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For the Prior Lake-Spring Lake Watershed District, April 2023

Adopted by the Board of Managers April 11, 2023

Sutton Lake Management Plan





April 2023

Cover Image

Trumpeter Swans on Sutton Lake - April, 2019

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1. INTRODUCTION

Sutton Lake is a shallow lake (max depth 3 feet) at the headwaters of the Ditch 13 channel that drains a portion of the Prior Lake-Spring Lake watershed. A low diversity, high density aquatic plant community dominates the open water portion of the lake. The emergent fringe is dominated by a vast floating mat of invasive cattail. Though the lake is in a clear water state, limited monitoring data suggests high internal loading with downstream impacts.

A controlled outlet structure was installed at Sutton Lake in 2021 with the intent of providing flood storage benefit while allowing for habitat enhancement. The outlet is currently maintained at 939.0 feet and has capacity for drawdown to 937.0 feet. Drawdown is currently not included in the Public Waters Work Permit (2018-3741). This management plan develops a framework for active management at Sutton Lake for the purpose of habitat enhancement, with secondary benefits that may include flood storage. This plan includes a review of general lake information, plant community, wildlife habitat, and water quality of Sutton Lake, and sets goals and objectives for lake management. Plan development included multiple meetings and reviews with riparian landowners, DNR, and the PLSLWD Board (Table 1).

Table 1. Project consultation and review

Date	Activity
2/15/22	DNR Meeting 1
3/1/22	Landowner Meeting 1
3/17/22	DNR Meeting 2
5/10/22	Board Workshop 1: Project Introduction
6/14/22	Board Workshop 2: Status Update
7/14/22	DNR Meeting 3
10/11/22	Board Workshop 3: Status Update
11/2/22	Draft LMP sent to DNR for Review & Comment
11/15/22	Board Workshop 4: Draft LMP
11/16/22	Landowner Meeting 2
2/24/23	Final Comments Received from DNR

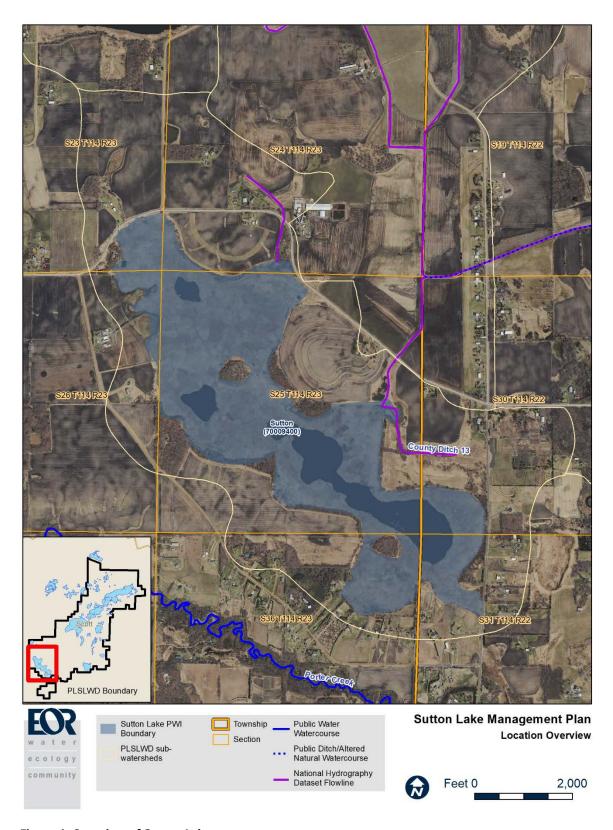


Figure 1. Overview of Sutton Lake

2. GENERAL LAKE INFORMATION

2.1. Location

Sutton Lake is located approximately 6.5 miles southwest of the City of Prior Lake, Scott County, Minnesota (Figure 1). The legal description is T114N, R22/23W, Sections 23, 24, 25, 26, 30, 31, 36.

2.2. Lake Dimensions

Sutton Lake is a public water basin approximately 490 acres in size with an open water area of approximately 64 acres. The remaining area is dominated by an emergent wetland fringe, primarily comprised of a floating mat. The maximum depth is 3 feet. Bathymetry transects beneath the floating mat suggest over 2 feet of free water is common beneath the mat consistent with the lake bottom across the open water portion of the lake (Figure 2).

2.3. Shoreline

The shoreline around the perimeter of the entire basin is 7.2 miles.

2.4. Access

No public boat access exists for Sutton Lake. The basin is entirely surrounded by private property with the exception of public roads.

2.5. Watershed

Sutton Lake's watershed encompasses 1,379 acres. The watershed to lake ratio is 2.8:1. Downstream of the lake, drainage is northeast to County Ditch 13, and then into Spring Lake and Prior Lake.

2.6. Inlets

There are no significant inlets to the basin, primary inflow is via overland flow from the surrounding upland.

2.7. Land Use

Land use in Sutton Lake's watershed is primarily row crop agriculture with hay/pasture, low-density residential, forest, and wetland.

2.8. Outlet

The outlet from Sutton Lake is located in the wetland complex along the east-central shoreline of Sutton Lake (as defined by the public water boundary). A controlled outlet structure was installed at Sutton Lake in 2021. The structure consists of two 10" storm sewer inlets with Clemson Levelers at 936.0, a 48" diameter storm manhole with stop logs, and a 24" outlet at 937.0. There are eight 6-inch PVC stop logs within the structure. The top of the stop logs are at 939.0. The bottom of the stop logs are at 935.0. All elevations are in NAVD 88 unless otherwise noted.

2.9. Runout Elevation

During normal operation, all eight stop logs remain in place to manage base-flow at 939.0 (same elevation as runout elevation prior to constructed outlet).

2.10. Ordinary High Water Level (OHWL)

The lake's OHWL is 940.5 feet (NGVD 29).

2.11. DNR Shoreland Management Classification

Sutton Lake is classified as a natural environment lake.

2.12. Historical Imagery

Historical aerial imagery is provided in Appendix A. The extent of open water and emergent fringe appears to have been relatively stable dating back to 1937.

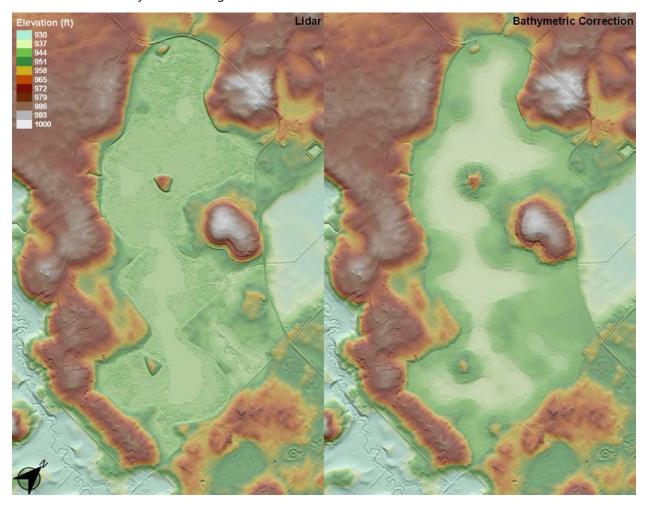


Figure 2. Left image is Lidar-derived digital elevation model (DEM). Right image is the corrected DEM with surveyed bathymetry data from open water areas and beneath the floating mat. Comparison of these two images illustrates the large area of cattail mat that is floating and the large volume of free water beneath the mat.

3. PLANT COMMUNITY

3.1. Existing Vegetation

The plant communities of Sutton Lake primarily consist of shallow open water communities in the center of the basin with a large emergent fringe of floating shallow marsh and small areas of wet meadow.

3.1.1. Shallow Open Water

The shallow open water community is dominated by dense cover of aquatic vegetation (~100% cover), primarily coontail (*Ceratophyllum demersum*) and white water lily (*Nymphaea odorata*) (Appendix B). The floristic quality index (FQI) for the plant community is 16.3 which is below the ecoregion average of 23.7±8 and median of 22.5 (Table 2; Radomski and Perleberg, 2012). That said, the score is within the standard deviation and diversity might be considered moderate for a basin of such small size. Floating mud mats provide habitat for emergent species like bur-marigold (*Bidens cernua*) and wild rice (*Zizania palustris*). The wild rice was likely planted and is not abundant. The dense aquatic plant community is likely helping maintain the lake in a clear water state. No invasive aquatic plants were observed in shallow open water.

Table 2. FQI of Sutton Lake based on 2018 survey by Blue Water Science. Calculations performed by EOR.

Common Name	Scientific Name	C- Value
Bur marigold	Bidens cernua	3
Coontail	Ceratophyllum demersum	2
Flat-stem pondweed	Potamogeton zosteriformis	6
Unknown bladderwort*	Utricularia sp.	8
Unknown duckweed**	Lemna sp.	5
Star duckweed	Lemna trisulca	5
White water lily	Nymphaea odorata	6
Wild rice	Zizania palustris	8
Yellow pond lily	Nuphar lutea ssp. variegata	6
Summary Table FQI = C*VS	Average C-Value	5.4
C= Mean coefficient of conservatism value	Number of species	9
S= Number of species in sample	FQI	16.3

^{*} C-value assigned by EOR based on Utricularia intermedia.

3.1.2. Emergent Fringe

The emergent fringe was surveyed as part of the Sutton Lake Natural Resource Inventory (Appendix C). The emergent fringe largely consists of low-diversity floating shallow marsh dominated by invasive/hybrid cattail (*Typha* x *glauca/Typha* angustifolia) (Figure 3). Pockets of floating sedge meadow with higher species diversity are scattered throughout and are threatened by cattail invasion. Based on Google Earth aerial imagery, cattail has expanded significantly at Sutton Lake since 1992. The sedge meadow pockets are likely representative of historical conditions prior to cattail invasion.

^{**} C-value assigned by EOR based on Lemna minor.

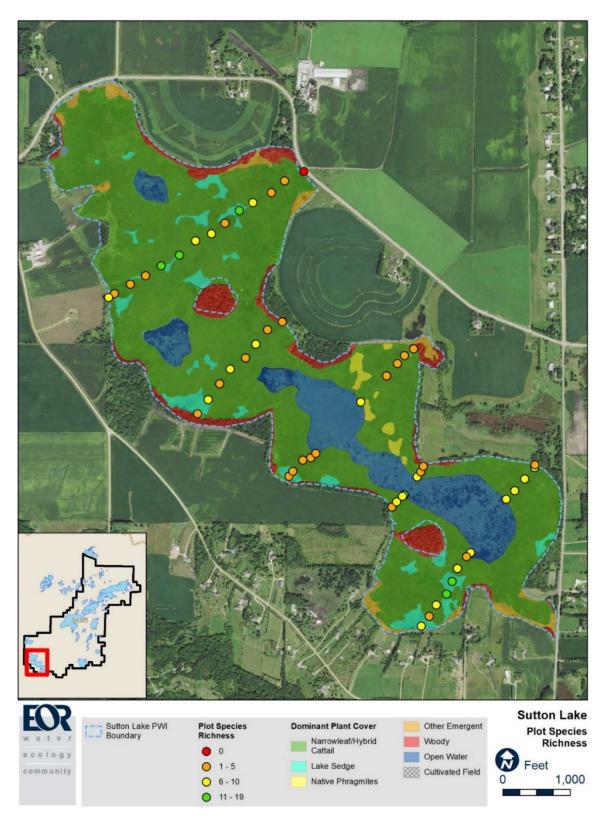


Figure 3. Vegetation sample plot locations from 2019 survey by EOR, with species richness for each plot.

3.2. Seed Bank

EOR used surface sediment cores to investigate the seed bank of Sutton Lake within both open water and shallow marsh plant communities (Appendix C). In general, seeds of submerged species were most abundant in cores from open water locations and seeds of emergent species were most abundant in cores from shallow marsh locations. Results also indicated that cattail propagules are abundant in both open water and shallow marsh sediments. Abundant propagules of native submerged plants muskgrass (*Chara* sp.) and naiad (*Najas* sp.) were observed in the seed bank. Although both these species produce many propagules and therefore are often common in seed banks, their presence is notable as they have not been observed in the existing open water plant community.

4. WILDLIFE HABITAT AND USE

Wildlife habitat at Sutton Lake primarily consists of shallow lake and cattail marsh. Shallow lakes provided excellent habitat for zooplankton, insects, waterfowl and other wildlife. They serve as especially important breeding areas for waterfowl and other waterbirds. Dense cattail marshes serve as important habitat for a few species such as the least bittern. However, the large dense monocultures present at Sutton Lake generally are poor habitat, as even species reliant on dense emergent cover require a more varied habitat structure not present in cattail stands (Bansal et al. 2019). Other species that benefit from dense cattail include ring-necked pheasant, muskrat and white-tailed deer.

