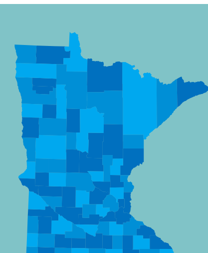
Coldwater lake habitats

December 2025

Development of water quality standards to protect coldwater lake habitats in Minnesota

MINNESOTA

Pollution Control Agency
Department of Natural Resources



Authors

R. William Bouchard, Jr. (MPCA)
Derek Bahr (MNDNR)

Contributors/acknowledgements

Tyler Ahrenstorff (MNDNR)
Jacquelyn Bacigalupi (MNDNR)
Brady Becker (MNDNR)
Lucas Borgstrom (MNDNR)
Rick Bruesewitz (MNDNR)
Brad Carlson (MNDNR)
Jeff Eibler (MNDNR-retired)
Lindsay Egge (MPCA)
Lee Engel (MPCA)
Bill Evarts (MNDNR)
Brent Flatten (MNDNR)
Leslie George (MNDNR)
Meghan Hemken (MPCA)
Pete Jacobson (MNDNR-retired)
Martin Jennings (MNDNR-retired)
Jim Levitt (MNDNR)
Bill McKibbin (MNDNR)
Jason Neuman (MNDNR)
Nathan Olson (MNDNR)
Tony Standera (MNDNR)
Calub Shavlik (MNDNR)
Aaron Sundmark (MNDNR)
Matt Ward (MNDNR)
David Weitzel (MNDNR)
Jim Wolters (MNDNR)

Minnesota Pollution Control Agency

520 Lafayette Road North | Saint Paul, MN 55155-4194 |

651-296-6300 | 800-657-3864 | Or use your preferred relay service. | Info.pca@state.mn.us

This report is available in alternative formats upon request, and online at www.pca.state.mn.us.

Document number: wq-bsm4-04

Contents

Figures

Tables

Acronyms or abbreviations

2A	Coldwater aquatic life and habitat
2B	Cool and warm water aquatic life and habitat
2Bd	Cool and warm water aquatic life and habitat, also protected for drinking water
a_{440}	Absorptivity at 440 nm
BWCAW	Boundary Water Canoe Area Wilderness
CFR	Code of Federal Regulations
ch.	Chapter
Chl-*a*	Chlorophyll-*a*
CPUE	Catch-per-unit-effort
CWA	Clean Water Act (33 U.S.C. § 1251 et seq.)
DOC	Dissolved organic carbon
EPA	U.S. Environmental Protection Agency
EQuIS	Environmental Quality Information System
FIBI	Fish index of biological (biotic) integrity
GAM	Generalized additive model
HUC 8	8-digit hydrological unit code (watershed subbasin)
IBI	Index of biological (biotic) integrity
mg/L	Milligrams per liter
Minn. R.	Minnesota Rules
MNDNR	Minnesota Department of Natural Resources
MPCA	Minnesota Pollution Control Agency
ORVW	Outstanding resource value waters
PCU	Platinum-cobalt units
SSS	Site-specific standard
TALU	Tiered aquatic life use(s)
T_{DO}	Oxythermal habitat
T_{DO3}	Oxythermal habitat: temperature where dissolved oxygen concentration equals 3 mg/L
TMDL	Total maximum daily load
TP	Total phosphorus
TSD	Technical support document
UAA	Use attainability analysis
U.S.C.	United States Code
WID	Waterbody identification number
WQBEL	Water quality-based effluent limit
WQS	Water quality standards
WRAPS	Watershed restoration and protection strategies

Definitions

The following definitions are based on standard use and are provided for the convenience of the reader. Unless otherwise specified, these definitions are specific to this document.

Aquatic life use: A designated use that protects aquatic biota including fish, insects, mollusks, crustaceans, plants, microscopic organisms, and all other aquatic-dependent organisms.

Aquatic life use goal: A goal for the condition of aquatic biota, which is required by the Clean Water Act (CWA). Minimum aquatic life use goals are established using the CWA interim goal ("…water quality which provides for the protection and propagation of fish, shellfish, and wildlife…" CWA Section 101(a)(2) [33 U.S.C. § 1251]). The objectives for these goals are established in Minnesota Rule using narrative standards, numeric standards, or both. The condition or health of aquatic life in aquatic habitats are measured in Minnesota using indices of biological integrity (IBIs) and other tools.

Beneficial use: A designated use described under Minn. R. 7050.0140 and listed under Minn. R. 7050.0400 to Minn. R. 7050.0470 for each surface water or segment thereof, whether or not the use is being attained. (The term "designated use" may be used interchangeably.) See also "existing use."

Biological integrity: The ability of an aquatic ecosystem to support and maintain an assemblage of organisms having a species composition, diversity, and functional organization comparable to that of natural habitats within a region.

Biological monitoring: The measurement of a biological entity (taxon, species, assemblage) as an indicator of environmental conditions. Ambient biological surveys and toxicity tests are common biological monitoring methods. (The term "biomonitoring" may be used interchangeably.)

Clean Water Act (CWA): An act passed by the United States Congress to control water pollution (formally referred to as the Federal Water Pollution Control Act of 1972). 33 U.S.C. § 1251 et seq.

Criteria: Narrative descriptions or numerical values, which describe the chemical, physical, or biological conditions in a water body necessary to protect designated uses

Designated use: See "beneficial use."

Dimictic lake: Lakes which mix twice a year in the spring and fall and are stratified during the summer and winter. Compared to polymictic lakes, dimictic lakes tend to be deeper with the littoral zone comprising a lower proportion of the total area.

Existing use: Those uses actually attained in a surface water on or after November 28, 1975. See Minn. R. 7050.0255, subp. 4.

Index of biological integrity or index of biotic integrity (IBI): An index developed by measuring attributes of an aquatic community representing the health of that community and that change in quantifiable and predictable ways in response to human disturbance.

Oxythermal habitat: A measure of temperature and dissolved oxygen in a water column where both dissolved oxygen and temperature is suitable to support coldwater fish communities during critical periods. For assessments, an oxythermal metric called T_{DO3} which is the temperature at 3 mg/L of dissolved oxygen in a lake profile is used.

Oxythermal layer: A water column layer of a designated thickness where both dissolved oxygen and thermal conditions need to be maintained at levels that support coldwater fish communities during critical periods. Oxythermal layer criteria may be defined using different methods including a fixed layer thickness which meet defined temperature and oxygen criteria or by determining the water temperature at which a dissolved oxygen threshold is meet in a lake profile. The layer thickness method could for example require a 1 m layer where the water temperature is less than 20 °C and dissolved oxygen is greater than 3 mg/L. The temperature threshold method can for example be used to require that water temperature be less than 20 °C on the lake profile where the dissolved oxygen equals 3 mg/L. The later method (i.e., temperature threshold) is used for setting draft oxythermal habitat criteria for cold water fishes in Minnesota.

Polymictic lake: Lakes with frequent mixing of the water column during the ice-free period. In general, these lakes are shallow and are largely consistent with the shallow lake definition in Minn. R. 7050.0150, subp. 4.

Standard: Regulatory limits on a particular pollutant, or a description of the condition of a water body, which supports or protects the beneficial use or uses. Standards may be narrative or numeric and are commonly expressed as a chemical concentration, a physical parameter, or a biological assemblage endpoint. See also the definition for "criteria."

Use attainability analysis (UAA): A structured scientific assessment of the physical, chemical, biological, and economic factors affecting attainment of the uses of water bodies. A UAA is required to remove a designated use specified in section 101(a)(2) of the CWA that is not an existing use. The allowable reasons for removing a designated use are described in 40 CFR § 131.10 (g). See Minn. R. 7050.0150, subp. 4.

Water quality standards (WQS): A law or regulation that consists of the beneficial use or uses of a water body, the narrative or numerical WQS that are necessary to protect the use or uses of that water body, and antidegradation.

Overview

The State of Minnesota has adopted water quality standards (WQS) that protect coldwater lake habitats, but it is necessary for water quality programs to review and revise existing standards as needed when new information is available or gaps in these standards are identified. One of the gaps identified for Minnesota's current coldwater lake standards is that they are focused only on lakes which support or are managed for trout species (e.g., Lake Trout [*Salvelinus namaycush* (Walbaum, 1792)], Brook Trout [*Salvelinus fontinalis* (Mitchill, 1814)], Rainbow Trout [*Oncorhynchus mykiss* (Walbaum, 1792)], Brown Trout [*Salmo trutta* Linnaeus, 1758]; Table 1). Minnesota's standards do not include protections for other coldwater fishes which occur in the state including Lake Whitefish (*Coregonus clupeaformis* [Mitchill, 1818]) and Cisco (*Coregonus artedi* Lesueur, 1818). The objectives of this study were to 1) determine if current lake standards are sufficient to protect coldwater fishes, 2) evaluate whether there are gaps in protections, and if so what WQS revisions are needed, and 3) identify specific lakes which support coldwater fish species.

Table 1. Minnesota's current lake eutrophication standards for coldwater (Class 2A) and warm water (Class 2B/2Bd) habitats.

Species	Total phosphorus (µg/L)	Chlorophyll-*a* (µg/L)	Secchi depth (m)
Coldwater: Lake Trout	12	3	4.8
Coldwater: Stream Trout	20	6	2.5
Warm water: Northern lakes*	30	9	2.0
Warm water: Central lakes	40	14	1.4
Warm water: Central shallow lakes	60	20	1.0
Warm water: South lakes	65	22	0.9
Warm water: South shallow lakes	90	30	0.7

**The lake eutrophication standards for northern cool water and warm water lakes are currently being reviewed and will likely be revised concurrently with coldwater lake standards. The draft standards for northern warm water, dimictic lakes are total phosphorus = 20 µg/L; chlorophyll-a = 9 µg/L; Secchi depth = 1.8 m. Draft standards for northern warm water, polymictic (i.e., shallow) lakes are total phosphorus = 32 µg/L; chlorophyll-a = 18 µg/L; Secchi depth = 0.9 m. The lake eutrophication standards for Central and South region lakes would not be revised as part of this rule making.*

Coldwater lakes are an important resource in Minnesota because they provide a variety of beneficial uses. Many of these lakes harbor one or more species of Salmonidae including Lake Trout, Lake Whitefish, Cisco, or stream trout species/hybrids (e.g., Brook Trout, Rainbow Trout, Brown Trout, and splake). A major difference in the ecological requirements of coldwater species compared to cool and warm water species is the need for habitat with cooler temperatures and higher oxygen levels. However, as in most taxonomic assemblages, the species comprising Salmonidae in Minnesota have different ecological requirements and need different WQS for their protection. As a result, this research focused on developing different dissolved oxygen, temperature, and lake productivity (i.e., chlorophyll-*a* [chl-*a*]) thresholds for Lake Trout, Lake Whitefish, and Cisco. Thresholds for protecting stream trout taxa were not assessed because these taxa are heavily managed through stocking and include a range of fishery types, including "put-and-take" fisheries, which complicates the use of field-based analyses. As a result, the chl-*a* standard for the protection of stream trout habitat will not be changed from current standards[1].

Analyses of coldwater fish distributions in Minnesota lakes were used to determine oxythermal (i.e., dissolved oxygen and temperature) requirements and lake productivity levels needed to support these fish species. This consisted of an analysis of oxythermal requirements for Cisco, Lake Whitefish, and Lake Trout using a measure of the water temperature at which dissolved oxygen equaled 3 mg/L in the water column (i.e., T_{DO3}). Analyses of lake productivity thresholds for these fish species followed Minnesota's existing lake eutrophication framework and determined requirements for chl-*a*, total phosphorus, and Secchi depth. These analyses verified that in many lakes, the cool/warm water habitat (Class 2B/2Bd) standards are not sufficient to protect these coldwater fish species. The one exception was the eutrophication parameters for Cisco in the northern nutrient region where the existing standards for dimictic lakes would be protective. However, there is currently no oxythermal habitat measure for lakes in rule so the addition of this parameter would add additional protections to these lakes. A suite of draft WQS criteria, including both oxythermal and eutrophication measures were developed to protect these sensitive fish species (Table 2). The draft oxythermal standards are new and unique to coldwater lakes and will provide a direct measure of habitat suitability for coldwater fishes. For Lake Trout, we confirmed the existing chl-*a* standard is protective although revisions to total phosphorus (TP) and Secchi depth models indicated that these parameters should be revised. The draft eutrophication standards for Lake Whitefish are more protective than the existing standards for these lakes. For Cisco the protectiveness of existing eutrophication standards is mixed. For central region lakes, the existing eutrophication standards are not sufficiently protective. However, the northern region lake standards are more protective than determined for Cisco and as a result, the more protective warm water standards would apply to these lakes (Table 2). This is because these lakes are two-story lakes which support both warm water and coldwater communities and it is necessary to apply the more stringent standards to protect the most sensitive community. These WQS will be adopted in Minnesota rules as part of the lake eutrophication standards for Class 2A waters (Minn. R. 7050.0222, subp. 2).

Table 2. Draft oxythermal habitat (T_{DO3}), total phosphorus, chlorophyll-*a*, and Secchi depth thresholds for Lake Trout (LAT), Lake Whitefish (LKW), Cisco (TLC), and stream trout (SRT) coldwater (Class 2A) habitats.

Species	T_{DO3} (°C)	Total phosphorus (µg/L)	Chlorophyll-*a* (µg/L)	Secchi depth (m)
Coldwater: Lake Trout [LAT]	8.8	7	3*	3.5
Coldwater: Lake Whitefish [LKW]	17.2	12	5	2.8
Coldwater: Cisco [TLC]#	21.2	25	12	1.3
Coldwater: Stream trout [SRT]	-	15	6*	2.5

** indicates a threshold which is unchanged from the current standard*

#The draft North region cool and warm water lake eutrophication criteria for dimictic lakes (total phosphorus = 20 µg/L; chlorophyll-a = 9 µg/L; Secchi depth = 1.8 m]) are more stringent than the Cisco eutrophication standards and will be the applicable standard for Cisco lakes in the North region. In Central region Cisco lakes, the Cisco eutrophication standards are more stringent and will be the applicable standard.

[1] The current standards are largely based on the 75th percentiles of water quality parameters from lakes managed for stream trout (Heiskary and Wilson 2005).

In addition to determining protective thresholds for coldwater fish species, we developed a list of lakes[2] which support or supported coldwater fish populations on or after November 28, 1975. These lakes are part of a list of lakes that will be proposed to be confirmed or newly designated as Class 2A for the protection of coldwater habitat. The current aquatic life use designations for Class 2A lakes are based on the presence or management of either Lake Trout or stream trout. Revisions to the list of coldwater habitats will include confirming use designations for Lake Trout or stream trout and will add Cisco and Lake Whitefish protections to lakes where appropriate. Although the current coldwater lake standards are based on protections for Lake Trout or stream trout, these species-specific designations are not codified in Minn. R. 7050.0470. As a result, Minn. R. 7050.0470 will be revised to document and codify the coldwater fish species protected in each lake. The review of coldwater habitats in this document includes confirmations or changes to use designations for a total of 731 lakes (see Appendix C). This includes 411 new coldwater habitat designations, 295 lakes where the current designated use class was confirmed, and 25 lakes where Class 2Bd was determined to be appropriate (Table 3). For the 295 lakes where the current designated use will be retained, 88 of these lakes have modifications to the fish species protected. The total draft designations included 111 Lake Trout lakes, 87 Lake Whitefish lakes, 465 Cisco lakes, and 170 stream trout lakes (Table 4).

Table 3. Summary of draft beneficial use designations for coldwater lakes. Abbreviations: LAT = Lake Trout (*Salvelinus namaycush*); LKW = Lake Whitefish (*Coregonus clupeaformis*); TLC = Cisco (*Coregonus artedi*); SRT = stream trout.

Current use[3]	Draft use	# of lakes	Type
2B/2Bd	2A[LAT/LKW/TLC/SRT]	411	2A designation
$2A^{LAT/SRT}$	2A[LAT/SRT]	207	Species confirmation
$2A^{LAT/SRT}$	2A[LAT/LKW/TLC/SRT]	88	Species modification
$2A^{LAT/SRT}$	2Bd	25	2Bd designation

Table 4. Number of lakes protected for each coldwater fish species based on draft designations.

Coldwater species	# of lakes
Lake Trout	111
Lake Whitefish	87
Cisco	465
Stream trout	170

The draft WQS for coldwater habitats and designations for specific lakes will provide appropriate protections for these sensitive fishes. The assignment of different criteria for different fish species provides refined goals that are tailored to the requirements of these species. These draft WQS consist of multiple endpoints (i.e., oxythermal habitat and eutrophication) which provide several advantages including:

1) Oxythermal habitat criteria directly measure if habitat is suitable for the survival of coldwater species;
2) Eutrophication criteria are consistent with existing WQS and provide targets for water quality management (e.g., total maximum daily load [TMDLs] studies, water quality-based effluent limits [WQBELs], watershed restoration and protection strategies [WRAPS]);
3) Multiple endpoints can be used to partition different threats including cultural eutrophication and climate change;

[2] For Lake Trout, Lake Whitefish, and Cisco, the draft list of designated lakes is limited to dimictic lakes. Stream trout lake designations include both dimictic and polymictic lakes.

[3] The type of coldwater habitat (i.e., the species of fish protected by the Class 2A designation) is currently not codified in Minn. R. 7050.0470. The current coldwater habitat type has been determined through a review of existing documentation. As part of this rule revision, fish species protected in each lake will be codified for clarity.

4) Multiple endpoints provide different options for assessing attainment of goals; and
5) Multiple endpoints can be used to determine if lakes are atypical when endpoint outcomes do not align.

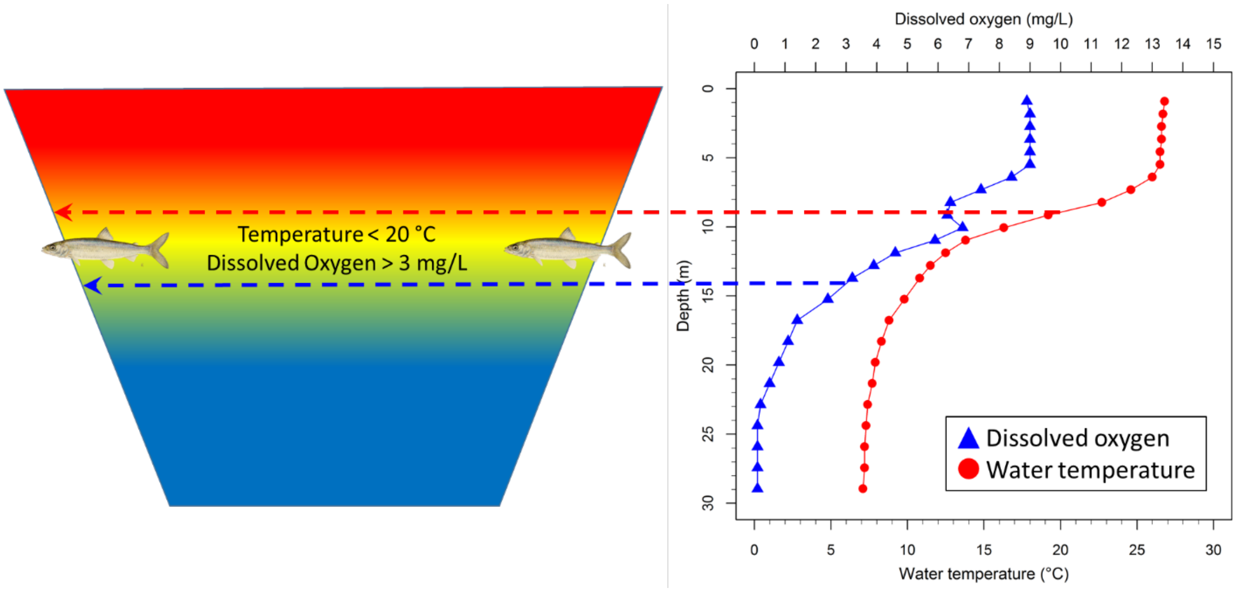
These improved tools for protecting coldwater lakes are coupled with an extensive review of coldwater lakes in Minnesota to determine which species should be protected in this subset of lakes. This provides clarity regarding the specific goals that are needed to support these fish species and the fisheries upon which they rely. Using these well-delineated goals, the MPCA, MNDNR, other agencies, organizations, or groups responsible for the protection of Minnesota's aquatic resources can implement protection and restoration programs to maximize effectiveness and efficiency. Given the threats that coldwater fishes and their habitats face, the responsible and effective use of available resources will be vital to ensuring that these habitats and the benefits they provide persist.

Introduction

Coldwater fish species provide several important benefits and uses to Minnesota lakes. Lake Trout are a very popular and important game fish in Minnesota's northern lakes and Lake Superior. Minnesota has more lakes supporting Lake Trout than any other state other than Alaska, making these lakes an important and unique resource in the United States. Other native salmonids such as Cisco and Lake Whitefish are not as popular as many other gamefish in the state, but they are netted and are also targeted by some anglers. Coldwater fishes such as Cisco and Lake Whitefish are also important forage for other game fishes (e.g., Lake Trout, Northern Pike (*Esox lucius* Linnaeus, 1758), Muskellunge (*Esox masquinongy* Mitchill, 1824), and Walleye (*Sander vitreus* (Mitchill, 1818)). For example, when fish like Cisco are present in a lake, the presence of this forage base can increase size of game fish and fishery yields (Trippel and Beamish 1989, Matuszek et al. 1990, Siesennop 1998, Kaufman et al. 2009, Kennedy et al. 2018, Vanderbloemen et al. 2020). These species are also very sensitive to environmental change and are useful indicators of water quality changes and declines. Their sensitivity to changes in temperature and lake productivity means that many populations of these coldwater fishes are at risk from nutrient enrichment and climate change. Recognizing the importance of these species, the MNDNR has developed several programs which provide protections for lakes supporting these fish species including Cisco Refuge Lakes, Lakes of Biological Significance, and Lakes of Phosphorus Sensitivity. Wisconsin has also adopted WQS rule revisions to specifically address protection of coldwater fishes. In addition, the EPA has developed recommended eutrophication standards (EPA 2021) which include standards for deepwater hypoxia and would benefit coldwater fish species.

Coldwater fishes differ in their habitat requirements compared to cool and warm water species in requiring cooler water with higher oxygen levels. Coldwater species are largely limited to deep, low nutrient lakes in Minnesota. During the summer when these lakes stratify, cooler, well-oxygenated water is present below the thermocline which provides a summer refuge for these species (Figure 1). If annual summer water temperatures increase, the available habitat for these species shrinks and they are forced deeper into the lake (Sharma et al. 2011). However, deepwater oxygen depletion can also force fish higher in the water column which narrows the available habitat for coldwater fishes (Siesennop 2000, Aku et al. 1997, Havens et al. 2014, Lyons et al. 2018). Cultural eutrophication reduces deepwater oxygen levels by increasing productivity, deposition of organic matter, and subsequently oxygen demand in the sediment and hypolimnion (Sharma et al. 2011, Havens et al. 2014). Rising temperatures can also reduce oxygen levels by increasing respiration and extending the period between spring and fall lake turnover (De Stasio et al. 1996, Stefan et al. 1998, Stefan et al. 2001, Sharma et al. 2011). Depending on the lake, coldwater fishes may be threatened by either temperature or productivity increases or both as suitable habitat shrinks. As a result, it is important to address both threats as part of a WQS framework for the protection of coldwater fish species.

Figure 1. Conceptual diagram of oxythermal requirements for coldwater fishes. Oxythermal criteria provided here are based on the "Cisco layer" described by Frey (1955).



The two largest threats to coldwater fish populations in the Upper Midwest are eutrophication and climate change (Jacobsen et al. 2019). Climate change will increase lake temperatures, extend the period of stratification (i.e., longer summers), and reduce dissolved oxygen levels in lakes (Woolway et al. 2019, Jane et al. 2021). Depending on different warming scenarios, increased temperatures are estimated to result in the loss of 25-70% of Cisco lakes in Minnesota and Wisconsin (Sharma et al. 2011, Fang et al 2012, Jiang et al. 2012, 2017, Custer et al. 2024). These fish also face threats from nutrient loading (Herb et al. 2014, Honsey et al. 2016) which increases oxygen depletion in deepwater habitats. Invasive species such as Rainbow Smelt (*Osmerus mordax* (Mitchill, 1814)) also threaten these species and have likely resulted in several coldwater fish species extirpations in Minnesota. The combination of these threats has resulted in a decline in the catch-per–unit-effort (CPUE) of these species since the 1960s as measured by MNDNR fisheries surveys (Jacobson et al 2012). Due to the declines in these species and their sensitivity to habitat degradation, it is important to have well-designed and effective WQS coupled with water quality protection programs.

Coldwater fishes are an important component of many Minnesota's lakes, but current WQS may not adequately protect some coldwater fish species. Currently, cool/warm water standards apply to some lakes which support salmonids such as Cisco and Lake Whitefish. As a result, productivity and hypolimnetic dissolved oxygen conditions which meet cool/warm water standards in these lakes could still result in the extirpations of these species. In addition, the current dissolved oxygen and temperature standards for cold and cool/warm lakes are not specific to the protection of coldwater fishes. Dissolved oxygen standards are 7 mg/L for coldwater lakes and 5 mg/L for cool/warm water lakes, but these standards do not specify oxygen levels for the hypolimnion or metalimnion which are critical habitats for coldwater fishes in the summer in dimictic lakes. A lake may have normoxic conditions in the epilimnion and meet dissolved oxygen standards while the hypolimnion or metalimnion is hypoxic or anoxic. Temperature standards for coldwater lakes do not allow any "material increase" which in theory should be sufficient to protect coldwater taxa. However, in practice this is more difficult to implement, and it is not specific to different coldwater fish taxa. As a result, review of oxygen and temperature requirements and development of specific, protective thresholds for coldwater fishes is warranted in conjunction with a review of existing eutrophication criteria.

Minnesota's coldwater fishes

Minnesota lakes support several native cold and cool water fish species including Lake Trout, Lake Whitefish, several species of Cisco, and Burbot. In addition, several native and non-native coldwater fish species and hybrids (e.g., Brook Trout, Rainbow Trout, Brown Trout, and splake) are stocked into lakes to create managed fisheries. This study is focused on assessing if new or revised standards are needed to protect Lake Trout, Lake Whitefish, and Cisco. This effort does not include analyses of Burbot (*Lota lota* (Linnaeus, 1758)) because gear types used in most fisheries surveys inadequately sample this species making the available data inadequate for assessment. The existing WQS for stream trout lakes was not extensively reviewed as part of this research and there are only minimal changes to the WQS that protect these fish species. The heavily managed nature of stream trout fisheries in lakes made it difficult to assess habitat requirements using field-based data analyses and therefore the existing criteria are largely retained.

Native populations of coldwater fish species are largely limited to north central and north eastern watersheds in Minnesota although some introductions have been successful outside of their native range. Native populations of Lake Trout are limited to the Rainy River and Lake Superior watersheds (Hatch 2015). Hatch (2015) lists Cisco and Lake Whitefish as being native to the Red River, Rainy River, Lake Superior, and Mississippi River Headwaters (upstream of the confluence with the St. Croix River) basins. Although Hatch (2015)[4] lists Cisco as being introduced into the St. Croix River basin, there is evidence that Cisco are native to this watershed above St. Croix Falls. For example, Grindstone and Hanging Horn lakes support or are thought to have once supported[5] native populations of Cisco. Cisco are also present in the St. Croix watershed below St. Croix Falls in Lake Elmo, but there are stocking records indicating that the presence is the result of stocking. In addition, Cisco may also be native in a small number of lakes in the Chippewa and Pomme de Terre watersheds in the Minnesota River basin. Miller et al. (2021) also determined that Cisco in Rachel Lake (Chippewa River watershed) and Cisco from several nearby lakes in the Mississippi River basin were composed of a single ancestral group. There is no evidence of stocking for the Minnesota River basin lakes, and they are close to watershed boundaries with the Mississippi River and Red River watersheds which suggests these populations are possibly native.

The following sections describe existing knowledge of coldwater fishes in Minnesota with a focus on oxythermal requirements for these species. Depending on the study, different temperature, and oxygen endpoints (e.g., optimum, lethal, preference) are used which makes comparison across studies difficult. These studies also use a variety of methods, fish year classes, and research settings (e.g., field and laboratory). It is not within the scope of Minnesota's standards development to extensively review these methods and determine environmental optima for these coldwater fishes from this literature. Rather this research provides a summary of previous research to help guide threshold development and to put draft values into the context of reported thermal and oxygen optima and lethal conditions. The draft WQS is based on extensive datasets from Minnesota lakes to ensure that these criteria are applicable to these habitats.

[4] Hatch (2015) limited watershed presence to records where the specimen could be examined.
[5] The cisco population in Grindstone is thought to have been extirpated due to the introduction of Rainbow Smelt in this lake based the absence of cisco in MNDNR fisheries surveys since the 1990s.

i. Cisco

Cisco (Lake Herring or Tullibee) is one of the most common and widespread salmonids in Minnesota (Eddy and Surber 1943), occurring in lakes throughout northern Minnesota and even in some lakes in the Minnesota, Red, and St. Croix river basins. Although less so than many other salmonid species, Cisco require cool, well-oxygenated water and are largely limited to deep, cool lakes which stratify in the summer. However, there are also some polymictic lakes, largely in northern Minnesota, which also apparently support self-sustaining populations. Their importance for fisheries is largely not related to their use as a game fish, although Cisco are a good food fish and there is some fishing pressure on these populations. For example, there is an important Cisco fishery on Lake Superior. Their greatest benefit may be a as food source for other popular fish species such as Walleye, Northern Pike, Muskellunge, and Lake Trout.

There are several cisco species in Minnesota although the exact number varies depending on the taxonomists or taxonomic resource. The taxonomy of cisco species is confusing due to the morphological plasticity of these species and the difficulty of delineating distinct morphological and genotypic types (Koelz 1931, Woodger 1976, Turgeon et al. 2016). For example, Jacobson et al. (2020) determined that the morphology of Cisco changed along a gradient of lake productivity. Hatch (2015) lists five cisco species (*C. artedi, C. hoyi, C. kiyi, C. nipigon*, and *C. zenithicus*) and indicates that other than *C. artedi*, these species are limited to Lake Superior. However, Etnier et al. (2003) identified *C. nipigon* and *C. zenithicus* from Lake Saganaga and there may be other inland lakes in Minnesota that support additional cisco species. However, it is not known if these other cisco species have different water quality requirements than *C. artedi* due to the small number of lakes supporting these species and a lack of consensus regarding the delineation of these species. Regardless, lakes that potentially support other cisco species also support Lake Trout or Lake Whitefish and would thereby be protected by these more stringent standards. As a result, the current research is focused on *C. artedi* because this species is widespread in central and northern Minnesota and there is sufficient data to determine ecological thresholds for this species. Although it is beyond the scope of this research, determining the ecological requirements of the other cisco species in Minnesota is important for their protection. However, developing standards for these species is not currently a priority because Lake Superior and the portion of Lake Saganaga in the U.S. already have some the most stringent WQS in Minnesota as both are classified as prohibited outstanding resource value waters[6]. Hereafter, the focus of this research is on *C. artedi* and unless otherwise noted, references to “Cisco” refer to this species alone.

There are numerous laboratory and field-based assessments of the dissolved oxygen and temperature requirements of Cisco (Table 5). Regardless of the endpoint, studies of dissolved oxygen requirements for Cisco were largely consistent and indicated that dissolved oxygen concentrations ranging from 1-3 mg/L were sufficient for survival. In a study of lakes experiencing summertime Cisco kills, Jacobson et al. (2008) determined that 0.5 mg/L is a lower lethal concentration for Cisco. However, the authors note that the lower lethal concentration is likely higher. Temperature thresholds for Cisco were more variable with upper limits ranging from 17-26 °C. Preferred or optimal temperatures ranged from 10-19 °C with most studies indicating 17-19 °C to be optimal. However, it is important to consider the interaction of oxygen and temperature on these fish which when considered separately will introduce variably in ecological threshold determinations.

[6] Prohibited outstanding resource value waters prohibit proposed activities that result in a “net increase in loading or other causes of degradation” (Minn R. 7050. 0265).

Frey (1955) proposed that a ''cisco layer'' with dissolved oxygen of 3 mg/L and water temperature of 20°C for the protection of Cisco in Indiana lakes. Wisconsin has adopted[7] a standard for Cisco which requires a 1 m layer of habitat with dissolved oxygen of >6 mg/L and water temperature of <22.8 °C. In Minnesota, Jacobson et al. (2008) demonstrated that the lower lethal dissolved oxygen for Cisco is temperature dependent, and that protection of these fish needs to consider both parameters (Table 6). Using a fixed dissolved oxygen threshold permits the identification of a consistent temperature endpoint. For example, Jacobson et al. (2010) used a dissolved oxygen of 3 mg/L to identify oxythermal niches for Cisco in Minnesota lakes. Jacobson et al. (2010) determined that the upper central and upper outer borders (see Heegaard 2002) for Cisco were 16.9 and 23.4 °C, respectively. The inner border represents the core habitat for the species whereas the outer border is the entire range for the species (Jacobson et al. 2010). This T_{DO3} measure has been used in several studies of coldwater lake fish habitat in Minnesota (e.g., Jacobsen et al. 2010, Fang et al. 2012, and Jiang et al. 2017). The use of this oxythermal metric in existing studies of Minnesota coldwater fishes and the incorporation of both temperature and oxygen measures makes the use of this metric preferable for determining coldwater habitat thresholds for Minnesota lakes.

Table 5. Summary of dissolved oxygen and temperature thresholds for Cisco (*Coregonus artedi*).

Reference	Dissolved oxygen (mg/L)	Water temperature (°C)	Habitat	Notes
Aku and Tonn (1997); Aku et al. (1997)	3.1 ± 1.3 (preferendum); 1.3 (avoidance concentration)	11.8 ± 2.1 (preferendum)	Amisk Lake, Alberta, Canada	Maximum abundance recorded
Cahn (1927)	-	17 (upper avoidance)	Wisconsin, USA	
Carlander (1969)	-	15.5 (upper avoidance); 13 (preferendum)	Lake Nippissing, Ontario, Canada	Cited in Wismer and Christie (1987)
Edsall and Colby (1970)	-	26.2 (upper lethal)	Laboratory	young-of-the-year Cisco
Edsall and DeSorcie (2002)	-	14.5 (optimum growth); 16.5 (preferendum); 26 (upper lethal)	Laboratory	Age 0 Cisco
Evans et al. (1996)	2.0 (greatest abundance)	-	Lake Simcoe, Ontario, Canada	Mean dissolved oxygen concentration at which fish were caught
Fry (1937)	-	20 (upper avoidance); 10 (preferendum)	Lake Nippissing, Ontario, Canada	Cited in Coutant (1977)
Frey (1955)	3 (minimum)	20 (maximum)	Indiana (USA) lakes	
Galligan (1951)	-	7.2 (preferendum)	Cayuga Lake, New York, USA	Cited in Coutant (1977)
Jobling (1981)	-	9.9-18.9 (preferendum)	Modeled	
Jacobson et al. (2008)	0.5 (lower lethal)	24 (upper lethal)	17 Minnesota (USA) lakes	Upper lethal temperature under normoxic conditions

[7] Administrative Rules Chapter NR 102 WATER QUALITY STANDARDS FOR WISCONSIN SURFACE WATERS

Reference	Dissolved oxygen (mg/L)	Water temperature (°C)	Habitat	Notes
Jacobson et al. (2010)	-	16.9 (central); 23.4 (outer)	Minnesota (USA) lakes	Based on temperature at 3 mg/L of dissolved oxygen
McCormick et al. (1971)	-	18.1 (optimum growth); 19.8 (lethal)	Laboratory	larvae
Nelson (1970)	1-3 (lower lethal)	18-26 (lethal)	Lake Itasca and Elk Lake, Minnesota, USA	Based on where fish were caught
Rudstam and Magnuson (1985)	1.9 (lower lethal)	12 (preferendum)	5 Wisconsin (USA) lakes	

Table 6. Modeled* results of the lethal niche boundary for adult Cisco from Jacobson et al. (2008).

O_{lethal} (mg/L)	1	2	3	4	5	6	7
T_{lethal} (°C)	19.5	21.2	22.0	22.6	23.0	23.3	23.6

*$O_{lethal} = 0.40 + 0.000006e^{0.59T_{lethal}}$

ii. Lake Whitefish

Lake Whitefish are similar to Cisco in terms of their importance and habitat requirements; however, the range of Lake Whitefish in Minnesota is more restricted. Lake Whitefish are found in far fewer lakes than Cisco and are limited to the Lake Superior, Rainy, Mississippi, and Red river basins. In addition, due in part to their larger size, Lake Whitefish are more important to anglers and commercial fisheries and there are inland lakes in Minnesota where netting of Lake Whitefish is allowed. Compared to Cisco, there are also fewer studies of oxygen and temperature thresholds for Lake Whitefish (Table 7). A single study from a lake in Ontario, Canada determined that the average dissolved oxygen at which fish were found was 2 mg/L which matched Cisco in that lake (Evans et al. 1996). Jacobson et al. (2010) used a dissolved oxygen of 3 mg/L to determine thermal requirements for Lake Whitefish in Minnesota lakes. Given the more restricted range of Lake Whitefish, it is likely they have more stringent oxythermal requirements than Cisco. Estimated optimal or preferred water temperatures for Lake Whitefish range from 12-17 °C and lethal temperatures have been determined to be as high as 26 °C although there are few studies which determined lethal temperature thresholds (Table 7). Using a dissolved oxygen of 3 mg/L, Jacobson et al. (2010) determined that upper central and upper outer borders (see Heegaard 2002) were 11.1 and 19.5 °C, respectively. The inner border represents the core habitat for the species whereas the outer border is the entire range for the species (Jacobson et al. 2010). This indicates that optimal temperatures may be near 11 °C and the upper range for the species is near 20 °C. Although there are limited data, these results suggest that temperatures less than 20 °C are needed to protect Lake Whitefish in Minnesota.

Table 7. Summary of dissolved oxygen and temperature thresholds for Lake Whitefish (Coregonus clupeaformis).

Reference	Dissolved oxygen (mg/L)	Water temperature (°C)	Habitat	Notes
Bernatchez and Dodson (1985)	-	12 (optimal swimming capacity)	Laboratory	Effect of temperature on swimming speed
Cooper and Fuller (1945)	-	11.9 (preferendum)	Moosehead Lake, Maine, USA	
Edsall (1999)	-	15.6-16.8 (preferendum)	Laboratory	Age-1 and age-0 fish

Reference	Dissolved oxygen (mg/L)	Water temperature (°C)	Habitat	Notes
Edsall and Rottiers (1976)	-	21-27 (upper lethal)	Laboratory	Based on different acclimation temperatures
Evans et al. (1996)	2.0 (greatest abundance)	-	Lake Simcoe, Ontario, Canada	Mean dissolved oxygen concentration at which fish were caught
Gorsky et al. (2012)	-	10-16 (greatest abundance)	Clear Lake, Maine, USA	Determined using acoustic telemetry
Hoagman (1974)	-	12-16 (preferendum)	Laboratory	Cited in Jobling (1981) and Coutant (1977)
Jacobson et al. (2010)	-	11.1 (inner); 19.5 (outer)	Minnesota (USA) lakes	Based on temperature at 3 mg/L of dissolved oxygen
Jobling (1981)	-	13.5-16.8 (optimum growth)	Modeled	
Madenjian et al. (2006)	-	11.1 (preference)	Lake Huron	Maximum temperature of tagged fish in early September
Magnuson et al. (1990)	-	12 ±2(preference)	Laboratory	
Opuszynski (1974)	-	10 (fingerlings); 17 (young fish)	Laboratory	Cited in Spotila (1979)
Qadri (1961)	-	7-14 (greatest abundance)	Lac la Ronge, Saskatchewan, Canada	Based on gill net sampling
Reckahn (1970)	-	17 (preferendum)	South Bay, Lake Huron, Ontario, Canada	Cited in Coutant (1977)
Tompkins and Fraser (1950)	-	12.7 (preferendum)	Laboratory	Cited in Christie and Regier (1988) and Ferguson (1958)

iii. Lake Trout

Lake Trout are one of the most sensitive fish species in Minnesota lakes and are only found in deep, low nutrient lakes. This species is only native to the Lake Superior and Rainy basins (possibly also the Mississippi River basin) and is only sustainable in a relatively small number of lakes in the state. Lake Trout are the largest native trout in North America, and they are an important fish for sport and commercial fisheries. Reported dissolved oxygen thresholds for Lake Trout range from 3-10 mg/L for optimal conditions with most estimated values at or near 6 mg/L (Table 8). Estimated lethal dissolved oxygen concentrations for Lake Trout range from 1-4 mg/L. Reported optimal water temperature thresholds for Lake Trout range from 4-13 °C with most studies indicating that 10 °C is optimal (Table 8). Lethal thresholds, including reports of maximum temperatures at which Lake Trout were observed, range from 16-24 °C. Lake Trout have lower thermal preferences than Lake Whitefish and Cisco and appear to also require higher dissolved oxygen levels. Jacobson et al. (2010) used a 3 mg/L threshold to determine oxythermal habitat requirements for Lake Trout which based on the upper central and upper outer borders (Heegaard 2002) were determined to be 5.1 and 6.8 °C, respectively. The inner border represents the core habitat for the species whereas the outer border is the entire range for the species

(Jacobson et al. 2010). Some studies indicated dissolved oxygen concentrations near 3 mg/L are lethal to Lake Trout (e.g., Gibson and Fry 1954, Paterson 1968, Evans et al. 1991, 1996).

Table 8. Summary of dissolved oxygen and temperature thresholds for Lake Trout (*Salvelinus namaycush*).

Reference	Dissolved oxygen (mg/L)	Water temperature (°C)	Habitat	Notes
Cooper and Fuller (1945)	8.3-10.1 (greatest abundance)	10-14 (greatest abundance)	Moosehead Lake, Maine, USA	Especially abundant at depths with these conditions
Dillon et al. (2003)	6 (optimal)	10 (optimal)	Lakes in Ontario, Canada	Based on other research
Edsall and Cleland (2000)	-	12.5 (highest growth); 10.1-10.2 (preferendum)	Laboratory	Age 0 fish
Evans et al. (1991)	Adults: 4.2 (lower threshold) 6 (response); 4 (incipient lethal) 2 (acute lethal)	Adults: 9.5 (±1.11); Juveniles: 10.2 (±1.12)	Adults – distribution; Juveniles - laboratory	Mean of published literature
Evans et al. (1996)	3.2 (greatest abundance)	-	Lake Simcoe, Ontario, Canada	Mean dissolved oxygen concentration at which fish were caught
Evans (2007)	6.6-7.5	-	Laboratory	¾ scope-for-activity at 4-14 °C
Galligan (1962); Webster et al. (1959)	-	7.2-12.8 (greatest abundance)	Cayuga Lake, New York, USA	Most fish captured at these temperatures; cited in Martin and Oliver (1980)
Gibson and Fry (1954)	3 (lethal)	23.5 (lethal); 15-17 (maximum activity)	Laboratory	Age 0 fish
Goddard et al. (1974)	-	11.5 (preferendum)	Laboratory	
Jacobson et al. (2010)	-	5.1 (inner); 6.8 (outer)	Minnesota (USA) lakes	Based on temperature at 3 mg/L of dissolved oxygen
Johnson (1975)	-	4-9 (greatest abundance); 15 (maximum)	Great Bear Lake, Northwest Territories, Canada	Based on gillnet surveys; cited in Martin and Oliver (1980)
Mac (1985)	-	9.2-12.6 (preferendum)	Laboratory	Preferendum determined at different rations
MacLean et al. (1990)	4 (usable) 6 (optimum)	15.5 (usable); 10 (optimum)	Lakes in Ontario, Canada	
Magnuson et al. (1990)	-	10 ±2 (preference)	Laboratory	

Reference	Dissolved oxygen (mg/L)	Water temperature (°C)	Habitat	Notes
Martin (1952)	-	6-18 (greatest abundance)	Redrock Lake, Ontario, Canada	Based on fisheries surveys
Martin and Oliver (1976)	>4 (minimum)	-	Lakes in Ontario, Canada	cited in Martin and Oliver (1980)
Martin and Oliver (1980)	-	6.1-7.2 (greatest abundance); 13.5 (upper limit)	Lake Tahoe, California/Nevada, USA	Based on fisheries surveys; unpublished data by Baker
Martin and Oliver (1980)	-	19.4 (upper limit)	Laboratory	All ages; unpublished data by Nolting
Martin and Oliver (1980)	>4 (greatest abundance)	-	Subalpine lakes in Colorado, USA	unpublished data by Nolting
McCauley and Tait (1970)	-	11.7 (preferendum)	Laboratory	
Novakowski (1955)	-	5-6 (greatest abundance); 17.5 (upper limit)	Reindeer Lake, Saskatchewan, Canada	Based on fisheries surveys; cited in Martin and Oliver (1980)
O'Connor et al. (1981)	-	10-12 (optimal growth)	Laboratory	Yearling trout
Paterson (1968)	1.4-2.9 (lethal)	-	Swan Lake, Alberta, Canada	Cited in Martin and Oliver (1980)
Peterson et al. (1979)	-	10.8 (preferendum)	laboratory	
Plumb and Blanchfield (2011)	>4-6 (greatest abundance)	<12-15 (greatest abundance)	Experimental Lake 373, Ontario, Canada	Used tagged fish
Rawson and Atton (1953); Rawson (1961)	3.6-4.3 (avoidance); 5.7 (no avoidance)	8-10 (greatest abundance); 16 (upper limit)	Lac la Ronge, Saskatchewan, Canada	Based on fisheries surveys
Séguin (1957)	-	17.8 (fry and fingerlings); 13.3 (yearlings)	Laboratory	
Sellers et al. (1998)	>6 (greatest abundance)	4-19 (greatest abundance)	3 small Canadian Shield lakes, Ontario, Canada	Temperature where fish were located differed between lakes
Snucins and Gunn (1995)	-	13-18 (location of tagged fish)	2 lakes, Ontario Canada	Body temperature of tagged fish
Straight (1969)	6 (greatest abundance)	<6 (greatest abundance); 18 (upper limit)	Alluring Lake, Ontario, Canada	Based on fisheries surveys; cited in Martin and Oliver (1980)

iv. Stream trout (multiple species and hybrids)

There are several stream trout (SRT) species and hybrids that are stocked in Minnesota lakes including: Brook Trout, Rainbow Trout, Brown Trout, and splake (Lake Trout ♀ x Brook Trout ♂). Like lake-dwelling salmonids, these fish species require cool, well-oxygenated water if they are to survive more than a season following stocking. However, there is limited information regarding their ecological requirements in lentic habitats. Most of these lakes are heavily managed because stream trout in Minnesota inland lakes are typically not naturally self-sustaining and are maintained through stocking. This management complicates field-based analyses of oxythermal and eutrophication requirements for these fish species. As a result, a threshold analysis for stream trout in lakes is not part of this study. Minnesota currently has lake eutrophication standards to protect stream trout lakes (TP: 20 µg/L; chl-*a*: 6 µg/L; Secchi depth: 2.5 m; Heiskary and Wilson [2005]). At this time, Minnesota is not considering major changes to these standards and the focus of this rule amendment for these lakes will be to review and confirm the list of stream trout lakes in rule.

Development of standards for the protection of coldwater fish in lakes

The analyses for determining oxythermal and eutrophication thresholds for Lake Trout, Lake Whitefish, and Cisco were based on field data to identify the ecological conditions under which these species occur in Minnesota. The oxythermal habitat analyses focused on separate T_{DO3} assessments for each fish species to determine the maximum T_{DO3} allowable, which will result in the maintenance of coldwater fish populations in most lakes. Eutrophication analyses were focused on identifying chl-*a* thresholds for these species and then modelling TP and Secchi depths which are consistent with protective levels of chl-*a*.

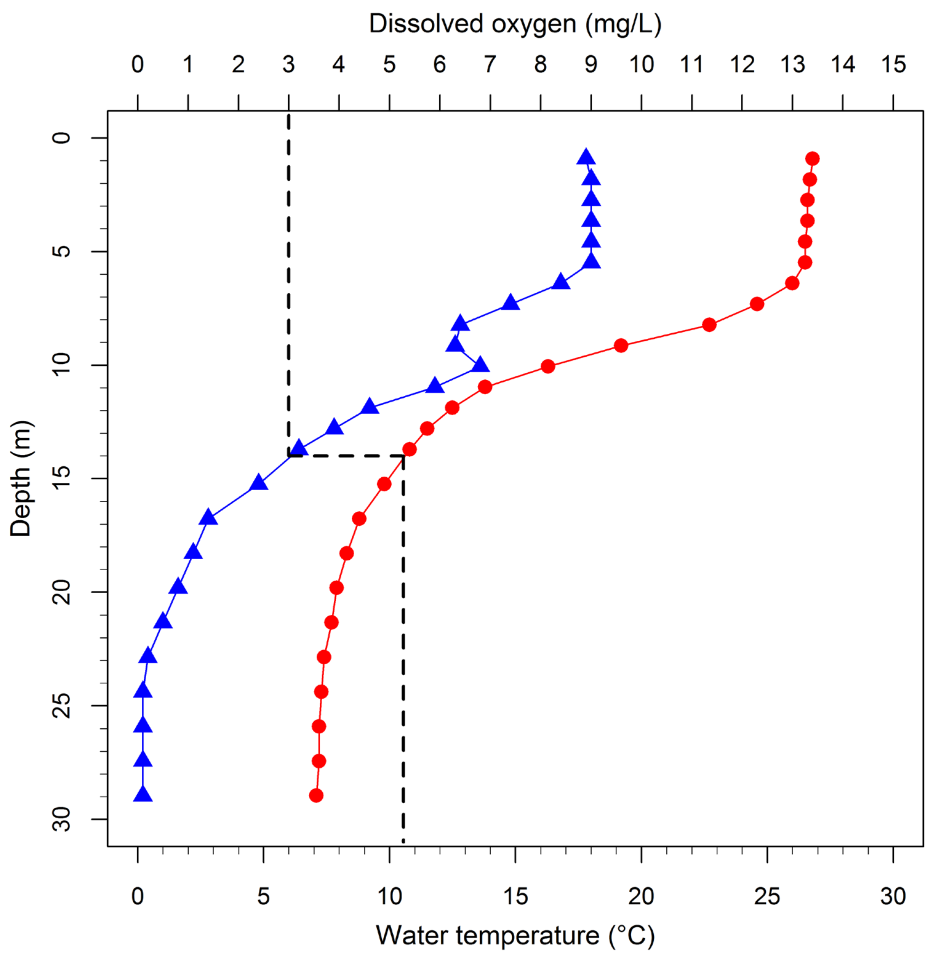
i. Data and methods

The specific datasets compiled and used were different for each analysis and are described in detail in the section for each analysis. Data used for most analyses consisted of data from 1990 through 2020. Data were limited to this range of years to estimate modern or contemporary oxythermal and productivity conditions for these lakes. In addition, this period has the greatest density of data available and sampling methodologies are more likely to be comparable.

a. Oxythermal habitat

Oxythermal habitat measures were calculated from temperature and oxygen profiles collected by the MNDNR and MPCA (1990-2020). Temperature and oxygen profiles were measured from lakes using electronic meters. Most profiles were measured using intervals ≤1 m (e.g., 1 ft, 3 ft, 1m). In some lakes, larger intervals were used in the hypolimnion when the rate of change in temperature and dissolved oxygen was observed to have greatly decreased. Oxythermal measures were calculated by interpolating a temperature using a fixed dissolved oxygen concentration from temperature and dissolved oxygen profiles. For example, a dissolved oxygen threshold of 3 mg/L was used to calculate T_{DO3} by interpolating water temperatures from dissolved oxygen and temperature profiles (Figure 2). In addition, using dissolved oxygen thresholds of 4, 5, 6, and 7 mg/L, T_{DO4}, T_{DO5}, T_{DO6}, and T_{DO7} metrics were calculated. Oxythermal layers of 1 m thickness based on Wisconsin's standards (Lyons et al. 2018) were also calculated. Some additional data processing was required to calculate T_{DOX} and oxythermal layer metrics for some profiles. For profiles where the minimum dissolved oxygen concentration (DO_{min}) was >3 mg/L, the minimum temperature (T_{min}) was used to determine T_{DOx}. For lake profiles where maximum dissolved oxygen concentration (DO_{max}) was less than the oxygen target (e.g., 3 mg/L), the maximum temperature (T_{max}) was used in place of T_{DOx}. Temperature and oxygen profiles were typically measured from the deepest part of lakes to characterize the hypolimnetic conditions in these lakes; however, this was not always the case especially if multiple basins within a lake were sampled. If lake profiles were measured from multiple locations on the same lake on the same day, the minimum value was used as this was assumed to be the best habitat in the lake. Average T_{DOx} calculation used only lake profiles during the period of maximum oxythermal stress (July 26 through August 24). If multiple T_{DO3} measurements were available in the same year during this period, the maximum value was used as this represented the highest measured oxythermal stress for that year. When multiple years of data were available the average T_{DOx} was calculated. For most analyses, 3 years of oxythermal habitat data were required to calculate average values.

Figure 2. Example of T_{DO3} (temperature at a dissolved oxygen concentration of 3 mg/L) calculation from water temperature (red circles) and dissolved oxygen (blue triangles) profiles. Data: Rose Lake (56-0360-00), T_{DO3} = 10.6 °C, 3 August 2006).



b. Water quality data

Water quality datasets were queried and compiled from Minnesota's water quality Environmental Quality Information System (EQuIS) database (1990-2020). These parameters included TP, chl-*a*, Secchi depth, and dissolved organic carbon (DOC). Epilimnetic water samples were collected using either a 2-m long, 32-mm diameter integrated sampler or surface grab samples. Standard analytical methods were used for TP, chl-*a*, and DOC (Table 9). The reporting detection limit was variable, but the dataset was screened for samples with a reporting detection limit greater than the reported value and these measurements were censored. All negative values were also removed. To address non-detects, one half of the reporting detection limit was used for analyses. Only data collected during the summer index period (June-September) were included. Most analyses in this study used only lakes with at least two years of water quality data and at least four measurements collected during the summer index period each year. Long-term summer averages for TP and chl-*a* were calculated as the average of individual summer averages.

Table 9. Summary of analytical methods used for water quality samples.

Water quality parameter	Analytical methods
Total phosphorus	365.1; 365.2; 365.3; 365.4; 4500-P (C, E, F, I)
Chlorophyll-*a*	10200-H; D3731-87; 445.0
Secchi depth	Field method
Dissolved organic carbon	5310-B; 5310-C; 9060A
Color	110.2; 110.3; 2120-B; 2120-C
Absorbance at 440 nm	see Brezonik et al. (2019)

c. Fisheries surveys

A large dataset of standard gill net fish surveys was available from the MNDNR and comprised most of the fish presence and abundance data used in these analyses. The fisheries datasets consisted of lake surveys performed from 1993 through 2020. The current, modern fisheries survey methods were adopted in 1993 so data from this year on were collected using similar methods. Older fisheries and water quality data are available; however, in this study these data were only used as part of the use designation review for these lakes (see Appendix C). Methods for MNDNR's fisheries surveys are described briefly below with more detailed descriptions in MNDNR (2017).

Standard gill net surveys: Fisheries surveys were conducted from February through November, but more than 95% of surveys were conducted in between June and September. Gear for standard gill net surveys consisted of 250 ft (76.2 m) long by 6 ft (1.8 m) deep nets constructed of five 50-ft-long (15.2 m) panels of white multifilament knotted-nylon mesh. The panels had mesh sizes (bar measure) of 0.75 in (1.9 cm), 1.0 in (2.5 cm), 1.25 in (3.2 cm), 1.5 in (3.8 cm), and 2.0 in (5.1 cm) and were ordered from small to large. The nets were set on the lake bottom, with brails and anchors at each end of the net to hold it taut and open. In some cases, a rope harness with added flotation at the top was substituted for the brail. Standard sets were deployed overnight or for about 24 hours. Where set locations were established, they were repeated in subsequent surveys whenever possible. For new sampling stations, locations were selected to include a variety of habitats, and the orientation of mesh sizes with respect to the shoreline was alternated. Where possible, nets were set perpendicular to shore and in waters deeper than nine ft (1.8 m) to avoid outboard motors. Before setting gill nets, a temperature-oxygen profile was measured to avoid setting nets in anoxic waters.

Coldwater fish species may not be targeted in some of the MNDNR's standard fisheries surveys. In many surveys, nets are set along the lake bottom in depths at or above the thermocline, rather than in pelagic areas. Consequently, standard gill net methods may not effectively sample coldwater fish for population studies (e.g., abundance measures may not be reliable for these data). However, in lakes known to support, or suspected of supporting a coldwater fish community, standard gill net sets, or portions of gill net sets, may be set deeper (i.e., below the thermocline). This practice is most common in north-eastern

Minnesota lakes, which coincides with the portion of the state with the largest number of lakes supporting coldwater fishes. Standard MNDNR fisheries surveys consist of a mix of survey methods that may or may not target coldwater fishes which do not provide precise estimates of abundance or other population metrics (Siesennop 1998). However, coldwater fishes are captured using these methods and these data can be used to at least determine species' presence or absence (Jacobson et al. 2010).

Data were available which used methods that differed from the MNDNR's standard survey. This included vertical gill net surveys which specifically target coldwater fishes. Vertical gill net gear was typically deployed to evaluate presence and size and depth distributions of coldwater fish and for use in conjunction with hydroacoustic surveys to estimate density and biomass. Vertical gill net gangs, comprised of seven panels of monofilament webbing ranging from 0.375 in (1.0 cm) to 1.75 in (4.4 cm) bar measure, were deployed during summer stratification (mid-June through mid-September) and were set in the deepest portion of the lake basin. Nets were set from the surface to the bottom such that the entire water column was covered. In simple lake basins, a single gang of nets was set and in more complex basins, multiple gangs of nets were set with a maximum of three nets per lake. As with standard gill net sets, a temperature-oxygen profile was measured. Nets were deployed overnight for a total duration of about 24 hours. A detailed description of the equipment used for vertical gill net surveys is provided in MNDNR (2017). Data from vertical gill net surveys were used to supplement standard MNDNR fisheries surveys.

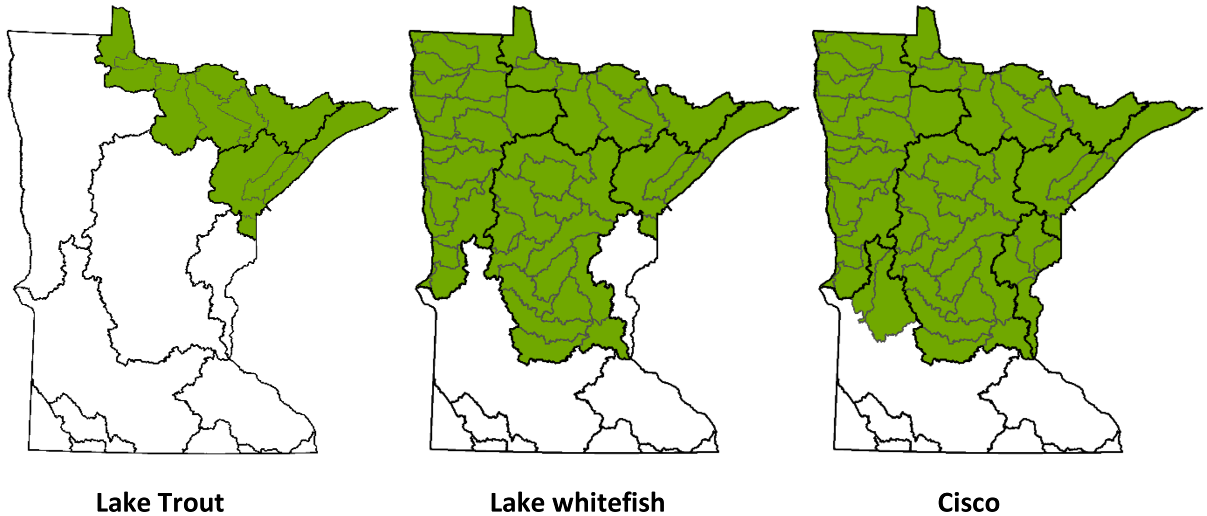
d. Lake filters

Data compilation for threshold analyses was focused on pairing coldwater fish survey data with stressor measures (i.e., T_{DO3} and chl-*a*) from lakes where these fish species could occur. The goal for developing this dataset was to identify lakes with the potential to support populations of coldwater fish based on lake morphology and biogeography. The distribution of extant populations of these fishes could then be made along a gradient of modern water quality data. Three filters were used to select lakes for analyses: species range, population status, and lake stratification.

Coldwater fish species range: To select lakes where coldwater fish are more likely to occur independent of water quality, biogeography and lake typology were considered. Lakes from watersheds and regions where these fish are considered to be native and are extant were selected for inclusion in the dataset. This is largely based on reported distributions in Hatch (2015) and then further refined based on current distribution of lakes where these fish are native or possibly native and extant. See ***Minnesota's coldwater fishes*** for additional details. The maps in Figure 3 indicate the watersheds from which lakes were selected for these analyses.

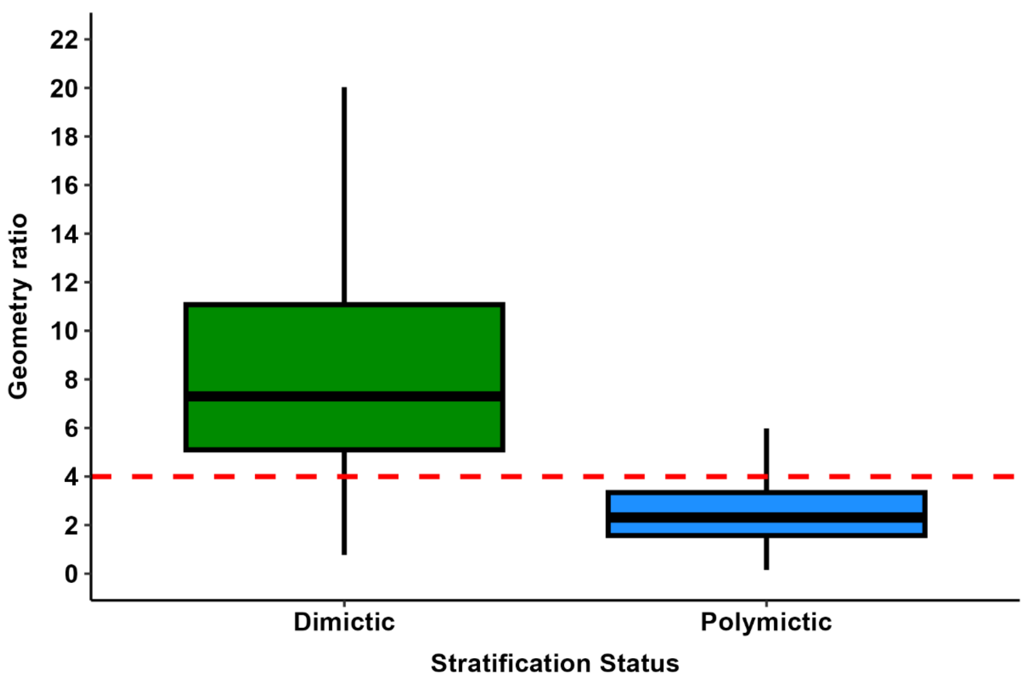
Coldwater fish species population status: Lakes with transient or extirpated populations of coldwater fishes were excluded from most analyses. Lakes with transient populations were removed because conditions in these lakes appear to not be suitable for long-term maintenance of coldwater fish populations and the inclusion of these lakes could impact analyses by indicating that the water quality conditions in these lakes were suitable to support coldwater fishes. Lakes with extirpated populations of coldwater fishes were removed because our analysis did not include temporal considerations, and the inclusion of these lakes could have indicated that coldwater fishes could be maintained under current water quality conditions even though the opposite was likely true. In addition, the number of lakes with extirpated populations of coldwater fishes was relatively small and their exclusion was unlikely to impact analyses. This status was determined through consultation with MNDNR area fisheries offices using fisheries survey data, lake morphology data, and other evidence. For example, a small number of large Lake Whitefish sampled in a lake with a connection to a lake with an extant, reproducing Lake Whitefish population, would likely be removed because these fish are likely not resident. See ***Coldwater lake habitat use designation reviews*** for additional details.

Figure 3. Watershed subbasin (8-digit hydrologic unit codes [HUC 8]) distributions of coldwater fish species in Minnesota based on current distributions of these species.



Lake stratification: Lakes were divided into dimictic and polymictic lakes using geometry ratio. Geometry ratio is calculated as: $A_0^{0.25}/z_{max}$, where A_0 is lake surface area (m^2) and z_{max} is maximum depth (m) (Stefan et al. 1996). A geometry ratio of 4 was used as a threshold to predict lake stratification where lakes with a geometry ratio of less than 4 were identified as dimictic. A geometry ratio 4 was selected as a threshold because it reasonably distinguishes between dimictic and polymictic lakes (Figure 4). Jacobson et al. (2010) also determined that there is little effect of geometry ratio on T_{DO3} for lakes with a geometry ratio above 4 indicating a transition between dimictic and polymictic lakes. Most analyses in this report use only lakes with a geometry ratio of less than 4. See ***Coldwater lake habitat use designation reviews*** for additional details.

Figure 4. Comparison of geometry ratio for dimictic and polymictic lakes. Dimictic lakes were determined to be lakes with a temperature gradient of at least 1 °C per meter for more than 50% of lake oxythermal profiles (June through September). Red dashed line indicates threshold used to predict lake stratification type.



e. Threshold analyses

Several analyses were used to determine thresholds for oxythermal habitat and eutrophication. These analyses were used both as supplemental evidence and to directly identify protective conditions for coldwater fishes. The probability of lakes supporting coldwater fish species as a function of T_{DO3} or chl-*a* was modeled using logistic regressions[8]. Generalized additive models using a logistic link function were fit to presence absence data for each species in R ver. 4.3.1 (R Development Core Team 2023) with the "gam" function ("mgcv" package; Wood 2011). To determine oxythermal and chl-*a* thresholds for each of the three coldwater fish species, the 95th percentile of the observed occurrence for each coldwater fish species were calculated using abundance weighted cumulative distribution functions. These values are referred to as extirpation (XC_{95}) values and are modified from methods in Cormier and Suter (2013). In Cormier and Suter (2013), 95th percentiles were used to determine XC values for multiple taxa which were aggregated to determine benchmarks for a stressor. This threshold is consistent with laboratory-based methods for determining toxicity where the intent is to protect 95% of taxa (Cormier and Suter 2013). Cormier and Suter (2013) selected the 95th percentile because it is more stable than a maximum value, but still represents the upper range of a taxon's tolerance to a stressor. Here the 95th percentile was used to determine protective thresholds for single coldwater fish species. To assess the performance of oxythermal and chl-*a* thresholds, receiver operating characteristic (ROC) curves were modeled in R version 4.3.1 (R Development Core Team 2023) using the "pROC" package (Robin et al. 2011). Area under the curve (AUC) scores were used to evaluate each ROC model. For this analysis, an AUC value of 1 indicates that the model perfectly predicts the occurrence of a fish species and a score of 0.5 indicates that it has no predictive ability. Scores between 0.5 and 1 indicate different levels of predictive ability for the models, but there is no absolute threshold which indicates whether a model is good or not. Hosmer et al. (2013) assigned approximate guidelines for AUC values[9] which we follow here to provide some context. Error rates for predicting the occurrence of coldwater fish species were plotted as a function of T_{DO3} thresholds. These plots were generated because these error rates can provide insight into the performance of the draft T_{DO3} criteria.

ii. Oxythermal criteria for the protection of coldwater fish species

a. Analysis of oxythermal habitat metrics

Coldwater fish species in Minnesota's lakes require cool, well-oxygenated water for survival. During the summer in most dimictic lakes, the habitat which meets the requirements for these fish species is limited to only a portion of the water column (see Figure 1). Typically, the upper layer (i.e., epilimnion) has sufficient dissolved oxygen, but is too warm for coldwater fish. Although the hypolimnion is typically cool enough, it may also be unsuitable due to dissolved oxygen depletion. As a result, the only suitable habitat for coldwater fish may be in the metalimnion or upper portion of the hypolimnion where dissolved oxygen and water temperature are suitable.

---

[8] **T_{DO3} logistic models:** gam(cisco presence ~ s(T_{DO3}, bs="tp", k=10), family=binomial(logit), method="REML"); gam(Lake Whitefish presence ~ s(T_{DO3}, bs="tp", k=10), family=binomial(logit), method="REML"); gam(lake trout presence ~ s(T_{DO3}, bs="tp", k=7), family=binomial(logit), method="REML")
Chlorophyll-*a* logistic models: gam(cisco presence ~ s(chl-*a*, bs="tp", k=3), family=binomial(logit), method="REML"); gam(Lake Whitefish presence ~ s(chl-*a*, bs="tp", k=3), family=binomial(logit), method="REML"); gam(lake trout presence ~ s(chl-*a*, bs="tp", k=10), family=binomial(logit), method="REML");

[9] AUC discrimination guidelines from Hosmer et al. (2013): 0.5-0.7 = poor; 0.7-0.8 = acceptable; 0.8-0.9 = excellent; >0.9 = outstanding

The most important factors influencing oxythermal habitat in Minnesota lakes include lake stratification type (i.e., morphology), lake trophic status, and air temperature (Jacobson et al. 2010). In Minnesota, most lakes which support coldwater fishes stratify during the summer which maintains cool water below the epilimnion. These lakes are typically deep with a sufficient volume of cool water below the epilimnion to provide habitat and dissolved oxygen for coldwater fish. There are also some polymictic lakes in Minnesota that also support coldwater fish, but most of these lakes are in northern Minnesota where air temperatures are cool enough to maintain cool water temperatures throughout much of the water column. Some lakes that do not stratify or which lack well-oxygenated water below the epilimnion may support coldwater fish due to refugia such as springs or other site-specific conditions (e.g., Ryan and Marshall 1994, Snucins and Gunn 1995).

The productivity of a lake affects oxygen availability in the hypolimnion. More productive or enriched lakes have lower hypolimnetic dissolved oxygen and less available habitat for coldwater fishes due to greater oxygen demand in sediment and the hypolimnion (Sharma et al. 2011, Müller et al. 2012, Havens et al. 2014). Some lakes may not support coldwater fish habitat due to natural productivity levels or cultural eutrophication may elevate productivity to the point that coldwater fish habitat is lost. Air temperature largely controls warming of lakes and is affected by weather, climate, and day of the year. Warmer air temperatures increase water temperature in the upper layers of the lake and shrinks available habitat for coldwater fishes by forcing these fish to move deeper to find cool water. Temperature also has interactive effects with productivity and dissolved oxygen level because warmer temperatures can expand growing seasons and increase growth rates and respiration.

Oxythermal requirements for coldwater fishes are complicated because other than under extreme conditions, there are not absolute values for temperature or oxygen which are lethal. Rather optimal, preferred, stressful, and lethal conditions for these fish vary depending on these and other variables. For example, at lower water temperatures, coldwater fish can survive at lower dissolved oxygen levels than they can at higher water temperatures (Jacobson et al. 2008). As a result, it is necessary to consider both oxygen and water temperature when developing water quality thresholds for coldwater fishes.

To analyze the specific requirements for Minnesota's coldwater fishes, both dissolved oxygen and temperature were considered. This was accomplished using the oxythermal habitat measure T_{DO3} (i.e., the temperature at which dissolved oxygen is 3 mg/L; see Figure 2). This endpoint has been used in other research of coldwater fishes in Minnesota lakes (e.g., Jacobson et al. 2010, Fang et al. 2012, and Jiang et al. 2017). Other studies have used different endpoints such as T_{DO6} or a layer which meets oxygen and thermal criteria (e.g., Lyons et al. 2017, EPA 2021). Lyons et al. (2017) determined that a 1 m layer with a T_{DO6} of 22.8 °C (i.e., dissolved oxygen ≥6 and temperature ≤22.8 °C) was needed to protect Cisco. The metric T_{DO6} was selected to align this threshold with existing coldwater standards in Wisconsin. Different T_{DOx} endpoints do not necessarily indicate preferential or lethal dissolved oxygen concentrations or temperatures for these coldwater fish. As a result, different endpoints can be used to develop similarly protective thresholds although the values identified will be different. This is because T_{DOx} consists of both a dissolved oxygen and a temperature target and by modifying one of these, the other is also altered. For example, changing the dissolved oxygen target from 6 mg/L to 3 mg/L will lower the protective temperature target and result in a different, but similarly protective T_{DOx} threshold. An exception to this would be using extreme measures of dissolved oxygen or temperature which result in interpolated values outside normal conditions in lakes or well outside the ecological requirements for these fish.

Over the course of a summer season, the T_{DO3} in a lake will change because of seasonal climatic patterns and weather. As a result, it is important to determine the period of maximum oxythermal stress in these lakes. Using the same methods from Jacobson et al. (2010), we repeated this analysis with our data to assess if similar results would be obtained. Generalized additive models (GAM) were fit to T_{DO3} data as a function of the geometry ratio, day of year, total phosphorus, July air temperature, and year in R ver. 4.3.1 (R Development Core Team 2023) using the "gam" function ("mgcv" package; Wood 2011). This analysis included statewide profile and total phosphorus data for lakes sampled from 1990-2020. The effect of these factors on T_{DO3} was analyzed for both polymictic (geometry ratio ≥4) and dimictic (geometry ratio <4) lakes to determine the 30 days of maximum oxythermal stress (i.e., the period with the highest T_{DO3} values). Geometry ratio, day of the year, and total phosphorus had the largest effects on T_{DO3} in dimictic lakes. July air temperature and year had weakly positive effects on T_{DO3}. In polymictic lakes, the day of the year also had a strong effect on T_{DO3}, but the effects of geometry ratio and total phosphorus were weaker. In contrast, July air temperature and year had a stronger effect on T_{DO3} in polymictic compared to dimictic lakes. This analysis identified the period from July 26 through August 24 for dimictic lakes (Figure 5) and July 11 through August 10 for polymictic lakes (Figure 6) as periods of highest oxythermal stress. Although our datasets differ, these results largely confirm those of Jacobson et al. (2010) which identified July 27 through August 26 for dimictic lakes and July 13 through August 12 for polymictic lakes as periods of highest oxythermal stress. The following analyses in this study use only oxythermal data from July 26 through August 24 unless otherwise noted. The effects of geometry ratio, total phosphorus, and July air temperature were also similar to that of Jacobson et al. (2010). Unlike Jacobson et al. (2010), we also included year to determine if there was a trend in the oxythermal conditions over time during this study period. Our results, indicate a weak positive trend in dimictic lakes and a stronger positive trend in polymictic lakes. For the dimictic lakes, the weak trend indicates that the dataset is representative of lake oxythermal conditions during this period.

Figure 5. Effect of A) geometry ratio, B) day of year, C) total phosphorus, D) July air temperature, and E) year on oxythermal habitat (T_{DO3}) for dimictic (geometry ratio <4) lakes (1990-2020). Fit: generalized additive model (GAM; bs = "tp", method = "REML"); shaded area: ±2 standard error; vertical dotted lines bracket the 30 days of highest oxythermal stress.

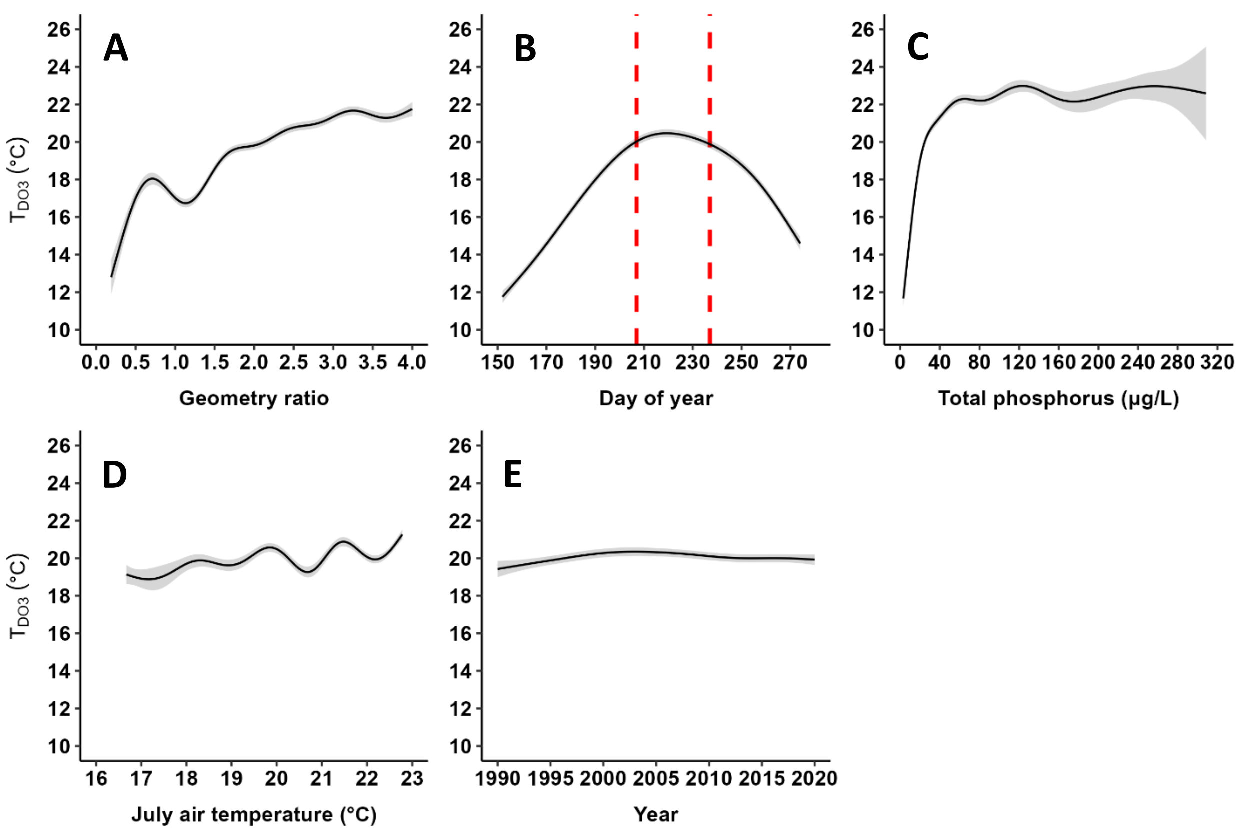
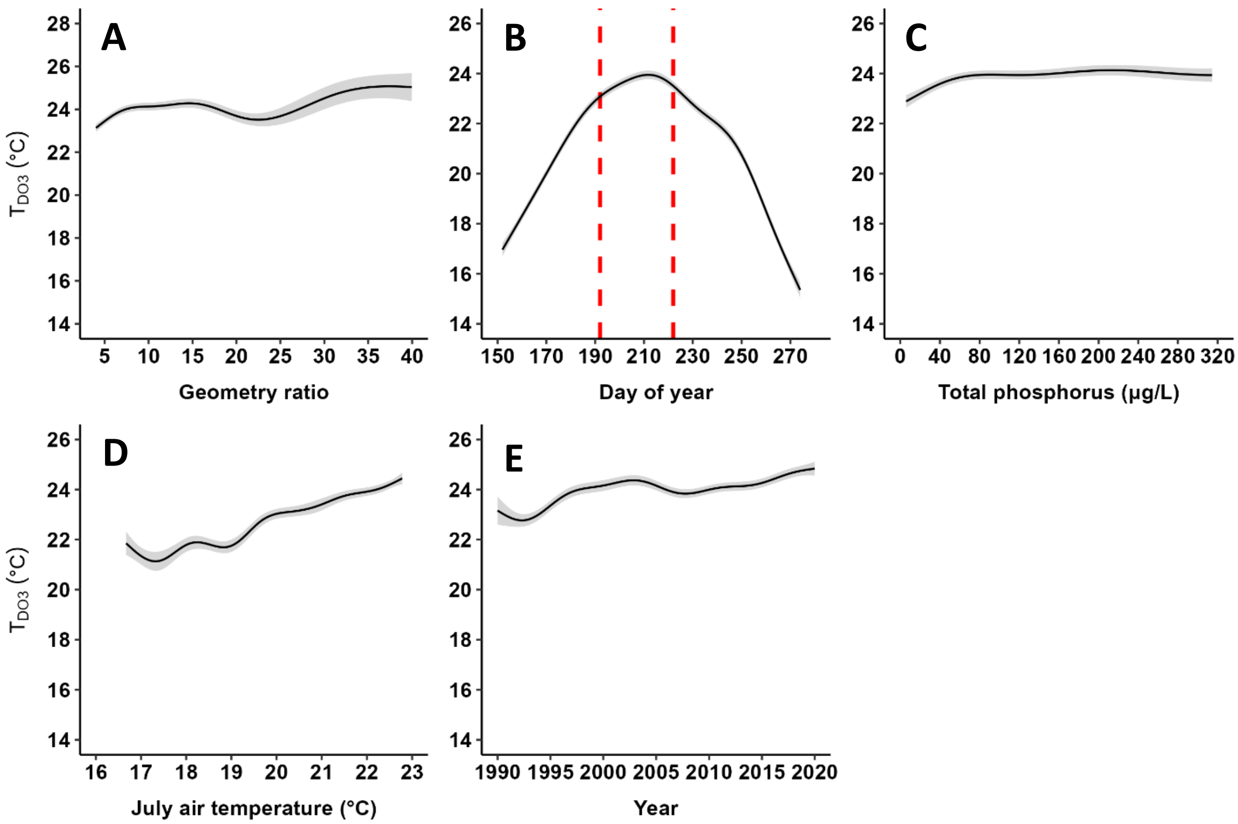
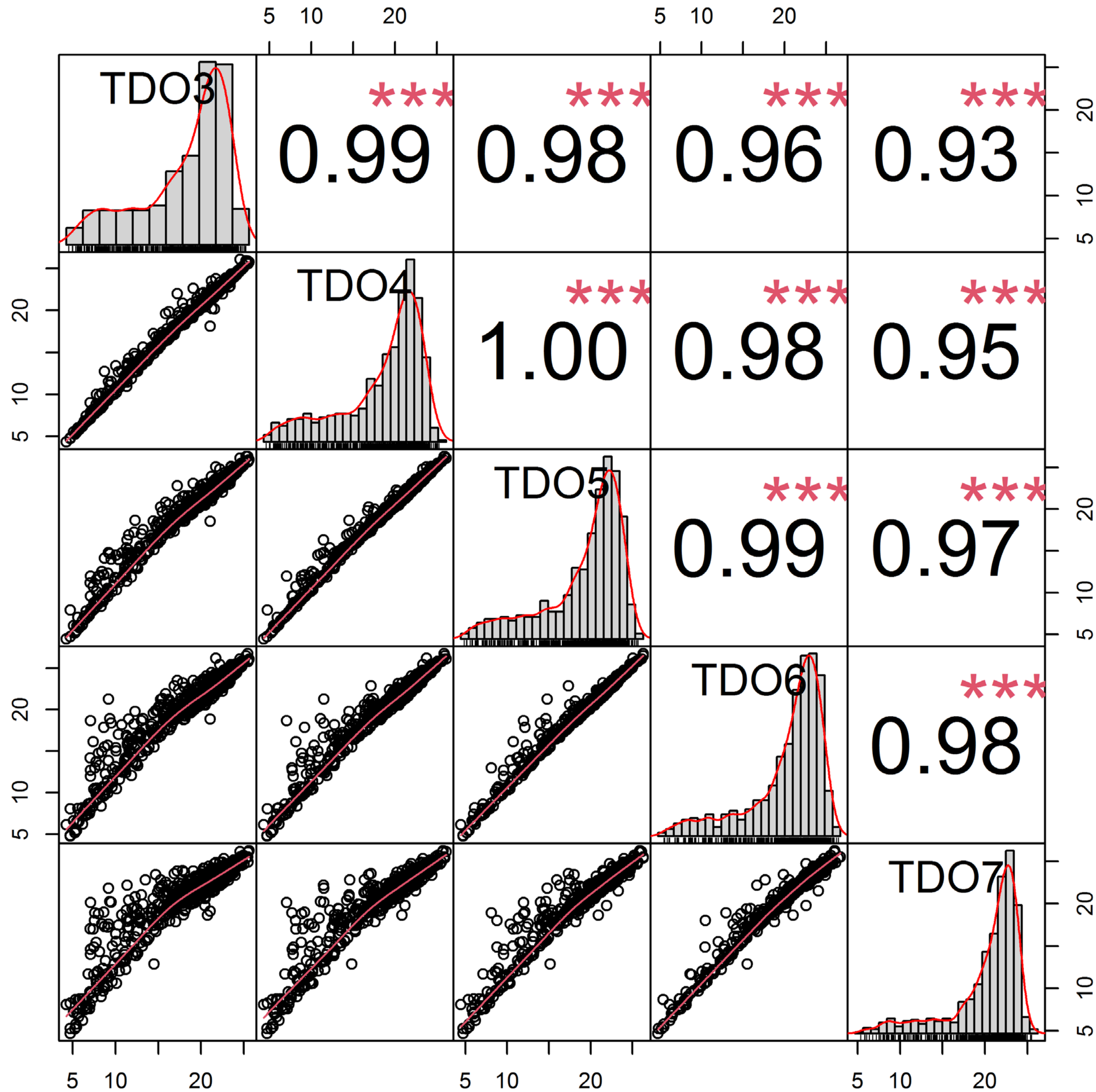


Figure 6. Effect of A) geometry ratio, B) day of year, C) total phosphorus, D) July air temperature, and E) year on oxythermal habitat (T_{DO3}) for polymictic (geometry ratio >4) lakes (1990-2020). Fit: generalized additive model (GAM; bs = "tp", method = "REML"); shaded area: ±2 standard error; vertical dotted lines bracket the 30 days of highest oxythermal stress.



