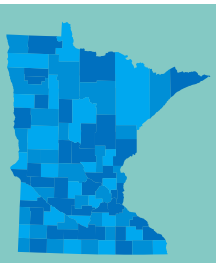
Grant

August 2023

Whitefish Lake Minor Watershed Nine Key Element Plan

MINNESOTA POLLUTION CONTROL AGENCY



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Document number: wq-cwp2-23

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Executive summary

The Crow Wing Soil and Water Conservation District (SWCD) has a long history of working with its member cities, watershed citizens, and many other partners in protecting and restoring the water resources within the watershed. The Whitefish Chain of Lakes hydrologic unit code (HUC) 10 0701010504 watershed is located in the Pine River HUC8 Watershed (Figure 1). The HUC10 is made up of six HUC12s: Arvig Creek (070101050401), Lower Hay Lake (070101050402), Arrowhead Lake (070101050403), Big Trout Lake (070101050404), Lower Whitefish Lake (070101050405), and Cross Lake (070101050406).

The Whitefish Chain of Lakes HUC10 is a mostly forested area with lakes that are among the cleanest in central Minnesota, with most water chemistry parameters well below the impairment threshold. The lakes are clean because the land around them is well over 50% forested, but increasing development pressure, particularly along shorelines, is threatening that status. Larger homes, larger lawns, and riprapped shorelines have contributed to a slow reduction in water clarity. A goal of local organizations has been to increase forestland in each subwatershed and lakeshed to 75%, which studies have shown is the level of natural vegetation required to keep water from degrading to impaired status.

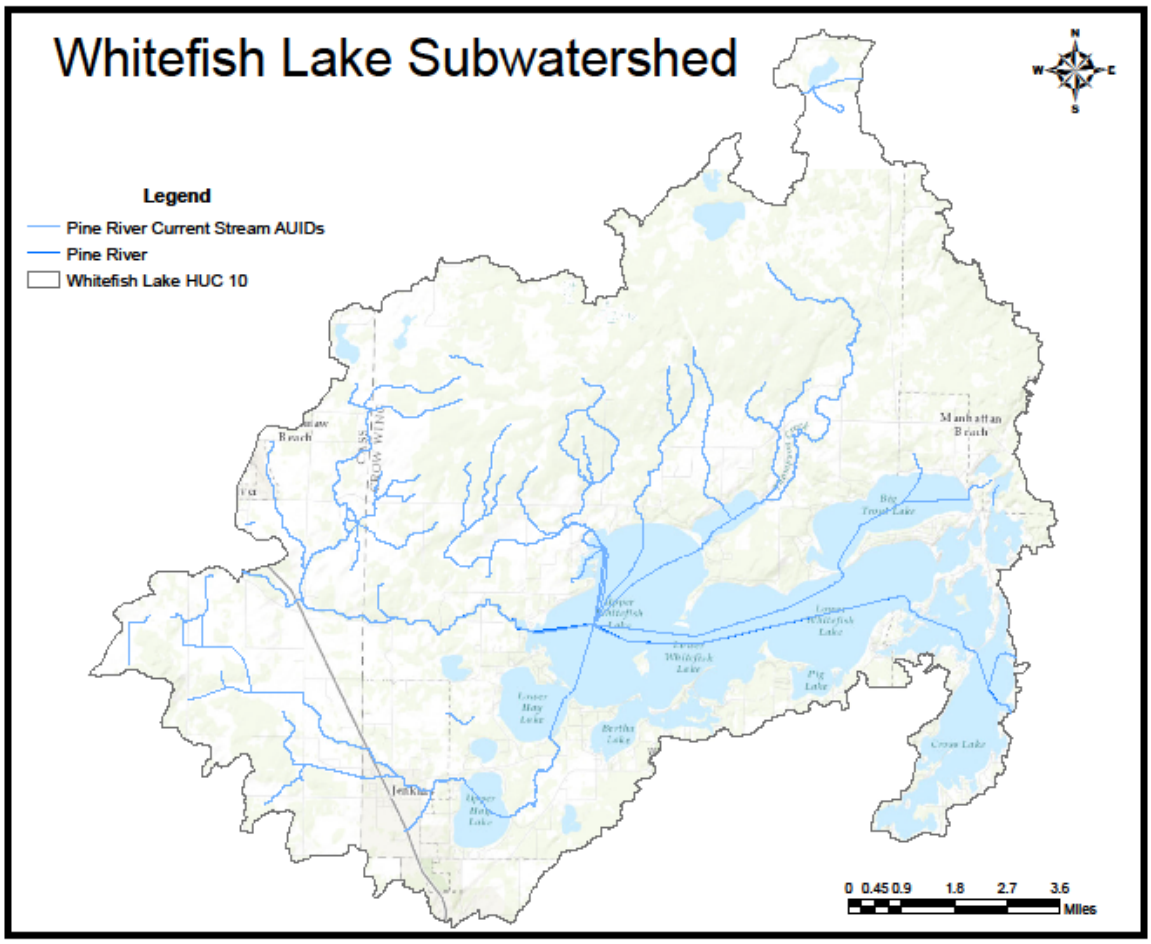
As part of the larger Pine River Watershed, the Whitefish Chain is a significant source of clean drinking water for St. Cloud, Minneapolis, St. Paul, and other cities downstream along the Mississippi River. The Pine River Watershed was identified in a report by the U.S. Department of Agriculture (USDA) Forest Service (USFS 2009) as one of the top watersheds in the entire northeast United States (Maine to Minnesota and south to Missouri) and the top clean water producing watershed in Minnesota.

The Whitefish Lakes Watershed was singled out in both the Pine River Watershed Restoration and Protection (WRAPS) report and the Pine Rive One Watershed, One Plan (1W1P) as priority for protection. The watershed is important both economically and environmentally to the state. While the lakes are currently meeting water quality standards, concerning trends in P loading have been observed. This nine key element (NKE) watershed-based plan was developed to further drill into the smaller watershed, provide specific activities and implementation needed to protect the lakes and restore the streams, identify critical loading areas and methods to address those, and to provide the metrics, schedule, and milestones to measure progress and adapt to new information. This NKE plan will build on the information from the existing reports and plans. When this plan is fully executed, the trend toward impairment will be turned and the reductions needed to reach water quality standards in the impaired streams will be met in 10 years.

There are two impaired streams in the watershed, both located west of the Whitefish Lake minor watershed and in an agricultural area of the watershed. Arvig Creek and Willow Creek are both impaired for fish bioassessments, with Arvig also impaired for benthic macroinvertebrates. Aquatic life in both creeks has been affected by habitat destruction as a result of nearby agriculture, as well as connectivity issues, and corrective actions to address this have already begun.

Because of the overall good water quality in the Whitefish Lake minor watershed, the primary goal is not restoration but working to protect existing water quality. There are many approaches that can contribute to this goal, but the focus for organizations and agencies in the watershed is to establish and protect 75% of the forestland in the Whitefish Lake minor watershed HUC10. Restoration of impaired water bodies costs many times what it costs to protect them from becoming impaired, so acting now will save potentially millions of dollars over what it would cost if action is not taken before impairment occurs.

Figure 1. Whitefish Lake Subwatershed (This is a placeholder map)



Goals

The following goals for the Whitefish Lake minor watershed were outlined it the Pine River One Watershed One Plan (1W1P)

- Protect and enhance forest cover, priority protection lakes, and surficial sand aquifers by promoting 75% land protection in the Whitefish Lake minor watershed, which has been determined to be a priority minor watershed in the 1W1P.
- Reduce P loading by 5% from BMPs in both residential and road areas. Of the Whitefish Lake minor watershed, Whitefish, Big Trout, Island-Loon, Clamshell, and Pig Lakes are considered the lakes with the highest P sensitivity and the most economically important lakes in the entire Pine River HUC8 Watershed.
- Reduce agricultural runoff to downstream lakes by 5% and improve stream habitat in impaired streams to meet the IBI standard in the Whitefish Subwatershed by promoting pasture management.

This NKE document is intended to address all pollutants, sources, and implementation strategies in the watershed to reach the reductions needed to achieve and protect water quality standards.

For the purposes of the Section 319 grant program, only practices and activities eligible for funding under the EPA 2014 Section 319 program guidance and Minnesota's Nonpoint Source Pollution Program Management Plan (NPSPPMP) are eligible for Section 319 funding. All match activities must be eligible

for Section 319 funding, except where noted in the NPSPPMP. Other activities will need to seek alternative funding sources, including local ad valorem taxes and various state grants.

Water quality condition summary

Water Quality in the Whitefish Lake minor watershed is generally very good. Phosphorus levels are in most cases approximately half of the standard of 30 ug/l, with some lakes less and Clamshell slightly more than half of the standard.

However, while Phosphorus levels continue to be relatively low, water clarity for Whitefish, Clamshell, Hen, Island, Pig, Arrowhead, and Big Trout is declining (Appendix A). Several of the lakes are now known to be infested by zebra mussels, which can contribute to better Secchi clarity readings in the short-term. Nine lakes are listed for impairment for aquatic consumption by mercury (Table 1). Arvig and Willow Creeks are listed for impairment for aquatic life by macroinvertebrate index of biologic impairment (MIBI) and fish (FIBI).

During the last intensive watershed monitoring that was done in 2011, 13 lakes had data available within the 10-year assessment window; 11 of these had sufficient datasets available to make an aquatic recreation assessment. All 11 lakes with sufficient assessment data fully supported aquatic recreation. Most of the lakes in the subwatershed are either flow through lakes on the Pine River or indirectly connected to the river through other lakes or channels. The deep lake basins in the southeastern portion of the subwatershed known as the Whitefish Lake minor watershed have good water quality despite high development density on shorelines. Deep lakes have the ability to assimilate higher amounts of phosphorus at depth without negatively impacting surface conditions until mixing occurs in the fall. Four lakes (Whitefish, Island, Bertha, Pig) have a decreasing trend in historical Secchi data suggesting that a potential change in water quality could be imminent.

Implementing development practices that limit runoff to the lakes will be very important.

Table 1. Impairments in Whitefish Lake minor watershed HUC10 0701010504

Water body name	Water body description	Year added to List	AUID	Use Class	Affected designated use	Pollutant or stressor	TMDL target
Arvig Creek	Rice Lake to Unnamed creek	2016	07010105-509	2Bg, 3C	Aquatic Life	MIBI FIBI	2026
Big Trout	Lake or Reservoir	2014	18-0315-00	1B, 2A, 3B	Aquatic Consumption	Mercury in fish tissue	
Cross Lake Reservoir (Main Basin)	Lake or Reservoir	2008	18-0312-01	2B, 3C	Aquatic Consumption		
Cross Lake Reservoir (Southeast Bay)	Lake or Reservoir	2008	18-0312-02	2B, 3C	Aquatic Consumption		
Cross Lake Reservoir (Unnamed Bay)	Lake or Reservoir	2008	18-0312-03	2B, 3C	Aquatic Consumption		
Lower Hay	Lake or Reservoir	2014	18-0378-00	1B, 2A, 3B	Aquatic Consumption		2027
Rush	Lake or Reservoir	2014	18-0311-00	2B, 3C	Aquatic Consumption		2027

Water body name	Water body description	Year added to List	AUID	Use Class	Affected designated use	Pollutant or stressor	TMDL target
Upper Hay	Lake or Reservoir	2010	18-0412-00	2B, 3C	Aquatic Consumption		
Whitefish	Lake or Reservoir	1998	18-0310-00	2B, 3C	Aquatic Consumption		
Willow Creek	Headwaters to Unnamed creek	2016	07010105-631	2Bg, 3C	Aquatic Life	FIBI	2026

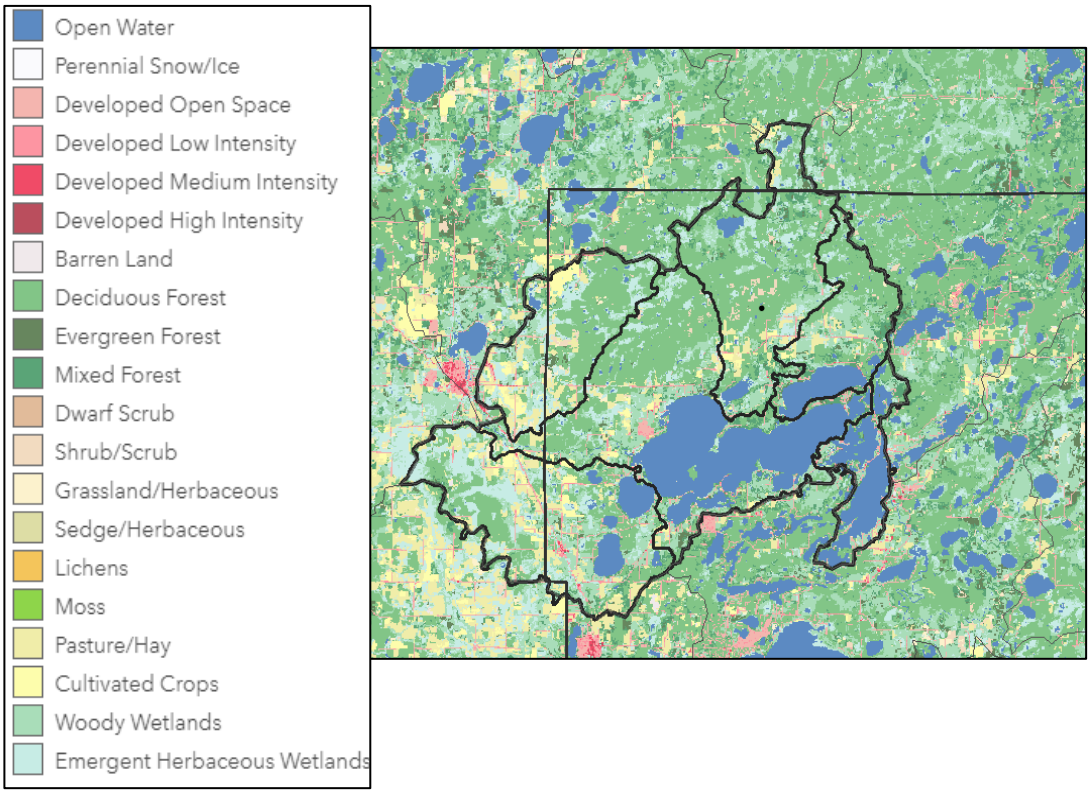
Implementation strategies

The Whitefish Lake minor watershed is a significant producer of clean water due mostly to its substantial forest cover, and finding ways to protect and enhance that forest cover is at the top of the implementation strategies for the Whitefish Lake minor watershed HUC10. If 75% of the watershed is protected by forests, wetlands, and grasslands, then the water quality has a high likelihood of remaining good. Such an approach reduces erosion, allows the continued benefits of the water cycle, and allows the ecosystem to utilize nutrients that would otherwise be delivered to surface and ground water. Tools such as conservation easements, SFIA (Sustainable Forest Incentive Act), and School Trust Lands (when used for environmental protection rather than development) are among those available to protect land in the watershed.

Land use in the Whitefish Lake minor watershed

The primary land cover in the Whitefish Lake minor watershed is forest (Figure 2).

Figure 2. Land use in the Whitefish Lake minor watershed (WHAF, 2021)



The Nature Conservancy has developed datasets that indicate the number of parcels, both state land and tax forfeit land that could be available for use as conservation easements or managed for protection by state agencies. Most of the state-owned lands in the Pine are managed by the counties. These publicly owned lands, although considered as protected from development because they are in public ownership, are also subject to logging and other similar activities, which can impact water quality to some extent, although if managed correctly the impact can be short-term or minimal (at least to water quality; impacts to wildlife can be much longer and more significant).

As much of the land ownership in the Whitefish Lake minor watershed HUC10 is on lakeshore, many of the practices to protect water quality must be implemented in those areas. Rain gardens, native buffers,

retention berms, rain barrels, infiltration trenches, and French drains are among the practices frequently installed on lakeshore properties in this watershed, and all are effective when properly implemented. Forest cover, wetlands, and undisturbed native shoreline vegetation reduce and filter runoff. Nature provides additional protection for lakes in the form of ice ridges, which unfortunately are routinely removed by lakeshore owners every spring free of permit fees or requirements.

Ice ridges are natural, heavily compacted berms that are created when ice that covers lakes in the winter cracks, expands, pushes dirt and rock up along the shorelines of lakes (Figure 3). Ice can push at 32,000 lbs./square inch, and this creates a stable and strong berm along the lake that will eventually become covered in vegetation and reduce erosion while keeping runoff from the upland out of the lakes if they are allowed to remain in place. However, current laws and perspectives make use of these natural structures extremely rare, as ice ridges are typically removed the same year that they are created with no-cost "annual ice ridge" permits. Leaving these in place, or keeping emergent aquatic vegetation in place along lake shores to minimize the extent and damage from ice ridges would reduce runoff from upland sources significantly, while also substantially reduce shoreline erosion.

Figure 3. An ice ridge begins to form on a Lake in central Minnesota. If left alone, the ice ridge would settle, compact further, and vegetate, stabilizing the shoreline and protecting from runoff for decades to come (Photo from Inforum.com).

Row crop and animal-based agriculture are contributors to water quality degradation in the watershed, and implementation efforts to mitigate those impacts are ongoing. The Crow Wing River Basin Forage Council (https://www.sfa-mn.org/forage-council/) is active in the area and has been working with farmers to incorporate soil health principles with practices such as cover crops, conservation tillage, flash grazing, and maintaining living roots in the soil are among the practices that have been used and will be encouraged going forward to increase organic material in the soil, thereby increasing water holding capacity and reducing soil loss into our surface waters.