A wildlife assessment was completed by EOR consisting of a fall 2019 and spring 2020 avian survey and incidental wildlife observations completed during all field work related to the natural resource inventory (Appendix C). EOR observed a total of 32 bird species, including one Species in Greatest Conservation Need (SGCN), the trumpeter swan. The survey also detected two frog species (leopard frog and wood frog) and two abundant invertebrate taxa (amphipods and dragonfly larvae). Anecdotal sightings by area landowners included trumpeter swan, scaup, blue-winged teal, and hooded merganser among other common bird and mammal species.

A search of the DNR Natural Heritage Information System (NHIS) database detected one rare species occurring within a 1-mile buffer of Sutton Lake. The species is a jumping spider designated as special concern. According to the DNR, insufficient information is available to make specific management recommendations for this species. The jumping spider is typically found in prairie and savanna habitat, neither of which are present nor immediately adjacent to Sutton Lake basin.

5. WATER QUALITY

Lakes are considered shallow when most (>80%) of the lake area is less than 15 feet deep. Maximum depth at Sutton Lake is 3 feet and the water is classified as a shallow lake. A summary of shallow lake ecology and implications for water quality is provided in Appendix D.

5.1. Water Quality Data

5.1.1. 2020

Water quality data at Sutton Lake was collected in 2020 by Citizen-Assisted Monitoring Program (CAMP) volunteers. Extremely high total phosphorus (TP) concentrations were observed, well above the 60 µg/L TP concentration standard for lakes in the North Central Hardwood Forest (NCHF) ecoregion. Further, chlorophyll-a (measurement of algae growth) concentrations far exceeded the 20 µg/L Chlorophyll-a standard (Figure 4). This information would seem to suggest that Sutton Lake is not in the ecologically preferred, clear water state. However, observers noted the physical condition of the water column as being crystal clear in four of the seven sampling events, with "some algae present" during three of the sampling events (Figure 5). This finding, coupled with the results from the 2018 aquatic plant survey, which found aquatic plants present at 100% of sampling locations, would suggest that aquatic plants are helping to maintain the preferred clear water state. Field observations by EOR during the 2019 natural resources inventory also suggest Sutton Lake is in a clear water state. Water quality data obtained in 2020 was likely to have been improperly collected.

5.1.2. 2021

Water quality data at Sutton Lake was collected in 2021 by District staff in May and June. Elevated but reasonable TP concentrations were observed (Figure 6). Only two of the five samples were within the growing season of June through September. Both of the TP concentrations were above the shallow lake water quality standard, however, the chlorophyll-a concentrations were at or below the standard and the Secchi depth was uncertain. All the Secchi depth data were noted as being obstructed by dense vegetation. With uncertainty surrounding the response variables the state of the lake (i.e. turbid vs. clear) remains uncertain. More chlorophyll-a sampling (a measure of how much algae is present) is needed to determine the overall health of the lake with respect to water quality. Given the lake is so shallow, it is also recommended that Secchi disk measurements be substituted with physical, qualitative descriptions of the water column (e.g., clear, turbid, stained, etc.) to validate that the lake remains in the ecologically preferred, clear-water state.

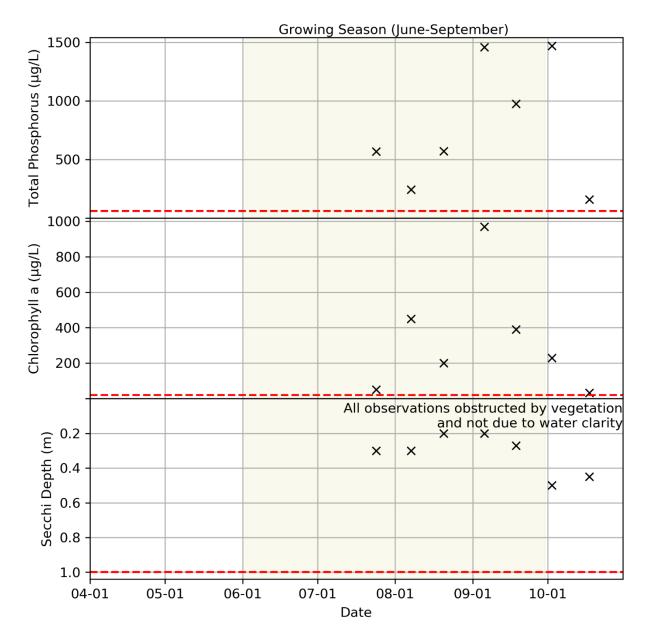


Figure 4. Sutton Lake 2020 Lake water quality observations. Red dashed lines are the water quality standards for shallow lakes in the North Central Hardwoods Ecoregion.

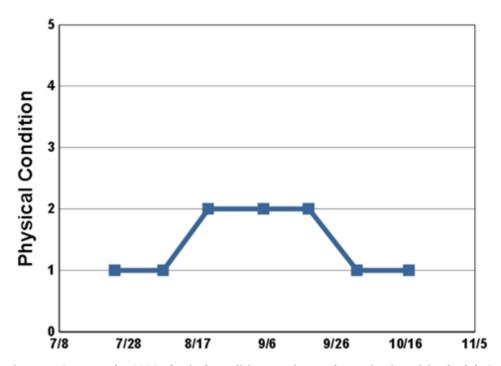


Figure 5. Sutton Lake 2020 physical condition. During each monitoring visit, the lake's physical condition, and was ranked on a 1-to-5 scale. 1 = Crystal Clear, 2 = Some Algae Present, 3 = Definite Algal Presence, 4 = High Algal Color, 5 = Severe Algal Bloom.

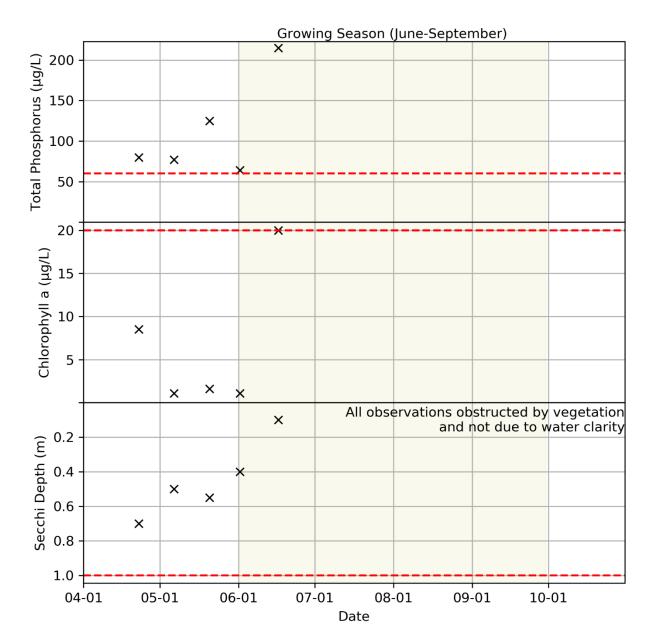


Figure 6. Sutton Lake 2021 Lake water quality observations. Red dashed lines are the water quality standards for shallow lakes in the North Central Hardwoods Ecoregion.

6. MANAGEMENT APPROACH

The management plan relies on adaptive management to achieve goals and objectives. Adaptive management is an iterative approach of implementation, evaluation, and course corrections that allows for implementation to proceed while accounting for uncertainty. The following sections outline the goals, critical permitting considerations, and the objectives to achieve the goals.

6.1. Goals

Goal: Enhance plant communities and wildlife habitat

Aquatic plant surveys conducted in 2018 found only four species of submerged aquatic plants in Sutton Lake. Additionally, the Sutton Lake Natural Resource Inventory (Appendix C) documented that the emergent vegetation along the fringe of Sutton Lake is currently dominated by a dense floating mat of invasive cattail. Invasive cattail reduces plant diversity and structural complexity that provides preferred habitat for a variety of breeding birds, pollinators, aquatic invertebrates, and other wildlife.

Desired Future Conditions:

Establishing desired future conditions helps set targets for management. Desired future conditions at Sutton Lake include.

- Increased frequency of occurrence and average density of native emergent plant species, specifically wild rice and bulrush, in the open water area of Sutton Lake.
- Submerged aquatic plant species richness increased from 4 to 6.
- Reduced density of invasive cattail in the floating mat.

6.1.1. Secondary Benefits

Secondary benefits are not goals of the lake management plan, but may provide other watershed benefits coinciding with habitat management. Realization of secondary benefits may be variable and subject to specific management actions and environmental conditions (e.g. climate).

Improve upper watershed storage capacity

Hydrologic and hydraulic modeling identified the Sutton Lake Outlet Retrofit Project as having relatively high flood damage reduction potential with relatively low implementation cost. The new controlled outlet constructed in 2021 is already providing significant flood reduction benefit. The structure provides approximately 0.35-feet of flood reduction on Prior Lake for the 100-yr, 30-day storm event through passive management alone (no drawdown). Drawdown under specific and infrequent conditions could provide an additional 0.15-feet of flood reduction. These infrequent conditions are when a winter drawdown is conducted for vegetation management purposes and there is large snow melt the following spring. Any proposed drawdown at Sutton Lake would be implemented based on achieving habitat enhancement goals, but drawdown could also have benefits for flood storage.

6.2. Permitting Considerations

Implementing the lake management plan will require multiple ongoing permits and significant coordination with DNR and riparian landowners. Cattail management within a public water requires a DNR Aquatic Plant Management (APM) permit. Each drawdown for vegetation management would require a DNR Public Waters permit amendment request. Each of these processes as well as other permits are described below.

6.2.1. DNR Aquatic Plant Management Permit

An APM permit is required from DNR to remove cattails at Sutton Lake. Specific permit requirements are subject to coordination and project review with DNR APM staff. Initial consultation with APM staff indicated that herbicide use is prohibited for natural environment lakes and would require justification for a permit variance. Cattail removal may be permitted using mechanical or physical methods such as floating mat removal, aboveground cutting, or burning. Up to 50% of the littoral area may be treated using mechanical methods (245 acres at Sutton Lake). Riparian landowners may request that control not occur adjacent to their properties (meaning within 150 feet of their shoreline).

6.2.2. DNR Public Waters Work Permit

Each lake drawdown would require a DNR permit amendment request of the existing permit for the Sutton Lake outlet structure.

The need for DNR permit amendments prior to drawdown is integrated into the adaptive management decision matrix (Figure 7). Amendment requests prior to each drawdown would require:

- Approval from DNR staff supporting that drawdown would benefit the ecology of Sutton Lake
- 75% riparian landowner permission
- Public hearing

Conditions of the permit amendment for drawdown are in addition to the frequency and duration constraints on drawdown outlined in Objective 2.

6.2.3. Other Permits

Burn permits from local authorities would be needed for any prescribed burn activity. If physical removal offsite is considered, no material should be placed in wetlands or other aquatic environments and disposal should adhere to local regulations.

6.3. Objectives

Two objectives were established to address the goals.

Objective 1: A) Assess effects of 2021/22 natural low water levels; B) if DNR permit amendment is approved and drawdown is supported by adaptive management, conduct a periodic winter drawdown (~September-March) to enhance the aquatic plant community

Historically, shallow lakes intermittently experienced droughts that would lower water levels and expose sediments. A warmer and wetter climate in recent decades has resulted in higher water levels in shallow lakes with fewer natural drawdowns (Hansel-Welch 2020). Hydrologic stabilization has also been identified as a driver of cattail invasion in the Laurentian Great Lakes Region and Prairie Pothole Region (Bansal et al. 2019).

Periodic winter drawdown may enhance the submerged aquatic plant community. Drawdown consolidates sediments and stimulates aquatic plant seed banks. Following winter drawdown, aquatic plant diversity would be expected to increase at Sutton Lake. For example, abundant seeds of two aquatic plants, slender naiad and muskgrass, are present in the Sutton Lake seed bank but not observed in the existing plant community (Appendix C: Sutton Lake Natural Resource Inventory). These two species are well-adapted to drawdown and provide good waterfowl forage (Turner et al. 2005, Wagner and Falter 2002, Knapton and Petrie 1999). A desired outcome of drawdown management would be the presence of these two species, which would increase submerged aquatic species richness at Sutton Lake from 4 to 6. Based on DNR comments, winter drawdown may freeze rhizomes of white water lily. Reduction of water lily density via freezing could open niches for other plant species. DNR comment also suggested the most benefit to submerged aquatic vegetation would be realized by extending drawdown into the early growing season. Proposed drawdowns at Sutton Lake could consider extending the drawdown into early summer. However, this scenario would require additional consultation with DNR staff to ensure impacts to nesting birds are avoided.

