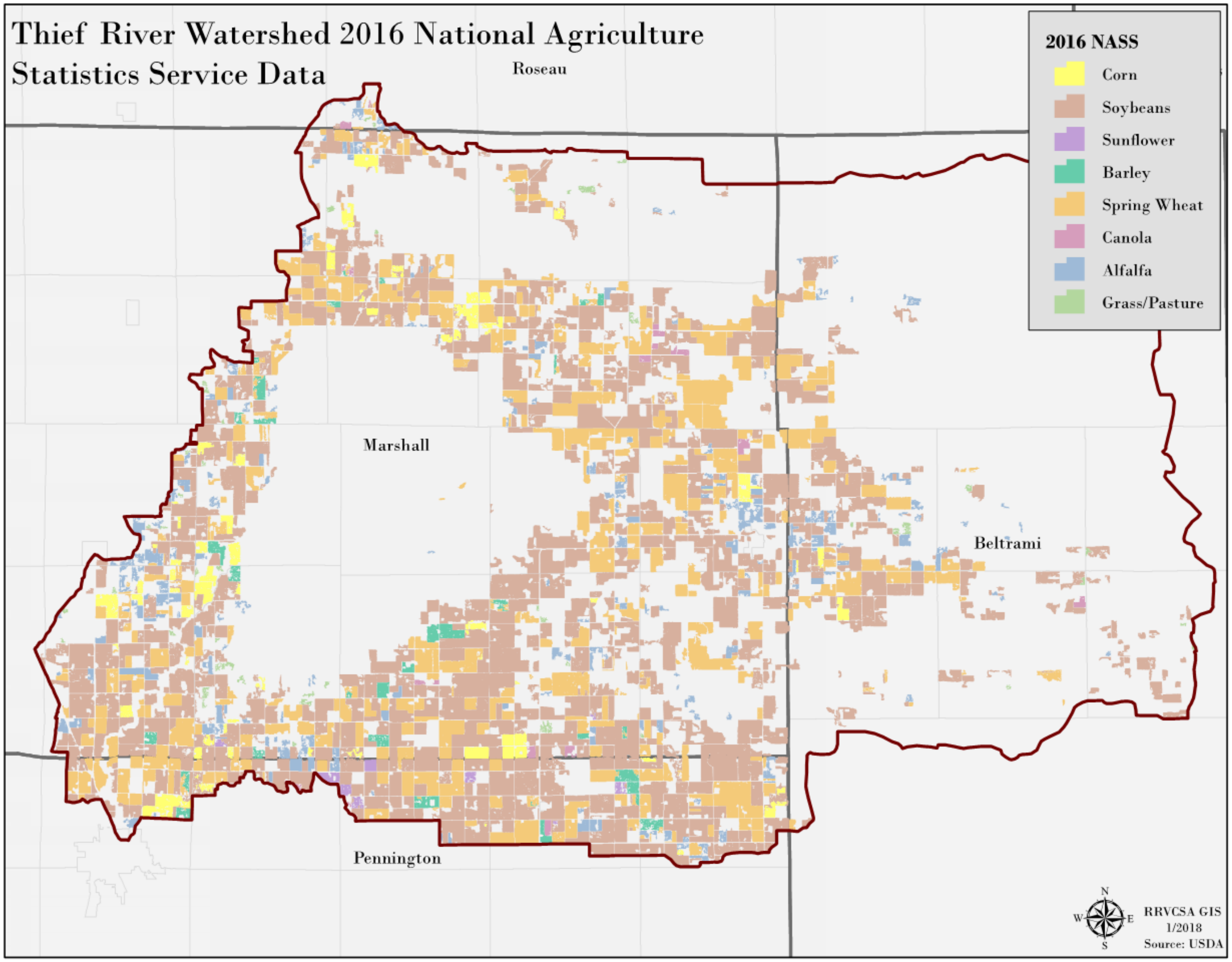


Figure 6: 2016 Agricultural Land Use in the Thief River Watershed

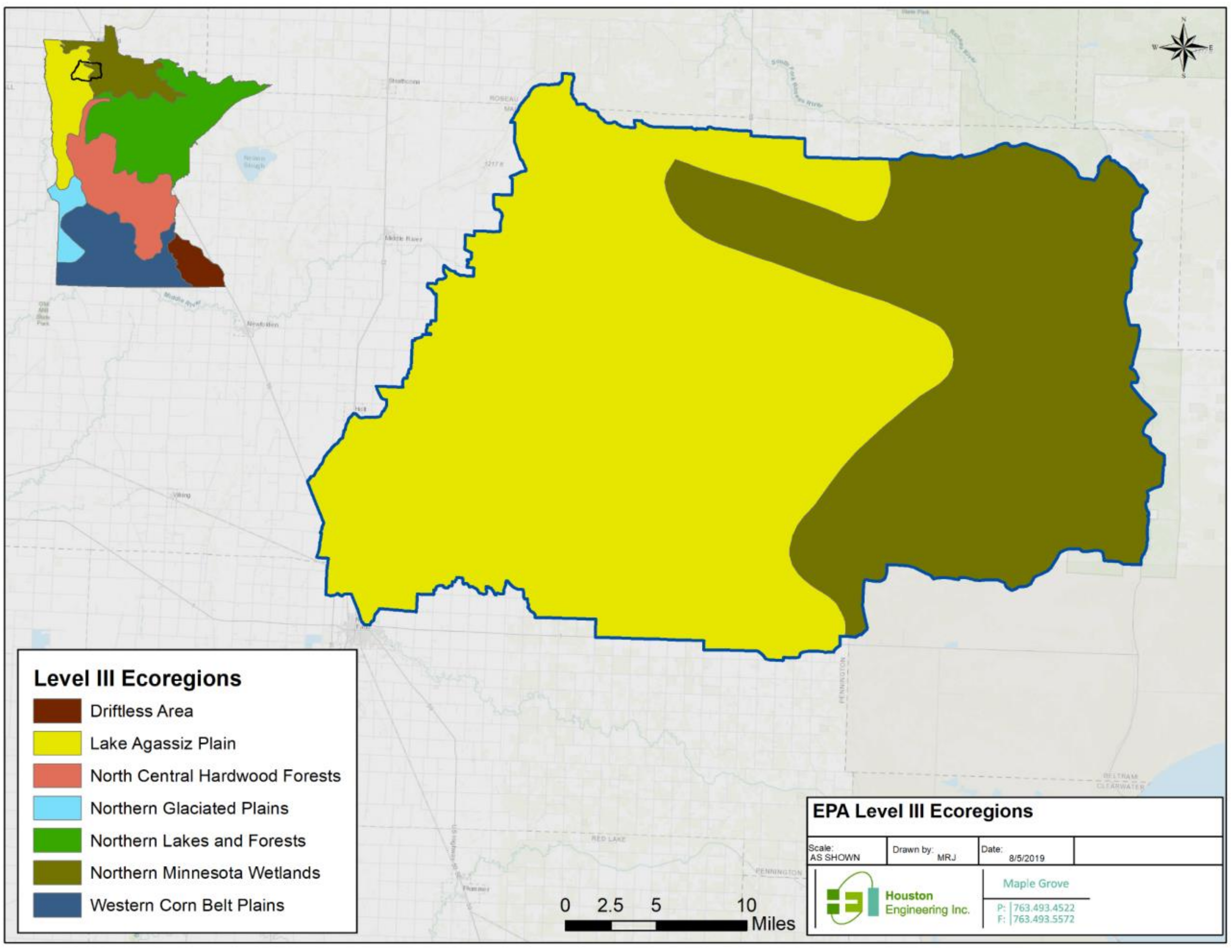


3. ECOREGIONS AND SOILS

3.1 Ecological Classification System (ECS)

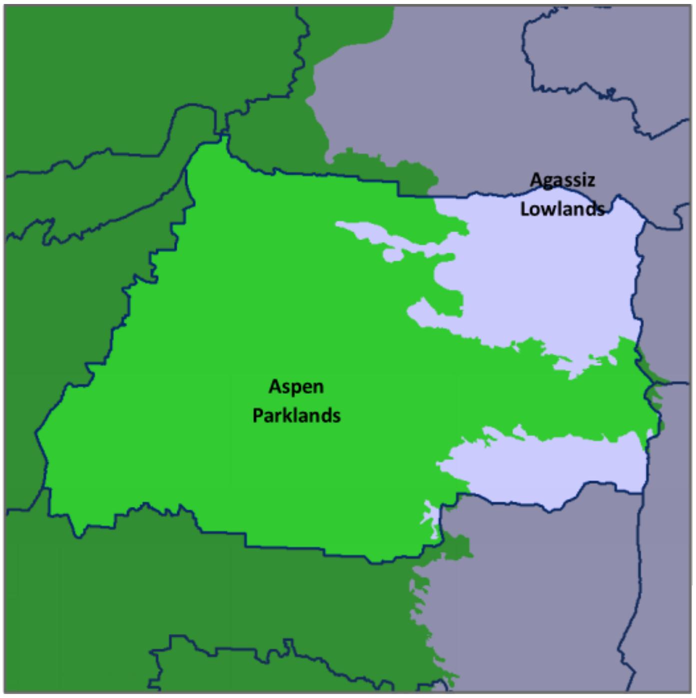
The US Environmental Protection Agency (EPA) defines an ecoregion as “a relatively homogenous ecological area defined by similarity of climate, landform, soil, potential natural vegetation, hydrology, or other ecologically relevant variables” (EPA 2010). Due to the relative homogeneity within ecoregions, Minnesota has developed several water quality standards based on these delineations. The Thief River Watershed is located within the Lake Agassiz Plain (LAP) and Northern Minnesota Wetlands (NMW) Level III Ecoregions (**Figure 7**). The LAP is dominated by glacial sediments and glacial landforms deposited from the Des Moines Lobe of the Wisconsin Glaciation approximately 14,000 years ago. These sediments consist of fine textured till containing Paleozoic limestone and cretaceous shale. As the NMW ecoregion name implies, this region is dominated by marshes and wetlands consisting of clays and silts that were deposited while Lake Agassiz existed. Formerly inundated by broad glacial lakes, most of the flat terrain in this ecoregion is still covered by standing water (Omernik et al.1988).

Figure 7: Thief River Watershed location within Level III Ecoregions



The Ecological Classification System (ECS), developed by the DNR and the US Forest Service, provides a basis for ecological mapping and classification of areas with uniform ecological features into progressively smaller units for Minnesota in accordance with the standards of the National Hierarchical Framework of Ecological Units (DNR, 2016). The Thief River Watershed is within the Aspen Parklands and Agassiz Lowlands ECS Subsections (**Figure 8**).

Figure 8: Thief River Watershed location in Minnesota ECS Provinces



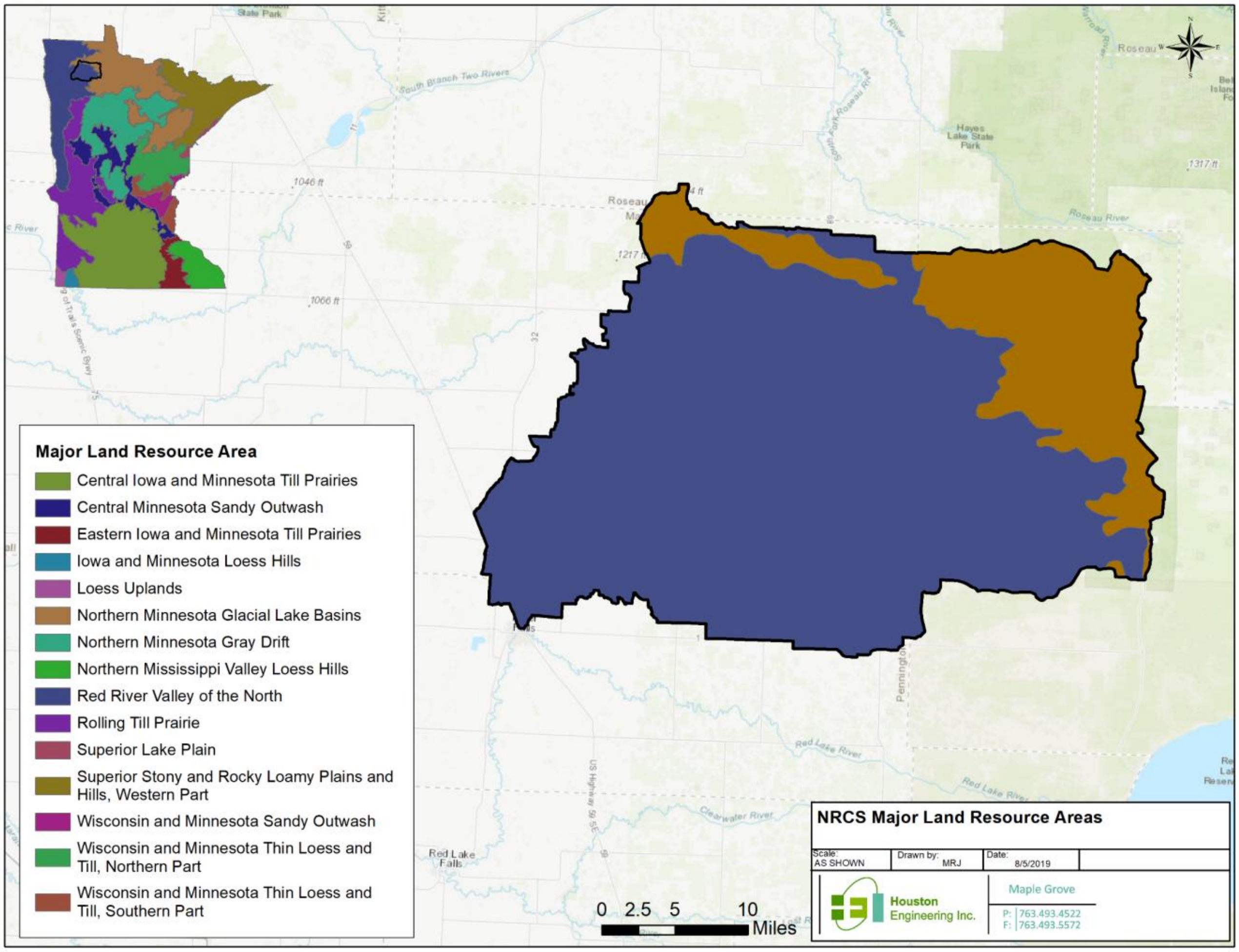
Percent Watershed Area by Subsection:
Aspen Parklands - **76.5 %**
Agassiz Lowlands - **23.5 %**

Source: Minnesota Dept. of Natural Resources Watershed Health Assessment – Setting the Thief River, p. 3. 2016. www.dnr state. mn.us/whaf

The Natural Resource Conservation Service (NRCS) divides the United States into Major Land Unit Resource Areas (MLRAs) in order to better relate land classification levels above ecological sites that contain sets of spatially associated soils and ecological sites. These MLRAs consist of a set of geographically associated Land Resource Units (LRUs) featuring a particular pattern of soils, water, climate, vegetation, land use, and farming practice.

There are two MLRAs in the Thief River Watershed **(Figure 9).** Making up much of the watershed's western half is the Red River Valley of the North; this area can be characterized as a lake plain with remnants of gravelly beaches left behind from glacial Lake Agassiz. The far eastern edge of the watershed is the Northern Minnesota Glacial Lake Basins. Consisting of a nearly flat landscape, this area is dominated by lake-washed till and organic soil matter (NRCS, 2007).

Figure 9: Major Land Resource Areas in the Thief River Watershed



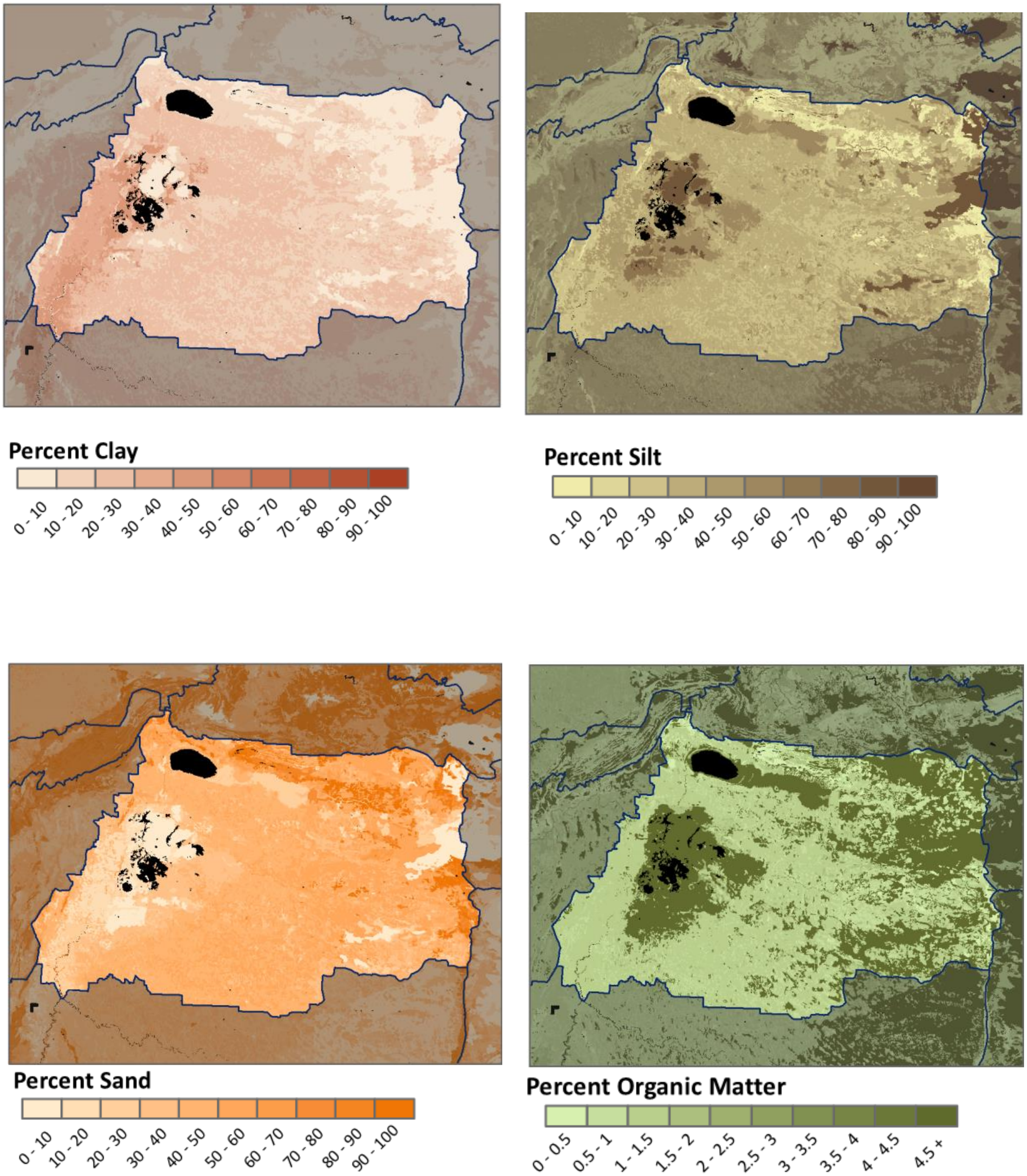
3.2 Soils

The surficial geology of the area is dominated by lake washed till. The till is described as a sandy, clay-silt loam containing fine to medium gravel with a scattering of boulders. The till is covered in areas by very fine to fine grained, uniform glacial lake sand generally less than 20 feet in thickness. Throughout the watershed, the till is overlain by a thin covering of peat (only a few feet thick) that results from the water table being close to or at land surface, paired with poor drainage in the area. Localized peat deposits are also present in many closed depressions within the till (NRCS, 2007).

Soil textures in the watershed range from fine-loamy in the west to coarse-loamy in the east, with a strip of sandy soils along the northern boundary of the watershed (RLWD, 2006). Soil texture results from the relative amount of sand, silt, and clay present in the soil. These particle types vary in size from clay particles (< .002 mm), to silt particles (.002-.05mm), to sand particles (> .05mm). The combination and relative amount of each particle type influences many soil properties (**Figure 10**) (DNR, 2016).

Further details on surficial and bedrock geology are found in Section 6.1. Visit the USDA NRCS Web Soil Survey for more information on soil types, properties, and erosion: https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm

Figure 10: Percentage of Soil Types in the Thief River Watershed

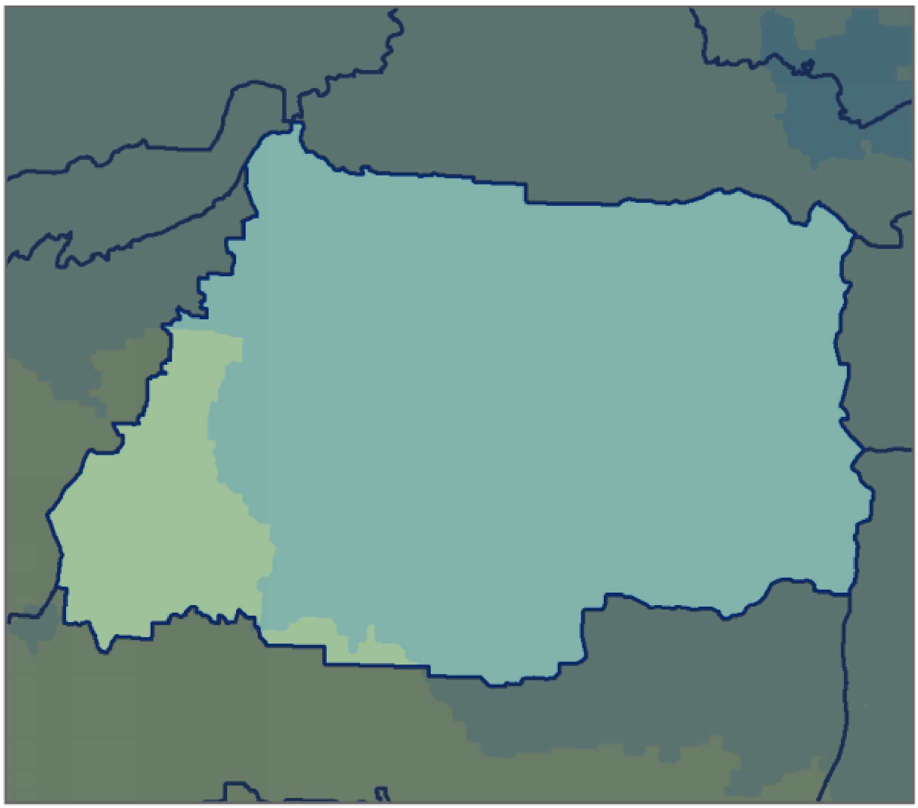


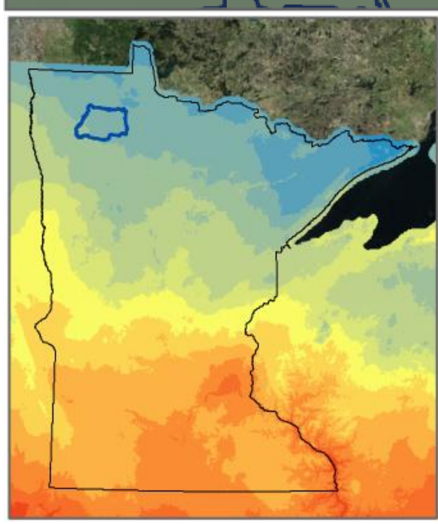
Source: Minnesota Dept. of Natural Resources Watershed Health Assessment – Setting the Thief River, p. 5-6. 2016. www.dnr state.mn.us/whaf

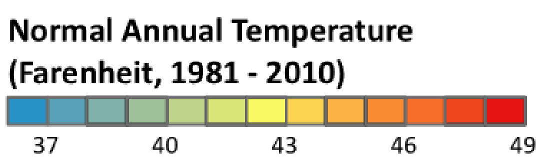
4. CLIMATE AND PRECIPITATION

Due to its position in the continent, Minnesota is located on the boundary between the semi-humid climate regime of the eastern US and the semi-arid regime to the west. Semi-humid climates are areas where average annual precipitation exceeds average annual evapotranspiration, leading to a net surplus of water. The Thief River Watershed has a continental climate marked by warm summers and cold winters. The mean annual temperature for Minnesota is 40.1˚F; the mean summer temperature for the Thief River Watershed is 64.04˚F; and the mean winter temperature is 6.08˚F (Minnesota State Climatologists Office, 2003). **Figure 11** shows the normal annual temperature for the Thief River Watershed.

Figure 11: Thief River Watershed Normal Annual Temperature (Fahrenheit, 1981-2010)



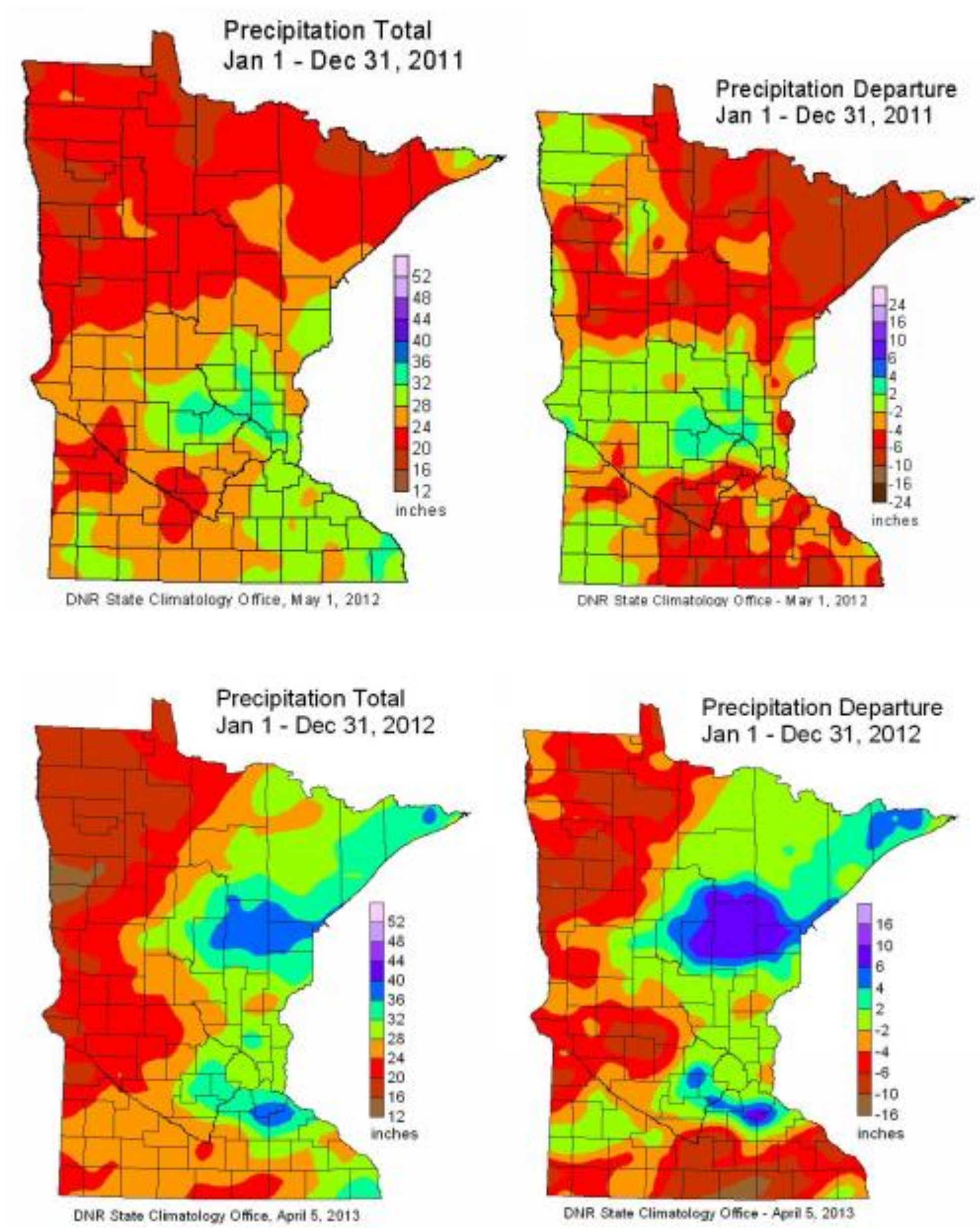




Source: Minnesota Dept. of Natural Resources Watershed Health Assessment – Setting the Thief River, p. 8. 2016. www.dnr state.mn.us/whaf

The Thief River Watershed received approximately 20-24 inches of precipitation in 2011, which was 2-4 inches lower than normal. In 2012, the watershed received 16 inches, with precipitation deviating 6-10 inches below normal (**Figure 12**) (MPCA, 2014).

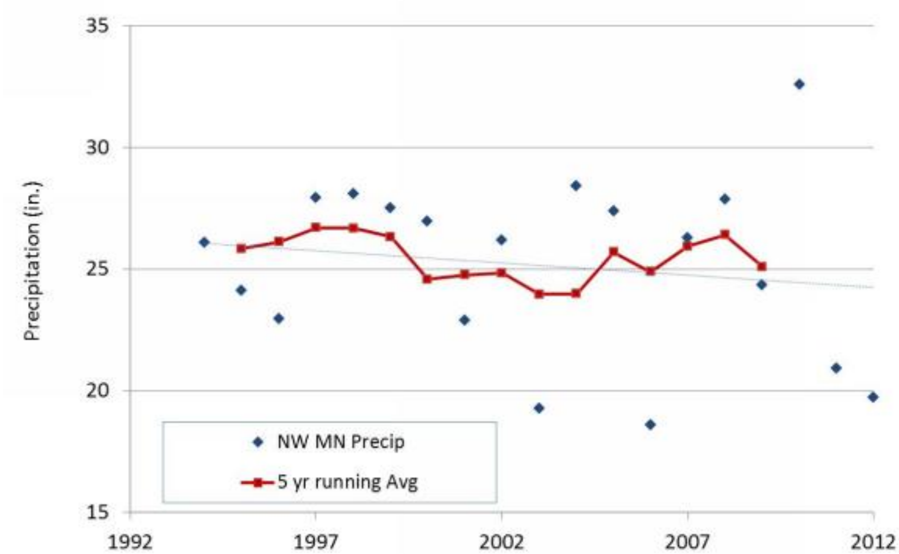
Figure 12: Statewide Precipitation Levels during the 2011 and 2012 Water Years



Source: DNR State Climatology Office, Annual Precipitation Maps.

Rainfall in the northwest region displays no significant trend over the last 20 years (**Figure 13**). Though rainfall can vary in intensity and time of year, it would appear that northwest Minnesota precipitation has not changed dramatically over this time period. This data is taken from the Western Regional Climate Center, available as a link to the University of Minnesota Climate website: http://www.wrcc.dri.edu/spi/divplot1map.html

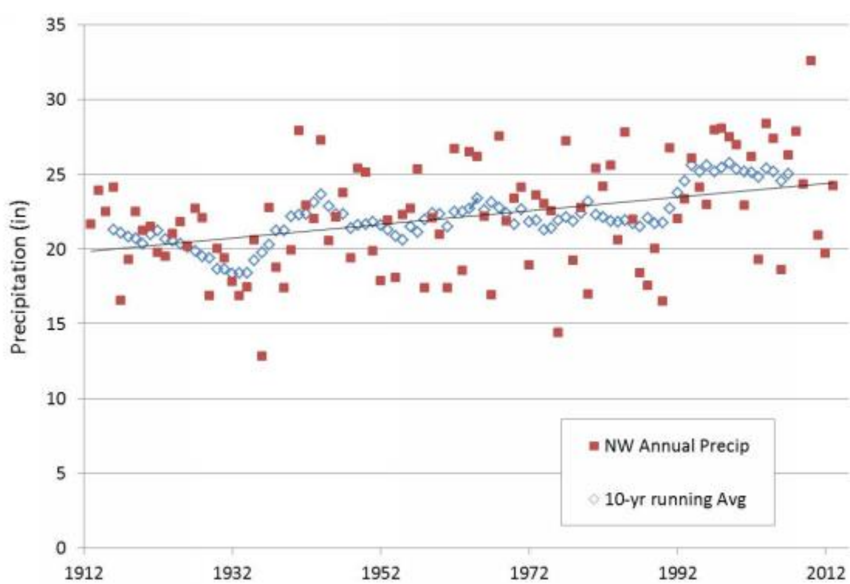
Figure 13: Precipitation Trends in North West Minnesota (1992-2012) with Five-Year Running Average



Source: MPCA Thief River Watershed Monitoring and Assessment Report, p. 16. 2014.

Precipitation in northwest Minnesota exhibits a statistically significant rising trend over the past 100 years, p=0.001. This is a strong trend and matches similar trends throughout Minnesota (**Figure 14**) (MPCA, 2014).

Figure 14: Precipitation Trends in North West Minnesota (1912-2012) with Nine-Year Running Average



Source: MPCA Thief River Watershed Monitoring and Assessment Report, p. 16. 2014.

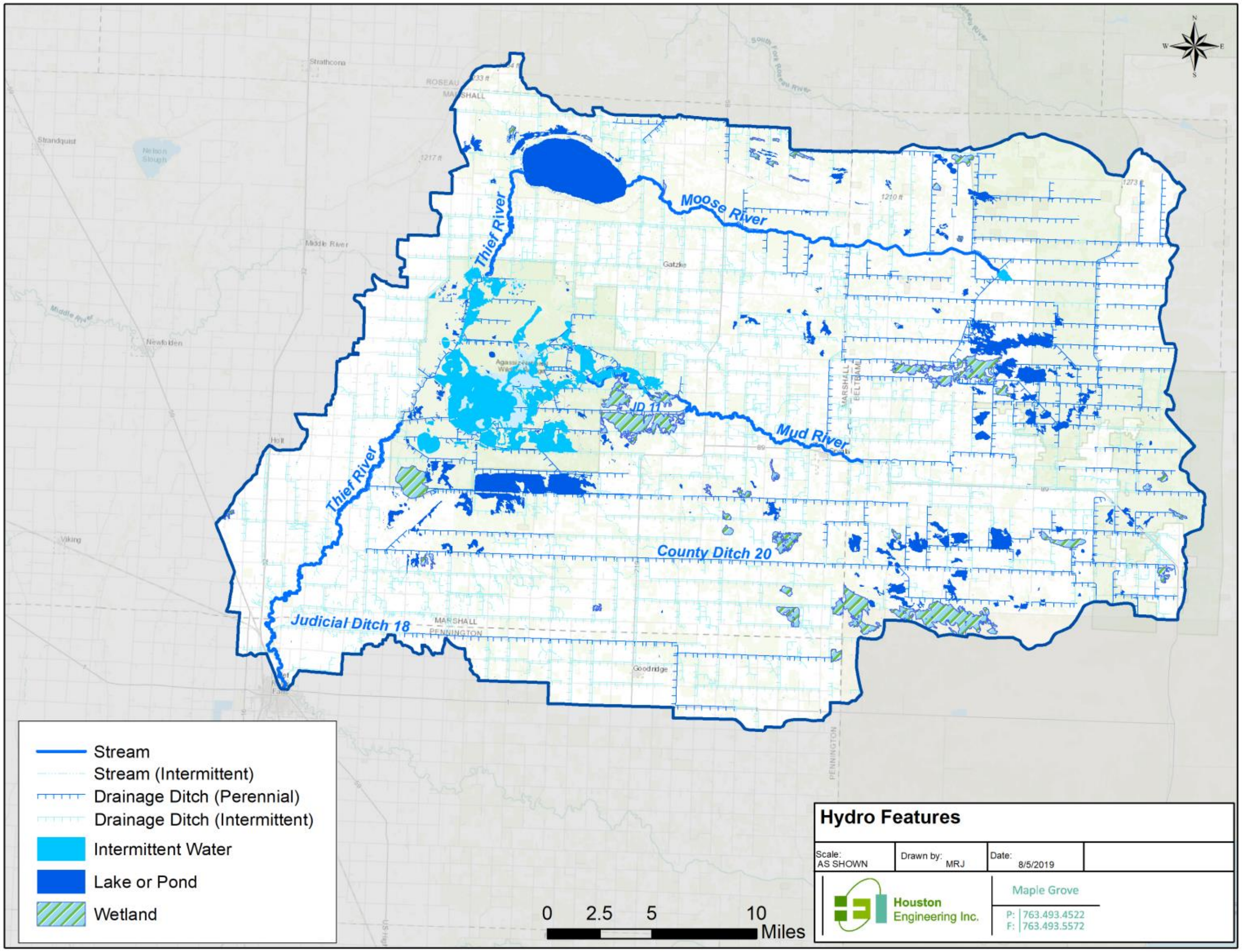
5. SURFACE WATER HYDROLOGY

From its headwaters at Thief Lake, the Thief River flows approximately 39 miles to its confluence with the Red Lake River in Thief River Falls. Like much of the watershed's streams, most of the main stem of Thief River has been historically channelized. Channelized at the outlet of Thief Lake, the river flows eight miles south before entering Agassiz NWR. Agassiz NWR lies in the center of the watershed and encompasses a large network of pools and ditches. The largest of those pools, Agassiz Pool, receives water from the Mud River, Thief River, and some smaller drainage systems. As the Thief River enters Agassiz Pool, some water flows into the pool and some flows along the inside of the northwestern dike of Agassiz Pool to the northwest outlet of Agassiz Pool.

There are two major tributaries that indirectly flow into the Thief River—the Moose River and the Mud River. From its headwaters at the outlet of the North Pool of the Moose River Impoundment, the Moose River flows east to west 23.4 miles to Thief Lake. These two tributaries are also legal ditch systems.

Along its course, the river is almost entirely contained within the Thief Lake and Wapiti Wildlife Management Areas (WMA). The Mud River subwatershed begins where the South Pool outlet of the Moose River Impoundment discharges to the Judicial Ditch 11 (JD11) drainage system. The Mud River (also part of JD11) flows northwest 20 miles to its confluence with the Agassiz Pool at Agassiz NWR. JD11 (including the Mud River) was dredged in the early 1900s. A portion of the ditch was also dug through the historical Mud Lake (now called Agassiz Pool) in a failed attempt to drain and farm that area. The old JD11 channel still exists within Agassiz Pool, although spoil piles have been breached and portions of the channel have filled with sediment. The main, radial gate outlet of Agassiz Pool discharges to the lower 2.3 miles of JD11. That portion of JD11 discharges to the Thief River on the southwestern edge of Agassiz NWR. Other significant, named tributaries that flow into Thief River between Agassiz NWR and the Red Lake River include Branch 200 of JD11, Marshall County Ditch 20 (CD20), and Judicial Ditch (JD30) (MPCA, 2014) (**Figure 15**). The Thief River eventually flows into the Red Lake River in the city of Thief River Falls.