In general, oxythermal measures are comparable when using normoxic (e.g., 30-100% saturation) dissolved oxygen endpoints. Different oxythermal measures are highly correlated based on Spearman correlations (Figure 7) although the relationship is slighter weaker for more distant measures (e.g., T_{DO3} and T_{DO7}). Use of a higher dissolved oxygen threshold also results in more scatter in the relationship in lakes with lower oxythermal values. This indicates that these lakes maintain normoxic conditions in the hypolimnion, but not high dissolved oxygen (e.g., 6 or 7 mg/L) concentrations (Figure 7). The oxythermal environment to which a fish is exposed is dependent on many factors including the accessible habitat within a lake, the location of prey or predators, the oxythermal preference of fish (as affected by life stage, age, and genetics), and the effect of acclimation. Although the relationship of coldwater fish to oxythermal endpoints is complex, in general, coldwater fish seem to seek the coldest habitat where dissolved oxygen requirements are met when lakes are stratified. As dissolved oxygen is depleted in the hypolimnion and metalimnion, coldwater fishes move higher in the water column where they are usually exposed to warmer water. When minimum dissolved oxygen concentrations for these fishes are found in waters exceeding the upper thermal limits in a lake, mortality events will occur. If these events are severe or frequent, it will result in the extirpation of the population.

Figure 7. Correlation matrix (Spearman's) of oxythermal measures for dimictic lakes (geometry ratio <4) in Minnesota.



b. Analysis of coldwater fish and oxythermal habitat

Using similar methods to those in Jacobson et al. (2010), an expanded dataset of Minnesota coldwater fishes was analyzed using logistic regression analysis. All three species had a negative relationship between their probability of occurrence and T_{DO3} with each exhibiting a different pattern in this relationship (Figures 8 and 9). These patterns largely match those reported in Jacobson et al. (2010). Cisco were the most eurythermic species with the steepest decline in presence occurring above 21 °C. Lake Whitefish were more sensitive to oxythermal habitat, although there was no distinct threshold along the gradient. Lake Trout were the most stenothermic with a steep decline in their occurrence above 8 °C. These relationships demonstrate the negative effects of high T_{DO3} on these species and provide some estimates of thresholds for at least Cisco and Lake Trout.

Figure 8. Probability of the occurrence of A) Cisco, B) Lake Whitefish, C) Lake Trout, and D) all three species (solid line = Cisco, dashed line = Lake Whitefish, dotted line = Lake Trout) as a function of average oxythermal habitat (T_{DO3}). Fit is a generalized additive model (GAM) logistic regression (bs = “tp”, method = “REML”, k =10 [Cisco, Lake Whitefish], 7 [Lake Trout]). Shaded area: 90% confidence interval. Datasets include only lakes with at least two fisheries surveys and three years of oxythermal profiles.

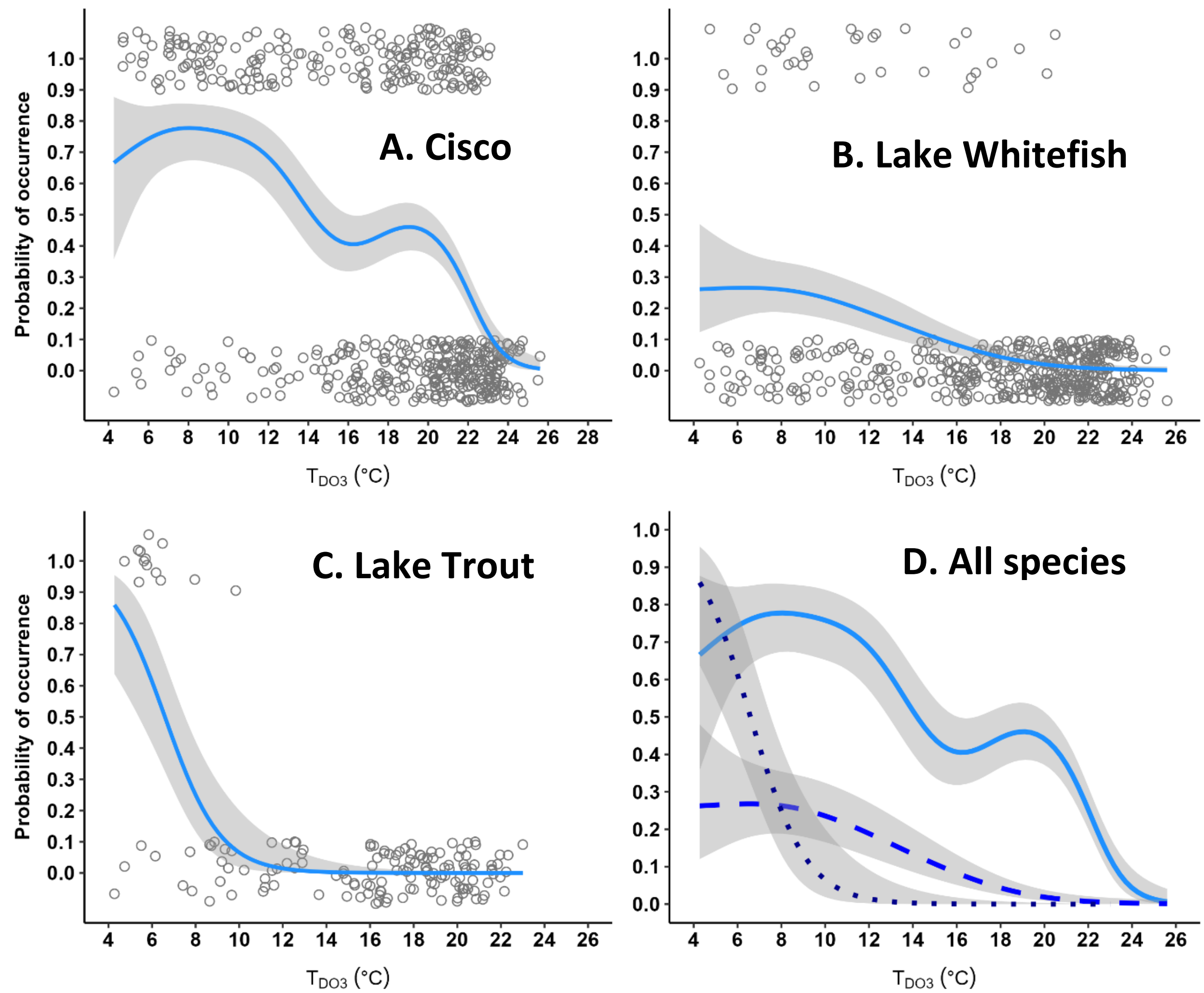
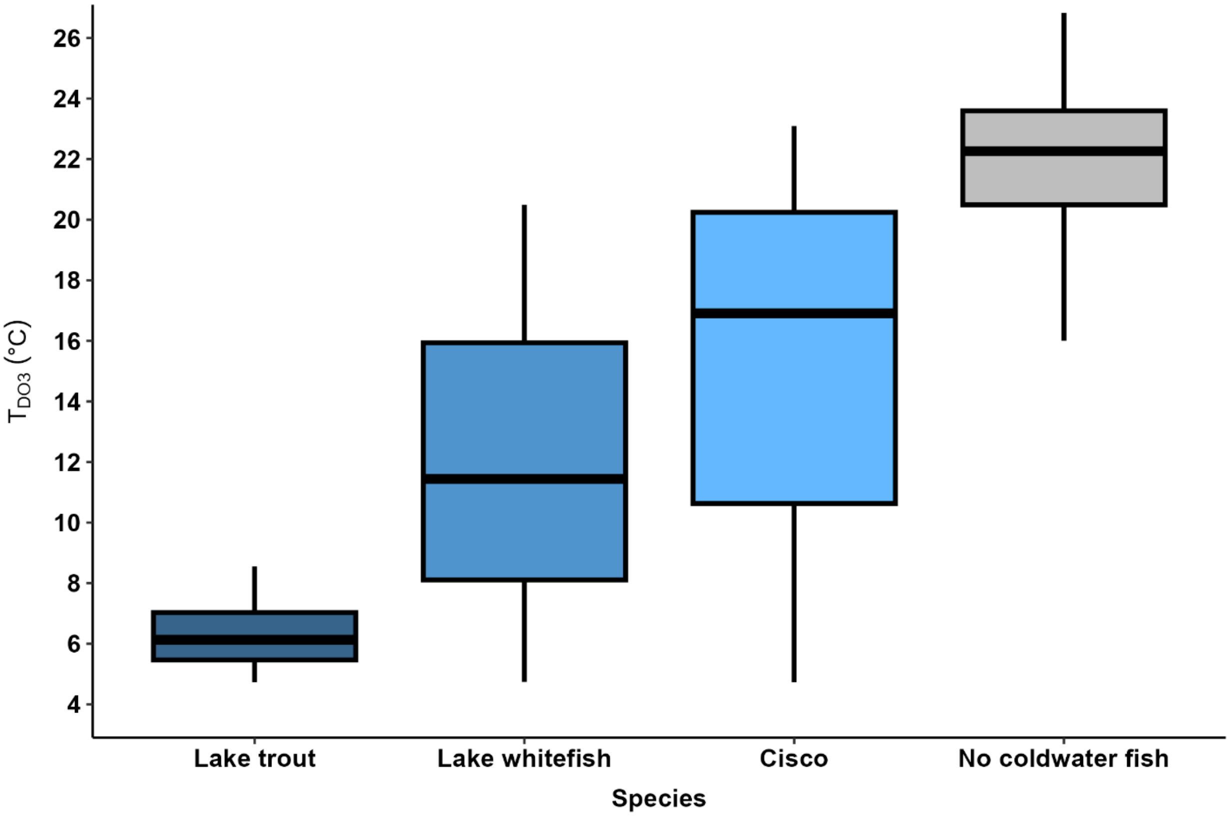


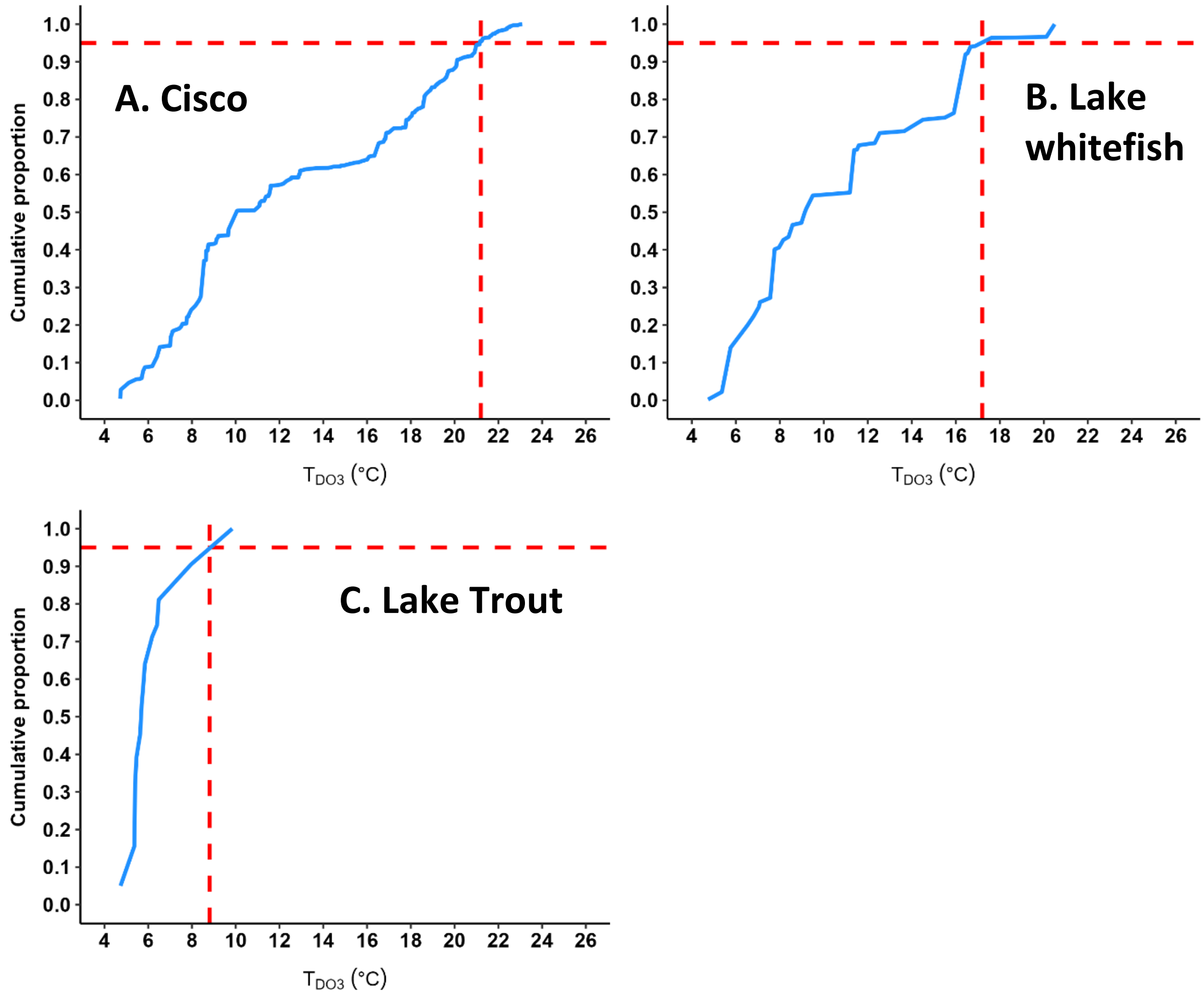
Figure 9. Box plots of average T_{DO3} for lakes supporting coldwater fish species. Description of box plots: lower hinge = 25th percentile; upper hinge = 75th percentile; whiskers = 1.5 x interquartile range.



c. Oxythermal habitat threshold development

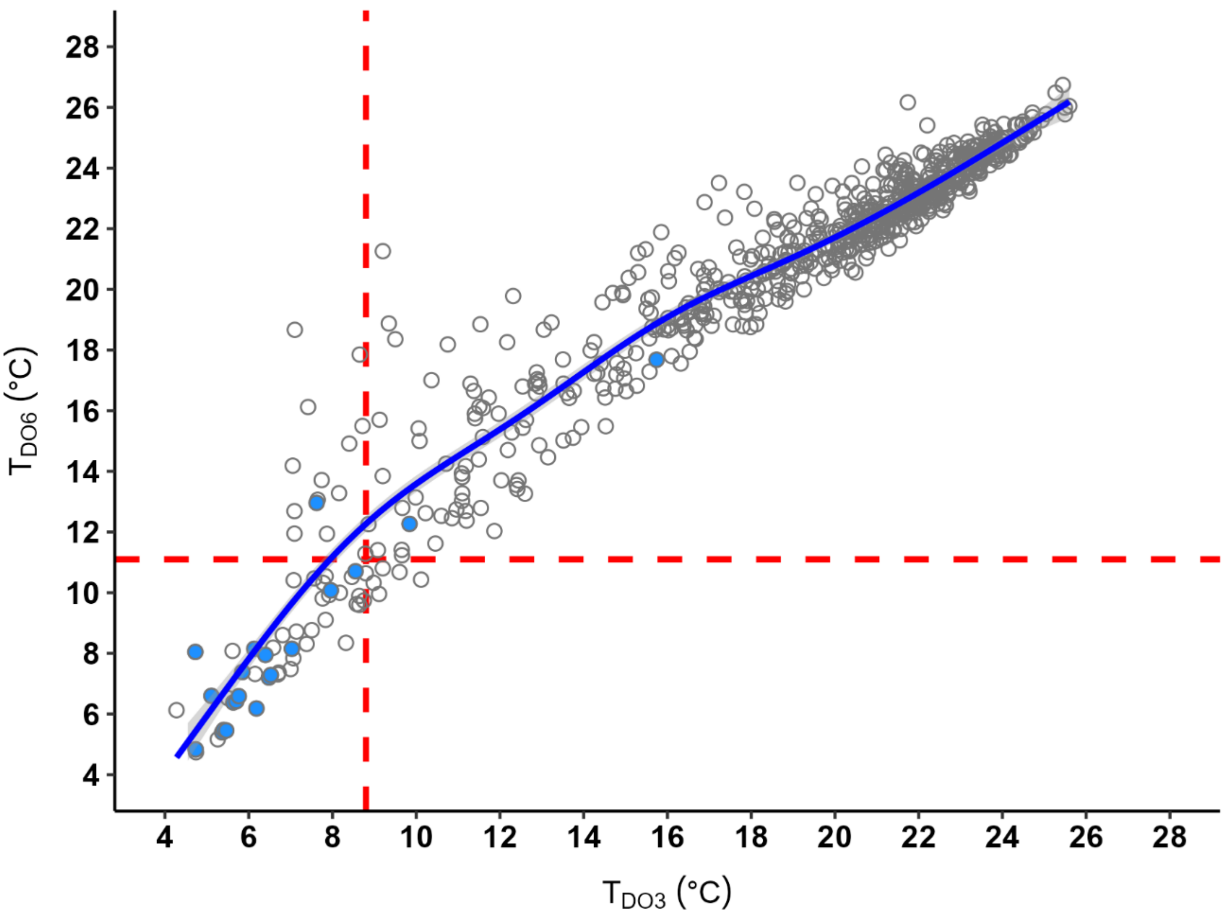
Minimum oxythermal thresholds for the protection of coldwater fish species were determined from abundance-weighted cumulative distribution functions. These T_{DO3} thresholds were determined by calculating 95th extirpation (XC_{95}) values for each coldwater fish species. These datasets consisted of lakes which were determined to support resident populations of these these coldwater fishes (see Appendix C). Analysis of species occurrence error rates along with the results of the previous section were also used to support these criteria. As demonstrated in previous analyses, XC_{95} values were different for the three fish species analyzed with increasing tolerance from Lake Trout to Lake Whitefish to Cisco (Figure 10). The XC_{95} was 21.2 °C for Cisco, 17.2 °C for Lake Whitefish, and 8.8 °C for Lake Trout (Figure 10). These values largely match observations from the logistic regression analyses (Figure 8).

Figure 10. Average abundance weighted cumulative distribution functions for T_{DO3} for A) Cisco, B) Lake Whitefish, and C) Lake Trout. Red dashed line: 95th percentile extirpation value.



To confirm the use of T_{DO3} as a reasonable metric for Lake Trout, this oxythermal measure was compared against T_{DO6}. These two measures are highly correlated (ρ = 0.96; Figure 7). An abundance-weighted XC_{95} for Lake Trout based on T_{DO6} is 11.1 °C compared to 8.8 °C for T_{DO3}. The plot of T_{DO3} and T_{DO6} indicates that regardless of the oxythermal measure, attainment of XC_{95}-based thresholds is similar (Figure 11). There was a single lake where absolute oxythermal measures indicated that assessment outcomes could be different. In this lake, oxythermal measures were within 2 °C of thresholds indicating coldwater habitat near marginal conditions. The MNDNR stocks Lake Trout in this lake (East Bearskin [16-0146-00]) and there is indication that there is natural reproduction. Therefore, this lake appears to currently sustain a Lake Trout population and although it is augmented through stocking, oxythermal conditions appear to be suitable. This indicates that T_{DO3} may be providing a more accurate assessment of Lake Trout habitat in this lake compared to T_{DO6}. Due to this specific example and the overall high correlation between these and other oxythermal measures, the use of T_{DO3} appears to be a suitable measure for Lake Trout habitat regardless of the results of studies determining lethal temperatures or dissolved oxygen concentrations. Although coldwater fishes may have different oxygen requirements, the same dissolved oxygen endpoint can be used as part of an oxythermal measure to develop protective criteria. Such fixed thresholds do not necessarily translate to optimal or lethal oxythermal thresholds for each species, but they can be used to measure the suitability of habitat within a lake when the oxythermal measure is linked to fish population health endpoints. However, as part of assessments, it may be useful to examine different oxythermal measures to better characterize coldwater habitat in lakes when a lake is near the threshold.

Figure 11. Relationship between average T_{DO3} and T_{DO6} for dimictic lakes (geometry ratio < 4) with at least 3 years of T_{DOx} data (1990-2020). Fit is a generalized additive model (GAM) logistic regression (bs = "tp", method = "REML", k =10). Shaded area: 90% confidence interval; red dashed lines: XC_{95} for Lake Trout; blue points: Lake Trout lakes; open points: non-Lake Trout lakes.



To evaluate how well T_{DO3} predicts the presence of coldwater fishes, ROC curves were modeled and evaluated using AUC scores. For the three coldwater fish species assessed, the discrimination ability of models to predict species occurrence based on T_{DO3} ranged from acceptable to outstanding (Figure 12). The Lake Trout model performed best with an AUC value of 0.9698 indicating that most lakes in in the dataset with a T_{DO3} below 8.8 °C support Lake Trout. T_{DO3} is also highly predictive of the occurrence of Lake Whitefish although the relatively small number of lakes supporting Lake Whitefish in Minnesota increases prediction error (Figure 12). The prediction of the occurrence of Cisco using T_{DO3} was acceptable. The largest error associated with predicting coldwater fish presence based on oxythermal habitat, especially for Lake Whitefish and Cisco, was due to many lakes with apparently suitable oxythermal habitat which do not support coldwater fishes (Table 10). The exact characteristics that make many of the lakes with good T_{DO3} unsuitable for Lake Whitefish or Cisco is not discernable from the analyses in this report. It could be due to local biogeography or other lake-specific habitat characteristics that make these lakes unsuitable for these fish species. However, these analyses support the draft T_{DO3} thresholds and indicate that these oxythermal thresholds have low (~10-20%) false negative rates (i.e., predicting that a lake does not support coldwater fish species when in fact it does; Figure 12).

Figure 12. Receiver operating characteristic (ROC) curves (top row) and cut-off plots (bottom row) using T_{DO3} as a predictor of species occurrence for A) Cisco (AUC = 0.7375), B) Lake Whitefish (AUC = 0.8425), and C) Lake Trout (AUC = 0.9696). For receiver operating characteristic curves, specificity refers to the true negativity rate and sensitivity refers to the true positivity rate. For error rate plots, solid lines are false negatives and dashed lines are false positives.

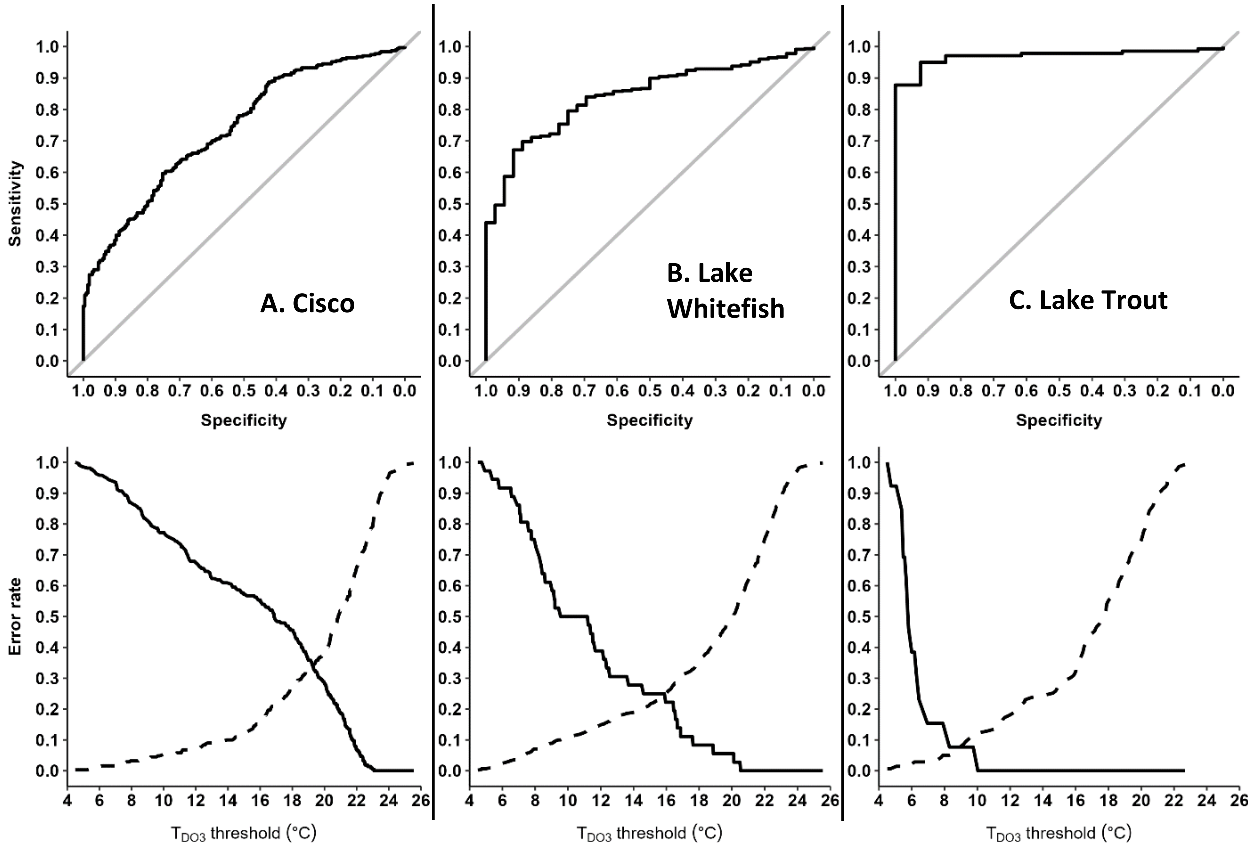


Table 10. Confusion matrices for predicting coldwater fish presence based on T_{DO3} 95th percentile extirpation thresholds determined from abundance-weighted cumulative distributions. Percentages are the proportion of lakes where the presence or absence of coldwater fishes was correctly or incorrectly predicted based on the draft standards. Blue cells are correct predictions and orange cells are incorrect predictions.

Confusion matrices

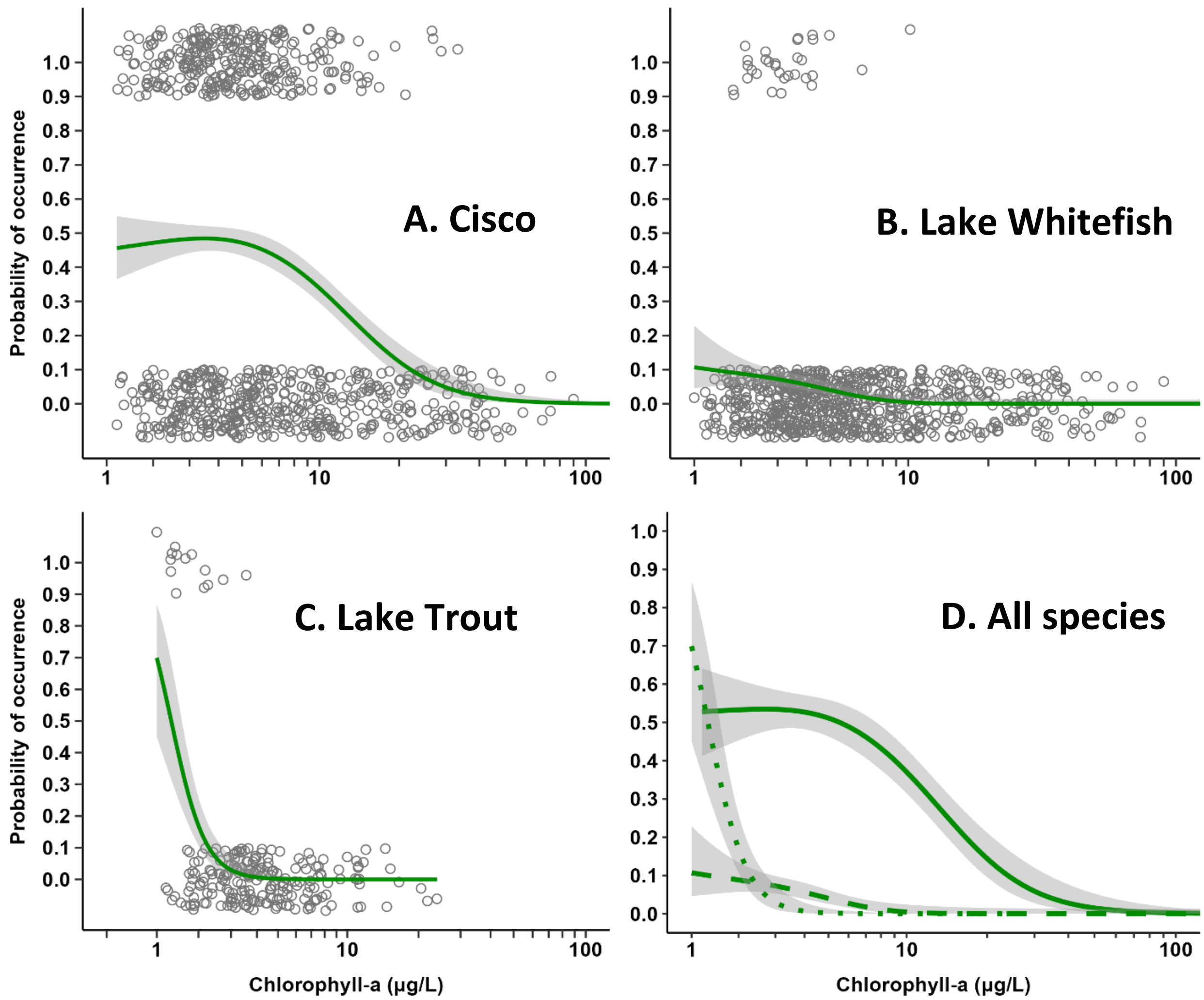
Cisco	T_{DO3} exceeds	T_{DO3} meets
Fish absent	146 (28%)	164 (31%)
Fish present	36 (7%)	179 (34%)
Lake Whitefish	**T_{DO3} exceeds**	**T_{DO3} meets**
Fish absent	307 (63%)	143 (29%)
Fish present	4 (1%)	32 (7%)
Lake Trout	**T_{DO3} exceeds**	**T_{DO3} meets**
Fish absent	129 (85%)	10 (7%)
Fish present	1 (1%)	12 (8%)

iii. Eutrophication criteria for the protection of coldwater fish species

a. Analysis of coldwater fish and chlorophyll-a

Nutrient levels and lake productivity directly influence the depletion of dissolved oxygen in the hypolimnion of lakes during the summer (Walker 1979, Molot et al. 1992, Clark et al. 2002, Clark et at. 2004). As with T_{DO3}, the presence of coldwater species was analyzed as a function of chl-*a*. Generalized additive models using a logistic link function were run for chl-*a*. As with T_{DO3}, all three species had a negative relationship between the probability of occurrence and chl-*a* with each exhibiting a different pattern in this relationship (Figure 13). Cisco were the most tolerant species with a decline in presence occurring above a chl-*a* concentration of 10 µg/L. Lake Whitefish were more sensitive to oxythermal habitat with their probability of occurrence declining at chl-*a* concentrations of 3-4 µg/L. However, in this dataset, Lake Whitefish lakes were uncommon, and the probability of occurrence was low along the gradient. Lake Trout were the most sensitive with a decline in their occurrence above chl-*a* concentration of 1 µg/L. These relationships demonstrate the negative effects of high chl-*a* on these species and provide some estimates of thresholds.

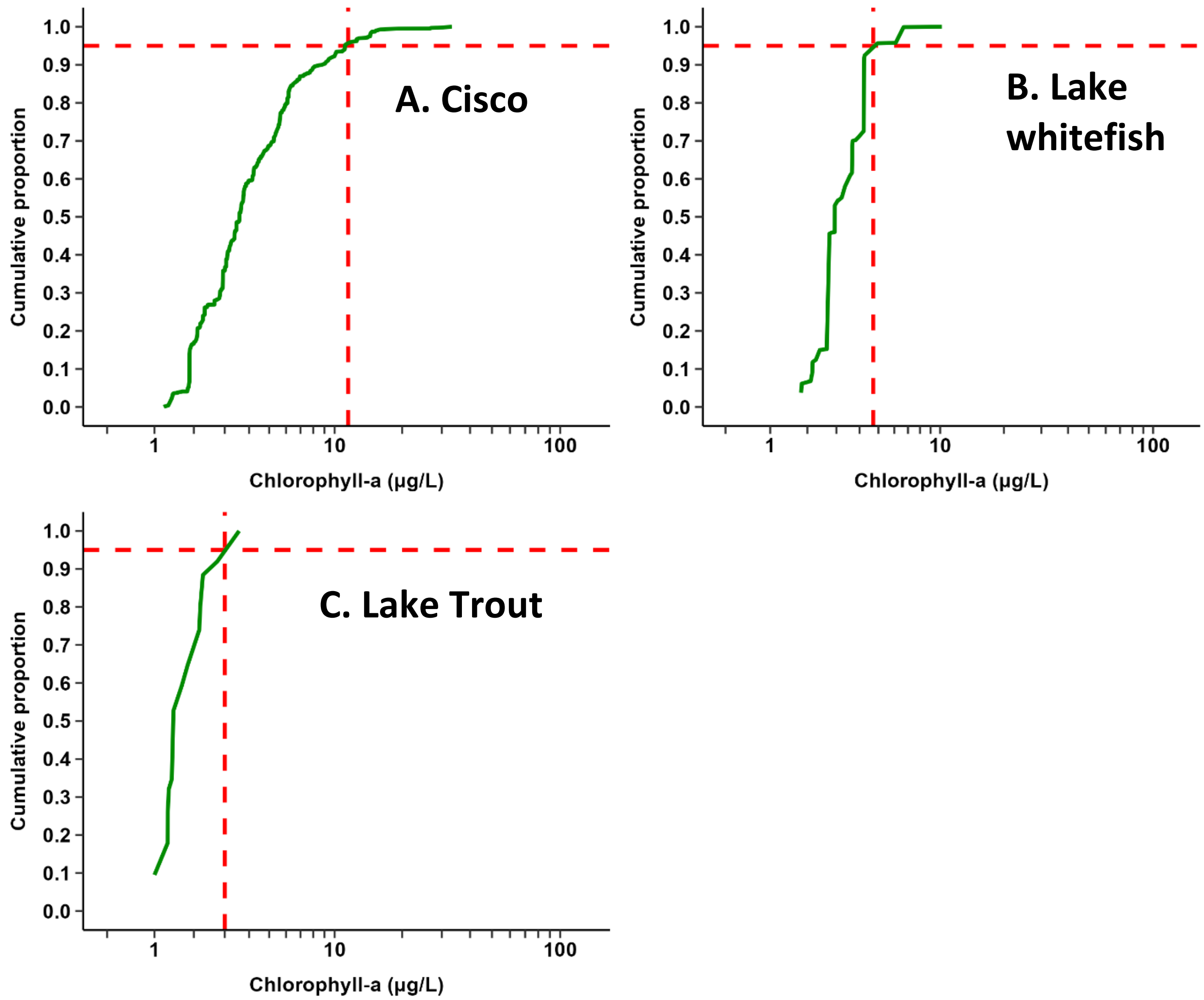
Figure 13. Probability of occurrence for A) Cisco, B) Lake Whitefish, C) Lake Trout, and D) all three species (solid line = Cisco, dashed line = Lake Whitefish, dotted line = Lake Trout) as a function of chlorophyll-*a*. Fits are generalized additive model (GAM) logistic regressions (bs = "tp", method = "REML", k = 3 [Cisco, Lake Whitefish], 10 [Lake Trout]). Shaded area: 90% confidence interval.



b. Chlorophyll-a threshold development

Minimum chl-*a* thresholds for the protection of coldwater fish species were determined from abundance weighted cumulative distribution functions. These datasets consisted of lakes which were determined to support resident populations of these these coldwater fishes (see Appendix C). Ninty-five percent extirpation values (XC_{95}) for chl-*a* were calcuated and resulted in thresholds of 12 µg/L for Cisco, 5 µg/L for Lake Whitefish, and 3 µg/L for Lake Trout (Figure 14). These values largely match observations from the logistic regression analyses (Figure 13) although they are somewhat higher. The Lake Trout threshold is consistent with the results of Ryan and Marshall (1994) which determined that most lakes supporting Lake Trout had chl-*a* below 3 µg/L (corresponding to predicted oxygen depletion levels of <40%). In addition, 3 µg/L matches Minnesota's existing standard for Lake Trout lakes.

Figure 14. Average abundance weighted cumulative distribution functions for chlorophyll-*a* for A) Cisco, B) Lake Whitefish, and C) Lake Trout. Red dashed line: 95th percentile extirpation value.



As with T_{DO3}, chl-*a* was evaluated to determine how well this measure predicts the presence of coldwater fishes using ROC curves and AUC scores. For the three coldwater fish species, the discrimination ability of models to predict species occurrence based on chl-*a* ranged from poor to outstanding (Figure 15). The Lake Trout model performed best with an AUC value of 0.9040 indicating that most lakes in the dataset with chl-*a* below 3 µg/L support Lake Trout. Chlorophyll-*a* was less predictive for Lake Whitefish and Cisco (Figure 15). There were a relatively high number of lakes with low chl-*a* concentrations that did not support these fish species (Figure 13; Table 11) which is similar to the pattern observed with T_{DO3} (see Table 10). As with T_{DO3}, the exact lake characteristics that make many of the lakes with good chl-*a* unsuitable for Lake Whitefish or Cisco could not be determined here, but it may be due to local biogeography or other lake-specific habitat characteristic that make these lakes unsuitable for these fish species. However, compared to T_{DO3}, chl-*a* performed poorer in predicting the presence or absence of all three fish species. The lower predictive ability of chl-*a* compared to T_{DO3} may have been related to T_{DO3} being a more proximate measure of coldwater habitat in lakes. In addition, oxythermal habitat accounts for both oxygen and temperature conditions, whereas chl-*a* is more closely linked to the hypolimnetic oxygen component of coldwater fish habitat. Although there is a higher false positive error rates (i.e., lakes with low chl-*a* which do not support coldwater fishes; Table 11, Figure 13) for lakes with suitable chl-a conditions, it is apparent that these fish species are limited to lakes with lower productivity. These analyses support the draft chl-*a* thresholds and indicate that at these concentrations, false negative rates (i.e., predicting that a lake does not support coldwater fish species when in fact it does) are acceptable (~1-18%; Table 11).

Figure 15. Receiver operating characteristic (ROC) curves (upper row) and cut-off plots (bottom row) using chlorophyll-*a* as a predictor of species occurrence for A) Cisco (AUC = 0.6436), B) Lake Whitefish (AUC = 0.7489), and C) Lake Trout (AUC = 0.9135). Data were not censored for lakes with high colored dissolved organic matter (CDOM). For receiver operating characteristic curves, specificity refers to the true negativity rate and sensitivity refers to the true positivity rate. For error rate plots, solid lines are false negatives and dashed lines are false positives.

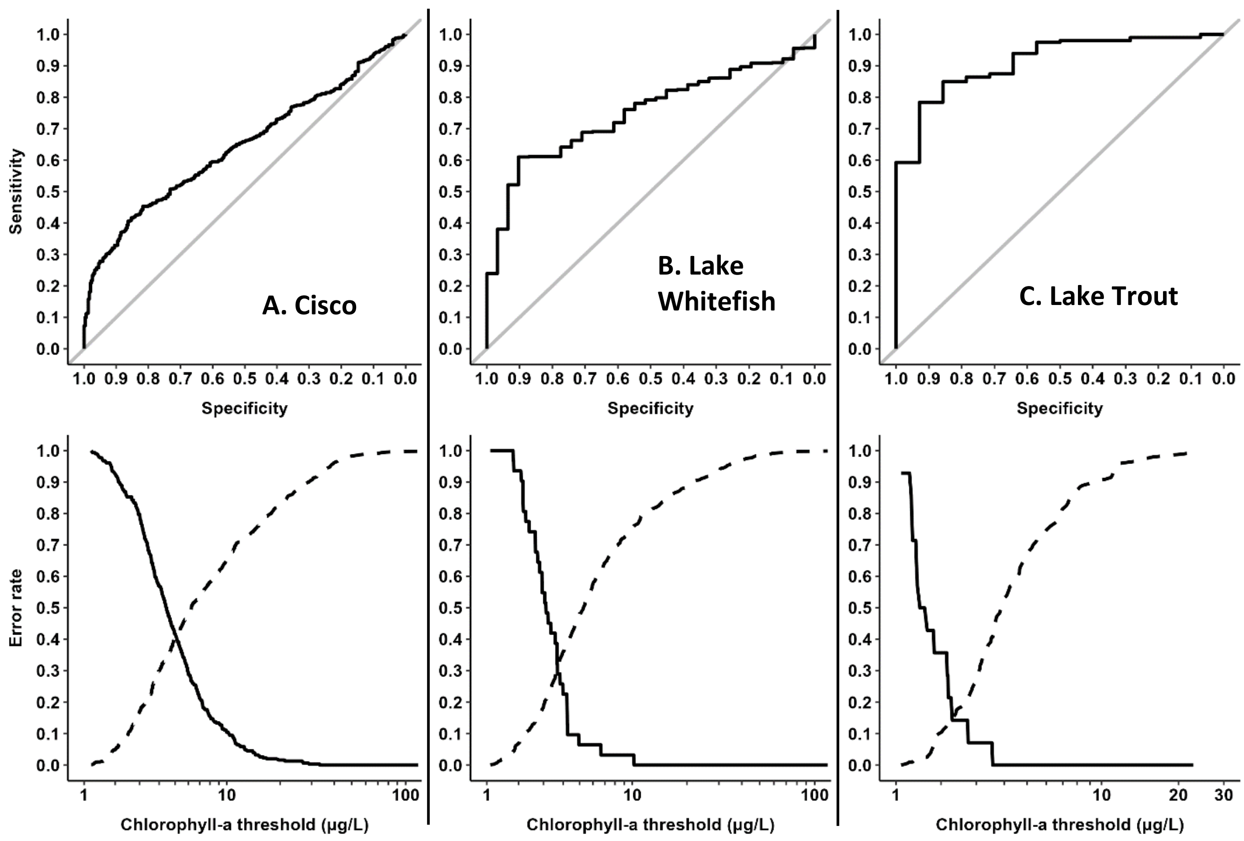


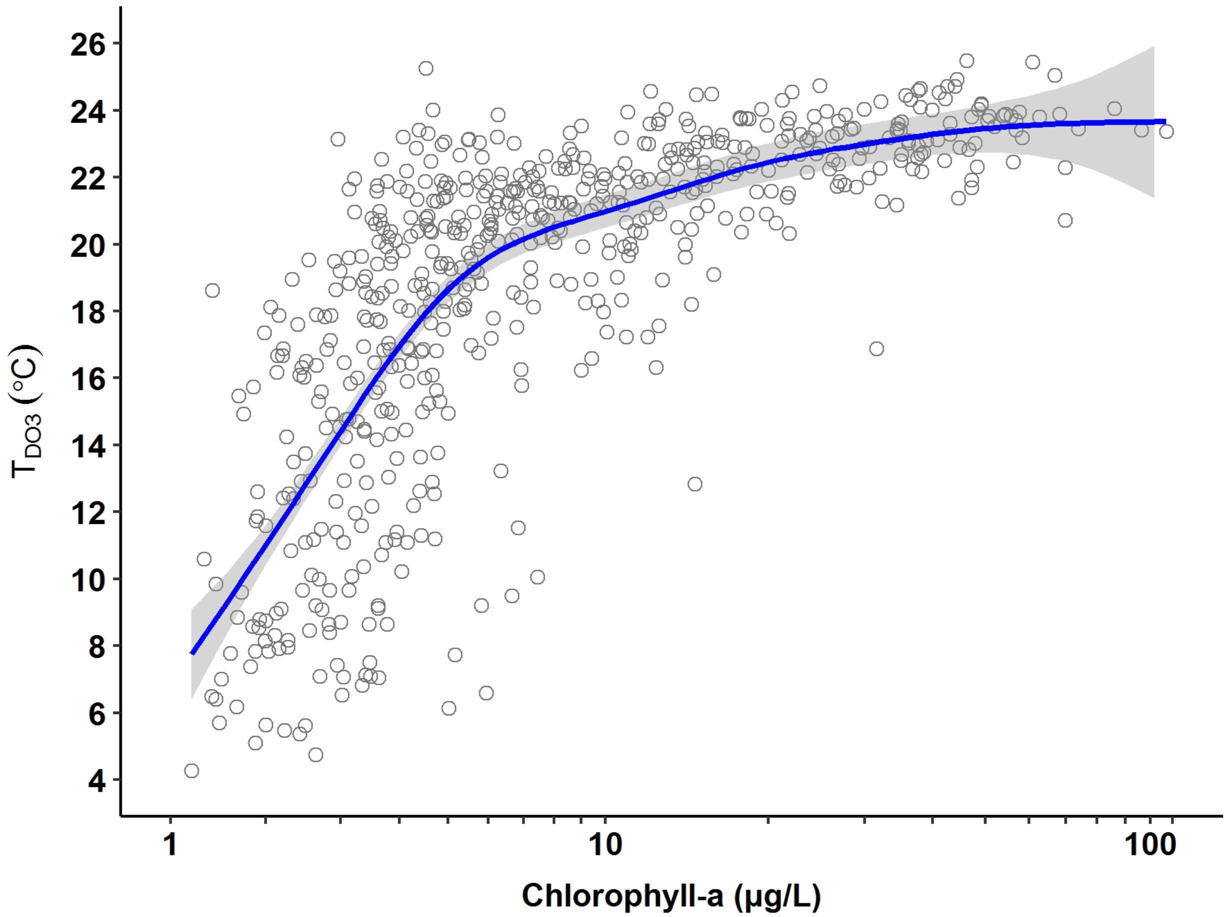
Table 11. Confusion matrices for predicting coldwater fish presence based on chlorophyll-*a* 95th percentile extirpation thresholds determined from abundance weighted cumulative distributions. Percentages are the proportion of lakes where the presence or absence of coldwater fishes was correctly or incorrectly predicted based on the draft standards. Blue cells are correct predictions and orange cells are incorrect predictions.

Confusion matrix

Cisco	**Chlorophyll-*a* exceeds**	**Chlorophyll -*a* meets**
Fish absent	141 (18%)	351 (44%)
Fish present	18 (2%)	288 (36%)
Lake Whitefish	**Chlorophyll-*a* exceeds**	**Chlorophyll-*a* meets**
Fish absent	386 (50%)	358 (46%)
Fish present	2 (0%)	29 (4%)
Lake Trout	**Chlorophyll-*a* exceeds**	**Chlorophyll-*a* meets**
Fish absent	146 (69%)	53 (25%)
Fish present	1 (0%)	13 (6%)

Protective thresholds for chl-*a* were not modeled directly from T_{DO3} because there are several lake-specific factors that can affect the relationship between these parameters. In dimictic lakes, there is an asymptotic relationship between chl-*a* and T_{DO3} with high variability in T_{DO3} at chl-*a* concentrations below ~6 µg/L (Figure 16). Above this threshold, T_{DO3} tends to be high although there is also considerable variability in this relationship. Variability in the relationship between chl-*a* and T_{DO3} is caused by several known lake-specific attributes which mitigate the effects of lake productivity on oxythermal habitat (EPA 2021). For example, EPA's deepwater hypoxia criteria models include the following lake-specific attributes to determine protective concentrations of chl-*a*: depth below thermocline, dissolved organic carbon (DOC), geographic location, and elevation (EPA 2021). Lower air temperatures for higher latitude and elevation lakes reduce water temperature and increase dissolved oxygen saturation which mitigates the effects of dissolved oxygen depletion caused by increased lake productivity. Deeper lakes will have a larger volume of oxygenated water following summer lake stratification which moderates the influence of dissolved oxygen depletion caused by increased oxygen demand in sediments and the hypolimnion (Müller et al. 2012, EPA 2021). Inputs of allochthonous organic matter can also increase lake productivity and oxygen depletion (Kritzberg et al. 2004, Pace et al. 2004) and DOC can be used as an indicator of this effect (Hanson et al. 2003, EPA 2021). The draft criteria provide a baseline of protective chl-*a* thresholds, but due to lake-specific characteristics, these criteria may need to be modified for individual lakes to ensure protection of these habitats.

Figure 16. Relationship between average chlorophyll-*a* and T_{DO3} based on dimictic lakes (geometry ratio < 4) with at least 2 years of chlorophyll-*a* data and 3 years of T_{DO3} data (1990-2020). Description of plot: fit is a generalized additive model (GAM) logistic regression (bs = "tp", k =10); shaded area: 90% confidence interval.



c. Total phosphorus and Secchi depth thresholds

Minnesota's current eutrophication standards for lakes include TP, chl-*a*, and Secchi depth (Heiskary and Wilson 2005; [Minn. R. 7050.0222]). These standards require an exceedance of both the nutrient (i.e., TP) and a response parameter (i.e., chl-*a* or Secchi depth). Of these three measures, chl-*a* provides the most proximate measure of lake productivity and whether beneficial uses are protected. Secchi depth also provides a reasonable estimate of lake productivity when water transparency is not affected by other factors such as colored dissolved organic matter (CDOM) and suspended sediment. Coupling TP and chl-*a* is useful in assessments because it can be used to diagnose atypical lakes and it ensures that the nutrient-response linkage matches that of the lakes used to develop the standards. Total phosphorus criteria are important because they serve as the basis for most management efforts for these waters including permitting, TMDLs, WRAPS, and protection plans. Ryan and Marshall (1994) identified all three of these water quality parameters as useful for predicting hypolimnetic oxygen depletion and to determine if habitat is suitable for Lake Trout. It is reasonable to include all three eutrophication measures as part of standards to protect coldwater fishes.

Statewide datasets were used to develop quantile regression models between TP and chl-*a* and chl-*a* and Secchi depth. Statewide average water quality values for lakes (1990-2020) were included. Due to the effect of the CDOM on Secchi depth, lakes with color >25 platinum-cobalt units (PCU) or absorptivity at 440 nm (a_{440}) >1.4 m^{-1} were censored from the chl-*a*-Secchi depth dataset. A 90th percentile quantile regression was used for the TP and chl-*a* model (Figure 17) and the 10th percentile for the chl-*a* and Secchi depth model (Figure 18). The use of a 90th percentile model results in a high likelihood that if TP criteria are attained, the chl-*a* criteria will also be attained. The 10th percentile model for Secchi depth was used to reduce false positive errors in assessments. This is important because Secchi depth is used in these standards as a surrogate for chl-*a* in assessments. For each coldwater fish species, the chl-*a* thresholds (i.e., XC_{95} values) were used to interpolate values of TP and Secchi depth (Table 12).

Figure 17. Quantile regression fits for total phosphorus and chlorophyll-*a* used to model total phosphorus from chlorophyll-*a* thresholds for the protection of coldwater fishes. Points are summer average values for lakes (1990-2020). Lakes with color >25 PCU or a_{440} >1.4 m^{-1} were censored from the dataset. Grey lines: 90th or 10th percentile quantile regression fit (degree = 5, df = 6); dashed red lines: interpolations of total phosphorus from chlorophyll-*a* thresholds.

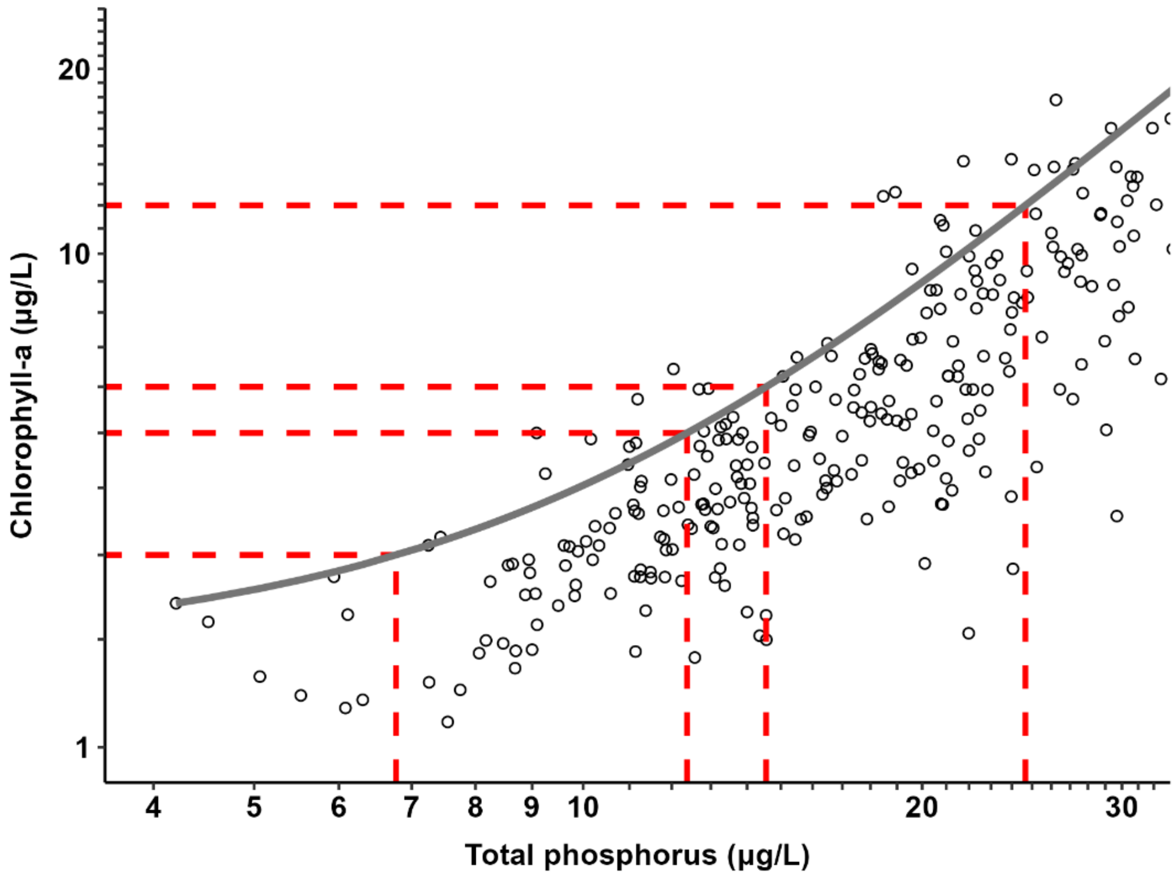


Figure 18. Quantile regression fits for chlorophyll-*a* and Secchi depth used to model Secchi depth from chlorophyll-*a* thresholds for the protection of coldwater fishes. Points are summer average values for lakes (1990-2020). Lakes with color >25 PCU or a_{440} >1.4 m^{-1} were censored from the dataset. Grey lines: 90th or 10th percentile quantile regression fit (degree = 7, df = 12); dashed red lines: interpolations of Secchi depth from chlorophyll-*a* thresholds.

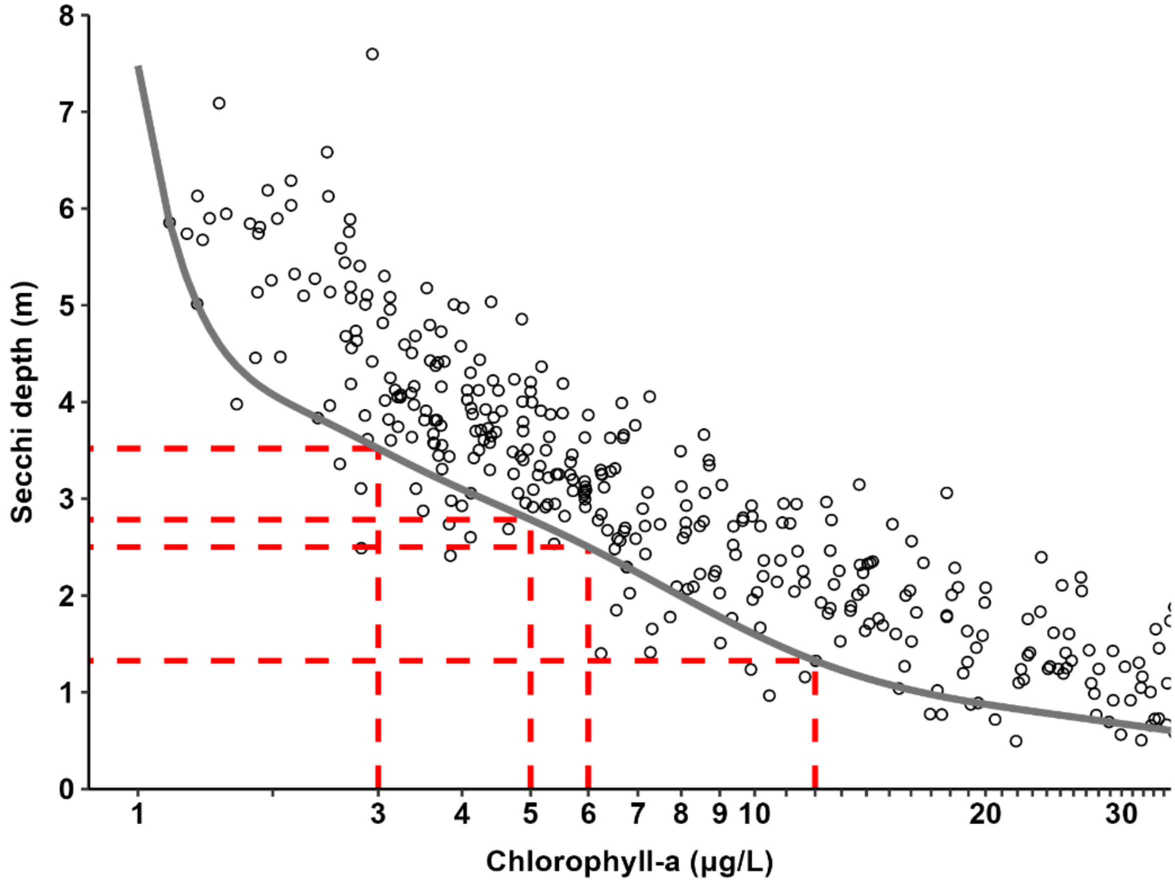


Table 12. Total phosphorus and Secchi depth thresholds interpolated from chlorophyll-*a* thresholds for Lake Trout, Lake Whitefish, Cisco, and stream trout (see Figures 17 and 18).

Species	Total phosphorus (µg/L)	Chlorophyll-*a* (µg/L)	Secchi depth (m)
Lake Trout	7	3	3.5
Lake Whitefish	12	5	2.8
Cisco*	25	12	1.3
Stream trout	15	6	2.5

** The lake eutrophication criteria for Cisco lakes are less protective than the existing northern cool/warm water lake standards. As a result, the cool/warm water standards would be applicable to these lakes to protect the most sensitive endpoint.*

The TP criteria for Lake Trout and stream trout lakes are more stringent than current values because the current standards are based on a least squares regression model (Heiskary and Wilson 2005). The existing model reasonably predicts the TP-chl-*a* relationship for Minnesota lakes; however, there is a higher likelihood of false negatives, particularly for lakes near thresholds. Such lakes often fall into an "inconclusive" assessment category because TP is not exceeded, but chl-*a* is high. Since chl-*a* is a more direct measure of productivity than TP and some lakes are more productive at lower nutrient levels, it is reasonable to establish criteria that will acknowledge these lake attributes. The updated models result in more stringent criteria, but this will reduce false negative errors.

The Secchi depth criteria for Lake Trout and stream trout lakes are less stringent compared to current values. As with TP this is due to differences between the current least squares chl-*a*-Secchi depth model (Heiskary and Wilson 2005) and the quantile regression model provided in this study (Figure 18). Assessments should ideally be based on chl-*a* and TP when these data are available because chl-*a* provides a more proximate measure of lake productivity. Secchi depth is also a good predictor of lake productivity, but it may be affected by other factors that can introduce error into assessments. As a result, the 10th percentile was used to minimize these errors while still retaining the information Secchi depth can provide to an assessment, even when chl-*a* data are not available. In addition, assessments relying on Secchi depth will need to account for CDOM and suspended sediment as part of assessments to reduce false positive errors (see Implementation of coldwater lake fish standards).

There are currently no TP or Secchi depth standards specifically associated with the protection of Cisco and Lake Whitefish in Minnesota, but the draft criteria in this report are consistent with the relative sensitivity of Minnesota coldwater fishes. Based on these new standards, Lake Whitefish habitats are not sufficiently protected by any existing cool/warm water lake standards (Class 2B/2Bd). However, the protective levels of the current cool/warm water lake eutrophication standards are mixed for Cisco. Cisco lakes in the central nutrient region are not sufficiently protected by current standards. In contrast, the draft TP, chl-*a*, and Secchi depth thresholds for Cisco are less stringent than the cool/warm water standards for northern dimictic lakes. This means that lake eutrophication standards in the northern region are currently sufficient to protect Cisco lakes. As a result, the cool/warm water standards for dimictic lakes are more stringent and should continue to apply to these northern coldwater lakes[10].

iv. Draft coldwater habitat standards

A framework of WQS for the protection of coldwater lake habitats in Minnesota are provided by the current research. This framework consists of standards for oxythermal habitat and eutrophication for three fish species and a species group (Table 13). This includes creating two new lake types for Lake Whitefish and Cisco and the addition of a new parameter. These standards would only apply to lakes once they are designated as coldwater, and the species protected are defined in rule. For lakes supporting multiple coldwater fish species, the standards for the most sensitive will be used for assessment. A list of dimictic lakes supporting or managed for these coldwater fishes is provided in Appendix C.

Table 13. Draft oxythermal habitat (T_{DO3}), total phosphorus, chlorophyll-*a*, and Secchi depth thresholds for Lake Trout, Lake Whitefish, Cisco, and stream trout habitats (* indicates a threshold which is unchanged from the current standard).

Species	T_{DO3} (°C)	Total phosphorus (µg/L)	Chlorophyll-*a* (µg/L)	Secchi depth (m)
Lake Trout	8.8	7	3*	3.5
Lake Whitefish	17.2	12	5	2.8
Cisco	21.2	25	12	1.3
Stream trout	-	15	6*	2.5

[10] Although these lakes are referred to as coldwater habitats, they support both coldwater and cool/warm water habitats. In many cases, these lakes can be referred to as two-story fisheries because both coexist in these lakes. As a result, the more sensitive use needs to be protected (i.e., northern region cool/warm water habitat) by the appropriate standards.

Oxythermal habitat is not currently implemented as a water quality standard in Minnesota. The current dissolved oxygen standard which applies to coldwater lakes is 7 mg/L, but this standard does not specify oxygen levels for the hypolimnion or metalimnion which are critical habitats for coldwater fishes in the summer in dimictic lakes. A lake may meet this standard in the epilimnion but fail to protect coldwater fish inhabiting the hypolimnion or metalimnion during summer stratification. The adoption of an oxythermal standard for the protection of coldwater fishes will improve management of these habitats by providing a direct measure of suitable habitat for these species.

The draft T_{DO3} standards do not necessarily reflect optimal conditions for these fish species, but rather are minimal conditions for their protection. As a result, the draft thresholds do not align exactly with reported optima and may more closely match lethal or avoidance levels for oxygen and temperature (Tables 5, 7, and 8). To maintain the health and viability of some populations of coldwater fishes in Minnesota lakes it will also be necessary to protect some lakes with better water quality than the draft standards. Such conditions should be considered as part of other regulations and programs such as antidegradation (see Minn. R. 7050.0250 through 7050.0335) and the protection of Cisco refuge lakes (Fang et al. 2012, Jiang and Fang 2016).

Although not providing a direct measurement of habitat, traditional lake eutrophication standards are also reasonable and effective for determining if coldwater habitats are protected (Ryan and Marshall 1994, Jacobson et al. 2010). The draft lake eutrophication standards to protect coldwater habitat include criteria for TP, chl-*a*, and Secchi depth. Although not as proximate a measure of coldwater habitat, these standards are largely equivalent to the draft oxythermal standards. As such, lake eutrophication and oxythermal standards can be used separately or in conjunction to ensure the protection of these habitats.

Comparison with other water quality programs

The importance of protecting coldwater fishes has been recognized in other water quality programs in the United States. State water quality programs with similar habitats and standards for the protection of coldwater fishes include Michigan and Wisconsin. In addition, the EPA has recently published lake eutrophication criteria which include criteria for deepwater hypoxia. A summary of these standards with a comparison to Minnesota's draft standards follows.

i. Michigan

In Michigan, coldwater fishery uses include lakes supporting trout, Lake Whitefish, and Cisco and there are dissolved oxygen standards for the protection of these fishes (State of Michigan 2006; R 323.1065 Dissolved oxygen; inland lakes). These standards include a minimum dissolved oxygen concentration (i.e., 7 mg/L) for coldwater habitats and specifies where this criterion needs to be met in a lake profile. Although 7 mg/L is applied to all coldwater lakes, the portion of the profile which must meet this criterion depends on the lake. Lakes are divided into three groups based on their capability to meet 7 mg/L in different portions of the water column including: 1) throughout the entire lake water column, 2) in the upper half of the hypolimnion (and thermocline and epilimnion), and 3) in the upper half of the thermocline (and epilimnion). The 7 mg/L criterion is similar to Minnesota's dissolved oxygen standard for coldwater lakes; however, Minnesota does not currently specify where in a lake this standard applies. As a result, Minnesota's current dissolved oxygen standard for coldwater lakes cannot be effectively and appropriately implemented to protect coldwater fishes.

ii. Wisconsin

Wisconsin's standards are based on the maintenance of a 1 m layer of water which meets species-specific oxythermal criteria (Lyons et al. 2018). For all three species (i.e., Cisco, Lake Whitefish, and Lake Trout), the same dissolved oxygen target of 6 mg/L is used, but temperature maximums differ between species. Specifically, Wisconsin requires a 1 m layer with dissolved oxygen ≥ 6 mg/L and temperature ≤ 22.8 °C for Cisco, ≤ 19 °C for Lake Whitefish, and ≤ 14 °C for Lake Trout. Based on logistic regression models of the probability of Minnesota lakes supporting Cisco (Figure 19A), a T_{DO3} of 21.2 °C has a similar probability (36%) of supporting Cisco compared to Wisconsin's standard for Cisco (30%). For Lake Whitefish (Figure 19B), a T_{DO3} of 17.2 °C has a similar probability (6%) of supporting Lake Whitefish compared to Wisconsin's standard (8%). At a T_{DO3} of 8.8 °C, 15% of lakes are predicted to support Lake Trout compared to 6% of lakes that meet Wisconsin's oxythermal habitat standard for Lake Trout (Figure 19C). We also directly compared Minnesota's draft standards to Wisconsin's standards using GAM models. Using this approach, we can determine if the different endpoints result in similar assessment outcomes. Interpolating Wisconsin's oxythermal habitat standard from a T_{DO3} of 21.2 °C results in a 1.3 m thick layer that meets Wisconsin's Cisco standard (Figure 20A). This result indicates that lakes meeting a T_{DO3} of 21.2 °C will on average meet or exceed Wisconsin's standards. A T_{DO3} of 17.2 °C is equivalent to a 0.0 m[11] layer that meets Wisconsin's Lake Whitefish standard (Figure 20B). For Lake Trout, a T_{DO3} of 8.8 °C is equivalent to a 1.7 m thick layer that meets Wisconsin's Lake Trout standard (Figure 20C). This indicates that Minnesota's standards are at least as stringent as Wisconsin's standards for Cisco and Lake Trout and less stringent than Wisconsin's Lake Whitefish standard. However, the outcomes of assessments based on these two sets of standards overall produces similar assessment outcomes (Figure 20 – confusion matrices). Based on this analysis, for the three fish species there is agreement in the oxythermal habitat status for 85-97% of lakes.

The comparability of these standards reflects the flexibility of oxythermal endpoints and how using different endpoints still results in similar protections. Oxythermal layers (e.g., 1 m of thickness where temperature is <22.8 °C and dissolved oxygen >6 mg/L) are correlated with oxythermal measures such as T_{DO3} and can be scaled to measure suitable coldwater habitat. These different oxythermal measures essentially measure the same conditions and by modifying the temperature target, each can be scaled to specific coldwater fish species. It is important not to focus too specifically on individual dissolved oxygen and temperature targets because these conditions are dynamic (e.g., Jacobson et al. 2008). For example, a layer of water with a dissolved oxygen of 2 mg/L and a temperature 21 °C may be survivable for Cisco, but so is a layer with a dissolved oxygen of 5 mg/L and a of temperature 25 °C. Therefore, focusing on the need for a lake to meet specific dissolved oxygen and temperature requirements based on laboratory studies may not address the variability of suitable coldwater fish habitat. However, fixed measures of oxythermal habitat can be used to predict the condition of coldwater habitat in lake for assessment and management purposes, but they should not be treated as optimal or lethal oxythermal thresholds for these species. As a result of the history of using T_{DO3} in Minnesota and its use to effectively identify coldwater fish habitat (e.g., Jacobson et al. 2010), this research is focused on this oxythermal measure. Although T_{DO3} is the primary endpoint used for developing coldwater fish thresholds, comparative analyses with other oxythermal measures are provided in this document to ensure that the use of T_{DO3} will not result in insufficient protection for these fishes or in assessment errors.

[11] A layer thickness of 0.0 m is equivalent to a T_{DO6} of 19 °C.

Figure 19. Comparison of probability of occurrence for A) Cisco, B) Lake Whitefish, and C) Lake Trout as a function of Wisconsin's draft oxythermal standards (left column) and T_{DO3} (right column). Description of figures: fits are generalized additive model (GAM) logistic regressions (bs = "tp", method = "REML", k = 4 [Cisco layer, Lake Whitefish layer], 7 [Lake Trout T_{DO3}], 10 [Cisco T_{DO3}, Lake Whitefish T_{DO3}, Lake Trout layer]); shaded areas = 90% confidence intervals.

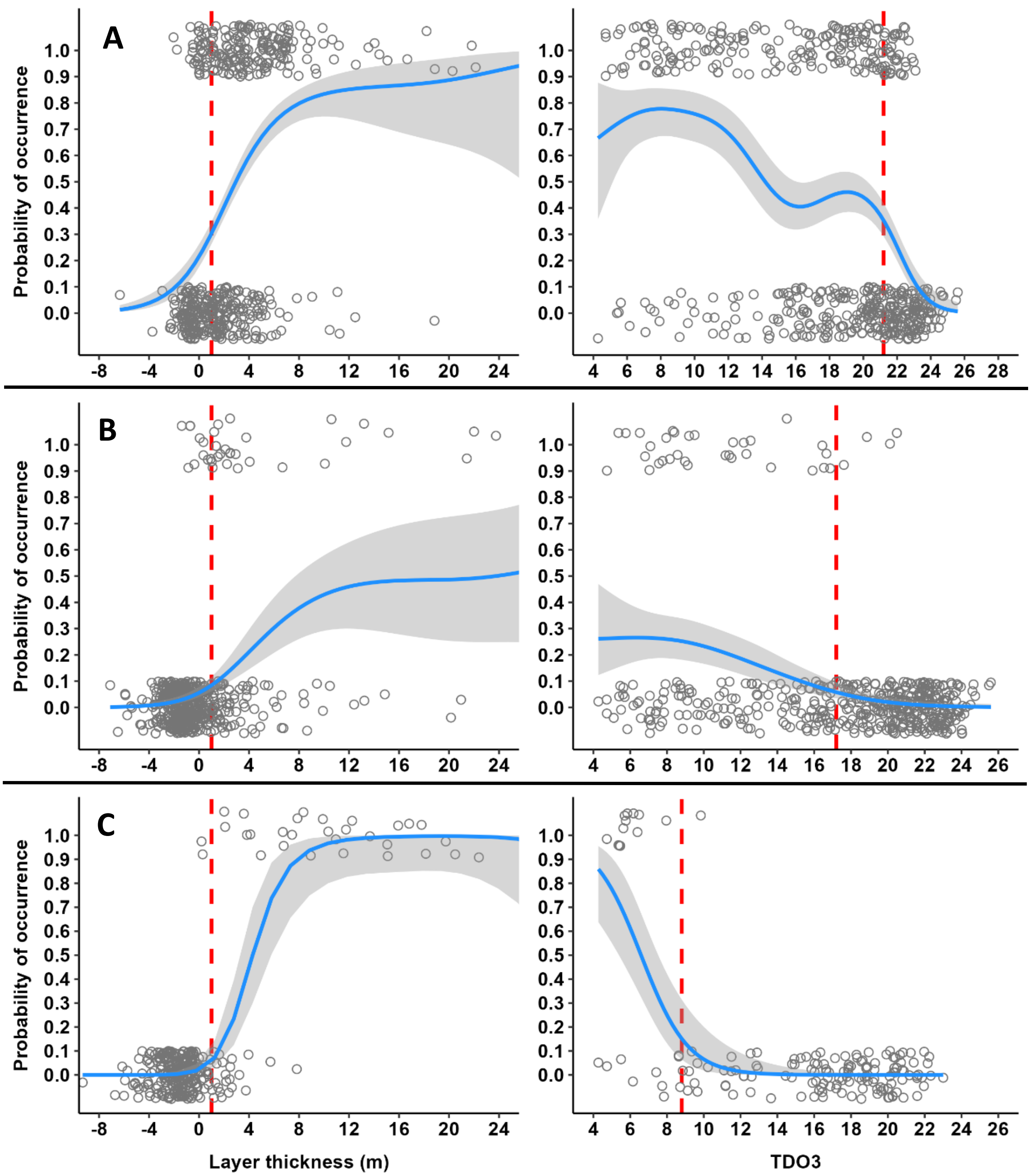
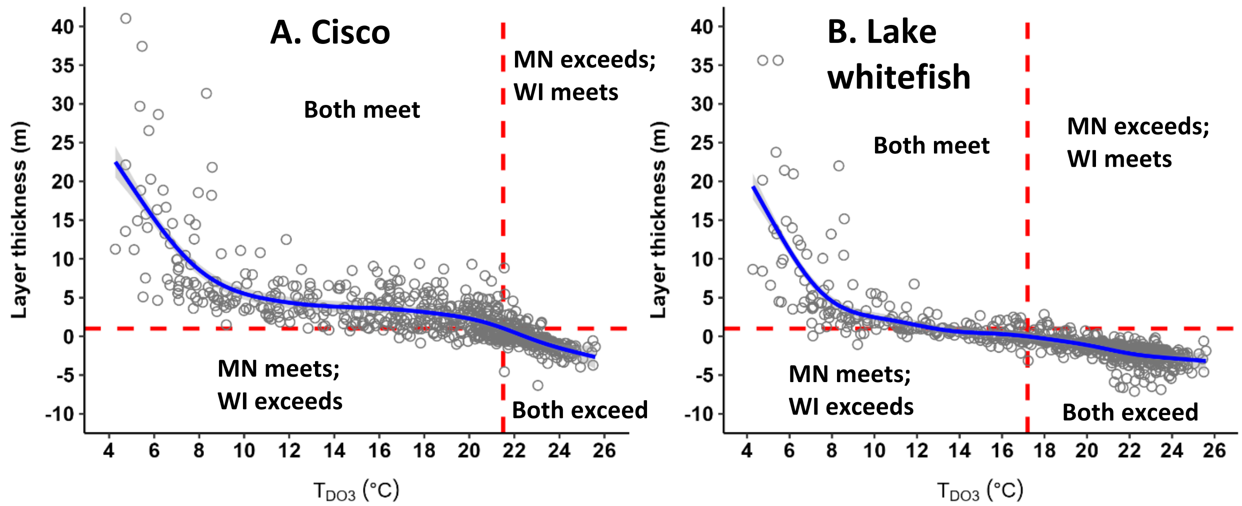
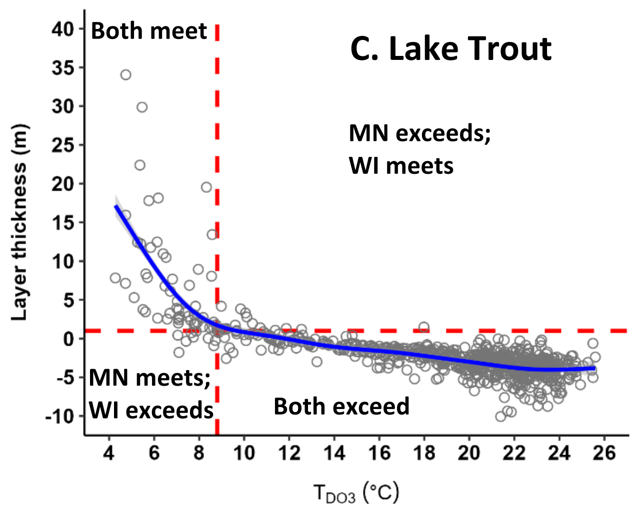


Figure 20. Comparison of T_{DO3} with Wisconsin's oxythermal measures: A) Cisco B) Lake Whitefish, and C) Lake Trout and confusion matrix. Datasets consist of lakes with at least 3 years of oxythermal data. Description of figures: fits are generalized additive model (GAM) logistic regressions (bs = "tp", method = "REML", k =10); shaded areas = 90% confidence intervals; red, dashed vertical line = Minnesota's draft T_{DO3} threshold; red, dashed horizontal line = Wisconsin's criteria (1 m layer thickness). For the confusion matrix, blue cells indicate that both standards resulted in the same outcome and orange cells indicate different outcomes between Minnesota and Wisconsin standards.