A secondary benefit of ~September to March drawdown is increased flood storage under specific and infrequent conditions. In years that drawdown occurs for vegetation management, the flood storage on Sutton Lake would be temporarily increased. If an event similar to the 2014 flood were to occur while Sutton Lake was drawn down, the additional downstream flood reduction benefit on Prior Lake would be a 0.13-feet reduction in high water elevation (for the 100-year, 30-day event). Note that environmental conditions where this benefit would be realized are uncommon. Drawdowns for vegetation management would need to coincide with large snow melts the following spring.

As described in Section 6.2, drawdowns are not permitted under the existing DNR permit. Any drawdown would require a DNR permit amendment request. DNR indicated drawdown could be a beneficial management practice based on review of the draft version of this lake management plan. However, any proposed drawdown would be subject to additional review.

Understanding the effects of drawdown at Sutton Lake would inform adaptive management and determine if it is a beneficial management strategy to pursue. Drought during 2021 and 2022 caused naturally low water levels at Sutton Lake. Landowners reported that by late summer, much of the open water areas of Sutton Lake were exposed mudflat. The extent and duration of the drawdown was not documented at the

time, but a logger was installed at the outlet recording water elevation data. The drought conditions may have been similar to proposed conditions under periodic drawdown management. Therefore, a better understanding of drought conditions and the subsequent response of vegetation, water quality, and other parameters would be useful for guiding the lake management plan. Results from this objective would be integrated into adaptive management.

Assessment of drought conditions would include analysis of 2021 and 2022 level logger and climate data to assess lake elevations and time to drawdown/refill along with a review of aerial imagery. Assessment of vegetation response would include aquatic plant point-intercept surveys one, three, and six years following drawdown. Point-intercept surveys should also include qualitative observations of floating mud flats, sediment consolidation, water levels, and floating mat condition (i.e. Is mat breaking up or losing buoyancy in response? Has it rooted?). Additionally, drone footage and aerial imagery of the open water areas should be obtained annually, or at least in concurrent years with point-intercept surveys. Aerial imagery from drone footage helps quantify areal cover of dominant vegetation and surface water. Drone footage vegetation signatures should be ground-truthed at least once to confirm dominant vegetation; further ground-truthing could be needed if new vegetation signatures are identified. Drone footage will help document expansion or colonization of invasive cattail and/or native species, and is especially important should environmental conditions prohibit access for point-intercept surveys. Ideally, two drone flights would be completed: once during mid-late summer to capture white water lily growth and once during the fall for direct comparison with vegetation signatures and open water extent documented by a drone flight in fall 2022. Finally, annual water quality monitoring should continue at Sutton Lake to assess potential effects of low-water conditions. Survey data and observations should be compared relative to the goals and desired future conditions stated in Section 6.1. Progress toward goals should be assessed after 5 years to determine if managed drawdown could benefit the lake.

Drawdown would only be implemented under conditions that support management goals to enhance the plant community and wildlife habitat. Though drawdowns replicate a natural disturbance for shallow lakes, they are a significant disturbance and need to be managed carefully according to specific management goals. In addition to DNR permitting constraints, the following guidelines would be applied at Sutton Lake to dictate if drawdown management is appropriate in a given year.

- Drawdowns would strive to mimic natural patterns of winter drought that historically occurred in shallow lakes.
- Drawdown would be conducted not more than once every 4 years.
- Timing of drawdown would adhere to MNDNR Wetland Management Minutes #17 and #18 for avoiding impacts to reptiles and amphibians (Appendix E).
 - o Drawdowns should reach their lowest level by September 15 and should stay dewatered through at least December 1.

Objective 2: Reduce monotypic-dominated cattail mat to enhance habitat.

Intensive management to reduce the cattail mat would enhance habitat for waterfowl and shorebirds. The fringe of Sutton Lake is dominated by a dense floating mat of invasive cattail with low plant diversity. The habitat value of invasive cattail is low compared to other emergent and open water wetland types or a more even mix of emergent vegetation and open water (Bansal et al. 2019). Waterbird and shorebird habitat in particular would be enhanced by restoration to emergent or shallow open water plant communities and a more even mix of emergent and open water habitat.

At this time, there do not appear to be any feasible management strategies to actively manage for Objective 2. Permitting and site access constraints restrict strategies at Sutton Lake. However, reduction of the cattail mat remains a worthwhile objective to consider for future management at Sutton Lake should constraints change or new strategies emerge. Existing cattail management strategies and their applicability to Sutton Lake are discussed below. Multiple years of treatment would likely be required with any management strategy, and combinations of management strategies should be considered.

Chemical control: Chemical treatment of cattails with herbicide can be effective as a standalone treatment or when combined with other management strategies such as cutting, burning, and flooding. Typical herbicides include aquatic-safe 2, 4-D, glyphosate, imazapyr, and imazamox (Bansal et al. 2019). All of these herbicides are considered non-selective, meaning they will kill or damage all plants. However, imazamox at low rates can achieve selective control. Chemical can be drone-applied and such application is likely the most cost-effective means of management at Sutton Lake. A 2022 contractor estimate for a 10-acre treatment area at Sutton Lake was \$4,000.

Disadvantages of herbicide include potential non-target species damage and elevated soil phosphorus (Bansal et al. 2019). Using imazamox at low rates and avoiding remnant sedge patches via drone application would help avoid non-target impacts. Increased phosphorus would likely be temporary or minimal based on the relatively small scale of a 10-acre proposed treatment and assuming the treatment area becomes vegetated.

Chemical treatment of cattail is prohibited by DNR at Sutton Lake due to its classification as a natural environment lake. An APM permit variance would be required to apply herbicide. Initial consultation with DNR APM staff indicated that other strategies would need to be attempted prior to discussion of a variance request.

Cutting and/or prescribed fire: Cutting (mowing or other methods) and prescribed burning are both methods that remove cattail biomass. Short-term reductions in cattail cover can be achieved, but effects to the belowground plant structures are limited. Neither cutting nor prescribed burning are viable long-term treatments on their own, but may be effective if combined with flooding or chemical treatment.

Cutting in fall followed by flooding in spring is a common approach to cattail control, but is challenging at Sutton Lake due to the floating mat. Accessibility for equipment to cut cattail on a floating mat is not possible without highly specialized equipment, and mat buoyancy likely prevents flooding. If cutting were possible, this strategy may boost effectiveness of chemical treatments by reducing standing biomass and allowing for better herbicide application to cattail re-sprouts. Equipment that shreds or

crushes cattail is preferable so that thickness of the litter layer is reduced and decomposition is accelerated.

Prescribed fire provides similar benefits to cutting with the added benefit of removing litter. Removal of dense litter may allow for better herbicide application and opens up light for the native seed bank. Additional light may also facilitate re-invasion by cattail given their abundance in the seed bank. Prescribed burns at Sutton Lake would likely be extremely challenging based on consultation with burn professionals.

Nutrients are tied up within cattail biomass. If cattail are cut, biomass could be removed from the lake. Removal of the biomass would potentially harvest phosphorus and provide water quality benefit, but biomass removal and disposal are typically expensive. Costs would likely be less than floating mat removal (see below), but many of the same costly equipment and disposal challenges would be similar. Conversely, both cutting and prescribed fire could cause pulses in bioavailable phosphorous, but impacts would likely be temporary (Liu et al. 2010).

Flooding: As discussed above, flooding cattail in combination with other methods is an effective treatment in most situations but is a limited strategy at Sutton Lake due to the buoyancy of the floating mat. Floating mat buoyancy is primarily driven by cattail rhizomes and cattail mats are at their least buoyant during early spring (Hogg and Wein 1988). Methane production under anoxic conditions also contributes to floating mat buoyancy to a lesser extent and would be at lowest production outside of the growing season (Azza et al. 2006). Drawdown could also reduce anoxic conditions conducive to methane production. Though spring conditions would provide the best opportunity for flooding cattail, it is unknown if the mat would flood sufficiently to reduce the cattail mat. Additional coordination with landowners may be needed prior to any flooding attempts.

Mechanical removal of the floating mat: This approach would use specialized equipment to cut, harvest, and remove the floating mat. Mechanical removal is a reliable technique to remove floating mats and cattail management. This technique has been used at several locations in Minnesota, such as at Voyageurs National Park and wild rice lakes managed by the Fond du Lac Band. Advantages of mechanical removal include complete removal of cattail mat, which would create additional open water area. Removal of the mat would also remove phosphorous tied up within the mat and cattail biomass.

Disadvantages primarily include high costs per acre associated with equipment and disposal. A 2022 contractor estimate for a 10-acre treatment area at Sutton Lake was \$220,000. There are also potential water quality impacts. The mechanical removal process carries some risk of disturbing bottom substrate and re-suspending phosphorous-containing sediment. Based on DNR comments, Sutton Lake would be inaccessible to the equipment necessary for mechanical removal.

The removal of the floating mat would represent a deviation from the historical condition of Sutton Lake dating back to 1937. The mat was likely dominated in the past by a floating sedge mat, remnants of which are still present scattered throughout the basin. Sedge mat remnants should be preserved.

Native plant revegetation: Poor colonization of native vegetation and subsequent reinvasion of cattail is a risk following cattail removal. Native plant revegetation would establish plants to compete with cattail if the native seed bank is not sufficient. Potential outcomes of cattail management where

revegetation might be necessary include a partially denuded mat following chemical treatment. Ideally, the mat would break up or sink under these conditions. Alternatively, the mat could remain relatively intact. If the mat remains intact and native vegetation does not establish naturally, cattail could reinvade the mat due to the dominance of cattail in the remnant seed bank and surrounding wetland (Appendix C). Results should be monitored and overseeding into the mat should be considered under adaptive management.

Summary of strategies and constraints:

- Chemical application provides the best combination of effectiveness and feasibility, but is prohibited by APM in natural environment lakes.
- Cutting and prescribed fire could be effective, especially in combination with other strategies, but are prohibited by access constraints and environmental conditions.
- Flooding is unlikely to be effective due to floating mat buoyancy.
- Mechanical removal would be effective, but is not feasible due to site constraints (shallow, unconsolidated bottom) that restrict equipment from accessing the lake. Additionally, mechanical removal is prohibited by high costs associated with equipment and biomass disposal.
- Native plant revegetation is a complementary tool, and would not be used as a standalone strategy.

Recommendation: Re-assess feasibility of cattail management if managed drawdown is determined to not be a viable option to achieve LMP goals after 5 years of monitoring the effects of the 2021/22 natural low water levels.

6.4. Adaptive Management at Sutton Lake

The implementation strategies, including recommended timelines and best management practices, provided in this lake management plan are the result of watershed and hydrologic/hydraulic modeling efforts, the latest science regarding lake management and aquatic plant management, and professional judgment. Multiple meetings and reviews were also completed with riparian landowners and DNR staff (Table 1). The proposed actions outlined are subject to adaptive management—an iterative approach of implementation, evaluation, and course correction that allows for implementation to proceed while accounting for uncertainty. The management approach to achieving the goals and objectives should be adapted as new monitoring data is collected and evaluated. Continued monitoring will inform and prioritize specific actions responding to hydrological, biological, and water quality monitoring conditions both within Sutton Lake and further downstream in the watershed. Management activities will be changed or refined to efficiently meet goals and objectives as identified in Sections 6.1 and 6.3. An adaptive management decision matrix is provided for Sutton Lake in Figure 7.