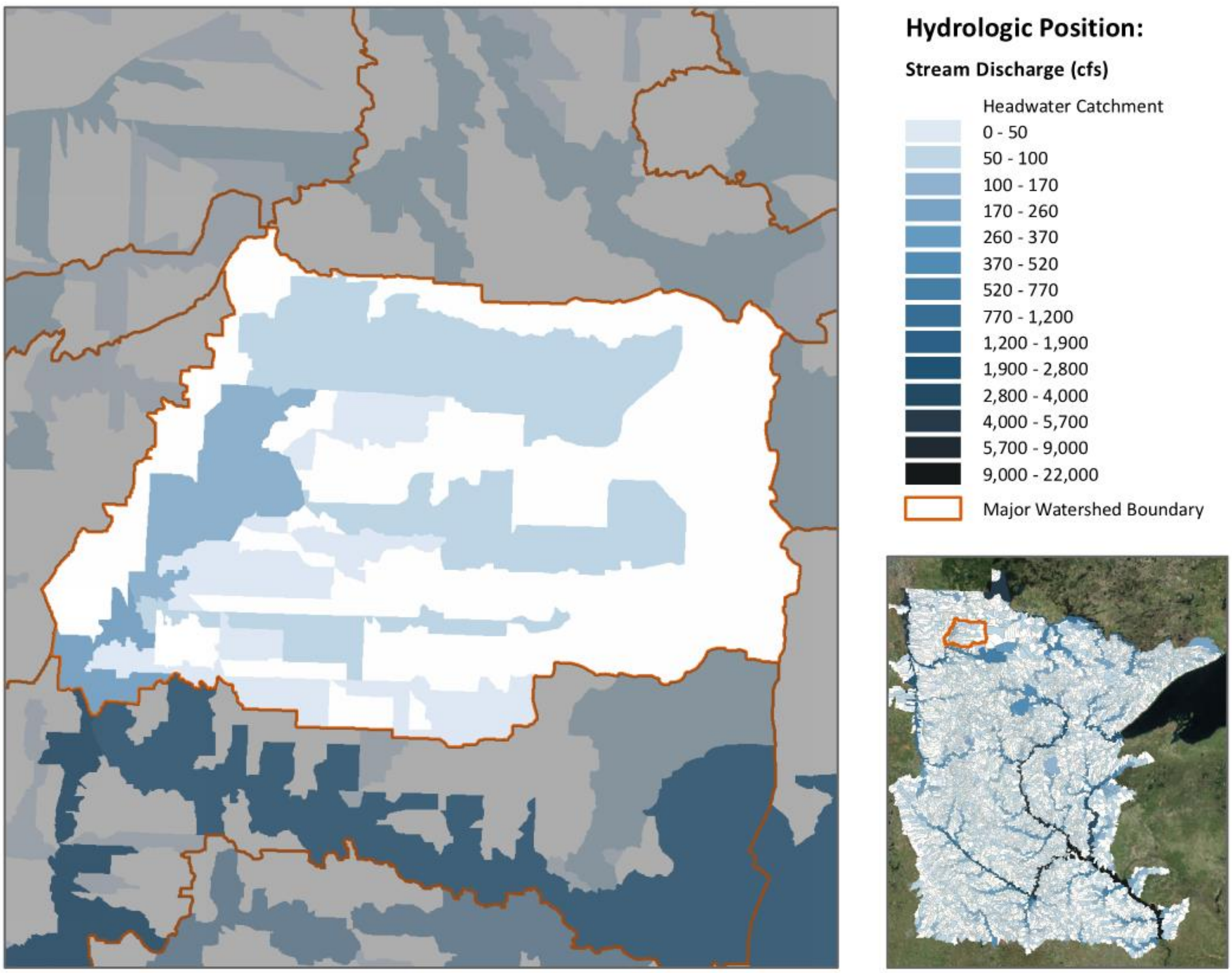
Figure 15: Hydrologic Features in the Thief River Watershed



5.1 Hydrologic Position

Hydrologic position maps help illustrate where each watershed catchment resides on the landscape in relationship to neighboring catchments (**Figure 16**). This relationship is based on the location of the mouth (i.e., pour point) of each catchment and the area that is upstream of that point. The amount of land area upstream influences the amount of water that leaves (i.e., discharges) from the mouth of each catchment. Headwater catchments are shown in white. These areas do not receive overland water flow from upstream but rather collect surface water within their boundary and send it downstream. In contrast, those catchments that encompass a major river receive flow from all catchments upstream. The mouths of major rivers accumulate all the water from the upstream river basins and have the largest water discharge rates. Larger discharge rates are shown in dark blue. (DNR, 2016).

Figure 16: Hydrologic Position of Catchments in the Thief River Watershed

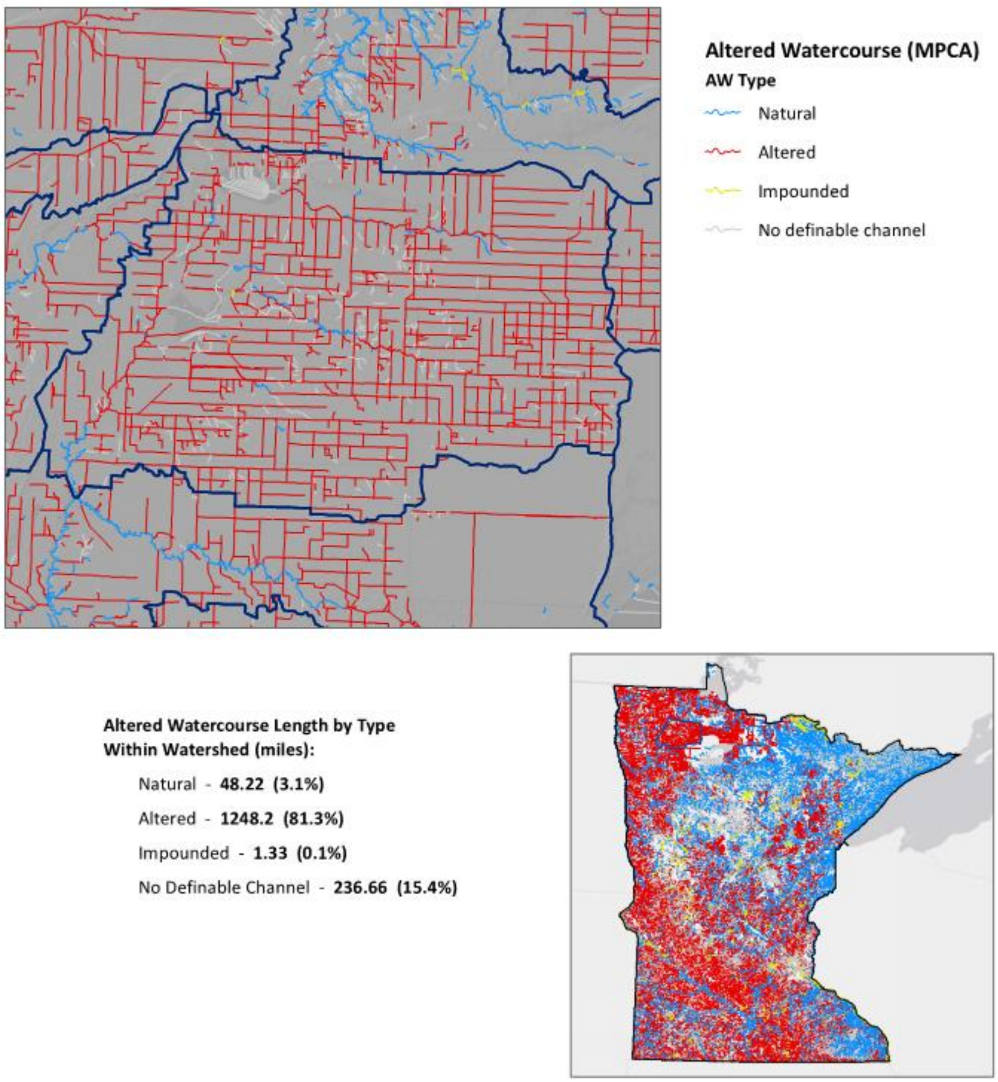


Source: Minnesota Dept. of Natural Resources Watershed Health Assessment – Setting the Context Thief River, p. 4. 2016. www.dnr.state.mn.us/whaf

5.2. Altered Watercourses

According to the Altered Watercourse Project (http://www.pca.state.mn.us/index.php/water/water-types-and-programs/surface-water/streams-and-rivers/minnesota-statewide-altered-watercourse-project.html) conducted by the MPCA, 1243.8 of the 1298.9 stream miles (95.8%)* within the watershed are considered altered. The remaining stream miles are either natural or impounded (**Figure 17**). The Thief River Watershed has the third highest percentage of altered streams among the 81 major watersheds in the state of Minnesota, behind only the Upper Wapsipinicon River and Winnebago River (MPCA, 2014).

Figure 17: Altered Watercourses in the Thief River Watershed*



Source: Minnesota Dept. of Natural Resources Watershed Health Assessment – Setting the Context Thief River Watershed, p. 14. 2016. www.dnr.state.mn.us/whaf.

*This figure cites 81.3% of watercourses as altered. The MPCA percentage in the above paragraph includes the 15.4% of watercourses with no definable channel. The MPCA definition of altered watercourses also includes natural watercourses that have been channelized.

5.3. Stream Flow Analysis

Stream channel size, shape, and pattern are formed by the frequency and magnitude of flow events moving through the channel. Increases in flow can be caused by changes to vegetative cover, increased agriculture or urban drainage, increased precipitation, or a combination of these. The gage with the longest period of record is located on the Thief River, approximately 4 miles north of Thief River Falls. Historical daily average discharge readings were first collected in July of 1909. **(Table 1)** (DNR, 2015a).

Table 1: Description of Stream Gages within the Thief River Watershed

River	ID	Location	Record of Period	Description
Thief River	USGS: 05076000 MPCA: S002-079	Nr. Thief River Falls, MN	07/01/1909 – present	Daily discharge
Thief River	RLWD: S002-088 MPCA: S002-088	Nr. Holt, MN (CSAH 7)	07/05/2007-present	Water level and flow
Mud River	USGS: 05075700 RLWD: S002-078 MPCA: S002-078	Nr. Grygla, MN (89)	05/29/2007-present	Water level and flow[1]
Moose River	RLWD: S004-211	Hwy 54, 10.5 miles N of Grygla	06/14/2007 – present	Water level and flow
Marshall County Ditch 20	RLWD: S004-494	180TH Ave NE, 8.25 miles N of Thief River Falls	05/25/2007 - Present	Water level and flow
Thief River	RLWD: S004-055 NWS: TRGM5, FWS ID: 482537095581201 USGS: 05075500	Northern boundary of Agassiz NWR, near Gatzke	6/9/2012 - Present	Water level and flow
Branch A of Judicial Ditch 21	RLWD: S006-540	CSAH 48, 7 miles SW of Casperson	03/30/2010 - Present	Water level and flow
Branch 200 of Judicial Ditch 11	RLWD: S004-493	190th Ave NE, 6 miles SE of Holt	05/09/2007 - Present	Water level and flow
Judicial Ditch 11[2]	NWS: AGDM5, FWS ID: 481840096033001	Nr. Holt, MN on Agassiz NWR	10/13/2010 – Present	Water level and flow
Judicial Ditch 30	RLWD: S004-966	149th Ave, 3 miles N of Thief River Falls	03/31/2010-Present	Water level and flow
Agassiz Pool	NWS: AGPM5, FWS ID:481918095583201	Nr. Middle River, MN on Agassiz NWR	2/16/2011 - Present	Pool level

[1]USGS annual peak flow data has also been collected since 1979

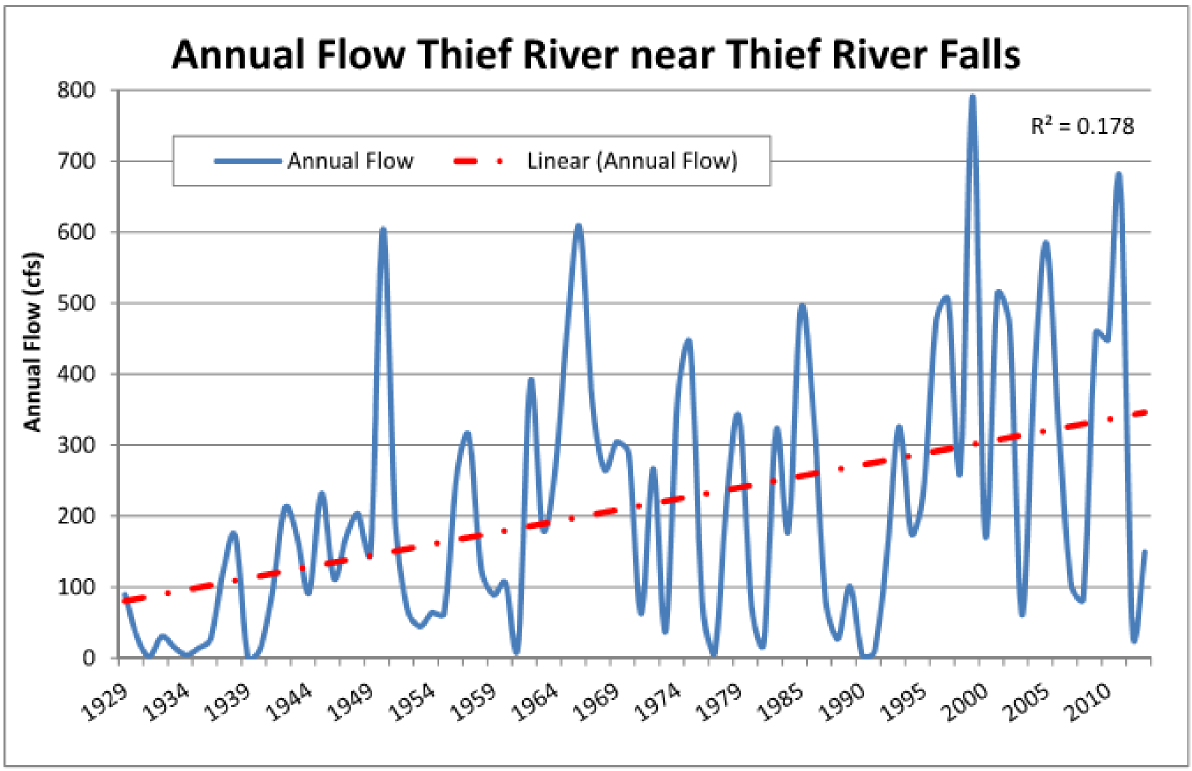
[2]Location of monitoring has changed over time since initial install in 2010

Source: Minnesota Dept. of Natural Resources Thief River Watershed Fluvial Geomorphology Report, p. 22. 2015.

Annual mean streamflow is the average of all daily streamflows for each year. **Figure 18** shows the annual means for the Thief River since 1929. The higher annual mean flows occurred during years that annual precipitation rates were also high, specifically in 1950, 1966, 1999, and 2011. In general, annual flow rates appear to be increasing since 1929. Fluctuations in annual mean stream flows may be a response to a variety of factors including precipitation rates, land use, land management techniques, hydrological soil group, evapotranspiration (ET), and other physiographic watershed variables (DNR, 2015a).

When comparing the highest 25% of annual maximum peaks since 1909, 12 of those 26 years were tallied since 1995. Though that 20-year timeframe (1995-2014) accounts for almost 20% of the period of record, it contains 48% of the highest annual peaks. The 20-year timeframe that contained the next highest number of annual peaks was from 1955-1974. Seven of the 25% occurred then and accounted for 28% of the highest annual peaks.

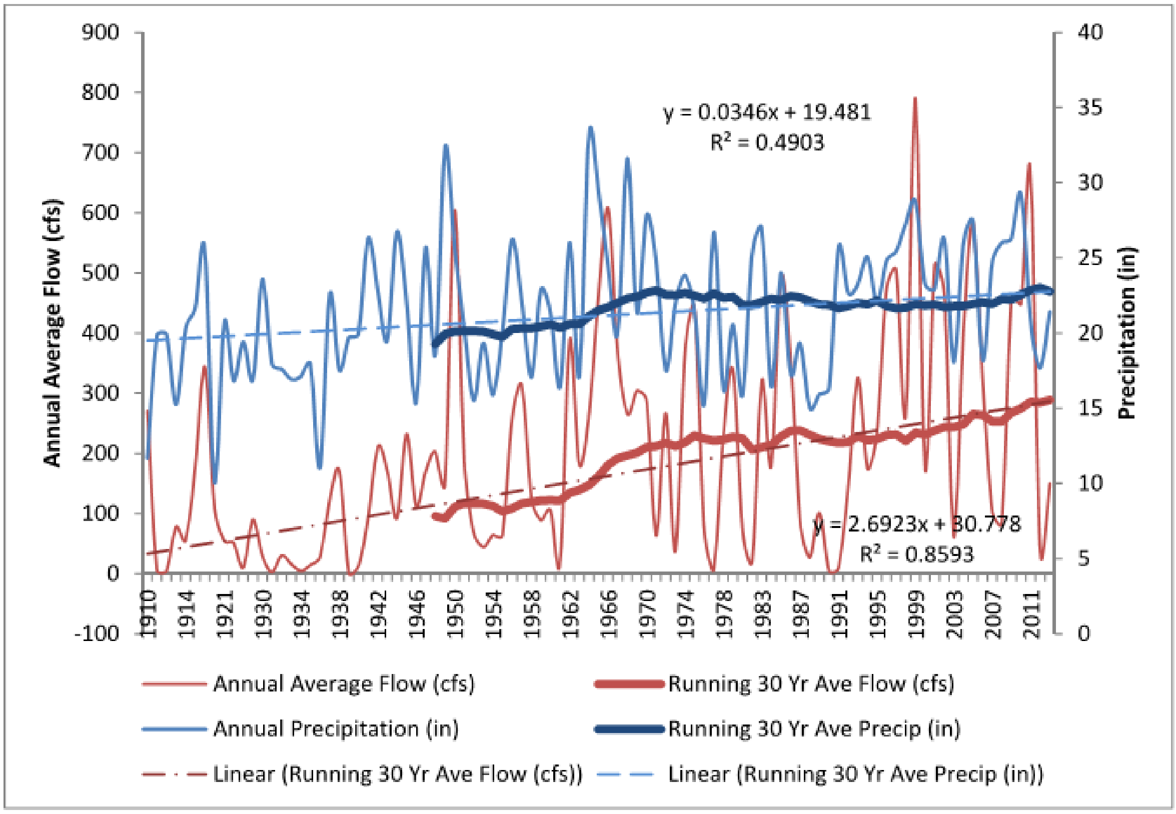
Figure 18: Annual Mean Flow at USGS Stream Gage 0507600 near Thief River Falls



Source: Minnesota Department of Natural Resources Thief River Watershed Fluvial Geomorphology Report, p. 23. June 2015.

The years with high annual mean flows and peaks correlate with higher precipitation rates. Though the mid-1950s to the early 1960s was drier on average, the next decade had a more pronounced wet period; and since 1995, the precipitation has been greater than average. However, when comparing the increases in precipitation and streamflow, the rate at which the streamflow is increasing appears to be greater (**Figure 17**). Precipitation rates undoubtedly impact the amount of water that reaches the Thief River each year; however, the additional variables that impact streamflow may be influencing the higher mean and peak flows observed at USGS gage 05076000 on the Thief River (DNR, 2015a).

Figure 19: Mean Annual Flow and Precipitation for USGS Stream Gage 0507600 at the Thief River near Thief River Falls



Source: Minnesota Department of Natural Resources Thief River Watershed Fluvial Geomorphology Report, p. 24. June 2015.

Stream and Lake Surface Water Quality

The Red Lake Watershed District, Pennington County SWCD, Grygla River Watch program, and the International Water Institute regularly collect samples in the watershed. The Red Lake Watershed District and the USGS completed concurrent intensive studies of the watershed and Agassiz NWR in 2009. Continuous water quality monitoring was conducted using Eureka Manta multi-parameter sondes during the Thief River Watershed Sediment Investigation, Thief River WRAPS, and the Agassiz National Wildlife Refuge water quality study. In 2011, the MPCA began an intensive watershed monitoring (IWM) effort of surface waters within the Thief River Watershed. Thirty-five sites were sampled for biology at the outlet of variable sized subwatersheds. Intensive data collection was also collected during the Thief River WRAPS.

The assessment results for the Thief River Watershed indicated that some surface waters were in poor condition with the caveat that only one reach, 09020304-501 – Thief River, was assessed for biology. The Thief River reach met biological standards but exceeded the turbidity standard. The remaining reaches in the watershed were not assessed as the Tiered Aquatic Life Use (TALU) standards were not yet in place. However, a less robust assessment of the overall condition of channelized streams using the fish and macroinvertebrate indices of biological integrity and habitat scores suggests that these streams are also in poor condition.

Of the seven stream segments assessed for aquatic recreation in 2013, five showed full support. The remaining two are impaired due to elevated levels of bacteria. The Mud River (09020304-507) remains impaired by *E. coli* bacteria, but Branch A of JD21 has been delisted due to improved water quality (**Figure 20**). The only lake in the watershed with assessment level data is Thief Lake, which fully supports aquatic recreation. Data is insufficient to make an aquatic life assessment for the lake (MPCA, 2017a).

Local water quality improvement efforts should not be limited to impaired waters. The Thief River was one of the last watersheds to be assessed by the State of Minnesota before the adoption of TALU aquatic life standards and regionalized sediment and nutrient standards. During the 2013 assessment, aquatic life impairments on channelized reaches were deferred until the next water quality assessment. Water quality protection efforts are important and should be ongoing for waters with deferred impairments, un-impaired waters, waters that are in danger of becoming impaired, and high-quality waters (MPCA, 2017a).

The following documents are available in draft or final versions on the MPCA webpage for the Thief River Watershed (https://www.pca.state.mn.us/water/watersheds/thief-river):

- Thief River Watershed Monitoring and Assessment Report
- Thief River Watershed Draft TMDL
- Thief River Watershed Sediment Investigation – Clean Water Partnership
- Thief River Watershed Fluvial Geomorphology Report – DNR

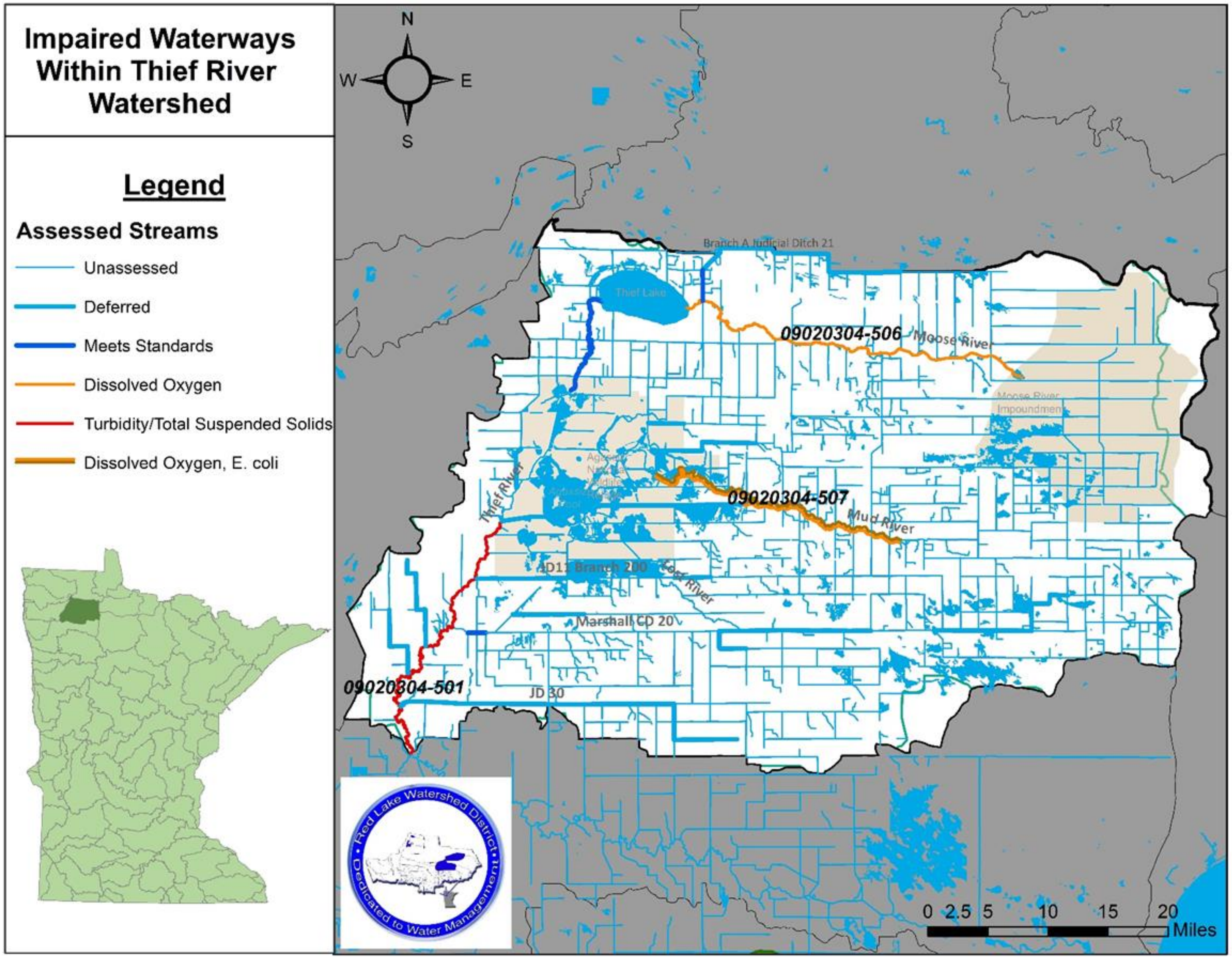
The Red Lake Watershed District webpage also provides a repository of resources concerning surface water quality for the Thief River Watershed: http://www.rlwdwatersheds.org/tr-docs

Notable studies available include:

- Assessment of Nutrients and Suspended Sediment Conditions in and near the Agassiz National Wildlife Refuge, Northwest Minnesota, 2008-2010
- Assessment of Water Quality Conditions: Agassiz National Wildlife Refuge, 2012
- Sediment Loading & Sources to Agassiz NWR
- Thief River Watershed Sediment Investigation
- Thief River Watershed SWAT Modeling
- Thief River Total Suspended Sediment Loadings Report
- Thief River Watershed Hydrogen Sulfide Monitoring 1999 Report
- Thief River Basin Erosion, Sedimentation, and Sediment Yield Report

Some of the waterbodies in the Thief River Watershed are impaired by mercury. 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.

Figure 20: Impaired Waters in the Thief River Watershed (after Branch A of Judicial Ditch 21 *E. coli* delisting)



Source: MPCA Draft Watershed Restoration and Protection Strategies Report, p. 22. 2017.

Pages 24-33 of the Thief River Watershed Restoration and Protection Strategies (WRAPS) Report provides detailed information on water quality trends for key parameters in the watershed.

5.3.1 Stream Conditions Status

Data collected in the years 2003 through 2012 was analyzed for the 2013 assessment and the 2014 303(d) List of Impaired Waters. Recent monitoring data shows that four of the water quality impairments within the Thief River Watershed on the 2014 USEPA 303(d) List of Impaired Waters continue to violate water quality standards. The number of official water quality impairments in the Thief River watershed impairments has been reduced after one reach was recommended for delisting (Table 2-4) using recent data. All the watershed's assessment units with sufficient data were assessed, but aquatic life impairments on channelized reaches were deferred until TALU water quality standards were in place. The TALU water quality standards were adopted in 2015 and will be used during the Thief River Watershed's next assessment cycle (2023) (MPCA, 2017a).

Table 2: Impaired Waterways of the Thief River Watershed on the 2014 303(d) List of Impaired Waters

Name	Reach	HUC/AUID Code	Impairment	Listed	Addressed in Accompanying TMDL?
Thief River	Agassiz Pool to Red Lake River	09020304-501	Aquatic Life – Turbidity	2006	Yes
Moose River	Headwaters to Thief Lake	09020304-505	Aquatic Life – Low DO	2006	No*
Mud River	Headwaters to Agassiz Pool	09020304-507	Aquatic Life – Low DO	2008	No*
Mud River	Headwaters to Agassiz Pool	09020304-507	Aquatic Recreation – *Escherichia coli*	2014	Yes
~~Branch A of JD21~~	~~Unnamed ditch to Moose River~~	~~09020304-555~~	~~Aquatic Recreation – *Escherichia coli*~~	~~2014~~	No**
*A lack of flow was determined to be the primary cause of this DO impairment instead of a pollutant. No TMDLs were established for this particular impairment.					
** Recent data shows that this reach is no longer violating the water quality standard for which it was listed. The reach has been recommended for delisting.					

Source: MPCA Draft Watershed Restoration and Protection Strategies Report, p. 20. 2017.

The Red Lake Watershed District has been collecting samples in the Thief River Watershed since 1980. The Pennington County SWCD and the International Water Institute (via a grant from the MPCA) also regularly collect samples in the watershed. The Red Lake Watershed District completed an intensive study of the watershed in 2009 for the Thief River Watershed Sediment Investigation. Continuous water quality monitoring (DO, turbidity, temperature, pH, and specific conductivity) was conducted using Eureka Manta multi-parameter sondes during the Thief River Watershed Sediment Investigation, Thief River Watershed WRAPS Report, and the Agassiz National Wildlife Refuge water quality study (MPCA 2016a).

Extensive data collection had been conducted in the watershed. A total of 2,350 sets of discrete daily values were available, equaling 235 per year. Nonetheless, only 35% of the 260.99 miles of stream channels in the watershed were officially assessed for either aquatic life or recreation (including Branch A of JD 21, which was listed for an E. coli impairment, but not officially assessed for aquatic life). The percentages of stream miles that were officially assessed in 2013 (**Table 3**) are not high (MPCA, 2017a). **Table 4** displays assessment units without monitoring data.

Table 3: Stream Mile Statistics for the 2013 MPCA Water Quality Assessment Summary

Impairment Assessment	Stream Length (Miles)		Stream Length (%)		Stream AUIDs (#)	
	Aquatic Life	Aquatic Recreation	Aquatic Life	Aquatic Recreation	Aquatic Life	Aquatic Recreation
Fully Supporting (FS)	0.0	59.2	0%	23%	0	5
Not Supporting (NS)	65.3	21.7	25%	8%	3	2
Insufficient Information (IF)	36.7	0.0	14%	0%	8	0
Not Assessed (NA)	159.0	180.1	61%	69%	47	51
Total	**261.0**	**261.0**	**100%**	**100%**	**58**	**58**

Source: MPCA Thief River Draft Watershed Restoration and Protection Strategies Report, p. 19. 2017.

Table 4: Established Assessment Units within the Thief River Watershed that have not been monitored.

Thief River Watershed Assessment Units with No Data			
River/Stream/Ditch Name	**AUID**	**Reach Description**	**Miles**
Thief River	09020304-502	Agassiz Pool below Mud R	3.26
Thief River (Agassiz Pool)	09020304-503	Agassiz Pool above Mud R	5.96
Mud River (Agassiz Pool)	09020304-508	Agassiz Pool portion	10.66
County Ditch 20	09020304-514	Unnamed ditch along CSAH 54 to CD 32	0.49
County Ditch 20	09020304-516	CD 31 to Unnamed ditch	2
County Ditch 22	09020304-518	Unnamed ditch to Unnamed ditch	3.51
Unnamed Ditch (Moose R Impoundment)	09020304-520	Unnamed ditch to unnamed ditch	1.01
Judicial Ditch 11	09020304-523	Unnamed ditch to Unnamed ditch (Carmel Rd)	0.99
Judicial Ditch 11	09020304-524	Unnamed ditch to Unnamed ditch (Carmel Rd to Outpost Rd)	1.96
Unnamed Ditch (Br55 JD11, Hwy 54 Road Ditch)	09020304-528	Unnamed ditch (Br 95 JD11, 330th St NE) to unnamed ditch (Br 51 JD11, 340th St	0.8
Unnamed Ditch	09020304-529	Unnamed ditch to unnamed ditch	2
Unnamed Ditch	09020304-530	Unnamed ditch to Mud R	1.54
Unnamed Ditch	09020304-531	Unnamed ditch to Lost R	0.84
Unnamed Ditch	09020304-532	Lost R to Unnamed ditch	2.67
Unnamed Ditch	09020304-533	Unnamed ditch to Unnamed ditch	2.47
Judicial Ditch 11 (Lost River Pool)	09020304-535	Unnamed ditch (Mud River) to unnamed ditch (Br 194 JD11)	4
Judicial Ditch 13	09020304-538	Unnamed ditch (195th St NE) to Unnamed ditch (200th St NE)	0.5
Judicial Ditch 13	09020304-539	Unnamed ditch to T154 R40W S15, west	1.01
Unnamed Ditch (Mud River Pool)	09020304-542	Unnamed ditch to Mud R (Agassiz Pool)	2.33
Webster Creek	09020304-544	Unnamed ditch to Agassiz Pool	4.47
Webster Creek (Agassiz Pool)	09020304-545	Agassiz Pool portion to Mud R	2.24
County Ditch 21	09020304-547	Unnamed ditch to Unnamed ditch	0.48
Unnamed ditch (Br 1 CD20)	09020304-553	CD 27 to CD 20	1.43
Totals:		**23 Reaches**	**56.62**

Source: MPCA Thief River Draft Watershed Restoration and Protection Strategies Report, p. 19. 2017.

The low percentage of assessed stream miles is due to a number of factors:

- Aquatic life assessments of channelized reaches were deferred until after the adoption of TALU standards. Assessment statistics were compiled for conventional water chemistry parameters using existing standards. Water quality problems (DO and turbidity) and low index of biotic integrity scores were identified in some of the reaches and will help prioritize protection efforts.
- Approximately 24 miles of stream assessment units in the Thief River Watershed lie wholly within pools and impoundments.
- Monitoring efforts have been focused on sites located near pour points of 10-digit HUCs.
- Upstream AUIDs are typically not sampled unless problems are found at the pour point or water quality problems are suspected in the upstream reaches.
- Several ditch systems were split into numerous assessment units. Monitoring results from primary
    - monitoring sites were only applied to relatively small assessment units in some cases (particularly Marshall CD 20, JD 11, and the JD 30/18/13 drainage system).
- Some of the assessment units are county road ditches that have not been of interest to local, long-term monitoring programs.

Data collected in the years 2003-2012 was analyzed for the 2013 assessment and the 2014 303(d) List of Impaired Waters. Recent monitoring data shows that three of the water quality impairments within the Thief River Watershed on the 2014 USEPA 303(d) List of Impaired Waters continue to violate water quality standards. The number of official water quality impairments in the Thief River Watershed impairments have been reduced after two reaches were recommended for delisting using recent data. *E. coli* concentrations in the Mud River (09020304-507) and in Branch A of JD 21 (09020304-555) have shown enough improvement to meet the State of Minnesota water quality standards for the protection of aquatic recreation after the addition of sampling data that was collected in 2013, 2014, and 2015.

The Moose River and Mud River remain impaired by low DO. The Thief River downstream of Agassiz Pool is listed as impaired by high turbidity. **Figure 20** displays the locations of the current impairments. The MPCA's new total suspended solids (TSS) standard (30 mg/l for the Central Nutrient Region) will be used to develop a TMDL to address the turbidity impairment. Data analysis revealed that sufficient base flow is needed in the Moose River in order to maintain acceptable DO levels. Data also indicates that improved base flows in the Mud River would improve DO levels (MPCA, 2017a).

5.3.2 Lakes

Thief Lake is the only lake in the Thief River Watershed that has been addressed by an MPCA water quality assessment (**Table 5**). The basin drains land from the NMW and Red River Valley ecoregions and neither has dedicated standards (for lakes). However, standards from the North Central Hardwood Forests are most commonly applied to lakes and reservoirs in the Red River Valley. Land use in the watershed is 76% water/wetland, 9% forest, and 10% agricultural. Thief Lake is a shallow lake with a maximum depth of 7.4 feet. Access to the lake is available through a variety of accesses. However, much of the lake is restricted access for hunting and waterfowl nesting because the lake lies entirely within the Thief Lake WMA. In any year, aquatic recreation is limited by the shallow depths of the lake, severe water level fluctuations, and limited access to the lake due to hunting and waterfowl nesting. The 2012 drought severely affected water levels. Wildlife viewing and hunting are the primary activities for this basin. It is not used for recreational swimming. A landowner at one of the stakeholder meetings stated that the lake supported a fishery at one time—before it was originally drained by JD 21 (MPCA, 2017a).

Table 5: Assessment Status of Thief Lake

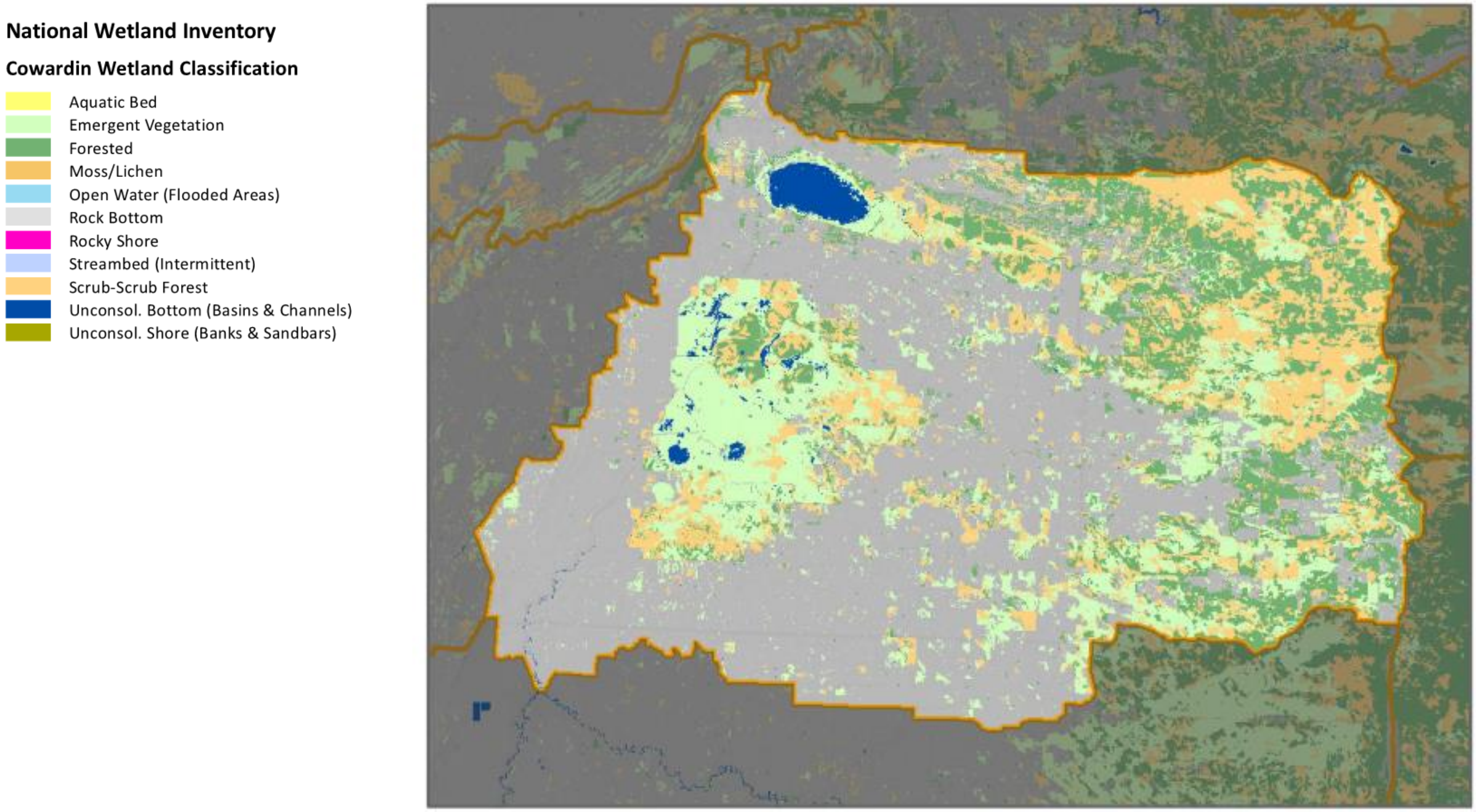
HUC-10 Subwatershed	Lake ID	Lake	Aquatic Life	Aquatic Recreation
Thief River 0902030402	45-0001-00	Thief Lake	Insufficient Information	Fully Supporting

Source: MPCA Thief River Draft Watershed Restoration and Protection Strategies Report, p. 24. 2017.

5.3.3 Wetlands

Wetlands are a prominent feature in the Thief River Watershed. The National Wetlands Inventory (NWI) estimates that there are 330,223 acres of wetlands—which is approximately half (49%) of the watershed area (**Figure 21**). This coverage far exceeds the state wetland coverage rate of 19% (Kloiber and Norris 2013). The majority of the wetlands are evenly split between three general cover types: emergent (i.e., dominated by grasses, sedges, bulrushes, and/or cattails), scrub-shrub, and forested. Wetlands are not distributed evenly throughout the watershed, as there is a distinct difference in wetland coverage that roughly corresponds to the Level II Ecoregion boundary. Wetland acreage exceeds upland acreage in the Mixed Wood Shield Ecoregion portion of the watershed and vice versa in the Temperate Prairies Ecoregion. There are two large, shallow, open water/emergent marsh complexes in the watershed: Agassiz National Wildlife Refuge and Thief Lake. National Wetlands Inventory may be underestimating wetlands in the watershed due to Thief Lake being classified as a deepwater habitat—the maximum depth of Thief Lake is 4 feet at normal pool elevation (can reach a maximum depth of 7.4 feet) and mixed patches of emergent wetland vegetation are present (MPCA, 2014).

Figure 21: Wetlands in the Thief River Watershed.