Table 2. Implementation, milestones, schedules, assessment criteria, and costs for Arvig Creek Watershed (HUC 12 070101050401)

Treatment type	Milestones					Assessment	Cost
	2-year (2023)	4-year (2025)	6-year (2027)	8-year (2029)	10 year (2031)		
Implement grazing management systems on 100% of the pastureland	311 acres grazing management	311 acres grazing management	311 acres grazing management	311 acres grazing management	311 acres grazing management	# feet fence # acres	$933,000
Restore in-stream habitat in impaired streams to improve biological health (8976 ft of stream, improve 30%)	Stream Restoration on 539 ft	Stream Restoration on 539 ft	Stream Restoration on 539 ft	Stream Restoration on 539 ft	Stream Restoration on 539 ft	# feet restored	$168,300
Install EQIP general water quality practices and CSP water quality enhancements on agricultural lands.	Enroll 4 participants	Enroll 4 participants	Enroll 4 participants	Enroll 4 participants	Enroll 4 participants	# participants	$80,000
Implement the Minnesota Agricultural Water Quality Certification Program.	Enroll 2 farms in program	Enroll 2 farms in program	Enroll 2 farms in program	Enroll 2 farms in program	Enroll 2 farms in program	# farms enrolled	$10,000
Replace culverts along Long Farm Road to improve stream connect 5	2 culverts	3 culverts				# culverts replaced	$3,000
Maintain current wetland coverage currently identified in Arvig Creek	Continue to implement federal, state, and local ordinances and protection as currently administered	Continue to implement federal, state, and local ordinances and protection as currently administered	Continue to implement federal, state, and local ordinances and protection as currently administered	Continue to implement federal, state, and local ordinances and protection as currently administered	Continue to implement federal, state, and local ordinances and protection as currently administered	100% acres wetland unchanged	$10,000
Exclude cattle from stream riparian corridor with fencing or intensive rotational graze 100%	1,000 feet of fencing	1,000 feet of fencing	1,000 feet of fencing	1,000 feet of fencing	1,000 feet of fencing	# feet	$29,375
100% cover crops over winter, soil health practices, and no till (1,745 acres)	349 acres enrolled	349 acres enrolled	349 acres enrolled	349 acres enrolled	349 acres enrolled	# acres	$552,000
Fix 6 critical area culverts	Fix 2 culverts		Fix 2 culverts		Fix 2 culverts	# culverts repaired	$75,000
Total cost							**$1,861,035**

Table 3. Implementation, milestones, schedules, assessment criteria, and costs for Upper & Lower Hay Lakes

Treatment type	Milestones					Assessment	Cost
	2-year (2023)	4-year (2025)	6-year (2027)	8-year (2029)	10 year (2031)		
Upper: enroll 100 acres school trust land east of lake	277 acres in SFIA or permanent conservation easement	277 acres in SFIA or permanent conservation easement	277 acres in SFIA or permanent conservation easement	277 acres in SFIA or permanent conservation easement	277 acres in SFIA or permanent conservation easement	# SFIA agreements # acres	$87,383
Conservation Easements						# acres # easements	$1,473,731
20 raingardens Upper Hay and Lower Hay	4 Raingardens	4 raingardens	4 raingardens	4 raingardens	4 raingardens	# raingardens # acres	$100,000
Maintain/enhance 2 miles (10,560 ft) of riparian vegetation on lakes with >10% impervious areas (154 parcels) (9 restorations of approximately 70 ft each, annually)	Restore 2,052 feet of riparian vegetation	Restore 2,052 feet of riparian vegetation	Restore 2,052 feet of riparian vegetation	Restore 2,052 feet of riparian vegetation	Restore 2,052 feet of riparian vegetation	#feet # projects	$68,000
Work with the landowners to promote projects	Contact 5 landowners	Contact 5 landowners	Contact 5 landowners	Contact 5 landowners	Contact 5 landowners	# landowners contacted	$5,000
Plant 500 trees along the shoreline	50 trees	50 trees	50 trees	50 trees	50 trees	#trees	$870
Develop 10 Forest Stewardship Plans for a minimum of 20 acres each	2 Forest Plans	2 Forest Plans	2 Forest Plans	2 Forest Plans	2 Forest Plans	#Forest Plans #Acres	$30,000
Encourage landowners to sign up for Sustainable Forest Initiative Act (SFIA) to keep woods undeveloped (minimum 20 acres/each) for a total of 1498 acres	140 acres	140 acres	140 acres	140 acres	140 acres	#Acres %Protected	$186,100
Permanent conservation alternatives to SFIA							
Continue to monitor Secchi depth annually	10 readings	10 readings	10 readings	10 readings	10 readings	# Readings	$3,000
Promote SSTS maintenance and health	1 Workshop	1 Workshop	1 Workshop	1 Workshop	1 Workshop	#Workshops #Participants	$10,000
Maintain and pump SSTS every three years on 90% of the watershed (300 SSTS)	10 SSTS pumped/maintained ever 3 years	10 SSTS pumped/maintained ever 3 years	10 SSTS pumped/maintained ever 3 years	10 SSTS pumped/maintained ever 3 years	10 SSTS pumped/maintained ever 3 years	#systems pumped	$42,000
Implement voluntary lake sweeps for SSTS inspections.	1/3 SSTS inspected on lakes	1/3 SSTS inspected on lakes	1/3 SSTS inspected on lakes	Repeat: 1/3 SSTS inspected on lakes	Repeat: 1/3 SSTS inspected on lakes	# inspections	$42,000
Seal 30 unused residential wells	2 unused wells sealed	2 unused wells sealed	2 unused wells sealed	2 unused wells sealed	2 unused wells sealed	#Wells	$12,000

Treatment type	Milestones					Assessment	Cost
	2-year (2023)	**4-year (2025)**	**6-year (2027)**	**8-year (2029)**	**10 year (2031)**		
Educate and promote chloride reduction in applications and softeners	Host two training for property management MPCA Chloride Trainings. 10 people attend the training.	Host two training for property management MPCA Chloride Trainings. 10 people attend the training.	Host two training for property management MPCA Chloride Trainings. 10 people attend the training.	Host two training for property management MPCA Chloride Trainings. 10 people attend the training.	Host two training for property management MPCA Chloride Trainings. 10 people attend the training.	#Participants	$75,000
Work with townships to ensure proper stormwater treatment.	2 stormwater workshops	2 stormwater workshops	2 stormwater workshops	2 stormwater workshops	2 stormwater workshops	# workshops # participants	$10,000
Implement 100% of grazing management on 100% of the pastured land 1129 acres	225 acres grazing management	225 acres grazing management	225 acres grazing management	225 acres grazing management	225 acres grazing management	# acres	$338,700
Nutrient/manure management plans on 332 acres (half cropland)	66.5 acres applying nutrient/manure management practices	66.5 acres applying nutrient/manure management practices	66.5 acres applying nutrient/manure management practices	66.5 acres applying nutrient/manure management practices	66.5 acres applying nutrient/manure management practices	# acres	$25,000
Implement feedlot fixes: manure storage, water diversions, reduced lot sizes, vegetative filter strips	Fix one feedlot	Fix second feedlot				# fixes	$50,000
Complete watershed-wide culvert inventory and identify incorrectly sized culverts	Inventory watershed					# inventory	$2,0000
Replace/improve priority culverts with more than 5 ditch crossings	Replace ditch crossing	Replace ditch crossing	Replace ditch crossing	Replace ditch crossing	Replace ditch crossing	# crossings	$30,000
Abandon 2 ditches that are not needed and contributing to WQ issues		One ditch abandoned		One ditch abandoned		# ditches	$200,000
Total cost							**$2,748,784**

Table 4. Implementation, milestones, schedules, assessment criteria, and costs for Arrowhead Lake (HUC12 070101050403)

Treatment type	Milestones					Assessment	Cost
	2-year (2023)	**4-year (2025)**	**6-year (2027)**	**8-year (2029)**	**10 year (2031)**		
Maintain/enhance 2 miles (10,560 ft) of riparian vegetation on lakes with >10% impervious areas (9 restorations of approximately 70 ft each)	Restore 2,052 feet of riparian vegetation	Restore 2,052 feet of riparian vegetation	Restore 2,052 feet of riparian vegetation	Restore 2,052 feet of riparian vegetation	Restore 2,052 feet of riparian vegetation	# feet vegetation	$68,000
Work with the landowners to promote projects	Contact 5 landowners	Contact 5 landowners	Contact 5 landowners	Contact 5 landowners	Contact 5 landowners	# landowners contacted	$5,000
Plant 500 trees along the shoreline	50 Trees	50 Trees	50 Trees	50 Trees	50 Trees		$720
Develop 5 Forest Stewardship Plans for a minimum of 20 acres each	1 Forest Stewardship Plan	1 Forest Stewardship Plan	1 Forest Stewardship Plan	1 Forest Stewardship Plan	1 Forest Stewardship Plan	# plans # acres	$15,000
Encourage landowners to sign up for Sustainable Forest Initiative Act (SFIA) to keep woods undeveloped (minimum 20 acres/each) for a total of 500 acres	100 acres in SFIA	100 acres in SFIA	100 acres in SFIA	100 acres in SFIA	100 acres in SFIA	# acres	$62,200
Permanent conservation alternatives to SFIA (500 acres)	100 acres easement	100 acres easement	100 acres easement	100 acres easement	100 acres easement	# acres	$7,400,000
Continue to monitor Secchi depth annually	10 readings/milestone (5 readings/yr.)	10 readings/milestone (5 readings/yr.)	10 readings/milestone (5 readings/yr.)	10 readings/milestone (5 readings/yr.)	10 readings/milestone (5 readings/yr.)	# readings	$10,000
Promote SSTS maintenance and health	Conduct 2 workshops for homeowners and professionals	Conduct 2 workshops for homeowners and professionals	Conduct 2 workshops for homeowners and professionals	Conduct 2 workshops for homeowners and professionals	Conduct 2 workshops for homeowners and professionals	# workshops	$10,000
Maintain and pump SSTS every three years on 90% of the watershed (SSTS)	Pump and maintain 20 SSTS	Pump and maintain 20 SSTS	Pump and maintain 20 SSTS	Pump and maintain 20 SSTS	Pump and maintain 20 SSTS	# SSTS	$1,440
Seal 5 unused residential wells	Seal 1 unused residential wells	1 Sealed Well	1 Sealed Well	1 Sealed Well	1 Sealed Well	# wells	$5,200
Educate and promote chloride reduction in applications and softeners	Host two trainings - 10 people attend the training.	Host two trainings - 10 people attend the training.	Host two trainings - 10 people attend the training.	Host two trainings - 10 people attend the training.	Host two trainings - 10 people attend the training.	# workshops	$10,000

Treatment type	Milestones					Assessment	Cost
	2-year (2023)	4-year (2025)	6-year (2027)	8-year (2029)	10 year (2031)		
Total							**$7,687,580**

Table 5. Implementation, milestones, schedules, goals, assessment criteria, and costs for Big Trout Lake (HUC12 070101050404)

Treatment type	Milestones					Assessment	Cost
	2-year (2023)	4-year (2025)	6-year (2027)	8-year (2029)	10 year (2031)		
25 Raingardens	5 raingardens	5 raingardens	5 raingardens	5 raingardens	5 raingardens	# raingardens	$125,000
Restore 2 miles (10,560 ft) of riparian vegetation in areas over 10% impervious surface/disturbed areas. 17 projects	Restore 2,052 feet of riparian vegetation	Restore 2,052 feet of riparian vegetation	Restore 2,052 feet of riparian vegetation	Restore 2,052 feet of riparian vegetation	Restore 2,052 feet of riparian vegetation	# feet vegetation	$68,000
Outreach to landowners	Conduct 1:1 outreach to minimum 5 landowners	Conduct 1:1 outreach to minimum 5 landowners	Conduct 1:1 outreach to minimum 5 landowners	Conduct 1:1 outreach to minimum 5 landowners	Conduct 1:1 outreach to minimum 5 landowners	# contacts # contracts # mailers	$5,000
Plant 500 trees along shoreline	100 trees planted	100 trees planted	100 trees planted	100 trees planted	100 trees planted	# trees	$720
Develop 5 Forest Stewardship Plans (min. 20 acre each)	1 Forest Stewardship Plan	1 Forest Stewardship Plan	1 Forest Stewardship Plan	1 Forest Stewardship Plan	1 Forest Stewardship Plan	# plans # acres	$3,000
Sustainable Forest Incentive Act (keep undeveloped)	135 acres in SFIA or permanent conservation easement (25 acres)	136 acres in SFIA or permanent conservation easement (25 acres)	137 acres in SFIA or permanent conservation easement	138 acres in SFIA or permanent conservation easement (25 acres)	139 acres in SFIA or permanent conservation easement (25 acres)	# SFIA agreements # acres	$85,100
Conservation Easements (100 acres)						# acres # easements	$1,473,731
Secchi monitoring	10 readings	10 readings	10 readings	10 readings	10 readings	# readings	$
30 shoreland zone above surficial sand aquifer SSTS maintained/pumped every three years	10 SSTS pumped/maintained ever 3 years	10 SSTS pumped/maintained ever 3 years	10 SSTS pumped/maintained ever 3 years	10 SSTS pumped/maintained ever 3 years	10 SSTS pumped/maintained ever 3 years	# pumps # SSTS	$8,400
Seal 30 unused wells in Shoreland Zone	2 unused wells sealed	2 unused wells sealed	2 unused wells sealed	2 unused wells sealed	2 unused wells sealed	# wells	$10,000

Treatment type	Milestones					Assessment	Cost
	2-year (2023)	4-year (2025)	6-year (2027)	8-year (2029)	10 year (2031)		
Educate and promote chloride reduction in applications and softeners	Host two training for property management MPCA Chloride Trainings. 10 people attend the training.	Host two training for property management MPCA Chloride Trainings. 10 people attend the training.	Host two training for property management MPCA Chloride Trainings. 10 people attend the training.	Host two training for property management MPCA Chloride Trainings. 10 people attend the training.	Host two training for property management MPCA Chloride Trainings. 10 people attend the training.	#participants # certification received	$50,000
2018 Installed three downstream defenders perforated pipes to filter the stormwater runoff from 120 acres of CSAH 66.	Completed						$330,500
Redirect 129 feet curb gutter of the CSAH 66 into the downstream defender	Install 2021 or 2022						$17,000
Total							**$1,893,201**

Table 6. Implementation, milestones, schedules, assessment criteria, and costs for Whitefish Lake (HUC12 070101050405)

Treatment type	Milestones					Assessment	Cost
	2-year (2023)	4-year (2025)	6-year (2027)	8-year (2029)	10 year (2031)		
Whitefish Lake							
30 raingardens	6 raingardens	6 raingardens	6 raingardens	6 raingardens	6 raingardens	# raingardens	$150,000
Maintain 2 miles (10,560 ft) of riparian vegetation	Maintain 1,760 ft of shoreline riparian vegetation	Maintain 1,760 ft of shoreline riparian vegetation	Maintain 1,760 ft of shoreline riparian vegetation	Maintain 1,760 ft of shoreline riparian vegetation	Maintain 1,760 ft of shoreline riparian vegetation	# ft shoreline vegetation	$120,000
Restore 2,100 ft riparian vegetation on lakes with >10% impervious areas (154 parcels) (total of 30 restorations of approximately 70 ft each, 50 ft wide annually) and maintain (total of 2.4 acres)	Conduct 6 shoreland restoration projects (approximately 350 ft each)	Conduct 6 shoreland restoration projects (approximately 350 ft each)	Conduct 6 shoreland restoration projects (approximately 350 ft each)	Conduct 6 shoreland restoration projects (approximately 350 ft each)	Conduct 6 shoreland restoration projects (approximately 350 ft each)	# feet # acres # participants	
Work with the landowners to promote shoreline vegetation projects	Make contact and educate about benefits for	Make contact and educate about benefits for	Make contact and educate about benefits for	Make contact and educate about benefits for	Make contact and educate about benefits for	# residents # contacts	$40,000