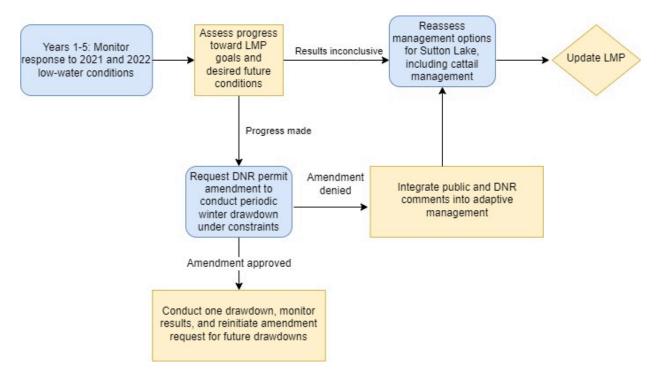


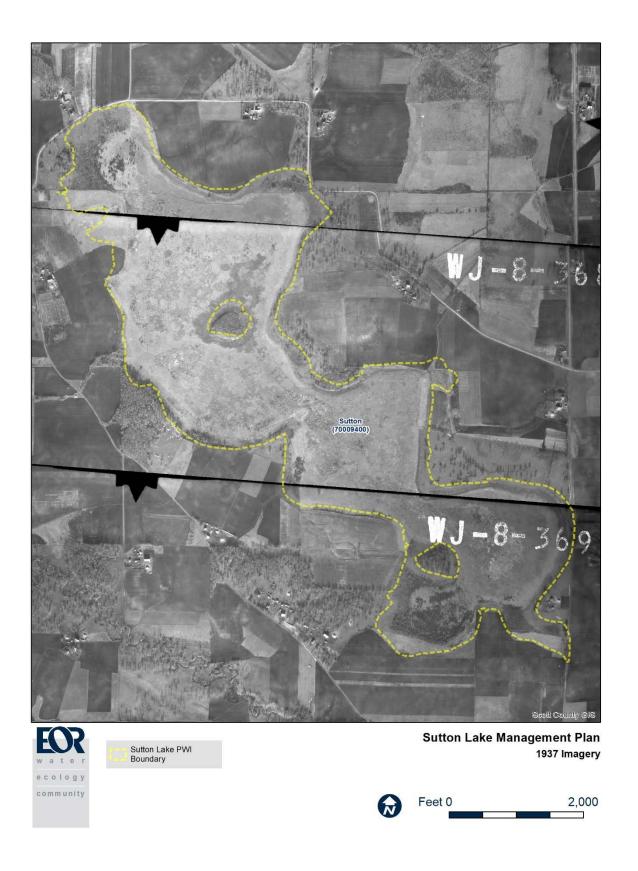
Figure 7. Sutton Lake Adaptive Management and Permitting Decision Matrix.

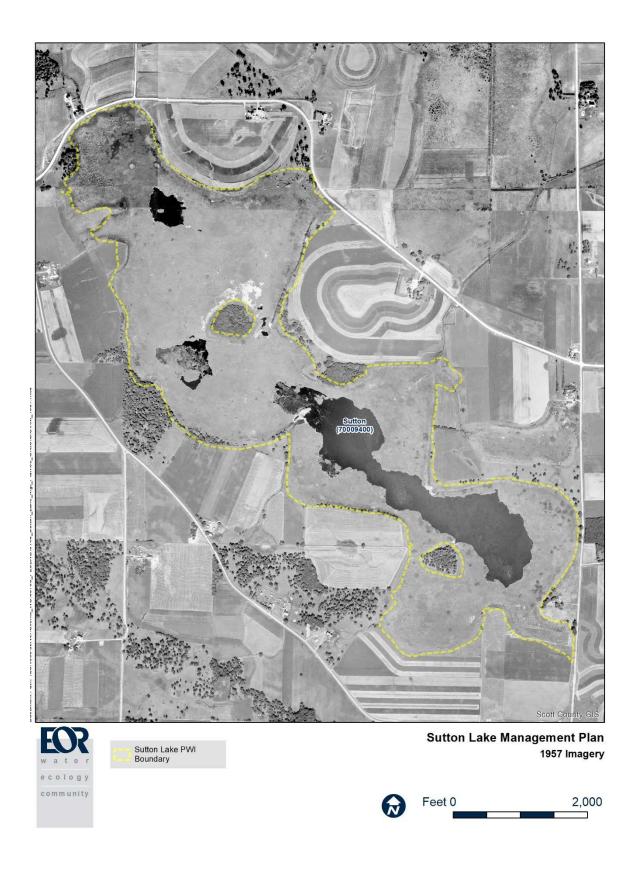
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APPENDIX A: HISTORICAL AERIAL IMAGERY











APPENDIX B: 2018 SUTTON LAKE AQUATIC PLANT SURVEY



Water Lilies were Abundant in Sutton Lake, September 2018

Aquatic Plant Point Intercept Survey for Sutton Lake, Scott County, Minnesota, 2018

Point Intercept Survey: September 11, 2018

Prepared for:

Prior Lake-Spring Lake Watershed District



Prepared by: Steve McComas Jo Stuckert Blue Water Science St. Paul, MN 55116

February 2019

Aquatic Plant Point Intercept Survey for Sutton Lake, Scott County, Minnesota in 2018

Summary

On September 11, 2018, a summer point intercept survey was conducted on Sutton Lake, Scott County. The most common submerged aquatic plant was coontail (Figure S1). Plant growth was found to a depth of 3 feet which is about the maximum depth in Sutton Lake The aquatic plant community in 2018 had 4 species of submerged plants, 3 floatingleaf species, and 2 emergent species which is a moderate plant diversity condition for a lake in this ecoregion setting.

No non-native submerged aquatic plants were found in the September 11, 2018 survey on Sutton Lake. Plant coverage was roughly 100% of the lake bottom. Maps of aquatic plant distribution are shown in Figure S2.



Figure S1. An Old Duck Blind out in Sutton Lake, September 2018



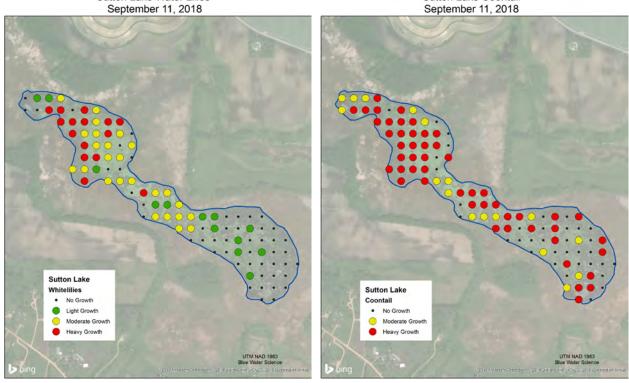


Figure S2. [top-left] Bur-marigold, an emergent rare plant in Minnesota was found in Sutton Lake on September 11, 2018. [top-right] Wild rice was found in a few locations in Sutton Lake on September 11, 2018. [bottom-left] White water lilies were abundant in Sutton Lake on September 11, 2018. [bottom-right] Coontail was the most abundance submerged plant in Sutton Lake on September 11, 2018. Key: green = light growth, yellow = moderate growth, and red = heavy growth.

Aquatic Plant Point Intercept Survey for Sutton Lake, Scott County, Minnesota, 2018

Lake ID: 70-009400

Size: 64 acres

Littoral area: 64 acres Maximum depth: 3 ft

Introduction

Sutton Lake is located within in Scott County. An aquatic plant point intercept survey was conducted on the 64-acre lake on September 11, 2018. A sampling grid is shown in Figure 1.

Sutton Lake 50m Grid 102Pts



Figure 1. Sample locations for the point-intercept aquatic plant survey.

Sutton Lake: 2018

Methods - Aquatic Plant Point Intercept Survey

Point Intercept Survey: An aquatic plant survey of Sutton Lake using a point intercept sampling method was conducted by Blue Water Science on September 11, 2018. A map and sampling grid were prepared by Blue Water Science and a consisted of a total of 102 points that were distributed throughout the lake (Figure 1). Points were spaced 50 meters apart and each point represented about 0.6 acres. At each sample point, plants were sampled with a fixed-head rake sampler and were sampled to depth of 3 feet. A plant density rating was assigned to each plant species on a scale from 1 to 3 (Figure 2). A density of a "1" indicated sparse growth and a "3" rating indicated heavy plant growth (Figure 2).

Chart of Aquatic Plant Density Ratings







Figure 2. Aquatic plant density ratings from 1 to 3.

Sutton Lake: 2018

Point Intercept Survey -- September 11, 2018

Aquatic plants were abundant in Sutton Lake for the September 2018 point intercept plant survey. Coontail was the dominant plant in Sutton Lake. Bur-marigold, which is relatively rare in lakes, was found in Sutton Lake as well (Figure 3). A total of 4 submerged aquatic plants, 3 floatingleaf plants, and 2 emergent plants were identified (Figure 4 and Table 1).

A summary of plant density and occurrence is shown in Table 1. Maps of the distribution of 4 selected plant species are shown in Figure 4.

Table 1. Sutton Lake aquatic plant occurrences and densities for the September 11, 2018 surv ey based on 102 sites in water depths from 0 to 3 feet. Density ratings are 1-3 with 1 being low and 3 being most dense.

	All	Stations (n=10	02)
	Occurrence	% Occur	Density
Emergents			
Wild rice (Zizania aquatica)	4	4	1.0
Bur-marigold (Bidens cernua)	12	12	1.7
Floatingleafs			
Duckweed (Lemna sp)	6	6	1.0
Spatterdock (Nuphar variegata)	11	11	1.4
White water lilies (Nymphaea odorata)	53	52	2.0
Submergents			
Coontail (Ceratophyllum demersum)	67	66	2.7
Star duckweed (Lemna trisulca)	8	8	1.0
Flatstem pondweed (Potamogeton zosteriformis)	1	1	1.0
Bladderwort (Utricularia sp)	1	1	1.0
Number of submerged species	4		



Figure 3. Bur-marigold in Sutton Lake in September 2018.

Sutton Lake: 2018

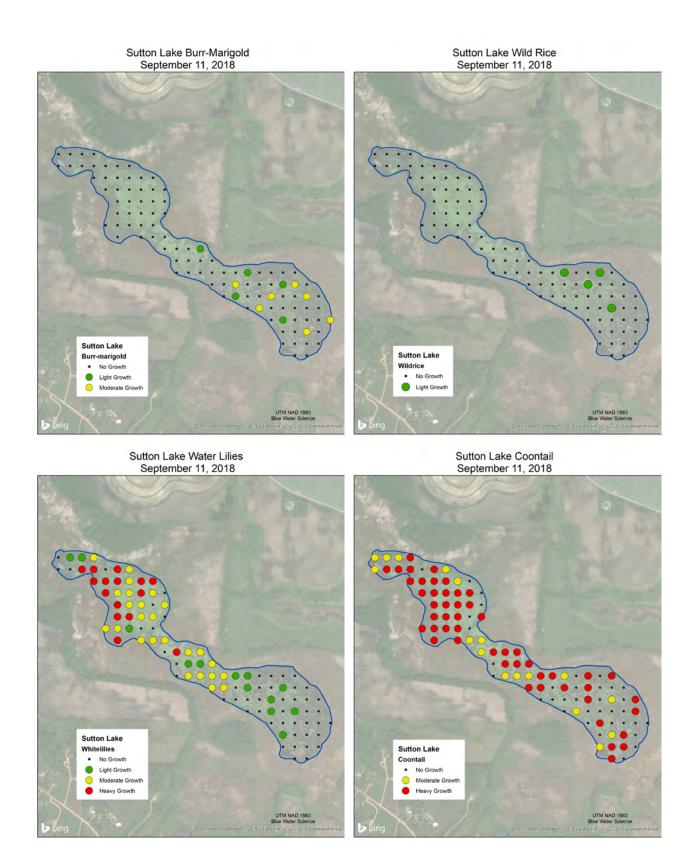


Figure 4. Distribution and abundance maps for September 11, 2018. [top-left] Bur-marigold. [top-right] Wild rice. [bottom-left] White water lilies. [bottom-right] Coontail. Key: green = light growth, yellow = moderate growth, and red = heavy growth.

Sutton Lake: 2018

Sutton Lake Point Intercept Survey Statistics

A summary of plant statistics from the point intercept survey is shown in Tables 2 and 3 and Figure 5. A total of 102 points were sampled. Plant occurrence and abundance for individual sites are shown in Table 4.

Table 2. MnDNR Template Statistics

Total # Points Sampled	102
Depth Range of Vegetation	1-3 feet
Maximum Depth of Growth (95%) in feet	3.0
# Points in Max Depth Range	102
# Points in Littoral Zone (0-15 feet)	102
% Points w/Submersed Native Taxa	69
Mean Native Submersed Taxa/Point	0.8
Mean Density of Native Submersed Taxa	1.4
# Submersed Native Taxa	4

Table 3. Aquatic plants sampled by depth.

Depth (feet)	Number of Points Sampled	Percent Sampling Points with Submerged Species Observed
0	0	0
1	8	100
2	82	61
3	12	100

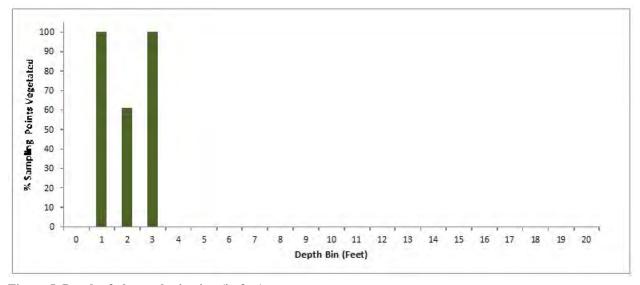


Figure 5. Depth of plant colonization (in feet).