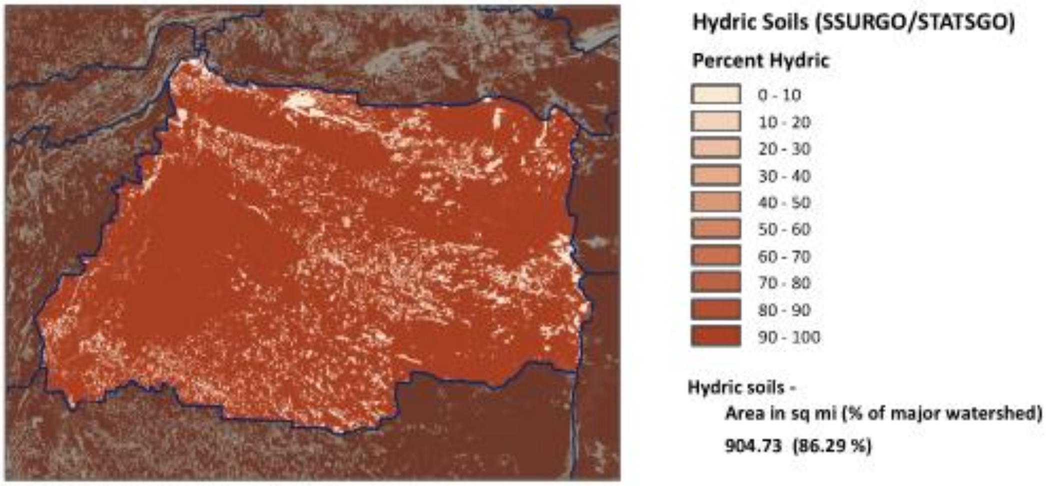
Source: Minnesota Dept. of Natural Resources Watershed Health Assessment – Setting the Context Thief River Watershed, p. 13. 2016. www.dnr.state.mn.us/whaf.

Historically, wetlands were more prevalent in Thief River Watershed than today. A network of drainage ditches has long been established—primarily in the Temperate Prairies ecoregion portion of the watershed—to drain wetlands and improve the land for agriculture. This included at least partial drainage of both Mud and Thief Lakes (which were subsequently restored). Digital soil survey data is available for the entire watershed and can be used to approximate the historical wetland extent by totaling the mapped hydric soils present—which form under wetland conditions and can persist after drainage. Soil map units designated as “all hydric” total 529,794 acres or 79% of watershed. Based on this estimate and the current wetland extent estimate from NWI—the Thief River Watershed has lost approximately 30% of its Wetlands (MPCA, 2014). **Figure 22** displays the extent of hydric soils in the watershed. Comparing the extent of hydric soils to the extent of current wetlands provides an estimate of the amount of wetland loss that has taken place within the watershed (DNR, 2016).

The prevalence of wetlands in the watershed is due to the glacial lake plain landform and climate patterns of the region. The plain was formed from sediment deposition in Glacial Lake Agassiz that covered the region approximately 11,000 years ago (MNGS 1997). The extremely flat landscape that remained following drainage of the lake had little capacity to drain surface water—promoting saturated soil conditions over expansive areas. Deep organic (peat) soils subsequently developed over the fine mineral lake sediments where constant saturated conditions existed at the surface and plant decay was inhibited (Wright et al. 1992). Mineral soil flat wetlands formed where saturated conditions were less permanent or seasonal. There is a climate-moisture gradient from west-east in the watershed that corresponds with the ecoregions. Relatively warmer/dryer conditions in the Temperate Prairies portion of the watershed promoted a larger share of uplands and mineral soil flat wetlands (prior to agricultural drainage). The cooler/wetter Mixed Wood Shield promoted the generation of the extensive peatland complexes that occupy north-central Minnesota. The Mud Lake/Agassiz NWR wetland complex appears to be an outlying western extension of the large peat lands in Minnesota.

The predominant water source for hydro-geomorphically flat type wetlands (both with mineral or organic soils) is precipitation, and the primary loss is by evapotranspiration and saturation-overland flow (Smith et al 1995). Wetland saturation/overland water—particularly from organic flat wetlands—can influence stream water quality by delivering high dissolved organic matter/low DO water as it very slowly drains from the surface of the wetland to the stream (Acreman and Holden 2013). In the Thief River Watershed, wetland saturation/overland flow likely provides most of the source waters for the streams and ditches above Mud and Thief lakes (MPCA, 2014).

Figure 22: Hydric Soils in the Thief River Watershed.



Source: Minnesota Dept. of Natural Resources Watershed Health Assessment – Setting the Context Thief River, p. 13. 2016. www.dnr.state.mn.us/whaf.

The MPCA is actively developing methods and building capacity to conduct wetland quality monitoring and assessment. Currently, the MPCA does not monitor wetlands systematically by watershed. The primary approach is to track changes in biological communities using statewide and ecoregional probabilistic surveys—where results from a small sample can be extrapolated to a larger population. The MPCA has developed macroinvertebrate and vegetation Index of Biotic Integrity (IBI) for depressional wetlands (i.e., wetlands occurring within a depression in the landscape that has marsh vegetation and semi-permanent to permanent open water) and has completed an initial baseline estimate of depressional wetland quality for Minnesota (MPCA 2014).

Unfortunately, as the landform is predominantly flat and few wetlands meet the MPCA depressional definition (no depressional wetland monitoring sites have been established in the watershed), the depressional wetland quality monitoring results are not readily applicable in the Thief River Watershed.

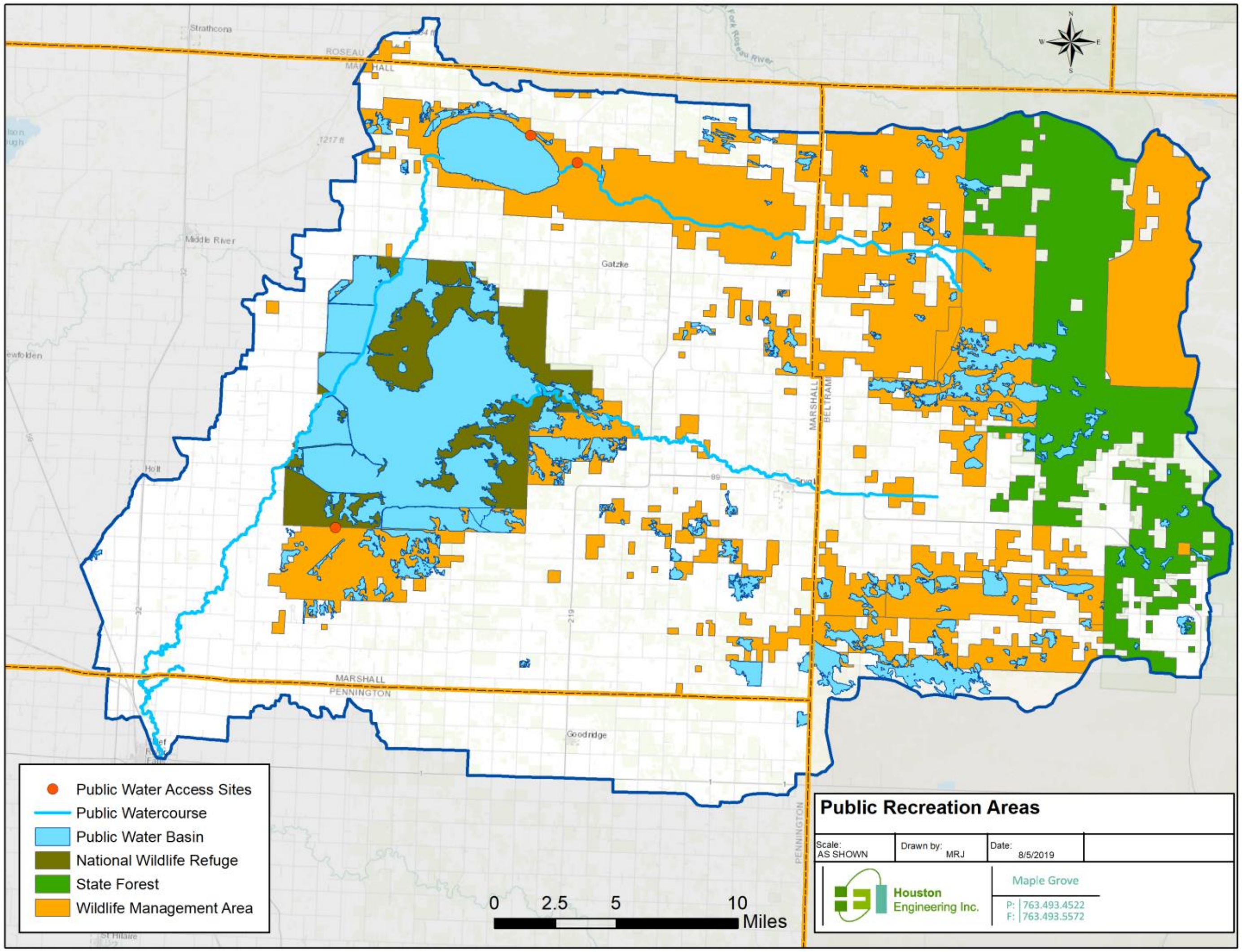
There have been significant changes in the surface hydrology in the watershed. In addition to drainage, a series of water control structures have been established to manipulate water levels to promote wildlife habitat and provide flood control (primarily at Mud and Thief lakes). Extensive drainage is an obvious impact to wetlands, but hydrological alterations that inundate and/or disrupt the natural water dynamics—while providing wildlife and flood retention benefits—can also negatively impact natural wetland biology conditions. Vegetation quality can be susceptible as hydrological alterations often promote the replacement of native species with more tolerant non-natives. The MPCA has conducted the field sampling and is in the process of compiling results for an expanded statewide random wetland quality survey that includes all wetland types. These results should be more applicable for documenting wetland condition in the Thief River Watershed when they become available. For more information visit: http://www.pca.state.mn.us/index.php/water/water-types-and-programs/surface-water/wetlands/wetland-monitoring-and-assessment.html (MPCA, 2014).

5.4 Recreation and Public Watercourses

Due in large part to the abundance of public land and waters (**Figure 23**), hunting and fishing are the primary outlets for recreational activity in the Thief River Watershed. The most heavily used is the 61,500-acre Agassiz National Wildlife Refuge, which receives over 20,000 visitors annually (MPCA, 2014). Birding is also a popular recreational activity in the watershed. Several streams, including the Thief River, the Mud River west of Grygla, and the Moose River west of Highway 89, are excellent for canoeing and kayaking. The state's only birding trail, the Pine to Prairie Trail, runs north to south in the western part of the watershed; through Agassiz NWR and Thief River Falls. More information can be accessed on the Minnesota Pine to Prairie Birding Trail website: http://www.mnbirdtrail.com/

WMAs are part of Minnesota's outdoor recreation system and are established to protect those lands and waters that have a high potential for wildlife protection, public hunting, trapping, fishing, and other such recreational uses. These areas are intended to protect wildlife habitat for future generations, provide citizens with various outdoor recreation opportunities, and promote wildlife-based tourism in the state. There are 33 WMAs located throughout the Thief River Watershed. More information on WMAs and those located within the watershed can be accessed on the DNR Wildlife Management Areas website: http://www.dnr.state.mn.us/wmas/index.html.

Figure 23: Public Recreational Areas in the Thief River Watershed.



5.5 Impoundments

Hydrologic modification within the Thief River watershed has had a significant impact upon flows, water quality, aquatic life, aquatic habitat, and the agricultural viability of the land. The drainage-related hydrologic modification made farming possible within this area. Some of the watershed's impoundments were built to address flooding concerns, but most are operated primarily for wildlife habitat management (**Figure 25**). Several of the larger lakes and impoundments within the Thief River watershed have some form of influence upon water quality within the watershed's impaired stream reaches. The locations of the watershed's most significant impoundments and drainage systems are shown in **Figure 24**.

The Moose River Impoundment is the largest impoundment operated by the Red Lake Watershed District. The impoundment reduces downstream flood damages by impounding floodwaters in the upper reaches of the watershed. Wildlife and associated recreational benefits are also enhanced by the water retained in the impoundment's pools. It can also be used for streamflow maintenance (a function that needs improvement) and to benefit fire control. The impoundment has two pools. The North Pool discharges to the Moose River (Judicial Ditch 21). The South Pool discharges to the Mud River subwatershed (Judicial Ditch 11). Management of the Moose River Impoundment is designed to reduce peak flows during flooding events. Other than during runoff events, flow in the Moose River is significantly influenced by the amount of discharge from the impoundment's outlet structure.

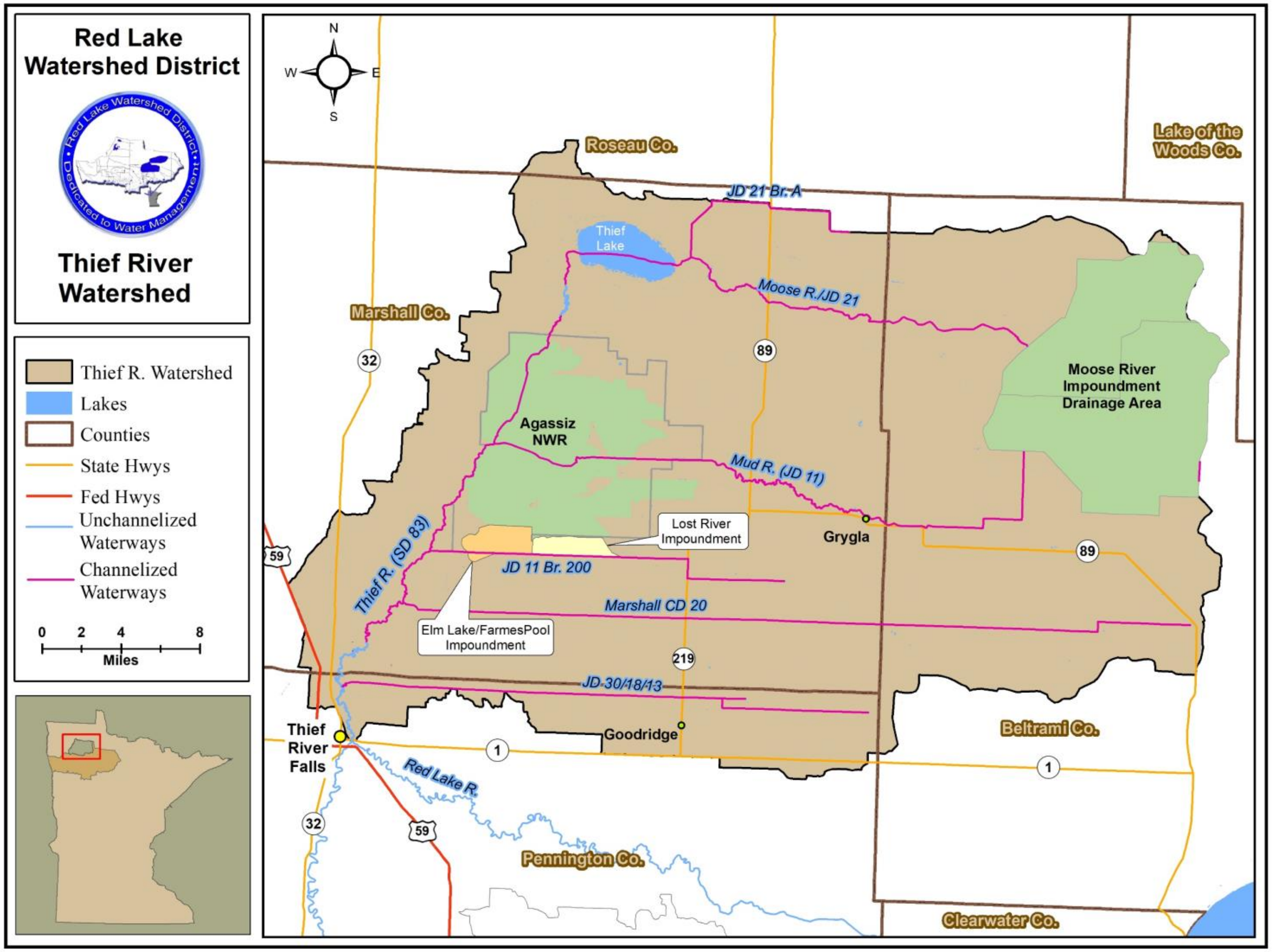
Agassiz NWR includes 26 impoundments (known variously as lakes, ponds, pools, or moist soil units) and three natural lakes. Water is contained within the impoundments by an extensive network of dikes. Water levels can be raised or lowered in any given impoundment by adjusting water control structures at pool outlets. A radial gate outlet discharges water to JD11 and a relatively new stop-log outlet structure discharges water to SD 83. **Figure 25** depicts the pools and inflows in Agassiz NWR.

Sediment infilling has led to a loss of depth and expansion of vegetation within Agassiz Pool. Sediment core and suspended sediment radioisotope analysis suggested that erosion from upland and agricultural fields is the dominant source of sediment entering Agassiz Pool. The USFWS has adopted a strategy of incremental excavation to promote scouring and flushing of sediment in the JD11 channel within the pool to address the sedimentation. This strategy includes consolidation of sediments through drying, improved water conveyance for more effective drawdowns and bypassing of sediment laden flood flows, and recreation of sediment trapping capacity of JD11 to protect the pool, in addition to sediment removal. Although necessary for waterfowl management, adverse water quality effects have occurred with this strategy.

Elm Lake (Farmes Pool) was drained sometime around 1920 by the construction of Branch 200 of JD11. Multiple agencies cooperated to complete the Elm Lake Project to restore the pool for the purpose of flood control, wildlife habitat, and upstream drainage improvement. Agassiz National Wildlife Refuge staff perform the actual operation of the outlet structure.

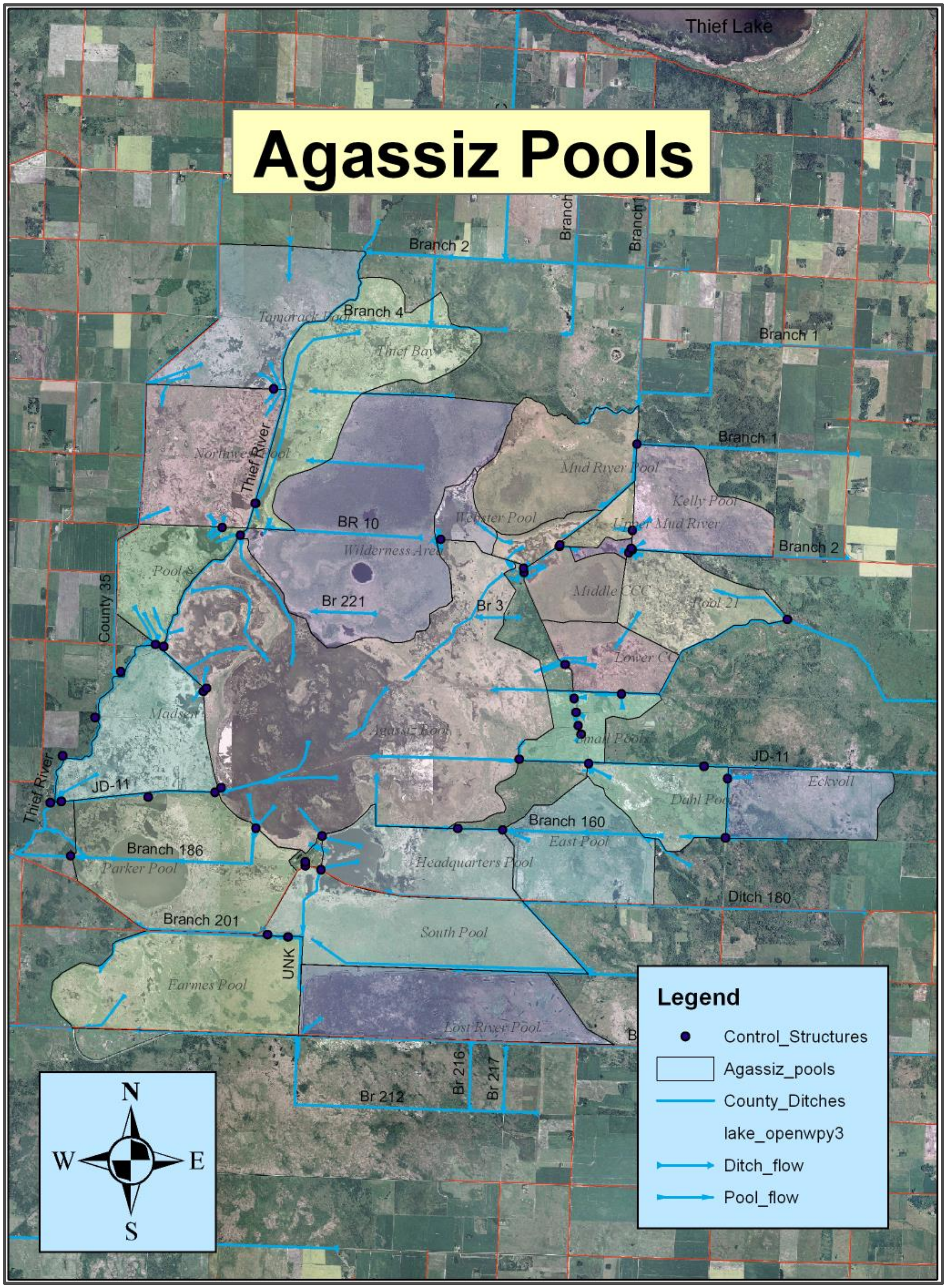
The DNR constructed the Lost River Impoundment in the mid-1970s to improve waterfowl habitat. The pool also provides flood control benefits. It receives water from the eastern Branch 200 of JD11 drainage area and discharges water back into Branch 200 of JD11.

Figure 24: Thief River Watershed Impoundments and Major Ditch Systems.



Source: MPCA Thief River Watershed Protection and Restoration Strategies Report, p. 17. 2017.

Figure 25: Flow Patterns within Agassiz NWR.



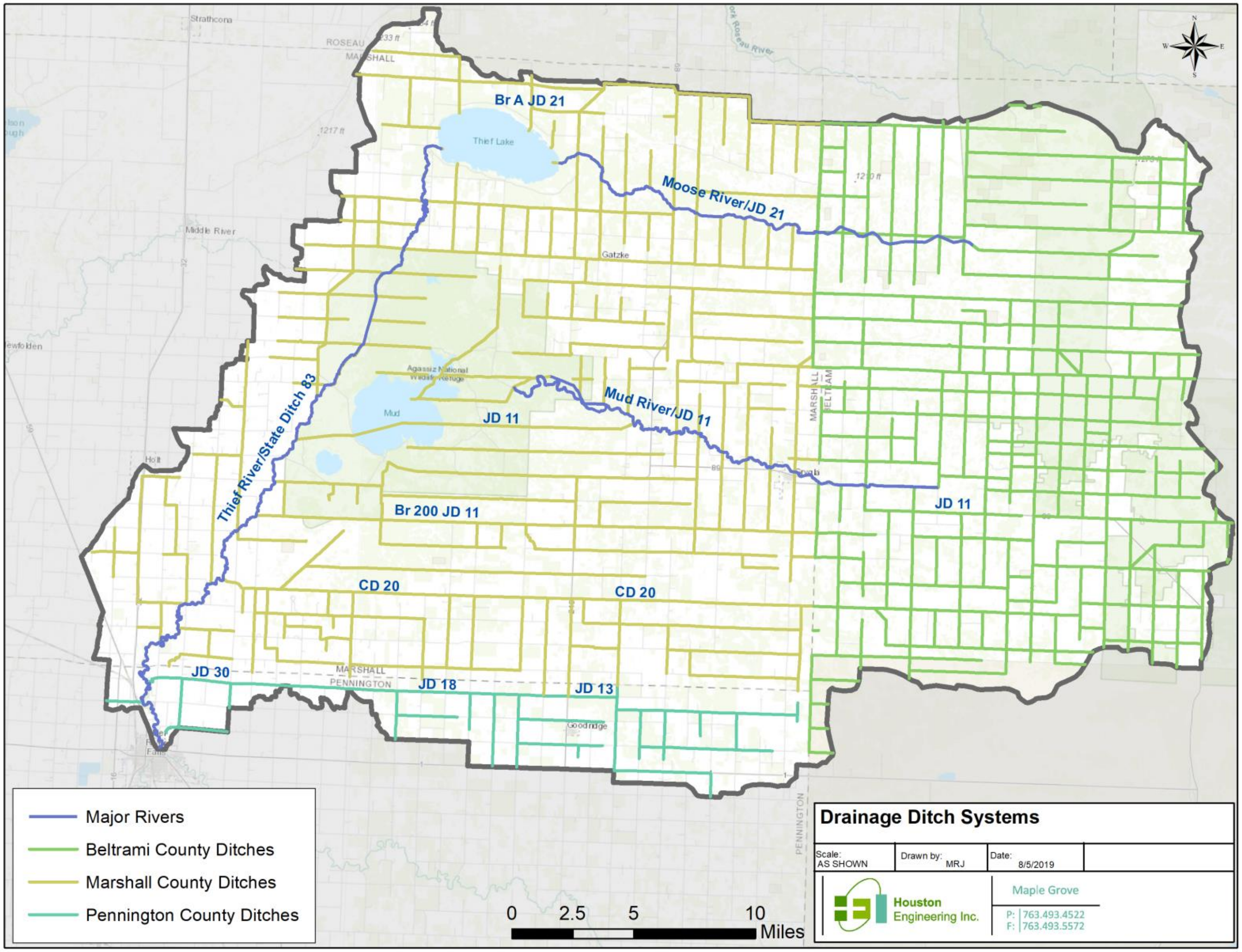
Source: MPCA Thief River Watershed Protection and Restoration Strategies Report, p. 16. 2017.

5.6 Drainage Systems

Drainage systems in the Thief River Watershed (**Figure 26**) form a complex network of natural streams and legal ditch systems developed for agriculture as well as impoundments that have been constructed for temporary water storage and wildlife habitat management. Generally, the ditch systems are under the administration of the county or watershed district in which they reside. All subwatersheds within the Thief River Watershed have a high percentage of perennial and intermittent drainage ditches. The mainstem subwatershed has the lowest at 64.7% and Branch 200 of JD11 subwatershed has the highest at 90%. There are an estimated 1,175 miles of public intermittent, perennial drainage ditches in the watershed. (DNR, 2015a).

There is little information on the use of tile drainage in the Thief River Watershed, but local resource managers do take note when new installations are observed. While tile drainage has not been common in the watershed historically, use in the last decade has increased considerably. A 2009 Red Lake Watershed District Study on tile drainage examined the impacts of a pumped outlet and gravity outlet on water quality. In both cases, tile drainage reduced TSS and total phosphorus concentrations and increased nitrate concentrations (RLWD, 2009). See **Emerging Issues Section 2.6.1.6 for more information**.

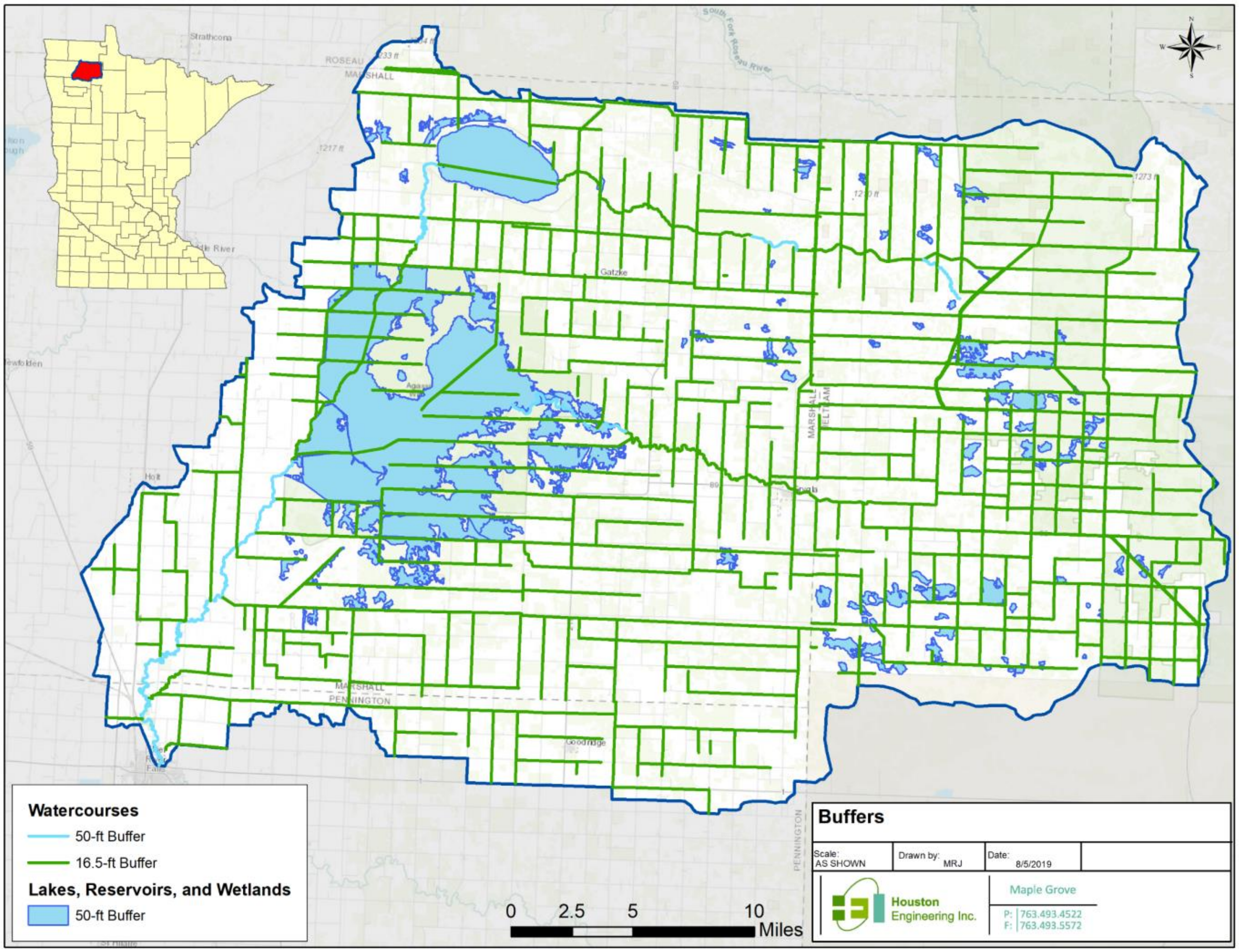
Figure 26: Drainage Ditch Systems within the Thief River Watershed.



5.7 Buffer Protection

In 2015, Minnesota passed the buffer law, which was amended in 2016 and 2017, requiring a 50-foot average buffer on public waters and a 16.5-foot buffer on public ditches as well as ditches that are also public watercourses. Local ordinances may require larger buffers. The law also allows flexibility for landowners to install alternative practices with equivalent water quality benefits. In the Thief River Watershed, there is a total of 1,288 miles that require a buffer: 40 miles of public watercourses require a 50-foot buffer, and 1,248 miles of public ditches require a 16.5-foot buffer. **Figure 27** depicts buffered watercourses in the watershed. (BWSR, 2017).

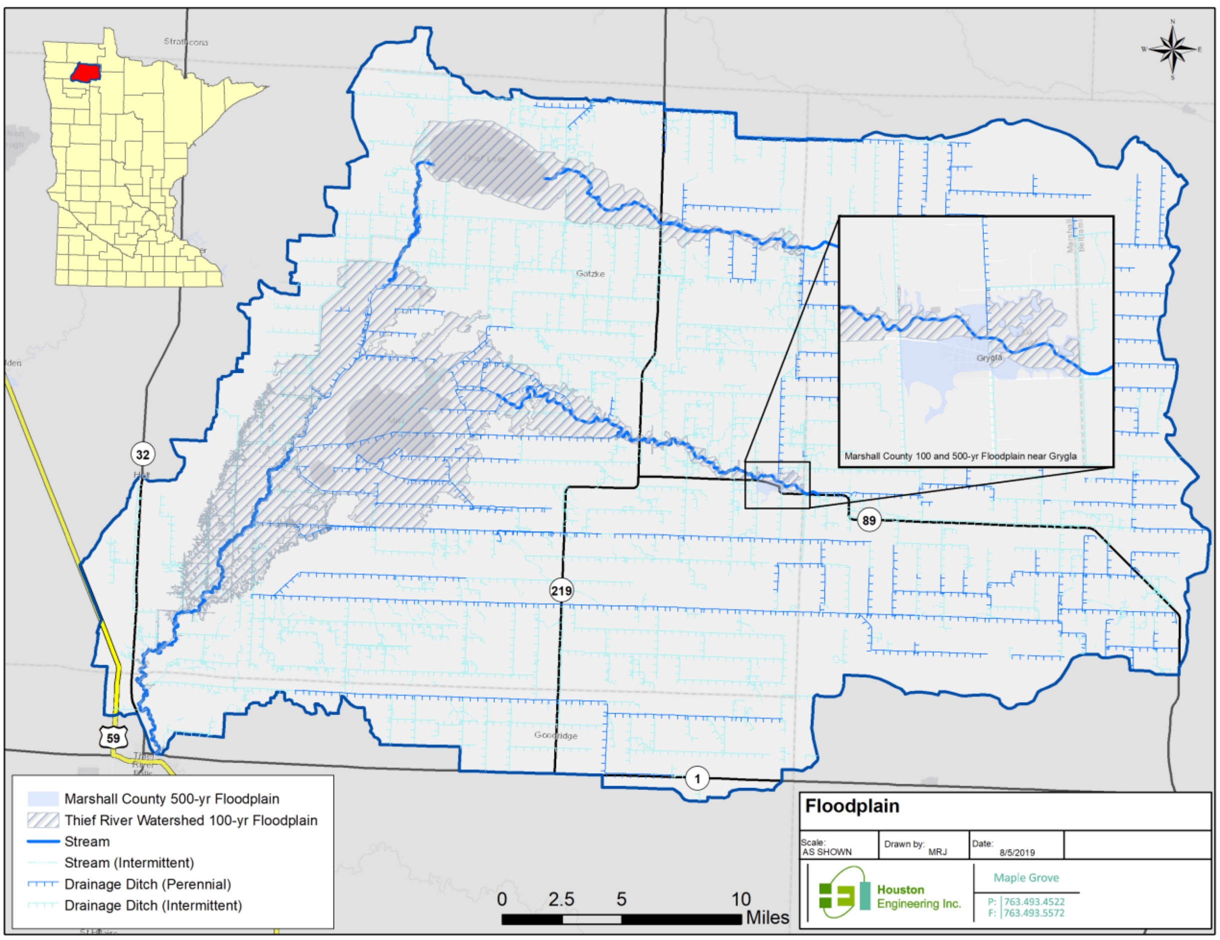
Figure 27: Thief River Watershed Required Buffered Watercourses



5.8 Flooding

Due to the terrain, draining of wetlands for cropland, and/or under-designed structures, the Thief River Watershed experiences frequent flooding. Spring flooding is almost an annual occurrence in the watershed, damaging public infrastructure, personal property, cropland, and public resources. Highest priority flooding issues for the Thief River Watershed include agricultural flooding and damages in the City of Goodridge (RLWD, 2006). Marshall County Ditch 20 and Branch 200 of JD 11 are particularly prone to flooding. Accounts from local water management staff reveal that during the 1997 flood, there was more flow in CD 20 than there was in the Thief River (MPCA, 2017a) There is currently no data available from the FEMA Flood Insurance Program for the Thief River Watershed. However, the 100-year floodplain has been delineated and provided by LGUs (**Figure 28**).

Figure 28: Thief River Watershed Floodplain*



*Based on best available data provided by LGUs.

Though flood mitigation practices such as diversions and levees have been used in the Thief River Watershed, and the Red River Basin more broadly, these practices may pass flood flows to downstream areas and communities. Thus, the Red River Basin Commission (RRBC) has put forth a plan within the Basin Wide Flow Reduction Strategy which calls for a reduction in peak flows throughout the entire Red River Basin (HDR, 2013). The primary practice utilized in this strategy is detention. There are several Flood Damage Reduction (FDR) impoundments in the Thief River Watershed (See **Figure 24**).

Impoundments within the Agassiz National Wildlife Refuge are primarily operated for habitat but have secondary flood management benefits (See **Figure 25**) (HDR, 2013).

5.9 Regulated Permitted Discharges

A statewide dataset of potentially contaminated sites and facilities with environmental permits and registrations is available at the MPCA's website, through a web-based application called, "What's In My Neighborhood." This MPCA resource gives the public access a wide variety of environmental information about communities across the state. The data is divided into two groups. The first is potentially contaminated sites, which includes contaminated properties, formerly contaminated sites, and those that are being investigated for suspicion of being contaminated. The second category is made up of businesses that have applied for and received different types of environmental permits and registrations from the MPCA. An example of an environmental permit would be for a business acquiring a permit for a stormwater or wastewater discharge, requiring it to operate within limits established by the MPCA. Two Municipal Wastewater Treatment Permit sites are in the Thief River Watershed, located in Goodridge and Grygla.

For more information regarding "What's in My Neighborhood," refer to the MPCA webpage: http://www.pca.state.mn.us/index.php/data/wimn-whats-in-my-neighborhood/whats-in-my-neighborhood.html

6. HYDROGEOLOGY

Hydrogeology is the study of the interaction, distribution, and movement of groundwater through the rocks and soil of the earth. The geology of a region strongly influences the quantity of groundwater available, the quality of the water, the sensitivity of the water to pollution, and how quickly the water will recharge and replenish the source aquifer. This branch of geology is important to understand as it indicates how to manage groundwater withdrawal and land use as well as determine if mitigation is necessary.

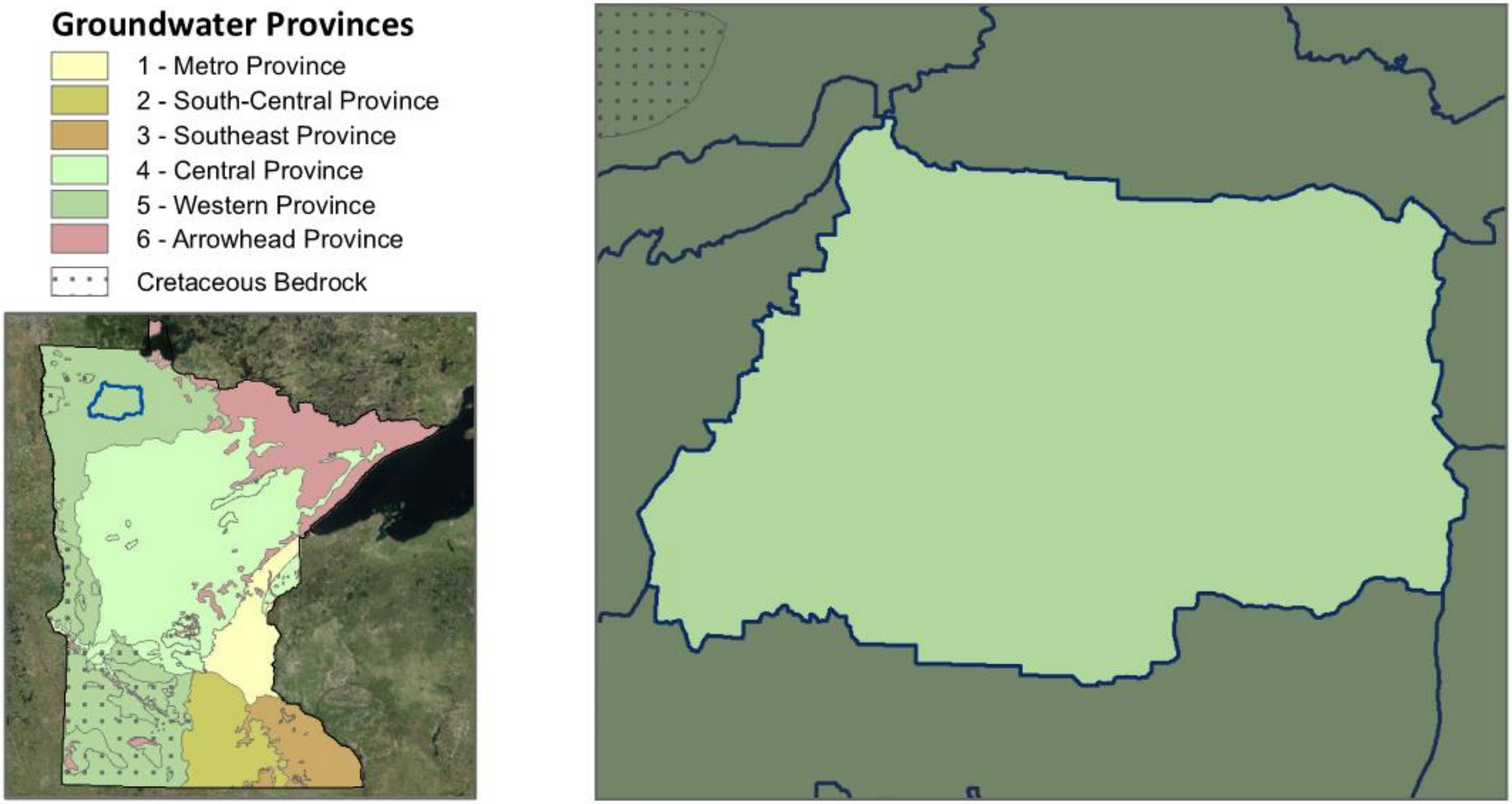
6.1 Surficial and Bedrock Geology

The geology of the Thief River Watershed is typical of watersheds in the Western Groundwater Province, which is characterized by clayey glacial drift overlying Cretaceous and Precambrian bedrock (**Figure 29**). The surficial geology is characterized by the lake-washed till. The till is described as a sandy, clay-silt loam containing fine to medium gravel with a scattering of boulders. The till is covered in areas by a very fine- to fine-grained, uniform glacial lake sand generally less than 20 feet in thickness. Throughout the watershed, the till is overlain by a thin covering of peat (only a few feet thick) that results from the water table being close to or at land surface, paired with poor drainage in the area. Localized peat deposits are also present in many closed depressions within the till (RLWD, 2006).