Treatment type	Milestones					Assessment	Cost
	2-year (2023)	4-year (2025)	6-year (2027)	8-year (2029)	10 year (2031)		
	restoring shorelines to 15 residents	restoring shorelines to 15 residents	restoring shorelines to 15 residents	restoring shorelines to 15 residents	restoring shorelines to 15 residents		
Plant 500 trees along the shoreline	Plant 100 trees along shoreline	Plant 100 trees along shoreline	Plant 100 trees along shoreline	Plant 100 trees along shoreline	Plant 100 trees along shoreline	# trees	$720
Develop 5 Forest Stewardship Plans for a minimum of 20 acres each	Develop a Forest Stewardship Plan for a minimum of 20 acres each	Develop a Forest Stewardship Plan for a minimum of 20 acres each	Develop a Forest Stewardship Plan for a minimum of 20 acres each	Develop a Forest Stewardship Plan for a minimum of 20 acres each	Develop a Forest Stewardship Plan for a minimum of 20 acres each	# acres protected # plans	$3,000
Encourage landowners to sign up for Sustainable Forest Initiative Act (SFIA) to keep woods undeveloped (minimum 20 acres/each) for a total of 1498 acres		Enroll 140 a/yr., for a total of 280 a/milestone		Enroll 140 a/yr., for a total of 280 a/milestone	Enroll 140 a/yr., for a total of 280 a/milestone	# acres # landowners	$94,702
Permanent conservation alternatives to SFIA						# acres	$481,858
Continue to monitor Secchi depth annually	10 readings/milestone (5 readings/yr.)	10 readings/milestone (5 readings/yr.)	10 readings/milestone (5 readings/yr.)	10 readings/milestone (5 readings/yr.)	10 readings/milestone (5 readings/yr.)	# readings # participants	$10,000
Promote SSTS maintenance and health	Conduct 2 workshops for homeowners and professionals	Conduct 2 workshops for homeowners and professionals	Conduct 2 workshops for homeowners and professionals	Conduct 2 workshops for homeowners and professionals	Conduct 2 workshops for homeowners and professionals	# workshops # participants	$2,000
Maintain and pump SSTS every three years on 90% of the watershed (300 SSTS)	Pump and maintain 60 SSTS	Pump and maintain 60 SSTS		Pump and maintain 60 SSTS	Pump and maintain 60 SSTS	# Systems % Compliance	$42,000
Seal 30 unused residential wells	Seal 6 unused residential wells	Seal 6 unused residential wells	Seal 6 unused residential wells	Seal 6 unused residential wells	Seal 6 unused residential wells	#sealed Wells	$30,000
Educate and promote chloride reduction in applications and softeners	Host two training for property management MPCA Chloride Trainings. 10 people attend the training.	Host two training for property management MPCA Chloride Trainings. 10 people attend the training.	Host two training for property management MPCA Chloride Trainings. 10 people attend the training.	Host two training for property management MPCA Chloride Trainings. 10 people attend the training.	Host two training for property management MPCA Chloride Trainings. 10 people attend the training.	# workshops # participants	$50,000

Treatment type	Milestones					Assessment	Cost
	2-year (2023)	4-year (2025)	6-year (2027)	8-year (2029)	10 year (2031)		
Expand the availability of information and network of resources for promoting stormwater management to lake residents on declining lakes (Whitefish, Big Trout, Island-Loon, Clamshell, Pig)	2 workshops	2 workshops	2 workshops	2 workshops	2 workshops	# workshops # participants	$10,000
Work with MNDOT to ensure proper stormwater treatment for new road improvements on the Hwy 371 corridor	Conversations as project come forward.	Conversations as project come forward.	Conversations as project come forward.	Conversations as project come forward.	Conversations as project come forward.		$10,000
Implement 100% of grazing managements systems on 100% of the ag land (EQUIP Payment rates for 2021 range from $ 17 an acre to $69 for the plans). Equip Rates for fences (.50-3.99 per foot of fence)	1,000 feet of fence, water sources, grazing plans, and solar pumps. 50 Acres into grazing management plan	1,000 feet of fence, water sources, and solar pumps. 50 Acres into grazing management plan	1,000 feet of fence, water sources, and solar pumps. 50 Acres into grazing management plan	1,000 feet of fence, water sources, and solar pumps. 50 Acres into grazing management plan	1,000 feet of fence, water sources, and solar pumps. 50 Acres into grazing management plan	# length fences # acres # paddocks #water sources	$20,000
Nutrient/manure management plans developed and implemented on 2 parcels		1 Plan		1 Plan		# plans # acres	$40,000
Implement 100% of grazing managements systems on 100% of the ag land (EQUIP Payment rates for 2021 range from $ 17 an acre to $69 for the plans). Equip Rates for fences (.50-3.99 per foot of fence)	1,000 feet of fence, water sources, grazing plans, and solar pumps. 50 Acres into grazing management plan	1,000 feet of fence, water sources, and solar pumps. 50 Acres into grazing management plan	1,000 feet of fence, water sources, and solar pumps. 50 Acres into grazing management plan	1,000 feet of fence, water sources, and solar pumps. 50 Acres into grazing management plan	1,000 feet of fence, water sources, and solar pumps. 50 Acres into grazing management plan	# length fences # acres # paddocks #water sources	$20,000
Complete watershed-wide culvert inventory and identify incorrectly sized culverts	Inventory	Inventory				# inventories # culverts Identified	$40,000
Replace/improve priority culverts with more than 5 ditch crossings.			Repair 5 ditch crossings	Repair 5 ditch crossings		# crossings	$10,000
Cost-share future culvert replacements and design assistance with townships to ensure proper function.	Replace 2 culverts	Replace 2 culverts	Replace 2 culverts	Replace 2 culverts	Replace 2 culverts	# culverts replaced	$8,000

Treatment type	Milestones					Assessment	Cost
	2-year (2023)	4-year (2025)	6-year (2027)	8-year (2029)	10 year (2031)		
Abandon 2 ditches that are not needed and contributing to WQ issues.				Abandon 2 ditches		# ditches abandoned	$5,000
Implement voluntary lake sweeps for SSTS inspections.	50 SSTS	50 SSTS	50 SSTS	50 SSTS	50 SSTS	# volunteers # systems checked	$10,000
Provide incentives for people to maintain their septic systems and get them pumped every three years.	90% compliance	90% compliance	90% compliance	90% compliance	90% compliance	% compliance	$10,000
Conduct a nitrate clinic for landowners with private wells to educate them about fertilizer application on lawns and the vulnerability of shallow groundwater	Host two nitrate clinics in the watershed.	Host two nitrate clinics in the watershed.	Host two nitrate clinics in the watershed.	Host two nitrate clinics in the watershed.	Host two nitrate clinics in the watershed.	# clinics # participants	$10,000
Upper Whitefish Boat Access Bioretention	Install 2023					# Ibis #native plants	$70,000
Total							**$1,227,280**
Bertha and Clamshell Lakes							
Install 10 raingardens Bertha Lake	Install 2 raingardens in Bertha Lake	Install 2 raingardens in Bertha Lake	Install 2 raingardens in Bertha Lake	Install 2 raingardens in Bertha Lake	Install 2 raingardens in Bertha Lake	# Raingardens	$50,000
Install 40 raingardens in Clamshell Lake	Install 8 raingardens in Clamshell Lake	Install 8 raingardens in Clamshell Lake	Install 8 raingardens in Clamshell Lake	Install 8 raingardens in Clamshell Lake	Install 8 raingardens in Clamshell Lake	# Raingardens	$200,000
Shoreline buffers/native vegetation 7 projects in Bertha Lake	Shoreline buffers/native vegetation 1 projects in Bertha Lake	Shoreline buffers/native vegetation 1 projects in Bertha Lake	Shoreline buffers/native vegetation 1 projects in Bertha Lake	Shoreline buffers/native vegetation 1 projects in Bertha Lake	Shoreline buffers/native vegetation 1 projects in Bertha Lake	#plants #feet #shoreline	$20,000

Treatment type	Milestones					Assessment	Cost
	2-year (2023)	4-year (2025)	6-year (2027)	8-year (2029)	10 year (2031)		
Shoreline buffers/native vegetation 4 projects in Clamshell Lake	Shoreline buffers/native vegetation 1 projects in Clamshell Lake	Shoreline buffers/native vegetation 1 projects in Clamshell Lake	Shoreline buffers/native vegetation 1 projects in Clamshell Lake	Shoreline buffers/native vegetation 1 projects in Clamshell Lake	Shoreline buffers/native vegetation 1 projects in Bertha Lake	#plants #feet #shoreline	$20,000
Plant 500 trees in the shoreline in both Bertha and Clamshell Lakes	Plant 100 trees in each lake shoreland (200 trees total)	Plant 100 trees in each lake shoreland (200 trees total)	Plant 100 trees in each lake shoreland (200 trees total)	Plant 100 trees in each lake shoreland (200 trees total)	Plant 100 trees in each lake shoreland (200 trees total)	# trees	$1,440
Develop 3 Forest Steward Ship Plans on minimum 20-acre parcels	Develop 1 Forest Stewardship Plan		Develop 1 Forest Stewardship Plan		Develop 1 Forest Stewardship Plan	# plans # acres	$1,800
Sign up 60 acres for SFIA to keep wooded acres undeveloped	Sign up 20 acres in protection		Sign up 20 acres in protection		Sign up 20 acres in protection	# acres	$23,000
Permanent easements to protect undeveloped land and (Conduct outreach to 2 parcel owners with > 3 RAQ scores in Clamshell Lake)							
Monitor Secchi depth 5 readings/yr./lake	Secchi disk 20 readings	Secchi disk 20 readings	Secchi disk 20 readings	Secchi disk 20 readings	Secchi disk 20 readings	# readings	$10,000
Seal 30 unused residential wells	Seal 6 unused residential wells	Seal 6 unused residential wells	Seal 6 unused residential wells	Seal 6 unused residential wells	Seal 6 unused residential wells	#wells	$6,000
Maintain and pump at least 116 SSTS in the Bertha and Clamshell Lake shoreland	Maintain and pump 58 SSTS every three years	Maintain and pump 58 SSTS every three years		Maintain and pump 58 SSTS every three years	Maintain and pump 58 SSTS every three years	# inspections # pumps # SSTS	$16,240
Educate and promote chloride reduction in applications and softeners	Host two training for property management MPCA Chloride Trainings. 10 people attend the training.	Host two training for property management MPCA Chloride Trainings. 10 people attend the training.	Host two training for property management MPCA Chloride Trainings. 10 people attend the training.	Host two training for property management MPCA Chloride Trainings. 10 people attend the training.	Host two training for property management MPCA Chloride Trainings. 10 people attend the training.	#training	$40,000
Bertha Boat Works West Bioretention	Install Summer 2023					# acres	$13,700

Treatment type	Milestones					Assessment	Cost
	2-year (2023)	**4-year (2025)**	**6-year (2027)**	**8-year (2029)**	**10 year (2031)**		
Bertha Boatworks North Bioretention	Install Summer 2023					# acres	$14,200
Bertha Boatworks Central Bioretention	Install Summer 2023					# acres	$11,000
Total							**$427,380**
Pig Lake							
Shoreline buffers at 50% of shoreline	One third	One third	One third			# feet buffer	$42,000
Outreach to private landowners to install buffers and promote projects.	Complete two site visits to visit with landowners.	Complete two site visits to visit with landowners.	Complete two site visits to visit with landowners.	Complete two site visits to visit with landowners.	Complete two site visits to visit with landowners.	# contacts	$5,000
20 Raingarden	2 raingardens	2 raingardens	2 raingardens	2 raingardens	2 raingardens	# raingardens	$100,000
Maintain/enhance 2 miles (10,560 ft) of riparian vegetation on lakes with >10% impervious areas (154 parcels) (30 restorations of approximately 70 ft each, annually)	1 shoreline buffer		1 shoreline buffer		1 shoreline buffer	#shoreline buffers	$16,000
Plant 500 trees along the shoreline	50 trees	50 trees	50 trees	50 trees	50 trees	# trees	$720
Develop 1 Forest Stewardship Plans for a minimum of 20 acres each			1 Forest Stewardship Plan			# Plans and # Acres	$600
Encourage landowners to sign up for Sustainable Forest Initiative Act (SFIA) to keep woods undeveloped (minimum 20 acres/each) for a total of 1498 acres	20 Acres			20 acres		# acres	$1,264,000
Permanent conservation alternatives to SFIA	20 Acres			20 acres		# acres	$21,817.00
Continue to monitor Secchi depth annually	Secchi disk 10 readings	Secchi disk 10 readings	Secchi disk 10 readings	Secchi disk 10 readings	Secchi disk 10 readings	# readings	$5,000
Promote SSTS maintenance and health	Conduct 2 workshops for homeowners and professionals					# participants	$4,000

Treatment type	Milestones					Assessment	Cost
	2-year (2023)	**4-year (2025)**	**6-year (2027)**	**8-year (2029)**	**10 year (2031)**		
Maintain and pump SSTS every three years on 90% of the watershed (48 SSTS)	Pump and maintain 48 SSTS	Pump and maintain 48 SSTS	Pump and maintain 48 SSTS	Pump and maintain 48 SSTS	Pump and maintain 48 SSTS	# Septic Systems	$35,520.00
Seal 10 unused residential wells	Seal 1 unused residential wells	Seal 1 unused residential wells	Seal 1 unused residential wells	Seal 1 unused residential wells	Seal 1 unused residential wells	# wells	$10,000.00
Educate and promote chloride reduction in applications and softeners	Host two training for property management MPCA Chloride Trainings. 10 people attend the training.	Host two training for property management MPCA Chloride Trainings. 10 people attend the training.	Host two training for property management MPCA Chloride Trainings. 10 people attend the training.	Host two training for property management MPCA Chloride Trainings. 10 people attend the training.	Host two training for property management MPCA Chloride Trainings. 10 people attend the training.	# participants	$10,000
Provide incentives for people to maintain their septic systems and get them pumped every three years (25 percent of the cost).	90% compliance	90% compliance	90% compliance	90% compliance	90% compliance	# participants	$8,880.00
Total							**$2,524,557**
Island-Loon Lakes							
Outreach to private landowners to install buffers and promote projects.	2 Site visit per year.	2 Site visits per year.	2 site visits per year.	2 Site visit per year.	2 Site visit per year.	# site visits	$7,000
10 Raingarden	2 raingardens	2 raingardens	2 raingardens	2 raingardens	2 raingardens	#raingardens	$50,000
Maintain/enhance 2 miles (10,560 ft) of riparian vegetation on lakes with >10% impervious areas (154 parcels) (30 restorations of approximately 70 ft each, annually)		2 shoreline Projects	2 shoreline Projects	2 Shoreline projects		# feet	$24,000
Work with the landowners to promote projects	Complete 5 site visits with residents provide benefits for restoring shorelines.	Complete 5 site visits with residents provide benefits for restoring shorelines.	Complete 5 site visits with residents provide benefits for restoring shorelines.	Complete 5 site visits with residents provide benefits for restoring shorelines.	Complete 5 site visits with residents provide benefits for restoring shorelines.	#site visits #projects	$2,500
Plant 500 trees along the shoreline	50 trees	50 trees	50 trees	50 trees	50 trees	# trees	$720

Treatment type	Milestones					Assessment	Cost
	2-year (2023)	4-year (2025)	6-year (2027)	8-year (2029)	10 year (2031)		
Continue to monitor Secchi depth annually	Secchi disk 20 readings	Secchi disk 20 readings	Secchi disk 20 readings	Secchi disk 20 readings	Secchi disk 20 readings	# readings # participants	$10,000
Maintain and pump SSTS every three years on 90% of the watershed (28 SSTS)	Pump and maintain 28 SSTS	Pump and maintain 28 SSTS	Pump and maintain 28 SSTS	Pump and maintain 28 SSTS	Pump and maintain 28 SSTS	#SSTS Pumped	$19,600
Seal 10 unused residential wells	Seal 1 unused residential wells	Seal 1 unused residential wells	Seal 1 unused residential wells	Seal 1 unused residential wells	Seal 1 unused residential wells	# wells	
Educate and promote chloride reduction in applications and softeners	Host two training for property management MPCA Chloride Trainings.	Host two training for property management MPCA Chloride Trainings.	Host two training for property management MPCA Chloride Trainings.	Host two training for property management MPCA Chloride Trainings.	Host two training for property management MPCA Chloride Trainings.	# attendees # trainings	$5,000
Expand the availability of information and network of resources for promoting stormwater management to lake residents on declining lakes (Whitefish, Big Trout, Island-Loon, Clamshell, Pig)	2 workshops	2 workshops	2 workshops	2 workshops	2 workshops	# workshops # participants	$10,000
Provide incentives for people to maintain their septic systems and get them pumped every three years.	90% compliance	90% compliance	90% compliance	90% compliance	90% compliance	% compliance	$20,000
Install three mechanical separators and 13,500 square feet bioretention area. Drainage area included: 43 acres of the CSAH 66 and Manhattan Point BLVD	Completed 2020						
Total							**$160,820**

Willow Creek							
Restore in-stream habitat in impaired streams to improve biological health (22,176 ft of stream, improve 30%)	Stream Restoration on 1331 ft	Stream Restoration on 1331 ft	Stream Restoration on 1331 ft	Stream Restoration on 1331 ft	Stream Restoration on 1331 ft	# feet restored	$415,467
Total							**$415,467**

Table 7. Implementation, milestones, schedules, assessment criteria, and costs for Cross Lake (HUC12 070101050406)

Treatment type	Milestones					Assessment	Cost
	2-year (2023)	4-year (2025)	6-year (2027)	8-year (2029)	10 year (2031)		
Promote SSTS maintenance and health (382 SSTS)	Conduct 2 workshops for homeowners and professionals	Conduct 2 workshops for homeowners and professionals	Conduct 2 workshops for homeowners and professionals	Conduct 2 workshops for homeowners and professionals	Conduct 2 workshops for homeowners and professionals	# workshops # participants	$2,000
Maintain 90% (pumping every 3 years)	First 230 SSTS pumped and maintained	Last 115 SSTS pumped and maintained Second of first 115 round begins	Second pumping schedule of 230 SSTS	Second pumping schedule of 230 SSTS	Second pumping schedule of 230 SSTS	# SSTS pumped	$161,000
Targeting road density -- Helping county reduce road salt on X road, etc.	Provide training for salt applicators, provide resources	Provide cost share to upgrade salt application equipment				# tons road salt # salt trainings # equipment upgrades	$15,000
Education for residents of impacts and how to reduce water softener salt discharge in Hay Lake Subwatershed	Newsletter to residents of Hay Creek about water softener usage/salt reduction	Workshop about water softener salt reduction				# newsletters # contacts # attendees	$5,500
Seal 30 unused residential wells (382 Wells along the Crosslake)	Seal 6 unused residential wells	Seal 6 unused residential wells	Seal 6 unused residential wells	Seal 6 unused residential wells	Seal 6 unused residential wells	# wells sealed	$30,000
Upgrade 14 failing SSTS in the Cross Lake subwatershed	Upgrade 4 failing SSTS	Upgrade 4 failing SSTS	Upgrade 3 failing SSTS	Upgrade 3 failing SSTS	Upgrade 3 failing SSTS	# SSTS upgraded	$ 280,000
Stormwater Runoff CSAH 66: 5 biorientation areas re-direct stormwater runoff from curb and gutter system at the Old Log Church, City Fire Station, Simeson Lumber and Crosslake Market Square	Install in Summer 2023						$315,000
Feasibility of CSAH 66 stormwater Runoff into the Pine River	Feasibility study of the potential BMPs for last drainage are						$10,000.00

Treatment type	Milestones					Assessment	Cost
	2-year (2023)	4-year (2025)	6-year (2027)	8-year (2029)	10 year (2031)		
	includes 23 acres of City of Crosslake draining to the Pine River Dam.						
Total							**$818,500**

Element a. sources

> *An identification of the causes and sources or groups of similar sources that will need to be controlled to achieve the load reductions estimated in this watershed-based plan (and to achieve any other watershed goals identified in the watershed-based plan), as discussed in item (b) immediately below. Sources that need to be controlled should be identified at the significant subcategory level with estimates of the extent to which they are present in the watershed (e.g., X numbers of dairy cattle feedlots needing upgrading, including a rough estimate of the number of cattle per facility; Y acres of row crops needing improved nutrient management or sediment control; or Z linear miles of eroded streambank needing remediation).*
>
> *EPA Handbook for Restoring and Protecting Our Waters*

The Whitefish Lake minor watershed, like most of the Pine River Major Watershed, is primarily forested, with less than 10% of the watershed developed. Approximately 15% of the watershed is in agricultural land use, and much of that area of the watershed drains into the Pine River, which flows into Whitefish Lake and contributes a significant quantity of phosphorus to the chain.