Sutton Lake: 2018 5

Table 4. Individual site data for September 11, 2018. Numbers indicate plant density.

Site	Depth	Wild	Duckweed	Spatterdock	White	Bladderwort			Flatstem	Star	No
1	(ft)	rice			lilies		marigold	3		duckweed	Plants
2	2							3			1
3	2							2			
4	2							3			
5	2							3			
6	2							3			1
7	2				1						'
8	2				!			2			
9	2						2	3			
10	2							3			1
11	2										1
12	2						1	3			'
13	2							-			1
14	2										1
15	2										1
16	2						2				•
17	2										1
18	2						2	2			1
19	2				1						
20	2				'						1
21	2	1			1						'
22	2	'			'						1
23	2							3			'
24	2							3			1
25	2						1				
26	2						'				1
27	2										1
28	2				1		2	3			
29	2				!			3			1
30	2							2			
31	2						2				
32	2							3			
33	2			1	2			3		1	
34	2			1	2			3			
35	2						2	3			
36	1				1			3			
37	2				'			3			1
38	2	1						3			'
39	2	'			1		1	3			
40	2						2				
41	2										1
42	2										1
43	2			1	2			2			•
44	2			1	2			2			
45	2			1	2	1		2		1	
46	2				2			3			
47	1				1	1		3			
48	1	1			1		1	2			
49	2	· ·			•			_		1	
50	2							3		1	
51	2	1						-		1	
52	2	· ·						3		1	
53	2							,		1	
54	1				1			3		1	
55	1				1			3		•	
56	2			1	2			3			
57	2			3				2			
58	3		1	1	3			3			
59	2			'	2			3			
			1	1	_	1	I		l .		

Sutton Lake: 2018

Table 4. Individual site data for September 11, 2018. Numbers indicate plant density.

Site	Depth (ft)	Wild rice	Duckweed	Spatterdock	White lilies	Bladderwort	Bur- marigold	Coontail	Flatstem	Star duckweed	No Plants
60	2			1	2		2	3			
61	3				3			3			
62	2			2	2			3			
63	2		1	1	2			2			
64	2		1	2	2			2			
65	2				2			3			
66	2				2			3			
67	1				1			3			
68	2							3			
69	2										1
70	3				3			3			
71	3				3			3			
72	2				2			3			
73	2				2						
74	2							3			
75	3				3			3			
76	2				2			3			
77	2				2			3			
78	2							3			
79	2				2						
80	3				3			3			
81	2				2			3			
82	2				2			3			
83	2				3			3			
84	2				2			3			
85	2							J			1
86	3				3			3			
87	3				3			3			
88	3				3			3			
89	2				2			3			
90	2				3			2			
91	2				3						
92	2				<u> </u>			2			
93	2							3			
94	3				3			3			
95	3				3			3			
96	2				J						1
97	3				3	+		3			'
98	2				2	1		2			
99	2		1			1		2			
100	1		1		1	1		2	1		
101	1		'		1	1		2	1		
101	2		1		2	1		3			
	rage	1.0	1.0	1.4	2.0	1.0	1.7	2.7	1.0	1.0	
	02 sites)	4	6	1.4	53	1.0	1.7	67	1.0	8	20
	ccur	4	6	11	52	1	12		1	8	20
% 0	ccui	4	Ö	11	52	Т	12	66	I	ď	

Sutton Lake: 2018 7

Representative Aquatic Plants in Sutton Lake





Coontail Water lilies





Bur-marigold Wild rice

Sutton Lake: 2018

APPENDIX C: SUTTON LAKE NATURAL RESOURCE INVENTORY

memo



Project Name | Sutton Lake Management Plan Date | 8/9/2021

To | Joni Giese, District Administrator

Cc | Carl Almer, EOR

From | Jimmy Marty and Mike Majeski, EOR

Regarding | Sutton Lake Natural Resource Inventory

Background

A Natural Resources Inventory (NRI) was conducted to document the existing wildlife and vegetation communities of Sutton Lake in order to consider potential effects of lake drawdown activities that may be contemplated as part of a Lake Management Plan. The NRI included the following tasks:

- 1. Spring and fall avian surveys (October 2019 and April 2020)
- 2. A review of DNR records of rare species (December 2020)
- 3. Vegetation survey (September 2019)
- 4. Seed bank investigation (samples collected September 2019 and analyzed summer/fall 2020).
- 5. Incidental wildlife observations (all field visits)

Wildlife Assessment

The wildlife assessment consisted of a fall 2019 and spring 2020 avian survey, a review of DNR records of rare species, and incidental wildlife observations during all field visits. A total of 32 bird species were observed, including one Species of Greatest Conservation Need (SGCN), the trumpeter swan (**Table 1** and **Table 2**). For the purposes of documenting species that could be directly impacted by potential lake drawdown activities, bird surveys were focused on the open water zone and wetland fringe of Sutton Lake and did not include adjacent land uses (hayfield, forest patches, agricultural land, shrub wetland, etc.). Incidental observations included two frog species and abundant amphipods and dragonfly larvae. Anecdotal wildlife sightings by landowners around Sutton Lake are provided in **Table 3**.

A search of the DNR Natural Heritage Information System (NHIS) database detected one rare species occurring within a 1-mile buffer of Sutton Lake. The species is a jumping spider designated as special concern. According to the DNR, insufficient information is available to make specific management recommendations for this species. The jumping spider is typically found in prairie and savanna habitat, neither of which are present nor immediately adjacent to Sutton Lake basin.

Vegetation Survey

In September 2019, vegetation was surveyed along five transects with plots every 100 to 200 feet (**Figure 1**). At each plot, all plant species within a 5-foot radius were identified and assigned percent cover. Open water areas were not surveyed. Following the field survey, dominant plant cover was mapped for Sutton Lake using aerial imagery and field observations.

Plot species richness is depicted on **Figure 1**. Three dominant emergent wetland cover types were identified and include narrowleaf/hybrid cattail (**Figure 2**), lake sedge (**Figure 3**), and native *Phragmites* (**Figure 4**). Other cover types included other emergent species (likely grasses), woody vegetation, open water, and cultivated field. A complete species list from the field survey is provided in **Table 4**.

Results

Results from the vegetation survey suggest that the majority of Sutton Lake is dominated by the invasives narrowleaf or hybrid cattail (*Typha angustifolia T.* x *glauca*) (**Photograph 1**). Where cattail is dominant, its cover is typically greater than 75% and species richness is less than 11 (**Figure 1** and **Figure 2**). The native broadleaf cattail (*Typha latifolia*) was also observed but was rare.

Small patches of lake sedge (*Carex lacustris*) dominated communities were scattered throughout Sutton Lake (**Figure 3** and **Photograph 2**). Wiregrass sedge (*Carex lasiocarpa*) was also intermixed as an occasional dominant. The sedge-dominated communities had higher species richness than other areas, typically exceeding 10 species.

Historically, the emergent wetland fringe of Sutton Lake was likely dominated by a floating sedge mat akin to the Sedge Meadow (Sedge Mat Subtype) Eggers and Reed wetland plant community type. Based on Google Earth aerial imagery, cattail has expanded significantly at Sutton Lake since 1992.

Seed Bank Investigation

Concurrent with the September 2019 vegetation survey, sediment cores were collected along two transects spanning the largest open water area of Sutton Lake. Six sediment cores were collected along each transect: three in open water and three from the floating mat (**Figure 5**). Samples were collected from both the floating mat and lake bottom at locations 1C and 2C. The top 6 inches of the cores were reserved as seed bank samples.

Seed bank composition of surface sediments was investigated via two complementary methods:

- 1) Seedling grow-out: Sediment samples were planted and maintained under moist to saturated conditions. Seedlings were identified upon emergence over three-months. These data indicate the identity of viable seeds in the seed bank that may germinate under moist/saturated conditions.
- 2) Seed identification: Seeds were extracted from samples following the end of the seedling grow-out by sieving remaining soils. Seeds were identified to finest taxonomic resolution feasible. These data indicate the identity of remaining seeds that did not germinate, due to non-viability or unsuitability of germination conditions (e.g., submerged aquatic plant species).

For the seedling grow-out, samples were kept in cold storage following collection so they could be planted outdoors during the growing season and to allow for cold stratification (i.e., dormancy break treatment required for many plant species). Samples were divided into two replicate trays each and placed outdoors from 6/25/20 until 9/29/20 (**Photograph 3** and **Photograph 4**). Two control trays filled with potting soil were also included to assess ambient colonization. A timed drip irrigation system kept samples saturated. Samples were haphazardly rotated to different locations every two-weeks to account for locational growing condition bias. Seedlings were identified approximately every two weeks and removed from trays following identification. Results are compiled in **Figure 6** and **Figure 7**.

Seed identification was initiated upon completion of the seedling grow-out. Only sample locations 1A, 1C, 1D, 2A, 2C, and 2D were analyzed due to the labor intensity of seed identification. Soils were sieved through 2 mm, 1 mm, 0.5 mm, 0.25, mm, 0.125 mm, and 0.063 mm screens and kept in separate containers. Only the 2 mm, 1mm, and 0.5 mm were assessed as initial analyses indicate that small size fractions were duplicative of 0.5 mm and highly labor intensive. Seeds were identified under a stereo microscope to the highest taxonomic resolution feasible (**Photograph 5** and **Photograph 6**).

Results

Results from the seed bank investigation suggest two trends across both study methods. First, emergent wetland species were most abundant in samples collected from the floating mat and submerged aquatic species were most abundant in samples collected in open water (**Figure 8**). Under drawdown conditions, slow establishment of emergent species in former open-water areas could result in abundant open niches for invasive species to establish.

The second trend was that cattail was present and abundant in nearly all sample locations from both the floating mat and open water locations. Invasive cattail and native cattail cannot be distinguished from seeds or seedlings. However, based on the field survey results, it is reasonable to assume that most of the seeds and seedlings observed were of invasive cattail. The abundance of cattail seeds and seedlings suggest cattail can be expected as a primary component colonization following drawdown.

Results from the seed bank studies should be interpreted with caution. Sample sizes were not sufficient to draw lake-wide conclusions. Seed identification did not assess viability of the seeds and is heavily biased toward vegetation with life history strategies that produce abundant seed production (e.g., cattail, muskgrass, flexuous naiad). Results should be assessed as snapshots of local seed bank conditions. Ultimately, colonization following disturbance will depend on numerous factors including but not limited to establishment conditions, vegetative reproduction, and competitive dynamics.

	of October 2019 and April 2020		
Date	Species	Count	Note
2019-10-04	American Crow	1	
2019-10-04	Blue Jay	1	
2019-10-04	Mallard	4	
2019-10-04	Northern Flicker	1	
2019-10-04	Red-winged Blackbird	8	
2019-10-04	Rock Pigeon	2	
2019-10-04	Swamp Sparrow	1	
2019-10-04	White-throated Sparrow	3	
2019-10-04	Wood Duck	4	
2020-04-09	American Coot	1	
2020-04-09	American Robin	8	
2020-04-09	Bald Eagle	1	Adult
2020-04-09	Black-capped Chickadee	2	
2020-04-09	Blue-winged Teal	6	3 pairs
2020-04-09	Bufflehead	5	
2020-04-09	Canada Goose	6	
2020-04-09	Cedar Waxwing	25	
2020-04-09	Eastern Bluebird	2	
2020-04-09	Green-winged Teal	2	Pair
2020-04-09	Killdeer	1	
2020-04-09	Mallard	6	
2020-04-09	Northern Cardinal	1	
2020-04-09	Northern Flicker	1	
2020-04-09	Northern Harrier	1	Female
2020-04-09	Red-winged Blackbird	8	
2020-04-09	Ring-billed Gull	4	
2020-04-09	Ring-necked Duck	58	Good mix of males & females
2020-04-09	Ring-necked Pheasant	2	
2020-04-09	Rusty Blackbird	2	Foraging in a flooded wooded area
2020-04-09	Song Sparrow	4	
2020-04-09	Turkey Vulture	1	
2020-04-09	Wood Duck	2	

Table 2. Incidental wildlife observations from the September 2019 vegetation survey.