The major Geomorphic Associations in the watershed are Lake Agassiz, Red River Lobe, and organic deposits (DNR, 2015a) (**Figure 30**). The northern to extreme western extents of the watershed are largely comprised of the sandy Lake Agassiz till. The majority of the watershed is associated with the clayey-pebble sediments of the Red River Lobe. The hydric, low-lying areas are filled with organic deposits (DNR, 2015a).

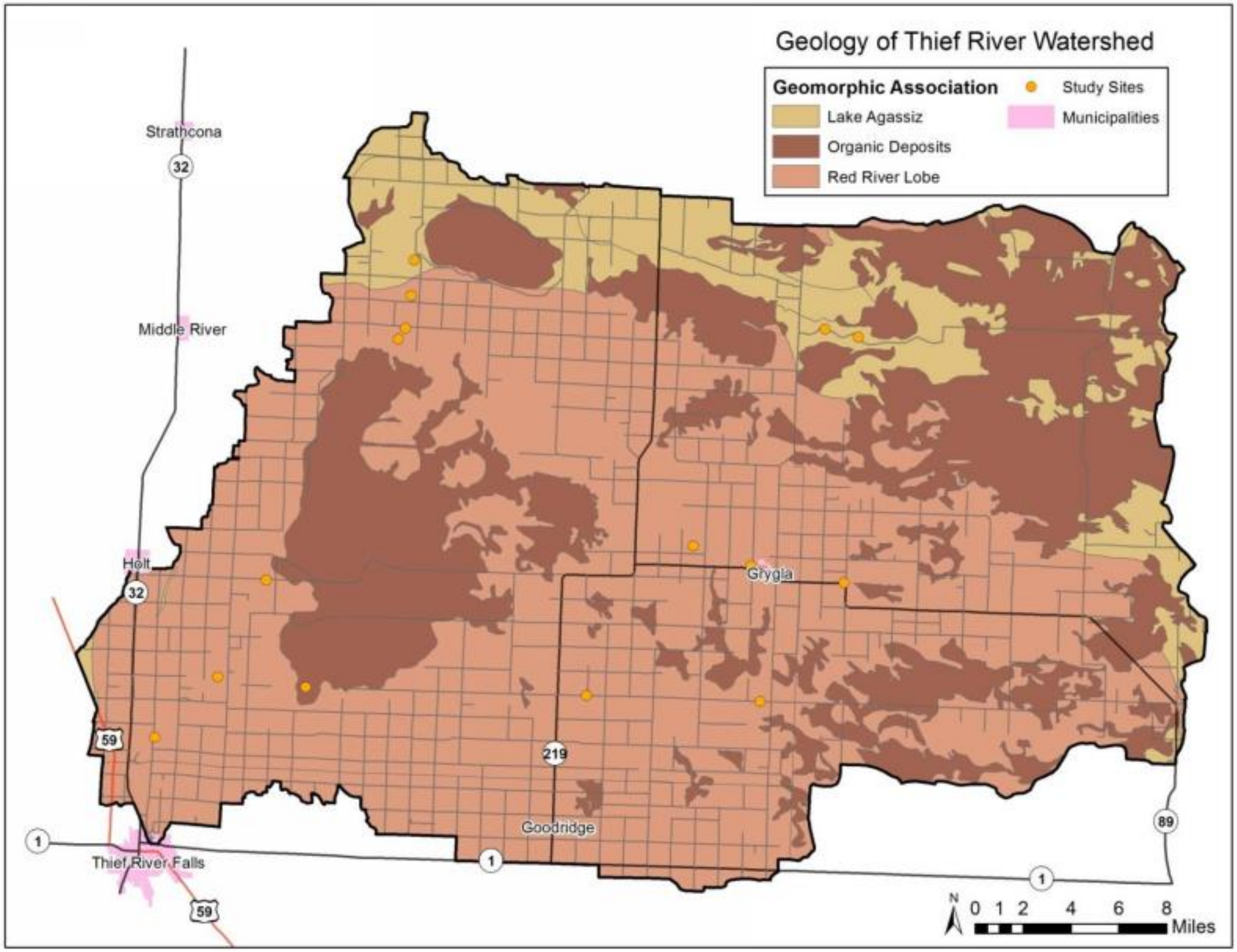
Though the DNR and Minnesota Geological Society are in the process of creating County Geologic Atlases for the state, no such atlas is available for the Thief River Watershed at this time.

Figure 29: Location of the Thief River Watershed within the Western Groundwater Province



Source: DNR Watershed Health Assessment – Setting the Context Thief River, p. 7. 2016. www.dnr.state.mn.us/wha

Figure 30: Major Geomorphic Associations in the Thief River Watershed.



Source: DNR Thief River Watershed Fluvial Geomorphology Report, p. 9. June 2015.

6.2 Aquifers

Glacial sediment aquifers in the region provide very moderate amounts of groundwater. Suitable yields of 5 gallons per minute (gpm), or more for domestic use, can be found in sand lenses within the till. These lenses are often localized, and yields can vary. The aquifer may accommodate municipal or industrial uses, possibly up to 250 gpm in some rare instances. Hardness of the groundwater is commonly greater than 180 mg/l.

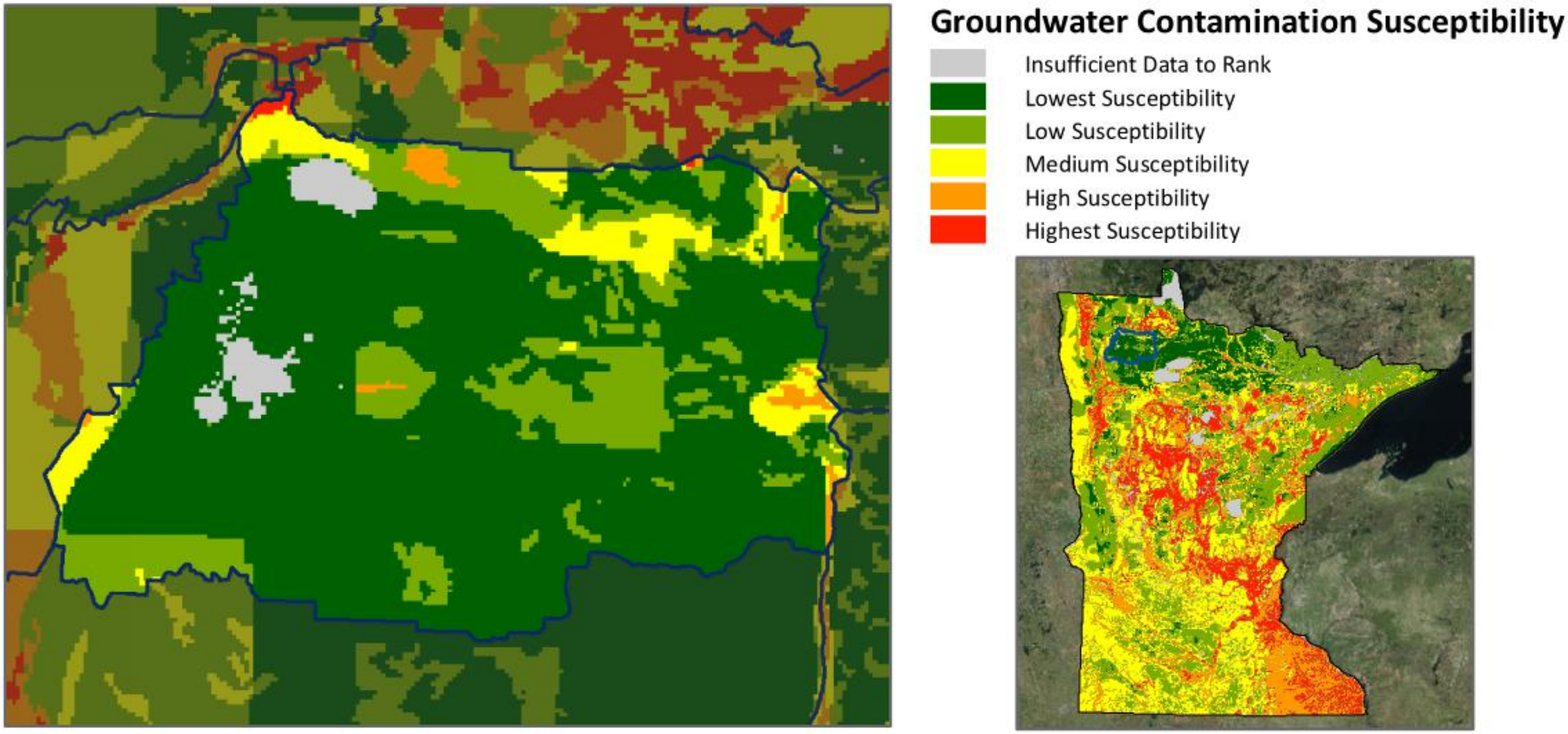
Paleozoic sediments consisting of shales and limestones are discontinuous and underlie the glacial lake deposits along the western side of the watershed. Precambrian crystalline rocks underlie the glacial sediments, forming the base of the groundwater reservoir for most of the watershed. The fractured surface of crystalline rocks may provide an adequate supply of groundwater for limited domestic use (RLWD, 2006).

6.3 Groundwater Contamination Susceptibility

When defining and discussing groundwater pollution sensitivity, refer to the DNR website: [http://www.dnr.state.mn.us/waters/groundwater_section/mapping/sensitivity.html.](http://www.dnr.state.mn.us/waters/groundwater_section/mapping/sensitivity.html)

The susceptibility of groundwater to pollution within the Thief River Watershed is generally low. The Groundwater Contamination Susceptibility ranking uses four parameters (aquifer materials, recharge potential, soil materials, and vadose zone materials) to delineate areas of relative susceptibility to ground water contamination. The range of relative susceptibility across the state reflects the rate at which contamination would likely reach groundwater resources. The areas of medium to highest susceptibility of groundwater pollution are generally in the outlying areas of the watershed, coinciding more with the Lake Agassiz Geomorphic Association. The areas considered to have the lowest to low susceptibility of groundwater pollution coincide with the glacial till soils (DNR, 2015b; 2016) (**Figure 31**).

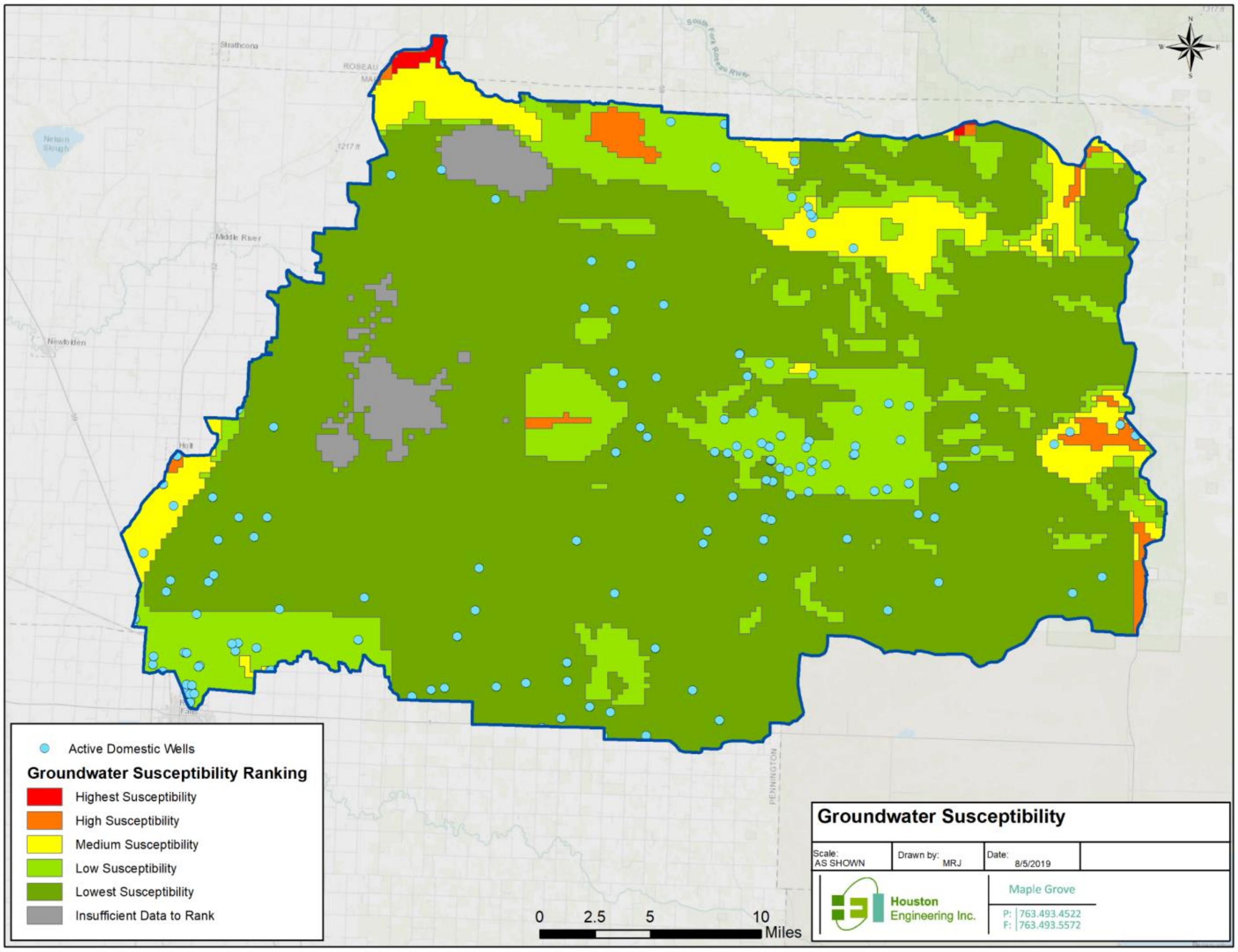
Figure 31: Groundwater Susceptibility for the Thief River Watershed.



Source: Minnesota Dept. of Natural Resources Watershed Health Assessment – Setting the Context Thief River, p. 7. 2016. www.dnr.state.mn.us/whaf.

There are many domestic wells located in the Thief River Watershed. **Figure 32** depicts known active domestic use well locations in relation to groundwater contamination susceptibility areas.

Figure 32: Active Domestic Use Well Locations Relative to Groundwater Contamination Susceptibility in the Thief River Watershed



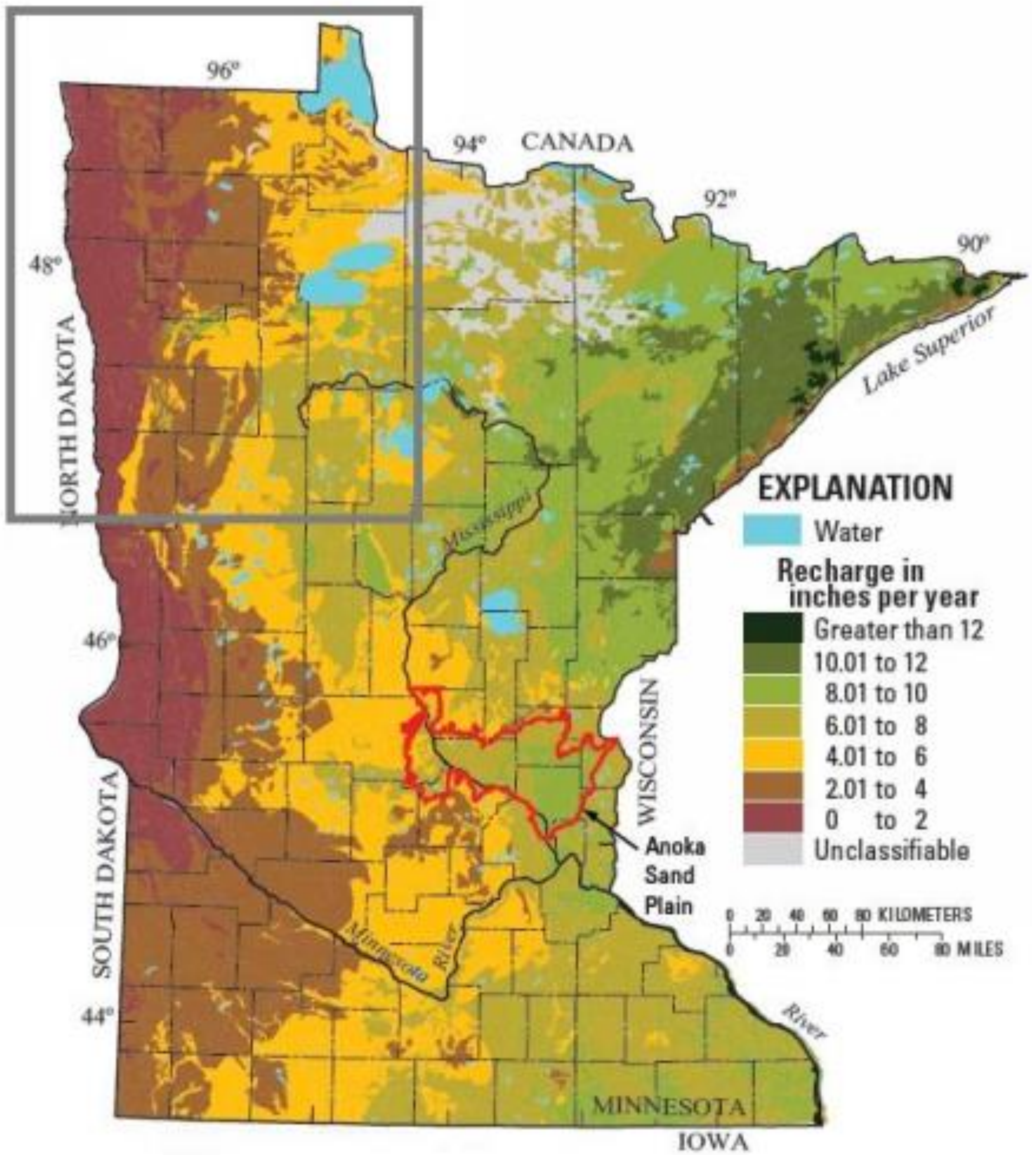
There are two Drinking Water Supply Management Areas and Wellhead Protection Areas in the Thief River Watershed in Grygla and Goodridge. A drinking water supply management area (DWSMA) is the Minnesota Department of Health (MDH) approved surface and subsurface area surrounding a public water supply well that completely contains the scientifically calculated wellhead protection area and is managed by the entity identified in a wellhead protection plan. The boundaries of the drinking water supply management area are delineated by identifiable physical features, landmarks or political and administrative boundaries (MPCA). The City of Thief River Falls is in a Source Water Assessment Area (SWAA). A SWAA is an assessment of water sources used by a public water system. The MDH uses these assessments to initiate source water protection plans (MDH) More information on source water assessments is available at http://www.health.state.mn.us/divs/eh/water/swp/swa/

6.4 Groundwater Recharge

Groundwater recharge is one of the most important parameters in the calculation of water budgets, which are used in general hydrologic assessments, aquifer recharge studies, groundwater models, and water quality protection. Recharge is a highly variable parameter, both spatially and temporally, making accurate estimates at a regional scale difficult to produce. The MPCA contracted the US Geological Survey to develop a statewide estimate of recharge using the Soil-Water-Balance Code (SWB). The result is a gridded data structure of spatially distributed recharge estimates that can be easily integrated into regional groundwater studies. The full report of the project as well as the gridded data files are available at: https://gisdata.mn.gov/dataset/geos-gw-recharge-1996-2010-mean

Groundwater is available primarily through surficial sand and gravel aquifers, buried sand and gravel aquifers, and deeper cretaceous aquifers. Recharge of these aquifers is limited to areas located at topographic highs, areas with surficial sand and gravel deposits, and those along the bedrock/surficial deposit interface. Typically, recharge rates in unconfined aquifers are estimated at 20%-25% of precipitation received, but can be less than 10% of precipitation where glacial clays or till are present (USGS, 2007) (**Figure 33**). For the Thief River Watershed, the average annual recharge rate to surficial materials is two to four inches per year in the western portion of the watershed, and four to six inches per year in the eastern reaches (MPCA, 2014).

Figure 33: Average Annual Recharge Rate to Surficial Materials in Minnesota (1971-2000)



Source: Thief River Watershed Monitoring and Assessment Report, p. 17. MPCA 2014.

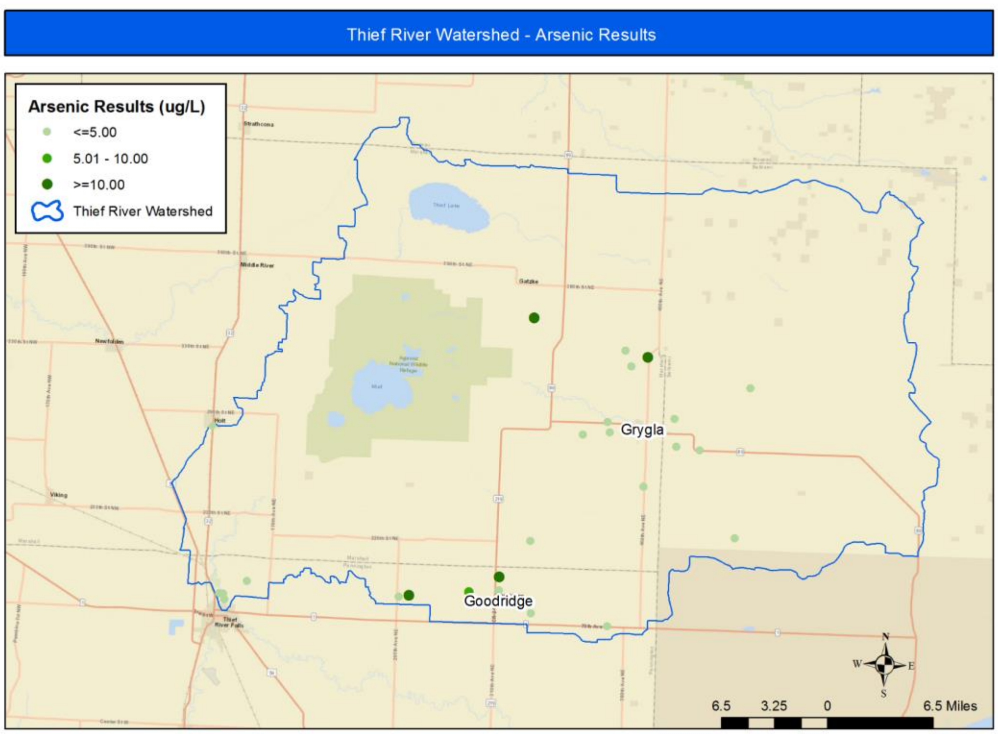
7. GROUNDWATER QUALITY

Despite the relatively low susceptibility of groundwater to pollution in the watershed, a baseline study conducted by the MPCA found that the median concentrations of most analytes in the sand and gravel aquifers in this region were slightly higher, while iron and sulfate concentrations were much higher when compared to similar aquifers statewide (MPCA, 1998).

The results of this study also identified exceedances of drinking water criteria in the three different aquifers—cretaceous, surficial, and buried sand and gravel. The two factors that most heavily influence water quality were determined to be the presence of cretaceous bedrock and its location. While water quality in cretaceous bedrock is typically poor, the location can dictate higher levels of contamination, such as higher arsenic concentrations in buried sand and gravel aquifers along stagnation moraines.

Another source of information on groundwater quality comes from the MDH. Mandatory testing for arsenic of all newly constructed wells has found that 10.4% of all wells installed from 2008 to 2013 have arsenic levels above the maximum contaminant level (MCL) for drinking water of 10 micrograms per liter. In northwest Minnesota, the majority of new wells are within the water quality standards for arsenic levels, but there are some exceedances (MPCA, 2014) (**Figure 34**). It is important to note that even though some private wells exceed the MCL drinking water standard for public water suppliers, there is no regulation for private wells.

Figure 34: Arsenic Concentrations in Northwest Minnesota Wells



Source: Minnesota Department of Health (MDH).

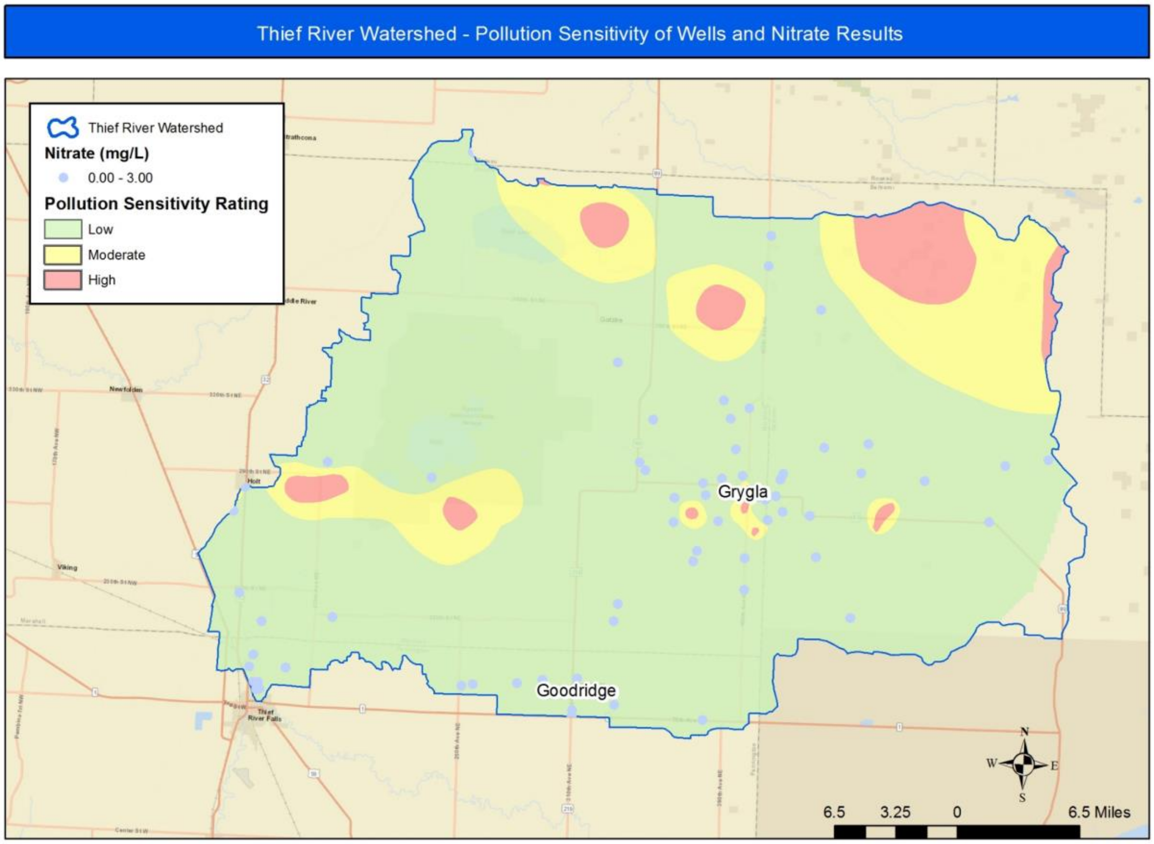
When developing the Thief River Falls SWAA and Grygla and Goodridge WPHs, the MDH conducted groundwater testing in wells for nitrates. The MDH also conducted a pollution sensitivity study of the watershed.

Figure 35 depicts a gradient of the geologic sensitivity of wells across the watershed. The geologic sensitivity was determined by characteristics recorded at the time of well drilling, such as the thickness and type of material overlying the aquifer. For example, a thick clay layer above the aquifer better protects it from contamination than a layer of sand, since it is more difficult for contaminants to penetrate a layer with low permeability. For unconfined aquifers, the depth of the water table also plays a role in calculating geologic sensitivity. The static water level measurement in the well reflects the approximate elevation of the water table in the aquifer. Wells with a relatively deep static water level are less likely to be contaminated than those with a higher static water level. This is because the time it takes for water and contaminants to infiltrate to the water table increases with depth.

Based on these characteristics, each well in the watershed was classified as having either “Low,” “Moderate,” “High,” or “Very High” geologic sensitivity to contamination. These values were then converted to a raster dataset using the natural neighbor technique in ArcMap, which allows for the interpolation between points to create a smooth gradient over the watershed. More details on the geologic sensitivity calculations can be found in the flowchart.

In comparison to the “Pollution Sensitivity of Near-Surface Materials” figure, which shows the vulnerability of the uppermost aquifers based on the top ten feet of surficial geomorphology, this figure reflects vulnerability of aquifers based on the subsurface. These figures can be used in tandem to assess the total susceptibility of groundwater to contamination in each area, by combining both surficial and subsurface data sources (MDH).

Figure 35: Pollution Sensitivity of Wells and Nitrate Results for the Thief River Watershed



Source: Minnesota Department of Health (MDH).

8. GROUNDWATER QUANTITY

Monitoring wells from the DNR Observation Well Network track the elevation of groundwater across the state. The elevation of groundwater is measured as depth to water in feet and reflects the fluctuation of the water table as it rises and falls with seasonal variations and anthropogenic influences. There are no DNR observation wells within the Thief River Watershed at this time (MPCA, 2014). However, monitoring well data is available for areas west and south of the watershed, notably in Middle River and Thief River Falls. These wells may provide data that is relevant to the Thief River Watershed. Data is available through the DNR Cooperative Groundwater Monitoring Website at:
http://www.dnr.state.mn.us/waters/groundwater_section/obwell/index.html

8.1 Groundwater and Surface Water Withdrawals

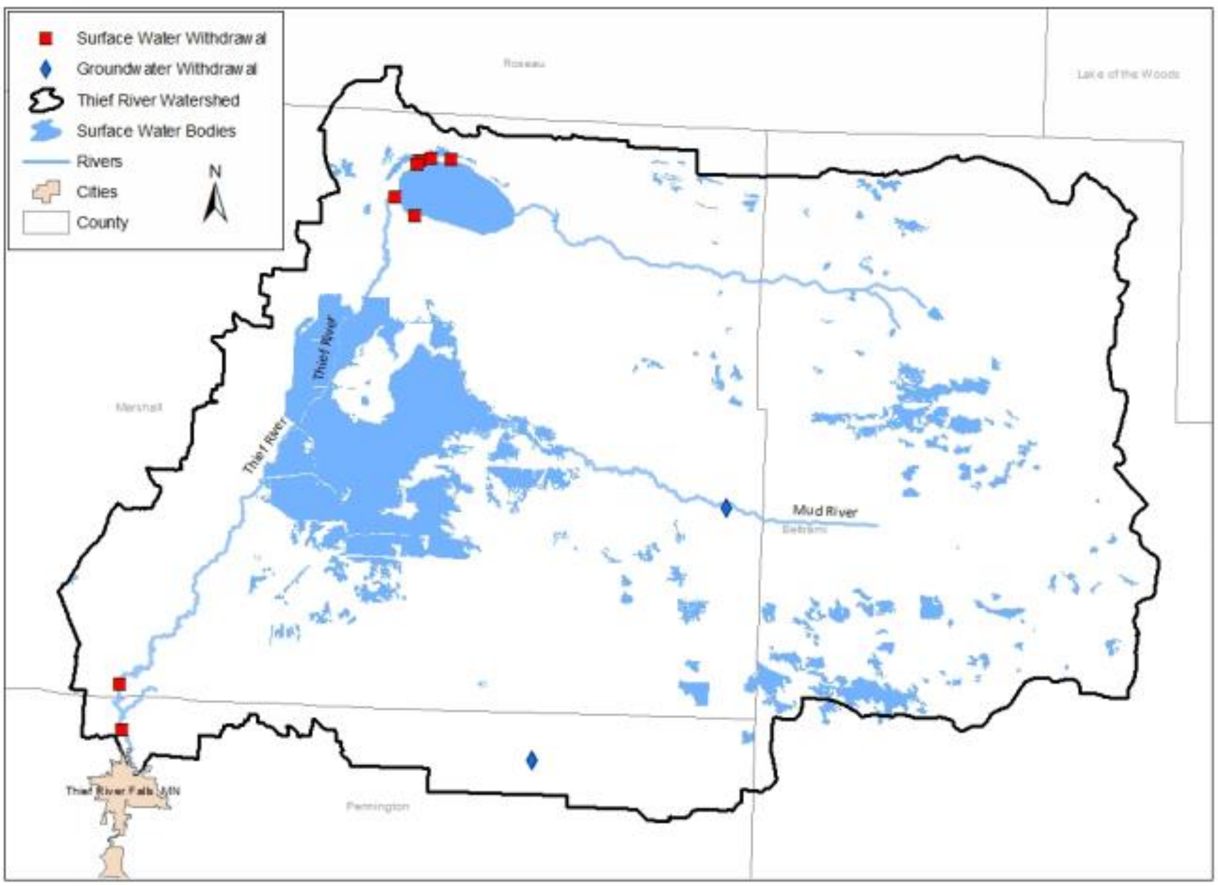
The DNR permits all high capacity water withdrawals where the pumped volume exceeds 10,000 gallons/day or one million gallons/year. Permit holders are required to track water use and report back to the DNR yearly. These data include temporary permit holders. Information on the program and the program database are found at:
http://www.dnr.state.mn.us/waters/watermgmt_section/appropriations/wateruse.html

The changes in withdrawal volume detailed in this inventory are a representation of water use and demand in the watershed and are taken into consideration when the DNR issues permits for water withdrawals. Other factors not discussed in this inventory but considered when issuing permits include interactions between individual withdrawal locations, cumulative effects of withdrawals from individual aquifers, and potential interactions between aquifers. This holistic approach to water allocations is necessary to ensure the sustainability of Minnesota's groundwater resources.

The three largest permitted consumers of water in the state (in order) are municipalities, industry, and irrigation. The withdrawals within the Thief River Watershed are mostly for municipal use and water level maintenance. **Figure 36** shows locations of withdrawals from the watershed.

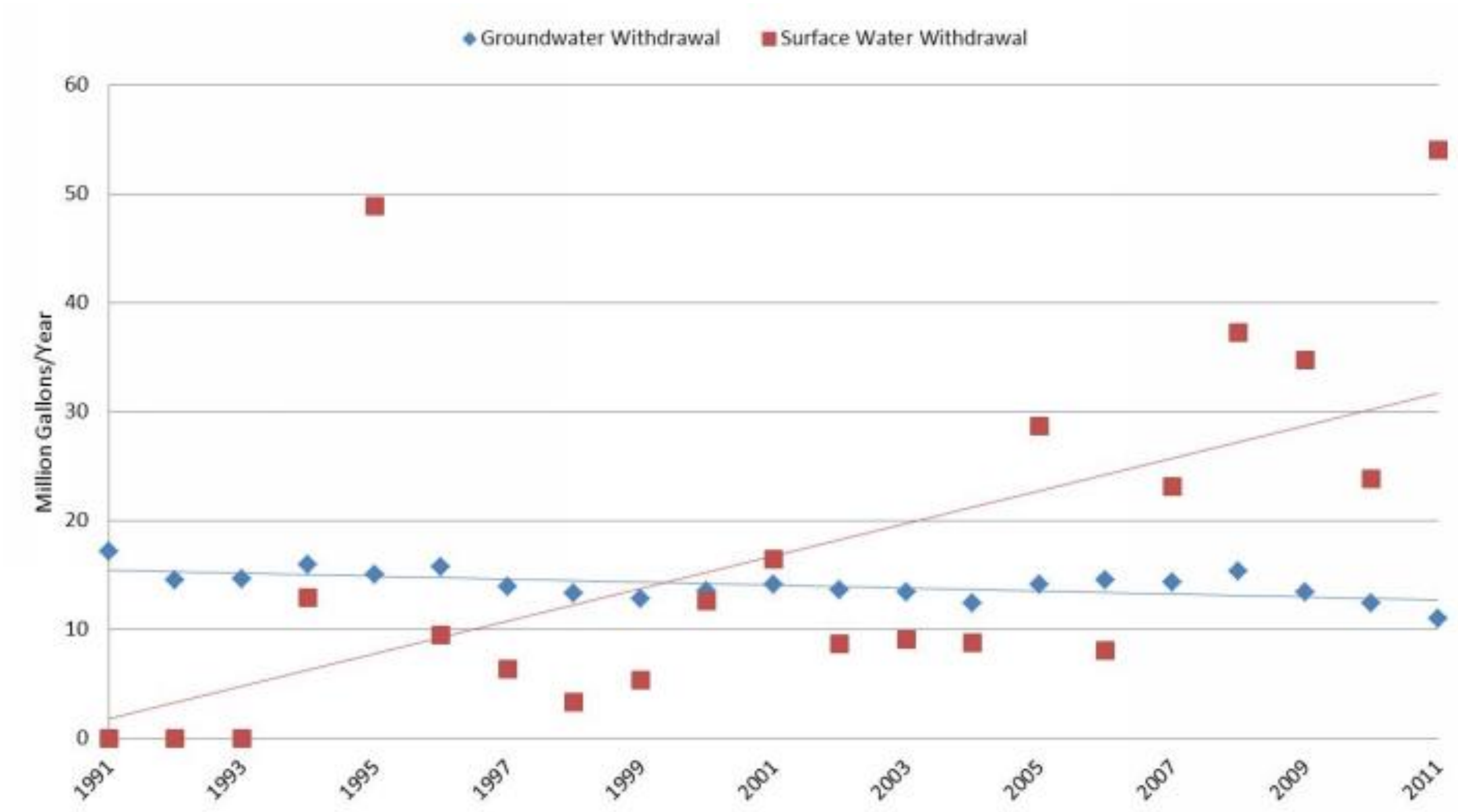
Figure 37 displays total groundwater withdrawals from the watershed from 1991-2011 as blue diamonds with total surface water withdrawals as red squares. During this time, surface water withdrawals exhibit a statistically significant rising trend (p=0.001) (MPCA, 2014).

Figure 36: Water Withdrawal Sites in the Thief River Watershed.



Source: Thief River Watershed Monitoring and Assessment Report, p. 71. MPCA 2014.

Figure 37: Total Groundwater and Surface Water Withdrawals in the Thief River Watershed from 1991-2011



Source: Thief River Watershed Monitoring and Assessment Report, p. 71. MPCA 2014.

9. FISH, WILDLIFE, AND RARE AND ENDANGERED FEATURES

9.1 Fish and Wildlife Habitat

9.1.1 Terrestrial Habitat

There are currently no readily available, watershedwide assessments of terrestrial wildlife habitat within the Thief River Watershed. However, public-managed lands can serve as indicators of terrestrial habitat coverage in the watershed. **Figure 38** depicts the extent and type of public-managed lands in the Thief River Watershed.

Public lands in Thief River Watershed include a national wildlife refuge, state forest, and wildlife management areas. These lands provide habitat for a wide range of species, including birds and wildlife, as well as protecting the soil from erosion and providing areas for infiltration of rain and snow melt. The largest public lands—Agassiz National Wildlife Refuge (NWR), Thief Lake Wildlife Management Area (WMA), Eckvoll WMA, and Elm Lake WMA—are summarized from the Red Lake Watershed District 10-year Comprehensive Plan (2006).