Figure 4. Mats of vegetation like this one are becoming problematic in some of the shallower bays of Upper Whitefish Lake.

Increased phosphorus loading can lead to increased vegetation as illustrated in Figure 4.

Currently, the highest phosphorus, nitrogen, and sediment unit-area loading rates are from feedlots, agriculture, and developed areas in the Whitefish Lake minor watershed (Pine River Watershed Pollutant Source Assessment and Evaluation of Resource Management and Precipitation Scenarios, RESPEC, 2014.)

Analysis with the SAM (Scenario Application Manager) tool indicates that the most significant sources of Phosphorus in the Whitefish Lake minor watershed HUC10 are, from largest down: deciduous forest (divided in the table by soil types AB and CD), wetland, cropland, and atmospheric deposition (see Figure 5). However, the plot in Figure 5 represents total load, as opposed to average total phosphorus concentration (Figure 6). When considering both plots, it becomes apparent that wetland loads are due mostly to their volume, as their load concentration is relatively low; whereas, cropland is a significant phosphorus contributor due to both total load and load concentration. Further, best management practices can effectively be implemented in croplands to mitigate and reduce loading, whereas there is little that will improve forest and wetland that already do a great deal to minimize loading.

Figure 5. Sources of Phosphorus loading in the Whitefish Lake Watershed HUC10 as calculated by the Scenario Application Manager (SAM) tool (Permit numbers represent the Pine River Sanitary District and The Crosslake WWTP)

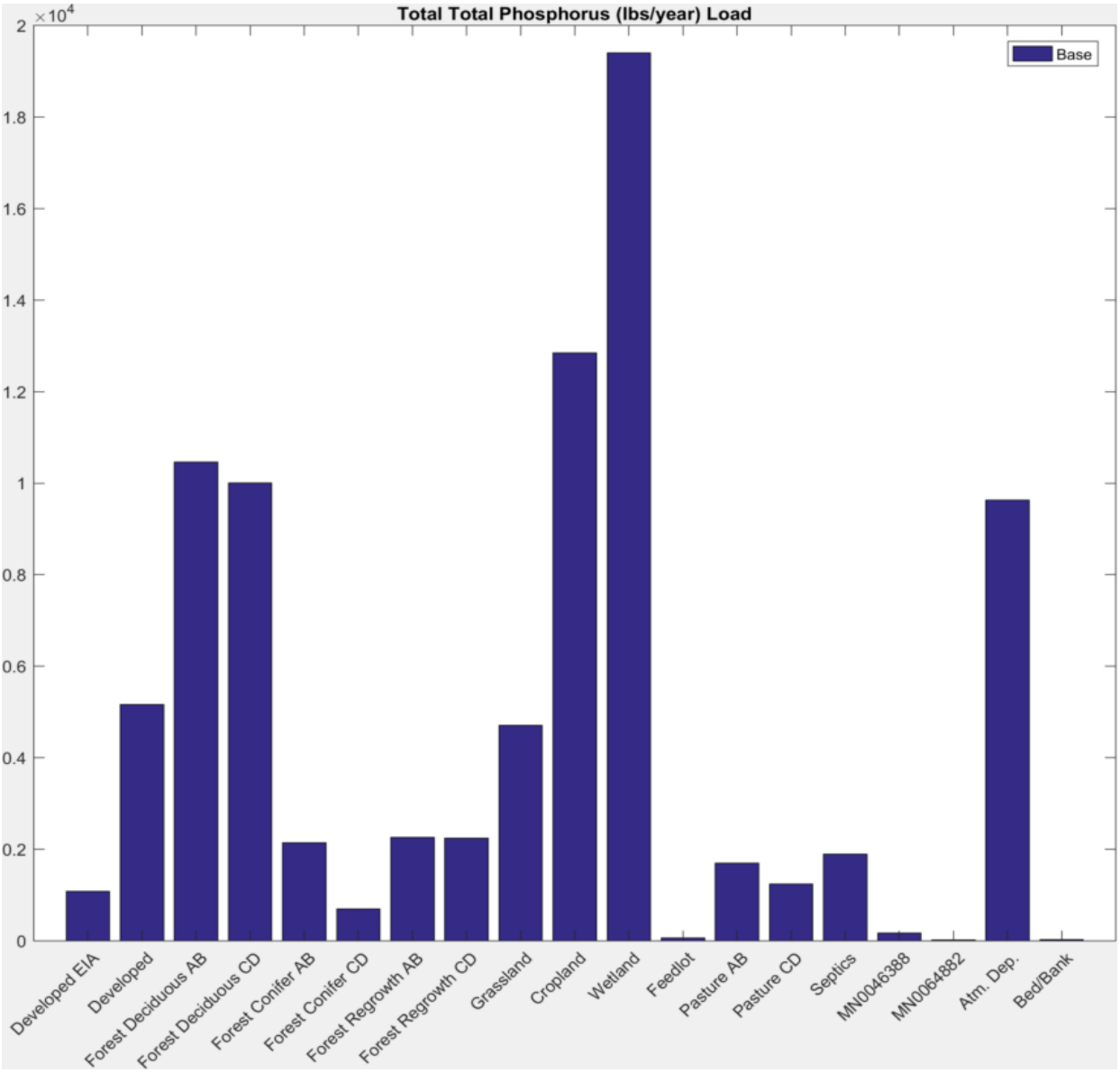
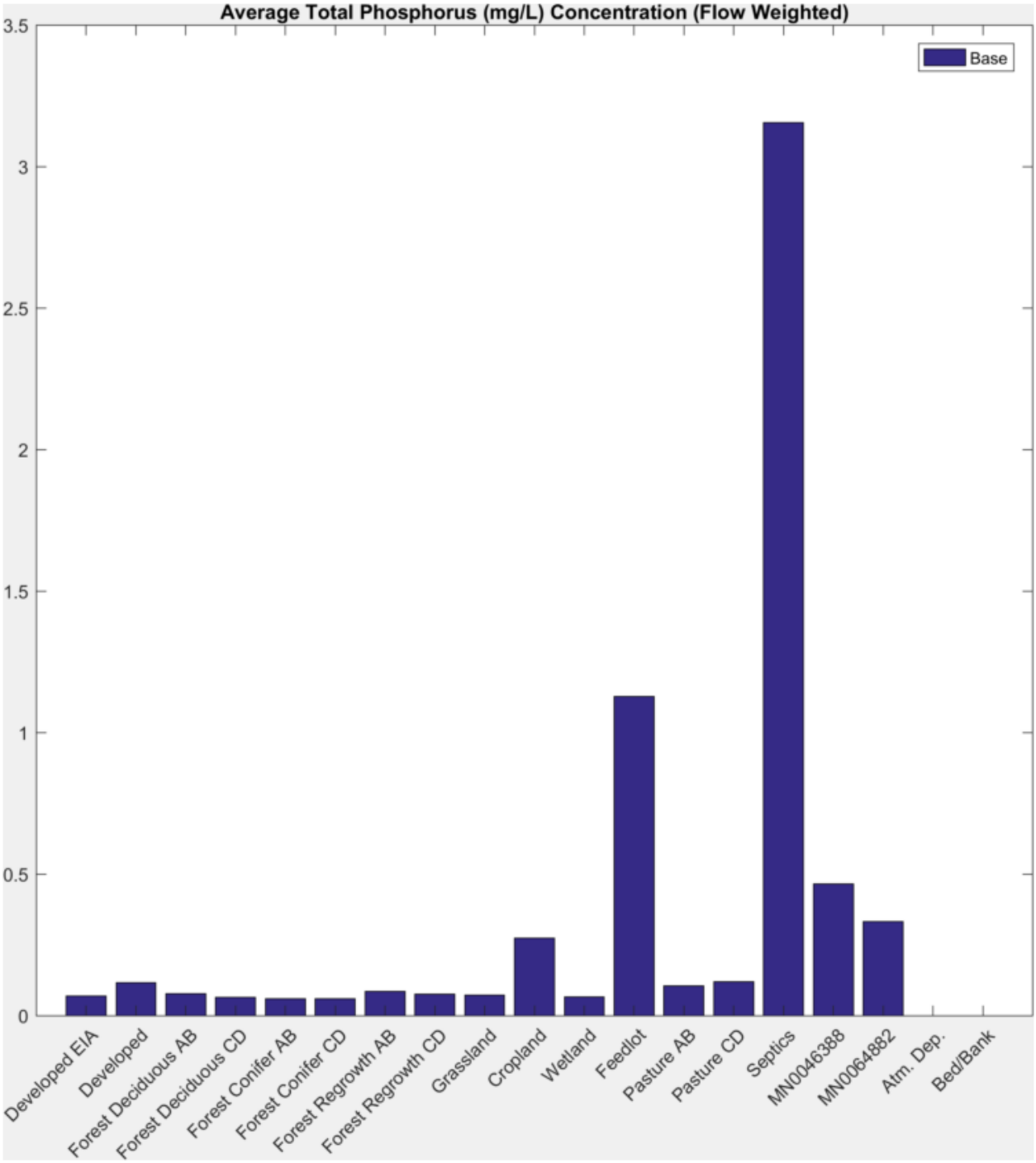


Figure 6. Phosphorus loading concentrations in the Whitefish Lake minor watershed HUC10



Development

Developed land has its own set of challenges for water quality management. Impervious pavement, removal of native vegetation and trees, and sculpted landscapes change the way and rates the water flows into lakes and other surface waters and increases pollutant loading. Impervious surfaces allow stormwater to run off quickly, transporting pollutants to surface water, without the opportunity for the soil to filter out impurities. Large homes, large buildings, native vegetation removal and increased runoff are illustrated in Figure 7 and Figure 8.

Figure 7: Large homes, native vegetation removal and subsequent runoff contribute to slow decline in Whitefish Lake minor watershed water quality.

Crow Wing County ordinance requires that no more than 25% of a shoreline zoned lake lot can be impervious (buildings, asphalt, concrete, etc.). Lots with more than 15% imperviousness must manage stormwater through the use of raingardens, shoreline buffers, tree planting. Figure 15 and Figure 16 illustrate the level of impervious land around the lakes. Any area with more than 20% impervious area is considered the highest priority for shoreline projects. The light green areas, or areas with less than 5% impervious area, are strong candidates for permanent conservation easements and other protection from future development.

Figure 8. Shoreline development, removal of native vegetation, and increases in impervious surfaces are contributing to a slow degradation of water quality in the Whitefish Lake subwatershed.

Impervious areas and ratios are illustrated in Figure 17 (Big Trout Lake) and Figure 18 (Whitefish Lake chain). These highest loading areas will be addressed first.

Agriculture

Most of the agriculture in the Whitefish HUC10 is located west of the Whitefish drain, much of which drains to Willow Creek or to waterbodies outside the planning area. Agriculture north and south of the Whitefish Chain of Lakes also falls within the drainage area of flowages coming into the Whitefish chain and are contributors to total phosphorus levels in the lakes.

Row crop makes up as smaller portion of the watershed. Grazing practices on pasture land, especially in the riparian areas of the creeks, increase P and TSS loading to the waterbodies.

In Willow and Arvig Creeks the causes of the impairments were determined to be habitat alteration resulting from livestock grazing near and into the streams. This caused deep-rooted riparian vegetation to be lost along the stream bank, which in turn caused erosion of the banks, causing widening of the stream and aquatic habitat loss due to sedimentation (WRAPS, 2017).

There are only six feedlots that are required to be registered under Minn. R. 7020 (Table 8). Most are small operations. None of the feedlots hold an NPDES or SDS permit or are considered confined animal feeding operations (CAFO). All the feedlots have pasture areas. The number of feedlots in this area make it feasible to address any associated loading from their farms. Feedlot farming is not a major activity in

the watershed; however, feedlots can be a significant source of nutrients and bacteria loading. The loading can be decreased by the implementation of feedlot BMPs. Practices that are planned for implementation in the Whitefish Lake area include manure storage, surface water diversion (channeling surface water to runoff settling basins), and vegetated filter strips. Smaller feedlot sizes can make contaminated runoff more manageable by containing runoff to a smaller area to be more easily treated.

Table 8. Registered feedlot animal counts in the Whitefish Lake HUC10 Watershed

Watershed	Type	Number of cattle	Number of dairy cows
Arrowhead Lake	Beef	454	0
Arvig Creek	Beef	450	0
Lower Hay Lake	Beef and dairy	200	975

SSTS

Shallow aquifers paired with sandy soil means that the groundwater is vulnerable to contaminants. Subsurface sewage treatment systems (septic systems) when not properly maintained, can leach nutrients (particularly P) and bacteria into the aquifers and lakes (1W1, 2020).

Stressors Willow and Arvig Creeks

The primary stressors for Arvig and Willow Creeks are summarized in Table 9.

Table 9. Stressors to Arvig and Willow Creeks (WRAPS report, 2017)

UC 10 Watershed	Stream Name	AUID #	Stressors						
			Low Dissolved Oxygen	Flow Alteration	Increased Sediment	Increased Bedded Sediment	Elevated Nutrients	Lack of Physical Habitat	Physical Connectivity
Whitefish Lake	Arvig Creek	-509	X			X		X	
Whitefish Lake	Willow Creek	-631				X		X	X

Point sources

Point source pollution is comprised of treated wastewater, NPDES permitted stormwater, industrial stormwater, construction stormwater, and feedlots with NPDES permits (Table 10). All of the point source entities are operating within their permit limits and are not considered a source of excess P loading.

Table 10. Point source permits in the Whitefish Lakes Watershed

Name	Permit #	Program type
Fifty Lakes Modified Sanitary Landfill	MNRNE3BVP	Industrial Stormwater
Whitefish Lake Bertha Boatworks Inc.	83454926	Industrial Stormwater
Maple Sanitary Landfill	MNRNE368X	Industrial Stormwater
LME Inc. (closed)	MNURNE3CX6	Wastewater

There are two wastewater dischargers in the Whitefish Lake minor watershed HUC-10: the Pine River Sanitary District (MN0046388) and the Crosslake WWTF (MN0064882). Together they are among the least significant dischargers of phosphorus.

Mercury

Almost all the mercury in Minnesota's lakes and rivers is delivered by the atmosphere. Mercury can be carried great distances on wind currents before it is brought down to earth in rain and snow. About 90% of the mercury deposited on Minnesota comes from other states and countries. Similarly, the vast majority of Minnesota's mercury emissions are carried by wind to other states and countries. It's impossible for Minnesota to solve this problem alone; the United States and other countries must greatly reduce mercury releases from all sources.

Atmospheric deposition of mercury is uniform across the state and supplies more than 99.5% of the mercury getting into fish. Agency research has demonstrated that 70% of current mercury deposition in Minnesota comes from human sources and 30% from natural sources, such as volcanoes. There are no known natural sources in the state that emit mercury directly to the atmosphere.

Element b. estimated reductions

> *An estimate of the load reductions expected for the management measures described under paragraph (c) below (recognizing the natural variability and the difficulty in precisely predicting the performance of management measures over time). Estimates should be provided at the same level as in item (a) above (e.g., the total load reduction expected for dairy cattle feedlots; row crops; or eroded stream banks).*
>
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The Spreadsheet Estimator for Pollutant Loading (STEPL) was used to determine loads and the estimated reductions associated with practices and suites of practices. It is the goal of the watershed partners to decrease TP loading by 5% across the Whitefish Lake Watershed HUC-10 (0701010504). This plan, as implemented and the projects currently underway, will exceed this load reduction. The total P load estimated by STEPL is 30,064.8 lbs./yr. and the expected reductions are 8,316 lbs./yr. This exceeds the partner goal of 1,503.2 lbs./yr. (Table 11).

Soil health and grazing practice reductions were calculated using PTMApp during the development of the 1W1P.