Confusion matrix		
Cisco	MN meets	MN exceeds
WI meets	353 (50%)	48 (7%)
WI exceeds	55 (8%)	244 (35%)
Lake Whitefish	MN meets	MN exceeds
WI meets	127 (18%)	7 (1%)
WI exceeds	91 (13%)	475 (68%)
Lake Trout	MN meets	MN exceeds
WI meets	53 (8%)	16 (2%)
WI exceeds	9 (1%)	622 (89%)

iii. United States Environmental Protection Agency

The EPA has developed recommended deepwater hypoxia criteria for cold and cool water fishes (EPA 2021). EPA's draft deepwater hypoxia criteria are based on the determination of chl-*a* concentrations required to maintain a layer of sufficiently oxygenated water meeting temperatures critical for the protection of cold and cool water organisms. This approach differs from those of Minnesota and Wisconsin in that it does not directly develop oxythermal standards from fisheries data. Rather it relies on users to select protective oxythermal criteria parameters including layer thickness, critical temperature, dissolved oxygen level, and certainty level[12]. These inputs, along with lake-specific characteristics (i.e., depth below thermocline, geographic location, and elevation), are used to model

[12] The credible interval in Bayesian statistics is similar to confidence limits in frequentist statistics.

chl-*a* concentrations needed to meet the selected oxythermal habitat target for a lake. The determination of criteria in EPA's deep water hypoxia framework are site specific and differ from Minnesota's draft standards which are species specific. The draft Minnesota criteria and EPA's draft standards accomplish similar overall objectives, but the lack of specific oxythermal endpoints and the determination of site-specific criteria in EPA's models make direct comparisons difficult. However, we can make some tentative comparisons using data from a subset of Minnesota lakes and calculating lake-specific criteria for these lake with EPA's interactive tool for deepwater hypoxia (https://nsteps.epa.gov/apps/chl-hypoxia/). The EPA's tool requires protective oxythermal attributes to be selected by the user including critical temperature, refugia thickness, dissolved oxygen threshold, and certainty level. The draft Minnesota standard parameters could not be exactly replicated using EPA's tool, so for comparison parameters as close to Minnesota's draft framework were input into the model. As such, this exercise only compares chl-*a* criteria between the two approaches and does not assess if oxythermal criteria would differ.

To approximately match draft oxythermal thresholds, we selected the minimum refugia thickness allowed by the model tool (30 cm). The critical temperature and dissolved oxygen thresholds selected differed depending on the most sensitive coldwater fish species present. These were modified to approximate the T_{DO3} thresholds as much as possible which required adjustments to both the critical temperature and dissolved oxygen threshold. The selected thresholds for temperature were 14 °C for Lake Trout, 17 °C for Lake Whitefish, and 21 °C for Cisco and thresholds for dissolved oxygen were 6 mg/L for Lake Trout, 4 mg/L for Lake Whitefish, and 4 mg/L for Cisco (Table 14). For Lake Trout, the minimum critical temperature (13-14 °C) was selected as the lowest valued that did not produce a model error. The dissolved oxygen threshold could not be set at 3 mg/L, so the minimum value of 4 mg/L was selected. A certainty level of 90% was selected for all lakes. Chl-*a* criteria based on the EPA deepwater hypoxia models were calculated for five lakes including two Lake Trout lakes (Trout, Greenwood), one Lake Whitefish lake (Ten Mile), and two Cisco lakes (Carlos, Locator). These lakes were selected because they are draft coldwater lake use designations for these coldwater fish species (Appendix C) and because sufficient data to run the model was available. Lakes with at least two years of DOC data available were selected. In all five lakes, the deepwater hypoxia model resulted chl-*a* criteria (Table 15) which as or more restrictive (2.3-4.6 µg/L) than the draft Minnesota criteria (Table 15). Total phosphorus concentrations were also modeled from EPA target chl-*a* concentrations using EPA's interactive tool (https://tp-tn-chl-prod.app.cloud.gov/). The EPA's recommended nitrogen criteria tool was not reviewed here because development of nitrogen criteria was not considered for Minnesota lakes due to data limitations and the narrow scope of this project. In the two Lake Trout lakes and the Lake Whitefish lake, the draft Minnesota and the EPA chl-*a* criteria were similar. For the other two lakes (Cisco lakes), the EPA chl-*a* criteria were lower than Minnesota's draft criteria. However, based on the analyses in this report, Cisco are sustainable in lakes with chl-*a* considerably higher than these thresholds. The TP criteria derived from EPA's models had a similar pattern with comparable thresholds in the Lake Trout and Lake Whitefish lakes and more stringent thresholds in the Cisco lakes. An important note is that these five lakes do not represent a random sample of Minnesota coldwater lakes so limited conclusions can be drawn from this exercise; however, the draft criteria for Minnesota's coldwater lakes appear in general to be protective.

Table 14. Input values for EPA's deepwater hypoxia model (EPA 2021) used to model chlorophyll-*a* targets for a subset of Minnesota lakes. Chlorophyll-*a* model results were based on EPA's interactive tool (https://nsteps.epa.gov/apps/chl-hypoxia/; accessed on November 20, 2024) and are in Table 15. Abbreviations: WID = waterbody identification code; T = temperature; DO = dissolved oxygen; DOC = dissolved organic carbon; LAT = Lake Trout, LKW = Lake Whitefish, TLC = Cisco.

WID	Lake name (most sensitive species)	Longitude, Latitude	Elevation (m)	Area (km²)	Critical T (°C)	DO threshold (mg/L)	DOC (mg/L)	Thermocline depth (m)
16-0049-00	Trout] (LAT)	-90.17, 47.87	500	1	14*	6	4.0	12
16-0077-00	Greenwood (LAT)	-90.17, 48.00	550	8	13*	6	5.1	22
11-0413-00	Ten Mile (LKW)	-94.58, 46.97	400	20	17	4*	3.6	52
21-0057-00	Carlos (TLC)	-95.36, 45.97	400	11	21	4*	6.5	39
15-0010-00	Elk (TLC)	-95.22, 47.19	450	1	21	4*	7.9	25

** The minimum possible value allowable by the model was selected.*

Table 15. Input values (see also Table 14) and results of EPA's deepwater hypoxia (chl-*a*) and total phosphorus models (EPA 2021) for a subset of Minnesota lakes. Total phosphorus model results are based on EPA's interactive tool (https://tp-tn-chl-prod.app.cloud.gov/; accessed November 20, 2024) and used the Northern Lakes and Forest ecoregion and 90% certainty level. The chl-*a* targets were modeled using the inputs in Table 14 from the deepwater hypoxia model. Abbreviations: WID = waterbody identification code; DOC = dissolved organic carbon; Chl-*a* = chlorophyll-*a*, TP = total phosphorus, LAT = Lake Trout, LKW = Lake Whitefish, TLC = Cisco.

WID	Lake name (most sensitive species)	DOC (mg/L)	Maximum depth (m)	EPA model results		Draft Minnesota standard	
				Chl-*a* target (µg/L)#	TP criterion (µg/L)	Chl-*a* (µg/L)	TP (µg/L)
16-0049-00	Trout (LAT)	4.0	23	3.3	10	3	7
16-0077-00	Greenwood (LAT)	5.1	34	2.7	10	3	7
11-0413-00	Ten Mile (LWF)	3.6	63*	4.4	11	5	12
21-0057-00	Carlos (TLC)	6.5	50	4.6	12	12	25
15-0010-00	Elk (TLC)	7.9	28	2.3	8	12	25

** The maximum possible value (60 m) allowable by the model was selected.*

 # Only whole numbers could be input so chl-a targets were rounded to the nearest integer.

Implementation of coldwater lake fish standards

The methods and requirements for performing assessments of coldwater lake habitats need to be described to ensure appropriate application of these standards and to minimize erroneous assessment decisions. Central to an assessment framework is where and how data need to be collected and what the minimum data requirements are for assessment. This includes considerations for lakes where monitored data are near thresholds. In addition, it is helpful to describe how to assess atypical situations where either the data collected are unusual or contradictory or for lakes that are unique and may require a site-specific standard (SSS). These aspects of implementing an assessment framework for coldwater lake habitat are described in the following section.

i. Sampling location

Coldwater lake standards are focused on assessing the condition of coldwater habitat within a lake which may be suitable to support coldwater fish species. However, that habitat does not exist throughout a lake when it is stratified and is usually associated with the deepest areas of a lake. As a result, collection of temperature and oxygen profiles should be from the deepest area or basin of a lake where coldwater fishes are likely to reside during the summer. When possible, a single station from the deepest area of a lake should be used for assessments. In cases where multiple distinct basins are present in a lake and these basins differ in terms of depth and trophic state, measurements from multiple basins may be averaged. If these basins are highly distinct and water quality or fisheries management differs between these basins, it may be necessary to designate separate WIDs for each basin. However, if assessments ensure that lake profile data used for assessments are from the deepest area of the lake, the splitting of a lake into subbasins will often not be necessary. In addition, where possible it is preferable to assign similar management units to that of the MNDNR. In most cases, the MNDNR includes all basins of a lake as a single management unit even if there are multiple fish community types managed in different zones (e.g., two-story lakes or morphologically complex lakes where only some basins support coldwater fishes). The measurement of eutrophication parameters (i.e., TP, chl-*a*, and Secchi depth) are also usually collected from the deepest area, but sample location is not as important for these measures. However, in complex lakes with multiple distinct basins, eutrophication measures should be collected from the same basin as the lake profiles used for the assessment of T_{DO3}. The goal of water quality data collection for the assessment of coldwater habitats is to collect samples that accurately reflect the available and usable habitat which is needed to maintain populations of coldwater fishes in these lakes.

ii. Oxythermal habitat

Specific temporal data requirements will need to be met to assess T_{DO3} in coldwater lakes. At least one profile should be taken per summer for three years[13]. Sampling should be focused on the 30-d period of maximum oxythermal stress (i.e., July 26 through August 24); however, for data used for a determination of impairment, lake temperature and oxygen profiles may be collected at any time during the summer index period (June through September). Determination of full support requires these data to be collected during the period of maximum oxythermal stress (i.e., July 26 through August 24). Oxythermal data from outside the period of maximum oxythermal stress may be used as supporting information for determining support of these standards. Measurement of T_{DO3} should be collected at depth intervals of ≤1m at the depth where the 3 mg/L dissolved oxygen threshold is crossed. Greater depth intervals are acceptable above and below this threshold. Profiles collected using depth intervals >1m at the 3 mg/L dissolved oxygen threshold, may be used if a review of these data indicate that the profile is indicative of oxythermal conditions. For example, the profile may clearly demonstrate attainment or nonattainment of oxythermal thresholds. If such profiles are deemed to not be indicative of oxythermal conditions, they may be relegated to supporting information.

[13] In some cases, assessments using less than 3 years of data may be acceptable if there is high confidence in the available data. For example, it may be reasonable to assess cisco lakes in the BWCAW with 2 years of T_{DO3} measurements indicating very good oxythermal conditions. See the discussion below regarding confidence limits.

In most lake profiles, calculation of T_{DO3} will be a simple interpolation of the temperature at the depth where dissolved oxygen is 3 mg/L. However, in some profiles this is not possible because the dissolved oxygen profile never crosses this threshold, or the profile is more complex. For lake profiles where DO_{max} is less than 3 mg/L, T_{max} is used in place of T_{DO3}. When the opposite is true and a lake profile has a DO_{min} greater than 3 mg/L, T_{min} is used in place of T_{DO3}. In unusual cases where dissolved oxygen drops below 3mg/L but then increases above this dissolved oxygen threshold again at a deeper depth, the T_{DO3} from the deeper depth will be used.

If lake profiles have been sampled at multiple locations within a lake, the most appropriate sampling station (usually deepest part of the lake) will need to be identified (see previous section). It may be possible to use multiple stations from a lake if these areas or basins have been determined (e.g., using depth contours or a defined geospatial area) to be likely support summer refugia for these fishes. If T_{DO3} measurements from multiple stations are available on the same day, the lowest T_{DO3} value may also be used since this may represent the best coldwater habitat within a lake. If multiple T_{DO3} measurements are available from the same year, the highest value will be used in assessment as this reflects the greatest measured stress to which the fish were exposed. Assessments will consist of a comparison of average T_{DO3} from the most recent 10 years against the standards assigned to a lake based on the fish species protected in the lake. If oxythermal data from outside the period of oxythermal stress is present and exceeds the standard, these data can be included in the average or used as supplemental data. However, it should be determined if poor oxythermal conditions (i.e., high T_{DO3} values) are the result of atypical conditions (e.g., severe drought). In which case it may not be appropriate to include these data in the calculation of the average and they should be relegated to supplemental data. If data outside the oxythermal index period are included in the average, other data from the same year should not be included in the average. Inclusion of data exceeding the standards from outside the index period is useful and informative in assessments because if a lake is experiencing low oxythermal conditions outside the oxythermal index period, it is likely to exceed standards during the index period. This enables the inclusion of additional data that would otherwise be excluded and can provide additional insight into the severity of the WQS exceedance.

As more continuous monitoring of temperature and dissolved oxygen are available from lakes, these data may also be incorporated into assessments. In most cases, the probe intervals will be greater than 1 m and not suitable for determining T_{DO3}. However, these data may provide useful supplemental data such as determining if a discrete T_{DO3} measurement on a lake was collected on a day that was an outlier. If continuous temperature and dissolved oxygen data are collected at 1 m or less increments, these data may be suitable for assessments. These data could be used by determining the day with the highest T_{DO3} value during the period of deployment. In general, continuous monitoring data will also be valuable for documenting temperature and dissolved oxygen patterns in lakes and thereby improve implementation of T_{DO3} standards.

Beyond a straightforward assessment of average T_{DO3}, other data attributes can be considered to ensure appropriate assessment outcomes (i.e., avoiding false negatives or false positives). Sample size (i.e., number of years of T_{DO3} data available) impacts the parameter estimation. The effect of sample size on error rates was analyzed by bootstrapping (*B* = 1000) and estimating mean T_{DO3} at different sample sizes from dimictic lakes (geometry ratio < 4) with at least 10 years of data (n = 144). Error rates were estimated as the number of individual replicate assessments which differed from an assessment[14] based on the mean T_{DO3} of all 1000 replicate samples. To assess the confidence limits of a 3-year sample size,

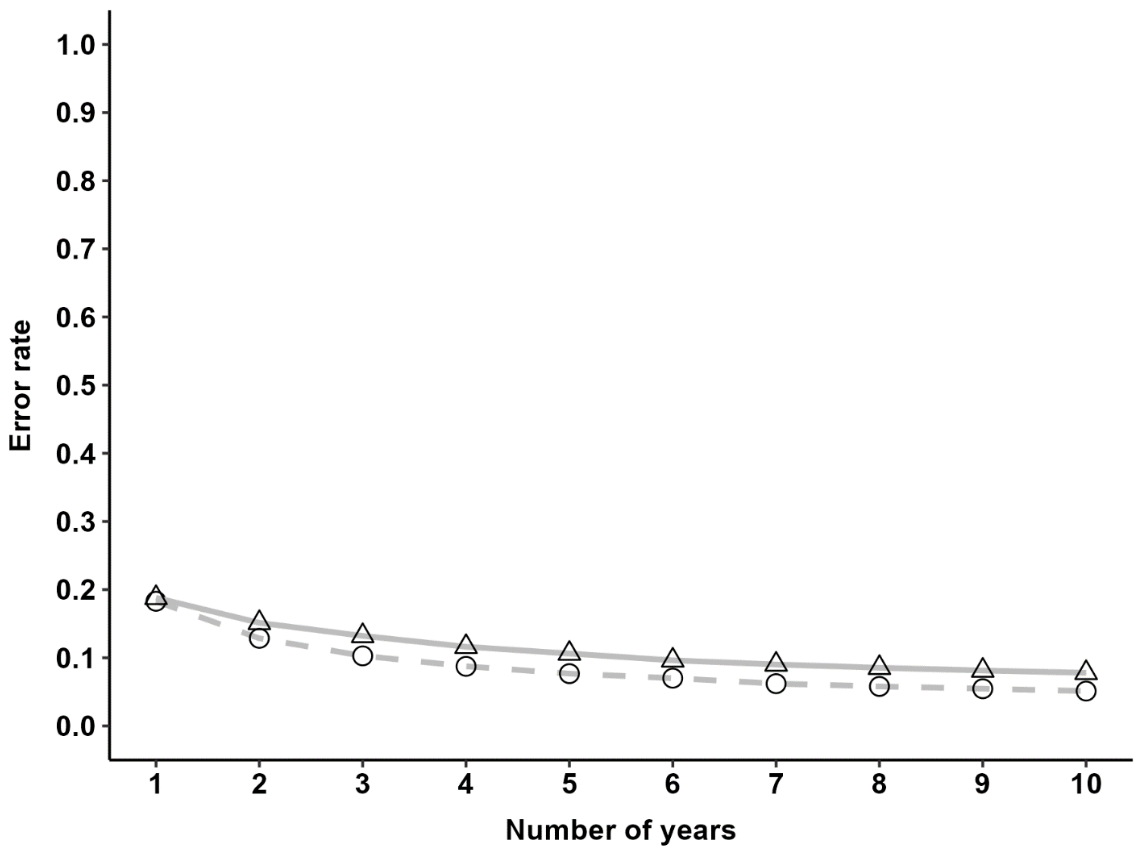
---

[14] Assessments were based on the cisco T_{DO3} draft standard (T_{D03} = 21.2 °C). Therefore, if the bootstrapped mean T_{DO3} indicated that a lake did not meet the cisco T_{DO3} draft standard, all replicate mean values that indicated attainment of this standard were considered errors.

3-year replicates were bootstrapped (*B* = 1000) from the same dataset of lakes with at least 10 years of data. For these lakes, 90% confidence limits were estimated from these bootstrapped samples by calculating 5th and 95th percentiles for each lake. The upper and lower confidence limits were estimated as the difference between the 5th and 95th percentiles and confidence limit widths were calculated as the difference between the 5th and 95th percentiles and the mean. The average of the upper and lower confidence limit widths was calculated and used to estimate variability in oxythermal habitat for each lake.

As sampling size increased, false positive and false negative errors decreased although there was no obvious breakpoint or lower asymptote for the sample sizes analyzed (Figure 21). A sample of three years was selected as a minimum dataset to reduce errors and maximize the number of lakes for which a sufficient dataset will be available. Although increased sample size reduces estimation error and is preferable when available, additional review of data and separate lines of evidence can be used in combination with T_{DO3} data to reduce assessment errors. It is important to note that these analyses used raw data which have not been scrutinized as in an assessment which likely increased estimated error rates. As a result, the absolute error rate values are likely to be lower as part of a fully implemented water quality assessment program.

Figure 21. Error rates (circles = false positives; triangles = false negatives) for different sample sizes estimated using bootstrapping (B = 1000). Dataset consisted of dimictic lakes with at least 10 years of data.



Confidence limits for estimating T_{DO3} from individual lakes will differ depending on available datasets, time of sampling during the index period, years sampled, and random sampling error. An analysis of confidence limits for individual lakes can be used to determine when additional scrutiny or sampling may be prudent to accurately estimate oxythermal conditions. The distribution of confidence limits for the 144 dimictic lakes with at least 10 years of oxythermal habitat data is provided in Figure 22. Most dimictic lakes (83%) had upper/lower confidence limits below 3 °C (Figure 22A). Review of individual T_{DO3} measurements can give insight into estimated average measurements. Large year-to-year variability in

T_{DO3} may indicate a need for additional sampling and these data can be manually examined or assessed using bootstrapping. Specific considerations for individual measurements include reviewing weather conditions (e.g., high temperatures, drought) during the time of sampling, the degree to which individual measurements exceed standards, proximity of average T_{DO3} to the standard, the estimated mean T_{DO3}, and contemporaneous fish surveys. Particularly high or low individual T_{DO3} measurements may be important for assessment decisions. For example, it may be appropriate to assess a lake near the standard as impaired if one or more of the years greatly exceeded the standard. In addition, review of weather conditions may provide insight into T_{DO3} measurements and could affect assessment decisions if a large proportion of measurements were collected during atypical years or periods. If all or most of the available data for a lake were collected during a warmer-than-average period, additional sampling may be recommended before making an assessment decision. The proximity of average T_{DO3} to the standard is important because assessment errors will increase as that gap narrows. For example, a lake with a mean T_{DO3} of 12 °C is unlikely to exceed the draft criterion for Cisco of 21.2 °C. The estimated T_{DO3} value may also be important because confidence limits vary as a function of T_{DO3} (Figure 22B; Table 16). We selected a subset of three lakes with at least 10 years of lake profile data and with different distributions of T_{DO3} measurements. These lakes included lakes with low, intermediate, and high T_{DO3} levels. Based on Figure 22B, lakes with low or high mean T_{DO3} values had narrower confidence limits (e.g., Figure 23A,C). Therefore, there is greater confidence in these estimates. Lakes with mid-range T_{DO3} values tended to have wider confidence limits (e.g., Figure 23B). It is not clear why this pattern occurs in these lakes, but it indicates that additional scrutiny may be needed for such lakes and for lakes that are near T_{DO3} criteria. For example, the current condition of coldwater fish populations may be used to inform assessments, as lakes with T_{DO3} values near the criterion but with a healthy population of coldwater fish species, indicate that standards are attained. In general, these confidence limits and other considerations provide guidelines for when additional review of individual T_{DO3} measurements or sampling should be recommended to minimize assessment error.

Figure 22. (A) Histogram of upper and lower confidence limits and (B) estimated confidence limits as a function of T_{DO3} for individual lakes. Confidence limits were estimated by bootstrapping (B = 1000) 3-year replicates. The dataset for both figures consisted of dimictic lakes with at least 10 years of data (n =144). Fits for (B) are generalized additive models (GAM; bs = "tp") including mean, 95th percentile, and 5th percentile.

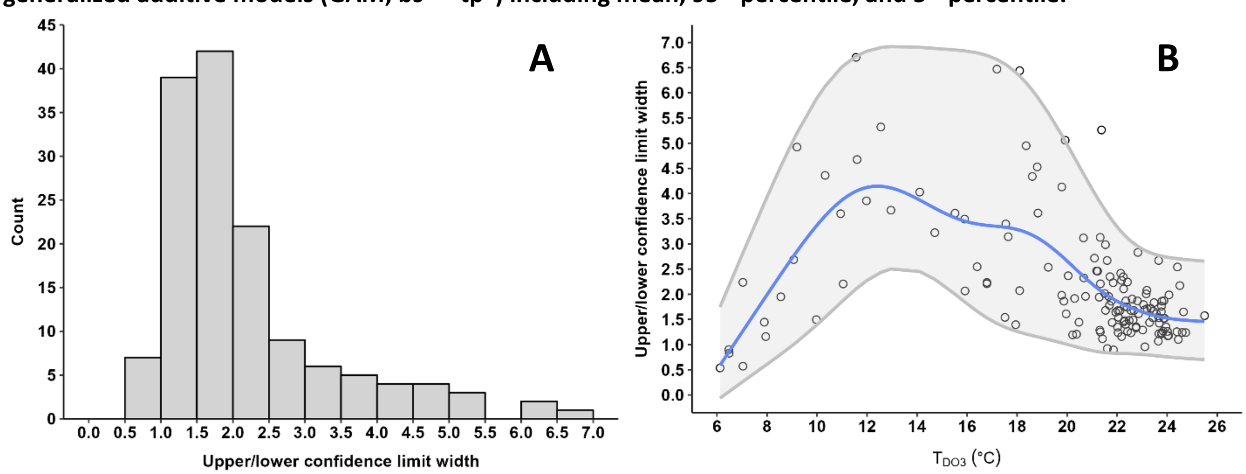
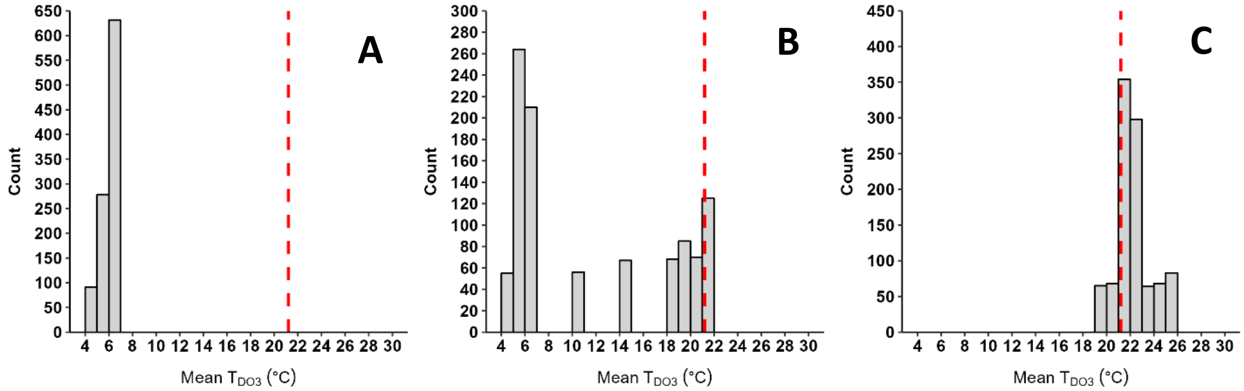


Table 16. Modeled confidence limits (C.L.) as a function of mean T_{DO3}. The values are derived from the analysis in Figure 22B. The mean confidence limits correspond to the blue line and the 95th percentile values correspond to the upper grey line in Figure 22B.

Mean T_{DO3}	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Mean C.L.	1.2	1.9	2.7	3.4	4.0	4.3	4.2	3.8	3.5	3.2	3.3	3.4	3.2	2.7	2.2	1.8	1.6	1.5
95th percentile C.L.	2.8	3.9	5.0	5.9	6.5	6.8	6.9	6.9	6.9	6.8	6.7	6.4	5.8	5.0	4.1	3.3	2.9	2.7

Figure 23. Histograms of mean T_{DO3} from bootstrapped samples (n = 3; *B* = 1000) for (A) Grindstone Lake (58-0123-00), (B) Cedar Lake (01-0209-00), and (C) Big Swan Lake (77-0023-00). Red dashed line = draft Cisco criterion.



iii. Total phosphorus, chlorophyll-a, and Secchi depth

Assessment of eutrophication parameters for coldwater lakes will follow existing lake eutrophication assessment guidance (MCPA 2024a). Sampling needs to occur during the summer index period (June through September) and samples should collected throughout this period. A minimum of two years of monitoring with at least four samples per year are required to perform an assessment. A determination of impairment is based on the exceedance of TP and one or both response parameters (chl-*a* or Secchi depth). All available data from the most recent ten years, assuming the 2-year minimum is met, is used for assessment and these data are averaged. If there is uneven sampling effort between years for a lake, data may need to be weighted by year to avoid bias. CDOM should be considered when Secchi depth is assessed as it can impact transparency (MPCA 2024b). Both color (PCU) or a_{440} can be used to determine if CDOM is negatively impacting Secchi depth and possibly invalidating this parameter as a measure of productivity. Lakes with color >73 PCU or a_{440} >4 m^{-1} should not be assessed using Secchi depth (Brezonik et al. 2019) and lakes with color >25 PCU or a_{440} >1.4 m^{-1} should be scrutinized to determine if an assessment is appropriate (MPCA 2024b). In many cases, it may be advisable to use only chl-*a* for assessment in lakes with elevated CDOM as Secchi depth measurements will not provide an accurate measure of lake productivity. Although it is not a widespread issue in coldwater lakes, suspended sediment may also need to be accounted for as part of Secchi depth assessments. Additional details regarding methods for the assessment of eutrophication in lakes can be found in MCPA (2024a).

iv. Multiple indicators

The draft coldwater habitat standards include multiple indicators for determining the attainment and protection of coldwater habitat goals. Eutrophication and oxythermal measures can measure similar impacts to coldwater fishes, but oxythermal measures may be a more comprehensive indicator. The oxythermal habitat standards incorporate both oxygen and temperature requirements for these sensitive fish. The eutrophication portion of this standard is largely a determinant of dissolved oxygen conditions although it will also be sensitive to other potential impacts such as food web alterations and harmful algal blooms. In many cases, these two indicators will agree, but in some lakes assessment outcomes may differ. Because there are multiple indicators and these indicators will conflict in some lakes, it is necessary to describe how these situations will be addressed in assessments. In these cases, a weight-of-evidence approach will need to be considered to minimize assessment error. This process is described below in detail and in a flowchart provided in Appendix A.

The oxythermal and eutrophication parameters, when both are available for a lake, are intended to be used together although they can be implemented independently. If a lake has only one of these indicators (i.e., T_{DO3} or TP and chl-*a*/Secchi depth), that is sufficient to perform an assessment. When both are available, these indicators can be used independently (i.e., determine a lake is impaired when one indicator demonstrates impairment, but the other does not). However, a more detailed review of the available data may reveal that one indicator is more appropriate. This may be due to one indicator consisting of a larger, more comprehensive dataset or it may be a better indicator for a specific lake. In cases where lakes have oxythermal habitat and eutrophication outcomes which disagree (assuming both have sufficient datasets for assessment), the size and robustness of each dataset should be considered. For example, if one indicator includes many more years of data or demonstrates lower variability in the estimation of parameter means, then it may be reasonable to use that parameter for assessment. In some cases, the use of eutrophication standards may not be appropriate due to impacts from zebra mussel infestations. These lakes may have lower mid-lake water column chl-*a* which does not accurately reflect the productivity of the system or the potential impacts to coldwater communities. This means that a decision of full support can be made even if one parameter exceeds that standard when the other parameter is determined to be a better, more accurate indicator of coldwater habitat. In cases where datasets for oxythermal habitat and eutrophication are similarly robust, more weight may be given to oxythermal habitat since it is a more proximate indicator of coldwater habitat. In addition, a recommendation to collect more data can be made when these results are deemed inconclusive. It may also be appropriate for some lakes to develop SSS to acknowledge a different relationship between oxythermal and eutrophication measures than that observed with the population of lakes used to develop these standards (see ***Atypical lakes and site-specific standards***). Multiple indicators are useful for making use of available datasets, but when complementary data are available, these data should be scrutinized to determine how to implement an assessment such that an appropriate determination is made regarding the ability of a lake to support coldwater fishes.

v. Atypical lakes and site-specific standards (SSS)

The draft standards were developed from a large population of Minnesota lakes, but these standards may not be appropriate for all lakes in the state that require protections for coldwater habitat. As a result, available assessment data and supplementary information should be reviewed to identify atypical relationships and unique lakes. For example, unique conditions include ground water inputs, lake morphology, lake residence time, high watershed area to lake area, and naturally high trophic state. For example, lakes with coldwater input from groundwater, springs, or coldwater streams may maintain good oxythermal conditions at higher chl-*a* levels. In these cases, the chl-*a* data should not be used for assessments or a SSS should be developed. In most cases, changes to oxythermal habitat or eutrophication standards should be supported by fisheries surveys which indicate that such lakes support coldwater fishes under these modified conditions. This document includes SSS for 11 lakes where it was determined that despite coldwater habitat measures indicating conditions are not consistent with most other coldwater lake habitats, these lakes support healthy communities of these fishes (Table 17). The details for these SSS are provided in Appendix C as part of a write up for the coldwater designation of each lake.

Table 17. Draft site-specific standards (SSS) for lakes indicating atypical conditions or populations of coldwater fish species (* indicates that the standards for this lake are unchanged from the draft statewide coldwater habitat standards; TLC = Cisco; LKW = Lake Whitefish; LAT = Lake Trout; SRT = stream trout).

Lake name	WID	Watershed subbasin (HUC 8)	Coldwater species	T_{DO3} (°C)	Total Phosphorus (µg/L)	Chlorophyll-*a* (µg/L)	Secchi depth (m)
Lake Vermilion	69-0378-01,-02	09030002	LKW,TLC	19.9	19	6	*
Jessie	31-0786-00	09030006	TLC	22.0	46	*	*
Whitefish	31-0843-00	09030006	TLC	22.0	*	*	*
Itasca	15-0016-00	07010101	TLC	22.5	32	13	*
North Twin Lake	31-0190-00	07010103	TLC	21.6	*	*	*
Farm Island	01-0159-00	07010104	TLC	22.3	*	*	*
Fish Trap	49-0137-00	07010108	TLC	22.2	*	*	*
Big Birch	77-0084-01,-02	07010202	TLC	22.1	28	*	*
Sauk	77-0150-02	07010202	TLC	23.0	*	*	*
Koronis (main lake)	73-0200-02	07010204	TLC	23.0	*	*	*
Grindstone	58-0123-00	07030003	LAT,TLC,SRT	*	14	5	*

vi. Impaired waters and TMDLs

The inclusion of both T_{DO3} and chl-*a* in assessments provides information regarding stressors responsible for the loss or degradation of coldwater lake habitats. T_{DO3} provides a more direct measure of a lake's coldwater habitat conditions, but it is affected by both changes in temperature (e.g., climate change) and lake productivity (e.g., cultural eutrophication). Chl-*a* is largely affected by lake productivity although there are interactive effects between productivity and temperature. As a result, which criteria are exceeded (T_{DO3}, chl-*a*, or both) can be informative regarding stressors and the need to develop a TMDL (i.e., 303(d) listing category). The two most relevant categories for lakes not meeting coldwater habitat standards are initially Category 4C and Category 5 (Table 18). Category 4C lakes are those that are impaired, but do not require a TMDL because non-attainment is caused by a non-pollutant (e.g., flow alteration or temperature). Category 5 impaired waters do require a TMDL and in the case of coldwater lake assessments, this will likely involve a need to reduce TP loading. Differences in the actions needed to restore lakes based on the causative stressor means that making these determinations can be considered as part of the assessment process. Ensuring that appropriate stressor is targeted will result in better restoration and protection outcomes and greater efficiency with water quality resources.

The coldwater lake standards themselves can be informative regarding the 303(d) listing category. For example, a lake exceeding the T_{DO3} standard, but not the chl-*a* standard may be indicative of an impact of climate change and thereby could result in a category 4C on the 303(d) list. In contrast, an exceedance of both chl-*a* and T_{DO3} would indicate that nutrient loading is at least partially the cause of nonattainment. However, additional work may be needed to determine if rising temperatures are also impacting lake productivity and hypolimnetic oxygen through mechanisms such as increasing the length of the growing season or increasing internal loading. This determination can be used to help direct management plans for the protection or restoration of lakes. However, disagreement between these indicators may be caused by other factors (e.g., dataset robustness, sampling variability, site-specific conditions) and these possible factors should be considered as part of the management of these lakes.

Table 18. Assessment categories for waters on the 303(d) list.

Category	Description
2	Waterbody's assessed designated uses are fully supported, the designated use is fully supported, or parameter meets standards.
3	Data insufficient or inconclusive to assess.
4A	Impaired and a TMDL study has been approved by EPA.
4B	Impaired but a TMDL study is not required because water quality standards are expected to be met in the near future.
4C	Impaired but a TMDL study is not required because the impairment is not caused by a pollutant.
4D	Impaired but a TMDL study is not required because the impairment is due to natural conditions with insignificant anthropogenic influence. To be considered insignificant, the elimination of the anthropogenic influence would not lead to the attainment of water quality standards and it would not be included in formal pollution reduction goal-setting activities. Category 4D indicates a site-specific water quality standard based on local natural conditions has yet to be determined.
4E	Impaired but existing data strongly suggests a TMDL study is not required because impairment is not caused by a pollutant or is due to natural conditions with only insignificant anthropogenic influence; a final determination of Category 4C or 4D will be made in the next assessment cycle pending confirmation from additional information.
5	Impaired and a TMDL study has not been approved by EPA.

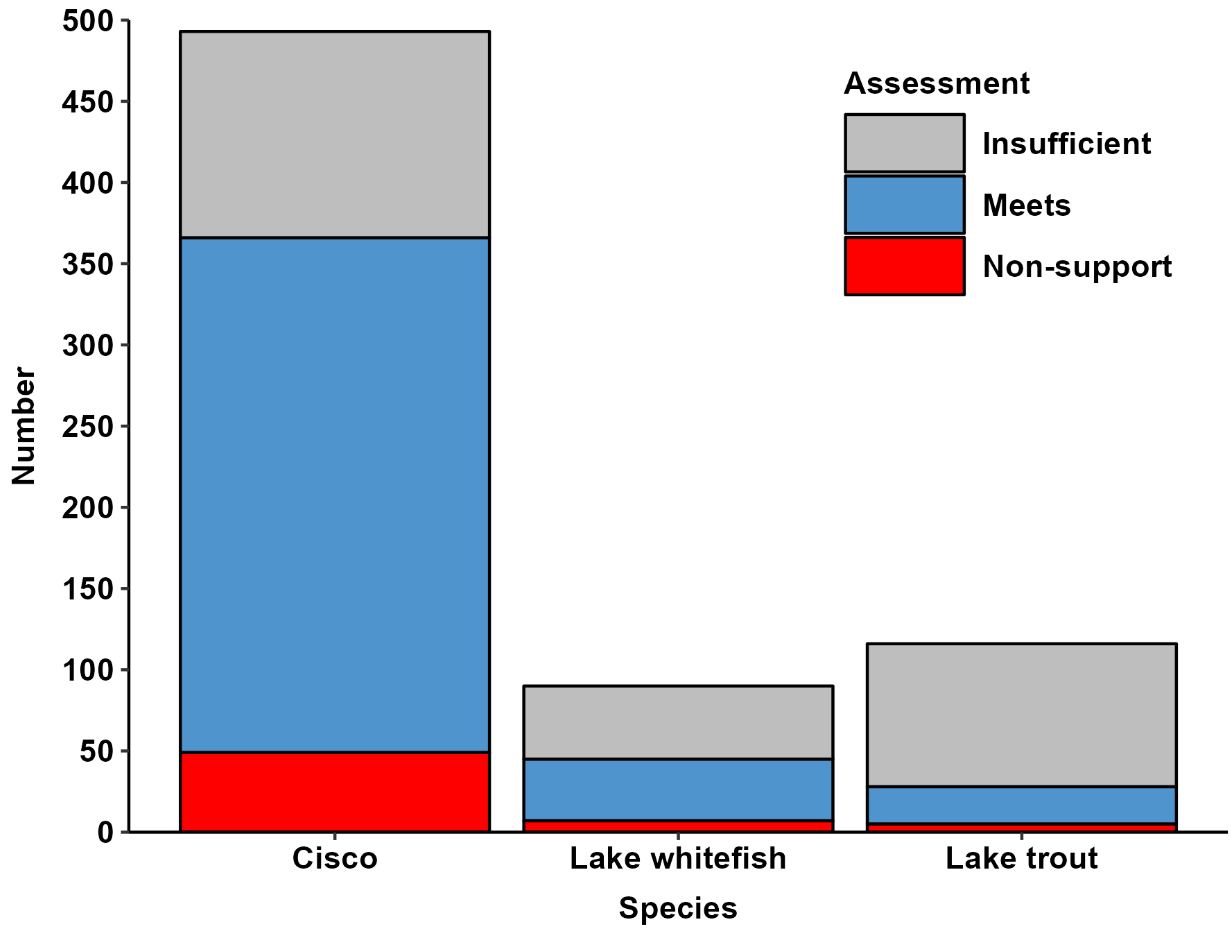
The determination of TP criteria for the draft chl-*a* criterion differ from the methods used to determine the eutrophication criteria adopted in 2008 (Heiskary and Wilson 2005). The models in the original lake eutrophication criteria were least-squares regressions of log transformed TP and chl-*a* data. As a result, the model predicts that approximately half of lakes at a given TP value will exceed the chl-*a* criterion. The updated model for the coldwater lakes uses a 90th percentile loess regression to predict TP concentrations associated with chl-*a* thresholds needed to protect coldwater fish species (Figures 17 and 18). For lakes at the TP criterion, this model predicts 10% of lakes will exceed the chl-*a* standard. Although useful for assessment and ensuring that lake assessments do not result in inconclusive results due to a misalignment between TP and chl-*a* (i.e., false negative errors), this model is less useful for developing TMDLs. Developing TMDLs based on the model using a 90th percentile will result in targets for some lakes where lower nutrient load reductions will still achieve productivity targets. As a result, other models such as the BATHTUB model or models derived from the datasets used in Figures 17 and 18 can be used to develop lake-specific targets to meet standards when appropriate.

vii. Pilot assessments

The draft coldwater lake standards were used as part of an exercise to informally assess the condition of the lakes which will be designated as coldwater habitat. Based on species-specific thresholds for T_{DO3} and chl-*a*, lake data were compared against these thresholds. For this assessment 3 years of T_{DO3} and 2 years of chl-*a* data were required and any data available from 1990 through 2020 were included and averaged for each lake. Both parameters were considered together and a determination of "non-support" was based on one or both parameters indicating non-attainment of the thresholds. A determination of "meets" was based on both parameters meeting the thresholds or one parameter meeting and the other insufficient. Lakes that lacked sufficient data to assess either parameter were flagged as having "insufficient" data. It should be noted that this is a preliminary, informal assessment of these draft thresholds. A full and formal assessment would be more detailed and would include additional considerations. For example, a formal assessment would restrict data to the most recent 10 years and include scrutiny of the data including sampling location, timing of sampling, and sample variability. Other considerations, especially for lakes near thresholds, may include review of fisheries data, watershed land use, lake morphology, ground water inputs, and other water quality data. As a result, the informal assessments used in this pilot analysis do not exactly reflect the actual outcomes of a formal assessment and these results should be treated as exploratory.

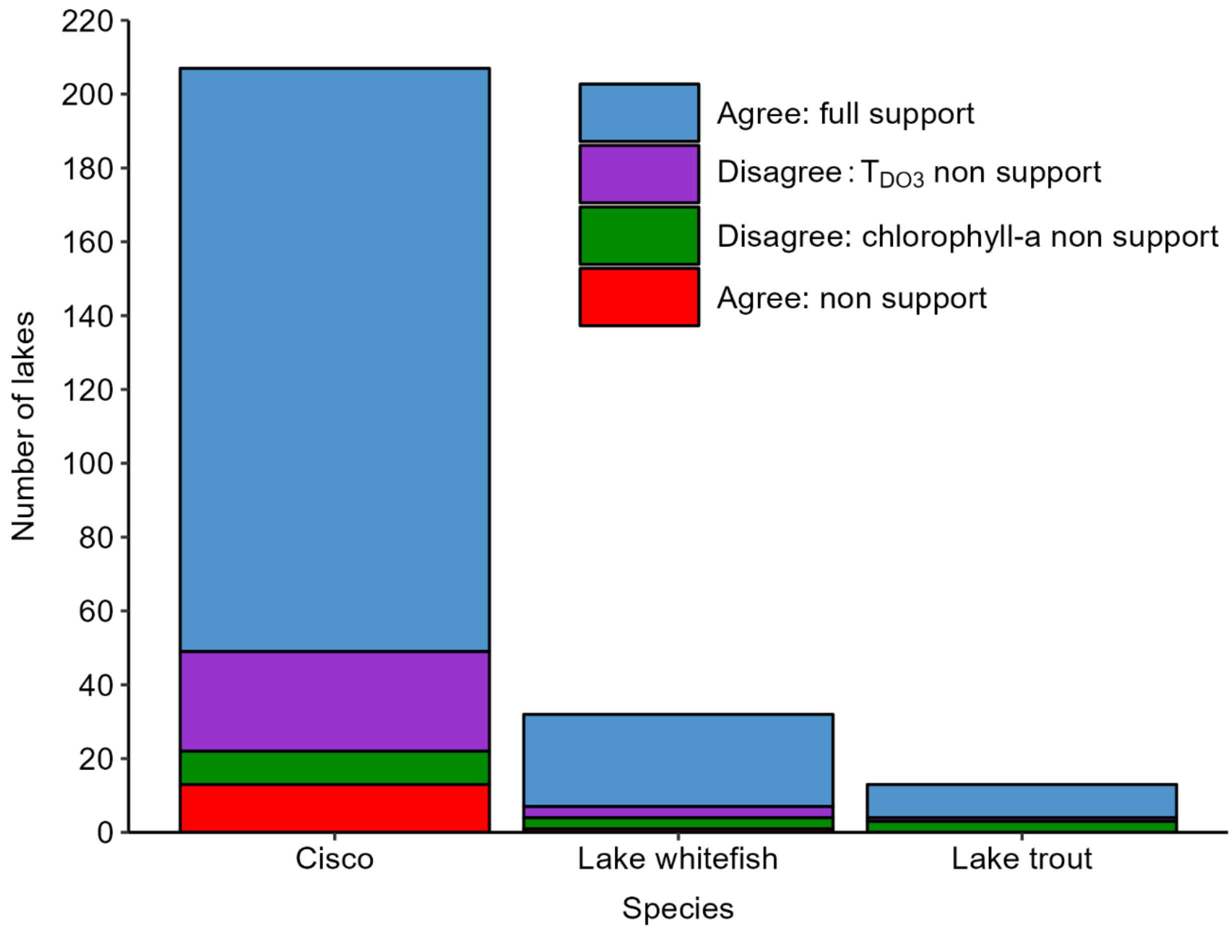
Exceedance rates of the draft coldwater habitat thresholds were generally low with 10%, 8%, and 4% of lakes not meeting one or both coldwater habitat indicators for Cisco, Lake Whitefish, and Lake Trout, respectively (Figure 24). In some cases, the lakes which exceeded the standard support good populations of coldwater taxa and site-specific standards may be needed to address atypical conditions in those lakes (see ***Atypical lakes and site-specific standards***). Sixty-four percent of Cisco lakes had good water quality indicating conditions that should support this fish species. The proportion of lakes meeting thresholds for Lake Whitefish and Lake Trout were lower (42%: Lake Whitefish; 20%: Lake Trout) due to large number of lakes lacking sufficient data for assessment. The large proportion of lakes lacking data were because many Lake Whitefish and Lake Trout lakes are in far northern Minnesota in remote areas such as the Boundary Water Canoe Area Wilderness (BWCAW) and are difficult to sample. As a result, it could be predicted that many of these lakes are relatively undisturbed and likely have conditions supportive of these sensitive coldwater fish species. Overall, this analysis is consistent with expectations for Minnesota lakes supporting these fish species. Cisco are more widespread, including into more heavily developed portions of central Minnesota and would therefore be expected to have more non-supporting or threatened lakes despite their greater tolerance to temperature and lake productivity impacts. Lake Trout and Lake Whitefish are largely limited to areas with low disturbance in Minnesota and as expected there are fewer lakes that indicate poor water quality.

Figure 24. Informal assessment outcomes for coldwater lakes based on available T_{DO3} and chlorophyll-*a* data.



An assessment of the agreement between the two coldwater habitat indicators was also performed. For lakes with both sufficient chl-*a* and T_{DO3} data (n=221), these two indicators agreed for 82% of lakes (Figure 25). In a formal assessment, the agreement between these parameters will be higher due to better temporal alignment of data within a 10-year window and data reviews that determine one indicator is a better measure of coldwater habitat or SSS which revise one indicator due to atypical conditions. Several of the lakes with disagreement between indicators are part of SSS reviews (see ***Atypical lakes and site-specific standards***). In addition, there are more disagreements where T_{DO3} indicates non-support while chl-*a* indicates support. In these cases, temperature impacts may be more important than nutrient loading. Overall, these indicators are useful when used in conjunction for assessments as they can be used to confirm non-attainment when they are aligned. When these indicators disagree, information on the condition of a lake can be obtained or it can be used as a flag for additional examination or monitoring.

Figure 25. Comparison of assessment outcomes for coldwater lakes with sufficient T_{DO3} and chlorophyll-*a* data for assessment.

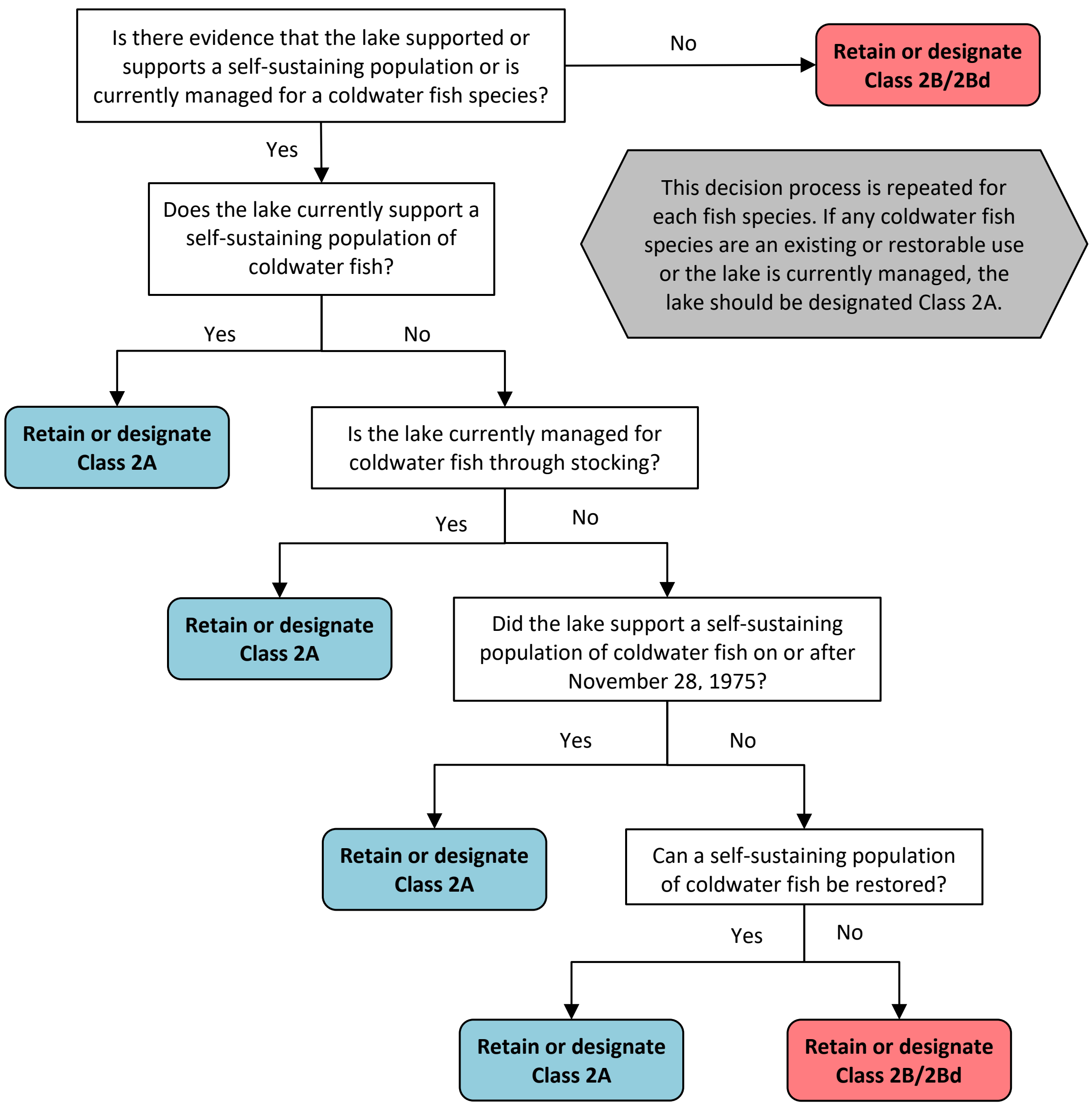


Coldwater lake habitat use designation reviews

Establishing criteria for the protection of coldwater habitats is only one part of WQS and the implementation of protection and restoration strategies. A second important element of WQS is the designation of beneficial uses. A beneficial or designated use determines which standards are applicable to a lake and is therefore critical to ensuring that the correct standards are applied. In the case of the draft coldwater lake standards, this requires a determination of which coldwater fish species are protected in a lake. The determination of the appropriate coldwater designation is largely driven by historical and contemporary biological data although several additional lines of evidence are also important for making use designation decisions. These use designation reviews consider existing and attainable aquatic life uses and rely on an assessment of factors, both natural and anthropogenic, that determine the suitably for a lake to support coldwater fish species.

Determining the species that need to be protected by a coldwater habitat designation in a lake are driven by the determination that the lake supports a self-sustaining population of that species or that the lake is currently managed[15] for that species. An important element of use designation reviews is the concept of "existing use." Existing uses are beneficial uses attained on or after November 28, 1975 (Minn. R. 7050.0255, subp. 14). This means that a use attained on or after that date, even if lost, must be retained. However, if a use was lost before that date and cannot be restored, it is not an existing use. An overview of the process for reviewing coldwater lake designations is in Figure 26 and a more detailed process chart is in Appendix B. Although these processes are described in these figures as a stepwise or linear process, these considerations are often iterative.

Figure 26. Clean Water Act beneficial use designation review decision process for coldwater lakes.



[15] In most cases, this involves fish stocking by the MNDNR to maintain or supplement the fish population.

A determination that a Lake Trout, Lake Whitefish, or Cisco population is an existing use that should be protected by a coldwater habitat designation is largely based on a determination that a lake supports a native or resident population that does not rely on stocking to sustain the population. However, this is not always the case, particularly for Lake Trout, which have been introduced into many lakes and where self-sustaining populations are now established. There are also a relatively small number of lakes where Cisco were stocked and have now become established. As a result, lakes with natural or introduced populations of coldwater species which become established and self-sustaining are existing uses and would need to be maintained even if a species was extirpated. There are some lakes which are managed for Lake Trout where the maintenance of that population depends on stocking. It is appropriate to maintain or add protections for coldwater species when that species is present, even when the population is maintained through stocking[16]. However, a situation where the population is naturally not self-sustaining and is reliant on stocking may not constitute an existing use and the cessation of stocking could result in the removal of that use.

Use designations for lakes protected for stream trout are similar to lakes with other coldwater species where the population is maintained through stocking. Most stream trout lakes only support trout because they are managed for these species through stocking. There are a small number of lakes in Minnesota that contain stream trout not because of stocking, but due to connections to coldwater streams supporting trout. In most cases, lakes with natural populations of trout (usually Brook Trout) are shallow and are only used seasonally by trout. Since most stream trout lakes only support trout due to stocking, the cessation of management results in the loss of these populations. When managed, stream trout lakes do not support a natural population and therefore are not an existing use.

The status and type of a coldwater fish population are general considerations that form the basis for coldwater lake use designation reviews, but these decisions rely on detailed lake information including fisheries surveys, lake morphology, and natural water quality. The following sections describe these considerations in detail. In addition, specific examples of coldwater habitat reviews are in Appendix C.

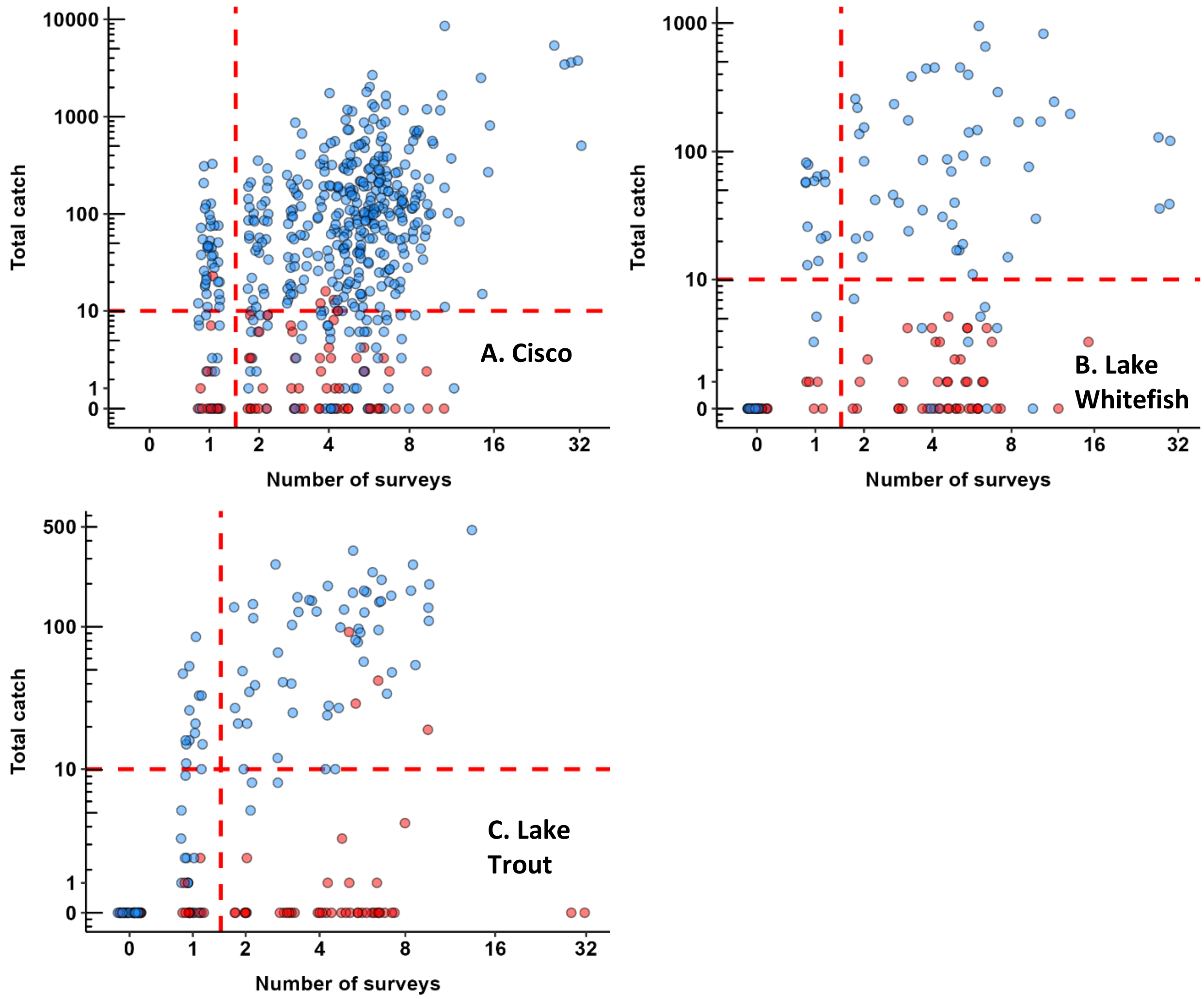
i. Fisheries surveys

The presence of a self-sustaining population of a coldwater fish species, whether contemporary or historical, are of primary importance for determining use designations[17]. MNDNR fisheries surveys are the most important line of evidence for establishing the status of populations of coldwater fishes for determining the appropriate use designation for a lake. For these use designation reviews, screening criteria have been developed to determine assignment of coldwater fish designations. A flow chart describing this, and other steps is provided in Appendix B. The number of surveys and the number of coldwater fish sampled are used to initially screen lakes. Lakes that have been surveyed at least twice and where surveys have sampled at least 10 individuals of a coldwater species typically indicate support for populations of coldwater fishes (Figure 27). Although this guideline is useful for screening lakes for coldwater designation, it is only one line of evidence that may be used for determining a fish population's status.

[16] There may be exceptions to this scenario if it is determined that coldwater habitat standards are not needed to maintain a heavily managed fishery. For example, a seasonal, put-and-take fishery for stream trout may not require coldwater habitat standards to support fishery goals.

[17] There are some cases where lakes that do not currently support self-sustaining populations of coldwater fish should be designated for the protection of these fishes. These include lakes that are managed for stream trout, some lakes where lake trout populations are maintained through stocking, lakes where self-sustaining populations of coldwater fish were extirpated on or after November 28, 1975, and lakes where self-sustaining populations of coldwater fish can be restored.

Figure 27. Classification of (A) Cisco, (B) Lake Whitefish, and (C) Lake Trout lakes based on number of fisheries surveys and total catch for lakes with draft designations (blue points) and lakes with an unknown fish population status (red points). Red dashed lines indicate guidelines for determination of coldwater fish population status. Dataset includes only dimictic lakes as determined by geometry ratio (<4).



Most MNDNR fisheries surveys consist of the use of standard gill nets which are not specifically deployed to estimate coldwater fish populations because these nets are typically set at or above the thermocline. Such data are useful at a lake population level but can be more difficult to use for specific lakes due to sampling variability. There is also variability in fisheries surveys due to natural variability and sampling error. As a result, it is often important to consider other evidence in use designation decisions especially when a limited number of surveys are available. There are other factors that should be considered as part of a coldwater habitat review including (1) whether fish are transient, (2) fish identification certainty, (3) stocking records, (4), if special, targeted surveys have been performed, and (5) other supporting information.

(1) Transient fish: There are many lakes in Minnesota from which coldwater fish have been surveyed, but the presence of these fish does not necessarily indicate the existence of a coldwater habitat. There are lakes where fish are transient from another coldwater habitat and are using the habitat during periods when conditions are suitable (e.g., spring/fall) or they represent stochastic migration. As a result, their presence does not represent the existence of a coldwater habitat and application of coldwater standards would not be appropriate. The determination of fish population status when these

fish are sampled from a lake include review of fisheries status from connected lakes, lake oxythermal habitat, and detailed review of the fisheries surveys. For example, if a lake is reviewed and it is determined that the geometry ratio is high or oxythermal habitat is limited, but the lake has a strong connection to a lake with good coldwater habitat that supports this coldwater fish species, then that may be used as evidence that the individuals sampled are transient. The lake surveys themselves may be useful if catches are small and irregular or if catches consist only of few large individuals, which can indicate a lack of recruitment in the lake. For examples see Farm Lake (38-0779-00) and Shagawa Lake (69-0069-00) in Appendix C.

(2) Fish identification: In some cases, fisheries surveys contain incorrect identifications especially between Cisco and Lake Whitefish. Vouchers are often not collected, but clues to incorrect identifications can often be detected from the available data. For example, a single Lake Whitefish identified from among several surveys containing only Cisco, may be a misidentification due to the presence of a large Cisco. In some cases, lakes with many fisheries surveys with Cisco will have a single survey which includes only Lake Whitefish. If this is the only survey in which Lake Whitefish were sampled, this is an indication of a misidentification. For examples see Alice Lake (38-0330-00), Shagawa Lake (69-0069-00), Gilstad Lake (04-0024-00), Big Sandy Lake (01-0062-00), and Charlotte Lake (77-0120-00) in Appendix C.

(3) Stocking records: Historical stocking records can be useful to understand the status of a fish population and if that population was self-sustaining. For example, if the presence of a coldwater fish species in fisheries surveys corresponds to a period when that species was stocked and surveys following the cessation of stocking did not sample that species, it could be an indication that the fish population was not self-sustaining. MNDNR fisheries surveys also often include information on whether sampled fish were stocked, or the result of natural reproduction based on fin clips or year class which can be useful for determination of population status. Such considerations can be important for the determination of an existing use. For examples see Alton Lake (16-0622-00), Bone Lake (38-0065-00), Ahsub Lake (38-0516-00), Eddy Lake (38-0187-00), and Johnson Lake (69-0691-00) in Appendix C.

(4) Targeted surveys: A subset of lakes have been surveyed using methods targeted to coldwater fishes such as vertical gill nets, deep-set gill nets, or hydroacoustic sampling. When data from these survey types are available, they may be given greater weight since they can better estimate populations of some coldwater fish species. For examples see Little McDonald Lake (56-0328-00), Scalp Lake (56-0358-00), West Battle Lake (56-0239-00), LaSalle Lake (29-0309-00), and Boot Lake (03-0030-00) in Appendix C.

(5) Supporting information: Some lakes have limited fisheries survey data, or the available fisheries data may be inconclusive, but other lines of evidence may be available to support a use designation decision. These lines of evidence may include oxythermal measures, lake morphology, creel surveys, and records from commercial fishing catches. If a small number of fisheries surveys are present, the size of the catches can be considered. For example, a single survey with a large catch of a coldwater fish species may be good evidence for the presence of a population of that fish. The catch size should also be considered in relation to the number of net sets that were part of the survey. A range of size classes for a fish species in a survey can also be useful to indicate that a resident population is present. There are many potential coldwater lakes in Minnesota with limited fisheries data. For example, many lakes supporting coldwater fishes are found in remote areas of northern Minnesota, including the BWCAW and Voyageurs National Park. For these lakes it may be appropriate to make use designation decisions based on limited data depending on the strength of available data and other lines of evidence. This may include a single survey with many coldwater fish present coupled with measures that indicate good oxythermal habitat or other lines of evidence. For examples see Eddy Lake (38-0187-00), Alice Lake (38-0330-00), Ashdick Lake (38-0210-00), and Harriet Lake (38-0048-00) in Appendix C.

ii. Lake mixing status

Following identification of the possible presence of a coldwater fish species population, determining the mixing status of the lake is important, especially for lakes where fisheries data are limited or not conclusive. Most lakes that support coldwater fish species in Minnesota are stratified[18]. To screen for dimictic lakes, a geometry ratio is used where lakes with a value of <4 are considered likely to be dimictic. For lakes near this threshold, additional data may also be considered. If summer temperature profiles exist for a lake they can be examined to determine if the lake is stratified. Typically, if a lake has more than a 1 °C/m change in the profile, it can be considered stratified. Even if a lake has data that indicate it stratifies or parts of the lake stratify, the size of this area should also be considered. Small, deep lakes may not provide suitable habitat for some fish species such as Lake Trout and should not be designated as coldwater habitat for Lake Trout unless there is active management for that species. In addition, for large, complex lakes, it should be determined if only part of the lake is likely to be suitable for coldwater fishes and to ensure that data used for the designation decision is from these suitable areas.

iii. Other evidence

Reviewing water quality data, especially dissolved oxygen, is important to establish if sufficient coldwater habitat is present in a lake. In addition to cool temperatures, coldwater fish species rely on sufficient levels of oxygen for survival and dissolved oxygen profiles can be instrumental for determining habitat suitability. Dissolved oxygen in a lake can be impacted by cultural eutrophication so how natural the dissolved oxygen conditions are may need to be considered through this lens especially when determining the designated use for a lake where coldwater fish have been extirpated. Land use and other measures of human activity may need to be reviewed to determine if a lake’s dissolved oxygen profile or trophic state are natural. If trophic conditions in a lake have been degraded, then the timing of this degradation and whether it contributed to the extirpation of coldwater fishes will need to be assessed. For example, if the degradation occurred before November 28, 1975, and it cannot be reversed then it may be appropriate to not designate a lake for the protection of a coldwater fish species. In contrast, if the degradation occurred after the existing use date or the fish population can be restored, then the lake should be designated for the protection of that fish species.

iv. Review of current coldwater use designations

Review of the coldwater habitat designation for a lake includes consideration of the existing designation applied to a lake. Coldwater habitat designations for lakes under the current framework includes two classifications: 1) Lake Trout and 2) stream trout lakes. The reviews in this rule revision consider whether the current trout classification is appropriate in regard to the species protected or managed and if additional coldwater species need to be added to the list of protected species. This review includes consideration of existing use and whether native, self-sustaining populations of these fish species were present on or after November 28, 1975, or if that population could be feasibly restored. In some cases, a coldwater fish species may be extirpated and not restorable, but if that species was self-sustaining on or after the existing use date, the protections for that species remain. The most common situation in Minnesota with this scenario are lakes where Rainbow Smelt have been introduced and the native

[18] There are a relatively small number of polymictic lakes which support populations of coldwater fish species, but the draft standards are not applicable to these lakes. As a result, the use designation reviews do not currently consider these lakes for designation. Standards need to be developed for these lakes before they are included for designation. See Appendix D.

coldwater fish populations have been extirpated. However, due to a warming climate in Minnesota, unrestorable losses of these coldwater fish populations are predicted to become more common (Sharma et al. 2011, Fang et al 2012, Jiang et al. 2012, Jiang et al. 2017).

The removal of protections for a current coldwater fish species is often due to the collection of new data. Previous designations, especially for Lake Trout, may have been based on limited information and a prediction that these lakes had the potential to support Lake Trout without extensive evidence to confirm the designation. In many cases these were lakes in the remote areas such as the BWCAW where limited fishery or water quality data were available. In some cases, stream trout lakes were also designated based on a potential to manage the lake as a stream trout fishery, but due to limiting factors (e.g., competition with other fish species or limited public access) it was determined to not be feasible, and management ended. Most designations where protections for a fish species are removed or a lake is designated Class 2Bd are due to the availability of new data and the need to make a correction to the designation. Very few designations in these draft revisions are for lakes with confirmed populations of coldwater fish which were extirpated before the existing use date.

The third element of WQS is antidegradation and it directly impacts coldwater habitat designations. Specifically, Lake Trout lakes outside of the BWCAW or Voyageurs National Park are designated restricted outstanding resource value waters (Minn. R. 7050.0335, subp. 1, Item C). As part of the review of coldwater designations, Outstanding Resource Value Water (ORVW) designations are also reviewed to determine if the ORVW should be added or removed and which ORVW should be applied (i.e., restricted or prohibited ORVW). It is not necessary for lakes within the BWCAW or Voyageurs National Park to be reviewed because these waters are prohibited outstanding resource value waters (Minn. R. 7050.0335, subp. 3) regardless of whether they are designated as a Lake Trout lake. The other coldwater fish protections (i.e., Cisco, Lake Whitefish, and stream trout) do not affect the ORVW designation for lakes.

Rule language changes

Rule revisions for the protection of coldwater fish communities will likely include amendments to Minn. R. 7050.0150, 7050.0222, and 7050.0470. The revisions to Minn. R. 7050.0150 should include new definitions for “oxythermal layer,” and for “dimictic” and “polymictic” lakes. The draft standards are specifically designed to protect lakes that support or should support 1) Lake Trout, 2) Lake Whitefish, and 3) Cisco or are managed for 4) stream trout. For each lake type, there are specific eutrophication and oxythermal standards and these standards will need to be described in Minn. R. 7050.0222. Specifically, these revisions include the addition of eutrophication standards (i.e., TP, chl-*a*, and Secchi depth) and T_{DO3} standards for two coldwater fish species (i.e., Lake Whitefish and Cisco). In addition, a T_{DO3} standard will be added for Lake Trout and two eutrophication parameters (TP and Secchi depth) will be revised based on new models for Lake Trout and stream trout lakes. The addition of the T_{DO3} standards may also require additional language to explain the application of the dissolved oxygen standard. For example, it may be appropriate for the existing dissolved oxygen standard for Class 2A (i.e., 7 mg/L) to only apply to streams whereas the T_{DO3} standards would apply to coldwater lake habitats only.

The amendments to Minn. R. 7050.0470 consist of two elements. First, the amendments will create tables incorporated by reference to store use designation information. This would bring the lakes in alignment with the system currently used for stream designations (see https://www.pca.state.mn.us/regulations/incorporations-reference). The second part of revisions to Minn. R. 7050.0470 would designate specific uses to lakes (see Appendix C). This includes Class 2A, 2B, and 2Bd designations as well as the addition of species codes to describe in the rule which coldwater fish species are protected in each designated coldwater lake. Class 1B designations will also be added to lakes designated as Class 2A.

There are other related and needed amendments that will likely be associated with the revision of coldwater lake standards and use designations. This includes revisions to northern lake eutrophication standards and the adoption of a tiered aquatic life uses (TALU) framework for lakes. These revisions include complementary changes such as adding language to define dimictic and polymictic lakes to rule (MPCA 2024b). The TALU framework for lakes will affect the lakes in the coldwater lakes revision by placing them into General and Exceptional Use tiers (MPCA 2024c). Upon adoption of a TALU lakes rule, the "e" and "g" designators will be added to the Class 2A, 2Bd, and 2B designations in Minn. R. 7050.0470 to acknowledge the different levels of biological condition for fish communities in these lakes. The TALU framework for lakes will also include the adoption of tiered fish biological criteria. Although these biological criteria were developed to largely measure the health of warm water fish communities in lakes, these criteria will also be applicable to coldwater lakes. This is because coldwater lakes support both coldwater and warm water communities of fish. For this reason, these lakes are sometimes called two-story lakes. In Minnesota's coldwater lakes, it is important that the warm water fish community is protected through specific biological and chemical standards and the coldwater community is managed using its own specific standards. In some cases, there will be multiple standards for the same parameter in lakes. For example, there may be eutrophication standards for both the protection of the warm water (see MPCA 2024b) and coldwater fish communities. In this case, the more stringent standards will be used to assess the status of the lake to ensure that the more sensitive portion of the community is protected. In addition, other minor changes may also be needed as part of a lake standards rule package. Through these revisions, Minnesota's lake standards will be more comprehensive in terms of protections for aquatic life and recreation in lakes.

Conclusions

The draft criteria for oxythermal habitat and eutrophication establish a framework of minimum conditions required to protect coldwater lake habitats in Minnesota. The criteria consist of an oxythermal habitat measure (i.e., T_{DO3}) and a set of eutrophication parameters including TP, chl-*a*, and Secchi depth (Table 13). T_{DO3} measures the condition of coldwater habitat and is affected by temperature and lake productivity whereas the eutrophication criteria are largely reflective of lake productivity. Together these standards can be used in conjunction to reduce missed impairments and to improve assessment accuracy. These standards are based on protections for three coldwater fish species (i.e., Lake Trout, Lake Whitefish, and Cisco) and a group of stream trout species and hybrids which are managed in a subset of Minnesota's lakes. Minnesota's existing standards for eutrophication include protections for Lake Trout and stream trout and changes to these standards include the inclusion of T_{DO3} criteria for Lake Trout and revisions to the TP and Secchi depth criteria for both lake and stream trout lakes. The currently adopted chl-*a* criteria would be unchanged for Lake Trout and stream trout lakes. Protections for other Minnesota salmonids including Cisco and Lake Whitefish were identified as a gap in WQS which these draft criteria would address. It was determined that like other salmonids, Cisco and Lake Whitefish are sensitive to increasing temperatures and declining dissolved oxygen. As a result, T_{DO3} and chl-*a* criteria will also be assigned to lakes which support these sensitive fish species. As part of eutrophication water quality standards for Cisco and Lake Whitefish lakes, TP and Secchi depth criteria are also included.

In addition to providing revised standards to protect coldwater fish species, this research also includes another important element of WQS: beneficial use designations. We have reviewed available data to determine which lakes support or are managed for these coldwater fish species. Use designations for 732 coldwater lakes will be confirmed or modified as part of this review including the addition of 410

Class 2A lakes and removal of 25 Class 2A lakes. The result is a comprehensive list of lakes with coldwater habitat for which these standards should apply. This includes a determination of the fish species that are supported or should be supported in these lakes. In doing so, WQS can be precisely applied to these lakes such that criteria specific to the taxa found in the lake can be protected. As with other WQS, the criteria for the most sensitive use (i.e., fish species) will be the applicable coldwater standards for a lake. These use designation reviews also identified a small subset of lakes which are atypical and should have a SSS for oxythermal habitat, eutrophication, or both. These include lakes with summer refugia (e.g., ground water sources) and lakes with good coldwater fish populations despite water quality conditions that exceed the draft criteria. The evidence supporting the draft coldwater use designations are described in Appendix C.

This report provides sufficient and reasonable technical information for amending use designations. These use designation lists coupled with the draft criteria for coldwater habitats can be implemented through or used to enhance existing programs such as the MPCA's Intensive Watershed Monitoring framework and Watershed Restoration and Protection Strategies and the MNDNR's Cisco Refuge Lakes, Lakes of Biological Significance, and Lakes of Phosphorus Sensitivity programs. In most cases this will require lakeshed protections to limit or reduce TP loading to these lakes through best management practices and maintaining natural landscapes. Unfortunately, climate change is likely to significantly increase temperature in Minnesota in the coming decades which alone will result in the loss of many coldwater habitats and the extirpation of coldwater fish species from some lakes. Cultural eutrophication of coldwater lakes also threatens these species which will require long-term planning to limit or reduce nutrient loading to these lakes. The interactive effects of rising temperatures and lake productivity will also exacerbate these challenges. However, coldwater fishes are important and valuable components of many Minnesota lakes and their loss will degrade Minnesota's natural and cultural ecosystems. These fish and their habitats are worth protecting and the draft coldwater lake standards along with other protection strategies provide a framework for preserving these resources.

References

Aku, P. and W. Tonn, 1997. Changes in population structure, growth, and biomass of cisco (*Coregonus artedi*) during hypolimnetic oxygenation of a deep, eutrophic lake, Amisk Lake, Alberta. Canadian Journal of Fisheries and Aquatic Sciences 54: 2196-2206.

Aku, P., L. Rudstam, and W. Tonn, 1997. Impact of hypolimnetic oxygenation on the vertical distribution of cisco (*Coregonus artedi*) in Amisk Lake, Alberta. Canadian Journal of Fisheries and Aquatic Sciences 54: 2182-2195.

Bacigalupi, J., D.F. Staples, M.T. Treml, and D.L. Bahr, 2021. Development of fish-based indices of biological integrity for Minnesota lakes. Ecological Indicators 125: 107512.

Bernatchez, L. and J. J. Dodson, 1985. Influence of temperature and current speed on the swimming capacity of lake whitefish (*Coregonus clupeaformis*) and cisco (*C. artedii*). Canadian Journal of Fisheries and Aquatic Sciences 42: 1522-1529.

Cahn, A.R. 1927. An ecological study of southern Wisconsin fishes, the brook silverside and the cisco, in their relation to the region. Illinois Biological Monographs 11.

Carlander, K.E. 1969. Handbook of freshwater fishery biology, Volume one, 3rd edition. Iowa State University Press, Ames, Iowa 752 p. [Cited in Wismer and Christie (1987)]

Clark, B.J., P.J. Dillon, and L.A. Molot, 2004. Lake trout (*Salvelinus namaycush*) habitat volumes and boundaries in Canadian Shield Lakes. In J.M. Gunn, R.J. Steedman, and R.A. Ryder (eds.), Boreal shield waters: lake trout ecosystems in a changing environment. Lewis Publishers, CRC Press, Boca Raton, Fla. pp. 111–117.

Clark, B., P. Dillon, L. Molot, and H. Evans, 2002. Application of a hypolimnetic oxygen profile model to lakes in Ontario. Lake and Reservoir Management 18: 32-43.

Cormier, S.M. and G.W. Suter II, 2013. A method for deriving water-quality benchmarks using field data. Environmental toxicology and chemistry 32(2): 255-262.

Coutant, C.C., 1977. Compilation of temperature preference data. Journal of the Fisheries Research Board of Canada 34: 739-745.

Custer, C.A., J.S. North, E.M. Schliep, M.R. Verhoeven, G.J. Hansen, and T. Wagner, 2024. Predicting responses to climate change using a joint species, spatially dependent physiologically guided abundance model. Ecology e4362.

Davis, J.C., 1975. Waterborne dissolved oxygen requirements and criteria with particular emphasis on the Canadian environment. Associate Committee on Scientific Criteria for Environmental Quality, Report No. 13. National Research Council of Canada. 111p.

De Stasio Jr, B.T., D.K. Hill, J.M. Kleinhans, N.P. Nibbelink, and J.J. Magnuson, 1996. Potential effects of global climate change on small north-temperate lakes: Physics, fish, and plankton. Limnology and oceanography 41(5): 1136-1149.

Edsall, T.A., 1999. Preferred temperatures of juvenile lake whitefish. Journal of Great Lakes Research 25: 583-588.

Edsall, T.A., and T.J. DeSorcie, 2002. The growth-temperature relation and preferred temperatures of juvenile lake herring. Advances in Limnology 57: 335-342.

Edsall, T.A. and D.V. Rottiers, 1976. Temperature tolerance of young-of-the-year lake whitefish, *Coregonus clupeaformis*. Journal of the Fisheries Research Board of Canada 33: 177–180.

EPA. 2000. Nutrient criteria technical guidance manual: Lakes and reservoirs. United States Environmental Protection Agency, Washington, D.C.

EPA. 2021. Ambient water quality criteria to address nutrient pollution in lakes and reservoirs. EPA-822-R-21-005. Office of Science and Technology, Office of Water, United States Environmental Protection Agency, Washington, D.C.

Etnier, D.A. and C.E. Skelton, 2003. Analysis of three cisco forms (*Coregonus*, Salmonidae) from Lake Saganaga and adjacent lakes near the Minnesota/Ontario border. Copeia 2003: 739-749.