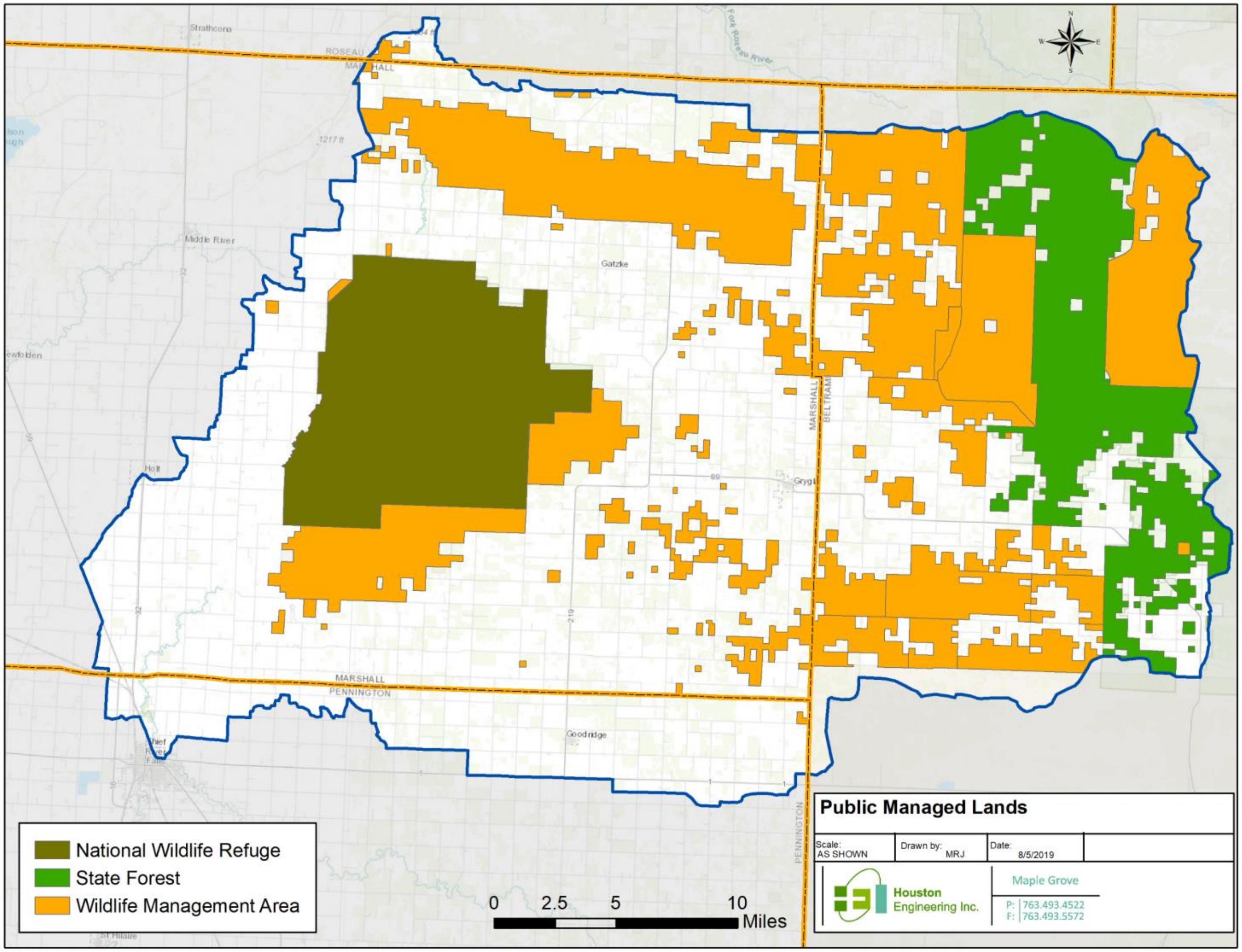
Agassiz National Wildlife Refuge provides some of the best terrestrial and aquatic habitat in the watershed. Agassiz NWR was established in 1937 as Mud Lake NWR. The Refuge was renamed in 1961 for the shallow depressional lake plains formed by Glacial Lake Agassiz. The NWR lies in the aspen parkland transition zone between the coniferous forest to the north and east and the tallgrass prairie to the south and west. The original focus of the Refuge was on waterfowl. Over the years, other migratory birds and year-round resident wildlife have received an increasing emphasis in NWR management.

Agassiz NWR is located in the eastern Red River Valley, an area of relatively flat terrain and a gentle gradient averaging 1.5 feet per mile, sloping east to west across the NWR. The major threat of flooding at Agassiz NWR is the result of spring runoff following wet winters and spring rains. Flooding is one of the key issues affecting the NWR's habitat and facilities. Sedimentation deposition from erosion off adjacent farmlands and ditch systems discharging into the NWR are other factors affecting the NWR pools, wildlife habitat, and water quality.

Agassiz's 61,500 acres includes 21 impoundments and two natural lakes. These diverse habitats provide a haven for many wildlife species. The refuge supports over 280 species of birds, 49 species of mammals, 12 species of amphibians, and nine species of reptiles.

The NWR is administered by the United States Fish and Wildlife Service (USFWS), a branch of the Department of the Interior. The goal of the USFWS is to conserve and enhance the nation's fish and wildlife populations and their habitats. The refuge is located in northeastern Marshall County, 23 miles northeast of Thief River Falls (RLWD, 2006).

Figure 38: Public Managed Lands in the Thief River Watershed



The Thief Lake WMA covers 55,000 acres and encompasses a variety of habitat types. The WMA includes DNR Division of Fish and Wildlife acquired lands, dedicated consolidated conservation lands, and trust fund lands.

Thief Lake Wildlife Management Area (WMA), 38 miles northeast of Thief River Falls, is located in northeastern Marshall County. The lake covers 7,100 acres at normal pool level and is approximately 5 miles long and 3 miles wide. The average water depth is 3 feet. Approximately 3,000 acres of the lake is in a sanctuary, while the remainder is open to the public, with four major boat launches and camping areas. The Moose River enters the lake from the east and the Thief River is the outlet to the west. A dam at the outlet controls the water level and the normal summer pool is 1,158.5 feet mean sea level (msl).

The Eckvoll WMA is in eastern Marshall County, 31 miles northeast of Thief River Falls, nine miles west of Grygla, and adjacent to the Agassiz NWR. Bisected by the main stem of JD 11, the area consists of 6,440 acres of mostly tax-forfeited land. Approximately 50% of the area is open, primarily wetland, consisting of cattail, cane, and sedges. Brush, largely willow and aspen, make up the bulk of the remaining cover types. An estimated 300 acres of open water type marsh is located on the north side of JD 11.

This management area produces and supports a high wildlife population, including such major species as moose, deer, ruffed grouse, sharp-tailed grouse, and waterfowl. Many other mammals and birds make use of the area for at least a portion of the year. The area will be managed both as a wildlife production and staging area, as well as for public hunting and wildlife viewing.

The Elm Lake WMA is in eastern Marshall County, 9 miles northeast of Thief River Falls. The area consists of 15,543 acres and adjoins the south boundary of Agassiz NWR. Approximately 75% of the area is open wetland consisting of marsh vegetation. The higher land is mainly brush with some open areas of grass, legumes, and scattered woodlands. This WMA produces and supports a high wildlife population, including such major species as moose, deer, ruffed grouse, sharp-tailed grouse, and waterfowl. Fur-bearing animals are common in the area. Farmes Pool Impoundment, which lies within Elm Lake WMA, was designed to help with flood control, drainage, and wildlife benefits, with funding of up to $1.5 million, funded by Ducks Unlimited, to be used toward the establishment of this project.

Quality habitats in this watershed primarily include forestlands, brushlands, and wetlands. Type 6 and 7 wetlands are particularly abundant. Grasslands are of relatively less importance compared to some other planning basins in the Red Lake Watershed District. These habitats provide seasonal and permanent homes to a variety of species, including game species such as white-tailed deer, moose, bear, waterfowl, and sharp-tail grouse. Some areas provide important winter habitat for deer as well as migratory and breeding habitat for waterfowl and other birds (e.g., Thief Lake WMA, Agassiz NWR). One of Minnesota’s two elk herds is also found in this watershed. Prime sharp-tail habitat is located near Grygla extending about 6 miles to the east and 10-15 miles west of Beltrami/Marshall county line. Conservation Reserve Program (CRP) lands provide some quality habitats and provide a habitat connection between public lands to the east and west. These lands are of particular importance because they contain a mix of relatively undisturbed areas of grassland, brushland, and wetland. East and west of this area the habitat becomes more wooded or wet and less desirable for sharp-tail (RLWD, 2006).

9.1.2 Aquatic Habitat

The Moose River, Thief River, and Mud River are the primary waterways in the Thief River Watershed. Portions of all these rivers have been channelized. Dams at impoundment outlets and other impassable areas (e.g., culverts) fragment these stream systems. A network of drainage systems and a few natural waterways are tributaries to these waterways. The hydrology of these waterways has also been modified due to land use changes (flashy flows and extended periods of low flow). All these changes have greatly reduced the potential of these waterways to support quality fish populations. The Thief River does provide some quality habitat for some species (RLWD, 2006).

A full stressor identification report has yet to be produced for the Thief River Watershed because there were no formal aquatic life impairments listed during the last assessment period. Despite the lack of official biological impairments, there are parts of this watershed in which stressors are known to be affecting aquatic life. Loss of connectivity, flow regime alteration, lack of in-stream habitat, excess suspended sediment, low DO, elevated ammonia, and pesticide toxicity are potential stressors that were identified in the 2014 Thief River Watershed Monitoring and Assessment Report. Monitoring data shows that three of the reaches fail to meet the water quality standard for DO. Excess sediment can also lead to sedimentation and bedloads of sediment that can negatively affect aquatic habitat.

Although they were not used to conduct formal biota assessments, fish and macroinvertebrate indices of biotic integrity were calculated and summarized in the 2014 Thief River Watershed Monitoring and Assessment Report. Proactive solutions to potential/probable aquatic life deficiencies can be identified based on those sampling results and observations made during the intensive examination of the watershed that has been conducted over the last decade. Local, state, and federal agencies should continue to identify and address problems until formal water quality assessments are completed.

A lack of connectivity can negatively affect fish IBI ratings. The fish IBI score in the lower Thief River was good, but fish IBI scores appear to be negatively affected upstream of the dams that create the pools in Agassiz National Wildlife Refuge, Moose River Impoundment and Thief Lake.

Extensive drainage and channelization affect the quality of in-stream habitat. Extensive drainage can result in flashy flows during runoff events. Storage in flood reduction impoundments (Agassiz pools are not managed for flood reduction) helps moderate flows during runoff events, but the management of FDR impoundments can cut off base flows once target water level elevations within the pools are reached. The flashy, high flows that result from the practice of releasing water from impoundments as fast as possible to reach target elevations can increase in-channel erosion rates. Based upon conversations with water management staff, water from spring runoff is discharged from impoundments at high rates because of the importance of quickly reaching summer pool elevations and resetting flood storage capacities.

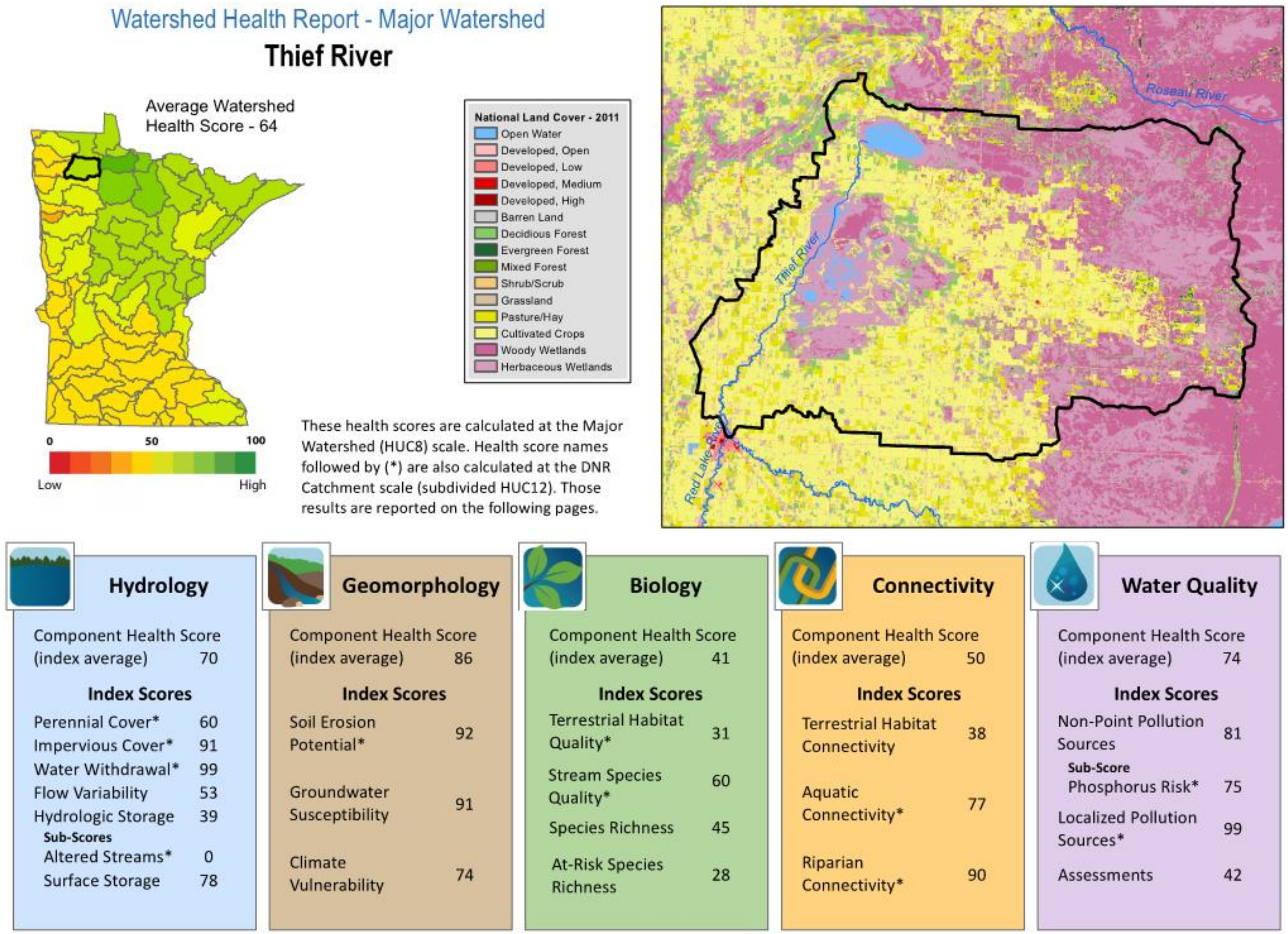
However, the operating plans of impoundments should be examined to identify ways in which the goal of regaining flood storage capacity can be accomplished without causing negative downstream impacts. The water stored between the summer and winter pool elevations could be used to augment late summer flows if it is gradually discharged over the late summer and fall months rather than waiting until October to discharge at a high rate of flow (MPCA, 2017a). It is worth noting that potential erosion and streambank instability can also be caused from sheet flow erosion or artificial surface drainage on agricultural lands.

9.2 Ecological Health

The DNR developed the Watershed Health Assessment Framework (WHAF) to assess the overall ecological health of a watershed. The WHAF evaluates and provides a score to each of the five core components of watershed health: hydrology, geomorphology, biology, connectivity, and water quality. Scores are ranked on a scale from 0 (“extremely poor”) to 100 (“extremely good”). Statewide mean health scores ranged from 40 (Marsh River Watershed) to 84 (Rapid River Watershed).

Figure 39 presents the watershed health scorecard for the Thief River Watershed. The mean health score for the watershed was 64. The overall score was limited by the following component indices: altered streams (0), water quality assessments (42), at-risk species (28), hydrologic storage (39), flow variability (53), species richness (45), terrestrial habitat quality (31), and terrestrial habitat connectivity (38) (DNR, 2015b).

Figure 39: Watershed Health Report Card for the Thief River Watershed



Source: Minnesota Dept. of Natural Resources Watershed Health Assessment – Watershed Report Card: Thief River, p. 2. 2015. www.dnr.state.mn.us/whaf.

9.3 Rare and Endangered Features

9.3.1 Rare and Endangered Plant and Animal Species.

Minnesota's Endangered Species Statute (MS.84.0895) requires the DNR to adopt rules designating species meeting the statutory definitions of endangered, threatened, or species of concern. Corresponding regulations that control the treatment of species designated as endangered and threatened is in Minnesota Administrative Rules (MN R.6212.1800-6212.2300). According to the DNR Rare Species Guide (http://www.dnr.state.mn.us/rsg/filter_search.html), there are 27 species on Minnesota's List of Endangered, Threatened, and Special Concern Species in the Thief River Watershed (**Table 6**).

Table 6: Threatened, Endangered, and Species of Special Concern in the Thief River Watershed

Common Name	Scientific Name	Group	Federal Status	State Status
American White Pelican	*Pelecanus erythrorhynchos*	bird	none	special concern
Common Moonwort	*Botrychium lunaria*	vascular plant	none	threatened
Dry Sedge	*Carex xerantica*	vascular plant	none	special concern
False Mountain Willow	*Salix pseudomonticola*	vascular plant	none	special concern
Few-flowered Spikerush	*Eleocharis quinqueflora*	vascular plant	none	special concern
Forster's Tern	*Sterna forsteri*	bird	none	special concern
Franklin's Gull	*Leucophaeus pipixcan*	bird	none	special concern
Frenchman's Bluff Moonwort	*Botrychium gallicomontanum*	vascular plant	none	endangered
Greater Prairie-chicken	*Tympanuchus cupido*	bird	none	special concern
Horned Grebe	*Podiceps auritus*	bird	none	endangered
Least Moonwort	*Botrychium simplex*	vascular plant	none	special concern
Least Weasel	*Mustela nivalis*	mammal	none	special concern
Marbled Godwit	*Limosa fedoa*	bird	none	special concern
Mingan Moonwort	*Botrychium minganense*	vascular plant	none	special concern
Nelson's Sparrow	*Ammodramus nelsoni*	bird	none	special concern
Northern Androsace	*Androsace septentrionalis*	vascular plant	none	special concern
Pale Moonwort	*Botrychium pallidum*	vascular plant	none	special concern
Piping Plover	*Charadrius melodus*	bird	threatened	endangered
Prairie Moonwort	*Botrychium campestre*	vascular plant	none	special concern
Sheathed Pondweed	*Stuckenia vaginata*	vascular plant	none	endangered
Short-eared Owl	*Asio flammeus*	bird	none	special concern
Siberian Yarrow	*Achillea alpina*	vascular plant	none	threatened
Spatulate Moonwort	*Botrychium spathulatum*	vascular plant	none	endangered
Spike Oat	*Avenula hookeri*	vascular plant	none	special concern
Trumpeter Swan	*Cygnus buccinator*	bird	none	special concern
Wilson's Phalarope	*Phalaropus tricolor*	bird	none	threatened
Yellow Rail	*Coturnicops noveboracensis*	bird	none	special concern

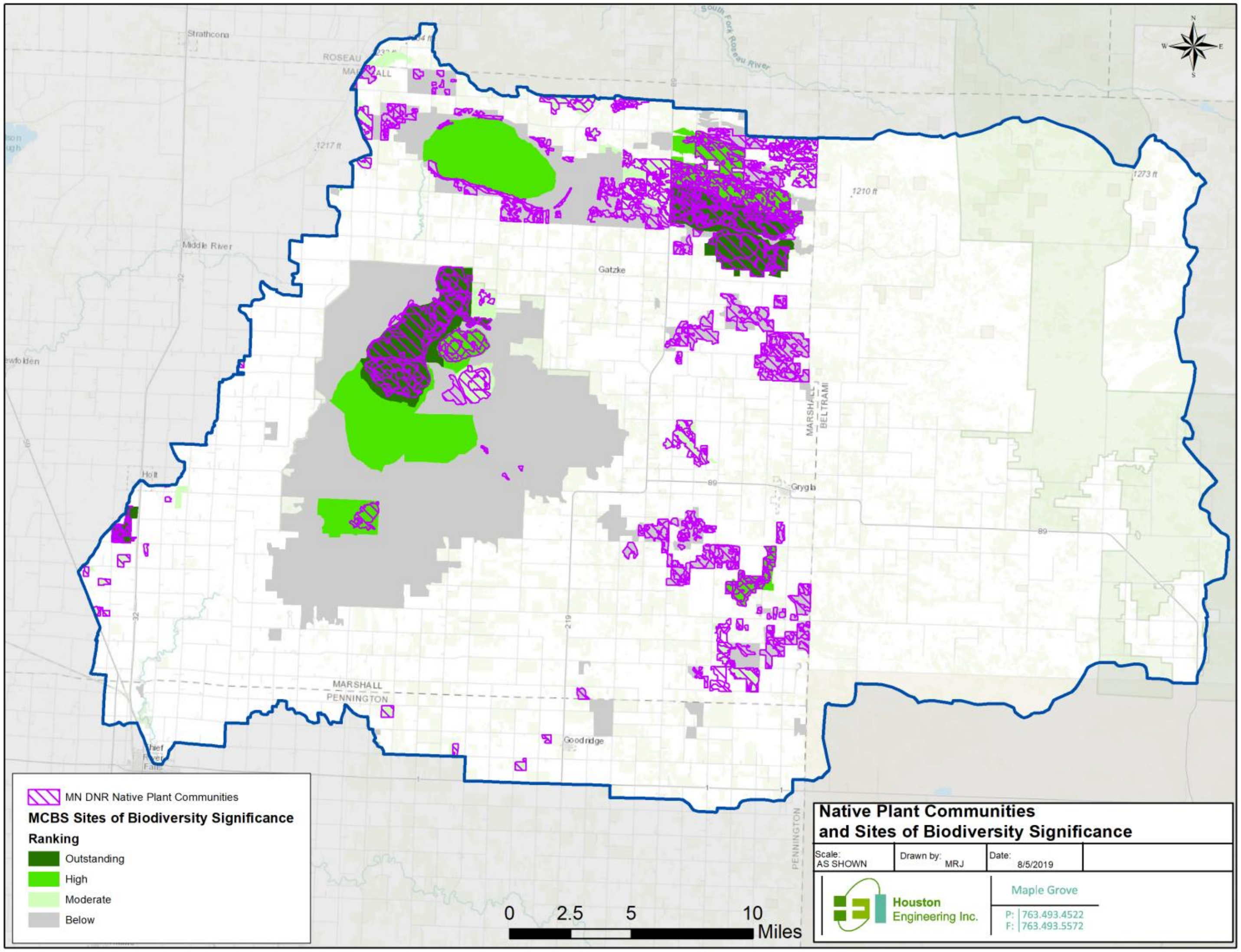
Source: DNR Rare Species Guide. Accessed 10-2-2017.

9.3.2 MCBS Sites of Biodiversity Significance and Native Plant Communities

The Minnesota County Biological Survey (MCBS) is a DNR program within the Division of Ecological and Water Resources with the goal of identifying significant natural areas and collecting and interpreting data on the distribution and ecology of rare plants, rare animals, and native plant communities. Data collected by MCBS are entered into the Natural Heritage Information System, managed by the DNR's Division of Ecological and Water Resources. Because of this systematic survey, the relative ecological importance of natural areas and representative ecological landscapes can be assessed.

Following the initial mapping of native plant communities from aerial photos in each county, MCBS ecologists delineated sites of biodiversity significance that helped to geographically organize the data. According to the MCBS data, there are 137 identified sites of biodiversity significance encompassing approximately 162,423 acres within the Thief River Watershed and 750 native plant communities encompassing approximately 45,743 acres. Minnesota Sites of Biodiversity Significance and Native Plant Communities are shown in **Figure 40**.

Figure 40: Native Plant Communities and MCBS Sites of Biodiversity Significance in the Thief River Watershed



10. SOCIOECONOMICS

As part of the TMDL/WRAPs process, the MPCA compiled a socioeconomic profile for the Thief River Watershed. The Thief River Watershed lies across parts of five counties—Beltrami, Marshall, and Pennington counties along with a very small area in Roseau and Lake of the Woods counties. The watershed's 975 square miles support a population of 2,840 people. This population is widely dispersed over most of the watershed, with fewer than two people per square mile in Beltrami County and fewer than three people per square mile in Marshall County. Pennington County accounts for 2% of the land area but 42% of the population, with a population density of 59 individuals per square mile. Watershed managers should consider the dispersed nature of the population when proposing strategies to achieve water quality goals.

The median age of the Thief River Watershed's population is 36, with the youngest population in Beltrami and the oldest in Marshall. The average age of farmers in the watershed is almost 57 years. As the population ages, consumption patterns change, generally moving from consuming to saving to spending over one's lifetime. Over the past 40 years, the amount of personal income derived from wages has been declining from 75% in 1970. This trend is consistent with the aging of the population. It suggests that an increasing proportion of residents are living on limited incomes.

On a broad scale, an aging population means an aging economy, with little or no growth. On an individual scale, as a person moves closer to retirement age, he or she is likely to receive personal income from retirement, disability, or dividends, than from wages or salary. Thus, a watershed manager can assume that as the population ages, the ability of individuals to pay for improvements that may be necessary to achieve watershed goals is reduced.

Farming is the dominant land use for the watershed, but it is not the dominant economic activity. The USDA's Economic Research Service classifies the economy of Marshall County as farm dependent, meaning that more than 15% of personal income derives from farming. Beltrami and Pennington counties are classified as nonspecialized, meaning that no single source accounts for 15% or more of personal income. The fact that farming dominates land use but not the local economy may present challenges to watershed managers.

The educational attainment of the population of the Thief River Watershed is below national and state averages. Approximately 75% of the Thief River Watershed has graduated from high school or attained an equivalent degree. The rate for Beltrami County is only 55%. About 10% of the watershed's population has done post-secondary study (MPCA, 2017b).

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APPENDIX B:
MEMORANDUM OF AGREEMENT

MEMORANDUM OF AGREEMENT

This agreement (Agreement) is made and entered into by and between:

The Counties of Marshall, Pennington, and Beltrami by and through their respective County Board of Commissioners, and

The Marshall, Pennington, and Beltrami Soil and Water Conservation Districts, by and through their respective Soil and Water Conservation District Board of Supervisors, and

The Red Lake Watershed District, by and through their respective Board of Managers,

Collectively referred to as the "Parties."

WHEREAS, the Counties of this Agreement are political subdivisions of the State of Minnesota, with authority to carry out environmental programs and land use controls, pursuant to Minnesota Statutes Chapter 375 and as otherwise provided by law; and

WHEREAS, the Soil and Water Conservation Districts (SWCDs) of this Agreement are political subdivisions of the State of Minnesota, with statutory authority to carry out erosion control and other soil and water conservation programs, pursuant to Minnesota Statutes Chapter 103C and as otherwise provided by law; and

WHEREAS, the Watershed Districts of this Agreement are political subdivisions of the State of Minnesota, with statutory authority to carry out conservation of the natural resources of the state by land use controls, flood control, and other conservation projects for the protection of the public health and welfare and the provident use of the natural resources, pursuant to Minnesota Statutes Chapters 103B, 103D and as otherwise provided by law; and

WHEREAS, the parties to this Agreement have a common interest and statutory authority to prepare, adopt, and assure implementation of a comprehensive watershed management plan in ***Thief River*** Watershed to conserve soil and water resources through the implementation of practices, programs, and regulatory controls that effectively control or prevent erosion, sedimentation, siltation and related pollution in order to preserve natural resources, ensure continued soil productivity, protect water quality, reduce damages caused by floods, preserve wildlife, protect the tax base, and protect public lands and waters; and

WHEREAS, with matters that relate to coordination of water management authorities pursuant to Minnesota Statutes Chapters 103B, 103C, and 103D with public drainage systems pursuant to Minnesota Statutes Chapter 103E, this Agreement does not change the rights or obligations of the public drainage system authorities.

WHEREAS, the Parties have formed this Agreement for the specific goal of developing a plan pursuant to Minnesota Statutes § 103B.801, Comprehensive Watershed Management Planning, also known as *One Watershed, One Plan*.

NOW, THEREFORE, the Parties hereto agree as follows:

1. **Purpose:** The Parties to this Agreement recognize the importance of partnerships to plan and implement protection and restoration efforts for the ***Thief River Watershed*** as shown in Attachment A. The purpose of this Agreement is to collectively develop and adopt, as local government units, a coordinated watershed management plan for implementation per the provisions of the Plan. Parties signing this agreement will be collectively referred to as ***"Thief River Watershed Planning Group"***.

2. **Term:** This Agreement is effective upon signature of all Parties in consideration of the Board of Water and Soil Resources (BWSR) Operating Procedures for One Watershed, One Plan; and will remain in effect until adoption of the plan by all parties or to correspond with the end date of the grant agreement, unless canceled according to the provisions of this Agreement or earlier terminated by law.

3. **Adding Additional Parties:** A qualifying party desiring to become a member of this Agreement shall indicate its intent by adoption of a board resolution prior to approval of the priority issues of concern. The party agrees to abide by the terms and conditions of the Agreement; including but not limited to the bylaws, policies and procedures adopted by the Policy Committee.

4. **Withdrawal of Parties:** A party desiring to leave the membership of this Agreement shall indicate its intent in writing to the Policy Committee in the form of an official board resolution. Notice must be made at least 30 days in advance of leaving the Agreement.

5. **General Provisions**:

    a. **Compliance with Laws/Standards:** The Parties agree to abide by all federal, state, and local laws; statutes, ordinances, rules and regulations now in effect or hereafter adopted pertaining to this Agreement or to the facilities, programs, and staff for which the Agreement is responsible.

    b. **Indemnification:** Each party to this Agreement shall be liable for the acts of its officers, employees or agents and the results thereof to the extent authorized or limited by law and shall not be responsible for the acts of any other party, its officers, employees or agents. The provisions of the Municipal Tort Claims Act, Minnesota Statute Chapter 466 and other applicable laws govern liability of the Parties. To the full extent permitted by law, actions by the Parties, their respective officers, employees, and agents pursuant to this Agreement are intended to be and shall be construed as a "cooperative activity." It is the intent of the Parties that they shall be deemed a "single governmental unit" for the purpose of liability, as set forth in Minnesota Statutes § 471.59, subd. 1a(a). For purposes of Minnesota Statutes § 471.59, subd. 1a(a) it is the intent of each party that this Agreement does not create any liability or exposure of one party for the acts or omissions of any other party.

    c. **Records Retention and Data Practices:** The Parties agree that records created pursuant to the terms of this Agreement will be retained in a manner that meets their respective entity's records retention schedules that have been reviewed and approved by the State in accordance with Minnesota Statutes § 138.17. The Parties further agree that records prepared or maintained in furtherance of the agreement shall be subject to the Minnesota Government Data Practices Act. At the time this agreement expires, all records will be turned over to the ***Red Lake Watershed District*** for continued retention.

d. **Timeliness:** The Parties agree to perform obligations under this Agreement in a timely manner and keep each other informed about any delays that may occur.

e. **Extension:** The Parties may extend the termination date of this Agreement upon agreement by all Parties.

f. **Amendments:** *This agreement may be amended from time to time if said amendment is agreed to in writing by all parties to this agreement.*

6. **Administration:**

a. **Establishment of Committees for Development of the Plan.** The Parties agree to designate one representative, who must be an elected or appointed member of the governing board or a Board delegate, to a Policy Committee for development of the watershed-based plan and may appoint one or more technical representatives to an Advisory Committee for development of the plan in consideration of the BWSR Operating Procedures for One Watershed, One Plan.

i. The Policy Committee will meet as needed to decide on the content of the plan, serve as a liaison to their respective boards, and act on behalf of their Board. Each representative shall have one vote.

ii. Each governing board may choose one alternate to serve on the Policy Committee as needed in the absence of the designated member.

iii. The Policy Committee will establish bylaws within 60 days of the execution of this document to describe the functions and operations of the committee(s).

iv. The Advisory Committee will meet monthly or as needed to assist and provide technical support and make recommendations to the Policy Committee on the development and content of the plan. Members of the Advisory Committee may not be a current board member of any of the Parties.

v. Policy Committee members are encouraged to attend Advisory Committee meetings.

b. **Submittal of the Plan.** The Policy Committee will recommend the plan to the Parties of this agreement. The Policy Committee will be responsible for initiating a formal review process for the watershed-based plan conforming to Minnesota Statutes Chapters 103B and 103D, including public hearings. Upon completion of local review and comment, and approval of the plan for submittal by each party, the Policy Committee will submit the watershed-based plan jointly to BWSR for review and approval.

   c. **Adoption of the Plan.** The Parties agree to adopt and begin implementation of the plan within 120 days of receiving notice of state approval, and provide notice of plan adoption pursuant to Minnesota Statutes Chapters 103B and 103D.

7. **Fiscal Agent:** Red Lake Watershed District will act as the fiscal agent for the purposes of this Agreement and agrees to:

   a. Accept all responsibilities associated with the implementation of the BWSR grant agreement for developing a watershed-based plan.

   b. Perform financial transactions as part of grant agreement and contract implementation.

   c. Annually provide a full and complete audit report.

   d. Provide the Policy Committee with the records necessary to describe the financial condition of the BWSR grant agreement.

   e. Retain fiscal records consistent with the agent's records retention schedule until termination of the agreement.

8. **Grant Administration**: Pennington SWCD will act as the grant administrator for the purposes of this Agreement and agrees to provide the following services:

   a. Accept all day-to-day responsibilities associated with the implementation of the BWSR grant agreement for developing a watershed-based plan, including being the primary BWSR contact for the *One Watershed, One Plan* Grant Agreement and being responsible for BWSR reporting requirements associated with the grant agreement.

   b. Provide the Policy Committee with the records necessary to describe the planning condition of the BWSR grant agreement.

9. **Coordination of Policy and Advisory Committee meeting:** Red Lake Watershed District will provide meeting room and staff to complete the following tasks:

   a. Provide advance notice of meetings.

   b. Prepare and Distribute the Agenda and related materials.

   c. Prepare and Distribute Policy Committee Minutes.

   d. Maintain all records and documentation of the Policy Committee.

   e. Provide public notices to the counties and watershed district for publication.

10. **Authorized Representatives:** The following persons will be the primary contacts for all matters concerning this Agreement:

Marshall County
Scott Peters or successor
County Auditor-Treasurer
208 E Colvin, Suite 11 & 12
Warren, MN 56762
Telephone: 218-745-4831

Marshall County SWCD
Darren Carlson or successor
Project Planner
105 South Division Street
Warren, MN 56762
Telephone: 218-745-5010

Beltrami County
Kay Mack or successor
County Administrator
701 Minnesota Ave. NW Suite 200
Bemidji, MN 56601
Telephone: 218-333-8478

Beltrami County SWCD
Brent Rud or successor
District Manager
701 Minnesota Ave. NW Suite 113
Bemidji, MN 56601
Telephone: 218-333-4158

Pennington County
County Auditor
101 Main Ave. North
Thief River Falls, MN 56701
Telephone: (218) 683-7000

Pennington SWCD
District Manager
201 Sherwood Ave. S
Thief River Falls, MN 55965
Telephone: (218) 683-7075

Red Lake Watershed District
Myron Jesme or successor
District Administrator
1000 Pennington Ave. South
Thief River Falls, MN 56701
Telephone: 218-681-5800

IN TESTIMONY WHEREOF the parties have duly executed this Agreement by their duly authorized officers.

Partner: Red Lake Watershed District

APPROVED:

BY: ________________________ 3/24/17

Board Chair Date

BY: ________________________ 3-24-17

District Administrator Date

IN TESTIMONY WHEREOF the parties have duly executed this Agreement by their duly authorized officers.

Partner: Pennington County

APPROVED:

BY: ______________________________ 3-14-17
Board Chair Date

BY: ______________________________ 3/14/17
Auditor Date

IN TESTIMONY WHEREOF the parties have duly executed this Agreement by their duly authorized officers.

Partner: Pennington SWCD

APPROVED:

BY: ______________________ 3-16-17

Board Chair Date

BY: Bryan E Malone 3/16/17

District Manager Date

IN TESTIMONY WHEREOF the parties have duly executed this Agreement by their duly authorized officers.

Partner: Marshall County

APPROVED:

BY: ______________________ 3-7-17
Board Chair Date

BY: ______________________ 3/7/17
Auditor -Treasurer Date

IN TESTIMONY WHEREOF the parties have duly executed this Agreement by their duly authorized officers.

Partner: Marshall County SWCD

APPROVED:

BY: Carl Green 3-21-17

Board Chair Date

BY: Dan Carlson 3/21/17

District Manager Date

IN TESTIMONY WHEREOF the parties have duly executed this Agreement by their duly authorized officers.

Partner: Beltrami County

APPROVED:

BY: ______________________ 3/21/17
Board Chair Date

BY: ______________________ 3-22-17
Auditor Date

IN TESTIMONY WHEREOF the parties have duly executed this Agreement by their duly authorized officers.

Partner: Beltrami County SWCD

APPROVED:

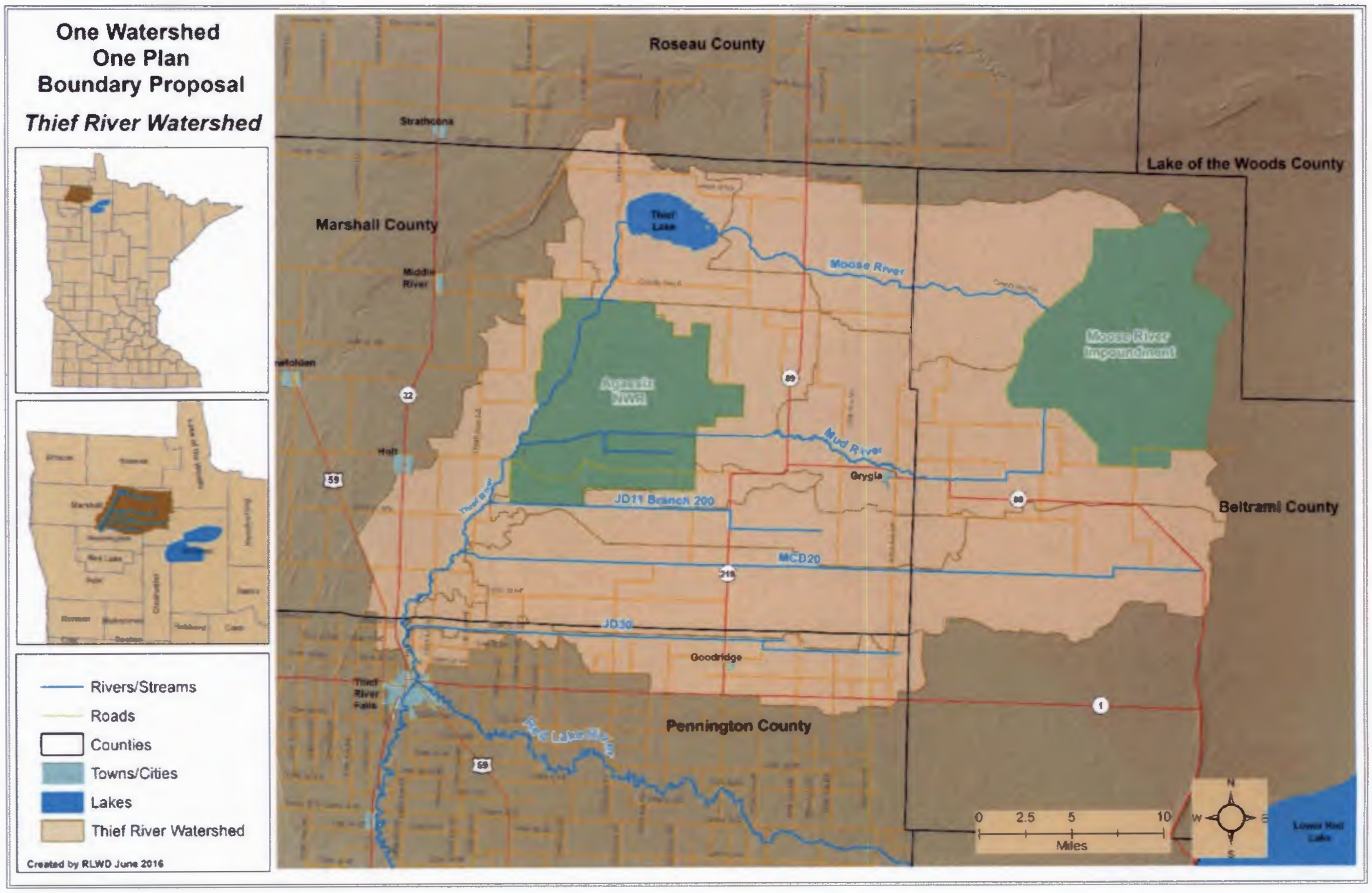
BY: ______________________ 3/16/17

Board Chair Date

BY: ______________________ 3/16/17

District Manager Date

Attachment A



APPENDIX C:
POLICY COMMITTEE MEMBERS

Appendix C – Policy Committee Members

The Policy Committee Members, their affiliation, and contact information are listed in **Table 1**.