Species	Count
A	vian
American Coot	2
Blue-winged Teal	8
Canada Goose	4
Great Blue Heron	1
Green Heron	1
Killdeer	2
Mallard	6
Red-winged Blackbird	50
Sora Rail	2
Trumpeter Swan	2
Turkey Vulture	2
Wood Duck	6
Amp	hibian
Leopard Frog	1
Wood Frog	1
Inver	tebrate
Amphipods	Abundant
Dragonfly Larvae	Abundant

Table 3. Anecdotal wildlife sightings by landowners around Sutton Lake.

Species
Trumpeter Swan
Canada Goose
Blue-winged Teal
Scaup spp. (Greater/Lesser)
Wood Duck
Mallard
Hooded Merganser
Northern Shoveler
Sandhill Crane
Ring-necked Pheasant
White-tailed Deer
American Beaver
Muskrat
River Otter
Coyote

Table 4. Plant list compiled from field survey, seedling grow-out, and seed identification studies.

		Field	Seedling	Grow-out	Seed Identification		
Common Name	Scientific Name	Survey	Open Water	Floating Mat	Open Water	Floating Mat	
boxelder	Acer negundo	х					
purple false foxglove	Agalinis purpurea	х					
marsh milkweed	Asclepias incarnata	х		х			
bog birch	Betula pumila	х					
nodding bur-marigold	Bidens cernua	х					
devil's beggarticks	Bidens frondosa	х					
cf. beggarticks/bur-marigold	Bidens sp.	х			х	х	
bluejoint	Calamagrostis canadensis	х					
marsh bellflower	Campanula aparinoides	х					
slough sedge	Carex atherodes	х					
cf. bristly sedge	Carex cf. comosa	х			х		
cf. wiregrass sedge	Carex cf. lasiocarpa	х			х		
bristly sedge	Carex comosa	х	х	х			
lake sedge	Carex lacustris	х	х	х			
wiregrass sedge	Carex lasiocarpa	х	х	х			
bristle-stalked sedge	Carex leptalea			х			
sedge	Carex sp.	х			Х	х	
coontail	Ceratophyllum demersum				Х		
cf. marsh cinquefoil	cf. Potentilla palustris	х				х	
cf. aster	cf. Symphyotrichum sp.	х			Х	х	
muskgrass	Chara sp.				Х	х	
bulbet-bearing hemlock	Cicuta bulbifera	х					
red-osier dogwood	Cornus sericea	х					
swamp dodder	Cuscuta gronovii	х					
Engelmann's flatsedge	Cyperus engelmanni		х				
common spikerush	Eleocharis palustris	х					

		Field	Seedling	Grow-out	Seed Ide	ntification
Common Name	Scientific Name	Survey	Open Water	Floating Mat	Open Water	Floating Mat
spikerush	Eleocharis sp.	х			X	х
marsh willowherb	Epilobium palustre	x		x		
water horsetail	Equisetum fluviatile	x				
common boneset	Eupatorium perfoliatum	x				
spotted Joe-pye weed	Eutrochium maculatum	x				
black ash	Fraxinus nigra	x				
stiff marsh bedstraw	Galium tinctorium	x				
fowl manna grass	Glyceria striata	x				
jewelweed	Impatiens capensis	x			X	x
rush	Juncus sp.				Х	
rice cutgrass	Leersia oryzoides	х		х	Х	х
lesser duckweed	Lemna minor	x				
bugleweed	Lycopus sp.	х			Х	х
northern bugleweed	Lycopus uniflorus	x		x		
tufted loosestrife	Lysimachia thyrsiflora	х		х		
clustered muhly grass	Muhlenbergia glomerata	х				
cf. flexuous naiad	Najas cf. flexilis				Х	
water or pond lily	<i>Nymphaceae</i> sp.				х	
sensitive fern	Onoclea sensibilis	х				
cf. nodding smartweed	Persicaria cf. lapathifolia				х	х
cf. arrow-leaved tearthumb	Persicaria cf. sagittata	х			Х	х
dotted smartweed	Persicaria punctata	х		х		
reed canary grass	Phalaris arundinacea	х				
native common reed	Phragmites australis	х				
black-fruited clearweed	Pilea fontana	х		х	х	х
eastern cottonwood	Populus deltoides		х	x		
pondweed	Potamogeton sp.				Х	х

		Field	Seedling	Grow-out	Seed Ide	ntification
Common Name	Scientific Name	Survey	Open Water	Floating Mat	Open Water	Floating Mat
cursed crowfoot	Ranunculus sceleratus			х		
great water dock	Rumex britannica	X				
broad-leaf arrowhead	Sagittaria latifolia	x			X	x
black willow	Salix cf. nigra	X				
pussy willow	Salix discolor	Х				
meadow willow	Salix petiolaris	х				
hardstem bulrush	Schoenoplectus acutus	Х				
river bulrush	Schoenoplectus fluviatilis	Х				
hardstem or softstem bulrush	Schoenoplectus sp.		x	х	х	х
marsh skullcap	Scutellaria galericulata	Х		х		
giant goldenrod	Solidago gigantea	Х				
Sphagnum moss	Sphagnum sp.	х				
white meadowsweet	Spiraea alba	Х				
greater duckweed	Spirodela macrorhiza	х				
long-leaved chickweed	Stellaria longifolia	Х				
northern bog aster	Symphyotrichum boreale	Х				
panicled aster	Symphyotrichum lanceolatum	Х		х		
purple-stemmed aster	Symphyotrichum puniceum	х		х		
marsh fern	Thelypteris palustris	Х		х		
marsh st. john's wort	Triadenum fraseri	Х		х		х
narrowleaf cattail	Typha angustifolia or x glauca	Х				
broadleaf cattail	Typha latifolia	Х				
cattail	Typha sp.	Х	х	х	х	х
small white violet	Viola macloskeyi			х		
northern wild rice	Zizania palustris	Х				

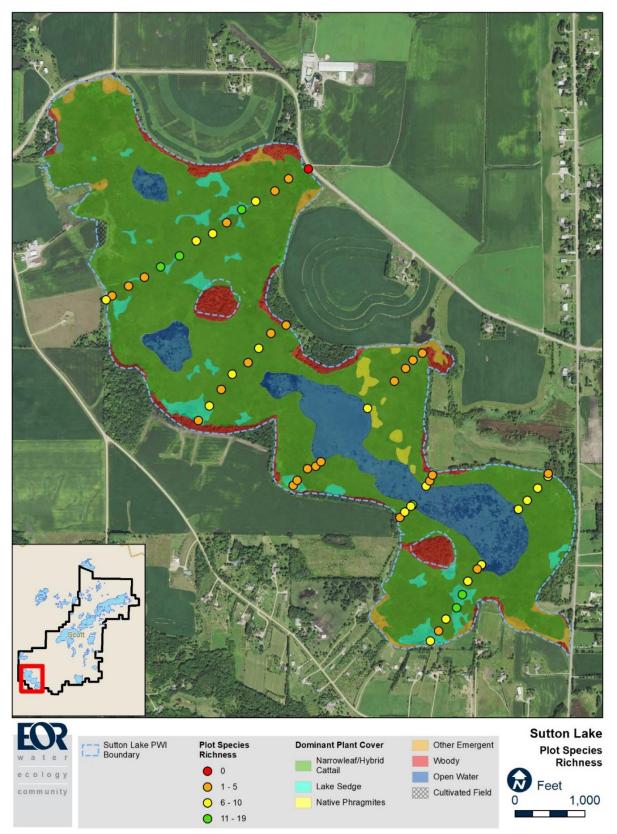


Figure 1. Vegetation sample plot locations with species richness for each plot.

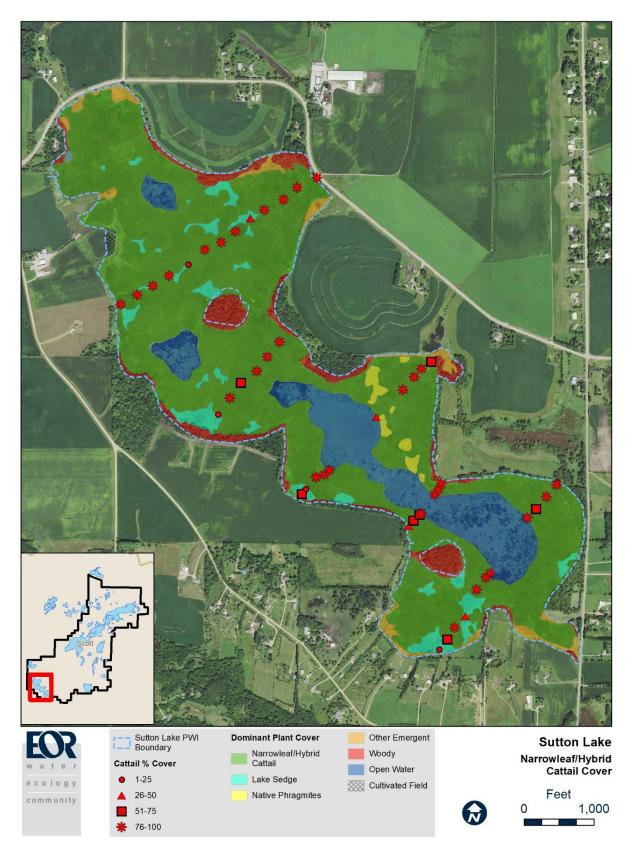


Figure 2. Narrowleaf/hybrid cattail cover at Sutton Lake.

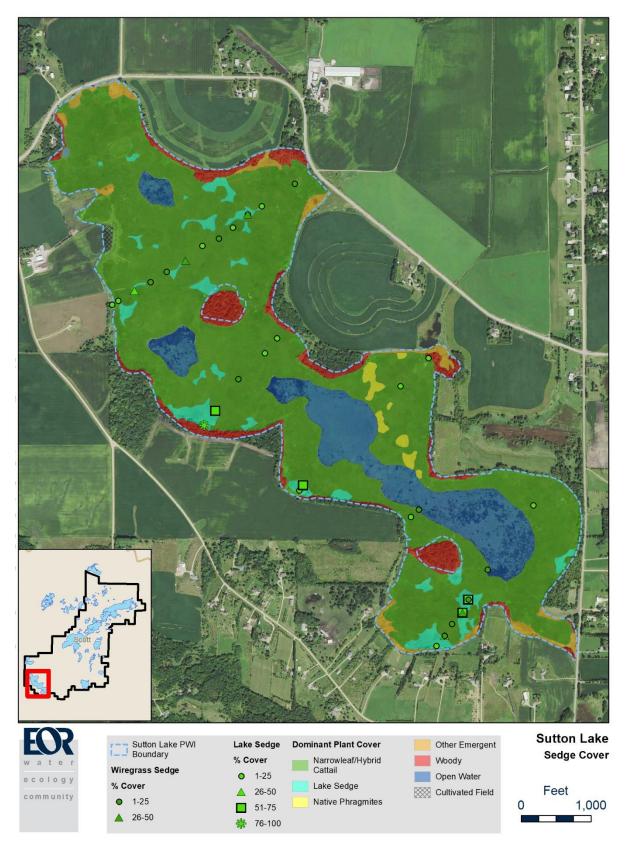


Figure 3. Lake sedge and wiregrass sedge cover at Sutton Lake.

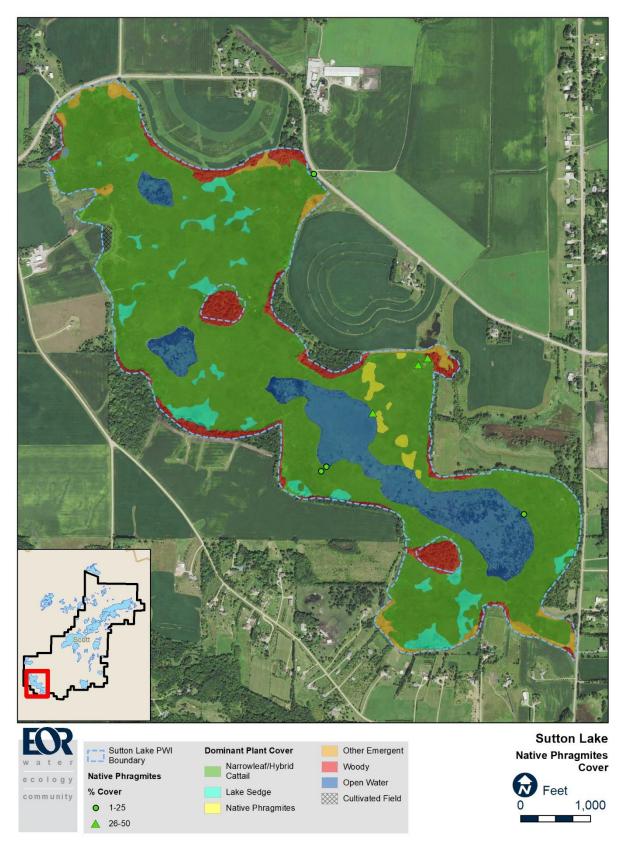


Figure 4. Native Phragmites cover at Sutton Lake.