Evans, D.O., J. Casselman, and C. Willox, 1991. Effects of exploitation, loss of nursery habitat, and stocking on the dynamics and productivity of lake trout populations in Ontario lakes: Lake trout synthesis, response to stress working group. Ontario Ministry of Natural Resources.

Evans, D.O., K.H. Nicholls, Y.C. Allen, and M.J. McMurtry, 1996. Historical land use, phosphorus loading, and loss of fish habitat in Lake Simcoe, Canada. Canadian Journal of Fisheries and Aquatic Sciences 53: 194-218.

Fang, X., L. Jiang, P.C. Jacobson, H.G. Stefan, S.R. Alam, and D.L. Pereira, 2012. Identifying cisco refuge lakes in Minnesota under future climate scenarios. Transactions of the American Fisheries Society 141: 1608-1621.

Ferguson, R.G., 1958. The preferred temperature of fish and their midsummer distribution in temperate lakes and streams. Journal of the Fisheries Board of Canada 15(4): 607-624.

Fry, F.E.J., 1937. The summer migration of the cisco, (*Leucichthys artedi*) (LeSueur), in Lake Nippissing, Ontario. University of Toronto studies - Biological series, No. 11 (Publication of the Ontario Fisheries Research Laboratory, No.55), 91 pp. [Cited in Coutant (1977)]

Galligan, J.P. 1951. The distribution of lake trout and associated species in Cayuga Lake. M.S. Thesis. Cornell University, New York. 112 pp. [Cited in Coutant (1977)]

Galligan, J.P., 1962. Depth distribution of lake trout and associated species in Cayuga Lake, New York. New York Fish and Game Journal 9: 44-68. [Cited in Martin and Oliver (1980)]

Goddard, C., J. Lilley, and J. Tait, 1974. Effects of MS 222 anesthetization on temperature selection in lake trout, *Salvelinus namaycush*. Journal of the Fisheries Board of Canada 31: 100-103.

Gorsky, D., J. Zydlewski, and D. Basley, 2012. Characterizing seasonal habitat use and diel vertical activity of lake whitefish in Clear Lake, Maine, as determined with acoustic telemetry. Transactions of the American Fisheries Society 141: 761-771.

Hansen, G.J., K.E. Wehrly, K. Vitense, J.R. Walsh, and P.C. Jacobson, 2022. Quantifying the resilience of coldwater lake habitat to climate and land use change to prioritize watershed conservation. Ecosphere 13: p.e4172.

Hanson, P.C., D.L. Bade, S.R. Carpenter, and T.K. Kratz, 2003. Lake metabolism: Relationships with dissolved organic carbon and phosphorus Limnology and Oceanography 48(3): 1112-1119.

Hatch, J., 2015. Minnesota fishes: just how many species are there anyway? American Currents 40: 10-21.

Havens, S., M. Rennie, P. Blanchfield, M. Paterson, and S. Higgins, 2014. Evaluation of eutrophication and water level drawdown on Lake Whitefish (*Coregonus clupeaformis*) productivity; Fish habitat assessment. Canadian Technical Report of Fisheries and Aquatic Sciences 3110: vi + 40 p.

Heegaard, D., 2002. The outer border and central border for species–environmental relationships estimated by non-parametric generalised additive models. Ecological Modelling 157(2-3): 131–139.

Heiskary, S. and C.B. Wilson, 2005. Minnesota lake water quality assessment report- developing nutrient criteria: third edition, MPCA, St. Paul, MN.

Herb, W.R., L.B. Johnson, P.C. Jacobson, and H.G. Stefan, 2014. Projecting cold-water fish habitat in lakes of the glacial lakes region under changing land use and climate regimes. Canadian journal of fisheries and aquatic sciences 71: 1334-1348.

Hoagman, W.W., 1974. Vital activity parameters as related to the early life history of larval and post-larval whitefish (*Coregonus clupeaformis*). In J.H.S. Blaxter (ed.), The Early Life History of Fish. Springer-Verlag, New York, NY. [Cited in Jobling (1981) and Coutant (1977)]

Honsey, A.E., S.B. Donabauer, and T.O. Höök, 2016. An analysis of lake morphometric and land-use characteristics that promote persistence of cisco in Indiana. Transactions of the American Fisheries Society 145: 363-373.

Hosmer Jr, D.W., S. Lemeshow, and R.X. Sturdivant, 2013. Applied logistic regression (3rd ed.). John Wiley & Sons, Hoboken, NJ, USA.

Jacobson, P.C., T.K. Cross, J. Zandlo, B.N. Carlson, and D. Pereira, 2012. The effects of climate change and eutrophication on cisco *Coregonus artedi* abundance in Minnesota lakes. Advances in Limnology 63: 417-427.

Jacobson, P.C., T.S. Jones, P. Rivers, and D.L. Pereira, 2008. Field estimation of a lethal oxythermal niche boundary for adult ciscoes in Minnesota lakes. Transactions of the American Fisheries Society 137: 1464-1474.

Jacobson, P.C., G.J. Hansen, L.G. Olmanson, K.E. Wehrly, C.L. Hein, and L.B. Johnson, 2019. Loss of coldwater fish habitat in glaciated lakes of the midwestern United States after a century of land use and climate change. In R.M. Hughes, L. Wang, K. Chen, and B. F. de Terra (eds.), Advances in understanding landscape influences on freshwater habitats and biological assemblages. American Fisheries Society, Bethesda, MD. pp. 141-158.

Jacobson, P.C., H.G. Stefan, and D.L. Pereira, 2010. Coldwater fish oxythermal habitat in Minnesota lakes: influence of total phosphorus, July air temperature, and relative depth. Canadian Journal of Fisheries and Aquatic Sciences 67: 2002-2013.

Jacobson, P.C., K.D. Zimmer, R., Grow, and R.L. Eshenroder 2020. Morphological variation of cisco across gradients of lake productivity. Transactions of the American Fisheries Society, 149(4), 462-473.

Jane, S.F., G.J. Hansen, B.M. Kraemer, P.R. Leavitt, J.L. Mincer, R.L. North, and K.C. Rose, 2021. Widespread deoxygenation of temperate lakes. Nature 594(7861): 66-70.

Jiang, L. and X. Fang, 2016. Simulation and validation of cisco lethal conditions in Minnesota lakes under past and future climate scenarios using constant survival limits. Water 8(7): 279.

Jiang, L., X. Fang, and G. Chen, 2017. Refuge lake reclassification in 620 Minnesota cisco lakes under future climate scenarios. Water 9: 675.

Jiang, L., X. Fang, H.G. Stefan, P.C. Jacobson, and D.L. Pereira, 2012. Oxythermal habitat parameters and identifying cisco refuge lakes in Minnesota under future climate scenarios using variable benchmark periods. Ecological modelling 232: 14-27.

Johnson, L., 1975. Distribution of fish species in Great Bear Lake, Northwest Territories, with reference to zooplankton, benthic invertebrates, and environmental conditions. Journal of the Fisheries Board of Canada 32: 1989-2004. [Cited in Martin and Oliver (1980)]

Kaufman, S.D., G.E. Morgan, and J.M. Gunn, 2009. The role of ciscoes as prey in the trophy growth potential of walleyes. North American Journal of Fisheries Management 29: 468-477.

Kennedy, P., T. Bartley, D. Gillis, K. McCann, and M. Rennie, 2018. Offshore prey densities facilitate similar life history and behavioral patterns in two distinct aquatic apex predators, northern pike and lake trout. Transactions of the American Fisheries Society 147: 972-995.

Koelz, W., 1931. The coregonid fishes of North-Eastern America. Papers of the Michigan Academy of Science, Arts, and Letters 13: 303-432.

Koenker, R., 2019. quantreg: Quantile Regression. R package version 5.54. https://CRAN.R-project.org/package=quantreg

Kritzberg, E., J.J. Cole, M.L. Pace, W. Granéli, and D.L. Bade, 2004. Autochthonous versus allochthonous carbon sources of bacteria: Results from whole-lake 13C addition experiments. Limnology and Oceanography 49(2): 588-596.

Lyons, J., T.P. Parks, K.L. Minahan, and A.S. Ruesch, 2017. Evaluation of oxythermal metrics and benchmarks for the protection of cisco (*Coregonus artedi*) habitat quality and quantity in Wisconsin lakes. Canadian Journal of Fisheries and Aquatic Sciences 75: 600-608.

Mac, M. J., 1985. Effects of ration size on preferred temperature of lake charr *Salvelinus namaycush*. Environmental Biology of Fishes 14: 227-231.

MacLean, N., J. Gunn, F. Hicks, P. Ihessen, M. Malhiot, T. Mosindy, and W. Wilson, 1990. Genetic and environmental factors affecting the physiology and ecology of lake trout. Ontario Ministry of Natural Resources, Toronto, Ontario.

Madenjian, C. P., D.V. O'Connor, S.A. Pothoven, P.J. Schneeberger, R.R. Rediske, J.P. O'Keefe, R.A. Bergstedt, R.L. Argyle, and S.B. Brandt, 2006. Evaluation of a lake whitefish bioenergetics model. Transactions of the American Fisheries Society 135(1): 61-75.

Martin, N. V., 1952. A study of the lake trout, *Salvelinus namaycush*, in two Algonquin Park, Ontario, lakes. Transactions of the American Fisheries Society 81: 111-137.

Martin, N. and C. Oliver, 1976. The distribution and characteristics of Ontario lake trout lakes. Ontario Ministry of Natural Resources Report 97, 30 pp. [Cited in Martin and Oliver (1980)]

Martin, N. and C. Oliver, 1980. The lake charr, *Salvelinus namaycush*. In E.K. Balon (ed.), Charrs: Salmonid Fishes of the Genus *Salvelinus*. Kluwer, Boston, MA. pp. 205–277.

Matuszek, J.E., B.J. Shuter, and J.M. Casselman, 1990. Changes in lake trout growth and abundance after introduction of cisco into Lake Opeongo, Ontario. Transactions of the American Fisheries Society 119: 718–729.

McCormick, J.H., B.R. Jones, and R.F. Syrett, 1971. Temperature requirements for growth and survival of larval ciscos (*Coregonus artedii*). Journal of the Fisheries Board of Canada 28: 924-927.

Miller, L.M., J.L. Cruise, N. Niezgocki, J. Prell, and P.C. Jacobson, 2021. Cisco population genetic structure in Minnesota. Investigational Report #570, MNDNR, St. Paul, MN.

Minnesota Department of Conservation, 1967. Minnesota’s trout program. Minnesota Department of Conservation, Division of Game and Fish, Section of Fisheries.

MNDNR, 2017. Manual of instructions for lake survey. Special Publication. Minnesota Department of Natural Resources, St. Paul, MN.

Molot, L.A., P.J. Dillon, B.J. Clark and B.P. Neary, 1992. Predicting end-of-summer oxygen profiles in stratified lakes. Canadian Journal of Fisheries and Aquatic Sciences 49(11): 2363-2372.

MPCA, 1987. Summary of fisheries and water quality data pertaining to the proposed ORVW lake trout lakes. Exhibit 95.

MPCA, 2024a. Guidance for assessing the quality of Minnesota surface waters for determination of impairment: 305(b) Report & 303(d) Impaired Waters List: 2024 Assessment and Listing Cycle, St. Paul, MN. 194 pp. https://www.pca.state.mn.us/sites/default/files/wq-iw1-04m.pdf

MPCA, 2024b. Development of eutrophication standards for northern lakes in Minnesota. St. Paul, MN.

MPCA, 2024c. Development of a tiered aquatic life use framework for Minnesota lakes based on fish index of biotic integrity scores and thresholds. St. Paul, MN.

Müller, B., L.D. Bryant, A. Matzinger, and A. Wüest, 2012. Hypolimnetic oxygen depletion in eutrophic lakes. Environmental Science & Technology 46: 9964–9971.

Novakowski, N., 1955. The ecology of Reindeer Lake with special reference to fish. Unpublished Thesis Department Biology. University of Saskatchewan. [Cited in Martin and Oliver (1980)]

O'Connor, D., D. Rottiers, and W. Berlin, 1981. Food consumption, growth rate, conversion efficiency, and proximate composition of yearling lake trout. Administrative Report 81-5. Great Lakes Fisheries Laboratory, Ann Arbor, MI

Opuszynski, K., 1974. Selected temperatures of whitefish, *Coregonus clupeaformis* (Mitchell), in the vertical gradient tank. Roczniki Nauk Rolniczych 96: 63-72. [Cited in Spotila (1979)]

Pace, M.L., J.J. Cole, S.R. Carpenter, J.F. Kitchell, J.R. Hodgson, M.C. Van de Bogert, D.L. Bade, E.S. Kritzberg, and D. Bastviken, 2004. Whole-lake carbon-13 additions reveal terrestrial support of aquatic food webs. Nature 427: 240–243.

Paterson, R., 1968. The lake trout (*Salvelinus namaycush*) of Swan Lake, Alberta. Fisheries Section, Research Report. Alberta Department of Lands and Forests. Fish and Wildlife Division. [Cited in Martin and Oliver (1980)]

Peterson, R., A. Sutterlin, and J. Metcalfe, 1979. Temperature preference of several species of *Salmo* and *Salvelinus* and some of their hybrids. Journal of the Fisheries Board of Canada 36: 1137-1140.

Plumb, J.M. and P.J. Blanchfield, 2009. Performance of temperature and dissolved oxygen criteria to predict habitat use by lake trout (*Salvelinus namaycush*). Canadian Journal of Fisheries and Aquatic Sciences 66: 2011-2023.

Qadri, S., 1961. Food and distribution of lake whitefish in Lac la Ronge, Saskatchewan. Transactions of the American Fisheries Society 90: 303-307.

R Core Team, 2023. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL https://www.R-project.org/.

Rawson, D., 1961. The lake trout of Lac la Ronge, Saskatchewan. Journal of the Fisheries Board of Canada 18: 423-462.

Reckahn, J.A. 1970. Ecology of young lake whitefish (*Coregonus clupeaformis*) in South Bay, Manitoulin Island, Lake Huron. In Lindsay, C.C. and C.S. Woods (Eds.), Biology of coregonid fishes. University of Manitoba Press, Winnipeg, Manitoba, pp. 437-460. [Cited in Coutant (1977)]

Robin, X., N. Turck, A. Hainard, N. Tiberti, F. Lisacek, J. Sanchez, and M. Müller, 2011. pROC: an open-source package for R and S+ to analyze and compare ROC curves. BMC Bioinformatics, 12, p. 77.

Ryan, P.A. and T.R. Marshall, 1994. A niche definition for lake trout (*Salvelinus namaycush*) and its use to identify populations at risk. Canadian Journal of Fisheries and Aquatic Sciences 51(11): 2513-2519.

Seguin, L.R., 1957. Scientific fish culture in Quebec since 1945. Transactions of the American Fisheries Society 86: 136-143.

Sellers, T.J., B.R. Parker, D.W. Schindler, and W.M. Tonn, 1998. Pelagic distribution of lake trout (*Salvelinus namaycush*) in small Canadian Shield lakes with respect to temperature, dissolved oxygen, and light. Canadian Journal of Fisheries and Aquatic Sciences 55: 170-179.

Sharma, S., M.J. Vander Zanden, J.J. Magnuson, and J. Lyons, 2011. Comparing climate change and species invasions as drivers of coldwater fish population extirpations. PLoS One 6: e22906.

Siesennop, G.D., 1998. Evaluation of lake trout index netting methods in ten northeastern Minnesota lakes. Minnesota Department of Natural Resources Investigational Report 461

Siesennop, G.D., 1998. Growth of lake trout captured during spring, summer, and fall index gill netting in 10 northeastern Minnesota lakes. Minnesota Department of Natural Resources Investigational Report 469.

Siesennop, G.D., 2000. Estimating potential yield and harvest of lake trout (*Salvelinus namaycush*) in Minnesota's lake trout lakes, exclusive of Lake Superior. Minnesota Department of Natural Resources Investigational Report 487.

Snucins, E. and J. Gunn, 1995. Coping with a warm environment: behavioral thermoregulation by lake trout. Transactions of the American Fisheries Society 124: 118-123.

Spotila, J.R., K.M. Terpin, R.R. Koons, and R.L. Bonati, 1979. Temperature requirements of fishes from eastern Lake Erie and the upper Niagara River: a review of the literature. Environmental Biology of Fishes 4: 281-307.

State of Michigan, 2006. Part 4. Water quality standards. January 13, 2006.

State of Minnesota, 2018. State Register, 30 April 2018. Volume 42, Number 44. pp. 1298-1341 (42 SR 1298).

State of Minnesota, 2024. State Register, 15 July 2024. Volume 49, Number 3. p. 45 (49 SR 45).

Stefan, H.G., M. Hondzo, X. Fang, J.G. Eaton, and J.H. McCormick, 1996. Simulated long term temperature and dissolved oxygen characteristics of lakes in the north-central United States and associated fish habitat limits. Limnology and Oceanography 41(5): 1124-1135.

Stefan, H.G., X. Fang, and M. Hondzo, 1998. Simulated climate change effects on year-round water temperatures in temperate zone lakes. Climatic change 40(3): 547-576.

Stefan, H.G., X. Fang, and J.G. Eaton, 2001. Simulated fish habitat changes in North American lakes in response to projected climate warming. Transactions of the American Fisheries Society 130(3): 459-477.

Straight, W.J. 1969. Depth distribution of splake of known ability to retain swimbladder gas. M. Sc. Thesis, York University, Toronto, Ontario. [Cited in Martin and Oliver (1980)]

Trippel, E.A. and Beamish, F.W.H., 1989. Lake trout (*Salvelinus namaycush*) growth potential predicted from cisco (*Coregonus artedii*) population structure and conductivity. Canadian Journal of Fisheries and Aquatic Sciences 46(9): 1531-1538.

Tompkins, F.T. and J.M. Fraser, 1950. The preferred temperature of a sample of Great Lakes whitefish (*Coregonus clupeaformis*). Department of Zoology. University of Toronto. [Cited in Christie and Regier (1988) and Ferguson (1958)]

Turgeon, J., S.M. Reid, A. Bourret, T.C. Pratt, J.D. Reist, A.M. Muir, and K.L. Howland, 2016. Morphological and genetic variation in cisco (*Coregonus artedi*) and Shortjaw Cisco (*C. zenithicus*): multiple origins of Shortjaw Cisco in inland lakes require a lake-specific conservation approach. Conservation Genetics 17(1): 45-56.

Vanderbloemen, S.N., J.A. Gorne, G.G. Sass, and S.L. Shaw, 2020. Influence of cisco (*Coregonus artedi*, Lesueur) on muskellunge (*Esox masquinongy*, Mitchill) mean length, population size structure, and maximum size in northern Wisconsin lakes. Journal of Applied Ichthyology 36: 159-167.

Walker Jr, W.W., 1979. Use of hypolimnetic oxygen depletion rate as a trophic state index for lakes. Water Resources Research 15: 1463-1470.

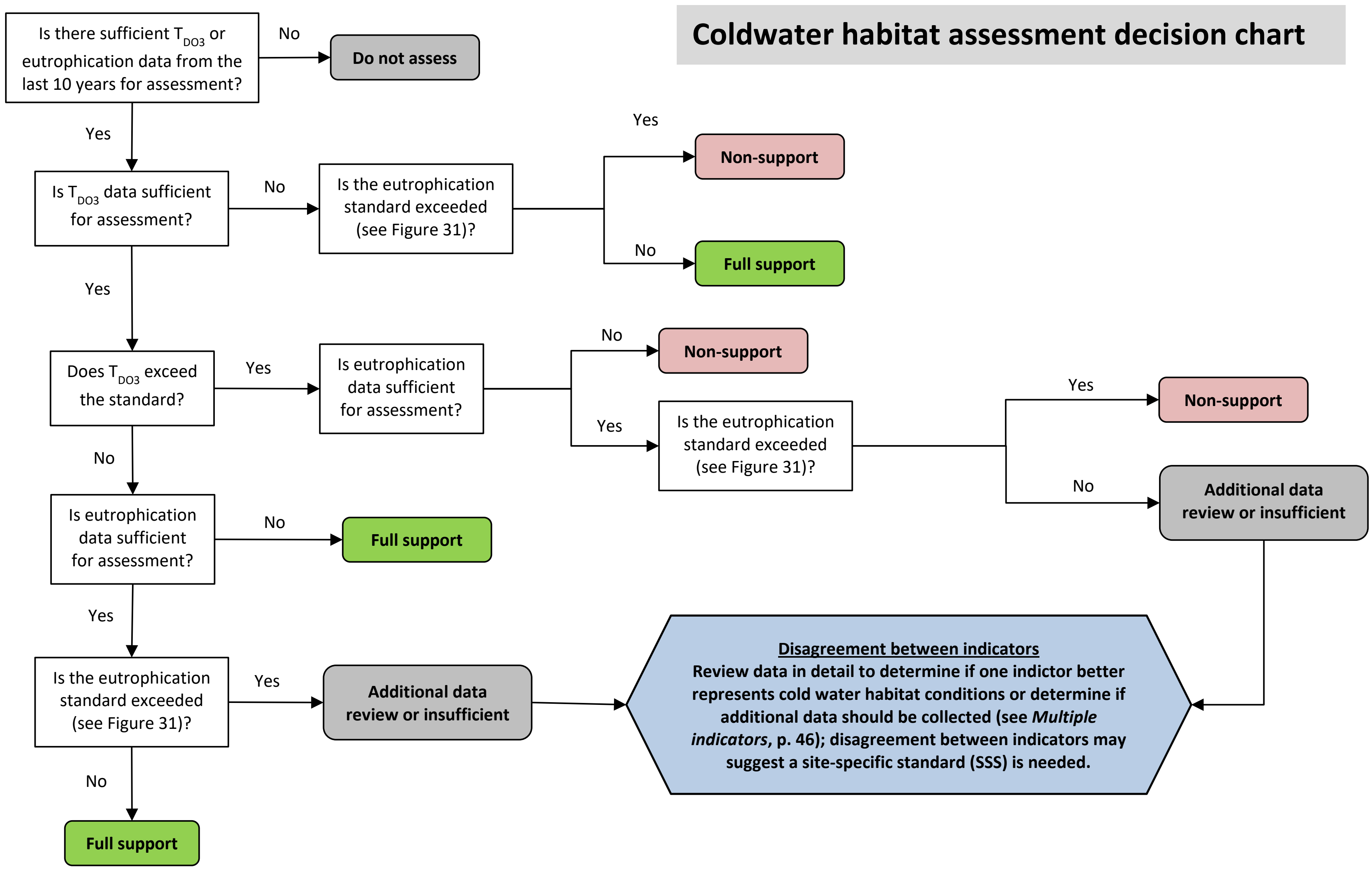
Webster, D.A., W.G. Bentley, and J.P. Galligan, 1959. Management of the lake trout fishery of Cayuga Lake, New York, with special reference to the role of hatchery fish. Memoirs of the Cornell University Agricultural Experiment Station 357: 1-83. [Cited in Martin and Oliver (1980)]

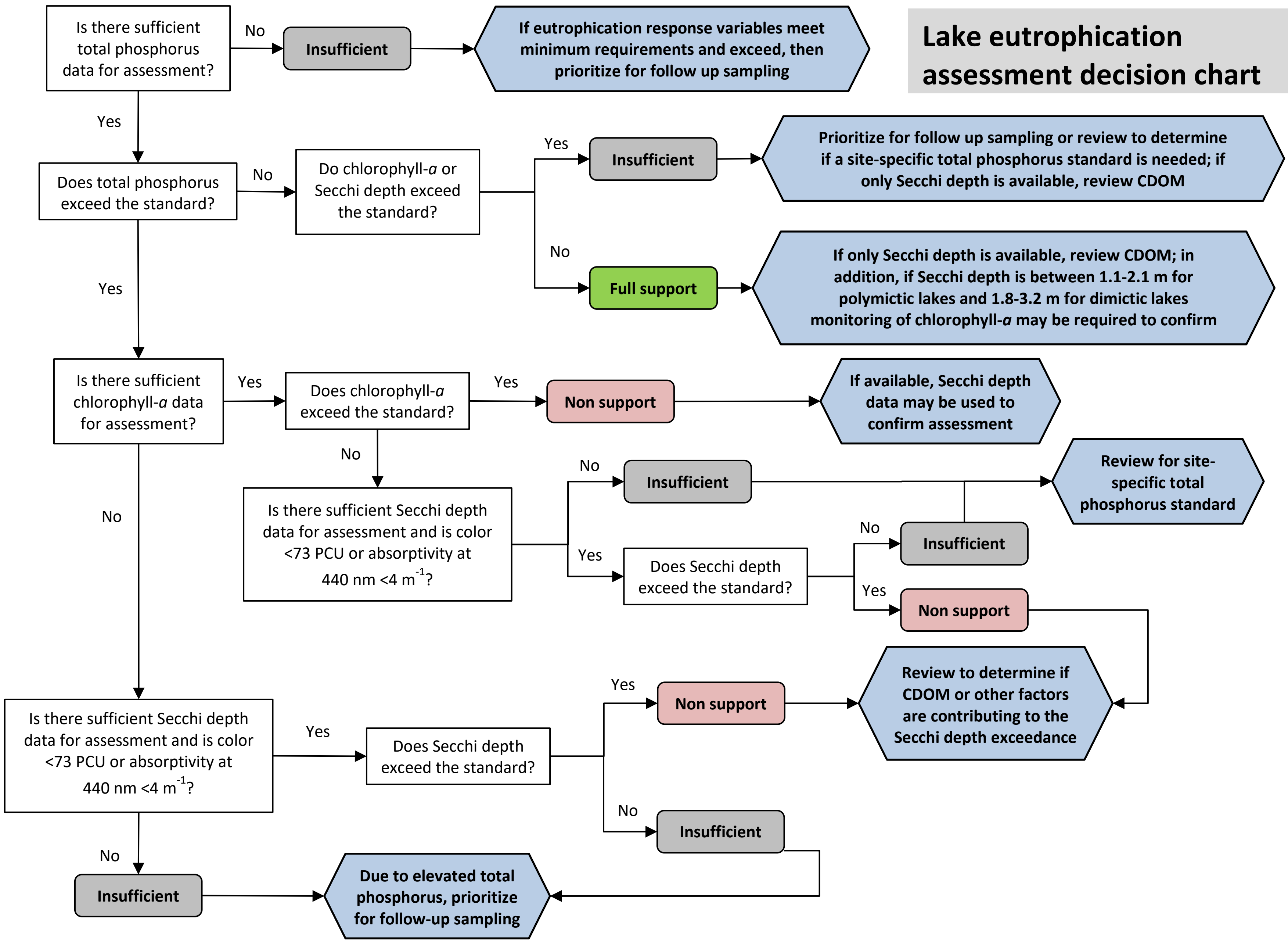
Wood, S.N., 2011. Fast stable restricted maximum likelihood and marginal likelihood estimation of semiparametric generalized linear models. Journal of the Royal Statistical Society (B) 73(1): 3-36.

Woodger, C. D., 1976. Morphological variations as induced by environment in coregonids. Environmental Biology of Fishes 1: 101-105.

Woolway, R.I., C.J. Merchant, J. Van Den Hoek, C. Azorin-Molina, P. Nõges, A. Laas, E.B. Mackay, and I.D. Jones, 2019. Northern Hemisphere atmospheric stilling accelerates lake thermal responses to a warming world. Geophysical Research Letters 46(21): 11983-11992.

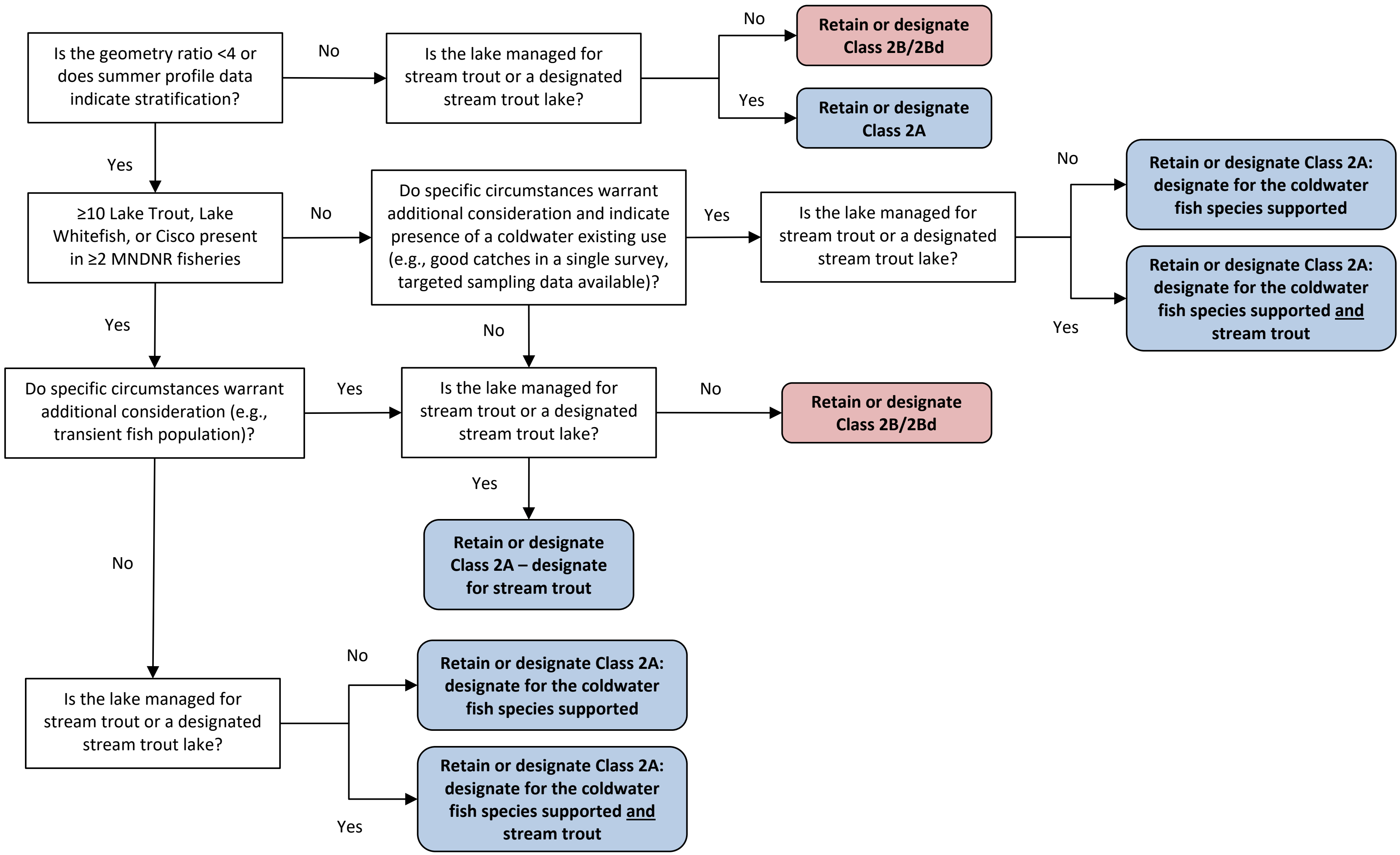
Appendix A: Water quality assessment decision charts





Lake eutrophication assessment decision chart
Is there sufficient total phosphorus data for assessment?
No
Insufficient
If eutrophication response variables meet minimum requirements and exceed, then prioritize for follow up sampling
Yes
Does total phosphorus exceed the standard?
No
Do chlorophyll-a or Secchi depth exceed the standard?
Yes
Insufficient
Prioritize for follow up sampling or review to determine if a site-specific total phosphorus standard is needed; if only Secchi depth is available, review CDOM
No
Full support
If only Secchi depth is available, review CDOM; in addition, if Secchi depth is between 1.1-2.1 m for polymictic lakes and 1.8-3.2 m for dimictic lakes monitoring of chlorophyll-a may be required to confirm
Yes
Is there sufficient chlorophyll-a data for assessment?
Yes
Does chlorophyll-a exceed the standard?
Yes
Non support
If available, Secchi depth data may be used to confirm assessment
No
Is there sufficient Secchi depth data for assessment and is color <73 PCU or absorptivity at 440 nm <4 m-1?
No
Insufficient
Review for site-specific total phosphorus standard
Yes
Does Secchi depth exceed the standard?
No
Insufficient
Yes
Non support
No
Review to determine if CDOM or other factors are contributing to the Secchi depth exceedance
Is there sufficient Secchi depth data for assessment and is color <73 PCU or absorptivity at 440 nm <4 m-1?
Yes
Does Secchi depth exceed the standard?
Yes
Non support
No
Insufficient
No
Insufficient
Due to elevated total phosphorus, prioritize for follow-up sampling

Appendix B: Coldwater habitat designation decision chart



Appendix C: Coldwater lake use designations

The following provides the specific documentation for the draft coldwater lake use designations and the fish species protected in each lake. The lakes are organized by major watershed and then by subbasin (8-digit Hydrologic Unit Codes [HUC 8]). Within these sections, data supporting the draft use designation and the coldwater fish species protected in each lake is summarized in a table. These tables include information on the coldwater species these lakes support or should support, fisheries survey summaries for these species, geometry ratio, and current and draft use designations. The current and draft aquatic life use designation class (i.e., Class 2A, 2B, or 2Bd) and the coldwater fish species protected (i.e., Lake Trout, Lake Whitefish, Cisco, and stream trout) are provided for each lake. The species codes (i.e., LAT, LKW, TLC, SRT) appear as superscripts or in brackets. The species codes in superscript are the species designations currently assigned to these lakes, but which are not codified in rule (Minn. R. 7050.0470). When the species codes are in brackets, they are the draft coldwater habitat designation and reflect the formatting for Minn. R. 7050.0470 as part of this rule revision. In cases where additional information is required to describe the proposed or confirmed designated use, a more detailed description is provided following the table. Lakes with additional information are largely lakes where the fisheries surveys did not meet the minimum criteria for designation (i.e., number of fish sampled or number of surveys present), but where supplemental information did demonstrate that the lake should be designated for the protection of a coldwater species. This information serves as the technical documentation for these beneficial use designations.

In addition to the coldwater lake designations, the designations in this document include TALU designations. The information supporting these designations is included in the TALU framework rule technical support document (TSD; MPCA 2024c). The TALU designations are included in Appendix C to be comprehensive and to avoid confusion by listing the same draft use designations across documents. The TALU framework includes two tiers which are assigned based on the condition of the warm water fish community: Exceptional and General uses. The General Use is assigned by default to lakes and to lakes where it has been demonstrated that it supports a good fish community. This is determined through a review of fish index of biotic integrity (IBI) scores and supporting information (see MPCA 2024c). General Use lakes are identified by the inclusion of the subclass designator “g” which is added to the Class 2 designation. Exceptional Use lakes are those that have been determined to support excellent fish communities (see MPCA 2024c). Exceptional Use lakes are identified by the inclusion of the subclass designator “e” which is added to the Class 2 designation.

The abbreviations and symbols used in the following section are as follows:

ALU	Aquatic life use
2B	Cool and warm water aquatic life and habitat (Class 2B)
2Bd	Cool and warm water aquatic life and habitat also protected as a source for drinking water (Class 2Bd)
2Be	Exceptional use cool and warm water aquatic life and habitat (Class 2Be)
2Bdg	General use cool and warm water aquatic life and habitat also protected as a source for drinking water (Class 2Bdg)
2Bg	General Use cool and warm water aquatic life and habitat (Class 2Bg)
2A	Coldwater aquatic life and habitat
2Ae	Exceptional use coldwater aquatic life and habitat
2Ag	General use coldwater aquatic life and habitat

GR	Geometry ratio
LAT	Lake Trout (*Salvelinus namaycush*) coldwater habitat
LKW	Lake Whitefish (*Coregonus clupeaformis*) coldwater habitat
NC	No change
SC	Species change
SM	Species modification
SRT	stream trout coldwater habitat
TLC	Cisco/Tullibee/Lake Herring (*Coregonus artedi*) coldwater habitat

Table field descriptions

Lake name: The lake name as it appears in the MPCA waterbody unit database. Different names may also be assigned to a lake and where possible additional lake names are provided in parentheses.

WID: Lakes are assigned a Waterbody identification or WID code, which is used to identify assessment units and track assessment efforts. WIDs are also used to assign and track designated uses. For lakes, the code follows MNDNR conventions, where the first two numbers refer to the county number (alphabetical), the middle four numbers are a random, unique lake number, and the final two digits are the embayment (basin) number. The MPCA includes dashes between the county number, lake number, and bay number and the MNDNR does not include dashes. The MPCA's convention for WID numbers is followed in this report.

In some cases, multiple basins are listed because these separate basins may be used by the MPCA to organize data collection and for water quality assessments. In addition, there may be some lakes listed in this rule where not every bay is included in the designation. This is because some of the bays were determined to be shallow and unlikely to support coldwater fishes even though other portions of the lake are suitable. This was done to align with the MPCA's assessment process and to help ensure that data used for assessments is not from these shallow bays. However, the MNDNR does not divide lakes into bays for management purposes.

Geometry ratio (GR): Geometry ratio is a measure of lake depth relative to lake size and provides an estimate of mixing status. Geometry ratio is calculated as: $A_0^{0.25}/z_{max}$, where A_0 is lake surface area (m^2) and z_{max} is maximum depth (m) (Stefan et al. 1996). Lakes with a geometry ratio of less than 4 tend to be dimictic whiles lakes with a geometry ratio of more than 4 are polymictic (see Figure 4).

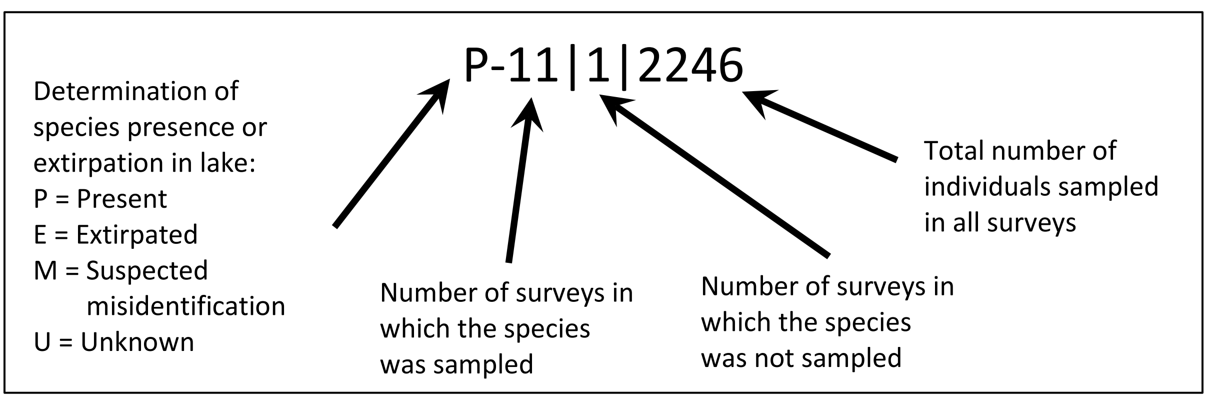
Fisheries survey summary: An abbreviated summary of fisheries survey information is provided for Cisco, Lake Whitefish, Lake Trout, and stream trout. The summaries for Cisco, Lake Whitefish, and Lake Trout differ from stream trout because the former are largely native populations whereas stream trout in lakes are typically highly managed and not sustainable without stocking. The information provided is largely derived from the Fishes of Minnesota Mapper (https://maps2.dnr.state.mn.us/ewr/fom/mapper.html) and much of this information can also be found on the MNDNR's Lake Finder (https://www.dnr.state.mn.us/lakefind/index.html). The fisheries survey summaries are coupled with information regarding the MNDNR's assessment of the current status of the population or management of the coldwater fishes present. See ***Fisheries surveys*** (p. 53) for additional description of the use of fisheries survey data for determining the status of coldwater fish populations.

Cisco, Lake Whitefish, and Lake Trout survey summaries (Figure 28): This summary includes a determination of whether the species' current status in a lake is present (P), extirpated (E), suspected misidentification (M), or unknown (U). The fisheries evaluation is based on the most recent surveys and is a best determination of the status of the species. Descriptions of species' population status categories are as follows:

- **Present (P):** The species has been observed in the most recent gill net surveys or by other means (e.g., vertical gill net survey) within last decade (2010-2020).
- **Extirpated (E):** The population of coldwater fish species has been extirpated or the lake has a declining trend in catches with no recent observations. The extirpation flag can indicate that a native population of a coldwater fish was extirpated; however, in most cases the extirpation flag indicates that a stocked population is no longer extant due to the cessation of stocking. For these coldwater fish species, the cessation of stocking was typically due to a failure to establish as a self-sustaining population or poor returns from the stocking. The extirpation flag may also indicate that a species was sampled infrequently due to the species being transient from connected lakes, but it is not considered to be a native, self-sustaining population.
- **Suspected misidentification (M):** Records of the presence of a species in a lake are likely incorrect due to misidentification. Identification errors of Cisco and Lake Whitefish sometimes occur and although vouchers are often not present, other evidence can be used to determine if identifications are suspected to be incorrect.
- **Unknown (U):** Indicates that that the species has been observed but is not present in most recent gill net survey or within last decade (2010-2020). In cases where recent surveys are lacking or the survey information is inconclusive, the species' status is left as unknown.

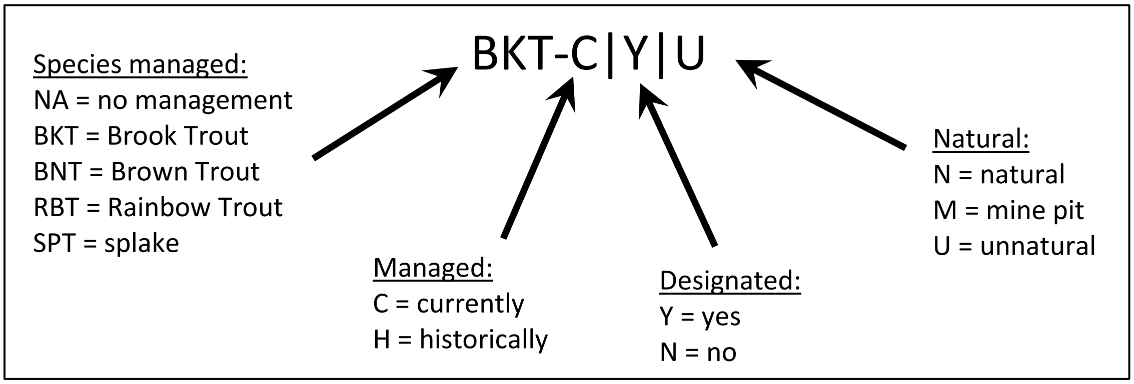
The summary also provides the number of surveys in which the species was sampled and the number of surveys in which it was not sampled. Finally, the summary includes the total number of individuals of a species collected in all surveys. An example of this summary is provided below with an explanation of each element.

Figure 28. Example of Lake Trout, Lake Whitefish, and Cisco fisheries survey information.



Stream trout survey summaries (Figure 29): Stream trout summaries include a list of the stream trout species managed in the lake and if trout are currently managed in the lake. Lakes which are not currently managed for stream trout are listed as having "no management (NA)." In the next field, management status is indicated. Currently managed lakes are those which are currently stocked on a regular basis whereas historically managed lakes are no longer stocked regularly. Historically managed lakes may be removed from the MNDNR's list of designated trout lakes or stocking may resume in the in the future. The designation flag indicates whether the lake is currently a designated trout lake on the MNDNR's trout lakes list (Minn. R. 6264.0050). Finally, the lake type and fish population origin are provided in the last code. "Natural" lakes are those with at some natural recruitment of stream trout from connected stream habitats whereas stream trout are only maintained in “unnatural” lakes through stocking. Populations of stream trout in “mine pits” are also maintained only through stocking.

Figure 29. Example of stream trout fisheries survey information.



Current ALU: Current aquatic life use (ALU) assigned to the lake. When a coldwater fish species is protected by the current ALU designation this is indicated by superscript code (LAT = Lake Trout or SRT = stream trout).

Draft ALU: The draft ALU with additional annotation for coldwater lakes to indicate the species protected in each lake. This includes the thermal classification (i.e., coldwater versus warm/cool water) and the proposed TALU designation.

Trout lake: This field indicates whether the lake is designated by the MNDNR as a trout lake in Minn. R. 6264.0050, subp. 2. These lakes are largely managed for stream trout although other coldwater species may be present. Lakes that the MNDNR manages for Lake Trout are not designated trout lakes unless they are also managed for stream trout. In addition, some lakes that are managed for stream trout are not designated trout lakes.

Designation type (Type): There are four use designation types in this rule revision This field codes for these four types: 1) Species confirmation (SC): confirmation of coldwater species protected by the current Class 2A designation, 2) Species modification (SM): modification of the coldwater fish species protected by the current Class 2A designation, 3) 2A designation (2A): designation from Class 2B/2Bd to Class 2A and confirmation of the coldwater fish species protected by the draft Class 2A designation, 4) 2Bd designation (2Bd): designation from Class 2A to Class 2Bd based on a use attainability analysis (UAA), and 5) No change (NC): after review it was determined that the current use designation is appropriate.

1. Lake Superior basin

a. Lake Superior – North watershed (04010101)

Class 2A confirmations and designations

The following lakes will be confirmed or designated for the protection of coldwater aquatic life and habitat (Class 2A). A summary of the evidence supporting these use designations is provided in Table 19 and if needed, additional information is provided following this table. Available evidence demonstrates that these lakes support or should support naturally reproducing populations of Lake Trout, Lake Whitefish, or Cisco or are managed for coldwater fish through stocking. The use designations for these lakes will be amended in Minn. R. 7050.0470 by updating the beneficial uses for lakes in the Lake Superior – North watershed (04010101).

Table 19. List of draft Class 2A use confirmations and designations for lakes in the Lake Superior – North watershed (04010101) with supporting information. Abbreviations and fisheries survey codes are described in the introduction of Appendix C.

Lake name	WID	GR	Fisheries survey: LAT	Fisheries survey: LKW	Fisheries survey: TLC	Fisheries survey: SRT	Current ALU	Draft ALU	Trout lake	Type
Alder*	16-0114-00	1.79	P-11|0|61				$2A^{LAT}$	2Ag[LAT]	No	SC
Alton*	16-0622-00	2.03	E-4|8|7		P-11|1|2246		$2A^{LAT}$	2Ag[TLC]	No	SM
Bath	16-0164-00	2.61				BKT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Bearskin	16-0228-00	1.58	P-10|1|272				$2A^{LAT}$	2Ag[LAT]	No	SC
Bearskin, East*	16-0146-00	1.93	P-8|9|54				$2A^{LAT}$	2Ag[LAT]	No	SC
Bench*	16-0063-00	3.36				BKT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Benson	38-0018-00	1.87				SPT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Birch	16-0247-00	1.49	P-11|1|117			RBT-C|N|U	$2A^{LAT}$	2Ag[LAT,SRT]	No	SM
Bogus (Patty's)	16-0050-00	2.17				SPT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Bone (Long)	38-0065-00	1.30	E-4|11|19			RBT, SPT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Boys (Kimball)	16-0044-00	4.45				BKT-C|Y|N	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Brule*	16-0348-00	3.51	E-2|10|15		P-12|0|1379		$2A^{LAT}$	2Ag[TLC]	No	SM
Caribou*	16-0141-00	2.13	E-0|5|0	U-5|0|1823			2Bd	2Ag[LKW]	No	2A
Carrot	16-0071-00	4.10				BKT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Chester	16-0033-00	1.98	E-1|19|4			BNT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Clearwater*	16-0139-00	1.22	P-19|0|668		P-19|0|2977		$2A^{LAT}$	2Ag[LAT,TLC]	No	SM

Lake name	WID	GR	Fisheries survey: LAT	Fisheries survey: LKW	Fisheries survey: TLC	Fisheries survey: SRT	Current ALU	Draft ALU	Trout lake	Type
Crosscut	38-0257-00	3.47				BKT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Crystal*	16-0090-00	1.09	P-6|0|63				$2A^{LAT}$	2Ag[LAT]	No	SC
Daniels*	16-0150-00	1.38	P-14|0|468				$2A^{LAT}$	2Ag[LAT]	No	SC
Davis*	16-0435-00	1.73	U-1|1|2				$2A^{LAT}$	2Ag[LAT]	No	SC
Deer*	16-0136-00	2.50		U-3|0|56			2Bd	2Ag[LKW]	No	2A
Devil Track	16-0143-00	3.42		P-14|5|88			2B	2Ag[LKW]	No	2A
Divide (Towhey)	38-0256-00	3.33				RBT, SPT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Duke	16-0111-00	5.14				BKT-C|Y|N	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Duncan*	16-0232-00	1.05	P-9|0|115		U-8|1|1097		$2A^{LAT}$	2Ag[LAT,TLC]	No	SM
Dunn*	16-0245-00	1.28	P-7|0|191				$2A^{LAT}$	2Ag[LAT]	No	SC
East	38-0020-00	4.12				NA-H|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Echo	38-0028-00	1.09	E-5|6|31			RBT, SPT-C|Y|U	$2A^{LAT,SRT}$	2Ag[SRT]	Yes	SM
Esther	16-0023-00	2.25	E-5|5|7			SPT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Feather	16-0905-00	1.87				BKT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Flour	16-0147-00	1.49	P-6|12|48		P-18|0|2538		$2A^{LAT}$	2Ag[LAT,TLC]	No	SM
Gadwell (Gadwall)*	16-0060-00	1.07				BKT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Gaskin*	16-0319-00	1.93	U-0|2|0	P-2|0|28	U-1|1|27		$2A^{LAT}$	2Ag[LAT,LKW,TLC]	No	SM
Gogebic (Duck)*	16-0087-00	1.21				BKT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Goldeneye (Duck)	38-0029-00	2.46				BKT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Greenwood	16-0077-00	1.74	P-20|0|515	U-12|8|86	P-20|0|3180		$2A^{LAT}$	2Ag[LAT,LKW,TLC]	No	SM
Jim	16-0135-00	2.90	U-5|1|16				$2A^{LAT}$	2Ag[LAT]	No	SC
Junco	16-0159-00	14.1				BKT-C|Y|N	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Kemo	16-0188-00	1.43	P-15|0|285				$2A^{LAT}$	2Ag[LAT]	No	SC
Kimball	16-0045-00	4.88				BNT, RBT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Leo	16-0198-00	2.97				RBT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Lima	16-0226-00	1.87				BKT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Little Trout*	16-0170-00	1.75	P-5|0|168				$2A^{LAT}$	2Ag[LAT]	No	SC
Loft	16-0031-00	1.06				BKT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC

Lake name	WID	GR	Fisheries survey: LAT	Fisheries survey: LKW	Fisheries survey: TLC	Fisheries survey: SRT	Current ALU	Draft ALU	Trout lake	Type
Margaret	16-0896-00	1.42				BKT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
McFarland	16-0027-00	2.37	U-0|9|0	P-9|0|111	P-8|1|27		$2A^{SRT}$	2Ag[LKW,TLC]	No	SM
Mink	16-0046-00	4.78				RBT, SPT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Misquah*	16-0225-00	1.15	P-7|1|17				$2A^{LAT}$	2Ag[LAT]	No	SC
Moose*	16-0043-00	1.08	U-4|0|54	U-4|0|315	U-3|1|108		$2A^{LAT}$	2Ag[LAT,LKW,TLC]	No	SM
Moosehorn	16-0015-00	7.30				SPT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Moss	16-0234-00	1.16	P-15|0|589	E-1|14|2	E-1|14|55		$2A^{LAT}$	2Ag[LAT]	No	SC
Mountain*	16-0093-00	0.71	P-8|0|852				$2A^{LAT}$	2Ag[LAT]	No	SC
Muckwa	16-0105-00	3.48				RBT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Musquash	16-0104-00	3.41	E-1|10|21			SPT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
North Shady	16-0076-00	3.09				BKT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Olga	16-0024-00	1.09	E-2|7|2			SPT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Olson	16-0158-00	3.49				RBT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Pancore (Lost)	16-0475-00	1.60				SPT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Partridge*	16-0233-00	1.05	P-7|0|279				$2A^{LAT}$	2Ag[LAT]	No	SC
Pemmican*	16-0085-00	1.18				BKT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Pierz*	16-0091-00	2.86	U-0|8|0			SPT-C|N|U	2Bd	2Ag[SRT]	No	2A
Pike	16-0252-00	3.49		P-17|2|346			2B	2Ag[LKW]	No	2A
Pike, East*	16-0042-00	2.53		U-6|0|538	U-6|0|436		2Bd	2Ag[LKW,TLC]	No	2A
Pike, West*	16-0086-00	1.16	U-6|0|270		U-5|1|53		$2A^{LAT}$	2Ag[LAT,TLC]	No	SM
Pine*	16-0041-00	1.57	P-8|3|31	P-10|1|1756	P-6|5|143		$2A^{LAT}$	2Ag[LAT,LKW,TLC]	No	SM
Pine	16-0194-00	2.40	E-5|16|17			RBT, SPT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Pine Mountain	16-0108-00	2.79				SPT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Poplar	16-0239-00	1.88	E-3|23|19	P-23|3|250	E-3|23|29		2Bd	2Ag[LKW]	No	2A
Ram*	16-0174-00	1.88	P-12|2|180			RBT-C|Y|U	$2A^{LAT,SRT}$	2Ag[LAT,SRT]	Yes	SC
Rose*	16-0230-00	1.46	U-3|0|26	U-3|0|155	U-3|0|82		$2A^{LAT}$	2Ag[LAT,LKW,TLC]	No	SM
Shoe	16-0080-00	5.76				SPT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Sock*	16-0335-00	2.42				BKT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC

Lake name	WID	GR	Fisheries survey: LAT	Fisheries survey: LKW	Fisheries survey: TLC	Fisheries survey: SRT	Current ALU	Draft ALU	Trout lake	Type
Sonju	38-0248-00	8.13				BKT-C|Y|N	$2A^{SRT}$	2Ag[SRT]	Yes	SC
South*	16-0244-00	0.95	U-2|0|91		U-2|0|12		$2A^{LAT}$	2Ag[LAT,TLC]	No	SM
State*	16-0293-00	1.43	U-0|0|0				$2A^{LAT}$	2Ag[LAT]	No	SC
Steer	38-0920-00	1.58				BKT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Superior	16-0001-00	-	-	-	-	-	2A	2Ag[LAT,LKW,TLC, SRT]	No	SM
Swan*	16-0268-00	0.98	U-0|4|0	P-4|0|248			$2A^{LAT}$	2Ag[LKW]	No	SM
Talus	16-0187-00	2.13				RBT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Thompson	16-0160-00	4.37				BNT, RBT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Thrasher	16-0192-00	2.10	E-1|7|1			SPT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Thrush	16-0191-00	1.05	E-5|1|30			BKT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Tom	16-0019-00	3.36		P-11|4|173			2B	2Ag[LKW]	No	2A
Topper (Sound, Round)*	16-0336-00	2.45				BKT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Trout	16-0049-00	1.36	P-15|0|344		E-9|6|84	RBT-C|N|U	$2A^{LAT}$	2Ag[LAT,TLC,SRT]	No	SM
Turnip	16-0132-00	2.24				BKT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Unnamed	16-0903-00	1.21	E-0|1|0			BKT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Unnamed	16-0908-00	-				SPT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Vale*	16-0061-00	1.68				BKT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Vernon*	16-0267-00	1.02	U-1|4|2	U-5|0|474	U-1|4|1		2Bd	2Ag[LKW]	No	2A
Weasel (Sled)	16-0897-00	2.07				BKT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Wee*	16-0483-00	1.41				BKT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Wench*	16-0398-00	0.98				BKT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Winchell*	16-0354-00	1.18	P-4|0|90	P-3|1|3	P-4|0|609		$2A^{LAT}$	2Ag[LAT,TLC]	No	SM

*** Partially or fully within the Boundary Waters Canoe Area Wilderness.**

Alton Lake (16-0622-00): The current Class 2A designation for Alton Lake was assigned to protect Lake Trout. It is listed as an "inland Lake Trout lake" in Minnesota Department of Conservation (1967) which also notes that dissolved oxygen conditions are "marginal." Lake Trout are not native to Alton Lake but were historically stocked. Lake Trout in this lake have been determined to not be sustainable and this species is no longer stocked. The poor survival of Lake Trout in this lake may be attributed to marginal dissolved oxygen conditions. As a result, Alton Lake will not be designated for the protection Lake Trout. However, Alton Lake supports a natural population of Cisco. Considering this information, it is reasonable to retain the Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]). This lake is in the BWCAW and therefore retains the prohibited ORVW designation.

Birch Lake (16-0247-00): The current Class 2A designation for Birch Lake was assigned to protect Lake Trout and it is listed as a "potential inland Lake Trout lake" in Minnesota Department of Conservation (1967). Lake Trout are not considered native to this lake, but stocking has resulted in a small, self-sustaining population of Lake Trout. Rainbow Trout are also stocked in Birch Lake, but it is not designated a trout lake by the MNDNR. Considering this information, it is reasonable to retain the Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Lake Trout and stream trout (Class 2Ag [LAT,SRT]).

Bone Lake (38-0065-00): Bone Lake is currently designated Class 2A to protect stream trout. Lake Trout were stocked from 1915-1985 but are not native to Bone Lake. Stocking was discontinued and the introduced population was not self-sustaining. As a result, it is not appropriate to assign protections for Lake Trout in Bone Lake. However, the lake is currently a MNDNR designated trout lake (Minn. R. 6264.0050) and is managed for Rainbow Trout. Considering this information, it is reasonable to retain the Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for stream trout (Class 2Ag [SRT]).

Brule Lake (16-0348-00): The Class 2A designation for Brule Lake was assigned to protect Lake Trout. It is listed as an "inland Lake Trout lake" in Minnesota Department of Conservation (1967) which also notes that the lake has an "adverse fish population." Lake Trout are possibly native to this lake, but there has also been stocking of Lake Trout in Brule Lake. Stocking efforts in the 1930s-1970s to establish a population were unsuccessful and Lake Trout have been determined to not be sustainable in this lake. As a result, Brule Lake will not be designated for the protection Lake Trout because this is not an existing use. However, Brule Lake supports a natural population of Cisco. Considering this information, it is reasonable to retain the Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]). This lake is in the BWCAW and therefore retains the prohibited ORVW designation.

Caribou Lake (16-0141-00): Caribou Lake is in the BWCAW and is currently designated Class 2Bd. It is unknown if Lake Trout were native to the lake, but trout were stocked in 1970. No Lake Trout were detected in the 5 fisheries surveys for the lake. As a result, Caribou Lake will not be designated for the protection Lake Trout. However, Caribou Lake supports a natural population of Lake Whitefish. Considering this information, it is reasonable to designate Caribou Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Lake Whitefish (Class 2Ag [LKW]).

Chester Lake (16-0033-00): Chester Lake is currently designated to protect stream trout and it is listed as a "potential inland lake trout lake" in Minnesota Department of Conservation (1967). This report also notes that this lake was reclaimed in 1965 and stocked with Ohrid trout (*Salmo letnica*).

Lake Trout are not native to Chester Lake and are not currently stocked. However, Chester Lake is currently designated a trout lake by the MNDNR (Minn. R. 6264.0050) and is managed for Brown Trout. Considering this information, it is reasonable to retain the Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for stream trout (Class 2Ag [SRT]). The WID number for this lake is incorrect in Minn. R. 7050.0470. It is listed as "69-0033-00," but it should be "16-0033-00." This error will be corrected as part of this revision. This lake is not currently designated as a Lake Trout lake, so the draft designation does not result in the removal of a Lake Trout lake designation.

Davis Lake (16-0435-00): Davis Lake is currently designated to protect Lake Trout and it is listed as an "inland lake trout lake" in Minnesota Department of Conservation (1967). Davis Lake is in the BWCAW and there is limited data on the fishery in this lake. Whether or not Lake Trout are native or if a population is currently extant in this lake is unknown. Two Lake Trout were collected in 1999 and at least one was from a previous stocking. Additional data is needed to confirm if a Lake Trout population has been established in Davis Lake. As a result, Davis Lake will retain the designation for the protection Lake Trout, but additional work may demonstrate that Lake Trout habitat is not an existing use. Considering this information, it is reasonable to retain the Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Lake Trout (Class 2Ag [LAT]).

East Lake (38-0020-00): East Lake is currently designated Class 2A to protect stream trout. Management of stream trout in East Lake was discontinued although the lake is still a MNDNR designated trout lake (Minn. R. 6264.0050). This lake is currently designated Class 2Ag and this use (Class 2Ag [SRT]) will be retained until the MNDNR removes this lake from the list of designated trout lakes or additional information indicates its removal is appropriate.

Echo Lake (38-0028-00): Echo Lake is currently designated to protect stream trout and Lake Trout. It is listed as an "inland lake trout lake" in Minnesota Department of Conservation (1967). Lake Trout were stocked from 1919-1985 but are not native to Echo Lake. Stocking was discontinued and the introduced population was not self-sustaining. As a result, it is not appropriate to retain protections for Lake Trout in Echo Lake. However, the lake is currently a MNDNR designated trout lake (Minn. R. 6264.0050) and is managed for Rainbow Trout and splake. Considering this information, it is reasonable to retain the Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for stream trout (Class 2Ag [SRT]). This lake is currently designated as a Lake Trout lake and is outside the BWCAW. As a result, the removal of the Lake Trout lake designation will also remove the restricted ORVW designation (Minn. R. 7050.0335, subp. 1, Item C) for Echo Lake.

Esther Lake (16-0023-00): Esther Lake is currently designated to protect stream trout and it is listed as an "inland lake trout lake" in Minnesota Department of Conservation (1967). Lake Trout are not native to Esther Lake and were stocked in 1954, 1965, 1970, and 1973. Stocking was discontinued and the introduced population was not self-sustaining. As a result, it is not appropriate to assign protections for Lake Trout to this lake. However, the lake is currently a MNDNR designated trout lake (Minn. R. 6264.0050) and is managed for splake. Considering this information, it is reasonable to retain the Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for stream trout (Class 2Ag [SRT]). This lake is not currently designated as a Lake Trout lake, so the draft designation does not result in the removal of a Lake Trout lake designation.

Gaskin Lake (16-0319-00): The current Class 2A designation for Gaskin Lake was assigned to protect Lake Trout. It is listed as an "inland lake trout lake" in Minnesota Department of Conservation (1967) which also notes that it has "good" dissolved oxygen conditions. Lake Trout are considered native to this lake, but their current status is unknown. Two MNDNR fisheries surveys for Gaskin Lake (1990 and 2012) found no Lake Trout, but anglers have reported catching the species. As a result, Gaskin Lake will retain the designation for the protection Lake Trout, but additional work may demonstrate that Lake Trout habitat is not an existing use. Gaskin Lake does support natural populations of Cisco and Lake Whitefish. Considering this information, it is reasonable to retain the Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Lake Trout, Lake Whitefish, and Cisco (Class 2Ag [LAT,LKW,TLC]).

McFarland Lake (16-0027-00): The Class 2A designation for McFarland Lake was assigned to protect stream trout, but it is not currently managed for stream trout. It is listed as a “potential inland Lake Trout lake” in Minnesota Department of Conservation (1967) which also notes that the lake has an “adverse fish population.” Comments from a 1987 MPCA rulemaking exhibit (MPCA 1987) indicate that Lake Trout were periodically stocked in this lake from the early 1940's until 1967, but there is no record of Lake Trout being captured. The MNDNR has conducted 6 fisheries surveys since 1985 and none have sampled trout. A study of the temperature-oxygen profile in this lake found no areas capable of supporting Lake Trout. Since efforts to stock and establish a population were unsuccessful and conditions are unsuitable to support Lake Trout, McFarland Lake will be designated for the protection Lake Trout. However, McFarland Lake supports natural populations of Cisco and Lake Whitefish. Considering this information, it is reasonable to retain the Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco and Lake Whitefish (Class 2Ag [TLC,LKW]). This lake is not currently designated as a Lake Trout lake, so the draft designation does not result in the removal of a Lake Trout lake designation.

Pierz Lake (16-0091-00): Pierz Lake is currently designated Class 2Bd and is not designated for the protection of any coldwater fish species. The status of a possible Lake Trout population in Pierz Lake is unknown. A single Lake Trout was sampled in 1956, but no additional fish have been sampled in subsequent surveys. At this time, it not appropriate to assign protections for Lake Trout in this lake, but additional monitoring could determine that a population is present and this designation is needed. Although the lake is not currently a designated trout lake, it is managed for splake. Considering this information, it is reasonable to designate Pierz Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for stream trout (Class 2Ag [SRT]). This lake is not currently designated as a Lake Trout lake, so the draft designation does not result in the removal of a Lake Trout lake designation.

Poplar Lake (16-0239-00): Poplar Lake is currently designated Class 2Bd. It is listed as an “inland lake trout lake” in Minnesota Department of Conservation (1967) which also notes that the lake has an “adverse fish population” and “marginal” dissolved oxygen. The MNDNR stocked Lake Trout in 1926 and 1997-2005, but fisheries surveys likely only sampled stocked fish. This indicated that a self-sustaining population was not established and stocking was stopped. Lake Trout are considered native to the lake, but no surveys have collected fish that were the result of natural reproduction. As a result, Poplar Lake will not be designated for the protection Lake Trout. Cisco were stocked in Poplar Lake in the 1930s, but this species was last recorded in 1959. Poplar Lake does support a natural population of Lake Whitefish. Considering this information, it is reasonable to designate Poplar Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Lake Whitefish (Class 2Ag [LKW]).

State Lake (16-0293-00): State Lake is currently designated Class 2A for the protection of Lake Trout. The status of a Lake Trout population in State Lake is unknown. MNDNR surveys have not sampled any Lake Trout, but there are angler reports of Lake Trout in this lake. Minnesota Department of Conservation (1967) listed this as a “potential inland Lake Trout lake” and indicated good dissolved oxygen and temperature conditions in the lake. As a result, State Lake will retain the designation for the protection of Lake Trout, but additional work may demonstrate Lake Trout habitat is not an existing use. Considering this information, it is reasonable to retain the Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Lake Trout (Class 2Ag [LAT]).

Swan Lake (16-0268-00): The current Class 2A designation for Swan Lake was assigned to protect Lake Trout. It is listed as a “potential inland lake trout lake” in Minnesota Department of Conservation (1967) which also notes that the lake has “good” dissolved oxygen and temperature conditions. Lake Trout are thought to be possibly native to this lake, but there is no record of an extant population of Lake Trout. MNDNR fisheries surveys for Swan Lake from 1973-2014 have not sampled any Lake Trout despite stockings in the 1990s. As a result, it is not appropriate to retain the designation for protection of Lake Trout. Swan Lake does support a natural population Lake Whitefish. Considering this information, it is reasonable to retain the Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Lake Whitefish (Class 2Ag [LKW]). This lake is in the BWCAW and therefore retains the prohibited ORVW designation.

Thrush Lake (16-0191-00): The current Class 2A designation for Thrush Lake was assigned to protect stream trout. Although not native, Lake Trout were stocked in 1973. Stocking was discontinued and the introduced population was not self-sustaining. As a result, it is not appropriate to assign protections for Lake Trout in this lake. However, the lake is currently designated a trout lake by the MNDNR (Minn. R. 6264.0050) and is managed for Brook Trout. Considering this information, it is reasonable to retain the Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for stream trout (Class 2Ag [SRT]). This lake is not currently designated as a Lake Trout lake, so the draft designation does not result in the removal of a Lake Trout lake designation.

Trout Lake (16-0049-00): The current Class 2A designation of Trout Lake was assigned to protect Lake Trout. Lake Trout are not currently stocked in this lake, but Lake Trout have been determined to be sustainable with natural recruitment. As a result, Trout Lake should be managed to protect Lake Trout. Trout Lake supported a natural population of Cisco. In 17 MNDNR surveys (1951-1999), Cisco were collected in 9 surveys with a total of 84 individuals sampled. Cisco have not been collected from this lake since 1999 and were likely extirpated due to the introduction of Rainbow Smelt. Although Cisco are extirpated, a population was present after November 28, 1975, demonstrating that protection of Cisco is an existing use. In addition, Trout Lake is also managed for Rainbow Trout. Considering this information, it is reasonable to retain the Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Lake Trout, Cisco, and stream trout (Class 2Ag [LAT,TLC,SRT]).

Vernon Lake (16-0267-00): Vernon Lake is currently designated Class 2Bd. Lake Trout are considered to be native in Vernon Lake and an effort to reintroduce the species took place in the 1990s. There was carry over observed from these stockings, but no natural recruitment was documented. The presence of Lake Trout in this lake is unlikely and additional surveys would be needed to establish if a Lake Trout population is present in Vernon Lake. As a result, Vernon Lake will not be designated for the protection of Lake Trout at this time. However, based on fisheries surveys, Vernon Lake supports a large population of Lake Whitefish. Considering this information, it is reasonable to retain the Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Lake Whitefish (Class 2Ag [LKW]). This lake is in the BWCAW and therefore retains the prohibited ORVW designation.

Wee Lake (16-0483-00): The WID number for Wee Lake listed in Minn. R. 7050.0470 is incorrect. This lake is currently listed as 16-0183-00 in rule and as part of this rule revision the WID number will be corrected to 16-0483-00.

Class 2Bd designations

The following lakes will be designated for the protection of warm and cool water aquatic life and habitat (Class 2Bd). A summary of the evidence supporting the use designation is provided in Table 20 and additional details are provided following the table. For these lakes, the designation of Class 2Bd from Class 2A results in the designation of a beneficial use that carries with it less stringent standards. As a result, a use attainability analysis (40 CFR § 131.3(g)) is required by the CWA (40 CFR § 131.10(j)) to demonstrate that the current use designation is not an existing use (40 CFR § 131.3(e)) or an attainable use (40 CFR § 131.10(d)). Considering the information below, it is reasonable to assign Class 2Bdg to these lakes for the protection of cool and warm waters also protected as a source of drinking water. The use designations for these lakes will be amended in Minn. R. 7050.0470 by updating the beneficial uses for lakes in the Lake Superior – North watershed (04010101).

Table 20: List of draft Class 2Bd use designations for lakes in the Lake Superior – North watershed (04010101) with supporting information. Abbreviations and fisheries survey codes are described in the introduction of Appendix C.

Lake name	WID	GR	Fisheries survey: LAT	Fisheries survey: LKW	Fisheries survey: TLC	Fisheries survey: SRT	Current ALU	Draft ALU	Trout water	Type
Cone, Upper*	16-0412-00	1.40					$2A^{SRT}$	2Bdg	No	2Bd
Devilfish	16-0029-00	2.90	E-3|10|79				$2A^{SRT}$	2Bdg	No	2Bd
Hungry Jack	16-0227-00	1.70	E-5|16|8				$2A^{SRT}$	2Bdg	No	2Bd
Lizz*	16-0199-00	1.85				NA-H|Y|U	$2A^{SRT}$	2Bdg	No	2Bd
Mulligan*	16-0389-00	0.94				NA-H|Y|U	$2A^{SRT}$	2Bdg	No	2Bd
Omega (Onega)*	16-0353-00	1.80					$2A^{SRT}$	2Bdg	No	2Bd
Otto, South*	16-0323-00	0.90					$2A^{SRT}$	2Bdg	No	2Bd
Vista*	16-0224-00	2.00					$2A^{LAT}$	2Bdg	No	2Bd
Wanihigan*	16-0349-00	1.70					$2A^{SRT}$	2Bdg	No	2Bd

*** Partially or fully within the Boundary Waters Canoe Area Wilderness.**

Cone, Upper Lake (16-0412-00): Upper Cone Lake is currently designated Class 2A to protect stream trout. This lake is not currently managed for stream trout nor is it a MNDNR designated trout lake (Minn. R. 6264.0050). It is listed as a "potential inland lake trout lake" in Minnesota Department of Conservation (1967). MNDNR fisheries survey's (1971, 1981, 1984, 1987 and 1998) did not capture Lake Trout although temperature-oxygen conditions were determined to be suitable for Lake Trout. The MNDNR determined that Lake Trout introduction would not be successful due a small total volume of suitable water, the presence of Walleye, Smallmouth Bass (*Micropterus dolomieu* Lacepède, 1802), and Northern Pike, and a limited forage base. Considering this information, it is reasonable to assign Class 2Bdg to Upper Cone Lake for the protection of cool and warm waters also protected as a source of drinking water. This lake is not currently designated as a Lake Trout lake, so the draft designation does not result in the removal of a Lake Trout lake designation.

Devilfish Lake (16-0029-00): Devilfish Lake was designated Class 2A to protect stream trout, but it is not currently designated (Minn. R. 6264.0050) or managed by the MNDNR for stream trout. It is listed as an "inland lake trout lake" in Minnesota Department of Conservation (1967) which noted that it has "marginal" dissolved oxygen and that it was reclaimed in 1959. Lake Trout are considered to be native to this lake, but this species was stocked on an almost annual basis from 1961-1980. It was considered a marginal Lake Trout lake and the introduction of Rainbow Smelt in the early 1970s likely contributed to a decline in the Lake Trout population. In the 10 MNDNR fisheries surveys conducted on Devilfish Lake since 1984, none captured Lake Trout. Temperature-oxygen conditions have consistently been marginal for Lake Trout. Based on this information, the Lake Trout population does not appear to have been sustainable on or after November 28, 1975 and the trout in surveys following this date were the result of stockings. Considering this information, it is reasonable to assign Class 2Bdg to Devilfish Lake for the protection of cool and warm waters also protected as a source of drinking water. This lake is not currently designated as a Lake Trout lake, so the draft designation does not result in the removal of a Lake Trout lake designation.

Hungry Jack Lake (16-0227-00): Hungry Jack Lake was designated Class 2A to protect stream trout, but it is not currently designated (Minn. R. 6264.0050) or managed by the MNDNR for stream trout. It is listed as a "potential inland lake trout lake" in Minnesota Department of Conservation (1967) which notes that Smallmouth Bass and Walleye are present. Lake Trout are considered to be native to this lake but were extirpated by the 1950s. Temperature-oxygen measurements for this lake have been mixed in terms of the suitability for Lake Trout. Numerous stockings have not resulted in natural recruitment or good carryover. It is possible that the introduction of Walleye impacted the ability of Hungry Jack Lake to support a sustainable population of Lake Trout. Based on this information, the Lake Trout population does not appear to have been sustainable on or after November 28, 1975. Considering this information, it is reasonable to assign Class 2Bdg to Hungry Jack Lake for the protection of cool and warm waters also protected as a source of drinking water. This lake is not currently designated as a Lake Trout lake, so the draft designation does not result in the removal of a Lake Trout lake designation.

Lizz Lake (16-0199-00): Lizz Lake was designated Class 2A because this lake was a designated trout lake (Minn. R. 6264.0050). Management of stream trout in Lizz Lake was discontinued this lake was removed from MNDNR's designated trout lakes list (State of Minnesota 2024). As a result, it is reasonable to assign Class 2Bdg to Lizz Lake for the protection of cool and warm waters also protected as a source of drinking water.

Mulligan Lake (16-0389-00): Mulligan Lake was designated Class 2A because this lake was a MNDNR designated trout lake (Minn. R. 6264.0050). Management of stream trout in Mulligan Lake was discontinued this lake was removed from MNDNR's designated trout lakes list (State of Minnesota 2024). Considering this information, it is reasonable to assign Class 2Bdg to Mulligan Lake for the protection of cool and warm waters also protected as a source of drinking water.

Omega (Onega) Lake (16-0353-00): Omega Lake was designated Class 2A to protect stream trout, but it is not currently designated (Minn. R. 6264.0050) or managed by the MNDNR for stream trout. It is listed as a "potential inland lake trout lake" in Minnesota Department of Conservation (1967) which noted that it has "good" dissolved oxygen conditions. There is no record of a Lake Trout population in this lake. Considering this information, it is reasonable to assign Class 2Bdg to Omega Lake for the protection of cool and warm waters also protected as a source of drinking water. This lake is not currently designated as a Lake Trout lake, so the draft designation does not result in the removal of a Lake Trout lake designation.

Otto, South Lake (16-0323-00): South Otto Lake was designated Class 2A to protect stream trout, but it is not currently designated (Minn. R. 6264.0050) or managed by the MNDNR for stream trout. It was listed as a "potential inland lake trout lake" in Minnesota Department of Conservation (1967), but there is no record of a Lake Trout population in this lake. Considering this information, it is reasonable to assign Class 2Bdg to South Otto Lake for the protection of cool and warm waters also protected as a source of drinking water. This lake is not currently designated as a Lake Trout lake, so the draft designation does not result in the removal of a Lake Trout lake designation.

Vista Lake (16-0224-00): Vista Lake was designated Class 2A to protect Lake Trout. It is listed as a "potential inland lake trout lake" in Minnesota Department of Conservation (1967) which noted that it has "marginal" dissolved oxygen conditions. Two MNDNR fisheries surveys (1985 and 1993) did not collect any Lake Trout and there is no evidence of a Lake Trout population in this lake. Considering this information, it is reasonable to assign Class 2Bdg to Vista Lake for the protection of cool and warm waters also protected as a source of drinking water. This lake is in the BWCAW and therefore retains the prohibited ORVW designation.

Wanihigan Lake (16-0349-00): Wanihigan Lake was designated Class 2A to protect stream trout, but it is not currently designated (Minn. R. 6264.0050) or managed by the MNDNR for stream trout. Minnesota Department of Conservation (1967) lists Wanihigan Lake as a "potential inland lake trout lake", but also noted that dissolved oxygen is "marginal" in this lake. There is no record of a Lake Trout population in this lake. Considering this information, it is reasonable to assign Class 2Bdg to Wanihigan Lake for the protection of cool and warm waters also protected as a source of drinking water. This lake is not currently designated as a Lake Trout lake, so the draft designation does not result in the removal of a Lake Trout lake designation.

b. Lake Superior – South watershed (04010102)

Class 2A confirmations

The following lakes will be confirmed for the protection of coldwater aquatic life and habitat (Class 2A). A summary of the evidence supporting these use designation confirmations is provided in Table 21 and additional evidence follows the table as needed. Available evidence demonstrates that these lakes support or should support naturally reproducing populations of Lake Trout or are managed for coldwater fish through stocking. The use designations for these lakes will be amended in Minn. R. 7050.0470 by updating the beneficial uses for lakes in the Lake Superior – South watershed (04010102).

Table 21. List of draft Class 2A use confirmations and designations for lakes in the Lake Superior – South watershed (04010102) with supporting information. Abbreviations and fisheries survey codes are described in the introduction of Appendix C.

Lake name	WID	GR	Fisheries survey: LAT	Fisheries survey: LKW	Fisheries survey: TLC	Fisheries survey: SRT	Current ALU	Draft ALU	Trout lake	Type
Bean (Lower Twin)	38-0409-00	2.34				RBT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Bear (Upper Twin)	38-0408-00	0.77	U-7|2|20			SPT-C|Y|U	$2A^{LAT,SRT}$	2Ag[LAT,SRT]	Yes	SC

Bear (Upper Twin) Lake (38-0408-00): Bear Lake is currently designated for protection of stream trout and Lake Trout. It is listed as an "inland lake trout lake" in Minnesota Department of Conservation (1967). Although Lake Trout are not native to this lake, this species has been stocked and has become established and is self-sustaining. Bear Lake is also managed for splake. Considering this information, it is reasonable to retain the Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Lake Trout and stream trout (Class 2Ag [LAT,SRT]).

Class 2Bd designations

The following lake will be designated for the protection warm and cool water aquatic life and habitat (Class 2Bd). A summary of the evidence supporting the draft use designation is provided in Table 22 and additional details are provided following the table. For this lake, the designation of Class 2Bd from Class 2A results in the designation of a beneficial use that carries with it less stringent standards. As a result, a use attainability analysis (40 CFR § 131.3(g)) is required by the CWA (40 CFR § 131.10(j)) to demonstrate that the current use designation is not an existing use (40 CFR § 131.3(e)) or an attainable use (40 CFR § 131.10(d)). Considering this information below, it is reasonable to assign Class 2Bdg to these lakes for the protection of cool and warm waters also protected as a source of drinking water. The use designations for these lakes will be amended in Minn. R. 7050.0470 by updating the beneficial uses for lakes in the Lake Superior – South watershed (04010102).

Table 22: List of draft Class 2Bd use designations for lakes in the Lake Superior – South watershed (04010102) with supporting information. Abbreviations and fisheries survey codes are described in the introduction of Appendix C.