Table 1. Policy Committee Members

Name	Designated (D) or Alternate (A)	Affiliation	Address	Phone	Email
Tim Sumner	D	Beltrami County			Timsumner15@gmail.com
Wally Byklum	A	Beltrami County			Wally.byklum@rcis.com
Ray Hendrickson	D	Beltrami SWCD			jackpine@gvtel.com
Gary Kiesow	D	Marshall County	25430 340th Avenue NE Goodridge, MN 56725	218-689-3084	Gary.kiesow@co.marshall.mn.us
Rolland Miller	A	Marshall County	26817 420th Avenue NW Warren, MN 56762	701-739-7396	Rolland.miller@co.marshall.mn.us
Brad Berg	D	Marshall SWCD			Bkberg83@gmail.com
Wallace Bengston	A	Marshall SWCD			wdbengtson@wiktel.com
Neil Peterson	D	Pennington County			ndpeterson@co.pennington.mn.us
Don Jensen	A	Pennington County	32094 120th Street NE Goodridge, MN 56725	218-689-3084	donjensen52@gmail.com
Linda Hanson	A	Pennington SWCD			miliha@gvtel.com
Grant Nelson	D	Pennington SWCD	17349 110th Street NW TRF, MN 56701		grantnelson@gvtel.com
LeRoy Ose	D	RLWD	15115 229th Street NE TRF, MN 56701	218-689-6675	leroyose@gmail.com
Dale M. Nelson	A	RLWD	10367 140th Street NW TRF, MN 56701	218-686-0032	Dalenelson62@gmail.com

Advisory Committee Members

The Advisory Committee Members, their affiliation, and contact information are listed in **Table 2**. Note that many of the Planning Work Group Members are also on the Advisory Committee.

Table 2. Advisory Committee Members

Name	Affiliation	Address	Phone	Email
		Local Members		
Ralph Smith	Beltrami County Landowner	PO Box 142 Grygla, MN 56727	218-294-6358	
Zach Gutknecht	Beltrami SWCD Clean Water Specialist	Beltrami County Administration 701 MN Ave Suite 173 Bemidji, MN 56601	218-333-4157	Zachrie.Gutknecht@co.beltrami.mn.us
Lowell Smeby	Beltrami County Landowner	62881 Flintlock Road Grygla, MN 56727	218-280-6916	
Bill Neuschwander	Beltrami County Landowner	6252 Lee Rd NW Grygla, MN 56727	218-294-6000	
Darrold Rodahl	Marshall County Landowner	18646 270th Street NE Thief River Falls, MN 56701	218-681-7025	dkrodahl@wiktel.com
Raymond Benson	Beltrami SWCD Spruce Gove Township Chair	31217 Todroff Rd NW, Grygla, MN 56727	218-294-6290	
Curtiss Hunt	Beltrami County lakes and Rivers Association	9217 Oman Rd Ne Bemidji, MN 56601	218-766-4529	
Josh Johnston	Marshall County Water Planner/Zoning Administrator	Marshall County Water and Land Office 208 E. Colvin Avenue, Suite 3 Warren, MN 56762	218-745-4217	Josh.johnston@co.marshall.mn.us

Loiell Dyrud	Marshall County Landowner	23484 150th Ave NE Thief River Falls, MN 56701	218-681-6964	lod@wiktel.com
Lon Aune	Marshall County Hwy Dept.	447 S. Main St. Warren, MN 56762	218-745-4381	Lon.Aune@co.marshall.mn.us
Randy McMillian	Marshall County Landowner	38847 380th St NE Grygla, MN 56747	218-686-3320	ranmac@gvtel.com
Darren Carlson	Marshall SWCD SWCD Staff	105 South Division St. Warren, MN 56762	218-745-5010	Darren.carlson@mn.nacdnet.net
Steve Holte	Marshall SWCD Landowner	28770 State Hwy 219 NE Grygla, MN 56727	218-689-2953	sholte@gvtel.com
Elroy Aune	Marshall SWCD			djaune@gvtel.com
Mike Drangstveit	Marshall SWCD			mikeyd@gvtel.com
Mike Flaagan	Pennington County	250 125th Ave NE, Thief River Falls, MN 56701	218-683-7017	mlflaagan@co.pennington.mn.us
Wayne Johnson	Pennington County	PO Box 528 Thief River Falls, MN 56701	218-681-3809	wjohnson@cityrft.net
Kevin Sanders	Pennington County	19385 250th Ave NE, Thief River Falls, MN 56701	218-681-2465 218-686-3462	kjsanders@wiktel.com krsanders@wiktel.com
Bryan Malone	Pennington SWCD	201 Sherwood Ave S. Thief River Falls, MN 56701	218-683-7075 ext. 118	Bryan.malone@mn.nacdnet.net
Sportsman Club **James Counter**	Pennington SWCD	James Counter, Box 232, Thief River Falls, MN	218-791-9808 218681-1901	jcounter@mncable.net
Golf Club	Pennington SWCD	Tim Erickson	218-681-4020	Tim.erickson@nsbtrf.com
Dale Nelson	RLWD	10367 140th St NW	218-686-0032	Dalenelson62@gmail.com

		Thief River Falls, MN 56701		
Brian Dwight	RLWD	PO Box 427 Waskish MN 56685	218-556-7109	Waskish1954@gmail.com
		State and Federal Agency Members		
Denise Oakes	MPCA Watershed Project Management	714 Lake Ave Suite 220 Detroit Lakes, MN 56501	218-846-8119	Denise.oakes@state.mn.us
Matt Fischer	BWSR Board Conservationist	403 4th St NW Rm 200 Bemidji, MN 56601	218-755-2683	Matt.fischer@state.mn.us
Henry Van Offelen	BWSR Clean Water Specialist	26624 N. Tower Road Detroit Lakes, MN 56501	218-846-8406	henry.van.offelen@state.mn.us
Jenilynn Marchand	Principal Planner Environmental Health Division, MDH	705 5th ST NW, Suite A Bemidji, MN 56601	218-308-5153	Jenilynn.marchand@state.mn.us
Robert Sip	MN Dept. of Ag.	625 N Robert Street St Paul, MN 55155	651-201-6456	Rob.Sip@state.mn.us
Annette Drewes	DNR	2532 Hannah Ave NW, Bemidji, MN 56601	218-308-2466	Annette.Drewes@state.mn.us
Stephanie Klamm	Area Hydrologist - DNR	246 125th Ave NE Thief River Falls, MN 56701	218-681-0947	Stephanie.klamm@state.mn.us
Craig Mowry	Agassiz NWR	22996 290th Street NE Middle River, Minnesota 56737	218-449-4115	craig_mowry@fws.gov
Shane Bowe	Red Lake Tribal	PO Box 279 Red Lake MN 56671	218-679-3959	Shane.bowe@redklakenation.org
Laurie Fairchild	USFWS Private Lands Biologist	Rydell and Glacial Ridge, Erskine MN 56535	218-687-2229 701-425-9080	laurie_fairchild@fws.gov

Jeff Franson	Golf Club Grounds Superintendent	NA	NA	JDsDodge@hotmail.com

Planning Work Group Members

The Planning Work Group Members, their affiliation, and contact information are listed in **Table 3**.

Table 3. Planning Work Group Members.

Name	Affiliation	Address	City/State/Zip	Phone	email
Peter Nelson	Pennington SWCD	201 Sherwood Ave S	Thief River Falls, MN 56701	218-683-7075	peter.nelson@mn.nacdnet.net
Myron Jesme	Red Lake WD	1000 Pennington Ave. S	Thief River Falls, MN 56701	218-681-5800	Myron.Jesme@redlakewatershed.org
Zach Gutknecht	Beltrami SWCD	701 Minnesota Ave NW, Suite 113	Bemidji, MN 56601	218-333-4158	zachrie.gutknecht@co.beltrami.mn.us
Darren Carlson	Marshall SWCD	105 Division Street South	Warren, MN 56772	218-745-5010	darren.carlson@mn.nacdnet.net
Josh Johnston	Marshall County	208 E Colvin Ave, Suite 5	Warren, MN 56762	218-745-5841	josh.johnston@co.marshall.mn.us
Corey Hanson	Red Lake WD	1000 Pennington Ave. S	Thief River Falls, MN 56701	218-681-5800	Corey.Hanson@redlakewatershed.org
Matt Fischer	BWSR	403 Fourth Street NW, Room 200	Bemidji, MN 56601	218-755-2683	matt.fischer@state.mn.us

APPENDIX D:
SUMMARY OF EXISTING MANAGEMENT PLANS AND REPORTS

Appendix D: Summary of Existing Management Plans and Reports

Author	Title	Link (If Available)
Local Water Plans		
Beltrami County	Beltrami County Local Water Management Plan	http://www.co.beltrami.mn.us/Departments/SWCD/Resources/Local%20Water%20Plan.pdf
Marshall County	Marshall County Local Water Management Plan	http://www.co.marshall.mn.us/document_center/WaterLand/Local%20Water%20Management%20Plan%20(LWMP)%202007-2012.pdf
Marshall County	Marshall County Local Water Management Plan Amendment for Years 2012-2015	http://www.co.marshall.mn.us/document_center/WaterLand/Goals,%20Objectives,%20Actions%20for%20Amended%20Plan.pdf
Pennington County	Pennington County 2010-2020 Comprehensive Local Water Management Plan	N/A
Red Lake Watershed District	10-Year Comprehensive Plan	http://www.redlakewatershed.org/planupdate/Final%20Draft/RLWD%2010-yr%20Plan-Atts_5.19.06_mk.pdf
City of Thief River Falls	Source Water Assessment, May, 2003	http://www.redlakewatershed.org/waterquality/Thief%20River%20Falls%20SWA.pdf
MN DNR Reports and Studies		
DNR	Desktop Water Quality Stressor Indicator Report - Thief River Watershed	N/A
DNR	Thief River Watershed Fluvial Geomorphology Report	http://redlakewatershed.org/waterquality/Thief%20R%20Geomorphology%20Report%20Nov2015.pdf
DNR	Watershed Context Report: Thief River	http://files.dnr.state.mn.us/natural_resources/water/watersheds/tool/watersheds/context_report_major_65.pdf
DNR	Watershed Report Card: Thief River	N/A
MPCA Reports and Studies		
MPCA	Thief River Watershed TMDL	https://www.pca.state.mn.us/sites/default/files/wq-iw5-11b.pdf
MPCA	Thief River Watershed WRAPs	https://www.pca.state.mn.us/sites/default/files/wq-ws4-49a.pdf
MPCA	Thief River Watershed Monitoring and Assessment Report	https://www.pca.state.mn.us/sites/default/files/wq-ws3-09020304b.pdf
MPCA	Thief River Watershed Sediment Investigation Final Report	http://www.redlakewatershed.org/waterquality/Thief%20River%20Watershed%20Sediment%20Investigation%20Final%20Report.pdf
NRCS Reports and Studies		

NRCS	**Erosion Sedimentation Sediment Yield Report, April 1996)**	**http://www.redlakewatershed.org/projects/Erosion%20Sedimentation%20Sediment%20Yield%20Report.pdf**
NRCS	Rapid Watershed Assessment: Thief River	https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_022516.pdf
USFWS Reports and Studies		
USFWS	Assessment of Water Quality Conditions: Agassiz National Wildlife Refuge, 2012	https://www.rlwdwatersheds.org/tr-docs
USFWS	Sediment Loading and Sources to Agassiz National Wildlife Refuge, 2011	https://ecos.fws.gov/ServCat/DownloadFile/23527?Reference=24824
USGS Reports and Studies		
USGS	Assessment of Nutrients and Suspended Sediment Conditions in and near the Agassiz National Wildlife Refuge, Northwest Minnesota, 2008-2010	https://pubs.usgs.gov/sir/2012/5112/sir2012-5112.pdf
USGS	Decision Analysis of Mitigation and Remediation of Sedimentation Within Large Wetland Systems – A Case Study Using Agassiz National Wildlife Refuge	https://pubs.usgs.gov/of/2014/1180/pdf/ofr2014-1180.pdf

APPENDIX E:

RESOURCE CONCERN MAPS DATA DICTIONARY

Appendix E: Resource Concern Maps Data Dictionary

Figure 2-4: Groundwater/Drinking Water		
Layer	Source	Link (if available)
Groundwater Contamination Susceptibility	MPCA and Land Management Information Center	https://www.mngeo.state.mn.us/chouse/metadata/gwc.html
Vulnerable Groundwater Area	MDA	https://gisdata.mn.gov/dataset/water-aquifer-vulnerability
Drinking Water Supply Management Area (DWSMA)	MDH	https://gisdata.mn.gov/dataset/water-drinking-water-supply
Wellhead Protection Area (WHPA)	MDH	https://gisdata.mn.gov/dataset/water-wellhead-protection-areas
Figure 2-5: Surface Waters/Aquatic Life and Aquatic Recreation		
Layer	Source	Link (if available)
2016 Assessed Streams	MPCA	https://gisdata.mn.gov/dataset/env-assessed-water-2016
2016 Impaired Streams	MPCA	https://gisdata.mn.gov/dataset/env-impaired-water-2016
DNR Lakes of Phosphorus Sensitivity	DNR	https://gisdata.mn.gov/dataset/env-lakes-phosphorus-sensitivity
Figure 2-6: Surface Waters/Surface Runoff and Flooding		
Layer	Source	Link (if available)
DNR Rivers and Streams	DNR	https://gisdata.mn.gov/dataset/water-measured-kittle-routes
Drainage Ditch	LGUs	N/A
100 yr. Floodplain	FEMA and DNR	https://gisdata.mn.gov/dataset/water-dnr-fema-dfirm
2011 NLCD (National Landuse/Land Cover Dataset)	Multi-Resolution Land Characteristics (MRLC) Consortium	https://gisdata.mn.gov/dataset/biota-landcover-nlcd-mn-2011
Figure 2-7: Surface Waters/Drainage Management Systems		
Layer	Source	Link (if available)
Water Control Structure	LGUs	N/A
Major Rivers	DNR	https://gisdata.mn.gov/dataset/water-measured-kittle-routes
County Ditches	LGUs	N/A

Figure 2-8: Surface Waters/Impoundments and Reservoirs		
Layer	Source	Link (if available)
Water Control Structure	LGUs	N/A
DNR Rivers and Streams	DNR	https://gisdata.mn.gov/dataset/water-measured-kittle-routes
Drainage Ditch	LGUs	N/A
Impoundment Drainage Area	Red Lake Watershed District	N/A
Figure 2-9: Surface Waters/Drinking Water		
Layer	Source	Link (if available)
2016 Impaired Streams	MPCA	https://gisdata.mn.gov/dataset/env-impaired-water-2016
DNR Rivers and Streams	DNR	https://gisdata.mn.gov/dataset/water-measured-kittle-routes
Drainage Ditch	LGUs	N/A
Thief River Falls Source Water Management Area	MDH	N/A
Figure 2-10: Surface Waters/Wetlands		
Layer	Source	Link (if available)
Drainage Ditch	LGUs	N/A
DNR Rivers and Streams	DNR	https://gisdata.mn.gov/dataset/water-measured-kittle-routes
Restorable Wetlands	Ducks Unlimited	https://www.ducks.org/conservation/geographic-information-systems/minnesota-restorable-wetlands
Palustrine Wetlands	DNR and USFWS National Wetlands Inventory (NWI)	https://gisdata.mn.gov/dataset/water-nat-wetlands-inv-2009-2014
Figure 2-11: Fish and Wildlife Habitat and Unique Natural Features/Aquatic Habitat		
Layer	Source	Link (if available)
MPCA IBI Site	MPCA Index of Biological Integrity Sampling Sites	N/A
Water Control Structure	LGUs	N/A
River/Stream	DNR	https://gisdata.mn.gov/dataset/water-measured-kittle-routes
Drainage Ditch	LGUs	N/A
Priority Shallow Lakes	DNR	https://gisdata.mn.gov/dataset/water-shallow-lakes-id-by-wldlif
Wetland Banking Easement	BWSR	https://gisdata.mn.gov/dataset/bdry-wetland-banking-easements

Sites of Biodiversity Significance	DNR Biological Survey	https://gisdata.mn.gov/dataset/biota-mcbs-sites-of-biodiversity
BWSR Conservation Easements	BWSR Reinvest in Minnesota (RIM) Easements	https://gisdata.mn.gov/dataset/bdry-bwsr-rim-cons-easements
Figure 2-12: Fish and Wildlife Habitat and Unique Natural Features/Shoreland and Riparian Zones		
Layer	Source	Link (if available)
Buffer Layers	DNR Buffer Protection Map	https://gisdata.mn.gov/dataset/env-buffer-protection-mn
Public Water Basins with DNR Shoreland Class	DNR Public Waters Basins and Watercourse Delineations	https://gisdata.mn.gov/dataset/water-mn-public-waters
Figure 2-13: Fish and Wildlife Habitat and Unique Natural Features/Terrestrial Habitat		
Layer	Source	Link (if available)
River/Stream	DNR	https://gisdata.mn.gov/dataset/water-measured-kittle-routes
Drainage Ditch	LGUs	N/A
Native Plant Community	DNR	https://gisdata.mn.gov/dataset/biota-dnr-native-plant-comm
Prairie Change Analysis	DNR	https://gisdata.mn.gov/dataset/env-prairie-change-analysis-2008
State Forest Plan Area	DNR	https://gisdata.mn.gov/dataset/bdry-state-forest
State Forest	DNR	
Other Forest Land	DNR	
Wildlife Management Area	DNR	https://gisdata.mn.gov/dataset/bdry-dnr-wildlife-mgmt-areas-pub
National Wildlife Refuge	USFWS	https://www.fws.gov/gis/data/CadastralDB/index_cadastral.html?q=Realty&sort=none&metadata_type=geospatial&organization=fws-gov&ext_location=&ext_bbox=&ext_prev_extent=-142.03125,8.754794702435605,-59.0625,61.77312286453148#sec-tags
BWSR Conservation Easements	BWSR Reinvest in Minnesota (RIM) Easements	https://gisdata.mn.gov/dataset/bdry-bwsr-rim-cons-easements
Sites of Biodiversity Significance	DNR Biological Survey	https://gisdata.mn.gov/dataset/biota-mcbs-sites-of-biodiversity
Figure 2-14: Local Development and Land Stewardship/Healthy Urban Landscapes		
Layer	Source	Link (if available)
River/Stream	DNR	https://gisdata.mn.gov/dataset/water-measured-kittle-routes

Drainage Ditch	LGUs	N/A
Wastewater	MPCA	https://gisdata.mn.gov/dataset/util-wastewater-facilities
2011 NLCD (National Landuse/Land Cover Dataset)	Multi-Resolution Land Characteristics (MRLC) Consortium	https://gisdata.mn.gov/dataset/biota-landcover-nlcd-mn-2011
Figure 2-15: Local Development and Land Stewardship/Healthy Rural Landscapes		
Layer	Source	Link (if available)
Public Water Access Site	DNR	https://gisdata.mn.gov/dataset/loc-water-access-sites
Highly Erodible Land	BWSR	N/A
River/Stream	DNR	https://gisdata.mn.gov/dataset/water-measured-kittle-routes
Drainage Ditch	LGUs	N/A
Cropland Data Layer 2015	USDA NRSC National Agricultural Statistics Service	https://www.nass.usda.gov/Research_and_Science/Cropland/Release/

APPENDIX F:
PRIORITIZATION OF ISSUES

Appendix F: Thief River One Watershed One Plan Prioritization Matrix

Prioritization of Issues

The "Prioritization Matrix" is a categorized table that lists the issues that were compiled for the Thief River watershed, results of the public meeting input process, and prioritization of issues based on public input and professional judgement. The table is the product of the following process.

1. HEI worked with all the project partners and advisors to compile and edit a list of issues for the watershed that was eventually approved by the TR1W1P Policy Committee.
2. Agency and public attendees of the January 9-10, 2018 public meetings used color-coded dots to provide input on the issues that they deemed most important. Agency staff used blue dots. Public attendees used orange dots. After the public meetings HEI tallied the number of blue and orange dots for each issue. **See Table 2-3.**
3. HEI ranked the issues based upon the total number of dots, blue and orange, that each issue received (Note: orange dots outnumbered blue dots at a ratio of 3.18:1). Percentiles (70th and 40th) were used as break-points between four categories ("A", "B", "C", and "unranked"). Category "A" includes the projects that are the highest priority in the watershed. These are the first issues to be addressed with projects in the watershed. Categories "A" and "B" will both be assigned measurable goals. Category C priorities were not assigned implementation actions directly.
4. The Planning Work Group (PWG) had a very productive discussion of each issue during a 2/8/2018 phone conference. Issues were moved up or down in the ranks based on the professional judgement of the group. Changes were only made if there was justification for making a change. The group was in unanimous agreement on nearly all of the issues. Sixteen of the issues were adjusted. Thirty of the issues remained in the category given to them as a result of the public meetings. Of the sixteen issues that were adjusted, nine issues were moved up to the next highest category, and six issues were moved down to the next lowest category. One issue (4.1.4) received an adjustment greater than one category (A to C).
5. Issues that received zero dots were not ranked or placed into prioritization categories. They will be, instead, described separately as issues that could become priorities in the future.
6. For the issues that were adjusted, this appendix provides the justification for the adjustment, and the plan maintains recognition of the amount of dots each issue received at the public meetings.

The Advisory Committee requested a narrative justification for each of the adjustments that the PWG made to the prioritization matrix. The following list of issues are those that were adjusted by the PWG. Each individual issue was discussed by the group. Adjustments were not made without justification. Most of the issues (>65%) remained in the same category that was assigned to them based on the total number of dots received at the public meetings.

Issues highlighted in yellow were recommended a higher priority by the PWG. Issues highlighted in gray were recommended a lower priority by the PWG.

- 1.1.1: Water Quality: Protection of generally good quality groundwater supplies from elevated levels of nitrates, arsenic, or other contaminants which if excessive can result in implications to human health and treatment costs for public and private wells. Protection is particularly important in vulnerable DWSMAs.
    - Reasons for the move from A to B:
        - The quality of groundwater is good

        - There are no known problems with high nitrates in drinking water in this watershed.
        - Clay soils in this area likely help keep nitrates out of the groundwater.
        - There was a lack of plans or ideas for projects that could directly affect this issue and produce measurable results.
        - The high rank is not currently justified by monitoring data.
        - Well sealing projects are addressed as they come in to the SWCD offices. It is already an ongoing program.
        - More information and monitoring is needed (Issue 1.1.2 is currently priority B)
        - Projects that get implemented for other priority issues will have multiple benefits including the protection of groundwater supplies from nitrates and other contaminants.
    - Reasons to keep it in A
        - The number of dots that it received (4th most).
        - Put a greater emphasis on "selling" the well sealing program
- 4.1.3 Increase regular input from stakeholders to guide future efforts related to this plan.
    - Reasons for the move from A to B
        - Because of stakeholder involvement in the development of the 1W1P, we won't necessarily need to address this issue immediately. It can be addressed later, after some projects have been completed.
- 4.1.4: Need for recognition of the fiscal impact of agricultural, conservation practices, and other economically important land uses in the context of individual landowners, taxpayers, and government entities that could be addressed through education, fiscal benefits, and incentives.
    - Reasons for move from A to C
        - How do we tackle this?
        - Secondary issue
        - Difficult to understand the meaning of the text – clarify with the author
        - Ongoing issue that covers multiple agencies
        - Part of this issue can be addressed through this planning process by identifying the cost/benefit of conservation practices
        - SWCDs and RLWD provide ongoing education and outreach to the public
    - Reasons to keep in A or B
        - Input from the kickoff meeting indicates it could be placed in B.
    - Other notes
        - Public input may have been a reaction to the Buffer Law.

Issues 2.1.1, 2.6.1, 3.1.3, 5.2.3 are recommended to be moved from B to A. The initial cut-off for priority "A" issues was at 80% and the PWG recommends moving the cut-off to 70% to include these four issues.

- 2.1.1: Water Quality: Elevated concentrations of suspended solids, sediment, and total phosphorus approaching (protection) or exceeding (restoration) water quality standards for aquatic life, which can lead to aquatic life impairments.
    - Reasons to move from B to A
        - Connected to 2.3.1 (erosion and sedimentation, the top vote-getting issue)
        - The Thief River is impaired for TSS from Agassiz to Thief River Falls
        - Mud River is listed as a potential impairment for Phosphorus
        - Moose River is listed as nearly impaired for Phosphorus

- 2.6.1: Sediment deposition in wetlands degrades hydrologic function, contributes to nonnative plant species succession, and contributes to sediment and highly organic/low dissolved oxygen water to downstream waterways.
    - Reasons to move up from B to A
        - Connected to 2.3.1 (erosion and sedimentation, the top vote-getting issue)
        - Mud River is impaired for DO
        - Moose River is impaired for DO
        - TSS Impairment on the Thief River from Thief River to Agassiz
- 3.1.3: Degradation of aquatic habitat, aquatic vegetation, and riparian habitat associated with increased drainage, channelization, ditch maintenance, and development, and the physical damage to the banks and beds of creeks, streams and rivers from higher and faster flows pose to public lands and waters management challenges.
    - Reasons to move up from B to A
        - Connected to 2.3.1 (erosion and sedimentation, the top vote-getting issue)
        - Streambank stabilization projects are high priority projects to implement
        - The major source of sediment yielded to streams and ditches is from streambank and ditch bank erosion (63% Erosion Sedimentation Sediment Yield Report 1996)
- 5.2.3: Improperly installed or poorly functioning subsurface sewage treatment systems (SSTS) and individual sewage treatment system (ISTS) increase the potential for ground and surface water contamination, adversely impacting human health and water quality.
    - Reasons to move up from B to A
        - Mud River is impaired for E. Coli
        - Supported by data.
        - SWCDs have been seeking and receiving grant funding for projects that address this issue.
        - Marshall County is planning a grant application.
        - Action is part of current and near-future plans
- 3.3.2: Presence of noxious weeds threatening the quality of native plant communities.
    - Reasons to move down from B to C
        - Discussion focused on the lack of known noxious weed problems in the Thief River watershed.
    - Reasons to keep at B
        - There are noxious weed problems in neighboring watersheds…prevention and protection are important.
- 2.1.2: Water Quality: Elevated concentrations of bacteria approaching (protection) or exceeding (restoration) water quality standards for aquatic recreation, which can impact beneficial uses.
    - Reasons to move up from B to A
        - The Mud River *E. coli* impairment should be a high priority for restoration efforts. Nearly restored. This will likely be one of the first areas that we target for projects.
        - Sources have been identified. Areas can be targeted.
        - Immediate and potentially severe health effects from E. *coli* bacteria
- 5.1.3: Point sources and their impact on surface water quality.
    - Reasons to move down from B to C
        - Grygla and Goodridge are the only wastewater treatment facilities.
        - Wastewater treatment facilities are regulated by the state (MPCA), not local agencies

- 5.2.5: Frequency of use and public access to quality outdoor recreation experiences.
    - Reasons to move down from B to C
        - Lack of locations that have been identified as places that need improved access.
- 2.1.3: Water Quality: Reduced concentrations of dissolved oxygen approaching (protection) or exceeding (restoration) tolerable levels that can affect the diversity of quality of aquatic life.
    - Reasons to move up from C to B
        - There are two dissolved oxygen impairments in the watershed that we will need to address
        - Water quality data analysis for the Protection and Restoration section indicates that the DO impairments should be priorities.
- 4.1.1: Increase public awareness and knowledge of water management issues including general citizens down through school aged children.
    - Reasons to move up from C to B
        - Ongoing education activities in each of the Counties and SWCDs
        - RLWD is also involved with ongoing public education activities
- 4.2.1: Information needed to understand baseline conditions for resources to better inform management decisions.
    - Reasons to move up from C to B
        - Data collection is very important.
        - There will likely be a monitoring plan in the 1W1P (WRAPS monitoring plan + additional monitoring).
        - Important to measure progress of goals and actions identified in the plan
        - Ongoing work (RLWD and Pennington SWCD long-term monitoring, USFWS monitoring)
- 2.1.6: Aquatic Life use assessments needed for channelized reaches now that Tiered Aquatic Life Use (TALU) standards are in place.
        - Dropped from rankings as this is a task that will be undertaken by the MPCA irrespective of this plan. Therefore, it was determined that it does not need to be listed as a priority.

Table XXX: Priority Issues – Public Input Ranking.

ISSUE	Agency Input	Public Input	*Total*	% Rank Agency	% Rank Public	*% Rank TOTAL*	Original Category
2.3.1: Increased erosion and sedimentation resulting from bank failure and slumping, and gully formation prevents the proper function of drainage systems and increases maintenance costs.	3	81	*84*	0.64	1	*1*	A
2.2.2: Water Quantity: High peak flows causing flood damages to agricultural land and public infrastructure, homes and other structures, rerouted flows, and accelerated bank erosion to artificial and natural waterways; low flows which can impact aquatic life and aquatic recreation.	4	24	*28*	0.8	0.95	*0.97*	A
2.2.1: Water Quantity: Changes in natural water storage and vegetative cover on the landscape, including natural depressional areas, wetlands, loss of vegetative cover and soil organic matter, which can cause an Increase in the volume of runoff, peak discharges, and water levels, causing flooding and flood damages to agricultural land, wildlife habitat, transportation systems, and building and structures.	1	26	*27*	0.37	0.97	*0.95*	A
1.1.1: Water Quality: Protection of generally good quality groundwater supplies from elevated levels of nitrates, arsenic, or other contaminants which if excessive can result in implications to human health and treatment costs for public and private wells. Protection is particularly important in vulnerable DWSMAs.	6	18	*24*	0.88	0.93	*0.93*	A

ISSUE	Agency Input	Public Input	*Total*	% Rank Agency	% Rank Public	*% Rank TOTAL*	Original Category
5.2.1: Reduced soil health, soil protection, excess loss of fertilizers or pesticides, and its impact on agricultural productivity, surface water quality and quantity, sedimentation in water features, and water holding capacity.	6	16	*22*	0.88	0.91	*0.91*	A
2.5.1: Water Quality: Elevated concentrations of sediment, and organic matter have a detrimental impact on drinking water quality.	11	10	*21*	1	0.8	*0.88*	A
3.2.1: Quantity and quality of vegetation along waterways, including riparian forests and buffers along ditches in shorelines, that filter pollutants, retain soil, improve water quality, and restore wildlife habitat.	2	15	*17*	0.51	0.86	*0.86*	A
4.1.3: Increase regular input from stakeholders to guide future efforts related to this plan.	0	15	*15*	0	0.86	*0.84*	A
2.1.7: Water Quality: Decreased stream channel stability driven by hydrologic changes that increase erosion and sediment transport, which can decrease beneficial uses of streams, rivers, and lakes.	2	11	*13*	0.51	0.82	*0.82*	A
4.1.4: Need for recognition of the fiscal impact of agricultural, conservation practices, and other economically important land uses in the context of individual landowners, taxpayers, and government entities that could be addressed through education, fiscal benefits, and incentives.	1	11	*12*	0.37	0.82	*0.8*	A

ISSUE	Agency Input	Public Input	*Total*	% Rank Agency	% Rank Public	*% Rank TOTAL*	Original Category
2.1.1: Water Quality: Elevated concentrations of suspended solids, sediment, and total phosphorus approaching (protection) or exceeding (restoration) water quality standards for aquatic life, which can lead to aquatic life impairments.	8	3	*11*	0.95	0.35	*0.73*	A
2.6.1: Sediment deposition in wetlands degrades hydrologic function, contributes to nonnative plant species succession, and contributes to sediment and highly organic/low dissolved oxygen water to downstream waterways.	10	1	*11*	0.97	0.2	*0.73*	A
3.1.3: Degradation of aquatic habitat, aquatic vegetation, and riparian habitat associated with increased drainage, channelization, ditch maintenance, and development, and the physical damage to the banks and beds of creeks, streams and rivers from higher and faster flows pose public lands and waters management challenges.	5	6	*11*	0.86	0.71	*0.73*	A
5.2.3: Improperly installed or poorly functioning subsurface sewage treatment systems (SSTS) and individual sewage treatment system (ISTS) increase the potential for ground and surface water contamination, adversely impacting human health and water quality.	4	6	*10*	0.8	0.71	*0.71*	A
1.1.2: Water Quality: A limited amount of data available for nitrate, arsenic, and other types of groundwater contamination, which can lead to poorly informed management decisions.	2	7	*9*	0.51	0.75	*0.66*	B
5.1.1: Downstream water quality consequences from stormwater runoff due to increased	0	9	*9*	0	0.77	*0.66*	B

ISSUE	Agency Input	Public Input	*Total*	% Rank Agency	% Rank Public	*% Rank TOTAL*	Original Category
impervious surface area around water bodies such as lake, streams, and wetlands.							
5.2.2: Increased sheet, rill, and wind erosion, and its impact on agricultural productivity, surface water quality, and deposits in drainage systems.	6	2	*8*	0.88	0.31	*0.64*	B
2.4.1: Increased erosion and sedimentation resulting in reduced storage capacity, invasive species takeover, and ultimately, wildlife habitat degradation.	3	4	*7*	0.64	0.46	*0.62*	B
2.6.2: Wetlands have been altered or drained for agricultural production, resulting in a loss of wildlife habitat and temporary water storage on the landscape.	2	4	*6*	0.51	0.46	*0.53*	B
3.1.1: Modification of waterways, culverts, and dams at impoundment outlets reduce hydrologic connectivity and altered the flow regime resulting in the reduced potential of waterways to support quality fish populations.	3	3	*6*	0.64	0.35	*0.53*	B
3.3.2: Presence of noxious weeds threatening the quality of native plant communities.	2	4	*6*	0.51	0.46	*0.53*	B
5.1.4: High levels of E. coli in water monitoring data at stormwater outlets in Thief River Falls, which can impact the beneficial use of downstream resources.	1	5	*6*	0.37	0.6	*0.53*	B
2.1.2: Water Quality: Elevated concentrations of bacteria approaching (protection) or exceeding (restoration) water quality standards for aquatic recreation, which can impact beneficial uses.	2	3	*5*	0.51	0.35	*0.4*	B

ISSUE	Agency Input	Public Input	*Total*	% Rank Agency	% Rank Public	*% Rank TOTAL*	Original Category
2.2.3: Regional and basin wide flood issues that might not be addressed by local actions, which can impact local infrastructure, natural resources, agricultural lands and communities.	0	5	*5*	0	0.6	*0.4*	B
3.3.1: Increased habitat fragmentation and loss of habitat providing food, shelter, terrestrial ecological corridors, and breeding territory for both protected (e.g. endangered, threatened, special concern, and Species of Greatest Conservation Need) and unprotected species.	0	5	*5*	0	0.6	*0.4*	B
5.1.3: Point sources and their impact on surface water quality.	0	5	*5*	0	0.6	*0.4*	B
5.2.4: The impact of feedlots on surface and groundwater quality.	0	5	*5*	0	0.6	*0.4*	B
5.2.5: Frequency of use and public access to quality outdoor recreation experiences.	1	4	*5*	0.37	0.46	*0.4*	B
2.1.3: Water Quality: Reduced concentrations of dissolved oxygen approaching (protection) or exceeding (restoration) tolerable levels that can affect the diversity of quality of aquatic life.	3	1	*4*	0.64	0.2	*0.26*	C
2.3.2: Water Quantity: Changes in the timing and magnitude of runoff delivery related to drainage management systems and the effects on surface runoff, which impacts flooding, ditch maintenance, wildlife habitat, and agricultural productivity.	0	4	*4*	0	0.46	*0.26*	C
2.3.3: Altered Hydrology: Extreme flow fluctuations, peak discharges, erosion and sedimentation from bank failure, slumping, and gully formation, and stream instability, as a result of changes in watershed hydrology.	4	0	*4*	0.8	0	*0.26*	C

ISSUE	Agency Input	Public Input	*Total*	% Rank Agency	% Rank Public	*% Rank TOTAL*	Original Category
2.4.2: Need for increased coordination for management of waters released from impoundments and reservoirs needed to balance interests of natural resources management, agricultural productivity, and flood damage reduction.	3	1	*4*	0.64	0.2	*0.26*	C
2.4.3: Levels controlled by water control structures and its impact on aquatic life, development, recreation, and the local economy.	0	4	*4*	0	0.46	*0.26*	C
2.5.2: Water Quality: Protect surface water intakes, the inner-emergency response area, and outer source water management area from potential contaminants and sediment to protect the source and quality of drinking water.	3	1	*4*	0.64	0.2	*0.26*	C
2.1.4: Water Quality: Elevated concentrations of nitrate-nitrite and ammonia approaching (protection) water quality standards for aquatic life, which can impact the beneficial uses of the water body.	0	3	*3*	0	0.35	*0.2*	C
2.3.4; Nitrates entering tile drainage and impacting aquatic life and drinking water supplies of downstream resources.	0	3	*3*	0	0.35	*0.2*	C
4.1.1: Increase public awareness and knowledge of water management issues including general citizens down through school aged children.	3	0	*3*	0.64	0	*0.2*	C
4.2.1: Information needed to understand baseline conditions for resources to better inform management decisions.	1	1	*2*	0.37	0.2	*0.15*	C
5.1.2: The frequency of flooding and its impact on commercial, residential and infrastructure areas.	0	2	*2*	0	0.31	*0.15*	C

ISSUE	Agency Input	Public Input	*Total*	% Rank Agency	% Rank Public	*% Rank TOTAL*	Original Category
2.1.6: Aquatic Life use assessments needed for channelized reaches now that Teared Aquatic Life Use (TALU) standards are in place.	1	0	*1*	0.37	0	*0.13*	C
1.1.3: Water Quality: Current and future land use (and associated potential contaminants) can negatively impact DWSMAs and groundwater recharge areas. Protection is particularly important in vulnerable DWSMAs.	0	0	*0*	0	0	*0*	Unranked
2.1.5: Water Quality: Biochemical oxygen demand and dissolved oxygen fluctuation approaching (protection) or exceeding (restoration) water quality standards for aquatic life, which can impact beneficial uses of the water body.	0	0	*0*	0	0	*0*	Unranked
2.1.8: Elevated concentrations of algal toxins that can impact aquatic life and aquatic recreation uses.	0	0	*0*	0	0	*0*	Unranked
2.5.3: Water Quality: Excess hydrogen sulfide gas resulting in foul odors during certain winter conditions.	0	0	*0*	0	0	*0*	Unranked
3.1.2: Elevated nutrient loads coming into aquatic habitat contribute to algal blooms as well as the growth of invasive species (e.g., hybrid cattail).	0	0	*0*	0	0	*0*	Unranked
4.1.2: Engage citizen participation in sampling and data collection in standardized monitoring program.	0	0	*0*	0	0	*0*	Unranked

APPENDIX G:

USING RESTORATION AND PROTECTION STRATEGIES TO ACHIEVE MEASURABLE GOALS

Appendix G: Using Restoration and Protection Strategies to Achieve Measurable Goals

This section will provide information that will help with setting goals and planning projects that will restore and protect water quality and aquatic habitat in the Thief River watershed. It uses water quality and biological data to categorize and identify waters that need restoration and protection efforts. Restoration efforts are applied to streams that are included in the Draft 2018 List of Impaired Waters. Actions will be taken to improve conditions in those streams so that they meet water quality standards in future assessments. Protection efforts are directed at streams that are not on the most recent impaired waters list but need improvement to prevent future impairments.

Assessment statistics (exceedance rate, for example) for total suspended solids (TSS), *E. coli* bacteria, dissolved oxygen (DO), total phosphorus (TP), biochemical oxygen demand (BOD), chlorophyll-a, fish index of biological integrity (F-IBI), and macroinvertebrate index of biological integrity (M-IBI) were compared to impairment thresholds and other statistical benchmarks. Waterways were categorized according to the proximity of their current condition to the impairment threshold. For example, a reach that was exceeding the TSS standard in 8.1% of samples was within 2 percentage points of becoming impaired. That reach should be a high priority for protection efforts because it is nearly impaired. River, stream, and ditch reaches were categorized into four restoration and protection classes:

1. Restoration
2. Potential Impairment
3. Nearly Impaired
4. Highest Quality

A total of 4 water quality impairments have been formally identified on 3 separate reaches for 3 different parameters within the Thief River watershed. Those reaches of the Thief River, Mud River, and Moose River will all be categorized as streams that need **restoration** efforts. Due to the small number of impairments in the watershed, only one category was needed to classify the watershed's impaired waters. Unimpaired waterways in the Thief River watershed fell into three different categories. There were some waters that failed to meet state water quality standards but were not formally listed as impaired by the state. Data indicates that there is a high potential for these reaches to be listed as impaired after the next assessment (2023). A stream (usually a channelized stream or a ditch) that was not currently listed as impaired on the Draft 2018 List of Impaired Waters but failed to meet standards was classified as a waterway with a **potential impairment**. Streams that were **nearly impaired** met a water quality standard but were relatively close to impairment threshold. Degradation of water quality could result in future impairments on those reaches. The **highest quality** waterways are those that met water quality standards by a relatively wide margin. There is no immediate concern that the highest quality reaches may become impaired, but protection is still recommended to prevent degradation of water quality.