Table 11. Estimated loading and load reductions for the Whitefish Lake Watershed HUC 10 0701010504 (STEPL)

Watershed	P load (lbs./yr.)	P reduction goal (5%) (lbs./yr.)	Sediment Load (no BMP) (t/yr.)
Arvig Creek	6794.3	339.7	524.8
Lower Hay Lake	8646.8	432.3	703.8
Arrowhead Lake	6332.9	316.7	420.8
Big Trout Lake	607.6	30.4	214.1
Lower Whitefish Lake	7358.9	367.9	638.2
Cross Lake	421.3	21.1	100.8
Total Load	**30161.9**		**2602.5**
Total goal reduction		**1,508.1**	

The estimated reductions needed for each subwatershed are summarized below.

Arvig Creek Watershed includes a stream impairment for aquatic life (fish and macroinvertebrate index of biological integrity). Properly sized road culverts will decrease the velocity of water entering the stream, cutting down on bank erosion, as well as the sediment loading from quickly rushing water from roads and ditches. Ensuring the proper size and removing perched culverts will help to restore connectivity. The streambank restoration will also restore the habitat, increasing the fish and macroinvertebrate populations to meet the water quality standard for aquatic life in 10 years.

Practices outlined in this plan will decrease the loading of P to the watershed by 924.8 lbs./yr., exceeding the reduction goal of 339.7 lbs./yr. P (5%). The estimated reductions are summarized in Table 12.

Table 12. Summary of TP loading and estimated reductions to Arvig Creek Watershed HUC12 070101050401 (STEPL)

	Total landuse	% applied	P reduction (lbs./yr.)	TSS reduction (t/yr.)
STEPL combined forestry activities	4953			
STEPL combined Urban activities	22.47	22.50%	2.9	0.6
Grazing (PTMApp)	1554	100.00%	139.86	
Cover Crops (PTMApp)	782	100.00%	782	
Streambank restoration	2695 ft	30%	24.8	34.9
Total:			**924.76**	**35.5**
Total Load STEPL			**6794.3**	**524.8**
% reductions			**13.98%**	**6.76%**

The estimated reductions for Hay Lake exceed the 432.3 lbs./yr. P (Table 13).

Table 13. Summary of TP loading and estimated reductions to Lower Hay Lake Watershed HUC12 070101050402 (STEPL)

	Total landuse	% applied	P reduction (lbs./yr.)	TSS reduction (t/yr.)
STEPL combined forestry activities	780	13.89%	13.6	1.3
STEPL combined Urban activities	138.6	2.47%	12.3	0
STEPL feedlot fixes	20	100%	5895.8	
STEPL Manure/Nutrient Mgmt.	355	50%	125.5	
Grazing (PTMApp)	2501	100%	101.6	
STEPL Ditch abandonment	710	11.27%	64.5	11.2
Cover Crops (PTMApp)	782	100.00%	782	
Total:			**6213.3**	**12.5**
Total Load STEPL			**8646.6**	**703.8**
% reductions			**71.86%**	**1.78%**

The estimated reductions for Arrowhead Lake exceed the reduction goal of 316.7 lbs./yr. P (Table 14).

Table 14. Summary of TP loading and estimated reductions to Arrowhead Lake Watershed HUC12 070101050403 (STEPL)

	Total landuse	% applied	P reduction (lbs./yr.)	TSS reduction (t/yr.)
STEPL combined forestry activities	400	4.21%	29.1	0.8
STEPL combined Urban activities	133.63	2.47%	0.5	0.1
STEPL Feedlot fix	40	100.00%	2418.5	
STEPL Manure/Nutrient Mgmt.	318	50.00%	116.4	
Grazing (PTMApp)	835	100.00%	75	
STEPL Ditch abandonment	318	11.27%	118.1	11.2
Cover Crops (PTMApp)	782	100.00%	782	
Total:			**2757.6**	**12.1**
Total Load STEPL			**6332.9**	**420.8**
% reductions			**43.54%**	**2.88%**

The estimated reductions for Big Trout Lake exceed the reduction goal of 30.4 lbs./yr. P (Table 15).

Table 15. Summary of TP loading and estimated reductions to Big Trout Lake Watershed HUC12 070101050404 (STEPL)

	Total landuse	% applied	P reduction (lbs./yr.)	TSS reduction (t/yr.)
STEPL combined forestry activities	300	7.08%	5.1	0.7
STEPL combined Urban activities	144.3	65.00%	3.8	0.9
Bioretention CSAH 66		100.00%	40	
Total:			**48.9**	**1.6**
Total Load STEPL			**607.6**	**214.1**
% reductions			**8.05%**	**0.75%**

The estimated reductions for Whitefish Lake Watershed exceed the reduction goal of 367.9 lbs./yr. P (Table 16). The watershed also includes Willow Creek, which is impaired for aquatic life. The restoration of 30% of the streambank and addressing incorrectly sized/perched culverts will help to rebuild the habitat. These practices also reduce TSS loading by an estimated 125 t/yr. TSS was identified as a stressor in Willow Creek. The combination of these practices is expected to meet the water quality standard for aquatic life in 10 years.

Table 16. Summary of TP loading and estimated reductions to Lower Whitefish Lake Watershed HUC12 070101050405 (STEPL)

	Total landuse	% applied	P reduction (lbs./yr.)	TSS reduction (t/yr.)
STEPL combined forestry activities	9298	4.30%	29	0.8
STEPL combined Urban activities	992	73.39%	65.8	15.6
STEPL Feedlot fix	20	100.00%	2419	
STEPL Manure/Nutrient Mgmt.	332	50.00%	121.1	
Grazing (PTMApp)	1129	24.10%	102	
STEPL Ditch abandonment	332	25.00%	118.5	11.1
Bertha Boatworks (total)			9	1.891
Whitefish Boat access			7	2.0365
Bioretention (completed)			6	1.2
Cover Crops (PTMApp)	782	100.00%	782	
Streambank Restoration Willow Creek	6652.8	30%	66	92.4
Total:			**3725.r**	**125**
Total Load STEPL			**7358.9**	**638.2**
% reductions			**50.20%**	**19.59%**

The estimated reductions for Cross Lake Watershed exceed the reduction goal of 21.1 lbs./yr. P (Table 17).

Table 17. Summary of TP loading and estimated reductions to Cross Lake Watershed HUC12 070101050405 (STEPL)

	% applied	P reduction (lbs./yr.)	TSS reduction (t/yr.)
Bioretention CSAH 66	62.50%	0.6	
Upgrade 14 failing SSTS	100%	160.67	
Total:		**161.27**	
Total Load STEPL		**421.3**	**100.8**
% reductions		**38.28%**	**0%**

The estimated reductions were run as HUC 12 packages, using combined reduction efficiencies as needed. Forestry, urban, soil health, feed lot fixes, and grazing practices are meant to be implemented as a combination of practices. The following tables are estimated reductions for individual practices for planning purposes. The by practice estimated reductions were calculated using STEPL.

Table 18. Suite of forestry activities and individual practice estimated reductions

Practice	Acres treated	P reductions (lbs./yr.)	TSS reductions (t/yr.)
Development and implementation of forestry plan that includes practices to decrease erosion and protect the land use	20	1.6	0.04
Conservation easements plus erosion control practices	20	0.9	0.03
SFIA conservation practices (20 ac)	20	0.5	0.01

Table 19. Suite of grazing management practices and individual practice estimated reductions

Practice	Acres treated	P reductions (lbs./yr.)	TSS reductions (t/yr.)
Alternative Water Sources	5	0.2	0.1
Exclusion fencing	5	0.65	0.1
Rotational grazing	5	0.45	--

Table 20. Suite of urban stormwater practices and individual practices estimated reductions

Practice	Treatment area (ac)	P reduction	TSS reduction
Raingardens	5	1.7	0.2
Shoreland buffer project (70 ft x 100 ft or .02 acres)	5	1.1	0.2
Tree planting (per 10 trees)	2.5	0.6	0.1
Road culvert improvement, including properly sized, replacement, restoration	5	2.9	0.6

Table 21. Suite of soil health practices (STEPL)

Practice	Treatment area (ac)	P reduction	TSS reduction
Cover crops	1	0.28	0.03
No till	1	1.27	0.03
Riparian buffers	25	20.4	2.2
WASCOBs	15	13.6	1.5

Element c. BMPs and critical loading areas

> *A description of the BMPs (NPS management measures) that are expected to be implemented to achieve the load reductions estimated under paragraph (b) above (as well as to achieve other watershed goals identified in this watershed-based plan), and an identification (using a map or a description) of the critical areas (by pollutant or sector) in which those measures will be needed to implement this plan.*
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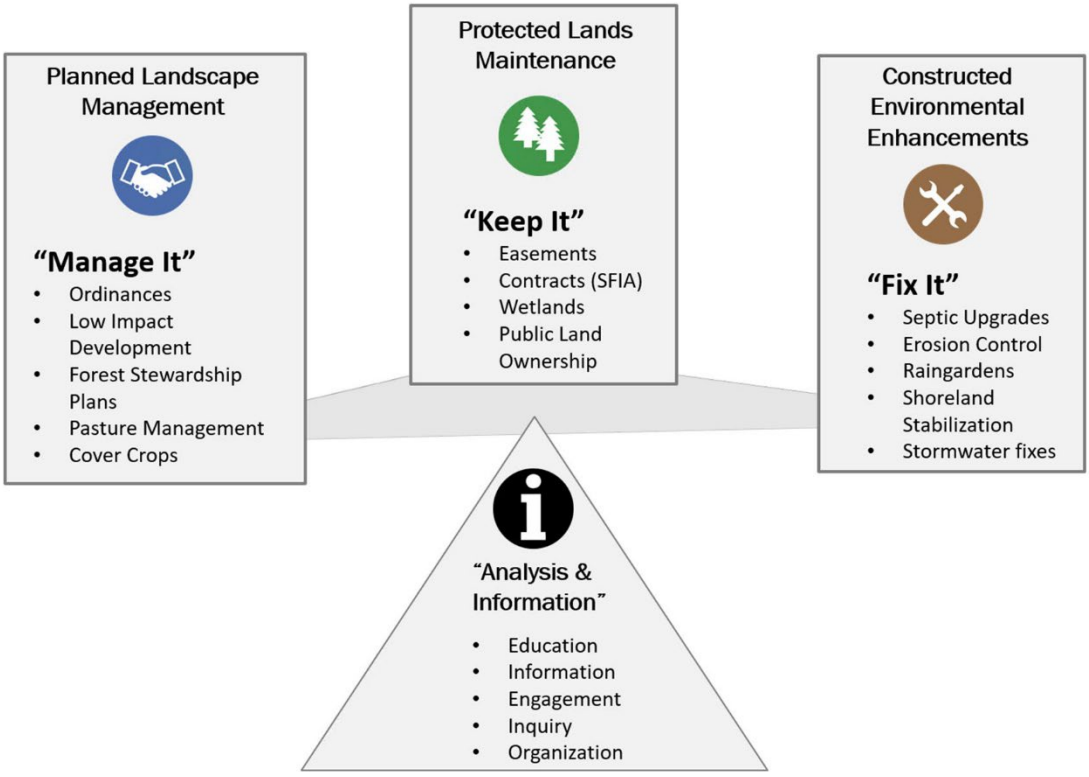
Specific tasks, milestones, and costs for each HUC12 watershed can be found in Table 2, Table 3, Table 4, Table 5, Table 6, and Table 7.

The programs to address the concerns in the Whitefish Lake minor watershed HUC10 are described in the Pine River 1W1P (2019). The partners have divided the plans into four categories: Planned Landscape Management (Manage It), Protected Lands Maintenance (Keep It), Constructed Environmental Enhancements (Fix It), and Analysis and Information.

Figure 9. Description of the planning categories, taken from Pine River 1W1P (2019)



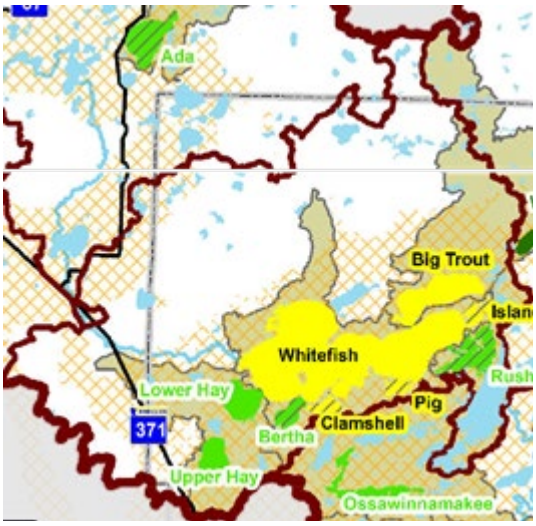
These have been used to determine the courses of action for each waterbody in the watershed. The development of the 1W1P included Prioritize, Target, Measure (PTM) to focus on the priority lakes and forests in the Whitefish Lake minor watershed. Protecting and enhancing the upstream forest habitat through BMPs, including vegetative buffers and stormwater management and restoration and protection of forest and lakeshore lands. The Riparian, Adjacency, Quality (RAQ) scoring is used to

further narrow the selection of properties for BMPs by determining which properties have the most significant impact on water quality. These scores are illustrated in Figure 17 and Figure 18. Parcels that score above 7.1 will be targeted.

Forestry protection

According to the DNR Fisheries research, once a minor watershed (i.e., Whitefish Lake minor watershed) is over 25% disturbed by farming and residential development. Protection of these lands is through private forest management including Sustainable Forest Incentive Act (SFIA), forestry plans, and conservation easements. Upper and Lower Hay Lakes are less than 50% protected, which makes them a primary focus for protection (Figure 10). Bertha Lake is between 50 and 75% protected and is considered a secondary priority for this implementation (1W1P, 2019).

Figure 10. Prioritized area for protection – Green primary, green hatched is secondary.



The forestry management plans will include riparian management, erosion controls, protection of existing forests, stream crossing management, and other water quality improving BMPs.

Stormwater practices

Stormwater BMPs in residential/developed areas will be used to prevent P loading to the lakes, especially the lakes with declining water quality. Whitefish, Big Trout, Island-Loon, Clamshell, and Pig Lakes were identified as the lakes with the highest sensitivity to P loading and the most economic significance in the Pine River Watershed. Whitefish and Big Trout Lakes are considered the most sensitive and highest economic impact (first tier) and Clamshell, Island-Loon, and Pig Lakes as the second tier. Stormwater practices will include the restoration of vegetation, raingardens, planting trees and the upgrade/replacement of culverts. (1W1P, 2019).

Pasture management

Improving practices on pasture land is expected to improve habitat for fish and macroinvertebrates in the impaired streams, Willow and Arvig Creeks. Addressing the conditions of the pastures will also reduce nutrient loading to the watershed. Promoting and supporting the adoption of rotational grazing,

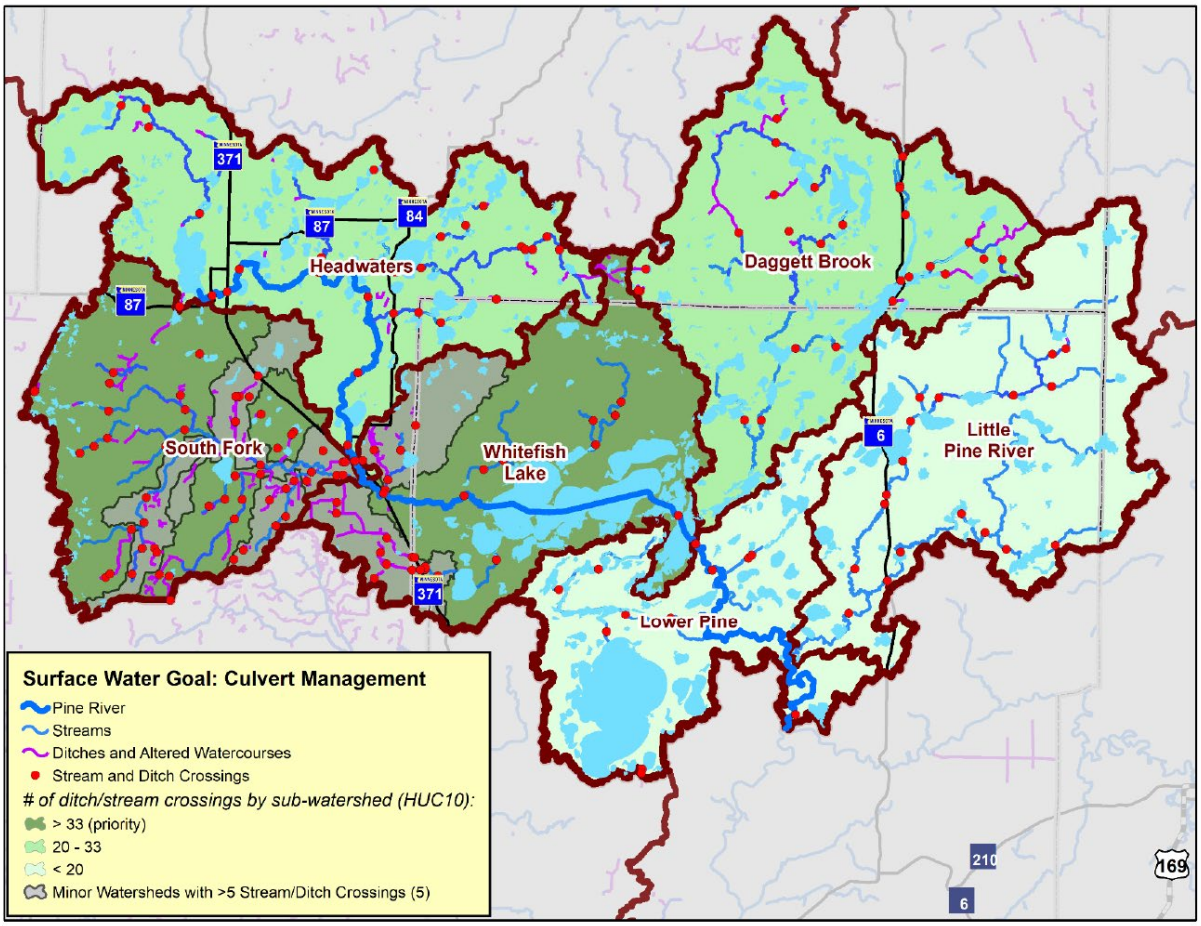
cattle exclusions, fencing, and alternative water supplies will decrease erosion and nutrient loading (1W1P, 2019). One of the benefits of utilizing pasture management is the long life span of the practice.