Lake name	WID	GR	Fisheries survey: LAT	Fisheries survey: LKW	Fisheries survey: TLC	Fisheries survey: SRT	Current ALU	Draft ALU	Trout water	Type
Normanna	69-1383-00	1.02				NA-H|Y|U	2A[SRT]	2Bdg	Yes	2Bd

Unnamed lake (69-0122-00): This unnamed lake was incorrectly designated Class 2A and is labeled as Normanna Lake in Minn. R. 7050.0470. However, this lake was never managed for stream trout. The MNDNR designated and managed a separate, nearby lake called Normanna Lake (69-1383-00) for stream trout. Management of Brook Trout in Normanna Lake (69-1383-00) was discontinued in 2003 although the lake is still designated a trout lake by the MNDNR (Minn. R. 6264.0050). It is reasonable to remove the Class 2A designation from 69-0122-00 because it was erroneously designated. 69-1383-00 will not be designated Class 2Ag [SRT] at this time because the MNDNR no longer manages this lake for stream trout and because the MNDNR intends to remove this lake from its designated trout lakes list.

c. St. Louis River watershed (04010201)

Class 2A confirmations and designations

The following lakes will be confirmed or designated for the protection of coldwater aquatic life and habitat (Class 2A). A summary of the evidence supporting these use designations is provided in Table 23 and if needed, additional information is provided following this table. Available evidence demonstrates that these lakes support or should support naturally reproducing populations of Lake Trout, Lake Whitefish, or Cisco or the lakes are managed for coldwater fish through stocking. The use designations for these lakes will be amended in [Minn. R. 7050.0470] by updating the beneficial uses for lakes in the St. Louis River watershed (04010201).

Table 23. List of draft Class 2A use confirmations and designations for lakes in the St. Louis River watershed (04010201) with supporting information. Abbreviations and fisheries survey codes are described in the introduction of Appendix C.

Lake name	WID	GR	Fisheries survey: LAT	Fisheries survey: LKW	Fisheries survey: TLC	Fisheries survey: SRT	Current ALU	Draft ALU	Trout lake	Type
Corona (John)	09-0048-00	1.92				RBT-H|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Ely	69-0660-00	1.93	E-0|13|0		U-8|5|142		2B	2Ag[TLC]	No	2A
Esquagama	69-0565-00	1.36	E-0|6|0		P-6|0|499		2B	2Ag[TLC]	No	2A
Judson Mine Pit	69-1295-00	0.63				NA-H|Y|M	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Little Elbow	69-1329-00	1.12				NA-H|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Sabin	69-0434-01	2.72			P-8|1|138		2B	2Ag[TLC]	No	2A
Sabin (Embarrass Mine, Lake Mine)	69-0429-00	0.19	P-10|1|202		U-0|11|0	NA-H|Y|M	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Spring Hole	69-1372-00	2.04				BKT-C|Y|N	$2A^{SRT}$	2Ag[SRT]	Yes	SC
St. Mary's	69-0651-00	2.34			P-5|0|117		2Bd	2Ag[TLC]	No	2A
Twin Lakes (Twin Ponds)	69-0967-01,-02	3.29-3.35				RBT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Wynne	69-0434-02	2.07			P-8|1|255		2B	2Ag[TLC]	No	2A

Ely Lake (69-0660-00): Ely Lake is currently designated Class 2B and is not designated for the protection of coldwater fish species. Lake Trout are not considered to be native to this lake, but Lake Trout were stocked in 1912. Lake Trout in this lake were determined to not be sustainable and this species is no longer stocked. As a result, Ely Lake will not be designated for the protection Lake Trout. However, Ely Lake supports a natural population of Cisco. Considering this information, it is reasonable to designate Ely Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]).

Esquagama Lake (69-0565-00): Esquagama Lake is currently designated Class 2B and is not designated for the protection of coldwater fish species. Lake Trout are not considered to be native to this lake, but Lake Trout were stocked in 1941. Lake Trout in this lake were determined to not be sustainable and this species is no longer stocked. As a result, Esquagama Lake will not be designated for the protection Lake Trout. However, Esquagama Lake supports a natural population of Cisco. Considering this information, it is reasonable to designate Esquagama Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]).

Judson Mine Pit (69-1295-00): Judson Mine Pit is currently designated Class 2A to protect stream trout. Management of Rainbow Trout in Judson Mine Pit was discontinued although waterbody lake is still designated a trout lake by the MNDNR (Minn. R. 6264.0050). This waterbody is currently designated Class 2Ag and this use (Class 2Ag [SRT]) will be retained until the MNDNR removes this waterbody from the list of designated trout lakes or additional information indicates its removal is appropriate.

Little Elbow Lake (69-1329-00): Little Elbow Lake is currently designated Class 2A to protect stream trout. Management of Rainbow Trout in Little Elbow Lake was discontinued although the lake is still designated a trout lake by the MNDNR (Minn. R. 6264.0050). This lake is currently designated Class 2Ag and this use (Class 2Ag [SRT]) will be retained until the MNDNR removes this lake from the list of designated trout lakes or additional information indicates its removal is appropriate.

Sabin Lake (Embarrass Mine) (69-0429-00): Sabin Lake is currently designated Class 2A to protect stream trout. However, this waterbody is no longer managed for stream trout. The protections for stream trout will be retained until the MNDNR removes this waterbody from its list of designated trout lakes (Minn. R. 6264.0050) or additional information indicates its removal is appropriate. Lake Trout were also stocked in this waterbody and have established a self-sustaining population. There is uncertainty regarding the long-term management goals for this introduced species, and until that is resolved, a Lake Trout designation is not appropriate. Cisco have also been stocked in this waterbody. Considering this information, it is reasonable to retain the Class 2Ag classification assigned to coldwater aquatic life and habitat and maintain protections for stream trout (Class 2Ag [SRT]).

d. Cloquet River watershed (04010202)

Class 2A designations

The following lakes will be confirmed or designated for the protection of coldwater aquatic life and habitat (Class 2A). A summary of the evidence supporting these draft use designations is provided in Table 24 and if needed, additional information is provided following this table. Available evidence demonstrates that these lakes support or should support naturally reproducing populations of Cisco or are managed for coldwater fish through stocking. The use designations for these lakes will be amended in Minn. R. 7050.0470 by updating the beneficial uses for lakes in the Cloquet River watershed (04010202).

Table 24. List of draft Class 2A use confirmations and designations for lakes in the Cloquet River watershed (04010202) with supporting information. Abbreviations and fisheries survey codes are described in the introduction of Appendix C.

Lake name	WID	GR	Fisheries survey: LAT	Fisheries survey: LKW	Fisheries survey: TLC	Fisheries survey: SRT	Current ALU	Draft ALU	Trout lake	Type
Briar	69-0128-00	4.00				RBT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Clearwater	69-0397-00	2.01				RBT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Donna	69-0941-00	3.46				BNT-C|Y|U	2B	2Ag[SRT]	Yes	2A
Sand (Loraine)	69-0016-00	3.73				RBT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC

Lake name	WID	GR	Fisheries survey: LAT	Fisheries survey: LKW	Fisheries survey: TLC	Fisheries survey: SRT	Current ALU	Draft ALU	Trout lake	Type
Smith	69-0111-00	1.88			U-4|1|20		2B	2Ag[TLC]	No	2A

Donna Lake (69-0941-00): Donna Lake is currently designated Class 2B and is not designated for the protection of any coldwater fish species. The MNDNR added Donna Lake to Minn. R. 6264.0050 as a trout lake in 2018 (State of Minnesota 2018) because this lake supports a small, self-sustaining population of Brook Trout that migrate from a connected stream. In addition, the MNDNR intends to manage the lake as a put-and-take Brown Trout fishery. Considering this information, it is reasonable to assign Class 2Ag for the protection of coldwater habitat to this lake. The designation will be based on protections for stream trout and will be designated Class 2Ag [SRT].

Class 2Bd designations

The following lake will be designated for the protection of warm and cool water aquatic life and habitat (Class 2Bd). A summary of the evidence supporting the use designation is provided in Table 25 and additional details are provided following the table. For this lake, the designation of Class 2Bd from Class 2A results in the designation of a beneficial use that carries with it less stringent standards. As a result, a use attainability analysis (40 CFR § 131.3(g)) is required by the CWA (40 CFR § 131.10(j)) to demonstrate that the current use designation is not an existing use (40 CFR § 131.3(e)) or an attainable use (40 CFR § 131.10(d)). Considering this information below, it is reasonable to assign Class 2Bdg to this lake for the protection of cool and warm waters also protected as a source of drinking water. The use designations for these lakes will be amended in Minn. R. 7050.0470 by updating the beneficial uses for lakes in the Cloquet River watershed (04010202).

Table 25: List of draft Class 2Bd use designations for lakes in the Cloquet River watershed (04010202) with supporting information. Abbreviations and fisheries survey codes are described in the introduction of Appendix C.

Lake name	WID	GR	Fisheries survey: LAT	Fisheries survey: LKW	Fisheries survey: TLC	Fisheries survey: SRT	Current ALU	Draft ALU	Trout lake	Type
Mirror	69-0234-00	2.03				NA-H|N|U	$2A^{SRT}$	2Bdg	No	2Bd

Mirror Lake (69-0234-00): Mirror Lake is currently designated Class 2A to protect stream trout. Mirror Lake is proposed to be designated as a cool and warm water aquatic life and habitat also protected as a source of drinking water (Class 2Bdg). The MNDNR removed Mirror Lake from its designated trout lakes list (Minn. R. 6264.0050) in 2010 due to limited success of Brown Trout and splake stocking. Poor survivorship was attributed to the presence of undesirable cool water fish species. Considering this information, it is reasonable to assign Class 2Bdg for the protection of cool and warm waters also protected as a source of drinking water (Class 2Bdg).

e. Nemadji River watershed (04010301)

No draft use designations or confirmations.

2. Lake of the Woods basin

a. Rainy River - Headwaters watershed (09030001)

Class 2A confirmations and designations

The following lakes will be confirmed or designated for the protection of coldwater aquatic life and habitat (Class 2A). A summary of the evidence supporting these use designations is provided in Table 26 and if needed, additional information is provided following this table. Available evidence demonstrates that these lakes support or should support naturally reproducing populations of Lake Trout, Lake Whitefish, or Cisco or the lakes are managed for coldwater fish through stocking. The use designations for these lakes will be amended in Minn. R. 7050.0470 by updating the beneficial uses for lakes in the Rainy River - Headwaters watershed (09030001).

Table 26. List of draft Class 2A use confirmations and designations for lakes in the Rainy River - Headwaters watershed (09030001) with supporting information. Abbreviations and fisheries survey codes are described in the introduction of Appendix C.

Lake name	WID	GR	Fisheries survey: LAT	Fisheries survey: LKW	Fisheries survey: TLC	Fisheries survey: SRT	Current ALU	Draft ALU	Trout lake	Type
Adams*	38-0153-00	1.47	E-0|4|0	P-4|0|267			$2A^{LAT}$	2Ag[LKW]	No	SM
Ahmakose*	38-0365-00	0.97	U-3|0|30				$2A^{LAT}$	2Ag[LAT]	No	SC
Ahsub*	38-0516-00	0.93	E-3|5|9		E-0|8|0	NA-H|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Alice*	38-0330-00	3.07		U-1|0|2	U-1|0|88		2Bd	2Ag[TLC]	No	2A
Alpine*	16-0759-00	2.39	U-2|2|3	U-4|0|471	U-2|2|359		$2A^{LAT}$	2Ag[LAT,LKW,TLC]	No	SM
Alruss*	69-0005-00	1.32				BKT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Amber*	38-0336-00	3.23		U-0|1|0	U-1|0|39		2Bd	2Ag[TLC]	No	2A
Amoeber*	38-0227-00	1.07	P-3|0|26		P-3|0|739		$2A^{LAT}$	2Ag[LAT,TLC]	No	SM
Ashdick (Caribou)*	38-0210-00	1.69			U-1|0|54		$2A^{SRT}$	2Ag[TLC]	No	SM
Ashigan*	38-0502-00	1.55			U-1|0|18		2Bd	2Ag[TLC]	No	2A
Basswood*	38-0645-00	2.86	U-0|6|0	P-4|2|38	P-6|0|524		$2A^{LAT}$	2Ag[LKW,TLC]	No	SM
Bat*	16-0752-00	0.79	P-4|1|77				$2A^{LAT}$	2Ag[LAT]	No	SC
Bear Island	69-0115-00	2.93	E-0|16|0		P-15|1|320		2B	2Ag[TLC]	No	2A
Bear Trap*	69-0089-00	2.28			U-1|0|102		2Bd	2Ag[TLC]	No	2A
Beaver (Elbow)*	38-0223-00	1.32			U-1|0|122		$2A^{SRT}$	2Ag[TLC]	No	SM
Beaver Hut	38-0737-00	3.56				NA-H|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC

Lake name	WID	GR	Fisheries survey: LAT	Fisheries survey: LKW	Fisheries survey: TLC	Fisheries survey: SRT	Current ALU	Draft ALU	Trout lake	Type
Beetle	38-0551-00	2.25				RBT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Bingshick*	16-0627-00	1.69				BKT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Blue Snow*	16-0532-00	1.38	U-0|0|0				$2Bd^{LAT}$	2Ag[LAT]	No	2A
Boot*	38-0503-00	1.16			P-3|0|45		2Bd	2Ag[TLC]	No	2A
Burntside	69-0118-00	1.51	P-33|12|778	P-36|9|2193	E-22|23|649		$2A^{LAT}$	2Ag[LAT,LKW,TLC]	No	SM
Cash (Cache)*	16-0438-00	1.52	U-1|0|5				$2A^{LAT}$	2Ag[LAT]	No	SC
Cedar	38-0810-00	2.69			P-5|8|24		2Bd	2Ag[TLC]	No	2A
Chant	69-0172-00	1.41				RBT,BKT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Cherokee*	16-0524-00	1.00	P-4|0|14				$2A^{LAT}$	2Ag[LAT]	No	SC
Cherry*	38-0166-00	1.03	P-3|0|11		P-3|0|193		$2A^{LAT}$	2Ag[LAT,TLC]	No	SM
Clearwater*	38-0638-00	2.86		U-1|0|7			2Bd	2Ag[LKW]	No	2A
Conchu*	38-0720-00	1.03				NA-H|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Crab*	69-0220-00	2.06			U-2|1|13		$2A^{SRT}$	2Ag[TLC]	No	SM
Crooked*	38-0817-00	3.71		U-3|0|18	U-3|0|340		$2A^{SRT}$	2Ag[LKW,TLC]	No	SM
Crooked*	16-0723-00	1.37	P-4|0|78				$2A^{LAT}$	2Ag[LAT]	No	SC
Cruiser[#]	69-0832-00	0.95	P-5|0|230				$2A^{LAT}$	2Ag[LAT]	No	SC
Cub	69-1318-00	1.07				BKT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Cummings*	69-0325-00	3.23			P-2|0|47		2Bd	2Ag[TLC]	No	2A
Dan	38-0853-00	1.65				SPT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Devils Elbow*	16-0616-00	1.42		U-2|0|22	U-2|0|22		2Bd	2Ag[LKW,TLC]	No	2A
Disappointment*	38-0488-00	2.66			U-8|0|883		2Bd	2Ag[TLC]	No	2A
Dry	69-0064-00	1.80			P-17|0|1275	BNT, SPT-C|Y|U	$2A^{SRT}$	2Ag[TLC,SRT]	Yes	SM
Eddy*	38-0187-00	1.01	U-0|2|0	U-2|0|260			$2A^{LAT}$	2Ag[LAT,LKW]	No	SM
Eikala	38-0677-00	1.47				BKT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Ester (Gnig)*	38-0207-00	1.04	P-2|0|33	P-2|0|154	P-1|1|26		$2A^{LAT}$	2Ag[LAT,LKW,TLC]	No	SM
Eugene*	69-0473-00	1.60		P-4|0|55	U-3|1|5		$2A^{SRT}$	2Ag[LKW]	No	SM
Explorer*	38-0399-00	0.93	U-1|0|25				$2A^{LAT}$	2Ag[LAT]	No	SC

Lake name	WID	GR	Fisheries survey: LAT	Fisheries survey: LKW	Fisheries survey: TLC	Fisheries survey: SRT	Current ALU	Draft ALU	Trout lake	Type
Extortion	16-0450-00	1.48				RBT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Farm*	38-0779-00	2.80		U-3|16|5	P-19|0|1544		2Bd	2Ag[TLC]	No	2A
Fat*	69-0481-00	1.69	U-6|0|382				$2A^{LAT}$	2Ag[LAT]	No	SC
Fay*	16-0783-00	1.16	U-2|0|5				$2A^{LAT}$	2Ag[LAT]	No	SC
Fenske	69-0085-00	1.95			P-9|1|72		2Bd	2Ag[TLC]	No	2A
Fern*	16-0716-00	1.09	U-2|0|12				$2A^{LAT}$	2Ag[LAT]	No	SC
Finger*	69-0348-00	1.77			U-1|0|151		$2A^{SRT}$	2Ag[TLC]	No	SM
Fishdance*	38-0343-00	1.86		U-1|0|53	U-1|0|179		$2A^{SRT}$	2Ag[LKW,TLC]	No	SM
Found*	38-0620-00	1.91				BKT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Fraser*	38-0372-00	1.29	U-2|0|25		U-2|0|290		$2A^{LAT}$	2Ag[LAT,TLC]	No	SM
French*	16-0755-00	0.64	U-3|0|6				$2A^{LAT}$	2Ag[LAT]	No	SC
Frost*	16-0571-00	1.34	U-3|0|50				$2A^{LAT}$	2Ag[LAT]	No	SC
Gabbro*	38-0701-00	2.97			P-3|0|288		2Bd	2Ag[TLC]	No	2A
Gabimichigami*	16-0811-00	0.74	P-4|0|69				$2A^{LAT}$	2Ag[LAT]	No	SC
Garden	38-0782-00	2.39		U-1|16|1	P-17|0|568		2B	2Ag[TLC]	No	2A
Ge-Be-On-Equat*	69-0350-00	2.41		P-6|0|81	P-5|1|191		$2A^{SRT}$	2Ag[LKW,TLC]	No	SM
Gibson*	38-0508-00	2.63			U-1|0|11		2Bd	2Ag[TLC]	No	2A
Gift*	38-0162-00	1.87		U-1|0|119			2Bd	2Ag[LKW]	No	2A
Gijikiki (Cedar)*	38-0209-00	1.04	U-1|0|6				$2A^{LAT}$	2Ag[LAT]	No	SC
Gillis*	16-0753-00	0.72	P-4|0|188				$2A^{LAT}$	2Ag[LAT]	No	SC
Glacier Pond 1	38-0712-01	4.41				RBT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Glacier Pond 2	38-0712-02	1.26				BKT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Gneiss*	16-0617-00	1.04	U-2|0|4	U-2|0|31	U-2|0|231		$2Bd^{LAT}$	2Ag[LAT,LKW,TLC]	No	2A
Good*	38-0726-00	1.87		P-1|2|1	P-3|0|149		2Bd	2Ag[TLC]	No	2A
Gordon*	16-0569-00	0.97	U-1|1|1				$2A^{LAT}$	2Ag[LAT]	No	SC
Granite*	16-0580-00	1.48		U-1|0|10	U-1|0|84		2Bd	2Ag[LKW,TLC]	No	2A
Gull*	16-0632-01	2.32		P-6|0|64	P-6|0|125		2Bd	2Ag[LKW,TLC]	No	2A
Gun*	69-0487-00	0.72	U-3|0|44		U-3|0|89		$2A^{LAT}$	2Ag[LAT,TLC]	No	SM

Lake name	WID	GR	Fisheries survey: LAT	Fisheries survey: LKW	Fisheries survey: TLC	Fisheries survey: SRT	Current ALU	Draft ALU	Trout lake	Type
Gunflint	16-0356-00	0.89	P-15|0|460		P-15|0|360		$2A^{LAT}$	2Ag[LAT,TLC]	No	SM
Gypsy	38-0665-00	2.87				BKT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Hanson*	38-0206-00	1.08	P-2|0|27	P-2|0|139	P-2|0|24		$2A^{LAT}$	2Ag[LAT,LKW,TLC]	No	SM
Hanson	69-0189-00	0.83				SPT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Harriet	38-0048-00	3.00		U-2|10|2			2B	2Ag[LKW]	Yes	2A
Heritage*	69-0469-00	2.46			U-2|0|114		2Bd	2Ag[TLC]	No	2A
High	69-0071-00	1.61				BKT,RBT,SPT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Hogback and Canal[19]	38-0057-01, -02	1.35-1.17				RBT, SPT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Holt*	38-0178-00	1.18	U-1|0|10				$2A^{LAT}$	2Ag[LAT]	No	SC
Horseshoe*	38-0580-00	2.47		U-1|0|20	U-1|0|22		2Bd	2Ag[LKW,TLC]	No	2A
Howard*	16-0789-00	0.78	U-2|0|51				$2A^{LAT}$	2Ag[LAT]	No	SC
Hudson*	38-0484-00	3.36		U-1|0|9	U-1|0|64		2Bd	2Ag[LKW,TLC]	No	2A
Hustler*	69-0343-00	1.43			P-4|1|47		$2A^{SRT}$	2Ag[TLC]	No	SM
Ima*	38-0400-00	1.18	U-3|1|64		U-4|0|344		$2A^{LAT}$	2Ag[LAT,TLC]	No	SM
Insula*	38-0397-00	3.09		U-4|0|15	U-4|0|415		2Bd	2Ag[LKW,TLC]	No	2A
Iron*	69-0121-00	2.73		P-1|1|1	P-2|0|122		2Bd	2Ag[TLC]	No	2A
Jacob (Louis)*	69-0077-00	1.08				BKT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Jasper*	16-0768-00	0.84	U-2|0|10	U-2|0|38			$2A^{LAT}$	2Ag[LAT,LKW]	No	SM
Jenny*	38-0194-01, -02	0.67 -0.81		U-1|0|63			2Bd	2Ag[LKW]	No	2A
Johnson	69-0691-00	1.90	E-1|9|3	P-10|0|514	P-9|1|663		$2A^{LAT}$	2Ag[LKW,TLC]	No	SM
Jordan*	38-0511-00	1.39			U-1|0|6		2Bd	2Ag[TLC]	No	2A
Jouppi	38-0909-00	2.09				RBT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Karl*	16-0461-00	1.17	U-1|1|1				$2A^{LAT}$	2Ag[LAT]	No	SC

[19] Both basins are listed together as Hogback (Twin) Lake in Minn. R. 6264.0050.

Lake name	WID	GR	Fisheries survey: LAT	Fisheries survey: LKW	Fisheries survey: TLC	Fisheries survey: SRT	Current ALU	Draft ALU	Trout lake	Type
Kek (Little Kekekabic)*	38-0228-00	0.55	U-1|0|18				$2A^{LAT}$	2Ag[LAT]	No	SC
Kekekabic*	38-0226-00	0.86	P-3|0|137				$2A^{LAT}$	2Ag[LAT]	No	SC
Kingfisher*	16-0812-00	1.73	U-1|0|1	U-1|0|28			2Bd	2Ag[LKW]	No	2A
Knife*	38-0404-00	1.57	P-7|0|154	P-7|0|717	P-7|0|808		$2A^{LAT}$	2Ag[LAT,LKW,TLC]	No	SM
Lac la Croix*	69-0224-00	2.16	P-5|2|172	P-6|1|479	P-6|1|2092		$2Bd^{LAT}$	2Ag[LAT,LKW,TLC]	No	2A
Lake of the Clouds (Dutton)*	38-0169-00	0.56	U-0|1|0[20]				$2A^{LAT}$	2Ag[LAT]	No	SC
Link*	38-0163-00	2.19		U-1|0|14			2Bd	2Ag[LKW]	No	2A
Little Dry	69-1040-00	1.89			U-6|11|75	BNT,SPT-C|Y|U	$2A^{SRT}$	2Ag[TLC,SRT]	Yes	SM
Little Knife*	38-0229-00	0.65	P-5|1|50	P-6|0|418	P-6|0|393		$2Bd^{LAT}$	2Ag[LAT,LKW,TLC]	No	2A
Little Long	69-0066-00	2.46	E-0|12|0		U-8|4|392		2Bd	2Ag[TLC]	No	2A
Little Loon*	69-0484-00	1.38		U-1|0|1	U-1|0|20		2Bd	2Ag[TLC]	No	2A
Little Saganaga*	16-0809-00	1.11	P-4|0|34				$2A^{LAT}$	2Ag[LAT]	No	SC
Little Shell*	69-0384-00	2.02			U-1|0|28		2Bd	2Ag[TLC]	No	2A
Little Trout[#]	69-0682-00	1.1	U-8|1|69		P-8|1|194		$2A^{LAT}$	2Ag[LAT,TLC]	No	SM
Little Vermilion*	69-0608-00	2.43		U-4|2|6	P-6|0|1332		2Bd	2Ag[TLC]	No	2A
Long Island*	16-0460-00	2.39	P-3|0|23				$2A^{LAT}$	2Ag[LAT]	No	SC
Loon*	69-0470-00	2.34	U-1|5|1	P-6|0|44	P-6|0|269		$2A^{LAT}$	2Ag[LKW,TLC]	No	SM
Loon	16-0448-00	0.70	P-16|0|414		P-16|0|1804		$2A^{LAT}$	2Ag[LAT,TLC]	No	SM
Lunar (Moon)*	38-0168-00	1.48	U-1|0|14				$2A^{LAT}$	2Ag[LAT]	No	SC
Lynx*	69-0383-00	1.26			U-2|0|56		$2A^{SRT}$	2Ag[TLC]	No	SM
Magnetic	16-0463-00	1.03	U-3|0|16		U-3|0|80		$2A^{LAT}$	2Ag[LAT,TLC]	No	SM
Makwa (Bear)*	38-0147-00	1.17	U-1|0|4				$2A^{LAT}$	2Ag[LAT]	No	SC
Malberg*	38-0090-00	3.18		P-2|0|118	M-1|1|43		2Bd	2Ag[LKW]	No	2A
Marabaeuf*	16-0610-00	2.12	U-1|1|5	U-2|0|57	U-2|0|71		$2Bd^{LAT}$	2Ag[LAT,LKW,TLC]	No	2A

[20] In addition to a standard gill net survey in 1973, test netting was performed in 1980 following the stocking of lake trout. The test netting sampled 8 lake trout.

Lake name	WID	GR	Fisheries survey: LAT	Fisheries survey: LKW	Fisheries survey: TLC	Fisheries survey: SRT	Current ALU	Draft ALU	Trout lake	Type
Mavis*	16-0528-00	0.79				BKT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Mayhew	16-0337-00	1.20	P-14|0|182			RBT-C|N|U	$2A^{LAT}$	2Ag[LAT,SRT]	No	SM
Meditation*	16-0583-00	1.96				BKT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Memegwesi	38-0440-00	2.24				BKT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Mesaba*	16-0673-00	1.53	U-2|1|3				$2A^{LAT}$	2Ag[LAT]	No	SC
Miner's Pit	69-1293-01, -02	0.64	E-0|4|0			BKT,BNT, RBT-C|Y|M	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Missing Link*	16-0529-00	2.57				BKT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Missionary*	38-0398-00	1.15	U-1|0|14				$2A^{LAT}$	2Ag[LAT]	No	SC
Moose*	38-0644-00	2.41		U-7|7|12	U-12|2|711		2Bd	2Ag[LKW,TLC]	No	2A
Mudro*	69-0078-00	1.06	U-0|4|0		P-3|1|55		2Bd	2Ag[TLC]	No	2A
Mukooda#	69-0684-00	1.77	P-9|1|115		P-10|0|2302		$2A^{LAT}$	2Ag[LAT,TLC]	No	SM
Namakan#	69-0693-00	1.82	U-0|47|0	P-34|13|151	P-47|0|5072		2Bd	2Ag[LKW,TLC]	No	2A
Neglige*	38-0492-00	1.06				BKT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Newfound*	38-0619-00	2.92		P-5|8|11	P-13|0|2398		2Bd	2Ag[LKW,TLC]	No	2A
Newton*	38-0784-00	2.65		U-2|8|3	U-9|1|88		2Bd	2Ag[TLC]	No	2A
Norberg	69-1312-00	1.57				BKT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
North (Little North)	16-0331-00	1.01	U-2|0|71		U-2|0|54		$2A^{LAT}$	2Ag[LAT,TLC]	No	SM
North Branch Kawishiwi*	38-0738-00	2.30			U-1|0|26		2Bd	2Ag[TLC]	No	2A
Norway	38-0688-00	2.53				SPT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Ogishkemuncie*	38-0180-00	1.97	P-5|0|17	P-5|0|499			$2A^{LAT}$	2Ag[LAT,LKW]	No	SM
Ojibway	38-0640-00	0.99	P-18|2|230		P-20|0|3395		$2A^{LAT}$	2Ag[LAT,TLC]	No	SM
One*	38-0605-00	2.51		P-4|3|25	P-7|0|253		2Bd	2Ag[LKW,TLC]	No	2A
Ottertrack (Cypress)*	38-0211-00	0.97	U-4|2|19	P-6|0|452	P-6|0|1831		$2Bd^{LAT}$	2Ag[LAT,LKW,TLC]	No	2A
Owl*	16-0726-00	1.10	U-2|0|3				$2A^{LAT}$	2Ag[LAT]	No	SC

Lake name	WID	GR	Fisheries survey: LAT	Fisheries survey: LKW	Fisheries survey: TLC	Fisheries survey: SRT	Current ALU	Draft ALU	Trout lake	Type
Oyster*	69-0330-00	1.06	U-5|3|34		U-4|4|58		$2A^{LAT}$	2Ag[LAT,TLC]	No	SM
Parent*	38-0526-00	2.41			P-10|0|880		2Bd	2Ag[TLC]	No	2A
Paulson*	16-0626-00	1.45	U-3|2|153			NA-H|Y|U	$2A^{LAT,SRT}$	2Ag[LAT]	No	SM
Peter*	16-0757-00	0.89	P-3|0|188				$2A^{LAT}$	2Ag[LAT]	No	SC
Portage	16-0327-00	1.77				SPT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Portage*	38-0524-00	1.63			U-1|0|70		$2A^{SRT}$	2Ag[TLC]	No	SM
Powell*	16-0756-00	0.93	U-2|0|9				$2A^{LAT}$	2Ag[LAT]	No	SC
Rabbit*	38-0214-00	0.96	U-1|0|21				$2A^{LAT}$	2Ag[LAT]	No	SC
Raven*	38-0113-00	1.70	U-1|0|13				$2A^{LAT}$	2Ag[LAT]	No	SC
Red Rock*	16-0793-00	1.88	U-1|3|1	U-4|0|37	U-3|1|140		$2A^{LAT}$	2Ag[LKW,TLC]	No	SM
Regenbogen	69-0081-00	1.41				SPT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Rog*	16-0765-00	1.77				NA-H|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Saganaga*	16-0633-00	2.74	P-14|1|178	P-15|0|1424	P-15|0|3905		$2A^{LAT}$	2Ag[LAT,LKW,TLC]	No	SM
Sand Point[#]	69-0617-00	1.18		P-26|15|55	P-41|0|4737		$2A^{SRT}$	2Ag[LKW,TLC]	No	SM
Scarp (Cliff)	38-0058-00	4.41				RBT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Sea Gull*	16-0629-00	1.60	P-14|0|252	P-14|0|2172	U-11|3|248		$2A^{LAT}$	2Ag[LAT,LKW,TLC]	No	SM
Section Eight	38-0258-00	1.70				BKT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Section Twelve	38-0714-00	1.33			P-13|1|309		2B	2Ag[TLC]	No	2A
Sema*	38-0386-00	1.09	P-3|0|51				$2A^{LAT}$	2Ag[LAT]	No	SC
Shagawa	69-0069-00	3.78		U-2|16|5	P-18|0|1182		2B	2Ag[TLC]	No	2A
Shoofly	38-0422-00	1.89				BKT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Skull*	38-0624-00	1.58	E-1|14|1			BKT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Slim*	69-0181-00	2.24	E-0|7|0		P-4|3|36		2Bd	2Ag[TLC]	No	2A
Snowbank*	38-0529-00	1.44	P-20|8|413		P-23|5|1465		$2A^{LAT}$	2Ag[LAT,TLC]	No	SM
South Farm*	38-0778-00	4.25			P-16|0|1699		2Bd	2Ag[TLC]	No	2A
South Hegman*	69-0075-02	1.56			P-6|0|135		2Bd	2Ag[TLC]	No	2A
Spoon (Fames)*	38-0388-00	1.23		P-1|1|58	M-1|1|36		$2A^{SRT}$	2Ag[LKW]	No	SM

<table>
<tr><th>Lake name</th><th>WID</th><th>GR</th><th>Fisheries survey: LAT</th><th>Fisheries survey: LKW</th><th>Fisheries survey: TLC</th><th>Fisheries survey: SRT</th><th>Current ALU</th><th>Draft ALU</th><th>Trout lake</th><th>Type</th></tr>
<tr><td>Spring</td><td>69-0761-00</td><td>1.68</td><td>U-3|6|29</td><td>P-9|0|760</td><td>P-9|0|1007</td><td></td><td>$2A^{LAT}$</td><td>2Ag[LKW,TLC]</td><td>No</td><td>SM</td></tr>
<tr><td>Steamhaul</td><td>38-0570-00</td><td>3.26</td><td></td><td></td><td></td><td>NA-H|Y|U</td><td>$2A^{SRT}$</td><td>2Ag[SRT]</td><td>Yes</td><td>SC</td></tr>
<tr><td>Steep*</td><td>69-0475-00</td><td>2.07</td><td></td><td></td><td>P-2|0|6</td><td></td><td>2Bd</td><td>2Ag[TLC]</td><td>No</td><td>2A</td></tr>
<tr><td>Strup*</td><td>38-0360-00</td><td>0.72</td><td>U-0|0|0 [21]</td><td></td><td></td><td></td><td>$2A^{LAT}$</td><td>2Ag[LAT]</td><td>No</td><td>SC</td></tr>
<tr><td>Stuart*</td><td>69-0205-00</td><td>3.45</td><td></td><td></td><td>P-4|3|32</td><td></td><td>2Bd</td><td>2Ag[TLC]</td><td>No</td><td>2A</td></tr>
<tr><td>Sucker*</td><td>38-0530-00</td><td>3.83</td><td></td><td>U-1|11|4</td><td>P-12|0|2097</td><td></td><td>2Bd</td><td>2Ag[TLC]</td><td>No</td><td>2A</td></tr>
<tr><td>Surber</td><td>16-0343-00</td><td>2.08</td><td></td><td></td><td></td><td>BKT-C|Y|U</td><td>$2A^{SRT}$</td><td>2Ag[SRT]</td><td>Yes</td><td>SC</td></tr>
<tr><td>Takucmich*</td><td>69-0369-00</td><td>0.75</td><td>P-6|0|77</td><td></td><td>P-6|0|475</td><td></td><td>$2A^{LAT}$</td><td>2Ag[LAT,TLC]</td><td>No</td><td>SM</td></tr>
<tr><td>Thomas*</td><td>38-0351-00</td><td>1.47</td><td>P-2|1|23</td><td></td><td>P-2|1|157</td><td></td><td>$2A^{LAT}$</td><td>2Ag[LAT,TLC]</td><td>No</td><td>SM</td></tr>
<tr><td>Three*</td><td>38-0600-00</td><td>3.90</td><td></td><td>P-1|1|21</td><td>P-2|0|57</td><td></td><td>2Bd</td><td>2Ag[LKW,TLC]</td><td>No</td><td>2A</td></tr>
<tr><td>Thumb*</td><td>69-0352-00</td><td>1.36</td><td></td><td></td><td>U-1|0|68</td><td></td><td>$2A^{SRT}$</td><td>2Ag[TLC]</td><td>No</td><td>SM</td></tr>
<tr><td>Toe*</td><td>69-0213-00</td><td>1.65</td><td></td><td></td><td>U-1|0|9</td><td></td><td>2Bd</td><td>2Ag[TLC]</td><td>No</td><td>2A</td></tr>
<tr><td>Tofte</td><td>38-0724-00</td><td>1.27</td><td></td><td></td><td>E-1|11|19</td><td>RBT, SPT-C|Y|U</td><td>$2A^{SRT}$</td><td>2Ag[SRT]</td><td>Yes</td><td>SC</td></tr>
<tr><td>Topaz (Star)*</td><td>38-0172-00</td><td>1.82</td><td>U-1|1|5</td><td></td><td>P-2|0|284</td><td></td><td>$2A^{LAT}$</td><td>2Ag[TLC]</td><td>No</td><td>SM</td></tr>
<tr><td>Town*</td><td>16-0458-00</td><td>1.33</td><td>U-0|0|0 [22]</td><td></td><td></td><td></td><td>$2A^{LAT}$</td><td>2Ag[LAT]</td><td>No</td><td>SC</td></tr>
<tr><td>Trappers</td><td>38-0431-00</td><td>4.20</td><td></td><td></td><td></td><td>BKT-C|Y|N</td><td>$2A^{SRT}$</td><td>2Ag[SRT]</td><td>Yes</td><td>SC</td></tr>
<tr><td>Triangle</td><td>38-0715-00</td><td>2.52</td><td></td><td></td><td>P-10|1|317</td><td></td><td>2B</td><td>2Ag[TLC]</td><td>No</td><td>2A</td></tr>
<tr><td>Trip</td><td>16-0451-00</td><td>2.55</td><td></td><td></td><td></td><td>NA-H|Y|U</td><td>$2A^{SRT}$</td><td>2Ag[SRT]</td><td>Yes</td><td>SC</td></tr>
<tr><td>Trygg (Twigg)*</td><td>69-0389-00</td><td>1.63</td><td></td><td></td><td></td><td>BKT-C|Y|U</td><td>$2A^{SRT}$</td><td>2Ag[SRT]</td><td>Yes</td><td>SC</td></tr>
<tr><td>Tuscarora*</td><td>16-0623-00</td><td>1.07</td><td>U-3|0|83</td><td></td><td></td><td></td><td>$2A^{LAT}$</td><td>2Ag[LAT]</td><td>No</td><td>SC</td></tr>
<tr><td>Two*</td><td>38-0608-00</td><td>3.61</td><td></td><td>P-3|1|12</td><td>P-4|0|185</td><td></td><td>2Bd</td><td>2Ag[LKW,TLC]</td><td>No</td><td>2A</td></tr>
<tr><td>Unnamed (Peanut)</td><td>38-0662-00</td><td>1.80</td><td></td><td></td><td></td><td>BKT-C|Y|U</td><td>$2A^{SRT}$</td><td>2Ag[SRT]</td><td>Yes</td><td>SC</td></tr>
<tr><td>Unnamed (Little Portage)</td><td>16-0297-00</td><td>1.77</td><td></td><td></td><td></td><td>BKT-C|Y|U</td><td>$2A^{SRT}$</td><td>2Ag[SRT]</td><td>Yes</td><td>SC</td></tr>
</table>

[21] Eight lake trout were sampled in a 1978 fisheries survey.
[22] One lake trout sampled in 1990.

Lake name	WID	GR	Fisheries survey: LAT	Fisheries survey: LKW	Fisheries survey: TLC	Fisheries survey: SRT	Current ALU	Draft ALU	Trout lake	Type
Unnamed (Pear)	38-0769-00	3.36				BKT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Unnamed (Judd)	38-0615-00	2.80				RBT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Unnamed (Ennis)	38-0634-00	1.36				SPT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Vera*	38-0491-00	1.88	E-0|5|0		U-4|1|492		$2A^{SRT}$	2Ag[TLC]	No	SM
West Fern*	16-0718-00	1.32	U-2|0|16				$2A^{LAT}$	2Ag[LAT]	No	SC
Windy	38-0068-00	3.11		P-12|0|1499			2B	2Ag[LKW]	No	2A
Wine*	16-0686-00	1.92	U-2|1|23				$2A^{LAT}$	2Ag[LAT]	No	SC
Wisini*	38-0361-00	0.62	U-2|0|67				$2A^{LAT}$	2Ag[LAT]	No	SC

*** Partially or fully within the Boundary Waters Canoe Area Wilderness.**

 # Partially or fully within Voyageurs National Park.

Adams Lake (38-0153-00): The current Class 2A designation for Adams Lake was assigned to protect Lake Trout and it is listed as an “inland lake trout lake” in Minnesota Department of Conservation (1967). Lake Trout are not considered to be native to this lake but were historically stocked. Four MNDNR fisheries surveys did not sample any Lake Trout and this species is not considered to be self-sustaining in Adams Lake. As a result, Adams Lake is will not retain protections for Lake Trout. Adams Lake does support a natural population of Lake Whitefish as determined by the presence of this species in all four MNDNR fisheries surveys. Considering this information, it is reasonable to retain the Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Lake Whitefish (Class 2Ag [LKW]). This lake is in the BWCAW and therefore retains the prohibited ORVW designation.

Ahsub Lake (38-0516-00): The current Class 2A designation for Ahsub Lake was assigned to protect stream trout. Management of stream trout in Ahsub Lake was discontinued although this lake is still a designated trout lake (Minn. R. 6264.0050). Lake Trout are not native to this lake but were stocked in 1979. This stocking did not result in a self-sustaining Lake Trout population. Cisco were also historically present in Ahsub Lake, but surveys from 1966-2005 did not sample this species and Cisco are considered extirpated. This lake is currently designated Class 2Ag and this use (Class 2Ag [SRT]) will be retained until the MNDNR removes this lake from its list of designated trout lakes or additional information indicates its removal is appropriate. This lake is not currently designated as a Lake Trout lake, so the draft designation does not result in the removal of a Lake Trout lake designation.

Alice Lake (38-0330-00): Alice Lake is currently designated Class 2Bd and is not designated for the protection of any coldwater fish species. Alice Lake was surveyed once in 1979 and a high number of Cisco (n=88) were sampled. In this survey, a fish specimen was identified as a Lake Whitefish, but this likely represents a misidentification. This lake is in the BWCAW and despite limited monitoring data, it is reasonable to designate Alice Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]). Due to the limited monitoring data (i.e., a single fisheries survey), it is possible that additional information could result in a change to this designation.

Alpine Lake (16-0759-00): The current Class 2A designation for Alpine Lake was assigned to protect Lake Trout. It is listed as an "inland lake trout lake" in Minnesota Department of Conservation (1967) which also notes that it has "marginal" dissolved oxygen conditions. Lake Trout are considered to be native to this lake, but available data are limited due to the difficulty of sampling this lake. Lake Trout were sampled in two MNDNR fisheries surveys of Alpine Lake (1982 and 1990). As a result, Alpine Lake will retain the designation for the protection of Lake Trout, but additional work may demonstrate the protection of Lake Trout is not an existing use. Based on MNDNR fisheries surveys, Alpine Lake supports natural populations of Cisco and Lake Whitefish. Considering this information, it is reasonable to retain the Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Lake Trout, Lake Whitefish, and Cisco (Class 2Ag [LAT,LKW,TLC]).

Ashdick Lake (38-0210-00): The current Class 2A designation for Ashdick Lake was assigned to protect stream trout although this lake is not included on the MNDNR's trout lakes list (Minn. R. 6264.0050). It is listed as a "potential inland lake trout lake" in Minnesota Department of Conservation (1967) which also notes that dissolved oxygen conditions are "doubtful." A survey in 1973 did not sample any Lake Trout although high numbers of Cisco (n=54) were sampled indicating that Ashdick Lake supports a natural population of Cisco. Considering this information, it is reasonable to retain the Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]). Due to the limited monitoring data (i.e., a single fisheries survey), it is possible that additional information could result in a change to this designation. This lake is not currently designated as a Lake Trout lake, so the draft designation does not result in the removal of a Lake Trout lake designation.

Ashigan Lake (38-0502-00): Ashigan Lake is currently designated Class 2Bd and is not designated for the protection of coldwater fish species. Ashigan Lake was surveyed once in 1974 and a moderate number of Cisco were collected (n=18). However, because this lake is in the BWCAW, it is reasonable to assign the Class 2Ag designation for the protection of Cisco (Class 2Ag [TLC]). Due to the limited monitoring data (i.e., a single fisheries survey), it is possible that additional information could result in a change to this designation.

Basswood Lake (38-0645-00): The current Class 2A designation for Basswood Lake was assigned to protect Lake Trout. Lake Trout are considered native to this lake although they were stocked in 1941. No MNDNR fisheries surveys (n=6) on the Minnesota side of Basswood Lake have sampled Lake Trout and most of the habitat considered suitable for Lake Trout is on the Canadian side of the lake. Basswood Lake supports a population of Lake Trout although the fish are more prevalent on the Canadian side of the lake. Due to the size and complexity of Basswood Lake, application of standards to protect Lake Trout on the Minnesota side of the lake are not appropriate. If it can be determined that Lake Trout habitat is present on the Minnesota side of this lake, then designation of Lake Trout can be pursued. However, without the demonstration that Lake Trout habitat is present on the Minnesota side, assessment errors could occur due to natural conditions. Basswood Lake does support natural populations of Cisco and Lake Whitefish. Considering this information, it is reasonable to retain the Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Lake Whitefish and Cisco (Class 2Ag [LKW,TLC]). This lake is partially within the BWCAW and therefore retains the prohibited ORVW designation.

Bear Trap Lake (69-0089-00): Bear Trap Lake is currently designated Class 2Bd and is not designated for the protection of coldwater fish species. Bear Trap Lake was surveyed once in 1973 and a high number of Cisco were collected (n=102). However, because this lake is in the BWCAW, it is reasonable to assign the Class 2Ag designation for the protection of Cisco (Class 2Ag [TLC]). Due to the limited monitoring data (i.e., a single fisheries survey), it is possible that additional information could result in a change to this designation.

Beaver (Elbow) Lake (38-0223-00): Beaver Lake is designated Class 2A to protect stream trout although this lake is not included on the MNDNR's trout lakes list (Minn. R. 6264.0050). It is listed as a "potential inland lake trout lake" in Minnesota Department of Conservation (1967), but there is no record of a Lake Trout population in this lake. Beaver Lake was surveyed once in 1964 and a high number of Cisco were collected (n=122). This lake is in the BWCAW and it is reasonable to assign the Class 2Ag designation for the protection of Cisco (Class 2Ag [TLC]). Due to the limited monitoring data (i.e., a single fisheries survey), it is possible that additional information could result in a change to this designation. This lake is not currently designated as a Lake Trout lake, so the draft designation does not result in the removal of a Lake Trout lake designation.

Beaver Hut Lake (38-0737-00): Beaver Hut Lake is designated Class 2A to protect stream trout although this lake is not included on the MNDNR's trout lakes list (Minn. R. 6264.0050). Management of stream trout in Beaver Hut Lake was discontinued due to low survival and poor summer oxythermal conditions. However, this lake is still a designated by the DNR as a trout lake (Minn. R. 6264.0050). Beaver Hut Lake is currently designated Class 2Ag and this use (Class 2Ag [SRT]) will be retained until the MNDNR removes this lake from the list of designated trout lakes or additional information indicates its removal is appropriate.

Blue Snow Lake (16-0532-00): Blue Snow Lake is currently designated Class 2Bd, but it is listed for the protection of Lake Trout. There are no MNDNR fisheries surveys to demonstrate the presence of a population of Lake Trout. The lack of monitoring is due to its location in the BWCAW and the lack of an established portage to reach this lake. However, there are numerous angler reports, as recent as 2013, which indicate that Lake Trout are present in Blue Snow Lake. As a result, it is reasonable to designate Blue Snow Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Lake Trout (Class 2Ag [LAT]). Due to the lack of monitoring data, it is possible that additional information could result in a change to this designation.

Clearwater Lake (38-0638-00): Clearwater Lake is currently designated Class 2Bd and is not designated for the protection of any coldwater fish species. It was surveyed once in 1977 and 7 Lake Whitefish were collected. However, because this lake is in the BWCAW it is reasonable to designate Clearwater Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Lake Whitefish (Class 2Ag [LKW]). Due to the limited monitoring data (i.e., a single fisheries survey), it is possible that additional information could result in a change to this designation.

Conchu Lake (38-0720-00): Conchu Lake is designated Class 2A to protect stream trout, but management of stream trout has been discontinued. However, this lake is still a designated trout lake on the MNDNR's designated trout lakes list (Minn. R. 6264.0050). Conchu Lake is currently designated Class 2Ag and this use (Class 2Ag [SRT]) will be retained until the MNDNR removes this lake from the list of designated trout lakes or additional information indicates its removal is appropriate.

Crab Lake (69-0220-00): The current Class 2A designation for Crab Lake was assigned to protect stream trout although this lake is not included on the MNDNR's trout lakes list (Minn. R. 6264.0050). It is listed as a "potential inland lake trout lake" in Minnesota Department of Conservation (1967) which also notes that dissolved oxygen conditions are "doubtful." Three fisheries surveys from 1950 through 2001 did not sample any Lake Trout. However, based on these fisheries surveys, Crab Lake does support a natural population of Cisco. Considering this information, it is reasonable to retain the Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]). This lake is not currently designated as a Lake Trout lake, so the draft designation does not result in the removal of a Lake Trout lake designation.

Crooked Lake (38-0817-00): The current Class 2A designation for Crooked Lake was assigned to protect stream trout although this lake is not included on the MNDNR's trout lakes list (Minn. R. 6264.0050). It is listed as a "Minnesota-Ontario boundary potential lake trout lake" in Minnesota Department of Conservation (1967). Three fisheries surveys from 1983 through 2007 did not sample any Lake Trout. Fisheries surveys do indicate that Crooked Lake supports natural populations of Cisco and Lake Whitefish. Considering this information, it is reasonable to retain the Class 2Ag classification assigned to coldwater aquatic life and habitat and assign protections for Cisco and Lake Whitefish (Class 2Ag [LKW,TLC]). This lake is not currently designated as a Lake Trout lake, so the draft designation does not result in the removal of a Lake Trout lake designation.

Eddy Lake (38-0187-00): The current Class 2A designation for Eddy Lake was assigned to protect Lake Trout. It is listed as a "potential inland lake trout lake" in Minnesota Department of Conservation (1967) which also notes that dissolved oxygen conditions are "good." Lake Trout are considered to be native to this lake. This lake is in the BWCAW and there is limited water quality and fisheries information. Two MNDNR fisheries surveys were conducted in 1972 and 1985 and one Lake Trout was captured in the 1972 survey. Lake Trout fingerlings were stocked from 1976-1979 and 1982 and some Lake Trout were reported in a winter 1979 creel census. Indications are that there was minimal or no survival of stocked fish and that there is not an extant population in this lake. Since there is limited information and the existing use status of the Lake Trout population cannot be determined, the protections for Lake Trout will be retained. Additional information could result in the removal of the Lake Trout designation if appropriate. Eddy Lake does support a natural population of Lake Whitefish which should be protected. Considering this information, it is reasonable to retain the Class 2Ag classification assigned to coldwater aquatic life and habitat and assign protections for Lake Trout and Lake Whitefish (Class 2Ag [LAT,LKW]).

Eugene Lake (69-0473-00): The current Class 2A designation for Eugene Lake was assigned to protect stream trout although this lake is not included on the MNDNR's trout lakes list (Minn. R. 6264.0050). It is listed as a "potential inland lake trout lake" in Minnesota Department of Conservation (1967) which also notes that dissolved oxygen conditions are "fair." This lake is in the BWCAW and there is limited water quality and fisheries information. Four MNDNR fisheries surveys were conducted between 1965 and 2016 and no Lake Trout were captured. Eugene Lake does support a natural population of Lake Whitefish which should be protected. Low numbers of Cisco were also collected in three MNDNR fisheries surveys from 1965 through 2001. This lake will not be designated for the protection of Cisco until additional data can be collected. Considering this information, it is reasonable to retain the Class 2Ag classification assigned to coldwater aquatic life and habitat and assign protections for Lake Whitefish (Class 2Ag [LKW]). This lake is not currently designated as a Lake Trout lake, so the draft designation does not result in the removal of a Lake Trout lake designation.

Explorer Lake (38-0399-00): The current Class 2A designation for Explorer Lake was assigned to protect Lake Trout. Explorer Lake was surveyed once in 1972 and a moderate number of Lake Trout (n=25) were sampled. This lake is in the BWCA and despite limited monitoring data from Explorer Lake, it is reasonable to retain the Class 2Ag designation for the protection of Lake Trout (Class 2Ag [LAT]). Due to limited monitoring data (i.e., a single fisheries survey) from this lake, it is possible that additional information could result in a change to this designation.

Farm Lake (38-0779-00): Farm Lake is currently designated Class 2Bd and is not designated for the protection of coldwater fish species. Nineteen MNDNR fisheries surveys have been conducted and every survey sampled Cisco indicating that this lake supports a good population of Cisco. In addition to Cisco, Lake Whitefish have also been sampled in Farm Lake. However, Lake Whitefish have been irregularly sampled and the status of a potential population is unknown. Farm Lake is connected to the Kawishiwi River and thereby to other lakes supporting Lake Whitefish which could be the source of transient fish. Additional sampling is recommended, particularly using deep-set gill nets, to determine if Farm Lake should also be protected for Lake

Whitefish. Considering this information, it is reasonable to designate Farm Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]).

Fay Lake (16-0783-00): The current Class 2A designation for Fay Lake was assigned to protect Lake Trout. Fay Lake was surveyed twice (1986 and 1996) and 5 Lake Trout were sampled. Lake Trout were also observed in the first survey conducted in 1939. This lake is in the BWCAW and despite limited sampling for Fay Lake, it is reasonable to retain a Class 2Ag designation for the protection of Lake Trout (Class 2Ag [LAT]). Due to the limited monitoring data (i.e., two fisheries surveys indicating a small population), it is possible that additional information could result in a change to this designation.

Finger Lake (69-0348-00): The current Class 2A designation for Finger Lake was assigned to protect stream trout although this lake is not included on the MNDNR's trout lakes list (Minn. R. 6264.0050). It is listed as a "potential inland lake trout lake" in Minnesota Department of Conservation (1967) which also notes that dissolved oxygen conditions are "fair." This lake is in the BWCAW and there is limited water quality and fisheries information, but there is no evidence of a Lake Trout population. Finger Lake was surveyed once in 1980 and a high number of Cisco (n=151) were sampled. This lake is in the BWCAW and despite limited monitoring data, it is reasonable to designate Finger Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]). Due to the limited monitoring data from this lake (i.e., a single fisheries survey), it is possible that additional information could result in a change to this designation. This lake is not currently designated as a Lake Trout lake, so the draft designation does not result in the removal of a Lake Trout lake designation.

Fishdance Lake (38-0343-00): The current Class 2A designation for Fishdance Lake was assigned to protect stream trout although this lake is not included on the MNDNR's trout lakes list (Minn. R. 6264.0050). It is listed as a "potential inland lake trout lake" in Minnesota Department of Conservation (1967). This lake is in the BWCAW and there is limited water quality and fisheries information. A single MNDNR fisheries survey was conducted in 1964 and no Lake Trout were captured. However, during this single survey, high numbers of Cisco (n=100) and Lake Whitefish (n=53) were sampled indicating that this lake does support natural populations of these coldwater fishes. Considering this information, it is reasonable to retain the Class 2Ag classification assigned to coldwater aquatic life and habitat and assign protections for Cisco and Lake Whitefish (Class 2Ag [TLC,LKW]). This lake is not currently designated as a Lake Trout lake, so the draft designation does not result in the removal of a Lake Trout lake designation. Due to the limited monitoring data from this lake (i.e., a single fisheries survey), it is possible that additional information could result in a change to this designation.

Fraser Lake (38-0372-00): The current Class 2A designation for Fraser Lake was assigned to protect Lake Trout. It is listed as an "inland lake trout lake" in Minnesota Department of Conservation (1967) and notes that "walleyes dominate." Fraser Lake was surveyed twice (1976 and 1986) and 25 Lake Trout were sampled. Angler reports indicate that Lake Trout are still likely present, but additional sampling is recommended to confirm the presence of Lake Trout. This lake is in the BWCAW and despite limited monitoring data from Fraser Lake, it is reasonable to retain the Class 2Ag designation for the protection of Lake Trout (Class 2Ag [LAT]). Due to the limited monitoring data from this lake (i.e., two fisheries surveys), it is possible that additional information could result in a change to this designation.

French Lake (16-0755-00): The current Class 2A designation for French Lake was assigned to protect Lake Trout. French Lake was surveyed three times (1982, 1992, and 1996) and 6 Lake Trout were sampled. This lake is in the BWCAW and despite limited monitoring data from French Lake, it is reasonable to retain the Class 2Ag designation for the protection of Lake Trout (Class 2Ag [LAT]). Due to the limited monitoring data for this lake (i.e., limited sampling and low Lake Trout abundance), it is possible that additional information could result in a change to this designation.

Garden Lake (38-0782-00): Garden Lake is currently designated Class 2Bd and it is not designated for the protection of any coldwater fish species. Seventeen MNDNR fisheries surveys have been conducted in Garden Lake which have demonstrated that this lake supports a population of Cisco. A single Lake Whitefish was also sampled in 1989, but this fish may have been transient. Garden Lake is connected to the Kawishiwi River and through this waterway to other lakes supporting Lake Whitefish which could be the source of transient fish. This lake will not be designated for the protection of Lake Whitefish until additional data can be collected to confirm the presence of a resident population of Lake Whitefish. Considering this information, it is reasonable to designate Garden Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]).

Ge-Be-On-Equat Lake (69-0350-00): The current Class 2A designation for Ge-Be-On-Equat Lake was assigned to protect stream trout although this lake is not included on the MNDNR's trout lakes list (Minn. R. 6264.0050). It is listed as a "potential inland lake trout lake" in Minnesota Department of Conservation (1967) which also notes that dissolved oxygen conditions are "poor." Five MNDNR fisheries surveys have been conducted between 1981 and 2009 and no Lake Trout have been sampled. However, during these surveys, Cisco and Lake Whitefish were sampled during most surveys, indicating that this lake supports natural populations of these coldwater fishes. Considering this information, it is reasonable to retain the Class 2Ag classification assigned to coldwater aquatic life and habitat and assign protections for Cisco and Lake Whitefish (Class 2Ag [TLC,LKW]). This lake is not currently designated as a Lake Trout lake, so the draft designation does not result in the removal of a Lake Trout lake designation.

Gibson Lake (38-0508-00): Gibson Lake is currently designated Class 2Bd and is not designated for the protection of coldwater fish species. Gibson Lake was surveyed once in 1982 and a moderate number of Cisco (n=11) were sampled. This lake is in the BWCAW and despite limited monitoring data, it is reasonable to designate Gibson Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]). Due to the limited monitoring data from this lake (i.e., a single fisheries survey), it is possible that additional information could result in a change to this designation.

Gift Lake (38-0162-00): Gift Lake is currently designated Class 2Bd and it is not designated for the protection of any coldwater fish species. Gift Lake was surveyed once in 1973 and a high number of Lake Whitefish (n=119) were sampled. This lake is in the BWCAW and despite limited monitoring data, it is reasonable to designate Gift Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Lake Whitefish (Class 2Ag [LKW]). Due to the limited monitoring data (i.e., a single fisheries survey), it is possible that additional information could result in a change to this designation.

Gijikiki Lake (38-0209-00): The current Class 2A designation for Gijikiki Lake is based on protections for Lake Trout. Gijikiki Lake was surveyed once in 1976 and a moderate number of Lake Trout (n=6) were sampled. This lake is in the BWCAW and despite limited monitoring data from Gijikiki Lake, it is reasonable to retain a Class 2Ag designation for the protection of Lake Trout (Class 2Ag [LAT]). Due to the limited monitoring data (i.e., a single fisheries survey), it is possible that additional information could result in a change to this designation.

Gneiss Lake (16-0617-00): The current Class 2A designation for Gneiss Lake was assigned to protect Lake Trout. Gneiss Lake was surveyed twice (1978 and 1999) and low numbers of Lake Trout were sampled (n=4). However, Lake Trout were sampled in both fisheries surveys indicating the possible presence of a natural population of this species although this lake is also connected to Marabaeuf Lake (16-0610-00) and Gunflint Lake (16-0356-00). Moderate to high numbers of Lake Whitefish and Cisco were also sampled in these two surveys. This lake is in the BWCAW and despite limited monitoring data from Gneiss Lake, it is reasonable to retain the Class 2Ag designation for the protection of coldwater aquatic life and habitat and assign protections for Lake Trout, Lake Whitefish, and Cisco (Class 2Ag [LAT,LKW,TLC]). Due to the limited monitoring data (i.e., two fisheries surveys), it is possible that additional information could result in a change to this designation.

Good Lake (38-0726-00): Good Lake is currently designated Class 2Bd and it is not designated for the protection of any coldwater fish species. Good Lake has been surveyed by the MNDNR three times (1975, 1988, and 2019) and Cisco were collected in all three surveys. A single Lake Whitefish was also sampled in 2019, but this fish may have been transient from Basswood Lake (38-0645-00). This lake will not be designated for the protection of Lake Whitefish until additional data can be collected to confirm the presence of a resident population of Lake Whitefish. Considering this information, it is reasonable to designate Good Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]).

Gordon Lake (16-0569-00): Gordon Lake is currently designated Class 2A to protect Lake Trout. It is listed as a “potential inland lake trout lake” in Minnesota Department of Conservation (1967) and a single Lake Trout was sampled in two MNDNR fisheries surveys. However, this fish was possibly transient as Gordon Lake is connected to Cherokee (16-0524-00) and Long Island (16-0460-00) lakes. Gordon lake is deep (Z_{max} = 29 m) with a low geometry ratio (0.97), but it is also relatively small (58 ha) indicating that the extent of Lake Trout habitat in this lake would be limited. The available data suggest that a small population of Lake Trout is possibly preset in Gordon which may be supplemented by connected lakes. However, the presence or absence of such a population cannot be confirmed based on these data. Due to the limited information for Gordon Lake, it is reasonable to retain a Class 2Ag designation for the protection of Lake Trout (Class 2Ag [LAT]). Due to the limited monitoring data (i.e., two fisheries surveys) and low catch, it is possible that additional information could result in a change to this designation.

Granite Lake (16-0580-00): Granite Lake is currently designated Class 2Bd and it is not designated for the protection of any coldwater fish species. Granite Lake was surveyed once in 1978 and a moderate number of Lake Whitefish (n=10) and a high number of Cisco (n=84) were sampled. This lake is in the BWCAW and despite limited monitoring data, it is reasonable to designate Granite Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Lake Whitefish and Cisco (Class 2Ag [LKW,TLC]). Due to the limited monitoring data (i.e., a single fisheries survey), it is possible that additional information could result in a change to this designation.

Gull Lake (16-0632-01): Gull Lake is delineated into two basins in the MPCA’s waterbody database. Only the main basin (16-0632-01) appears to be deep enough to support coldwater fish species. The other basin, southeast basin of Gull Lake (16-0632-02), is shallow (1.2 m maximum depth) and unlikely to support coldwater fishes during the period of maximum oxythermal stress. The MNDNR has consistently sampled Lake Whitefish and Cisco in this lake indicating that these species are supported in this lake. Considering this information, it is reasonable to designate the main basin of Gull Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Lake Whitefish and Cisco (Class 2Ag [LKW,TLC]).

Harriet Lake (38-0048-00): Harriet Lake is currently designated Class 2B and it is not designated for the protection of any coldwater fish species. Lake Whitefish (n=2) were sampled in Harriet Lake in two MNDNR fisheries surveys, including a 2013 MNDNR survey indicating this species is present. In addition, Lake Whitefish were harvested by commercial fishermen in 1981 from Harriet Lake. Despite limited numbers of Lake Whitefish in fisheries surveys, it is reasonable to designate Harriet Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Lake Whitefish (Class 2Ag [LKW]).

Hogback (Twin) Lake (38-0057-01,-02): Hogback Lake consists of two distinct bays and both are designated trout lakes (Minn. R. 6264.0050). It is reasonable to retain a Class 2Ag for the protection of stream trout (Class 2Ag [SRT]) in both bays. These bays are named Hogback (38-0057-01) and Canal (38-0057-02) and this nomenclature will be clarified in Minn. R. 7050.0470 as part of this revision.

Holt Lake (38-0178-00): The current Class 2A designation for Holt Lake was assigned to protect Lake Trout. Holt Lake was surveyed once in 1979 and a moderate number of Lake Trout (n=10) were sampled. This lake is in the BWCAW and despite limited monitoring data from Holt Lake, it is reasonable to retain a Class 2Ag designation for the protection of Lake Trout (Class 2Ag [LAT]). Due to the limited monitoring data (i.e., a single fisheries survey), it is possible that additional information could result in a change to this designation.

Horseshoe Lake (38-0580-00): Horseshoe Lake is currently designated Class 2Bd and it is not designated for the protection of any coldwater fish species. Moderate numbers of Lake Whitefish (n=20) and Cisco (n=22) were sampled in Horseshoe Lake in fisheries surveys in 1963 and 1992. This lake is in the BWCAW and despite limited monitoring data, it is reasonable to designate Horseshoe Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Lake Whitefish and Cisco (Class 2Ag [LKW,TLC]). Due to the limited monitoring data (i.e., two fisheries surveys), it is possible that additional information could result in a change to this designation.

Hudson Lake (38-0484-00): Hudson Lake is currently designated Class 2Bd and it is not designated for the protection of any coldwater fish species. Moderate numbers of Lake Whitefish (n=9) and high numbers of Cisco (n=64) were sampled in Hudson Lake in a fisheries survey in 1962. Cisco were also present in a 1992 survey. This lake is in the BWCAW and despite limited monitoring data, it is reasonable to designate Hudson Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Lake Whitefish and Cisco (Class 2Ag [LKW,TLC]). Due to the limited monitoring data (i.e., two fisheries surveys), it is possible that additional information could result in a change to this designation.

Hustler Lake (69-0343-00): The current Class 2A designation for Hustler Lake was assigned to protect stream trout although this lake is not included on the MNDNR's trout lakes list (Minn. R. 6264.0050). It is listed as a "potential inland lake trout lake" in Minnesota Department of Conservation (1967). There have been six MNDNR fisheries surveys on Hustler Lake and no Lake Trout were sampled. However, during four of the six surveys, Cisco were sampled indicating that this lake supports a natural population of this coldwater fish species. Considering this information, it is reasonable to retain the Class 2Ag classification assigned to coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]). This lake is not currently designated as a Lake Trout lake, so the draft designation does not result in the removal of a Lake Trout lake designation.

Iron Lake (69-0121-00): Iron Lake is currently designated Class 2Bd and it is not designated for the protection of any coldwater fish species. Two MNDNR fisheries surveys have been conducted on Iron Lake which have demonstrated that this lake supports a population of Cisco. A single Lake Whitefish was also sampled in 2018, but this fish may have been transient from Crooked Lake (38-0817-00). This lake will not be designated for the protection of Lake Whitefish until additional data can be collected to confirm the presence of a resident population of Lake Whitefish. Considering this information, it is reasonable to designate Iron Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]).

Jenny Lake (38-0194-01,-02): Jenny Lake is currently designated Class 2Bd and it is not designated for the protection of any coldwater fish species. Jenny Lake was surveyed once in 1980 and a high number of Lake Whitefish (n=63) were sampled. This lake is in the BWCAW and despite limited monitoring data, it is reasonable to designate Jenny Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Lake Whitefish (Class 2Ag [LKW]). Due to the limited monitoring data (i.e., a single fisheries survey), it is possible that additional information could result in a change to this designation.

Jordan Lake (38-0511-00): Jordan Lake is currently designated Class 2Bd and it is not designated for the protection of any coldwater fish species. Two MNDNR fisheries surveys have been conducted on Jordan Lake which have demonstrated that this lake supports a population of Cisco. A single Lake Whitefish was also sampled in 2018, but this fish may have been transient from Ima Lake (38-0400-00). This lake will not be designated for the protection of Lake Whitefish until additional data can be collected to confirm the presence of a resident population of Lake Whitefish. Considering this information, it is reasonable to designate Jordan Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]).

Johnson Lake (69-0691-00): The current Class 2A designation for Johnson Lake was assigned to protect Lake Trout. It is listed as an "inland lake trout lake" in Minnesota Department of Conservation (1967). Lake Trout are not considered native in this lake and were stocked. Ten MNDNR fisheries surveys have been conducted between 1970 and 2016 and Lake Trout were only collected in 2016 (n=3). Lake Trout are no longer stocked and based on surveys this species is not considered sustainable in Johnson Lake. However, during the MNDNR fisheries surveys, Cisco and Lake Whitefish were sampled during most surveys, indicating that this lake supports natural populations of these coldwater fishes. Considering this information, it is reasonable to retain the Class 2Ag classification assigned to coldwater aquatic life and habitat and assign protections for Cisco and Lake Whitefish (Class 2Ag [TLC,LKW]). The removal of the Lake Trout lake designation will also remove the restricted ORVW designation (Minn. R. 7050.0335, subp. 1, Item C) assigned to Johnson Lake.

Karl Lake (16-0461-00): Karl Lake is currently designated Class 2A to protect Lake Trout. It is listed as an "inland lake trout lake" in Minnesota Department of Conservation (1967) which also notes that it has "good" dissolved oxygen conditions. A single Lake Trout was sampled in a MNDNR fisheries survey in 1983, but the species was absent from a second survey in 1996. Karl Lake is broadly connected to Long Island Lake (16-0460-00) which could have been the source of the Lake Trout. Karl lake is relatively deep (Z_{max} = 21 m) with a low geometry ratio (1.17), but it is also relatively small (51 ha). Most of the lake is shallow indicating that the extent of Lake Trout habitat in this lake would be limited. The available data suggest that a small population of Lake Trout is possibly present in Karl which is supplemented by fish from Long Island Lake. However, the presence or absence of such a population cannot be confirmed based on these data. Due to the limited information for Karl Lake, it is reasonable to retain a Class 2Ag designation for the protection of Lake Trout (Class 2Ag [LAT]). Due to the limited monitoring data (i.e., two fisheries surveys) and low catch, it is possible that additional information could result in a change to this designation.

Kek Lake (38-0228-00): The current Class 2A designation for Kek Lake was assigned to protect Lake Trout and it is listed as an "inland lake trout lake" in Minnesota Department of Conservation (1967). Kek Lake was surveyed once in 1988 and a moderate number of Lake Trout (n=18) were sampled. This lake is in the BWCAW and despite limited monitoring data from Kek Lake, it is reasonable to assign a Class 2Ag designation for the protection of Lake Trout (Class 2Ag [LAT]). Due to the limited monitoring data (i.e., a single fisheries survey), it is possible that additional information could result in a change to this designation.

Kingfisher Lake (16-0812-00): Kingfisher Lake is currently designated Class 2Bd. A single MNDNR fisheries survey was conducted in 1978 and a single Lake Trout was sampled, but this fish may have been transient from Ogishkemuncie Lake (38-0180-00). This lake will not be designated for the protection of Lake Trout until additional data can be collected to confirm the presence of a resident population of Lake Trout. However, during the MNDNR fisheries surveys, a moderate number of Lake Whitefish were sampled (n=28), indicating a good likelihood that this lake supports a natural population of this coldwater fish species. Considering this information, it is reasonable to retain the Class 2Ag classification assigned to coldwater aquatic life and habitat and assign protections for Lake Whitefish (Class 2Ag [LKW]).

Lake of the Clouds (38-0169-00): The current Class 2A designation for Lake of the Clouds was assigned to protect Lake Trout and it is listed as an "inland lake trout lake" in Minnesota Department of Conservation (1967). Lake of the Clouds Lake was surveyed twice including a 1980 survey that sampled a moderate number of Lake Trout (n=8). A 1973 survey did not collect any Lake Trout. It is not clear if Lake Trout are native to this lake, but Lake Trout were stocked from 1976-1979 and the 1980 test netting indicated an above average population of trout. This lake is in the BWCAW and despite limited monitoring data from Lake of the Clouds, it is reasonable to assign a Class 2Ag designation for the protection of Lake Trout (Class 2Ag [LAT]). Due to the limited monitoring data (i.e., a single fisheries survey), it is possible that additional information could result in a change to this designation.

Link Lake (38-0163-00): Link Lake is currently designated Class 2Bd and it is not designated for the protection of any coldwater fish species. Link Lake was surveyed once in 1973 and a moderate number of Lake Whitefish (n=14) were sampled. This lake is in the BWCAW and despite limited monitoring data, it is reasonable to designate Link Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Lake Whitefish (Class 2Ag [LKW]). Due to the limited monitoring data (i.e., a single fisheries survey), it is possible that additional information could result in a change to this designation.

Little Long Lake (69-0066-00): Little Long Lake is currently designated Class 2Bd and it is not designated for the protection of any coldwater fish species. Twelve MNDNR fisheries surveys have been performed and none sampled Lake Trout. Eight of the MNDNR fisheries surveys did sample Cisco indicating that this lake supported a population of Cisco. However, Cisco were last sampled in 2004 and were likely extirpated by the introduction of Rainbow Smelt. Since the Cisco population was native and occurred after November 28, 1975, this is an existing use and it should be protected. Considering this information, it is reasonable to designate Little Long Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]).

Little Loon Lake (69-0484-00): Little Loon Lake is currently designated Class 2Bd and it is not designated for the protection of any coldwater fish species. A single MNDNR fisheries survey was conducted in 2009 on Little Loon Lake and a moderate number of Cisco were sampled (n=20) indicating that this lake supports a population of Cisco. Despite limited sampling for Little Loon Lake, it is reasonable to assign protections for Cisco because this lake is in the BWCAW. A single Lake Whitefish was also sampled in 2009, but this fish may have been transient from Loon Lake (69-0470-00). This lake will not be designated for the protection of Lake Whitefish until additional data can be collected to confirm the presence of a resident population of Lake Whitefish. Considering this information, it is reasonable to designate Little Loon Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]).

Little Saganaga Lake (16-0809-00): The WID number for Little Saganaga Lake listed in Minn. R. 7050.0470 is incorrect. This lake is currently listed as 16-0890-00 and as part of this rule revision the WID number will be corrected to 16-0809-00.

Little Shell Lake (69-0384-00): Little Shell Lake is currently designated Class 2Bd and it is not designated for the protection of any coldwater fish species. A single MNDNR fisheries survey was conducted in 1974 on Little Shell Lake and a moderate number of Cisco were sampled (n=28) demonstrating that this lake supports a population of Cisco. This lake is in the BWCAW and despite limited monitoring data, it is reasonable to designate Little Shell Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]). Due to the limited monitoring data (i.e., a single fisheries survey), it is possible that additional information could result in a change to this designation.

Little Vermilion Lake (69-0608-01, -02): Little Vermilion Lake is currently designated Class 2Bd and it is not designated for the protection of any coldwater fish species. Six MNDNR fisheries surveys were conducted on Little Vermilion Lake and high numbers of Cisco were sampled (n = 1332) demonstrating that this lake supports a population of Cisco. Lake Whitefish were sampled in four of the six surveys with a total of 6 fish sampled, but these fish may have been transient from Sand Point Lake (69-0617-00). This lake will not be designated for the protection of Lake Whitefish until additional data can be collected to confirm the presence of a resident population of Lake Whitefish. Considering this information, it is reasonable to designate Little Vermilion Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]).

Loon Lake (69-0470-00): The current Class 2A designation for Loon Lake was assigned to protect Lake Trout. It is listed as a “Minnesota-Ontario boundary potential lake trout lake” in Minnesota Department of Conservation (1967). Lake Trout are not considered native in this lake and were stocked. A single Lake Trout was sampled in 2008, but the other five surveys did not sample any Lake Trout. This species is no longer stocked and is not considered sustainable in this lake. However, during the MNDNR fisheries surveys, Cisco and Lake Whitefish were sampled in all six surveys, indicating that this lake supports natural populations of these coldwater fishes. Considering this information, it is reasonable to retain the Class 2Ag classification assigned to coldwater aquatic life and habitat and assign protections for Cisco and Lake Whitefish (Class 2Ag [TLC,LKW]). This lake is partially within the BWCAW and therefore retains the prohibited ORVW designation.

Lunar Lake (38-0168-00): The current Class 2A designation for Lunar Lake was assigned to protect Lake Trout. Lunar Lake was surveyed once in 1973 and a moderate number of Lake Trout (n=14) were sampled. This lake is in the BWCAW and despite limited monitoring data from Lunar Lake, it is reasonable to retain the Class 2Ag designation for the protection of Lake Trout (Class 2Ag [LAT]). Due to the limited monitoring data (i.e., a single fisheries survey), it is possible that additional information could result in a change to this designation.

Lynx Lake (69-0383-00): The current Class 2A designation for Lynx Lake was assigned to protect stream trout although it is not designated (Minn. R. 6264.0050) or managed for stream trout by the MNDNR. It is listed as a “potential inland lake trout lake” in Minnesota Department of

Conservation (1967) which noted that dissolved oxygen conditions are “good.” There have been two MNDNR fisheries surveys (1974 and 2002) on Lynx Lake and no Lake Trout were sampled. However, during these surveys, Cisco were sampled in both indicating that this lake supports a natural population of this coldwater fish species. Considering this information, it is reasonable to retain the Class 2Ag classification assigned to coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]). This lake is not currently designated as a Lake Trout lake, so the draft designation does not result in the removal of a Lake Trout lake designation.

Makwa Lake (38-0147-00): The current Class 2A designation for Makwa Lake was assigned to protect Lake Trout and it is listed as a “potential inland lake trout lake” in Minnesota Department of Conservation (1967). Makwa Lake was surveyed once in 1980 and a small number of Lake Trout (n=4) were sampled. However, the sampling effort was small and only consisted of 2 gill nets. In addition, there are angler reports indicating that Lake Trout are present in this lake. This lake is in the BWCAW and despite limited monitoring data from Makwa Lake, it is reasonable to assign a Class 2Ag designation for the protection of Lake Trout (Class 2Ag [LAT]). Due to the limited monitoring data (i.e., a single fisheries survey), it is possible that additional information could result in a change to this designation.

Malberg Lake (38-0090-00): Malberg Lake is currently designated Class 2Bd and it is not designated for the protection of any coldwater fish species. Two MNDNR fisheries surveys have been conducted and both sampled Lake Whitefish. In the 1963 survey, a fish specimen was identified as a Cisco in Malberg Lake, but this possibly represents a misidentification. This lake will not be designated for the protection of Cisco until additional data can be collected to confirm the presence of a natural population of this species. As a result, it is reasonable to designate Malberg Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Lake Whitefish (Class 2Ag [LKW]).

Marabaeuf Lake (16-0610-00): Marabaeuf Lake is currently designated Class 2Bd and is also designated for the protection of Lake Trout. Marabaeuf Lake was surveyed twice (1978 and 1999) and low numbers of Lake Trout were sampled (n=5). Lake Trout were sampled in both fisheries surveys indicating the possible presence of a natural population of this species although this lake is also connected Gneiss Lake (16-0617-00). Good numbers of Lake Whitefish and Cisco were also sampled in these two surveys. This lake is in the BWCAW and despite limited monitoring data, it is reasonable to designate Marabaeuf Lake a Class 2Ag designation for the protection of coldwater aquatic life and habitat and assign protections for Lake Trout, Lake Whitefish, and Cisco (Class 2Ag [LAT,LKW,TLC]). Due to the limited monitoring data (i.e., two fisheries surveys), it is possible that additional information could result in a change to this designation.

Mesaba Lake (16-0673-00): Mesaba Lake is currently designated Class 2A to protect Lake Trout. Lake Trout are not considered native to Mesaba Lake and were stocked in 1977. Both fish surveys following stocking (1981 and 1993) sampled low numbers of Lake Trout for a total of 3 individuals indicating that if natural reproduction was occurring it was low. It is questionable whether Lake Trout are sustainable in this lake and there are no plans to stock additional Lake Trout in Mesaba Lake. Mesaba lake is relatively deep (Z_{max} = 20 m) with a low geometry ratio (1.53), but it is also relatively small (84 ha) so there is limited habitat for Lake Trout. The available data suggest that a small, introduced population of Lake Trout is possibly present in Mesaba Lake. However, the presence or absence of such a population cannot be confirmed based on these data. Due to the limited information for Mesaba Lake, it is reasonable to retain a Class 2Ag designation for the protection of Lake Trout (Class 2Ag [LAT]). Due to the limited monitoring data (i.e., two fisheries surveys) and low catch, it is possible that additional information could result in a change to this designation.

Missionary Lake (38-0398-00): The current Class 2A designation for Missionary Lake was assigned to protect Lake Trout. It is listed as a "potential inland lake trout lake" in Minnesota Department of Conservation (1967) which notes that it has "good" dissolved oxygen. Missionary Lake was surveyed once in 1979 and a moderate number of Lake Trout (n=14) were sampled. This lake is in the BWCAW and despite limited monitoring data from Missionary Lake, it is reasonable to retain the Class 2Ag designation for the protection of Lake Trout (Class 2Ag [LAT]). Due to the limited monitoring data (i.e., a single fisheries survey), it is possible that additional information could result in a change to this designation.

Mudro Lake (69-0078-00): Mudro Lake is currently designated Class 2Bd and it is not designated for the protection of any coldwater fish species. Mudro Lake was stocked with Lake Trout, but no Lake Trout were sampled in the four MNDNR fisheries surveys conducted on this lake. Without additional data, this lake should not be designated for the protection of Lake Trout. However, MNDNR fisheries surveys did identify a population of Cisco in Mudro Lake. Considering this information, it is reasonable to assign the Class 2Ag classification assigned to coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]).

Namakan Lake (69-0693-00): Namakan Lake is currently designated Class 2Bd and it is not designated for the protection of any coldwater fish species. Lake Trout are possibly native to Namakan Lake, but no Lake Trout have been sampled in 47 MNDNR fisheries surveys. It is not clear if this lake can support a sustainable population of Lake Trout so at this time Namakan Lake will not be designated for the protection of Lake Trout. MNDNR fisheries surveys did identify populations of Cisco and Lake Whitefish in Namakan Lake. Considering this information, it is reasonable to designate Namakan Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Lake Whitefish and Cisco (Class 2Ag [LKW,TLC]).