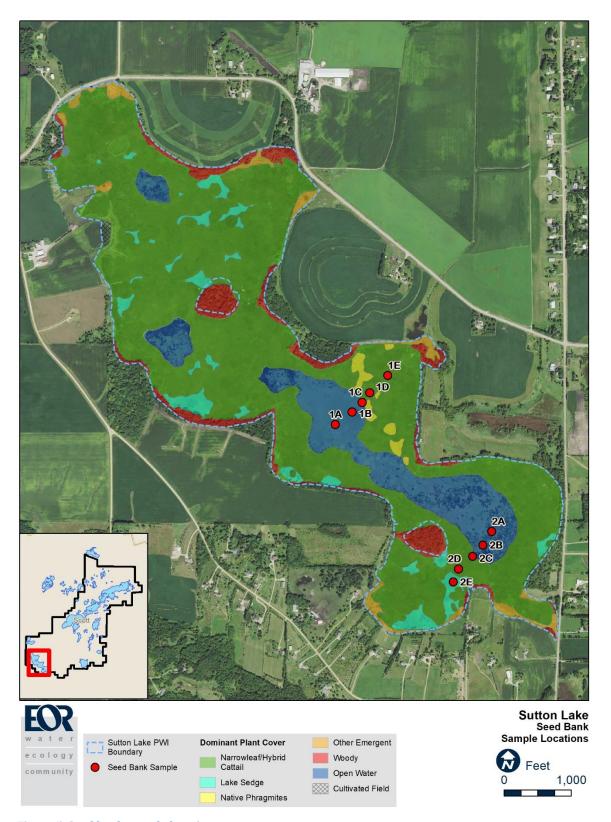


Figure 5. Seed bank sample locations.

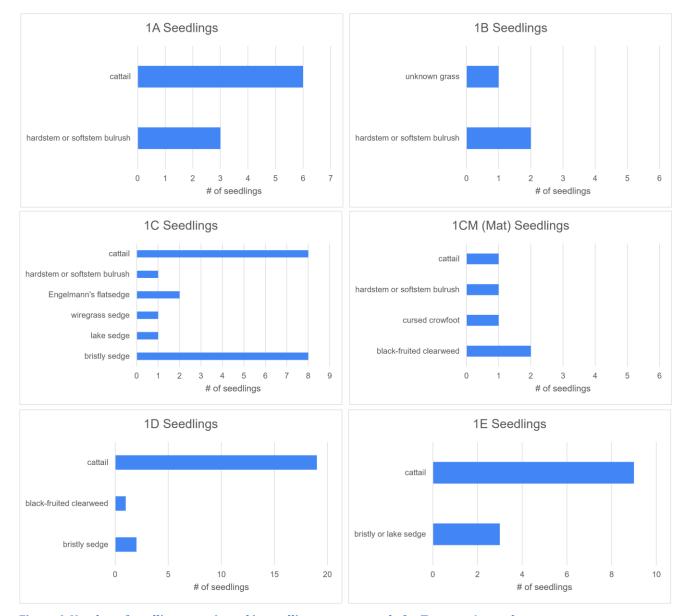


Figure 6. Number of seedlings germinated in seedling grow-out study for Transect 1 samples.

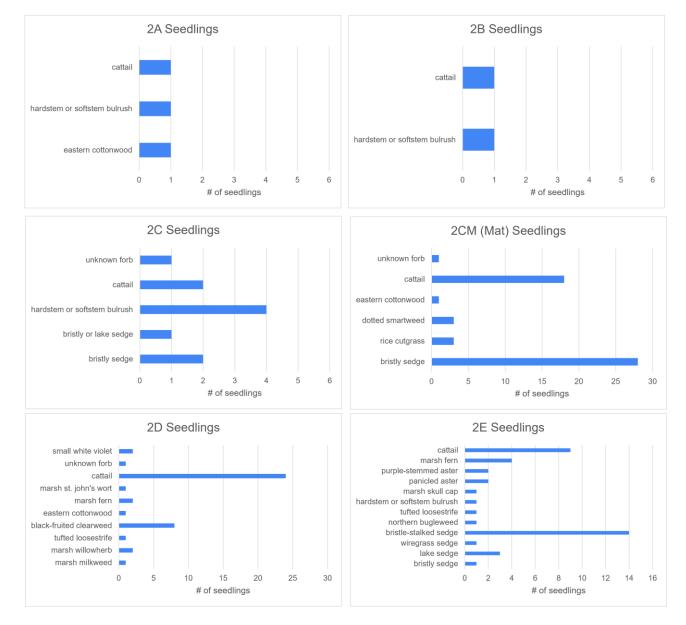


Figure 7. Number of seedlings germinated in seedling grow-out study for Transect 2 samples.

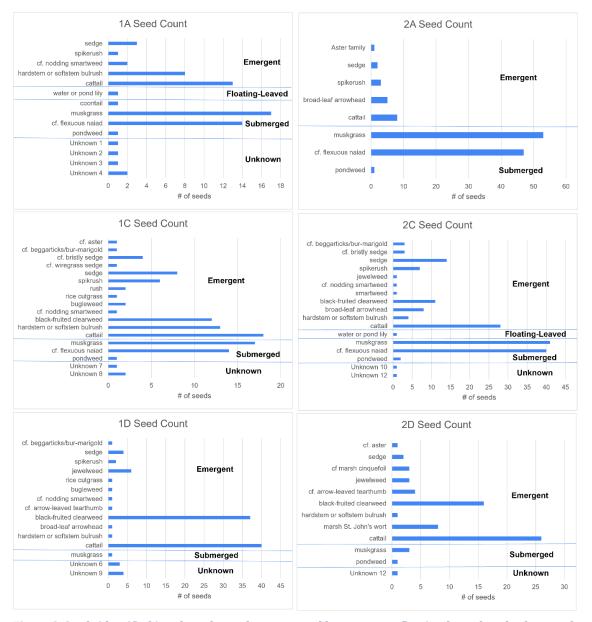


Figure 8. Seeds identified in selected samples, separated by emergent, floating-leaved, and submerged growth habits.



 $Photograph \ 1. \ Typical \ dense \ narrowleaf/hybrid \ cattail \ at interior \ of \ Sutton \ Lake \ wetland \ fringe.$



Photograph 2. Patch of sedge meadow floating mat within Sutton Lake wetland fringe.



Photograph 3. Seedling grow-out study setup.



Photograph 4. Small cattail seedlings among larger tufted loosestrife and marsh fern seedlings.



 $Photograph \ 5. \ Hardstem \ or \ softstem \ bulrush \ seed \ under \ stereo \ microscope.$



 $Photograph\ 6.\ Coontail\ seed\ extracted\ from\ Sutton\ Lake\ sediments.$

APPENDIX D: SHALLOW LAKE ECOLOGY AND WATER QUALITY

Lakes are considered shallow when most (>80%) of the lake area is less than 15 feet deep. Maximum depth at Sutton Lake is 3 feet and the water is classified as a shallow lake. In shallow lakes, sunlight can penetrate to the lake bottom and support aquatic plant growth. In addition, all the living organisms in shallow lakes are concentrated in a smaller volume than in deeper lakes. Consequently, the relationship between the total phosphorus (limiting nutrient) concentration and the amount of algae growth (measured by chlorophyll-a pigments and water transparency) is often different in shallow lakes as compared to deeper lakes. In deeper lakes, algae abundance is often controlled by physical and chemical factors such as light availability, temperature, and nutrient concentrations. The biological components of the lake (such as microbes, algae, aquatic plants, zooplankton and other invertebrates, and fish) are distributed throughout the lake, along the shoreline, and on the bottom sediments. In shallow lakes, the biological components are more concentrated into less volume and exert a stronger influence on the ecological interactions within the lake. There is a denser biological community at the bottom of shallow lakes than in deeper lakes because oxygen is replenished in the bottom waters and light can often penetrate to the bottom. These biological components can control the relationship between phosphorus and the response factors.

The result of this impact of biological components on the ecological interactions is that shallow lakes normally exhibit one of two ecologically alternative stable states (Figure 8): the turbid water, algaedominated state, and the clear water, aquatic plant-dominated state. The clear state is the most preferred, since algae communities are held in check by diverse and healthy zooplankton and fish communities. In addition, rooted plants stabilize the sediments, lessening the amount of sediment stirred up by the wind.



Figure 8. Clear and turbid water states in shallow lakes.

As shown in Figure 9, the transition in water quality of shallow lakes from clear to turbid is often abrupt. When shallow lakes have historically been in the clear water state and dominated by submerged aquatic

vegetation, they are capable of assimilating large amounts of phosphorus loading without becoming dominated by algae. That is to say, they are stable in a clear-water state. They may experience some periods of turbid water conditions, but tend to revert to clear water conditions. However, as phosphorus loading increases, the stability of the clear-water state declines until the lake is stable in a turbid-water state. Consequently, drastic reductions in nutrients or changes in the biological community of a shallow lake are needed to promote a clear-water state (Figure 10).

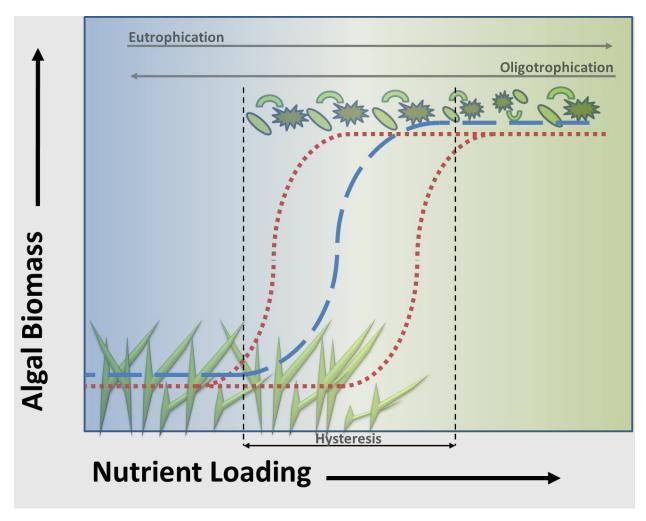


Figure 9. Trophic state shifts in shallow lakes in response to changes in nutrient loading



Figure 10. Cascading biological communities in shallow lakes under clear and turbid water states

Shallow Lake Dissolved Oxygen Dynamics

Dense aquatic canopies, that occupy at least 50% of the water column (e.g. Figure 11) can trigger diurnal fluxes in dissolved oxygen concentration in lakes. Recent research conducted on shallow lakes shows that when aquatic plants occupy more than 50% of the water depth, anoxia manifested before sunset and lasted until night-time surface cooling induced vertical mixing of the water column (Vilas et al. 2017).

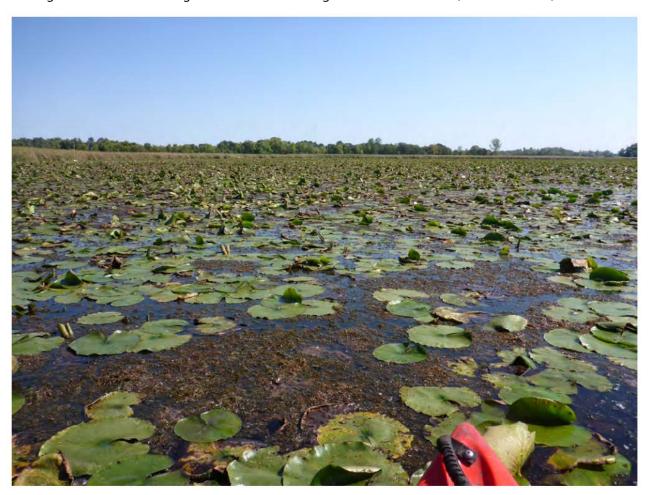


Figure 11. Sutton Lake September 2018 photo showing abundant water lilies and submergent aquatic vegetation exceeding 50% of the water column.

The major sources of dissolved oxygen in shallow lakes includes diffusion from the atmosphere, wind mixing (wave action), and photosynthesis from aquatic plants. The major uses of dissolved oxygen include respiration and decomposition. Shallow lakes can become anoxic (without oxygen) whenever the rate of oxygen consuming activities (respiration and decomposition) exceed the rate of oxygen production. This phenomenon is most pronounced in lakes containing stands of aquatic plants that are dense enough to prevent wind mixing and subsequent reoxygenation of the water column.