The MPCA conducts a formal assessment of surface waters in each major watershed once every ten years. Each waterbody's ability to support aquatic life and aquatic recreation is assessed. Typically, these assessments use data that has been collected throughout the most recent ten years. Each parameter is assessed separately, and it is possible for a stream to have the highest quality statistics for one designated use (e.g., aquatic life) while being impaired for another use (e.g., aquatic recreation). The Thief River watershed was formally assessed by the MPCA in 2013. All the watershed's assessment units with sufficient data were assessed, but aquatic life impairments on channelized reaches were deferred until TALU water quality standards were in place. The TALU water quality standards were formally adopted in 2015.

An updated, informal assessment was completed for the Thief River WRAPS and 1W1P. Assessment statistics for water chemistry were calculated using the same methods that are used by the MPCA. Those methods can be found in the most recent version of the MPCA's *Guidance Manual for Assessing the Quality of Minnesota Surface Waters for Determination of Impairment: 305(b) Report and 303(d) List*. The updated assessment statistics (2007-2016 data) were used to guide the categorization of waterways for restoration and protection.

The clarity of water in Thief River was assessed in 2013 using turbidity data. One reach of the Thief River failed to meet the 25 NTU standard (09020304-501). Since that assessment, regional total suspended solids (TSS) standards have been established. MPCA documents indicate that the 30 mg/L TSS standard of the Central River Nutrient Region has been applied to much of the Thief River watershed. That standard provides a level of protection that is similar to the formerly-used 25 NTU standard. The east-to-west flowing streams of the watershed begin in the North River Nutrient Region and flow into the South River Nutrient Region. There is evidence that suggests that the 15 mg/L North River Nutrient Region standard may be more appropriate for those rivers and ditches. The MPCA river nutrient region maps have shown that the North River Nutrient Region (15 mg/L standard) encompassed the Moose River. Every one of those east-to-west flowing streams either meets the 15 mg/L TSS standard of that region or has met that standard recently. Multiple studies have found that sediment from the Mud River (one of those east-to-west flowing streams) has caused degradation of habitat within Agassiz Pool. Although the east-to-west flowing streams and ditches were not assessed in 2013 due to channelization, there were biological sampling results in both rivers that failed to meet expectations. Those poor biological scores indicate that current conditions in the stream are inadequate for aquatic life. Excess sediment would likely be a potential stressor of aquatic life in the Mud River, along with low DO and altered hydrology, if a stressor identification study was conducted for the watershed. Data shows that degradation would need to occur for most of the east-to-west flowing reaches to exceed the 15 mg/L standard and even more degradation would need to occur for the 30 mg/L standard to be exceeded. Local planning efforts strive to improve and protect water quality, rather than allow for degradation. Therefore, with support from professionals on the PWG, North River Nutrient Region standards for TSS were applied to east-to-west flowing streams in the Thief River watershed. These expectations may differ from the standards that the MPCA uses in the next assessment, but they provide appropriate benchmarks that will aid local planning efforts and help local planners set measurable goals.

If a waterway has exceeded its respective TSS standard in >10% of days (April through September) at the time of a formal assessment, it is typically listed as impaired on the next Draft 303(d) List of Impaired Waters. The impaired portion of the Thief River (09020304-501) is on the Draft 2018 List of Impaired Waters and was therefore placed into the **restoration** category. The updated, informal assessment found one stream in which assessment statistics have recently worsened, raising its exceedance rate above 10%. That reach of the Mud River was placed in the **potential** impairment category. Protection consideration should be given to reaches that have rates of exceedance that are within 2.5 percentage points of the threshold (**nearly impaired)**. Mud River itself is listed as "Nearly Impaired" within this plan, despite the single reach exceeding TSS standards. Efforts should be made to ensure that these reaches do not become impaired in the future. Other streams that exceeded their respective standards at a relatively low frequency were placed into the **highest quality** category.

E. coli bacteria is sampled to assess whether a waterbody supports safe aquatic recreation or not. The MPCA has established acute (1,260 MPN/100ml) and chronic (126 MPN/100ml monthly geometric mean) standards for *E. coli*. For this assessment and categorization process, monthly geometric means from data collected in 2007 through 2016 were calculated and compared to the standard. The Mud River was the only stream that was currently listed on the Draft 2018 List of Impaired Waters and included in the **restoration** category. The 2007-2016 data did not reveal any other potential *E. coli* impairments in the watershed. A statistical benchmark at 75% of the chronic standard (0.75*126 MPN/100ml = **94.5 MPN/100ml**) was used to separate **nearly impaired** waterways (94.5 – 126 MPN/100ml) from the **highest quality** (<94.5 MPN/100ml) waterways.

Aquatic life needs dissolved oxygen to thrive. The 5 mg/L daily minimum MPCA standard applies to the waterways of the Thief River watershed. If a reach of a stream falls below that threshold on at least 10% of the days in which it was measured, it is impaired by low DO. Although DO was assessed by the MPCA and some waterways failed to meet standards, many of those potential impairments were deferred (due to channelization) until the adoption of TALU standards. The Moose River and Mud River are listed as impaired by low DO on the Draft 2018 List of Impaired Waters and are the only streams in the **restoration** category. Some waterways failed to meet the DO standard but were not included in the Draft 2018 List of Impaired Waters (often due to deferment of channelized streams and ditches). There is a strong possibility that those waterways could be listed as impaired when the next formal assessment is completed. Those waterways were placed in the **potential impairment** category. Dissolved oxygen concentrations within a waterbody fluctuate throughout a day. It increases during the daylight hours due to photosynthesis and decreases at night. At night, photosynthesis decreases while consumption of DO (respiration, decomposition, oxidation) continues. Most discrete measurements (collected in person) are recorded during working hours, during the daytime while DO concentrations are on the rise. If 5% or more of those discrete measurements are lower than 5 mg/L, then that is a sign that the stream is **nearly impaired.** A relatively small number of low measurements could cause the stream to exceed the impairment threshold. There also is a good chance that continuous DO data could indicate an impairment of that reach and cause the waterway to be placed on a future list of impaired waters if 5% of the discrete values are lower than 5 mg/L. The **highest quality** streams are those that rarely failed to maintain at least 5 mg/L of DO.

Total phosphorus is the primary (cause indicator) parameter that is used for the assessment of river eutrophication (excess algae and plant growth due to excess nutrients). Instead of the exceedance rate that is used for other parameters, a growing season mean (June through September) is calculated and compared to an impairment threshold. To designate a **potential impairment**, a reach needed to exceed the TP standard and at least one of the response variable standards. Those response variables are biochemical oxygen demand (BOD), chlorophyll-a, and daily DO fluctuation (DO flux). The level of protection for a stream differs by location in the state. There are three river nutrient regions (north, central, and south). The MPCA has assigned the Thief River to the Central River Nutrient Region (100 µg/L, which equals 0.1 mg/L), but has not formally assessed the watershed for river eutrophication. River eutrophication standards were not officially adopted and approved by the EPA until January 23, 2015, after the 2013 assessment process was completed. Based upon feedback from professionals in the PWG, the North River Nutrient standard for TP (50 µg/L, which equals 0.05 mg/L) was applied to east-to-west flowing streams and ditches, as it was for the TSS assessment. The 0.1 mg/L Central River Nutrient Region standard is still applied to the Thief River and tributaries that enter it from the west.

The MPCA has not yet formally assessed aquatic biology throughout most of the Thief River watershed. Only stations 11RD031 and 05RD097 were assessible in 2013, the rest were deferred due to channelization. The MPCA anticipates that the agency will conduct an official assessment of these waters using MPCA's TALU methods and a use attainability analysis during the 2018-19 winter season. The agency has already collected biological data, calculated fish and macroinvertebrate index of biological integrity (IBI) scores, and classified waterways in this watershed. Biological data, information, and assessment methods are currently available in published reports and can be used for local planning. Published MPCA IBI scores, classifications, impairment thresholds, and confidence limits were used to perform an informal assessment of biological data to assist in setting priorities for this 1W1P. The methods used for the informal assessment were very similar to the methods that have been used by the MPCA in recent formal assessments. The results of this informal assessment are based solely upon data, however, and have not been subjected to the official use attainability analysis, watershed assessment team, professional judgement group, and public reviews that would occur during a formal assessment by the MPCA. It also exceeds the scope of recent formal assessments by identifying streams that are nearly impaired and in need of protection to prevent future impairment due to low fish IBI (F-IBI) or macroinvertebrate IBI (M-IBI) scores.

This informal assessment used published information to assign impairment thresholds to each reach. Fish and macroinvertebrate scores and stream classes were obtained from Appendix 5.1 of the *Thief River Watershed Monitoring and Assessment Report*. Impairment thresholds and confidence limits are based upon statewide IBI thresholds and confidence limits that are listed in the appendices of Watershed Monitoring and Assessment Reports that have been written after the adoption of TALU standards (Appendix 3.1 of the *Clearwater River Watershed Monitoring and Assessment Report*, for example). Compared to water chemistry assessments, IBI assessments are more complicated. Reaches are assigned impairment thresholds that differ by stream class and by "use attainment." The MPCA assigned stream classes to Thief River streams but official "use attainment" classifications were not available. Generally, a biological community at a sampling station is assigned an impairment threshold based upon the best use that the waterway has attained and by characteristics of the stream. For each stream class, impairment thresholds have been established by the MPCA for exceptional use (highest standard), general use (the default), and modified use (channelized streams and artificial watercourses, lowest standard). Impairment threshold assignments (modified, general, or exceptional) are influenced by the highest attained use for a stream AUID. Those factors were considered when choosing an impairment threshold for this informal assessment. If a station on a channelized reach failed to meet the general use threshold, it was assigned the respective, modified use threshold. This protocol is based upon the methods that were described in MPCA TALU documents. There was one station (11RD040 on the SD 83 portion of the Thief River) for which fish/invert classes were not listed in the WMA report. The classes from the next upstream AUID (504) were used.

The MPCA considers confidence limits when conducting biological assessments. Those confidence limits represent ranges of values surrounding (plus/minus) each IBI impairment threshold. If a stream exceeds the impairment threshold by an amount greater than the confidence limit, then there is a relatively high level of confidence that the stream is meeting the standard. If a stream falls below the lower confidence limit, there is a sufficient degree of confidence that the stream is not meeting the IBI standard. Streams with IBI scores that are near enough to the impairment threshold to be within the boundaries set by the confidence limits have a more uncertain status. Approximate average confidence limits for F-IBIs (+/- 10 points) and M-IBI (+/- 13.5 points) were calculated for the watershed in order to create consistent statistical thresholds for classifying reaches. The differences between IBI scores and impairment thresholds were calculated and compared to those confidence limits.

1. **Potentially impaired** waterways are those with an IBI score that fell far below expectations. There are no official biological impairments because TALU standards were not adopted at the time of the 2013 assessment. Potentially impaired waterways produced poor F-IBI scores that failed to reach the impairment threshold by a margin of at least 10 points or poor M-IBI scores that failed to reach the impairment threshold by a margin of at least 13.5 points. These reaches would likely be listed as impaired if they were formally assessed by the MPCA.
2. **Nearly impaired** waterways are those with an F-IBI score that is within 10 points of the impairment threshold (plus or minus) or an M-IBI score that is within 13.5 points of the

impairment threshold. The IBI scores for these streams are relatively close to their respective impairment thresholds. The future formal impairment status of these streams is relatively uncertain and could be affected by changes in the watershed.

3. **Highest quality** waterways are those that exceeded expectations by a significant amount. They produced high F-IBI scores that exceeded the impairment threshold by a margin of at least 10 points or high M-IBI scores that exceeded the impairment threshold by a margin of at least 13.5 points.

To simplify goals for improving in-stream habitat and water quality conditions for aquatic life, the results of the F-IBI and M-IBI assessments were combined into one category for the classification of streams. The index of biotic integrity classification table and maps show the worst (most degraded) fish or macroinvertebrate community that was sampled along each specific reach. For example, AUID 09020304-504 of the Thief River has an F-IBI that fell into the “nearly impaired” classification and an M-IBI that fell into the “highest quality” classification. The “nearly impaired” classification represented the most degraded condition that was found along that reach and was used classification of that reach.

APPENDIX H:
PLANNING REGION
PRIORITIZATION PROCESS

Appendix H: Planning Region Prioritization Process

Tier A Issues	Lower Thief	JD 30/18/13	Marshall CD 20	Lost River	Middle Thief	Upper Thief	Mud River	Moose River	Comments
2.1.1: Water Quality: Elevated concentrations of suspended solids, sediment, and total phosphorus approaching (protection) or exceeding (restoration) water quality standards for aquatic life, which can lead to aquatic life impairments. (Sediment)	X						X		Based on Protection and Restoration Categories like the goals. Sediment and Phosphorus counted separately (Sediment in this row, Phosphorus in row below).
2.1.1 (Phosphorus)	X	X	X	X	X	X	X	X	All of the planning regions had reaches that were in either the nearly impaired or potential impairment categories. All reaches have P reduction goals.
2.1.2: Water Quality: Elevated concentrations of bacteria approaching (protection) or exceeding (restoration) water quality standards for aquatic recreation, which can impact beneficial uses.	X						X	X	Section 3 only has a goal for the 1 impairment - Mud River. Thief River is nearly impaired - probably should have had a goal in Section 3. Branch A of JD21 used to be impaired and fell into the nearly impaired category - probably should have had

Tier A Issues	Lower Thief	JD 30/18/13	Marshall CD 20	Lost River	Middle Thief	Upper Thief	Mud River	Moose River	Comments
									reduction goal for that reach, too. This comment was addressed an the relevant sections updated.
2.1.7: Water Quality: Decreased stream channel stability driven by hydrologic changes that increase erosion and sediment transport, which can decrease beneficial uses of streams, rivers, and lakes.	X	X	X			X	X	X	Areas with high BANCS estimates. JD3 30/18/13 was not assessed with the BANCS model but was included because of known issues documented by LGU staff.
2.2.1: Water Quantity: Changes in natural water storage and vegetative cover on the landscape, including natural depressional areas, wetlands, loss of vegetative cover and soil organic matter, which can cause an Increase in the volume of runoff, peak discharges, and water levels, causing flooding and flood damages to agricultural land, wildlife habitat, transportation systems, and building and structures.	X	X	X	X					Based on Distributed Detention Study priority areas for storage. Directly related to goal.

Tier A Issues	Lower Thief	JD 30/18/13	Marshall CD 20	Lost River	Middle Thief	Upper Thief	Mud River	Moose River	Comments
2.2.2: Water Quantity: High peak flows causing flood damages to agricultural land and public infrastructure, homes and other structures, rerouted flows, and accelerated bank erosion to artificial and natural waterways; low flows which can impact aquatic life and aquatic recreation.	X								100-year floodplain, specifically where there was a significant overlap with ag land.
2.3.1: Increased erosion and sedimentation resulting from bank failure and slumping, and gully formation prevents the proper function of drainage systems and increases maintenance costs.	X	X	X			X	X	X	Areas with high BANCS estimates. Directly related to goal.
2.5.1: Water Quality: Elevated concentrations of sediment, and organic matter have a detrimental impact on drinking water quality.	X	X	X	X	X	X			TRF Stormwater Management Area.
2.6.1: Sediment deposition in wetlands degrades hydrologic function, contributes to nonnative plant species succession, and contributes to sediment and highly organic/low dissolved oxygen water to downstream waterways.				X	X	X	X	X	Planning regions with large impoundments/wetlands near the bottom of planning region (large contributing areas). Agassiz, Thief Lake, and Lost River/Farmes Pools.

Tier A Issues	Lower Thief	JD 30/18/13	Marshall CD 20	Lost River	Middle Thief	Upper Thief	Mud River	Moose River	Comments
3.1.3: Degradation of aquatic habitat, aquatic vegetation, and riparian habitat associated with increased drainage, channelization, ditch maintenance, and development, and the physical damage to the banks and beds of creeks, streams and rivers from higher and faster flows pose public lands and waters management challenges.	X	X	X	X	X		X	X	Based on MSHA like goals. They are all currently rated as poor besides Upper Thief River which was rated fair.
3.2.1: Quantity and quality of vegetation along waterways, including riparian forests and buffers along ditches in shorelines, that filter pollutants, retain soil, improve water quality, and restore wildlife habitat.	X		X			X	X		Poor buffers in the upper reaches of the Mud R are leading to sedimentation and a bed load of sand in downstream areas. Removal of deep-rooted and woody vegetation along the Thief River has contributed to bank failures. Use the Thief River erosion problem GIS layer that was used for zonation to focus on buffer problems that have been observed.
5.2.1: Reduced soil health, soil protection, excess loss of fertilizers or pesticides, and its impact on agricultural productivity, surface	X	X	X	X	X	X	X		Checks are planning regions with a "significant" amount

Tier A Issues	Lower Thief	JD 30/18/13	Marshall CD 20	Lost River	Middle Thief	Upper Thief	Mud River	Moose River	Comments
water quality and quantity, sedimentation in water features, and water holding capacity.									of ag land based on Cropland Data Layer.
5.2.3: Improperly installed or poorly functioning subsurface sewage treatment systems (SSTS) and individual sewage treatment system (ISTS) increase the potential for ground and surface water contamination, adversely impacting human health and water quality.							X		Mud River a priority because human fecal DNA markers have been found in an impaired reach.
Total	11	7	8	6	5	7	10	6	X

Tier B Issues	Lower Thief	JD 30/18/13	Marshall CD 20	Lost River	Middle Thief	Upper Thief	Mud River	Moose River	Comments
1.1.1: Water Quality: Protection of generally good quality groundwater supplies from elevated levels of nitrates, arsenic, or other contaminants which if excessive can result in implications to human health and treatment costs for public and private wells. Protection is particularly important in vulnerable DWSMAs.	X					X			Groundwater Contamination Susceptibility at medium or high in ag areas.
1.1.2: Water Quality: A limited amount of data available for nitrate, arsenic, and other types of groundwater contamination, which									NA - watershed wide.

Tier B Issues	Lower Thief	JD 30/18/13	Marshall CD 20	Lost River	Middle Thief	Upper Thief	Mud River	Moose River	Comments
can lead to poorly informed management decisions.									
2.1.3: Water Quality: Reduced concentrations of dissolved oxygen approaching (protection) or exceeding (restoration) tolerable levels that can affect the diversity of quality of aquatic life.			X	X	X		X	X	Based on Protection and Restoration Cateogories like the goals.
2.2.3: Regional and basin wide flood issues that might not be addressed by local actions, which can impact local infrastructure, natural resources, agricultural lands and communities.	X	X	X	X					Based on Distributed Detention Study priority areas for storage. Directly related to goal.
2.4.1: Increased erosion and sedimentation resulting in reduced storage capacity, invasive species takeover, and ultimately, wildlife habitat degradation.				X	X	X	X	X	Planning regions with large impoundments/wetlands near the bottom of planning region (large contributing areas). Agassiz, Thief Lake, and Lost River/Farmes Pools.
2.6.2: Wetlands have been altered or drained for agricultural production, resulting in a loss of wildlife habitat and temporary water storage on the landscape.		X	X	X	X		X		Based on Restorable Wetlands data layer.

Tier B Issues	Lower Thief	JD 30/18/13	Marshall CD 20	Lost River	Middle Thief	Upper Thief	Mud River	Moose River	Comments
3.1.1: Modification of waterways, culverts, and dams at impoundment outlets reduce hydrologic connectivity and altered the flow regime resulting in the reduced potential of waterways to support quality fish populations.		X		X	X	X	X	X	MPCA noted that fish scores were depressed compared to bugs, likely due to fish passage issues caused by Agassiz Pool and Thief Lake dams. Lower Thief has scored well in the past (in the natural portion - near the USGS gauge). The Thief River Falls dam restricts the migration of some species upstream (catfish, for example), but good F-IBI scores have still been found on the Red Lake River and Thief River upstream of that dam. Lost River is iffy: there is good fish passage and walleyes have been spotted in the channel between Farmes Pool and the Thief River. The portion of the watershed upstream of the Lost and Farmes pools is cut off from downstream reaches, though.

Tier B Issues	Lower Thief	JD 30/18/13	Marshall CD 20	Lost River	Middle Thief	Upper Thief	Mud River	Moose River	Comments
3.3.1: Increased habitat fragmentation and loss of habitat providing food, shelter, terrestrial ecological corridors, and breeding territory for both protected (e.g. endangered, threatened, special concern, and Species of Greatest Conservation Need) and unprotected species.			X	X	X	X	X	X	Based on areas with significant amount of large habitat blocks.
4.1.1: Increase public awareness and knowledge of water management issues including general citizens down through school aged children.									NA - watershed wide.
4.1.3: Increase regular input from stakeholders to guide future efforts related to this plan.									NA - watershed wide.
4.2.1: Information needed to understand baseline conditions for resources to better inform management decisions.									NA - watershed wide.
5.1.1: Downstream water quality consequences from stormwater runoff due to increased impervious surface area around water bodies such as lake, streams, and wetlands.	X	X					X		3 cities in the watershed.
5.1.4: High levels of E. coli in water monitoring data at stormwater outlets in Thief River Falls, which can impact the beneficial use of downstream resources.	X								Issue is specific to Thief River Falls stormwater.

Tier B Issues	Lower Thief	JD 30/18/13	Marshall CD 20	Lost River	Middle Thief	Upper Thief	Mud River	Moose River	Comments
5.2.2: Increased sheet, rill, and wind erosion, and its impact on agricultural productivity, surface water quality, and deposits in drainage systems.	X	X	X	X	X	X	X		Checks are planning regions with a "significant" amount of ag land based on Cropland Data Layer.
5.2.4: The impact of feedlots on surface and groundwater quality.							X		Mud River should be a priority because livestock operations and feedlots are contributing to the E. coli impairment - significant amount of ruminant fecal DNA markers in the water at Grygla. That was the only place where ruminant fecal DNA markers were found (of the sites that were tested).
Total	5	5	5	7	6	5	8	4	X

Tier 1 Planning Regions (Rank 1-3)								
Tier 2 Planning Regions (Rank 4-6)								
Tier 3 Planning Regions (Rank 7-8)	**Lower Thief**	**JD 30/18/ 13**	**Marshall CD 20**	**Lost River**	**Middle Thief**	**Upper Thief**	**Mud River**	**Moose River**
Tier A Total	11	7	8	6	5	7	10	6
Tier B Total	5	5	5	7	6	5	8	4
Total	**16**	**12**	**13**	**13**	**11**	**12**	**18**	**10**
Planning Region Rank	**2**	**5**	**3**	**3**	**7**	**5**	**1**	**8**
*No weighting applied. Tiers based on total count of H's and M's for both Tier A and Tier B issues.								
Tier A Total	11	7	8	6	5	7	10	6
Tier A Total Weighted x 2	**22**	**14**	**16**	**12**	**10**	**14**	**20**	**12**
Tier B Total	5	5	5	7	6	5	8	4
Tier B Total Weighted x 1	**5**	**5**	**5**	**7**	**6**	**5**	**8**	**4**
Weighted Total	**27**	**19**	**21**	**19**	**16**	**19**	**28**	**16**
Planning Region Rank	**2**	**4**	**3**	**4**	**7**	**4**	**1**	**7**
*Tier A issues weighted at 2x the value of Tier B issues (Preferred Ranking).								

APPENDIX I:
TOP TEN PRACTICES BY TREATMENT GROUP AND PLANNING REGION

Appendix I: Top Ten Practices by Treatment Group and Planning Region

JD 30/18/13 Planning Region Top Ten Most Cost-Effective Practices by PTMApp Treatment Group

Treatment Group	Unique BMP ID	Sediment Load Reduction (tons/yr.)	Total Phosphorus Load Reduction (lbs./yr.)	Cost (2016 EQIP $)	Cost-Efficiency (Sediment tons/$/yr.)
Biofiltration*	5251_577308_3	19.58	4.62	$ 36,562.39	$ 1,867.34
	5418_578951_3	33.60	7.39	$ 64,779.13	$ 1,927.79
	4939_575258_3	14.42	3.72	$ 30,518.47	$ 2,116.75
	5108_576532_3	12.76	4.61	$ 30,127.29	$ 2,361.82
	5143_576610_3	12.91	3.25	$ 33,473.28	$ 2,592.71
	4995_576238_3	13.68	3.82	$ 36,461.66	$ 2,666.19
	5504_579715_3	13.43	3.32	$ 38,086.81	$ 2,835.08
	5083_576528_3	23.51	8.14	$ 68,711.04	$ 2,922.04
	5106_576825_3	13.76	4.16	$ 49,617.27	$ 3,604.99
Filtration	587565_578951_2	19.79	3.00	$ 269.90	$ 13.64
	562391_576528_2	6.37	1.66	$ 247.76	$ 38.90
	578518_578213_2	16.37	2.24	$ 786.51	$ 48.05

JD 30/18/13 Planning Region Top Ten Most Cost-Effective Practices by PTMApp Treatment Group					
Treatment Group	Unique BMP ID	Sediment Load Reduction (tons/yr.)	Total Phosphorus Load Reduction (lbs./yr.)	Cost (2016 EQIP $)	Cost-Efficiency (Sediment tons/$/yr.)
	552943_575226_2	9.50	2.06	$ 474.44	$ 49.96
	538278_574889_2	8.24	1.66	$ 438.59	$ 53.24
	593067_579481_2	6.32	1.17	$ 406.96	$ 64.36
	575768_577936_2	24.24	3.01	$ 1,706.92	$ 70.41
	536975_574702_2	7.69	1.87	$ 764.37	$ 99.45
	522107_573322_2	9.18	1.99	$ 936.22	$ 101.95
	585385_578951_2	14.91	2.71	$ 1,564.59	$ 104.97
Infiltration	39747_577436_4	56.29	2.96	$ 74,946.89	$ 1,331.38
	42804_579352_4	39.62	1.32	$ 75,370.31	$ 1,902.11
	42572_578951_4	45.15	2.02	$ 96,360.28	$ 2,134.42
	42802_579274_4	17.58	0.61	$ 38,773.97	$ 2,205.98
	41512_577987_4	17.51	2.16	$ 39,923.28	$ 2,279.39
	41909_578213_4	23.73	1.00	$ 61,820.59	$ 2,604.98

JD 30/18/13 Planning Region Top Ten Most Cost-Effective Practices by PTMApp Treatment Group					
Treatment Group	Unique BMP ID	Sediment Load Reduction (tons/yr.)	Total Phosphorus Load Reduction (lbs./yr.)	Cost (2016 EQIP $)	Cost-Efficiency (Sediment tons/$/yr.)
	42261_578412_4	18.80	1.43	$ 49,359.69	$ 2,625.69
	39584_575258_4	25.31	1.00	$ 69,623.78	$ 2,751.37
	41841_78100_4	33.98	1.59	$ 103,619.06	$ 3,048.98
	40650_576757_4	29.26	2.79	$ 89,343.46	$ 3,053.25
Protection	42340_573322_5	8.93	0.45	$ 2,049.61	$ 229.47
	45906_577959_5	11.87	0.42	$ 4,345.93	$ 366.05
	44766_576701_5	5.89	0.20	$ 2,168.22	$ 368.42
	44767_576702_5	23.35	0.77	$ 10,257.52	$ 439.29
	45856_577920_5	11.56	0.51	$ 5,161.97	$ 446.48
	43780_575386_5	1.95	0.19	$ 1,181.37	$ 607.09
	47286_579493_5	2.23	0.16	$ 1,527.72	$ 684.52
	42430_573991_5	16.95	1.58	$ 12,383.04	$ 730.47
	43268_574732_5	5.11	0.36	$ 3,795.57	$ 742.07

JD 30/18/13 Planning Region Top Ten Most Cost-Effective Practices by PTMApp Treatment Group					
Treatment Group	Unique BMP ID	Sediment Load Reduction (tons/yr.)	Total Phosphorus Load Reduction (lbs./yr.)	Cost (2016 EQIP $)	Cost-Efficiency (Sediment tons/$/yr.)
	45402_577357_5	2.00	0.29	$ 1,503.99	$ 752.72
Source Reduction	39468_580549_6	22.57	2.38	$ 533.57	$ 23.64
	39303_580549_6	11.81	1.75	$ 393.18	$ 33.30
	42182_577955_6	11.97	1.56	$ 461.49	$ 38.55
	37786_70288_6	17.37	3.20	$ 759.72	$ 43.73
	43346_580602_6	14.11	1.77	$ 624.47	$ 44.26
	40088_580601_6	7.16	1.22	$ 327.20	$ 45.69
	40553_580601_6	6.69	1.17	$ 313.68	$ 46.86
	40532_580601_6	23.53	4.23	$ 1,132.02	$ 48.10
	40325_580549_6	8.63	1.93	$ 432.93	$ 50.14
	42018_580602_6	6.81	1.00	$ 352.53	$ 51.75
Storage	676051_577955_1	19.37	1.61	$ 2,856.63	$ 147.49
	628862_575015_1	34.91	6.32	$ 8,289.54	$ 237.43

JD 30/18/13 Planning Region Top Ten Most Cost-Effective Practices by PTMApp Treatment Group					
Treatment Group	Unique BMP ID	Sediment Load Reduction (tons/yr.)	Total Phosphorus Load Reduction (lbs./yr.)	Cost (2016 EQIP $)	Cost-Efficiency (Sediment tons/$/yr.)
	668186_580602_1	0.85	0.14	$ 206.91	$ 243.18
	644072_580601_1	2.19	0.40	$ 536.18	$ 245.09
	664531_576789_1	1.94	0.29	$ 489.51	$ 252.92
	721180_579104_1	1.01	0.13	$ 258.72	$ 256.21
	661920_576421_1	24.21	3.57	$ 6,228.13	$ 257.27
	697141_578040_1	17.99	2.22	$ 4,673.80	$ 259.86
	591199_573419_1	34.45	7.12	$ 8,963.38	$ 260.22
	695896_578096_1	9.17	1.52	$ 2,434.55	$ 265.45
*Biofiltration Treatment Group only contains 9 practices for Planning Region.					

Branch 200 of JD 11 (Lost River) Planning Region Top Ten Most Cost-Effective Practices by PTMApp Treatment Group					
Treatment Group	Unique BMP ID	Sediment Load Reduction (tons/yr.)	Total Phosphorus Load Reduction (lbs./yr.)	Cost (2016 EQIP $)	Cost-Efficiency (Sediment tons/$/yr.)
Filtration*	394285_555655_2	3.76	0.72	$ 999.48	$ 265.81
	367751_551304_2	7.06	1.29	$ 2,211.94	$ 313.40
	380115_552819_2	3.40	0.75	$ 1,391.69	$ 408.88
	393979_555633_2	2.46	0.65	$ 1,035.33	$ 421.32
	354729_551055_2	4.53	1.11	$ 2,147.62	$ 474.45
	425769_60155_2	1.89	0.36	$ 6,280.51	$ 3,325.50
	401588_556541_2	1.33	0.27	$ 5,500.32	$ 4,148.40
Infiltration	26508_555607_4	13.60	0.55	$ 43,189.73	$ 3,175.37
	26789_554976_4	11.57	0.51	$ 58,614.63	$ 5,068.16
	26759_555238_4	10.99	0.40	$ 66,115.37	$ 6,014.59
	26634_555493_4	13.53	0.91	$ 91,884.03	$ 6,788.90
	28629_557320_4	7.43	0.88	$ 59,763.94	$ 8,046.99

Branch 200 of JD 11 (Lost River) Planning Region Top Ten Most Cost-Effective Practices by PTMApp Treatment Group					
Treatment Group	Unique BMP ID	Sediment Load Reduction (tons/yr.)	Total Phosphorus Load Reduction (lbs./yr.)	Cost (2016 EQIP $)	Cost-Efficiency (Sediment tons/$/yr.)
	24666_551482_4	13.25	1.80	$ 118,015.64	$ 8,904.22
	27383_557095_4	8.42	1.72	$ 135,678.67	$ 16,113.02
	26710_555244_4	2.24	0.78	$ 54,622.31	$ 24,378.50
	24909_552248_4	4.09	1.14	$ 106,401.59	$ 25,987.22
	27816_556610_4	2.90	0.11	$ 112,329.59	$ 38,668.14
Protection	26859_549793_5	11.36	2.36	$ 14,608.19	$ 1,285.94
	29480_552819_5	1.99	0.22	$ 3,164.56	$ 1,588.11
	30649_554707_5	16.69	1.93	$ 28,632.82	$ 1,715.33
	29373_554290_5	4.80	0.63	$ 9,237.46	$ 1,923.07
	29951_554290_5	1.74	0.16	$ 3,620.02	$ 2,076.86
	28190_551192_5	5.70	0.91	$ 13,146.90	$ 2,304.47
	29503_552764_5	9.62	1.66	$ 22,882.53	$ 2,379.33
	30889_555115_5	1.65	0.14	$ 3,994.84	$ 2,425.77

Branch 200 of JD 11 (Lost River) Planning Region Top Ten Most Cost-Effective Practices by PTMApp Treatment Group					
Treatment Group	Unique BMP ID	Sediment Load Reduction (tons/yr.)	Total Phosphorus Load Reduction (lbs./yr.)	Cost (2016 EQIP $)	Cost-Efficiency (Sediment tons/$/yr.)
	28396_552248_5	3.25	0.57	$ 8,236.38	$ 2,536.15
	31911_556594_5	3.66	0.66	$ 9,375.05	$ 2,559.26
Source Reduction	26292_580537_6	12.10	3.04	$ 676.37	$ 55.91
	25771_549793_6	26.30	6.76	$ 1,518.95	$ 57.75
	26777_549854_6	12.87	4.50	$ 1,003.23	$ 77.96
	27202_551403_6	4.62	1.64	$ 366.27	$ 79.33
	26967_50734_6	5.56	1.03	$ 455.17	$ 81.93
	26309_550184_6	9.19	3.99	$ 897.57	$ 97.66
	29516_554707_6	20.19	4.44	$ 2,301.19	$ 114.00
	26652_550824_6	3.47	1.78	$ 397.43	$ 114.70
	28666_51620_6	8.95	2.13	$ 1,081.15	$ 120.84
	27165_50734_6	17.78	5.04	$ 2,216.61	$ 124.66
Storage	370404_554707_1	1.04	0.17	$ 435.41	$ 419.83

Branch 200 of JD 11 (Lost River) Planning Region Top Ten Most Cost-Effective Practices by PTMApp Treatment Group					
Treatment Group	Unique BMP ID	Sediment Load Reduction (tons/yr.)	Total Phosphorus Load Reduction (lbs./yr.)	Cost (2016 EQIP $)	Cost-Efficiency (Sediment tons/$/yr.)
	353162_552764_1	15.53	3.72	$ 8,699.76	$ 560.22
	378738_555653_1	0.70	0.17	$ 637.54	$ 913.30
	364880_553894_1	2.35	0.83	$ 2,346.55	$ 998.15
	386198_557095_1	2.45	1.03	$ 3,709.77	$ 1,512.16
	393766_556541_1	0.80	0.22	$ 4,336.91	$ 5,417.55
	419926_60155_1	0.78	0.25	$ 4,563.29	$ 5,824.35
	388117_556497_1	0.65	0.22	$ 3,903.38	$ 5,983.61
	390675_556541_1	0.80	0.26	$ 5,223.68	$ 6,516.41
	384214_556610_1	2.02	0.35	$ 16,085.88	$ 7,979.86
*Filtration Treatment Group only contains 7 practices for Planning Region.					