Newton Lake (38-0784-00): Newton Lake is currently designated Class 2Bd and it is not designated for the protection of any coldwater fish species. Ten MNDNR fisheries surveys have been conducted on Newton Lake and Cisco were present in nine of these surveys. This indicates that this lake supports a population of Cisco. Lake Whitefish were sampled in two of the ten surveys with a total of 3 fish sampled, but these fish may have been transient from Fall[23] (38-0811-00) or Basswood (38-0645-00) lakes. This lake will not be designated for the protection of Lake Whitefish until additional data can be collected to confirm the presence of a resident population of Lake Whitefish. Considering this information, it is reasonable to designate Newton Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]).

North Branch of the Kawishiwi (38-0738-00): The North Branch of the Kawishiwi is currently designated Class 2Bd and it is not designated for the protection of any coldwater fish species. This lake was surveyed once in 1978 and a moderate number of Cisco (n=26) were sampled. This lake is in the BWCAW and despite limited monitoring data, it is reasonable to designate the North Branch of the Kawishiwi a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]). Due to the limited monitoring data (i.e., a single fisheries survey), it is possible that additional information could result in a change to this designation.

---

[23] Fisheries surveys indicate that Fall Lake appears to support Cisco and Lake Whitefish despite lake characteristics (both geometry ratio and temperature profiles) indicating that it is polymictic (see Appendix D).

Owl Lake (16-0726-00): The current Class 2A designation for Owl Lake was assigned to protect Lake Trout. It is listed as an "inland lake trout lake" in Minnesota Department of Conservation (1967) which notes that it has "good" dissolved oxygen. Owl Lake was surveyed twice (1980 and 1993) and low numbers of Lake Trout were sampled (n=3). This lake is in the BWCAW and despite limited monitoring data from Owl Lake, it is reasonable to assign a Class 2Ag designation for the protection of Lake Trout (Class 2Ag [LAT]). Due to limited monitoring data (i.e., two fisheries surveys), it is possible that additional information could result in a change to this designation.

Paulson Lake (16-0626-00): The current Class 2A designation for Paulson Lake was assigned to protect stream trout. Paulson Lake was removed from the MNDNR's designated trout lakes list (Minn. R. 6264.0050) because it is no longer managed by the MNDNR for stream trout (State of Minnesota 2024). However, three surveys from 1986 through 2004 sampled moderate to high numbers of Lake Trout indicating that Paulson Lake does support a self-sustaining population of Lake Trout. Considering this information, it is reasonable to retain the Class 2Ag classification assigned to coldwater aquatic life and habitat and assign protections for Lake Trout (Class 2Ag [LAT]).

Portage Lake (38-0524-00): The current Class 2A designation for Portage Lake was assigned to protect stream trout although it is not designated (Minn. R. 6264.0050) or managed for stream trout by the MNDNR. It is listed as a "potential inland lake trout lake" in Minnesota Department of Conservation (1967) which also notes that dissolved oxygen conditions are "fair." This lake is in the BWCAW and there is limited water quality and fisheries information. A single MNDNR fisheries survey was conducted in 1979 and no Lake Trout were captured. However, during this single survey, high numbers of Cisco (n=70) were sampled indicating that this lake supports a natural population of this coldwater fish. Considering this information, it is reasonable to retain the Class 2Ag classification assigned to coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]). This lake is not currently designated as a Lake Trout lake, so the draft designation does not result in the removal of a Lake Trout lake designation.

Powell Lake (16-0756-00): The current Class 2A designation for Powell Lake was assigned to protect Lake Trout and it is listed as a "potential inland lake trout lake" in Minnesota Department of Conservation (1967). Powell Lake was surveyed twice (1980 and 1992) and moderate numbers of Lake Trout were sampled (n=9). This lake is in the BWCAW and despite limited monitoring data from Powell Lake, it is reasonable to retain the Class 2Ag designation for the protection of Lake Trout (Class 2Ag [LAT]). Due to the limited monitoring data (i.e., two fisheries surveys), it is possible that additional information could result in a change to this designation.

Rabbit Lake (38-0214-00): The current Class 2A designation for Rabbit Lake was assigned to protect Lake Trout and it is listed as an "inland lake trout lake" in Minnesota Department of Conservation (1967). Rabbit Lake was surveyed once in 1980 and a moderate number of Lake Trout (n=21) were sampled. This lake is in the BWCAW and despite the limited monitoring data from this lake, it is reasonable to retain the Class 2Ag designation for the protection of Lake Trout (Class 2Ag [LAT]). Due to the limited monitoring data (i.e., a single fisheries survey), it is possible that additional information could result in a change to this designation.

Raven Lake (38-0113-00): The current Class 2A designation for Raven Lake was assigned to protect Lake Trout and it is listed as a "potential inland lake trout lake" in Minnesota Department of Conservation (1967). Raven Lake was surveyed once in 1975 and a moderate number of Lake Trout (n=13) were sampled. This lake is in the BWCAW and despite the limited monitoring data from this lake, it is reasonable to retain the Class 2Ag designation for the protection of Lake Trout (Class 2Ag [LAT]). Due to the limited monitoring data (i.e., a single fisheries survey), it is possible that additional information could result in a change to this designation.

Red Rock Lake (16-0793-00): The current Class 2A designation for Red Rock Lake was assigned to protect Lake Trout and it is listed as a "potential inland lake trout lake" in Minnesota Department of Conservation (1967). Lake Trout have been historically stocked in this lake, but it is not known if Lake Trout are native or sustainable in this lake. A single Lake Trout was sampled in 1998 which corresponds to the last year Lake Trout were stocked in Red Rock Lake. Three other MNDNR fisheries surveys did not collect any Lake Trout. Therefore, it is not appropriate to retain protections for Lake Trout in Red Rock Lake. However, in most fisheries surveys, Cisco and Lake Whitefish were sampled indicating that this lake supports natural populations of these coldwater fish species. Considering this information, it is reasonable to retain the Class 2Ag classification assigned to coldwater aquatic life and habitat and assign protections for Lake Whitefish and Cisco (Class 2Ag [LKW,TLC]). This lake is in the BWCAW and therefore retains the prohibited ORVW designation.

Rog Lake (16-0765-00): Rog Lake is currently designated Class 2A by the MPCA for the protection of stream trout. However, management of Brook Trout in Rog Lake was discontinued due to the introduction of Smallmouth Bass. Despite the cessation of stream trout management, Rog Lake is still a MNDNR designated trout lake (Minn. R. 6264.0050). This lake is currently designated Class 2Ag and this use (Class 2Ag [SRT]) will be retained until the MNDNR removes this lake from the list of designated trout lakes or additional information indicates its removal is appropriate.

Sand Point Lake (69-0617-00): The current Class 2A designation for Sand Point Lake was assigned to protect stream trout although it is not designated (Minn. R. 6264.0050) or managed for stream trout by the MNDNR. It is listed as a "Minnesota-Ontario boundary potential lake trout lake" in Minnesota Department of Conservation (1967) which notes that Lake Trout are native to this lake. There have been MNDNR fisheries surveys conducted almost every year since 1982 on Sand Point Lake, but Lake Trout have never been sampled. However, these surveys have demonstrated that that this lake supports natural populations of Lake Whitefish and Cisco. Considering this information, it is reasonable to retain the Class 2Ag classification for coldwater aquatic life and habitat and assign protections for Lake Whitefish and Cisco (Class 2Ag [LKW,TLC]). This lake is not currently designated as a Lake Trout lake, so the draft designation does not result in the removal of a Lake Trout lake designation.

Shagawa Lake (69-0069-00): Shagawa Lake is currently designated Class 2B and it is not designated for the protection of any coldwater fish species. Numerous MNDNR fisheries surveys have demonstrated that Shagawa Lake supports a population of Cisco. In fisheries surveys in 1966 and 1967, 5 fish were identified as Lake Whitefish, but due to their small size, these fish were possibly misidentified. In addition, Shagawa Lake is connected to Fall[23] (38-0811-00) and Burntside (69-0118-00) lakes which means that if the fish collected in the 1960s were Lake Whitefish, they may have been transient. As a result, it is reasonable to designate Shagawa Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]).

Spoon Lake (38-0388-00): The current Class 2A designation for Spoon Lake was assigned to protect stream trout; however, this lake is not currently designated (Minn. R. 6264.0050) or managed for stream trout by the MNDNR. It is listed as a "potential inland lake trout lake" in Minnesota Department of Conservation (1967) which notes that dissolved oxygen conditions are "doubtful." A single fisheries survey in 1972 included a single fish identified as a Cisco, but this fish was possibly misidentified. In 2015, a MNDNR gill net survey sampled 58 Lake Whitefish indicating that Spoon Lake supports a population of Lake Whitefish. Considering this information, it is reasonable to retain the Class 2Ag classification for coldwater aquatic life and habitat and assign protections for Lake Whitefish (Class 2Ag [LKW]).

Spring Lake (69-0761-00): Spring Lake is currently designated Class 2A to protect Lake Trout and it is listed as an "inland lake trout lake" in Minnesota Department of Conservation (1967). Lake Trout are not considered to be native but were stocked from 1955-2019. Lake Trout had poor survival which was attributed to competition with Lake Whitefish and not water quality issues. As a result, stocking of Lake Trout was discontinued in Spring Lake. All nine MNDNR fisheries surveys did sample Cisco and Lake Whitefish indicating that this lake supports natural populations of these coldwater fish species. Considering this information, it is reasonable to retain the Class 2Ag classification for coldwater aquatic life and habitat and assign protections for Lake Whitefish and Cisco (Class 2Ag [LKW,TLC]). This lake is currently designated as a Lake Trout lake and is outside the BWCAW and Voyageurs National Park. As a result, the removal of the Lake Trout lake designation will also remove the restricted ORVW designation (Minn. R. 7050.0335, subp. 1, Item C) for Spring Lake.

Steamhaul Lake (38-0570-00): The current Class 2A designation for Steamhaul Lake was assigned to protect stream trout. Steamhaul Lake is a designated MNDNR trout lake (Minn. R. 6264.0050), but it is not actively managed by the MNDNR because there is no reasonable public access. This lake is currently designated Class 2Ag and this use (Class 2Ag [SRT]) will be retained unless the MNDNR removes this lake from the list of designated trout lakes or additional information indicates its removal is appropriate.

Steep Lake (69-0475-00): Steep Lake is currently designated Class 2Bd and it is not designated for the protection of any coldwater fish species. Steep Lake was surveyed twice (1974 and 2018) and low numbers of Cisco were sampled (n=6). However, Cisco were sampled in both fisheries surveys which indicates the presence of a possible population of this species. This lake is in the BWCAW and despite limited monitoring data, it is reasonable to designate the Steep Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]). Due to the limited monitoring data (i.e., two fisheries surveys), it is possible that additional information could result in a change to this designation.

Strup Lake (38-0360-00): Strup Lake is currently designated Class 2A to protect Lake Trout and it is listed as an "inland lake trout lake" in Minnesota Department of Conservation (1967). Strup Lake was surveyed once in 1978 and a moderate number of Lake Trout (n=8) were sampled. This lake is in the BWCAW and despite limited monitoring data for Strup Lake, it is reasonable to retain the Class 2Ag designation for the protection of Lake Trout (Class 2Ag [LAT]). Due to the limited monitoring data (i.e., a single fisheries survey), it is possible that additional information could result in a change to this designation.

Sucker Lake (38-0530-00): Sucker Lake is currently designated Class 2Bd and it is not designated for the protection of any coldwater fish species. Twelve MNDNR fisheries surveys have been conducted on Sucker Lake indicating that this lake supports a population of Cisco. Lake Whitefish were sampled in one of the twelve surveys with a total of 4 fish sampled, but these fish may have been transient from Basswood (38-0645-00) or the Moose Chain of Lakes. This lake will not be designated for the protection of Lake Whitefish until additional data can be collected to confirm the presence of a resident population of Lake Whitefish. Considering this information, it is reasonable to designate Sucker Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]).

Lake Three (38-0600-00): Lake Three is currently designated Class 2Bd and it is not designated for the protection of any coldwater fish species. Lake Three was surveyed twice (1978 and 2017) and moderate numbers of Lake Whitefish were sampled (n=21) in 2017. In addition, Lake Whitefish were present in two additional MNDNR gill net surveys. Good numbers of Cisco were also sampled in these two surveys. This lake is in the BWCAW and despite limited monitoring data, it is reasonable to designate Lake Three a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Lake Whitefish and Cisco (Class 2Ag [LKW,TLC]). Due to the limited monitoring data (i.e., two fisheries surveys), it is possible that additional information could result in a change to this designation.

Thumb Lake (69-0352-00): The current Class 2A designation for Thumb Lake was assigned to protect Lake Trout. It is listed as a "potential inland lake trout lake" in Minnesota Department of Conservation (1967), but fisheries surveys have not collected Lake Trout and there is no record of a Lake Trout population in this lake. A single MNDNR fisheries survey was conducted in 1980 and high numbers of Cisco (n=68) were sampled indicating that this lake supports a natural population of this coldwater fish species. This lake is in the BWCAW and despite limited monitoring data, it is reasonable to retain the Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]). Due to the limited monitoring data (i.e., two fisheries surveys), it is possible that additional information could result in a change to this designation. This lake is in the BWCAW and therefore retains the prohibited ORVW designation.

Toe Lake (69-0213-00): Toe Lake is currently designated Class 2Bd and it is not designated for the protection of any coldwater fish species. A single MNDNR fisheries survey was conducted in 2002 and a moderate number of Cisco (n=9) were sampled indicating that this lake supports a natural population of this coldwater fish species. This lake is in the BWCAW and despite limited monitoring data, it is reasonable to designate Toe Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]). Due to the limited monitoring data (i.e., one fisheries survey), it is possible that additional information could result in a change to this designation.

Topaz Lake (38-0172-00): The current Class 2A designation for Topaz Lake was assigned to protect Lake Trout. It is listed as an "inland lake trout lake" in Minnesota Department of Conservation (1967). Lake Trout are considered native to this lake, but Lake Trout have also been stocked. This lake was surveyed in 1973 and 5 Lake Trout were captured, but a subsequent survey in 2018 did not sample Lake Trout. Topaz Lake is connected to Amoeber (38-0227-00) and Cherry (38-0166-00) lakes which may be the source of the fish sampled in 1973. Additional information is needed before Topaz Lake should be designated for the protection of Lake Trout. Both MNDNR fisheries surveys sampled high numbers of Cisco indicating that this lake supports a natural population of this coldwater fish. Considering this information, it is reasonable to retain the Class 2Ag classification for coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]). This lake is in the BWCAW and therefore retains the prohibited ORVW designation.

Town Lake (16-0458-00): The current Class 2A designation for Town Lake was assigned to protect Lake Trout. It is listed as a "potential inland lake trout lake" in Minnesota Department of Conservation (1967) which also notes that the lake has "good" dissolved oxygen and temperature conditions. Town Lake was surveyed once in 1990 and a single Lake Trout was sampled. This fish is considered to represent the presence of a small, native population of Lake Trout in Town Lake. This lake is in the BWCAW and despite limited monitoring data from Town Lake, it is reasonable to retain the Class 2Ag designation for the protection of Lake Trout (Class 2Ag [LAT]). Due to the limited monitoring data (i.e., a single fisheries survey), it is possible that additional information could result in a change to this designation.

Trip Lake (16-0451-00): Trip Lake is currently designated Class 2A by the MPCA to protect stream trout. However, management of stream trout in Trip Lake was discontinued due to low survivorship of stocked fish and a failure to meet management goals. However, this lake is still a designated trout lake by the MNDNR (Minn. R. 6264.0050). Trip Lake is currently designated Class 2Ag and this use (Class 2Ag [SRT]) will be retained until the MNDNR removes this lake from the list of designated trout lakes or additional information indicates its removal is appropriate.

Vera Lake (38-0491-00): The current Class 2A designation for Vera Lake was assigned to protect stream trout, but this lake is not currently designated (Minn. R. 6264.0050) or managed by the MNDNR for stream trout. It is listed as a "potential inland lake trout lake" in Minnesota Department of Conservation (1967) which notes that dissolved oxygen conditions are "good." Lake Trout are not considered native to Vera Lake, but yearlings were stocked in 1977 because the 1972 survey indicated oxythermal conditions might be suitable for Lake Trout. Subsequent investigations indicated poor midsummer oxygen concentrations below 9 m and 5 fisheries surveys since 1972 did not sample Lake Trout. Most MNDNR fisheries surveys did sample Cisco indicating that this lake supports a natural population of this coldwater fish. Considering this information, it is reasonable to retain the Class 2Ag classification for coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]). This lake is not currently designated as a Lake Trout lake, so the draft designation does not result in the removal of a Lake Trout lake designation.

Class 2Bd designations

The following lakes will be designated for the protection of warm and cool water aquatic life and habitat (Class 2Bd). A summary of the evidence supporting the draft use designations are provided in Table 27 and additional details are provided following the table. For these lakes, the designation of Class 2Bd from Class 2A results in the designation of a beneficial use that carries with it less stringent standards. As a result, a use attainability analysis (40 CFR § 131.3(g)) is required by the CWA (40 CFR § 131.10(j)) to demonstrate that the current use designation is not an existing use (40 CFR § 131.3(e)) or an attainable use (40 CFR § 131.10(d)). Considering the information below, it is reasonable to assign Class 2Bdg for the protection of cool and warm waters also protected as a source of drinking water. The use designations for these lakes will be amended in Minn. R. 7050.0470 by updating the beneficial uses for lakes in the Rainy River - Headwaters watershed (09030001).

Table 27: List of draft Class 2Bd use designations for lakes in the Rainy River - Headwaters watershed (09030001) with supporting information. Abbreviations and fisheries survey codes are described in the introduction of Appendix C.

Lake name	WID	GR	Fisheries survey: LAT	Fisheries survey: LKW	Fisheries survey: TLC	Fisheries survey: SRT	Current ALU	Draft ALU	Trout lake	Type
Agamok*	38-0011-00	2.90					$2A^{SRT}$	2Bdg	No	2Bd
Arkose*	38-0382-00	1.47					$2A^{SRT}$	2Bdg	No	2Bd
Beartrack*	69-0480-00	2.65			U-1|4|1		$2A^{LAT}$	2Bdg	No	2Bd
Big Ruby (Warpaint)*	69-0333-00	1.36					$2A^{SRT}$	2Bdg	No	2Bd
Brandt (Everett)*	16-0600-00	1.05					$2A^{SRT}$	2Bdg	No	2Bd
Crab	16-0357-00	4.57			E-5|3|62		$2A^{SRT}$	2Bdg	No	2Bd
Marble*	38-0109-00	-					$2A^{SRT}$	2Bdg	No	2Bd

Lake name	WID	GR	Fisheries survey: LAT	Fisheries survey: LKW	Fisheries survey: TLC	Fisheries survey: SRT	Current ALU	Draft ALU	Trout lake	Type
Mora*	16-0732-00	2.33					$2A^{LAT}$	2Bdg	No	2Bd
Tarry*	16-0731-00	1.23					$2A^{SRT}$	2Bdg	No	2Bd
Virgin*	16-0719-00	1.80	U-0|1|0				$2A^{SRT}$	2Bdg	No	2Bd
West Crab*	69-0297-00	4.93[24]					$2A^{SRT}$	2Bdg	No	2Bd

*** Partially or fully within the Boundary Waters Canoe Area Wilderness.**

Agamok Lake (38-0011-00): Agamok Lake was designated Class 2A to protect stream trout, but it is not currently designated (Minn. R. 6264.0050) or managed by the MNDNR for stream trout. It is listed as a "potential inland lake trout lake" in Minnesota Department of Conservation (1967), but there is no record of a Lake Trout population in this lake. The lake is also relatively small (43 ha) and shallow (Z_{max} = 9 m) compared to other Lake Trout lakes. Considering this information, it is reasonable to assign Class 2Bdg to Agamok Lake for the protection of cool and warm waters also protected as a source of drinking water. This lake is not currently designated as a Lake Trout lake, so the draft designation does not result in the removal of a Lake Trout lake designation.

Arkose Lake (38-0382-00): Arkose Lake was designated Class 2A to protect stream trout, but it is not currently designated (Minn. R. 6264.0050) or managed by the MNDNR for stream trout. It is listed as a "potential inland lake trout lake" in Minnesota Department of Conservation (1967). There is no record of a Lake Trout population in this lake and a 1979 survey only collected White Sucker (*Catostomus commersonii* [Lacepède, 1803]), Yellow Perch (*Perca flavescens* [Mitchill, 1814]), and Green Sunfish (*Lepomis cyanellus* Rafinesque, 1819). Considering this information, it is reasonable to assign Class 2Bdg to Arkose Lake for the protection of cool and warm waters also protected as a source of drinking water. This lake is not currently designated as a Lake Trout lake, so the draft designation does not result in the removal of a Lake Trout lake designation.

Beartrack Lake (69-0480-00): Beartrack Lake was designated Class 2A to protect Lake Trout. It is listed as a "potential inland lake trout lake" in Minnesota Department of Conservation (1967) which also notes that it has "good" dissolved oxygen conditions. Ohrid Trout (*Salmo letnica*) were stocked in 1965, but no stocked fish were recovered in subsequent sampling. There is no record of a Lake Trout population in this lake and 5 surveys from 1965-2000 did not sample any trout. Surveys on Beartrack Lake sampled White Sucker, Yellow Perch, Rock Bass (*Ambloplites rupestris* [Rafinesque, 1817]), and Green Sunfish. Cisco have also been sampled, but Beartrack Lake is connected to Eugene (69-0473-00) and Lac La Croix (69-0224-00) lakes and the single Cisco sampled in 1966 was likely transient. Considering this information, it is reasonable to assign Class 2Bdg to Beartrack Lake for the protection of cool and warm waters also protected as a source of drinking water. This lake is in the BWCAW and therefore retains the prohibited ORVW designation.

[24] Depth (17.5') was estimated from MNDNR map to calculate geometry ratio.

Big Ruby Lake (69-0333-00): Big Ruby Lake was designated Class 2A to protect stream trout, but it is not currently designated (Minn. R. 6264.0050) or managed for stream trout by the MNDNR. It is listed as a "potential inland lake trout lake" in Minnesota Department of Conservation (1967). There is no record of a Lake Trout population in this lake and monitoring would be required to determine if this lake supports a population of coldwater fish. Considering this information, it is reasonable to assign Class 2Bdg to Big Ruby Lake for the protection of cool and warm waters also protected as a source of drinking water. This lake is not currently designated as a Lake Trout lake, so the draft designation does not result in the removal of a Lake Trout lake designation. The WID number for Big Ruby Lake listed in Minn. R. 7050.0470 is incorrect. This lake is currently listed as 16-0333-00 and as part of this rule revision the WID number will be corrected to 69-0333-00.

Brandt Lake (16-0600-00): Brandt Lake was designated Class 2A to protect stream trout, but it is not currently designated (Minn. R. 6264.0050) or managed for stream trout by the MNDNR. It is listed as a "potential inland lake trout lake" in Minnesota Department of Conservation (1967) which also notes that it has "marginal" dissolved oxygen conditions. There is no record of a Lake Trout population in this lake and a 1979 survey only sampled White Sucker, Yellow Perch, and Northern Pike. Considering this information, it is reasonable to assign Class 2Bdg to Brandt Lake for the protection of cool and warm waters also protected as a source of drinking water. This lake is not currently designated as a Lake Trout lake, so the draft designation does not result in the removal of a Lake Trout lake designation.

Crab Lake (16-0357-00): Crab Lake was designated Class 2A to protect stream trout, but it is not currently designated (Minn. R. 6264.0050) or managed for stream trout by the MNDNR. It is listed as a "potential inland lake trout lake" in Minnesota Department of Conservation (1967). This report indicates that the maximum depth is 24 m; however, this is an error as the maximum depth for Crab Lake is 5 m. The geometry ratio in Crab Lake is greater than 4 and this lake is likely polymictic at least part of the summer. This lake was reportedly stocked between 1931 and 1944 with Lake Trout and stream trout in 1950, but numerous surveys from 1950 through 2001 failed to sample Lake Trout. Cisco were sampled in this lake from 1971 through 1997, but subsequent surveys have not produced Cisco. The shallow depth and likely polymictic nature of this lake indicate that it is marginal for Cisco and the Cisco may have been transient from Loon Lake (16-0448-00). The draft coldwater standards for Cisco were not developed for polymictic lakes and even if there is a resident population of Cisco in Crab Lake, the application of dimictic lake standards would not be appropriate for this lake. Considering this information, it is reasonable to assign Class 2Bdg to Crab Lake for the protection of cool and warm waters also protected as a source of drinking water. This lake is not currently designated as a Lake Trout lake, so the draft designation does not result in the removal of a Lake Trout lake designation.

Marble Lake (38-0109-00): Marble Lake was designated Class 2A to protect stream trout, but it is not currently designated (Minn. R. 6264.0050) or managed by the MNDNR for stream trout. It is listed as a "potential inland lake trout lake" in Minnesota Department of Conservation (1967), but there is no record of a Lake Trout population in this lake. Considering this information, it is reasonable to assign Class 2Bdg to Marble Lake for the protection of cool and warm waters also protected as a source of drinking water. This lake is not currently designated as a Lake Trout lake, so the draft designation does not result in the removal of a Lake Trout lake designation.

Mora Lake (16-0732-00): Mora Lake was designated Class 2A to protect Lake Trout. It is listed as a "potential inland lake trout lake" in Minnesota Department of Conservation (1967). There is no record of a Lake Trout population in this lake and the fisheries survey indicated that this lake has limited oxythermal habitat suitable to support Lake Trout. A MNDNR fisheries survey in 1983 sampled only White Sucker and Northern Pike. Mora Lake is relatively shallow (Z_{max} = 12 m) and small (85 ha) for a Lake Trout lake indicating that Lake Trout habitat is likely not present in this lake. Considering this information, it is reasonable to assign Class 2Bdg to Mora Lake for the protection of cool and warm waters also protected as a source of drinking water. This lake is in the BWCAW and therefore retains the prohibited ORVW designation.

Tarry Lake (16-0731-00): Tarry Lake was designated Class 2A to protect stream trout, but it is not currently designated (Minn. R. 6264.0050) or managed for stream trout by the MNDNR. It is listed as a "potential inland lake trout lake" in Minnesota Department of Conservation (1967), but there is limited fisheries and water quality data and no record of a Lake Trout population in this lake. Tarry Lake is relatively shallow (Z_{max} = 16 m) and small (15 ha) for a Lake Trout lake indicating that Lake Trout habitat is likely not present. Considering this information, it is reasonable to assign Class 2Bdg to Tarry Lake for the protection of cool and warm waters also protected as a source of drinking water. This lake is not currently designated as a Lake Trout lake, so the draft designation does not result in the removal of a Lake Trout lake designation.

Virgin Lake (16-0719-00): Virgin Lake was designated Class 2A to protect stream trout, but it is not currently designated (Minn. R. 6264.0050) or managed by the MNDNR for stream trout. It is listed as a "potential inland lake trout lake" in Minnesota Department of Conservation (1967), but there is limited fisheries and water quality data and no record of a Lake Trout population in this lake. A MNDNR fisheries survey in 1980 sampled only large numbers of White Sucker. Virgin Lake is shallow (Z_{max} = 12 m) and small (23 ha) for a Lake Trout lake indicating that Lake Trout habitat is likely not present. Considering this information, it is reasonable to assign Class 2Bdg to Virgin Lake for the protection of cool and warm waters also protected as a source of drinking water. This lake is not currently designated as a Lake Trout lake, so the draft designation does not result in the removal of a Lake Trout lake designation.

West Crab Lake (69-0297-00): West Crab Lake was designated Class 2A to protect stream trout, but it is not currently designated (Minn. R. 6264.0050) or managed by the MNDNR for stream trout. West Crab Lake is effectively a bay of Crab Lake (69-0220-00) which is connected by a narrow channel. Three fisheries surveys from 1950 through 2001 in Crab Lake sampled Cisco. Crab Lake (69-0220-00) will be proposed for coldwater habitat designation to protect Cisco (Class 2A [TLC]). There are no fisheries survey data for West Crab Lake, but the lake morphology (GR = 4.9) indicates that this lake/basin is polymictic and unlikely to support a resident population of coldwater fish. Considering this information, it is reasonable to assign Class 2Bdg to West Crab Lake for the protection of cool and warm waters also protected as a source of drinking water.

b. Vermilion River watershed (09030002)

Class 2A confirmations and designations

The following lakes will be confirmed or designated for the protection of coldwater aquatic life and habitat (Class 2A). A summary of the evidence supporting these use designations is provided in Table 28 and if needed, additional information is provided following this table. Available evidence demonstrates that these lakes support or should support naturally reproducing populations of Lake Trout, Lake Whitefish, or Cisco or are managed for coldwater fish through stocking. The use designations for these lakes will be amended in Minn. R. 7050.0470 by updating the beneficial uses for lakes in the Vermilion River watershed (09030002).

Table 28. List of draft Class 2A use confirmations and designations for lakes in the Vermilion River watershed (09030002) with supporting information. Abbreviations and fisheries survey codes are described in the introduction of Appendix C.

Lake name	WID	GR	Fisheries survey: LAT	Fisheries survey: LKW	Fisheries survey: TLC	Fisheries survey: SRT	Current ALU	Draft ALU	Trout lake	Type
Crane[#]	69-0616-00	2.43	E-1|17|1	U-6|12|8	P-17|1|938		2A[SRT]	2Ag[LKW,TLC]	No	SM
Elbow	69-0744-00	2.79		P-14|3|235	P-14|3|459		2B	2Ag[LKW,TLC]	No	2A
Kjostad	69-0748-00	2.07			P-15|0|1056		2B	2Ag[TLC]	No	2A
Little Trout*	69-0455-00	3.37			P-2|0|234		2Bd	2Ag[TLC]	No	2A
Mud	69-0275-00	3.07			P-8|0|409		2B	2Ag[TLC]	No	2A
Trout*	69-0498-00	2.47	P-16|7|168		P-19|4|11339		2A[LAT]	2Ag[LAT,TLC]	No	SM
Vermilion	69-0378-01,-02	4.36-4.91	E-0|54|0	P-14|40|76	P-39|15|7361		2Bd	2Ag[LKW,TLC]	No	2A
Winchester	69-0690-00	2.21	P-3|4|92		P-7|0|948		2B	2Ag[TLC,SRT]	No	2A

*** Partially or fully within the Boundary Waters Canoe Area Wilderness.**

[#] Partially or fully within Voyageurs National Park.

Crane Lake (69-0616-00): The current Class 2A designation for Crane Lake was assigned to protect stream trout, but it is not currently designated (Minn. R. 6264.0050) or managed by the MNDNR for stream trout. It is listed as a "potential inland lake trout lake" in Minnesota Department of Conservation (1967). There have been 18 MNDNR fisheries surveys and only a single Lake Trout was sampled (1991). The source of this Lake Trout is unknown, but Crane Lake is connected to lakes that support Lake Trout (e.g., Mukooda [69-0684-00]) or lakes that have been stocked with Lake Trout (e.g., Loon [69-0470-00]). There is no indication that this lake supports a population of Lake Trout, but these surveys did demonstrate that populations of Lake Whitefish and Cisco are present. This lake was reviewed in 1987 as part of review of ORVWs (State of Minnesota 1987) and it was determined that Crane Lake should not be designated as an ORVW to protect Lake Trout because the management of the lake is focused on the warm water fishery and the MNDNR had no plans to manage this lake for Lake Trout. Considering this information, it is reasonable to retain the Class 2Ag classification for coldwater aquatic life and habitat and assign protections for Lake Whitefish and Cisco (Class 2Ag [LKW,TLC]). This lake is not currently designated a Lake Trout lake, so the draft designation does not result in the removal of a Lake Trout lake designation.

Trout Lake (69-0498-00): Trout Lake is currently designated Class 2A to protect Lake Trout. It is listed as an "inland lake trout lake" in Minnesota Department of Conservation (1967) which notes that it has good dissolved oxygen. Lake Trout have been sampled in 16 of 23 MNDNR fisheries surveys and it is considered to support a healthy population of Lake Trout. The MNDNR recently stopped stocking Lake Trout due to the presence of a self-sustaining population. Considering this information, it is reasonable to retain the Class 2Ag designation for the protection of Lake Trout (Class 2Ag [LAT]).

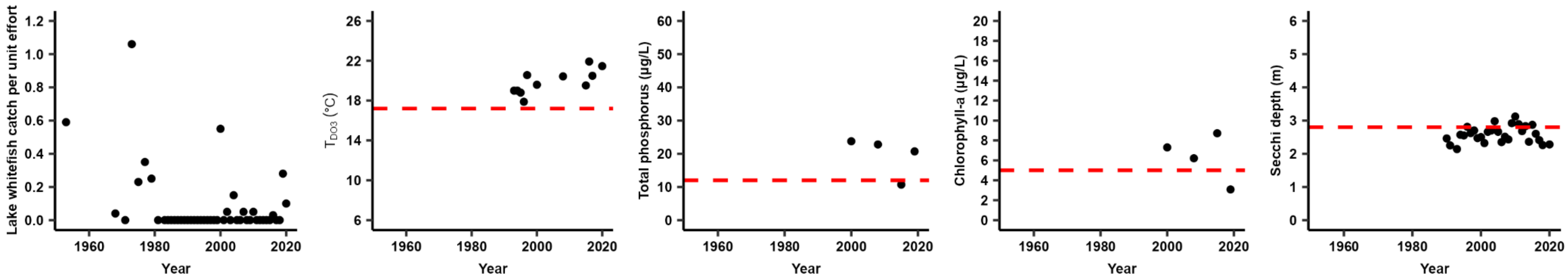
Although the current summer average estimate of T_{DO3} (8.6 °C) for Trout Lake is near the draft criterion, a SSS will not be adopted. MNDNR fisheries surveys consistently indicate the presence of a healthy population of Lake Trout, and it may be possible that a T_{DO3} above 8.8 °C will still sustain a good Lake Trout population in this lake. The average T_{DO3} value is based on a dataset consisting of 7 years of data so there is reasonable confidence in this estimated average. There is a small amount of watershed disturbance (5.5%), indicating a largely intact watershed. Monitoring by the MNDNR for macrophytes in 2002 indicated that Trout Lake supports a healthy population of macrophytes. The fish community in Trout Lake has not been monitored or assessed by the MNDNR because the fish IBI tool is not applicable to Canadian Shield lakes like Trout Lake (Bacigalupi et al. 2021). Recreation suitability data were collected from Trout Lake from 2006-2018 on 16 days and all indicated good recreation conditions. Summer average chl-*a* was low (2 µg/L) and Secchi depth (5.1 m) was also very good for this lake. However, TP (11 µg/L) was above the draft criterion for Lake Trout lakes. Overall, eutrophication measures demonstrate good trophic conditions for Trout Lake which indicates that the T_{DO3} near the threshold is likely the result of natural lake characteristics (e.g., lake morphology). Although T_{DO3} is near the draft criterion, aquatic life (i.e., Lake Trout and macrophytes) and recreation measures demonstrate that this lake meets goals. The low watershed disturbance also indicates that trophic conditions in this lake are likely near natural conditions. Although beneficial uses in Trout Lake are currently protected, oxythermal habitat is potentially near thresholds that could result in the loss of these uses and this lake should therefore be considered vulnerable and in need of protection. However, additional sampling may indicate a need for an SSS. Since this lake is in the BWCAW, this lake is already highly protected from local threats.

Lake Vermilion (69-0378-01,-02): Lake Vermilion is currently designated Class 2Bd and is not designated for the protection of any coldwater fish species. Although the geometry ratio for Lake Vermilion is relatively high (4.36-4.91), this lake is large and complex, and the deeper basins have temperature profiles that indicate regular and consistent summer stratification. Numerous MNDNR fisheries surveys indicate that Lake Vermilion supports populations of Lake Whitefish and Cisco. Considering this information, it is reasonable to designate Lake Vermilion a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Lake Whitefish and Cisco (Class 2Ag [LKW,TLC]). Water quality data for this lake are available from multiple basins and monitoring stations in this complex lake. Depth varies among the three basins delineated in the MPCA's waterbody database (69-0378-01, -02, and -03). Both the East (69-0378-01) and West (69-0378-02) basins have areas that are more than 12 m deep and should have suitable habitat for coldwater fishes. The third basin, Pike Bay (69-0378-03), is shallow and should not be included in the coldwater designation.

The summer average estimate of T_{DO3} (19.6 °C) for Lake Vermilion exceeds the preliminary thresholds for this parameter despite MNDNR fisheries surveys consistently indicating the presence of a healthy population of Lake Whitefish (Figure 30). There is low watershed disturbance (2.9%), indicating a largely intact watershed. Monitoring by the MNDNR for macrophytes in 2010 and 2014 indicated that Lake Vermilion supports a healthy population of macrophytes. The fish community in Lake Vermilion has not been monitored or assessed by the MNDNR because the fish IBI tool is not applicable to Canadian Shield Lakes like Lake Vermilion (Bacigalupi et al. 2021). Recreation suitability data were collected from Lake Vermilion from 1990-2018 on 1302 days and indicated good recreation conditions with <1% of days indicating condition where recreation suitability goals were not met. Summer average Secchi depth (2.6 m) was good for this lake. However, TP (24 µg/L) and chl-*a* (7 µg/L) were above the draft criteria for Lake Whitefish lakes. Although T_{DO3} and some eutrophication parameters are above the draft criterion, aquatic life (i.e., Lake Whitefish, Cisco, and macrophytes) and recreation measures demonstrate that this lake meets goals. The low watershed disturbance also indicates that trophic conditions in this lake are likely near natural conditions. As a result, it is reasonable to assign a SSS to this lake to address the atypical conditions which are suitable for the maintenance of a population of Lake Whitefish and other beneficial uses. Water quality goals for this lake should be based on current conditions as these are attaining aquatic life and recreation goals. The current attainment of the draft Secchi depth criterion indicates that it is appropriate to retain this standard. As a result, the draft oxythermal and eutrophication standards for Lake Vermilion are: T_{DO3} = 19.9 °C, TP = 19 µg/L, and chl-*a* = 6 µg/L. These averages excluded data from Pike Bay (69-0378-03) due to its shallowness and assessments of Lake Vermilion should exclude data from this basin. The average

T_{DO3} value is based on a dataset consisting of 15 years of data so there is reasonable confidence in this estimated average. However, additional sampling may indicate that adjustments to the draft SSS are required. Although beneficial uses in Lake Vermilion are currently protected, oxythermal habitat is potentially near thresholds that will result in the loss of these uses and this lake should therefore be considered vulnerable and in need of protection.

Figure 30. Annual water quality measures for Lake Vermilion (69-0378-01, -02). T_{DO3} is the maximum T_{DO3} measured during the period of maximum oxythermal stress for each year. Total phosphorus, chlorophyll-*a*, and Secchi depth are summer averages for years with at least 4 measurements from June through September. Red dashed lines indicate draft water quality thresholds for Lake Whitefish lakes.



Winchester Lake (69-0690-00): Winchester Lake is currently designated Class 2B and it is not designated for the protection of any coldwater fish species. All seven MNDNR fisheries surveys sampled good number of Cisco indicating that this lake supports a population of Cisco. The MNDNR stocked Lake Trout in Winchester Lake for 15 years but identified no natural reproduction. As a result, this lake does not support a natural or sustainable population of Lake Trout and the MNDNR intends to shift management of this lake to splake. Considering this information, it is reasonable to designate Winchester Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco and stream trout (Class 2Ag [TLC,SRT]).

c. Rainy River - Rainy Lake watershed (09030003)

Class 2A confirmations and designations

The following lakes will be designated for the protection of coldwater aquatic life and habitat (Class 2A). A summary of the evidence supporting these use designations is provided in Table 29 and if needed, additional information is provided following this table. Available evidence demonstrates that these lakes support or should support naturally reproducing populations of Lake Whitefish or Cisco. The use designations for these lakes will be amended in Minn. R. 7050.0470 by updating the beneficial uses for lakes in the Rainy River - Rainy Lake watershed (09030003).

Table 29. List of draft Class 2A use confirmations and designations for lakes in the Rainy River - Rainy Lake watershed (09030003) with supporting information. Abbreviations and fisheries survey codes are described in the introduction of Appendix C.

Lake name	WID	GR	Fisheries survey: LAT	Fisheries survey: LKW	Fisheries survey: TLC	Fisheries survey: SRT	Current ALU	Draft ALU	Trout lake	Type
Locator[#]	69-0936-00	1.71			P-3|5|40		2B	2Ag[TLC]	No	2A
Rainy[#]	69-0694-00	21.27	E-0|29|0	P-21|8|83	P-28|1|1148		2Bd	2Ag[LKW,TLC]	No	2A
War Club[#]	69-0937-00	1.96			P-4|3|59		2B	2Ag[TLC]	No	2A

[#] **Partially or fully within Voyageurs National Park.**

Rainy Lake (69-0694-00): Rainy Lake is currently designated Class 2Bd and it is not designated for the protection of any coldwater fish species. It is partially within Voyageurs National Park. It is not designated for the protection of Lake Trout and it is not listed in Minnesota Department of Conservation (1967) as a trout lake. Lake Trout were stocked from 1917-1944, but no Lake Trout have been sampled in 29 MNDNR fisheries surveys. There is no indication that this lake supports a population of Lake Trout, but MNDNR surveys did demonstrate that populations of Lake Whitefish and Cisco are present. Considering this information, it is reasonable to designate Rainy Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Lake Whitefish and Cisco (Class 2Ag [LKW,TLC]). This lake is not currently designated as a Lake Trout lake, so the draft designation does not result in the removal of a Lake Trout lake designation.

d. Little Fork River watershed (09030005)

Class 2A confirmations and designations

The following lakes will be confirmed or designated for the protection of coldwater aquatic life and habitat (Class 2A). A summary of the evidence supporting these use designations is provided in Table 30. Available evidence demonstrates that these lakes support or should support naturally reproducing populations of Lake Whitefish or Cisco or are managed for coldwater fish through stocking. The use designations for these lakes will be amended in Minn. R. 7050.0470 by updating the beneficial uses for lakes in the Little Fork River watershed (09030005).

Table 30. List of draft Class 2A use confirmations and designations for lakes in the Little Fork River watershed (09030005) with supporting information. Abbreviations and fisheries survey codes are described in the introduction of Appendix C.

Lake name	WID	GR	Fisheries survey: LAT	Fisheries survey: LKW	Fisheries survey: TLC	Fisheries survey: SRT	Current ALU	Draft ALU	Trout lake	Type
Camp A (Camp Four, Wessman)	69-0788-00	1.68				BKT,RBT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Deepwater	69-0858-00	1.49				BNT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Dewey	69-0912-00	2.53			U-3|0|58		2B	2Ag[TLC]	No	2A

Lake name	WID	GR	Fisheries survey: LAT	Fisheries survey: LKW	Fisheries survey: TLC	Fisheries survey: SRT	Current ALU	Draft ALU	Trout lake	Type
James (Jammer)	69-0734-00	1.62				RBT-C|Y|U	2A[SRT]	2Ag[SRT]	Yes	SC
Leander	69-0796-00	2.3			U-3|0|29		2B	2Ag[TLC]	No	2A
Long	69-0859-01,-02	1.88-2.69			U-4|3|47		2B	2Ag[TLC]	No	2A
Pickerel	69-0934-00	1.30				RBT,SPT-C|Y|U	2A[SRT]	2Ag[SRT]	Yes	SC
Side	69-0933-00	3.70			P-9|0|620		2B	2Ag[TLC]	No	2A
South Sturgeon	31-0003-00	2.29			U-7|1|341		2B	2Ag[TLC]	No	2A
Sturgeon	69-0939-01	2.06		U-3|6|14	P-8|1|349		2B	2Ag[LKW,TLC]	No	2A
West Sturgeon	69-0939-03	2.44			P-5|0|113		2B	2Ag[TLC]	No	2A

e. *Big Fork River watershed (09030006)*

Class 2A confirmations and designations

The following lakes will be confirmed or designated for the protection of coldwater aquatic life and habitat (Class 2A). A summary of the evidence supporting these use designations is provided in Table 31 and if needed, additional information is provided following this table. Available evidence demonstrates that these lakes support or should support naturally reproducing populations of Lake Trout, Lake Whitefish, or Cisco or are managed for coldwater fish through stocking. The use designations for these lakes will be amended in Minn. R. 7050.0470 by updating the beneficial uses for lakes in the Big Fork River watershed (09030006).

Table 31. List of draft Class 2A use confirmations and designations for lakes in the Big Fork River watershed (09030006) with supporting information. Abbreviations and fisheries survey codes are described in the introduction of Appendix C.

Lake name	WID	GR	Fisheries survey: LAT	Fisheries survey: LKW	Fisheries survey: TLC	Fisheries survey: SRT	Current ALU	Draft ALU	Trout lake	Type
Batson	31-0704-00	1.7			P-3|0|25		2B	2Ag[TLC]	No	2A
Bello	31-0726-00	2.14			P-7|0|240		2B	2Ag[TLC]	No	2A
Big Too Much	31-0793-00	1.12			P-8|0|970		2B	2Ae[TLC]	No	2A
Caribou	31-0620-00	0.68	P-9|0|189				2A[LAT]	2Ag[LAT]	No	SC
Clubhouse	31-0540-00	1.02			P-5|1|181		2B	2Ae[TLC]	No	2A
Deer	31-0334-00	3.42			P-11|1|223		2B	2Ag[TLC]	No	2A
East	31-0460-00	1.49			U-2|0|103		2B	2Ag[TLC]	No	2A
Elizabeth	31-0490-00	2.31			U-2|0|10		2B	2Ag[TLC]	No	2A

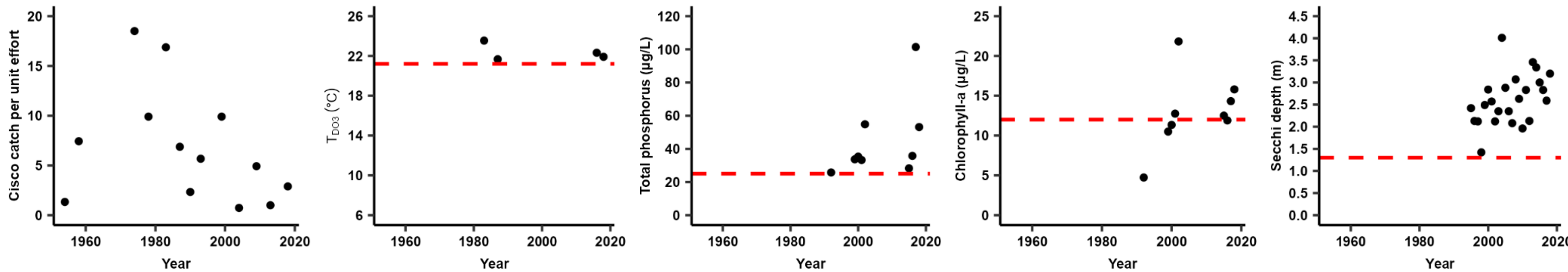
Lake name	WID	GR	Fisheries survey: LAT	Fisheries survey: LKW	Fisheries survey: TLC	Fisheries survey: SRT	Current ALU	Draft ALU	Trout lake	Type
Erskine	31-0311-00	1.15				RBT,SPT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Five Island	31-0183-00	3.09			U-3|1|44		2B	2Ag[TLC]	No	2A
Fox	31-0463-00	1.40			U-2|0|158		2B	2Ag[TLC]	No	2A
Grave	31-0624-01,-02	3.17			P-8|1|168		2B	2Ae[TLC]	No	2A
Gunn	31-0480-00	2.95			P-6|0|203		2B	2Ag[TLC]	No	2A
Gunn	31-0452-00	1.12			U-1|0|21		2B	2Ag[TLC]	No	2A
Hatch	31-0771-00	1.15		P-6|1|49	P-7|0|536		2B	2Ag[LKW,TLC]	No	2A
Highland	31-0481-00	2.19			P-3|0|39		2B	2Ag[TLC]	No	2A
Horseshoe	31-0466-00	1.54			P-3|0|13		2B	2Ag[TLC]	No	2A
Jack the Horse	31-0657-01,-02	1.86-2.61			U-5|0|380		2B	2Ag[TLC]	No	2A
Jessie	31-0786-00	4.03	E-0|13|0		P-13|0|991		2B	2Ag[TLC]	No	2A
Johnson	31-0687-00	2.17		M-1|10|5	P-10|1|206		2B	2Ag[TLC]	No	2A
Larson	31-0317-00	0.54				SPT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Little Bowstring	31-0758-00	3.34			P-8|1|68		2B	2Ag[TLC]	No	2A
Little Jessie	31-0784-00	2.66			P-9|0|807		2B	2Ag[TLC]	No	2A
Little North Star	31-0665-00	1.65			P-4|1|16		2B	2Ag[TLC]	No	2A
Long	31-0781-00	1.20			U-3|0|177		2B	2Ag[TLC]	No	2A
Maple	31-0773-00	2.65			P-7|0|198		2B	2Ag[TLC]	No	2A
North Star	31-0653-00	1.57			P-11|0|585		2B	2Ae[TLC]	No	2A
Pickerel	31-0339-00	1.46			P-11|1|408		2B	2Ag[TLC]	No	2A
Poplar	31-0196-00	1.71			U-3|0|41		2B	2Ag[TLC]	No	2A
Ruby	31-0422-00	1.16			U-10|1|132		2B	2Ag[TLC]	No	2A
Slauson	31-0502-00	2.11			U-2|0|26		2B	2Ag[TLC]	No	2A
Spring	31-0789-00	2.46			U-5|0|83		2B	2Ag[TLC]	No	2A
Turtle	31-0725-00	1.29	E-0|12|0	P-9|3|94	P-12|0|896		2B	2Ae[LKW,TLC]	No	2A
Unnamed (Nickel, Nichols)	31-0470-00	1.36				NA-H|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Whitefish	31-0843-00	2.43			P-8|0|199		2B	2Ag[TLC]	No	2A

Gunn Lake (31-0452-00): Gunn Lake is currently designated Class 2B and it is not designated for the protection of any coldwater fish species. Gunn Lake is in a remote area and there is limited fisheries information. A single MNDNR fisheries survey was conducted in 1982 and a moderate number of Cisco (n=21) were sampled indicating that this lake supports a natural population of this coldwater fish species. Although only a single fisheries survey is available, much of the watershed is undeveloped. Considering this information, it is reasonable to designate Gunn Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for and Cisco (Class 2Ag [TLC]). Due to the limited monitoring data (i.e., a single fisheries survey), it is possible that additional information could result in a change to this designation.

Jessie Lake (31-0786-00): Jessie Lake is currently designated Class 2B and it is not designated for the protection of any coldwater fish species. It is not listed in Minnesota Department of Conservation (1967) as a trout lake. Lake Trout were stocked from 1912-1945, but no Lake Trout have been sampled in 13 MNDNR fisheries surveys. There is no indication that this lake supports a population of Lake Trout, but MNDNR surveys did demonstrate that a population of Cisco are present. Cisco were sampled in all thirteen MNDNR fisheries surveys. Considering this information, it is reasonable to designate Jessie Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]).

Summer average estimates of TP (46 µg/L), chl-*a* (13 µg/L), and T_{DO3} (22.4 °C) for Jessie Lake currently exceed the draft criteria for these parameters despite MNDNR fisheries surveys consistently indicating the presence of a healthy population of Cisco. Summer average Secchi depth is also good for this lake (2.6 m). There is low disturbance (5.0%) in the watershed for this lake indicating that water quality in this lake is largely natural. Monitoring of this lake in 2001 and 2008 indicated that it has a good macrophyte community. The MNDNR also monitored the fish community in 2008 and 2018 and determined that Jessie Lake supports a healthy fish community. Recreation suitability data were collected from Jessie Lake from 1992-2019 on 135 days and >11% of the days had recreation suitability scores indicating non-attainment of recreation goals. Although chl-*a* and TP are elevated compared to the draft eutrophication standard for northern dimictic lakes, aquatic life (i.e., Cisco, macrophytes, and fish community) and recreation measures demonstrate that this lake meets goals although recreation suitability may be threatened. However, watershed disturbance indicates watershed conditions in this lake are likely near natural conditions. Jessie Lake is in the Chippewa Plains and is relatively shallow and naturally fertile. The geometry ratio is also greater than 4, indicating that this lake may not be strongly dimictic. As a result, it is reasonable to assign a SSS to this lake to address the atypical conditions which are suitable for the maintenance of a population of Cisco and other beneficial uses. At this time water quality goals for this lake should be based on near current conditions as these are attaining aquatic life and recreation goals. There are some indications that recreation suitability is degraded and the Cisco population may be declining (Figure 31). As a result, the draft lake eutrophication standards for Jesse Lake are slightly below the current conditions for most parameters: T_{DO3} = 22.0 °C and TP = 45 µg/L. Standards for chl-*a* and Secchi depth would be unchanged from draft thresholds. The average T_{DO3} value is based on a dataset consisting of 4 years of data and these measures consistently indicate T_{DO3} near 22-23 °C. Chlorophyll-*a* and TP estimates are based on data from 9 summers. However, additional sampling may indicate an adjustment to the draft SSS will be required. Although beneficial uses in Jessie Lake are currently protected, water quality is potentially near thresholds that will result in the loss of these uses and this lake should therefore be considered vulnerable and in need of protection.

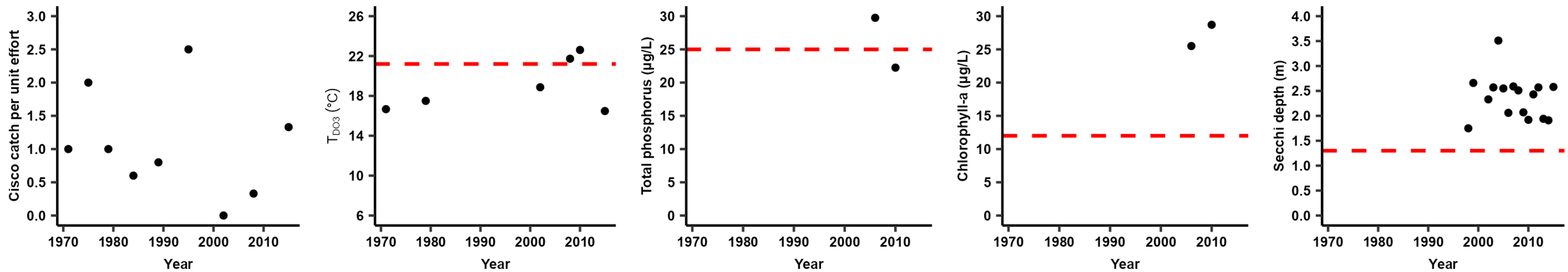
Figure 31. Annual water quality measures for Jessie Lake (31-0786-00). T_{DO3} is the maximum T_{DO3} measured during the period of maximum oxythermal stress for each year. Total phosphorus, chlorophyll-*a*, and Secchi depth are summer averages for years with at least 4 measurements from June through September. Red dashed lines indicate draft water quality thresholds for Cisco lakes.



Little Bowstring Lake (31-0758-00): Little Bowstring Lake is currently designated Class 2B and it is not designated for the protection of any coldwater fish species. Cisco were sampled in eight of nine MNDNR fisheries surveys indicating that a population of Cisco are present. Considering this information, it is reasonable to designate Little Bowstring Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]).

The summer average estimate of TP (26 µg/L) for Little Bowstring Lake currently exceeds the draft criterion for this parameter and chl-*a* (11 µg/L) is near the threshold (Figure 32) despite MNDNR fisheries surveys consistently indicating the presence of a healthy population of Cisco. There is low disturbance (6.6%) in the watershed for this lake indicating that water quality in this lake is likely to be near natural conditions. Monitoring of Little Bowstring Lake in 1995 and 2001 also indicated that it has a good macrophyte community. The MNDNR monitored the fish community in Little Bowstring in 2011, 2021, and 2022 and all IBI scores demonstrated the presence of a healthy cool/warm water fish community. Recreation suitability data were collected from 1998-2015 on 167 days and no days had recreation suitability scores indicating non-attainment of recreation goals. Summer average Secchi depth is also good for this lake (2.4 m) and T_{DO3} (19.9 °C) appears protective of the Cisco population. Although chl-*a* and TP are above or near the draft eutrophication standard for Cisco lakes, aquatic life (i.e., Cisco, fish community, and macrophytes) and recreation measures demonstrate that this lake meets goals. Furthermore, watershed disturbance indicates watershed conditions in this lake are likely near natural conditions. Little Bowstring Lake is in the Chippewa Plains and is relatively shallow and naturally fertile. The geometry ratio is also near 4, indicating that this lake may not be strongly dimictic. Although TP currently appears to exceed the draft criteria, it is near the threshold and this estimate is based on only 2 summers of data. As a result, a SSS for Cisco will not be assigned at this time as additional data may indicate attainment of the standard. In addition, the more stringent standard for northern dimictic lakes applies and a SSS should consider these goals. Although beneficial uses in Little Bowstring Lake are currently protected, water quality is potentially near thresholds that will result in the loss of these uses and this lake should therefore be considered vulnerable and in need of protection.

Figure 32. Annual water quality measures for Little Bowstring Lake (31-0758-00). T_{DO3} is the maximum T_{DO3} measured during the period of maximum oxythermal stress for each year. Total phosphorus, chlorophyll-*a*, and Secchi depth are summer averages for years with at least 4 measurements from June through September. Red dashed lines indicate draft water quality thresholds for Cisco lakes.



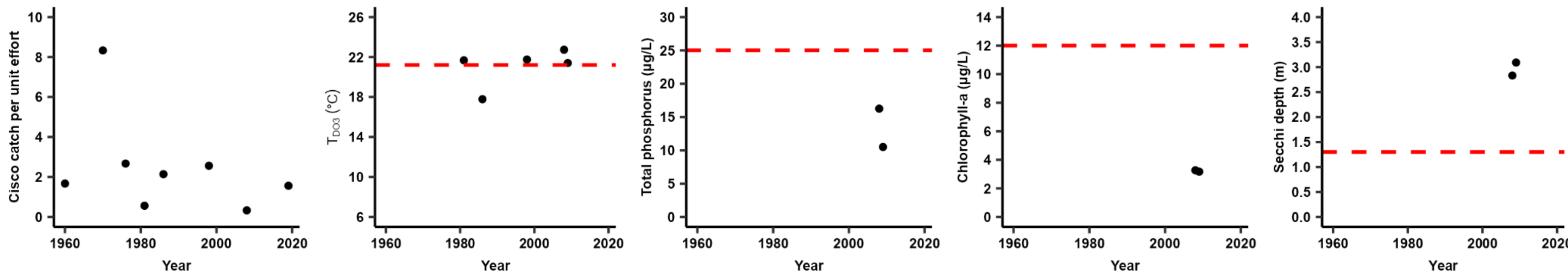
Turtle Lake (31-0725-00): Turtle Lake is currently designated Class 2B. It is not designated for the protection of Lake Trout and is not listed in Minnesota Department of Conservation (1967) as a trout lake. Lake Trout were stocked from 1916-1945, but no Lake Trout have been sampled in 12 MNDNR fisheries surveys. There is no indication that this lake supports a population of Lake Trout, but MNDNR surveys did demonstrate that populations of Lake Whitefish and Cisco are present. Considering this information, it is reasonable to designate Turtle Lake a Class 2Ae for the protection of coldwater aquatic life and habitat and assign protections for Lake Whitefish and Cisco (Class 2Ae [LKW,TLC]). Documentation for the Exceptional Use designation is provided in MPCA (2024c).

Unnamed (Nickel, Nichols) Lake (31-0470-00): The current Class 2A designation for this unnamed lake was assigned to protect stream trout. Management of Brown Trout in this unnamed (Nickel, Nichols) lake was discontinued although the lake is still a designated trout lake by the MNDNR (Minn. R. 6264.0050). This lake is currently designated Class 2Ag and this use (Class 2Ag [SRT]) will be retained until the MNDNR removes this lake from the list of designated trout lakes or additional information indicates its removal is appropriate.

Whitefish Lake (31-0843-00): Whitefish Lake is currently designated Class 2B and it is not designated for the protection of any coldwater fish species. Cisco were sampled in all eight MNDNR fisheries surveys on this lake indicating that a population of Cisco are present. Considering this information, it is reasonable to designate Whitefish Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]).

An estimate of T_{DO3} (22.0 °C) for Whitefish Lake currently exceeds the draft criteria for this parameter despite MNDNR fisheries surveys consistently indicating the presence of a healthy population of Cisco. There is also low disturbance (3.1%) in the watershed for this lake indicating that water quality in this lake is likely near natural conditions. Monitoring of Whitefish Lake in 1998 and 2001 indicated that it has a good macrophyte community. The MNDNR surveyed the fish community in Whitefish Lake in 2019 to assess attainment of fish IBI goals and determined that it supports a healthy fish community. No recreation suitability surveys are available for this lake. Summer average TP (13 µg/L), chl-*a* (3 µg/L), and Secchi depth (3.0 m) are also good for this lake. Although T_{DO3} is elevated compared to most Cisco lakes, aquatic life measures (i.e., Cisco, fish IBI, and macrophytes) demonstrate that this lake meets beneficial use goals. Watershed disturbance indicates watershed conditions in this lake are likely near natural conditions. In addition, the Cisco population appears stable (Figure 33) and there is no record of Cisco summer kills indicating that the current conditions are protective. As a result, it is reasonable to assign a SSS to this lake to address the atypical conditions which are suitable for the maintenance of a population of Cisco and other beneficial uses. As a result, the draft oxythermal standard for Whitefish Lake is: T_{DO3} = 22.0 °C. Eutrophication standards for Whitefish Lake would be unchanged from draft criteria. Although beneficial uses in Whitefish Lake are currently protected, water quality is potentially near thresholds that will result in the loss of these uses and this lake should therefore be considered vulnerable and in need of protection.

Figure 33. Annual water quality measures for Whitefish Lake (31-0843-00). T_{DO3} is the maximum T_{DO3} measured during the period of maximum oxythermal stress for each year. Total phosphorus, chlorophyll-*a*, and Secchi depth are summer averages for years with at least 4 measurements from June through September. Red dashed lines indicate draft water quality thresholds for Cisco lakes.



f. Rapid River watershed (09030007)

No draft use designations or confirmations

g. Rainy River - Lower watershed (09030008)

No draft use designations or confirmations

h. Lake of the Woods watershed (09030009)

No draft use designations or confirmations

3. Red River of the North basin

a. Bois de Sioux River watershed (09020101)

No draft use designations or confirmations

b. Mustinka River watershed (09020102)

No draft use designations or confirmations

c. Otter Tail River watershed (09020103)

Class 2A confirmations and designations

The following lakes will be confirmed or designated for the protection of coldwater aquatic life and habitat (Class 2A). A summary of the evidence supporting these use designations is provided in Table 32 and if needed, additional information is provided following this table. Available evidence demonstrates that these lakes support or should support naturally reproducing populations of Lake Whitefish or Cisco or the lakes are managed for coldwater fish through stocking. The use designations for these lakes will be amended in Minn. R. 7050.0470 by updating the beneficial uses for lakes in the Otter Tail River watershed (09020103).

Table 32. List of draft Class 2A use confirmations and designations for lakes in the Otter Tail River watershed (09020103) with supporting information. Abbreviations and fisheries survey codes are described in the introduction of Appendix C.

Lake name	WID	GR	Fisheries survey: LAT	Fisheries survey: LKW	Fisheries survey: TLC	Fisheries survey: SRT	Current ALU	Draft ALU	Trout lake	Type
Acorn	03-0258-00	1.65			U-2|8|83		2B	2Ag[TLC]	No	2A
Annie Battle	56-0241-00	2.22			U-3|5|27		2B	2Ag[TLC]	No	2A
Bass	56-0722-00	1.60				RBT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Bass	56-0770-00	2.12			U-1|0|6		2B	2Ag[TLC]	No	2A
Big Pine	56-0130-00	2.85			P-14|0|361		2B	2Ag[TLC]	No	2A
Clitherall	56-0238-00	2.68			P-11|2|170		2B	2Ag[TLC]	No	2A
Crystal	56-0749-00	2.91			P-9|3|274		2B	2Ag[TLC]	No	2A
Dead	56-0383-00	3.74			P-14|0|275		2B	2Ag[TLC]	No	2A
Detroit	03-0381-00	2.37			U-9|5|143		2B	2Ag[TLC]	No	2A

Lake name	WID	GR	Fisheries survey: LAT	Fisheries survey: LKW	Fisheries survey: TLC	Fisheries survey: SRT	Current ALU	Draft ALU	Trout lake	Type
East Battle	56-0138-00	2.00		E-1|12|1	P-13|0|201		2B	2Ag[TLC]	No	2A
East Loon	56-0523-00	1.40			P-9|0|311		2B	2Ag[TLC]	No	2A
Eunice	03-0503-00	3.82			P-8|2|50		2B	2Ag[TLC]	No	2A
Fish	56-0768-00	1.55			U-6|0|165		2B	2Ag[TLC]	No	2A
Franklin	56-0759-00	3.13			P-10|1|230		2B	2Ag[TLC]	No	2A
Hanson	03-0177-00	2.11				RBT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Jewett	56-0877-00	1.80			P-12|2|297		2B	2Ag[TLC]	No	2A
Little Floyd	03-0386-00	3.11			P-11|0|120		2B	2Ag[TLC]	No	2A
Little McDonald	56-0328-00	1.43			P-1|10|5		2B	2Ag[TLC]	No	2A
Little Pine	56-0142-00	2.26			P-13|1|861		2B	2Ag[TLC]	No	2A
Lizzie (north portion)	56-0760-01	2.61			P-13|2|230		2B	2Ag[TLC]	No	2A
Long	56-0388-00	1.23			P-10|1|107		2B	2Ag[TLC]	No	2A
Long	56-0784-00	1.87			P-6|4|24		2B	2Ag[TLC]	No	2A
Long	03-0383-00	1.92			P-12|1|221		2B	2Ag[TLC]	No	2A
Marion	56-0243-00	2.76			P-13|0|242		2B	2Ag[TLC]	No	2A
Meadow	03-0371-00	1.04			P-8|2|711	NA-H|N|U	2B	2Ag[TLC]	No	2A
Molly Stark	56-0303-00	1.89		U-1|7|1	P-7|1|60		2B	2Ag[TLC]	No	2A
Murphy	56-0229-00	3.65			U-5|0|110		2B	2Ag[TLC]	No	2A
Otter Tail	56-0242-00	2.37		E-0|21|0	P-21|0|3301		2B	2Ag[TLC]	No	2A
Otter Tail River (Red River)	56-0711-00	2.04			U-3|3|11		2B	2Ag[TLC]	No	2A
Paul	56-0335-00	1.38			P-1|7|14		2B	2Ag[TLC]	No	2A
Pebble	56-0829-00	1.54			P-6|3|103		2B	2Ag[TLC]	No	2A
Pelican	56-0786-00	3.24			P-14|0|133		2B	2Ag[TLC]	No	2A
Pickerel	56-0475-00	1.74			P-8|3|124		2B	2Ag[TLC]	No	2A
Rose	56-0360-00	1.12			P-4|7|24		2B	2Ag[TLC]	No	2A
Scalp	56-0358-00	1.15			P-4|5|5		2B	2Ag[TLC]	No	2A
Six	56-0369-00	0.69			U-3|5|34		2B	2Ag[TLC]	No	2A

Lake name	WID	GR	Fisheries survey: LAT	Fisheries survey: LKW	Fisheries survey: TLC	Fisheries survey: SRT	Current ALU	Draft ALU	Trout lake	Type
South Lida	56-0747-02	2.87			P-13|1|263		2B	2Ag[TLC]	No	2A
Star	56-0385-00	2.26			P-11|4|70		2B	2Ag[TLC]	No	2A
Stuart	56-0191-01	2.73			U-11|2|118		2B	2Ag[TLC]	No	2A
Sybil	56-0387-00	1.79			P-7|4|13		2B	2Ag[TLC]	No	2A
West Battle	56-0239-00	2.09		U-2|12|9	U-13|1|338		2B	2Ag[LKW,TLC]	No	2A
Wimer	56-0355-00	1.85			U-4|0|24		2B	2Ag[TLC]	No	2A

Little McDonald Lake (56-0328-00): Little McDonald Lake is currently designated Class 2B and it is not designated for the protection of any coldwater fish species. A single MNDNR fisheries surveys using gill nets sampled 5 Cisco in 1959, but 10 other surveys did not detect Cisco. A fisheries survey using vertical gill nets was conducted in 2020 and a high number of Cisco were sampled (n=376) indicating that this lake supports a population of Cisco. Considering this information, it is reasonable to designate Little McDonald Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]).

Meadow Lake (03-0371-00): Meadow Lake is currently designated Class 2B and it is not designated for the protection of any coldwater fish species. This lake was historically managed for stream trout, but it is no longer managed for stream trout nor is it a designated stream trout lake (Minn. R. 6264.0050). However, ten MNDNR fisheries surveys have been conducted which indicate that this lake supports a population of Cisco. Considering this information, it is reasonable to designate Meadow Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]).

Molly Stark Lake (56-0303-00): Molly Stark Lake is currently designated Class 2B and it is not designated for the protection of any coldwater fish species. Seven MNDNR fisheries surveys conducted on Molly Stark Lake have sampled Cisco indicating that this lake supports a population of Cisco. A single Lake Whitefish was sampled in one of the eight surveys, but this fish may have been transient from West Battle Lake (56-0239-00). At this time, this lake will not be designated for the protection of Lake Whitefish until additional data can be collected to confirm the presence of a resident population of Lake Whitefish. Considering this information, it is reasonable to designate Molly Stark Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]).

Paul (56-0335-00): Paul Lake is currently designated Class 2B and it is not designated for the protection of any coldwater fish species. A single MNDNR fisheries survey using gill nets sampled 14 Cisco in 2020, but 7 other surveys did not detect Cisco. A fisheries survey using vertical gill nets was conducted in 2021 and 31 Cisco were sampled indicating that this lake supports a population of Cisco. Considering this information, it is reasonable to designate Paul Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]).

Scalp Lake (56-0358-00): Scalp Lake is currently designated Class 2B and it is not designated for the protection of any coldwater fish species. Four MNDNR fisheries surveys using gill nets sampled a total of 5 Cisco and five surveys did not detect Cisco. A fisheries survey using vertical gill nets was conducted in 2020 and a high number of Cisco were sampled (n=59) indicating that this lake supports a population of Cisco. Considering this information, it is reasonable to designate Scalp Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]).

Stuart Lake (56-0191-01): Stuart Lake is currently designated Class 2B and it is not designated for the protection of any coldwater fish species. Cisco have been routinely sampled (11 of 13 surveys) in the main basin (56-0191-01). Considering this information, it is reasonable to designate Stuart Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]). Stuart Lake (Little West Bay) (56-0191-02) is shallow (~6 m maximum depth) with a small surface area (48 acres) and is unlikely to support coldwater fishes during the period of maximum oxythermal stress. A small number of Cisco have been collected in Little West Bay, but these fish only represent a small fraction of the total cisco catch. As a result, 56-0191-02 will not be included in the coldwater habitat designation.

West Battle Lake (56-0239-00): West Battle Lake is currently designated Class 2B and it is not designated for the protection of any coldwater fish species. Fourteen MNDNR fisheries surveys using standard gill nets have been conducted and Cisco were present in thirteen of these surveys. Lake Whitefish were present in two MNDNR fisheries surveys (n=9). In addition, Lake Whitefish were present in a 1993 MNDNR fall electrofishing survey. Considering this information, it is reasonable to designate West Battle Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Lake Whitefish and Cisco (Class 2Ag [LKW,TLC]).

Class 2Bd designations

The following lake will be designated for the protection of warm and cool water aquatic life and habitat (Class 2Bd). A summary of the evidence supporting the draft use designation is provided in Table 33 and additional details are provided following the table. For this lake, the designation of Class 2Bd from Class 2A results in the designation of a beneficial use that carries with it less stringent standards. As a result, a use attainability analysis (40 CFR § 131.3(g)) is required by the CWA (40 CFR § 131.10(j)) to demonstrate that the current use designation is not an existing use (40 CFR § 131.3(e)) or an attainable use (40 CFR § 131.10(d)). Considering the information below, it is reasonable to assign Class 2Bdg to this lake for the protection of cool and warm waters also protected as a source of drinking water. The use designations for these lakes will be amended in Minn. R. 7050.0470 by updating the beneficial uses for lakes in the Otter Tail River watershed (09020103).

Table 33: List of draft Class 2Bd use designations for lakes in the Otter Tail River watershed (09020103) with supporting information. Abbreviations and fisheries survey codes are described in the introduction of Appendix C.

Lake name	WID	GR	Fisheries survey: LAT	Fisheries survey: LKW	Fisheries survey: TLC	Fisheries survey: SRT	Current ALU	Draft ALU	Trout lake	Type
East Twin (Little Twin)	03-0362-00	0.66					$2A^{SRT}$	2Bdg	No	2Bd

East Twin Lake (03-0362-00): East Twin Lake is currently designated Class 2A, but there is no indication in the MPCA's waterbody database regarding why this lake was originally designated for coldwater habitat. Presumably it was designated for the protection for stream trout, but it is not designated by the MNDNR as a stream trout lake (Minn. R. 6264.0050) nor is it managed for stream trout. As a result, evidence indicates that East Twin Lake was erroneously designated as Class 2A. Considering this information, it is reasonable to assign Class 2Bdg to East Twin Lake for the protection of cool and warm waters also protected as a source of drinking water.

d. Upper Red River of the North watershed (09020104)

No draft use designations or confirmations

e. Buffalo River watershed (09020106)

Class 2A confirmations and designations

The following lake is considered for designation as coldwater aquatic life and habitat (Class 2A). A summary of the evidence supporting this use designation is provided in Table 34. Available evidence demonstrates that this lake supports or should support a naturally reproducing population of Cisco. The use designation for this lake will be amended in Minn. R. 7050.0470 by updating the beneficial uses for lakes in the Buffalo River watershed (09020106).

Table 34. List of draft Class 2A use confirmations and designations for lakes in the Buffalo River watershed (09020106) with supporting information. Abbreviations and fisheries survey codes are described in the introduction of Appendix C.

Lake name	WID	GR	Fisheries survey: LAT	Fisheries survey: LKW	Fisheries survey: TLC	Fisheries survey: SRT	Current ALU	Draft ALU	Trout lake	Type
Buffalo	03-0350-00	3.17			P-10|0|364		2B	2Ag[TLC]	No	2A

f. Red River of the North - Marsh River watershed (09020107)

No draft use designations or confirmations

g. Wild Rice River watershed (09020108)

Class 2A confirmations and designations

The following lake will be confirmed for the protection of coldwater aquatic life and habitat (Class 2A). A summary of the evidence supporting this use designation is provided in Table 35. This lake is currently managed for coldwater fish through stocking. The use designation for this lake will be amended in Minn. R. 7050.0470 by updating the beneficial uses for lakes in the Wild Rice River Watershed (09020108).

Table 35. List of draft Class 2A use confirmations and designations for lakes in the Wild Rice River Watershed (09020108) with supporting information. Abbreviations and fisheries survey codes are described in the introduction of Appendix C.

Lake name	WID	GR	Fisheries survey: LAT	Fisheries survey: LKW	Fisheries survey: TLC	Fisheries survey: SRT	Current ALU	Draft ALU	Trout lake	Type
Island (Wapatus)	15-0127-00	1.34				RBT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC

h. Red River of the North - Sandhill River watershed (09020301)

No draft use designations or confirmations

i. Upper/Lower Red Lake watershed (09020302)

No draft use designations or confirmations

j. Red Lake River watershed (09020303)

No draft use designations or confirmations

k. Thief River watershed (09020304)

No draft use designations or confirmations

l. Clearwater River watershed (09020305)

Class 2A confirmations and designations

The following lakes will be confirmed for the protection of coldwater aquatic life and habitat (Class 2A). A summary of the evidence supporting these use designations is provided in Table 36 and if needed, additional information is provided following this table. Available evidence demonstrates that these lakes support or should support naturally reproducing populations of Cisco or are managed for stream trout. The use designations for these lakes will be amended in Minn. R. 7050.0470 by updating the beneficial uses for lakes in the Clearwater River watershed (09020305).

Table 36. List of draft Class 2A use confirmations and designations for lakes in the Clearwater River watershed (09020305) with supporting information. Abbreviations and fisheries survey codes are described in the introduction of Appendix C.

Lake name	WID	GR	Fisheries survey: LAT	Fisheries survey: LKW	Fisheries survey: TLC	Fisheries survey: SRT	Current ALU	Draft ALU	Trout lake	Type
Buzzle	04-0297-00	1.19			U-2|0|113		2B	2Ag[TLC]	No	2A
Clearwater	04-0343-00	2.26			P-9|1|451		2B	2Ag[TLC]	No	2A
Deep	15-0090-00	0.89			E-3|6|25	RBT-C|Y|U	2B	2Ag[SRT]	No	2A

Buzzle Lake (04-0297-00): Buzzle Lake is currently designated Class 2B and is not designated for the protection of any coldwater fish species. The current status of Cisco in Buzzle Lake is uncertain due to a lack of recent fishery surveys and a lack of surveys using deep-set gill nets. However, a survey in 1970 sampled 112 Cisco and a single Cisco was sampled in 1986. The abundance of fish in these surveys may not reflect the actual population sizes in Buzzle Lake because the lake is difficult to survey due to steep drop offs in the lake margins and the 1986 survey only used two gill nets. It is likely that the Cisco population has persisted in Buzzle Lake, but additional sampling would be needed to confirm the status of this population. Regardless, the 1970 and 1986 surveys demonstrate that Cisco habitat is likely an existing use for Buzzle Lake. Considering this information, it is reasonable to designate Buzzle Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]).

Deep Lake (15-0090-00): Deep Lake is currently designated Class 2B, but it is stocked with Rainbow Trout. It is not a designated by the MNDNR as a trout lake (Minn. R. 6264.0050), but it is reasonable to assign the Class 2A classification assigned to coldwater aquatic life and habitat. Three MNDNR fisheries surveys sampled Cisco in the 1980s and 1990s which were likely the result of a stocking of fish in 1974. However, no Cisco have been captured since 1996 in three surveys (2005, 2012, and 2017). Anglers have also not reported catching Cisco in this lake despite heavy fishing pressure. It is likely that the introduced population of Cisco is no longer extant and given that stocking was unable to establish a self-sustaining population it is not appropriate to designate Deep Lake for the protection of Cisco at this time. Considering this information, it is reasonable to designate Deep Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for stream trout (Class 2Ag [SRT]).

m. Red River of the North - Grand Marais Creek watershed (09020306)

No draft use designations or confirmations

n. Snake River watershed (09020309)

No draft use designations or confirmations

o. Red River of the North - Tamarac River watershed (09020311)

No draft use designations or confirmations

p. Two Rivers watershed (09020312)

No draft use designations or confirmations

q. Roseau River watershed (09020314)

No draft use designations or confirmations

4. Upper Mississippi River basin

a. Mississippi River - Headwaters watershed (07010101)

Class 2A confirmations and designations

The following lakes will be confirmed or designated for the protection of coldwater aquatic life and habitat (Class 2A). A summary of the evidence supporting these use designations is provided in Table 37 and if needed, additional information is provided following this table. Available evidence demonstrates that these lakes support or should support naturally reproducing populations of Lake Whitefish or Cisco or are managed for coldwater fish through stocking. The use designations for these lakes will be amended in Minn. R. 7050.0470 by updating the beneficial uses for lakes in the Mississippi River - Headwaters watershed (07010101).

Table 37. List of draft Class 2A use confirmations and designations for lakes in the Mississippi River - Headwaters watershed (07010101) with supporting information. Abbreviations and fisheries survey codes are described in the introduction of Appendix C.