A study of 70 Minnesota Lakes found that the mean anoxic phosphorus release rate under anoxic conditions was higher in lakes in the turbid water state versus the healthy plant state (Figure 12; Bischoff and James 2012). This figure suggests that lakes with a healthy aquatic plant community have a lower release rate under anoxic conditions in comparison with lakes that are in the turbid water state with little or no aquatic

plants. The implications of Sutton Lake going anoxic include the potential release of "redox sensitive" phosphorus from lake sediments. Redox sensitive phosphorus is phosphorus that becomes soluble and available for biological uptake following the reduction of ferric iron to ferrous iron under anoxic conditions. Solu Internal loading in clear water, aquatic plant dominated shallow lakes is poorly understood. However, it seems likely the shallow nature of Sutton Lake makes any phosphorus released readily available for uptake by algae due to increased ecological interaction with the water column (see Appendix D).

Shallow Lake Anoxic Phosphorus Release

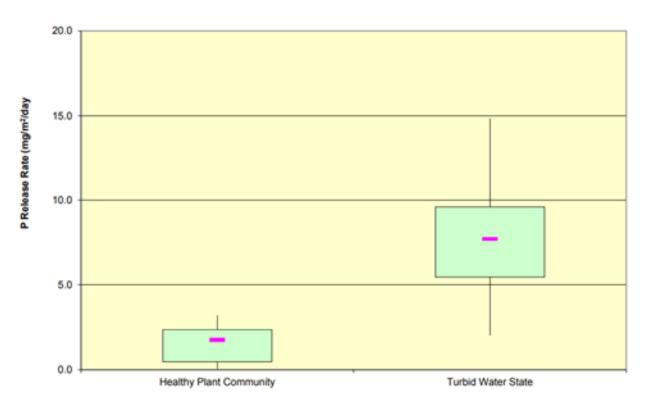


Figure 12. Comparison of anoxic phosphorus release rates in shallow lakes in the healthy aquatic plant dominated state versus the turbid water state. Red lines indicate the mean.

APPENDIX E: MNDNR WETLAND MANAGEMENT MINUTES #17 AND #18

Wetland Management Minute #17 - Drawdowns for Amphibian Management

While managers may not conduct drawdowns specifically to benefit amphibians, this common management practice can both benefit and hurt these species. Desirable outcomes of drawdowns include improved and diverse plant communities, increased invertebrate abundance, reduction of invasive plants, and removal of fish. However, the timing of drawdowns and habitat connectivity to nearby wetlands are important considerations to reduce negative impacts.

Amphibians, generally frogs, toads and salamanders, have relatively unique characteristics compared to wetland birds and mammals. They are relatively secretive. They are cold-blooded (ectothermic). They mature quickly but are relatively short-lived. Due to their small size and mode of travel their ability to disperse is much more limited. And they have extended periods of dormancy to survive cold temperatures.

As planktivores and insectivores amphibians are major links in the flow of energy within aquatic and terrestrial systems. They make up a high portion of biomass in fishless wetlands, in particular, so they are an important food source for many nongame and game species.

The best wetland habitats for amphibians feature vegetation for concealment, foraging and egg-laying; and locations for hibernacula. While breeding requirements tend to vary, most amphibians lay their eggs in fishless aquatic habitats ranging from vernal pools to more permanent wetlands. Juveniles are usually aquatic. Some adults are terrestrial during parts of the year yet need to have access to water or moist soil to prevent desiccation because of their permeable skin.

Most amphibians hibernate during Minnesota's winters. Species like northern leopard frog seek permanent waters to overwinter. Others like wood frog and gray treefrog burrow into leaf litter and rely on cryoprotectants to prevent their cells from rupturing when frozen. Still others like the American toad burrow in soft soils to get below the frost line.

Approximately 20 species of amphibians are native to Minnesota (see Moriarty and Hall 2014). Five (one endangered, four special concern) are listed on <u>Minnesota's list of endangered</u>, threatened and special concern species. Additional species have been identified as species of greatest conservation need in the <u>State Wildlife Action Plan</u> (2015 revision pending approval by U.S. Fish and Wildlife Service).

The limited ability of amphibians to disperse makes it is easier for localized extinctions to occur with changes in available wetland habitat. Populations in basins that are isolated from other wetlands or waterways, or face significant barriers such as roads, are particularly susceptible to the introduction of fish or dramatic changes in water levels. For some of these species, such changes may pose a threat to the continued persistence of local populations. When a nearby source population is unavailable or there are barriers to movements, extinctions can be permanent.

Recommendations to minimize negative impacts to amphibians:

Avoid conducting dramatic drawdowns when egg and larval stages will be affected. Drawdowns during the active breeding season may strand amphibian eggs, larvae, and adults or lead to desiccation. Consider designing wetlands or encouraging flow toward small pools to prevent animals from being trapped in areas that will become dry. Gradual drawdowns over 30 days are preferred over rapid drawdowns.

Initiate fall drawdowns earlier. The ideal timing for fall drawdowns is after metamorphosis has occurred but before these animals are seeking overwintering sites. Reducing water levels in late fall can lead to direct mortality when animals freeze over winter due to a lack of refugia under ice, or winterkill because of a lack of oxygen with lowered

water levels. Most should have metamorphosed by late summer. Drawdowns should reach their lowest level by 1 September for northern Minnesota and 15 September southern Minnesota and should stay dewatered through at least 1 December. This timing gives animals an opportunity to relocate to a suitable area for hibernation.

Avoid winter drawdowns. Winter drawdowns expose hibernating amphibians to freezing temperatures and make them susceptible to desiccation and freezing during a time when they are unable to escape. Late summer/early fall drawdowns are preferred, particularly if rare species are found in the vicinity.

Consider the status of nearby wetlands. When you plan a drawdown, consider whether the target wetland is the only suitable wetland for amphibians in the area. One or more satellite wetlands should have adequate winter water levels that extend into the next spring and summer to allow amphibians an alternate place to take refuge. Amphibians can then recolonize the drawdown wetland when water levels return. Depending on the objectives of the drawdown, also consider a partial drawdown to maintain some aquatic habitat in the area.

Be cognizant of indirect causes of mortality. During and immediately following a drawdown, many amphibians attempt to escape the area, increasing their vulnerability particularly when crossing roadways. Silt fencing (or other barriers) can be used to redirect amphibians toward more suitable habitat.

If you have Blanchard' Cricket Frog (endangered) or any other rare species in the area or want more specific information for your site, contact a Nongame Wildlife Specialist or Carol Hall, Minnesota Biological Survey Herpetologist.

Authored by Christine Herwig – MN DNR Nongame Wildlife Program and Christopher E. Smith – MnDOT Office of Environmental Stewardship (formerly with Nongame Wildlife Program)

Moriarty, John J. and Carol D. Hall. 2014. *Amphibians and Reptiles in Minnesota*. University of Minnesota Press, Suite 290 111 Third Avenue South, Minneapolis, MN, USA, 55401. 372 pages.

Drawdowns for Reptile Management

Wetland Management Minute #17 discussed drawdowns for amphibian management. While many considerations are similar for reptiles, life history traits of reptiles differ significantly and so do some of the recommendations for water level management.

Minnesota has 31 reptile species of which 11 (one endangered, four threatened, six special concern) are listed on Minnesota's list of endangered, threatened and special concern species. Additional species have been identified as species of greatest conservation need in the Minnesota Wildlife Action Plan. In addition, both Blanding's turtles and wood turtles are under review for federal listing under the Endangered Species Act.

Reptiles are ectothermic, secretive, and poor dispersers because of their small size and limited mobility. They have extended periods of dormancy and are susceptible to mortality through freezing in northern climates. General habitat requirements include features to allow thermoregulation such as basking structures and underwater or underground locations for shelter. Other necessary features include foraging areas, hibernacula, and egg laying sites. Distance, terrain, and other potential obstacles, such as roadways, negatively impact the use of these habitat complexes and consequently survival. All reptiles are inactive during Minnesota's winters. Species like Blanding's turtle seek permanent waters to overwinter; whereas others like the eastern hog-nosed snake burrow in soft soils to get below the frost line.

Among Minnesota's reptiles, turtles are the most affected by drawdowns. Although they tend to be long-lived, they are slow to mature, with many remaining in wetlands for more than one year as juveniles. Minnesota's adult turtles primarily live in aquatic environments but travel into uplands for summer foraging and to lay eggs.

Turtles have very high adult survivorship to compensate for naturally high levels of nest and hatchling mortality. Recent studies suggest that even seemingly slight increases in adult mortality, especially among females, can drive localized populations to extinction. Adult survival is susceptible to changes in wetlands such as the introduction of fish, dredging, and dramatic or poorly timed changes to water levels. Permanent wetlands and flowing water (e.g., rivers and streams, groundwater fed springs) are particularly critical for providing safe hibernacula. Desiccation or freezing can be the result of ill-timed changes in water levels. While wetland complexes featuring a variety of wetland types is beneficial, the ability of turtles to move between these habitats can be compromised by distance, terrain and other obstacles. Roadways, collection by people, and exposure to predators are direct causes of mortality that could limit repopulation of wetlands. When a nearby source population is unavailable due to distance or barriers, extinctions can be the result.

Recommendations:

Avoid artificially elevating water levels during active nesting season. Dramatic increases to water levels then (see figure below) may flood nearby turtle eggs resulting in nest failure. If elevating water levels is desired, do so before turtle nesting season begins (late May in much of Minnesota). Additionally, land managers may consider creating more desirable nesting conditions away from wetland edges. Please consult with Nongame Wildlife Program staff for details.

Initiate fall drawdowns earlier. The ideal timing is after animals breed but before they seek overwintering sites. Drawdowns in late summer/early fall provide an opportunity for turtles to relocate to a suitable area to overwinter. Reducing water levels in late fall can lead to direct mortality when animals freeze or winterkill because of lack of oxygen under ice with lowered water levels. Drawdowns should reach their lowest level by 1 September for northern Minnesota and 15 September southern Minnesota and should stay dewatered through at least 1 December. Water should be drawdown to ≤14" to discourage reptile overwintering. Depths to 24" might be acceptable if no listed reptile species are likely to be present and if there is some flow to prevent deep ice formation, but monitor closely for winterkill and practice adaptive management as necessary.

Avoid winter drawdowns. Winter drawdowns expose overwintering reptiles to freezing temperatures and make them susceptible to desiccation and freezing during a time when they are unable to escape. Although managers may prefer to dewater a basin in November after the close of duck hunting season, this would put resident turtles at risk and could decimate entire populations. Late summer/early fall drawdowns are preferred, particularly if rare species are found in the vicinity. If winter drawdowns are required, Blanding's and/or wood turtle surveys may need to be conducted during the prior field season to assess species presence. Please consult with Nongame Wildlife Program staff.

Assess landscape context and alternate refugia. Are alternate wetlands suitable for turtles (e.g., type, depth, substrate, vegetation) nearby and safely accessible? Manage wetland complexes with habitat corridors between basins to allow reptiles an alternate place to take refuge. Partial (vs. full) drawdowns may provide some aquatic habitat while still achieving some or all management objectives, depending on the objectives of the drawdown and landscape context of the site.

Reduce indirect causes of mortality. During and immediately following a drawdown, many reptiles attempt to escape the area, and may end up crossing roadways resulting in high mortality. Silt fencing (or other barriers) to direct reptiles away from roadways and toward more suitable habitat may be advised or required if endangered or threatened species are in the area. Directing reptiles through or under existing crossing structures such as culverts, bridges, and wildlife tunnels not only reduces wildlife mortality, but enhances public safety. In some instances, land managers may consider temporarily closing DNR roads that fall under their jurisdiction, and/or approach local road authorities about temporarily closing adjacent public roadways. Turtle crossing sightings, including both living and deceased turtles, can be reported to the Minnesota Turtle Crossing Tally & Count Project.

If you have rare species in the area or want more specific information for your site, contact a <u>Nongame Wildlife</u> <u>Specialist</u> or <u>Carol Hall</u>, Minnesota Biological Survey Herpetologist.

Approximate active season, breeding and overwintering timing for amphibians and reptiles.

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
nphibian ar	nd Repti	le Active	Season									
North												
South												
mphibian Eg	gg Laying	g										
North												
South												
ırtle Nestin	g											
North												
South												
eking Over	winterin	ng Sites										
North												
South												
ecommenda	itions - I	Drawdov	wn Timinį	g								
North												
South												
F	referre	d										•
			CN amphi	hians not	t nresent	consult	nongam	a				

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