Lower Thief River/SD 83 Planning Region Top Ten Most Cost-Effective Practices by PTMApp Treatment Group					
Treatment Group	Unique BMP ID	Sediment Load Reduction (tons/yr.)	Total Phosphorus Load Reduction (lbs./yr.)	Cost (2016 EQIP $)	Cost-Efficiency (Sediment tons/$/yr.)
Biofiltration	4370_567420_3	20.04	5.15	$ 31,960.62	$ 1,594.51
	5251_577308_3	19.37	4.46	$ 36,562.39	$ 1,887.70
	5418_578951_3	33.24	7.14	$ 64,779.13	$ 1,948.81
	4939_575258_3	14.26	3.59	$ 30,518.47	$ 2,139.83
	5108_576532_3	12.62	4.45	$ 30,127.29	$ 2,387.57
	3812_560970_3	14.24	4.88	$ 36,060.41	$ 2,531.46
	4505_569716_3	11.75	3.41	$ 30,355.62	$ 2,583.03
	5143_576610_3	12.77	3.14	$ 33,473.28	$ 2,620.98
	3715_560970_3	11.68	4.22	$ 31,351.19	$ 2,684.47
	4995_576238_3	13.53	3.69	$ 36,461.66	$ 2,695.26
Filtration	478024_567420_2	28.13	4.95	$ 293.10	$ 10.42

Lower Thief River/SD 83 Planning Region Top Ten Most Cost-Effective Practices by PTMApp Treatment Group					
Treatment Group	Unique BMP ID	Sediment Load Reduction (tons/yr.)	Total Phosphorus Load Reduction (lbs./yr.)	Cost (2016 EQIP $)	Cost-Efficiency (Sediment tons/$/yr.)
	499555_570223_2	19.49	2.96	$ 255.14	$ 13.09
	587565_578951_2	19.57	2.90	$ 269.90	$ 13.79
	479642_567251_2	12.40	1.76	$ 290.99	$ 23.46
	452702_563728_2	12.13	2.54	$ 327.89	$ 27.02
	274264_543159_2	8.30	1.10	$ 255.14	$ 30.74
	213513_536353_2	11.90	1.47	$ 410.13	$ 34.46
	562391_576528_2	6.30	1.60	$ 247.76	$ 39.32
	409510_557225_2	19.57	3.71	$ 835.01	$ 42.66
	578518_578213_2	16.19	2.17	$ 786.51	$ 48.58
Infiltration	6137_516128_4	17.85	0.96	$ 17,360.58	$ 972.58
Infiltration	33913_567475_4	22.10	0.90	$ 23,167.60	$ 1,048.17
Infiltration	28374_558150_4	41.65	0.98	$ 44,097.08	$ 1,058.86
Infiltration	32068_564463_4	24.24	0.81	$ 26,736.50	$ 1,102.94
Infiltration	28515_558256_4	17.43	0.68	$ 19,477.72	$ 1,117.31

Lower Thief River/SD 83 Planning Region Top Ten Most Cost-Effective Practices by PTMApp Treatment Group					
Treatment Group	Unique BMP ID	Sediment Load Reduction (tons/yr.)	Total Phosphorus Load Reduction (lbs./yr.)	Cost (2016 EQIP $)	Cost-Efficiency (Sediment tons/$/yr.)
	39747_577436_4	55.69	2.86	$ 74,946.89	$ 1,345.90
	31325_563661_4	17.91	0.77	$ 34,418.71	$ 1,921.73
	42804_579352_4	39.20	1.27	$ 75,370.31	$ 1,922.85
	36987_571748_4	26.31	1.87	$ 50,750.96	$ 1,928.98
	42572_578951_4	44.66	1.95	$ 96,360.28	$ 2,157.69
Protection	42340_573322_5	8.84	0.43	$ 2,049.61	$ 231.97
	35030_562299_5	5.85	0.18	$ 1,428.08	$ 243.92
	25296_547249_5	12.60	0.45	$ 3,359.08	$ 266.56
	36046_563801_5	4.24	0.13	$ 1,195.60	$ 282.29
	34697_561743_5	12.66	0.45	$ 3,577.32	$ 282.53
	41525_572169_5	5.58	0.19	$ 1,840.85	$ 330.03
	39407_568833_5	3.51	0.13	$ 1,285.75	$ 366.09
	45906_577959_5	11.74	0.41	$ 4,345.93	$ 370.04
	44766_576701_5	5.82	0.20	$ 2,168.22	$ 372.44

Lower Thief River/SD 83 Planning Region Top Ten Most Cost-Effective Practices by PTMApp Treatment Group					
Treatment Group	Unique BMP ID	Sediment Load Reduction (tons/yr.)	Total Phosphorus Load Reduction (lbs./yr.)	Cost (2016 EQIP $)	Cost-Efficiency (Sediment tons/$/yr.)
	20904_541730_5	3.94	0.22	$ 1,527.72	$ 388.16
Source Reduction	39468_580549_6	22.33	2.30	$ 533.57	$ 23.90
	33776_62804_6	18.81	1.88	$ 462.04	$ 24.56
	39303_580549_6	11.68	1.69	$ 393.18	$ 33.67
	42182_577955_6	11.84	1.51	$ 461.49	$ 38.97
	35641_580597_6	22.36	2.83	$ 899.01	$ 40.21
	34194_580597_6	7.82	1.00	$ 319.10	$ 40.81
	31105_558024_6	9.89	1.63	$ 413.36	$ 41.81
	33765_562749_6	26.48	3.45	$ 1,134.22	$ 42.84
	38063_570911_6	14.96	1.81	$ 660.38	$ 44.14
	37786_70288_6	17.19	3.09	$ 759.72	$ 44.20
Storage	676051_577955_1	19.16	1.56	$ 2,856.63	$ 149.10
	505347_567402_1	0.52	0.05	$ 104.25	$ 199.53
	432057_560709_1	0.53	0.06	$ 109.66	$ 205.87

Lower Thief River/SD 83 Planning Region Top Ten Most Cost-Effective Practices by PTMApp Treatment Group					
Treatment Group	Unique BMP ID	Sediment Load Reduction (tons/yr.)	Total Phosphorus Load Reduction (lbs./yr.)	Cost (2016 EQIP $)	Cost-Efficiency (Sediment tons/$/yr.)
	628862_575015_1	34.54	6.10	$ 8,289.54	$ 240.02
	529954_568832_1	11.00	1.50	$ 2,652.25	$ 241.15
	668186_580602_1	0.84	0.13	$ 206.91	$ 245.83
	644072_580601_1	2.16	0.39	$ 536.18	$ 247.76
	507461_580597_1	0.67	0.10	$ 170.05	$ 254.74
	664531_576789_1	1.91	0.28	$ 489.51	$ 255.68
	524651_568418_1	30.84	4.95	$ 7,921.31	$ 256.89

Marshall CD 20 Planning Region Top Ten Most Cost-Effective Practices by PTMApp Treatment Group					
Treatment Group	Unique BMP ID	Sediment Load Reduction (tons/yr.)	Total Phosphorus Load Reduction (lbs./yr.)	Cost (2016 EQIP $)	Cost-Efficiency (Sediment tons/$/yr.)
Biofiltration*	4370_567420_3	20.85	5.84	$ 31,960.62	$ 1,532.87
	4505_569716_3	12.22	3.86	$ 30,355.62	$ 2,483.18
	3079_553209_3	0.93	1.55	$ 30,849.21	$ 33,177.74

Marshall CD 20 Planning Region Top Ten Most Cost-Effective Practices by PTMApp Treatment Group					
Treatment Group	Unique BMP ID	Sediment Load Reduction (tons/yr.)	Total Phosphorus Load Reduction (lbs./yr.)	Cost (2016 EQIP $)	Cost-Efficiency (Sediment tons/$/yr.)
Filtration	478024_567420_2	29.26	5.61	$ 293.10	$ 10.02
	499555_570223_2	20.27	3.35	$ 255.14	$ 12.59
	479642_567251_2	12.90	2.00	$ 290.99	$ 22.55
	452702_563728_2	12.62	2.88	$ 327.89	$ 25.98
	409510_557225_2	20.36	4.21	$ 835.01	$ 41.01
	537018_574626_2	5.49	1.57	$ 288.88	$ 52.58
	411330_557936_2	11.13	1.88	$ 610.44	$ 54.84
	538586_574626_2	5.01	1.37	$ 294.15	$ 58.69
	497866_570223_2	18.98	3.01	$ 1,173.44	$ 61.82
	467275_565969_2	9.14	1.63	$ 590.41	$ 64.63
Infiltration	33913_567475_4	22.99	1.02	$ 23,167.60	$ 1,007.65
	28374_558150_4	43.32	1.11	$ 44,097.08	$ 1,017.93
	32068_564463_4	25.22	0.92	$ 26,736.50	$ 1,060.30
	28515_558256_4	18.13	0.77	$ 19,477.72	$ 1,074.12

Marshall CD 20 Planning Region Top Ten Most Cost-Effective Practices by PTMApp Treatment Group					
Treatment Group	Unique BMP ID	Sediment Load Reduction (tons/yr.)	Total Phosphorus Load Reduction (lbs./yr.)	Cost (2016 EQIP $)	Cost-Efficiency (Sediment tons/$/yr.)
	31325_563661_4	18.63	0.87	$ 34,418.71	$ 1,847.44
	36987_571748_4	27.37	2.11	$ 50,750.96	$ 1,854.41
	35111_569123_4	13.87	0.97	$ 31,878.13	$ 2,299.17
	32297_564865_4	22.06	3.41	$ 52,505.16	$ 2,380.49
	36307_571350_4	23.31	2.65	$ 56,497.49	$ 2,423.67
	33764_566674_4	24.96	1.22	$ 63,030.39	$ 2,525.75
Protection	35030_562299_5	6.09	0.20	$ 1,428.08	$ 234.49
	36046_563801_5	4.41	0.14	$ 1,195.60	$ 271.38
	34697_561743_5	13.17	0.51	$ 3,577.32	$ 271.61
	41525_572169_5	5.80	0.22	$ 1,840.85	$ 317.28
	39407_568833_5	3.65	0.15	$ 1,285.75	$ 351.94
	36903_565118_5	6.32	0.41	$ 2,533.54	$ 401.12
	39068_568418_5	24.92	1.34	$ 10,248.03	$ 411.28
	41795_573882_5	4.96	0.45	$ 2,457.63	$ 495.15

Marshall CD 20 Planning Region Top Ten Most Cost-Effective Practices by PTMApp Treatment Group					
Treatment Group	Unique BMP ID	Sediment Load Reduction (tons/yr.)	Total Phosphorus Load Reduction (lbs./yr.)	Cost (2016 EQIP $)	Cost-Efficiency (Sediment tons/$/yr.)
	39229_568619_5	4.68	0.50	$ 2,343.76	$ 501.32
	35368_562749_5	7.77	0.47	$ 3,975.86	$ 511.82
Source Reduction	35641_580597_6	23.25	3.20	$ 899.01	$ 38.66
	34194_580597_6	8.13	1.14	$ 319.10	$ 39.23
	33765_562749_6	27.54	3.91	$ 1,134.22	$ 41.19
	38063_570911_6	15.56	2.05	$ 660.38	$ 42.43
	33227_561743_6	11.06	2.20	$ 495.13	$ 44.79
	37065_67481_6	19.26	2.78	$ 863.52	$ 44.84
	36805_568418_6	22.38	3.69	$ 1,004.26	$ 44.88
	34840_580572_6	9.38	1.74	$ 431.90	$ 46.05
	34335_580597_6	7.13	1.18	$ 330.43	$ 46.35
	37275_569305_6	14.32	2.45	$ 667.86	$ 46.65
Storage	505347_567402_1	0.54	0.06	$ 104.25	$ 191.81

Marshall CD 20 Planning Region Top Ten Most Cost-Effective Practices by PTMApp Treatment Group					
Treatment Group	Unique BMP ID	Sediment Load Reduction (tons/yr.)	Total Phosphorus Load Reduction (lbs./yr.)	Cost (2016 EQIP $)	Cost-Efficiency (Sediment tons/$/yr.)
	432057_560709_1	0.55	0.07	$ 109.66	$ 197.91
	529954_568832_1	11.44	1.70	$ 2,652.25	$ 231.82
	507461_580597_1	0.69	0.12	$ 170.05	$ 244.89
	524651_568418_1	32.08	5.60	$ 7,921.31	$ 246.96
	446007_561950_1	4.03	0.66	$ 1,005.66	$ 249.54
	419635_58277_1	2.73	0.46	$ 686.59	$ 251.40
	445284_561950_1	1.72	0.31	$ 442.79	$ 257.68
	589722_572971_1	0.66	0.09	$ 178.95	$ 269.81
	536350_569285_1	34.41	4.70	$ 9,319.45	$ 270.87
*Biofiltration Treatment Group only contains 3 practices for Planning Region.					

Middle Thief River/SD 83 Planning Region Top Ten Most Cost-Effective Practices by PTMApp Treatment Group					
Treatment Group	Unique BMP ID	Sediment Load Reduction (tons/yr.)	Total Phosphorus Load Reduction (lbs./yr.)	Cost (2016 EQIP $)	Cost-Efficiency (Sediment tons/$/yr.)
Biofiltration*	2857_549452_3	5.94	1.62	$ 36,528.82	$ 6,147.14

Middle Thief River/SD 83 Planning Region Top Ten Most Cost-Effective Practices by PTMApp Treatment Group					
Treatment Group	Unique BMP ID	Sediment Load Reduction (tons/yr.)	Total Phosphorus Load Reduction (lbs./yr.)	Cost (2016 EQIP $)	Cost-Efficiency (Sediment tons/$/yr.)
	2426_543826_3	4.46	1.69	$ 31,023.81	$ 6,951.41
	1540_527726_3	4.16	1.45	$ 36,354.21	$ 8,744.97
	2691_545957_3	1.98	1.07	$ 42,421.64	$ 21,402.06
	1630_531124_3	1.67	1.93	$ 38,165.71	$ 22,857.43
	2728_545979_3	1.50	1.25	$ 42,876.62	$ 28,502.62
	2258_541600_3	0.92	0.61	$ 31,106.07	$ 33,927.85
	2652_545541_3	0.74	2.01	$ 31,403.23	$ 42,650.03
	2353_542591_3	0.77	1.46	$ 37,341.39	$ 48,319.33
Filtration	274264_543159_2	8.92	1.37	$ 255.14	$ 28.62
	155308_529543_2	4.37	0.71	$ 255.14	$ 58.42
	184958_532217_2	3.69	0.74	$ 298.37	$ 80.91
	199953_535028_2	4.29	1.26	$ 553.51	$ 128.90
	176661_531569_2	5.45	0.83	$ 752.78	$ 138.18
	295384_545172_2	3.97	0.84	$ 589.36	$ 148.40

Middle Thief River/SD 83 Planning Region Top Ten Most Cost-Effective Practices by PTMApp Treatment Group					
Treatment Group	Unique BMP ID	Sediment Load Reduction (tons/yr.)	Total Phosphorus Load Reduction (lbs./yr.)	Cost (2016 EQIP $)	Cost-Efficiency (Sediment tons/$/yr.)
	226712_538117_2	5.34	0.91	$ 839.23	$ 157.22
	269990_541603_2	4.02	0.48	$ 717.98	$ 178.45
	190814_533195_2	3.37	0.63	$ 665.27	$ 197.62
	306631_546123_2	3.69	0.72	$ 739.07	$ 200.47
Infiltration	12920_530552_4	14.37	0.69	$ 57,465.33	$ 3,998.77
	13568_532104_4	12.45	1.44	$ 61,760.10	$ 4,960.25
	13614_532217_4	19.11	1.70	$ 115,777.51	$ 6,059.03
	15319_536752_4	11.52	0.59	$ 72,406.31	$ 6,285.07
	13455_531924_4	6.34	0.48	$ 41,496.01	$ 6,545.64
	23633_550032_4	13.26	0.65	$ 102,893.18	$ 7,760.73
	15013_536463_4	7.13	0.50	$ 65,994.39	$ 9,256.93
	10032_524500_4	7.34	0.49	$ 71,377.99	$ 9,729.79
	12096_528597_4	11.35	1.11	$ 115,051.64	$ 10,137.92
	22382_546914_4	4.76	0.41	$ 48,512.83	$ 10,184.43

Middle Thief River/SD 83 Planning Region Top Ten Most Cost-Effective Practices by PTMApp Treatment Group					
Treatment Group	Unique BMP ID	Sediment Load Reduction (tons/yr.)	Total Phosphorus Load Reduction (lbs./yr.)	Cost (2016 EQIP $)	Cost-Efficiency (Sediment tons/$/yr.)
Protection	14304_530603_5	1.77	0.07	$ 1,375.89	$ 777.88
	9061_520354_5	2.05	0.13	$ 1,817.13	$ 885.81
	11625_525575_5	3.66	0.19	$ 3,596.30	$ 982.70
	20141_540613_5	1.40	0.07	$ 1,485.02	$ 1,058.74
	16534_535028_5	1.07	0.09	$ 1,228.82	$ 1,147.04
	15908_533720_5	3.40	0.28	$ 4,834.61	$ 1,421.44
	13778_529755_5	0.97	0.09	$ 1,546.69	$ 1,600.40
	14622_531233_5	1.78	0.11	$ 2,884.63	$ 1,617.56
	14995_531969_5	1.15	0.14	$ 1,940.48	$ 1,688.46
	25815_547893_5	1.18	0.09	$ 2,011.65	$ 1,702.80
Source Reduction	14313_532938_6	4.41	0.41	$ 310.59	$ 70.36
	18029_39112_6	6.35	0.67	$ 475.36	$ 74.81
	12111_33424_6	8.79	1.50	$ 853.57	$ 97.12
	15564_535161_6	3.04	0.59	$ 351.16	$ 115.59

Middle Thief River/SD 83 Planning Region Top Ten Most Cost-Effective Practices by PTMApp Treatment Group					
Treatment Group	Unique BMP ID	Sediment Load Reduction (tons/yr.)	Total Phosphorus Load Reduction (lbs./yr.)	Cost (2016 EQIP $)	Cost-Efficiency (Sediment tons/$/yr.)
	10751_580564_6	2.82	0.58	$ 332.90	$ 117.93
	18612_39363_6	4.07	0.88	$ 511.54	$ 125.82
	23056_44903_6	5.53	1.12	$ 709.53	$ 128.29
	19467_40645_6	3.18	0.70	$ 425.38	$ 133.75
	10954_26982_6	8.23	1.63	$ 1,117.74	$ 135.78
	14878_534228_6	4.48	1.02	$ 609.64	$ 136.14
Storage	172403_580564_1	0.96	0.15	$ 444.65	$ 464.16
	229894_540394_1	0.54	0.09	$ 320.09	$ 588.12
	135884_524220_1	0.62	0.10	$ 389.05	$ 626.47
	186231_533900_1	0.50	0.08	$ 314.29	$ 627.91
	326320_580588_1	0.84	0.14	$ 545.10	$ 652.54
	105551_519203_1	7.37	1.53	$ 4,838.91	$ 656.66
	232531_40265_1	0.61	0.11	$ 407.10	$ 664.23
	226667_539675_1	7.37	1.71	$ 5,099.51	$ 691.62

Middle Thief River/SD 83 Planning Region Top Ten Most Cost-Effective Practices by PTMApp Treatment Group					
Treatment Group	Unique BMP ID	Sediment Load Reduction (tons/yr.)	Total Phosphorus Load Reduction (lbs./yr.)	Cost (2016 EQIP $)	Cost-Efficiency (Sediment tons/$/yr.)
	315149_547957_1	10.80	2.27	$ 7,575.58	$ 701.76
	273283_543895_1	12.86	2.79	$ 9,138.61	$ 710.53
*Biofiltration Treatment Group only contains 9 practices for Planning Region.					

Moose River/JD 21 Planning Region Region Top Ten Most Cost-Effective Practices by PTMApp Treatment Group					
Treatment Group	Unique BMP ID	Sediment Load Reduction (tons/yr.)	Total Phosphorus Load Reduction (lbs./yr.)	Cost (2016 EQIP $)	Cost-Efficiency (Sediment tons/$/yr.)
Biofiltration*	468_512365_3	2.81	1.12	$ 31,505.64	$ 11,219.77
Filtration	19546_503715_2	10.54	3.01	$ 269.90	$ 25.60
	63310_515241_2	10.65	1.31	$ 477.60	$ 44.85
	19884_504543_2	5.10	1.45	$ 277.28	$ 54.42
	10656_501436_2	8.33	1.63	$ 740.12	$ 88.90
	72999_515528_2	10.89	2.17	$ 1,302.07	$ 119.57

Moose River/JD 21 Planning Region Region Top Ten Most Cost-Effective Practices by PTMApp Treatment Group					
Treatment Group	Unique BMP ID	Sediment Load Reduction (tons/yr.)	Total Phosphorus Load Reduction (lbs./yr.)	Cost (2016 EQIP $)	Cost-Efficiency (Sediment tons/$/yr.)
	66476_516188_2	2.86	1.00	$ 351.08	$ 122.88
	16397_502375_2	8.40	6.09	$ 1,064.85	$ 126.70
	5523_500844_2	8.33	3.28	$ 1,538.23	$ 184.73
	12575_501917_2	10.26	2.26	$ 2,237.24	$ 218.15
	68893_516305_2	4.27	1.55	$ 1,363.22	$ 319.44
Infiltration*	10154_524565_4	18.82	0.94	$ 66,841.25	$ 3,551.44
	3996_512174_4	24.32	2.83	$ 132,049.27	$ 5,430.58
	684_500844_4	12.83	2.15	$ 70,289.17	$ 5,477.68
	5080_514442_4	5.99	1.03	$ 38,532.02	$ 6,432.67
	3406_510580_4	8.30	2.33	$ 115,535.56	$ 13,926.86
	3933_511965_4	0.54	0.68	$ 72,950.72	$ 135,214.83
Protection	4641_512384_5	4.27	0.25	$ 1,736.47	$ 406.90
	6180_514898_5	3.19	0.24	$ 1,945.23	$ 610.60

Moose River/JD 21 Planning Region Region Top Ten Most Cost-Effective Practices by PTMApp Treatment Group					
Treatment Group	Unique BMP ID	Sediment Load Reduction (tons/yr.)	Total Phosphorus Load Reduction (lbs./yr.)	Cost (2016 EQIP $)	Cost-Efficiency (Sediment tons/$/yr.)
	8277_518727_5	8.52	0.92	$ 6,338.60	$ 744.16
	5061_13645_5	1.59	0.14	$ 1,219.33	$ 765.49
	6762_515977_5	2.73	0.28	$ 2,258.36	$ 827.58
	4423_511875_5	13.11	1.55	$ 11,462.62	$ 874.44
	6770_516054_5	26.65	2.83	$ 23,356.98	$ 876.50
	8789_519707_5	5.59	0.69	$ 5,185.70	$ 927.00
	5979_580540_5	1.78	0.20	$ 1,660.56	$ 931.53
	4540_512213_5	3.42	0.29	$ 3,197.77	$ 935.35
Source Reduction	4358_580540_6	14.81	2.40	$ 692.57	$ 46.77
Source Reduction	5833_517190_6	11.50	1.94	$ 559.94	$ 48.69
Source Reduction	5054_13645_6	7.39	1.33	$ 367.30	$ 49.71
Source Reduction	1938_505217_6	10.96	2.40	$ 577.92	$ 52.75
Source Reduction	1676_503013_6	11.49	2.91	$ 676.03	$ 58.82
Source Reduction	3402_13645_6	8.11	1.74	$ 480.23	$ 59.19

Moose River/JD 21 Planning Region Region Top Ten Most Cost-Effective Practices by PTMApp Treatment Group					
Treatment Group	Unique BMP ID	Sediment Load Reduction (tons/yr.)	Total Phosphorus Load Reduction (lbs./yr.)	Cost (2016 EQIP $)	Cost-Efficiency (Sediment tons/$/yr.)
	6544_15260_6	7.12	1.59	$ 434.85	$ 61.06
	4345_13718_6	5.43	1.35	$ 332.83	$ 61.33
	7905_521063_6	7.15	1.36	$ 439.59	$ 61.47
	8260_20935_6	8.67	1.74	$ 534.88	$ 61.66
Storage	13958_500844_1	16.74	2.94	$ 3,219.99	$ 192.36
	122374_521684_1	26.21	3.94	$ 6,136.69	$ 234.13
	117768_520896_1	0.70	0.09	$ 172.57	$ 245.00
	91633_515375_1	0.65	0.15	$ 169.38	$ 261.78
	19072_501603_1	1.26	0.24	$ 344.49	$ 274.13
	29640_505056_1	5.46	1.32	$ 1,560.59	$ 285.85
	111230_519417_1	0.53	0.11	$ 171.30	$ 320.68
	28182_505217_1	3.14	0.75	$ 1,010.07	$ 321.98
	12119_500844_1	5.77	1.50	$ 1,897.38	$ 329.04
	101191_517307_1	0.66	0.15	$ 217.40	$ 331.73

Moose River/JD 21 Planning Region Region Top Ten Most Cost-Effective Practices by PTMApp Treatment Group					
Treatment Group	Unique BMP ID	Sediment Load Reduction (tons/yr.)	Total Phosphorus Load Reduction (lbs./yr.)	Cost (2016 EQIP $)	Cost-Efficiency (Sediment tons/$/yr.)
Biofiltration Treatment Group only contains 1 practice and Infiltration Treatment Group only contains 6 practices for Planning Region.					

Mud River/JD 11 Planning Region Top Ten Most Cost-Effective Practices by PTMApp Treatment Group					
Treatment Group	Unique BMP ID	Sediment Load Reduction (tons/yr.)	Total Phosphorus Load Reduction (lbs./yr.)	Cost (2016 EQIP $)	Cost-Efficiency (Sediment tons/$/yr.)
Biofiltration	2857_549452_3	14.46	3.57	$ 36,528.82	$ 2,526.36
	2426_543826_3	10.86	3.74	$ 31,023.81	$ 2,856.90
	1540_527726_3	10.12	3.21	$ 36,354.21	$ 3,594.02
	2691_545957_3	4.82	2.36	$ 42,421.64	$ 8,795.84
	1630_531124_3	4.06	4.27	$ 38,165.71	$ 9,393.97

Mud River/JD 11 Planning Region Top Ten Most Cost-Effective Practices by PTMApp Treatment Group

Treatment Group	Unique BMP ID	Sediment Load Reduction (tons/yr.)	Total Phosphorus Load Reduction (lbs./yr.)	Cost (2016 EQIP $)	Cost-Efficiency (Sediment tons/$/yr.)
	2728_545979_3	3.66	2.76	$ 42,876.62	$ 11,714.04
	2258_541600_3	2.23	1.36	$ 31,106.07	$ 13,943.70
	2652_545541_3	1.79	4.44	$ 31,403.23	$ 17,528.36
	2353_542591_3	1.88	3.23	$ 37,341.39	$ 19,858.33
	2859_549187_3	1.08	1.47	$ 52,162.44	$ 48,388.78
Filtration	274264_543159_2	21.69	3.04	$ 255.14	$ 11.76
	155308_529543_2	10.63	1.56	$ 255.14	$ 24.01
	184958_532217_2	8.97	1.63	$ 298.37	$ 33.25
	199953_535028_2	10.45	2.78	$ 553.51	$ 52.97
	176661_531569_2	13.26	1.84	$ 752.78	$ 56.79
	295384_545172_2	9.66	1.87	$ 589.36	$ 60.99
	226712_538117_2	12.99	2.00	$ 839.23	$ 64.62
	269990_541603_2	9.79	1.05	$ 717.98	$ 73.34
	190814_533195_2	8.19	1.39	$ 665.27	$ 81.22

Mud River/JD 11 Planning Region Top Ten Most Cost-Effective Practices by PTMApp Treatment Group					
Treatment Group	Unique BMP ID	Sediment Load Reduction (tons/yr.)	Total Phosphorus Load Reduction (lbs./yr.)	Cost (2016 EQIP $)	Cost-Efficiency (Sediment tons/$/yr.)
	306631_546123_2	8.97	1.59	$ 739.07	$ 82.39
Infiltration	12920_530552_4	34.97	1.53	$ 57,465.33	$ 1,643.42
	13568_532104_4	30.30	3.18	$ 61,760.10	$ 2,038.57
	13614_532217_4	46.49	3.76	$ 115,777.51	$ 2,490.15
	15319_536752_4	28.03	1.31	$ 72,406.31	$ 2,583.04
	13455_531924_4	15.43	1.05	$ 41,496.01	$ 2,690.13
	23633_550032_4	32.26	1.44	$ 102,893.18	$ 3,189.51
	15013_536463_4	17.35	1.11	$ 65,994.39	$ 3,804.43
	12096_528597_4	27.61	2.46	$ 115,051.64	$ 4,166.49
	19117_543826_4	14.72	1.22	$ 63,030.39	$ 4,281.06
	16772_539490_4	17.79	1.64	$ 80,632.93	$ 4,531.61
Protection	11625_525575_5	8.90	0.42	$ 3,596.30	$ 403.87
	20141_540613_5	3.41	0.15	$ 1,485.02	$ 435.12
	16534_535028_5	2.61	0.19	$ 1,228.82	$ 471.41

Mud River/JD 11 Planning Region Top Ten Most Cost-Effective Practices by PTMApp Treatment Group					
Treatment Group	Unique BMP ID	Sediment Load Reduction (tons/yr.)	Total Phosphorus Load Reduction (lbs./yr.)	Cost (2016 EQIP $)	Cost-Efficiency (Sediment tons/$/yr.)
	15908_533720_5	8.28	0.63	$ 4,834.61	$ 584.19
	14622_531233_5	4.34	0.25	$ 2,884.63	$ 664.79
	25815_547893_5	2.87	0.20	$ 2,011.65	$ 699.82
	26557_548827_5	2.85	0.39	$ 2,263.11	$ 792.71
	15276_532364_5	11.13	1.01	$ 8,853.16	$ 795.51
	20617_541610_5	9.21	1.05	$ 7,415.59	$ 805.16
	14884_531692_5	1.76	0.15	$ 1,451.80	$ 827.07
Source Reduction	14313_532938_6	10.74	0.91	$ 310.59	$ 28.92
	18029_39112_6	15.46	1.48	$ 475.36	$ 30.75
	15564_535161_6	7.39	1.30	$ 351.16	$ 47.50
	10751_580564_6	6.87	1.27	$ 332.90	$ 48.47
	18612_39363_6	9.89	1.94	$ 511.54	$ 51.71
	23056_44903_6	13.46	2.48	$ 709.53	$ 52.72
	19467_40645_6	7.74	1.54	$ 425.38	$ 54.97

Mud River/JD 11 Planning Region Top Ten Most Cost-Effective Practices by PTMApp Treatment Group					
Treatment Group	Unique BMP ID	Sediment Load Reduction (tons/yr.)	Total Phosphorus Load Reduction (lbs./yr.)	Cost (2016 EQIP $)	Cost-Efficiency (Sediment tons/$/yr.)
	10954_26982_6	20.03	3.59	$ 1,117.74	$ 55.80
	14878_534228_6	10.90	2.25	$ 609.64	$ 55.95
	18735_540394_6	7.23	1.34	$ 409.65	$ 56.64
Storage	172403_580564_1	2.33	0.34	$ 444.65	$ 190.76
	174123_531692_1	0.84	0.10	$ 176.75	$ 211.60
	231220_539905_1	0.60	0.08	$ 138.28	$ 229.17
	203837_537519_1	1.10	0.16	$ 255.58	$ 232.90
	318810_548476_1	0.61	0.09	$ 146.23	$ 237.93
	184565_533720_1	0.97	0.17	$ 231.70	$ 238.79
	211903_537591_1	1.07	0.19	$ 256.17	$ 239.17
	134804_523750_1	0.58	0.08	$ 138.89	$ 240.51
	229894_540394_1	1.32	0.20	$ 320.09	$ 241.71
	260416_543159_1	0.53	0.08	$ 132.84	$ 251.32

Upper Thief River/SD 83 Planning Region Top Ten Most Cost-Effective Practices by PTMApp Treatment Group					
Treatment Group	Unique BMP ID	Sediment Load Reduction (tons/yr.)	Total Phosphorus Load Reduction (lbs./yr.)	Cost (2016 EQIP $)	Cost-Efficiency (Sediment tons/$/yr.)
Biofiltration*	45_500812_3	7.41	4.13	$ 38,251.34	$ 5,159.35
	468_512365_3	0.80	0.38	$ 31,505.64	$ 39,521.86
	254_504869_3	0.71	5.18	$ 34,784.47	$ 48,893.23
	256_504869_3	0.57	4.55	$ 30,060.14	$ 52,330.57
Filtration	19546_503715_2	2.99	1.01	$ 269.90	$ 90.19
	19924_504794_2	10.28	2.29	$ 1,021.62	$ 99.40
	32216_510419_2	12.13	1.78	$ 1,517.15	$ 125.07
	63310_515241_2	3.02	0.44	$ 477.60	$ 157.98
	19367_504094_2	2.93	0.51	$ 546.13	$ 186.35
	19884_504543_2	1.45	0.49	$ 277.28	$ 191.70
	10656_501436_2	2.36	0.55	$ 740.12	$ 313.14
	7952_501067_2	7.02	1.73	$ 2,311.04	$ 329.05
	72999_515528_2	3.09	0.73	$ 1,302.07	$ 421.18
	66476_516188_2	0.81	0.34	$ 351.08	$ 432.86

Upper Thief River/SD 83 Planning Region Top Ten Most Cost-Effective Practices by PTMApp Treatment Group					
Treatment Group	Unique BMP ID	Sediment Load Reduction (tons/yr.)	Total Phosphorus Load Reduction (lbs./yr.)	Cost (2016 EQIP $)	Cost-Efficiency (Sediment tons/$/yr.)
Infiltration	2877_509150_4	28.11	1.68	$ 79,725.58	$ 2,836.58
	718_500812_4	17.45	1.27	$ 77,366.48	$ 4,434.52
	845_501070_4	14.53	1.61	$ 71,982.89	$ 4,954.09
	2678_508108_4	12.66	1.26	$ 82,145.18	$ 6,489.76
	2216_504794_4	19.37	3.43	$ 156,547.65	$ 8,083.23
	822_500812_4	9.90	1.33	$ 83,113.01	$ 8,395.13
	188_500497_4	24.75	4.39	$ 222,300.09	$ 8,980.44
	657_500681_4	5.61	0.46	$ 57,828.27	$ 10,309.36
	2260_505262_4	6.37	1.22	$ 79,604.60	$ 12,487.25
	10154_524565_4	5.34	0.32	$ 66,841.25	$ 12,510.02
Protection	4594_512300_5	5.63	0.42	$ 2,713.83	$ 481.65
	329_500393_5	3.18	0.23	$ 1,769.68	$ 555.98
	2719_507903_5	10.08	1.22	$ 7,610.11	$ 755.04
	1914_502755_5	7.33	0.61	$ 6,281.67	$ 857.29

Upper Thief River/SD 83 Planning Region Top Ten Most Cost-Effective Practices by PTMApp Treatment Group					
Treatment Group	Unique BMP ID	Sediment Load Reduction (tons/yr.)	Total Phosphorus Load Reduction (lbs./yr.)	Cost (2016 EQIP $)	Cost-Efficiency (Sediment tons/$/yr.)
	4654_12475_5	1.77	0.26	$ 1,916.76	$ 1,085.43
	3909_11165_5	1.58	0.26	$ 1,764.94	$ 1,114.78
	422_593_5	1.33	0.20	$ 1,575.16	$ 1,182.06
	3084_508108_5	2.76	0.60	$ 3,525.13	$ 1,275.06
	3603_510639_5	12.72	2.23	$ 16,259.27	$ 1,278.51
	365_500468_5	2.72	0.28	$ 3,482.43	$ 1,282.39
Source Reduction	2485_8730_6	6.89	1.42	$ 339.15	$ 49.21
	2670_10017_6	6.05	1.39	$ 344.36	$ 56.96
	2025_6054_6	14.49	3.40	$ 825.62	$ 56.98
	2654_11165_6	16.21	3.96	$ 959.77	$ 59.21
	2423_509473_6	11.25	2.75	$ 676.78	$ 60.18
	2699_10952_6	7.01	1.79	$ 422.15	$ 60.19
	2671_580585_6	11.86	3.06	$ 721.48	$ 60.85

Upper Thief River/SD 83 Planning Region Top Ten Most Cost-Effective Practices by PTMApp Treatment Group					
Treatment Group	Unique BMP ID	Sediment Load Reduction (tons/yr.)	Total Phosphorus Load Reduction (lbs./yr.)	Cost (2016 EQIP $)	Cost-Efficiency (Sediment tons/$/yr.)
	3288_580534_6	12.89	3.57	$ 811.69	$ 62.95
	2580_10952_6	25.96	7.19	$ 1,696.49	$ 65.35
	2633_10952_6	14.39	4.05	$ 954.14	$ 66.29
Storage	42692_510048_1	0.64	0.15	$ 179.26	$ 278.80
	14909_501070_1	0.53	0.12	$ 164.00	$ 307.80
	34330_506590_1	2.04	0.39	$ 669.34	$ 328.32
	10799_500592_1	1.17	0.15	$ 383.67	$ 329.17
	41255_509256_1	0.59	0.17	$ 212.65	$ 361.17
	42292_510987_1	1.18	0.25	$ 453.18	$ 385.33
	45717_511061_1	1.84	0.56	$ 717.04	$ 388.80
	12711_500983_1	0.60	0.19	$ 246.99	$ 412.82
	44031_510687_1	1.05	0.27	$ 457.30	$ 435.18
	46012_510735_1	0.65	0.26	$ 397.53	$ 610.10
*Biofiltration Treatment Group only contains 9 practices for Planning Region.					

APPENDIX J: LOCAL FUNDING AUTHORITIES

Local Funding Authorities

Purpose: *This table provides an overview of Minnesota statutes and laws that provide authorities to local governments to fund water management projects, to be used by local governments while exploring funding options for locally funded water projects. Does not include fees, fines, or wetland banking, grants, etc. This is not a legal document and should not be considered comprehensive, complete, or authoritative.*
note: "metro" refers to Anoka, Carver, Dakota, Hennepin, Ramsey, and Washington counties or watershed organizations in the 7-county metro area.

Citation	Applies to	Summary *(please see details in the full text of each provision)*
§40A.152	Counties (metro)	Money from the county conservation account (see chapter 287) must be spent by the county to reimburse the county and taxing jurisdictions within the county for revenue lost under the conservation tax credit under §273.119 or the valuation of agricultural preserves under §473H.10. Money remaining in the account after reimbursement may be spent on: 1) agricultural land preservation and conservation planning and implementation of official controls under this chapter or chapter 473H; 2) soil conservation activities and enforcement of soil loss ordinances; 3) incentives for landowners who create exclusive agricultural use zones; 4) payments to municipalities within the county for the purposes of clauses 1-3.
§103B.241	Watershed districts & watershed management organizations (metro)	May levy a tax to pay for plan preparation costs & projects in the adopted plan necessary to implement the Metropolitan Water Management Program.
§103B.245	Watershed districts & watershed management organizations (metro)	May establish a watershed management tax district within the watershed to pay the costs of: planning required under §§103B.231 and 103B.235, the capital costs of water management facilities described in the capital improvement program of the plans, and normal & routine maintenance of the facilities.
§103B.251	Watershed districts & watershed management organizations (metro), counties	May certify for payment by the county all or any part of the cost of a capital improvement contained in the capital improvement program of plans developed in accordance with §103B.231. Counties may issue general obligation bonds to pay all or part of the cost of project. The county may pay the principal and interest on the bonds by levying a tax on all property located in the watershed or subwatershed in which the bonds are issued. Loans from counties to watershed districts for the purposes of implementing this section are not subject to the loan limit set forth in §103D.335.

Citation	Applies to	Summary *(please see details in the full text of each provision)*
§103B.331 Subdivisions 3 & 4	Counties	(3) May charge users for services provided by the county necessary to implement the local water management plan.
		(4) May establish one or more special taxing districts within the county and issue bonds to finance capital improvements under the Comprehensive Local Water Management Act. After adoption of the resolution, a county may annually levy a tax on all taxable property in the district.
§103B.335	Counties, municipalities, or townships	May levy a tax to implement the Comprehensive Local Water Management Act or a comprehensive watershed management plan (§103B.3363). A county may levy amounts needed to pay the reasonable costs to SWCDs and WDs of administering and implementing priority programs identified in an approved & adopted plan or comprehensive watershed management plan.
§103B.555 Subdivisions 1 & 3	Counties	(1) May establish a Lake Improvement District and impose service charges on the users of lake improvement district services within the district. May levy an ad valorem tax solely on property within the lake improvement district for projects of special benefit to the district; may impose or issue any combination of service charges, special assessments, obligations, and taxes.
		(3) A tax under Subd. 1 may be in addition to amounts levied on all taxable property in the county for the same/similar purposes.
§103C.331 Subdivision 16	County boards on behalf of soil and water conservation districts	May levy an annual tax on all taxable real property in the district for the amount that the board determines is necessary to meet the requirements of the district.
§103D.335	Watershed districts	A watershed district has the power to incur debts, liabilities, and obligations and to provide for assessments and to issue certificates, warrants, and bonds.
§103D.601	Watershed districts	May set up special taxing districts via petition to conduct larger, Capital Improvement Projects (CIP). The costs to the affected parties cannot exceed $750,000.
§103D.615	Watershed districts	May declare an emergency and order that work be done without a contract. The cost of work undertaken without a contract may be assessed against benefitted properties or raised by an ad valorem tax levy if the cost is not more than 25% of the most recent administrative ad valorem levy and the work is found to be of common benefit to the watershed district.

Citation	Applies to	Summary *(please see details in the full text of each provision)*
§103D.729	Watershed districts	May establish a water management district or districts in the territory within the watershed to collect revenues and pay the costs of projects initiated under §§103B.231, 103D.601, 103D.605, 103D.611, or 103D.730. (Guidelines for creating water management districts)
§103D.901	Watershed districts	County auditors assess the amount specified in an assessment statement filed by managers. The county may issue bonds (§103E.635). An assessment may not be levied against a benefited property in excess of the amount of benefits received.
§103D.905 Subdivisions 2,3, 7-9	Watershed districts	Established funds for watershed districts (not a complete list – see full statute language): **Organizational expense fund** - consisting of an ad valorem tax levy, shall be used for organizational expenses and preparation of the watershed management plan for projects. **General fund** - consisting of an ad valorem tax levy, shall be used for general administrative expenses and for the construction or implementation and maintenance of projects of common benefit to the watershed district. May levy a tax not to exceed 0.00798 percent of estimated market value to pay the cost attributable to projects initiated by petition. **Repair and maintenance funds** - established under §103D.631, Subd. 2. **Survey and data acquisition fund** - consists of the proceeds of a property tax that can be levied only once every 5 years and may not exceed 0.02418 percent of estimated market value. **Project tax levy** - a WD may levy a tax: 1. To pay the costs of projects undertaken by the WD which are to be funded, in whole or in part, with the proceeds of grants or construction or implementation loans under the Clean Water Partnership Law; 2. To pay the principal of, or premium or administrative surcharge (if any), and interest on, the bonds and notes issued by the WD pursuant to §103F.725; 3. To repay the construction or implementation loans under the Clean Water Partnership Law.
§103E.011 Subdivision 5	Drainage authorities	A drainage authority can accept and use external sources of funds together with assessments from benefited landowners in the watershed of the drainage system for the purposes of flood control, wetland restoration, or water quality improvements.
§103E.015 Subdivision 1a	Drainage authorities	When planning a "drainage project" or petitioned repair, the drainage authority must investigate the potential use of external sources of funding, including early coordination for funding and technical assistance with other applicable local government units.
§103E.601 §103E.635 §103E.641	Drainage authorities	Funding of all costs for constructed "**drainage projects"** are apportioned to benefited properties within the drainage system pro rata on the basis of the benefits determined (§103E.601). After the contract for the construction of a drainage project is awarded, the board of an affected county may issue bonds of the county

Citation	Applies to	Summary *(please see details in the full text of each provision)*
		in an amount necessary to pay the cost of establishing and constructing the drainage project. (§103E.635). Drainage authorities may issue drainage funding bonds (§103E.641).
§103E.728 §103E.731 §103E.735	Drainage authorities	Costs for drainage system **repairs** are apportioned pro rata on all benefited properties of record. The drainage authority may charge an additional assessment on property that is in violation of §103E.021 (ditch buffers) or a county soil loss ordinance (§103E.728). If there is not enough money in the drainage system account to make a repair, the board shall assess the costs of the repairs on all property and entities that have been assessed benefits for the drainage system (§103E.731). To create a repair fund for a drainage system to be used only for repairs, the drainage authority may apportion and assess an amount against all property and entities benefited by the drainage system, including property not originally assessed and subsequently found to be benefited according to law. (§103E.735).
Chapter 287	Counties	Counties participating in the agricultural land preservation program impose a fee of $5 per transaction on the recording or registration of a mortgage or deed that is subject to tax under §§287.05 and 287.21.
Chapter 365A	Towns	Townships may create subordinate service districts with special taxing authority. Requires a petition signed by at least 50 percent of the property owners in the part of the town proposed for the subordinate service district.
§373.475	Counties	A county board must deposit the money received from the sale of land under Laws 1998, chapter 389, article 16, section 31, subd. 3, into an environmental trust fund. The county board may spend interest earned on the principal only for purposes related to the improvement of natural resources.
Chapter 429	Municipalities	May levy special assessments against properties benefitting from special services (including curbs, gutters and storm sewer, sanitary sewers, holding ponds, and treatment plants).
§444.075	Municipalities	May collect stormwater utility fees to build, repair, operate & maintain stormwater management systems.
§462.358 Subdivision 2b(c)	Municipalities	May accept a cash fee for lots created in a subdivision or redevelopment that will be served by municipal sanitary sewer and water service or community septic and private wells. May charge dedication fees for the acquisition and development or improvement of wetlands and open space based on an approved parks and open space plan.
M. L. 1998, Chapter 389 Article 3, Section 29	Red River Watershed Management Board	Watershed Districts that are members of the Red River Watershed Management Board may levy an ad valorem tax not to exceed 0.04836 percent of the taxable market value of all property within their district. This levy is in excess of levies authorized by §103D.905.