Lake name	WID	GR	Fisheries survey: LAT	Fisheries survey: LKW	Fisheries survey: TLC	Fisheries survey: SRT	Current ALU	Draft ALU	Trout lake	Type
Bass	31-0576-00	4.70			P-9|0|288		2B	2Ag[TLC]	No	2A
Beltrami	04-0135-00	2.71			P-10|0|275		2B	2Ag[TLC]	No	2A
Bemidji (main lake)	04-0130-02	3.10	E-0|11|0	U-5|6|27	P-11|0|1298		2B	2Ag[LKW,TLC]	No	2A
Benjamin	04-0033-00	0.49				RBT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	No	SC
Big LaSalle	15-0001-00	2.13			P-4|1|16		2B	2Ag[TLC]	No	2A
Blacksmith	29-0275-00	1.46				RBT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Chase	31-0749-00	1.05			P-7|2|268		2B	2Ag[TLC]	No	2A
Deer	31-0719-00	2.09	E-0|10|0	P-8|2|46	P-8|2|394		2B	2Ag[LKW,TLC]	No	2A
Deer	04-0230-00	2.58			P-10|2|231		2B	2Ag[TLC]	No	2A
Elk	15-0010-00	1.14	E-0|10|0		P-10|0|655		2B	2Ag[TLC]	No	2A

Lake name	WID	GR	Fisheries survey: LAT	Fisheries survey: LKW	Fisheries survey: TLC	Fisheries survey: SRT	Current ALU	Draft ALU	Trout lake	Type
Gilstad	04-0024-00	1.89		M-1|8|4	U-7|2|152		2B	2Ag[TLC]	No	2A
Grant	04-0217-00	1.07			P-7|0|537		2B	2Ag[TLC]	No	2A
Itasca	15-0016-00	3.32	E-0|12|0		P-12|0|262		2B	2Ag[TLC]	No	2A
Jay Gould	31-0565-00	3.59		U-2|6|2	P-7|1|46		2B	2Ag[TLC]	No	2A
LaSalle	29-0309-00	0.48			P-2|1|5		$2A^{SRT}$	2Ag[TLC]	No	SM
Leighton	31-0739-00	1.62		U-2|3|5	U-4|1|265		2B	2Ag[TLC]	No	2A
Little Bass	31-0575-00	1.50			P-6|1|138		2B	2Ag[TLC]	No	2A
Little Jay Gould	31-0566-00	1.63			P-3|1|280		2B	2Ag[TLC]	No	2A
Long	15-0057-00	1.14				RBT-C|N|U	2B	2Ag[SRT]	No	2A
Loon	31-0579-00	1.36			U-1|0|67		2B	2Ag[TLC]	No	2A
Loon	31-0571-00	1.47			P-9|0|538		2B	2Ag[TLC]	No	2A
Lucky	31-0603-00	1.15				BNT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Marquette	04-0142-00	2.44	E-0|4|0	P-1|3|1	P-4|0|163		2B	2Ag[TLC]	No	2A
Moose	31-0722-00	2.56			P-17|0|1680		2B	2Ag[TLC]	No	2A
Movil	04-0152-00	2.77			P-10|0|258		2B	2Ag[TLC]	No	2A
Newman (Putman)	29-0237-00	1.06			E-1|14|105	RBT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Pimushe	04-0032-00	3.86		U-1|8|3	P-9|0|223		2B	2Ag[TLC]	No	2A
Plantagenet	29-0156-00	2.85		U-1|8|1	P-9|0|407		2B	2Ag[TLC]	No	2A
Pokegama	31-0532-01, -02	2.01-2.05	U-0|10|0	U-6|4|9	P-9|1|368		$2A^{LAT}$	2Ag[TLC]	No	SM
Rabideau	04-0034-00	1.18			P-6|3|20		2B	2Ag[TLC]	No	2A
Rice	31-0717-00	2.07			P-10|0|510		2B	2Ag[TLC]	No	2A
Siseebakwet	31-0554-00	1.47			P-10|2|206		2B	2Ag[TLC]	No	2A
Spearhead	29-0239-00	1.17			P-4|0|122		2B	2Ag[TLC]	No	2A
Tioga Mine Pit	31-0946-00	0.31				RBT-C|Y|M	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Turtle	04-0159-00	3.67	E-0|11|0		P-11|0|552		2B	2Ag[TLC]	No	2A
Turtle River	04-0111-00	2.68		U-2|8|2	P-10|0|649		2B	2Ag[TLC]	No	2A
Wolf	04-0079-00	2.63		U-5|6|7	P-11|0|802		2B	2Ag[TLC]	No	2A

Lake Bemidji (main lake) (04-0130-02): Lake Bemidji is currently designated Class 2B and it is not designated for the protection of any coldwater fish species. Eleven MNDNR fisheries surveys have been conducted on Lake Bemidji which demonstrate that this lake supports populations of Lake Whitefish and Cisco. Lake Trout were stocked in 1909, but this species has not been present in any MNDNR fisheries survey. Considering this information, it is reasonable to designate Lake Bemidji a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Lake Whitefish and Cisco (Class 2Ag [LKW,TLC]).

Deer Lake (31-0719-00): Deer Lake is currently designated Class 2B and it is not designated for the protection of any coldwater fish species. Eight of the ten MNDNR fisheries surveys conducted on Deer Lake sampled Cisco and Lake Whitefish indicating that this lake supports populations of Lake Whitefish and Cisco. Lake Trout were stocked from 1913-45, but this species has not been present in any MNDNR fisheries survey. Considering this information, it is reasonable to designate Deer Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Lake Whitefish and Cisco (Class 2Ag [LKW,TLC]).

Elk Lake (15-0010-00): Elk Lake is currently designated Class 2B and it is not designated for the protection of any coldwater fish species. Ten MNDNR fisheries surveys have been conducted on Elk Lake and all surveys sampled Cisco indicating that this lake supports a population Cisco. Lake Trout were stocked in 1911, but this species has not been present in any MNDNR fisheries survey. Considering this information, it is reasonable to designate Elk Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]).

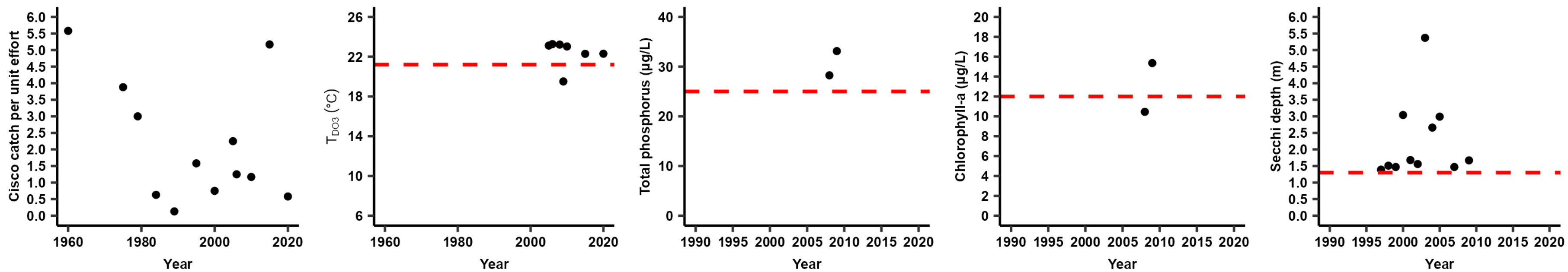
Gilstad Lake (04-0024-00): Gilstad Lake is currently designated Class 2B and it is not designated for the protection of any coldwater fish species. Nine MNDNR fisheries surveys have been conducted and Cisco were present in eight of these surveys. In the single survey (1977) where Cisco were absent, four Lake Whitefish were identified. This is the only survey from Gilstad Lake which included fish identified as Lake Whitefish, indicating that these fish were possibly misidentified. This lake will not be designated for the protection of Lake Whitefish until additional data can be collected to confirm the presence of a resident population of Lake Whitefish. As a result, it is reasonable to designate Gilstad Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]).

Lake Itasca (15-0016-00): Lake Itasca is currently designated Class 2B and it is not designated for the protection of any coldwater fish species. Twelve MNDNR fisheries surveys have been conducted on Lake Itasca and all sampled Cisco indicating that this lake supports a population of Cisco. Lake Trout were stocked in 1912, but this species has not been present in any MNDNR fisheries survey. Considering this information, it is reasonable to designate Lake Itasca a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]).

Summer average estimates of chl-*a* (13 µg/L), TP (31 µg/L), and T_{DO3} (22.4 °C) for Lake Itasca currently exceed the draft criteria for these parameters (Figure 34) despite MNDNR fisheries surveys consistently indicating the presence of a healthy population of Cisco. There is also low disturbance (2.6%) in the watershed for this lake indicating that water quality in this lake is likely near natural conditions. In addition, Lake Itasca is connected to Elk Lake (15-0016-00) so the Cisco population in Lake Itasca may be supplemented from Elk Lake. This lake was monitored five times from 1995-2007 and all indicated that Lake Itasca supports a good macrophyte community. Monitoring of fish in this lake in 2015 and 2020 by the MNDNR also indicated that the cool/warm water fish community is healthy. Recreation suitability data were collected from Lake Itasca from 2008-2010 on 20 days and there was only a single day where the recreation suitability score indicated conditions that would not be suitable for swimming. This recreation suitability score was also only recorded from one station with 2 other stations on the same day indicating better conditions. Most recreation survey scores for Lake Itasca indicated excellent conditions for recreation such as swimming. Summer average Secchi depth is also good for this lake

(2.3 m). Although chl-*a* and TP are elevated compared to the eutrophication standard for northern dimictic lakes, aquatic life (i.e., Cisco, macrophytes, and fish community) and recreation measures demonstrate that this lake meets benefical use goals. Watershed disturbance indicates water quality in this lake are likely near natural conditions. As a result, it is reasonable to assign a SSS to this lake to address the atypical conditions which are suitable for the maintenance of a population of Cisco and other beneficial uses. Water quality goals for this lake should be based on current conditions as these are attaining aquatic life and recreation goals. As a result, the draft lake eutrophication standards for Lake Itasca are: T_{DO3} = 22.5 °C, chl-*a* = 13 µg/L, and TP = 32 µg/L. Secchi depth (2.2 m) meets the draft criterion, and this parameter does not need to be modified. The average T_{DO3} value is based on a relatively large dataset consisting of 7 years of data with a standard error of 0.5 °C indicating good confidence in this estimate. In contrast, chl-*a* and TP estimates are based on data from 2 summers. There are 11 years of Secchi depth data and based on a 50th percentile loess model, a Secchi depth of 2.3 m is predicted to occur at a chl-*a* concentration of 10 µg/L. The higher chl-*a* than predicted at this Secchi depth may be the result of low CDOM in Lake Itasca and may not indicate an estimate error for chl-*a*. However, due to the limited chl-*a* and TP datasets, additional sampling may indicate an adjustment to the draft SSS will be required. Although beneficial uses in Lake Itasca are currently protected, water quality is potentially near thresholds that will result in the loss of these uses and this lake should therefore be considered vulnerable and in need of protection.

Figure 34. Annual water quality measures for Lake Itasca (15-0016-00). T_{DO3} is the maximum T_{DO3} measured during the period of maximum oxythermal stress for each year. Total phosphorus, chlorophyll-*a*, and Secchi depth are summer averages for years with at least 4 measurements from June through September. Red dashed lines indicate draft water quality thresholds for Cisco lakes.



Jay Gould Lake (31-0565-00): Jay Gould Lake is currently designated Class 2B and it is not designated for the protection of any coldwater fish species. Eight MNDNR fisheries surveys have been conducted on Jay Gould Lake and they indicate that this lake supports a population of Cisco. Lake Whitefish were sampled in two of the eight surveys with a total of 2 fish sampled. Jay Gould Lake is broadly connected to the Mississippi River and these Lake Whitefish may have been transient. This lake will not be designated for the protection of Lake Whitefish until additional data can be collected to confirm the presence of a resident population of Lake Whitefish. Considering this information, it is reasonable to designate Jay Gould Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]).

LaSalle Lake (29-0309-00): The current Class 2A designation for LaSalle Lake was assigned to protect stream trout, but it is not a designated by the MNDNR as a stream trout lake (Minn. R. 6264.0050) nor is it managed for stream trout. Small numbers of Cisco (n=5) were present in two MNDNR fisheries surveys. In addition, a high number of Cisco (n=126) were sampled in a 2017 MNDNR vertical gill net survey. This information indicates that LaSalle Lake supports a population of Cisco. Considering this information, it is reasonable to retain the Class 2Ag classification assigned to coldwater aquatic life and habitat. The designation for LaSalle Lake will be based on the protection of Cisco and will be designated Class 2Ag [TLC].

Leighton Lake (31-0739-00): Leighton Lake is currently designated Class 2B and it is not designated for the protection of any coldwater fish species. Five MNDNR fisheries surveys have been conducted on Leighton Lake and they indicate that this lake supports a population of Cisco. Lake Whitefish were sampled in two of the surveys with a total of 5 fish sampled. Leighton Lake is connected to the Mississippi River and these Lake Whitefish may have been transient. This lake will not be designated for the protection of Lake Whitefish until additional data can be collected to confirm the presence of a resident population of Lake Whitefish. Considering this information, it is reasonable to designate Leighton Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]).

Long Lake (15-0057-00): Long Lake is currently designated Class 2B and it is not designated for the protection of any coldwater fish species. Although it is not a designated stream trout lake, it is managed for Rainbow Trout. Available information (geometry ratio = 1.14 and temperature profile) indicates that this lake is dimictic and would likely benefit from coldwater lake standards to protect trout during the summer. Considering this information, it is reasonable to designate Long Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for stream trout (Class 2Ag [SRT]).

Loon Lake (31-0579-00): Loon Lake is currently designated Class 2B and it is not designated for the protection of any coldwater fish species. Loon Lake is in a remote area and there is limited fisheries information. A single MNDNR fisheries survey was conducted in 1980 and a high number of Cisco (n=67) were sampled indicating that this lake supports a natural population of this coldwater fish. Although only a single fisheries survey is available, much of the watershed is undeveloped. Considering this information, it is reasonable to designate Loon Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]). Due to the limited monitoring (i.e., a single fisheries survey), it is possible that additional information could result in a change to this designation.

Marquette Lake (04-0142-00): Marquette Lake is currently designated Class 2B and it is not designated for the protection of any coldwater fish species. Four MNDNR fisheries surveys have been conducted on Marquette Lake and they indicate that this lake supports a population of Cisco. A single Lake Whitefish was sampled in one survey. Marquette Lake is connected to the Mississippi River, Schoolcraft River, and Lake Bemidji (04-0130-02) and this Lake Whitefish may have been transient. This lake will not be designated for the protection of Lake Whitefish until additional data can be collected to confirm the presence of a resident population of Lake Whitefish. Lake Trout were stocked in 1917, but this species has not been present in any MNDNR fisheries survey. Considering this information, it is reasonable to designate Marquette Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]).

Movil Lake (04-0152-00): Movil Lake is currently designated Class 2B and it is not designated for the protection of any coldwater fish species. Ten MNDNR fisheries surveys have been conducted on Movil Lake and Cisco were present in all surveys indicating that this lake supports a population of Cisco. The summer average estimate of T_{DO3} (21.3 °C) for Movil Lake is near the draft criterion for this parameter despite MNDNR fisheries surveys consistently indicating the presence of a healthy population of Cisco. There is some disturbed land use (19.6%) in the watershed of this lake indicating possible impacts, but the watershed is largely intact. In addition, Movil Lake is connected to Turtle Lake (04-0159-00) so the Cisco population in Movil Lake may be supplemented from Turtle Lake. This lake has not been monitored by the MNDNR for macrophytes, but a 2011 MNDNR fish survey did determine that the cool/warm water fish community is healthy. Recreation suitability data were collected from Movil Lake from 2000-2019 on 226 days and there were no surveys with recreation suitability scores indicating poor conditions for swimming. Most recreation survey scores for Movil Lake indicated excellent conditions for recreation such as swimming. Summer average TP and chl-*a* was low (TP = 14 µg/L; chl-*a* = 5 µg/L) and Secchi depth (3.9 m) is also very good for this lake. Although T_{DO3} is near the draft criterion, aquatic life (i.e., Cisco and fish community) and recreation measures demonstrate that this lake meets beneficial use goals. The average T_{DO3} value is based on a relatively good dataset consisting of 5 years of data, but additional sampling may indicate a need for an SSS. Although coldwater habitat is limited in this lake (i.e., narrow oxythermal layer) and fish may be supplemented from Turtle Lake (04-0159-00), the Cisco population in Movil Lake may be self-sustaining. Considering this information, it is reasonable to designate Movil Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]).

Newman (Putman) Lake (29-0237-00): The current Class 2A designation for Newman Lake was assigned to protect stream trout and it is designated by the MNDNR as a stream trout lake (Minn. R. 6264.0050) and it is managed for Rainbow Trout. Cisco were stocked in this lake in 1977 and this species was sampled in high numbers in 1984. However, the lake was reclaimed in 1984 for the management of stream trout and the introduced population of Cisco was extirpated. Considering this information, it is reasonable to retain the Class 2Ag classification assigned to coldwater aquatic life and habitat. The designation for Newman Lake will be based on the protection of stream trout and will be designated Class 2Ag [SRT].

Pimushe Lake (04-0032-00): Pimushe Lake is currently designated Class 2B and it is not designated for the protection of any coldwater fish species. Nine MNDNR fisheries surveys have been conducted on Pimushe Lake which indicate that this lake supports a population of Cisco. Lake Whitefish were sampled in one of the surveys with a total of 3 fish sampled, but these fish may have been transient from Cass Lake (04-0030-00) or the Turtle River. This lake will not be designated for the protection of Lake Whitefish until additional data can be collected. Considering this information, it is reasonable to designate Pimushe Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]).

Summer average estimates of chl-*a* and TP (7 years from 2007-18; chl-*a* = 12 µg/L; TP = 26) for Pimushe Lake are at or exceed the draft criteria despite MNDNR fisheries surveys consistently indicating the presence of a population of Cisco. In contrast, T_{DO3} (20.8 °C; 3 years from 1993-2008) is below the draft criterion for Cisco. There is some disturbed land use (7.2%) in the watershed of this lake indicating possible impacts, but the watershed is largely natural. In addition, Pimushe Lake is connected to Cass Lake so the Cisco population in Pimushe Lake may be supplemented from Cass Lake. This lake has been monitored by the MNDNR for macrophytes four times (1993-2011) and all surveys indicated a good macrophyte community. The MNDNR has not surveyed this lake for assessment using the fish IBI. Recreation suitability data were collected from Pimushe Lake from 2003-2019 on 44 days and most recreation survey scores for Pimushe Lake indicated excellent conditions for recreation such as swimming. No recreation suitability scores indicating non-attainment of beneficial uses were recorded. Secchi depth (3.0 m) is also very good for this lake. Although eutrophication measures indicate marginal conditions for northern dimictic lakes, aquatic life (i.e., Cisco and macrophytes) and recreation measures demonstrate that this lake meets beneficial use goals and watershed disturbance indicates watershed conditions in this lake are likely near natural conditions. Average eutrophication parameter estimates were based on a relatively large dataset consisting of 7 years of data indicating reasonable confidence in these estimates. However, additional sampling may indicate a need for a SSS in the future. Although beneficial uses in Pimushe Lake are currently protected, water quality is potentially near thresholds that will result in the loss of these uses and this lake should therefore be considered vulnerable and in need of protection.

Plantagenet Lake (29-0156-00): Plantagenet Lake is currently designated Class 2B and it is not designated for the protection of any coldwater fish species. Nine MNDNR fisheries surveys have been conducted on Plantagenet Lake which indicate that this lake supports a population of Cisco. A single Lake Whitefish was sampled in one survey, but this fish may have been transient from the Schoolcraft River or Lake Bemidji (04-0130-02). This lake will not be designated for the protection of Lake Whitefish until additional data can be collected to confirm the presence of a resident population of Lake Whitefish. Considering this information, it is reasonable to designate Plantagenet Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]).

Pokegama Lake (31-0532-01,-02): Pokegama Lake is currently designated Class 2A to protect Lake Trout. It is listed as an "inland lake trout lake" in Minnesota Department of Conservation (1967) which also notes that the lake has an "adverse fish population." Ten MNDNR fisheries surveys have been conducted on Pokegama Lake and they indicate that this lake supports a population of Cisco. Lake Whitefish were sampled in six of the surveys with a total of 9 fish sampled. Pokegama Lake is connected to the Mississippi River, catches of Lake Whitefish are variable, and catches largely consist of large individuals which indicate this species is transient. Due to low numbers of this fish species in samples and the possibility that these fish were transient; this lake will not be designated at this time for the protection of Lake Whitefish until additional data can be collected to confirm the presence of a resident population of Lake Whitefish. Lake Trout were stocked in Pokegama Lake from 1909-1945 and are currently stocked opportunistically, but this species is not managed to support a long-term fishery. In addition, Lake Trout have not been present in any MNDNR fisheries surveys. Due to the lack of documented natural reproduction and management goals for Pokegama Lake, the Lake Trout designation will not be retained. Considering this information, it is reasonable to designate Pokegama Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]). As a result, the removal of the Lake Trout designation will also remove the restricted ORVW designation (Minn. R. 7050.0335, subp. 1, Item C) from Pokegama Lake.

Turtle Lake (04-0159-00): Turtle Lake is currently designated Class 2B and it is not designated for the protection of any coldwater fish species. Eleven MNDNR fisheries surveys have been conducted on Turtle Lake and Cisco were present in every survey indicating that this lake supports populations of Cisco. Lake Trout were stocked in 1911, but this species has not been present in any MNDNR fisheries survey. Considering this information, it is reasonable to designate Turtle Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]).

The summer average estimate of T_{DO3} (21.3 °C) for Turtle Lake is near the draft criterion for this parameter although MNDNR fisheries surveys consistently indicating the presence of a healthy population of Cisco. There is some disturbed land use (20.3%) in the watershed of this lake indicating possible impacts, but the watershed is relatively natural. Monitoring by the MNDNR for macrophytes in 2011 indicated that Turtle Lake supports a healthy population of macrophytes. Fish were also surveyed twice in 2001 and once in 2021 for biological assessment by the MNDNR. These surveys all met Exceptional Use thresholds indicating that Turtle Lake has a very good cool/warm water fish community. Recreation suitability data were collected from Turtle Lake from 1993-2019 on 320 days and there were only 5 surveys with a recreation suitability score indicating poor conditions (<2% of days). Most recreation survey scores for Turtle Lake indicated excellent recreation conditions for beneficial uses such as swimming. Summer average TP and chl-*a* were low (TP = 20 µg/L; chl-*a* = 6 µg/L) and Secchi depth (3.1 m) was also very good for this lake. Eutrophication measures demonstrate good trophic conditions for Turtle Lake which indicates that the elevated T_{DO3} is likely the result of natural lake characteristics (e.g., lake morphology). Although T_{DO3} is near the draft criterion, aquatic life (i.e., Cisco, fish community, and macrophytes) and recreation measures demonstrate that this lake meets goals. The average T_{DO3} value is based on a dataset consisting of 3 years of data so additional sampling may indicate a need for a SSS in the future. Although beneficial uses in Turtle Lake are currently protected, oxythermal habitat is potentially near thresholds that will result in the loss of these uses and this lake should therefore be considered vulnerable and in need of protection.

Turtle River Lake (04-0111-00): Turtle River Lake is currently designated Class 2B and it is not designated for the protection of any coldwater fish species. Ten MNDNR fisheries surveys conducted on Turtle River Lake all sampled Cisco indicating that this lake supports a population of Cisco. Lake Whitefish were sampled in two of the surveys with a total of 2 fish sampled, but these fish may have been transient from Cass Lake (04-0030-00). This lake will not be designated for the protection of Lake Whitefish until additional data can be collected to confirm the presence of a resident population of Lake Whitefish. Considering this information, it is reasonable to designate Turtle River Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]).

Wolf Lake (04-0079-00): Wolf Lake is currently designated Class 2B and it is not designated for the protection of any coldwater fish species. Eleven MNDNR fisheries surveys conducted on Wolf Lake all sampled Cisco indicating that this lake supports a population of Cisco. Lake Whitefish were sampled in five of the surveys with a total of 7 fish sampled, but these fish may have been transient from Cass Lake (04-0030-00). This lake will not be designated for the protection of Lake Whitefish until additional data can be collected to confirm the presence of a resident population of Lake Whitefish. Considering this information, it is reasonable to designate Wolf Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]).

b. Leech Lake River watershed (07010102)

Class 2A confirmations and designations

The following lakes will be confirmed or designated for the protection of coldwater aquatic life and habitat (Class 2A). A summary of the evidence supporting these use designations is provided in Table 38 and if needed, additional information is provided following this table. Available evidence demonstrates that these lakes support or should support naturally reproducing populations of Lake Whitefish or Cisco or are managed for coldwater fish through stocking. The use designations for these lakes will be amended in Minn. R. 7050.0470 by updating the beneficial uses for lakes in the Leech Lake River watershed (07010102).

Table 38. List of draft Class 2A use confirmations and designations for lakes in the Leech Lake River watershed (07010102) with supporting information. Abbreviations and fisheries survey codes are described in the introduction of Appendix C.

Lake name	WID	GR	Fisheries survey: LAT	Fisheries survey: LKW	Fisheries survey: TLC	Fisheries survey: SRT	Current ALU	Draft ALU	Trout lake	Type
Baby	11-0283-00	1.97			P-11|0|494		2B	2Ag[TLC]	No	2A
Benedict	29-0048-00	1.34		P-2|9|2	P-11|0|532		$2A^{SRT}$	2Ag[TLC]	No	SM

Lake name	WID	GR	Fisheries survey: LAT	Fisheries survey: LKW	Fisheries survey: TLC	Fisheries survey: SRT	Current ALU	Draft ALU	Trout lake	Type
Big Deep	11-0277-00	1.26			U-3|3|45		2B	2Ag[TLC]	No	2A
Blackwater	11-0274-00	2.05			P-14|0|755		2B	2Ag[TLC]	No	2A
Boy	11-0143-00	4.52			P-12|0|543		2B	2Ag[TLC]	No	2A
Child	11-0263-00	3.70			U-5|4|25		2B	2Ag[TLC]	No	2A
Cooper	11-0163-00	1.27			U-2|0|104		2B	2Ag[TLC]	No	2A
Crappie	29-0127-00	0.74				RBT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Diamond	11-0396-00	2.49				RBT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Girl	11-0174-00	1.46			P-10|0|204		2B	2Ag[TLC]	No	2A
Hazel	11-0295-00	1.33				RBT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Howard	11-0472-00	1.88			U-6|0|580		2B	2Ag[TLC]	No	2A
Inguadona	11-0120-01,-02	1.81-2.52			P-12|0|901		2B	2Ag[TLC]	No	2A
Kabekona	29-0075-00	1.38	E-0|12|0	P-2|10|13	P-12|0|1674		$2A^{LAT}$	2Ag[LKW,TLC]	No	SM
Kid	11-0262-00	1.81			U-2|2|47		2B	2Ag[TLC]	No	2A
Leech	11-0203-01,-02, -03,-04	1.49-3.12		P-13|24|38	P-29|8|5101		2B	2Ag[LKW,TLC]	No	2A
Little Boy	11-0167-00	2.23			P-13|2|446		2B	2Ag[TLC]	No	2A
Long	11-0480-00	1.33			P-8|0|355		2B	2Ag[TLC]	No	2A
Man	11-0282-00	1.40			P-8|1|553		2B	2Ag[TLC]	No	2A
May	11-0482-00	1.78			U-6|2|38		2B	2Ag[TLC]	No	2A
McKeown	11-0261-00	2.53			U-2|1|17		2B	2Ag[TLC]	No	2A
Mule	11-0200-00	2.66			U-6|7|57		2B	2Ag[TLC]	No	2A
Pleasant	11-0383-00	2.09			P-12|2|136		2B	2Ag[TLC]	No	2A
Portage	11-0476-00	1.27			U-2|7|145		2B	2Ag[TLC]	No	2A
Shingobee	29-0043-00	2.42			U-2|0|15		2B	2Ag[TLC]	No	2A
Steamboat	11-0504-00*	1.82		P-3|9|3	U-8|4|598		2B	2Ag[TLC]	No	2A
Swift	11-0133-00	2.31			U-5|0|74		2B	2Ag[TLC]	No	2A
Teepee (Cranberry)	11-0312-00	1.85				RBT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Ten Mile	11-0413-00	1.06		P-19|0|670	P-3|16|19		2B	2Ag[LKW,TLC]	No	2A

Lake name	WID	GR	Fisheries survey: LAT	Fisheries survey: LKW	Fisheries survey: TLC	Fisheries survey: SRT	Current ALU	Draft ALU	Trout lake	Type
Upper Trelipe	11-0105-00	1.71			P-12|0|523		2B	2Ag[TLC]	No	2A
Wabedo	11-0171-01,-02	1.38-2.56			P-13|0|1842		2B	2Ag[TLC]	No	2A

Benedict Lake (29-0048-00): The current Class 2A designation for Benedict Lake was assigned to protect stream trout, but it is not a designated stream trout lake (Minn. R. 6264.0050) nor is it managed for stream trout. It is listed as a "potential inland Lake Trout lake" in Minnesota Department of Conservation (1967). Lake Trout were stocked on an experimental basis in 1955, but test nettings did not capture any Lake Trout and all MNDNR fisheries surveys have failed to sample Lake Trout. Eleven MNDNR fisheries surveys have demonstrated that Benedict Lake supports a population of Cisco. A total of 2 Lake Whitefish were sampled in two of the fisheries surveys. Benedict Lake is connected to Leech Lake (11-0203-00) which indicates these 2 fish may been transient. This lake will not be designated for the protection of Lake Whitefish until additional data can be collected to confirm the presence of a resident population of Lake Whitefish. As a result, it is reasonable to designate Benedict Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]).

Kabekona Lake (29-0075-00): Kabekona Lake is currently designated Class 2A to protect Lake Trout. It is listed as a "potential inland lake trout lake" in Minnesota Department of Conservation (1967). Lake Trout were stocked periodically from 1911-2004, but the 12 MNDNR fisheries surveys conducted on Kabekona Lake have never sampled Lake Trout. However, fisheries survey data do indicate that this lake supports populations of Lake Whitefish and Cisco. Considering this information, it is reasonable to retain the Class 2Ag designation for coldwater aquatic life and habitat and assign protections for Lake Whitefish and Cisco (Class 2Ag [LKW,TLC]). As a result, the removal of the Lake Trout lake designation will also remove the restricted ORVW designation (Minn. R. 7050.0335, subp. 1, Item C) from Kabekona Lake.

Steamboat Lake (11-0504-00): Steamboat Lake is currently designated Class 2B and it is not designated for the protection of any coldwater fish species. Twelve MNDNR fisheries surveys have been conducted and Cisco were present in eight of these surveys. Lake Whitefish were also sampled in 3 fisheries surveys for a total of 3 fish. Steamboat Lake is connected to Leech Lake (11-0203-00) which indicates these fish may have been transient. This lake will not be designated for the protection of Lake Whitefish until additional data can be collected to confirm the presence of a resident population of Lake Whitefish. As a result, it is reasonable to designate Steamboat Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco only (Class 2Ag [TLC]).

c. Mississippi River – Grand Rapids watershed (07010103)

Class 2A confirmations and designations

The following lakes will be confirmed or designated for the protection of coldwater aquatic life and habitat (Class 2A). A summary of the evidence supporting these use designations is provided in Table 39 and if needed, additional information is provided following this table. Available evidence demonstrates that these lakes support or should support naturally reproducing populations of Lake Trout, Lake Whitefish or Cisco or are managed for coldwater fish through stocking. The use designations for these lakes will be amended in [Minn. R. 7050.0470] by updating the beneficial uses for lakes in the Mississippi River – Grand Rapids watershed (07010103).

Table 39. List of draft Class 2A use confirmations and designations for lakes in the Mississippi River – Grand Rapids watershed (07010103) with supporting information. Abbreviations and fisheries survey codes are described in the introduction of Appendix C.

Lake name	WID	GR	Fisheries survey: LAT	Fisheries survey: LKW	Fisheries survey: TLC	Fisheries survey: SRT	Current ALU	Draft ALU	Trout lake	Type
Antler	31-0349-00	1.14			P-7|0|115		2B	2Ag[TLC]	No	2A
Ball Bluff	01-0046-00	0.38			P-7|0|105		2B	2Ag[TLC]	No	2A
Balsam	31-0259-00	3.60			P-11|1|710		2B	2Ag[TLC]	No	2A
Barwise	31-0278-00	1.60			P-1|1|30		2B	2Ag[TLC]	No	2A
Bass	11-0069-00	1.77			P-7|0|313		2B	2Ag[TLC]	No	2A
Bass	01-0073-00	0.38			U-4|1|11		2B	2Ag[TLC]	No	2A
Bee Cee	31-0443-00	1.85				NA-H|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Big Sandy	01-0062-00	0.85		M-1|15|54	P-14|2|1255		2B	2Ag[TLC]	No	2A
Bluewater	31-0395-00	0.95	P-9|0|178		P-9|0|147		$2A^{LAT}$	2Ag[LAT,TLC]	No	SM
Bray	31-0147-00	2.17			P-5|0|107		2B	2Ag[TLC]	No	2A
Crooked	31-0193-00	1.80		M-1|9|7	P-10|0|520		2B	2Ag[TLC]	No	2A
Cutaway	31-0429-00	1.89			U-2|0|64		2B	2Ag[TLC]	No	2A
Hale	31-0373-00	1.54			P-4|2|43		2B	2Ag[TLC]	No	2A
Hanson	31-0344-00	1.14			U-2|0|26		2B	2Ag[TLC]	No	2A
Hart	31-0020-00	2.01	E-0|4|0		U-4|0|415		2B	2Ag[TLC]	No	2A
Hartley	31-0154-00	2.16		U-2|7|12	U-6|3|72		2B	2Ag[LKW,TLC]	No	2A
Haskell	31-0945-00	1.44		M-1|1|9	P-1|1|128		2B	2Ag[TLC]	No	2A
Kremer	31-0645-00	0.89	E-0|9|0			BNT,RBT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Little Ball Bluff	01-0057-00	0.41			U-5|2|18		2B	2Ag[TLC]	No	2A
Little Thunder	11-0009-01,-02	1.06-1.40			P-3|2|19		2B	2Ag[TLC]	No	2A
Little Trout	31-0394-00	0.99	E-1|1|1		U-2|0|169		$2A^{LAT}$	2Ag[TLC]	No	SM
Little Wabana	31-0399-00	1.50			U-2|1|77		2B	2Ag[TLC]	No	2A
Loon	01-0024-00	0.91				BNT,RBT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC

Lake name	WID	GR	Fisheries survey: LAT	Fisheries survey: LKW	Fisheries survey: TLC	Fisheries survey: SRT	Current ALU	Draft ALU	Trout lake	Type
Lower Balsam	31-0247-00	3.62			P-5|0|90		2B	2Ag[TLC]	No	2A
Lower Hanson	31-0239-00	1.00			U-1|0|68		2B	2Ag[TLC]	No	2A
Moonshine (Little Moonshine)	31-0444-00	0.87				RBT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Nashwauk	31-0192-00	1.75			U-3|0|481		2B	2Ag[TLC]	No	2A
North Twin	31-0190-00	2.47			U-4|2|98		2B	2Ag[TLC]	No	2A
No-ta-she-bun	31-0775-00	2.56			U-3|6|80		2B	2Ag[TLC]	No	2A
O'Reilly	31-0219-00	1.24			P-7|0|142		2B	2Ag[TLC]	No	2A
Ox Hide	31-0106-00	2.18			P-4|3|18		2B	2Ag[TLC]	No	2A
Prairie	69-0848-00	3.09			P-10|0|394		2B	2Ag[TLC]	No	2A
Round	01-0070-00	0.56			P-8|0|275		2B	2Ag[TLC]	No	2A
Shallow	31-0084-00	1.49			P-8|4|480		2B	2Ag[TLC]	No	2A
Shamrock	31-0218-00	1.28			P-6|0|50		2B	2Ag[TLC]	No	2A
Snaptail	31-0255-00	1.38			U-5|4|248		2B	2Ag[TLC]	No	2A
South Twin	31-0191-00	2.29			U-5|0|82		2B	2Ag[TLC]	No	2A
Swan	31-0067-02	2.73	E-0|14|0		P-13|1|1675		2B	2Ag[TLC]	No	2A
Taylor	01-0109-00	0.24			P-4|2|11	BKT, RBT-C|Y|U	$2A^{SRT}$	2Ag[TLC,SRT]	Yes	SM
Thunder	11-0062-00	1.95		U-4|4|4	P-8|0|720		2B	2Ag[TLC]	No	2A
Trout	31-0410-00	1.08	P-9|4|66		P-13|0|2858		$2A^{LAT}$	2Ag[LAT,TLC]	No	SM
Trout	31-0216-00	1.26	E-0|12|0	U-2|10|18	U-10|2|220		$2A^{LAT}$	2Ag[LKW,TLC]	No	SM
Wabana	31-0392-00	1.56			P-9|1|523		$2A^{SRT}$	2Ag[TLC]	No	SM
Wasson	31-0281-00	1.76	E-0|4|0		U-2|2|19		2B	2Ag[TLC]	No	2A

Bee Cee Lake (31-0443-00): Bee Cee Lake is currently designated Class 2A to protect stream trout. Management of stream trout in Bee Cee Lake was discontinued although the lake is still a designated trout lake (Minn. R. 6264.0050). This lake is currently designated Class 2Ag and this use (Class 2Ag [SRT]) will be retained until the MNDNR removes this lake from the list of designated trout lakes or additional information indicates its removal is appropriate.

Big Sandy Lake (01-0062-00): Big Sandy Lake is currently designated Class 2B and it is not designated for the protection of any coldwater fish species. Fourteen MNDNR fisheries surveys have sampled Cisco indicating that this lake supports a population of Cisco. Cisco were possibly misidentified as Lake

Whitefish in 1982 as 54 Lake Whitefish and no Cisco were identified in this survey. The size of most of these fish were more typical of Cisco although one large specimen was observed and identified as a Lake Whitefish. However, Big Sandy Lake is connected to the Mississippi River and distantly to Pokegama Lake (31-0532-01, -02) which could have been the source of this fish. This lake will not be designated for the protection of Lake Whitefish until additional data can be collected to confirm the presence of a resident population of Lake Whitefish. As a result, it is reasonable to designate Big Sandy a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]). Big Sandy Lake is a large and complex lake with several bays, but suitable summer habitat for Cisco is largely in Bell Horn Bay. Cisco likely use the whole lake most of the year but require the refuge of Bell Horn Bay during the period of maximum oxythermal stress. As a result, assessment of Cisco habitat should be based only on monitoring from Bell Horn Bay to ensure an accurate measure of the condition of Cisco habitat in Big Sandy Lake.

Hart Lake (31-0020-00): Hart Lake is currently designated Class 2B and it is not designated for the protection of any coldwater fish species. Four MNDNR fisheries surveys have been conducted on Hart Lake and Cisco were present in every survey indicating that this lake supports populations of Cisco. Lake Trout were stocked from 1913-1945, but this species has not been present in any MNDNR fisheries survey. Considering this information, it is reasonable to designate Hart Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]).

Haskell Lake (31-0945-00): Haskell Lake is currently designated Class 2B and it is not designated for the protection of any coldwater fish species. Two MNDNR fisheries surveys have been conducted on this lake and a high number of Cisco (n=128) were present in the 2016 survey. No Lake Whitefish were sampled in 2016. A fisheries survey in 1972 collected 9 fish identified as Lake Whitefish, but no fish were identified as Cisco. These data indicate a possible misidentification as most or all of these fish may have been Cisco. Any Lake Whitefish present may have been transient as Hartley Lake is distantly connected to Crooked Lake (31-0193-00). This lake will not be designated for the protection of Lake Whitefish until additional data can be collected to confirm the presence of a resident population of Lake Whitefish. As a result, it is reasonable to designate Hartley Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco only (Class 2Ag [TLC]).

Kremer Lake (31-0645-00): Kremer Lake is currently designated Class 2A to protection stream trout. This lake is currently managed (Brown and Rainbow Trout) and designated as a stream trout lake by the MNDNR (Minn. R. 6264.0050). Lake Trout were stocked in 1943, but this species has not been present in any of the nine MNDNR fisheries surveys conducted on this lake. Considering this information, it is reasonable to retain the Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for stream trout (Class 2Ag [SRT]).

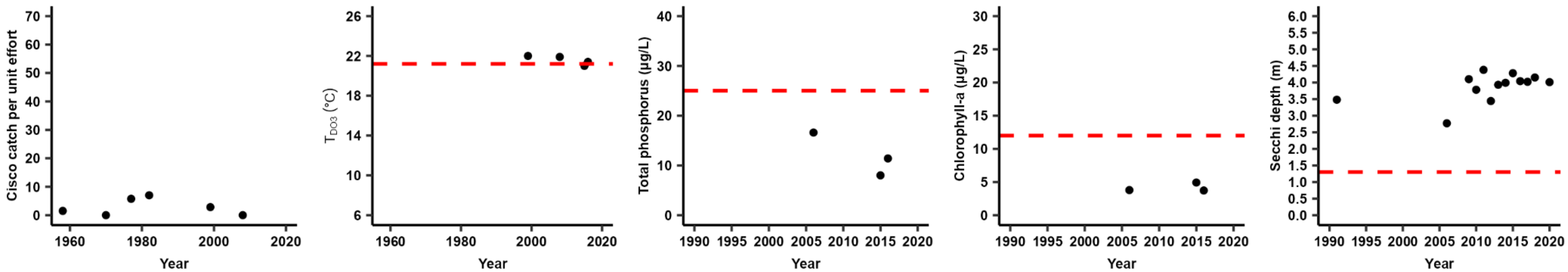
Little Trout Lake (31-0394-00): Little Trout Lake is currently designated Class 2A to protect Lake Trout. It is listed as a “potential inland lake trout lake” in Minnesota Department of Conservation (1967) which also notes the presence of “good” dissolved oxygen conditions. It was presumably listed as a Class 2A based on the 1967 report. A single Lake Trout was sampled in a 1981 MNDNR fisheries survey, but no trout were sampled in a subsequent survey. Little Trout Lake is connected to Trout Lake (31-0410-00) and the Lake Trout sampled in 1981 may have been transient. This lake will not be designated for the protection of Lake Trout until additional data can be collected to confirm the presence of a resident population of Lake Trout. However, both MNDNR fisheries surveys did sample Cisco indicating that this lake supports a population of this coldwater fish species. Considering this information, it is reasonable to retain the Class 2Ag designation for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]). As a result, the removal of the Lake Trout lake designation will also remove the restricted ORVW designation (Minn. R. 7050.0335, subp. 1, Item C) from Little Trout Lake.

Lower Hanson Lake (31-0239-00): Lower Hanson Lake is currently designated Class 2B and it is not designated for the protection of any coldwater fish species. A single MNDNR fisheries survey was conducted in 1980 and a high number of Cisco (n=68) were sampled indicating that this lake supports a natural population of this coldwater fish. Considering this information, it is reasonable to designate Lower Hanson Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]). Due to the limited monitoring (i.e., a single fisheries survey), it is possible that additional information could result in a change to this designation.

North Twin Lake (31-0190-00): North Twin Lake is currently designated Class 2B and it is not designated for the protection of any coldwater fish species. Four of six MNDNR fisheries surveys sampled Cisco indicating that this lake supports a natural population of this coldwater fish. Considering this information, it is reasonable to designate North Twin Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]).

The summer average estimate of T_{DO3} (21.6 °C) for North Twin Lake exceeds the draft criterion for this parameter despite MNDNR fisheries surveys consistently indicating the presence of a healthy population of Cisco. There is some disturbed land use (15.2%) in the watershed of this lake indicating possible impacts, but the watershed is relatively intact. Macrophytes were monitored four times by the MNDNR for from 1999-2016 which indicated that North Twin Lake supports a healthy population of macrophytes. Recreation suitability data were collected from North Twin Lake from 1993-2019 on 320 days and no surveys indicated recreation suitability conditions that did not meet goals. The majority (>98%) of recreation survey scores for North Twin Lake were indicative of excellent recreation conditions which support beneficial uses such as swimming. Summer average TP and chl-*a* was low (TP = 12 µg/L; chl-*a* = 4 µg/L) and Secchi depth (3.9 m) was also very good for this lake (Figure 35). Eutrophication measures demonstrate good trophic conditions for North Twin Lake which indicates that the elevated T_{DO3} is likely the result of natural lake characteristics (e.g., lake morphology). Although T_{DO3} is above the draft criterion, aquatic life (i.e., Cisco and macrophytes) and recreation measures demonstrate that this lake meets goals. The current attainment of aquatic life and recreation beneficial uses (macrophytes, eutrophication, and recreation suitability) and the presence of a resident population of Cisco indicate that current conditions in this lake are suitable to protect beneficial uses. As a result, an oxythermal criterion for North Twin Lake of 21.6 °C is proposed. The other parameters (i.e., TP, chl-***a***, and Secchi depth) are attained and no site-specific changes to these criteria are needed. The oxythermal habitat in North Twin Lake is potentially near thresholds that will result in the loss of Cisco and this lake should therefore be considered vulnerable and in need of protection.

Figure 35. Annual water quality measures for North Twin Lake (31-0190-00). T_{DO3} is the maximum T_{DO3} measured during the period of maximum oxythermal stress for each year. Total phosphorus, chlorophyll-*a*, and Secchi depth are summer averages for years with at least 4 measurements from June through September. Red dashed lines indicate draft water quality thresholds for Cisco lakes.



Swan Lake (31-0067-02): Swan Lake is currently designated Class 2B and it is not designated for the protection of any coldwater fish species. Fourteen MNDNR fisheries surveys have been conducted on Swan Lake and Cisco were present in thirteen of these surveys indicating that this lake supports a population of Cisco. Lake Trout were stocked from 1913-1945, but this species has not been present in any MNDNR fisheries survey. Considering this information, it is reasonable to designate Swan Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]). Swan Lake West Bay (31-0067-01) and Southwest Bay (31-0067-03) are shallow (< 6.1 m) and unlikely to support coldwater fishes during the period of maximum oxythermal stress. A small number of Cisco have been collected in West Bay, but these fish only represent a small fraction of the total Cisco catch. As a result, 31-0067-01 and 31-0067-03 will not be included with the coldwater habitat designation.

Thunder Lake (11-0062-00): Thunder Lake is currently designated Class 2B and it is not designated for the protection of any coldwater fish species. Eight MNDNR fisheries surveys have been conducted on this lake and Cisco were present in every survey. Lake Whitefish were sampled in four of these surveys with a total of 4 fish sampled. These Lake Whitefish may have been transient as Thunder Lake is distantly connected to Leech Lake (11-0203-00). This lake will not be designated for the protection of Lake Whitefish until additional data can be collected to confirm the presence of a resident population of Lake Whitefish. As a result, it is reasonable to designate Thunder Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]).

Trout Lake (31-0216-00): Trout Lake is currently designated Class 2A to protect Lake Trout. It is listed as an "inland lake trout lake" in Minnesota Department of Conservation (1967) which also notes the presence of an "adverse fish population." Lake Trout were stocked in 1965, but this species has never been sampled in the 12 MNDNR fisheries surveys conducted on Trout Lake. This lake will not be designated for the protection of Lake Trout. However, MNDNR fisheries surveys did sample Lake Whitefish and Cisco indicating that this lake supports populations of these coldwater fish species. Considering this information, it is reasonable to retain the Class 2Ag classification for coldwater aquatic life and habitat and assign protections for Lake Whitefish and Cisco (Class 2Ag [LKW,TLC]). Trout Lake is not currently designated as a restricted ORVW so the removal of the Lake Trout designation for Trout Lake does not affect the ORVW designation.

Wabana Lake (31-0392-00): Wabana Lake is currently designated Class 2A to protect stream trout. However, this lake is not currently managed or designated as a stream trout lake (Minn. R. 6264.0050) by the MNDNR. However, nine MNDNR fisheries surveys did sample Cisco indicating a population of this species is supported in this lake. Considering this information, it is reasonable to retain the Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]).

Wasson Lake (31-0281-00): Wasson Lake is currently designated Class 2B and it is not designated for the protection of any coldwater fish species. Lake Trout were stocked from 1923-1944, but this species has never been sampled in the four MNDNR fisheries surveys conducted on Wasson Lake. This lake will not be designated for the protection of Lake Trout. However, MNDNR fisheries surveys did sample Cisco in 2 surveys indicating that this lake supports a population of this coldwater fish species. Considering this information, it is reasonable to designate Wasson Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]).

Class 2Bd designations

The following lake will be designated for the protection of warm and cool water aquatic life and habitat (Class 2Bd). A summary of the evidence supporting this draft use designation is provided in Table 40 and additional details are provided following the table. For this lake, the designation of Class 2Bd from Class 2A results in the designation of a beneficial use that carries with it less stringent standards. As a result, a use attainability analysis (40 CFR § 131.3(g)) is required by the CWA (40 CFR § 131.10(j)) to demonstrate that the current use designation is not an existing use (40 CFR § 131.3(e)) or an attainable use (40 CFR § 131.10(d)). Considering the information below, it is reasonable to assign Class 2Bdg to this lake for the protection of cool and warm waters also protected as a source of drinking water. The use designations for these lakes will be amended in Minn. R. 7050.0470 by updating the beneficial uses for lakes in the Mississippi River – Grand Rapids watershed (07010103) to acknowledge the cool and warm water status of this lake.

Table 40: List of draft Class 2Bd use designations for lakes in the Mississippi River – Grand Rapids watershed (07010103) with supporting information. Abbreviations and fisheries survey codes are described in the introduction of Appendix C.

Lake name	WID	GR	Fisheries survey: LAT	Fisheries survey: LKW	Fisheries survey: TLC	Fisheries survey: SRT	Current ALU	Draft ALU	Trout lake	Type
Kennedy	31-0137-00	1.04					$2A^{SRT}$	2Bdg	No	2Bd

Kennedy Lake (31-0137-00): Kennedy Lake is currently designated Class 2A to protect stream trout. It is not currently designated (Minn. R. 6264.0050) or managed as a stream trout lake by the MNDNR. It is listed as a “potential inland lake trout lake” in Minnesota Department of Conservation (1967) which also notes the presence of Rainbow Smelt and “good” dissolved oxygen conditions. It was presumably listed as a Class 2A based on the 1967 report. However, there is no indication that this lake supported Lake Trout or any other coldwater fish species at any time. Eight MNDNR fisheries surveys from 1959 through 2003 have not sampled any coldwater fish species. Considering this information, it is reasonable to assign Class 2Bdg to Kennedy Lake for the protection of cool and warm waters also protected as a source of drinking water. This lake is not currently designated as a Lake Trout lake, so the draft designation does not result in the removal of a Lake Trout lake designation.

d. *Mississippi River - Brainerd watershed (07010104)*

Class 2A confirmations and designations

The following lakes will be confirmed or designated for the protection of coldwater aquatic life and habitat (Class 2A). A summary of the evidence supporting these use designations is provided in Table 41 and if needed, additional information is provided following this table. Available evidence demonstrates that these lakes support or should support naturally reproducing populations of Lake Trout or Cisco or are managed for coldwater fish through stocking. The use designations for these lakes will be amended in Minn. R. 7050.0470 by updating the beneficial uses for lakes in the Mississippi River - Brainerd watershed (07010104).

Table 41. List of draft Class 2A use confirmations and designations for lakes in the Mississippi River - Brainerd watershed (07010104) with supporting information. Abbreviations and fisheries survey codes are described in the introduction of Appendix C.

Lake name	WID	GR	Fisheries survey: LAT	Fisheries survey: LKW	Fisheries survey: TLC	Fisheries survey: SRT	Current ALU	Draft ALU	Trout lake	Type
Bass	77-0024-00	1.12			P-6|3|370		2B	2Ag[TLC]	No	2A
Bay	18-0034-00	2.44			P-8|0|187		2B	2Ag[TLC]	No	2A
Big Swan	77-0023-00	3.16			U-5|4|38		2B	2Ag[TLC]	No	2A
Black Bear	18-0140-00	2.08			P-4|0|373		2B	2Ag[TLC]	No	2A
Blue	01-0181-00	0.20	E-0|7|0			RBT-C|N|U	$2A^{SRT}$	2Ag[SRT]	No	SC
Cedar	01-0209-01, -03	0.48-1.77			U-11|2|497		2B	2Ag[TLC]	No	2A
Clearwater	18-0038-00	2.70			P-8|0|262		2B	2Ag[TLC]	No	2A
Crooked	18-0041-01, -02	1.58-2.32			P-11|0|747		2B	2Ag[TLC]	No	2A
Dam	01-0096-00	0.82			P-11|2|185		2B	2Ag[TLC]	No	2A
Farm Island	01-0159-00	0.95			P-10|1|118		2B	2Ag[TLC]	No	2A
Hanks	18-0044-00	2.07			P-10|0|804		2B	2Ag[TLC]	No	2A
Huntington Mine (Martin, Feigh)	18-0441-00	0.32				BNT, RBT-C|Y|M	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Lady	77-0032-00	1.55			P-1|7|2		2B	2Ag[TLC]	No	2A
Little Pine	01-0176-00	0.70			P-6|0|48		2B	2Ag[TLC]	No	2A
Little Rabbit	18-0139-00	2.88			P-4|0|111		2B	2Ag[TLC]	No	2A
Little Swan	77-0034-00	1.41			P-7|1|174		2B	2Ag[TLC]	No	2A

Lake name	WID	GR	Fisheries survey: LAT	Fisheries survey: LKW	Fisheries survey: TLC	Fisheries survey: SRT	Current ALU	Draft ALU	Trout lake	Type
Long	01-0089-00	0.31			P-11|0|251	SPT-C|N|U	2B	2Ag[TLC,SRT]	No	2A
Long	77-0027-00	1.85			U-5|3|83		2B	2Ag[TLC]	No	2A
Mahnomen, Alstead, and Arco Mines	18-0440-01, -02,-03,-04, -05,-06,-07	0.15-0.53	U-0|2|0			RBT-C|Y|M	$2A^{SR}$	2Ag[SRT]	Yes	2A
Mallen Pit	18-0740-00	0.42				BKT, RBT-C|Y|M	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Manuel Mine (South Yawkey)	18-0435-00	0.40				RBT-C|Y|M	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Miller	18-0133-00	2.38			U-2|0|71		2B	2Ag[TLC]	No	2A
Mons	77-0022-00	1.01			P-4|4|533		2B	2Ag[TLC]	No	2A
Nokay	18-0104-00	3.20			P-8|0|157		2B	2Ag[TLC]	No	2A
Pennington Mine	18-0439-00	0.27	U-0|2|0			RBT-C|Y|M	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Portage	18-0050-00	2.89			P-9|1|212		2B	2Ag[TLC]	No	2A
Portsmouth Mine	18-0437-00	0.25				RBT-C|Y|M	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Sagamore Mine	18-0523-00	0.41	U-0|3|0			RBT-C|Y|M	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Snoshoe Mine	18-0524-00	0.49				RBT-C|Y|M	$2A^{SRT}$	2Ag[SRT]	Yes	SC
South Long	18-0136-00	3.33			P-9|0|163		2B	2Ag[TLC]	No	2A
Spirit	01-0178-00	0.78			P-10|2|87		2B	2Ag[TLC]	No	2A
Unnamed (Section 6)	18-0667-00	0.31				BNT, RBT-C|Y|M	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Upper Mission	18-0242-00	3.93			P-7|1|359		2B	2Ag[TLC]	No	2A
Upper South Long	18-0096-00	2.95			P-9|0|152		2B	2Ag[TLC]	No	2A
Yawkey Mine (North Yawkey)	18-0434-00	0.32	U-0|0|0			RBT-C|Y|M	$2A^{SRT}$	2Ag[SRT]	Yes	SC

Big Swan Lake (77-0023-00): Big Swan Lake is currently designated Class 2B and it is not designated for the protection of any coldwater fish species. MNDNR fisheries surveys sampled Cisco in 5 surveys from 1981 through 2000 indicating that this lake supports a population of this coldwater fish species. However, 5 subsequent surveys from 2004 through 2020 have not sampled this species indicating a possible extirpation. Additional targeted sampling is needed to confirm if Cisco have been extirpated from this lake. Although water data indicate limited change in TP and chl-*a* or improving conditions in Secchi depth over time, T_{DO3} may have increased and is now over the 21.2 °C threshold (22.4 °C). Although TP and chl-*a* indicate non-attainment of goals, these conditions appear to be historically high, and Cisco were present in Big Swan Lake during a period when these water quality parameters were elevated compared to most other Cisco lakes. The greater enrichment may have made this lake more vulnerable to temperature increases and resulted in the extirpation of the Cisco. Big Swan Lake is currently listed as impaired for nutrients. Older MNDNR fisheries survey data demonstrate that a population of Cisco was likely present on or after November 28, 1975, indicating that this lake should be protected for coldwater fish species. Considering this information, it is reasonable to designate Big Swan Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]). Additional study may be warranted to determine if the Cisco population is extant and if a SSS is appropriate for Big Swan Lake.

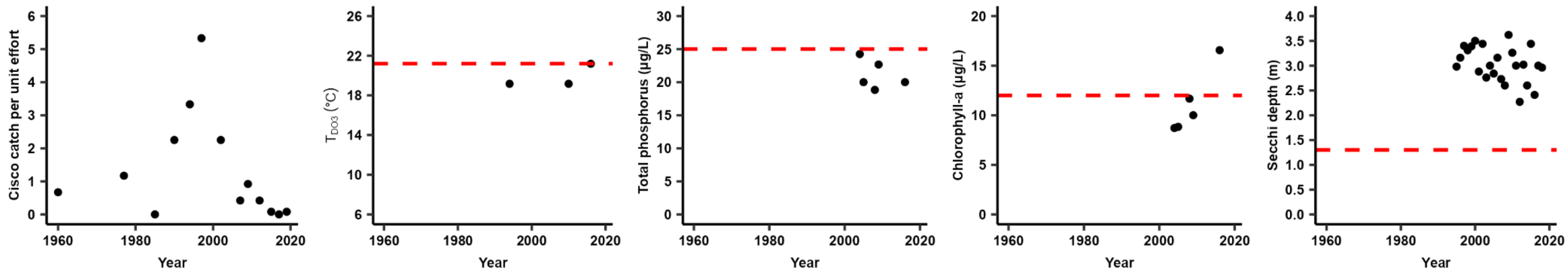
Blue Lake (01-0181-00): Blue Lake is currently designated Class 2A to protect stream trout. This lake is currently managed for Rainbow Trout, and it is designated by the MNDNR as a stream trout lake (Minn. R. 6264.0050). It is listed as an "inland lake trout lake" in Minnesota Department of Conservation (1967) which also notes "good" dissolved oxygen conditions. Lake Trout are not native and were historically stocked in Blue Lake, but this species has not been present in any of the seven MNDNR fisheries surveys conducted on this lake. Considering this information, it is reasonable to retain the Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for stream trout (Class 2Ag [SRT]). Blue lake is also listed as a restricted ORVW presumably due to its listing as a Lake Trout lake in the 1967 report. However, evidence demonstrates that this lake is not a Lake Trout lake and as a result, the restricted ORVW designation (Minn. R. 7050.0335, subp. 1, Item C) for Blue Lake will be removed.

Cedar Lake (01-0209-01,-03): Cedar Lake is currently designated Class 2B and it is not designated for the protection of any coldwater fish species. Cisco have been routinely sampled (11 of 13 surveys) in the main basin (01-0209-01) and West Bay (01-0209-03). Considering this information, it is reasonable to designate Cedar Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]). Cedar Lake (N.E. Arm) (01-0209-02) is shallow (~8 m maximum depth) with a small surface area (25 acres) and is unlikely to support coldwater fishes during the period of maximum oxythermal stress. This basin has been surveyed for fish and no Cisco have been collected in the N.E. Arm. As a result, 01-0209-02 will not be included in the coldwater habitat designation.

Dam Lake (01-0096-00): Dam Lake is currently designated Class 2B and it is not designated for the protection of any coldwater fish species. Cisco were sampled in eleven of thirteen MNDNR fisheries surveys indicating that a population of Cisco is present. Dam Lake is connected to Long Lake (01-0089-00) so the Cisco population in Dam Lake may be supplemented from Long Lake. Considering this information, it is reasonable to designate Dam Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]).

It is important to note that there is an indication that the Cisco population has been declining in Dam Lake. Although standard gill net surveys are not ideal for surveying deep-water fish populations, there is a steady decline in catch per net since 2000 (Figure 36). This may correspond to an increase in chl-*a* (Figure 36). Summer average Secchi depth (3.0 m) and T_{DO3} (19.8 °C) were good for this lake and should be protective of the Cisco population. However, T_{DO3} data are limited (3 years) so temporal patterns cannot be determined, but all measurements were below the 21.2 °C T_{DO3} threshold. There is relatively low disturbance (9.1%) in the watershed for this lake indicating that water quality in this lake is largely natural. In addition, monitoring of Dam Lake in 1995 and 2002 indicated that it has a good macrophyte community. The fish community was assessed in 2018 and determined to be meeting aquatic life use goals. Recreation suitability data were collected from Dam from 1997-2018 on 277 days and approximately 2% of days had recreation suitability scores indicating non-attainment of recreation goals. Although beneficial uses in Dam Lake are currently protected, declines in the Cisco population and water quality which is potentially near thresholds indicate that this lake should be considered vulnerable and in need of protection.

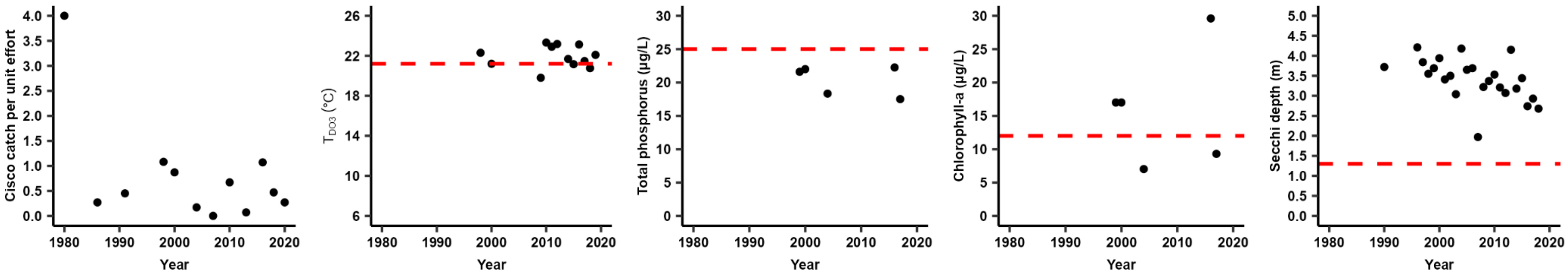
Figure 36. Annual water quality measures for Dam Lake (01-0096-00). T_{DO3} is the maximum T_{DO3} measured during the period of maximum oxythermal stress for each year. Total phosphorus, chlorophyll-*a*, and Secchi depth are summer averages for years with at least 4 measurements from June through September. Red dashed lines indicate draft water quality criteria for Cisco lakes.



Farm Island Lake (01-0159-00): Farm Island Lake is currently designated Class 2B and it is not designated for the protection of any coldwater fish species. Cisco were sampled in ten of eleven MNDNR fisheries surveys indicating that a population of Cisco is present. Considering this information, it is reasonable to designate Farm Island Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]).

The summer average estimate of T_{DO3} (22.3 °C) for Farm Island Lake exceeds the draft criteria for this parameter despite MNDNR fisheries surveys consistently indicating the presence of a population of Cisco. There is also relatively low disturbance (14.4%) in the watershed for this lake indicating that water quality in this lake is largely natural although there could be some impacts. Farm Island Lake is connected to Little Pine Lake (01-0176-00) so the Cisco population in Farm Island Lake may be supplemented from Little Pine Lake. Macrophytes in Farm Island Lake were monitored four times from 1995 and 2013 which indicated this lake supports a good macrophyte community. The fish community was monitored in 2010 and 2017 and fish IBI scores met goals indicating that the warm water fish community is healthy. Recreation suitability data were collected from Farm Island from 1990-2018 on 415 days and approximately 3% of days had recreation suitability scores indicating non-attainment of recreation goals. Summer average TP (20 µg/L), chl-*a* (9 µg/L), and Secchi depth (3.4 m) were also good for this lake. T_{DO3} and the Cisco population in this lake appear to have been stable since the 1980-90s (Figure 37). Aquatic life (i.e., Cisco, macrophyte, and fish community) and recreation measures demonstrate that this lake meets beneficial use goals. As a result, it is reasonable to assign a SSS to this lake to address the atypical conditions which are suitable for the maintenance of a population of Cisco. Oxythermal habitat goals for this lake should be based on current conditions as these are consistent with conditions where a Cisco population was supported and the attainment of aquatic life and recreation goals. The draft TP, chl-*a*, and Secchi depth standards will be retained because they are currently attained. As a result, the draft oxythermal criterion for Farm Island Lake is: T_{DO3} = 22.3 °C. The average T_{DO3} value is based on a dataset consisting of 13 years of data so there is good confidence in this estimate (SE = 0.4). The oxythermal habitat in Farm Island Lake is potentially near thresholds that will result in the loss of Cisco and this lake should therefore be considered vulnerable and in need of protection.

Figure 37. Annual water quality measures for Farm Island Lake (01-0159-00). T_{DO3} is the maximum T_{DO3} measured during the period of maximum oxythermal stress for each year. Total phosphorus, chlorophyll-*a*, and Secchi depth are summer averages for years with at least 4 measurements from June through September. Red dashed lines indicate draft water quality criteria for Cisco lakes.



Lady (77-0032-00): Lady Lake is currently designated Class 2B and it is not designated for the protection of any coldwater fish species. A single MNDNR fisheries survey using gill nets sampled 2 Cisco in 2016, but 7 other surveys did not detect Cisco. A fisheries survey using vertical gill nets was conducted in 2021 and 7 Cisco were sampled. The number of Cisco was not large, but lengths of individuals ranged from 96 to 444 mm indicating natural recruitment. This indicates that Lady Lake supports a population of Cisco. Considering this information, it is reasonable to designate Lady Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]).

Long Lake (01-0089-00): Long Lake is currently designated Class 2B, but it has been stocked with splake since 2018. It is not a designated MNDNR trout lake (Minn. R. 6264.0050), but it is reasonable to assign the Class 2A classification for coldwater aquatic life and habitat. In addition, eleven MNDNR fisheries surveys sampled Cisco indicating that this lake supports a population of Cisco. Considering this information, it is reasonable to designate Long Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco and stream trout (Class 2Ag [TLC,SRT]).

Mahnomen, Alstead, and Arco Mines (18-0440-01,-02,-03,-04,-05,-06,-07): Mahnomen, Alstead, and Arco Mines (Mahnomen Mine #1-3 [-01,-02,-03], Louise Mine [-04], unnamed mine [-05], Alstead Mine [-06], and Arco Mine [-07]) are currently designated Class 2A. They are managed for Rainbow Trout and are included on the MNDNR designated trout lake list (Minn. R. 6264.0050). These waterbodies have been stocked with Lake Trout and Cisco since 2019, but there is not sufficient information to determine if a fishery for these species can be established. These waterbodies will not be designated for the protection of Lake Trout or Cisco until additional data can be collected to confirm the presence of resident populations of Lake Trout and Cisco. Considering this information, it is reasonable to designate Mahnomen, Alstead, and Arco Mines Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for stream trout (Class 2Ag [SRT]).

Pennington Mine Lake (18-0439-00): Pennington Mine Lake is currently designated Class 2A to protect stream trout. It is managed for Rainbow Trout and is a MNDNR designated trout lake (Minn. R. 6264.0050). This waterbody has also been stocked with Lake Trout since 2019, but there is not sufficient information to determine if a fishery for this species can be established. This lake will not be designated for the protection of Lake Trout until additional data can be collected to confirm the presence of a resident population of Lake Trout. Considering this information, it is reasonable to designate Pennington Mine Lake Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for stream trout (Class 2Ag [SRT]).

Sagamore Mine Lake (18-0523-00): Sagamore Mine Lake is currently designated Class 2A to protect stream trout. It is managed for Rainbow Trout and is a MNDNR designated trout lake (Minn. R. 6264.0050). This waterbody has also been stocked with Lake Trout since 2019, but there is not sufficient information to determine if a fishery for this species can be established. This waterbody will not be designated for the protection of Lake Trout until additional data can be collected to confirm the presence of a resident population of Lake Trout. Considering this information, it is reasonable to designate Sagamore Mine Lake Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for stream trout (Class 2Ag [SRT]).

Yawkey Mine Lake (18-0434-00): Yawkey Mine Lake is currently designated Class 2A to protect stream trout. It is managed for Rainbow Trout and is a MNDNR designated trout lake (Minn. R. 6264.0050). This waterbody was stocked with Lake Trout in 1988, but there have not been any standard gill net surveys conducted on this lake. A gill net survey in 1999, a winter creel survey in 2016, a short-term gill net survey by research staff in 2015, and angler reports indicate that Yawkey Mine Lake supports a population of naturally reproducing Lake Trout. However, there is uncertainty regarding the long-term management goals for this introduced species, and until that is resolved, a Lake Trout designation is not appropriate. Considering this information, it is reasonable to retain the Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for stream trout (Class 2Ag [SRT]) in Yawkey Mine Lake.

e. Pine River watershed (07010105)

Class 2A confirmations and designations

The following lakes will be confirmed or designated for the protection of coldwater aquatic life and habitat (Class 2A). A summary of the evidence supporting these use designations is provided in Table 42 and if needed, additional information is provided following this table. Available evidence demonstrates that these lakes support or should support naturally reproducing populations of Lake Trout, Lake Whitefish, or Cisco or are managed for coldwater fish through stocking. The use designations for these lakes will be amended in Minn. R. 7050.0470 by updating the beneficial uses for lakes in the Pine River watershed (07010105).

Table 42. List of draft Class 2A use confirmations and designations for lakes in the Pine River watershed (07010105) with supporting information. Abbreviations and fisheries survey codes are described in the introduction of Appendix C.

Lake name	WID	GR	Fisheries survey: LAT	Fisheries survey: LKW	Fisheries survey: TLC	Fisheries survey: SRT	Current ALU	Draft ALU	Trout lake	Type
Ada	11-0250-00	2.42			P-12|0|316		2B	2Ag[TLC]	No	2A

Lake name	WID	GR	Fisheries survey: LAT	Fisheries survey: LKW	Fisheries survey: TLC	Fisheries survey: SRT	Current ALU	Draft ALU	Trout lake	Type
Allen	18-0208-00	1.46			E-1|1|57	BKT,RBT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Bass	18-0358-00	1.84			U-2|1|28		2B	2Ag[TLC]	No	2A
Bertha	18-0355-00	1.75		P-6|0|94	P-5|1|732		2B	2Ag[LKW,TLC]	No	2A
Big Trout	18-0315-00	1.24	P-7|2|155	P-9|0|343	P-9|0|1846		$2A^{LAT}$	2Ag[LAT,LKW,TLC]	No	SM
Bowen	11-0350-00	3.85			P-6|0|41		2B	2Ag[TLC]	No	2A
Clamshell	18-0356-00	2.26		P-4|2|17	P-6|0|89		2B	2Ag[LKW,TLC]	No	2A
Clear	18-0364-00	1.51			P-6|1|195		2B	2Ag[TLC]	No	2A
Cross Lake Reservoir	18-0312-01	2.02		P-8|0|32	P-8|0|147		2B	2Ag[LKW,TLC]	No	2A
Daggett	18-0271-00	4.55		U-1|6|6	P-7|0|37		2B	2Ag[TLC]	No	2A
Deep Portage	11-0237-00	0.84			P-4|1|96		2B	2Ag[TLC]	No	2A
Eagle	18-0296-01, -02	2.79-2.93			P-6|1|36		2B	2Ag[TLC]	No	2A
East Fox	18-0298-00	1.56			P-5|3|22		2B	2Ag[TLC]	No	2A
Five Point	11-0351-00	2.81		M-1|9|1	P-8|2|70		2B	2Ag[TLC]	No	2A
Hand	11-0242-00	1.87			P-9|0|238		2B	2Ag[TLC]	No	2A
Hattie	11-0232-00	8.02			U-4|0|80		2B	2Ag[TLC]	No	2A
Hay	11-0199-00	2.04			P-9|0|50		2B	2Ag[TLC]	No	2A
Island	18-0269-00	1.27		P-5|1|38	P-6|0|244		2B	2Ag[LKW,TLC]	No	2A
Kimball	18-0361-00	1.25		U-1|7|1	P-8|0|407		2B	2Ag[TLC]	No	2A
Lawrence	11-0053-00	1.42			U-4|2|14		2B	2Ag[TLC]	No	2A
Leavitt	11-0037-00	1.44			P-8|0|49		2B	2Ag[TLC]	No	2A
Little Andrus (Snowshoe)	11-0054-00	2.35				BKT,RBT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Little Pine	18-0266-00	3.15		U-3|3|8	P-6|0|179		2B	2Ag[TLC]	No	2A
Lower Hay	18-0378-00	1.35	U-1|6|1	P-6|1|109	P-6|1|141		$2A^{LAT}$	2Ag[LKW,TLC]	No	SM
Margaret	11-0045-00	1.10				RBT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Marion	11-0046-00	0.85				BKT,RBT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Mitchell	18-0294-00	1.52			P-7|0|129		2B	2Ag[TLC]	No	2A

Lake name	WID	GR	Fisheries survey: LAT	Fisheries survey: LKW	Fisheries survey: TLC	Fisheries survey: SRT	Current ALU	Draft ALU	Trout lake	Type
Ossawinnamakee	18-0352-00	2.13		U-1|7|1	P-8|0|484		2B	2Ag[TLC]	No	2A
Pelican	18-0308-00	2.41		U-1|17|3	P-17|1|284		2B	2Ag[TLC]	No	2A
Pig	18-0354-00	1.74		P-6|0|29	P-6|0|224		2B	2Ag[LKW,TLC]	No	2A
Pine Mountain	11-0411-00	2.11			P-13|1|144		2B	2Ag[TLC]	No	2A
Pleasant	18-0278-00	0.81				BKT, RBT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Roosevelt	11-0043-01, -02	1.20 -1.44	E-4|6|42		P-10|0|2543		$2A^{LAT}$	2Ag[TLC]	Yes	SM
Rush	18-0311-00	1.35		P-7|0|137	P-7|0|645		2B	2Ag[LKW,TLC]	No	2A
Star	18-0359-00	1.05			P-3|0|62		2B	2Ag[TLC]	No	2A
Strawberry (Lost)	18-0363-00	1.32				RBT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Washburn	11-0059-00	1.49			P-10|0|315		2B	2Ag[TLC]	No	2A
West Fox	18-0297-00	2.19			P-7|2|101		2B	2Ag[TLC]	No	2A
Whitefish	18-0310-00	1.78		P-12|0|215	P-12|0|782		2B	2Ag[LKW,TLC]	No	2A

Allen Lake (18-0208-00): Allen Lake is currently designated Class 2A to protect stream trout. This lake is currently managed for Brook Trout and Rainbow Trout and is designated by the MNDNR as a stream trout lake (Minn. R. 6264.0050). Cisco were stocked in this lake in 1977, and a high number of Cisco were collected in 1989. However, this lake was reclaimed in 2007 which resulted in the removal of the Cisco population. This lake is also atypically small (18 ha) for a Cisco lake indicating that Allen Lake may not have supported a Cisco population in the long term. This lake will not be designated for the protection of Cisco at this time because these fish were not native, it is not clear how suitable this lake is to support a population of Cisco, and the applicable water quality criteria for stream trout are more protective. Even if the stream trout designation was removed from this lake, the northern warm-water lake eutrophication standards are more protective than the Cisco eutrophication standard and therefore would result in the maintenance of water quality conditions. Considering this information, it is reasonable to retain the Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for stream trout (Class 2Ag [SRT]).

Big Trout Lake (18-0315-00): Big Trout Lake is currently designated Class 2A to protect Lake Trout. It is listed as a "potential inland lake trout lake" in Minnesota Department of Conservation (1967) which also notes "good" dissolved oxygen conditions. It is not known if Lake Trout are native to this lake, but stocking of Lake Trout began in 1930. During the period of stocking, carryover has occurred, but natural recruitment has not. The Lake Trout fishery has been determined to not be sustainable, but stocking of Lake Trout is ongoing to maintain a population. It is reasonable to assign protections for Lake Trout to this lake, but because the presence of Lake Trout is contingent on stocking, the cessation of stocking could result in a change to the use designation for this lake. Big Trout Lake supports natural populations of Lake Whitefish and Cisco. In nine MNDNR surveys (1950-2011), Cisco and Lake Whitefish were sampled in all 9 surveys (Cisco: n=1,364; Lake Whitefish: n=272). Considering this information, it is reasonable to retain the Class 2Ag classification assigned to coldwater aquatic life and habitat and assign protections for Lake Trout, Lake Whitefish, and Cisco (Class 2Ag [LAT,LKW,TLC]).

Cross Lake Reservoir (18-0312-01): Cross Lake Reservoir is currently designated Class 2B and it is not designated for the protection of any coldwater fish species. Cross Lake Reservoir is delineated into three basins in the MPCA's waterbody database. Only the main basin (18-0312-01) appears to be deep enough to support coldwater fish species. The other basins (Southeast Bay [18-0312-02] and Unnamed Bay [18-0312-03]) are shallow (<3 m maximum depth) and are unlikely to support coldwater fishes during the period of maximum oxythermal stress. The MNDNR has consistently sampled Lake Whitefish and Cisco in this lake indicating that these species are supported in this lake. Considering this information, it is reasonable to designate the main basin of Cross Lake Reservoir a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Lake Whitefish and Cisco (Class 2Ag [LKW,TLC]).

Daggett Lake (18-0271-00): Daggett Lake is currently designated Class 2B and it is not designated for the protection of any coldwater fish species. Seven MNDNR fisheries surveys have been conducted on this lake and Cisco were present in every survey. Lake Whitefish were sampled in one of these surveys with a total of 6 fish sampled. These Lake Whitefish may have been transient as Daggett Lake is connected to Cross Lake Reservoir (18-0312). This lake will not be designated for the protection of Lake Whitefish until additional data can be collected which demonstrates that a resident population of Lake Whitefish is present. As a result, it is reasonable to designate Daggett Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco only (Class 2Ag [TLC]).

Eagle Lake (18-0296-01,-02): Eagle Lake is currently designated Class 2B and it is not designated for the protection of any coldwater fish species. Cisco have been routinely sampled (6 of 7 surveys) in the Main Bay (18-0296-01) and West Bay (18-0296-02). Considering this information, it is reasonable to designate Eagle Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]). Eagle Lake (East Bay) (18-0296-03) is shallow (6 m maximum depth) with a small surface area (67 acres) and is unlikely to support coldwater fishes during the period of maximum oxythermal stress. This basin has been surveyed for fish and no Cisco have been collected in the East Bay. As a result, 18-0296-03 will not be included in the coldwater habitat designation.

Five Point Lake (11-0351-00): Five Point Lake is currently designated Class 2B and it is not designated for the protection of any coldwater fish species. Ten MNDNR fisheries surveys have been conducted and Cisco were present in eight of these surveys. In the 1977 fisheries survey, a single Lake Whitefish was identified. This is the only survey from Five Point Lake which included fish identified as Lake Whitefish, indicating that these fish may represent a misidentification. This lake will not be designated for the protection of Lake Whitefish until additional data can be collected to confirm the presence of a resident population of Lake Whitefish. As a result, it is reasonable to designate Five Point Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]).

Kimball Lake (18-0361-00): Kimball Lake is currently designated Class 2B and it is not designated for the protection of any coldwater fish species. Eight MNDNR fisheries surveys have been conducted and Cisco were present in all surveys. In the 1999 fisheries survey, a single Lake Whitefish was identified. Several lakes in the Pelican Brook (070101050603) and Pelican Lake (070101050602) subwatersheds (i.e., 12-digit HUC) had small and irregular catches of Lake Whitefish indicating that these fish may be transient. These lakes are connected to the Pine River and Whitefish Chain of Lakes which may be the source of these fish. This lake will not be designated for the protection of Lake Whitefish until additional data can be collected which demonstrates that a resident population of Lake Whitefish is present. As a result, it is reasonable to designate Kimball Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]).

Little Pine Lake (18-0266-00): Little Pine Lake is currently designated Class 2B and it is not designated for the protection of any coldwater fish species. Six MNDNR fisheries surveys have been conducted on this lake and Cisco were present in every survey. Lake Whitefish were sampled in three of these surveys with a total of 8 fish sampled. These Lake Whitefish present may have been transient as Little Pine Lake is connected to Cross Lake Reservoir (18-0312). This lake will not be designated for the protection of Lake Whitefish until additional data can be collected to confirm the presence of a resident population of Lake Whitefish. As a result, it is reasonable to designate Little Pine Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]).

Lower Hay Lake (18-0378-00): Lower Hay Lake is currently designated Class 2A to protect Lake Trout. It is listed as a "potential inland lake trout lake" in Minnesota Department of Conservation (1967) which also notes "good" dissolved oxygen conditions. The Class 2A designation of Lower Hay Lake was initially based on its potential to support Lake Trout. This lake was intermittently stocked with Lake Trout between 1911 and 1945 although there is no evidence that natural recruitment occurred. In 2005, a MNDNR fisheries survey collected a single Lake Trout, but this was determined to likely be a migrant from Big Trout Lake (18-0315-00). Currently there is no evidence that this lake supports a population of Lake Trout given the low numbers of trout collected despite past stocking efforts and connectivity with a lake stocked with Lake Trout. This lake will not be designated for the protection of Lake Trout because it is not managed for Lake Trout and a Lake Trout fishery has been determined to not be sustainable. However, Lower Hay Lake supports natural populations of Lake Whitefish and Cisco. In seven MNDNR surveys (1950-2018), Lake Whitefish and Cisco were sampled in 6 surveys (Cisco: n= 149; Lake Whitefish: n=109). Considering this information, it is reasonable to retain the Class 2Ag classification assigned to coldwater aquatic life and habitat. The designation for Lower Hay Lake will be based on the protection of Cisco and Lake Whitefish and will be designated Class 2Ag [TLC,LKW]). Lower Hay Lake is not designated as a restricted ORVW designation so the removal of the Lake Trout designation for Lower Hay Lake does not affect the ORVW designation.