Pastures in the Willow and Arvig Creeks riparian areas, where cattle have access to the stream are critical loading areas. The practices to address pastures are rotational grazing, cattle exclusions, fencing, and alternative water supplies.

Culverts and road restorations

Expansion of anthropomorphic land uses such as agriculture and urban expansion can result in artificial drainage to move water from the landscape quicker than naturally. Installation of ditches and culverts for this purpose has changed the water drainage, storage and connections in the watershed. In addition, when culverts are not sized correctly or installed properly, they can cause impacts to habitat, fish migration, water levels, channel stability and increase nutrient transfer. (1W1P, 2019) Problem culverts identified in the WRAPS report are to be targeted first for replacement, resizing, and elevational correction.

Figure 11. Stream and ditch crossings in Whitefish Lake (this map is a placeholder – GIS working on only HUC10)



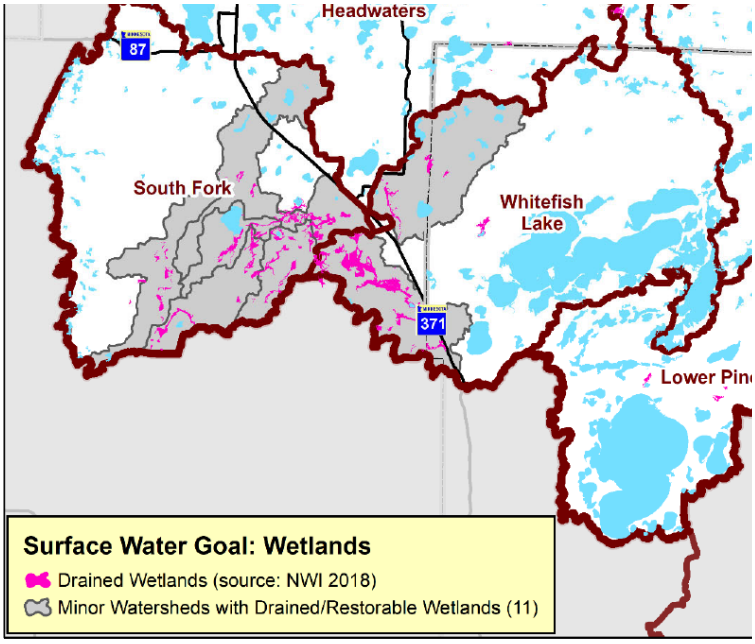
Wetland restoration and protection

Arvig Creek subwatershed has areas of drained and restorable wetlands (Figure 12). Wetland restoration provides multiple benefits, including improving habitat and acting as a filter for nutrients. The most

significant benefit to the subwatershed, however, may be the increase in water storage volume. Adding storage volume to the subwatershed will help to reduce the "bounce" in flows for Arvig Creek, thus reducing bank erosion and improving habitat for fish and invertebrates in Arvig Creek.

Further wetland degradation will be prevented by the continued enforcement of rules, regulations, and ordinances developed by the federal, state, and local governments. (1W1P, 2019)

Figure 11. Wetlands in the Whitefish Lake minor watershed with drained wetlands highlighted.



SSTS maintenance and repairs

Shallow aquifers paired with sandy soil means that the groundwater is vulnerable to contaminants. Subsurface sewage treatment systems (septic systems) when not properly maintained, can leach nutrients and bacteria into the aquifers and lakes. Proper maintenance includes pumping septic systems at a minimum of every three years. The watershed partners have made 90% maintenance rate the goal for the watershed. A 90% maintenance rate means that 90% of property owners are pumping their systems at least every three years. There are approximately 378 SSTS in the Whitefish Lake minor watershed (). This goal will be accomplished by providing information to residents and installers about proper maintenance and providing cost share for failing SSTS replacement (1W1P, 2019).

Failing or noncompliant systems are a priority to address anywhere in the watershed. SSTS that are in surficial sand aquifers (Figure 19 and Figure 20) have the potential to be higher loading than in other areas. These areas identified will be monitored closely for failure and owners will be targeted with maintenance education.

Chloride

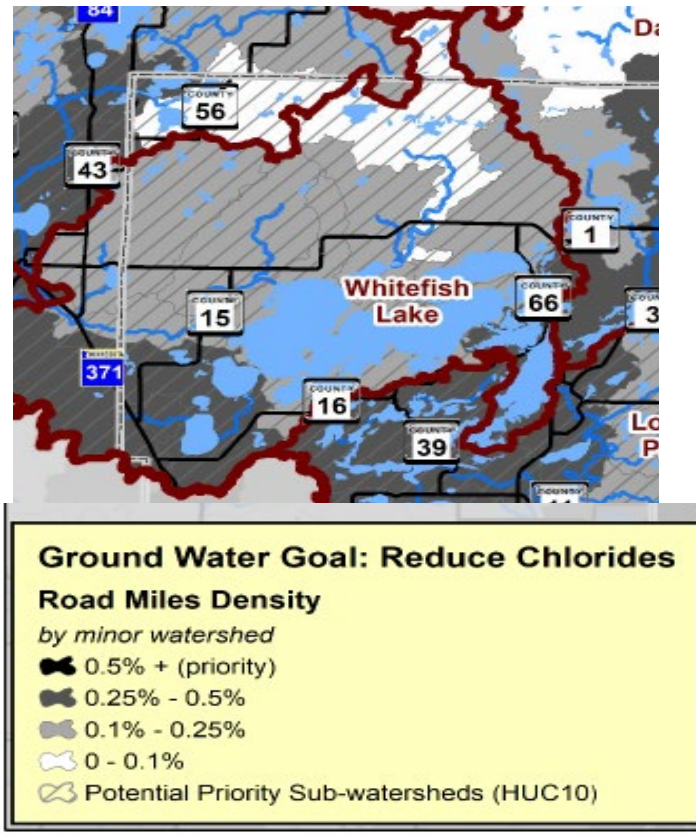
Chlorides can affect the biology and habitat of the lake including plant and fish life. The State of Minnesota has best BMP guidelines for cities and homeowners to use when applying road salt in winter (https://www.pca.state.mn.us/water/salt-and-water-quality).

An emerging issue is the overuse of water softener salts in homes. This issue applies to both rural residents using septic systems and those on city wastewater treatment. Too much salt in a septic system can affect its biological function in the treatment of the waste. Salt in city wastewater is not treated; therefore, it is discharged into the environment after leaving the facility (1W1P, 2019).

The implementation planned is to assist cities in the upgrade of road salting equipment, training for private companies, and public education about water softener use. (1W1P, 2019).

Critical loading areas of road salt are found in the Hay Creek Subwatershed. Areas of .5 to .8% of road densities will be targeted for road salt reduction (Figure 13). This includes State Hwy 371, County Road 145, County Road 15, and a number of smaller residential roads in the area between Lower Hay Lake and Whitefish Lake.

Figure 12. Road density in the Whitefish Lake minor watershed

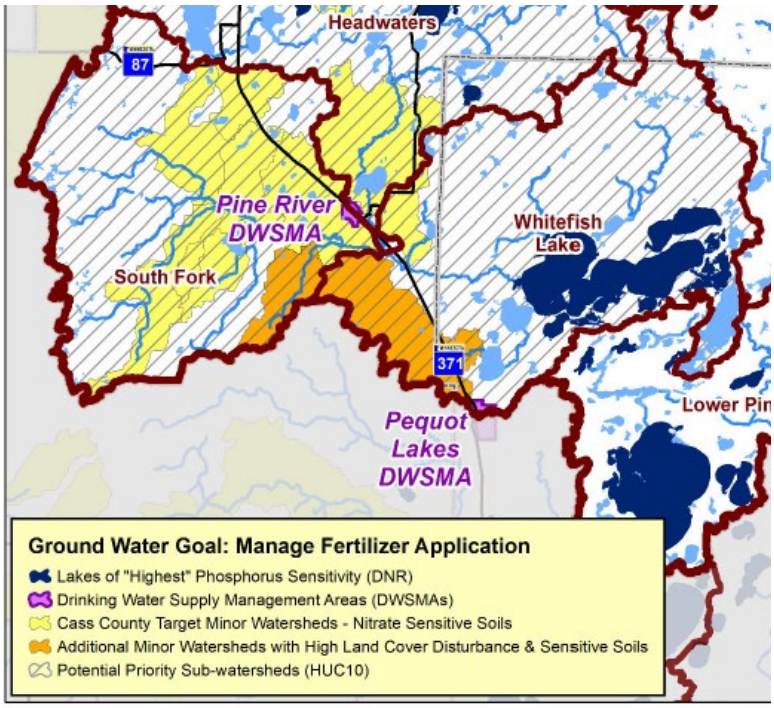


Fertilizer management

The sandy soils in Arvig Creek water can allow nitrates to pass quickly into shallow aquifers. Nitrates in the groundwater are not yet a problem in this watershed, but land use and soil types indicate it could become an issue in the future. Managing this will be providing voluntary nitrate testing for residential wells and outreach to residents and agricultural producers (1W1P, 2019). At least half the cropland in the Whitefish Lake minor watershed will have nutrient and manure management plans developed and implemented to reduce loading from cropland.

Hay Lake Watershed is an area described as high land cover disturbance and sensitive soils (Figure 14).

Figure 13. Priority areas for nitrate management



Well sealing

Unused wells that are not properly sealed can pose a safety, health, and environmental threat to the community as well as a potential legal risk to the landowner. If a landowner has a well that is not in use and does not have a Water Well Maintenance Permit, or the well poses a threat to health or safety, Minnesota law requires that the well must be sealed. Once fully sealed, the contractor is required to submit a Well and Boring Sealing Record to MDH and landowner. Cass SWCD and Crow Wing County have a cost share program available throughout the county to help landowners with well sealing.

An inventory and map of all wells in the watershed will be developed and used to contact residents with unused wells for sealing. Critical loading areas are unused private wells in surficial sand areas (Figure 16).

Impervious cover does not allow for the infiltration of stormwater and increases the loading of nutrients, sediment, bacteria, and other pollutants to surface waters. Impervious surfaces are limited to 25% or less in the shoreland area. Parcels with more than 20% of impervious surfaces are considered a priority for targeting lakeshore restoration projects. These areas are illustrated in Figure 15 and Figure 16.

Mercury

Atmospheric deposition of mercury is uniform across the state and supplies more than 99.5% of the mercury getting into fish. Agency research has demonstrated that 70% of current mercury deposition in Minnesota comes from human sources and 30% from natural sources, such as volcanoes. There are no known natural sources in the state that emit mercury directly to the atmosphere.

The long-term goal of the mercury TMDL is for the fish to meet water quality standards; the approach for Minnesota's share is mass reductions from state mercury sources. This mercury TMDL establishes that there needs to be a 93% reduction in state emissions from 1990 for the state to meet its share.

Water point sources will be required to stay below 1 percent of the total load to the state and all but the smallest dischargers will be required to develop mercury minimization plans. Air sources of mercury will have a 93% emission reduction goal.

Almost all the mercury in Minnesota's lakes and rivers is delivered by the atmosphere. Mercury can be carried great distances on wind currents before it is brought down to earth in rain and snow. About 90% of the mercury deposited on Minnesota comes from other states and countries. Similarly, the vast majority of Minnesota's mercury emissions are carried by wind to other states and countries. It is impossible for Minnesota to solve this problem alone; the United States and other countries must greatly reduce mercury releases from all sources.

Because mercury in runoff is derived from atmospheric deposition, mercury in stormwater is accounted for in the calculation of the atmospheric load. Separate strategies for reducing nonpoint sources are not included in this plan because implementation of the strategies to reduce air deposition will ultimately reduce stormwater loading.

Any efforts to reduce soil erosion will tend to reduce mercury entering a lake or river from nonpoint water sources. Many of these practices are already employed for control of sediment and nutrient loading and will result in reducing mercury loading to surface waters.

Critical areas

Development

Impervious developed areas around the lake shore are critical loading areas of P. Areas with over 20% impervious surface coverage are the highest loading areas along the shore line. The implementation of the stormwater BMPs, shoreline restorations and vegetation establishment, and tree planting will have the largest impact when conducted in these lots. The dark purple lots represent those lots with over 20% impervious surface coverage around Big Trout Lake (Figure 15) and Whitefish Lakes (Figure 16). Big Trout and Whitefish, Pig, and Island-Loon, Lakes are the primary targets, with Berth and Clamshell Lakes as the secondary target.

Figure 14. Impervious surfaces around Big Trout Lake

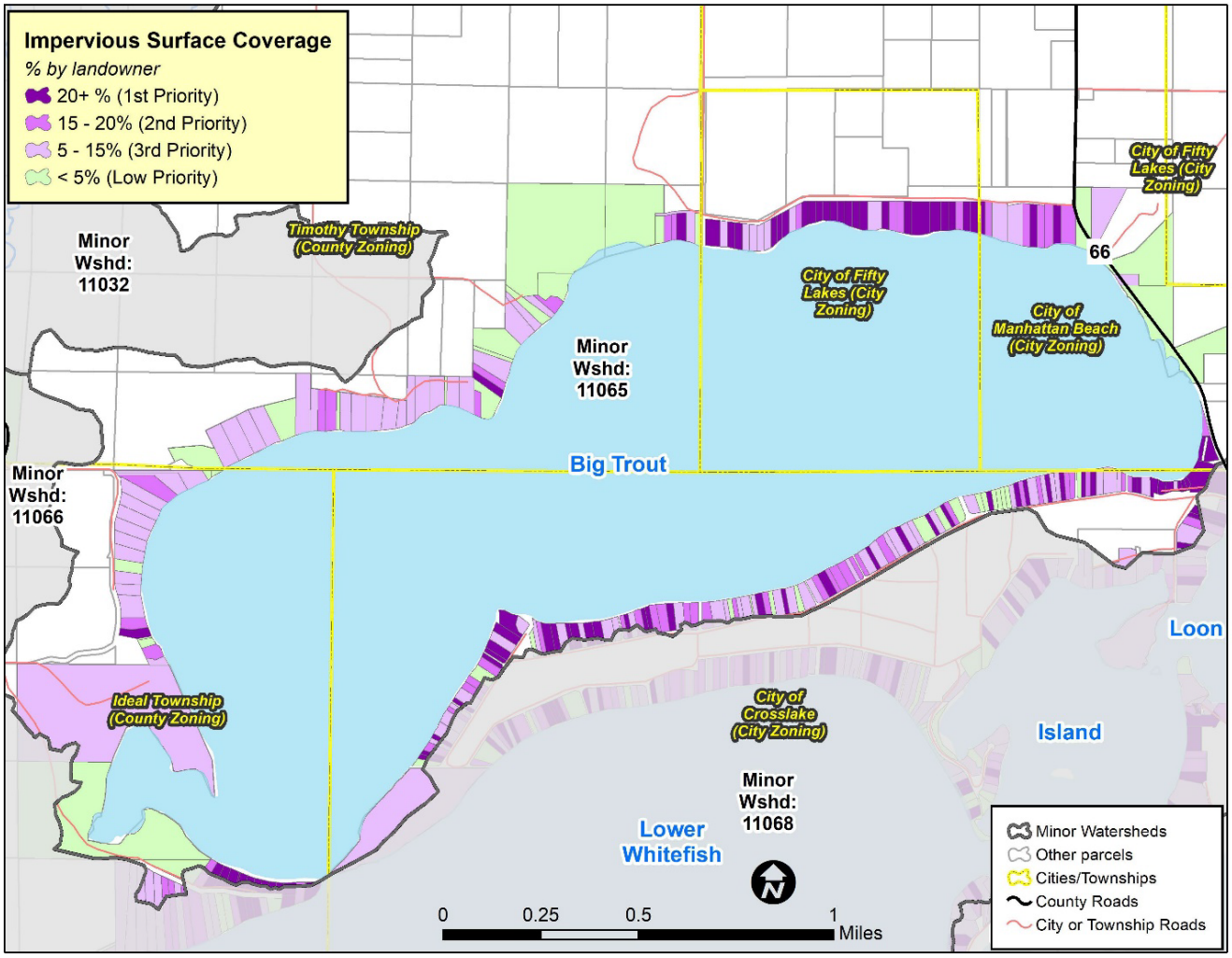
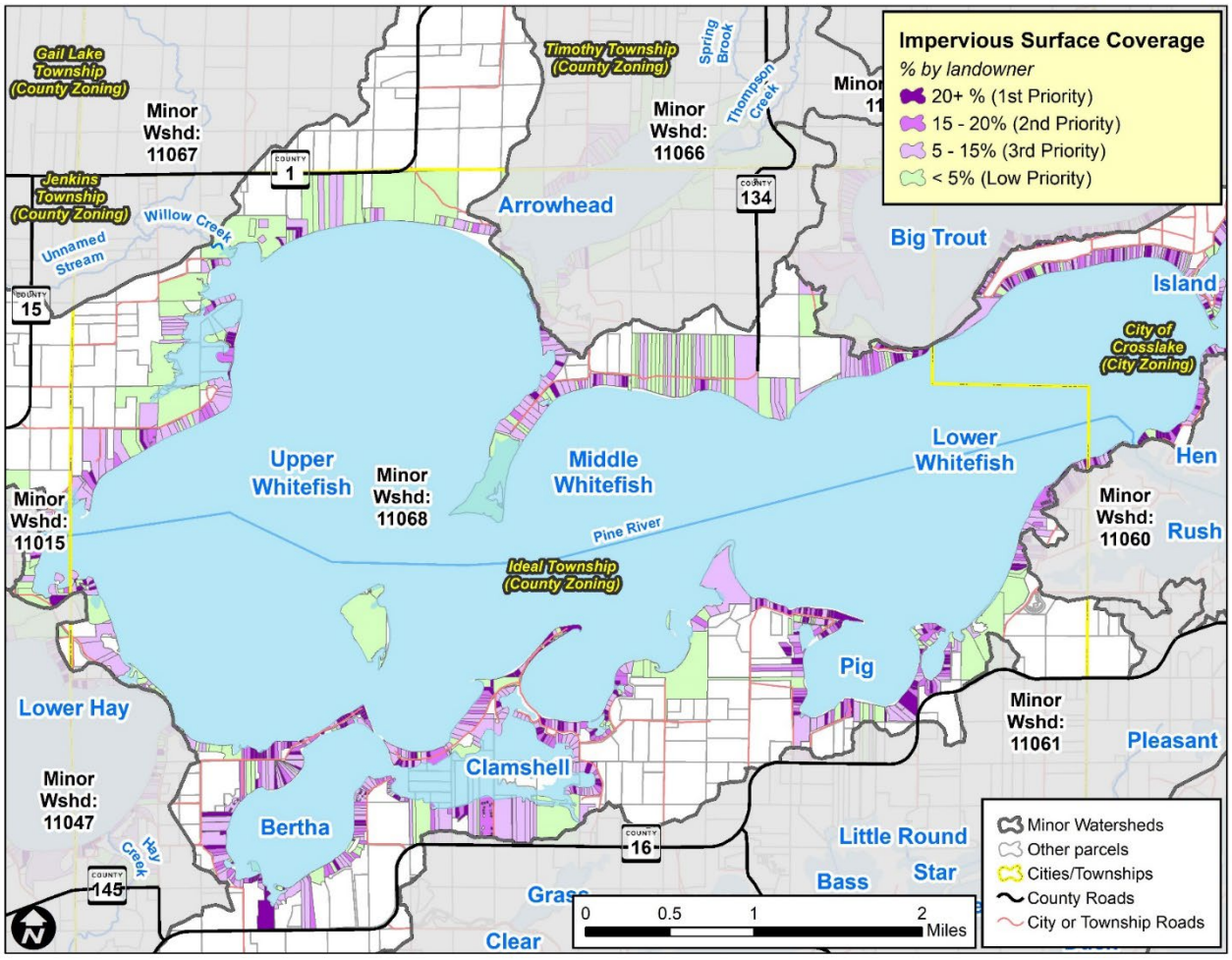