Ossawinnamakee Lake (18-0352-00): Ossawinnamakee Lake is currently designated Class 2B and it is not designated for the protection of any coldwater fish species. Eight MNDNR fisheries surveys have been conducted on this lake and Cisco were present in every survey. A single Lake Whitefish was sampled in one of these surveys. Several lakes in the Pelican Brook (070101050603) and Pelican Lake (070101050602) subwatersheds (i.e., 12-digit HUC) had small and irregular catches of Lake Whitefish indicating that these fish may be transient. These lakes are connected to the Pine River and Whitefish Chain of Lakes which may be the source of these fish. This lake will not be designated for the protection of Lake Whitefish until additional data can be collected which demonstrates that a resident population of Lake Whitefish is present. As a result, it is reasonable to designate Ossawinnamakee Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco only (Class 2Ag [TLC]).

Pelican Lake (18-0308-00): Pelican Lake is currently designated Class 2B and it is not designated for the protection of any coldwater fish species. Eighteen MNDNR fisheries surveys have been conducted on this lake and Cisco were present in seventeen of these surveys. Lake Whitefish were sampled in one of these surveys with a total of 3 fish sampled. Several lakes in the Pelican Brook (070101050603) and Pelican Lake (070101050602) subwatersheds (i.e., 12-digit HUC) had small and irregular catches of Lake Whitefish indicating that these fish may be transient. These lakes are connected to the Pine River and Whitefish Chain of Lakes which may be the source of these fish. This lake will not be designated for the protection of Lake Whitefish until additional data can be collected which demonstrates that a resident population of Lake Whitefish is present. As a result, it is reasonable to designate Pelican Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]).

Roosevelt Lake (North [11-0043-01] and South [11-0043-02]): Roosevelt Lake is currently designated Class 2A to protect Lake Trout. It is listed as a "potential inland lake trout lake" in Minnesota Department of Conservation (1967) which also notes "good" dissolved oxygen conditions and an "adverse fish population." The MNDNR began stocking Lake Trout in 1982. During the period of stocking, carryover was observed, but natural recruitment was not. The Lake Trout fishery was determined to not be sustainable, and stocking ceased in 2006. Roosevelt Lake supports a natural population of Cisco. In ten MNDNR fisheries surveys (1968-2018), Cisco were collected in all surveys and a total of 2,543 individuals were sampled. Considering this information, it is reasonable to retain the Class 2Ag classification assigned to coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]). As a result, the removal of the Lake Trout lake designation will also remove the restricted ORVW designation (Minn. R. 7050.0335, subp. 1, Item C) from Roosevelt Lake.

Class 2Bd designations

The following lake will be designated for the protection of warm and cool water aquatic life and habitat (Class 2Bd). A summary of the evidence supporting the draft use designation is provided in Table 43 and additional details are provided following the table. For these lakes, the designation of Class 2Bd from Class 2A results in the designation of a beneficial use that carries with it less stringent standards. As a result, a use attainability analysis (40 CFR § 131.3(g)) is required by the CWA (40 CFR § 131.10(j)) to demonstrate that the current use designation is not an existing use (40 CFR § 131.3(e)) or an attainable use (40 CFR § 131.10(d)). Considering the information below, it is reasonable to assign Class 2Bdg to this lake for the protection of cool and warm waters also protected as a source of drinking water. The MPCA use designation for this lake will be amended in Minn. R. 7050.0470 by updating the beneficial uses for lakes in the Pine River Watershed (07010105).

Table 43: List of draft Class 2Bd use designations for lakes in the Pine River watershed (07010105) with supporting information. Abbreviations and fisheries survey codes are described in the introduction of Appendix C.

Lake name	WID	GR	Fisheries survey: LAT	Fisheries survey: LKW	Fisheries survey: TLC	Fisheries survey: SRT	Current ALU	Draft ALU	Trout lake	Type
Willard	11-0564-00	1.15				NA-H|N|U	$2A^{SRT}$	2Bdg	No	2Bd

Willard Lake (11-0564-00): Willard Lake is currently designated Class 2A to protect stream trout. Willard Lake will be proposed to be designated as a cool and warm water aquatic life and habitat also protected as a source of drinking water (Class 2Bd). Stocking of Rainbow Trout was discontinued in 2009 and the MNDNR no longer manages or lists Willard Lake as a trout lake (Minn. R. 6264.0050). Management and delisting of this lake occurred due to a poor forage base for trout (zooplankton) and the introduction of other fish species including black crappie (*Pomoxis nigromaculatus* [Lesueur, 1829]) and Yellow Perch, which can negatively impact the stream trout fishery. Considering this information, it is reasonable to assign Class 2Bdg to Willard Lake for the protection of cool and warm waters also protected as a source of drinking water.

f. *Crow Wing River watershed (07010106)*

Class 2A confirmations and designations

The following lakes will be confirmed or designated for the protection of coldwater aquatic life and habitat (Class 2A). A summary of the evidence supporting these use designations is provided in Table 44 and if needed, additional information is provided following this table. Available evidence demonstrates that these lakes support or should support naturally reproducing populations of Cisco or are managed for coldwater fish through stocking. The use designations for these lakes will be amended in Minn. R. 7050.0470 by updating the beneficial uses for lakes in the Crow Wing River watershed (07010106).

Table 44. List of draft Class 2A use confirmations and designations for lakes in the Crow Wing River watershed (07010106) with supporting information. Abbreviations and fisheries survey codes are described in the introduction of Appendix C.

Lake name	WID	GR	Fisheries survey: LAT	Fisheries survey: LKW	Fisheries survey: TLC	Fisheries survey: SRT	Current ALU	Draft ALU	Trout lake	Type
Big Sand	29-0185-00	1.23			P-10|5|350		2B	2Ag[TLC]	No	2A
Blue	29-0184-00	1.32			P-10|2|1051	RBT-C|N|U	$2A^{SRT}$	2Ae[TLC,SRT]	No	SM
Boot	03-0030-00	1.06			P-1|11|1		2B	2Ae[TLC]	No	2A
Eagle	29-0256-00	1.54			P-10|0|101		2B	2Ae[TLC]	No	2A
East Crooked	29-0101-01	1.19			U-7|4|172		2B	2Ag[TLC]	No	2A
Edna	18-0396-00	1.46			P-5|0|67		2B	2Ag[TLC]	No	2A
Edward	18-0305-00	2.49		E-0|8|0	E-5|3|46		2B	2Ag[TLC]	No	2A
Eleventh Crow Wing	29-0036-01,-02	1.53-1.84			P-9|1|1229		2B	2Ae[TLC]	No	2A
Emma	29-0186-00	1.50			U-4|4|34		2B	2Ag[TLC]	No	2A
Fifth Crow Wing	29-0092-00	3.34			P-8|3|135		2B	2Ae[TLC]	No	2A
Fish Hook	29-0242-00	2.19			P-9|2|121		2B	2Ae[TLC]	No	2A
Gull	11-0305-00	3.26			P-17|0|1066		2B	2Ae[TLC]	No	2A
Hubert	18-0375-00	2.21			U-6|2|53		2B	2Ag[TLC]	No	2A
Island	29-0254-00	1.93			P-10|0|198		2B	2Ae[TLC]	No	2A
Little Sand	29-0150-00	1.47			P-5|5|9		2B	2Ag[TLC]	No	2A
Long	29-0161-00	1.35			P-8|3|288		2B	2Ae[TLC]	No	2A
Lower Bottle	29-0180-00	1.02			U-5|6|18		2B	2Ag[TLC]	No	2A
Lower Cullen	18-0403-00	3.27			P-8|0|628		2B	2Ag[TLC]	No	2A

Lake name	WID	GR	Fisheries survey: LAT	Fisheries survey: LKW	Fisheries survey: TLC	Fisheries survey: SRT	Current ALU	Draft ALU	Trout lake	Type
Mantrap	29-0151-01,-02, -03,-04,-05	1.45-3.91			P-9|1|171		2B	2Ag[TLC]	No	2A
Margaret	11-0222-00	3.97			P-4|4|43		2B	2Ag[TLC]	No	2A
Middle Cullen	18-0377-00	2.53			P-8|0|784		2B	2Ae[TLC]	No	2A
Ninth Crow Wing	29-0025-00	1.57			P-7|2|142		2B	2Ae[TLC]	No	2A
North Long	18-0372-00	2.39			P-10|0|469		2B	2Ag[TLC]	No	2A
Perch	11-0826-00	1.28				RBT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC
Pillager	11-0320-00	2.52			P-6|0|988		2B	2Ag[TLC]	No	2A
Potato	29-0243-00	2.03			P-12|1|635		2B	2Ae[TLC]	No	2A
Round	18-0373-00	3.27			P-10|1|352		2B	2Ag[TLC]	No	2A
Second Crow Wing	29-0085-00	2.89			U-9|1|137		2B	2Ag[TLC]	No	2A
Seventh Crow Wing	29-0091-00	2.61			P-11|0|164		2B	2Ae[TLC]	No	2A
Sixth Crow Wing	29-0093-00	2.80			P-9|2|176		2B	2Ae[TLC]	No	2A
Spider	29-0117-01,-02	1.27-1.29			P-4|7|8		2B	2Ag[TLC]	No	2A
Straight	03-0010-00	1.94			P-9|1|86		2B	2Ag[TLC]	No	2A
Tenth Crow Wing	29-0045-00	2.38			P-8|1|85		2B	2Ae[TLC]	No	2A
Third Crow Wing	29-0077-00	3.99			P-11|0|316		2B	2Ag[TLC]	No	2A
Tripp	29-0005-00	1.41			U-3|0|265		2B	2Ag[TLC]	No	2A
Two Inlets	03-0017-00	2.13			P-12|0|165		2B	2Ae[TLC]	No	2A
Upper Bottle	29-0148-00	2.02			U-5|6|10		2B	2Ag[TLC]	No	2A
Upper Cullen	18-0376-00	2.96			P-6|2|147		2B	2Ae[TLC]	No	2A
Upper Gull	11-0218-00	2.19			P-9|0|503		2B	2Ag[TLC]	No	2A

Blue Lake (29-0184-00): Blue Lake is currently designated Class 2A to protect stream trout. It is listed as a "potential inland lake trout lake" in Minnesota Department of Conservation (1967). Stocking records show that during the period 1910 to 1945 Walleye, Northern Pike, Lake Trout, and bass were stocked. However, there have been 12 MNDNR fisheries surveys conducted on this lake since 1957 and none of these sampled Lake Trout. Rainbow Trout stocking began in 1984, and although it is not a MNDNR designated stream trout lake (Minn. R. 6264.0050), the lake is currently managed for stream trout. Cisco were sampled in ten of the MNDNR fisheries surveys indicating that Blue Lake supports a population of this coldwater fish species. Considering this information, it is reasonable to retain the Class 2A designation for the protection of coldwater aquatic life and habitat and assign protections for Cisco and stream trout (Class 2Ae [TLC,SRT]). Blue Lake is also listed as a restricted ORVW. This designation was presumably due to its listing as a potential Lake Trout lake in the 1967 report. However, evidence demonstrates that this lake is not a Lake Trout lake and as a result, the restricted ORVW designation (Minn. R. 7050.0335, subp. 1, Item C) for Blue Lake will be removed. Documentation for the Exceptional Use designation is provided in MPCA (2024c).

Boot Lake (03-0030-00): Boot Lake is currently designated Class 2B and is not designated for the protection of any coldwater fish species. A single Cisco was present in one of MNDNR's 12 fisheries surveys. However, a high number of Cisco (n=43) were sampled in a 2020 MNDNR vertical gill net survey indicating that Boot Lake supports a population of Cisco. Considering this information, it is reasonable to designate Boot Lake a Class 2Ae for the protection of Exceptional coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ae [TLC]). Documentation for the Exceptional Use designation is provided in MPCA (2024c).

Edward Lake (18-0305-00): Edward Lake is currently designated Class 2B and is not designated for the protection of any coldwater fish species. Five MNDNR fisheries surveys have sampled Cisco indicating that Edward Lake supports a population of Cisco. "Whitefish" fry were stocked once in the 1920s, but Lake Whitefish have never been sampled by MNDNR fisheries surveys. Considering this information, it is reasonable to designate Edward Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]).

Little Sand Lake (29-0150-00): Little Sand Lake is currently designated Class 2B and is not designated for the protection of any coldwater fish species. Nine Cisco were sampled in five MNDNR fisheries surveys. In addition, a moderate number of Cisco (n=23) were sampled in a 2019 MNDNR vertical gill net survey. This information indicates that Little Sand Lake supports a population of Cisco. Considering this information, it is reasonable to designate Little Sand Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]).

g. Redeye River watershed (07010107)

Class 2A confirmations and designations

The following lakes will be confirmed or designated for the protection of coldwater aquatic life and habitat (Class 2A). A summary of the evidence supporting these use designations is provided in Table 45. Available evidence demonstrates that these lakes support or should support naturally reproducing populations of Cisco. The use designations for these lakes will be amended in Minn. R. 7050.0470 by updating the beneficial uses for lakes in the Redeye River watershed (07010107).

Table 45. List of draft Class 2A use confirmations and designations for lakes in the Redeye River watershed (07010107) with supporting information. Abbreviations and fisheries survey codes are described in the introduction of Appendix C.

Lake name	WID	GR	Fisheries survey: LAT	Fisheries survey: LKW	Fisheries survey: TLC	Fisheries survey: SRT	Current ALU	Draft ALU	Trout lake	Type
East Leaf	56-0116-02	2.51			U-6|3|60		2B	2Ag[TLC]	No	2A
Middle Leaf	56-0116-01	2.72			P-7|1|31		2B	2Ag[TLC]	No	2A
West Leaf	56-0114-00	2.64			P-8|1|81		2B	2Ag[TLC]	No	2A

h. *Long Prairie River watershed (07010108)*

Class 2A confirmations and designations

The following lakes will be designated for the protection of coldwater aquatic life and habitat (Class 2A). A summary of the evidence supporting these use designations is provided in Table 46 and if needed, additional information is provided following this table. Available evidence demonstrates that these lakes support or should support naturally reproducing populations of Cisco. The use designations for these lakes will be amended in Minn. R. 7050.0470 by updating the beneficial uses for lakes in the Long Prairie River watershed (07010108).

Table 46. List of draft Class 2A use confirmations and designations for lakes in the Long Prairie River watershed (07010108) with supporting information. Abbreviations and fisheries survey codes are described in the introduction of Appendix C.

Lake name	WID	GR	Fisheries survey: LAT	Fisheries survey: LKW	Fisheries survey: TLC	Fisheries survey: SRT	Current ALU	Draft ALU	Trout lake	Type
Alexander	49-0079-00	2.89			P-7|6|87		2B	2Ae[TLC]	No	2A
Andrew	21-0085-00	1.75			P-11|0|145		2B	2Ag[TLC]	No	2A
Brophy	21-0102-00	2.45			U-6|3|29		2B	2Ag[TLC]	No	2A
Burgen	21-0049-00	2.20			P-9|1|254		2B	2Ag[TLC]	No	2A
Carlos	21-0057-00	1.15			P-2|12|11		2B	2Ag[TLC]	No	2A
Charlotte	77-0120-00	1.09		M-1|8|31	P-6|3|326		2B	2Ae[TLC]	No	2A
Cowdrey	21-0103-00	1.98			P-7|2|55		2B	2Ag[TLC]	No	2A
Darling	21-0080-00	2.40			P-8|1|152		2B	2Ag[TLC]	No	2A
Fish Trap	49-0137-00	3.63			P-7|5|20		2B	2Ag[TLC]	No	2A
Geneva	21-0052-00	2.10			U-6|4|51		2B	2Ag[TLC]	No	2A
Ida	21-0123-00	2.01			P-16|1|88		2B	2Ae[TLC]	No	2A
Irene	21-0076-00	2.99			P-8|0|127		2B	2Ag[TLC]	No	2A
Latoka	21-0106-01,-02	1.15-1.22			P-10|0|158		2B	2Ag[TLC]	No	2A
Le Homme Dieu	21-0056-00	2.00			P-8|3|56		2B	2Ag[TLC]	No	2A
Lobster	21-0144-01,-02	2.07-3.81			U-6|4|152		2B	2Ag[TLC]	No	2A
Lottie	21-0105-00	2.24			U-3|4|16		2B	2Ag[TLC]	No	2A
Louise	21-0094-00	3.01			U-7|1|69		2B	2Ag[TLC]	No	2A
Mill	21-0180-00	2.99			U-8|3|157		2B	2Ag[TLC]	No	2A
Miltona	21-0083-00	2.16			P14|2|199		2B	2Ae[TLC]	No	2A

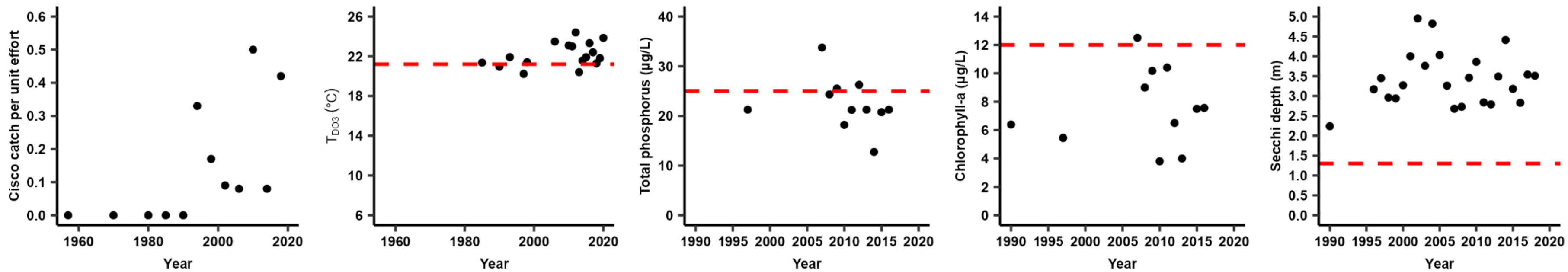
Lake name	WID	GR	Fisheries survey: LAT	Fisheries survey: LKW	Fisheries survey: TLC	Fisheries survey: SRT	Current ALU	Draft ALU	Trout lake	Type
Mina	21-0108-00	0.96			P-8|1|119		2B	2Ae[TLC]	No	2A
North Union	21-0095-00	2.05			P-4|3|18		2B	2Ag[TLC]	No	2A
Stony	21-0101-00	1.38			U-4|3|23		2B	2Ag[TLC]	No	2A
Turtle	77-0088-00	2.17			P-7|1|165		2B	2Ag[TLC]	No	2A
Victoria	21-0054-00	1.97			P-7|3|105		2B	2Ag[TLC]	No	2A

Charlotte Lake (77-0120-00): Charlotte Lake is currently designated Class 2B and it is not designated for the protection of any coldwater fish species. Six MNDNR fisheries surveys on this lake sampled Cisco. A fisheries survey in 1978 collected 31 fish identified as Lake Whitefish, but no fish were identified as Cisco. These data indicate a possible misidentification since Cisco were present in most other surveys. This lake will not be designated for the protection of Lake Whitefish until additional data can be collected that demonstrates the presence of a resident population of Lake Whitefish in this lake. As a result, it is reasonable to designate Charlotte Lake a Class 2Ae for the protection of coldwater aquatic life and habitat and assign protections for Cisco only (Class 2Ae [TLC]). Documentation for the Exceptional Use designation is provided in MPCA (2024c).

Fish Trap Lake (49-0137-00): Fish Trap Lake is currently designated Class 2B and it is not designated for the protection of any coldwater fish species. Seven of twelve MNDNR fisheries surveys on this lake sampled low numbers of Cisco. Fish Trap Lake is connected to Alexander Lake (49-0079-00) so the Cisco population in Fish Trap Lake may be supplemented from Alexander Lake. However, smaller fish have been sampled in Fish Trap Lake indicating that natural reproduction is occurring in this lake. Considering this information, it is reasonable to designate Fish Trap Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]).

The summer average estimate of T_{DO3} (22.2 °C) for Fish Trap Lake exceeds the preliminary thresholds for this parameter despite the seven most recent MNDNR fisheries surveys indicating the presence of a population of Cisco. There is also relatively low disturbance (7.6%) in the watershed for this lake indicating that water quality in this lake is likely near natural conditions. Fish Trap Lake was monitored eight times from 1998 and 2014 and seven of these surveys indicated that this lake supports a good macrophyte community (in one survey, the floristic quality index was 1 point below the threshold). The warm water fish community was monitored in 2008, 2010, and 2018 and fish IBI scores were above thresholds indicating that the fish community meets aquatic life use goals. Recreation suitability data were collected from Fish Trap Lake from 1990-2019 on 237 days and fewer than 2% of days had recreation suitability scores indicating non-attainment of recreation goals. Summer average TP (22 µg/L), chl-*a* (7.4 µg/L), and Secchi depth (3.4 m) were also good for this lake. Zebra mussels have been introduced into Fish Trap Lake (identified in 2015), but there is limited water quality data following this introduction so it cannot be determined if this has impacted water quality measures. The Cisco population in this lake appears to have been stable since 1990 although there may be some indication that T_{DO3} has slightly increased (Figure 38). Aquatic life (i.e., Cisco, macrophyte, and fish community) and recreation measures demonstrate that this lake meets beneficial use goals. Despite T_{DO3} regularly exceeding 21.2 °C, the Cisco population appears to be healthy. As a result, it is reasonable to assign a SSS to this lake to address the atypical conditions which are suitable for the maintenance of a population of Cisco. Oxythermal habitat goals for this lake should be based on current conditions as these are consistent with conditions that support a Cisco population and attainment of aquatic life and recreation goals. The draft TP, chl-*a*, and Secchi depth standards are currently attained and not SSS is required for these parameters. As a result, the draft oxythermal criterion for Fish Trap Lake is: T_{DO3} = 22.2 °C. The average T_{DO3} value is based on a dataset consisting of 16 years of data so there is good confidence in this estimate (SE = 0.3). The oxythermal habitat in Fish Trap Lake is potentially near thresholds that will result in the loss of Cisco and this lake should therefore be considered vulnerable and in need of protection.

Figure 38. Annual water quality measures for Fish Trap Lake (49-0137-00). T_{DO3} is the maximum T_{DO3} measured during the period of maximum oxythermal stress for each year. Total phosphorus, chlorophyll-*a*, and Secchi depth are summer averages for years with at least 4 measurements from June through September. Red dashed lines indicate draft water quality criteria for Cisco lakes.



i. *Mississippi River - Sartell watershed (07010201)*

Class 2A confirmations and designations

The following lakes will be confirmed or designated for the protection of coldwater aquatic life and habitat (Class 2A). A summary of the evidence supporting these use designations is provided in Table 47 and if needed, additional information is provided following this table. Available evidence demonstrates that these lakes support or should support naturally reproducing populations of Cisco or are managed for coldwater fish through stocking. The use designations for these lakes will be amended in Minn. R. 7050.0470 by updating the beneficial uses for lakes in the Mississippi River - Sartell watershed (07010201).

Table 47. List of draft Class 2A use confirmations and designations for lakes in the Mississippi River - Sartell watershed (07010201) with supporting information. Abbreviations and fisheries survey codes are described in the introduction of Appendix C.

Lake name	WID	GR	Fisheries survey: LAT	Fisheries survey: LKW	Fisheries survey: TLC	Fisheries survey: SRT	Current ALU	Draft ALU	Trout lake	Type
Big Watab	73-0102-00	0.84				BNT, RBT-C|N|U	2A[SRT]	2Ag[SRT]	No	SC
Cedar	49-0140-00	1.17			U-4|3|103		2B	2Ag[TLC]	No	2A
Middle Spunk	73-0128-00	1.26			P-6|0|368		2B	2Ag[TLC]	No	2A
Sullivan	49-0016-00	2.64			U-8|3|52		2B	2Ag[TLC]	No	2A

Big Watab Lake (73-0102-00): Big Watab Lake is currently designated Class 2A to protect stream trout. It is listed as a "potential inland lake trout lake" in Minnesota Department of Conservation (1967) which notes that this lake has "good" dissolved oxygen conditions. Six MNDNR fisheries surveys have been conducted on this lake and Lake Trout have not been sampled nor there is evidence this lake ever supported a Lake Trout population. Rainbow Trout stocking began in 1989, and although not a MNDNR designated stream trout lake (Minn. R. 6264.0050), the lake is currently managed for stream trout. Considering this information, it is reasonable to retain the Class 2Ag designation for the protection of coldwater aquatic life and habitat and assign protections for stream trout (Class 2Ag [SRT]).

j. Sauk River watershed (07010202)

Class 2A confirmations and designations

The following lakes will be designated for the protection of coldwater aquatic life and habitat (Class 2A). A summary of the evidence supporting these use designations is provided in Table 48 and if needed, additional information is provided following this table. Available evidence demonstrates that these lakes support or should support naturally reproducing populations of Cisco. The use designations for these lakes will be amended in Minn. R. 7050.0470 by updating the beneficial uses for lakes in the Sauk River watershed (07010202).

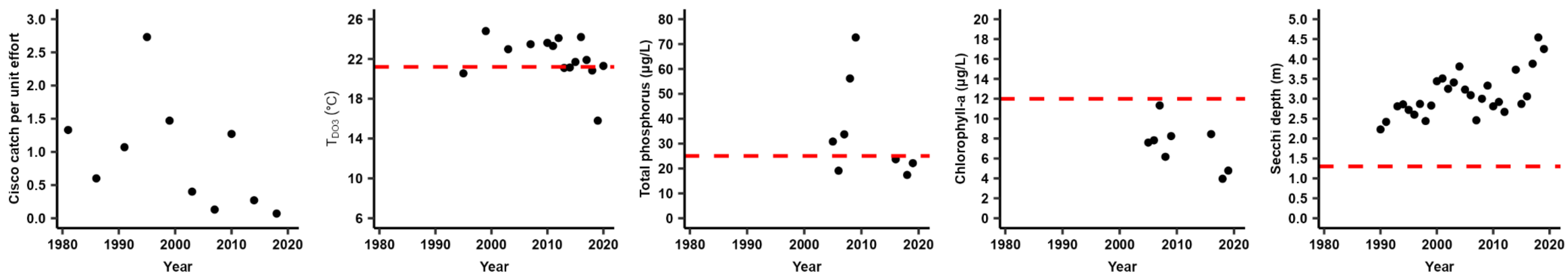
Table 48. List of draft Class 2A use confirmations and designations for lakes in the Sauk River watershed (07010202) with supporting information. Abbreviations and fisheries survey codes are described in the introduction of Appendix C.

Lake name	WID	GR	Fisheries survey: LAT	Fisheries survey: LKW	Fisheries survey: TLC	Fisheries survey: SRT	Current ALU	Draft ALU	Trout lake	Type
Big Birch	77-0084-01,-02	1.71-1.97			P-10|0|140		2B	2Ag[TLC]	No	2A
Fairy	77-0154-00	3.08			P-5|4|16		2B	2Ag[TLC]	No	2A
Little Birch	77-0089-00	1.58			P-8|2|144		2B	2Ag[TLC]	No	2A
Osakis	77-0215-00	3.49			P-14|1|285		2B	2Ag[TLC]	No	2A
Sauk	77-0150-02	2.75			P-11|0|415		2B	2Ag[TLC]	No	2A
St. Anna	73-0183-00	0.82			E-1|5|8		2B	2Ag[TLC]	No	2A
Sylvia	73-0249-00	1.42			U-6|1|147		2B	2Ag[TLC]	No	2A

Big Birch Lake (77-0084-01, -02): Big Birch Lake is currently designated Class 2B and it is not designated for the protection of any coldwater fish species. Cisco were sampled in all ten MNDNR fisheries surveys (1981-2018) indicating that this lake supports a population of Cisco. As a result, it is reasonable to designate Big Birch a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]).

The summer average estimate of T_{DO3} (22.1 °C) for Big Birch Lake exceeds the draft criterion for this parameter despite MNDNR fisheries surveys consistently indicating the presence of a population of Cisco. Chlorophyll-*a* (7 µg/L) and Secchi depth (3.1 m) are good although TP (28 µg/L) is above the draft threshold for Cisco lakes. However, the better than predicted values for chl-*a* and Secchi depth may be related to the introduction of zebra mussels in Big Birch Lake around 2016. All eutrophication parameters and T_{DO3} show improving trends although a possible decline in Cisco may be occurring despite improving trophic parameters (Figure 39). Macrophytes were monitored three times by the MNDNR for from 1999-2007, all of which indicated that Big Birch Lake supports a healthy population of macrophytes. The fish community was monitored three times by the MNDNR from 1999-2018, all of which had fish IBI scores above the threshold for healthy lakes. Recreation suitability data were collected from Big Birch Lake from 1993-2019 on 1144 days and <5% of surveys indicated a recreation suitability that did not meet goals. The majority (>59%) of recreation survey scores for Big Birch Lake indicated excellent conditions for recreation uses such swimming. Although T_{DO3} is above the draft criterion to protect Cisco, MNDNR surveys indicate that this population is maintained under these conditions. Based on water quality trends, it does not appear that possible declines in the Cisco population are the result of the loss of suitable oxythermal habitat. It is reasonable to assign a SSS to this lake to address the atypical conditions which are suitable for the maintenance of a population of Cisco. Oxythermal habitat goals for this lake should be based on current conditions as these are attaining aquatic life and recreation goals. The current attainment of the draft chl-*a*, and Secchi depth criteria indicates that it is appropriate to retain these standards. As a result, the draft SSS criteria for Big Birch Lake are 22.1 °C for oxythermal habitat (T_{DO3}) and 28 µg/L for TP. The average T_{DO3} value is based on a dataset consisting of 15 years of data so there is good confidence in this estimate (SE = 0.6). The oxythermal habitat in Big Birch Lake is potentially near thresholds that will result in the loss of Cisco and this lake should therefore be considered vulnerable and in need of protection or restoration.

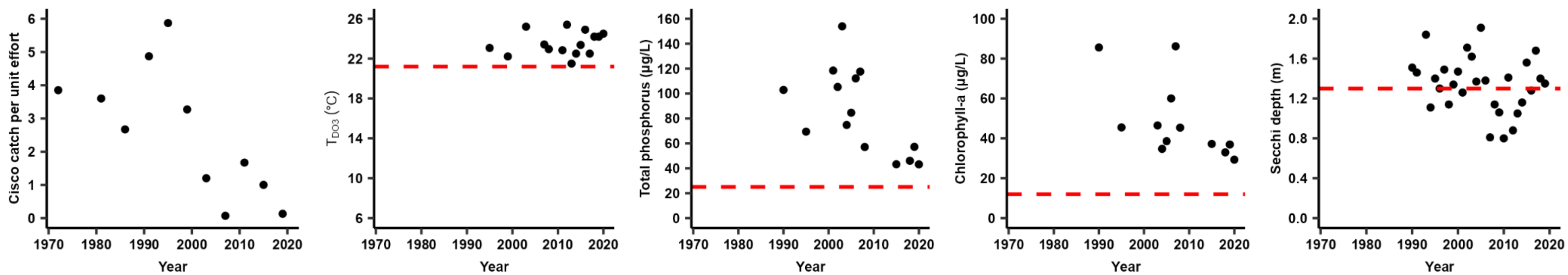
Figure 39. Annual water quality measures for Big Birch Lake (77-0084-01, -02). T_{DO3} is the maximum T_{DO3} measured during the period of maximum oxythermal stress for each year. Total phosphorus, chlorophyll-*a*, and Secchi depth are summer averages for years with at least 4 measurements from June through September. Red dashed lines indicate draft water quality criteria for Cisco lakes.



Sauk Lake (77-0150-02): Sauk Lake is currently designated Class 2B and it is not designated for the protection of any coldwater fish species. Cisco were sampled in all eleven MNDNR fisheries surveys (1972-2019) indicating that this lake supports a population of Cisco. As a result, it is reasonable to designate Sauk a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]). Sauk Lake (Southwest Bay) (77-0150-01) is shallow (<6 m maximum depth) and is unlikely to support coldwater fishes during the period of maximum oxythermal stress. As a result, 77-0150-01 will not be included in the coldwater habitat designation.

The summer average estimate of T_{DO3} (23.5 °C) for Sauk Lake currently exceeds the draft criterion for this parameter despite MNDNR fisheries surveys consistently indicating the presence of a population of Cisco. Summer average TP (85 µg/L), chl-*a* (48 µg/L), and Secchi depth (1.3 m) all indicate poor trophic conditions compared to other Cisco lakes. However, the Cisco population in this lake appears to have persisted under these poor conditions. In the last decade, TP and chl-*a* have improved although Secchi depth has continued to decline (Figure 40). Improving chl-*a* may be related to the introduction of zebra mussels around 2009 and the lack of an associated increase in Secchi depth may be due suspended sediment from the Sauk River. Although some eutrophication parameters are improving and T_{DO3} is stable, there also appears to be decline in Cisco despite improving or stable conditions (Figure 40). Macrophytes were monitored three times by the MNDNR for from 1999-2015, all of which indicated that Sauk Lake supports a healthy population of macrophytes. The fish community was monitored three times by the MNDNR from 2011-2015, all of which had fish IBI scores below the threshold for healthy lakes. Recreation suitability data were collected from Sauk Lake from 1991-2019 on 743 days and >21% of surveys indicated a recreation suitability that did not meet goals. Although T_{DO3} is above the draft criterion to protect Cisco, MNDNR surveys indicate that this population is maintained under these conditions. Based on water quality trends (Figure 40), possible declines in the Cisco population do not appear to be the result of a lack of sufficient oxythermal habitat. Some aquatic life (i.e., fish community) and recreation measures demonstrate that this lake may not meet other beneficial use goals, but these are separate from the draft oxythermal habitat criterion. As a result, it is reasonable to assign a SSS to this lake to address the atypical conditions which are suitable for the maintenance of a population of Cisco. Oxythermal habitat goals for this lake should be based on current conditions as these are attaining aquatic life and recreation goals. The draft TP, chl-*a*, and Secchi depth standards will be retained until it can be demonstrated which values will be consistent with the attainment of all beneficial use goals. As a result, the draft oxythermal criterion for Sauk is: T_{DO3} = 23.0 °C. The average T_{DO3} value is based on a dataset consisting of 15 years of data so there is good confidence in this estimate (SE = 0.3). The oxythermal habitat in Sauk Lake is potentially near thresholds that will result in the loss of Cisco and this lake should therefore be considered vulnerable and in need of protection or restoration.

Figure 40. Annual water quality measures for Sauk Lake (77-0150-02). T_{DO3} is the maximum T_{DO3} measured during the period of maximum oxythermal stress for each year. Total phosphorus, chlorophyll-*a*, and Secchi depth are summer averages for years with at least 4 measurements from June through September. Red dashed lines indicate draft water quality criterion for Cisco lakes.



St. Anna Lake (73-0183-00): St. Anna Lake is currently designated Class 2B and it is not designated for the protection of any coldwater fish species. A low number of Cisco (n=8) were sampled in a MNDNR fisheries survey in 1980, and this species was present in a MNDNR gill net survey (n=2) in 1973. Cisco have not been sampled in 5 subsequent surveys which may indicate Cisco have been extirpated from St. Anna Lake. However, the presence of this species in 1980 indicates that a Cisco coldwater habitat is an existing use. As a result, it is reasonable to designate St. Anna Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]). Due to the limited monitoring (i.e., a two fisheries surveys) and the small catch size, it is possible that additional information could result in a change to this designation.

k. Mississippi River - St. Cloud watershed (07010203)

Class 2A confirmations and designations

The following lakes will be confirmed or designated for the protection of coldwater aquatic life and habitat (Class 2A). A summary of the evidence supporting these use designations is provide Table 48 and if needed, additional information is provided following this table. Available evidence demonstrates that these lakes support or should support naturally reproducing populations of Cisco or are managed for coldwater fish through stocking. The use designations for these lakes will be amended in Minn. R. 7050.0470 by updating the beneficial uses for lakes in the Mississippi River - St. Cloud watershed (07010203).

Table 49. List of draft Class 2A use confirmations and designations for lakes in the Mississippi River - St. Cloud watershed (07010203) with supporting information. Abbreviations and fisheries survey codes are described in the introduction of Appendix C.

Lake name	WID	GR	Fisheries survey: LAT	Fisheries survey: LKW	Fisheries survey: TLC	Fisheries survey: SRT	Current ALU	Draft ALU	Trout lake	Type
Augusta	86-0284-00	1.14			P-6|1|87		2B	2Ag[TLC]	No	2A
Cedar	86-0227-00	1.28			E-4|3|54		2B	2Ag[TLC]	No	2A
Clearwater	86-0252-01,-02	2.28-3.19			U-4|3|12		2B	2Ag[TLC]	No	2A
Little Mud	47-0096-00	1.54				RBT-C|N|U	2B	2Ag[SRT]	No	2A
Otter	73-0015-00	1.61			U-3|1|6		2B	2Ag[TLC]	No	2A
Pleasant	86-0251-00	1.74			E-2|9|11		2B	2Ag[TLC]	No	2A
Sugar	86-0233-00	2.13			P-5|2|15		2B	2Ag[TLC]	No	2A

Cedar Lake (86-0227-00): Cedar Lake is currently designated Class 2B and it is not designated for the protection of any coldwater fish species. Cisco were sampled in MNDNR fisheries surveys until 1996, but Cisco have not been sampled in 3 subsequent surveys and a MNDNR vertical gill net survey. This indicates that Cisco may have been extirpated from Cedar Lake. However, the presence of this species until at least 1996 indicates that a Cisco coldwater habitat is an existing use. As a result, it is reasonable to designate Cedar Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]).

Otter Lake (73-0015-00): Otter Lake is currently designated Class 2B and it is not designated for the protection of any coldwater fish species. Six Cisco were sampled in three MNDNR fisheries surveys and dead Cisco were observed in another survey (2011). This information indicates that Otter Lake supports or supported a population of Cisco. As a result, it is reasonable to designate Otter Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]).

Pleasant Lake (86-0251-00): Pleasant Lake is currently designated Class 2B and it is not designated for the protection of any coldwater fish species. Cisco were sampled in 1980 and 1986 in MNDNR fisheries surveys. Cisco have not been sampled in 4 subsequent surveys which may indicate Cisco have been extirpated from Pleasant Lake. This lake was historically connected to Clearwater Lake (86-0252-00), but an outlet structure prevents fish passage and may be preventing reestablishment of a Cisco population. However, the presence of this species in 1980 and 1986 indicates that a Cisco coldwater habitat is an existing use. As a result, it is reasonable to designate Pleasant Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]).

l. North Fork Crow River watershed (07010204)

Class 2A confirmations and designations

The following lakes will be designated for the protection of coldwater aquatic life and habitat (Class 2A). A summary of the evidence supporting these use designations is provided in Table 50 and if needed, additional information is provided following this table. Available evidence demonstrates that these lakes support or should support naturally reproducing populations of Cisco. The use designations for these lakes will be amended in Minn. R. 7050.0470 by updating the beneficial uses for lakes in the North Fork Crow River watershed (07010204).

Table 50. List of draft Class 2A use confirmations and designations for lakes in the North Fork Crow River watershed (07010204) with supporting information. Abbreviations and fisheries survey codes are described in the introduction of Appendix C.

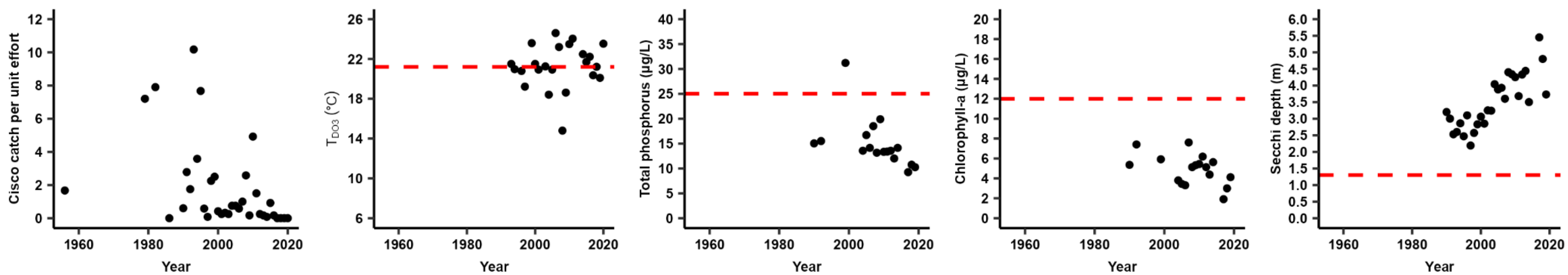
Lake name	WID	GR	Fisheries survey: LAT	Fisheries survey: LKW	Fisheries survey: TLC	Fisheries survey: SRT	Current ALU	Draft ALU	Trout lake	Type
East Lake Sylvia	86-0289-00	1.71			U-2|5|3		2B	2Ag[TLC]	No	2A
Green	34-0079-00	2.05			U-30|7|731		2B	2Ag[TLC]	No	2A
Koronis (main lake)	73-0200-02	1.46			P-16|5|243		2B	2Ag[TLC]	No	2A
West Lake Sylvia	86-0279-00	1.62			U-1|5|1		2B	2Ag[TLC]	No	2A

East Lake Sylvia (86-0289-00): East Lake Sylvia is currently designated Class 2B and it is not designated for the protection of any coldwater fish species. Five Cisco were sampled in two MNDNR fisheries surveys and were also present in a James Ford Bell Museum survey in 1984. This information indicates that East Lake Sylvia supports or supported a population of Cisco. As a result, it is reasonable to designate East Lake Sylvia a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]).

Green Lake (34-0079-00): Green Lake is currently designated Class 2B and it is not designated for the protection of any coldwater fish species. Cisco were sampled in 30 of 37 MNDNR fisheries surveys (1956-2020) indicating that this lake supports a population of Cisco. As a result, it is reasonable to designate Green a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]).

The summer average estimate of T_{DO3} (21.3 °C) for Green Lake is above the draft criterion for this parameter despite MNDNR fisheries surveys consistently indicating the presence of a population of Cisco. However, the Cisco population in this lake appears to have persisted under these oxythermal conditions. Water quality is generally good with TP (15 µg/L), chl-*a* (5 µg/L), and Secchi depth (3.5 m) all meeting goals. Summer average TP, chl-*a*, and Secchi depth have improved (Figure 41), which may be the result of the introduction of zebra mussels. Although eutrophication parameters are improving and T_{DO3} is stable, there is a decline in Cisco catches despite these improving or stable water quality conditions (Figure 41). Macrophytes were monitored eight times by the MNDNR from 1994-2018, all of which indicated that Green Lake supports a healthy population of macrophytes. The warm water fish community was monitored twice by the MNDNR in 2012 and 2016, both of which had fish IBI scores above the threshold for healthy lakes. Recreation suitability data were collected from Green Lake from 1990-2019 on 282 days and no surveys indicated a recreation suitability that did not meet goals. Green Lake has historically had marginal oxythermal conditions and may support a population that is more tolerant than Cisco in more northern Cisco lakes. Although T_{DO3} regularly exceeds 21 °C, fish kills are not commonly observed unless T_{DO3} exceeds 22-23 °C. Some recruitment has been documented using vertical gill net surveys; however, the Cisco population has declined. This decline is attributed to poor spawning substrates. Aquatic life (i.e., macrophyte and fish community) and recreation measures demonstrate that this lake meets other beneficial use goals. The draft T_{DO3}, TP, chl-*a*, and Secchi depth standards will be retained because they are currently or nearly attained and declines in the Cisco population have been attributed to other factors. However, the oxythermal habitat in Green Lake is potentially near thresholds that will result in the loss of Cisco and this lake should therefore be considered vulnerable and in need of protection or restoration.

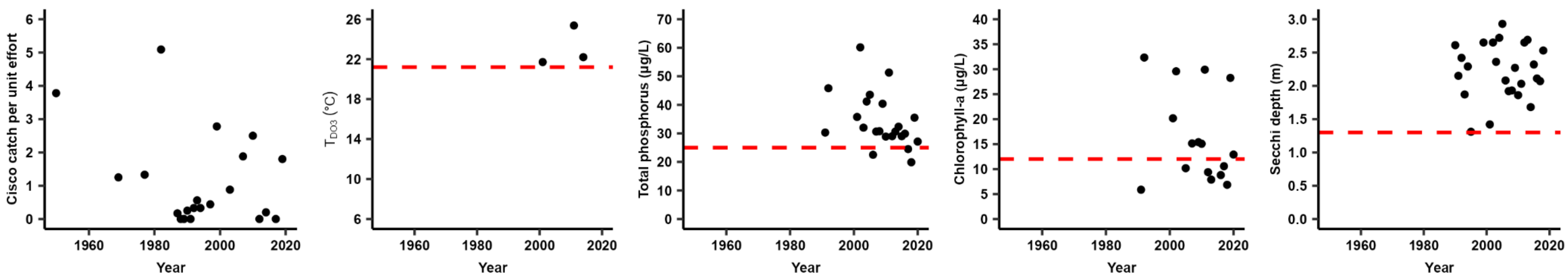
Figure 41. Annual water quality measures for Green Lake (34-0079-00). T_{DO3} is the maximum T_{DO3} measured during the period of maximum oxythermal stress for each year. Total phosphorus, chlorophyll-*a*, and Secchi depth are summer averages for years with at least 4 measurements from June through September. Red dashed lines indicate draft water quality criteria for Cisco lakes.



Koronis (main lake) Lake (73-0200-02): Koronis Lake is currently designated Class 2B and it is not designated for the protection of any coldwater fish species. Cisco were sampled in 16 of 21 MNDNR fisheries surveys (1950-2019) indicating that this lake supports a population of Cisco. As a result, it is reasonable to designate Koronis a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]).

The summer average estimate of T_{DO3} (23.1 °C) for Koronis Lake exceeds the draft criterion for this parameter despite MNDNR fisheries surveys consistently indicating the presence of a population of Cisco. However, the Cisco population in this lake appears to have persisted under these poorer oxythermal conditions. Summer average TP (34 µg/L) and chl-*a* (16 µg/L) indicate an exceedance of the standard although Secchi depth is good (2.2 m). Although eutrophication parameters are improving, there is limited T_{DO3} data to determine trends (Figure 42). Macrophytes were monitored nine times by the MNDNR for from 1997-2018, all of which indicated that Koronis Lake supports a healthy population of macrophytes. The warm water fish community was monitored twice by the MNDNR in 2012 and 2016, both of which had fish IBI scores below the threshold for healthy lakes. Koronis Lake is listed as impaired for fish. Recreation suitability data were collected from Koronis Lake from 1990-2019 on 367 days and 8% of surveys indicated a recreation suitability that did not meet goals. Koronis Lake has historically had marginal oxythermal conditions and may support a population that is more tolerant than Cisco in more northern Cisco lakes. Although T_{DO3} regularly exceeds 21 °C, fish kills are not commonly observed unless T_{DO3} exceeds 22-23 °C. Some aquatic life (i.e., Cisco and macrophytes) measures demonstrate that this lake partly meets beneficial use goals although warm water fish measures indicate threats to beneficial uses. It is reasonable to assign a SSS to this lake to address the atypical conditions which are suitable for the maintenance of a population of Cisco. Oxythermal habitat goals for this lake should be based on current conditions as these are consistent with conditions where a Cisco population was supported and the attainment of aquatic life and recreation goals. The draft TP, chl-*a*, and Secchi depth standards will be assigned because the fish assessment indicates impairment and reductions from current conditions may be needed to restore this beneficial use. Management of this lake is also complicated by the introduction of starry stonewort. The draft oxythermal criterion for Koronis Lake is: T_{DO3} = 23.0 °C. The average T_{DO3} value is based on a dataset consisting of 3 years of data so additional sampling may indicate an adjustment to the draft SSS will be required. The oxythermal habitat in Koronis Lake is potentially near thresholds that will result in the loss of Cisco and this lake should therefore be considered vulnerable and in need of protection or restoration.

Figure 42. Annual water quality measures for Koronis Lake (73-0200-02). T_{DO3} is the maximum T_{DO3} measured during the period of maximum oxythermal stress for each year. Total phosphorus, chlorophyll-*a*, and Secchi depth are summer averages for years with at least 4 measurements from June through September. Red dashed lines indicate draft water quality criteria for Cisco lakes.



West Lake Sylvia (86-0279-00): West Lake Sylvia is currently designated Class 2B and it is not designated for the protection of any coldwater fish species. A single Cisco was sampled in a MNDNR fisheries survey in 1981 and a moderate number (n=23) were sampled in a MNDNR vertical gill net survey in 2015. This information indicates that West Lake Sylvia supports or supported a population of Cisco. As a result, it is reasonable to designate West Lake Sylvia a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]).

m. South Fork Crow River watershed (07010205)

No draft use designations or confirmations

n. Mississippi River - Twin Cities watershed (07010206)

Class 2A confirmations and designations

The following lake will be confirmed for the protection of coldwater aquatic life and habitat (Class 2A). A summary of the evidence supporting this use designation is provided in Table 51. The use designation for this lake will be amended Minn. R. 7050.0470 by updating the beneficial uses for this lake in the Mississippi River - Twin Cities watershed (07010206).

Table 51. List of draft Class 2A use confirmations and designations for lakes in the Mississippi River - Twin Cities watershed (07010206) with supporting information. Abbreviations and fisheries survey codes are described in the introduction of Appendix C.

Lake name	WID	GR	Fisheries survey: LAT	Fisheries survey: LKW	Fisheries survey: TLC	Fisheries survey: SRT	Current ALU	Draft ALU	Trout lake	Type
Unnamed (Cenaiko)	02-0654-00	1.67	E-0|4|0			RBT-C|Y|U	$2A^{SRT}$	2Ag[SRT]	Yes	SC

o. Rum River watershed (07010207)

Class 2A confirmations and designations

The following lakes will be designated for the protection of coldwater aquatic life and habitat (Class 2A). A summary of the evidence supporting these use designations is provided in Table 52. Available evidence demonstrates that these lakes support or should support naturally reproducing populations of Cisco. The use designations for these lakes will be amended in Minn. R. 7050.0470 by updating the beneficial uses for lakes in the Rum River watershed (07010207).

Table 52. List of draft Class 2A use confirmations and designations for lakes in the Rum River watershed (07010207) with supporting information. Abbreviations and fisheries survey codes are described in the introduction of Appendix C.

Lake name	WID	GR	Fisheries survey: LAT	Fisheries survey: LKW	Fisheries survey: TLC	Fisheries survey: SRT	Current ALU	Draft ALU	Trout lake	Type
Barbour	18-0030-00	1.37			P-2|1|123		2B	2Ag[TLC]	No	2A
Borden	18-0020-00	1.74			U-7|1|111		2B	2Ag[TLC]	No	2A
Kenney	18-0019-00	1.52			U-2|0|53		2B	2Ag[TLC]	No	2A
Round	01-0204-00	0.33			P-8|1|251		2B	2Ag[TLC]	No	2A

Lake name	WID	GR	Fisheries survey: LAT	Fisheries survey: LKW	Fisheries survey: TLC	Fisheries survey: SRT	Current ALU	Draft ALU	Trout lake	Type
Smith	18-0028-00	2.24			P-4|0|84		2B	2Ag[TLC]	No	2A
Whitefish	18-0001-00	2.18			P-4|0|238		2B	2Ag[TLC]	No	2A

5. Minnesota River basin

a. Minnesota River - Headwaters watershed (07020001)

No draft use designations or confirmations

b. Pomme de Terre River watershed (07020002)

Class 2A confirmations and designations

The following lake will be designated for the protection of coldwater aquatic life and habitat (Class 2A). A summary of the evidence supporting this use designation is provided in Table 53. Available evidence demonstrates that this lake supports or should support a naturally reproducing populations of Cisco. The use designation for this lake will be amended in Minn. R. 7050.0470 by updating the beneficial uses for lakes in the Pomme de Terre River watershed (07020002).

Table 53. List of draft Class 2A use confirmations and designations for lakes in the Pomme de Terre River watershed (07020002) with supporting information. Abbreviations and fisheries survey codes are described in the introduction of Appendix C.

Lake name	WID	GR	Fisheries survey: LAT	Fisheries survey: LKW	Fisheries survey: TLC	Fisheries survey: SRT	Current ALU	Draft ALU	Trout lake	Type
Stalker	56-0437-00	1.67			U-5|6|15		2B	2Ag[TLC]	No	2A

c. Lac qui Parle River watershed (07020003)

No draft use designations or confirmations

d. Minnesota River - Yellow Medicine River watershed (07020004)

No draft use designations or confirmations

e. Chippewa River watershed (07020005)

Class 2A confirmations and designations

The following lakes will be designated for the protection of coldwater aquatic life and habitat (Class 2A). A summary of the evidence supporting these use designations is provided in Table 54. Available evidence demonstrates that these lakes support or should support naturally reproducing populations of Cisco. The use designations for these lakes will be amended in Minn. R. 7050.0470 by updating the beneficial uses for lakes in the Chippewa River watershed (07020005).

Table 54. List of draft Class 2A use confirmations and designations for lakes in the Chippewa River watershed (07020005) with supporting information. Abbreviations and fisheries survey codes are described in the introduction of Appendix C.

Lake name	WID	GR	Fisheries survey: LAT	Fisheries survey: LKW	Fisheries survey: TLC	Fisheries survey: SRT	Current ALU	Draft ALU	Trout lake	Type
Chippewa	21-0145-00	1.59			P-7|3|60		2B	2Ag[TLC]	No	2A
Rachel	21-0160-00	1.84			P-8|1|181		2B	2Ag[TLC]	No	2A

f. Redwood River watershed (07020006)

No draft use designations or confirmations

g. Minnesota River - Mankato watershed (07020007)

No draft use designations or confirmations

h. Cottonwood River watershed (07020008)

No draft use designations or confirmations

i. Blue Earth River watershed (07020009)

No draft use designations or confirmations

j. Watonwan River watershed (07020010)

No draft use designations or confirmations

k. Le Sueur River watershed (07020011)

No draft use designations or confirmations

l. Lower Minnesota River watershed (07020012)

Class 2A confirmations and designations

The following lakes will be confirmed or designated for the protection of coldwater aquatic life and habitat (Class 2A). A summary of the evidence supporting these use designations is provided in Table 55 and if needed, additional information is provided following this table. Available evidence demonstrates that these lakes are managed for coldwater fish through stocking. The use designations for these lakes will be amended in Minn. R. 7050.0470 by updating the beneficial uses for lakes in the Lower Minnesota River watershed (07020012).

Table 55. List of draft Class 2A use confirmations and designations for lakes in the Lower Minnesota River watershed (07020012) with supporting information. Abbreviations and fisheries survey codes are described in the introduction of Appendix C.

Lake name	WID	GR	Fisheries survey: LAT	Fisheries survey: LKW	Fisheries survey: TLC	Fisheries survey: SRT	Current ALU	Draft ALU	Trout lake	Type
Courthouse	10-0005-00	0.84	E-1|2|1			BKT,BNT,RBT-C|Y|U	2A[SRT]	2Ag[SRT]	Yes	SC
Quarry	70-0343-00	1.06				BKT,BNT,RBT-C|Y|M	2B	2Ag[SRT]	Yes	2A

Quarry Lake (70-0343-00): Quarry Lake will be proposed to be designated as a coldwater aquatic life and habitat (Class 2A). The MNDNR added Quarry Lake to its list of designated trout lakes (Minn. R. 6264.0050) in 2018 (State of Minnesota 2018). Temperature and dissolved oxygen levels indicate that the lake can support trout and it is currently stocked with Rainbow Trout. Considering this information, it is reasonable to designate Quarry Lake coldwater habitat and assign protections for stream trout (Class 2Ag [SRT]).

6. Saint Croix River basin

a. Upper St. Croix River watershed (07030001)

No draft use designations or confirmations

b. Kettle River watershed (07030003)

Class 2A confirmations and designations

The following lakes will be confirmed or designated for the protection of coldwater aquatic life and habitat (Class 2A). A summary of the evidence supporting these use designations is provided in Table 56 and if needed, additional information is provided following this table. Available evidence demonstrates that these lakes support or should support naturally reproducing populations of Lake Trout or Cisco or are managed for coldwater fish through stocking. The use designations for these lakes will be amended in [Minn. R. 7050.0470] by updating the beneficial uses for lakes in the Kettle River watershed (07030003).

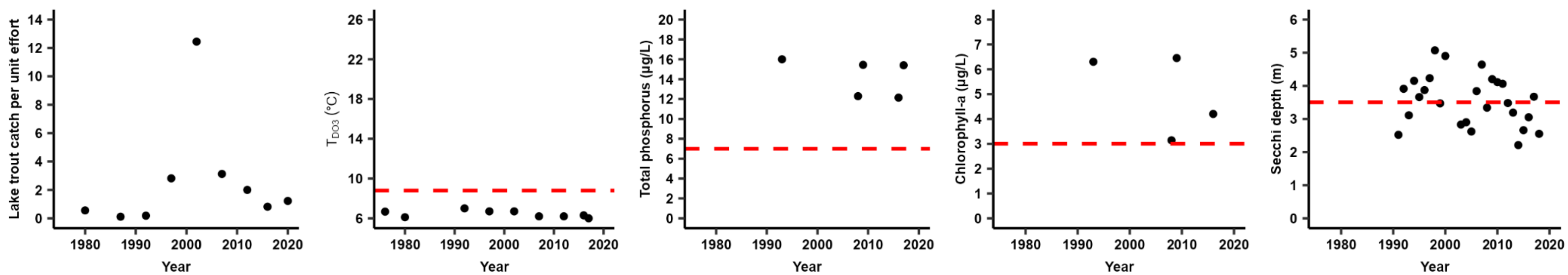
Table 56. List of draft Class 2A use confirmations and designations for lakes in the Kettle River watershed (07030003) with supporting information. Abbreviations and fisheries survey codes are described in the introduction of Appendix C.

Lake name	WID	GR	Fisheries survey: LAT	Fisheries survey: LKW	Fisheries survey: TLC	Fisheries survey: SRT	Current ALU	Draft ALU	Trout lake	Type
Grindstone	58-0123-00	0.82	P-8|0|580		E-3|5|11	BNT, RBT-C|N|U	$2A^{LAT}$	2Ag[LAT,TLC,SRT]	No	SM
Hanging Horn	09-0038-00	1.40	E-1|11|2		P-12|0|3452	NA-H|N|U	2B	2Ag[TLC]	No	2A
Little Hanging Horn	09-0035-00	1.22			U-6|1|49		2B	2Ag[TLC]	No	2A

Grindstone Lake (58-0123-00): Grindstone Lake is currently designated Class 2A to protect Lake Trout. It is listed as an “inland lake trout lake” in Minnesota Department of Conservation (1967) which also notes that the lake has “poor reproduction.” Lake Trout are managed in this lake and although the population is not self-sustaining, good numbers are present in fisheries surveys. Cisco were sampled in all MNDNR fisheries surveys from 1949-1992, but this species has not been sampled in any gill net sampling efforts since. Cisco may have been extirpated by the introduction Rainbow Smelt. Since the Cisco population was possibly native and occurred after November 28, 1975, this is an existing use, and it should be protected. Although it is not a designated stream trout lake, Grindstone Lake is also managed for Brown and Rainbow Trout. Considering this information, it is reasonable to designate Grindstone Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Lake Trout, Cisco, and stream trout (Class 2Ag [LAT,TLC,SRT]).

Summer average estimates of chl-*a* and TP (5 years from 1993-18; chl-*a* = 5 µg/L; TP = 14 µg/L) for Grindstone Lake exceed draft criteria despite ongoing management of Lake Trout (Figure 43). In contrast, T_{DO3} (6.1 °C; 10 years from 1992-2020) is good and indicative of a lake that could support Lake Trout. This lake was monitored by the MNDNR for macrophytes four times from 1997-2018 and all indicated a healthy macrophyte community. The warm-water fish community was monitored three times from 2012 through 2016 by the MNDNR which determined that the warm water fish community is healthy. Recreation suitability data were collected from Grindstone Lake from 1991-2018 on 330 days and all recreation survey scores for Grindstone Lake indicated overall good recreation conditions with no days surveyed indicating non-attainment of recreation uses. Although eutrophication measures indicate elevated trophic conditions for a Lake Trout lake, aquatic life (i.e., macrophytes and warm water fish community) and recreation measures demonstrate that this lake meets goals. In addition, Grindstone Lake is geologically unique and likely has substantial ground water inputs that could mitigate the effects of elevated nutrients. The Lake Trout population in Grindstone Lake is also not natural and is further south than other Lake Trout populations in Minnesota. This species was introduced and is maintained through stocking. Historically, the introduced Lake Trout population was self-sustaining, but the introduction of Rainbow Smelt in Grindstone Lake has negatively affected the Lake Trout population. As a result, it is reasonable to assign a SSS to this lake to address the atypical conditions which are suitable for the maintenance of a Lake Trout fishery and other beneficial uses. The current attainment of the draft T_{DO3} criterion indicates that it is appropriate to retain the draft criterion. Other water quality goals for this lake should be based on current conditions as this lake is currently attaining aquatic life and recreation goals. As a result, the draft lake eutrophication criteria for Grindstone Lake are: chl-*a* = 5 µg/L and TP = 14 µg/L. Secchi depth and T_{DO3} in Grindstone Lake are currently good and these standards do not need to be modified. Average eutrophication parameter estimates were based on a relatively large dataset consisting of 5 years of data indicating reasonable confidence in these estimates. However, additional sampling may indicate an adjustment to the draft SSS will be required. Although beneficial uses in Grindstone Lake are currently protected, water quality is potentially near thresholds that will result in the loss of these uses and this lake should therefore be considered vulnerable and in need of protection.

Figure 43. Annual water quality measures for Grindstone Lake (58-0123-00). T_{DO3} is the maximum T_{DO3} measured during the period of maximum oxythermal stress for each year. Total phosphorus, chlorophyll-*a*, and Secchi depth are summer averages for years with at least 4 measurements from June through September. Red dashed lines indicate draft water quality criteria for Lake Trout lakes.



Hanging Horn Lake (09-0038-00): Hanging Horn Lake is currently designated Class 2B and it is not designated for the protection of any coldwater fish species. Twelve MNDNR fisheries surveys conducted on Hanging Horn Lake all sampled Cisco indicating that this lake supports a population of Cisco. Lake Trout were stocked in 2007, but this effort failed to produce a Lake Trout fishery and stocking was discontinued. Hanging Horn Lake was historically managed for Rainbow and Brown Trout, but it is no longer managed for stream trout, and it is not a designated stream trout lake. Considering this information, it is reasonable to designate Hanging Horn Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]).

c. Snake River watershed (07030004)

No draft use designations or confirmations

d. Lower St. Croix River watershed (07030005)

Class 2A confirmations and designations

The following lake will be designated for the protection of coldwater aquatic life and habitat (Class 2A). A summary of the evidence supporting the use designation is provided in Table 57 and additional details are provided following this table. Available evidence demonstrates that this lake supports or should support a naturally reproducing population of Cisco. The use designation for this lake will be amended in Minn. R. 7050.0470 by updating the beneficial uses for lakes in the Lower St. Croix River watershed (07030005).

Table 57. List of draft Class 2A use confirmations and designations for lakes in the Lower St. Croix River watershed (07030005) with supporting information. Abbreviations and fisheries survey codes are described in the introduction of Appendix C.

Lake name	WID	GR	Fisheries survey: LAT	Fisheries survey: LKW	Fisheries survey: TLC	Fisheries survey: SRT	Current ALU	Draft ALU	Trout lake	Type
Elmo	82-0106-00	0.84	E-1|14|15		P-8|7|463		2B	2Ag[TLC]	No	2A

Elmo Lake (82-0106-00): Elmo Lake is currently designated Class 2B and it is not designated for the protection of any coldwater fish species. Cisco are not native to this lake but were introduced around 1878. Cisco were extirpated in the 1930s due to drought and stocked again in 1996, 1997, and 1998. Eight MNDNR fisheries surveys conducted on Elmo Lake sampled Cisco indicating that Cisco have been established and that this lake supports a population of this species. Lake Trout were stocked in 2006 and 15 fish were sampled the same year. These fish were stocked fish and additional sampling has not sampled Lake Trout indicating poor survival and a lack of a self-sustaining population. As a result of this information, it is reasonable to designate Elmo Lake a Class 2Ag for the protection of coldwater aquatic life and habitat and assign protections for Cisco (Class 2Ag [TLC]).

7. Lower Mississippi River basin

a. Mississippi River - Lake Pepin watershed (07040001)

No draft use designations or confirmations

b. Cannon River watershed (07040002)

No draft use designations or confirmations

c. Mississippi River - Winona watershed (07040003)

No draft use designations or confirmations

d. Zumbro River watershed (07040004)

No draft use designations or confirmations

e. Mississippi River - La Crescent watershed (07040006)

No draft use designations or confirmations

f. Root River watershed (07040008)

No draft use designations or confirmations

g. Mississippi River - Reno watershed (07060001)

No draft use designations or confirmations

h. Upper Iowa River watershed (07060002)

No draft use designations or confirmations

8. Cedar-Des Moines Rivers basin

a. Upper Wapsipinicon River watershed (07080102)

No draft use designations or confirmations

b. Cedar River watershed (07080201)

No draft use designations or confirmations

c. Shell Rock River watershed (07080202)

No draft use designations or confirmations

d. Winnebago River watershed (07080203)

No draft use designations or confirmations

e. Des Moines River – Headwaters watershed (07100001)

No draft use designations or confirmations

f. Lower Des Moines River watershed (07100002)

No draft use designations or confirmations

g. East Fork Des Moines River watershed (07100003)

No draft use designations or confirmations

9. Missouri River basin

a. Upper Big Sioux River watershed (10170202)

No draft use designations or confirmations

b. Lower Big Sioux River watershed (10170203)

No draft use designations or confirmations

c. Rock River watershed (10170204)

No draft use designations or confirmations

d. Little Sioux River watershed (10230003)

No draft use designations or confirmations

Appendix D: Polymictic lakes potentially supporting coldwater fishes

The current research was focused on developing protective standards for coldwater fishes in dimictic lakes and documenting which lakes support these coldwater fishes. However, there are some polymictic lakes in Minnesota that support resident populations of Cisco or Lake Whitefish. The environmental requirements for the maintenance of these fish populations are not fully understood and these lakes were not a focus of this research. However, it is apparent that the application of WQS developed for dimictic lakes are not appropriate for polymictic lakes because many polymictic lakes that support coldwater fishes do not meet the draft criteria for dimictic lakes. Using the same analysis approach in the "***Assessment of implementation outcomes***" section, 43% of polymictic Cisco lakes and 89% of polymictic Lake Whitefish lakes did not meet either the draft T_{DO3} or chl-*a* thresholds. These rates are considerably higher than for dimictic lakes indicating that different measures are likely required to develop protective water quality standards for these lakes. This is beyond the scope of this study, but this is an area of research that should be pursued in future efforts. Although, the current research does not provide thresholds for the protection of these lakes, a list of polymictic lakes which potentially support coldwater fish species is included below (Table 58). Other than a determination that these lakes do not appear to have oxythermal conditions and habitat typical of coldwater lakes due to natural characteristics, the status of the coldwater fish in these lakes has not been fully reviewed. For example, some of these lakes may have transient populations of coldwater fishes which would exclude them from a coldwater habitat designation. This list serves to document why these lakes were not included in the list of coldwater habitats in Appendix C and identifies lakes where additional research may be needed to protect these populations of coldwater fishes.

Table 58. List of polymictic lakes which may support populations of Cisco or Lake Whitefish. Abbreviations: HUC 8 = 8-digit hydrologic unit code; WID = water body identification code; GR = geometry ratio; LKW = Lake Whitefish; TLC = Cisco. Abbreviations and fisheries survey codes are described in the introduction of Appendix C.

HUC8	Lake name	WID	LAT	LKW	TLC
7010101	Campbell	04-0196-00	4.82		P-9|1|160
7010101	George	29-0216-00	4.82		U-9|4|37
7010102	Lower Trelipe	11-0129-00	4.06		P-11|1|285
7010102	Woman	11-0201-00	3.76		P-19|0|1005
7010103	Split Hand	31-0353-00	4.68	M-1|16|1	P-17|0|902
7010104	Lower Mission	18-0243-00	4.99		E-2|6|22
7010106	Eighth Crow Wing	29-0072-00	4.11		P-10|0|143
7010106	First Crow Wing	29-0086-00	8.34		P-11|0|42
7010106	Lower Twin	80-0030-00	4.36		P-5|4|10
7010106	Roy	18-0398-00	4.24		P-5|2|21
7010108	Mary	21-0092-00	5.41		P-15|1|355
7010207	Mille Lacs	48-0002-00	14.15	U-0|28|0	P-28|0|14826
7020005	Minnewaska	61-0130-00	7.73		U-7|9|76
9020103	Blanche	56-0240-00	2.45		P-8|1|71
9020103	Cotton	03-0286-00	6.07		P-10|0|192
9020103	Deer	56-0298-00	4.61		U-6|4|21
9020103	Floyd	03-0387-00	4.49		U-8|2|69

HUC8	Lake name	WID	LAT	LKW	TLC
9020103	Hoot	56-0782-00	4.69		U-5|3|18
9020103	Little Pelican	56-0761-00	4.56		U-4|1|67
9020103	Maud	03-0500-00	4.15		U-6|5|113
9020103	Melissa	03-0475-00	3.99		P-11|0|284
9020103	North Lida	56-0747-01	4.69		P-16|0|640
9020103	Prairie	56-0915-00	6.98		U-3|7|21
9020103	Rush	56-0141-00	3.26	U-0|14|0	P-14|0|781
9020103	Sallie	03-0359-00	3.12		P-7|4|257
9020103	Walker	56-0310-00	4.42		U-8|1|178
9020302	Blackduck	04-0069-00	6.70	P-10|2|83	M-1|11|1
9020302	Red (Upper Red)	04-0035-01	13.90	U-19|13|169	
9030001	Agnes	69-0223-00	4.96		P-2|0|140
9030001	Bald Eagle	38-0637-00	4.32	U-1|2|1	P-3|0|105
9030001	Birch	38-0532-00	3.34	U-7|3|10	P-10|0|392
9030001	Birch	69-0003-00	9.68		P-17|0|1647
9030001	Boot	69-0100-00	4.08		U-1|0|64
9030001	Crab	16-0357-00	4.57		E-5|3|62
9030001	Ensign	38-0498-00	5.34		U-3|0|539
9030001	Fall	38-0811-00	5.62	U-6|10|28	P-16|0|1366
9030001	Four	38-0528-00	5.34	P-2|0|18	P-2|0|6
9030001	Fourtown	38-0813-00	6.12		U-2|0|333
9030001	Horse	38-0792-00	5.38		U-2|0|43
9030001	Isabella	38-0396-00	8.67	P-9|0|419	
9030001	Kabetogama	69-0845-00	6.41	U-11|18|16	P-29|0|1955
9030001	Koma	38-0098-00	7.45	P-2|0|54	U-1|1|19
9030001	Little Gabbro	38-0703-00	3.74		P-3|0|67
9030001	Little Johnson	69-0760-00	4.55	P-5|3|21	
9030001	Perent	38-0220-00	4.36	P-4|1|306	M-1|4|95
9030001	Silver Island	38-0219-00	9.69	P-10|0|256	
9030001	Splash	38-0531-00	4.51		P-2|0|104
9030001	T	38-0066-00	7.21	P-6|2|121	
9030001	White Iron	69-0004-00	4.17	U-10|11|21	P-20|1|2210
9030005	Little Sturgeon	69-1290-00	4.82		P-6|0|70
9030006	Bowstring	31-0813-00	8.01	M-1|10|1	P-11|0|191
9030006	Island	31-0913-00	5.21		P-13|0|714
9030006	Little Turtle	31-0779-00	4.03		P-8|0|223
9030009	Lake of the Woods[25]	39-0002-00	3.64	P-14|20|158	P-26|8|24806

[25] Lake Trout occur on the Canadian side of Lake of the Woods, but this species has not been sampled on the United States side of this lake. Based on available information, suitable lake trout habitat is not present on the Minnesota side of Lake of the Woods and therefore will not be designated lake trout habitat.

Appendix E: Lakes reviewed for coldwater designation

In addition to the lakes listed for designation in Appendix C and the polymictic lakes in Appendix D, there are other lakes that were reviewed because coldwater fish were sampled in surveys or there was past stocking of one or more coldwater fish species (Lake Trout, Lake Whitefish, or Cisco). These lakes did not meet the criteria for consideration as coldwater habitat or the available data were deemed to be insufficient for designation. The following table documents the lakes which have been reviewed as part of this process. The inclusion on this list does not indicate that these lakes will not be designated in a future rule. In some cases, these lakes did indicate some coldwater potential, but additional data will be required to determine if a coldwater designation is appropriate and which species should be protected under such a designation.

Table 59. List of lakes which are not included for coldwater designation (Appendix C) and are not identified as polymictic lakes possibly supporting coldwater fish (Appendix D), but from which coldwater fish were sampled during MNDNR fisheries surveys. Abbreviations: HUC 8 = 8-digit hydrologic unit code; WID = water body identification code; LAT = Lake Trout; LKW = Lake Whitefish; TLC = Cisco.

HUC8	Lake name	WID	LAT	LKW	TLC
4010101	Mid Cone	16-0391-00	X		
4010101	South Temperance	16-0457-00			X
4010101	Sawbill	16-0496-00			X
4010101	Dyers	16-0634-00			X
4010201	Embarrass	69-0496-00			X
4010201	Bass	69-0553-00			X
4010201	Burns Pit	69-1378-00			X
4010202	Island Lake Reservoir	69-0372-00			X
4010301	Hay	09-0010-00			X
7010101	Swenson	04-0085-00			X
7010101	Three Island	04-0134-00			X
7010101	Irving	04-0140-00		X	X
7010101	Carr	04-0141-00			X
7010101	Little Turtle	04-0155-00			X
7010101	Black	04-0157-00			X
7010101	Fox	04-0162-00			X
7010101	Bootleg	04-0211-00			X
7010101	Little Vermillion	11-0030-00			X
7010101	Frontenac	29-0241-00			X
7010101	Hattie	29-0300-00			X
7010101	South Sugar	31-0555-00			X
7010101	Blackwater	31-0561-00			X
7010101	Fawn	31-0609-00			X
7010101	Little Moose	31-0610-00			X
7010101	Little Rice	31-0716-00			X
7010101	Dixon	31-0921-00			X
7010102	Birch	11-0412-00			X

HUC8	Lake name	WID	LAT	LKW	TLC
7010102	Fifth	11-0466-00			X
7010102	Anway	11-0469-00			X
7010102	Unnamed	11-0866-00			X
7010103	Aitkin	01-0040-00			X
7010103	Little Thunder	11-0061-00			X
7010103	Island	31-0217-00			X
7010103	Lawrence	31-0231-00			X
7010103	Little Split Hand	31-0341-00			X
7010103	Scrapper	31-0345-00			X
7010103	Prairie	31-0384-00			X
7010103	Middle Hanson	31-0396-00			X
7010103	Blandin	31-0533-00			X
7010104	Ripple	01-0146-00		X	X
7010104	Hanging Kettle	01-0170-00			X
7010104	Hickory	01-0179-00			X
7010104	Long / Tame Fish	18-0002-00			X
7010104	Maple	18-0045-00		X	
7010104	Portage	18-0069-00		X	X
7010104	Serpent	18-0090-00			X
7010104	Rabbit (West Portion)	18-0093-02			X
7010104	Roe Mine	18-0119-00			X
7010104	Clinker	18-0131-00			X
7010104	Rice	18-0145-00		X	
7010105	Mule	11-0047-00			X
7010105	Lind	11-0367-00			X
7010105	Pug Hole	18-0209-00			X
7010105	Blue	18-0211-00			X
7010105	Goggle	18-0223-00			X
7010105	Pine	18-0261-00		X	
7010105	Little Star	18-0360-00			X
7010105	Arrowhead	18-0366-00		X	
7010106	Ray	11-0220-00			X
7010106	Sylvan	11-0304-00			X
7010106	Fawn	18-0397-00			X
7010106	Nisswa	18-0399-00			X
7010106	Buck	29-0206-00			X
7010106	Bad Axe	29-0208-00			X
7010106	Hinds	29-0249-00			X
7010108	Jessie	21-0055-00			X
7010201	Little Rock	05-0013-00		X	
7010201	Platte	18-0088-00			X
7010201	Round	49-0019-00			X
7010201	Big Spunk	73-0117-00			X

HUC8	Lake name	WID	LAT	LKW	TLC
7010201	Lower Spunk	73-0123-00			X
7010202	Zumwalde	73-0089-00			X
7010202	Cedar Island	73-0133-00			X
7010202	Long	73-0139-00			X
7010202	Horseshoe	73-0157-00			X
7010202	Little Sauk	77-0164-00		X	
7010202	Lily	77-0358-00			X
7010203	Caroline	86-0281-00			X
7010204	Rice	73-0196-00			X
7030003	Bear	09-0034-00			X
9020103	Height of Land	03-0195-00			X
9020103	Siverson	56-0180-00			X
9020103	Boedigheimer	56-0212-00			X
9020103	Fischer	56-0247-00			X
9020103	Tenter	56-0348-00			X
9020103	Graham	56-0368-00			X
9020103	East Lost	56-0378-00			X
9020103	West Lost	56-0481-00			X
9020103	Elbow	56-0514-00			X
9020103	Big Crow	56-0576-00			X
9020103	Orwell	56-0945-00			X
9020302	Myrtle	04-0304-00		X	
9020302	Sandy	04-0307-00		X	
9030001	Clove	16-0581-00		X	
9030001	Romance	16-0630-00			X
9030001	Zephyr	16-0813-00		X	
9030001	Granite Bay	16-0900-00		X	
9030001	Fish	38-0161-00		X	
9030001	Kekekabic Pond 2	38-0188-02	X		
9030001	Annie	38-0195-00		X	
9030001	Sagus	38-0225-00			X
9030001	Hatchet	38-0369-00			X
9030001	Shepo	38-0373-00			X
9030001	Alworth	38-0401-00			X
9030001	Cache	38-0477-00			X
9030001	Greenstone	38-0718-00			X
9030001	Stub	38-0781-00			X
9030001	Moosecamp	38-0816-00			X
9030001	One Pine	69-0061-00			X
9030001	Little Sletten	69-0086-00			X
9030001	East Twin	69-0174-00		X	
9030001	Thumb	69-0337-00			X
9030002	Eagles Nest #1	69-0285-01	X		

HUC8	Lake name	WID	LAT	LKW	TLC
9030005	Shannon	69-0925-00			X
9030006	Tank	31-0188-00			X
9030006	Battle	31-0197-00			X
9030006	Unnamed	31-0338-00			X
9030006	Mink	31-0455-00			X
9030006	Oar	31-0464-00			X
9030006	Aspen	31-0690-00			X
9030006	Lundeen	31-0705-00			X
9030006	Little Too Much	31-0778-00			X
9030006	Little Spring	31-0797-00			X
9030006	Dora	31-0882-00			X
9030006	Shallow Pond	31-0910-00		X	X
9030006	Hamrey	31-0911-00			X
9020302	Julia	04-0166-00	X		
9020302	Dark	04-0167-00	X		
9020302	Island	04-0265-00	X		
7010105	Norway	11-0307-00			X
7010102	Fourth	11-0465-00			X
7010104	Hamlet	18-0070-00			X
7010104	Eagle	18-0099-00			X
7010105	Trout	18-0218-00			X
7010102	Oak	29-0060-00			X
7010103	Bass	31-0115-00	X		
9030005	Bear	31-0157-00			X
7010103	Blackberry	31-0210-00	X		
7010103	Mountain Ash	31-0531-00	X		
7010103	Spider	31-0538-00			X
4010101	Hare	38-0026-00	X		
4010101	Ninemile	38-0033-00	X		
9030001	Gerund	38-0366-00	X		X
9030001	Wind	38-0642-00			X
7010104	Pine	49-0081-00			X
9020103	Leek (Trowbridge)	56-0532-00			X
7030001	Razor	58-0010-00	X		
7030001	Greigs	58-0013-00	X		
7030001	Lena	58-0018-00	X		
7030001	Tamarack	58-0024-00	X		
7030003	Sturgeon	58-0067-00	X		
9020305	Spring	60-0012-00	X		
9020301	Union	60-0217-00	X		
7020005	Linka	61-0037-00			X
9030001	Muckwa	69-0159-00	X		
9030001	Little Hustler	69-0332-00	X		

HUC8	Lake name	WID	LAT	LKW	TLC
4010201	Lower Comstock	69-0412-02			X
9030002	Black	69-0740-00	X		
4010201	St. Louis River Estuary	69-1291-00			X
4010201	Iron Chief Complex	69-1428-00	X		
7010202	Deep	73-0141-00			X
7010202	Big	73-0159-00			X