Figure 15. Whitefish Lake impervious surface

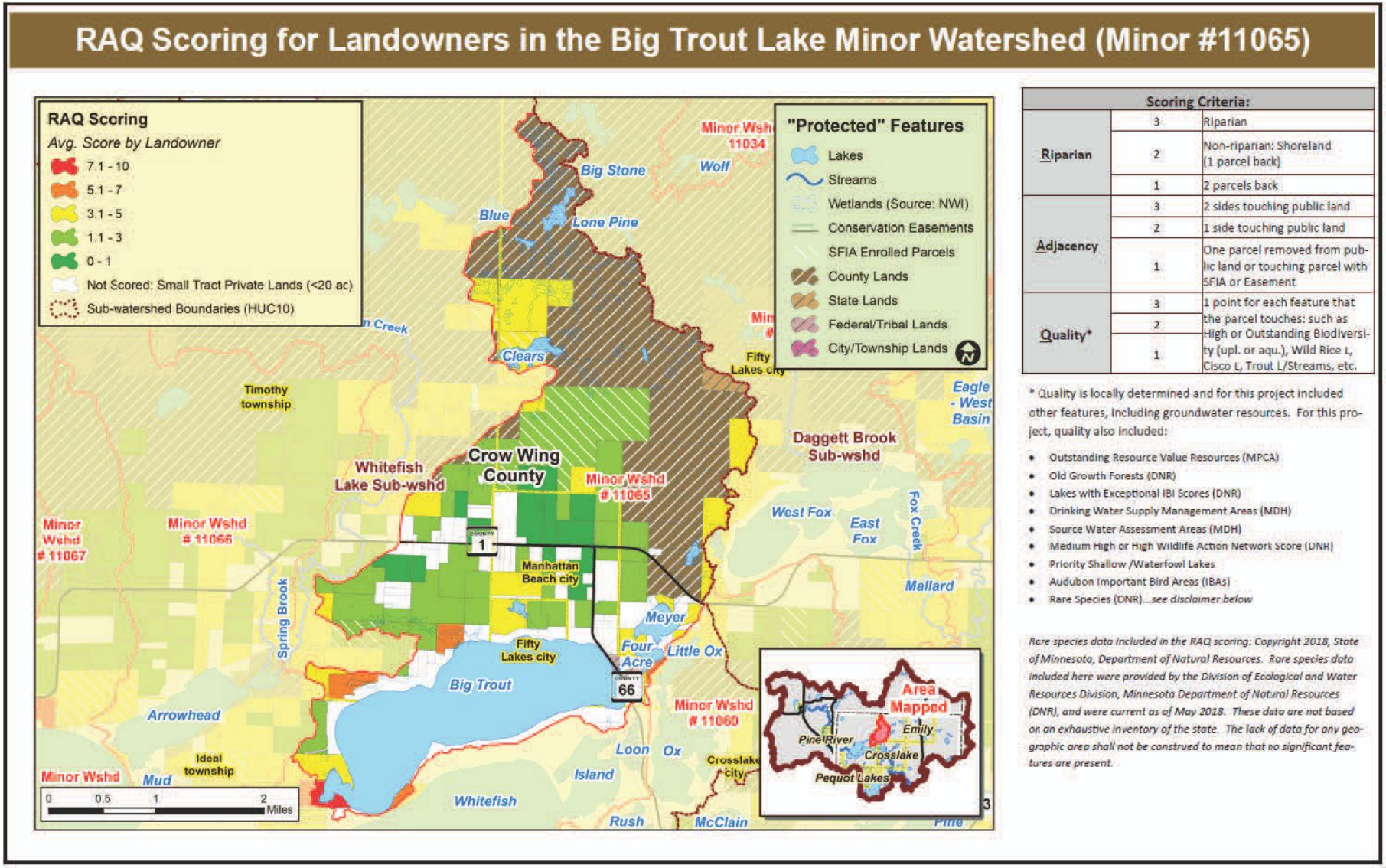


Forestry protection

The critical areas for forestry are determined using the methodology developed by BWSR and Mitch Brinks, a mapping specialist. The RAQ scoring process has been employed by BWSR since 2017. It is a GIS based scoring system to determine the following on parcels of at least 20 acres or more. Addressing riparian lands have historically shown a large impact on lake water quality; therefore, the closer areas to the lake are scored the highest on a 1-3 point scale. Adjacency scores the parcel's proximity to existing forest lands on a 1-3 point scale. By focusing on parcels that can offer a larger, more contiguous forest area, the larger the impact of this restoration can have on water quality and habitat. Parcels that are adjacent to public lands offer an opportunity to build on that the contiguous forests and score higher. Quality is scored, with a 1-4 point scale and measures the quality of the water body, the biological significance, impact on drinking water sources and other local concerns (BWSR, 2021). Suites of BMPs employed to protect and restore forests show efficiencies of approximately 80% for sediment, 70% for total nitrogen, and 85% for phosphorus (Edwards & Williard, 2010).

The areas with the highest RAQ score are shown in red in the following figures. Figure 17 illustrates the critical areas for forestry intervention around Big Trout Lake and Figure 18 illustrates the critical areas around Whitefish Lake. The proximity to the lakes increases the loading impact.

Figure 16. Riparian Adjacency, Quality (RAQ) scores around Big Trout Lake



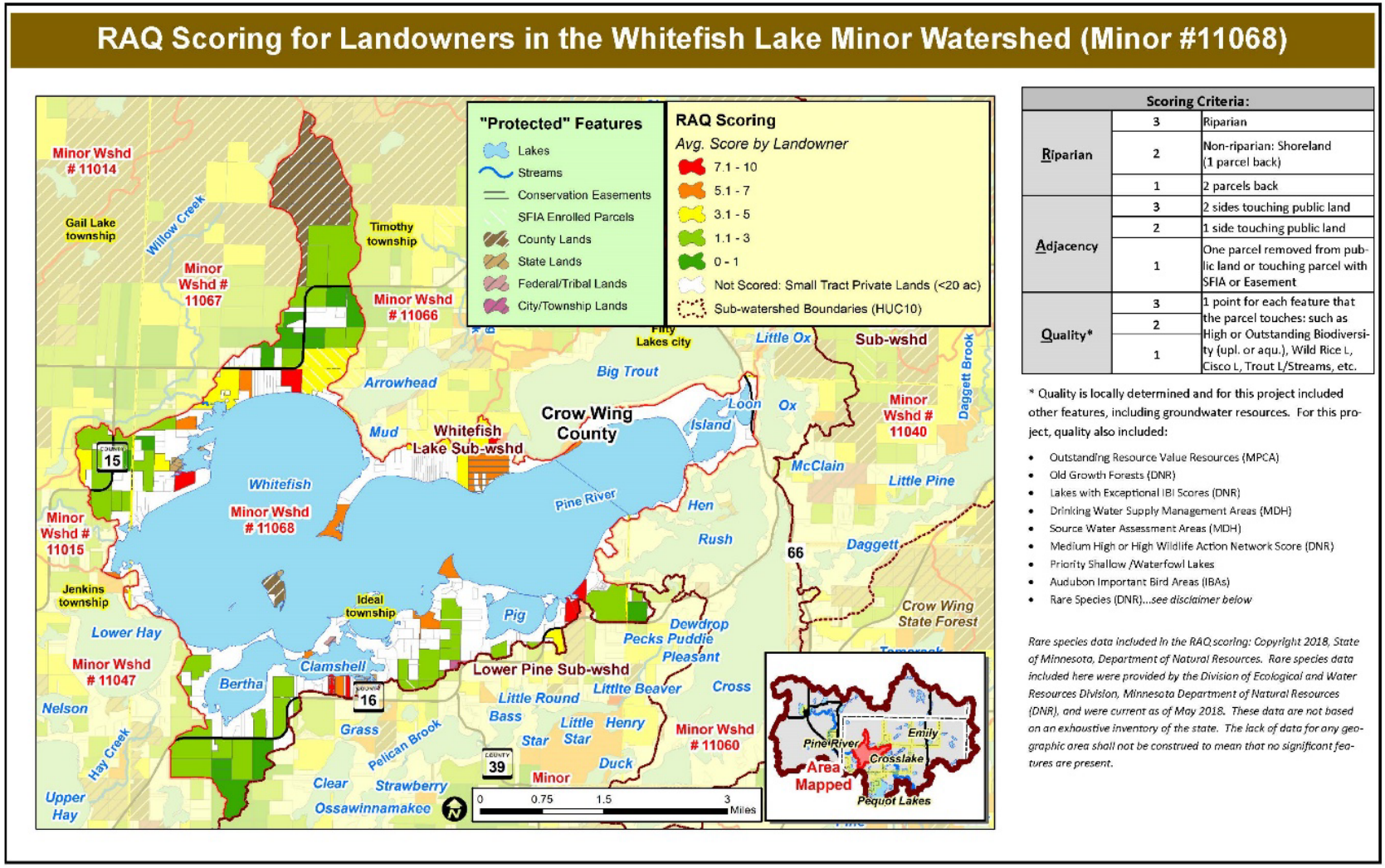
Scoring Criteria:		
Riparian	3	Riparian
	2	Non-riparian: Shoreland (1 parcel back)
	1	2 parcels back
Adjacency	3	2 sides touching public land
	2	1 side touching public land
	1	One parcel removed from public land or touching parcel with SFIA or Easement
Quality*	3	1 point for each feature that the parcel touches: such as High or Outstanding Biodiversity (upl. or aqu.), Wild Rice L, Cisco L, Trout L/Streams, etc.
	2	
	1	

* Quality is locally determined and for this project included other features, including groundwater resources. For this project, quality also included:

- Outstanding Resource Value Resources (MPCA)
- Old Growth Forests (DNR)
- Lakes with Exceptional IBI Scores (DNR)
- Drinking Water Supply Management Areas (MDH)
- Source Water Assessment Areas (MDH)
- Medium High or High Wildlife Action Network Score (DNH)
- Priority Shallow /Waterfowl Lakes
- Audubon Important Bird Areas (IBAs)
- Rare Species (DNR)...*see disclaimer below*

Rare species data included in the RAQ scoring: Copyright 2018, State of Minnesota, Department of Natural Resources. Rare species data included here were provided by the Division of Ecological and Water Resources Division, Minnesota Department of Natural Resources (DNR), and were current as of May 2018. These data are not based on an exhaustive inventory of the state. The lack of data for any geographic area shall not be construed to mean that no significant features are present.

Figure 17. Riparian Adjacency, Quality (RAQ) scores around Whitefish Lake



Scoring Criteria:		
Riparian	3	Riparian
	2	Non-riparian: Shoreland (1 parcel back)
	1	2 parcels back
Adjacency	3	2 sides touching public land
	2	1 side touching public land
	1	One parcel removed from public land or touching parcel with SFIA or Easement
Quality*	3	1 point for each feature that the parcel touches: such as High or Outstanding Biodiversity (upl. or aqu.), Wild Rice L, Cisco L, Trout L/Streams, etc.
	2	
	1	

* Quality is locally determined and for this project included other features, including groundwater resources. For this project, quality also included:

- Outstanding Resource Value Resources (MPCA)
- Old Growth Forests (DNR)
- Lakes with Exceptional IBI Scores (DNR)
- Drinking Water Supply Management Areas (MDH)
- Source Water Assessment Areas (MDH)
- Medium High or High Wildlife Action Network Score (DNR)
- Priority Shallow /Waterfowl Lakes
- Audubon Important Bird Areas (IBAs)
- Rare Species (DNR)...*see disclaimer below*

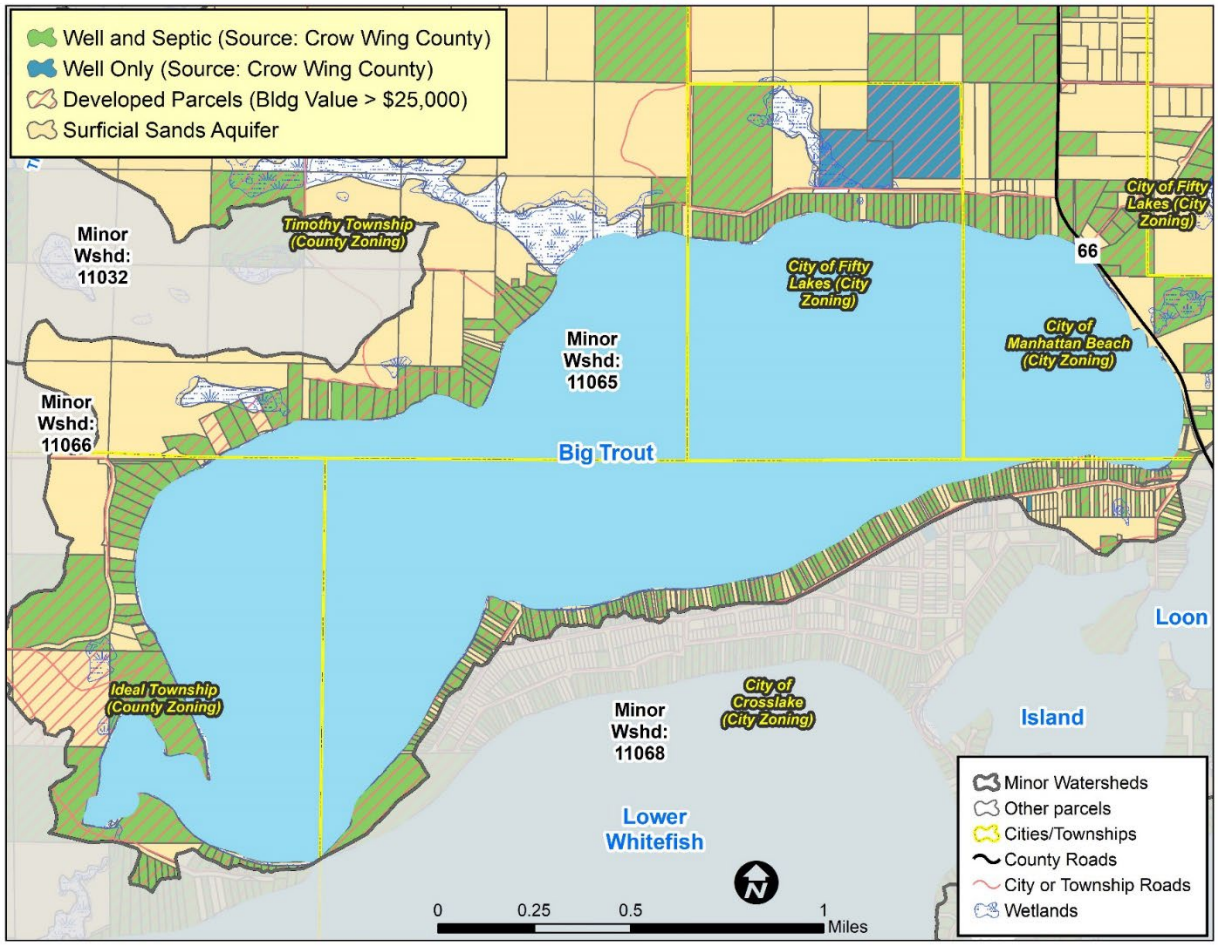
Rare species data included in the RAQ scoring: Copyright 2018, State of Minnesota, Department of Natural Resources. Rare species data included here were provided by the Division of Ecological and Water Resources Division, Minnesota Department of Natural Resources (DNR), and were current as of May 2018. These data are not based on an exhaustive inventory of the state. The lack of data for any geographic area shall not be construed to mean that no significant features are present.

Well sealing and SSTS

In the Whitefish Lake minor watershed, approximately 21% of the wells are in the surficial sand aquifer (1W1P, 2019).

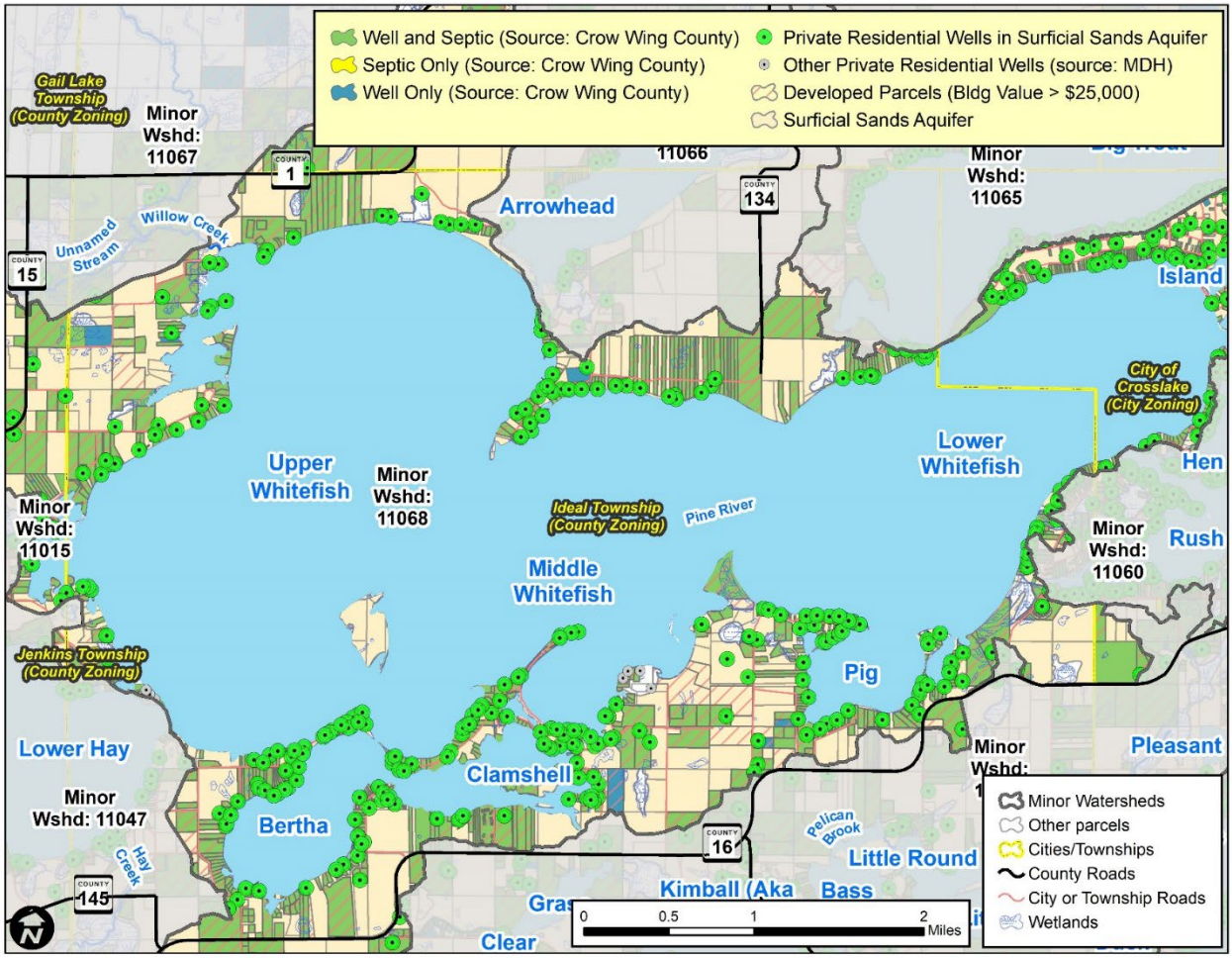
Wells and SSTS in the surficial sand aquifer pose more of a risk for contamination and pollution loading. Wells and SSTS (green) with hash marks represent areas in the surficial sands aquifer. Big Trout Lake (Figure 19) illustrates that a significant portion of the wells and SSTS around the lake are in this aquifer. The lots with an unused well or a noncompliant or failed SSTS will be prioritized for implementation.

Figure 18. Wells and SSTS in surficial sands aquifer in Big Trout Lake



Wells and SSTS in Whitefish Lake are illustrated in Figure 20.

Figure 19. Wells and SSTS in surficial sands aquifer in Whitefish Lakes



Element d. technical and financial assistance

An estimate of the amounts of technical and financial assistance needed, associated costs, and/or the sources and authorities that will be relied upon, to implement the entire plan (include administrative, Information and Education, and monitoring costs). Expected sources of funding, States to be used Section 319, State Revolving Funds, USDA's Environmental Quality Incentives Program and Conservation Reserve Program, and other relevant Federal, State, local and private funds to assist in implementing this plan.

The Whitefish Lake minor watershed NKE will be implemented with the support and partnerships described in Table 22. Luckily, there are many established organizations in the watershed to partner with in implementing this plan including the Pine River Watershed Alliance (PRWA), the Whitefish Area Property Owners Association (WAPOA), the Association of Cass County Lakes (ACCL), Lakes and Rivers Alliance (LARA), Lake Associations, and others. This plan will continue the Advisory Committee, which is made up of local stakeholders in the watershed. The Advisory Committee will meet twice a year to track progress of the plan implementation. Advisory Committee members are also advocates of this plan and will help promote it to their respective community groups and others (1W1P, 2019).

It is estimated that the cost of implementation of this NKE plan will be $19,764,604.

Table 22. List of partners that provide technical assistance and funding sources.

Organization
Army Corps of Engineers
Board of Soil and Water Resources
Conservation Reserve Program
Cass County Environmental Services
Cass Soil and Water Conservation District
Crow Wing County
Department of Natural Resources
Lake Associations
Legislative Citizen Commission for Minnesota Resources
Lessard Sam's Outdoor Heritage Council
Minnesota Department of Agriculture
Minnesota Department of Health
Mississippi Headwaters Board
Minnesota Land Trust
Minnesota Pollution Control Agency
Northern Waters Land Trust (formerly Leech Lake Area Watershed Foundation)
The Nature Conservancy
US Department of Agriculture
US Forest Service
US Fish and Wildlife Service
US Geological Survey

Element e. education and outreach

> *An information/education component that will be implemented to enhance public understanding of the project and encourage their early and continued participation in selecting, designing, implementing, and maintaining the NPS management measures that will be implemented.*

Analysis and information programs include inventories, monitoring, and public outreach efforts. These efforts are integral to achieving the plan's goals. Public Participation and Engagement Public participation and engagement are crucial to this plan's success. Because this is a protection watershed, much of the activities are voluntary rather than regulated.

Specific tasks, milestones, and costs for each HUC12 watershed can be found in Table 2, Table 3, Table 4, Table 5, Table 6, and Table 7.

Outreach activities named in this plan include:

- Promote private forestry stewardship planning [Goal 1].
- Expand the availability of educational materials, workshops, and network of resources for promoting stormwater management to lake residents [Goal 2].
- Implement an educational program to increase knowledge of septic system maintenance, individual wellhead protection, water softener and road salt use [Goals 6, 7, 9].
- Provide training to road authorities, private snow removal contractors, and dust control on chloride best management practices [Goal 7].
- Provide education and/or conduct workshops on shoreland best management practices and restoration options including the need for proper permits/project reviews within shoreland areas [Goal 11].
- A total of $257,000 (average $25,700/year) is proposed for implementing outreach in this plan.

Information on better land management choices to citizens

Most of the actions listed above are related to providing information on better land management choices to citizens. Throughout this planning process, the Advisory Committee discussed and encouraged these activities. These activities ranged from groundwater to surface water to forests.

A summary of the subjects and ways to reach citizens is presented in Table 23.

Table 23. Ways to reach citizens about better land management choices (adapted from 1W1P, 2019)

Subject	Lake Association meetings	Mailers	Educational articles	Presentations/ workshops
Septic System Maintenance	x	x	x	x
Wellhead protection	x	x	x	x
Shoreland habitat protection	x	x	x	x
Water softener salt use	x	x	x	x

Subject	Lake Association meetings	Mailers	Educational articles	Presentations/ workshops
Private Forest Management	x	x	x	x

Outreach related to the specific goals described in this plan are:

- Promotion of private forestry stewardship planning
- Expand the availability of educational materials, workshops, and network of resources for promoting stormwater management to lake residents.
- Implement and educational program to increase knowledge of SSTS, wellhead protection, water softeners and road salt usage.
- Provide training to road authorities, private snow removal contractors, and dust control on chloride BMPs.
- Provide education and/or conduct workshops on shoreland BMPs and restoration options including the need for proper permits/project reviews within shoreland areas.

Element f. reasonably expeditious schedule

A schedule for implementing the activities and NPS management measures identified in this plan that is reasonably expeditious.

Activities planned for this NKE plan are expected to obtain the habitat improvements needed to meet water quality standards in Arvig and Will Creeks in 10 years. Reductions in P are expected to exceed the 5% goal developed by the watershed to protect the Whitefish Lake Watershed lakes.

Specific tasks, milestones, and costs for each HUC12 watershed can be found in Table 2, Table 3, Table 4, Table 5, Table 6, and Table 7.

Element g. milestones

A description of interim, measurable milestones for determining whether NPS management measures or other control actions are being implemented.

Specific tasks, milestones, and costs for each HUC12 watershed can be found in Table 2, Table 3, Table 4, Table 5, Table 6, and Table 7.

Element h. assessment criteria

A set of criteria that can be used to determine whether loading reductions are being achieved over time and substantial progress is being made toward attaining water quality standards.

Specific tasks, milestones, and costs for each HUC12 watershed can be found in Table 2, Table 3, Table 4, Table 5, Table 6, and Table 7.

Element i. monitoring

The monitoring & evaluation component to track progress and evaluate the effectiveness of the implementation efforts over time, measured against the criteria established under item (h) immediately above.

Data collection and monitoring are crucial in watershed management. These activities inform watershed managers of current conditions and track project progress toward meeting the watershed plan's goals. Sometimes additional data is needed to implement plan projects, so filling data gaps is another activity in this plan. Monitoring is already occurring on many levels with many organizations (Table 24). These programs are ongoing and provide valuable information for this plan. Because these are already established projects, they don't cost any additional funds for this plan.

Specific tasks, milestones, and costs for each HUC12 watershed can be found in Table 2, Table 3, Table 4, Table 5, Table 6, and Table 7.

Table 24. Summary of ongoing water quality and quantity monitoring programs RS = rivers and streams, L=lakes, W=wetlands, and GW=groundwater (Pine River 1W1P, 2019)

Parameters	MPCA	MN DNR	MDH	MDA	County	Lake Associations	Water bodies to be monitored?	Frequency/ years?
Nutrients	RS, L, W	RS, L		RS, GW	GW	RS, L		
Suspended Solids	RS, L, W	RS		RS				
Productivity	RS, L	RS		RS		RS, L		
Pesticides				RS, L, W, GW				
Bacteria	RS, L		GW					
Biology	RS, L, W	RS, L						
Water level/Flow	RS, L	RS, L						
Algal Toxins	L							
Invasive Species		RS, L			L	RS, L		
Fish Contaminants	RS	L						
Chlorides	RS, L, W	RS	RS, L, GW	RS				
Sulfates	RS, L, W	RS, L	RS, L, GW					

Surface water monitoring

Every 10 years, the MPCA conducts intensive monitoring of each of the state's 80 major watersheds (HUC8). This monitoring resulted in the Watershed Restoration and Protection Strategy (WRAPS) for the Pine River Watershed in 2017. This intensive monitoring is expected to occur again in the Pine River Watershed in 2022.

The organizations in the Pine River Watershed have a strong history of water quality monitoring, with over 95 of the lakes in the watershed having 10-year transparency trend data (Table 25). This plan intends to continue to encourage local lake association volunteers to collect this data so that future trends may be tracked throughout the plan's 10-year lifespan.

Table 25. Ten-year transparency trends for lakes in the Whitefish Lake minor watershed

DNR_DOW	Lake	Final trend
18036600	Arrowhead Lake	Declining
18035500	Bertha Lake	No trends/stable
18035600	Clamshell Lake	Decreasing
11019900	Hay Lake	Increasing
18026900	Island Lake	Decreasing
18037800	Lower Hay	Improving
18041200	Upper Hay Lake	No trends/stable
18035400	Pig Lake	Declining
18031000	Whitefish Lake	Declining

There are many stream sites being monitored by volunteers through the MPCA's Citizen Stream Monitoring Program and through local laboratories. Stream testing for transparency and phosphorus tracks the loading going into lakes and throughout the watershed.

The biological community is tracked in lakes by the DNR (fish communities) and in streams by the MPCA (macroinvertebrate and fish communities). The biological communities better illustrate the full picture of water quality and habitat quality than just water samples, because the data show what animals can live in the water body year-to-year. After restoration activities are implemented from this planning effort, these streams can be retested to see if the biological communities have recovered.

For Whitefish Lake, specifically, additional monitoring will be needed to track water quality improvements from projects such as alum treatment in Arrowhead Lake, pasture management in the South Fork subwatershed, and restoration of impaired streams. This will be done by monitoring transparency and phosphorus concentrations in Arrowhead Lake, monitoring the Pine River inlet to Upper Whitefish Lake for phosphorus concentration, and re-assessing the biological communities of the impaired streams in the next MPCA intensive watershed round.

Groundwater, forestry, and habitat

Crow Wing County offers nitrate testing for watershed residents. The Minnesota Department of Health requires arsenic, nitrate, and bacteria tests on every new well installed. The Minnesota DNR monitors groundwater quantity through the Cooperative Groundwater Monitoring System. The PRW1W1P's major focus for groundwater is protecting the shallow sand aquifer and preventing contamination. Protection will be measured by the 75% of the minor watershed metric, which is the same as used in the Forestry and Habitat section. Records will be kept at the county of the number of acres in each

watershed that are protected including updating any new easements, SFIA contracts, and acquisitions. Habitat restoration will be tracked by the amount of feet and miles restored in shoreland areas of lakes with over 10% shoreland impervious surface and/or a declining water quality trend over the 10-year timeframe of this plan.

References

Cass SWCD, Cass County, Crow Wing SWCD, Crow Wing County, WAPOA, & Pine River Watershed Alliance. (n.d.). *Bertha and Clamshell Lakes Implementation Plan.*

Cass SWCD, Cass County, Crow Wing SWCD, Crow Wing County, WAPOA, & Pine River Watershed Alliance. (n.d.). *Big Trout Lake Implementation Plan.*

Cass SWCD, Cass County, Crow Wing SWCD, Crow Wing County, WAPOA, & Pine River Watershed Alliance. (n.d.). *Whitefish Lake Implementation Plan.*

Edwards, P. J., & Williard, K. W. (2010). Efficiencies of forestry best management practices for reducing sediment and nutrient losses in the eastern United States. *Journal of Forestry*, *108*(5), 245-249.

Minnesota Board of Soil and Water Resources (BWSR). (2021). *Watershed drilldown & RAQ scoring methodology (or PTM in the forested zone) user's guide.*

Appendix A
Lake transparency trends

The Pine River 1W1P included a lake transparency trend analysis from the MPCA and RMB Environmental Laboratories, Inc. (Table 26). The trend analysis was completed with the Mann Kendall trend statistic with 8 or more years of data included. A 90% probability was required to illustrate a trend. “No trend/stable” indicated that there were no statistical trend above 90% in the data (1W1P, 2019).

Table 26. Lake transparency trends in the Whitefish Lake minor watershed, adapted from 1W1P, 2019

DNR_DOW	Lake name	Trend
18036600	Arrowhead	Declining
18035500	Bertha	No trend/stable
18031500	Big Trout	Declining
18035600	Clamshell	Decreasing
11019900	Hay	Decreasing
18018300	Island	Declining
18026900	Island	Decreasing
11010200	Island	No trend/stable
18037800	Lower Hay	Improving
18028800	Ox	Declining (95%)
18035400	Pig	Declining
18041200	Upper Hay	No trend/stable
18031000	Whitefish	Declining